OPERATING INSTRUCTIONS

NAV300
Laser Positioning Sensor

SICK
Sensor Intelligence.

Software version described

Software/tool	Function	Status
NAV300	Firmware	V 2.4.3
Device description NAV300	Device specific software module for SOPAS ET	V 1.0 or higher
SOPAS ET	Configuration software	V 02.18 or higher

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Acrobat® Reader™ is a trademark of Adobe Systems Incorporated.

Version of the operating instructions

The latest version of these operating instructions can be obtained as PDF at **www.sick.com**.

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Abbreviations

BCC	Block character check
CAN	Controller area network = standardised fieldbus system with message-based protocol for exchanging data
CS	Checksum
DSP	Digital signal processor = digital signal processor for internal data processing using application software
HTML	Hypertext markup language = page description language on the Internet
LED	Light emitting diode
RAM	Random access memory = volatile memory with direct access
ROM	Read-only memory (permanent)
SOPAS ET	SICK OPEN PORTAL for APPLICATION and SYSTEMS ENGINEERING TOOL = configuration software for the configuration of the NAV300
UPF	User protocol frame
USP	User services protocol = protocol for user-programmed evaluation

Tables

Figures

1 About this document

Please read this chapter carefully before working with this documentation and the NAV300 Laser Positioning Sensor.

1.1 Function of this document

These operating instructions are designed **to address the technical personnel** in regards to safe mounting, installation, configuration, electrical installation, commissioning, operation and maintenance of the following Laser Positioning Sensor:

- NAV300

1.2 Target group

The intended audience for this document is people in the following positions:

Activities	Target group
Mounting, electrical installation, maintenance and replacement	Factory electricians and service engineers
Commissioning, operation and configuration	Technicians and engineers

Tab. 1: Target groups of this document

1.3 Depth of information

These operating instructions contain the following information on the NAV300:

- mounting
- electrical installation
- commissioning and configuration
- maintenance
- fault, error diagnosis and troubleshooting
- ordering information
- conformity and approval

Planning and using laser measurement systems such as the NAV300 also require specific technical skills which are not detailed in this documentation.

In addition, online help is available in SOPAS ET configuration software supplied; this help provides information on the usage of the software user interface, as well as on the configuration of the NAV300.

More detailed information on the NAV300 is available from SICK AG, Division Auto Ident. On the internet at www.sick.com.

1.4 Symbology used

Recommendation Recommendations are designed to give you assistance in the decision-making process with respect to a certain function or a technical measure.

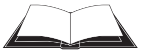
Important Sections marked “Important” provide information about special features of the device.

Explanation Explanations provide background knowledge on technical relationships.

MENU COMMAND This typeface indicates a term in the SOPAS ET user interface.

Terminal output This typeface indicates messages that the NAV300 outputs via its terminal interface.

➢ **Take action …** Instructions for taking action are shown by an arrow. Read carefully and follow the instructions for action.



This symbol refers to additionally available documentation.

NOTICE

Note!

A note provides indicates potential hazards that could involve damage or degradation of the functionality of the NAV300 or other devices.

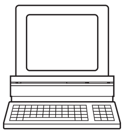
⚠ WARNING

Warning!

A warning indicates an actual or potential hazard. They are designed to help you to prevent accidents.

The safety symbol beside the warning indicates the nature of the risk of accident, e.g. due to electricity. The warning category (DANGER, WARNING, CAUTION) indicates the severity of the hazard.

➢ Read carefully and follow the warning notices!



Software notes show where you can make the appropriate settings and adjustments in the SOPAS ET configuration software.

2 For your safety

This chapter deals with your own safety and the safety of the equipment operators.

➢ Please read this chapter carefully before working with the NAV300.

2.1 Authorised personnel

The NAV300 laser measurement system must only be installed, commissioned and serviced by adequately qualified personnel.

NOTICE

Repairs to the NAV300 are only allowed to be undertaken by trained and authorised service personnel from SICK AG.

The following qualifications are necessary for the various tasks:

Activities	Qualification
Mounting and maintenance	• basic technical training • knowledge of the current safety regulations in the workplace
Electrical installation and replacement	• practical electrical training • knowledge of current electrical safety regulations • knowledge on the use and operation of devices in the related application (e.g. conveyors)
Commissioning, operation and configuration	• knowledge on the use and operation of devices in the related application (e.g. conveyors) • knowledge on the software and hardware environment in the related application (e.g. conveyors) • basic knowledge of the Windows operating system • basic knowledge of the usage of an HTML browser (e.g. Internet Explorer) • basic knowledge of data transmission

Tab. 2: Authorised personnel

2.2 Correct use

NOTICE

The NAV300 laser measurement system is intended for use in industrial environments. When used in residential areas, it can cause radio interferences.

The NAV300 is an electro-sensitive distance measurement system for stand-alone or network operation. It is suitable for applications in which precise, electro-sensitive measurements of contours and reflectors are required. It is possible to use the measurements in a AGV controller to calculate position information.

It must be initialised only by qualified personnel and only in industrial environments.

NOTICE

In case of any other usage as well as in case of modifications to the NAV300, e.g. due to opening the housing during mounting and electrical installation, or to the SICK software, any claims against SICK AG under the warranty will be rendered void.

The NAV300 is only allowed to be operated in the ambient temperature range allowed (see section 9.1 "Data sheet NAV300 Laser Positioning Sensor" on page 54).

2.3 General safety notes and protective measures

⚠ WARNING

Safety notes

Please observe the following items in order to ensure the correct and safe use of the NAV300.

- The notices in these operating instructions (e.g. on use, mounting, installation or integration into the existing machine controller) must be observed.
- When operating the NAV300, the national, local and statutory rules and regulations must be observed.
- National/international rules and regulations apply to the installation, commissioning, use and periodic technical inspections of the laser measurement system, in particular:
  – work safety regulations/safety rules
  – other relevant health and safety regulations
- Manufacturers and operators of the system are responsible for obtaining and observing all applicable safety regulations and rules.
- The tests must be carried out by specialist personnel or specially qualified and authorised personnel and must be recorded and documented to ensure that the tests can be reconstructed and retraced at any time.
- The operating instructions must be made available to the operator of the system where the NAV300 is used. The operator of the system is to be instructed in the use of the device by specialist personnel and must be instructed to read the operating instructions.
- The NAV300 is not a device for the protection of people in the context of the related safety standards for machinery.

2.3.1 Electrical installation work

NOTICE

- Electrical installation work is only allowed to be undertaken by authorised personnel.
- Only make and disconnect electrical connections when the device is electrically isolated.
- Select and implement wire cross-sections and their correct fuse protection as per the applicable standards.

➢ Do not open the housing.

➢ Observe the current safety regulations when working on electrical systems.

2.3.2 Laser radiation of the laser measurement system

⚠ CAUTION

Laser radiation!

The NAV300 operates with an infrared laser of class 1 (eye safe). The laser beam cannot be seen with the human eye.

- Incorrect usage can result in hazardous exposure to laser radiation.

➢ Do not open the housing (opening the housing will not switch off the laser).

➢ Pay attention to the laser safety regulations as per IEC 60825-1 (latest version), complies with 21 CFR 1040.10 with the exception of the deviations as per Laser Notice No. 50, July 26, 2001.

Increased laser radiation if scanner head broken off!

The rotating scanner head (see Fig. 1 on page 13) on the NAV300 is equipped with defined fracture points to prevent damage to the internal mechanism in case of a heavy impact on the scanner head.

If the scanner head is broken off, the NAV300 is categorised as laser class 1M.

➢ Do not look into the open output aperture for the laser beam, also not with optical instruments.

➢ Immediately switch off the device and secure against placing back in operation.

Important No maintenance is necessary to ensure compliance with laser class 1.

Laser output aperture

The laser output aperture is the round optic in the rotating scanner head on the NAV300.

Fig. 1: Laser output aperture in the rotating scanner head on the NAV300

Laser power

The laser operates at a wavelength λ = 905 nm (invisible infrared light). The radiation emitted in normal operation is not harmful to the eyes and human skin.

2.4 Quick stop and Quick restart

2.4.1 Switching the NAV300 off

➢ Switch off the voltage supply for the NAV300 or disconnect the supply cable.

The NAV300 retains parameters stored in the internal, non-volatile memory. Measured values on the interface are lost.

2.4.2 Switching the NAV300 on again

➢ Switch on the voltage supply for the NAV300 or reconnect the supply cable.

The NAV300 restarts operation with the last saved parameters.

2.5 Environmental protection

The NAV300 has been designed to minimise environmental impact. It uses only a minimum of power.

While working, always act in an environmentally responsible manner. For this reason please note the following information on disposal.

2.5.1 Power consumption

- The NAV300 draws a maximum of 36 W in operation (however, on power up the power supply must be able to briefly supply 2.1 A/51 W).

2.5.2 Disposal after final de-commissioning

- Always dispose of unserviceable or irreparable devices in compliance with local/ national rules and regulations on waste disposal.
- Dispose of all electronic assemblies as hazardous waste. The electronic assemblies are straightforward to dismantle.

See section 7.2 “Disposal” on page 50.

Important SICK AG does not accept unusable or irreparable devices that are returned.

3 Product description

This chapter provides information on the special features and properties of the NAV300 laser measurement system. It describes the construction and the operating principle of the device, in particular the different operating modes.

Please read this chapter before mounting, installing and commissioning the device.

3.1 Delivery

The NAV300 delivery includes the following components:

Quantity	Components	Comment
1	A NAV300 laser positioning sensor	NAV300
1	CD-ROM "Manuals & Software Auto Ident"	Contents see 3.1.1
1	Lens cloth	

Tab. 3: Delivery

Section 10.3 "Ordering information" on page 68 provides an overview of the systems available and the accessories available.

3.1.1 Contents of the CD-ROM

- SOPAS ET configuration software
- operating instructions "NAV300 Laser Positioning Sensor" in German and English as PDF
- Telegramlisting LD-OEM in English as PDF
- Supplement to Telegramlisting in English as PDF
- freely available software "Adobe Acrobat® Reader™"

The latest versions of the publications and programs included on the CD-ROM are also available for download at www.sick.com.

3.2 Device variants

Type	Data interfaces	Outputs	Enclosure rating
NAV300 - 2232	CAN, Ethernet, RS-232, RS-422	Digital	IP 65

Tab. 4: Device variants

NAV300
(IP 65)

Fig. 2: NAV300

3.3 Special features of the NAV300

Variant	Special features
NAV300	• electro-sensitive, active measurement technique • scanning range up to 100 m (328.08 ft) on reflectors • resolution of the angular step width: maximum 0.125° • max. pulse frequency of the laser diode 14.4 kHz • flexible system configurations • configuration/measured value request using user protocol services (command strings) **Measured value output (raw data)** • Field of view 360° • scanner head rotational frequence 5 ... 15 Hz (selectable in 1Hz steps) • data interface CAN, ethernet, RS-232, RS-422 (CAN is not supported by RDI) • contents of one revolution (360°): incl. number of the profile emitted, profile counter, sector numbers, step width, number of points per sector, time stamp for start/end of each sector, direction at the start/end of each sector, value and direction of the distances measured, status **Integrated Reflector-Data-Interface (RDI)** • Measurements on reflectors in the surroundings are summarised to reflector co-ordinates

Tab. 5: Special features of the NAV300

3.4 Operating principle of the NAV300

The NAV300 is an electro-optical laser measurement system that electro-sensitively scans the perimeter of its surroundings in a plane with the aid of laser beams. The NAV300 measures its surroundings in two-dimensional polar co-ordinates. If a measuring beam is incident on an object, the position is determined in the form of distance and direction.

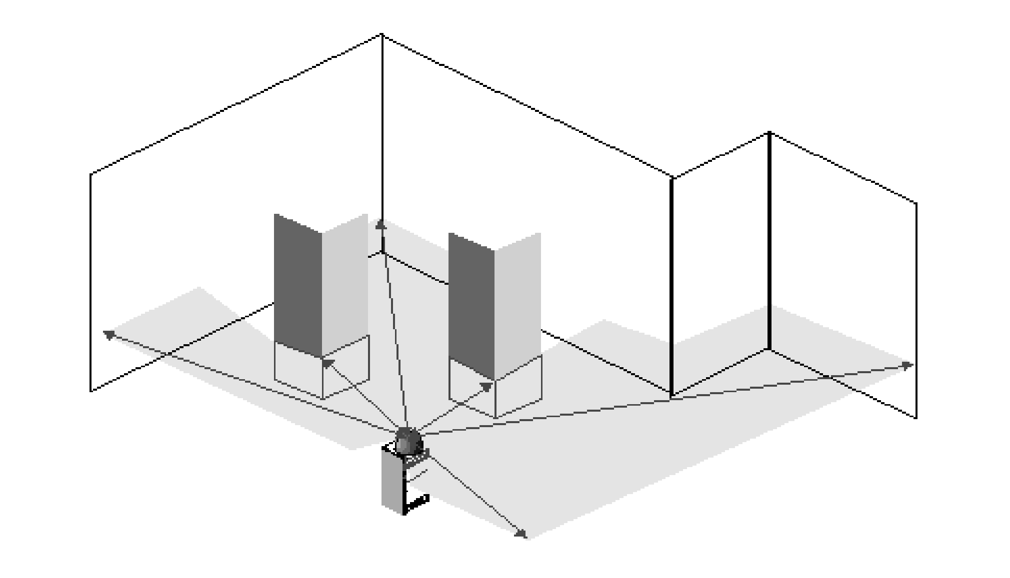


Fig. 3: Measuring principle of the NAV300

Scanning takes place in a sector of 360°. The scanning ranges of the sensors are for the NAV300 approx. 100 m (328.08 ft) on light, natural surfaces (e.g. a white house wall).

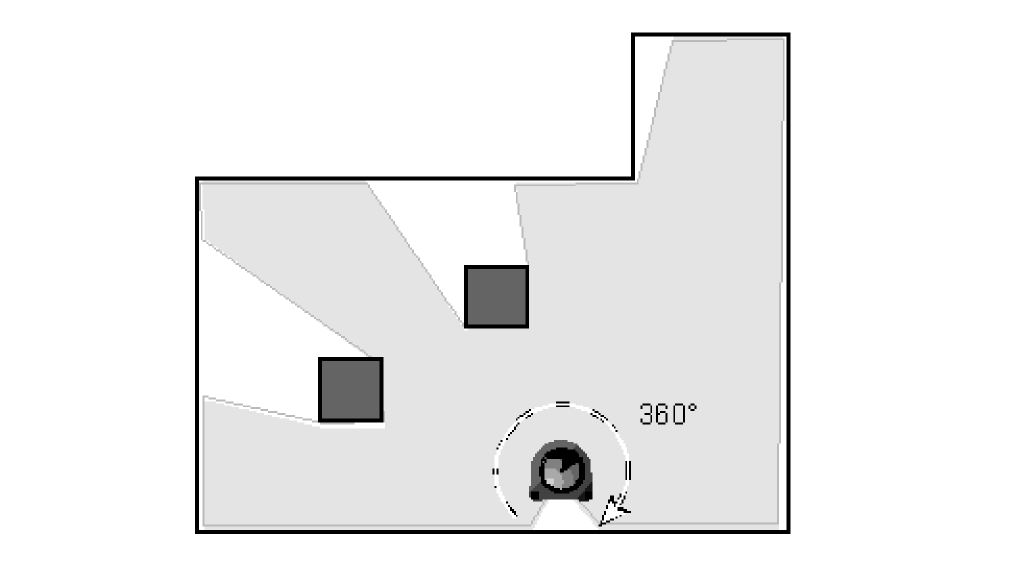


Fig. 4: Depiction of the measured result

Distance measurement

The NAV300 emits pulsed laser beams using a laser diode. If such a laser pulse is incident on an object, it is reflected at its surface. The reflection is detected in the laser measurement system's receiver using a photodiode.

The distance to the object is calculated from the propagation time that the light requires from emission to reception of the reflection at the sensor.

This principle of “pulse propagation time measurement” is used by radar systems in a similar manner.

The laser beams emitted are deflected using a mirror in the scanner head and scan the surroundings in a circular manner. The measurements are triggered at regular angular steps using an angular encoder.

Direction measurement

The scanner head rotates at a selectable frequency of from 5 to 15 Hz. During this process, a laser pulse and therefore a distance measurement is triggered after an angular step of e.g. 0.25° (adjustable). The maximum angular resolution is 0.125°. This angle is defined by the angular encoder with 5760 steps. The angular resolution can be selected as an integer multiple of 0.125°.

NOTICE

- Within the maximum scanning range area of 360°, the average pulse frequency of 12 kHz is not allowed to be exceeded (see also section 3.4.5 “Maximum and mean pulse frequency” on page 24).
- The maximum pulse frequency is not allowed to exceed 14.4 kHz (see also section 3.4.5 “Maximum and mean pulse frequency” on page 24).
- The minimum time between 2 laser pulses is 70 µs (corresponds to 14.4 kHz).

3.4.1 Reflector Data Interface (RDI)

With the aid of the integrated Reflector-Data-Interface, the NAV300 generates an image of its current reflector environment within one revolution of the scanner head. The NAV300 measures a maximum of 32 visible reflectors at this time and determines the reflector co-ordinates relative to its own position.

In actual operation, this enables the vehicle computer of the AGV to directly access the coordinates measured by the NAV300. The vehicle computer can evaluate the data from this direct access using its own algorithms to calculate the vehicle absolute position.

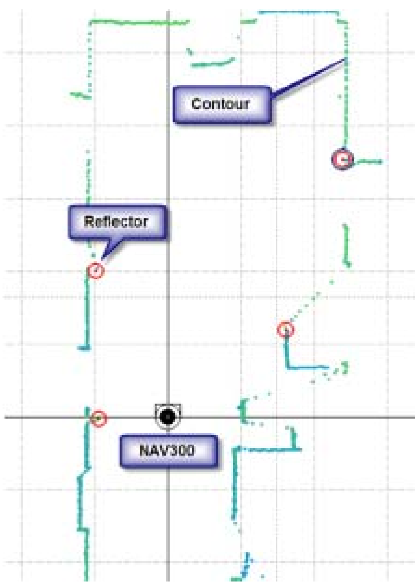


Fig. 5: Mixed Mode

Influences of object surfaces on the measurement

The signal received from a perfectly diffuse reflecting white surface corresponds to the definition of a remission of 100%. As a result of this definition, the remissions for surfaces that reflect the light bundled (mirrored surfaces, reflectors), are more than 100%.

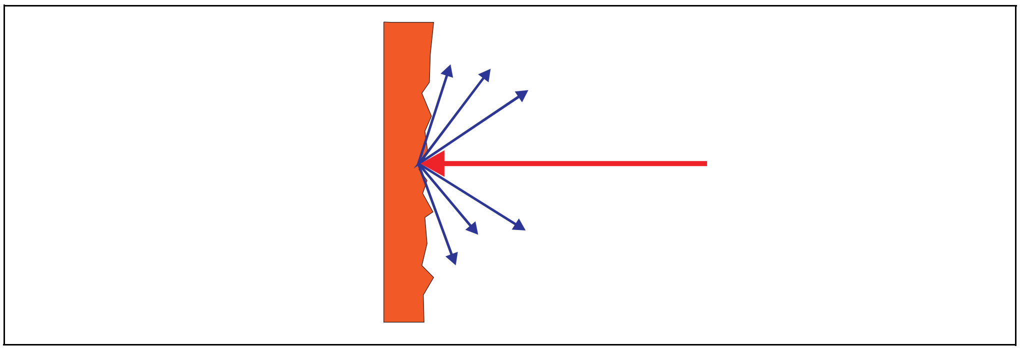


Fig. 6: Reflection of the laser beam at the surface of an object

The majority of surfaces reflect the laser beam diffusely in all directions.

The reflection of the laser beam will vary as a function of the surface structure and colour. Light surfaces reflect the laser beam better than dark surfaces and can be detected by the NAV300 over larger distances. Brilliant white plaster reflects approx. 100% of the incident light, black foam rubber approx. 2.4%. On very rough surfaces, part of the energy is lost due to shading. The scanning range of the NAV300 will be reduced as a result.

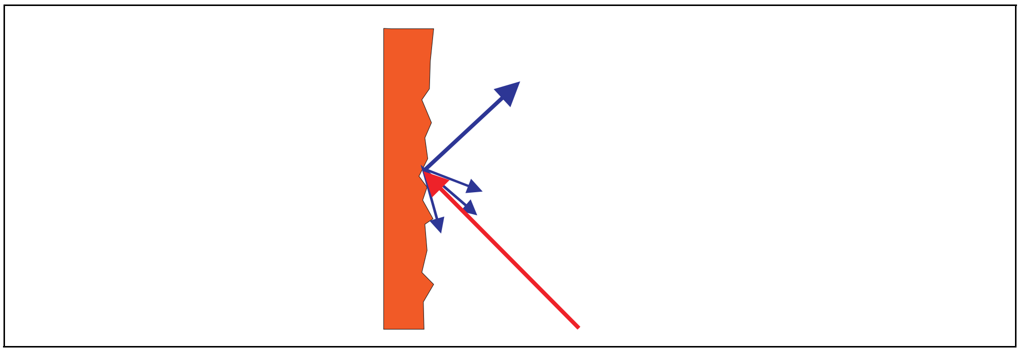


Fig. 7: Reflection angle

The reflection angle is the same as the angle of incidence. If the laser beam is incident perpendicularly on a surface, the energy is optimally reflected (**Fig. 6 on page 19**). If the beam is incident at an angle, a corresponding energy and scanning range loss is incurred (**Fig. 7 on page 19**).

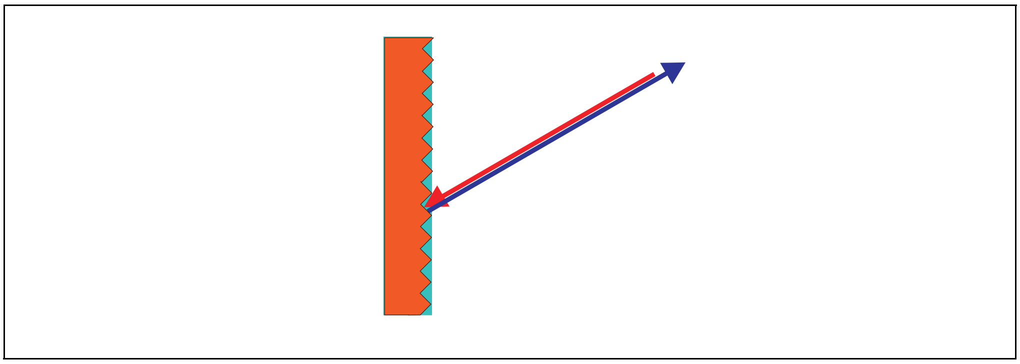


Fig. 8: Degree of reflection

If the reflected energy returned is over 100% (basis: Kodak standard) the incident beam is not reflected diffusely in all directions, but is reflected in a specific direction. As a result a large portion of the energy emitted can be received by the laser distance measurement device. Plastic reflectors ("cats' eyes"), reflective tape and triple prisms have these properties.

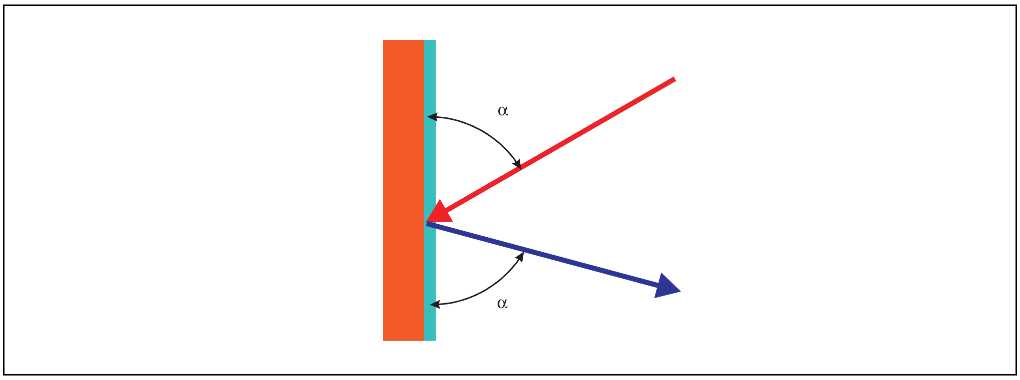


Fig. 9: Mirror surfaces

At mirror surfaces the laser beam is almost entirely deflected (Fig. 9 on page 20).

Instead of the surface of the mirror, it is possible that the object on which the deflected laser beam is incident may be detected.

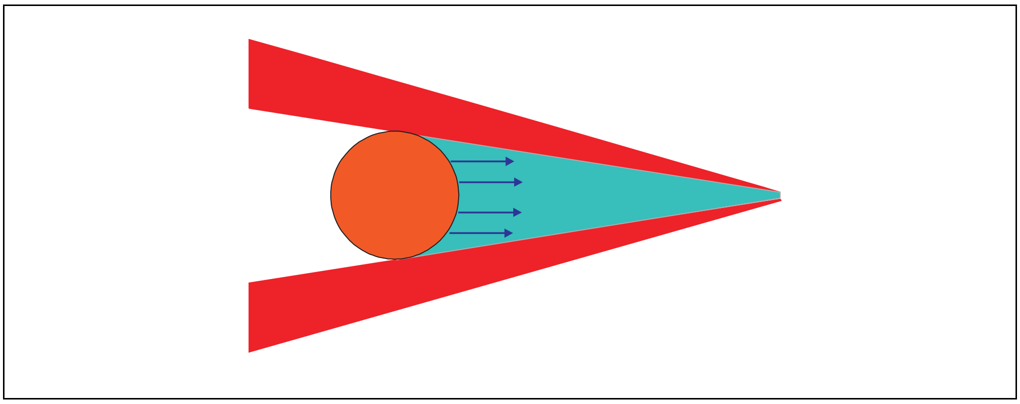


Fig. 10: Object smaller than diameter of the laser beam

Objects that are smaller than the diameter of the laser beam cannot reflect all the energy of the laser light (Fig. 10 on page 20). The energy in the portion of the laser light that is not reflected is lost. This means that the scanning range is less than would be possible theoretically based on the surface of the object.

3.4.2 Scanning range of the NAV300

The scanning range of the NAV300 is dependent on the remission of the objects to be detected. The better a surface reflects the incident radiation, the greater the scanning range of the NAV300.

Material	Remission	Measurement area NAV300
Black car paint, matt	5%	0.5...24 m (1.64...78.74 ft)
Black photographic cardboard, matt	10%	0.5...35 m (1.64...114.83 ft)
Grey concrete	18%	0.5...45 m (1.64...147.64 ft)
White cardboard	90%	0.5...100 m (1.64...328.08 ft)
White plaster	100%	0.5...100 m (1.64...328.08 ft)
Reflective film	>300%	0.5...approx. 100 m (1.64... approx. 328.08 ft)

Tab. 6: Typical reflection values and scanning ranges

3.4.3 Beam diameter and distance between measured points

With increasing distance from the NAV300 the laser beam on NAV300 increases in size. As a result the diameter of the measured point on the surface of the object increases.

The distance-dependent diameter of the measured point is the distance (mm) × 0.005 rad + 20 mm.

With increasing distance from the NAV300, the distance between the individual measured points also increases. The distance between the measured points is also dependent on the angular resolution configured. With a coarser resolution, the distance is larger, with a finer resolution the distance is smaller.

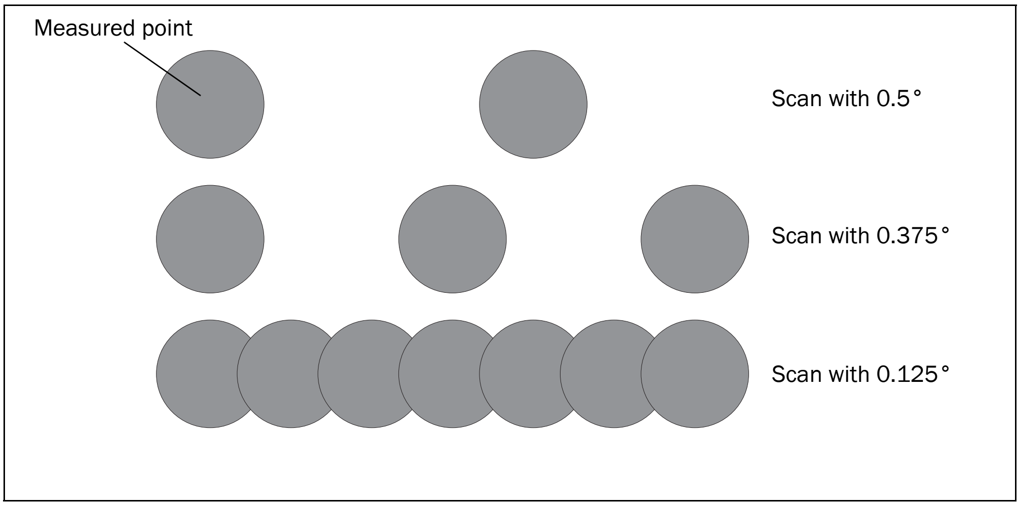


Fig. 11: Schematic layout of the distance between measured points at different angular resolutions

The two diagrams in Fig. 12 and Fig. 13 show the beam diameter and the distance between the measured points as a function of the distance from the NAV300.

Explanation The grey areas in the diagrams mark the area in which the distance between the measured points is larger than the beam diameter. In these areas there are therefore gaps between the points measured.

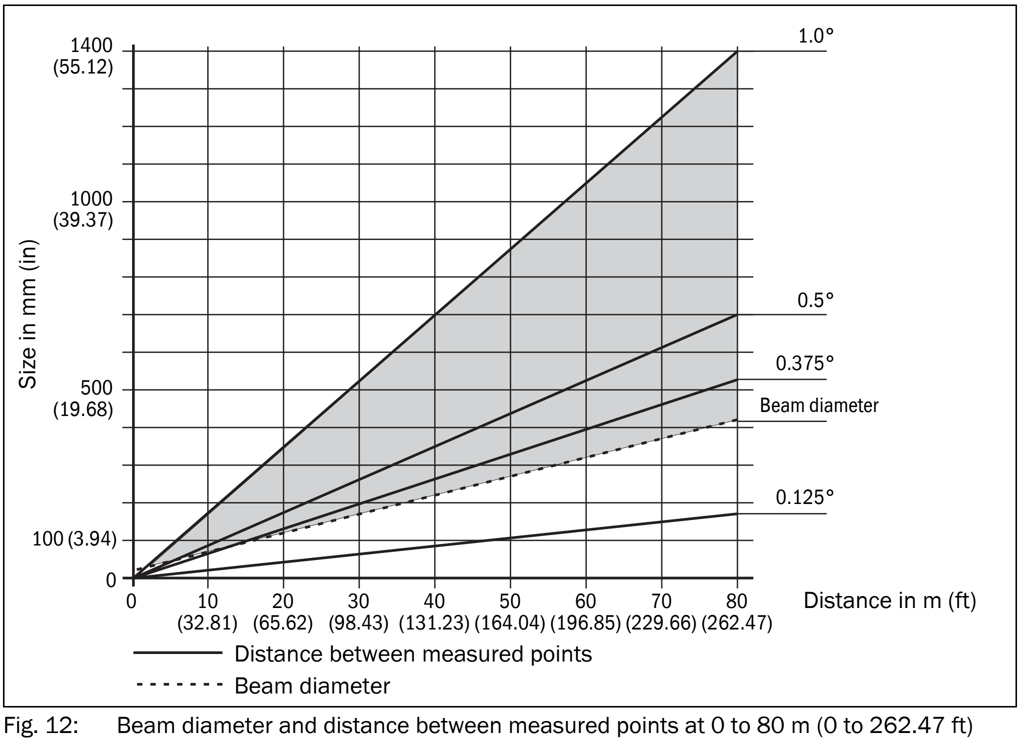


Fig. 12: Beam diameter and distance between measured points at 0 to 80 m (0 to 262.47 ft)

Example for angular resolution of 0.125° in Fig. 12

Distance 40 m (131.23 ft)

Distance intersection point 40 m (131.23 ft) gives a distance between the measured points of approx. **87 mm (3.43 in)**

Distance intersection point 40 m (131.23 ft) with the characteristic curve for beam diameter gives a beam size of approx. **220 mm (8.67 in)**

Result: no gaps during scanning

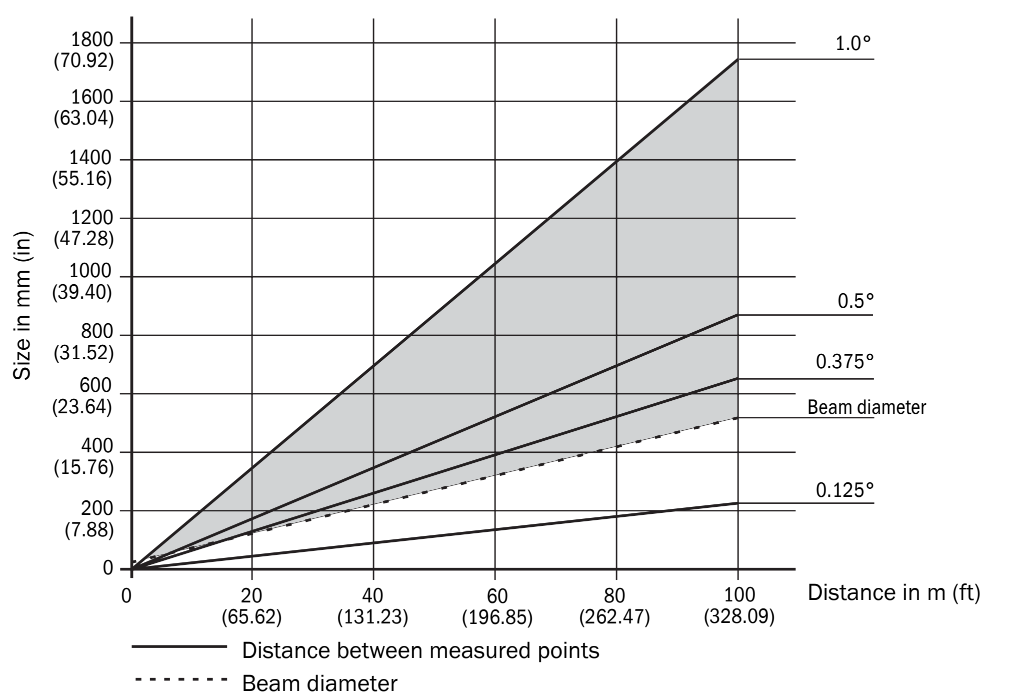


Fig. 13: Beam diameter and distance between measured points at 0 to 100 m (0 to 328.08 ft)

Example for angular resolution 0.5° in Fig. 13

Distance 30 m (98.43 ft)

Distance intersection point 30 m (98.43 ft) gives a distance between the measured points of approx. **260 mm (10.24 in)**

Distance intersection point 30 m (98.43 ft) with the characteristic curve for beam diameter gives a beam size of approx. **170 mm (6.70 in)**

Result: gaps of approx. 90 mm during scanning (3.55 in)

Minimum object size: >90 mm (>3.55 in)

3.4.4 Minimum object size

For it to be possible to reliably detect an object, a beam must be fully incident on it once. If the beam is partially incident, less energy will be reflected by an object than necessary in some circumstances (see Fig. 10 on page 20).

It will be certain the beam is fully incident on the object if the object is at least as large as the distance between the measured points plus the beam diameter.

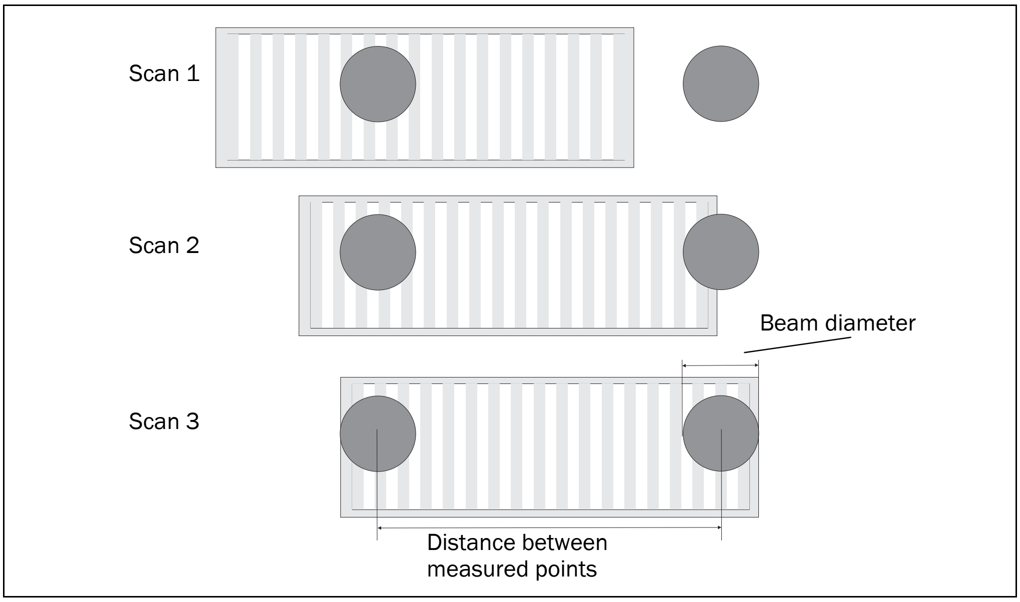


Fig. 14: Minimum object size for detection

Important In the example in Fig. 14, the beam is fully incident on a moving object at least once during each scan. It will therefore be reliably detected if it has the necessary remission.

If an object is only as large as the beam diameter, then it will be detected if the laser is fully incident on it and it has the necessary remission.

How to calculate the minimum object size:

Beam diameter + distance between the measured points = minimum object size

➢ For the beam diameter and distance between the measured points as a function of the distance from the NAV300, see the diagrams in Fig. 12 and Fig. 13.

Important

- In particular on the usage of the NAV300 for measured value output, it is necessary for a reliable measurement that the beam is incident on the object several times.
- On the usage of the NAV300 field application, as a rule the beam must be incident on an object several times in succession for the object to be detected as an infringement of the field.

3.4.5 Maximum and mean pulse frequency

On the NAV300 the scanner head rotates at a selectable frequency from 5 to 15 Hz. During this process, a laser pulse is emitted after each angular step of e.g. 0.25° (adjustable).

The faster the scanner head rotates, the faster the measured value output and the finer the angular resolution is configured, the more exactly the contour will be determined.

Important In this case the interface selected on the NAV300 and the downstream host must be able to transmit and process the volume of data.

NOTICE

During each laser pulse, the laser diode heats up. Like all semiconductors, a laser diode will also be irreparably damaged by excessively high temperatures. For this reason the pulse frequency is limited.

The maximum pulse frequency for the laser diode must never exceed 14.4 kHz. The maximum pulse frequency is given by the number of head revolutions per second and the angular resolution.

The mean pulse frequency must not exceed 12 kHz. The mean pulse frequency is given by the maximum pulse frequency and the size of the area scanned.

- For a scan area of 360° the mean pulse frequency is equal to the maximum pulse frequency.
- For a scan area of <360° the mean pulse frequency is lower than the maximum pulse frequency.

Examples for the maximum and mean pulse frequency

	Scanning area	Head revolutions	Angular resolution	Maximum pulse frequency	Mean pulse frequency
Example 1	270°	10 Hz	1/4° = 0.25°	14.4 kHz	10.8 kHz
Example 2	270°	5 Hz	1/8° = 0.125°	14.4 kHz	10.8 kHz
Example 3	360°	8 Hz	1/4° = 0.25°	11.52 kHz	11.52 kHz
Example 4	360°	10 Hz	1/2° = 0.5°	7.20 kHz	7.20 kHz
Example 5	360°	15 Hz	1/2° = 0.5°	10.8 kHz	10.8 kHz

Tab. 7: Typical settings for the NAV300

Calculation example 1

Scan area: 270°

Head revolutions: 10 Hz

Angular resolution: 1/4° = 0.25°

Max. pulse frequency: 10 Hz × 360 × 4 = 14.4 kHz

Mean pulse frequency: 14.4 kHz × 270/360 = 10.8 kHz

Calculation example 2

Scan area: 270°

Head revolutions: 5 Hz

Angular resolution: 1/8° = 0.125°

Max. pulse frequency: 5 Hz × 360 × 8 = 14.4 kHz

Mean pulse frequency: 14.4 kHz × 270/360 = 10.8 kHz

Calculation example 3

Scan area: 360°

Head revolutions: 8 Hz

Angular resolution: 1/4° = 0.25°

Max. pulse frequency: 8 Hz × 360 × 4 = 11.52 kHz

Mean pulse frequency: 11.52 kHz × 360/360 = 11.52 kHz

Calculation example 4

Scan area: 360°

Head revolutions: 10 Hz

Angular resolutions: 1/2° = 0.5°

Max. pulse frequency: 10 Hz × 360 × 2 = 7.20 kHz

Mean pulse frequency: 7.20 kHz × 360/360 = 7.20 kHz

3.5 Application

AGV Line-Guidance, based on contour and reflector measurement (Mixed-Mode-Navigation)

3.6 Measured value output (raw data)

The NAV300 outputs the following measured values on its interfaces:

- profile of the field of view in two-dimensional polar co-ordinates, as hex values
- contents of one revolution (360°): incl. number of the profile emitted, profile counter, sector numbers, step width, number of points per sector, time stamp for start/end of each sector, direction at the start/end of each sector, value and direction of the distances measured, status

The measured values can be transmitted to a computer system connected and evaluated there (see section 3.7.1 "Data communication using telegrams" on page 27).

Important

- It is only possible to output all measured values of a scan in real-time using the Ethernet interface.
- CAN and serial interface has lower maximum transmission rates. Pay attention to this if real time transmission is required.
- The CAN-Interface is not supported by the RDI Application.

3.6.1 Near range suppression

The near range suppression is used to suppress interference that could occur, e.g., on the usage of housing windows or due to the contamination of the optics.

If near range suppression is activated, measurements are only made from 2.5 m (8.2 ft), in the near range the measurement system is disabled.

- On the NAV300 the near range suppression is inactive in the default delivery status. If you install a NAV300 in a housing (e.g. for explosion protection), then you must configure the near range filter in SOPAS ET.

Using telegrams you can enable and disable the near range suppression on the NAV300 for individually configured sectors, if e.g. a reference measurement is to be performed in the near range (see message listing "TLLDOEMLRSen" on the CD-ROM supplied).

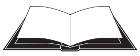
3.7 Data interfaces

The NAV300 has different interfaces for the configuration and the transmission of measured values.

To transmit 360° measured values and RDI data in real time, using the ethernet interface is recommended.

3.7.1 Data communication using telegrams

The NAV300 continuously outputs, on request, the raw data for the profiles measured in two-dimensional polar co-ordinates as hex values. And/or reflector co-ordinates determined by the RDI Application in two-dimensional polar co-ordinates as hex values. The structure of the data is described in **section 10.2 "Data communication via the data interfaces" on page 57**.



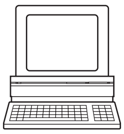
The contents of the individual telegrams is described in the telegram listing "TLLDOEMLRSen" and „Suppl_TL_NAV300" supplied on the CD-ROM.

3.7.2 Ethernet interface

The Ethernet interface has a data transmission rate of 10 MBaud (10BaseT). The interface is a TCP/IP peer to peer interface. Only half duplex is supported. Please ensure that the interface of your application is set to half duplex.

The factory setting for the Ethernet interface is as follows:

- IP address: 192.168.1.10
- subnet mask: 255.255.255.0
- TCP/IP port for SOPAS ET: 2111
- TCP/IP port for data messages: 49152



If necessary, adjust the TCP/IP configuration for the Ethernet interface to enable a connected PC (client) to communicate with the NAV300 via Ethernet: PROJECT TREE, NAV300, INTERFACES, ETHERNET, area ETHERNET

Important To make the changes to the interface parameters effective, the NAV300 must be reset after configuration (see **2.4 "Quick stop and Quick restart" on page 13**).

You will find a description of the electrical interface in section **5.2 "Connections of the NAV300" on page 36**.

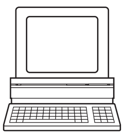
3.7.3 CAN

Important The NAV300 supports the CAN standard 2.0A.

The CAN-Interface is not supported by the RDI Application.

The CAN interface supports data transmissions between 10 kBit/s and 1 Mbit/s. The maximum cable length is 30 m (98.43 ft).

For data communication via CAN you must configure the NAV300 so that it can communicate with the host:



PROJECT TREE, NAV300, INTERFACES, CAN, area CAN

The following interface parameters can be configured

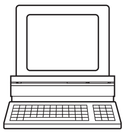
- baud rate of the CAN bus
- ID of the scanner on the CAN
- the IDs of the devices from which the NAV300 accepts telegrams

3.7.4 RS-232 interface

Use DIP switch 1 (see **Fig. 17 on page 36**) to decide whether you want to use the RS-232 interface or the RS-422 interface. The RS-232 interface allows the configuration of the NAV300 as well as the output of measured values.

The following interface parameters are defined and cannot be changed:

- number of data bits: 8
- number of stop bits: none
- number of parity bits: 1



The baud rate can be configured. PROJECT TREE, NAV300, INTERFACES, SERIAL, area SERIAL HOST

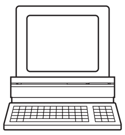
You will find a description of the electrical interface in section **5.2 "Connections of the NAV300" on page 36**.

3.7.5 RS-422

Use DIP switch 1 (see **Fig. 17 on page 36**) to decide whether you want to use the RS-232 interface or the RS-422 interface.

The RS-422 interface allows the configuration of the NAV300 as well as the output of measured values. The following interface parameters are defined and cannot be changed:

- number of data bits: 8
- number of stop bits: none
- number of parity bits: 1



The baud rate can be configured. PROJECT TREE, NAV300, INTERFACES, SERIAL, area SERIAL HOST

You will find a description of the electrical interface in section **5.2 "Connections of the NAV300" on page 36**.

3.8 Controls and status indicators

3.8.1 User interface

The laser measurement system operates fully automatically in normal operation without the intervention of an operator.

The interactive configuration is carried out using the provided SOPAS ET configuration software. The software used for this purpose runs on a PC that is connected to the NAV300 via one of the interfaces.

Use the graphic scan view in SOPAS ET to verify the generated measured values and to verify the measurement area online. During this process, note that the monitor cannot display the data in real-time and therefore does not display all measured values.

Operating modes

Using SOPAS ET or using messages the NAV300 can be switched to different operating modes:

- IDLE mode: stand by (scanner head at rest, laser off)
  protects the laser diode and saves energy
- ROTATE mode: rotation (scanner head rotates, laser off)
  protects the laser diode, the NAV300 can switch quickly to the measure mode, particularly useful in cold weather
- MEASURE mode: measurement mode

3.8.2 Status indicators

The NAV300 has four LEDs. These visually signal the actual operational status and the status of the continuous self-check. The LEDs are on the front of the device on the NAV300. Tab. 8 shows the function of the LEDs.

The two yellow LEDs can be operated as required in a custom programmed evaluation and are not coupled to the four digital outputs OUT1 to OUT4.

Yellow LED (1)	**Yellow LED (2)**	**Green LED**	**Red LED**	**Meaning**
Off	Off	Off	Off	Device switched off. No supply voltage.
On	On	On	On	LED test for 1 s after switching on. All switching outputs are active.
On	Off	Flashing	Off	The device is operational. Application NAV200-Mode (RDI). All switching outputs are inactive. In the measure mode the LED flashes quickly.
Off	ON	Flashing	Off	The device is operational. Application NAV300-Mode. All Switching outputs are inactive. In the measure mode the LED flashes quickly.
Off	Off	Off	On	System error in the device. For information on troubleshooting see chapter 8 “Troubleshooting” on page 51.

Tab. 8: Significance of the LEDs

3.9 Planning

3.9.1 System requirements of the NAV300

For commissioning and operating the NAV300, the following are required at the user:

- supply voltage 24 V DC ±15%, generated as per IEC 364-4-41 (VDE 0100, part 410), output power minimum 40 W (see also section 5.3.1 “Supply voltage” on page 38)
- standard Intel Pentium PC or compatible, at least Pentium III, 500 MHz; RAM: minimum 256 MB, 512 MB recommended; operating system: MS Windows 2000, XP or VISTA; monitor: minimum 256 colours, 65536 colours recommended; screen resolution at least 800 × 600; hard disc: minimum 220 MB free memory; CD-ROM drive; HTML browser on PC, e.g. Internet Explorer™: for the online help system for SOPAS ET; Data interface RS-232, RS-422, Ethernet or CAN (see also section 5.3.3 “General conditions for the data interface” on page 39). If necessary RS-232/RS-422 converter, if PC interface and interface on the NAV300 do not match

3.9.2 Mounting requirements

The NAV300 must be mounted robust.

Mounting kits

The following mounting kit is available (see section 10.3.2 “Available accessories” on page 68):

NAV300:

- mounting kit part no. 5311055 with mounting material

As an alternative you can use a strong stable mounting bracket that provides adjustable alignment of the NAV300 in the X and Y axis. The NAV300 weighs approx. 2,4 kg (5.29 lb).

3.9.3 Distance between NAV300 and the object/surface to be monitored

The measurement area on the NAV300 starts at 0.5 m (1.64 ft)or 2.5 m (8.2 ft)with activated nearfield suppression in front of the optics (light output window).

To prevent false measurements, in the case of the recessed installation of the NAV300 on a ledge or in a niche the increase in the size of the laser beam with increasing distance along the wall is to be taken into account. If mounted incorrectly, the wall (or an object fastened to it) may be continuously detected in the scan area, as the laser beam is incident on it.

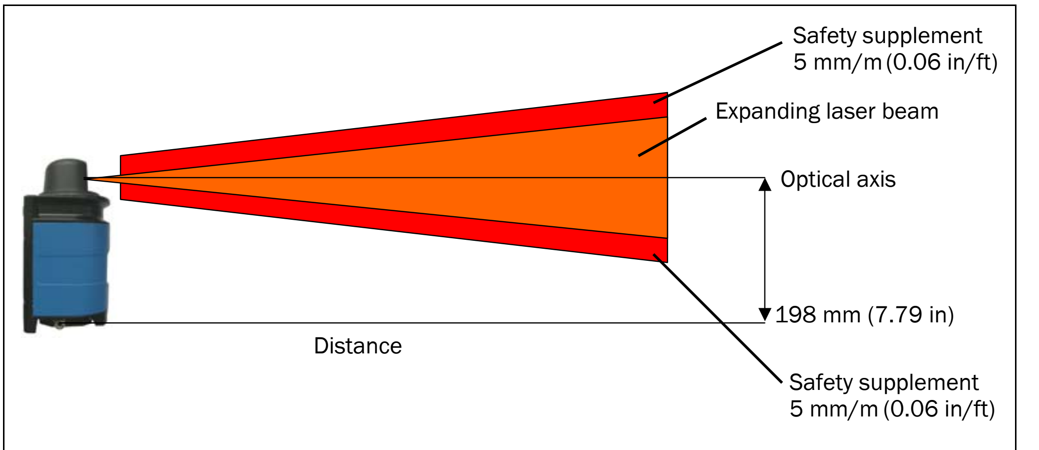


Fig. 15: Increase in the size of the beam and safety supplement

The optical axis is used as the reference plane for the distance to be maintained from the wall; on the vertically mounted NAV300 this axis is approx. 198 mm (7.79 in) above the bottom edge of the housing.

The distance-dependent increase in the size of the beam can be calculated using the formula:

beam diameter = (distance (mm) × 5.0 mrad) + 20 mm[1)]

The following table shows a few values as examples:

Distance	5 m (16.4 ft)	10 m (32.81 ft)	15 m (49.21 ft)	20 m (65.62 ft)	25 m (82.02 ft)	30 m (98.43 ft)
Beam diameter	45 mm (1.77 in)	70 mm (2.75 in)	95 mm (3.74 in)	120 mm (4.72 in)	145 mm (5.71 in)	170 mm (6.69 in)

Tab. 9: Beam diameter at different distances from the laser measurement system

1) Due to the transmit lens.

For the assessment of whether the laser beam can be incident on an object or the wall, the distance of half the beam diameter from the optical axis is used.

Recommendation Take into account safety supplement of approx. 5 mm per meter (0.06 in/ft).

Example

Recessed installation of the NAV300 with a monitoring radius of 15 m (49.21 ft).

Beam diameter in 15 m (49.21 ft) distance = (15000 mm × 5.0 mrad) + 20 mm = 95 mm.

Safety distance = 5 mm/m × 15 m = 75 mm (0.06 in/ft × 49.21 ft = 2.95 in).

Distance to the optical axis = beam diameter/2 + safety distance

= 95 mm/2 + 75 mm (3.23 in/2+ 2.95 in)

= 122.5 mm (4.82 in)

Result:

At a distance of 15 m (49.21 ft) there is a clearance between the bottom edge of the device and the edge of the increased size laser beam of approx. 122.5 mm (198 mm – 122.5 mm = 75.5 mm) (7.7923 in – 4.8210 in = 2.9713 in).

4 Mounting

NOTICE

Do not open the housing for the NAV300. If the housing is opened, any warranty claims against SICK AG will be rendered void.

4.1 Overview of the mounting steps

- select mounting method for the NAV300
- mounting and adjusting the NAV300

4.2 Preparations for mounting

4.2.1 Components to be mounted

- A NAV300 (weight approx. 2.4 kg (5.29 lb))

4.2.2 Material and accessories necessary

For the NAV300

- mounting kit part no. 5311055 with mounting material (not included with delivery, see section 10.3.2 “Available accessories” on page 68)

  or

- alternative on provision of a fixing bracket by the user:
  - stable mounting bracket that provides adjustable alignment of the NAV300 in the X and Y axis
  - 3 screws M6 for the NAV300, screw length dependent on the wall thickness of the fixing bracket used

4.3 Mounting and adjustment of the device

NOTICE

Risk of damage to the device!

The maximum screw length in the M6 blind threaded hole is 12 mm (0.47 in). Longer screws will damage the device.

➢ Use screws of suitable length.

The NAV300 hat three M6 blind thread holes and is fastened using 3 M6 screws (see section 9.2.1 “Dimensional drawing NAV300” on page 55).

For secure mounting at least 3 M6 screws with washers and locking washers are required. The supply of power must be switched off.

The NAV300 can be fitted in any position.

1. Prepare surface from mounting the fixing bracket for the NAV300 as described in section 4.2 “Preparations for mounting” on page 32.
2. Insert screws in the holes in the bracket and screw into the blind threaded hole in the NAV300. Only tighten screws lightly.
3. The scanner head on the NAV300 must be free to rotate.
4. Align the NAV300.
5. Tighten screws.
6. Check the alignment.

Mounting with bracket for the NAV300

The NAV300 can be mounted with the aid of the SICK fixing bracket part no. 5311055. The slots on the fixing bracket permit rotation by ±5° for the fine alignment of the NAV300.

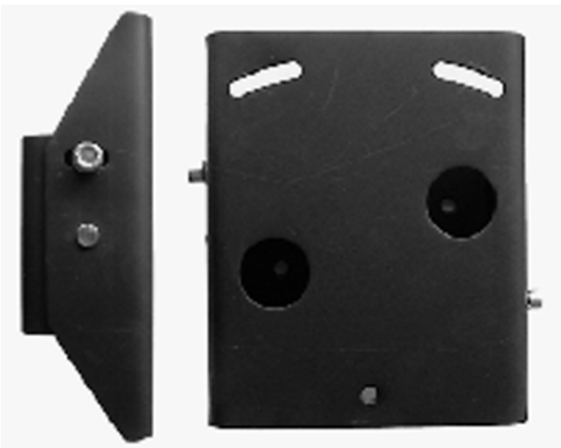


Fig. 16: Fixing bracket NAV300

The dimensions of the fixing bracket are shown in Fig. 27 on page 56.

4.4 Dismantling the system

1. Switch off the supply voltage.
2. Remove the connection cables.
3. Loosen screws for mounting the NAV300 to the fixing and remove device.

Important On final decommissioning, please observe the disposal requirements in section 7.2 "Disposal" on page 50 for environmentally correct disposal.

5 Electrical installation

NOTICE

Only authorised personnel are allowed to perform the electrical installation work.

- Do not open the housing.
- Observe the current safety regulations when working on electrical systems.

Switch the entire machine/system offline!

The machine/system could inadvertently start up while you are connecting the device.

- Ensure that the entire machine/system is disconnected during the electrical installation.

5.1 Overview of the installation steps

- Connect supply voltage to the NAV300.
- Wire switching outputs (application-dependent).
- Temporarily connect PC (configuration).
- Wire data interface for operation.

5.2 Connections of the NAV300

5.2.1 Connections of the NAV300

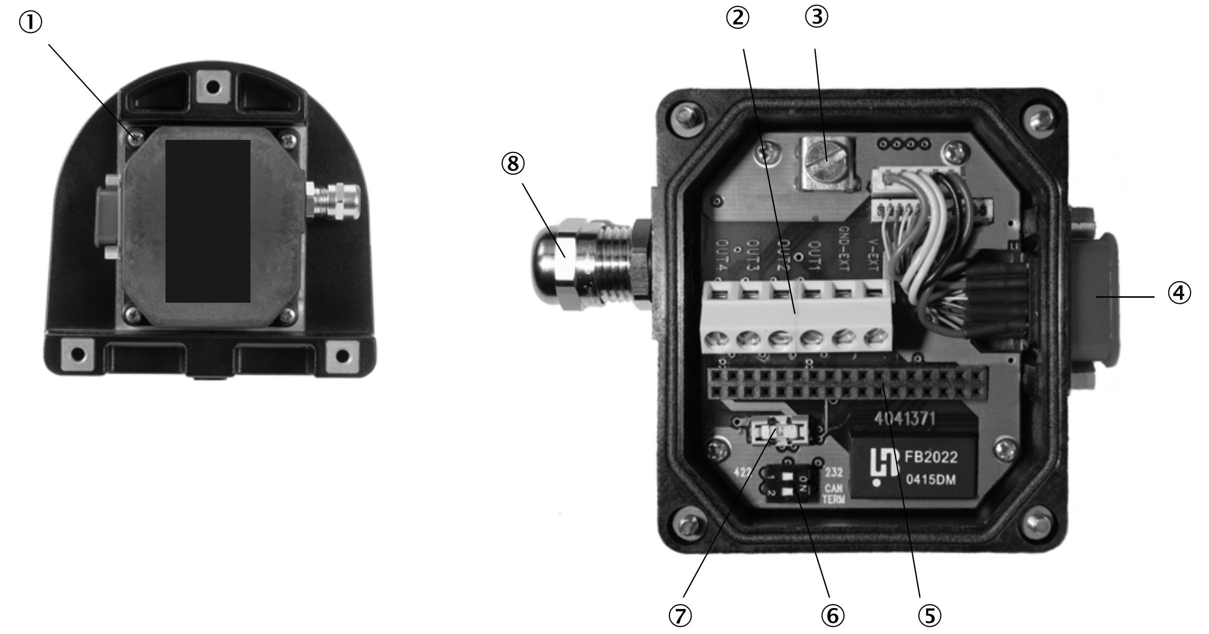


Fig. 17: NAV300: layout of the interface adapter

Elements of the interface adapter

1. fixing screw (4 ×)
2. 6-way terminal block
   (supply voltage, switching outputs)
3. ground connection
4. 15 pin D-Sub HD plug
   (data, outputs, supply voltage)
5. 34-pin connector(connection to the NAV300)
6. DIP switch 1 (RS-232/RS-422)
   DIP switch 2 (CAN bus termination)
7. fuse (supply voltage)
8. PG7 cable entry

Function of the DIP switches

DIP switch	Function	Default setting
1	RS-232/RS-422	RS-232
2	CAN bus termination	Termination ON[1)]

Tab. 10: Function of the DIP switches

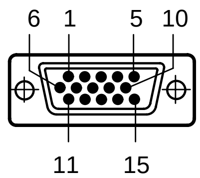
1) If an external terminating resistor is used, you must deactivate the termination in the NAV300.

Assignment for the 6-way terminal block

Label on printed circuit board	Signal	Function
V-EXT	DC +24 V	Supply voltage
GND-EXT	GND	Sensor ground
OUT1	OUT1	Switching output 1, function depending on application
OUT2	OUT2	Switching output 2, function depending on application
OUT3	OUT3	Switching output 3, function depending on application
OUT4	OUT4	Switching output 4, function depending on application

Tab. 11: Assignment for the 6-way terminal block

15-pin D-Sub HD plug



Pin	Signal	Interface	Function
1	DC 24 V		Supply voltage
2	CAN L	CAN bus (IN/OUT)	CAN bus Low
3	CAN H	CAN bus (IN/OUT)	CAN bus High
4	GND_Data		Data interfaces ground
5	GND		Supply voltage ground
6	RD+	RS-422	Receiver+
7	RD–/RxD	RS-422/RS-232	Receiver–
8	TD+	RS-422	Sender+
9	TD–/TxD	RS-422/RS-232	Sender–
10	OUT1		Switching output 1, function depending on application
11	TPIP	Ethernet IN	Receiver+
12	TPIN	Ethernet IN	Receiver–
13	TPOP	Ethernet OUT	Sender+
14	TPON	Ethernet OUT	Sender–
15	OUT2		Switching output 2, function depending on application
Housing	–	–	Screen

Tab. 12: Pin -assignment for the 15 pin D-Sub HD plug

5.3 Preparing the electrical installation

5.3.1 Supply voltage

24 V DC ±15% as per IEC 364-4-41 (note the permissible cable lengths in Tab. 13 on page 38).

The NAV300 draws the following power:

- on switching on without switching outputs wired typically 36 W
- in operation typically 12 W

The supply of power/the external power supply for the supply of power must be able to provide at least 40 W continuous power

⚠ WARNING

Use safety transformer

The output circuit must be safely electrically isolated from the input circuit, this feature is normally provided by a safety transformer in accordance with IEC 742 (VDE 0551).

5.3.2 Wire cross-sections

➢ Wire all connections with copper cables!

➢ Use the following wire cross-sections:

- supply voltage at least 0.25 mm^2 (approx. 24 AWG), if local supply of power (power supply) in the immediate vicinity
- supply voltage at least 1.0 mm^2 (approx. 18 AWG) at maximum length of 20 m (65.62 ft), if connection is made to an existing 24 V DC supply
- data interface minimum 0.25 mm^2 (approx. 24 AWG)
- For the NAV300 the outside diameter of the common cable must be a maximum of 5.6 mm (0.22 in) due to the PG7 cable entry.

➢ Lay all cables such that there is no risk of tripping and all cables are protected against damage.

On the usage of a typical power supply with a nominal voltage of 24 V DC ±5%, the following maximum cable lengths are allowed for the supply of the operating voltage:

Wire cross-section	Cable length
0.25 mm^2 (0.01 in^2 approx. 24 AWG)	5 m (16.4 ft)
0.5 mm^2 (0.02 in^2 approx. 22 AWG)	10 m (32.81 ft)
1.0 mm^2 (0.04 in^2 approx. 18 AWG)	20 m (65.62 ft)

Tab. 13: Maximum cable lengths for the supply voltage

5.3.3 General conditions for the data interface

The table below shows the recommended maximum length of cable as a function of the data transmission rate selected.

Interface type	Transmission rate	Maximum cable length
RS-232	115200 Bd	10 m (32.81 ft)
RS-422	115200 Bd	100 m (328.08 ft)
CAN bus[1)]	1 MBit/s	30 m (98.43 ft)

Tab. 14: Maximum cable lengths for the data interfaces

1) With appropriate cable termination, termination in accordance with related specification.

Important

- Use screened cable (twisted-pair) with at least 0.25 mm^2 (approx. 24 AWG).
- To prevent interference, do not lay data cable in parallel with power supply and motor cables over a long run, e.g. in cable ducts.

5.4 Electrical installation on the NAV300

5.4.1 Equipment

- tool set
- digital multimeter (current/voltage measurement)

NOTICE

Reduced enclosure rating!

➢ If the interface adapter is removed, the NAV300 is no longer compliant with enclosure rating IP 65. To prevent damage due to the entry of moisture and dirt, only open the adapter in dry, clean surroundings.

➢ If necessary, pre-wire and fit the adapter in suitable surroundings.

➢ Ensure the power supply to which the NAV300 is connected is switched off.

➢ Remove interface adapter on the underside of the device. For this purpose loosen the four fixing screws (Fig. 17 on page 36) and pull the adapter carefully off the device perpendicular to the base.

Connecting cable for supply voltage and switching outputs

The PG7 cable entry (metal) has an ground connection to the device. If a screened connecting cable is used, connect the screen braid on the cable to the cable entry as necessary .

➢ For this purpose, shorten the screen braid as appropriate before assembling the cable entry and fit over the plastic insert for the cable entry.

1. Loosen fitting for the PG7 cable entry.
2. Pull cable for supply voltage and switching outputs with maximum outside diameter ∅ 5.6 mm (0.22 in) through plastic insert for the PG7 cable entry.
3. Connect electrically isolated wires to the terminal block.
4. If necessary, connect screen braid on the cable to the cable entry.
5. Fit PG7 cable entry fitting and tighten.

6. Carefully re-fit interface adapter to the NAV300 such that the 15 pin D-Sub socket is over the related plug in the device.
7. Press adapter gently.
8. Tighten the four fixing screws for the adapter.

Connecting supply voltage

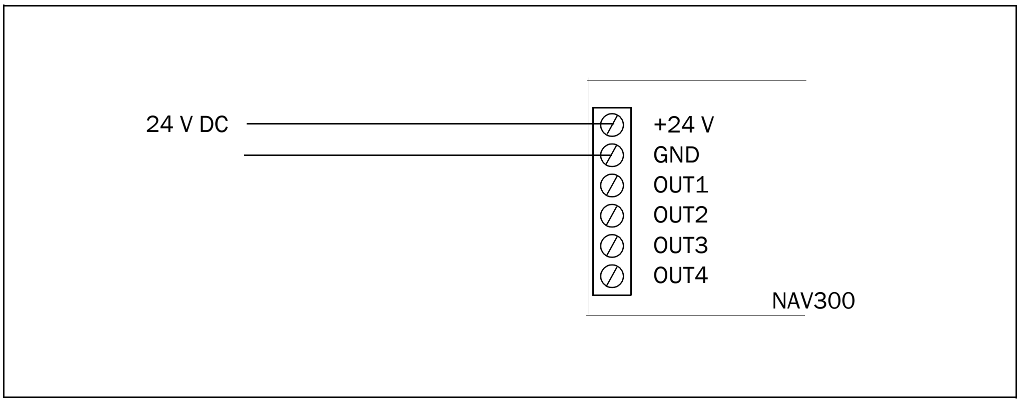


Fig. 18: Connecting supply voltage

Wiring CAN interface

To wire the CAN interface a screened "twisted-pair" cable is required. The 120 Ω terminator must be connected to pin 7 and pin 8.

➢ Pay attention to max. cable length as per **section 5.3.3 "General conditions for the data interface" on page 39**.

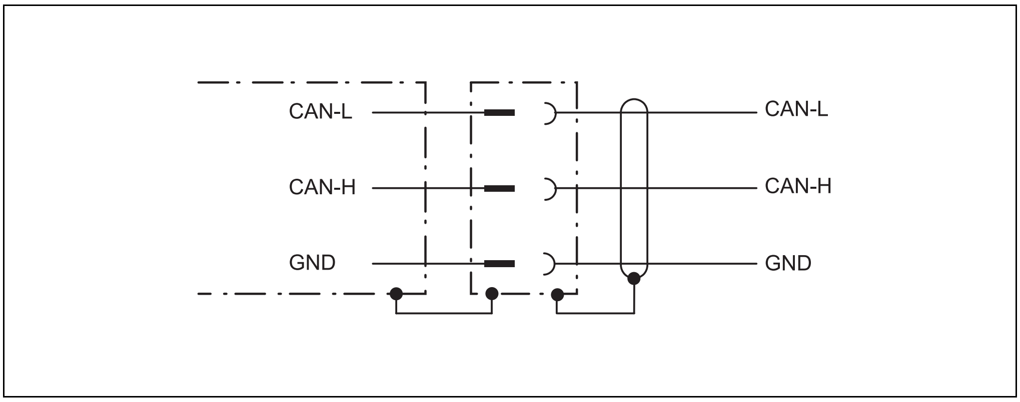


Fig. 19: Wiring of the CAN interface

Wiring the RS-232 interface

A screened cable is required for the wiring of the RS-232 interface.

➤ Pay attention to max. cable length as per section 5.3.3 "General conditions for the data interface" on page 39.

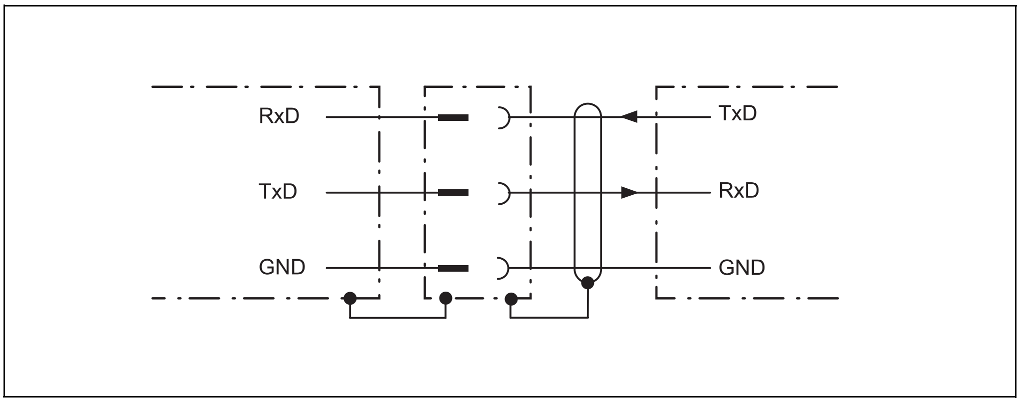


Fig. 20: Wiring the RS-232 interface

Wiring the RS-422 interface

A screened cable is required for the wiring of the RS-422 interface.

➤ Pay attention to max. cable length as per section 5.3.3 "General conditions for the data interface" on page 39.

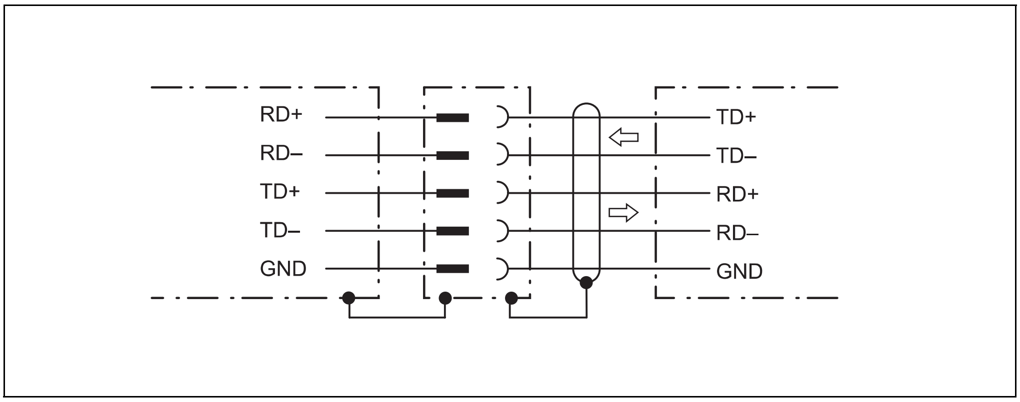


Fig. 21: Wiring the RS-422 interface

5.4.2 Connection of the NAV300 with pre-assembled cables

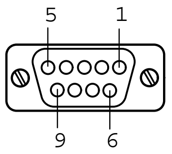
Pre-assembled cables are available for the NAV300, these can be used, for example to connect a PC via RS-232 or Ethernet.

Temperature range 0…+40 °C (32…104 °F).

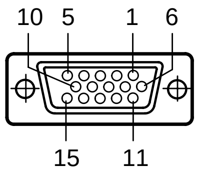
Connection	Part number	Length	Version
NAV300 on PC (RS-232)	6032508	3 m (9.84 ft)	RS-232 null modem cable, 3-core, screened, 15 pin D-Sub HD socket to 9 pin D-Sub socket for configuration using the PC, for pin assignment see Tab. 16 on page 42
NAV300 on PC (Ethernet)	6032509	3 m (9.84 ft)	Ethernet cross-over cable, screened, 15 pin D-Sub HD socket to 8 pin RJ-45 plug for configuration using the PC, for pin assignment see Tab. 17 on page 43

Tab. 15: Pre-assembled cable for NAV300

Pin assignment RS-232 null modem cable Part no. 6032508



9 pin D-Sub socket



15 pin D-Sub HD socket (NAV300)

9 pin D-Sub socket (PC)		**15 pin D-Sub HD socket (NAV300)**	
Pin	**Signal**	**Pin**	**Signal**
1	–	1	DC 24 V
2	RxD	9	TD–/TxD
3	TxD	7	RD–/RxD
4	–	8	TD+
5	GND_Data	4	GND_Data
6	–	5	GND
7	–	2	CAN L
8	–	3	CAN H
9	–	6	RD+
		10	OUT1
		11	TPIP
		12	TPIN
		13	TPOP
		14	TPON
		15	OUT2
Housing	Screen	Housing	Screen

Tab. 16: Pin assignment for the RS-232 null modem cable Part No. 6032508

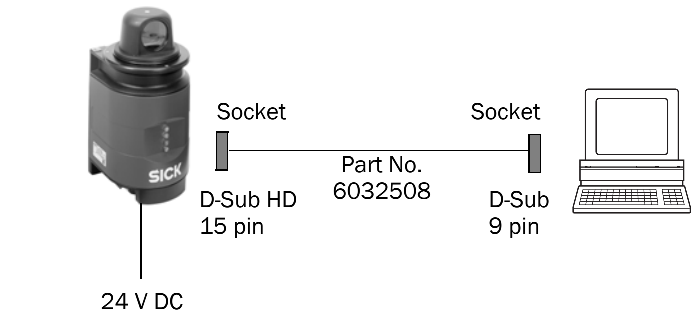
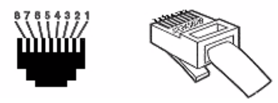
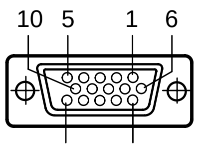


Fig. 22: NAV300: RS-232 connection using null modem cable part no. 6032508

Pin assignment Ethernet cross-over cable Part No. 6032509



RJ-45



On NAV300

RJ-45 connector (PC)		15 pin D-Sub HD socket (NAV300)	
Pin	**Signal**	**Pin**	**Signal**
		1	DC 24 V
		9	TD–/TxD
		7	RD–/RxD
		8	TD+
		4	GND_Data
		5	GND
		2	CAN L
		3	CAN H
		6	RD+
		10	OUT1
1	TPOP	11	TPIP
2	TPON	12	TPIN
3	TPIP	13	TPOP
6	TPIN	14	TPON
		15	OUT2
Housing	Screen	Housing	Screen

Tab. 17: Pin assignment Ethernet cross-over cable Part No. 6032509

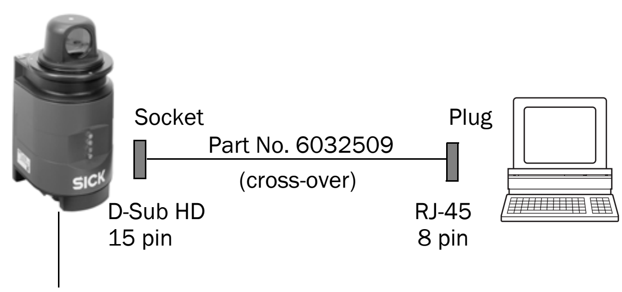


Fig. 23: NAV300: Ethernet connection using the Ethernet cross-over cable part no. 6032509

6 Commissioning and configuration

WARNING

Commissioning requires a thorough check by qualified personnel!

Before you operate a system equipped with the NAV300 for the first time, make sure that the system is first checked and released by qualified personnel. On this issue, observe the notes in chapter 2 "For your safety" on page 10.

Commissioning, configuration and diagnostics are undertaken using the SOPAS ET configuration software supplied.

6.1 Overview of the commissioning steps

- Install SOPAS ET configuration software.
- Establish communication with the NAV300.
- Create a custom parameter set using SOPAS ET and save in non-volatile memory in the NAV300.
- Test NAV300 for correct function.

6.2 SOPAS ET configuration software

The interactive configuration is undertaken with the aid of SOPAS ET. Using this configuration software, you can configure and test the measurement properties, the analysis of the system as required. The configuration data can be saved as a parameter set (project file) on the PC and archived.

Help for the program user interface as well as for the different options can be found in SOPAS ET:

- menu HELP, HELP F1: comprehensive online help for the program interface and the different options
- HELP window (on the bottom left in the program user interface): context sensitive help for the visible dialog
- tool tips: Move the mouse pointer over an input field. A short text ("tool tip") with information about valid entries appears.

Primary functions are:

- selection of the menu language (German/English)
- establishment of the communication with the NAV300
- password-protected configuration with different operating levels
- system diagnostics

6.2.1 System requirements for SOPAS ET

- standard Intel Pentium PC or compatible, at least Pentium III, 500 MHz
- minimum 256 MB RAM, 512 MB RAM recommended
- data interface RS-232, RS-422, Ethernet or CAN (see also section 5.3.3 "General conditions for the data interface" on page 39)
- operating system: MS Windows 2000, XP or VISTA

- monitor with 256 colours minimum, 65536 colours recommended (16 Bit High Color), screen resolution at least 800 × 600
- hard disc: minimum 220 MB free memory
- CD-ROM drive
- HTML browser on PC, e.g. Internet Explorer™: for the online help system for SOPAS ET

6.2.2 Installation of SOPAS ET

1. Start PC and insert installation CD.
2. If the installation does not start automatically, run the file setup.exe on the CD-ROM.
3. To complete the installation, follow the instructions.

6.2.3 SOPAS ET default setting

Parameter	Value
Language for the user interface	English (the software must be re-started after a change)
Units of length	Metric
User group (operating level)	Machine operator
Download the parameters to the NAV300	Immediate on change, temporary in the NAV300 RAM
Upload the parameters from NAV300	After switching online, automatic
Window layout	3 (project tree, help, working area)
Serial communication	COM1: 9600 Bd/19200 Bd, 8 data bits, no parity, 1 stop bit

Tab. 18: SOPAS ET default setting

6.3 Establish communication with the NAV300

Important For communication via TCP-IP, the TCP-IP protocol must be active on the PC.

On the connection of PC/host, following this sequence:

1. Switch on the PC.
2. Connect PC to the NAV300 using data cable.
3. Switch on the supply voltage for the NAV300.
   The NAV300 performs a self-test and initialises itself.

6.3.1 Connect the data interfaces

➢ Connect PC and laser measurement system together as per table.

Variant	Data interface	Comment
NAV300	RS-232/RS-422	Connect PC (serial interface) to the NAV300 using null modem cable (see Fig. 22 on page 42).
	Ethernet	Connect PC to the NAV300 using Ethernet cross-over cable (see Fig. 23 on page 43).

Tab. 19: Connect the data interfaces

6.3.2 Starting SOPAS ET and opening scan assistant

1. Start SOPAS ET.
   By default SOPAS ET opens the program window with the English user interface.
2. To change the language setting, in the start dialog box click CANCEL and using the menu TOOLS, OPTIONS change the language for the user interface to GERMAN/DEUTSCH.
3. If the language setting has been modified, quit SOPAS ET and re-start.
4. In the dialog box, choose the option CREATE NEW PROJECT and confirm with OK.
5. In the main window in SCAN ASSISTANT click the CONFIGURATION button.
   The SCAN ASSISTANT dialog box appears.

6.3.3 Configuring the serial connection

1. In the SCAN ASSISTANT dialog box, under SERIAL CONNECTION, STANDARD PROTOCOL, activate the checkbox ACTIVATE SERIAL COMMUNICATION.
2. Click ADVANCED... button.
3. In COLA DIALECT choose the BINARY option.
4. In BAUD RATE deactivate all baud rates except 115 200.
5. Choose following PORT SETTINGS: 8 data bits, no parity, 1 stop bit.
6. Confirm the settings with OK.
   The ADVANCED SCAN SETTINGS dialog box is closed.
7. Confirm the settings in the SCAN ASSISTANT dialog box with OK.
   The SCAN ASSISTANT dialog box is closed.

6.3.4 Configuring the Ethernet connection

Important Deactivate all programs on your PC/notebook that access Ethernet or TCP/IP.

1. In the SCAN ASSISTANT dialog box, under INTERNET PROTOCOL, IP COMMUNICATION, activate the checkbox ACTIVATE IP COMMUNICATION.
2. Click ADD button.
3. Enter IP address for the NAV300 (192.168.1.10 is set in the factory).
4. Confirm with OK.
5. Click ADVANCED... button.
6. In COLA DIALECT choose the BINARY option.
7. In DUPLEX MODE choose the HALF DUPLEX option.
8. Confirm the settings with OK.
   The ADVANCED SCAN SETTINGS dialog box is closed.
9. Confirm the settings in the SCAN ASSISTANT dialog box with OK.
   The SCAN ASSISTANT dialog box is closed.

6.3.5 Performing scan for devices in SOPAS ET

1. In the SCAN ASSISTANT dialog box, click on the START SCAN button.
2. Choose devices listed and accept using ADD DEVICE.
   A scan is performed for devices connected via the connection. SOPAS ET adds the devices found to the project tree and uploads the actual parameter set from the device.

6.4 Initial commissioning

The NAV300 is adapted to the local measurement situation using SOPAS ET. For this purpose a custom parameter set is created using SOPAS ET. The parameter set can either be loaded initially from the device (upload) or it can be prepared independently.

The parameter set is then loaded into the NAV300 (download). This action is performed either immediately (SOPAS ET option DOWNLOAD IMMEDIATELY) or using a command.

Important Once the configuration has been completed, the parameter set must be saved in non-volatile memory in the laser measurement system. In addition, the parameter set can be saved as a project file (spr file with configuration data) on the PC and archived.

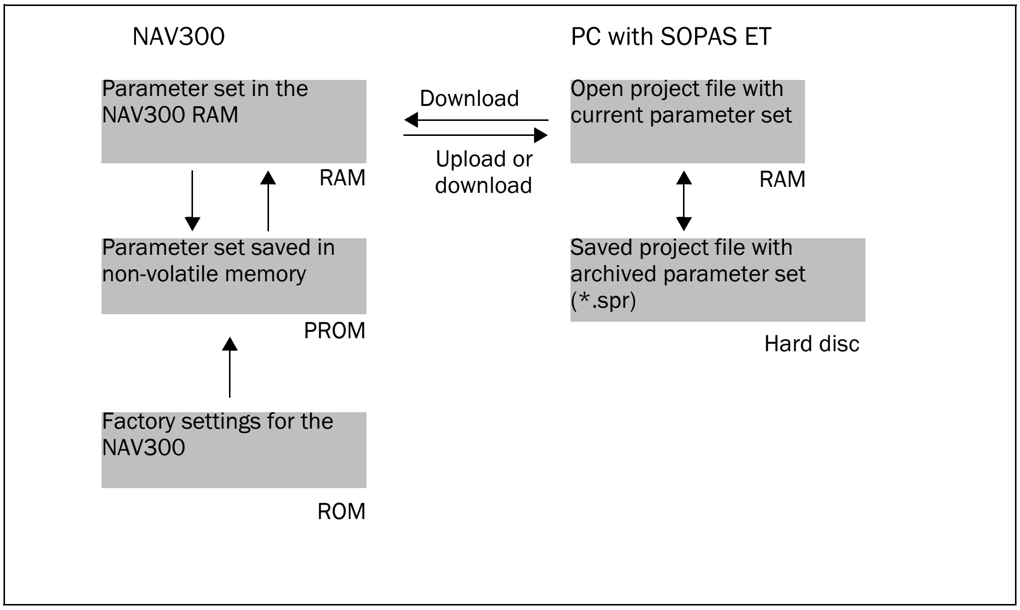


Fig. 24: Principle of data storage

6.4.1 Configuring the NAV300

You can configure the NAV300 in two ways:

- interactively using SOPAS ET
  This section describes the interactive configuration.
- using configuration messages
  On this subject please read section 3.7.1 "Data communication using telegrams" on page 27.

Interactive configuration using SOPAS ET

All parameters that can be configured for the NAV300 are combined into a corresponding device description (jar file) for SOPAS ET. You can open this file using the device description project tree.

The function of each parameter is explained in context-sensitive online help ([F1] key). The valid range of values and the default are listed in the PARAMETER INFO window (right mouse button when the pointer is positioned over the parameter).

Important Software access to the NAV300 is password protected. Following completion of the configuration, you should change the password so that it can perform its protective function.

Firmware	User level	Password
V 2.4 or higher	Authorised client	client

Tab. 20: Passwords

6.5 Performing the configuration

Use the project tree in SOPAS ET to configure the parameters necessary for your application.

1. From the Options menu select the Login device command and log in to the system using the password "client" as Authorised client.

NOTICE

Do not switch off the voltage supply during configuration!

Switching off the voltage supply during configuration causes all parameters already configured to be lost.

2. Configure the NAV300 for the required application with the aid of the parameters in SOPAS ET.

Help for the program user interface as well as for the different options can be found in SOPAS ET.

6.6 Connection and test measurement

Use the graphic scan view in SOPAS ET to verify the generated measured values and to verify the measurement area online.

1. In the project tree, choose NAV300, Monitor, Scan view.
2. In order to start the measurement, click on Play.
3. Compare the measurement line with the desired result.

Important

– The Scan View in the Monitor is dependent on the available computing power of the PC and is **not** output in real-time. For this reason not all measured values are displayed. The same limitation also applies when saving measured values displayed in a file.

– The monitor displays the measured values **unfiltered**, i.e. the action of filters can **not** be checked with the aid of the monitor.

4. After completing the test measurement successfully, save the configuration permanently to the NAV300: Menu NAV300, Parameter, Save permanent.

7 Maintenance

NOTICE

Claims under the warranty rendered void!

The housing screws of the NAV300 are sealed. Claims under the warranty against SICK AG will be rendered void if the seals are damaged or the device opened. The housing is only allowed to be opened by authorised service personnel.

7.1 Maintenance during operation

The NAV300 is maintenance-free apart from the maintenance measures listed below. No maintenance is necessary to ensure the retention of laser class 1.

Recommendation To obtain the full performance of the NAV300, the optics in the NAV300 must be regularly checked for contamination. This applies particularly in harsh operating environments (dust, powder, moisture, finger marks).

NOTICE

Damage to the optics in the NAV300

The optics in the NAV300 are made of glass. The optical power is reduced by scratches and smearing on the front screen.

- Do not use aggressive detergents.
- Do not use abrasive cleaning agents.
- Only use use fabric cleaning cloths, never paper tissues.
- Avoid scratching or scouring movements on the optics or cover.

NOTICE

Particles of dust will adhere to the optics in the NAV300 due to static charging. You can prevent this effect by using the antistatic plastic cleaner (SICK part number 5600006) and the SICK lens cloth (part number 4003353).

Fig. 25: Optics for the NAV300

How to clean the optics for the NAV300:

➤ Switch off the NAV300 while performing cleaning, as otherwise the scanner head will rotate.

➤ Remove the dust from the optics or the cover using a clean, soft brush.

➤ Then wipe off the optics or the cover using a clean, moist cloth.

Important If the optics or the cover is scratched or damaged (cracked, broken), it must be replaced. Please contact the SICK Service.

7.2 Disposal

After de-commissioning, dispose of unusable or irreparable devices in an environmentally correct manner:

1. Observe national waste disposal regulations.
2. Dismantle the housing of the NAV300.
3. Remove electronics assemblies.
4. Remove optics and glass components and send for glass recycling.
5. Send chassis and cover for die-cast aluminium recycling.
6. Dispose of all electronic assemblies as hazardous waste.

SICK AG does not accept any devices returned that have become unusable or are irreparable.

7.3 Replacement of a system or replacement of components

As all external cable connections end in the interface adapter, it is not necessary to re-install the device electrically on a device replacement. The replacement device can be simply placed on the adapter.

If the system or individual components are replaced, proceed as follows:

1. Switch off the voltage supply for the NAV300.
2. Remove connection cable/s from the NAV300.
3. Mount the replacement device (see chapter **4 “Mounting” on page 32**).
4. Configure replacement device (see chapter **6 “Commissioning and configuration” on page 44**).

8 Troubleshooting

NOTICE

Claims under the warranty rendered void!

The housing screws of the NAV300 are sealed. Claims under the warranty against SICK AG will be rendered void if the seals are damaged or the device opened. The housing is only allowed to be opened by authorised service personnel.

This chapter describes how to identify and rectify errors and malfunctions during the operation of the NAV300.

8.1 In the event of faults or errors

WARNING

Cease operation if the cause of the malfunction has not been clearly identified!

Stop the machine/system if you cannot clearly identify or allocate the error and if you cannot safely rectify the malfunction.

8.2 Monitoring error and malfunction indications

The NAV300 monitors itself in operation:

- After switching on the supply voltage the NAV300 runs through a self-test prior to initialisation (loading the parameter set and initialisation of the device functions); during this self-test the device checks important hardware components.
- During operation the NAV300 continuously monitors the function of the rotation of the scanner head.
- If the NAV300 detects a device error during the self-test or in operation, it indicates this situation using the LEDs. The coded errors can be read with the aid of the user protocol services.

8.3 Troubleshooting and rectification

Fault	Possible cause	Solution
1. All LEDs are off and the scanner head is not rotating.	• No supply voltage at the connection terminals	➢ Check supply voltage (24 V DC ±20%). ➢ Check whether supply cables in the interface adapter are correctly screwed to the terminal strip. ➢ Check whether cables are connected to the correct terminals.
2. No LED is illuminated. The scanner head only rotates briefly.	• Excessively low supply voltage at the connection terminals	➢ Increase wire cross-section.
3. Red LED illuminated.	• Scanner head does not rotate and is locked	➢ With the aid of SOPAS ET, release the lock on the scanner head. ➢ Disconnect supply voltage and re-connect. If the red LED is still illuminated, inform SICK service.
4. SOPAS ET cannot communicate with the NAV300.	• Supply voltage for NAV300 not switched on	➢ See 1., 2. and 3.
	• PC not connected to NAV300	➢ Connect PC to NAV300 (use data cable to suit interface type).
	• Wrong interface selected	➢ Select interface in SOPAS ET as per the connection made to the PC.
	• Another application on the PC is already accessing the interface.	➢ Check assignment of the interface, if necessary quit related application.
	• Pay attention to sequence when switching on the NAV300 and the PC connected	➢ 1. Switch on PC, 2. Connect PC to NAV300, 3. Switch on NAV300.
5. Measurements in the near range with no measurement target.	• Contaminated or scratched optics	➢ Carefully clean optics using soft, fluff-free cloth. If the optics are scratched, contact SICK service.
6. The NAV300 does not detect objects present.	• Smoke and dust	➢ Check whether the scanner head is clean and dry.
7. The NAV300 is not transmitting a measured result.	• Wiring fault in the data connection	➢ Check wiring.
8. Frequent CRC error on the RS-232 interface.	• Data transmission time critical	➢ Increase the baud rate. ➢ Restrict scanning area. ➢ Reduce angular resolution. ➢ Reduce scanning frequency.

Tab. 21: Troubleshooting and rectification

8.4 Detailed error analysis

The NAV300 outputs occurring errors in various ways. Errors are output in stages and always permit detailed analysis:

- Communication errors can occur on the transfer of messages to the NAV300. The NAV300 then returns an error code.
- In case of status errors occurring during a scan, error codes are written to a status log.

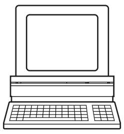
8.4.1 Querying status log

Important

- The status protocol is retained also after the device is switched off and on again.
- The NAV300 differentiates between four error types: “Information”, “Warning”, “Error” and “Serious error”. For each error type, the system saves only the last five occurrences.

Displaying log with the aid of SOPAS ET

You can display this logfile using SOPAS ET:



➢ Connect SOPAS ET to the device.

➢ Open the project tree NAV300, SERVICE, SYSTEM STATUS, Area SYSTEM STATUS.

8.5 SICK support

If a system error occurs repeatedly or if an error cannot be eliminated using the above measures, the NAV300 may be defective. The NAV300 cannot be repaired by the user, meaning that it is not possible to re-establish functions after a failure. However, the NAV300 can be rapidly replaced by the user. See **chapter 7.3 “Replacement of a system or replacement of components” on page 50**.

If an error occurs which cannot be eliminated, please contact competent SICK branch office or SICK subsidiary.

- For telephone numbers and e-mail addresses see the back page of these operating instructions.
- For the postal addresses please visit **www.sick.com**.

➢ Only return devices after consultation with the SICK service.

NOTICE

Repairs to the NAV300 should only be carried out by qualified and authorised SICK AG service staff.

9 Technical specifications

9.1 Data sheet NAV300 Laser Positioning Sensor

Feature	NAV300
Measurement range	0.5 (1.64 ft) to 35m (88.9 ft) on 10% black 0.5 (1.64 ft) to 50m (164 ft) with 20% reflection 0.5 (1.64 ft) to 100m (328 ft) with 90% reflection 0.5 (1.64 ft) to 100m (328 ft) on reflectors
Useful scanning angle	360°
Angular resolution (increment)	0.125°; selectable 0.125° - 1.5°
Scanning frequency	5 to 15 Hz ± 5% in increments of 1 Hz
Measurement resolution	3.9mm (=1/256m) (0.15in/=1/840ft)
Systematical error Distance [1)]	± 15mm (0.59in) (at 25°C (77°F)) with 20% to 90% reflection
Temperature drift typ.	0.6mm/K
statistical error Distance (1 sigma)	15mm (0.59in) with 20% to 90% reflection
Systematical error Distance by RDI! [1) 3)]	± 10mm (0.39in) (at 25°C (77°F)) on reflectors
Statistical error Distance by RDI (1 sigma)	10mm (0.39in) on reflectors
Systematical error Angle by RDI [1) 3)]	± 0.1° on reflectors
Statistical error Angle by RDI (1 sigma)	0.05° on reflectors
Beam divergence	5mrad
Laser diode (wavelength)	Infrared light (λ = 905nm)
Puls frequency	Max. 14.4kHz (10.8kHz with mean across 360°)
Laser class	Class 1 (to EN/IEC 60825-1), eye safe
RS-232/422 data interface	4.800; 9.600; 19.200; 38.400; 57.600; 115.200 Bd
Data format	8 data bits, 1 stop bit, no parity, fixed output format
CAN data transfer rate	10 Bit/s to 1 Mbit/s, max. cable length 30m (98.4ft)
Ethernet data interface	10 Mbit/s, TCP/IP
Operating voltage	DC 24 V ± 15% / IEC 364-4-41 (VDE 0100 Part 410)
Power consumption	When switched on: max. 35W (1.5A) at 24V DC, peak at start-up 2.1A
EMC-Test	As per EN 61000-6-2 / EN 61000-6-3
Housing	Die-cast aluminium
Protection class	IP 65 (to DIN 40 050)
Vibration test	Acc. to EN 60068-2-6
Weight	Approx. 2.4kg (approx. 5.28lb)
Operating/storage temperature	0 to +50°C (+32 to 122°F) / -20 to +80°C (-4 to 176°F)
Max. rel. humidty	5 to 85%, non condensing

[1)] Condition: Laser spot completely on the object, warming-up time of 30min has been elapsed

[2)] when operated without short range suppression

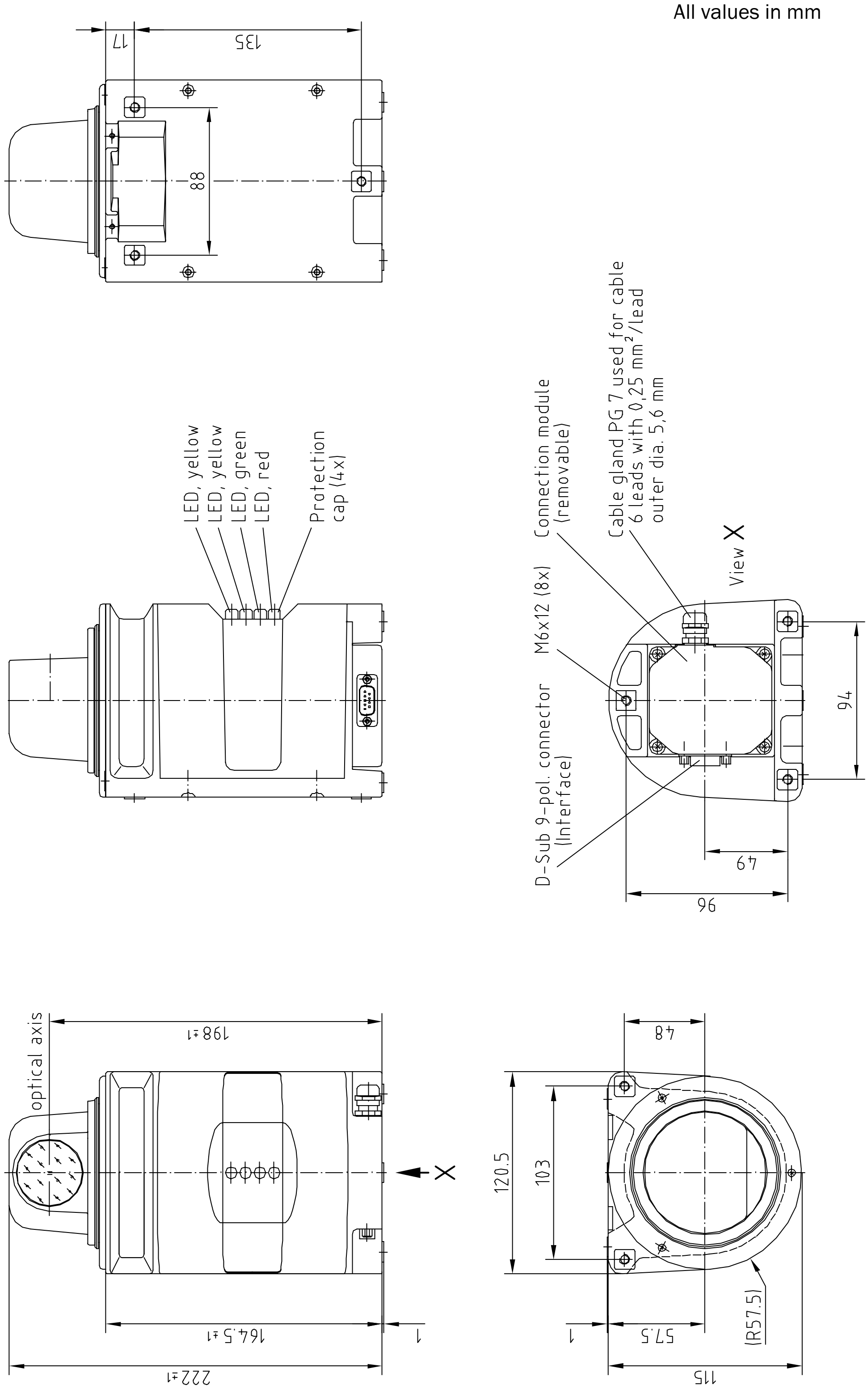
[3)] By the Reflector-Data-Interface (RDI), the NAV300 generates an image of its current reflector environment within one revolution of the scanner head. The NAV300 measures a maximum of 32 visible reflectors at this time and determines the reflector co-ordinates relative to its own position (local co-ordinate system) by processing several single measurements on each reflector. The technical data are valid for a reflector width of 80mm.
The RDI enables the vehicle computer of the AGV to directly access the coordinates measured by the NAV300. The vehicle computer can evaluate a AGV position from this direct access using its own algorithms.
General note:
For the settings of angle, scanning frequency and scanning sector, the following limits are applicable: mean pulse frequency over a max. 360° scan angle must not exceed 10.8 kHz. The maximum pulse frequency must not exceed 14.4 kHz. The minimum time between 2 laser pulses is 70 µs (= 14.4 kHz).

Tab. 22: Data sheet NAV300 Laser Positioning Sensor

9.2 Dimensional drawings

9.2.1 Dimensional drawing NAV300

All values in mm

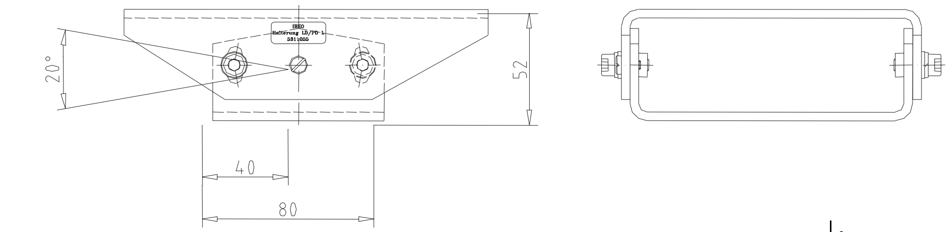


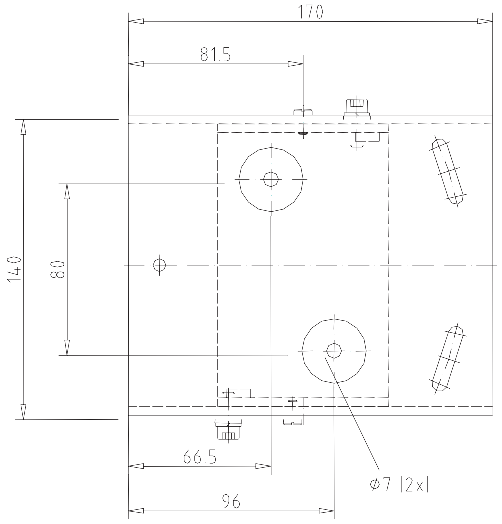
mm	in
0.25	0.01
1	0.04
5.6	0.22
17	0.67
48	1.89
49	1.93
57.5	2.27
88	3.47
94	3.70
96	3.78
103	4.06
115	4.53
120.5	4.75
135	5.32
164.5 ±1	6.48 ±0.04
198 ±1	7.80 ±0.04
222 ±1	8.75 ±0.04

Fig. 26: Dimensional drawing NAV300

9.2.2 Dimensional drawing bracket for NAV300

All values in mm





mm	in
∅ 7	∅ 0.28
40	1.58
52	2.05
66.5	2.62
80	3.15
81.5	3.21
96	3.78
140	5.52
170	6.70

Included for mounting the NAV300:

- 3 × cylinder head screws M6 × 10 (0.39 in)
- 3 locking washers
- 3 washers

Fig. 27: Dimensional drawing bracket for NAV300

10 Annex

10.1 Overview of the annexes

The annex contains the following supplementary information:

- data communication via the data interfaces
- ordering information
- glossary
- illustration containing the EU Declaration of Conformity

10.2 Data communication via the data interfaces

This chapter describes the data communication on the RS-232, RS-422, CAN and Ethernet data interface on the NAV300; communication is based on protocols.

The contents of the individual messages is described in the message listing "TLLDOEMLRSen" and „Suppl_TL_NAV300" on the CD-ROM supplied.

10.2.1 Terminology

Term	Meaning
BYTE	Without sign, 8 bits
WORD	Without sign, 16 bits
User Service	Service request to control the NAV300
User Protocol Frame (UPF)	Contains a service request comprising service code and data
UPF packet	A UPF can be divided into UPF packets. The UPF packets contain headers so that the original UPF can be assembled again
Interface packet (IF packet)	A UPF packet with information, dependent on the interface type

Tab. 23: Data communication: terminology

10.2.2 Addressing

CAN is a fieldbus system developed for the communication of several devices on a single connection. If several sensors and host computers are connected together, a mechanism must differentiate between the users on such a network. For this reason each user is allocated a unique address, the network node number (ID). A data frame sent over the network contains the network node numbers (ID) of the communication partners.

- SID source ID (identifies the sender)
- DID destination ID (identifies the recipient)

SID and DID are BYTE variables with a value between 1 and 254 (0 is reserved as the broadcast address, 255 is reserved for the application processor in the NAV300).

RS-232 is always a point-to-point connection, for this reason addressing is unnecessary. To maintain the consistency of the protocol for all interface types, addressing is nevertheless used and also evaluated on the RS-232 interface.

10.2.3 Frame format for the user protocol

Service requests and their replies are transmitted as a block of n words (WORDS), where the first word represents the service code, followed by n–1 service data words. If the service request/reply is transmitted over an external interface, the service request/reply is termed the User Protocol Frame.

User Protocol Frame	
1 WORD	n–1 WORDS
Service code	Service data

Tab. 24: Data communication: frame format

The number of data words (WORDS) that follows the service code is described indirectly by the service code itself or written in the service data. BYTE data are packed in the service data using the big endian format, this means:

Within a BYTE sequence of k BYTES (counted from 0 to k–1) the data bytes with the even ordinal numbers are written to the more significant byte and their successors to the less significant byte of the same data word.

Example:

Packing the BYTE string “Hello” in service data

WORD[1]		**WORD[2]**		**WORD[3]**	
Hi	Lo	Hi	Lo	Hi	Lo
“H”	“e”	“l”	“l”	“o”	

Tab. 25: Data communication: example for packing a BYTE string in the big endian format

10.2.4 Separation and re-assembly of packets

The communication in CAN networks is based on the exchange of data packets. The size of a data packet may vary, but is limited to a maximum size. This is:

- 4 words (WORDS) in one CAN packet (termed CAN message)
- 128 words (WORDS) in an RS-232/RS-422 packet

To transmit a user protocol frame, it is necessary to break it down into several parts. These parts are each supplemented with a header and are termed User Protocol Frame packets, or UPF packets for short. The length of a UPF packet is dependent on the interface used (see “Packet formats on external interfaces” on page 59).

The receiving node must re-assemble these packets into the original user protocol frame. Each UPF packet contains a packet header that provides information for the correct assembly of the frame.

The packet header comprises two words (WORDS):

1. Sequence Flag
   A sequence of packets is a number of UPF packets that contain data on the same user protocol frame. The sequence flag marks the first packet in a sequence of packets; the other packets do not have a sequence flag.
2. Packet ID
   The packet ID for the first UPF packet contains the number of packets necessary to complete the actual frame (including the first packet). Each subsequent packet in this

sequence has a packet ID value the same as the packet ID value for the previous packet, reduced by the value 1. For this reason the last packet in the sequence has the packet ID value 1.

Packet header		Packet data
Sequence Flag	Packet ID	
FFFFh	0002...FFFFh	

Tab. 26: Data communication: header format for the first UPF packet in a packet sequence

Packet header	Packet data
Packet ID	
0001...FFFEh	

Tab. 27: Data communication: header format for the following UPF packets in a packet sequence

Exception:

If a user protocol frame fits completely in only one packet, the sequence flag is suppressed and the packet ID has the value 0.

Packet header	Packet data
Packet ID	
0000h	

Tab. 28: Data communication: header format for a UPF packet sequence comprising a single packet

Example for the breakdown:

Frame	k, n	Meaning
1. frame: complete in 1 packet	k = 0	Frame data, single packet
2. frame: complete in 1 packet	k = 0	Frame data, single packet
3. frame: broken down down into 4 packets	n = FFFFh, k = 4	Frame data, first packet
3. frame (continued)	k = 3	Frame data, second packet
3. frame (continued)	k = 2	Frame data, third packet
3. frame (continued)	k = 1	Frame data, last packet
4. frame: complete in 1 packet	k = 0	Frame data, single packet
n is the value of the sequence flag, k is the packet ID value		

Tab. 29: Data communication: example for the packet breakdown

10.2.5 Packet formats on external interfaces

To be able to send a UPF packet to an interface, it must be inserted in an interface packet (IF packet). The header format for an IF packet is different for the RS-232/RS-422, Ethernet and CAN interface, individual packet sizes vary and the characteristics of the interface must be taken into account. One CAN message corresponds to the IF packet.

A common feature of all external interfaces is the mechanism for the separation and re-combination of packets. With the Ethernet interface, this is taken care of by the Ethernet controller.

10.2.6 Packet transmission via RS-232/RS-422

The IF packet format for the serial interface is structured as follows:

Word	Contents	Meaning
0	SID	Source address (more significant BYTE)
	DID	Target address (less significant BYTE)
1	LEN	Number of data words that follow, including CRC (max. 126)
2 to LEN	DATA	UPF packet data, including packet header (max. 125 words), see chapter *10.5.4 Separation and re-assembly of packets, page 10-6*
LEN + 1	CRC	Checksum, directly after the packet data

Tab. 30: RS-232/RS-422 interface: IF packet format

The 16-bit CRC value is calculated over all words (WORDS) (from SID to the last data word), except the CRC word itself. A “C” code example for the checksum calculation is given in **““C” code example for the CRC calculation (RS-232/RS-422)” on page 63**. The polynomial used for the CRC generator is 1021h:

$g(x) = x^{16} + x^{12} + x^{5} + 1$

The start value for the CRC is FFFFh.

All data values in an RS-232/RS-422 frame are transmitted as hexadecimal ASCII, the hexadecimal numbers Ah to Fh are coded using upper or lower case. The CRC value is calculated before the ASCII coding.

Example:
The decimal data word value 41853 is the hexadecimal A37Dh. As a result the four ASCII letters “a37d” are transmitted. The byte sequence is 61h 33h 37h 64h.

The IF packet is transmitted in the big endian format: The more significant byte is transmitted first. The packet starts with an STX (02h) and ends with an ETX (03h).

A complete IF packet for the RS-232/RS-422 interface contains max. 514 bytes.

Byte number	Meaning	Number of bytes
0	STX	1
1	SID	2
3	DID	2
5	LEN	4
9	DATA	LEN × 4
...	...	...
(LEN × 4) + 9	CRC	4
(LEN × 4) + 10	ETX	1

Tab. 31: RS-232/RS-422 interface: number of bytes in the complete IF packet

Transmission control:

The host can send the control character XON (11h)/XOFF (13h) to signal to the NAV300 that is is not allowed to send data (XOFF) or is allowed to send (XON). These control characters are not sent by the NAV300.

RS-232/RS-422 communication parameters

The data format is fixed: 8 data bits, 1 stop bit, no parity

Possible baud rates are:

- 4800 Bd
- 9600 Bd
- 19200 Bd
- 38400 Bd
- 57600 Bd
- 115200 Bd

Error handling

If an overflow or checksum error occurs while the NAV300 is receiving a packet, it send an NAK (15h) to the host to indicate that the actual packet will be ignored and the actual frame will be discarded.

10.2.7 Packet transmission via Ethernet

Structure of the UPF packet in the user service protocol

The structure of the UPF packet in the UPS (User Protocol Service) is given in the following. Service code and service data are the same as the format described in the message listing “TLLDOEMLRSen”.

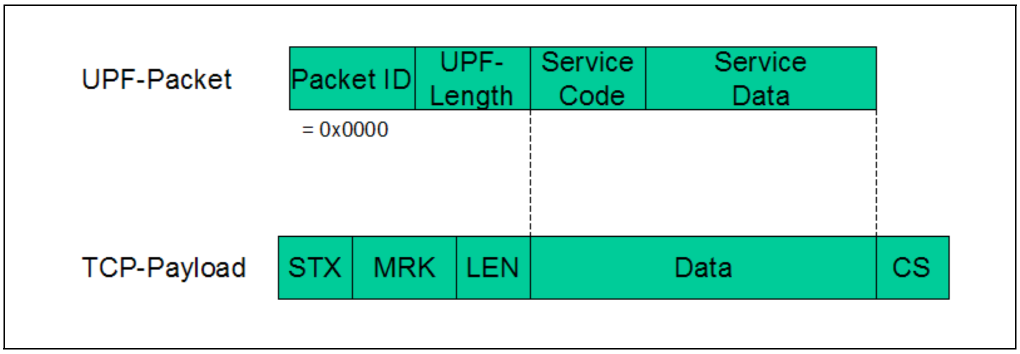


Fig. 28: Structure of the UPF packet in the user service protocol

STX “Start of text”, is transmitted as a single byte, 02h.

MRK Definition of the transmission format “UPS” = 55h, 53h, 50h (3 bytes)

LEN UPF-Length = The number of bytes that follow in <data> is coded as a 32-bit integer (four bytes) without a sign; the most significant byte must be transmitted first.

CS Checksum, is a single byte that is calculated using an exclusive OR operator on all bytes in “Data”.

10.2.8 Packet transmission via CAN

In CAN networks the data transmitted (CAN messages) have a unique identifier. Because the message identifier is used directly in the bus arbitration process, different nodes must not send a message with the same identifier, as the message identifier indirectly identifies the source node.

The last 8 significant bits of the CAN message identifier contain the host ID for messages that the host has sent. They contain the NAV300 ID for messages that the NAV300 has sent.

Identifiers used by the host are coded in the following manner:

TxHostCanId = TxHostCanBaseId BITOR SID

Identifier used by the NAV300 are coded in the following manner:

TxSensorCanId = TxSensorCanBaseId BITOR SID

TxHostCanBaseId and TxSensorCanBaseId are 11-bit identifier base values and configurable parameters.

A CAN message corresponds to one IF packet and comprises:

- identifier
- data block length code
- user data, max. 8 Bytes (incl. packet header and packet data)

The error monitoring is performed by the hardware in the CAN controller. This adds a CRC to the CAN message during transmissions and checks the CRC during reception. The polynomial used makes possible very reliable error monitoring such that a CAN message received can be assumed to be error-free.

CAN packet transmission

For the CAN communication the header in the UPF packet is expanded to add the destination node address (DID) and a reserved byte for the word alignment. Sequence flag, DID and the reserved byte are only sent in the first packet in a packet sequence. The packet header in all other packets in a packet sequence only contains the packet ID.

Packet header				**Packet data**
WORD	WORD	WORD		WORD
Sequence Flag	Packet ID	Reserved	DID	
FFFFh	0002...FFFFh	0	1...FFh	

Tab. 32: CAN interface: format of the first UPF packet in a packet sequence

Packet header	**Packet data**
WORD	Max. 3 WORDS
Packet ID	
0001...FFFEh	

Tab. 33: CAN interface: format of the following UPF packets in a packet sequence

Exception:

If a user protocol frame fits completely in only one packet (a UPF packet contains max. 2 data words), the sequence flag is suppressed and the packet ID has the value 0.

Packet header			**Packet data**
WORD	WORD		Max. 2 WORDS
Packet ID	Reserved	DID	
0000h	0	1...FFh	

Tab. 34: CAN interface: format for a single packet sequence

CAN communication parameter

The NAV300 uses standard identifiers (11 bits, CAN 2.0A), the parameters for the bit timing for different baud rates are:

Baud rate	Nominal bit time	Length of the time quantum (T_q)	TSEG1 [T_q]	TSEG2 [T_q]	SJW [T_q]	Sample Point
1 MBit/s	1 µs	50 ns	15	4	2	15 T_q, 800 ns
500 kBit/s	2 µs	100 ns	16	3	1	17 T_q, 1.70 µs
250 kBit/s	4 µs	250 ns	13	2	1	14 T_q , 3.5 µs
125 kBit/s	8 µs	500 ns	13	2	1	14 T_q, 7 µs
50 kBit/s	20 µs	1.25 µs	13	2	1	14 T_q, 17.5 µs
20 kBit/s	50 µs	2.5 µs	16	3	1	17 T_q, 42.5 µs
10 kBit/s	100 µs	6.25 µs	13	2	1	14 T_q, 87.5 µs

Tab. 35: CAN communication parameter: timing parameter

Error handling

The actual packet is ignored and the frame discarded if …

- an overflow occurs.
- a packet has an incorrect packet ID.

10.2.9 "C" code example for the CRC calculation (RS-232/RS-422)

Example C code to calculate a CRC sum:

```
/*
******************************************************************************
Project:        generic project
File:           crc16c.c
                CRC16 calculation
Version:        V0.0.1
Date:           20.09.1998
******************************************************************************
Abstract:
  routines for calculating a 16 bits CRC signature using the generator
  polynom x^16 + x^12 + x^5 + 1 as recommended by the ITU.T V.42
  (former CCITT); all routines use a table driven algorithm
---------------------------------------------------------------------------
Modification History:
0.0.1   20.09.1998
        created
******************************************************************************/
#define CRC16C_C
// includes
#include "cpu-dep.h"
//
=================================================================
// local scope defines
// (global scope in seperate header file: this_file.h)
//
=================================================================
// local scope macros
// (global macros in seperate header file: this_file.h)
```

```
//
=====================================================================
// local scope type definitions
// (global scope in seperate header file: this_file.h)
//
=====================================================================
// local scope prototype declarations (type modifier: PRIVATE)
// (global scope in seperate header file: this_file.h)
//
=====================================================================
// global scope global variable definitions (type modifier: PUBLIC)
//
=====================================================================
// local scope global variable definitions (type modifier: PRIVATE)
// XOR table for CRC algorithm, CRC-16, ITU.T X.25
// polynomial: h1021
PRIVATE const WORD crctab[256] =
  {
    0x0000, 0x1021, 0x2042, 0x3063, 0x4084, 0x50a5, 0x60c6, 0x70e7,
    0x8108, 0x9129, 0xa14a, 0xb16b, 0xc18c, 0xd1ad, 0xe1ce, 0xf1ef,
    0x1231, 0x0210, 0x3273, 0x2252, 0x52b5, 0x4294, 0x72f7, 0x62d6,
    0x9339, 0x8318, 0xb37b, 0xa35a, 0xd3bd, 0xc39c, 0xf3ff, 0xe3de,
    0x2462, 0x3443, 0x0420, 0x1401, 0x64e6, 0x74c7, 0x44a4, 0x5485,
    0xa56a, 0xb54b, 0x8528, 0x9509, 0xe5ee, 0xf5cf, 0xc5ac, 0xd58d,
    0x3653, 0x2672, 0x1611, 0x0630, 0x76d7, 0x66f6, 0x5695, 0x46b4,
    0xb75b, 0xa77a, 0x9719, 0x8738, 0xf7df, 0xe7fe, 0xd79d, 0xc7bc,
    0x48c4, 0x58e5, 0x6886, 0x78a7, 0x0840, 0x1861, 0x2802, 0x3823,
    0xc9cc, 0xd9ed, 0xe98e, 0xf9af, 0x8948, 0x9969, 0xa90a, 0xb92b,
    0x5af5, 0x4ad4, 0x7ab7, 0x6a96, 0x1a71, 0x0a50, 0x3a33, 0x2a12,
    0xdbfd, 0xcbdc, 0xfbbf, 0xeb9e, 0x9b79, 0x8b58, 0xbb3b, 0xab1a,
    0x6ca6, 0x7c87, 0x4ce4, 0x5cc5, 0x2c22, 0x3c03, 0x0c60, 0x1c41,
    0xedae, 0xfd8f, 0xcdec, 0xddcd, 0xad2a, 0xbd0b, 0x8d68, 0x9d49,
    0x7e97, 0x6eb6, 0x5ed5, 0x4ef4, 0x3e13, 0x2e32, 0x1e51, 0x0e70,
    0xff9f, 0xefbe, 0xdfdd, 0xcffc, 0xbf1b, 0xaf3a, 0x9f59, 0x8f78,
    0x9188, 0x81a9, 0xb1ca, 0xa1eb, 0xd10c, 0xc12d, 0xf14e, 0xe16f,
    0x1080, 0x00a1, 0x30c2, 0x20e3, 0x5004, 0x4025, 0x7046, 0x6067,
    0x83b9, 0x9398, 0xa3fb, 0xb3da, 0xc33d, 0xd31c, 0xe37f, 0xf35e,
    0x02b1, 0x1290, 0x22f3, 0x32d2, 0x4235, 0x5214, 0x6277, 0x7256,
    0xb5ea, 0xa5cb, 0x95a8, 0x8589, 0xf56e, 0xe54f, 0xd52c, 0xc50d,
    0x34e2, 0x24c3, 0x14a0, 0x0481, 0x7466, 0x6447, 0x5424, 0x4405,
    0xa7db, 0xb7fa, 0x8799, 0x97b8, 0xe75f, 0xf77e, 0xc71d, 0xd73c,
    0x26d3, 0x36f2, 0x0691, 0x16b0, 0x6657, 0x7676, 0x4615, 0x5634,
    0xd94c, 0xc96d, 0xf90e, 0xe92f, 0x99c8, 0x89e9, 0xb98a, 0xa9ab,
    0x5844, 0x4865, 0x7806, 0x6827, 0x18c0, 0x08e1, 0x3882, 0x28a3,
    0xcb7d, 0xdb5c, 0xeb3f, 0xfb1e, 0x8bf9, 0x9bd8, 0xabbb, 0xbb9a,
    0x4a75, 0x5a54, 0x6a37, 0x7a16, 0x0af1, 0x1ad0, 0x2ab3, 0x3a92,
    0xfd2e, 0xed0f, 0xdd6c, 0xcd4d, 0xbdaa, 0xad8b, 0x9de8, 0x8dc9,
    0x7c26, 0x6c07, 0x5c64, 0x4c45, 0x3ca2, 0x2c83, 0x1ce0, 0x0cc1,
    0xef1f, 0xff3e, 0xcf5d, 0xdf7c, 0xaf9b, 0xbfba, 0x8fd9, 0x9ff8,
    0x6e17, 0x7e36, 0x4e55, 0x5e74, 0x2e93, 0x3eb2, 0x0ed1, 0x1ef0
  };
//
=====================================================================
// global scope function definitions (type modifier: PUBLIC)
/*
---------------------------------------------------------------------
Function:    block_crc16_byte
```



```
Abstract:    calculates CRC16 signature of a block of bytes
Version:     1
-----------------------------------------------------------------------
Return value:
type      functional description
WORD      CRC signature
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Importlist:
type      identifier       functional description
BYTE*     data             pointer to data block
WORD      numofbytes       number of bytes in data block
WORD      initial_crc      initial CRC value
WORD[]    crctab           CRC XOR table (as global variable)
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Exportlist:
type      identifier       functional description
none
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
*/
PUBLIC WORD block_crc16_byte
 (
  BYTE*   data,
  WORD    numofbytes,
  WORD    initial_crc
 )
{
 WORD crc = initial_crc;
 while( numofbytes-- )
  crc = ( (crc << 8) | *data++ ) ^ crctab[crc>>8];
 return crc;
}
/*
-----------------------------------------------------------------------
Function:    block_crc16_word
Abstract:    calculates CRC16 signature of a block of data words (16bit)
Version:     1
-----------------------------------------------------------------------
Return value:
type      functional description
WORD      CRC signature
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Importlist:
type      identifier       functional description
WORD*     data             pointer to data block
WORD      numofbytes       number of bytes (not words!) in data block
WORD      initial_crc      initial CRC value
WORD[]    crctab           CRC XOR table (as global variable)
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Exportlist:
type      identifier       functional description
none
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
*/
PUBLIC WORD block_crc16_word
 (
  WORD*   data,
  WORD    numofbytes,
```



```
  WORD    initial_crc
 )
{
 register WORD d;
 register WORD crc = initial_crc;

 numofbytes >>= 1;
 while( numofbytes-- )
  {
   d = *data++;
   crc = ( (crc << 8) | ((BYTE)( d >> 8 ) ) ) ^ crctab[crc>>8];
   crc = ( (crc << 8) | ((BYTE)  d  ))       ^ crctab[crc>>8];
  }
 return crc;
}
/*
-------------------------------------------------------------------------
Function:    crc16_byte
Abstract:    calculates CRC16 signature of a single data byte
Version:     1
-------------------------------------------------------------------------
Return value:
type      functional description
WORD      CRC signature
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Importlist:
type      identifier        functional description
BYTE      data              data byte
WORD      initial_crc       initial CRC value
WORD[]    crctab            CRC XOR table (as global variable)
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Exportlist:
type      identifier        functional description
none
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
*/
PUBLIC WORD crc16_byte
 (
  BYTE    data,
  WORD    initial_crc
 )
{
 register WORD crc = initial_crc;

 crc = ( (crc << 8) | data ) ^ crctab[crc>>8];
 return crc;
}
/*
-------------------------------------------------------------------------
Function:    crc16_word
Abstract:    calculates CRC16 signature of a single data word (16bit)
Version:     1
-------------------------------------------------------------------------
Return value:
type      functional description
WORD      CRC signature
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```



```
Importlist:
type     identifier      functional description
WORD     data            data word
WORD     initial_crc     initial CRC value
WORD[]   crctab          CRC XOR table (as global variable)
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Exportlist:
type     identifier      functional description
none
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
*/
PUBLIC WORD crc16_word
  (
    WORD   data,
    WORD   initial_crc
  )
{
  register WORD crc = initial_crc;

  crc = ( (crc << 8) | ((BYTE)( data >> 8 ) ) ) ^ crctab[crc>>8];
  crc = ( (crc << 8) | ((BYTE)  data  ))        ^ crctab[crc>>8];
  return crc;
}

//
=================================================================
// local scope function definitions (type modifier: PRIVATE)
//
=================================================================
// EOF crc16c.c
```

Example C code to generate the CRC table used in the example above:

```
#include <stdio.h>
#define CRC_POLY 0x1021
typedef unsigned short WORD;
WORD get_crctab_val
  (
    int idx
  )
{
  WORD value;
  WORD old_val;
  int  k;
  value = ( (WORD) idx ) << 8;
  for( k=0; k<8; k++ )
    {
      old_val = value;
      value <<= 1;
      if( old_val & 0x8000 ) value ^= CRC_POLY;
    }
  return value;
}
void main( void )
{
  FILE  *out;
  WORD  value;
  int   k, i;
  out = fopen( "crctab.c", "wt" );
```



```
 if( out == NULL )
   {
     puts( "\ncannot generate crctab.c !!\n\n" );
     return;
   }
 fprintf( out, "// put header here\n\n" );
 fprintf( out, "#include \"cpu-dep.h\"\n\n" );
 fprintf( out, "// XOR table for CRC algorithm, CRC-16, ITU.T X.25\n" );
 fprintf( out, "// polynomial: h%4x\n\n", CRC_POLY );
 fprintf( out, "const WORD crctab[256] = \n" );
 fprintf( out, "  {" );
 i = 0;
 for( k=0; k<256; k++ )
   {
     value = get_crctab_val( k );
     if( i == 0 )
       fprintf( out, "\n    0x%04x,", value );
     else if( k >= 248 && i >= 7 )
       fprintf( out, " 0x%04x", value );
     else
       fprintf( out, " 0x%04x,", value );
     if( ++i >= 8 ) i = 0;
   }
 fprintf( out, "\n  };\n\n" );
 fclose( out );
}
```

10.3 Ordering information

10.3.1 Available systems

Part number	Device type	Code
1043365	NAV300-2232	Laser measurement system with maximum 360° field of view, housing with enclosure rating IP 65, data interfaces CAN, Ethernet, RS-232 (default setting)/ RS-422, 4 digital outputs

Tab. 36: Available systems

10.3.2 Available accessories

Part number	Description
6032508	RS-232 null modem cable for NAV300, 3-core, 3 m (9.84 ft), twisted-pair, screened, 15 pin D-Sub HD socket to 9 pin D-Sub socket for configuration using PC
6032509	Ethernet cross-over cable for NAV300, 3 m (9.84 ft), twisted-pair, screened, 15 pin D-Sub HD socket to 8 pin RJ-45 plug for configuration using PC
2035130	Interface adapter (spare part) for NAV300
5311055	Fixing bracket for NAV300, complete with mounting material and tools
6025934	Replacement fuse with holder T5A0, 125 V, SMD
2049145	CD-ROM “Manuals & Software NAV300”

Tab. 37: Available accessories

10.4 Glossary

Download

Transmission of the parameter set that has been modified offline in the SOPAS ET configuration software from the PC to the NAV300. SOPAS ET transmits either always a complete copy to the memory (RAM) in the NAV300 (menu COMMUNICATION, DOWNLOAD ALL PARAMETERS TO DEVICE) or only the parameter that has just been edited (menu COMMUNICATION, DOWNLOAD MODIFIED PARAMETERS TO DEVICE). With the menu NAV300, PARAMETER, SAVE PERMANENT, the parameter set is saved permanently in the flash memory of the NAV300.

Field of view α

Angle that defines the limits to which the laser beam is deflected by the polygon mirror wheel. A v-shaped area is formed radially in the scan direction in front of the laser output aperture; this area must contain the objects to be measured.

Parameter set

Data set using which the functions implemented in the NAV300 are initialised and activated. Is transmitted from the NAV300 to SOPAS ET and in the reverse direction using UPLOAD or DOWNLOAD respectively.

Remission

Remission is the quality of reflection at a surface. The basis is the Kodak standard, known worldwide in, among other areas, photography.

Scan

A scan encompasses all measured values determined referred to the scanning angle and the speed of rotation of the mirror.

SOPAS ET

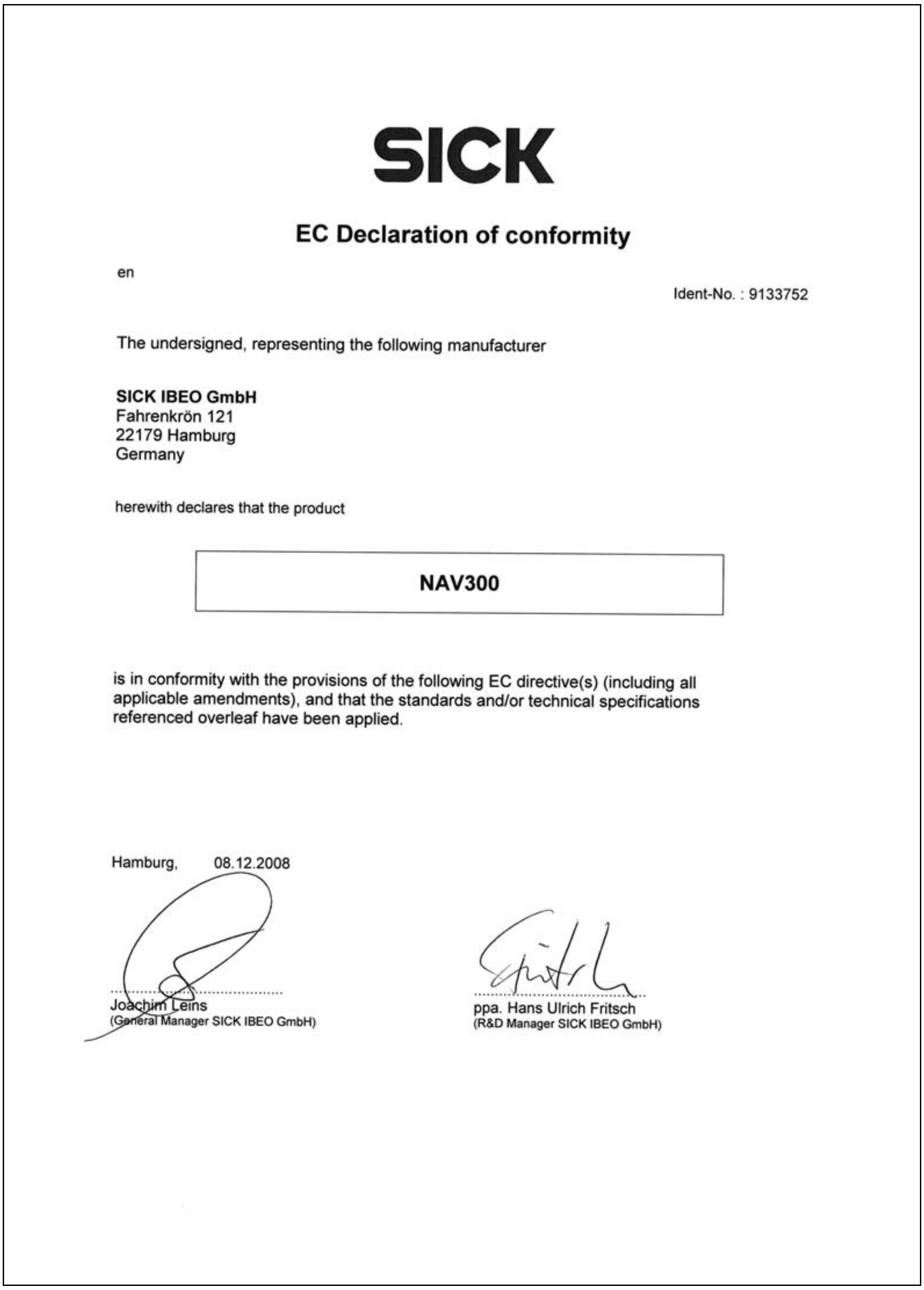
Configuration software, can be used with Windows 2000, XP or VISTA. Is used for the offline configuration (adaptation to the read situation on-site) and the online operation of the NAV300 in the dialog box.

Upload

Transmission of the parameter set from the NAV300 to the PC into the SOPAS ET configuration software. The values for the parameters are displayed on the file cards of the configuration software. Prerequisite for the modification of the current parameter set.

10.5 Illustration containing the EC Declaration of conformity

Fig. 29 shows page 1 of the EC Declaration of conformity (size reduced). The full EC Declaration of conformity is available on request.



SICK

EC Declaration of conformity

en

Ident-No. : 9133752

The undersigned, representing the following manufacturer

SICK IBEO GmbH
Fahrenkrön 121
22179 Hamburg
Germany

herewith declares that the product

NAV300

is in conformity with the provisions of the following EC directive(s) (including all applicable amendments), and that the standards and/or technical specifications referenced overleaf have been applied.

Hamburg, 08.12.2008

Joachim Leins
(General Manager SICK IBEO GmbH)

ppa. Hans Ulrich Fritsch
(R&D Manager SICK IBEO GmbH)

Fig. 29: Illustration containing the EC Declaration of conformity

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Phone +65 6744 3732
E-Mail admin@sicksgp.com.sg

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Phone +358-9-25 15 800
E-Mail sick@sick.fi

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Phone +46 10 110 10 00
E-Mail info@sick.se

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Phone +886 2 2375-6288
E-Mail sickgrc@ms6.hinet.net

Türkiye
Phone +90 216 587 74 00
E-Mail info@sick.com.tr

USA/Canada/México
Phone +1(952) 941-6780
1 800-325-7425 – tollfree
E-Mail info@sickusa.com

More representatives and agencies in all major industrial nations at **www.sick.com**

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