Triple-IN GmbH
Experts in Laser Distance Measurement

INvention
INnovation
INterfacing

PSxxx-270 Laser Scanner

User's Manual

PS250-270

PS150-270

Triple-In GmbH | Poppenbütteler Bogen 64, D-22339 Hamburg, Germany

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1 Introduction

1.1 About PS Laser Scanners

Triple-Ins PS Laser Scanners are 2D Laser Scanners for outdoor automation, industrial applications, security and surveying.

- long range
- large scan angle
- small spot size
- accurate in range and angle
- fast scan rate
- robust, IP67
- real time Ethernet

1.2 About this document

This document describes the PSxxx-270 Laser Scanner family. It is related to the

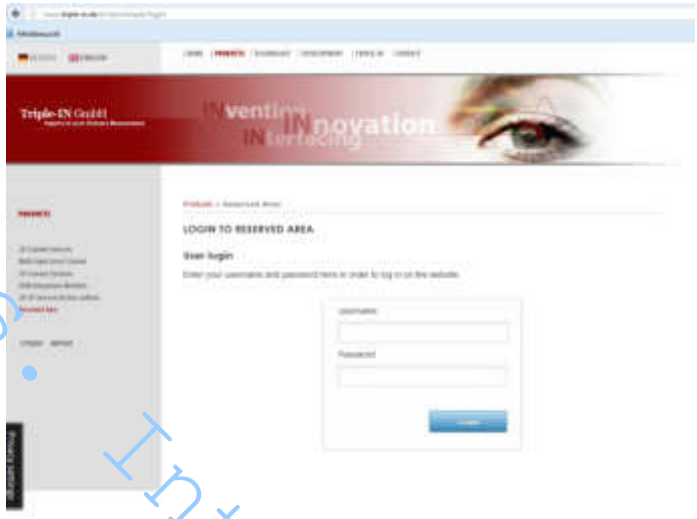
PS Firmware Version 3.03.20

If you or your colleagues have any comments on this manual, we would be grateful to hear from you. Please write to:

Triple-IN GmbH
Poppenbütteler Bogen 64
D-22399 Hamburg
Germany
Telefon +49(0)40 50091998
Mail info@triple-in.de

1.3 Webserver with latest Documents and Firmware Updates

The latest version of this document and the latest firmware updates can be obtained from Triple-IN's webserver:



Picture 1 Triple-IN webserver login

Please contact Triple-IN to get access to the reserved area of the webserver:

info@triple-in.de

2 Safety Instructions

ATTENTION

- Before using the PS Laser Sensor, the user manual must be read and all instructions must carefully be observed.
- The PS Laser Scanner must be installed, configured, and serviced only by qualified personnel.
- National and international rules and regulations must be applied according to the field of application and usage.
- PS Laser Sensor cannot be used as a safety device.

ATTENTION

- Measurement Laser is a laser class 1 product. Emits invisible light (905 nm). Do not look into the laser beam!
- Red laser marker is a laser class 2 product. Emits visible light (660 nm). Do not look into the laser beam!

ATTENTION

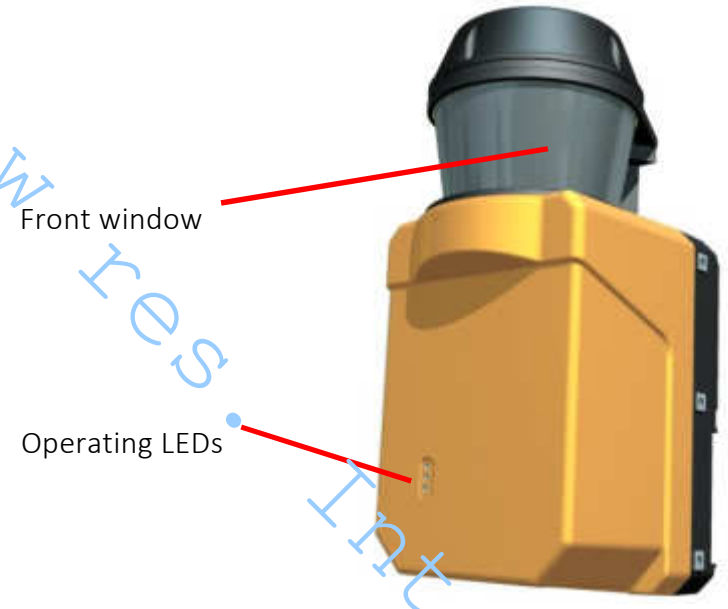
Only authorized personnel are allowed to perform the electrical installation work.
To reduce the risk of electric shock, do not remove the cover. Device contains high voltage components!
Connect and disconnect electrical linkages only under de-energized conditions.

WARNING

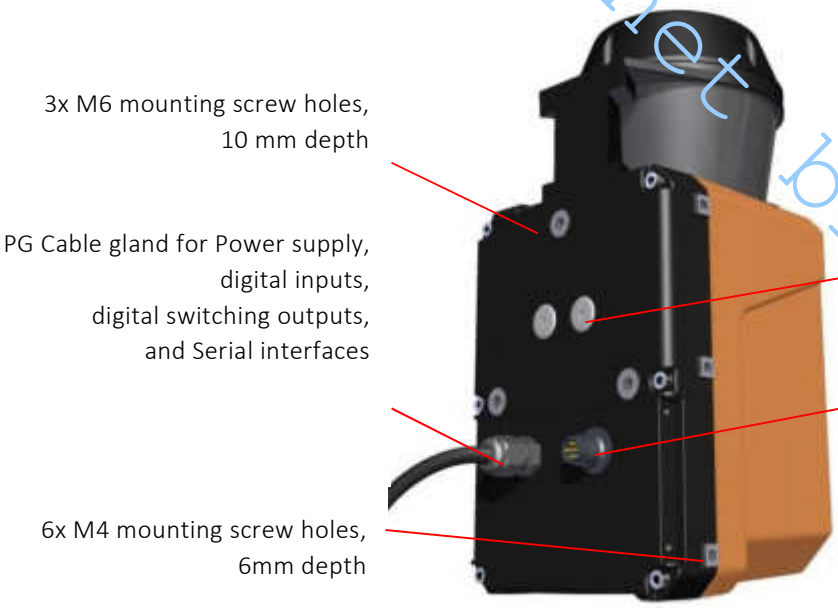
Do not open the PS Laser Scanner.
If opened, the mechanical adjustment will be damaged and warranty will get void!

3 About the PSxxx-270 Laser Scanner

3.1 Names and Functions of Components



Picture 2: PS Laser Scanner front view

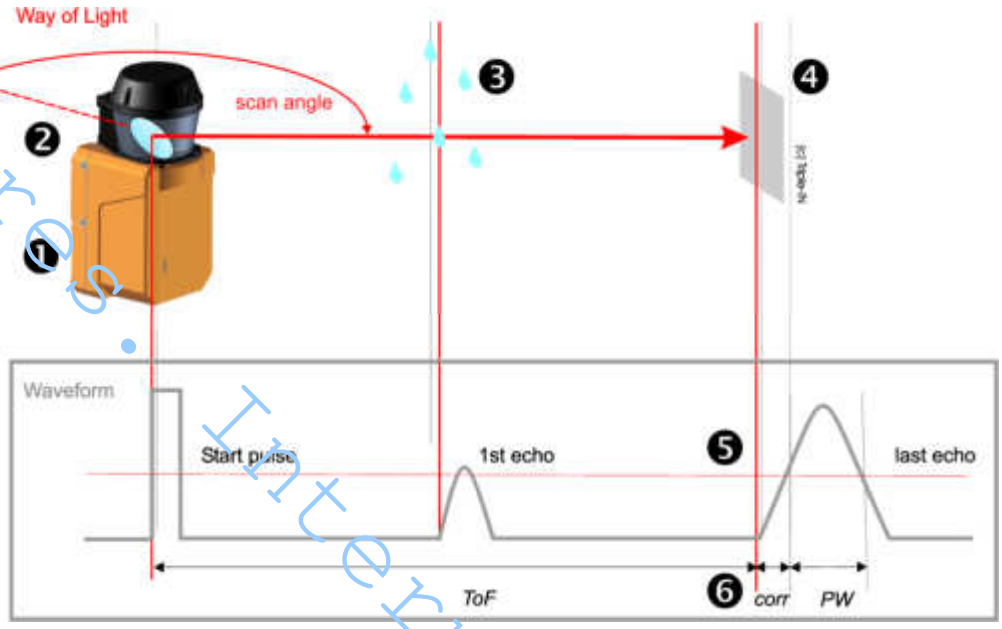


WARNING
Never remove these plastic caps!

Picture 3: PS Laser Scanner rear side.

3.2 Triple-IN's KEM Time-of-Flight Technology

The technological basis for the Triple-IN PS Laser Scanners is "Time-of-Flight" (ToF): the travel time of light emitted by a laser diode to natural surface. Triple-IN' KEM method ("kontinuierliche Event Messung") improves this well-known technology:



Picture 4 Principle of operation

1. An angle encoder triggers a laser diode in regular angle steps. The laser diode emits an infrared laser beam. This "start pulse" marks the beginning of the time-of-fligh measurement.
2. A mirror, which is connected to the angle encoder, reflects the laser beam in certain directions. An even scan area is formed by the rotation of the mirror.
3. The laser beam is reflected by natural surfaces. Several echoes can be the result of window panes, rain drops, snowflakes and similar objects which reflect parts of the laser pulse's energy. This effect is called "multi-echo". PS Laser sensors can record the results of up to 4 echoes for each laser beam.
4. The echo signal varies by the surface reflectivity and the distance to the object. The echo signal will be detected as soon as it passes a receiver threshold. The sensor measures the time-of-flight and the pulse width of the echo signal.

5. The KEM technology applies various corrections to compensate deviations of the echo signal strength.
6. The result is accurate time-of-flight measurement, independently of the temperature, reflectivity, and target distance. One echo signal is used as “Master Echo” to build the final measurement result.
   The distance to the target is calculated by

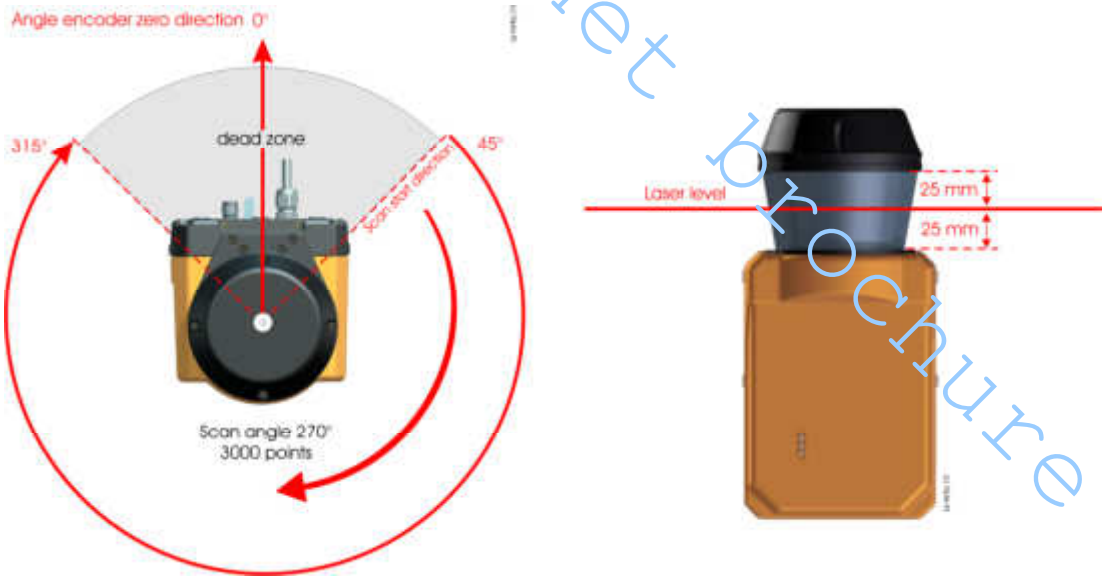
$$d = ToF * c / 2 - corr$$

d	distance
ToF	measured time-of-flight
c	speed of light in ambient atmosphere
corr	echo signal corrections

3.3 Sensor Origin and Scan Area

The scanner triggers 3000 laser beams on a 270° scan field, starting at 45°:

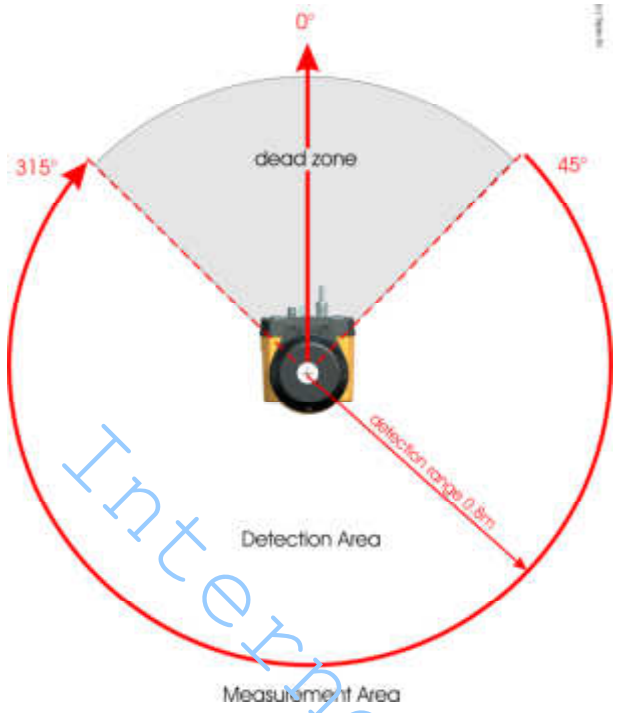
- The angle measurement system is defined by a 360° circle.
- The angle encoder zero direction is to the rear side of the sensor.
- The scanner has a 90° dead zone behind the rear, so the scan field starts at angle encoder position 45° and ends after 270° at encoder position 315°.
- The scanner firmware handles angles as integer value in milli-degree.



Picture 5: Scan area

3.4 PS150-270 Detection area

The PS150-270 can be used as safety device. Objects in the range from the window up to a distance of 0.8 m are detected without accurate distance measurement. Accurate distance measurements are achieved from 0.8 m. This area >0.8 m is called the measurement area.



Picture 6 : Detection area and Measurement area

4 Transport and Installation

4.1 General Handling Instructions

- Ensure during the installation that the entire system is disconnected from power supply.
- Mount the sensor at a location where the device is protected from damages, pollution and high humidity.
- Mount the PS laser sensors in a way that it is not exposed to direct sunlight!
- Route cables such that danger is excluded for persons and all cables are protected from damages.
- Do not remove the label or the two gray plastic caps from the rear side.
- Follow the safety instructions in the chapter 2.

4.2 Transport

PS Laser Sensors are optical instruments. Such equipment must be transported with special caution and sufficient packaging to protect the sensors from possible damage.

Picture 7 Transport package

ATTENTION

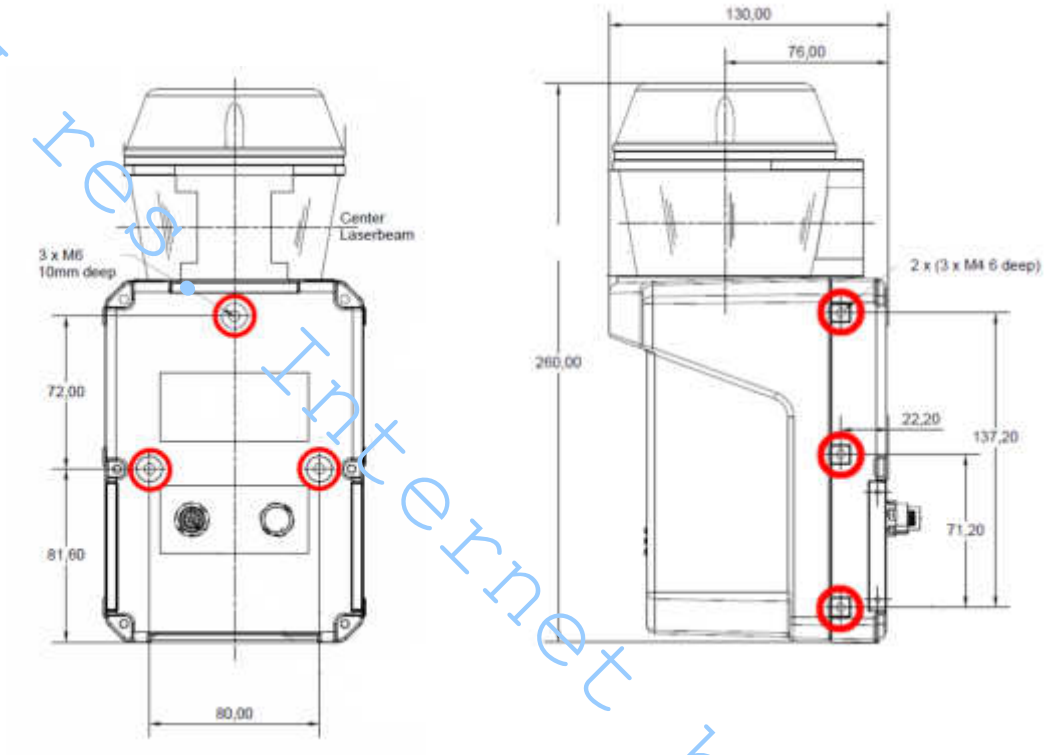
Your warranty may be voided if returned sensor is received as a result of inadequate packaging.

At the time of delivery, the user should examine the shipment for loss or damage. If there is evidence of loss or damage, note it on the delivery receipt; this will be used as evidence to back up the claim. Do not use or install a defective device.

4.3 Mechanical Mounting

PSxxx-270 Laser Sensors can be fitted with socket head screws with washers on

- three M6 thread holes on the rear side, screw-in depth max. 10 mm.
- three M4 thread holes on each side, screw-in depth max. 6 mm.
- Minimum screw-in depth is 4 mm.
- Maximum tightening torque is 12 Nm.



Picture 8: Mounting thread holes

ATTENTION

- Use correct M6 and M4 screws only.
- Apply washers.
  The sensor must be fixed with at least four mounting screws.
- Observe the maximum screw-in depth for the screw holes. The device will be mechanically destroyed if the maximum screw-in depth is exceeded!
- Do not extend the maximum tightening torque of 12 Nm.

5 Connectors

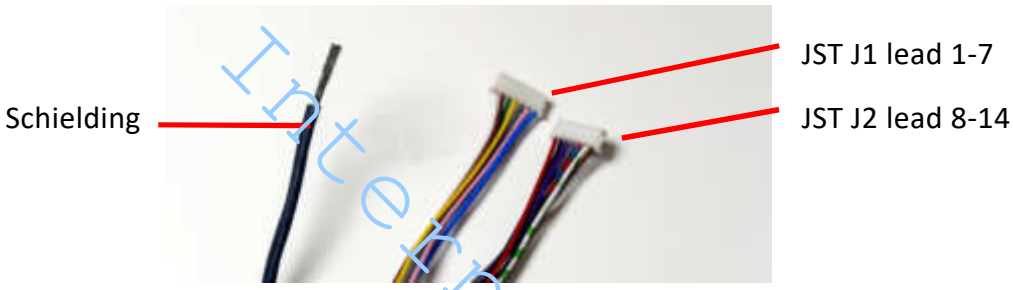
5.1 Serial Interface Cable

5.1.1 Serial Interface Cable Layout

The Serial Interface Cable is an open, shielded 14 lead cable. The cable provides

- 24 VDC power supply
- Serial RS232 interfaces to the MPU board and the Communication board
- Four digital switching outputs
- Voltage input for the digital switching outputs.

On delivery, the Serial Interface Cable is shipped with two 7-lead so-called JST connectors, J1 and J2.



Picture 9 Serial Cable with two JST connectors

Lead	Color	Name	Signal	Purpose
J1-1	White	STD_TXD	RS232 Measurement board transmit	Terminal mode, MPU Firmware update
J1-2	Brown	STD_RXD	RS232 Measurement board receive	Terminal mode, MPU Firmware update
J1-3	Green	OUT1	Digital switching output 1	Digital switching output
J1-4	Yellow	OUT2	Digital switching output 2	Digital switching output
J1-5	Gray	ORX	RS232 Communication board receive	Communication board firmware update
J1-6	Pink	OTX	RS232 Communication board transmit	Communication board firmware update
J1-7	Blue	IN1	Digital input 1	For future use
J2-8	Red	IN2	Digital input 2	For future use
J2-9	Black	OUT3	Digital switching output 3	Digital switching output (optional)

Lead	Color	Name	Signal	Purpose
J2-10	Violet	OUT4	Digital switching output 4	Digital switching output (optional)
J2-11	Gray/brown	VCC_IO	Voltage for outputs	Digital switching outputs
J2-12	Red/blue	GND	RS232 Measurement board RS232 communication board	Common ground for RS232
J2-13	White/green	24V DC+	Power supply	24 V supply voltage
J2-14	Brown/green	24V DC-	Power supply	Ground

5.1.2 Connecting 24V/DC Power Supply

The Serial Interface cable includes 24 Volt power lines.

WARNING

Power supply

- Without heater: 24 Volt, 0.30 Ampere, 8 Watt
- With optional internal heater: 24 Volt, 1.25 Ampere, 30 Watt

The layout of the Serial Interface cable can be found in chapter “5.1 Serial Interface Cable”.

Cable Lead	Color	Signal	Purpose
J2-14	Brown/green	24V DC-	24V Ground
J2-13	White/green	24V DC+	Power supply 24 Volt DC

5.1.3 Wiring the Measurement Board (MPU) RS232 Serial Interface

The Serial interface cable includes RS232 to the the Measurement Board (MPU).
The RS232 interface to the Measurement board (MPU) is used for system configuration, e.g. to setup the network parameter.
PS Laser Sensors are classified as Data Terminal Equipment (DTE). According to the standard, PS Laser Sensors shall be equipped with male connectors.
A “null modem cable” consisting only of transmit data, receive data, and ground, is commonly used since the full facilities of RS-232 are not required.
A DSUB9 connector must connect the following leads:

Picture 10 Measurement Board (MPU) DSUB9 male DTE pin layout (socket view)

DSUB9 Pin	Cable Lead	Color	Name	Signal
3	J1-1	White	STD_TxD	RS232 MPU board transmit
2	J1-2	Brown	STD_RXD	RS232 MPU board receive
5	J2-12	Red/blue	GND	5V ground

5.1.4 Wiring the Communication Board RS232 Serial Interface

The Serial interface cable includes the RS232 to the the Communication Board. The Communication board provides the Ethernet interface. The RS232 interface is only used for network status messages and for firmware updates of the Communication board.
PS Laser Sensors are classified as Data Terminal Equipment (DTE). According to the standard, PS Laser Sensors shall be equipped with male connectors. A “null modem cable” consisting only of transmit data, receive data, and ground, is commonly used since the full facilities of RS-232 are not required.

Picture 11 Communication Board DSUB9 male DTE pin layout (socket view)

DSUB9	Cable Lead	Color	Name	Signal
2	J1-5	Gray	ORX	RS232 Communication board receive
3	J1-6	Pink	OTX	RS232 Communication board transmit
5	J2-12	Red/blue	GND	5V ground

5.1.5 Wiring Digital Switching Outputs

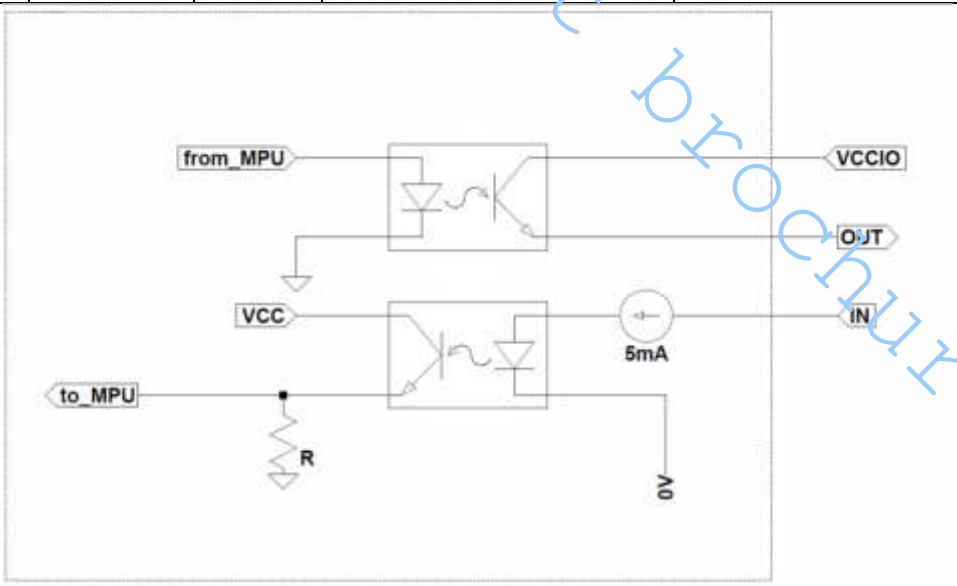
ATTENTION

Digital switching outputs OUT3 and OUT4 are options and not available for all PS Laser Sensors.

Depending on the PSxxx-270 type, the sensors have two or four digital open-collector outputs, called OUT1 to OUT4. These outputs can be programmed for different purposes (see chapter “6.8 Setting up the Digital Switching Outputs”).

- Maximum output current is 50 mA
- Maximum voltage to be applied is 30 V
- Output residual voltage is < 1 V
- Power supply range at VCC_IO is 10 to 30 V

Lead	Color	Name	Signal	Purpose
J1-3	Green	OUT1	Digital switching output 1	Digital switching output
J1-4	Yellow	OUT2	Digital switching output 2	Digital switching output
J2-9	Black	OUT3	Digital switching output 3	Digital switching output (optional)
J2-10	Violet	OUT4	Digital switching output 4	Digital switching output (optional)
J2-11	Gray/brown	VCC_IO	Voltage for outputs	Digital switching outputs



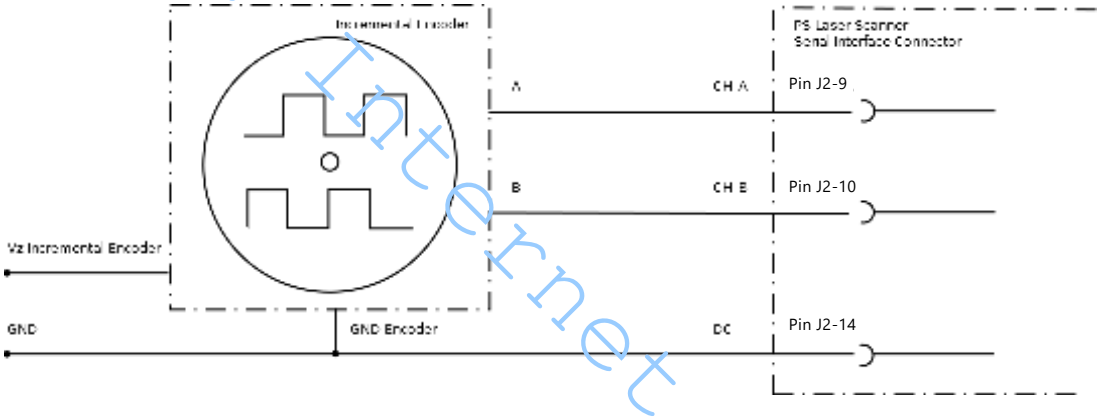
Picture 12 Digital switching input/output wiring scheme

5.1.6 External Incremental Encoder

ATTENTION

The external incremental encoder interface is an option and not available for all PS Laser Sensors.

The PS Laser Scanner provides one 3.3 to 5.0 Volt incremental encoder input.
Purpose of the external incremental encoder is to report changes in the horizontal position of the sensor.
The incremental encoder must provide two pulses A and B. The PS Sensor firmware counts these pulses in both directions by use of a 32 bit register.
Input is limited to 128.000 counts/second.
Reset of the counter is done at startup or by software.



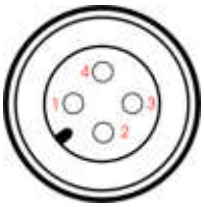
Picture 13 Incremental encoder wiring scheme

Lead	Color	Name	Signal	Direction
J2-14	Brown/green	CHGGND	Connect with incremental encoder ground	
J2-11	gray pink	CH_A	External incremental encoder input A	Input
J2-12	red blue	CH_B	External incremental encoder input B	Input

5.2 Ethernet connector

The Data Connector connects the sensor with the local network.

- M12 connector/ IP67/CAT6 connector
- Type Binder M12 Series 713/716, No 86 4231 1002 00004
- The pin/pair assignments conforms with the T568B standard



Picture 14: M12 Data cable scheme (plug side view)

Pin	T568B Color Code	Signal	Purpose
1.	White/Orange	Tx+	Transmit
2.	Orange	Tx-	Transmit
3.	White/Green	Rx+	Receive
4.	Green	Rx-	Receive

Seal and protect the unoccupied M12 sockets of the sensor with M12 screw plugs. In this way IP67 protection is reached for harsh environmental conditions, even if no connector is attached.

1. Remove the protection plastic cap.
2. Align marks at the retainer ring and the socket.
3. Push the connector into the socket.
4. Turn the retainer ring to secure the connection.

Picture 15: Using Binder M12 connectors

WARNING

Protection class IP67 is only reached by occupied connector.
Before attaching the connector, make sure the sealing rubber ring in the sockets is in place.
Be sure to protect unoccupied connection sockets with sealing protection caps.

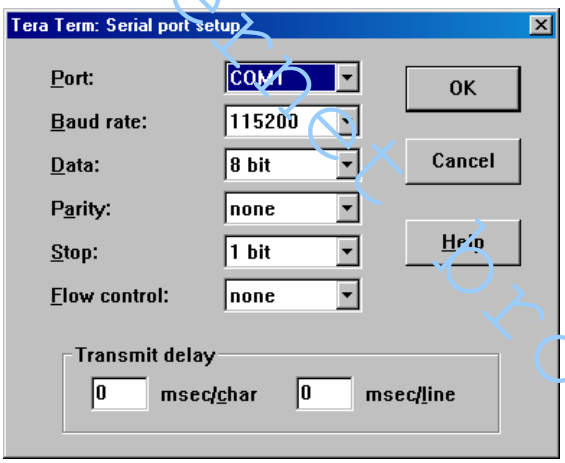
6 Setting into Operation

6.1 Windows® Software Tools

6.1.1 Windows Program TeraTerm for the RS232 Serial Interface

TeraTerm, written by T. Teranishi, is a very suitable program for the so-called Terminal Mode of the PS Laser Scanner. TeraTerm is a free software terminal emulator (serial communication program) for Microsoft Windows.
Any other terminal program will be suitable as well.

1. Download TeraTerm from Triple-IN's download server.
2. Run the TeraTerm program installer.
3. Connect the EDM via a RS232 connection, using either a generic COM port or an USB-to-serial adapter.
4. Open TeraTerm and navigate to "`Setup > Serial port...`"
5. Choose the correct COM port.
6. Set the baud rate to 115200, 8 data bits, no parity, 1 stop bit, no flow control.

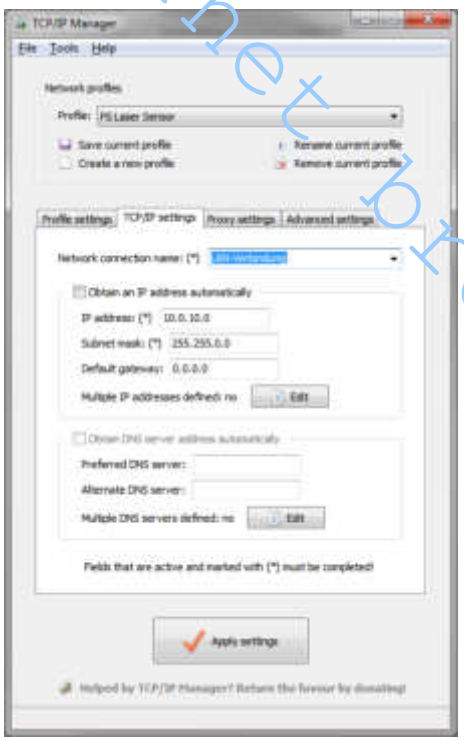


7. Close the setup dialog.
8. If you want to store these settings for future use, go to "Setup > Save setup..."
9. Navigate to the TeraTerm installation directory and store the setup in TERATERM.INI.

6.1.2 Windows® Program "TCP/IP Manager" to manage Network Configurations

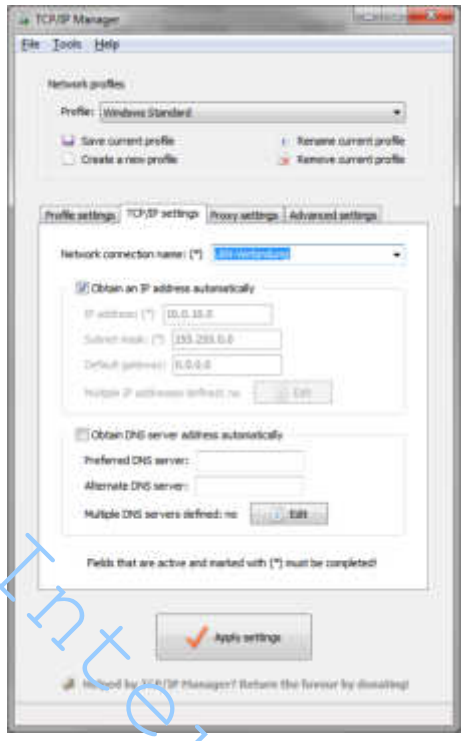
Triple-IN recommends the open-source Freeware "TCP/IP Manager" (author: A. C. Tundrea) to prepare the computer's network settings for PS Laser Sensors. With the tool, you may simply save and restore network settings for PS Laser Scanners and standard Windows applications in different profiles.
The program is available on Triple-IN's webserver.

1. Download TCP/IP Manager from Triple-IN's download server.
2. Run the installer resp. unpack the ZIP file.
3. Start TCP/IP Manager.
4. Select in "TCP/IP Settings > Network connection name" the network adapter connected with the PS Laser Sensor.
5. Check if "IP address" matches the Gateway IP address as stored in the PS Laser Sensor. The default Gateway address is 10.0.10.0.
6. Check if "Subnet mask" matches the subnet mask as stored in the PS Laser Sensor. The default network mask is 255.255.0.0.
7. For later use, consider "Network profile > Create a new profile" to save the setup.
8. Choose "Apply Settings".
9. To connect a PS Laser Sensor with the default settings:



Picture 16 Network configuration for PS Laser Sensors with TCP/IP Manager

After disconnecting the sensor, you may use TCP/IP Manager to restore the Windows standards:



Picture 17 Restore the Network configuration with TCP/IP Manager

1. Start TCP/IP Manager.
2. Select in “TCP/IP Settings > Network connection name” the network adapter connected with the PS Laser Sensor.
3. “Obtain an IP address automatically” should be checked.
4. For later use, consider “Network profile > Create a new profile” to save the setup.
5. Choose “Apply Settings”.

6.1.3 Triple-IN’s PSControlProgram

Triple-IN’s PSControlProgram is a PC application for controlling the functionality of Triple-In Laser sensors via Ethernet connection. It makes the user able to set the user parameters of the sensor, start measurements, record the scans to files or show it on the chart or in the table.
The program is available on Triple-IN’s webserver.

To install the application please follow the instructions:

1. Start Windows installation program “Install_PSControlProgram.exe”.
2. Confirm that you have administrator permissions to install the program.
3. The installer inspects the version information in order to use it during the installation process.
4. The product information (company, product name and version) is displayed on the screen if it's found during the analysis process.
5. Confirm installation.

A full description of the program can be found in the “of PSControlProgram User’s manual”. The manual is part of the program distribution.

6.2 Power-up

To start the system:

- Connect the control computer to the same network of the PS Laser Scanner.
- Connect the power supply to the PS Laser Scanner
- After switching on the supply voltage the scanner runs through a self-test. All LEDs are flashing. The firmware of the device checks important hardware components and parameters. Commands will respond to the control computer with a "device not ready" error.
- The red LED is switched off after the self-test has passed successfully.

ATTENTION

After disconnecting the sensor from power supply, you have to wait 30 seconds before turning it on. Otherwise capacitors not being discharged could leave the sensor peripheral not fully reset

6.3 Serial RS232 communication

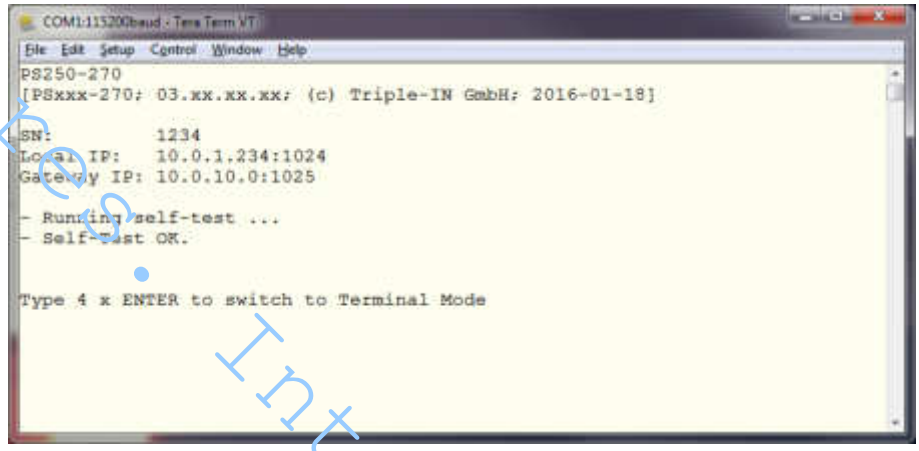
6.3.1 Setting up the serial Communication

PS Laser Scanners have serial RS232 interfaces to connect a control computer with the measurement board. A second RS232 can be connected to the Ethernet board to allow firmware updates. The standard communication settings are:

- RS232 Serial input/output
- Baud rate 115.200 Baud,
- Data 8 data bit,

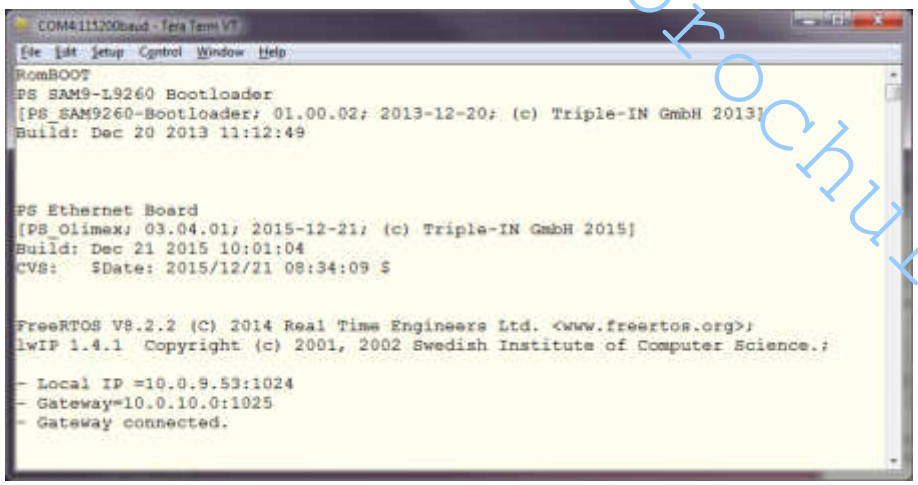
- no parity, 1 stop bit,
- no flow control, no handshake

The first serial interface, internally connected with the Measurement board (MPU), is used to program the TCP/IP connection parameters and to update the Measurement board firmware. This interface supports the so-called Terminal Mode (see chapter "Terminal Mode"). After startup displays the terminal the sensor's serial number, IP address and self-test results.



Picture 18: TeraTerm with Measurement Board startup message

The second serial interface is connected with the communication board and is used for Ethernet firmware updates only (see chapter "Firmware updates"). It displays the current Ethernet board firmware version and a connection status.



Picture 19: TeraTerm with Communication board startup message

6.3.2 Entering the Terminal Mode

The PS Laser Scanner provides a Terminal Mode as an additional user interface. This is an ASCII oriented, human-readable menu structure and user interface available on the RS232 serial interface.
The Terminal mode is entered after the user sends 4 successive carriage return characters from a RS232 terminal console.

Note

The Ethernet interface is not available while the sensor operates in the Terminal Mode.


```
_____________________________________________________________________
 Terminal Mode
_____________________________________________________________________
 1 - Show user parameter
 2 - Show system health status
 3 - Network configuration...
 4 - Restore to factory settings
 5 - Show reference tables...

 E - Edit parameter
 S - Take a scan
 L - Switch laser marker

 0 - Exit to Run Mode

>
```

Show user parameter
List the parameters set by the user. With the function "Edit parameter" these values can be edited.

Show system health status
List the results of the self-test.

Show reference tables
Display the firmware versions and parameter code reference tables.

Network configuration
Simplified IP setup and Network configuration. Some standard configurations are available and can be changed individually.

Restore to factory settings

This function is used to set parameters to their default values.

IMPORTANT

All changed user parameters will get lost.

Edit parameters

This function is used to change any parameter. The parameter codes are needed for this. After entering the parameter code the firmware shows the current value, the measurement unit and the valid range of values. The program then asks whether the changed parameters should be stored in the flash.

```
> E
> Enter parameter ID:
3_

> Enter parameter "Scan mode: 0=off, 1=normal, 2=fast, 3=fine, 4=reserved;":
2_
```

Take a scan

Starts the motor and carries out a single scan. The result is presented as CVS table. This function shall be used to check the basic functionality of the sensor.

6.3.3 Binary Command/Control Interface

Control computer programs, such as PSControlProgram, communicate with PS Laser Scanners over Ethernet or serial RS232 by use of binary commands. A full reference of the binary command/control interface can be found in the “PS Laser Scanner Programmer’s Manual”.

6.4 Ethernet Connection

6.4.1 PS Laser Scanner Network Settings

PS Laser scanners use the Internet Socket Interface for communications over Ethernet.
The sensor socket address is the combination of an IP address (the location of the sensor) and a port (which is mapped to the application program process) into a single identity.

The transport protocol UDP assumes that error checking and correction is performed in the application by checking the CRC that comes with the sensor command structure. This avoids the overhead of such processing at the network interface level. As a time-sensitive application use the firmware UDP because dropping packets is preferable to waiting for delayed packets.

- Type: 100 MBit/s Local area network
- Network layer Ethernet IPv4
- Transport Protocol UDP
- Application Protocol Binary Command Interface
- Sensor IP address 10.0.xx.xx
  where x is formed by the sensor serial number
- Server socket port 1024 (factory pre-setting)
- Gateway IP address 10.0.10.0 (factory pre-setting)
- Gateway socket port 1025 (factory pre-setting)

6.4.2 Changing the Sensor's Network Settings using the RS232 Terminal Mode

The sensor IP address and the Gateway IP address can be set in the RS232 Terminal Mode with the parameters "Sensor IP address", "Gateway IP address", and "IP Subnet Mask".
The Terminal Mode includes a function "3 - Network configuration ..." for a simple IP setup. The following configurations are available and can be changed individually:

```
_____________________________________________________________________
Network configuration menu

Sensor IP address is  10.0.8.01
Gateway IP address is 10.0.10.0
_____________________________________________________________________
1 - Set default sensor IP address
2 - Set static sensor IP address
3 - Set private sensor address (APIPA)
4 - Edit sensor IP address
5 - Edit Gateway IP address
6 - Edit network mask

0 - Exit
```

- Default sensor IP address which is created in address space 10.0.x.x according to the sensor serial number.
- A static sensor IP address which is 192.168.0.10 by default.

- Private sensor IP address (APIPA) which is 169.254.0.10 by default. APIPA addresses are by standalone Windows computers.

These IP settings can be changed individually after the default has been set:

```
> Enter Parameter “Sensor IP Address AAA.xxx.xxx.xxx”:
192
> Enter parameter “Gateway IP Address xxx.BBB.xxx.xxx”:
168
[…]
```

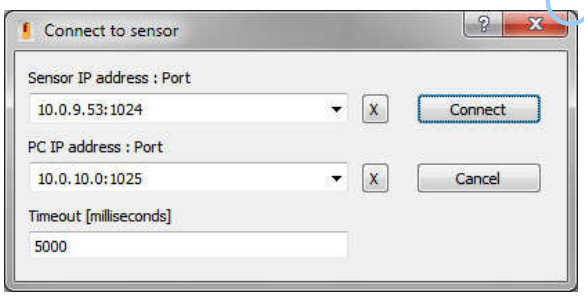
IMPORTANT

- The sensor need to be restarted after IP addresses has been changed.
- The Ethernet interface is disabled while the Terminal mode is active.

6.4.3 Changing the Sensor’s Network Settings using PSControlProgram

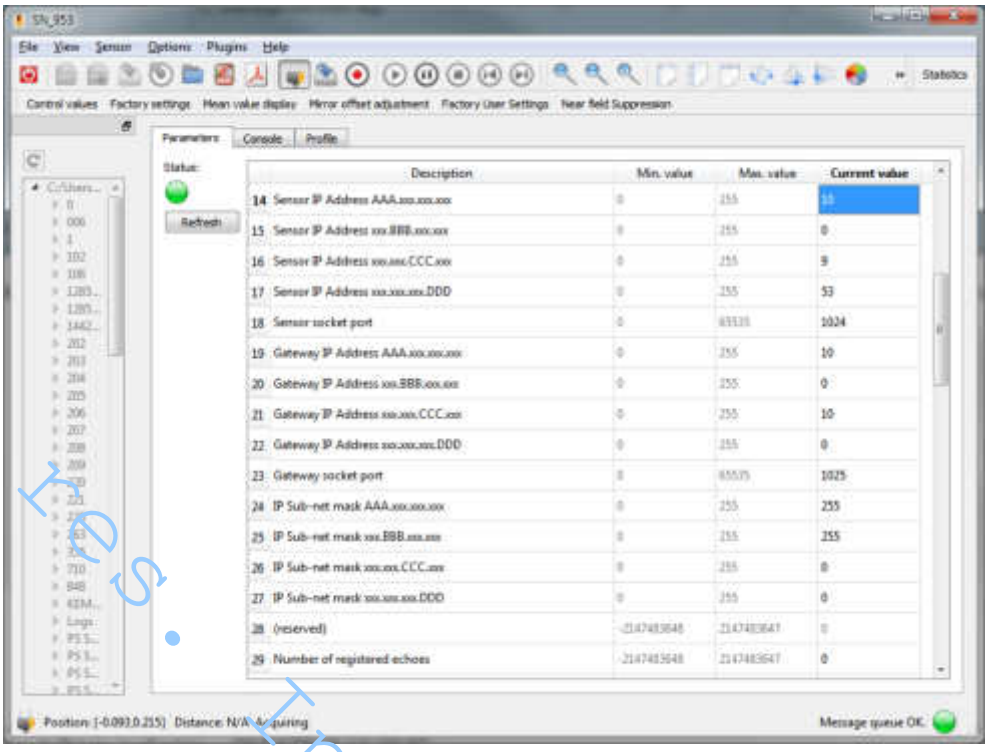
PSControlProgram is useful to change the sensors’s default network settings over Ethernet:

1. Start PSControlProgram.
2. Choose button “Connect” to connect the application with a sensor. The IP and port dialog appears on the beginning of the connection progress.
3. Enter the sensor’s standard IP address and the computer’s IP address. Note that both addresses must be part of the same network.



Picture 20 PSControlProgram network connection dialog

4. Once the connection has been made, all parameters including the network settings can be changed on the “Parameters” view.



Picture 21 PSControlProgram Parameter view

5. Switch-off and restart the sensor to apply the changed network settings.

6.5 PS Laser Scanner Configuration

6.5.1 Ways of Configuration

You can configure the PS Laser Scanner in two ways:

- Using the commands “GPRM get parameter” and “SPRM set parameter” of the binary command/control interface. This way is most suitable for computer programs, such as PSControlProgram
- interactively using the RS232 Terminal Mode

6.5.2 About User Parameters

The entire sensor configuration is stored in a table of user parameters. Every parameter has a number as unique parameter identification code. The user can

edit the parameter either by use of the Terminal Mode, or over RS232 and Ethernet by use of binary commands.

ATTENTION

Parameter identifiers always refer to a certain firmware version. Therefore an individual parameter reference table exists for every firmware version.
You find the description of the binary commands for the processing of the user parameters in the “PS Laser Scanner Programmer’s Manual”.

There are different types of parameter:

- Usual parameters can be set by the user for sensor configuration. Those parameters are stored in the non-volatile memory of the sensor.
- Constant parameters (e.g. the serial number) cannot be changed by the user.
- Temporary parameters (e.g. the system temperature) will be overwritten if a device status has been changed. Note that temporary parameters are typically updated by a self-test during the startup phase. It is recommended to set temporary parameters only after the self-test has been finished.

6.5.3 Table of User Parameters

ID	Default	Name	Description
1	20160112	Const: User settings	A version number of the parameter set
2	0	User parameter password, 0=disabled	The terminal mode can be protected by a password number. Enter "0" to disable the password
3	0	Scan mode: off=0, normal=1, fast=2, fine=3	This parameter defines the operating scan mode: fine/normal/fast.
4	0	Auto-start without SCAN/GSCN command, enabled=1, disabled=0	If this parameter is 1, the scanner provides a continuous output stream of profiles
5	0	Start mode, 0=Standard, 1=Terminal Mode	If this parameter was set to 1, the scanner enters the Terminal mode after startup.
6	1	Startup message on serial interface, enabled=1	If this parameter was set to 1, the startup messages like the firmware version are not displayed on the serial interface.
7	1	Red Laser Marker at startup: off=0, on=1, auto=2	If this parameter was set to 1, the red laser marker is switched after startup. Set to 0 if you wish the red laser marker to be off after startup.
8	1	Temp: Red Laser Marker status: off=0, on=1	Temporary parameter indicating the current status of the red laser marker.
9	360000	Const: Angle units on a full circle	A constant that defines the angle unit.
10	270000	Scan angle size [0.001 deg]	Defines the size of the scan angle and the scan area.
11	45000	Profile scan start direction [0.001 deg]	Defines the start direction of the scans.
12	90	Const: Scan angle step [0.001 deg]	Defines the angle between two measurements in a scan.
13	0	Const: Scan angle shift [0.001 deg]	Each of four subsequent scans is shifted by this angle. Only used by the “Fine Mode”.
14	10	Sensor IP Address AAA.xxx.xxx.xxx	Contains the local IP address of the sensor
15	0	Sensor IP Address xxx.BBB.xxx.xxx	Contains the local IP address of the sensor
16	0	Sensor IP Address xxx.xxx.CCC.xxx	Contains the local IP address of the sensor
17	220	Sensor IP Address xxx.xxx.xxx.DDD	Contains the local IP address of the sensor
18	1024	Sensor socket port	IP Socket number of the sensor
19	10	Gateway IP Address AAA.xxx.xxx.xxx	Contains the Gateway IP address of the control computer
20	0	Gateway IP Address xxx.BBB.xxx.xxx	Contains the Gateway IP address of the control computer
21	10	Gateway IP Address xxx.xxx.CCC.xxx	Contains the Gateway IP address of the control computer
22	0	Gateway IP Address xxx.xxx.xxx.DDD	Contains the Gateway IP address of the control computer
23	1025	Gateway socket port	Contains the socket number at the control computer

ID	Default	Name	Description
24	255	IP Sub-net mask AAA.xxx.xxx.xxx	Defines the IP sub-net mask of the local sensor network.
25	255	IP Sub-net mask xxx.BBB.xxx.xxx	Defines the IP sub-net mask of the local sensor network.
26	0	IP Sub-net mask xxx.xxx.CCC.xxx	Defines the IP sub-net mask of the local sensor network.
27	0	IP Sub-net mask xxx.xxx.xxx.DDD	Defines the IP sub-net mask of the local sensor network.
28	1	Const: Number of multi-echos	The number of different echoes the sensor is able to output. Constantly 1, because either the first echo or alternately the last echo is provided.
29	1	Master echo: 1=first, 0=last	Defines the master echo. If the parameter is set to "1" the closest target is measured. If the parameter is set to "0", the furthest target is measured.
30	4	Temp: Number of profiles to be measured with SCAN	Defines how many scans shall be buffered. This parameter is set by the SCAN command.
31	8	Scan data content: 4=distances, 7=distance+Echo+PW 8=distances+PW	Defines the data transmitted with the GSCN command. The parameter is equal with the number of bytes transferred for each echo: 4: only distances are transmitted (4 bytes) 7: distance (4 bytes), echo number (1 byte), and pulse widths are transmitted. 8: distances (4 bytes) and pulse widths (4 bytes) are transmitted Other values may lead to unexpected results.
32	14	Scan buffer size	Number of scans to be stored in the internal buffer
33	0	User defined distance offset [0.1 mm]	This offset is added to all distances.
34	0	Const: User defined ppm correction [mm/km]	This parts-per-million correction is applied to all distances.
35	150	Air condition heater ON threshold [0.1 celsius]	The heater is switched on if the internal temperature is below this threshold. Note that the internal temperature is about 15° Celsius above ambient temperature.
36	200	Air condition heater OFF threshold [0.1 celsius]	The heater is switched off if the internal temperature is above this threshold. The heater is always switched on if the temperature is below the operating range.
37	0	Temp: Air condition heater status, off=0, on=1	Temporary parameter containing the current status of the heater.
38	1	Vertical motor at startup, off=0, on=1	If set to "0", the motor is stopped after the sensor has passed the self-test. The motor is restarted by the first SCAN command.
39	1	Temp: Vertical motor status, 1=running	Temporary parameter containing the current status of the vertical motor.
40	0	External incremental encoder: enabled=1, disabled=0	The optional incremental encoder input is enabled if this parameter was set to 1.
42	0	External incremental encoder: offset	This parameter contains the offset of the external incremental encoder.

ID	Default	Name	Description
42	0	Temp: External incremental encoder: counts	This parameter contains the current reading from the external incremental encoder.
43	0	System health status	Bit map that reflects the system health. Invalid if bit 0 is set.
44	0	(reserved)	Reserved for future use.
45	1	Front side LEDs enabled=1, disabled=0	If this parameter was set on 0, the front LEDs flash only at the start and be turned off then.
46	368	Const: Temperature sensor reading [0.1 celsius]	Current reading of the temperature sensor in 0.1 Celsius
47	12000	Const: Pulse width at 100% signal [ps]	Constant parameter, containing the pulse width in picoseconds related to a signal of 100%.
48	4096	Const: Pulse width at 3% signal [ps]	Constant parameter, containing the pulse width in picoseconds related to a signal of 3%.
49	2025	Const: Sensor model;	Sensor model number to identify the type of sensor
50	1234	Const: Sensor serial number	Sensor serial number
51	21000	Const: Near field suppression range [0.1 mm]	Gives information about the actual near field dimension.
52	0	Near field suppression zone: 0=min	Defines the near field suppression zone. Each zone extends the near field for about 0.8 m.
53	1	SW1 function: 0=off, 1=scan sync, 2=switch, 3=counter	Programs the function of the digital switching output 1: 1=SW is closed while a scan is active 2=SW is closed if parameter "SW status" is set to 1 3=SW is used as a preset counter
54	0	Temp: SW1 status: 0=open 1=closed	Current logical status of the discrete output switch 1
55	0	Temp: SW1 preset counter: setup	Number of signals to be output if digital output switch 1 was configured as preset counter.
56	20	SW1 hold time [ms]	"Holds" digital switching output 1 for the given milliseconds after the input signal is removed. Allows the control device to ignore intermittent signal losses.
57	20	SW1 delay [ms]	Requires a sensing event to last for at least the given milliseconds before digital switching output 1 is switched. Allows the control device to ignore short sensing events.
58	0	SW1 logic: 0=normal, 1=low active	Defines the physical logic of digital switching output 1: 0=SW is high active, 1=SW is low active.
59	0	SW2 function: 0=off, 1=scan sync, 2=switch, 3=counter	Programs the function of the digital switching output 2: 1=SW is closed while a scan is active 2=SW is closed if parameter "SW status" is set to 1 3=SW is used as a preset counter
60	0	Temp: SW2 status: 0=open 1=closed	Current logical status of digital switching output 2
61	0	Temp: SW2 preset counter: setup	Number of signals to be output if digital switching output 2 was configured as preset counter.
62	20	SW2 hold time [ms]	"Holds" digital switching output 2 for the given milliseconds after the input signal is removed. Allows the control device to ignore intermittent signal losses.
63	20	SW2 delay [ms]	Requires a sensing event to last for at least the given milliseconds before digital switching output 2 is switched. Allows the control device to ignore short sensing events.

ID	Default	Name	Description
64	0	SW2 logic: 0=normal, 1=low active	Defines the physical logic of digital switching output 2: 0=SW is high active, 1=SW is low active.
65	0	Low echo filter: 0=disabled, 1=enabled	If the laser spot is only partly reflected by object edges, incorrect measuring arises. This filter removes measurements with very low echo signals.
66	1	High echo filter: 0=disabled, 1=enabled	If the laser spot is reflected by several surfaces, incorrect measurements arise. This filter removes measurements with very strong echo signals.
67	0	SW3 function: 0=off, 1=scan sync, 2=switch, 3=counter	Programs the function of the digital switching output 3: 1=SW is closed while a scan is active 2=SW is closed if parameter "SW status" is set to 1 3=SW is used as a preset counter
68	0	Temp: SW3 status: 0=open 1=closed	Current logical status of the discrete output switch 3
69	0	Temp: SW3 preset counter: setup	Number of signals to be output if digital switching output 3 was configured as preset counter.
70	20	SW3 hold time [ms]	"Holds" output digital switching output 3 for the given milliseconds after the input signal is removed. Allows the control device to ignore intermittent signal losses.
71	20	SW3 delay [ms]	Requires a sensing event to last for at least the given milliseconds before digital switching output 3 is switched. Allows the control device to ignore short sensing events.
72	0	SW3 logic: 0=normal, 1=low active	Defines the physical logic of digital switching output 3: 0=SW is high active, 1=SW is low active.
73	0	SW4 function: 0=off, 1=scan sync, 2=switch, 3=counter	Programs the function of the digital switching output 4: 1=SW is closed while a scan is active 2=SW is closed if parameter "SW status" is set to 1 3=SW is used as a preset counter
74	0	Temp: SW4 status: 0=open 1=closed	Current logical status of the discrete output switch 4
75	0	Temp: SW4 preset counter: setup	Number of signals to be output if digital switching output 4 was configured as preset counter.
76	20	SW4 hold time [ms]	"Holds" digital switching output 4 for the given milliseconds after the input signal is removed. Allows the control device to ignore intermittent signal losses.
77	20	SW4 delay [ms]	Requires a sensing event to last for at least the given milliseconds before digital switching output 4 is switched. Allows the control device to ignore short sensing events.
78	0	SW4 logic: 0=normal, 1=low active	Defines the physical logic of digital switching output 4: 0=SW is high active, 1=SW is low active.
79	0	IN1 function: 0=disabled	Programs the function of the Digital Input 1: 0=digital input is disabled
80	0	Temp: IN1 status: 0=off, 1=on	Gives the status of the digital input 1
81	0	IN2 function: 0=disabled	Programs the function of the Digital Input 2: 0=digital input is disabled
82	0	Temp: IN2 status: 0=off, 1=on	Gives the status of the digital input 2
83	0	(reserved)	For future use
84	0	(reserved)	For future use
85	0	User parameter ID used for testing	Parameter without function.
86	0	Temp: Memory write protection, 1=locked	User parameters are stored the volatile memory. Setting this parameter to “0” prevents the firmware to write parameters to the flash.

6.6 Taking Scans

6.6.1 Setting up the Scan mode

PS Laser Scanners can operate in “normal scan mode”, “fast scan mode”, or “fine scan mode”. Scan modes are set by binary commands or by use of the Terminal mode. The scan mod can be set with the user parameter:

```
Scan mode: 0=off, 1=normal, 2=fast, 3=fine
```

With each of the scan modes, the following measurement parameters are set:

- Scan rate: Number of scans per second.
- Scan start direction: direction of the first measurement point of a scan.
- Scan angle: size of the scan area in degree.
- Scan angle step: small angle between two subsequent measurement points. Defined by the scan angle size and the number of measurement points.
- Scan Angle Shift: small angle between the start directions of subsequent scans.

Normal scan mode

The „Normal Scan Mode” is defined by the following parameters:

- Scan rate: 10 scans per second.
- Scan start direction: min. 45°
- Scan angle: max. 270° with 3000 points.
- Scan angle step: 270°/3000 points = 0.090°
- Scan Angle Shift: Normal-Mode scans are not shifted.

Fast scan mode

For increasing the scan rate the point density has to be reduced. In „Fast Scan Mode” the point density is halved, the scan rate is doubled and the “profile rate” reduced accordingly.

- Scan rate: 20 scans per second.
- Scan start direction: min. 45°
- Scan angle: max. 270° with 1500 points.
- Scan angle step: 270°/1500 points = 0.180°
- Scan Angle Shift: Fast-Mode scans are not shifted.

Fine scan mode

If the scan rate is not important but the lateral resolution is the important parameter, the shift of the scans may be reduced. This leads to more “scans/profile” and consequently to a better lateral resolution with overlapping spots and a reduced profile rate. This measurement mode is called “Fine Scan Mode”.

- Scan rate: 10 scans per second
- Scan start direction: min. 45°
- Scan angle: max. 270° with 3000 points.
- Scan angle step: 270°/3000 points = 0.090°
- Scan Angle Shift: Each scan is shifted by 0.045°. Subsequent scans are interlaced to a single profile.

6.6.2 Taking Scans with the Terminal Mode

The Terminal Mode function “Take a scan” creates a table with the latest profile scan. The ASCII format is "comma separated" and can easily use Excel or Open Office.

1. Enter the Terminal Mode
2. Open in TeraTerm "File > Log...". Check "Plain text" and disable "Append"
3. Choose a log file name and close the dialog. Teraterm will now record all sensor outputs.
4. Choose "S – Take a Scan"
5. Close TeraTerm
6. The log file can be opened directly with a common spread sheet program like Excel or OpenOffice Calc.

```
Scan;
_____________________________________________________________________________
   375.877; Time Stamp [s] ;
         0; Incremental encoder position [counts];
    45.000; Profile start direction [deg];
   270.000; Scan angle [deg];
     0.090; Angle step [deg];
      3000; Points in profile ;
         0; Master echo (0=last echo);
         1; Number of echoes;
      31.7; Temperature [Celsius];
_____________________________________________________________________________
  Point ;    Echo ;   Direction ;    Distance ; Pulse width ;
        ;         ;       [deg] ;         [m] ;        [ps] ;
```

```
_____________________________________________________________________________
      1 ;       1 ;      45.000 ;      2.4388 ;        9907 ;
      2 ;       1 ;      45.090 ;      2.4305 ;        9895 ;
      3 ;       1 ;      45.180 ;      2.4340 ;        9871 ;
      4 ;       1 ;      45.270 ;      2.4437 ;        9772 ;
[…]
   3000 ;       1 ;     314.910 ;      1.6629 ;        6465 ;
```


The header of the table contains

- Time stamp [s]: is the time in seconds since the sensor was started
- Incremental encoder position [count]: is the count of the external incremental encoder.
- Profile start direction: is the start direction of the profile, where 0 is upwards to the zenith.
- Scan angle: is the scanned area in degrees.
- Angle steps: give the scan resolution in degrees.
- Points in profile: give the length of the following table.
- Master echo: 1 for the first echo or 0 for the last echo.
- Number of echoes: the number of echoes processed.
- Temperature: is the reading from the internal temperature sensor in Celsius.

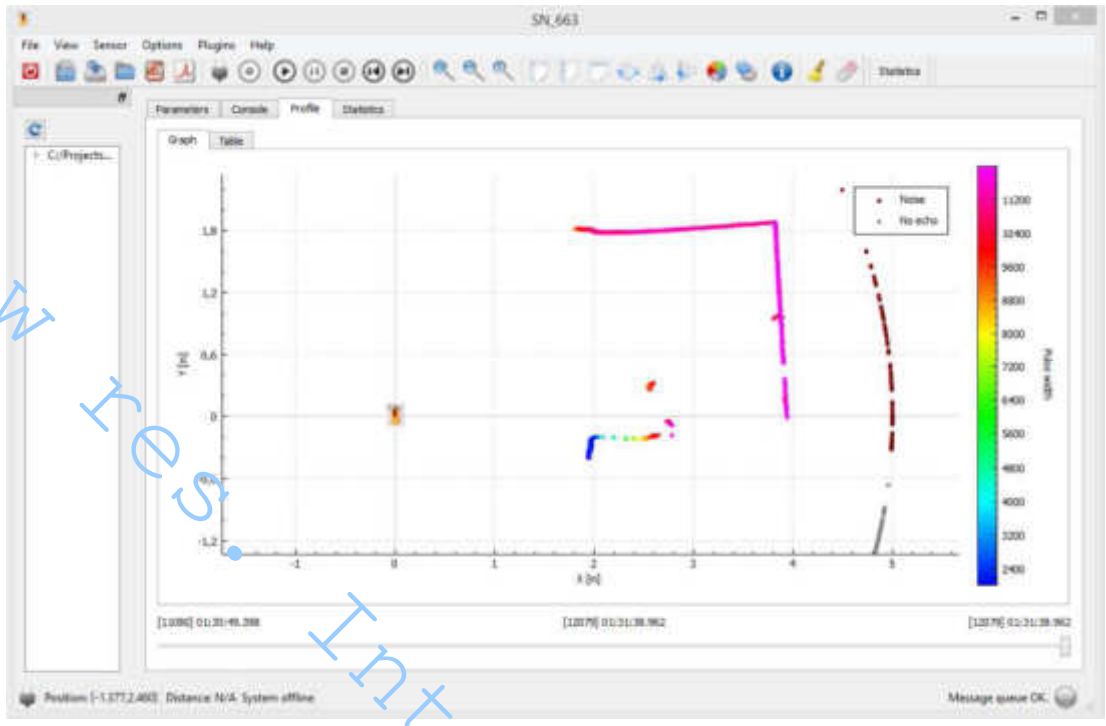
The measurement table contains

- Point: the number of the current point in the scan
- Echo: the number of the evaluated echo. This value is always 1 if the Master Echo parameter has been set to “1=first echo”. The echo number varies from 1 to 4 if the Master Echo has been set to “0=last echo”.
- Direction: direction to the target in degree.
- Distance: distance in meters to the target surface.
- Pulse width : echo signal pulse width in pico-seconds

6.6.3 Taking Scans with Triple-IN’s PSControlProgram

Triple-IN’s PSControlProgram is a Windows application with user menu, toolbar, status line, workspace explorer bar and the data output widgets ordered in the tabs. User menu and main toolbar are providing the basic functionality for the

system actions like connecting the program with a sensor, performing the scans, recording, loading or, exporting the data to “*.csv” files.



1. Connect to the PS Laser Sensor
2. Once online the record button allows the user to write the scans to the binary files for later evaluation.
3. If the recording starts successfully the application starts to write the binary data to files. Every minute the new file for recorded files is created.
4. To find the easily files easily press “Open output directory” button on the toolbar and windows

6.7 Filters and Master Echo selection

6.7.1 Near-field suppression

The near-field suppression is used to suppress measurements to targets close to the sensor. This prevents the sensor to detect contamination of the optics.
PS Laser Scanners have optional, adjustable near-field suppression. This is divided up in zones, each with a width of 760 millimeter. Zone 0 defines the closest distance. The closest distance depends on the PS Senor type.
The near field suppression zone can be configured with the user parameter:

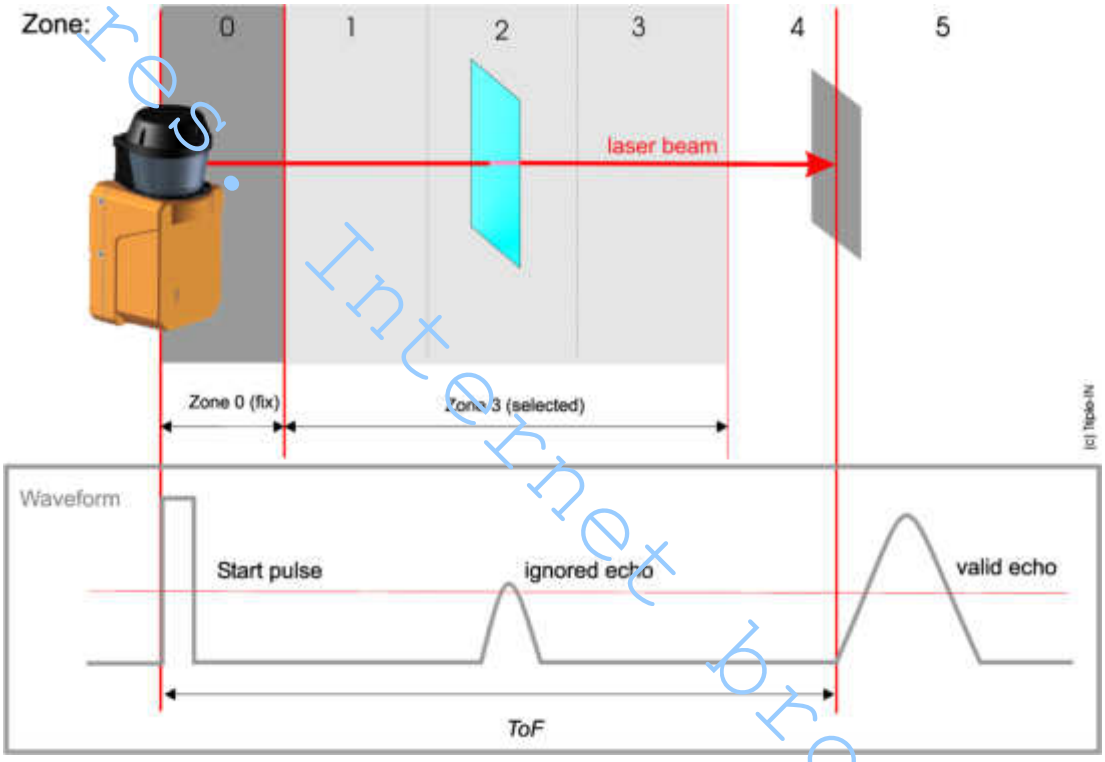
```
Near-field suppression zone, min=0
```

The current near field range can be obtained by the parameter

```
Const: Near field suppression range [0.1 mm]
```

Example:
Zone 3 has been set as near field suppression range. Any echo from a target in the range will be ignored:

```
Near_field_range = zone0 + zone1 + zone2 + zone3
```



Picture 22 Near-field configuration, example with zone 3

6.7.2 Low echo filter

If the laser spot is only partly reflected by object edges, incorrect measurements may arise. A “low echo filter” removes measurements with echo signals less than 3%. To use the full range of sensitivity, the low echo filter can be disabled. The user parameter must be set to 0:

```
Low echo filter; 0=disabled, 1=enabled
```

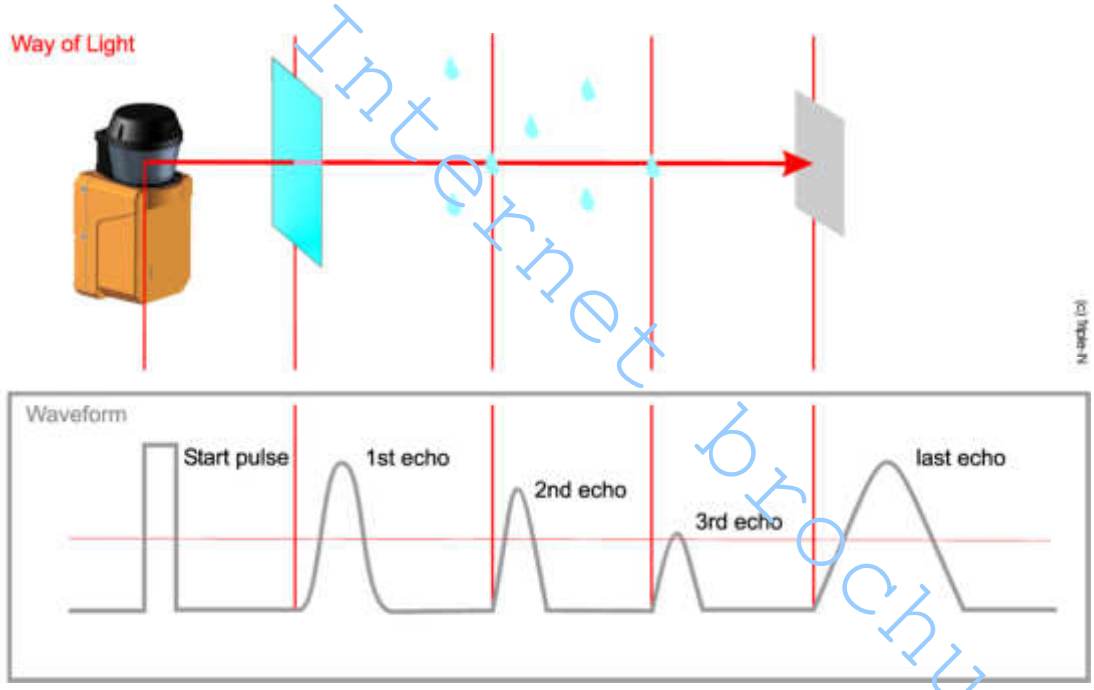
6.7.3 High echo filter

If the laser spot is reflected by several surfaces, incorrect measurements may arise due to deformations of the echo signal. The “high echo filter” removes measurements which appear with very wide echo signal amplitudes.
The high echo filter can be disabled to allow measurements on reflectors and reflecting foil. The user parameter must be set to 0:

```
High echo filter: 0=disabled, 1=enabled
```

6.7.4 Master Echo selection

At measuring through rain, through protection windows, or in dusty surroundings several objects may reflect the laser beam. The echo of the actual measuring target is called “Master Echo”.



Picture 23 Master echo selection

PS Laser scanners can handle the first or the last one of up to 4 echoes as "Master Echo". For configuration the user parameter “Master echo” is used:

```
Master echo: 1=first, 0=last
```

- Scans contain the first echo (closest object) if the parameter has been set to “1”.
- If the parameter is set to “0”, the furthest measuring is evaluated.

6.8 Setting up the Digital Switching Outputs

Depending on the PS Laser Scanner type, the sensor has two or four programmable digital outputs. These outputs can be programmed for different purposes:

- To give a scan synchronization signal
- As switch output, controlled by the connected computer
- As a preset counter, providing a programmable number of output signals.

6.8.1 Using a digital output for scan synchronization signals

One digital output can be configured to provide a scan synchronization signal. The signal is set high while the measuring laser is active during a scan. The signal is cleared during the idle period between two scans.
Only one of the digital outputs can be used for the synchronization signal. Changing the synchronization output port will leave the previous synchronization output port inactive.
The feature is set active by setting the parameter “OUT function” to “1=scan sync”:

```
OUT function: 1=scan
```

6.8.2 Setting the status of a digital switching output

The state of the digital switching outputs can be set by software. This allows a control computer to signal application depending status information to another system.
The feature is set active by setting the parameter “OUT function” to “2=switch”.
The open/closed status of the output is set by the user parameter:

```
OUT function: 2=switch
OUT status: 0=open, 1=closed
```

6.8.3 Using a digital switching output as preset counter

User applications can set a counter value in advance to produce output signals of a specific count. This function permits a control computer to transmit a counting stand or volume information as digital signals to another system. All digital switching outputs can be used independently. The preset counter feature is set active by setting user parameter “OUT function” to “3=counter”.
The counter value must be written to the parameter

```
OUT function: 3=counter
OUT preset counter: setup
```

The sensor firmware copies this value, sets the parameter register back to 0, and starts the count down. After this, new counts can be added to current output by writing another counter value. Make sure that the parameter “`OUT preset counter setup`” has reached 0 before adding new counts.
The hold time can be defined by the user parameter

```
OUT hold time [ms]
```

The delay between counter signals can be defined by the user parameter

```
OUT delay [ms]
```

The resolution of both timing parameters is about 10 ms

Example
The parameter setup

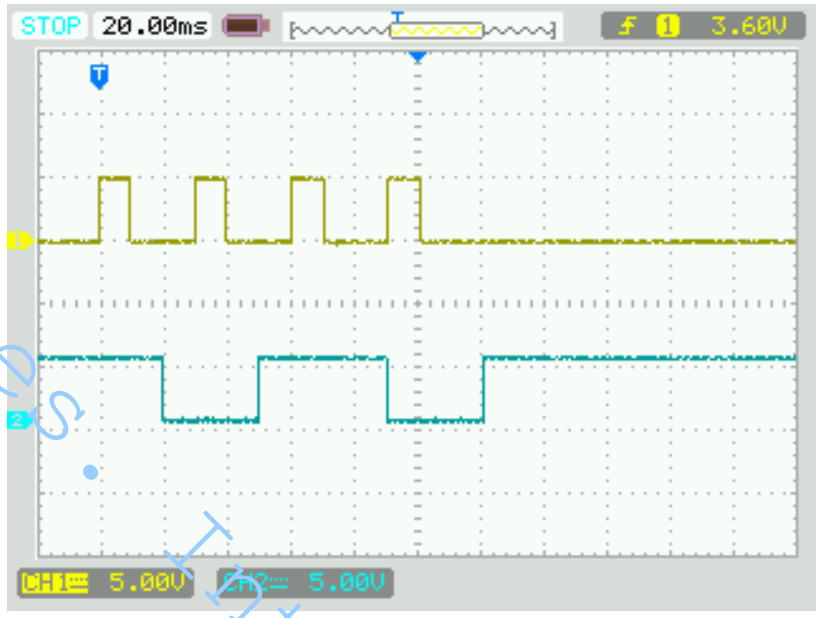
```
53;          3; OUT1 function: 0=off, 1=scan sync, 2=switch, 3=counter;
56;         10; OUT1 hold time [ms];
57;         20; OUT1 delay [ms];
58;          0; OUT1 logic: 0=normal, 1=low active;
59;          3; OUT2 function: 0=off, 1=scan sync, 2=switch, 3=counter;
62;         30; OUT2 hold time [ms];
63;         40; OUT2 delay [ms];
64;          1; OUT2 logic: 0=normal, 1=low active;
```

In conjunction with the counter parameters

```
55;          4; Temp: OUT1 preset counter: setup;
```

```
61;          2; Temp: OUT2 preset counter: setup;
```

Results in the following signal pattern:



Picture 24 Digital switching output example signal pattern

6.9 Controlling the Heater (optional)

PS Laser Scanners for outdoor applications can optionally be equipped with an internal heater. Temperature parameters are handled in 10th Celsius. Example: “312” are 3.12°C.
The switching points of the heater can be configured by the user parameters

```
Air condition heater ON threshold [0.1 celsius]
Air condition heater OFF threshold [0.1 celsius]
```

The heater is switched on if the internal temperature is below the ON threshold and is switched off if the internal temperature is above the OFF threshold.
Note that the internal temperature during operation is about 15° Celsius above ambient temperature. Allow a hysteresis difference between the on and the off temperature of >5° Celsius.
The current heater status and the actual system temperature can be read from the user parameters

```
Temp: Air condition heater status, off=0, on=1
```

```
Const: Temperature sensor reading [0.1 celsius]
```

6.10 Reading the external Incremental Encoder (optional)

The PS Range Module provides one 3.3 to 5.0 Volt incremental encoder input. Purpose of the external incremental encoder is to report changes in the horizontal position of the sensor.
The incremental encoder must provide two pulses A and B. The PS Sensor firmware counts these pulses in both directions by use of a 32 bit register. Input is limited to 128.000 counts/second.
The external incremental encoder must be enabled by setting the parameter

```
External incremental encoder: 0=disabled, 1=enabled=1;
```

An offset can be added to every encoder value:

```
External incremental encoder: offset;
```

The current reading plus offset can be read from parameter:

```
Temp: External incremental encoder: counts;
```

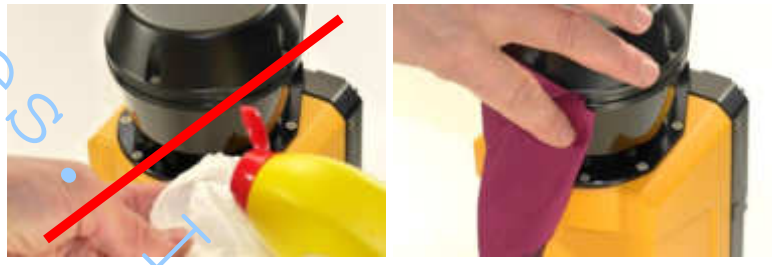
Reset of the counter is done at startup or with software by disabling and re-enabling the external incremental encoder.

7 Maintenance

7.1 Cleaning

PS Laser Scanners are mainly free of maintenance. The front window must be checked regularly and must be cleaned from dust and dirt.

- Use a clean and moistened cloth to clean the body.
- Use a microfiber cloth to clean the front window. Don’t put pressure on the cloth while cleaning the front window.



Picture 25 Cleaning the front window

WARNING

Don't use abrasives, household cleaners, or other aggressive liquids.

7.2 Updating the Firmware

The PS Laser Scanner contains two different computer boards:

- The MPU board is responsible for the measurement process
- The communication board is used for the Ethernet communication.

Both boards can be updated over the serial RS232 interfaces by use of the XMODEM protocol. The sensor supports XMODEM-CRC and XMODEM-1K variants to improve performance and transfer safety.

ATTENTION

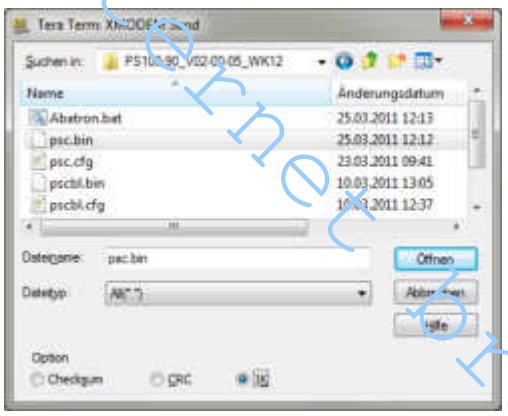
Carefully read this entire instructions before you start updating your sensor.
Do not power off the sensor until the firmware is updated!

7.2.1 Updating the Measurement Board (MPU)

1. Download the new firmware image from the internet.
2. Make sure that the "MPU RS232" lines of the serial interface connector are connected with the serial interface of your computer.
3. Start Teraterm.
4. Switch the sensor **on**. Make sure the following message appears:

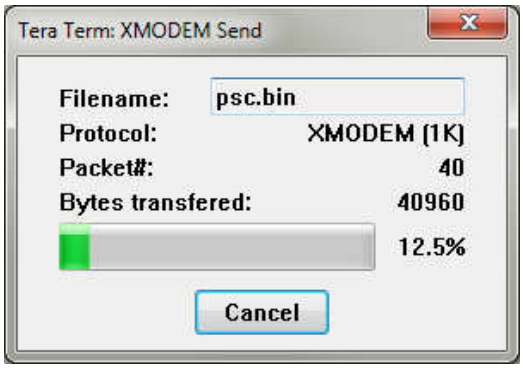
```
- Running self-test ...
- Selftest OK!

Type 4 x ENTER to switch to Terminal Mode
```

   Check the serial connection if that message does not appear.
5. Switch the sensor off.
6. Choose Teratrem `File > Transfer > XModem > Send...`
7. Locate and single click on the required firmware binary file.
8. Select **1K** from the options at the foot of the dialogue and click "**Open**":



Picture 26 Teraterm Firmware file selection

9. When the XMODEM Send dialogue is displayed in TeraTerm, power the sensor on
10. Data will start transferring to the sensor. TeraTerm Pro will display progress:



Picture 27 Teraterm XMODEM upload

11. Once the firmware has been transferred, the sensor will update the firmware in the flash memory. This process needs about 30 seconds.

```
- new firmware; size: 328704
- unlock and erase 20 blocks from 1 to 20
- Programming from RAM 0x04001000  to ROM 0x00008000  = 164352 words
```

12. The sensor will now reboot the new firmware.

```
PS250-270
[PS Firmware; 03.xx.xx; 2016-01-20; (c) Triple-IN GmbH 2016]

SN:         1234
Local IP:   10.0.12.34:1024
Gateway IP: 10.0.10.0:1025
```

13. The parameters stored in the non-volatile memory of the sensor might be incompatible with the new firmware version and must be updated. In this case the sensor will request a parameter update. The firmware asks to reset all parameters and to store the parameters in the flash. Confirm both questions with “yes”:

```
- Warning: Firmware update detected; System need factory reset.

> Set all parameters to defaults (y/n)?
> Y

- Restoring control values...
- Restoring user settings...
```

```
- Restoring factory settings...
- Restoring factory user settings...
> Write changed parameters to flash (y/n)?
> Y

- Writing parameter setup file...
- Saving user settings...
- System needs to be restarted.
>
```

For a clean restart, finally switch the sensor off and on again with a delay of 30s.

7.2.2 Updating the Communication Board

The Ethernet support is implemented on a separate board inside of the laser scanner. The communication board firmware can be updated in the same way like the MPU firmware.

14. Make sure that the Communication board RS232 of the serial interface connector is connected with the serial interface of your computer.
15. Proceed like described for the MPU board update.

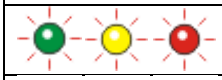
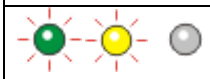
8 Trouble Shooting

8.1 LED Indicators

The PS Laser Scanner supports 3 LEDs:

- Green LED: Power indicator; blinks if the scanner is in Terminal mode.
- Yellow LED: Measurement laser indicator.
- Red LED: Error indicator.

LEDs can be turned off permanently with the user parameter:
"Front side LEDs enabled=1, disabled=0."

Indicator	System Status	Description
	Power off	
	Startup	all LEDs are on
	Self-test	All LEDs are blinking
	After self-test	System error has occurred, check system health status.
	Measurement laser off	Yellow is off
	Starting the motor, Waiting for SCAN command	Green is blinking Yellow is blinking
	scan in process	Green is steady on Yellow is steady on
	Terminal mode, waiting for user input	Green is blinking
	Terminal mode, Scan in process	Green is steady on Yellow is steady on
	System error	Red is steady on. Check system health status.

8.2 Self-test messages and System Health status

PS Laser Scanners perform a self-test at startup and check various hardware components. All LED are blinking during the self-test.
The result of the self-test is reported on the RS232 of the MPU board.

```
PS Laser Scanner
[PS Firmware; 03.xx.xx; 2016-01-20; (c) Triple-IN GmbH 2015]

SN:         1234
Local IP:   10.0.1.234 1024
Gateway IP: 10.0.10.0:1025

- Running self-test ...
- Warning [see below]
- Error [see below]
```

The Terminal mode provides the function “Show system health status”.

```
_____________________________________________________________________________
 Terminal Mode
_____________________________________________________________________________
 1 - Show user parameter
 2 - Show system health status
 3 - Show reference tables...
 4 - Restore to factory settings

 E - Edit parameter
 S - Take a scan
 L - Switch laser marker

 0 - Exit to Run Mode

> 2


System health & Self-test bits;
ystem health & Self-test bits;
_____________________________________________________________________________
 Bit ;      Result  ; Error ;
_____________________________________________________________________________
   0 ;          OK ; - Warning: System not ready.
   1 ;          OK ; - Scan buffer is empty.
   2 ;          OK ; - Sensor operates in Terminal Mode.
   3 ;    disabled ; - Error: Switching output failure!
   4 ;          OK ; - Error: Digital input failure!
   5 ;    disabled ; - Error: External incremental encoder failure!
   6 ;          OK ; - Error: Check mirror motor!
   7 ;          OK ; - Error: Check angle encoder settings!
```

```
 8 ;     disabled ; - Error: Check field of view!
 9 ;           OK ; - Error: Temperature out of operating range!
10 ;           OK ; - Warning: Check Ethernet!
11 ;           OK ; - Error: Check CPLD version.
12 ;           OK ; - Warning: No serial number set!
13 ;           OK ; - Warning: No basic system offset.
14 ;           OK ; - Warning: No basic system ppm.
15 ;           OK ; - Warning: No close range compensation.
16 ;           OK ; - Warning: No pulse width compensation.
17 ;           OK ; - Warning: No temperature drift compensation.
18 ;           OK ; - Warning: Check KEM-IC delay unit!
19 ;           OK ; - Error: Measurement clock error
20 ;           OK ; - Warning: Synthetic echoes are enabled!
21 ;           OK ; - Error: Cannot read Factory Parameter File!
22 ;           OK ; - Error: Cannot read compensation file!
23 ;           OK ; - Error: Cannot read User Parameter File!
24 ;           OK ; - Warning: Check mirror/scan line settings!
25 ;           OK ; - Measurement laser is switched off.
26 ;           OK ; - Warning: User configuration disabled.
27 ;     disabled ; - (reserved)
28 ;           OK ; - Warning: Firmware update needs factory reset.
29 ;           OK ; - Error: Check Communication Board version!
30 ;           OK ; - Warning: System needs to restart.
```

he following warnings can be fixed by the user:

Warning: User Parameter File was restored!
The user parameter setup got lost, probably due to a power-off while parameters were written to the internal non-volatile memory.
Enter the terminal mode and check the user parameter setup.

Error: Temperature out of operating range!
The sensor is too hot or too cold. Disconnect immediately from power supply and check the environmental conditions. Let the sensor operate only in it's specified temperature range.

Warning: Check Ethernet!
Check the Ethernet connections.
Restart the sensor to apply changed IP settings.

Warning: Firmware update needs factory reset.
The firmware has been updated, but the parameter setup does not match for the new version. Restart the sensor. The sensor will ask for a parameter update.
Follow the instructions from chapter "7.2.1 Updating the Measurement Board (MPU)"

Error: Check I/O Board version!
The MPU firmware has been updated and requires a newer version of the communication board firmware. Please follow the instructions from chapter “7.2.2 Updating the Communication Board“.

Warning: System needs to restart.
Restart the system by power-off and power-on.

WARNING

Any other warning or error message reports a serious system defect. In this case, contact Triple-IN for a service and repair request.

9 Technical Specifications

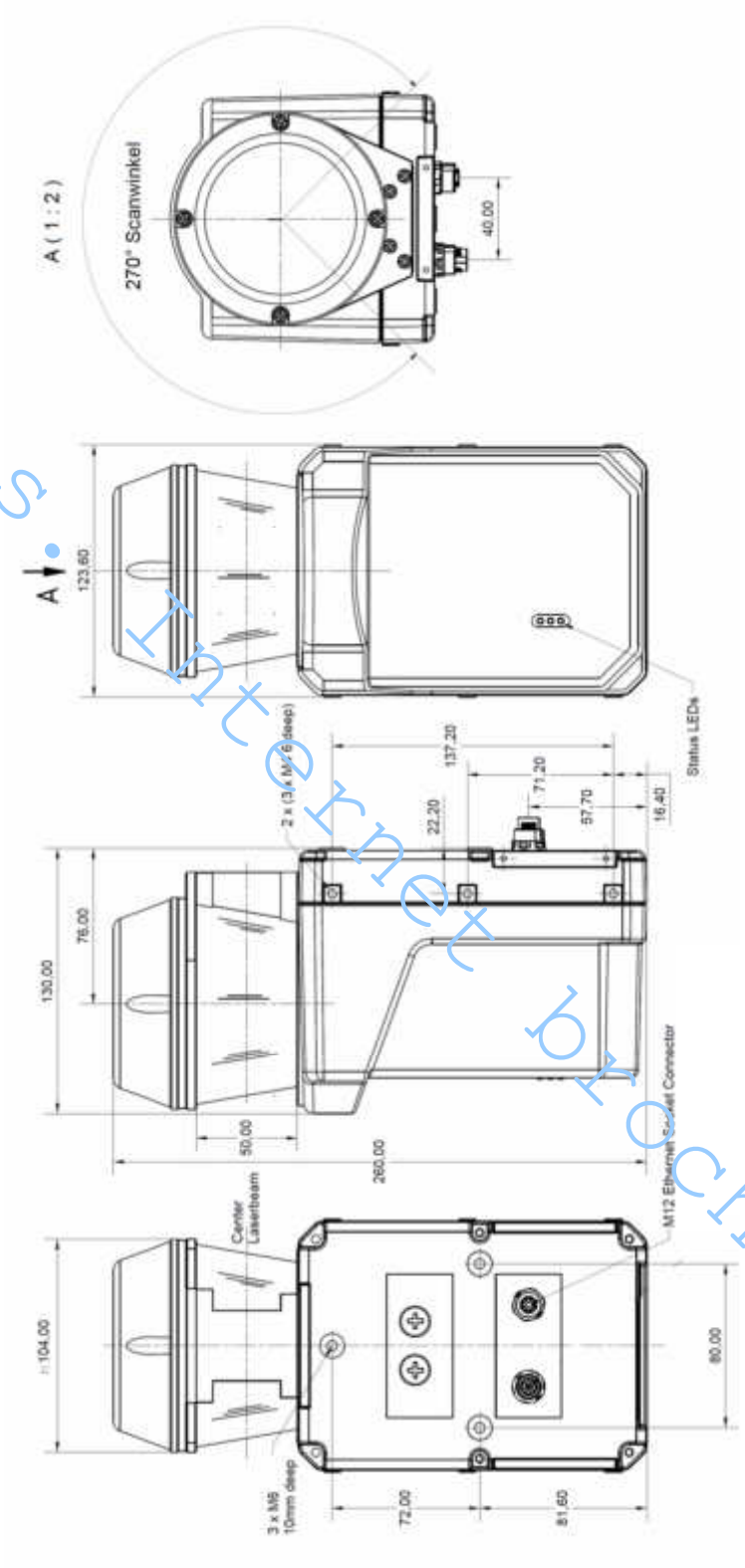
9.1 Technical Data

Sensor		PS250-270 preliminary	PS150-270
	Order No.	4100	4000
WORKING RANGE			
	Maximum Range @ R = 100%, lambertian Reflector (m)	**200**	**160**
	Maximum Range @ R = 10%, lambertian Reflector (m)	65	50
	Minimum Range (m)	2.1	0.8
ACCURACY DATA			
	Resolution (mm)	1	
	Repeatability 1 σ @ strong signal (mm)	**5**	
	Repeatability 1 σ @ weak signal (mm)	20	
	Accuracy (systematic error) (mm)	≤ 4	
SPOT PROPERTIES			
	Beam Divergence (°)	**0.09**	
	Spot close to the sensor window (mm)	12 x 16	
	Focusing distance (m)	45	
SCAN AND PROFILE PROPERTIES			
	Maximum Scan and Profile Angle	270° - programmable	
	Scanning Mechanism	Rotating Mirror	
	Maximum Scanning Duty Cycle	75%	
OPERATIONAL MODES			
Normal Mode			
	Beam Scan Angle Step (°)	0.09	
	Measurements in 270° Scan	3000	
	Scan Rate (Hz)	10	
	Scan Time @ 270° Scan (ms)	75	
Fast Mode			
	Beam Scan Angle Step (°)	0.18	
	Measurements in 270° Scan	1500	
	Scan Rate (Hz)	20	

Fine Mode		
	Beam Scan Angle Step (°)	0.045
	Measurements in 270° Scan	6000 interlaced
	Scan Rate (Hz)	5
	Scan Time @ 270° Scan (ms)	75
MULTI-ECHO EVALUATION		
	Echoes evaluated	4
	Selectable echoes	First or last
LASER DATA		
Measurement Laser		
	Measurement Laser Type	Pulse Laser Diode
	Wave Length (nm)	905
	Safety Class; EN 60825-1; 94,96,01	1 1
	Measurement or Pulse Rate (kHz)	40

Sensor	PS250-270	PS150-270
INTERFACES		
Ethernet	UDP 100 Mb/s	
RS232 for Sensor Programming	115 kBaud, 8n1	
Discrete Switching Outputs	4 Solid State Relays	
Discrete Switching Inputs	2 Digital Inputs	
POWER SUPPLY		
Power Voltage	24 VDC ± 5 VDC	
Power Consumption (W)	8	
Power Consumption with optional Internal Heater (W)	30	
Start-up Time (s)	< 20	
SENSOR PROTECTION		
Ingress Protection	IP67	
Operating Temperature Range	-10°C to +50°C	
Temperature Range with optional Heater	-30°C to +50°C	
Temperature Range for Storage	-30°C to + 80°C	
Enclosure	Aluminum, Die Cast	
Enclosure Finish	Powder coated	
Front Screen	Black plastic sheet	
Function in strong Sunshine	Ambient light control	
DIMENSIONS & WEIGHT		
Height x Width x Length (mm)	260 x 123.6 x 130	
Weight (kg)	2.6	

9.2 Dimensional drawings and outlines



Picture 28 PSxxx-270 Outlines

9.3 3D CAD Model

A 3D CAD model (STEP format) of the PS Laser Scanner outlines is available on demand.

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10.2 Document versions

Date	Changes
2017-01-10	Update technical data according to production year 2017 Updated system status bits