

rotoScan ROD4plus / ROD4-08plus
Software and Protocol Description



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1 General information

1.1 On the 'RODplussoft' program

RODplussoft is used for the configuration of the measurement functions of the rotoSCAN ROD4...plus via a PC with Microsoft® Windows 2000/XP operating systems.

The software offers the following options:

- Interface configuration of the ROD4...plus
- Measurement data visualisation
- Configuration of measurement segments
- Filtering data output
- Output of extreme values

The measurement data are transferred via the interfaces Y2 or Y4 as selected. You can select the protocol best suited to your measurement task in each case. The following options are available:

- **ROD4-compatible binary protocol**, for fast measurement data transfer. A detailed protocol description may be found in chapter 5.
- **ASCII Remote** for extended, flexible measurement data transfer and remote control operation. In this operating mode, the ROD4...plus reacts to commands from the control. A detailed protocol description may be found in chapter 6.

1.2 Explanation of symbols

The symbols used in this description are explained below.




Attention!

This symbol appears before text passages which must absolutely be observed. Failure to heed this information may lead to injuries to personnel or damage to the equipment.



Notice!

This symbol indicates text passages containing important information.

 *This symbol asks you to carry out an action.*

The **Courier** font indicates terms contained in the software interface of RODplussoft.

1.3 Contact address

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2 Hardware and software Installation

2.1 Hardware

↳ *Install the rotoSCAN ROD4...plus as described in the 'Electrical Connection' chapter of the Technical description ROD4plus.*

2.2 Software

2.2.1 System requirements

The PC used should meet the following requirements:

- Intel[®] processor at Pentium[®] level or faster (or compatible models, e.g. AMD[®])
- At least 512 MB RAM
- CD-ROM drive
- Hard disk with at least 150 MB available memory.
- RS 232 interface for scanner configuration
- Ethernet interface or, alternatively, RS 232 / RS 422 for measurement data transfer
- Microsoft[®] Windows 2000/XP SP2
- Microsoft[®] .NET Framework 2.0 SP1

2.2.2 Installation

The **RODplussoft** configuration software can be found on the supplied CD. To install, follow the instructions in the respective readme files, which can likewise be found on the supplied CD.

You can also download the respective, latest version of **RODplussoft** from www.leuze.de:
Download -> identify -> Optical distance measuring and positioning.

Unzip the ZIP file supplied into a suitable folder on your hard disk.

↳ *Start the installation by double-clicking on the setup.exe file.*

↳ *Follow the instructions of the installation routine.*



Notice!

Before installing RODplussoft, ensure that Microsoft[®] .NET Framework 2.0 SP1 or later is installed on your computer.

3 First steps - sample application

This chapter explains the configuration of the ROD4...plus using a sample application. We assume the following measurement task:

- data transfer via Ethernet
- ROD4-compatible binary protocol
- definition of a measurement segment
- measurement data filtering
- output of
 - status information on the ROD4...plus
 - measurement data in Cartesian coordinate display
 - minimum and maximum values

3.1 Establishing a connection between PC and ROD4...plus

To configure the ROD4...plus using **RODplussoft** or **RODsoft**

↳ *Connect interface Y3 of the ROD4...plus to an unused COM port of your PC. Use the KB-ROD4plus cable available as an accessory.*

If you want to display the measurement data on the PC, or if you want to use the ASCII Remote protocol for remote control:

↳ *Also connect interface Y2 of the ROD4...plus to a free network port on the same network as your PC or connect interface Y4 of the ROD4...plus to another free COM port on your PC.*

Beginning with version 1.10, **RODplussoft** offers the option of configuring the ROD4...plus via the same interface as is used to transfer measurement data.

This facilitates the following procedure:

- Configuration of the Ethernet interface of the ROD4...plus prior to the mechanical installation at the installation site. At the installation site, there may be difficulties in attaching the cable between Y3 and the COM port of the PC due to the installation situation.
- Subsequent selection of Y2 as interface for configuration.
- Mechanical installation of the ROD4...plus at the installation site.
- Configuration of the ROD4...plus via the Ethernet interface.



Attention!

Ensure that the connectors for the interfaces Y1, Y2 and Y4 are wired correctly. An incorrect wiring of the Y1 or Y4 interfaces on the rotoScan ROD4...plus may result in severe device damage that may be beyond repair.



Notice!

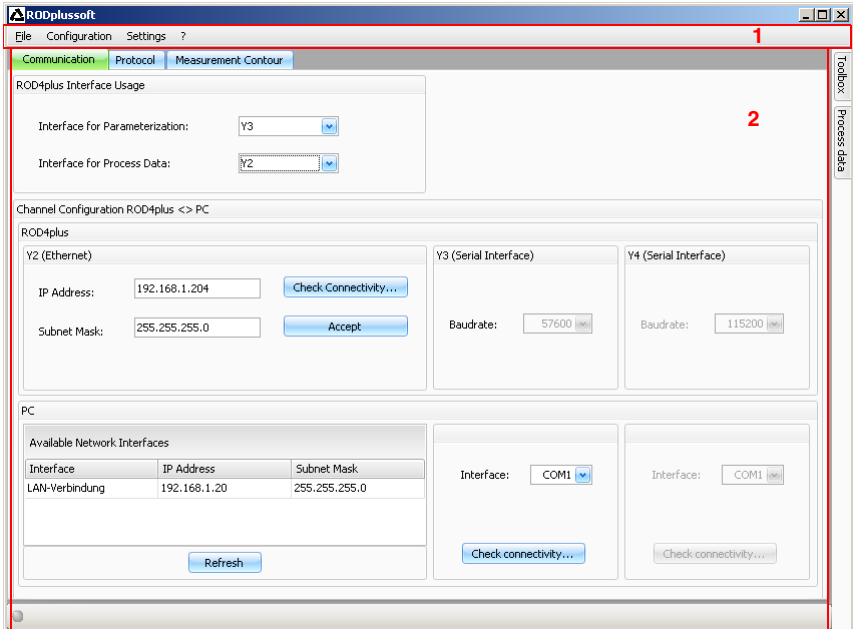
*Before starting **RODplussoft**, switch on the power supply of the ROD4...plus. Otherwise no data can be received from the device. You can, however, define parameters and save them to the hard disk or evaluate previously saved data without connecting the ROD4...plus to the PC.*

3.2 Starting the program

↳ To start **RODplussoft**, open the Windows®

Start menu -> **All Programs** -> **Leuze electronic** -> **RODplussoft**.

The following screen appears, split into two areas:

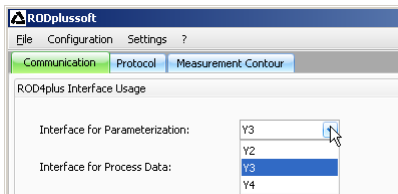


1 - Menu bar

2 - Configuration/measurement box

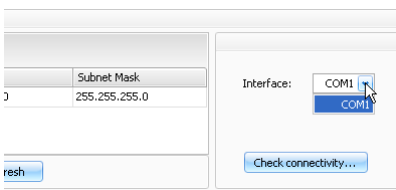
3.3 Adjusting the interface for parameterization

↪ In the **Communication** tab in the configuration/measurement box, select interface Y3 as **Interface for Parameterization**. You previously connected this interface to a free COM port on your PC.

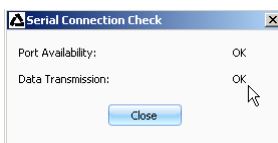


↪ In the PC -> **Interface** part of the **Communication** tab, set the COM port (interface) to which Y3 is connected.

RODPlussoft then automatically sets the required interface parameters for the selected COM port.



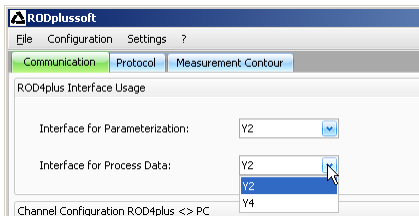
↪ Click **Check connectivity...** to determine whether your PC can communicate with the ROD4...plus.



3.4 Selecting the Interface for Process Data on the PC

The interface for process data is used both for displaying process data (measurement data) and for transmitting online commands via the ASCII Remote protocol. On the ROD4...plus, the Y2 (Ethernet) and Y4 (serial) interfaces are available for this purpose. First, you must select which of these interfaces is connected to your PC and then make the settings for this interface, see chapter 3.4.1 and chapter 3.4.2.

↪ In the **Interface for Process Data** area in the configuration/measurement box on the **Communication** tab, select the interface of the ROD4...plus that you have connected to the PC.



3.4.1 Configuring the Ethernet interface of the ROD4...plus

If you have selected Y2 as the interface for process data, you still need to set the IP address of the ROD4...plus. In order to be able to display the measurement data on the PC, the IP address of your PC and the IP address of the ROD4...plus must lie in the same address

range. The ROD4...plus has no built-in DHCP client, so that you need to set the address manually.



Notice!

If you are using a desktop firewall, please ensure that RODplussoft can communicate with the ROD4...plus via the Ethernet interface on port 9008. Furthermore, the firewall must allow ICMP echo messages to pass through for the connection test (ping).

In this example, we assume that PC and ROD4...plus are in the same network segment (subnet).

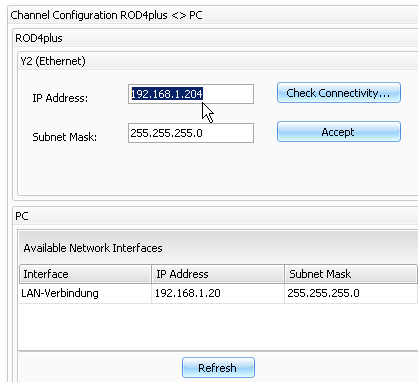
➤ Find an unused IP address in the network in which the ROD4...plus is to be used, or ask the responsible network administrator to allocate an address for the ROD4...plus.

➤ In the **Y2 (Ethernet)** area in the configuration/measurement box on the **Communication** tab, enter this address in the **IP Address** field.

➤ Enter the **Subnet Mask** according to your network configuration.

➤ Click **Check connectivity...**

➤ If the connectivity test was successful, you can accept the settings in the ROD4...plus by clicking the **Accept** button.



The configuration data are now transferred to the ROD4...plus and the measurement data are displayed in the **Measurement Contour** area.

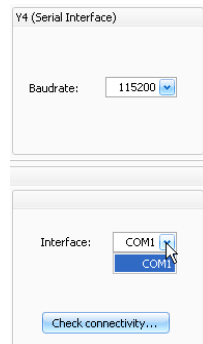
3.4.2 Configuring serial interface Y4 of the ROD4...plus

If you have selected Y4 as interface for process data, you now only need to select the COM port on the PC to which you have connected Y4.

➤ In the **Y4 (Serial Interface)** part of the **Communication** tab, select the **COM** port to which Y4 is connected.

RODPlussoft then automatically sets the required interface parameters for the selected COM port.

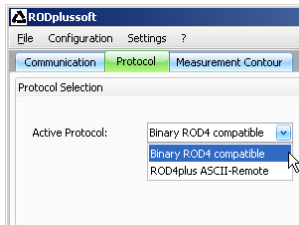
➤ Click **Check connectivity...** to ascertain whether your PC can communicate with the ROD4...plus.



3.5 Configuring the measurement data protocol of the ROD4...plus

Two different protocols are available for the measurement data transfer:

- **Binary ROD4 compatible** (see chapter 5) for the fast and efficient measurement data transfer, no remote control of the ROD4...plus is possible.
- **ROD4plus ASCII Remote** (see chapter 6) for extended, flexible measurement data transfer and remote control of the ROD4...plus.



↳ In the **Active Protocol** area in the configuration/measurement box on the **Protocol** tab, select the desired protocol.

You can now make further settings depending on which protocol is selected.

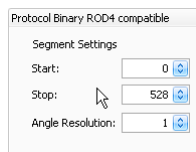
3.5.1 Settings for the ROD4-compatible binary protocol

Under **Protocol Binary ROD4 compatible**, define the start segment (see chapter 5.1.8), stop segment (see chapter 5.1.9) and angular resolution (see chapter 5.1.7).

↳ Set the values as shown in the screenshot:

Start = 0, Stop = 528, Angle resolution = 1.

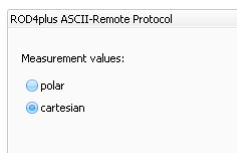
You may change these values later.



3.5.2 Settings for the ASCII Remote protocol

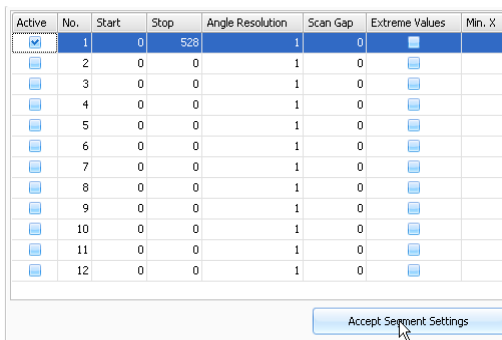
Under **Protocol ROD4plus ASCII Remote**, specify whether measurement data are to be transferred in polar or Cartesian coordinates.

↳ Set **cartesian**.



You must then define and activate at least one measurement segment to be able to start measurement operation of the ROD4...plus.

↳ Set the values for segment **no. 1** as shown in the screenshot, set the tick in **Active** and then click **Accept Segment Settings**.

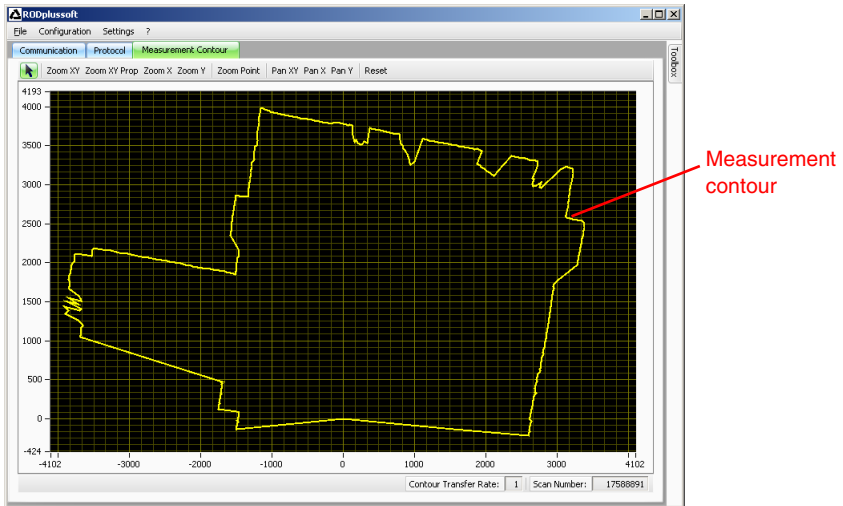


3.6 Displaying the measurement contour

After all interfaces are correctly connected, **RODplussoft** can receive measurement data from the PC and display the data in the Measurement Contour window area.

↳ Click the *Measurement Contour* tab.

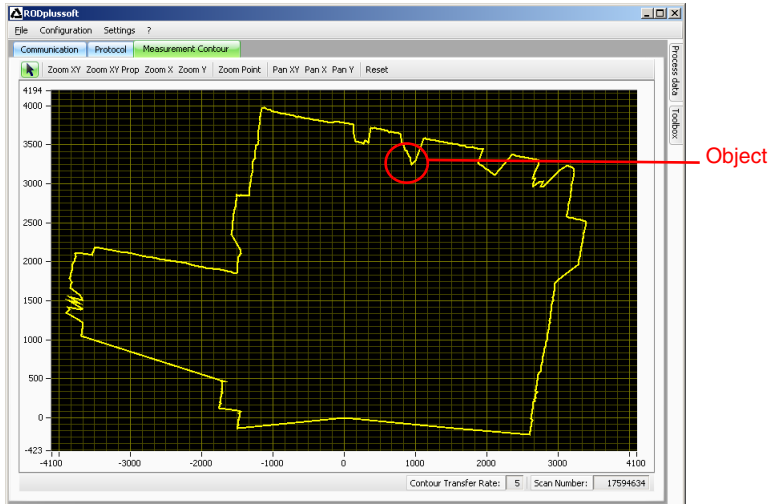
This starts the measurement and transfers the measurement data. **RODplussoft** graphically displays the measurement data as a measurement contour.



The ROD4...plus is located at coordinates 0/0. The measurement contour graphically displays the measured distance within the measurement range of the ROD4...plus. This distance can also be read directly on the coordinate axes in mm.

3.7 Configuring measurement segments

Insert an object into the detection field of the ROD4...plus at a position that you want to use for measurements later.



You can now restrict the measurement range of the ROD4...plus to the area around this object in order to transfer only those measurement data which are actually of interest. The procedure depends on the active protocol selected and is described in the next two subchapters.

3.7.1 Configuring measurement segments for the ROD4-compatible binary protocol

Switch to the **Protocol** tab and experiment with the measurement segment settings under **Protocol Binary ROD4 compatible**.

Protocol Binary ROD4 compatible

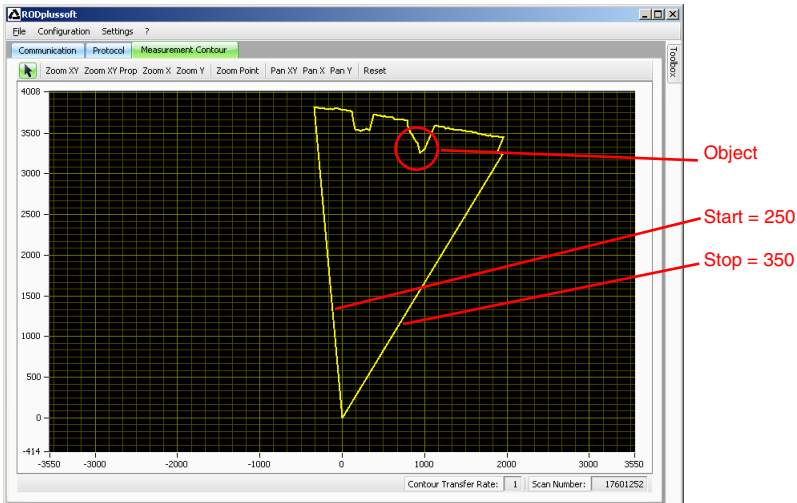
Segment Settings

Start: 250

Stop: 350

Angle Resolution: 1

The settings shown in our example result in the following measurement contour:



You can fine-tune and adapt these settings further depending on the angular range and resolution you wish to measure with.



Notice!

The settings made under the ROD4-compatible binary protocol persist even after the ROD4...plus has been switched off. This lets you take the thus configured ROD4...plus and commission it directly on the process control.

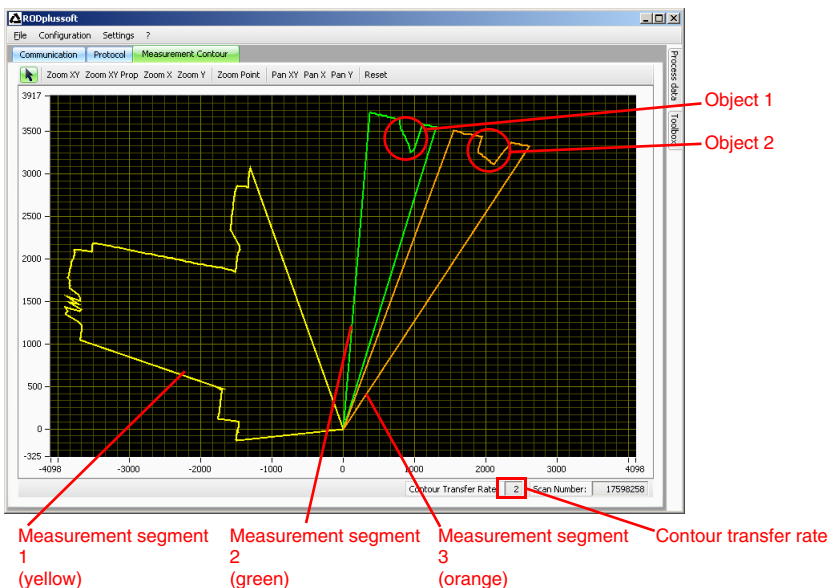
3.7.2 Configuring measurement segments for the ASCII Remote protocol

Here we show as an example the configuration of 3 measurement segments and two objects entering the detection area of the ROD4...plus.

On the **Protocol** tab, change the **Start**, **Stop**, **Angle Resolution** and **Scan Gap** values for one or more measurement segments and transfer the so-defined measurement segments to the ROD4...plus by clicking the **Accept Segment Settings** button.

Active	No.	Start	Stop	Angle Resolution	Scan Gap	Extreme Values
<input checked="" type="checkbox"/>	1	0	200	1	0	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	2	280	320	1	0	<input type="checkbox"/>
<input checked="" type="checkbox"/>	3	330	370	1	0	<input type="checkbox"/>
<input type="checkbox"/>	4	0	0	1	0	<input type="checkbox"/>

The settings shown in our example result in the following measurement contour:



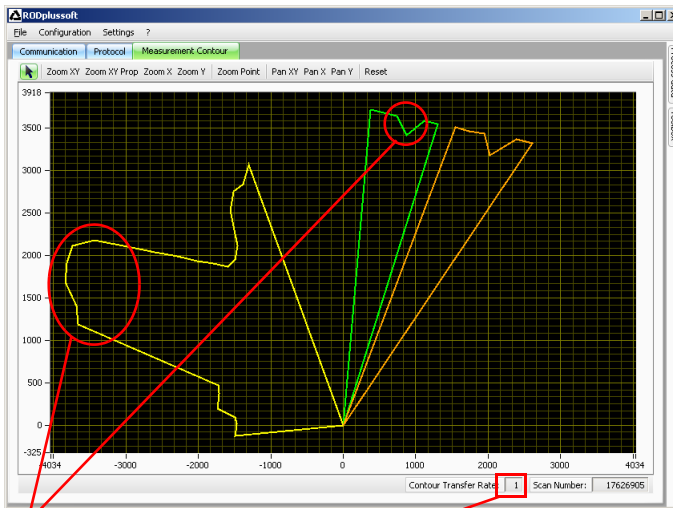
In the areas marked yellow, green, and orange, measurement values are now transferred. Note that for the ASCII Remote protocol with maximum data transmission rate at the interface, less data may be transferred than are delivered by the ROD4...plus. Looking at the **Contour Transfer Rate** tells us whether this is the case here, too. If the value = 1, each measured contour is also transferred.

With a contour transfer rate > 1, not all measured contours are transferred. In our example, only every second measurement contour is transferred. To obtain consistent data, make certain that the contour transfer rate = 1.

There are two ways to achieve this:

- **Increasing the value for Angle Resolution.**
This reduces the angular resolution, and with it the amount of data to be transferred.
- **Increasing the value for Scan Gap.**
This increases the time interval between the transfer of two scans. The angular resolution remains the same, but movements are captured less precisely.

Increasing the value for **Gap** to 7 results in the following figure:

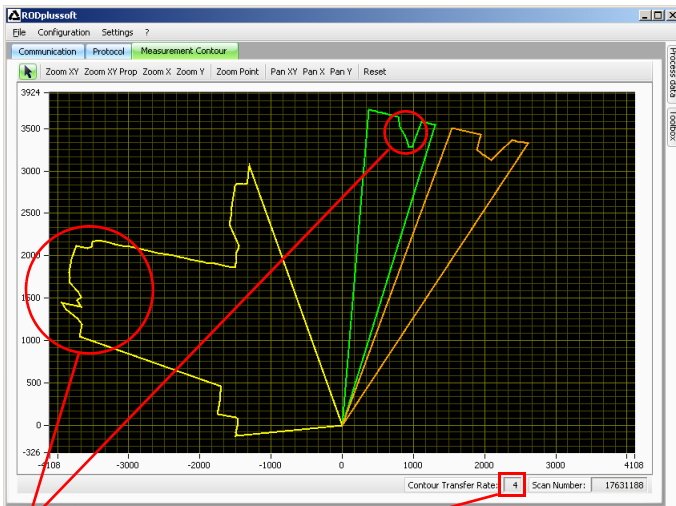


Object contours are captured with less accuracy

Every scan is transferred

In particular, the contour of the small object in the green measurement segment 2 is no longer resolved accurately. Instead, all scans are now transferred completely.

This is perhaps not sufficiently accurate. We start another attempt with angle **Angle resolution = 2** and **Scan Gap = 3**.



Object contours are captured more precisely

Every 4th scan is transferred

This lets you obtain the optimum values for the application through trial and error.

- ↳ Note down the values of **Start**, **Stop**, **Angle Resolution**, and **Scan Gap** for each of the measurement segments configured here, and program your process control such that these calculated values are used to configure the ROD4...plus via the online command '**CS**' (see chapter 6.1.2).

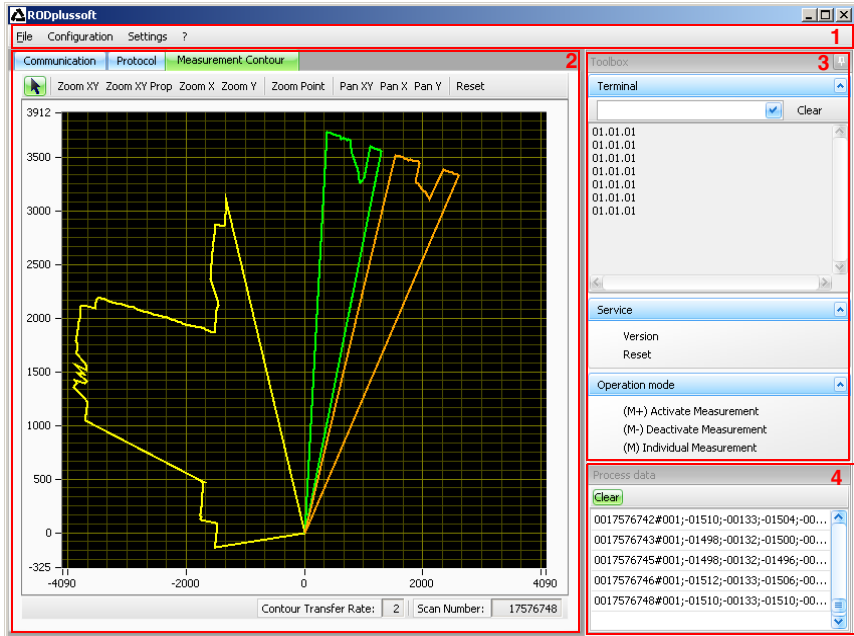


Notice!

The segment settings carried out via the ASCII Remote protocol are volatile. In combination with the ASCII Remote protocol, the **RODplussoft** is predominantly intended for the graphical display of the measurement area and for finding the values for the measurement segments.

4 Menu description

The RODplussoft program window can be divided into 4 areas which are described here in the order specified.



- 1 - Menu bar
- 2 - Configuration/measurement box
- 3 - Toolbox docking window
- 4 - Process data docking window

4.1 Menu bar

The menu bar is used for the basic operation of the software. It consists of 4 menu items.

4.1.1 File

Configurations of the ROD4...plus may be edited either with or without a ROD4...plus connected, and may be saved as files in the *.r4p format. The file menu is used to administer these files:

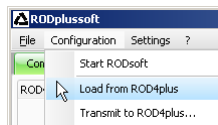
- **New** opens a new blank configuration file.
- **Open** opens a configuration file which has earlier been stored on the hard disk.
- **Save as** saves the current configuration on the hard disk under a different name.
- **Record** saves the measurement data of the ROD4...plus in file(s) on the hard disk. A detailed description can be found in "Process data" on page 27.
- **Exit** closes RODplussoft.



4.1.2 Configuration

The data exchange between RODplussoft and the ROD4...plus takes place in the **Configuration** menu.

- **Start RODsoft** starts the RODsoft program for configuring the detection functions of the ROD4...plus.
- **Load from ROD4plus** loads the configuration of the connected ROD4...plus.
- **Transmit to ROD4plus** saves the current configuration in the ROD4...plus. Note here that only settings for the "Binary ROD4 compatible" protocol are retained after the ROD4...plus is switched off.



4.1.3 Settings

Under **Settings**, you can set the language of the RODplussoft user interface.

- **Language** selects the dialog language (German/English).



Notice!

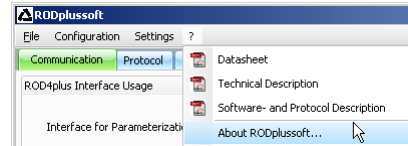
If RODsoft is also installed on the same computer, the language set here is also set in RODsoft if the **Configuration -> Start RODsoft** menu command is executed.

4.1.4 Question mark '?'

The first three menu items in the question mark '?' menu each invoke PDF documents. This requires the Adobe Acrobat Reader® to be installed on your PC.

- **Datasheet**
- **Technical Description**
- **Software and Protocol Description**

About RODplussoft... displays information on the software version.



4.2 Configuration/measurement box

The configuration/measurement box contains three tabs: **Communication**, **Protocol** and **Measurement Contour**.

4.2.1 Communication

The **Communication** tab is used to configure the measurement data transfer of the ROD4...plus.

The screenshot shows the 'Communication' tab of the configuration software. It is divided into three main sections:

- ROD4plus Interface Usage:** Contains two dropdown menus. 'Interface for Parameterization:' is set to 'Y3' and 'Interface for Process Data:' is set to 'Y2'.
- Channel Configuration ROD4plus <-> PC:**
 - ROD4plus:**
 - Y2 (Ethernet):** IP Address: 192.168.1.204, Subnet Mask: 255.255.255.0. Includes 'Check Connectivity...' and 'Accept' buttons.
 - Y3 (Serial Interface):** Baudrate: 57600.
 - Y4 (Serial Interface):** Baudrate: 115200.
- PC:**
 - Available Network Interfaces:** A table with columns 'Interface', 'IP Address', and 'Subnet Mask'. It lists 'LAN-Verbindung' with IP 192.168.1.20 and Subnet Mask 255.255.255.0. A 'Refresh' button is below the table.
 - Interface Selection:** Two dropdown menus, both set to 'COM1'. Each has a 'Check connectivity...' button.

ROD4plus Interface Usage

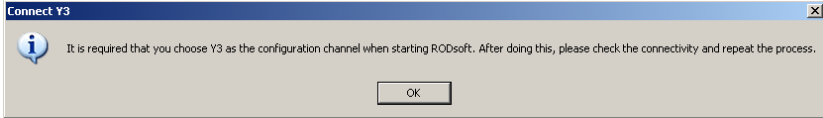
In the **ROD4plus Interface Usage** window area, specify the interfaces of the ROD4...plus that you use.

The **Interface for Parameterization** is used for communication between RODplussoft (and RODsoft) and ROD4...plus. Available for selection are **Y2**, **Y3** and **Y4**.

This is a close-up of the 'ROD4plus Interface Usage' window. It shows two dropdown menus: 'Interface for Parameterization:' set to 'Y3' and 'Interface for Process Data:' set to 'Y2'. A mouse cursor is visible over the 'Y3' dropdown.

**Notice!**

If you would like to use RODsoft, you must first have selected Y3 as the interface here and have made the connection to the PC. If this has not yet been performed, the following warning appears:



The **Interface for Process Data** is used to transfer the measurement data between RODplussoft and ROD4...plus. Available for selection are **Y2** and **Y4**.

**Notice!**

You have the option of selecting the same interface for configuration and process data (**Y2** or **Y4**). Thus, you can minimise wiring work and connect just one cable from the ROD4...plus to the PC. If you would like to use only Y2 (without preconfiguring the Ethernet interface via Y3), please note that you must then manually set your PC to an address in address range **192.168.60.xxx** (in the factory configuration of the ROD4...plus) in order to communicate with the ROD4...plus.

Channel configuration ROD4plus <> PC

Depending on the selected interfaces, set additional parameters here for ROD4plus and PC.

For the **ROD4...plus**, you can set the **IP Address** and the **Subnet Mask** for **Y2 (Ethernet)** under which the ROD4...plus is to be addressed during operation.

The default address is **192.168.60.3** with subnet mask **255.255.255.0**.

The **Check Connectivity** button sends a ping command to the set **IP Address**, checks whether the ROD4...plus answers this ping command, establishes a connection, transfers data, and then tears down the connection.

Use the **Accept** button to save changed values for **IP Address** and **Subnet Mask** in ROD4...plus.

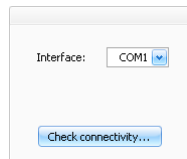
Under **Y3 (Serial Interface)**, there are no options for making settings; only the permanently set baud rate is displayed.

Under **Y4 (Serial Interface)** you can see the **Baudrate** for the RS 232/422 transfer.

For the **PC**, an overview of the IP configuration for your PC is displayed in the **Available Network Interfaces** window area.

Available Network Interfaces		
Interface	IP Address	Subnet Mask
LAN-Verbindung	192.168.1.20	255.255.255.0

If interfaces **Y3** and/or **Y4** were selected under **ROD4plus Interface Usage**, then use this option to set the COM port on the PC to which the interfaces are connected. Immediately after making this setting, you can **Check connectivity**.



4.2.2 Protocol

Depending on which protocol is enabled, the RODplussoft offers different options for settings.

For **Protocol Binary ROD4 compatible**, you can define a measurement segment whose data are transferred. In doing so, you specify the **Start** angle (0 ... 528) from which the measurement data transfer is to begin, the **Stop** angle (0 ... 528) to which the measurement data transfer is to take place, and the **Angle Resolution** between two transferred angular segment (1 ... 8). The measurement data transfer always occurs here in polar coordinates.



With **ASCII Remote**, you can only select whether the measurement data are to be transferred in **polar** or **cartesian** form.



Configuring measurement segments

In the lower part of the protocol window, you can define up to 12 measurement segments.

Click **Accept Segment Settings** to overwrite the segment definitions configured in the RAM of the ROD4...plus with the settings made here. Measurement segments previously defined in the ROD4...plus are deleted in this process unless the **Active** tick is set for the respective segment number.

Active	No.	Start	Stop	Angle Resolution	Scan Gap	Extreme Values	Min. X	Max. X	Min. Y	Max. Y	Min. Radius	Max. Radius
<input type="checkbox"/>	1	0	528	1	0	<input type="checkbox"/>						
<input type="checkbox"/>	2	0	0	1	0	<input type="checkbox"/>						
<input checked="" type="checkbox"/>	3	0	0	1	0	<input checked="" type="checkbox"/>						
<input type="checkbox"/>	4	0	0	1	0	<input type="checkbox"/>						
<input type="checkbox"/>	5	0	0	1	0	<input type="checkbox"/>						
<input type="checkbox"/>	6	0	0	1	0	<input type="checkbox"/>						
<input type="checkbox"/>	7	0	0	1	0	<input type="checkbox"/>						
<input type="checkbox"/>	8	0	0	1	0	<input type="checkbox"/>						
<input type="checkbox"/>	9	0	0	1	0	<input type="checkbox"/>						
<input type="checkbox"/>	10	0	0	1	0	<input type="checkbox"/>						
<input type="checkbox"/>	11	0	0	1	0	<input type="checkbox"/>						
<input type="checkbox"/>	12	0	0	1	0	<input type="checkbox"/>						

**Notice!**

To display a measurement contour, you must have defined and activated at least 1 measurement segment and transferred these settings to the ROD4...plus by clicking **Accept Segment Settings**.

Measurement data transfer of the ROD4...plus occurs only for the activated segments.

This lets you reduce the transferred data volume to the data required for your application.

A tick in front of **Active** activates the defined segment (after data transfer with the **Accept Segment Settings** button).

The number in **Start** specifies at which angular segment number of a scan the measurement data output is to begin, and the number in **Stop** specifies where the measurement data output finishes.

In **Angle resolution**, you specify whether all measurement values of the scan (**Angle resolution = 1**), only every second value (**Angle resolution = 2**), etc., are transferred between **Start** and **Stop**. This lets you reduce the data quantity transferred if the maximum angular resolution of the ROD4...plus is higher than the resolution required for the application. The **Angle Resolution** may be set in the range from 1 ... 8.

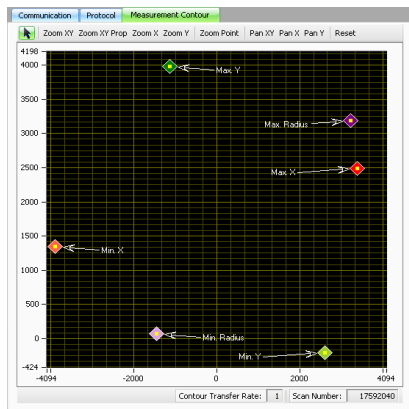
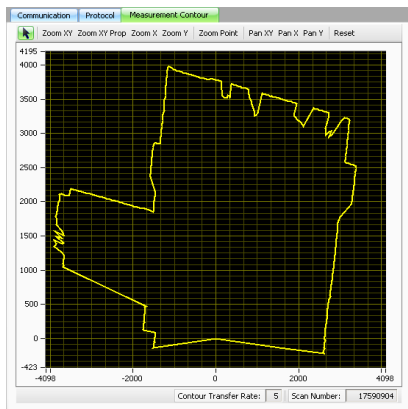
In **Scan Gap** you specify whether all scans (**Scan Gap = 0**) only every second scan (**Scan Gap = 1**), etc., are transferred. This lets you again considerably reduce the data quantity transferred, if the response time required for the application exceeds the duration of the scan (40ms). **Scan Gap** may be set in the range from 0 ... 11.

**Notice!**

The two functions described in the following: **Extreme Values** and **Measurement Value Filtering** are only available if **Cartesian** measurement data transfer is selected.

Outputting extreme values

A tick in the **Extreme Values** field results in only the extreme values being transferred for the respective measurement segment, i.e. the minimum value and maximum values for X, Y and radius. The function is illustrated in the two following screenshots. In the image on the left, the entire measurement contour is transferred; in the image on the right, on the other hand, only the extreme values are transferred, which the **RODplussoft** then consequently displays as individual points.



For better understanding, we will consider some sample process data. Measurement segment **No. 1** is configured with **Start = 50, Stop = 80, Angle Resolution = 4, Scan Gap = 0; Extreme Values** are not activated:

```
Process data
[Clear]
0001392750#001;-01701;+00391;-01691;+00434;-03694;+01048;-03666;+01140;-03883;+01315;-03895;+01430;-03892;+01540;-03850;+01637;-03827;+01684#
0001392751#001;-01689;+00388;-01689;+00433;-03684;+01045;-03670;+01141;-03883;+01315;-03899;+01431;-03890;+01540;-03844;+01635;-03831;+01686#
```

As a result, 9 measurement values are output in X/Y coordinates for each scan. If extreme value output is now activated, the process data change:

```
Process data
[Clear]
0001394647#001;-03884;+01426;-01681;+00431;-01682;+00387;-03822;+01682;-01682;+00387;-03884;+01536#
0001394648#001;-03888;+01427;-01683;+00387;-01683;+00387;-03823;+01683;-01683;+00387;-03823;+01683#
```

Now, only the extreme values are output in X/Y coordinates in the following order:

- Coordinate with minimum X-value
- Coordinate with maximum X-value
- Coordinate with minimum Y-value
- Coordinate with maximum Y-value
- Coordinate with minimum radius
- Coordinate with maximum radius

Measurement value filtering

You can further reduce the measurement values transferred within a segment by entering minimum and maximum values for X, Y and radius in the provided fields. Measurement value transfer then only occurs within the defined ranges. This can be useful on a conveying belt, for example, for outputting only measurement values for objects which lie on the conveying belt.

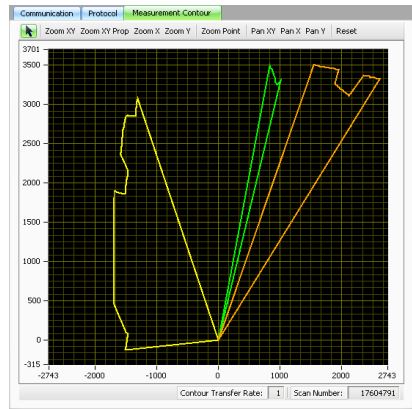
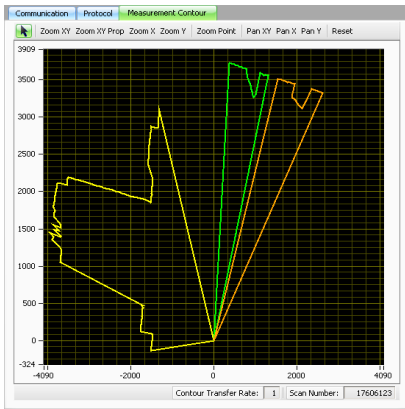
The following example illustrates the effect of the filter:

Extreme Values	Min. X	Max. X	Min. Y	Max. Y	Min. Radius	Max. Radius
<input type="checkbox"/>	-1700			3500		
<input type="checkbox"/>						4200
<input type="checkbox"/>						
<input type="checkbox"/>						

In the first segment, a filter is set that only outputs measurement values with X-values greater than -1700mm (**Min. X**).

In the second segment, only measurement values with Y-values less than 3500mm (**Max. Y**) are output. In the third segment, only measurement values with radii less than 4200mm (**Max. Radius**) are output.

At the left we see the measurement contour without filter; at the right with activated filter:



For better understanding, we will again consider some sample process data. Only measurement segment **No. 1** is configured with **Start = 50**, **Stop = 80**, **Angle Resolution = 4**, **Scan Gap = 0**; **Extreme Values** are not activated:

```

Process data
[Clear]
0001392750#001;-01701;+00391;-01691;+00434;-03694;+01048;-03666;+01140;-03883;+01315;-03895;+01430;-03892;+01540;-03850;+01637;-03827;+01684#
0001392751#001;-01689;+00388;-01689;+00433;-03684;+01045;-03670;+01141;-03883;+01315;-03899;+01431;-03890;+01540;-03844;+01635;-03831;+01686#
    
```

As a result, 9 measurement values are output in X/Y coordinates for each scan.

If a measurement value filter is set to **Max. X 0 -3500**, only measurement values whose X-value is less than -3500 are output:

```

Process data
[Clear]
0001416727#001;-03682;+01044;-03664;+01140;-03881;+01315;-03893;+01429;-03884;+01538;-03844;+01635;-03829;+01685#
0001416728#001;-03684;+01045;-03668;+01141;-03881;+01315;-03895;+01430;-03886;+01538;-03844;+01635;-03816;+01680#
    
```

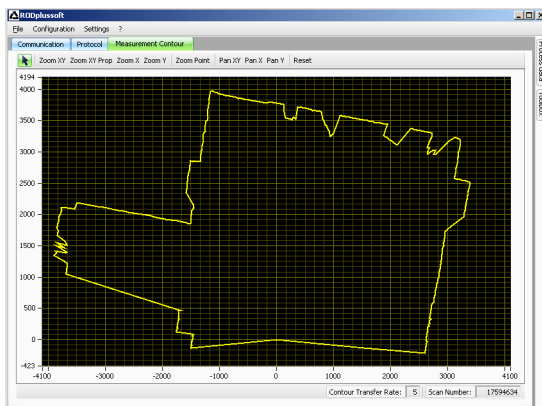
4.2.3 Measurement contour

The **Measurement Contour** tab is used to display the data measured by the ROD4...plus.

For this purpose, the **Interface for Process Data** must be connected to the PC and the measurement function activated.

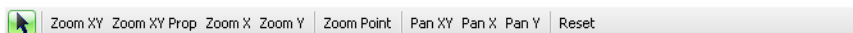
This is automatically the case if the active protocol is **Binary ROD4 compatible**.

For **ROD4plus ASCII-Remote**, you must first define measurement segments and start the measurement.



Toolbar

RODplussoft is equipped standard with a toolbar for viewing the measurement contour. This bar appears automatically when the **Measurement Contour** tab is selected in the configuration/measurement box.



- **Zoom XY** zooms to the area in measurement contour defined by clicking and dragging. Different zoom factors in x- and y-direction are possible.
- **Zoom XY Prop** zooms in the same way as before, but with the same zoom factor in x- and in y-direction.
- **Zoom X** magnifies the display of the x-axis only, while the scale of the y-axis remains the same.
- **Zoom Y** magnifies the display of the y-axis only, while the scale of the x-axis remains the same.
- **Zoom Point** zooms in on the point which is clicked and centres it in the middle of the measurement window.
- With **Pan XY**, the displayed section of the measurement contour can be moved in x- and y-direction while pressing the mouse button.
- **Pan X** moves in x-direction only.
- **Pan Y** moves in y-direction only.
- **Reset** adjusts the view so that the measured contour optimally fits into the xy-plane.



Attention!

The scale in x- and y-direction is not fixed but varies according to the shape and size of the RODplussoft window. To obtain the most realistic possible representation of the measurement contour, you should first adjust proportions of the RODplussoft window to those of the area monitored by the ROD4...plus.

4.3 Toolbox and Process Data docking windows

In the **Toolbox** docking window, you can enter online commands for controlling the ROD4...plus with the **ASCII Remote** protocol. For this purpose, the ROD4...plus must first be connected to the PC via the previously defined Interface for Process Data and the **ASCII Remote** protocol defined as the active protocol.

The **Process data** docking window is used for the numerical display of the measurement data.

4.3.1 Toolbox

The **Toolbox** is divided into 3 areas. These areas can be shown or hidden by clicking on the arrow on the top right of the title bar.

Terminal

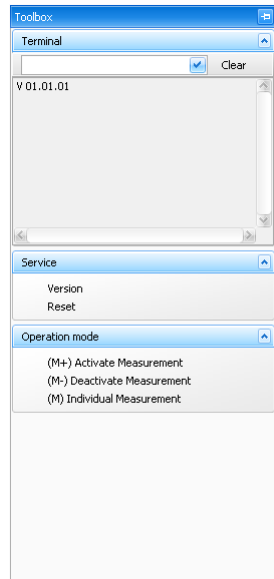
In the upper input field of the **Terminal** area, you can enter arbitrary online commands for the ROD4...plus and transfer them by clicking on the tick. The response of the ROD4...plus will then appear in the output field located below (for online commands see chapter 6.1).

Service

Under **Service**, you can query the firmware version of the ROD4...plus (**Version**) and reset the ROD4...plus (**Reset**).

Operation mode

Under Operation mode, you can activate (**M+**) or deactivate (**M-**) the continuous measurement, or carry out an individual measurement (**M**).



Notice!

*The measurement data are transferred only if at least one measurement segment has been configured and the measurement process has subsequently been started with **M** or **M+**.*

4.3.2 Process data

The Process data window displays the ASCII measurement data transfer of the ROD4...plus.

Two measurement segments are configured in the examples below. Segment **No. 1** with **Start = 0** and **Stop = 0**, Segment **No. 2** with **Start = 1** and **Stop = 2**. Thus, for segment 1, one measurement value is transferred; for segment 2, two measurement values are transferred.

In the upper screenshot, measurement data transfer is **cartesian**; in the lower, it is **polar**. The respective first lines read as follows:

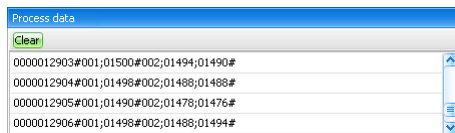
Cartesian:

- Scan number 0000014251
- Segment 1 with measurement value X = -1486mm, Y = -131mm
- Segment 2 with measurement values X1 = -1485mm, Y1 = -121mm, X2 = -1479mm, Y2 = -111mm



Polar:

- Scan number 0000012903
- Segment 1 with measurement value radius = 1500mm
- Segment 2 with measurement values radius 1 = 1494mm, radius 2 = 1490mm



Recording process data

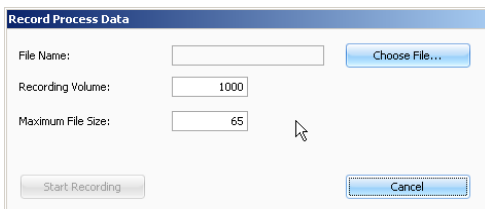
In addition to the pure screen output, RODplussoft also offers the option of writing measurement data to one or more files.

Click **Record** in the **File** menu to open the following window:

Here, you can use **Choose File** to define a CSV file name in which the measurement data are to be stored. Use the **Recording Volume** to define the maximum quantity of data (in kByte) that is to be recorded.

Use **Maximum File Size** to define the maximum size of a recording file; for larger volumes of data, multiple files are then created with the file name defined above and appended with ordinal numbers.

The measurement values are always recorded in X/Y coordinates independent of measurement protocol.



5 ROD4-compatible binary protocol

The structure of the ROD4-compatible binary protocol cannot be specified by the user.

If the ROD4-compatible binary protocol is set as the active protocol, the ROD4...plus continuously sends data with the protocol described here after application of the supply voltage and the subsequent self test (in operation without **RODplussoft**). The protocol data are always bordered by a start frame and an end frame.

The ROD4...plus cannot receive data from the PC via this protocol, which means it is a kind of 'one-way' protocol.



Notice for Ethernet connections!

If you are using a desktop firewall, please ensure that RODplussoft can communicate with the ROD4...plus via the Ethernet interface on port 9008. Furthermore, the firewall must allow ICMP echo messages to pass through for the connection test (ping).

5.1 Protocol structure

The protocol structure is described chronologically from top to bottom. The possible values of individual bytes and their meaning are described below.

Time	No. of bytes	Designation	Description
↓	2	Start	Start of the data transfer from the ROD4...plus
↓	1	Operation	Normal operation / error / warning
↓	1	Option 1	Is always transferred, indicates the operating state, and whether Options 2 and 3 are transferred
↓	1	Option 2	State of the detection fields near and far
↓	1	Option 3	Active field pair
↓	8	Scan number	Is incremented by 1 following each scan of the ROD4 to permit each scan to be uniquely identified
↓	1	Angular resolution	Angular separation between two subsequently transferred measurement values
↓	2 (3) ¹⁾	Start angle	Angle at which the measurement value output starts for each scan
↓	2 (3) ¹⁾	Stop angle	Angle of the most recently transferred measurement segment for each scan
↓	2x no. of meas. values ²⁾	Distance measurement value	Output of the distance measurement values of the entire scan in sequence
↓	1	Check byte	XOR of all characters transferred
↓	3	End	End of the data transfer from the ROD4...plus

1) 3 bytes, if the value = 0, see note on page 29

2) + number of 0xFF inserted



Attention!

If two zeros follow each other in the data stream, a byte with the value 255 is inserted. A distance measurement value of 0, for example, is represented as 0x00 0x00 0xFF.

5.1.1 Start

The start character consists of two bytes that always have the value 0x00,0x00.

MSB		start byte 1						LSB		MSB		start byte 2						LSB	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

5.1.2 Operation

The operation character consists of one byte and identifies the message type.

MSB		operation byte						LSB		Meaning of the bits
0	0	1	0	0	0	1	1	0x23 = measurement values are transferred		

5.1.3 Option 1

Option byte 1 is always transferred and indicates whether further option bytes follow. Information on the operating state is also transferred again, so that the correct working of the data transmission can be checked via redundant data.

MSB		option byte 1						LSB		Meaning of the bits
							0	1	Option 1 only	
							1	0	Option 1 + Option 2	
							1	1	Option 1 + Option 2 + Option 3	
			0	0	1				Initialisation	
			0	1	0				Measurement operation (normal operation)	
			1	0	0				Error / fault	

5.1.4 Option 2

Option byte 2 specifies whether objects have been detected in the near and far detection fields. Information on the operating state is also transferred again, so that the correct working of the data transmission can be checked via redundant data.

MSB						option byte 2			LSB			Meaning of the bits
											0/1	1 = detection field near 1 occupied
											0/1	1 = detection field far 1 occupied
									0/1			1 = warning
								0/1				1 = fault
								0/1				1 = restart-disable
							0/1					1 = detection field near 2 occupied
							0/1					1 = detection field far 2 occupied
						0/1						1 = option byte 3 is transferred

5.1.5 Option 3

The option byte 3 It specifies which field pairs are transferred as detection field 1 and detection field 2 in option byte 2.

MSB						option byte 3			LSB			Meaning of the bits	
1						E1.2	E1.1	E1.0					001: detection field 1 = field pair 1 to 100: detection field 1 = field pair 4
1		E2.2	E2.1	E2.0									001: detection field 2 = field pair 1 to 100: detection field 2 = field pair 4
1	0/1												specifies the state of outputs Fn1/Fn2. 0 = outputs Fn1/Fn2 switched off

5.1.6 Scan number

The scan number can be used to determine the time between two transferred scans. For each individual scan, the ROD4...plus increments the scan number by 1. The ROD4...plus captures 25 individual scans per second.

The scan number itself consists of 32 bits. To prevent a small value in the transfer of 4 bytes from creating a double null (i.e., start sequence), fill bytes with a value of 0xFE are inserted between the individual bytes of the scan number.

MSB								scan number (8 bytes)								LSB	
byte 3		fill byte		byte 2		fill byte		byte 1		fill byte		byte 0		fill byte			
xxxx	xxxx	1111	1110	xxxx	xxxx	1111	1110	xxxx	xxxx	1111	1110	xxxx	xxxx	1111	1110		

5.1.7 Angular resolution

The angular resolution specifies the angular separation between two successively transferred measurement values as a multiple of 0.36 °.

Factory setting: 1

MSB	angular resolution						LSB	Example
x	x	x	x	x	x	x	x	0000 0101: angular resolution = 1.8°

5.1.8 Start angle

This value specifies the angular segment of the current scan at which the measurement value output begins. Possible values: 1 (0x00,0x01) = start angle -5.04° to 529 (0x02,0x11) = start angle 185.04°.

Factory setting: 1

MSB	start angle byte 1				LSB	MSB	start angle byte 2				LSB	Example	
x	x	x	x	x	x	x	x	x	x	x	x	x	0x00 0x0A: start angle = 10 = -1.8°



Notice!

The value range here extends from 1 to 529, unlike the 0 to 528 for the ROD4plus ASCII-Remote protocol. This prevents the output of two successive zeros for start/stop angle = 0.

5.1.9 Stop angle

This value specifies the angular segment of the current scan at which the measurement value output ends. Possible values: 1 (0x00,0x01) = stop angle -5.04° to 529 (0x02,0x11) = stop angle 185.04°.

Factory setting: 529

MSB	stop angle byte 1				LSB	MSB	stop angle byte 2				LSB	Example	
x	x	x	x	x	x	x	x	x	x	x	x	x	0x00 0x14: stop angle = 20 = 1.8°



Notice!

The value range here extends from 1 to 529, unlike the 0 to 528 for the ROD4plus ASCII-Remote protocol. This prevents the output of two successive zeros for start/stop angle = 0.

5.1.10 Distance measurement value

All distance measurement values that were measured between start and stop angle using the previously defined angular resolution are transferred as successive 2 byte values.

MSB								distance byte 1								LSB	MSB								distance byte 2								LSB	Meaning of the bits				
																																					0/1	1 = object in detection field near detected
x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		15 bit distance measurement value with 2mm resolution	

The following table shows by means of example the chronological order of distance measurement values transmitted for start angle = 10, angular resolution = 2, stop angle = 18:

Time	Bytes	Designation	Meaning
↓	0x10, 0x00	Distance 1	4096mm at angle -1.8° (angular segment no. 10), no object in detection field near
↓	0x10, 0x01	Distance 2	4096mm at angle -1.08° (angular segment no. 12), object in detection field near
↓	0x10, 0x03	Distance 3	4098mm at angle -0.36° (angular segment no. 14), object in detection field near
↓	0x10, 0x02	Distance 4	4098mm at angle 0.36° (angular segment no. 16), no object in detection field near
↓	0x10, 0x04	Distance 5	4100mm at angle 1.08° (angular segment no. 18), no object in detection field near

5.1.11 Check byte

The check byte has a value range of 0x01 to 0xFF.

It is the result of an XOR of all bytes transferred, including operation and option bytes, i.e., from after the start byte up to the last byte before the check byte.

To avoid collision with the end mark, the check byte must never have the value 0x00. If a 0x00 is calculated as the result of the XOR, then a 0xFF is transferred as check character and used for the evaluation.

MSB								check byte								LSB	Meaning of the bits
x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	XOR of all bytes from the start to the check byte

5.1.12 End

The end mark consists of three bytes that always have the value 0x00,0x00,0x00.

MSB								end byte 1								LSB	MSB								end byte 2								LSB	MSB								end byte 2								LSB
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				

6 ASCII-Remote protocol

The ASCII-Remote protocol is used to configure the ROD4...plus from a terminal using commands known as 'online commands' and to carry out simple measurement tasks, the results of which are also directly displayed in the terminal window.

Prerequisites for using the ASCII-Remote protocol:

- The ROD4plus... has been configured with **RODsoft** or **RODplussoft** such that
- Y2 or Y4 is defined as the active interface, and
- the ASCII-Remote protocol has been activated.



Notice!

Settings applied via the ASCII-Remote protocol are only temporarily stored in the ROD4...plus and are lost when the ROD4...plus is switched off.



Notice for Ethernet connections!

If you are using a desktop firewall, please ensure that RODplussoft can communicate with the ROD4...plus via the Ethernet interface on port 9008. Furthermore, the firewall must allow ICMP echo messages to pass through for the connection test (ping).

6.1 Online commands

With the commands, you can

- configure up to 12 segments within which measurement values are transferred
- configure measurement value filtering
- activate/deactivate extreme value transfer
- delete configured segments
- activate/deactivate measurements
- query device information
- carry out a software reset in order to reinitialise the device

Syntax

"Online" commands consist of one or two ASCII characters followed by command parameters. An 'STX' (0x02) must be transferred prior to each command and an 'ETX' (0x03) must be transferred afterward.

No separation characters may be entered between the command and the command parameter(s). Capital letters must be used.

Example:

Command '**M**': **M** Measurement function

Parameter '**+**': **+** activates the continuous measurement

Transmitted is: '**M+**'

Notation

Commands, command parameters and returned data are enclosed between single quotation marks ' ' in the text of this manual. The ROD4...plus responds to an 'Online' command with an acknowledgement or returns measurement data.

6.1.1 General 'Online' Commands

Software version number

Corresponds to the "Version" command in the **RODplussoft** toolbox.

Command	'V'
Description	Requests device version information
Parameter	-
Acknowledgement	'V 01.01.01' The software version number of the ROD4...plus is shown.



Notice!

Use this command to check whether the ROD4...plus is connected and configured correctly. If you do not receive an acknowledgement, please check interface connections and protocol.

Software reset

Corresponds to the "Reset" command in the **RODplussoft** toolbox.

Command	'H'
Description	Carries out a software reset. The device is restarted and reinitialised, leaving it in the same state as when the supply voltage is switched on.
Parameter	-
Acknowledgement	-

6.1.2 Online commands for configuration of the measurement function

The commands described here correspond in function to the adjustment options in the **Protocol** window area in **RODplussoft** (see chapter 4.2.2).

Measurement segment configuration

Command	'CS'	
Description	The command configures one of 12 possible measurement segments.	
Parameter	'_x_yyy_zzz_l_s'	Replace the '_' characters by space characters
	'x'	Measurement segment number Attention: if the number of an already defined segment is specified here, the data are simply overwritten without confirmation
	'yyy'	Start angular segment: 0 ... 528 start angular segment ≤ stop angular segment
	'zzz'	Stop angular segment: 0 ... 528
	'l'	Angular resolution, possible values: 1 ... 8: 1 = each angular segment is transferred 2 = every second angular segment is transferred
	's'	Scan gap: distance between two scans transmitted, possible values: 0 ... 11: 0 = each scan is transferred 1 = every second scan is transferred, etc.
Acknowledgement	-	Command accepted: start of measurement data output for the selected measurement segment
	-	Command not accepted: no measurement data output for the selected measurement segment
Example	'CS 1 264 300 2 1'	Configuration of area 1, start at angular segment 264, end at angular segment 300, angular resolution = 2, i.e., a measurement value is transferred every 0.72°, every second scan is transferred



Notice!

Measurement segments should be defined so that the start angular segment of the measurement segment is always larger than the stop angular segment of the previous measurement segment, i.e. each individual angular segment should only be contained once in one of the measurement segments.

If an angular segment is contained in multiple measurement segments, the corresponding measurement value is transferred **only in the first** measurement segment which contains the angular segment.

Example: Defined in measurement segment 1 are $yyy = 100$ and $zzz = 120$; defined in measurement segment 2 are $yyy = 110$ and $zzz = 130$. Measurement data transfer occurs for angular segment 100 to 120 in measurement segment 1 and for 121 to 130 in measurement segment 2.

Measurement area deletion

Command	'DS'	
Description	The command deletes one of 12 possible measurement segments.	
Parameter	'_x'	Replace the '_' character by a space character
Acknowledgement	-	Command accepted: stop of measurement data output for the selected measurement segment
	-	Command not accepted: measurement data output for the selected measurement segment continues
Example	'DS 1'	Deletes measurement segment 1



Notice!

At least 200ms must pass after sending 'CS' before a 'DS' command is accepted.

Configuration of measurement value filtering

Command	'PS'	
Description	The command configures measurement value filtering for a previously defined measurement segment.	
Parameter	'_x aaa bbb c_d'	Replace the '_' characters by space characters
	'x'	Measurement segment number Attention: The measurement segment must first be configured with 'CS', otherwise nothing happens here.
	'aaa'	aaa = SET (activate) or aaa = CLR (delete) measurement data filtering for segment no. x
	'bbb'	bbb = MIN (minimum value) or bbb = MAX (maximum value)
	'c'	c = X (X-values) or c = Y (Y-values) or c = R (radius values)
	'd'	d = value
Acknowledgement	-	Command accepted: start of measurement data filtering for the selected measurement segment
	-	Command not accepted: no measurement data filtering for the selected measurement segment
Example	'PS 1 SET MIN R 3000'	In segment 1, only the measurement values with a radius greater than 3000mm are transferred.

Configuration of extreme value output

Command	'FS'	
Description	The command configures extreme value output for a previously defined measurement segment.	
Parameter	'_x_aaa_EXT'	Replace the '_' characters by space characters
	'x'	Measurement segment number Attention: The measurement segment must first be configured with 'CS', otherwise nothing happens here.
	'aaa'	aaa = SET (activate) or aaa = CLR (delete) extreme value output for segment no. x
Acknowledgement	-	Command accepted: start of extreme value output for the selected measurement segment
	-	Command not accepted: no extreme value output for the selected measurement segment
Example	'FS 1 SET EXT'	Only extreme values are output in segment 1.

6.1.3 Online commands for measurement function control

Starting/stopping the measurement

Corresponds to the "Activate Measurement", "Deactivate Measurement" and "Individual Measurement" commands in the RODplussoft toolbox.

Command	'M'	
Description	Controls the measurement function according to parameter.	
Parameter	','	Without parameter: Individual measurement, transfers the next scan
	'+'	Activates the continuous measurement.
	'-'	Deactivates the continuous measurement.
Acknowledgement	Measurement data output, see chapter 6.2	
Example	'M+'	Continuous measurement activated, the measurement values are output via the active process interface

6.2 Measurement data protocol

The ROD4...plus can continuously output measurement data. For this purpose, the measurement data of an individual scan are combined.

A measurement data transfer might look like the following, for example:

STX0001048577#001;00889;00890;...#002;00799;... ...;00800#ETX

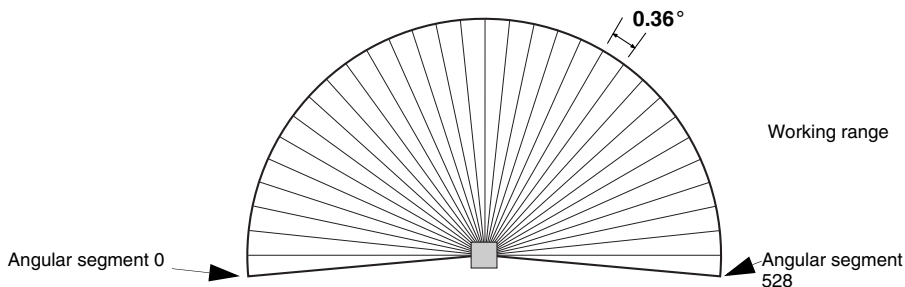
The individual elements here are:

Time	ASCII value	Designation	Meaning
↓	STX=0x02	Preamble	Indicates the beginning of a new individual scan
↓	0000178923	Scan number	Incremented by one for each individual scan, labels each individual scan uniquely
↓	#001;	Segment number	Number of the measurement segment whose measurement data are about to be transferred
		then	
↓	008895; 008897; 008893; ...	Measurement data, polar coordinates	Measurement values in mm for each angular segment within the measurement segment
		or	
↓	+06615; -03475; +06617; -03473; +06611; -03472; ...	Measurement data, cartesian coordinates	Cartesian measurement values in mm for each angular segment within the measurement segment. Negative X values are located left of the middle of the sensor, negative Y values behind the front of the sensor.
↓	#ETX = 0x03	Suffix	Indicates the end of the individual scan just transferred.

7 Appendix

7.1 Terms and abbreviations ROD4...plus software

The terms used in this description are most easily explained using the drawing below. The ROD4...plus scans the area in front of it clockwise from left to right and calculates the distance measurement values in steps of 0.36° .



Angular resolution

Distance between to measurement segments (angular segments) **transferred**, specified in number of angular segments.

Example:

- Angular resolution = 1: each measurement value of a measurement segment is transferred
- Angular resolution = 2: every second measurement value of a measurement segment is transferred...

Angular segment

Uniquely identifies one of 529 measurement values of an individual scan.

Individual scan

Detection of 529 measurement values. The ROD4...plus requires 40ms for this.

Measurement segment

Area between two angular segments between which the measurement data captured by the ROD4...plus are transferred via the active process interface. Within one measurement segment, the angular resolution parameter can be used to specify how many measurement values from the measurement segment are to be transferred.

Measurement data, polar coordinates

Transfer of radius data

Measurement data, cartesian coordinates

Transfer of X/Y-data, negative X-values are located left of sensor centre, negative Y-values behind the sensor front.

Scan gap

Time interval (in scan units) between two individual scans **transferred**.

Example:

- Scan Gap = 0: each individual scan is transferred
- Scan Gap = 1: every second individual scan is transferred
- Scan Gap = 2: every third individual scan is transferred ...

Scan number

All individual scans of the ROD4...plus are sequentially numbered with the scan number. When the ROD4...plus is switched on, the scan number is restarted with 0.

Start angle

First angular segment of a measurement segment

Stop angle

Last angular segment of a measurement segment