Acuity AR2000 Series

Laser Distance Meters
Operation and Specification Manual

LLL002001 Rev. 3.2

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Acuity AR2000 Series Laser Distance Meters Operation and Specification Manual

LLL002001

Manual Revision # 3.2

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Corporate Offices

2765 NW Nicolai St.

Portland, OR 97210 USA

sales@acuitylaser.com

Tel: +1 503.227.7908

Fax: +1 503.223.1258

www.acuitylaser.com

Signs, abbreviations and references

	Important note
	The **Caution** sign warns against dangers to health which may occur if this advice is not observed.
	The **Attention** sign warns against possible damage to the device.
	The **Attention** sign warns against possible damage to the device.
	This sign indicates that special environmental protection guidelines must be observed when disposing of the device.

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1. GENERAL INFORMATION

The laser distance sensors of the AR2000 series have been designed for applications in industrial facilities.

Within the measuring range of 15 cm to 500 meters the sensors work with a high accuracy of up to +/- 1 mm and at an adjustable measuring frequency of up to 100 Hz.

Due to the excellent optical measuring performance of the AR2000, the sensors can be used both indoors and outdoors, even in bright light. Moreover, they can be used for measuring very hot surfaces such as glowing steel.

When large distances of more than 50 meters need to be measured, the sensor can be used in combination with a reflector. Simple assembly and standard interfaces enable the quick integration of the device into complex measuring and control systems. Data can be displayed and parameters can be set using an internal keypad and display or an external communication program.

2. SAFETY ADVICE

The safety and operating advice must be read carefully and be observed when using the measuring module.

2.1 Basic safety advice

Please read the safety and operating advice carefully, and observe the advice when operating the AR2000 laser distance measurement device.

⚠	**Danger, laser radiation** The AR2000 must not be opened unauthorized, otherwise laser radiation can be emitted that can cause injuries to the eyes. Please observe all information and guidelines for operating the laser.
⚠	**Danger, electric shock** The AR2000 may only be opened for repair purposes by the manufacturer. If the device is opened arbitrarily without authorization, all warranty claims will be voided.
⚠	The operating and storage conditions (see chapter 3) have to be observed. The non-observance of this advice and the adverse use of the device can lead to injuries of the user or to damage of the device.
⚠	Connectors may not be plugged or unplugged when voltage is applied. All installation work may only be carried out when no voltage is applied.

The device may only be operated as intended and in faultless condition.

Safety installations must not be rendered ineffective.

Safety and warning signs must not be removed.

2.2 Protection Rating

In accordance with the protection rating IP67, the AR2000 is protected against water spray, dust, and against short term submersion into water.

When operating the device under extreme outdoor environmental conditions, the use of additional weather protection is recommended (eg. enclosure with the window sealed to the laser sensor). Rapid temperature changes can lead to humidity entering the device. If the device is exposed to humidity, the temperature difference between the device and the environment may be ± 5°C maximum.

⚠	The device is not shatter-proof. Do not let the device fall to the ground, and avoid any vibration for best results.
⚠	The device should not be used in explosive environments to prevent the danger of damage to the AR2000 and the surrounding equipment, and injuries to the user.

2.3 Laser Class

⚠	Based on the standard EN 60825-1:2007 the AR2000 is in correspondence with laser Class 2. When looking into the laser beam accidentally and for a short moment, the eye will be protected by the eye reflex and blinking. The eyelid closing reflex can be affected by pharmaceuticals, alcohol and other substances.

2.4 Transport and Storage

The AR2000 laser distance sensor is delivered in standard packaging. All kinds of transport are permitted. It is recommended to store the unit inside the transport packaging until it is used. Please observe the storage conditions.

2.5 Cleaning and Maintenance

The AR2000 does not require any maintenance. To ensure trouble-free measurements, the optical surfaces through which the laser beam exits and enters must be free of deposits. Dust can be removed using an airbrush. In case of dirt that is hard to remove, please contact the manufacturer.

The device must not be cleaned using solvents or mechanical tools.

Mechanical or electrical modifications of the device are not permitted.

2.6 Service

In case repair work is necessary, please contact us for Return Authorization before shipment:

Acuity Service
Schmitt Measurement Systems, Inc.
2765 NW Nicolai St.
Portland, OR 97210 USA

If you have any questions, please contact us:
Tel: +1 503.227.7908
Fax: +1 503.223.1258
Email: sales@acuitylaser.com

3. INTENDED USE

3.1 Operating and storage conditions

Operating temperature[1]:	- 10°C to + 60°C (special type – 40°C to + 60°C)
Storage temperature:	- 40°C to + 70°C
Humidity:	15 % to 90 %, non-condensing

[1] Dependent on the type of device;

Explanation: The values specified as operating temperature describe the temperature range in which the AR2000 can be used according to the specification. The operating temperature refers to the internal temperature of AR2000 and could be approx. 10°C above the ambient temperature (see EN 60204-1).

> ⚠ If AR2000 operates near the upper limit of temperature range (ambient temperature > 40 °C), the probability of measuring errors will be increased. A permanent operation of AR2000 at higher temperatures (ambient temperature > 40 °C) shortens the life time of the sensor.

> ⚠ For permanent operation of AR2000 it is recommended not to exceed an operation temperature of 50 °C, which correlates to a maximum ambient temperature of 40 °C.

3.2 Improper use and possible error sources

- The unit may be used only as prescribed.
- Please do not remove any labels and type plates.
- Repair work must not be performed by the user. In case of questions or doubts, the manufacturer is to be consulted. For contact data see section 2.4.
- In order to obtain correct measuring values the following advice is to be observed:

  1. Measurements against the sun or onto surfaces with low reflectivity in very bright environments can result in faulty measurements.

  2. Measurements through glass, optical filters, Plexiglas or other translucent materials are possible to a limited extent but can result in measurement errors.

3.3 Warning signs and type plate

Laser label

The AR2000 operates with a class 2 laser.

When looking into the laser beam accidentally and for a short moment, the eye will be protected by the eyelid-closing reflex.

The eyelid-closing reflex can be affected by pharmaceuticals, alcohol and drugs.

This device may be used without any additional safety precautions when the following advice is observed:

  • Do not look directly into the laser beam.
  • Do not look at the laser beam using optical instruments.
  • Do not point the laser beam at other people

Type plate

The type plate shown is an example. Type (PN) and serial number (SN) may differ from this image.

```
Type:  AR2000                      CE
YOM:  2013
SN:  130004
Power:  10... 30VDC, max. 10W
Op.-temp:  −10°C...+60°C
IP67
```
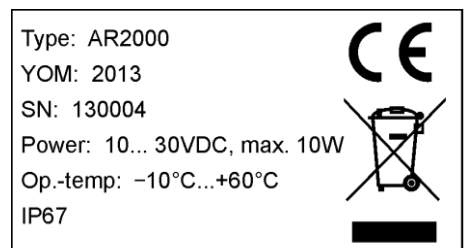
4. DEVICE DESCRIPTION

4.1 General Information

- The AR2000 distance meter is available in different versions. Types can be selected based on the required interface and on the temperature conditions at the place of application.
- AR2000 "heater" versions are designed for an operating temperature of as low as – 40°C and can be used for applications outdoors or in refrigerated warehouses.
- The required connecting cables are available with straight and angular plug-in connectors.
- In order to prevent the direct incidence of extraneous light into the device optics, an optional light protector "sun screen" is available that can be screwed onto the device.
- Devices with a cable length of up to 10m are demonstrably EMC-safe.

4.2 Scope of delivery

The AR2000 device versions and accessories are available under the following part numbers:

Designation	Part No.	Remarks
AR2000	APL222101	RS232/ RS422/ RS485
AR2000	APL222102	SSI + RS232/ RS422/ RS485
AR2000	APL222103	Profibus + RS232/ RS422/ RS485
AR2000	APL222104	SSI + Profibus + RS232/ RS422/ RS485
AR2000 +Heater	APL222141	Temperatures down to – 40°C |RS232/ RS422/ RS485
AR2000 +Heater	APL222142	Temperatures down to – 40°C |SSI + RS232/ RS422/ RS485
AR2000 +Heater	APL222143	Temperatures down to – 40°C |PB DB + RS232/ RS422/ RS485
AR2000 +Heater	APL222144	Temperatures down to – 40°C |SSI + PB DB + RS232/ RS422/ RS485
Cables and connectors	**Part No.**	**Remarks**
Device cable, 2m	APL024144	2 meter cable with connector for the AR2000 laser with bare wires on one end.
Device cable 5m	APL024145	5 meter cable with connector for the AR2000 laser with bare wires on one end.
Device cable, 10m	APL024146	10 meter cable with connector for the AR2000 laser with bare wires on one end.
Device cable, 2m, angular	APL024110	2 meter cable with 90 degree connector for the AR2000 laser with bare wires on one end.
Device cable, 5m, angular	APL024111	5 meter cable with 90 degree connector for the AR2000 laser with bare wires on one end.
Device cable, 10m, angular	APL024112	10 meter cable with 90 degree connector for the AR2000 laser with bare wires on one end.
SSI cable, 2 meter	APL024101	2 meter cable for the SSI Output
Profibus in/out cable, 5m	APL024170	5 meter cable In/Out for the Profibus cable
Profibus in cable jack, 5m	APL024165	5 meter cable In for the Profibus cable
Profibus in cable jack, 10m	APL024166	10 meter cable In for the Profibus cable
Profibus out cable plug, 5m	APL024160	5 meter cable Out for the Profibus cable
Profibus out cable plug, 10m	APL024161	10 Meter cable Out for the Profibus cable
Profibus female connector protective cap	APL094366	Screw cap for Profibus jack
Profibus male connector protective cap	APL094363	Screw cap for Profibus plug

Device Description

Profibus terminating resistor M12	APL094145	Profibus Terminator, M12
Profibus 5-pin female connector	APL094136	Profibus 5-pole jack
Profibus 5-pin male connector	APL094133	Profibus 5-pole plug
AR2000 Sun Screen	APL025012	Sun Screen tube for the AR2000 Laser
Reflective tape 3M 3279 special	TBD	300x300mm; measurements from as low as 0.5m

Additional Device Cable options:

The following chart shows cable exit orientation options with regard to the sensor when installed

Laser Emission

Cable Exit Direction
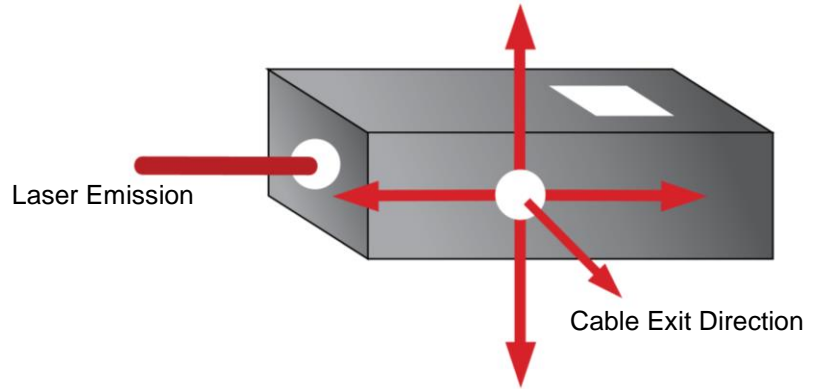
Direction	Cable exit	Cable Length	Part Number
↑	Rt-angle connector 0 deg. orientation	2m	APL024110-0
		5m	APL024111-0
		10m	APL024112-0
		15m	APL024113-0
→	Rt-angle connector 90 deg. orientation	2m	APL024110-1
		5m	APL024111-1
		10m	APL024112-1
		15m	APL024113-1
↓	Rt-angle connector 180 deg. orientation	2m	APL024110-2
		5m	APL024111-2
		10m	APL024112-2
		15m	APL024113-2
←	Rt-angle connector 270 deg. orientation	2m	APL024110-3
		5m	APL024111-3
		10m	APL024112-3
		15m	APL024113-3
↘	Straight out connector	2m	APL024144
		5m	APL024144
		10m	APL024144

4.3 Mechanical Installation

The AR2000 can be screwed on using 3 (underside) or 2 M6 fastening screws respectively (length to be chosen depending on the mounting piece). 3 M6 fastening screws plus washers and washer springs are included in the scope of delivery**.**

The zero point for measurement is the front face of the laser's housing.
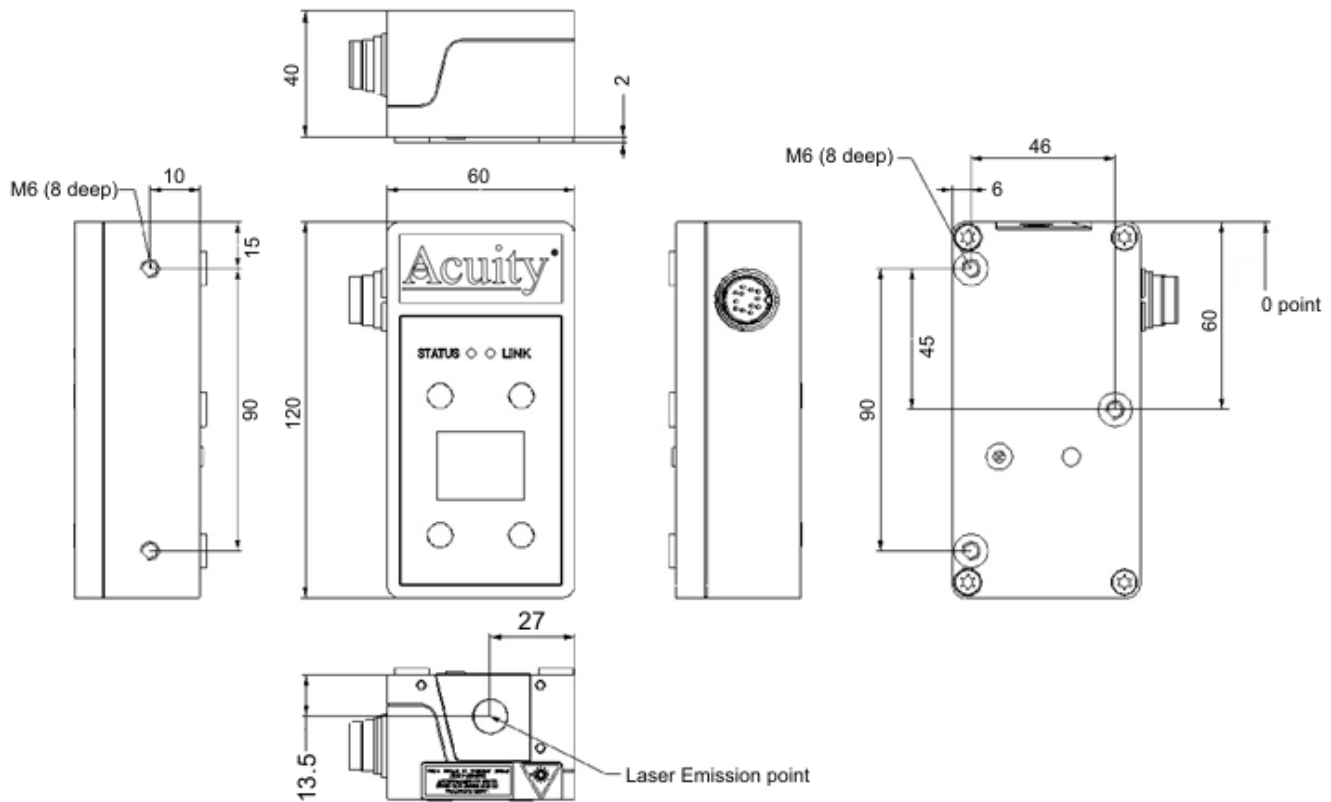
Figure 1. AR2000 dimensions

4.4 Device cable connector pin assignment

PIN	Color code	RS232	RS422	RS485	Description
A	White	RxD	Rx+	n.c.	RS232 received data /RS422 received data+
B	Brown	n.c.	Rx-	n.c.	RS422 received data-
C	Green	TRIG	TRIG	TRIG	Trigger input/output
D	Yellow	QA	QA	QA	Analog output (3mA…21 mA)
E	Grey	n.c.	Tx-	B	RS422 transmitted data-
F	Pink	TxD	Tx+	A	RS232 transmitted data /RS422 transmitted data+
G	Blue	Q3	Q3	Q3	Q3 switching output
H	Red	VCC	VCC	VCC	Supply voltage 10… 30 V DC
J	Black	GND$_{power}$	GND$_{power}$	GND$_{power}$	Ground supply voltage
K	Violet	Q2	Q2	Q2	Q2 switching output
L	Grey/pink	GND$_{signal}$	GND$_{signal}$	GND$_{signal}$	Ground measurement for the analog signal
M	Red/blue	Q1	Q1	Q1	Q1 switching output
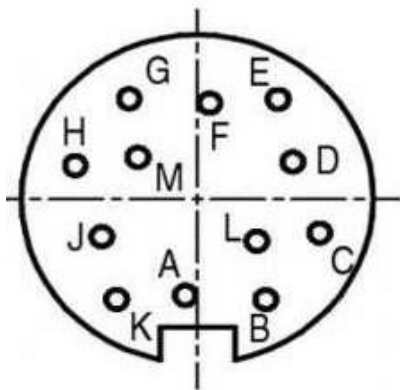
The shield of the device cable is to be connected to the shield connector of the equipment, e.g. PLC.

Open, unused cable wires must be insulated.

☞	Inverse polarity protection is provided.
☞	Overvoltage protection is provided up to a maximum of 30 V DC.
!	Open, unused cable wires must be insulated.

Figure 2. Cable box pin assignment, view from above on the device

Device Description

4.5 Serial Interface RS232

The serial interface RS232 can be used for
- Measured data transmission
- AR2000 parameterization
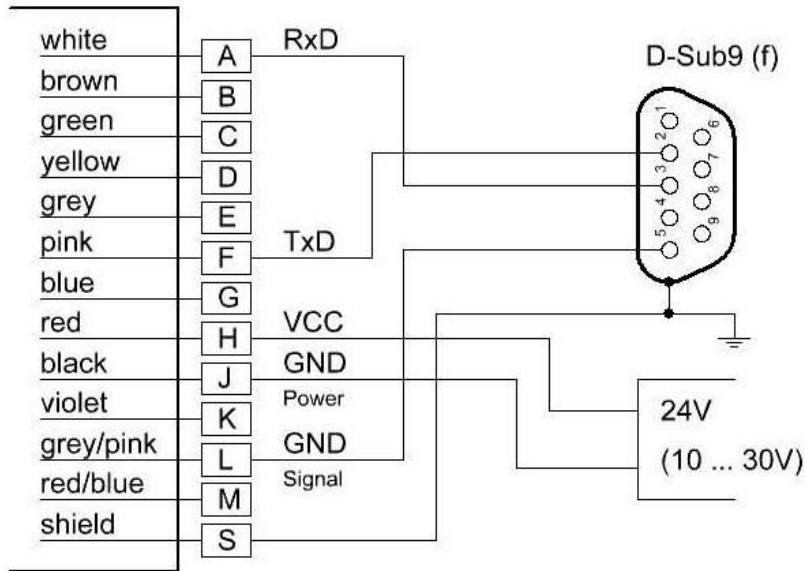
Figure 3. Wiring of serial interface RS232

4.6 Serial Interface RS422
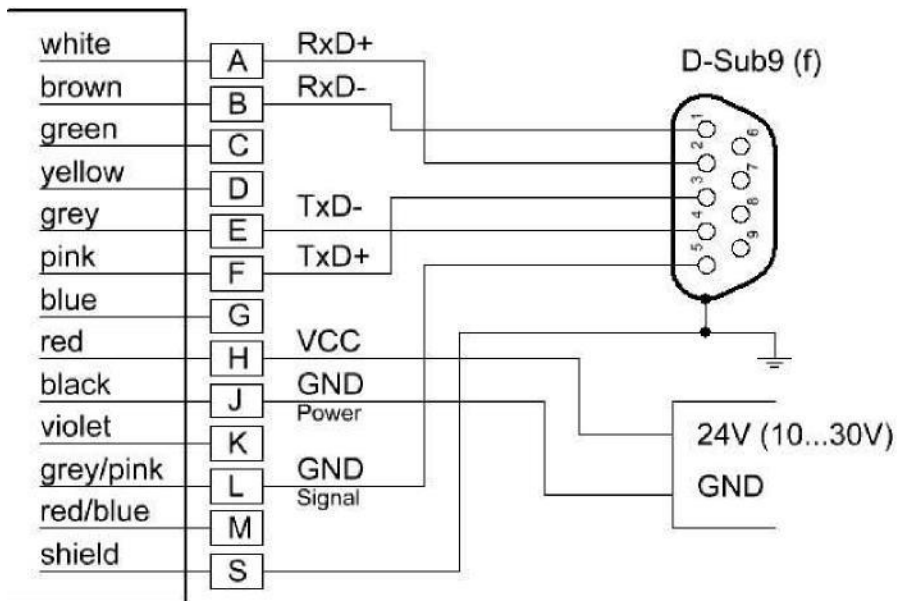
Figure 4. Wiring of serial interface RS422

4.7 Serial interface RS485
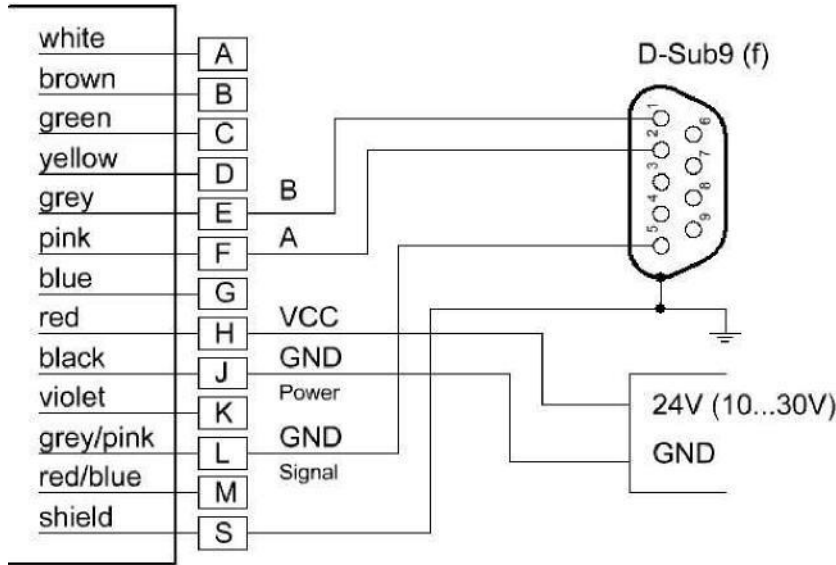
Figure 5. Wiring of serial interface RS485

4.8 Laser Beam Spot Specifications

The laser beam of the AR2000 has a divergence of 0.13 mrad x 0.17 mrad (width x height).

The diameter of the laser spot on the exit lens measures 4 mm.

The table below shows the size of the laser spot in relation to the distance from the target. The laser spot has an elliptical shape.

Distance	Laser spot width	Laser spot height
1m	5mm	5mm
5m	3mm	3mm
10m	4mm	5mm
50m	6mm	7mm
100m	26mm	34mm
200m	52mm	68mm
400m	104mm	136mm
500m	130mm	170mm

The above-mentioned laser spot holds approximately 50% of the entire laser energy. An aura with less energy forms around that spot.

4.9 SSI - Synchronous Serial Interface

> ⚠ SSI will be parameterized via serial interface or the internal display of the AR2000.

SSI data interface is optional for the AR2000 (please see the sensor types and order numbers in chapter 4.2). At the request of a SSI clock the AR2000 starts output of measuring values and sends the data bit by bit from the shift register of the AR2000 (Slave) to an external controller (Master).

It could be used for all measuring modes of AR2000. The active measurement mode will be set via serial interface or the internal display.

Setup via serial interface - see chapter 6.4.23 SSI and 6.4.17 SE

Setup via internal display - Parameters / BUS / SSI / SSI mode

SSI works independently of the Profibus interface.

Transmission rate	150 kHz … 300 kHz
Break duration	minimum 25 µs (between 2 bit sequences)
Data length	24 bit or 25 bit (programmable)
Format	binary code or gray code (programmable)

Bit string:

1) Data length 24 bits → bit 23 – 0 = data string

Bit	23	22 – 1	0
	MSB		LSB

2) Data length 25 bits → bit 24 = error bit , bit 23 – 0 = data string

Bit	24	23 – 1	0
	MSB = error bit		LSB

The inputs (CLOCK) are galvanic isolated, the potential separation is realized up to 500V. To ensure undisturbed data transfer paired twisted wires are required.

Clock rate	Cable length
< 300 kHz	< 100 m
< 250 kHz	< 150 m
< 200 kHz	< 200 m
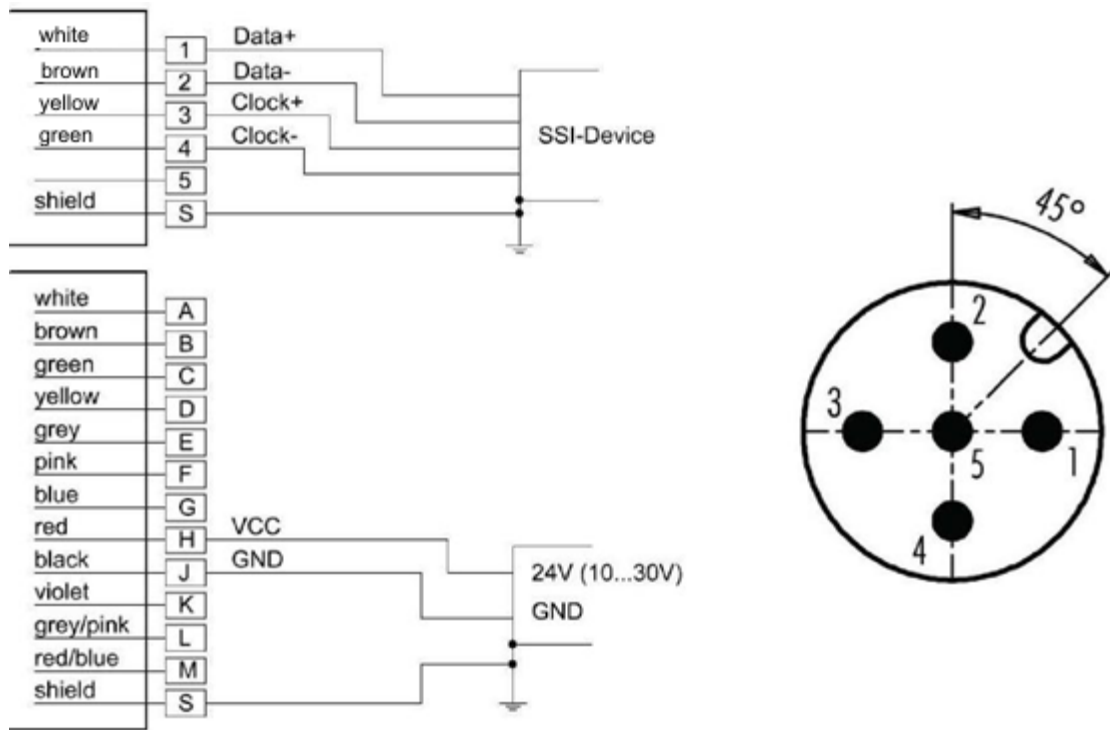
Figure 6. Wiring of SSI and cable jack pin

The measuring mode will be defined with command AUTOSTART AS.

Please note that when using the parameter measurement window MW (chapter 6.4.6) and / or offset OF (chapter 6.4.9) the distance output value has to be in the positive range (distance value > 0). Otherwise the SSI output will be 000000.

4.10 Profibus Interface

Please see detailed Profibus information in chapter 8
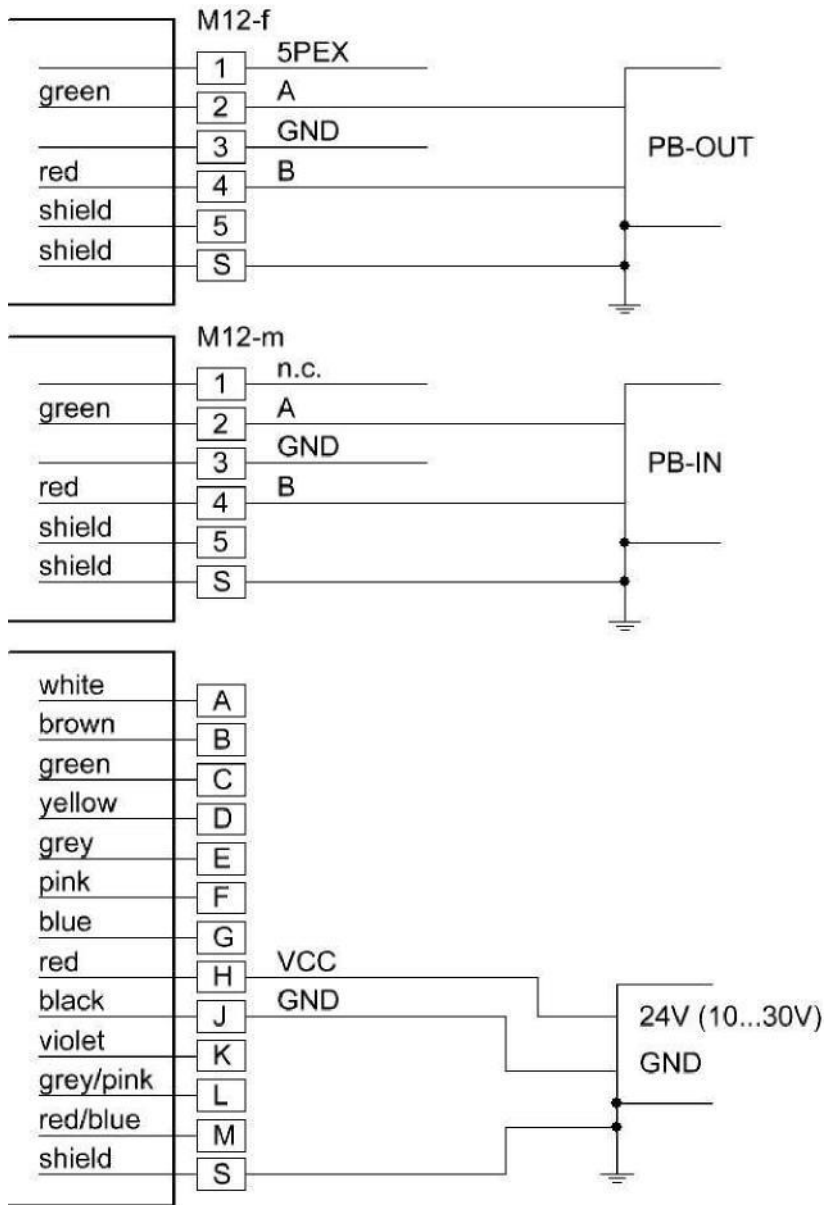
Figure 7. Wiring of Profibus Interface

5. INSTALLATION AND COMMISSIONING

5.1 Mechanical installation conditions

There are two different ways to install the AR2000 laser distance meter.

3 M6 socket cap screws are included in the scope of delivery.

1. Fastening through one of the side faces

Two M6 screws + washer spring + washer

2. Fastening through the housing bottom

Three M6 screws + washer spring + washer

3. Cable connections

In order to ensure variability in the application of the device, connecting cables with straight or angular connectors are available (also see chapter 4.2).

The cables are not included in the scope of delivery. Please order them as required.

4. Attaching the light protector (optional)

An optional light protector is available for application in very bright environments.

Part number: APL025012 The light protector is attached to the front face (laser beam emission point) using three M3x6 screws.

The screws are included with the extra Sun Screen.

> [!] When the device is used outdoors under extreme environmental conditions, an enclosure is recommended. Otherwise, moisture may enter the device despite the IP 67 rating due to rapid temperature changes.

5.2 Commissioning

5.2.1 Preparatory work prior to installation

- Remove the packaging of the AR2000.

- Check the delivery for completeness.

- Examine the device and the accessories for damage.

- Examine the connections and cables for damage.

5.2.2 Installation work checklist

The following table suggests a commissioning procedure for the AR2000, without claiming to be exhaustive. The user is responsible for the application-specific cabling and for the parameterization of the Profibus (optional), particularly of the slave address. Thus, the latter are taken as a given.

When the AR2000 is taken into operation for the first time, we recommend carrying through the configuration steps at a laboratory or office.

The device can be configured using either the display or a communication program. For example, the program HyperTerminal (included in Win32 operating systems) or any other communication or terminal emulation program can be used.

In order to parameterize the device using a communication program, the AR2000 must be connected to supply voltage and a PC (also see chapter 4.4).

SSI and/or Profibus need to be set up separately.

No.	Work step
1	Unpack the AR2000, check it for damage.
2	Mount the AR2000 at the target location (with 2 screws through the side face or 3 screws through the bottom) --> see 5.1. Roughly direct it at the target surface.
3	Plug and firmly screw on the interface cable in the de-energized condition.
4	Connect and firmly screw on the Profibus and SSI connections (optional).
5	Wire the open cable end. Energize. Green status LED must light up.
6	As soon as STATUS LED is green, the red laser beam will be visible. Precondition: AS DT/ CT (default value). Mechanical fine adjustment can be executed.
7	Parameterize the AR2000 via the menu navigation on the display. Alternatively parameterize the device using a terminal emulation program.
8	Activate the distance measurement mode (e.g. DT).
9	Start the distance measurement (laser is switched on). Measurement output and target LED must be checked. Stop the distance measurement mode. Alternative: Start measurement via Profibus. The SSI measurement mode is to be defined in the AUTOSTART AS command.
10	Final visual check

6. PARAMETER SETUP AND MEASURING OPERATION

6.1 General information

The AR2000 is parameterized using the serial interface or the display. The precondition for programming via serial interface is a connection provided by a terminal program (e.g. HyperTerminal > see chapter 7).

The set parameters are stored in an EEPROM.

The last entered data will be available upon restarting.

- **Retrieval of parameters**

  Input PARAMETER <ENTER>   <ENTER> = CR = (0x0D)

- **Setting of parameters**

  Input PARAMETER VARIABLE <ENTER>
  The variables are described with the individual parameters.
  Several variables are separated by spaces (0x20).

- **Starting a measurement** (operating modes) Input COMMAND <ENTER>

- **Stopping a measurement** <ESC>   <ESC> = (0x1B)

- Distances are always entered in 0.1 mm (100 µm).
  The scale factor SF has no influence on the input parameters.
  Example: Input: 3.20 m = 32000

The output values shown in the manual are examples. They may vary depending on the settings and environmental conditions.

Whenever an incorrect or incomplete command is entered, the following responses are shown:

?	The input does not contain any parameter or command. e.g.: HELLO<ENTER>
Parameter with current value	Entry of a parameter with incorrect figure/ parameterization e.g.: Input: SAxxx<ENTER> e.g.: Output: SA 10 (where SA = 10 prior to input)

6.2 Measurement involving moving targets

Where measurements involve a moving object or the AR2000 is moved during measuring an impact on the accuracy of the measured value may be observed.

This must be observed particularly when calculating average values (parameter SA).

The speed of the moving object may be 20 m/s at the highest.

Measurement jumps of > 30 cm and/or considerable changes in the reflectivity of the target surface can prolong the measurement period. In case of a fixed measuring frequency (parameter MF), this may result in no measured value being generated within the predefined time. A warning or error message will be displayed instead.

6.3 Identification

6.3.1 ID recognition

When entering the command ID, the AR2000 will respond by displaying the manufacturer's data in the following order: Device type, serial number, manufacturer's part number, firmware version, time stamp.

Query:	ID

Example: AR2000 13006 012890-901-22 V5.15.0925 14-01-27.12.43

6.3.2 ID? – Online help

By entering the command ID?, the user will obtain an overview of all available operations and parameters described in the following sections.

Query:	ID?

Response:

Command list: Command must start with the correct beginning, e.g.: "DM2" = "DM 2"

(%u) declares the option of adding a positive integer to change the parameter.

(%d) declares the option of adding an integer to change the parameter.

(%f) declares the option of adding a floating-point number to change the parameter.

(%s) declares the option of adding a string (e.g. "cm" in case of MUN) to change the parameter.

(%b) declares the option of adding a Boolean value (0 = false, or 1 = true) to change the parameter

Identifications

ID?	- prints this help.
ID	- prints the firmware ID.

Status/Parameters

TP	- Prints the temperature of the device.
PA	- Prints all parameters.
PR	- Resets the parameters to firmware defaults.
SA (%u)	- Prints/Changes average. Co-domain: (1, 50).
MF (%f)	- Prints/Changes measurement frequency. Co-domain: [0.0, 100.0], (0 == auto).
MW (%u %u)	- Prints/Changes the expected ranges for measurements in "mm / 10'.
MUN (%s)	- Prints/Changes the unit of measurements. Co-domain: {mm, cm, dm, m, in/8, in/16, in, ft, yd}.
OF (%d)	- Prints/Changes the offset in 'mm / 10'. Co-domain: [-5000000, 5000000].
SO	- Carries out a single distance measurement and sets it as –OF (offset), it can be used for a zero.
SD (%u %b %b %b)	- Prints/Changes the output format.
Q1 (%d %u %d %b)	- Prints/Changes the parameterization of switching output Q1.
Q2 (%d %u %d %b)	- Prints/Changes the parameterization of switching output Q2.
Q3 (%d %u %d %b)	- Prints/Changes the parameterization of switching output Q3.
QA (%u %u)	- Prints/Changes the parameterization of the analog switching output QA.
TRI (%u %u)	- Prints/Changes the parameterization of the input trigger TRI.
TRO (%u %u)	- Prints/Changes the parameterization of the input trigger TRO.

BR (%u)   - Prints/Changes the baudrate of the serial port. Co-domain: {1200, 2400, 4800, 9600, 14400, 19200, 28800, 38400, 56000, 57600, 115200,128000, 230400, 256000}.

SB (%f)   - Prints/Changes the stopbits of the serial port. Co-domain: {0.5, 1.0, 1.5, 2.0}

RS (%u)   - Prints/Changes the mode of the serial port. Co-domain: {232, 485, 422}.

AS (%u)   - Prints/Changes the autostart commands. Co-domain: {0 .. 12].

TE (%u)   - Prints/Changes the terminator. Co-domain: {1 … 10}.

SE (%u)   - Prints/Changes the behavior on errors. Co-domain: {0 .. 2}.

SP (%u)   - Prints/Changes the character that separates the values (e.g. distance and temperature). Co-domain: {1..5}

SF (%f)   - Prints/Changes the scaling factor. To use [MUN] set "SF 0". Co-domain: [(+/-)0.001, (+/-)10.000].

MCT (%b)   - Prints/Changes the tracking mode, started from the menu. Co-domain: {0==standard, 1 == continuous}.

DF   - Turns off the OLED display.

DN   - Turns on the OLED display.

**Operation Mode""

DR   - Restarts the device (does not reset parameters}.

LF   - Deactivates laser diode.

DM   - Starts single (precise) measurement.

DT   - Activates/Deactivates tracking mode.

CT   - Activates/Deactivates continuous tracking mode.

SDT   - Deactivates tracking modes.

LN   - Activates laser diode.

6.4 Status

6.4.1 TP - Internal temperature

Output of the internal device temperature in °C. The internal temperature (operating temperature) is about 10 kelvins higher than the ambient temperature (see EN 60204-1).

When the internal temperature of the laser unit is 75°C the laser will be switched off.

Warning w1906 will be generated in a cycle of 10 sec.

After the cooling of AR2000 and reaching of a internal temperature of +70°C the interrupted measurement starts automatically (depends on the setup with DT or CT).

The AR2000 will not be switched off automatically when the temperature is below the defined temperature range.

Query:	TP

Response (example): 26°C

!	Please see the notes in chapter 3.1.

6.4.2 PA – Parameter setting

Output of a parameter list with the current settings

Query:	PA

Output:

Baudrate of serial port [BR]	115200
Stopbits of serial port [SB]:	1
Serial port mode (RS232/422/485) [RS]:	232
Average [SA]:	1
Measurement frequency [MF]:	0.0
Minimum distance from target [MW]:	-5000000
Maximum distance from target [MW]:	5000000
Offset in mm / 10'[OF]:	0
Parameterization of switching output Q1 [Q1]:	0, 1000000, 2500, 0
Parameterization of switching output Q2 [Q2]:	0, 1000000, 2500, 0
Parameterization of switching output Q3 [Q3]:	0, 1000000, 2500, 0
Parameterization of the analog switching output QA [QA]:	0, 100000
Unit for the distances [MUN]:	mm
Trigger (input) [TRI]:	0, 0
Trigger (output) [TRO]:	0, 0
Autostart commands [AS]:	DT
Output format [SD]:	0 0 1 0
Terminator [TE]:	0x0D0A
Scale factor [SF]:	0.000
Error mode [SE]:	0
Separator [SP]:	0x2C
Standard tracking mode from menu [MCT]:	0

6.4.3 PR – Parameter setting reset

Resetting of all parameters to factory settings (default values)

The following parameters are not reset by entering PR:

BR   Baud rate
RS   Serial port
SB   Stop bits
SSI   SSI interface parameters
PB   Profibus interface parameters

Input:	PR

Output:

Parameters set to firmware defaults.
Baudrate of serial port [BR]:   115200
Stopbits of serial port [SB]:   1
Serial port mode (RS232/422/485) [RS]:   232
Average [SA]:   1
Measurement frequency [MF]:   0.0
Minimum distance from target in 'mm / 10' [MW]:   -5000000
Maximum distance from target in 'mm / 10' [MW]:   5000000
Offset in 'mm / 10' [OF]:   0
Parametrization of switching output Q1 [Q1]:   0, 1000000, 2500, 0
Parametrization of switching output Q2 [Q2]:   0, 1000000, 2500, 0
Parametrization of switching output Q3 [Q3]:   0, 1000000, 2500, 0
Parametrization of the analog switching output QA [QA]:   0, 1000000
Unit for the distances [MUN]:   mm
Trigger (input) [TRI]:   0, 0
Trigger (output) [TRO]:   0, 0
Autostart commands [AS]:   DT
Output format [SD]:   0 0 0 0
Terminator [TE]:   0x0D0A
Scale factor [SF]:   0.000
Error mode [SE]:   0
Separator [SP]:   0x2C
Standard tracking mode from menu [MCT]:   0

6.4.4 SA – Average value

SA determines the number x of the individual measured values to be averaged for the measured value output. SA directly correlates with the measuring frequency MF.

SA and MF determine the output frequency for the measured values.

Query:	SA
Set:	SAx
Range of parameter x:	1 to 50; resolution: 1
Standard:	1

The spread of the measured values can be reduced by determining average values.

$$\sigma_{SA} = \sigma_1 / \sqrt{SA}$$

σ_{SA} Spread after average determination including several distance measurements

σ_1 Spread of individual measured values (+ 1 mm)

SA   Average value

Example values of measurements involving a target with 80% reflectivity and a maximum distance of 30 m

Measuring frequency MF (Hz)	Average value SA	Output frequency (Hz)	Spread in mm
20	1	20	± 1.0
20	10	2	± 0.3

6.4.5 MF – Measuring frequency

MF parameterizes the number x of the measured value outputs per second.

When a value x outside of the measurement range is entered, the lowest or highest permissible MF value will automatically be set.

Entered value < x → MF 0.0

Entered value > x → MF 100.0

MF 0 = Automatic measurement. The output frequency ranges between 0.3 Hz and 10 Hz in most cases.

Essential factors concerning the measurement period are, among others, the reflectivity of the target surface and the environmental conditions (e.g. light, fog, rain).

Query:	MF
Set:	MFx
Range of parameter x:	0.0 …100.0 (Hz), resolution: 0.1
Standard:	0

Output: Measurement frequency [MF]: 0.0

> **!**   The measuring period will be longer when an average value SA ≠ 1 is set!

6.4.6 MW – Measurement window

Parameterizes the scope of a measurement window by start x and end y.

Only measured values within the measurement window will be put out.

For example, the measurement window can be used to:

Eliminate interfering objects before or behind a measurement range

Define a measurement range

If there is no target object within the defined measurement window, an error message will be generated cyclically:

e1207   A target before or behind the measurement window is recognized .

e1203   No target was found.

Query:	MW
Set:	MWx y
Range of parameter x:	Resolution: 0.1 mm
Range of parameter y:	Resolution: 0.1 mm
Standard:	-5000000 5000000

Output:

Minimum distance from target [MW]: -5000000 (-500 m)

Maximum distance from target [MW]: 5000000 (500 m)

The AR2000 does not check the set measurement window for plausibility. The user is responsible for correct parameterization!

6.4.7 MUN – Unit of the measured value

MUNx enables the definition of a unit for the output value. It is shown together with the measured value.

In order to use MUN, SF 0 must be set.

Query:	MUN
Set:	MUNx
Range of parameter x:	mm, cm, dm, m, in/8, in/16, in, ft, yd
Standard:	mm

Output: Unit for the distances [MUN]: mm

6.4.8 SF – Scale factor

SFx defines a factor by which the output value is multiplied.

Query:	SF
Set:	SFx
Range of parameter x:	-10.000 to 10.000
Standard:	0

Output: Scale factor [SF]: 0.000

> **!**
> At SF ≠ 0 the parameter MUN is ineffective.
> At SF = 0 the unit defined by MUN becomes effective.

Example of the data output:

SF	0	1	2	10
Distance 1.23 m	001230.0 mm	001230.0	002460.0	00012300

6.4.9 OF – Offset

OF parameterizes a user-specific offset x that is added to the measured value.

It is entered in 0.1 mm.

Query:	OF
Set:	OFx
Range of parameter x:	-5000000 to 5000000
Standard:	0

Output: Offset in 0.1 mm (100µm) [OF]: 0

The AR2000 does not check the Set Offset for plausibility. The user is responsible for correct parameterization!

The offset can be set by a measurement command SO) (see chapter 6.4.10).

6.4.10 SO – Set Offset

With the parameter SO a single distance measurement is carried out and set a – OF (negative offset).

SO can only be executed in this way, it is not a parameter in the strict sense. SO is used for the zero-adjustment of applications, systems, processes.

Input: SO

Output (for example):   Offset in 'mm / 10' [SO]: -21091

6.4.11 SD – Data format of the serial interface output

SD parameterizes the output format and the possible output values.

The following outputs are possible:

> Distance
> Signal quality
> Temperature
> Switching outputs (active/ inactive)

Query:	SD
Set:	SDw x y z
Range of parameter w:	0 to 5
Range of parameter x, y, z:	0 or 1
Standard:	0 0 0 0

Output: [SD]: 0 0 0 0

Separator in correspondence with parameter TE

Parameter w	Output format	Separators between the values	Unit of measure (SF 0 + MUN x)	Example (SF 0 + MUN mm)
0	Decimal	1 separator	Unit	d002 925.4 mm = 2925.4 mm
1	Decimal	None	None	d002925.4 = 2925.4 mm
2	Hexadecimal (floating point format IEEE-754)	None	None	h4536E9EC = 2926.6 mm
3	Hexadecimal	None	None	h000B6E = 2926 mm
4	Binary	None	None	0x80 0x01 0x64 0x46 = 2925.4 mm
5	SSI and switching outputs only	None	None	SSI: Distance value in 0.1 mm Switching output: 0 or 1

Parameter	Value	Signal quality	Temperature	Switching outputs
X	0	Off		
X	1	On		
Y	0		Off	

Y	1		On	
Z	0			Off
Z	1			On

Data Format SD- **Binary format:**

Distance:
> 4 Byte, MSB = Bit 31
> MSB of Byte 3 always 1
> MSB of Byte 2, 1 and 0 always 0
> Measurement data of each Byte = Bit 6 … Bit 0
> Coding: Two´s complement

Signal:
> 2 Byte
> MSB = Bit 15
> MSB of Byte 1 and 0 always 0
> Measurement data of each Byte = Bit 6 … Bit 0
> no sign bit
> maximum value: 16383 (14 Bit data)

Temperature:
> 2 Byte
> MSB = Bit 15
> Sign bit = Bit 14
> MSB of Byte 1 and 0 always 0
> Measurement data of each Byte = Bit 6 … Bit 0

Binary format of switching outputs Q1, Q2, Q3

> 1 Byte
> MSB = Bit 7 always 0
> Q1 = Bit 2
> Q2 = Bit 1
> Q3 = Bit 0
>
> 1 = switching output on (active)
> 0 = switching output off

Bit	7	6	5	4	3	2	1	0
	0	0	0	0	0	1	0	1
	MSB					Q1	Q2	Q3
	= 0					on	off	on

For configuring the switching outputs see chapter 6.6

6.4.12 BR – Baud rate

BR enables the adjustment of the serial baud rate x.

As soon as a new baud rate is set, the device will start communicating with the new baud rate.

BR will not be modified upon a parameter reset via PR.

Query:	BR
Set:	BRx
Range of parameter x:	1200,2400,4800,9600,14400,19200,28800,38400,56000, 57600,115200,128000,230400,256000
Standard:	115200 baud/ 8 data bits /1 stop bit / no parity

Output: Baud rate of serial port [BR]: 115200

> **!** Prior to setting a high baud rate of > 115200 baud, make sure that the subsequent system is capable of processing that baud rate.

6.4.13 SB – Stop bit of the serial output

Sets the parameter of the stop bit for serial data transmission

Query:	SB
Set:	SBx
Range of parameter x:	0.5 / 1.0/ 1.5/ 2.0
Standard:	1.0

Output: Stop bits of serial port [SB]: 1

6.4.14 RS – Serial port

Selection of the serial interface to be used for communication

Query:	RS
Set:	RSx
Range of parameter x:	232/ 422/ 485
Standard:	232

Output: Serial port mode (RS232/422/485) [RS]: 232

> **!** If RS is set to a wrong interface, communication will be impossible!
> The setting must be adjusted via the device display afterwards:
> Parameters --> BUS --> UART --> RS-232/422/485.

6.4.15 AS – Autostart

The autostart function defines the behavior of the AR2000 after a cold boot.

After the connection to the supply voltage and the internal start-up routine the AR2000 will automatically execute the command and send the data to the available outputs.

A figure from the table below must be entered.

The display / output shows the command.

Query:	AS
Set:	ASx

Range of parameter x:	1 to 24 (see table below)
Standard:	5

Value x	Command	Meaning
1	ID	Output of device identification
2	ID?	Output of command list
3	TP	Output of internal device temperature
4	DM	Start of individual measurement
5	DT	Start of continuous measurement
6	CT	Start of quick continuous measurement
7	DF	Display is deactivated
8	DF ID	Display is deactivated + output of device identification
9	DF TP	Display is deactivated + output of internal device temperature
10	DF DM	Display is deactivated + start of individual measurement
11	DF DT	Display is deactivated + start of continuous measurement
12	DF CT	Display is deactivated + start of uninterrupted continuous measurement
		AR2000 laser with heating option commands (temperature range -40 °C to +60 °C)
13	SH	Heating is deactivated
14	SH ID	Heating is deactivated + output of device identification
15	SH TP	Heating is deactivated + output of internal device temperature
16	SH DM	Heating is deactivated + start of individual measurement
17	SH DT	Heating is deactivated + start of continuous measurement
18	SH CT	Heating is deactivated + start of uninterrupted continuous measurement
19	SH DF	Heating is deactivated + display is deactivated
20	SH DF ID	Heating is deactivated + display is deactivated + output of identification
21	SH DF TP	Heating is deactivated + display is deactivated + output of internal device temperature
22	SH DF DM	Heating is deactivated + display is deactivated + start of individual measurement
23	SH DF DT	Heating is deactivated + display is deactivated + start of continuous measurement
24	SH DF CT	Heating is deactivated + display is deactivated + start of uninterrupted continuous measurement

Depending on the measurement mode used, it takes max. 6 secs from applying the supply voltage to the point where the first measured value is put out.

Output: Autostart commands [AS]: DT

6.4.16 TE – Terminator

TE is used to set the terminator for the output of measured values in the ASCII format (also see command SD).

Query:	TE
Set:	TEnn
Range of parameter nn:	1 to 10
Standard:	1

Example:

Input: TE 1

Output: Terminator [TE]: 0x0D0A

Value selection:

nn	ASCII	Meaning
1	0x0D 0x0A	CR LF (ENTER)
2	0x0D	CR
3	0x0A	LF
4	0x02	STX
5	0x03	ETX
6	0x09	HTab (Tabulator)
7	0x20	Space
8	0x2C	Single Quote
9	0x3A	Colon
10	0x3B	Semicolon

When an invalid character is entered, it will not be set. The current separator will be kept instead.

6.4.17 SE – Error mode

Parameterizes the behavior x of switching outputs Q1, Q2, Q3 and of the analog output QA in case of faulty measurements as well as the condition upon execution of an individual distance measurement.

Query:	SE
Set:	SEx
Range of parameter x:	0, 1 or 2
Standard:	1

X	Q1, Q2, Q3 (z=0)	Q1, Q2, Q3 (z=1)	QA
0	Last value	Last value	Last value
1	High	Low	3 mA
2	Low	High	21 mA

Low: U < 1 V

High: U = operating voltage – 1 V

The AR2000 does not check the set error mode for plausibility!

6.4.18 SP – Separator for parameters

Output values are separated by the character SP.

Query:	SP
Set:	SPx
Range of parameter x:	1 to 5
Standard:	1

Output: Separator [SP]: 0x2C

Value x	Symbol	ASCII
1	Comma	0x2C
2	Semicolon	0x3B

3	Space	0x20
4	Slash	0x2F
5	Tabulator	0x09

6.4.19 HE – Heating adjustment

The parameter HE defines the switching thresholds for switching the heating element on and off.

The command is enabled only where the device is actually equipped with a heating element.

Query:	HE
Set:	HEx y
Range of parameter x: Switching on heating	-40 to 40 (integer)
Range of parameter y: Switching off heating	-40 to 40 (integer)
Standard:	HE4 10

6.4.20 MCT – Output/ modification of the operating mode when starting a measurement using the display

When starting a continuous measurement using the integrated display, you need to define if the AR2000 should measure based on the operating mode DT or CT.

The operating mode is selected via the command MCT.

When starting a measurement using the display, the predefined operating mode will be applied as a rule.

When a measurement is started using a communication program or PLC, the command DT or CT will determine the type of measurement.

Query:	MCT
Set:	MCTx
Range of parameter x:	0 (DT), 1 (CT)
Standard:	0

6.4.21 PB – Setting the Profibus parameters

Also see Profibus and SSI Communication chapter 8.

PB parameterizes the availability of profibus interface

Query:	PB
Set:	PBx
Range of parameter x:	0 (disabled), 1 (enabled)
Standard:	0

Output: Profibus mode [PB]: 0

For AR2000 models with Profibus interface the default value is PB1 (Profibus enabled).

If AR2000 models with Profibus interface will be used via serial interface only, the Profibus parameter PB must be disabled with command PB 0.

6.4.22 SSA – Profibus slave address

With parameter SSA the profibus slave address can be set.

It could be set via AR2000 keys or via service program SL5.exe too.

Query:	SSA
Set:	SSAx
Range of parameter x:	0 … 126
Standard:	4

Output: Profibus slave address [SSA]: 4

6.4.23 SSI – Setting the SSI parameters

Also see Profibus and SSI Communication chapter 8.

SSI defines the Synchronous Serial Interface (see chapter 4.9)

Query:	SSI
Set:	SSIx
Range of parameter x:	0… 4 (see list below)
Standard:	0

Value x	Description
0	SII off (disabled)
1	SII on / 24 bit / binary
2	SII on / 24 bit / gray
3	SII on / 25 bit / binary / MSB = Errorbit
4	SII on / 25 bit / gray / MSB = Errorbit

Output: SSI mode (SSI): 0

6.4.24 Additional commands

Command	Description
DF	Switches off the display (OLED)
DN	Switches on the display
LF	Switches off the laser diode
LN	Switches on the laser diode
SDT or ESC key	Deactivates the continuous measurement mode
SH	Switches off the heating until restart (available only in devices that are equipped with a heating element)
TP	Output of device temperature
DR	Executes a restart (does not reset the parameters; no PR!)

6.5 Operating modes

6.5.1 DM – Individual distance measurement

The AR2000 will perform exactly one measurement and then wait for new instructions.

The duration of the measurement depends on the number of preset measuring values SA and the preset measuring frequency MF.

Input: DM

Typical parameter settings

MF0, SA1, DM

Execute single measurement, allowing for a sufficient period of time as needed to determine the distance to a static (during the measurement) target object.

MFx, SA1, DM

Execute a single measurement, allowing for a period of time of maximally 1 / x seconds to reliably determine the distance to a static (during the measurement) target object.

6.5.2 DT – Continuous distance measurement (distance tracking)

The AR2000 performs a continuous measurement.

The measurement can be interrupted by a command:

Display   STOP
RS232/422/485   ESC (Escape) = 0x1B
RS232/422/485   Command SDT = 0x53 0x44 0x54

The output frequency of the measured values depends on the selected parameters MF and SA. The DT mode works with high measuring stability in the collection of the measured values, even in case of beam interruptions and discontinuous motion sequences of the target.

Input: DT

!	Full measurement (new adjustment of frequencies to define the unambiguous range) will be forced after beam interruptions.

Example response (setting SD1 1 1 0, MUNm):

d002.0305,02736,00029

Output format   =   dezimal (d)
Distance   =   2,0305 m
Signal quality   =   2736
Temperature   =   29 °C

Remarks:

In case of poor target reflectivity, it cannot be guaranteed at 100 % that the respective measurement will be completed within the available time, which is defined by Parameter MF.

If the time between 2 measurement outputs is too short a warning will be generated (→w1910). The output frequency will remain constant.

The frequency of warnings and error messages will increase if MF > 20 Hz. In addition an output of wrong distance values could be happen with bare probability. For optimal results the recommendation is to set MF to 20 Hz or lower in mode DT.

There are the following alternatives:

1) A variable output frequency can be selected for surfaces with low reflectivity. The AR2000 will

keep measuring until a representative distance value can be determined. Normally, the measuring period ranges between 0.01 and 3 seconds (no average determination). The maximum measuring time is 6 sec.

2) Where a measured value output is not needed, a lower frequency can be set via the parameter MF. While this parameter influences the output frequency, it has no impact on the internal measuring frequency. The output frequency can also be reduced by using the average determination function. For example, if an average determination covering 5 measured values (SA 5) includes a warning, only 4 measured values will be used for average determination. Where there is only one measured value, there will be one output. The output of warnings is avoided.

The table below shows exemplary ranges and accuracies in relation to the target surface for outdoor applications. The conditions for the measurements were environmental temperature of +25°C and ambient light around the target of 1.2 kLux.

The measuring range in an application depends on a large number of factors, e.g. target reflectivity, stray light, output frequency and other environmental conditions.

Before integration of AR2000 in a whole system special tests are necessary, to get optimal application results.

Operation Mode DT			
Target	**Measuring frequency**	**Measuring range**	**Maximum accuracy**[1]
white, matte, reflectivity approx. 80%	variable	15 cm to 100 m	± 1mm
	20 Hz	15 cm to 40 m	± 1mm
black, matte, reflectivity approx. 6%	variable	15 cm to 40 m	± 1 mm
	20 Hz	15 cm to 15 m	± 1.5 mm
Reflective tape 3M 3279 special	variable	50 cm to 100 m	± 1.1 mm
	20 Hz	50 cm to 100 m	± 1 mm
Reflective tape Oralite 5200 [2]	variable	50 m to 500 m	± 1 mm…+4.5 mm
	20 Hz	50 m to 450 m	± 1 mm…+3.5 mm

[1] in consideration of parameterization in accordance with other chapters.
[2] values for maximum accuracy for the lower and upper limit of measuring range.

Measurements on targets with low reflectivity may cause error messages.

Where the output frequency is too high, the following errors may result with poor surfaces:

w1910	Generating a measured value within the predefined period of time was impossible(laser searches for suitable parameterization after distance jump/surface change). MF too high.
e1201/e1203	No laser reflection received (unsuitable / poorly reflecting surface). Reduce the value of the measuring frequency MF.
e1206	Target surface too bright or ambient light too intensive.
e1207	Distance is outside of the measurement window MW.

6.5.3 CT – Continuous tracking

The AR2000 performs an uninterrupted continuous measurement, adjusting the laser parameters (unambiguous ranges) in relation to the target only every 6 seconds or when an obvious distance measurement error has occurred.

The accuracy for MF>20 Hz is higher in the CT mode compared to the DT mode.

Areas of application:

- Scanning of static targets.
- Quick measurements on hot surfaces.
- Tracking of continuously quickly moving targets (e.g. crab [crane], vehicle)

> [!] Distance jumps or laser beam interruptions can result in faulty measurements! The warning w1912 is issued.

The tables below show the ranges and accuracies in relation to the target surface for outdoor applications. The conditions for the measurements were environmental temperature of +25°C and ambient light around the target of 1.2 kLux. The measuring range depends on target reflectivity, stray light, output frequency and environmental conditions.

Operation Mode CT			
Target	**Measuring frequency**	**Measuring range**	**Maximum accuracy[1]**
white, matte, reflectivity approx. 80 %	variable	15 cm to 100 m	± 1mm
	20 Hz	15 cm to 40 m	± 1mm
	50 Hz	50 cm to 35 m	± 2.5 mm
	100 Hz	50 cm to 30 m	± 2.5 mm
black, matte, reflectivity approx. 6%	variable	15 cm to 90 m	± 1 mm
	20 Hz	15 cm to 20 m	± 1 mm
	50 Hz	50 cm to 15 m	± 2.5 mm
	100 Hz	50 cm to 10 m	± 2.5 mm
Reflective tape 3M 3279 special	variable	50 cm to 100 m	± 1 mm
	20 Hz	50 cm to 100 m	± 1 mm
	50 Hz	50 cm to 100 m	± 2.5 mm
	100 Hz	50 cm to 100 m	± 2.5 mm
Reflective tape Oralite 5200 [2]	variable	50 m to 500 m	± 1 mm…+4.5 mm
	20 Hz	50 m to 450 m	± 1 mm…+3.5 mm
	50 Hz	50 m to 400 m	± 2.5 mm…+3.5 mm
	100 Hz	50 m to 400 m	± 2.5 mm…+3.5 mm

[1] in consideration of parameterization in accordance with other chapters.

[2] values for maximum accuracy for the lower and upper limit of measuring range.

6.6 Q1/Q2/Q3 – Switching output

The switching outputs Q1, Q2 and Q3 show distance information as logic switching information. They signalize when values are above or below a preset switching range subject to hysteresis. Hence, they are perfectly suitable for the direct further processing of monitoring variables such as filling level or object detection. Parameterization is done via the serial interface.

A load resistance of > 150 ohms/ 6W (30 V max. operating voltage : 0.2 A max. load current) must be switched against GND power at the switching output. It is essential that the load current of 0.2 A is not exceeded.

> ☞ Typical resistance: 1 K ohm against GND power (not against GND signal)!
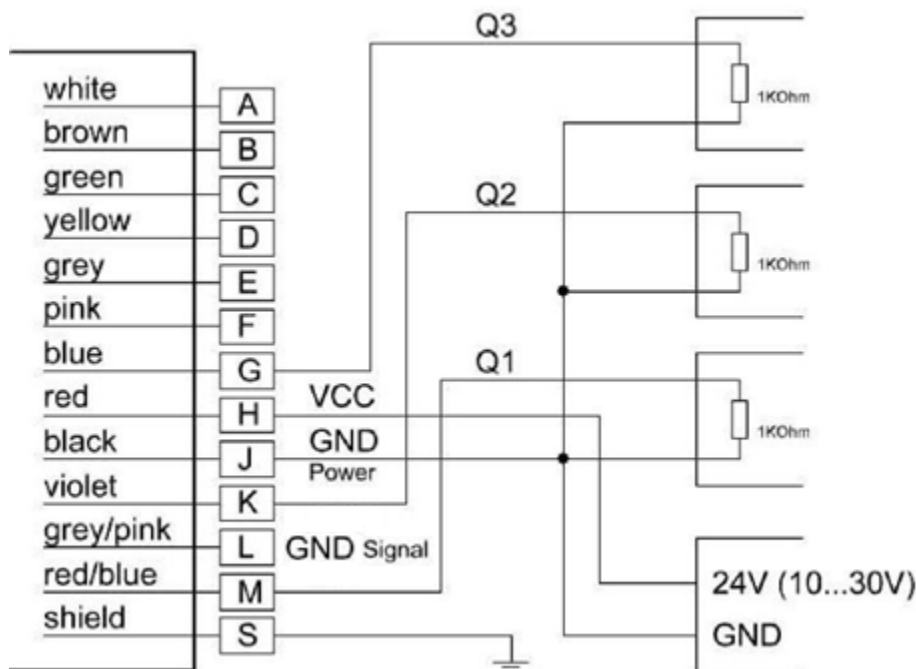
Figure 8.Wiring of switching outputs Q1, Q2, Q3

Q1/Q2/Q3 parameterizes the behavior of the switching outputs.

Parameterization covers the beginning w of the measurement range, i.e. the point where the output will switch, the length x of the measurement range, the hysteresis y and the logic behavior z.
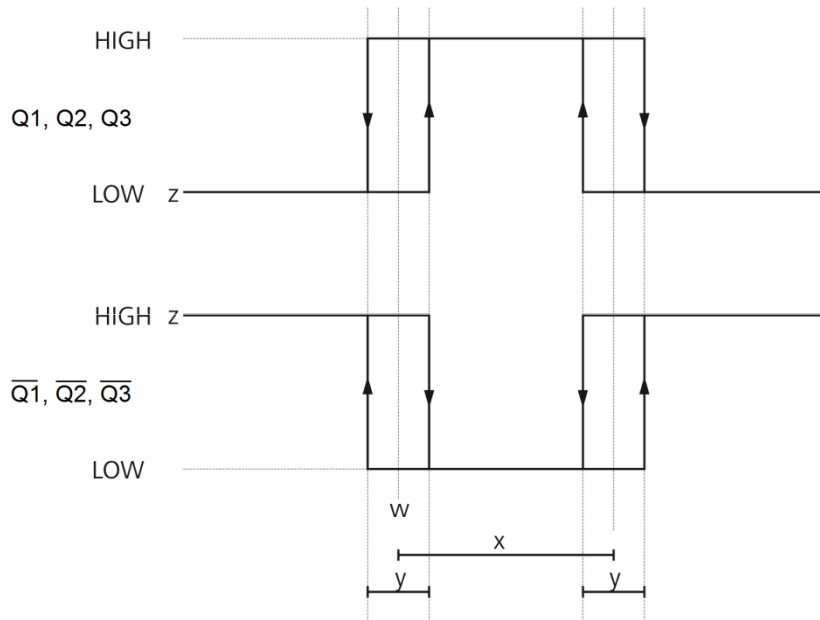
Figure 9. Switching behavior and parameters of the switching outputs

Low = 0   U < 1 V

High = 1   U = operating voltage – 1V

Variable	Description	Specification
w	Switching threshold (in 0.1mm); activate switching status z from this distance	32 bits integer
x	Switching range (in 0.1mm); a range of x μm from w	32 bits integer
y	Switching hysteresis (in 0.1mm); length of the tolerance range	32 bits integer y ≥ 0
z	Switching status	z = 0 or 1

Query:	Q1 or Q2 or Q3
Set:	Q1w x y z or Q2w x y z or Q3w x y z
Standard:	0 1000000 2500 0 (corresponds to: 0 m 100 m 25 cm 0)

The AR2000 does **not** check the settings of Q1, Q2 and/or Q3 for plausibility.

6.7 QA – Analog output

The analog output enables the stable, analog transmission of distance data across large distances using a two-wire line. The 4-20 mA current output is proportional to the measured distance within an adjustable distance interval. Parameterization is done via the serial interface.

The current output when faulty measurements occur is parameterized using the command SEx.

Properties of the analog output:

- 4 mA to 20 mA
- Indication in case of an error: 3 mA or 21 mA or last measured value (selectable via the parameter SE)
- Resolution: 12 bit D/A converter

Where current/ voltage is to be converted, a load resistance of 100 ohms ≤ R ≤ 500 ohms/ 0.5 W is to be switched between current output QA and GND.

Capacitive load ≤ 10 nF

Operating voltage ≥ 12 V
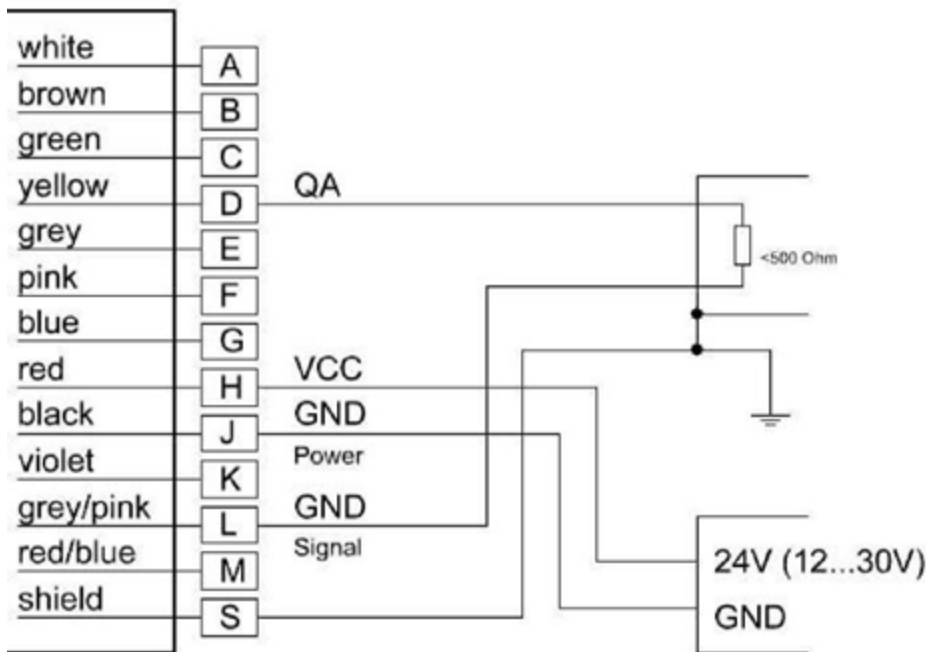
Figure 10. Wiring of analog output

The lower and upper distance value (limit) defines the analog output range.

Value	Description	Specification
X	Lower limit	x ≠ y
Y	Upper limit	y ≠ x
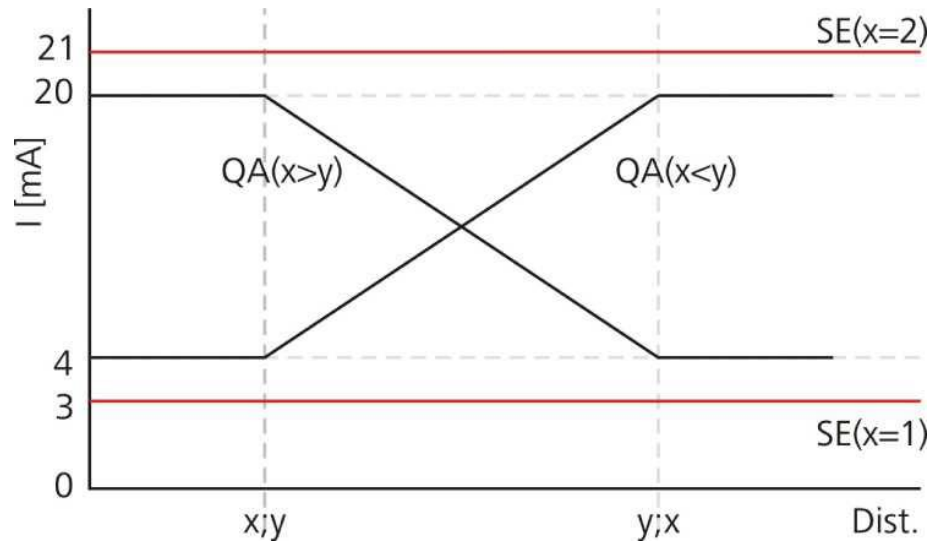
The lower limit can be lower or higher than the upper limit. The current range inverts accordingly. Entries of identical limits will be ignored and not accepted.

Query:	QA
Set:	QAx y
Range of parameter x:	-5000000 to 5000000
Range of parameter y:	-5000000 to 5000000
Standard:	0 1000000 (0 to 100 m)

The measurement window MW also applies to the analog output.

The AR2000 does not check the QA settings for plausibility. The user is responsible for correct parameterization!

The value of the output current (in mA) is calculated as follows:

X<Y	$$QA[mA] = 4mA + 16\frac{Dist - x}{y - x}mA$$
X>Y	$$QA[mA] = 20mA - 16\frac{Dist - y}{x - y}mA$$

Dist = Measuring Distance

Examples for analog setup:

To set the AR2000 laser to output 4 mAmps at 1 meter and 20 mAmps at 100 meters the command to input to the laser would be:

QA10000 1000000

(Note - the units are in 0.1 mm.)

To set the AR2000 laser in the reverse direction where at 1 meter the laser outputs 20 mAmps and at 100 meters the laser outputs 4 mAmps set the command as shown below:

QA1000000 10000

(Note - the units are in units of 0.1 mm.)

Readings outside of the programmed range will output either 3 or 21 mAmps depending upon the setup of the analog output ranges.

6.8 TRI + TRO Trigger

6.8.1 Trigger function

The AR2000 Trigger could be used as input or output.

1) Trigger input / external trigger function:
   External trigger signal will be sent → start of measurement DM in accordance with parameter TRI.

2) Trigger output / e.g. connection between 2 AR2000:
   The output trigger signal of the 1. AR2000 (parameterized with TRO) starts a single measurement DM of the second AR2000 (parameterized with TRO).

Differences between trigger input and trigger output

The parameter y of TRI and TRO is important

TRI y>0 / TRO y=0   Trigger input

The measurement starts after an external trigger impulse.

TRI y=0 / TRO y>0   Trigger output

AR2000 sends a trigger impulse to the second device.

The configuration of the trigger connection is carried out via the serial interface or the internal display.

> **!** The trigger function may only be activated TRI or TRO. Concurrent use of TRI and TRO is not possible → output of warning information w1907.

Voltage levels for the trigger signals

Low level	0 – 1.5 V
High level	3 – 30 V
Threshold	2.25 V
Hysteresis	0.1 V

6.8.2 TRI – Trigger input

The configuration of the trigger input will be set with command TRI.

X   edge   parameterized the edge of trigger signal
             0   rising edge (from LOW to HIGH)
             1   falling edge (from HIGH to LOW)
             2   every edge
y   delay   parameterized the time (delay) up to the measurement in milliseconds msec

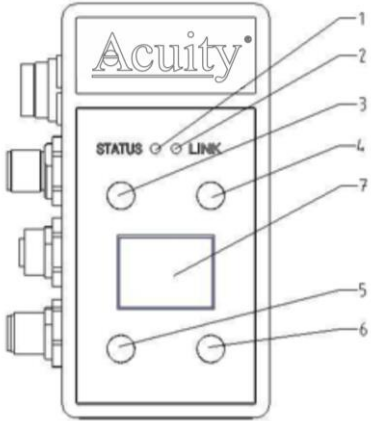| Query:	TRI
Set:	TRI x y
Value range parameter x:	0, 1, 2

Value range parameter y:	0 to 60,000 msec (1 minute)
	      active: from 1 msec upward
	      disabled: 0 msec

Standard:	0 0

Output: Trigger (input) [TRI]: 0, 0
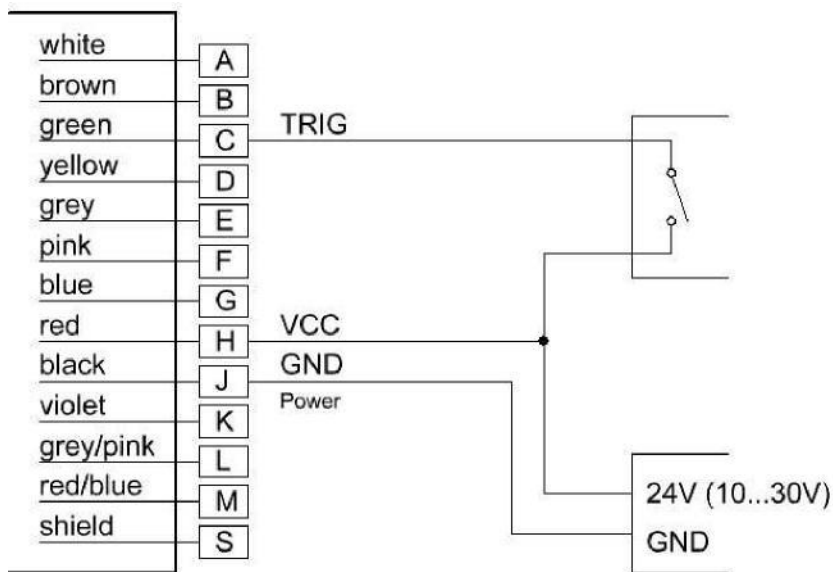
Figure 11. Wiring of trigger input

Maximum frequency of external trigger signal = MF / SA

If the trigger frequency is too high, no measurement value can be determined. The output is E1203. The trigger frequency must be reduced.

> ☞ Parameter MF should be set ≠ 0 (for MF = 0 the measurement time is variable).

6.8.3 TRO – Trigger

The configuration of the trigger output will be set with the command TRO.

x edge parameterized the edge of the trigger signal

       0 rising edge (from LOW to HIGH)

       1 falling edge (from HIGH to LOW)

       2 every edge

y delay parameterized the time (delay) up to the measurement in milliseconds (msec)

Query:	TRO
Set:	TRO x y
Value range parameter x:	0, 1, 2

Value range parameter y:	0 to 60,000 msec (1 minute)
	   active: from 1 msec upward
	   disabled: 0 msec

Standard:	0 0

Output: Trigger (output) [TRO]: 0, 0
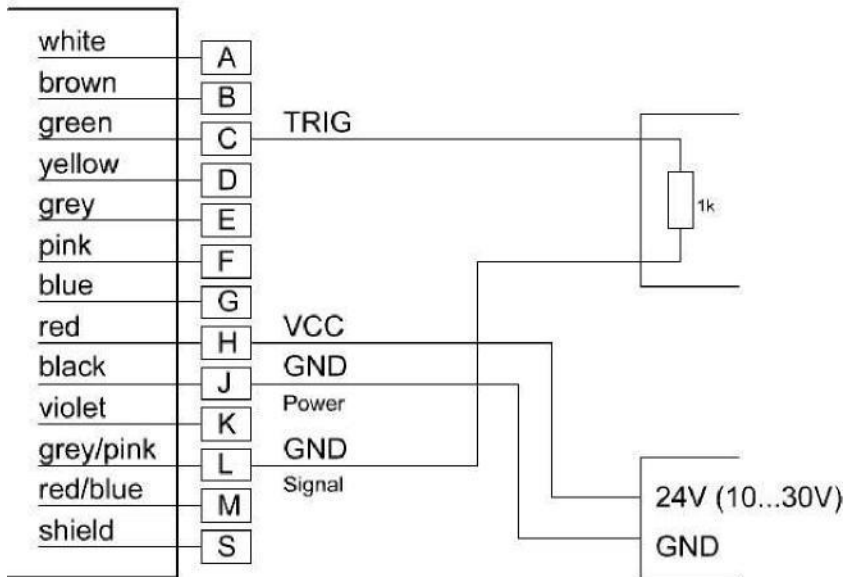
Figure 12. Wiring of trigger output

6.9 Direct controlling of the AR2000

The AR2000 can be programmed directly and set for measurements without a PC interface. The laser will need to be powered up. The AR2000 is ready for operation when the green STATUS LED is lit.

The individual menu items can be selected using 4 membrane keys, 2 above and 2 below the OLED display. The user language is English. The display can be deactivated during the measurement. It can be switched on again by pressing key T3 or T4.

	1 Status LED off Power supply off
	                             red Power supply on, not ready
	                                        for operation
	                             green AR2000 ready for operation
	
	2 LINK LED off no data transfer
	                       green, flashing
	                                 data transfer (Profibus/
	                                 serial) active
	
	3 Key T1 Function see display indication
	4 Key T2 Function see display indication
	5 Key T3 Function see display indication
	6 Key T4 Function see display indication
	7 Display

	STOP Measurement will be stopped (Disabled if Profibus active). Disp.⏻ Display will be disabled The display can be enabled with key T4 or T3.
	Parameter setting After STOP (measurement) parameters can be set. Menu↑ move cursor/ selection bar up Menu↓ move cursor/ selection bar down Select select parameter Meas.on start measurement

	Execute command Example "Identification": → stop measurement → Status → Select → Identification → Select Again repeat command Return return to upper menu

Figure 13. AR2000 Display

7. Serial interface and communication software

### 7.1 Transmission protocol

- Interface settings: Asynchronous, 8 data bits, no parity, 1 stop bit
- Transmission protocol format / syntax: 7 bit ASCII
- Proprietary transmission protocol
- Commands are not case-sensitive (NO differentiation between lower and upper case).
- Decimal separator in the output of figures is the dot "." (0x2E).
- The terminator of a command (sending command) is the enter key (0x0D, 0x0A) or Carriage Return (0x0D) or Line Feed (0x0A)
- Where parameters have several values, they are separated by a space (0x20).
- The response to commands with parameters is the respective command including the parameters.
- The response to commands without parameters is the respective command including the current parameters.
- The response to commands with parameters outside of the valid value range is the respective command including the current parameters.
- The response to unknown commands and faulty parameter formats is a "?" (0x3F).

7.2 Installation of the communication program

HyperTerminal is a terminal program generally included in Win32 operating systems. It can be used as a communication program to parameterize the AR2000. There is a link on our website to get a free copy if you do not already have it on your PC. http://www.acuitylaser.com/literature-and-downloads

Start HyperTerminal via the following menu path:

|Start | Programs | Accessories | Communication | HyperTerminal|
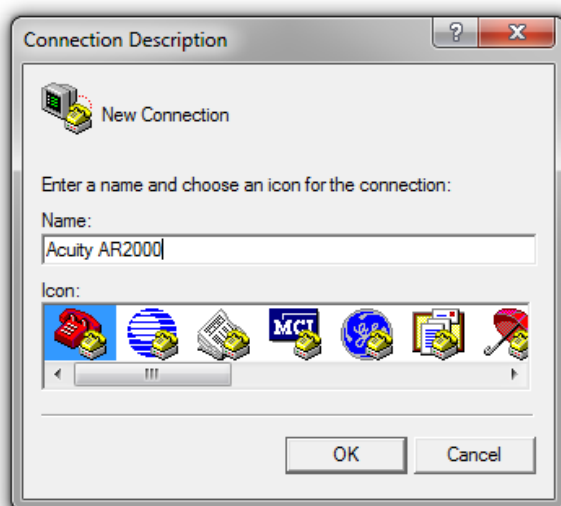
Enter the name of the new connection in the dialog box. You can select any name. Confirm with [OK].

Select the serial COM interface in the second dialog box. Upon confirming with [OK] a third dialog box will appear where the parameter settings for the current HyperTerminal session can be selected.
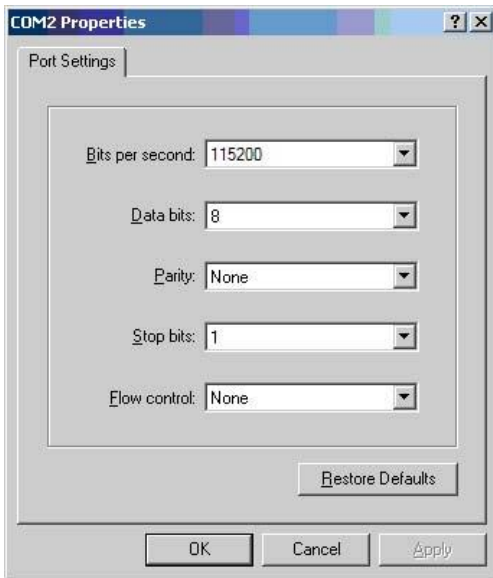
At this point, baud rate (bits per second) and flow control must be initialized correctly. As soon as the settings in the third dialog box are confirmed with [OK], the terminal window will open.
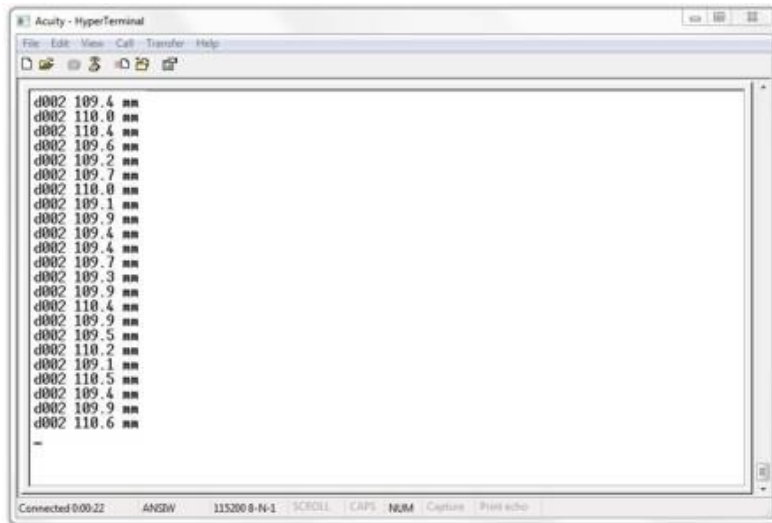
The status indication in the left bottom corner reads "Connected" when the requirements for communication have been set correctly. As soon as the AR2000 is ready for operation (power supply, connection with PC), the commands can be entered e.g.: ID.

☞ A command just entered will be displayed only when the "Local echo" function has been activated. The function can be parameterized via the menu "File":

|File | Properties | Settings | |ASCII configuration...|
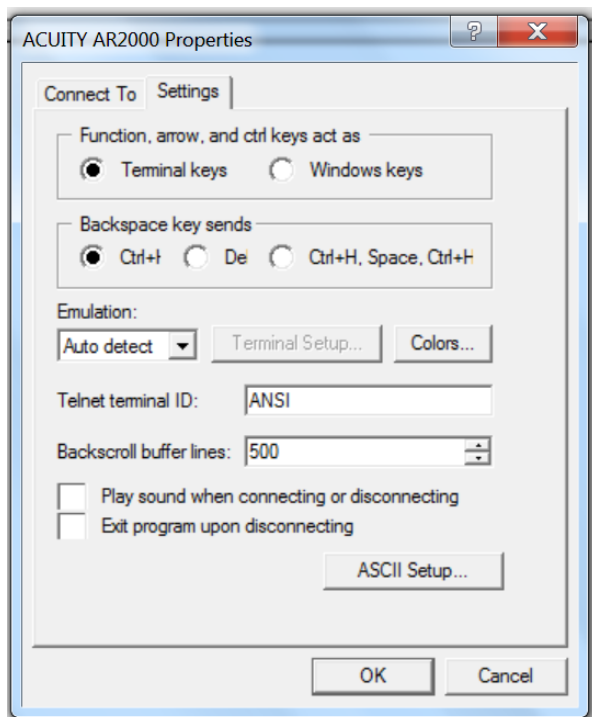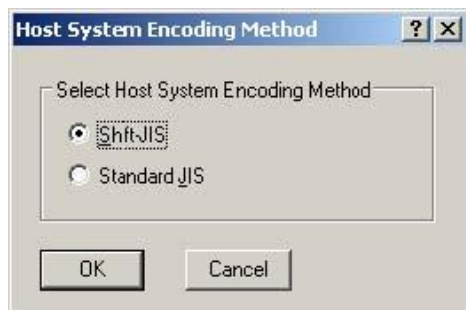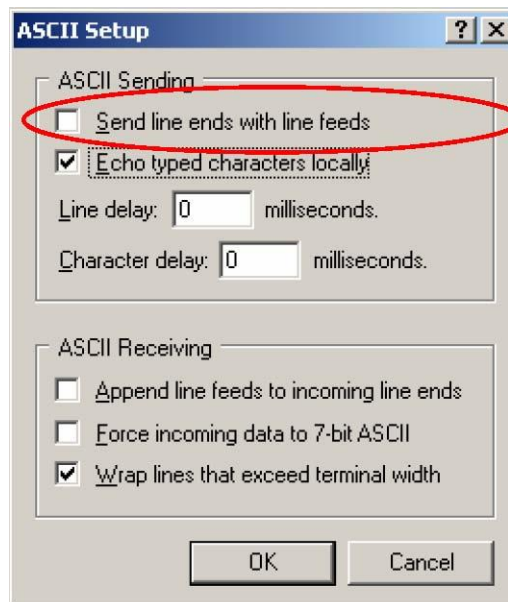
Please note: Do not check the box "Send line end with line feeds".
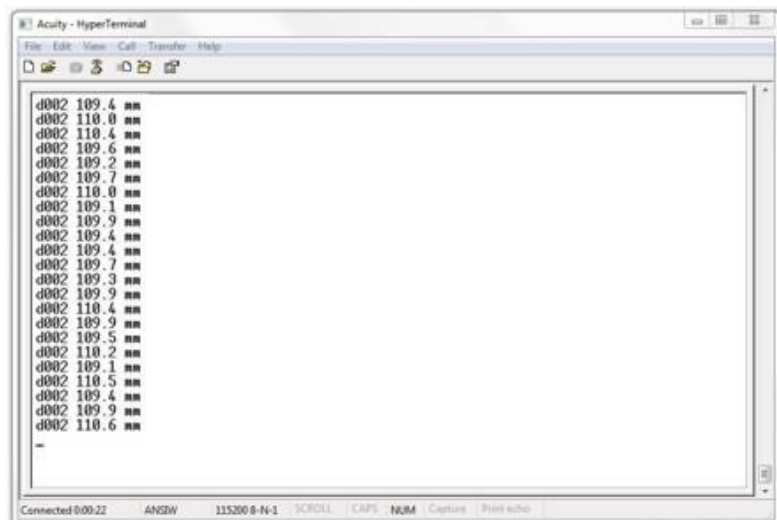
End the session with |File | Quit|.

Serial Interface and Communication Software

A small window will appear where you are asked if the connection should really be terminated. This question must be responded to by pressing the [Yes] button.
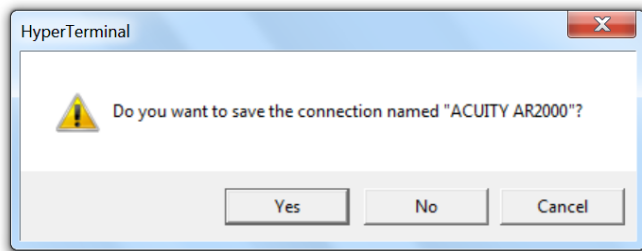
If the current HyperTerminal session has not been saved yet, a small window will appear where you are asked if the session should be saved. Confirm with "Yes". HyperTerminal will not have to be configured again upon restart.

8. Profibus and SSI Communication protocols

8.1 ID-Nummer

AR2000 is registered under ID number 0E36 (HEX) by PROFIBUS Nutzerorganisation e.V..

8.2 Connecting conditions

AR2000 can be connected to any Profibus-DP structure. The connected Profibus-DP master has to be able to send a parameterization.

The master configuration tool (usually configuration software) must support the parameters of the GSD file.

8.3 GSD file

The GSD file is named AR2000.GSD.

The current GSD is for downloading available under the following address:

http://www.acuitylaser.com/

The inclusion of the GSD file into the master configuration tool should be carried out to the documentation of the configuration tool.

8.4 Slave address

The Profibus slave address can be set under consideration of the other Profibus slaves in the range of 0 … 126. The address can be set with command SSAx via the serial interface or via the AR2000 keys and the GUI (graphical user interface) → see chapter 6.4.21.

The documentation of the master configuration tool will inform how the slave address has to be changed via the master configuration tool. The default address is 4.

The slave address will be stored permanently in the EEPROM and will be available even after power failure. If several slaves are operated on a Profibus master they must have different addresses and have to connect one by one.

8.5 Profibus termination

The Profibus termination is to realize externally.

The supply voltage of 5 VDC will be supplied via Profibus OUT. The 5 VDC are isolated galvanically from the power supply (VCC). The maximum load is 100 mA.

The terminator could be ordered with order number APL094145.

8.6 Baud rate

The AR2000 Profibus has an automatic baud rate for the following baud rates: 9.6 / 19.2/ 93.75/ 187.5/ 500 kBaud and 1.5/ 3/ 6/ 12 MBaud.

8.7 Length of segment

The maximum segment length between two Profibus participants depends on the selected baud rate. The following segment length must be observed:

Baud rate	Length of segment
9.6 kBaud .... 93.75 kBaud	1200 m
187.5 kBaud	1000 m
500 kBaud	400 m
1.5 MBaud	200 m
3 MBaud ... 12 MBaud	100 m

Cable type A is strongly recommended for connection of different Profibus units. Cable type A has the following properties:

Characteristic wave impedance	135 ... 165Ω
Capacitance per length	≤ 30pf/m
Loop resistance	≤ 110 Ω /km
Wire diameter	> 0.64mm
Wire cross-section	> 0.34mm^2

8.8 Profibus Interface

The Profibus interface of AR2000 is a standard Profibus-DP V0 interface (local peripherals).

V0 is the version number. The telegrams are byte-oriented. Bytes are also referred to as Octets in Profibus standard terminology. From the user's angle, the description can be restricted to a few telegram types:

- Cyclical data exchange telegrams (DataEx)
- Diagnostic telegrams
- Parameter setting telegrams.

The different Profibus-slaves of the same or similar function are described in profiles. The profiles make it easier for the user to use PB slaves having the same function but coming from different suppliers.

For using AR2000 at the Profibus, the encoder profile of the Profibus (order No. 3062 of PNO) is supported.

For this AR2000 serves as linear encoder. Under the encoder profile, AR2000 can work as Class1 or Class2 (recommended) encoder.

All versions are implemented via GSD file. In addition to profile-specific data, the AR2000 provides specific settings which refer to the control of the laser and to diagnostics.

Profile	Class	Functions
Encoder	Class 1	Input only Simple diagnostics Minimum parameter setting
	Class 2	Input and output (preset) Extended diagnostics Extended parameter setting
AR2000	Class 1	See encoder profile
	Class 2	Additional manufacturer-specific diagnostics and parameter setting

8.9 Configuration data

The configuration of the input and output data can be selected as follows:

mandantory		
class 1	D1 hex	2 words inputs, consistency
class 2	F1 hex	2 words of input data, 2 words of output data for preset value, consistency
class 2	D3 hex	4 words inputs, consistency
class 2	D3 E1 hex	4 words of input data 2 words of output data for preset value, consistency
class 2	98 A4 hex	9 bytes of input data 5 bytes of output data, consistency
optional		
class 1	D0 hex	** not realized !! **
class 2	F0 hex	** not realized !! **

8.10 Cyclical data exchange – input (slave -> master)

Position data supplied by AR2000 is signed. The sign can be inverted in the parameter SF (scale factor). The resolution is also defined by SF.

The arrangement of octets in the telegrams conforms to the Profibus (big endian), i.e., the MSB comes first, the LSB comes last.

Octet	Bit	Type	Output
1..4		signed 32	Position data from encoder in 0.1 mm
Configuration with 8 byte input and SS mode:			
5..8		signed 32	Signal level
Configuration with 9 byte input:			
9		signed 8	Temperature in °C

8.11 Cyclical data exchange – output (master -> slave)

The most significant bit in the present value (bit 32) defines the validity of the preset.

Octet	Bit	Type	Output
1..4		signed 32	Preset value
			Normal mode: MSB = 0 (bit 31)
			Preset mode : MSB = 1 (bit 31)
Configuration with 5 byte output:			
5	0	bit	0:laser off, 1:laser on
	1	bit	0:normal – 1:ext. diagnostics with Exxxx
	2	bit	0:no diagnostics, 1:Diag. as needed
	3	bit	0:no OLED control, 1:OLED-Ctrl active
	4	bit	0:OLED off, 1:OLED on

The internal offset can be set to a required value by the present.

The offset can be changed by setting bit 31. The following applies:

MDataEx   Value transported on the Profibus in cyclical data exchange

MLaser   Value measured by the laser

MOffset   Offset calculated internally

Cyclical calculation of: MDataEx = MLaser + MOffset

The MOffset value can be written in the AR2000 directly as parameter Octet 32..35 (see chapter 8.12) and can be changed by cyclical data while the system is operating and the configuration is as required.

If bit 31 of MPreset is set in the cyclical output data, MOffset is updated. If bit 31 is zero, MOffset is not changed. The new offset can be read as octets 30..33 in the diagnostic data.

Bit 31 has no particular release function for parameter data; the offset is always adopted.

8.12 Parameter data

At least the following parameters apply to class 1 devices:

Octet	Bit	Type	Output
1		byte	station status (profibus default)
2		byte	wd_fact_1 (watch dog) (profibus default)
3		byte	wd_fact_2 (profibus default)
4		byte	min_tsdr (profibus default)
5..6		word	ident number (profibus default)
7		byte	group ident (profibus default)
8		byte	spc3 spec (profibus default)
9	0	bool	Unused
	1	bool	class 2 functionality on/off
	2	bool	commissioning diagnostic on/off
	3	bool	unused
	4	bool	reserved for future used
	5	bool	unused
	6	bool	unused
	7	bool	unused

The following additional parameters apply to class 2 devices:

Octet	Bit	Type	Output
10..13		unsigned 32	unused – Linear Encoder (Measuring units per revolution)
14..17		unsigned 32	unused – linear encoder (Measuring range in ..)
18..25		byte(s)	unused – (reserved for future use)
			manufacture specific (AR2000):
26	0	Bool	Unused
	1	bool	unused
	2..3	2 bit number	error reaction 0..2 [SEnn]
			(0:last valid value, 1:min value, 2:max value)
	4	bool	unused
	5..7	3 bit number	measure mode [0:DT, 1:CT, 2:TDM]
27	0..1	2 bit number	TRI x 0..2
	2..3	2 bit number	TRO x 0..2
	4	bool	Q1 z
	5	Bool	Q2 z
	6	Bool	Q3 z
	7	bool	unused
28..29		signed 16	TRI y : 0..32767
30..31		signed 16	TRO y : 0..32767
32..33		unsigned 16	SA x : 0.1..1000
34..37		unsigned 32	MF x : 0.0000..200.0000 (in 0.0001 steps)
38..41		unsigned 32	OF -2147483648 .. 2147483647
42..45		signed 32	SF -1000.000 .. 1000.000 (in 0.001 steps)
46..49		signed 32	MW min -2147483648 .. 2147483647
50..53		signed 32	MW max -2147483648 .. 2147483647
54..55		unsigned 16	diag time (in 100 ms steps)
56..59		signed 32	Q1w -2147483648 .. 2147483647

60..63		signed 32	Q1x -2147483648 .. 2147483647
64..67		signed 32	Q1y -2147483648 .. 2147483647
68..71		signed 32	Q2w -2147483648 .. 2147483647
72..75		signed 32	Q2x -2147483648 .. 2147483647
76..79		signed 32	Q2y -2147483648 .. 2147483647
80..83		signed 32	Q3w -2147483648 .. 2147483647
84..87		signed 32	Q3x -2147483648 .. 2147483647
88..91		signed 32	Q3y -2147483648 .. 2147483647
92..95		signed 32	QAx -2147483648 .. 2147483647
96..99		signed 32	QAy -2147483648 .. 2147483647

As AR2000 is a linear encoder and measures absolute distances, the parameters

- "Code sequence",
- "Scaling function control",
- "Measuring units per revolution" and
- "Measuring range in measuring units" of the encoder profile are ignored.

8.13 Diagnostic data

Class 2 functionality	Commissioning diagnostic	Diagnostic Information
-	0	6 byte normal diagnostic
0	1	16 byte Class 1 diagnostic
1	1	61 byte Class 2 diagnostic

Octet	Bit	Type	Output
			profibus default diagnostic
1		byte	diag state 1
2		byte	diag state 2
3		byte	diag state 3
4		byte	master address
5..6		word	slave ident
			class 1 diagnostic
7		byte	extended diag. header, length (class 1:0A, class 2:37)
8		byte	alarms – unused
9	0	Bool	Unused
	1	Bool	class 2 functionality on/off
	2	Bool	commisioning diagnostic on/off
	3	Bool	unused
	4	Bool	reserved for future use
	5	Bool	unused
	6	Bool	unused
	7	bool	unused
10		byte	encoder type (=7 absolute linear encoder)
11..14		unsigned 32	single turn resolution => 100000nm = 0.1mm
15..16		unsigned 16	no. of distinguishable revolutions – unused (=0)

			class 2 diagnostic
17	0	bool	E1001 "unexpected error"
	1	bool	E1002 "mail-box error"
	2	bool	E1003 "mutex error"
	3..7	bool	-
18..19	0	bool	E1101 "pc usart error"
	1	bool	E1102 "pc usart error"
	2	bool	E1103 "laser usart error"
	3	bool	E1104 "laser usart error"
	4	bool	E1105 "laser usart error"
	5	bool	E1106 "spi error"
	6	bool	E1107 "spi error"
	7	bool	E1108 "i2c error"
	8	bool	E1109 "i2c error"
	9	bool	E1110 "ssi error"
	10	bool	E1111 "ssi error"
	11	bool	E1112 "profibus error"
	12	bool	E1113 "profibus error"
	13	bool	E1201 "no destination found"
	14	bool	E1202 "calibration error"
	15	bool	E1203 "bad surface"
20..21	0	bool	E1204 "measure aborted"
	1	bool	E1205 "measure running"
	2	bool	E1206 "dest. too bright"
	3	bool	E1207 "destination not in window"
	4	bool	E1208 "parameter error"
	5	bool	E1209 "no answer from laser"
	6	bool	W1901 "reboot"
	7	bool	W1902 "supply outer limit"
	8	bool	W1903 "supply outer limit"
	9	bool	W1904 "temp outer limit"
	10	bool	W1905 "temp outer limit"
	11	bool	W1906 "heating active"
	12	bool	E1910 "measure time out"
	13	bool	W1911 "measure frequ. too high"
	14	bool	E1912 "."
	15	bool	-
22..23		word	warnings – unused (=0)
24..25		word	profile version (z.B. 1.1 = 0110 hex)
26..27		word	software version (z.b. 1.11 = 0111 hex)
28..31		unsigned 32	operating time (of laser), in 0.1 hours
32..35		signed 32	offset value (also see output data)
36..39		signed 32	manufacture offset – unused (=0)
40..43		unsigned 32	measuring units per revolution – unused (=0)
44..47		unsigned 32	measuring range – unused (=0)
48..57		10 byte	serial number
58..59		signed 16	laser temperature in °C
60		byte	reserved - unused
61		byte	reserved - unused

8.14 Tips for start-up (Siemens STEP7)

The programming software must be made familiar with the possibilities of the AR2000:

- Open the Simatic Manager

- Open HW Config

- Extras – install new GSD file

- Select AR2000.GSD

After that AR2000 can be integrated at the Profibus:

Select DP slave at 'Other field devices' – 'Encoder' – AR2000

A Profibus address must be assigned to AR2000 (in SSA Set Slave Address): Target system – Profibus – Assign Profibus Address

8.15 Error display

External errors are not displayed at the module.

8.16 Monitoring

Set to a trigger time of 500ms, a watchdog internal to the PU monitors the functioning of the module. The following functions are monitored:

- the main loop with Profibus request processing
- the laser control
- the update function.

In case of transient errors (ESD, program error, ..) the module can be started again after a watchdog reset. Each reset increments the watchdog counter by one.

Other reset causes are also counted:

- Spike detection reset
- SW reset
- Programming and debug reset
- Brownout reset (monitoring of the operating voltage)
- External reset
- Power-on reset

8.17 SSI Communication protocols

8.17.1 Overview

The service program SL5.exe supports the commissioning.

All settings are made into a SPS directly have to perform according to the specifications of the manufacturer of SPS.

The service program can be purchased along with an USB master of softing.

Order number: 95831

After installation of a Profibus master, product of Softing, the related drivers (also see 2.4.), the service program for lasers AR2000 (SL5.EXE) can be started. The program as such does not need an installation (it is linked statically). Only the papi.dll for the Profibus must be placed in the folder.

Copy the service program SL5.EXE and the papi.dll file in any network folder and execute SL5.EXE.
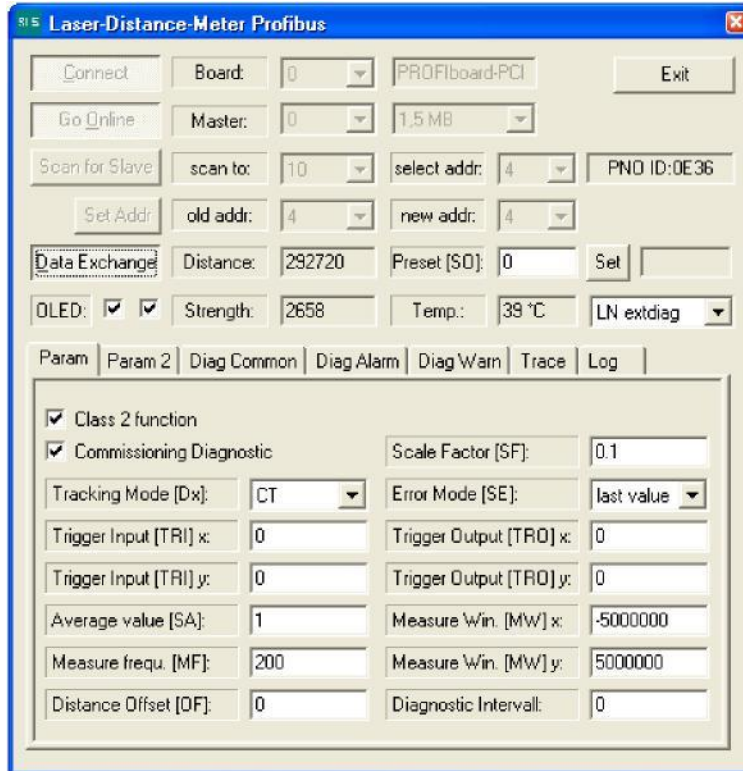
In the SL5.EXE program, confirm the four big buttons on the left one after the other, starting from top:

If a computer contains several PB masters, a master module on the right of the word "Board" can be selected with the combo-box. The selected master module will be analyzed and its type displayed on the right of it, e.g., PROFIboard PCI or PROFIcard

1. Press the **Connect** button

2. The selected board is activated and – if successful - the 'Go Online' button enabled. If a problem occurs, open 'Trace' with a mouse-click on the 'Trace' tab (in the middle of the dialog) for more information on the Profibus.

3. On the right of the word 'Master:' an address can be assigned on the Profibus with the combo-box of the PB master module.

4. Every address must be unique!

5. Depending on what type of Profibus is connected, different PB masters and PB slaves with addresses in the range 0..125 can be available. Normally, the preset 0 as address of the PB master is okay.

6. The baud rate should be set as a function of the length of the line or masters already active on the bus.

7. Press the **Go Online** button

8. The PB master will become active on the bus (exchanges the token). If everything is okay, the 'Scan for Slave' button will be enabled after about 2 seconds. Now the bus can be searched for slaves. The search always begins at address 0. The master address is skipped. To cut the search short, the highest address to be used can be defined.

9. Press the **Scan for Slave** button

10. A search of the bus is made and the first AR2000 found is selected as slave. If the slave address ('select addr:') is changed, a diagnosis request is sent to the slave and the PNO Ident of the slave displayed when the reply is received.

11. Press the **Data Exchange** button

12. The master adopts Operate state, sends a data exchange request to the AR2000, whereupon the latter activates its laser. The distances measured can be viewed at Distance.

8.17.2 Setting a Profibus slave address at the AR2000

Perform steps 1 to 10 in chapter 8.17.1. One AR2000 PI-LB module must have been found at the bus. The Profibus slave address of that module can now be changed to between 0 and 125 but the addresses of other bus users must not be assigned to the module.

For this, select 'old addr:' the current address and the required new address at 'new addr:'.

Then press 'Set Addr'. 'Set Slave Adress' (SSA), a Profibus global control, transfers the new address to the PB slave, which uses the new address henceforth. The new address is stored permanently in the EEPROM and is the new slave address also after a power outage.

8.17.3 Parameter dialog

A PB master generates parameters for the slave by means of the GSD file and must send the parameters to the slave at least once to enable the slave to be used for the regular exchange of data.

The slave is programmed with sufficient tolerance so that it can be used with only 7 Byte standard PB parameters (i.e., without profile-specific user parameters).

The SL5 generates a complete encoder profile specific parameter record, which is transmitted to the slave immediately when a datum is changed (provided it is active on the bus).

(Profibus) parameters cannot be read back. Therefore, the setting of the parameters may not agree with the parameters active in the slave when the SL5 is started.

- Class 2 function: Selection of the slave type according to the encoder profile

- Commissioning diagnostic: Send more than the 6 Byte standard diagnostic (16 Byte as Class1 slave, 61 Byte as Class 2 slave)

- Tracking mode: Mode (trigger) of the laser (DT,CT,TDM)

- Trigger input flank and time spacing: Values are transferred directly to the TRI x y command

- Trigger output flank and time spacing: Values are transferred directly to the TRO x y command

- Averaging: Value is transferred to the SAn command

- An offset can be applied to the measuring value (correction).

- Scale factor: Scaling factor –1000.000 .. +1000.000. Up to 3 decimal digits are processed.

- Error mode: Selects the distance value in case of an error

- Measure frequency: Measuring time output, 0 means no firm frequency, range 0.0 .. 200.0 with up to 4 decimal digits

- Measure window: Setting of the valid measuring window

- Diagnostic interval: 0=Send diagnostic data only in case of alarm, 1..10000 : Send diagnostic data every n x 100ms

- Switched output Q1/2/3: Switching threshold for output n in units of distance – is transferred to Q1/2/3 command

- Analog switched output: min. and max. distance values for 4 and 20 mA

8.17.4 Diag Common

The (general) diagnostic data is in full agreement with the profile standard and is updated by every Profibus diagnostic request.

The Common Diag data requires Class2 functionality and the Commissioning diagnostic function. In case of error (Ennnn) or warnings (Wnnnn) an alarm message with all diagnostic data is sent as extended diagnostic.

To view temperature and operating time, set the diagnostic interval other than 0. A diagnostic interval of 100 causes an update every 10secs.

8.17.5 Diag Alarm

Alarm messages of the laser module are sent once as EXT. DIAG.

Active alarms are marked X instead of –. Alarms are counted but not stored anywhere.

If an error occurs, it is reported as Ext.Diag and then an attempt at reactivating the laser is made. Thus, permanently active errors increment the appropriate error count.

8.17.6 Trace

Certain messages will be displayed on the Trace tab for diagnostic purpose if problems occur with the Profibus or the PB master in the PC.

8.17.7 Log file

If required, the SL5 program can write distances and temperature in a log file in regular intervals.

The log file can have a firm name. For this, uncheck the 'automatic' box. Select a target folder and a file name with the Browse button ('...'). Data will then be written in that file continuously.

For longer recording times, the log can be split into day files. For this, check the 'automatic' box. This generates a file by the generic name ‚L5_yymmdd' (yy=year, mm=month, dd=day). That file is closed at midnight and a new file generated for the next day. The system time (UTC, GMT) is used as file time.
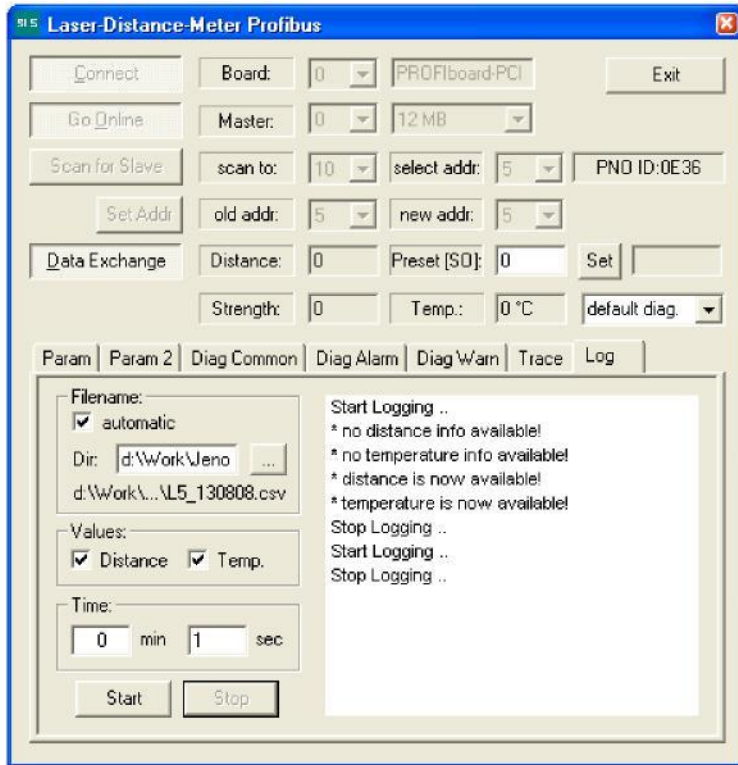
The file is written with special 'share' attributes so that it can be read by other programs (databases, control systems, ..) at the same time. Also see tail programs.

Under Values, select the values to be written.

Under Time, enter the time spacing between 2 values in minutes and/or seconds.

The log can be started or stopped at any time with Start and Stop.

The message in the messages window contains additional information whether the module is supplying distance or temperature data

9. Error Processing

In case of errors or when a measured value cannot be determined or put out, a warning or an error message will be displayed.

Error	Meaning	Action
e1001	Error operation system/ firmware	Restart system
e1002	Error operation system/ firmware	
e1003	Error operation system/ firmware	
e1101	Error in communication with PC	check connection to external system/ contact service for repair
e1102	Error in communication with PC	
e1103	Laser module error	contact service/ send AR2000 to supplier
e1104	Laser module error	
e1105	Laser module error	
e1106	Hardware error (internal data transfer)	
e1107	Hardware error (internal data transfer)	
e1108	Hardware error (controller)	
e1109	Hardware error (controller)	
e1110	Hardware error (SSI)	
e1111	Hardware error (SSI)	
e1112	Hardware error (Profibus)	
e1113	Hardware error (Profibus)	
e1201	Measurement impossible / no target	adjust device/ check target
e1202	Error measuring module (calibration)	contact service/ send AR2000 to supplier
e1203	Target with unsuitable reflectivity	check target and distance
e1204	Measurement interrupted (measuring module)	Restart system
e1205	Measurement still running (measuring module)	Restart system
e1206	Target too bright / too much back light	check/ limit ambient light
e1207	Target outside of the measurement window (MW)	no action or change MW setup
e1208	Incorrect measurement parameterization	check setup
e1209	Hardware error (measuring module)	contact service/ send AR2000 to supplier
e1210	Current of laser is over the limit (laser stops working)	Restart measurement DT
e1211	Stop of measurement (internal error)	Restart of measurement DT
Warnings	**Meaning**	**Action**
w1901	Restart being executed	no action
w1902	Input voltage outside of the specification (too low)	check power supply (10 - 30 VDC)
w1903	Input voltage outside of the specification (too high)	
w1904	Temperature outside of the specification (too low)	check ambient temperature
w1905	Heating active, min. temperature not reached, no measurement possible	no action/ wait until AR2000 is ready
w1906	Temperature outside of the specification (too high)	check ambient temperature
w1907	Trigger input and trigger output active at the same time	Activate TRI or TRO, not both for the same system
w1910	Measurement not completed within predefined period of time	use variable measuring time (MF0)/ check target
w1911	Measuring frequency too high	change MF
w1912	Distance jump	Ensure continuous movement of target