FLUKE
Process Instruments

MP Series

Infrared Linescanner

Users Manual

PN 5259583, English, Rev. 1.0, Apr 2021

Warranty

The manufacturer warrants this instrument to be free from defects in material and workmanship under normal use and service for the period of two years from date of purchase. This warranty extends only to the original purchaser. This warranty shall not apply to fuses, batteries or any product which has been subject to misuse, neglect, accident, or abnormal conditions of operation.

In the event of failure of a product covered by this warranty, the manufacturer will repair the instrument when it is returned by the purchaser, freight prepaid, to an authorized Service Facility within the applicable warranty period, provided manufacturer's examination discloses to its satisfaction that the product was defective. The manufacturer may, at its option, replace the product in lieu of repair. With regard to any covered product returned within the applicable warranty period, repairs or replacement will be made without charge and with return freight paid by the manufacturer, unless the failure was caused by misuse, neglect, accident, or abnormal conditions of operation or storage, in which case repairs will be billed at a reasonable cost. In such a case, an estimate will be submitted before work is started, if requested.

The foregoing warranty is in lieu of all other warranties, expressed or implied, including but not limited to any implied warranty of merchantability, fitness, or adequacy for any particular purpose or use. The manufacturer shall not be liable for any special, incidental or consequential damages, whether in contract, tort, or otherwise.

Software Warranty

The manufacturer does not warrant that the software described herein will function properly in every hardware and software environment. This software may not work in combination with modified or emulated versions of Windows operating environments, memory-resident software, or on computers with inadequate memory. The manufacturer warrants that the program disk is free from defects in material and workmanship, assuming normal use, for a period of one year. Except for this warranty, the manufacturer makes no warranty or representation, either expressed or implied, with respect to this software or documentation, including its quality, performance, merchantability, or fitness for a particular purpose. As a result, this software and documentation are licensed "as is," and the licensee (i.e., the User) assumes the entire risk as to its quality and performance. The liability of the manufacturer under this warranty shall be limited to the amount paid by the User. In no event shall the manufacturer be liable for any costs including but not limited to those incurred as a result of lost profits or revenue, loss of use of the computer software, loss of data, the cost of substitute software, claims by third parties, or for other similar costs. The manufacturer's software and documentation are copyrighted with all rights reserved. It is illegal to make copies for another person.

This manual is available in different languages. In case of differences between the language versions, the English manual is binding.

Table of Contents

Chapter **Page**

List of Tables

Table **Page**

List of Figures

Figure **Page**

Compliance Statement

The device complies with the requirements of the European Directives:

EC – Directive 2014/30/EU – EMC

EC – Directive 2011/65/EU – RoHS II

EN 61326-1: 2013	Electrical measurement, control and laboratory devices - Electromagnetic susceptibility (EMC)
EN 50581: 2012	Technical documentation for the evaluation of electrical products with respect to restriction of hazardous substances (RoHS)

Electromagnetic Compatibility Applies to use in Korea only. Class A Equipment (Industrial Broadcasting & Communication Equipment)
This product meets requirements for industrial (Class A) electromagnetic wave equipment and the seller or user should take notice of it. This equipment is intended for use in business environments and is not to be used in homes.

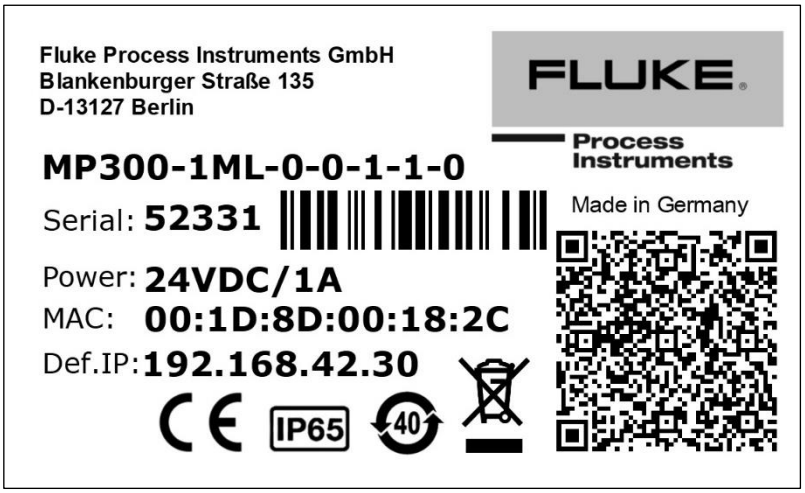
Safety Information

This document contains important information, which should be kept at all times with the instrument during its operational life. Other users of this instrument should be given these instructions with the instrument. Eventual updates to this information must be added to the original document. The instrument can only be operated by trained personnel in accordance with these instructions and local safety regulations.

Acceptable Operation
This instrument is intended only for the measurement of temperature. The instrument is appropriate for continuous use. The instrument operates reliably in demanding conditions, such as in high environmental temperatures, as long as the documented technical specifications for all instrument components are adhered to. Compliance with the operating instructions is necessary to ensure the expected results.

Unacceptable Operation
The instrument should not be used for medical diagnosis.

Replacement Parts and Accessories
Use only original parts and accessories approved by the manufacturer. The use of other products can compromise the operation safety and functionality of the instrument.



Safety Symbol	Description
	Read all safety information before in the handbook
	Hazardous voltage. Risk of electrical shock.
	Warning. Risk of danger. Important information. See manual.
	Laser warning
	Earth (ground) terminal
	Protective conductor terminal
	Switch or relay contact
	DC power supply
	Conforms to European Union directive.
	Disposal of old instruments should be handled according to professional and environmental regulations as electronic waste.
	Conforms to relevant South Korean EMC Standards.
	International Ingress Protection Marking
	China RoHS

To prevent possible electrical shock, fire, or personal injury follow these guidelines:

- Read all safety information before you use the product.
- Use the product only as specified, or the protection supplied by the product can be compromised.
- Do not use the product around explosive gases, vapor, or in damp or wet environments.
- Carefully read all instructions.
- Do not use and disable the product if it is damaged.
- Do not use the product if it operates incorrectly.
- Do not apply more than the rated voltage between the terminals or each terminal and earth ground.
- Do not look directly into the laser with optical tools (for example, binoculars, telescopes, microscopes). Optical tools can focus the laser and be dangerous to the eye.
- Do not look into the laser. Do not point laser directly at persons or animals or indirectly off reflective surfaces.
- Do not use laser viewing glasses as laser protection glasses. Laser viewing glasses are used only for better visibility of the laser in bright light.
- Use the product only as specified or hazardous laser radiation exposure can occur.
- Incorrect wiring can damage the sensor and void the warranty. Before applying power, make sure all connections are correct and secure!
- To prevent possible electrical shock, fire, or personal injury make sure that the sensor is grounded before use.
- Have an approved technician repair the product.
- The metallic enclosure of the sensor is not necessarily earthed by installation. At least one of the following safety measures must be met to minimize the danger of electrostatic charges:
  - Earth grounding of the cable shield
  - Installing the unit’s metallic enclosure on an earth grounded mounting bracket or on any other grounded bases
  - Protect the operator from electrostatic discharge

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For more information, contact your local office.

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1 Description

The MP infrared thermal linescanner is designed for use in highly demanding industrial environments and provides accurate temperature images of moving objects. This multi-point measurement is achieved by a rotating optical system, which collects infrared radiation at up to 1024 points within a 90º field-of-view (FOV). The motorized mirror scans at rates up to 300 lines per second.

An internal high-speed microprocessor calculates the temperature of the individual measurement points of each line of data. The MP thermal linescanner includes provision for air or water-cooling and three PC independent analog outputs. The thermal linescanner also features on-board Ethernet TCP/IP communication capability and a built-in line laser for rapid alignment.

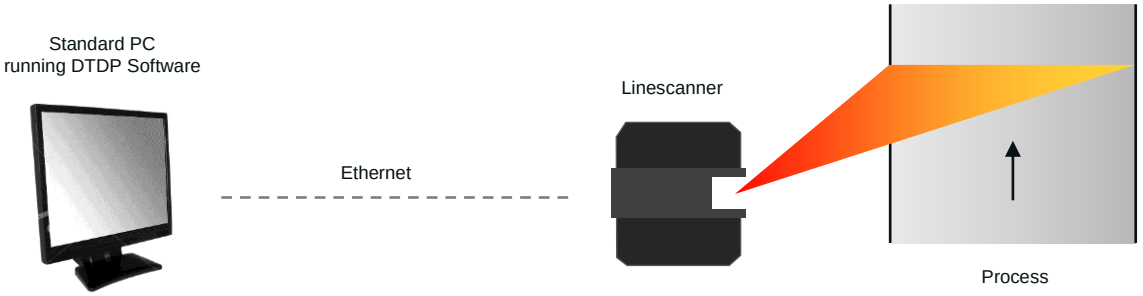
The MP linescanner series comes with the following features:

- Scan speeds up to 300 lines per second
- Up to 1024 measurement points per line
- Optical resolution up to 200:1
- Real-time color thermal images
- Accurate data analysis
- Reliable Ethernet communication
- Rugged, waterproof housing
- 40,000 MTBF brushless scanning motor
- Field-replaceable window
- Built-in air purge and water cooling
- 3 PC independent analog outputs, one alarm relay
- I/O module support for up to 10 sectors/zones (PC independent)

Figure 1-1: MP Linescanner

The following figure shows the principal structure of the system. It shows a solution with one scanner connected to a standard Windows PC via Ethernet communications.

Figure 1-2: Principal Structure of the Linescanning System



The following linescanner model variants are available:

MP	**300**	–	**1ML**	–	**0**	–	**0**	–	**0**	–	**1**	–	**0**
Series:	Frequency:		Spectral:		Connector:		Protocol:		Data Points:		Air Purge:		Certificate:
Linescanner	150 = 150 Hz 300 = 300 Hz		3M 2M 1ML 1MH		0 = M12 plug 7.5 m (25 ft) cable with RJ45		0 = Ethernet TCP/IP		0 = 512 1 = 1024		0 = no 1 = yes		0 = no 1 = yes

Example: MP300-1ML-0-0-0-1-0

2 Technical Data

2.1 Measurement Specification

Temperature Range

MP150-3M	200 to 1500°C (392 to 2732°F)
MP300-3M	250 to 1500°C (482 to 2732°F)
MP150-2M	350 to 1500°C (662 to 2732°F)
MP300-2M	400 to 1500°C (752 to 2732°F)
MP150-1ML	600 to 1500°C (1112 to 2732°F)
MP300-1ML	650 to 1500°C (1202 to 2732°F)
MP150-1MH	700 to 1800°C (1292 to 3272°F)
MP300-1MH	700 to 1800°C (1292 to 3272°F)

Spectral Response

3M	2.4 µm
2M	1.6 µm
1ML	1 µm
1MH	1 µm

Detectors

3M	extended InGaAs
2M	InGaAs
1ML, 1MH	Si

System Accuracy[1]

All models	± 0.5% of reading or ± 3°C (6°F), whichever is greater

Repeatability[2]

All models	± 2°C (± 4°F)

Temperature Resolution

Digital output	0.1 K
Analog output	16 bit

Scan Rate

MP150	max. 150 Hz
MP300	max. 300 Hz

Measured Points per Line

MP150	256 pixel @ 150 Hz scan rate
	512 pixel @ 80 Hz scan rate
	1024 pixel @ 40 Hz scan rate
MP300	256 pixel @ 300 Hz scan rate
	512 pixel @ 160 Hz scan rate

[1] at ambient temperature 0 - 50°C (32 - 122°F), emissivity = 1.0 and calibration geometry
[2] at ambient temperature 0 - 50°C (32 - 122°F), emissivity = 1.0 and calibration geometry

	1024 pixel @ 80 Hz scan rate
Scan Angle (FOV)	
All models	90°

2.2 Optical Specifications

Optical Resolution **D:S[3]**

Measurement Resolution (90% energy)

3M	200:1 (IFOV = 5 mrad)
2M	200:1 (IFOV = 5 mrad)
1ML	200:1 (IFOV = 5 mrad)
1MH	200:1 (IFOV = 5 mrad)

Hot Spot Detection (50% energy)

3M	600:1 (IFOV = 1.7 mrad)
2M	600:1 (IFOV = 1.7 mrad)
1ML	600:1 (IFOV = 1.7 mrad)
1MH	600:1 (IFOV = 1.7 mrad)

For more information, see sections 2.2.1 Optical Diagrams, page 17 and 2.2.2 Optical Resolution over Scan Rate, page 19.

Focus Distances

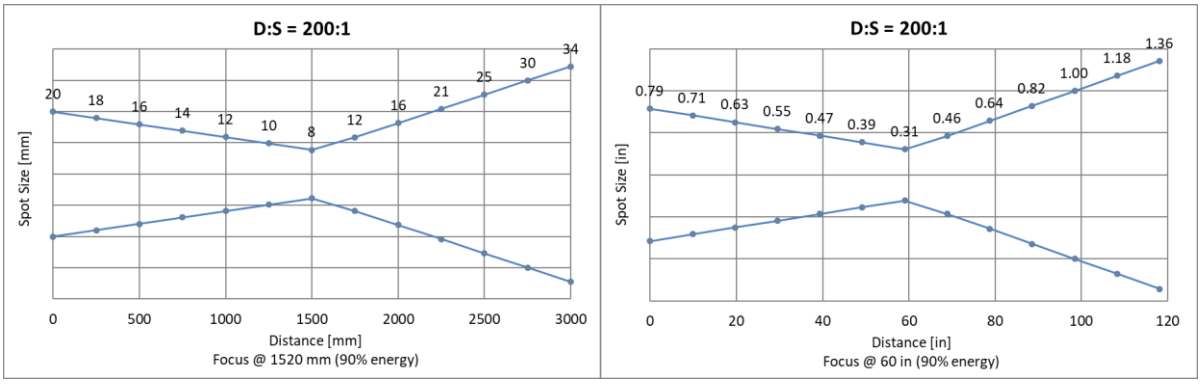
all	standard focus: 1.52 m (4.9 ft) special focal distances available, minimal focal distance: 500 mm (20 in)

Note
The focus distance is measured from the front end of the scanner!

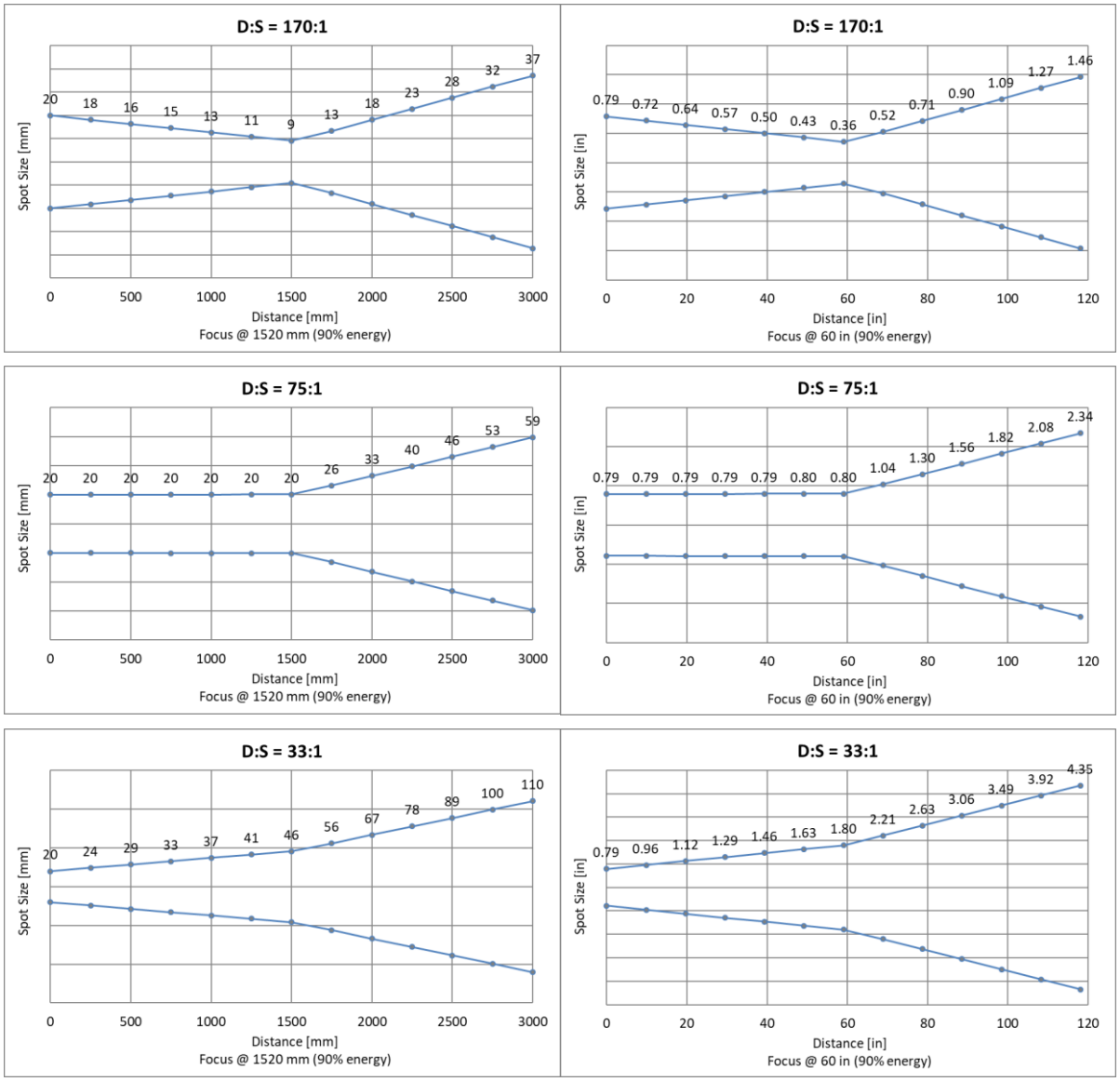
2.2.1 Optical Diagrams

2.2.1.1 Standard Focus

Figure 2-1: Optical Diagrams Standard Focus

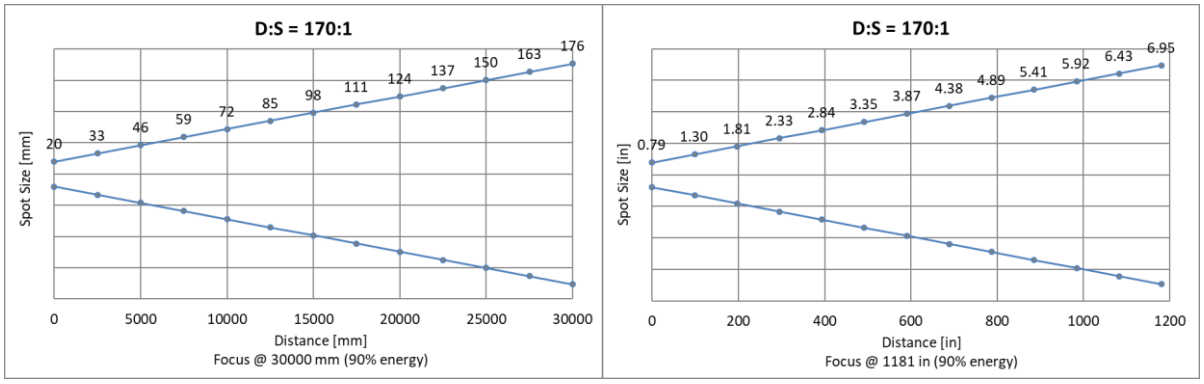


[3] measured as slit response at 20 Hz scan rate, per pixel at focus distance



2.2.1.2 Far Focus

Figure 2-2: Optical Diagrams Far Focus



2.2.2 Optical Resolution over Scan Rate

Figure 2-3: Measurement Resolution depending on Scan Rate

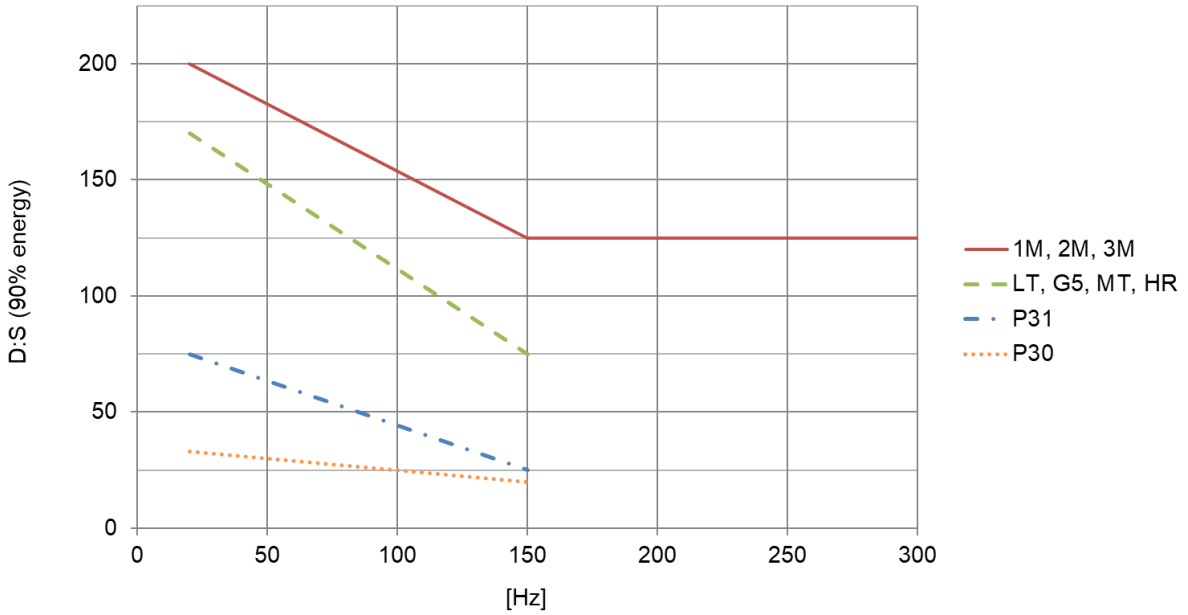
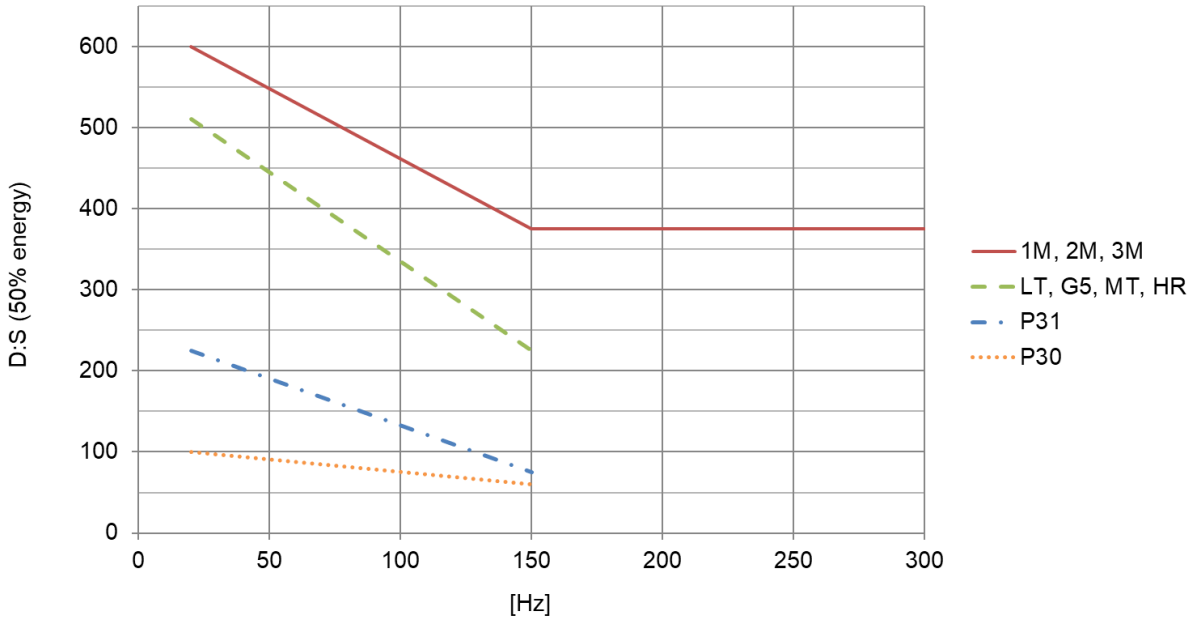


Figure 2-4: Hot Spot Detection depending on Scan Rate



2.3 Electrical Specifications

Power	24 VDC ± 25%, 1 A
Ethernet	
Connection	M12 socket, 4 wires (full duplex) 100 MBit/s, 100BASE-TX / IEEE 802.3u, Auto-Negotiation electrically isolated from power supply
Addressing	fixed IP address BootP (using UDP sockets 67 and 68)
Protocol	TCP/IP version 4
Default Settings	IP Address: 192.168.42.30, port 2727 Subnet Mask: 255.255.255.0 Gateway: 192.168.42.1 BootP: enabled per factory default MAC address: see sticker on the scanner
RS485	
Connection	full-duplex, not addressable, electrically isolated 9.6, 57.6, 115.2, 230.4 kBaud
Outputs	
Analog	3 active current outputs, each adjustable 0/4 ... 20 mA, maximum load: 500 Ω, minimal load: 47 Ω common ground connection for all current outputs, electrically isolated to the GND ground
Alarm	potential-free relay contacts: 30 V / 1 A normally open / normally closed
Exposure Time[4]	$\frac{1}{f_{scan}}$
Response Time[5]	20 ms + $\frac{1}{f_{scan}}$
Inputs	
Trigger	+ 5 to 24 VDC pulse, high/low active
Functional Input	max. + 5 VDC function depends on the specific system
Signal Processing	
Stand-alone scanner	up to 3 sectors / zones, PC independent at runtime Max, Min, Average, Peak/Valley Hold, Alarm setpoints further signal processing function configurable through software
I/O module support	up to 10 sectors / zones, PC independent at runtime Max, Min, Average, Peak/Valley Hold, Alarm setpoints further signal processing function configurable through software

[4] The exposure time is the minimum time during which the measured object must be present. The output value of the sensor is delayed.
[5] Time interval between the instant of an abrupt change for the object temperature and its availability on the output

2.4 Environmental Specifications

Ingress Protection	IP65 (IEC 60529)

Ambient Operating Temperature[6]

All	0 to 50°C (32 to 122°F) without cooling max. 180°C (356°F) with integrated water cooling (Standard)

Internal Operating Temperature

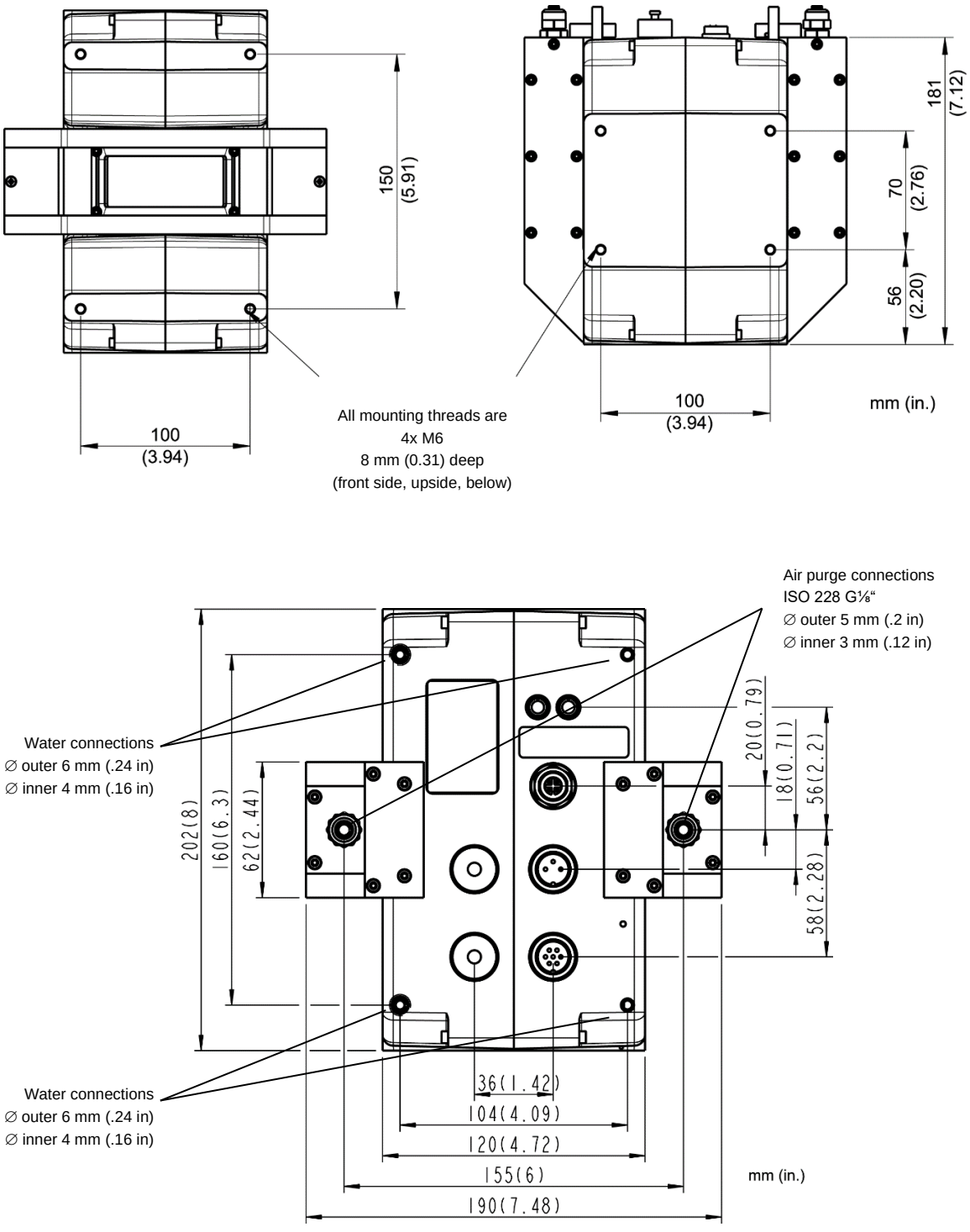
Scanner	0 to 60°C (32 to 140°F)
Laser	automatic switch off at < 5°C (41°F) or > 50°C (122 °F)

Storage temperature	-25 to 65°C (-13 to 149°F)
Humidity	10% to 90%, non-condensing (operating and storage)
Vibration and shock	IEC 60068-2-6, 3 axes, 10 to 150 Hz, operating 2 g above 20 Hz IEC 60068-2-27, 3 axes, operating: 5 g at 11 ms, 15 g at 6 ms
EMC	EN 61326-1:2013 industrial
KCC	Electromagnetic Compatibility - applies to use in Korea only. Class A Equipment (Industrial Broadcasting & Communication Equipment) This product meets requirements for industrial (Class A) electromagnetic wave equipment and the seller or user should take notice of it. This equipment is intended for use in business environments and is not to be used in homes.
Warm up Period	30 min.
MTBF	40,000 h (about 4.5 years) meantime between failures (MTBF) for the mechanical scanning system at 48 Hz scan rate
Weight	7 kg (15.4 lbs), incl. air purge

[6] at still air (e.g. by using a protective housing)

2.5 Dimensions

Figure 2-5: Dimensions and Mounting Locations



Note
The mounting dimensions are the same for top and bottom view!

2.6 Scope of Delivery

The scope of delivery includes the following:

- Linescanner
- Operating instructions (also included as PDF file on the data carrier)
- DataTemp DP Software (lite version)
- Protocol manual as PDF file on the data carrier
- 1x spare window for linescanner
- 1x connector (female) 6-pin for inputs/outputs
- 1x connector (female) 4-pin for analog current outputs
- Tools: 1x hex key wrench 2.5 mm
  1x hex key wrench 5 mm

3 Basics

3.1 Measurement of Infrared Temperature

All surfaces emit infrared radiation. The intensity of this infrared radiation changes according to the temperature of the object. Depending on the material and surface properties, the emitted radiation lies in a wavelength spectrum of approximately 1 to 20 µm. The intensity of the infrared radiation (heat radiation) is dependent on the material. For many substances, this material-dependent constant is known. This constant is referred to as the emissivity value.

Infrared thermometers are optical-electronic sensors. These sensors are sensitive to the emitted radiation. Infrared thermometers are made up of a lens, a spectral filter, a sensor, and an electronic signal processing unit. The task of the spectral filter is to select the wavelength spectrum of interest. The sensor converts the infrared radiation into an electrical signal. The signal processing electronics analyze the electrical signal and convert it into a temperature measurement. As the intensity of the emitted infrared radiation is dependent on the material, the required emissivity can be selected on the sensor.

The biggest advantage of the infrared thermometer is its ability to measure temperature without touching an object. Consequently, surface temperatures of moving or hard to reach objects can easily be measured.

3.2 Emissivity of Target Object

To determine the emissivity of the target object, see section 9.3 Typical Emissivity Values, page 62. If emissivity is low, measured results could be falsified by interfering infrared radiation from background objects (such as heating systems, flames, fireclay bricks, etc. located close beside or behind the target object). This type of problem can occur when measuring reflective surfaces and very thin materials, such as plastic film and glass.

This measurement error can be reduced to a minimum, if particular care is taken during installation and the sensing head is shielded from these reflecting radiation sources.

4 Environment

The linescanner complies with ingress protection IP65 and is therefore dust and splash resistant. The linescanner's window is made of a material that is resistant to thermal stress.

4.1 Ambient Temperature

Without water cooling, the linescanner is designed for ambient operating temperatures between 0 to 50°C (32 to 122°F). With water cooling, it can be used in environments of up to 180°C (356°F), see section 5.6 Water Cooling, page 29. The internal temperature is the determining factor for proper operation of the linescanner. It is displayed in the DataTemp software. The difference between the external ambient temperature and the temperature inside the housing also depends on the thermal contact of the linescanner and its mounting hardware.

The temperature inside the housing must be between 0 to 60°C (32 to 140°F) during operation and never more than 65°C (150°F) at any time, including non-operation!

4.2 Atmospheric Quality

If the window gets dirty, infrared energy will be blocked and the sensor will not measure accurately. It is good practice to always keep the window clean. The air purge collar helps keep contaminants from building up on the window, see section 5.7 Air Purge Collar, page 31. If you use air purging, make sure a filtered air supply with clean, dry air at the correct air pressure is installed before proceeding with the sensor installation.

4.3 Electrical Interference

To minimize electrical or electromagnetic interference or noise, please be aware of the following:

- Mount the instrument as far away as possible from potential sources of electrical interference, such as motorized equipment, which can produce large step load changes.
- Use shielded wire for all input and output connections.
- For additional protection, use conduit for the external connections. Solid conduit is better than flexible conduit in high-noise environments.
- Do not run AC power in the same conduit as the sensor signal wiring.
- To avoid potential differences use a single power circuit to power both the linescanner and the PC running the software!
- To avoid ground loops, make sure that only ONE POINT is earth grounded. Use a single power circuit to power both the linescanner and the PC running the software!

The housing of the linescanner is electrically grounded. All inputs and outputs are electrically isolated from the housing, the input voltage, and from one another. The current outputs have a joint ground connection, but are electrically isolated from any other ground connection.

5 Installation

Risk of Personal Injury

When this instrument is being used in a critical process that could cause property damage and personal injury, the user should provide a redundant device or system that will initiate a safe process shutdown in the event that this instrument should fail.

5.1 Positioning

Sensor location depends on the application. Before deciding on a location, you need to be aware of the ambient temperature of the location, the atmospheric quality of the location, and the possible electromagnetic interference in that location. If you plan to use air purging, you need to have an air connection available. Wiring and conduit runs must be considered, including computer wiring and connections, if used.

5.2 Geometry

The smallest possible object which can be measured depends on two conditions:

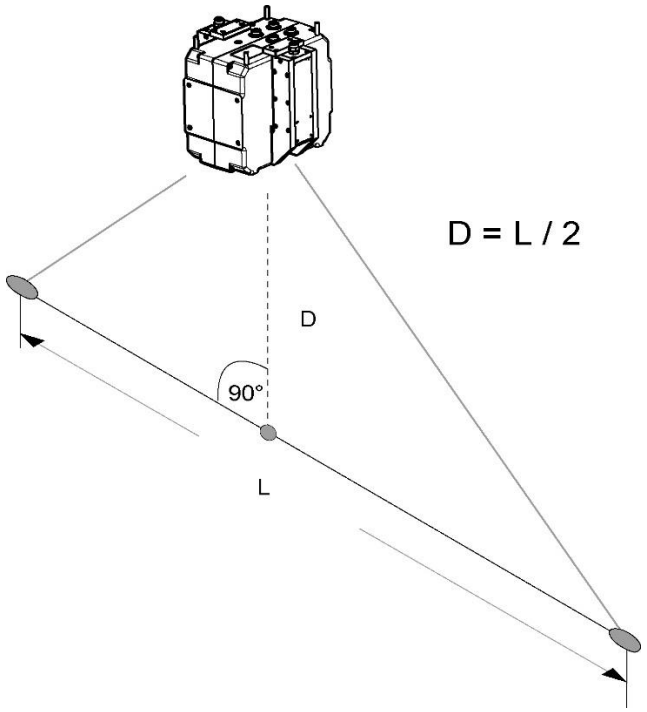
- The area measured must be no less than 90% (90% energy response, see measurement resolution).
- Hot spots must be clearly detected, when in front of a cold background (50% energy response, see hot spot detection).

The measured area for 50% energy response is approximately a third of the area size of the measured spot for 90% energy response.

For a list indicating the available optics, see section 2.2 Optical Specifications, page 17. The manufacturer provides a tool for calculating spot sizes, see section 9.1 Spot Size Calculator, page 61.

The relationship between the scan line width L and the distance to the target D is defined as described below. The distance to the target is measured from the front surface of the housing. For longer distances, the scan line width is about twice the measurement distance.

Figure 5-1: Scan Line Width L and Distance to Target D



5.3 Mounting

The linescanner can be installed as follows:

- on a tripod with a standard 1/4-20 UNC (photo equipment) thread. This type of setup requires the tripod mounting plate (A-MP-MP, available as accessory) and is recommended if the linescanner is to be used only for temporary or mobile measurements.
- with the mounting holes of the linescanner housing. This type of setup is recommended for permanent installations where higher stability is desired.

Prevent all contact between heat sources and the linescanner to protect the linescanner from overheating.

5.4 Warm-Up Time

For accurate temperature readings we recommend a 30 minute warm-up period after power on. During this time the internal calibration sources will be stabilized. Digital communication and the analog outputs can be started 120 seconds after power on.

5.5 Laser

The built-in laser sighting function allows fast and precise aiming at small or rapidly moving targets, or targets passing at irregular intervals. The laser is specially aligned with the scan line of the linescanner. A small, bright red laser line shows you the center of the scanned line, not the size of the spots being measured.

The laser is a Class II type laser diode with an output power less than 1 mW and an output wavelength of 650 nm. The horizontal angle is 70°, non-symmetrically.

The laser can be turned on and off via the scanner runtime software, see menu <Scanner> <Switch Laser on/off>.

The laser automatically turns off for an internal case temperature outside of at < 5°C (41°F) or > 50°C (122 °F)

Note

To preserve laser longevity, the laser automatically turns off after approximately 10 minutes of constant use!

Risk of Personal Injury

Avoid exposure to laser light! Eye damage can result.
Use extreme caution when operating!
Never look direct into the laser beam!
Never point directly at another person!

5.6 Water Cooling

The linescanner is equipped with integrated stainless-steel pipes for water cooling. These pipes are embedded in the cast aluminum housing. The water cooling system enables the linescanner to be installed in ambient temperatures up to 180°C (356°F). Maximum pressure for the cooling fluid is 15 bar (218 PSI). Only filtered water should be used in order to reduce the risk of clogging at the hose couplings. In order to prevent the accumulation of water condensation on the scanner window and to protect the window, the air purge system should always be used when water cooling is used.

Threaded tube fittings to connect a water cooling system are provided as accessory, see section 7.4 Tube Fittings (A-MP-FS-xxx), page 46. The internal stainless steel tube is designed to mate to a hose with an internal diameter of 6 mm (0.24 in).

The following table gives some examples for the efficiency of the water cooling system.

Table 5-1: Efficiency of the Water Cooling System

Ambient Temperature	Water Flow	Water Temperature at Inlet	Resulting Internal Temperature
180°C (356°F)	1 l / min (0.26 gallons / min)	25°C (77°F)	36°C (97°F)
180°C (356°F)	2 l / min (0.52 gallons / min)	15°C (59°F)	27°C (81°F)

5.6.1 Avoidance of Condensation

If environmental conditions make water cooling necessary, it is strictly recommended to check whether condensation will be a real problem or not. Water-cooling also causes a cooling of the air in the inner part of the sensor, thereby decreasing the capability of the air to hold water. The relative humidity increases and can reach 100% very quickly. In case of a further cooling, the surplus water vapor will condense out as water. The water will condense on the lenses and the electronics, resulting in possible damage to the sensor. Condensation can even happen on an IP65 sealed housing.

Note
There is no warranty repair possible in case of condensation within the housing!

To avoid condensation, the temperature of the cooling media and the flow rate must be selected to ensure a minimum device temperature. The minimum sensor temperature depends on the ambient temperature and the relative humidity. Please consider the following table.

Table 5-2: Minimum device temperatures [°C/°F]

Relative Humidity [%]

Ambient Temperature [°C/°F]	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**	**95**	**100**
0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32
5/ 41	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	5/ 41
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20/ 68	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	5/ 41	5/ 41	5/ 41	10/ 50	10/ 50	10/ 50	10/ 50	15/ 59	15/ 59	15/ 59	15/ 59	15/ 59	20/ 68
25/ 77	0/ 32	0/ 32	0/ 32	0/ 32	5/ 41	5/ 41	10/ 50	10/ 50	10/ 50	10/ 50	15/ 59	15/ 59	15/ 59	20/ 68	20/ 68	20/ 68	20/ 68	20/ 68	25/ 77
30/ 86	0/ 32	0/ 32	0/ 32	5/ 41	5/ 41	10/ 50	10/ 50	15/ 59	15/ 59	15/ 59	20/ 68	20/ 68	20/ 68	20/ 68	25/ 77	25/ 77	25/ 77	25/ 77	30/ 86
35/ 95	0/ 32	0/ 32	5/ 41	10/ 50	10/ 50	15/ 59	15/ 59	20/ 68	20/ 68	20/ 68	25/ 77	25/ 77	25/ 77	25/ 77	30/ 86	30/ 86	30/ 86	30/ 86	35/ 95
40/ 104	0/ 32	5/ 41	10/ 50	10/ 50	15/ 59	20/ 68	20/ 68	20/ 68	25/ 77	25/ 77	25/ 77	30/ 86	30/ 86	30/ 86	35/ 95	35/ 95	35/ 95	35/ 95	40/ 104
45/ 113	0/ 32	10/ 50	15/ 59	15/ 59	20/ 68	25/ 77	25/ 77	25/ 77	30/ 86	30/ 86	35/ 95	35/ 95	35/ 95	35/ 95	40/ 104	40/ 104	40/ 104	40/ 104	45/ 113
50/ 122	5/ 41	10/ 50	15/ 59	20/ 68	25/ 77	25/ 77	30/ 86	30/ 86	35/ 95	35/ 95	35/ 95	40/ 104	40/ 104	40/ 104	45/ 113	45/ 113	45/ 113	45/ 113	50/ 122
60/ 140	15/ 59	20/ 68	25/ 77	30/ 86	30/ 86	35/ 95	40/ 104	40/ 104	40/ 104	45/ 113	45/ 113	50/ 122	50/ 122	50/ 122	50/ 122	50/ 122	50/ 122	50/ 122	60/ 140
70/ 158	20/ 68	25/ 77	35/ 95	35/ 95	40/ 104	45/ 113	45/ 113	50/ 122	50/ 122	50/ 122	50/ 122	50/ 122	60/ 140	60/ 140	60/ 140	60/ 140	60/ 140	60/ 140	
80/ 176	25/ 77	35/ 95	40/ 104	45/ 113	50/ 122	50/ 122	50/ 122	60/ 140	60/ 140	60/ 140	60/ 140	60/ 140							
90/ 194	35/ 95	40/ 104	50/ 122	50/ 122	50/ 122	60/ 140	60/ 140	60/ 140											
100/ 212	40/ 104	50/ 122	50/ 122	60/ 140	60/ 140														

Example:

Ambient temperature = 50°C
Relative humidity = 40 %
Minimum device temperature = 30°C

The use of lower temperatures is at your own risk!

The use of a thermostat is strongly recommended, see section 7.5 Thermostat (A-MP-THERM), page 48.

5.7 Air Purge Collar

The air purge system produces a laminar air flow that protects the linescanner window from dust, moisture, and vapor. The air flows from the couplings through the walls of the housing and through side slits near the scanner's window. The air flow should be between 1.67 l/s (0.44 gallons/s) and 3.33 l/s (0.88 gallons/s) through each side, which corresponds to a pressure between 0.5 bar (7.25 PSI) and 3.0 bar (43 PSI) when using the supplied metric fittings. The inside diameter for the air hose should be 4 mm (0.16 in.). The hose couplings for the air purge system are connected to the housing through ISO 228 G 1/8" stainless steel fittings.

Use only clean or "instrument grade" air (free from oil contaminants). Do not use cooled air. This could lead to condensation on the linescanners window!

5.8 Power Supply

The linescanner requires a nominal 24 VDC power supply, 18 VDC minimum. To insure that sufficient voltage is supplied to the linescanner, it is necessary to define the gage and the length of the power cable to determine the resistance and the voltage drop. The maximum current draw of the linescanner is 1 A.

The following table shows typical parameters from shielded 2 wire copper cables and the maximum recommended cable length.

Table 5-3: Maximum allowed Cable Length from a 24 VDC Power Supply to the Linescanner

Cable gauge	Resistance per m (1 wire)	Voltage drop per m at 1 A (2 wire)	Max. cable length
0.5 mm²	0.040 Ω/m	0.080 V/m	75 m
0.75 mm²	0.027 Ω/m	0.054 V/m	111 m
1.0 mm²	0.020 Ω/m	0.040 V/m	150 m
1.5 mm²	0.014 Ω/m	0.028 V/m	214 m
0.56 mm² (AWG 20)	0.031 Ω/yd	0.062 V/yd	289 ft
0.82 mm² (AWG 18)	0.021 Ω/yd	0.042 V/yd	427 ft
1.31 mm² (AWG 16)	0.014 Ω/yd	0.027 V/yd	656 ft
2.08 mm² (AWG 14)	0.008 Ω/yd	0.016 V/yd	1093 ft

The linescanner is equipped with an electronic fuse to prevent damage from voltage spikes greater than 36 V on power or signal lines. If the fuse circuit switches the power off, disconnect the power line for several seconds and turn power on again.

Power supply cables offered by the manufacturer can be found as electrical accessories, see section 7.7 Power Supply Cable (A-CB-xx-PS-xx), page 51.

A power supply offered by the manufacturer can be found as electrical accessories, see section 7.9 Power Supply DIN Rail (A-PS-DIN-24V), page 53.

5.9 Ethernet

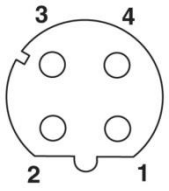
The linescanner can communicate via Ethernet interface or RS485. During system configuration the user selects either Ethernet or RS485. You cannot use Ethernet and RS485 communications for the data transfer at the same time!

The Ethernet connection between linescanner and the PC has a maximum speed of 100 MBit/s and permits real-time data transfer for all temperature pixels. For multi-scanner systems you can use a standard Ethernet Switch to connect to the PC network adapter.

5.9.1 Connector

The LAN/Ethernet socket supports a M12 plug-in connector, 4 pin D-coded, and a screw retention feature.

Figure 5-2: M12 Connector Socket and Pin Assignment



M12-Pin	
1	TX+
2	RX+
3	TX-
4	RX-

For appropriate cables, see section 7.8 Ethernet Cable (A-CB-xx-M12-W04-xx), page 52.

5.9.2 Scanner Addressing

IP Address

The factory default IP address for the linescanner is 192.168.42.30.

The scanners address is not free of choice: It has to be unique in the network meaning that no other device in the network including the PC network adapter may run at the same IP address.

Note
Ask your IT administrator for a free IP address to be used!

Advanced Ethernet Settings

Subnet Mask:

The Subnet Mask defines the interpretation of the IP address. The factory default setting is 255.255.255.0. The Subnet Mask can be changed using the <NM> command of the scanner.

Port:

In the case that the default scanners port (2727) should conflict with something else (it could be blocked by the firewall for example) it can be changed using the <PO> command of the scanner.

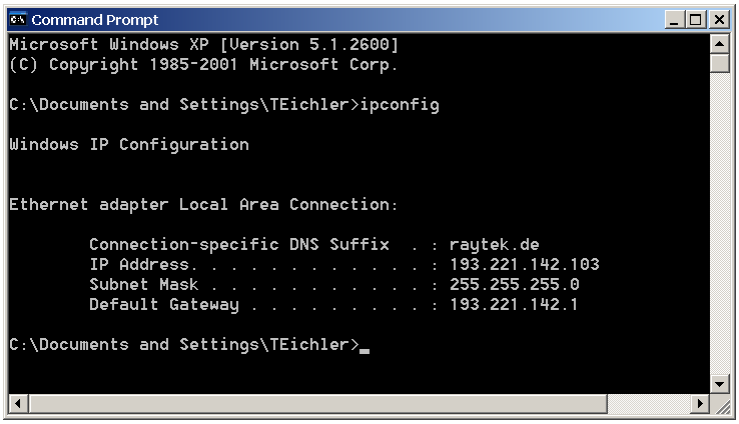
Gateway:

A gateway connects two subnets (which have a different subnet address). The IP address of this gateway is given with the route command <RO>. The default is RO0.0.0.0 - this does mean no gateway is set.

Note
To establish the Ethernet communication, the subnet addresses for both the scanner and the PC need to match! Appropriate changes can be applied either on the scanner side or on the PC network adapter!

The current settings for the IP address and the netmask of the PC can be asked with the command <ipconfig> in a Command Prompt window!

Figure 5-3: Command Prompt

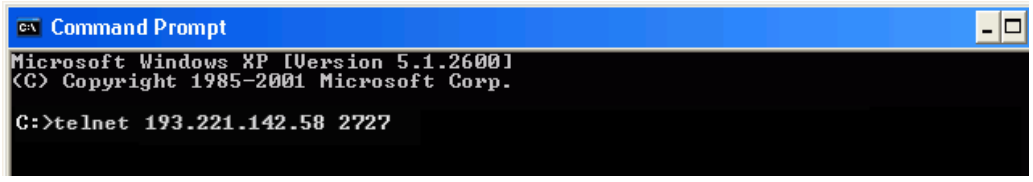


For the example above, the IP address of the PC is 193.221.142.103. The subnet address is 193.221.142, the host address is 103. The scanner's subnet address must be 193.221.142 as well. The host address of the scanner must be in the range from 1 to 254 with the exception of 103 which is already used for the PC.

5.9.3 Scanner Address Changing

When using the linescanner on an Ethernet network you may need to change the IP address of the scanner so that the factory default address does not conflict with another device on the network. Change the IP address following the procedure described below:

- Make sure that the PC network adapter is configured as required, see section 5.9.4 PC Network Adapter, page 36.
- Make sure that the scanner runtime DTDP software is stopped!
- Switch off the scanner!
- Switch on the scanner!
- Open the Command Prompt window and start a Telnet session by using the command:
  `telnet <IPAddressScanner> <Port>`



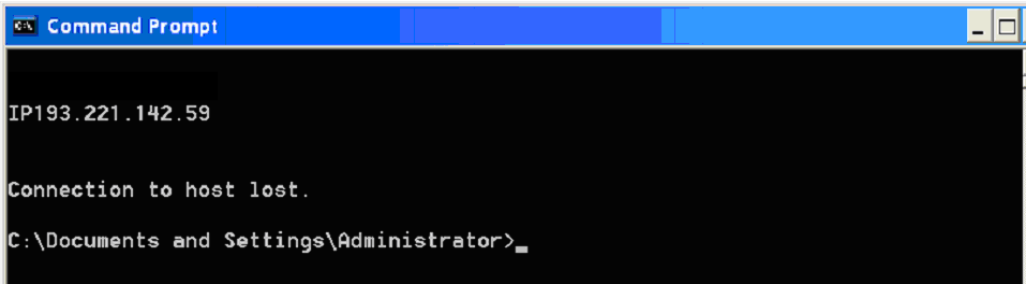
Note

Windows 7 does not have Telnet enabled by default. Enable the Telnet Client by using the command:

`pkgmgr /iu:"TelnetClient"`

- Under Telnet you have access to the scanner command level. Give the new IP address for the scanner with the command:

`IP<NewScannerIPAddress>`



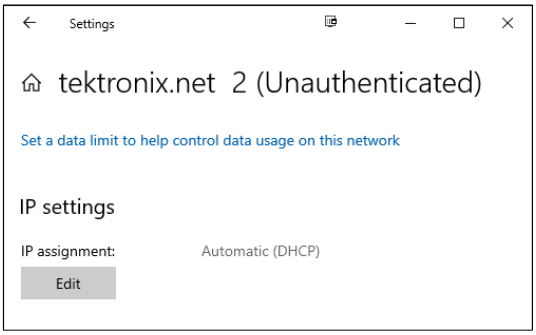
- With changing the IP address for the scanner you will immediately loose the connection, so you have to restart a further Telnet session by using the new IP address for the scanner: `telnet <NewScannerIPAddress> <Port>`
- Save the new IP address permanentely in the scanner with the command:
  `PS`

- Stopp the Telnet session by closing the Prompt window. The Ethernet communication will be automatically closed.

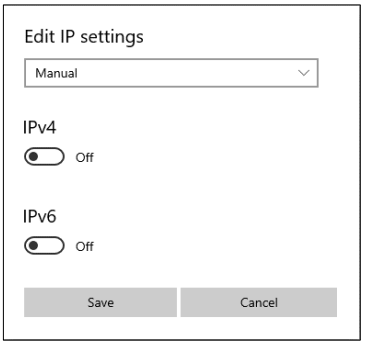
5.9.4 PC Network Adapter

The network adapter on the PC side can be configured as following:

1. Go to <Start> <Settings> <Network & Internet> <Status> <Change Connection Properties>
2. Under <IP Settings> <IP assignment> click on <Edit>

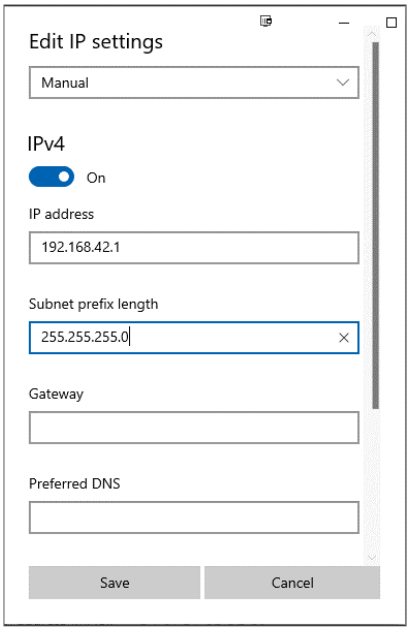


3. Under <Edit IP settings> select <Manual> and switch <IPv4> to On.



4. Make the following settings:

IP address:	192.168.42.x where x is an address between 0 and 255 except 30 which is already used by the linescanner by factory default
Subnet prefix length:	255.255.255.0 (subnet mask)
Gateway:	{empty}
Preferred DNS:	{empty}



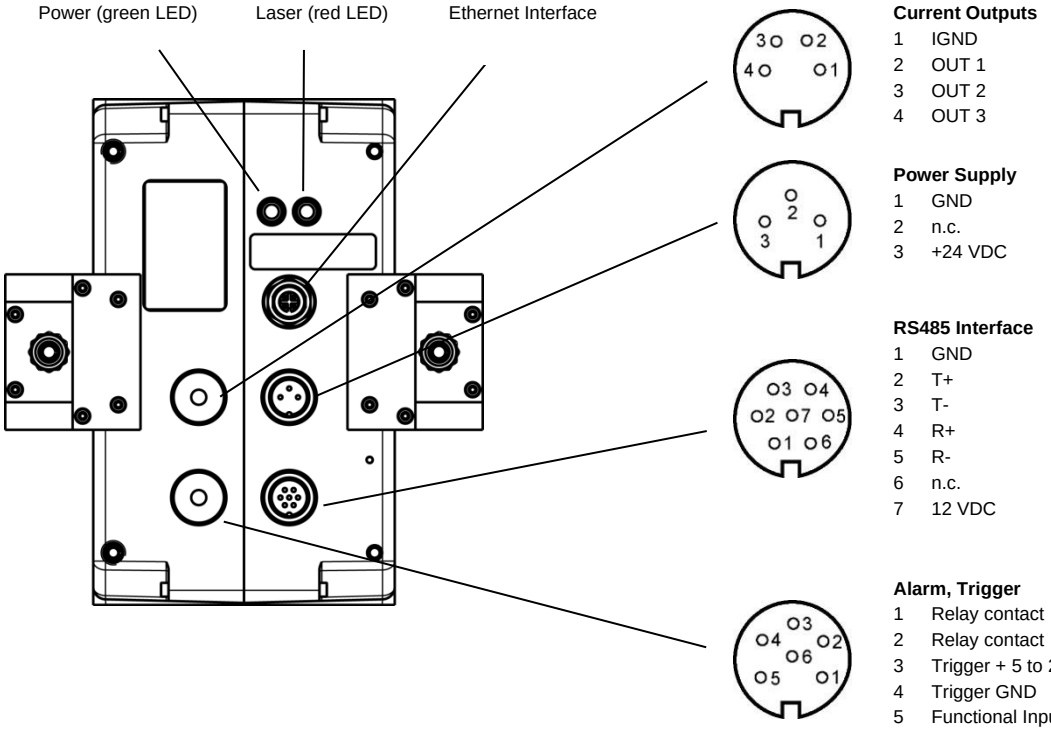
5. Close the dialog box by pressing on <Save>.

5.10 Inputs and Outputs

In addition to the communication interfaces, the linescanner is also equipped with the following:

- three active analog current outputs
- an alarm output (potential-free relay contacts)
- a trigger input for synchronization
- a functional input

Figure 5-4: Input and Output Connectors (view on connectors)



Current Outputs
1 IGND
2 OUT 1
3 OUT 2
4 OUT 3

Power Supply
1 GND
2 n.c.
3 +24 VDC

RS485 Interface
1 GND
2 T+
3 T-
4 R+
5 R-
6 n.c.
7 12 VDC

Alarm, Trigger
1 Relay contact
2 Relay contact
3 Trigger + 5 to 24 VDC
4 Trigger GND
5 Functional Input: max. + 5 VDC
6 Functional Input: GND

Table 5-4: Current Outputs, 4 pins

		Description	Color
1	IGND	common ground connection for all current outputs, electrically isolated to the GND ground	brown, pink, gray
2	OUT1	current output 1	yellow
3	OUT2	current output 2	green
4	OUT3	current output 3	white
		shield	black

Table 5-5: Power Supply, 3 pins

		Description	Color
1	GND	power ground	brown
2			not connected
3	+ 24 VDC	input for + 24 VDC power supply voltage	white
		shield	black

Table 5-6: RS485 Interface, 7 pins

		Description	Color
1	GND	Ground, (connected to power ground)	gray
2	T+	RS485 transmit	brown
3	T-	RS485 transmit	white
4	R+	RS485 receive	green
5	R-	RS485 receive	yellow
6	n.c.		
7	+ 12 VDC	regulated voltage for the RS232/485 converter	pink
		shield	

Table 5-7: Alarm and Trigger, 6 pins

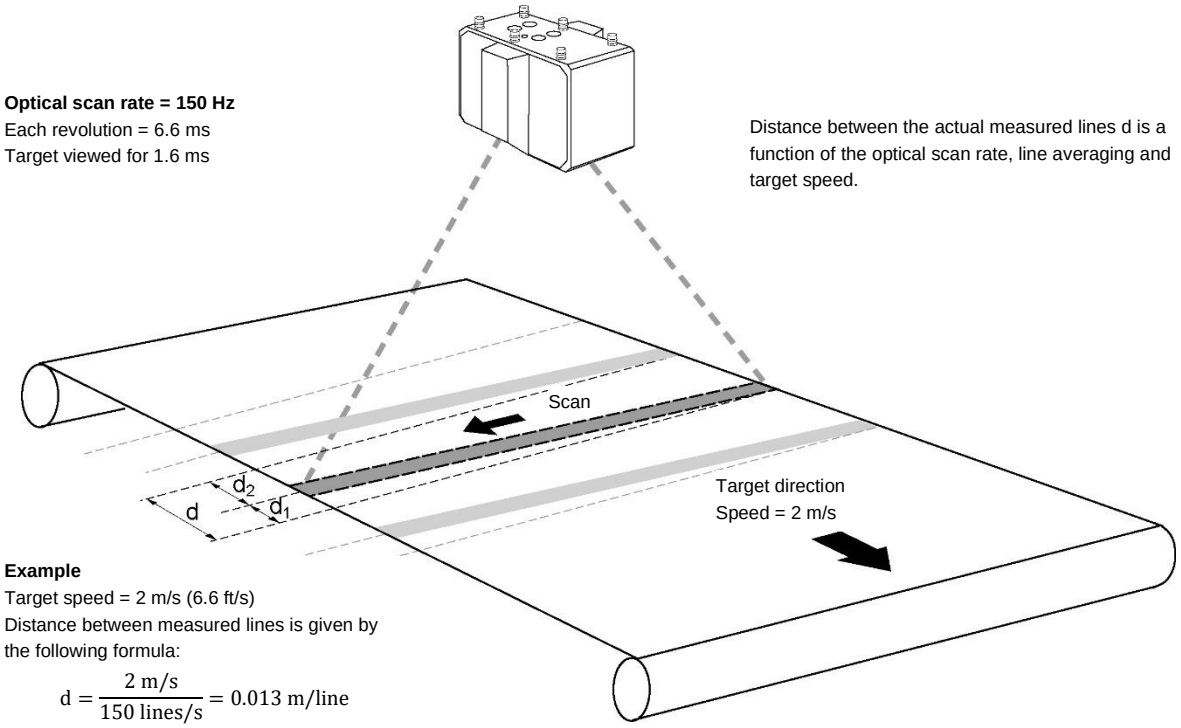
		Description	Color
1	Relay contact	Potential free relay contact, capacity max. 30 V, 1 A	brown
2	Relay contact	Potential free relay contact, capacity max. 30 V, 1 A	white
3	Trigger +	Trigger input: + 5 to + 24 VDC	green
4	Trigger -	Trigger input GND	yellow
5	Functional input	max. + 5 VDC	pink
6	Functional input	GND	gray
		shield	black

6 Operation

6.1 Target Viewing

The relationship between scan rate, target speed, and target viewing time is shown in the figure below. Please note, the manufacturer provides the tool called “Spot Size Calculator” which allows the calculation distance between measured lines, see section 9.1 Spot Size Calculator, page 61.

Figure 6-1: Calculation of Target Viewing Time



Example
Target speed = 2 m/s (6.6 ft/s)
Distance between measured lines is given by the following formula:

$$d = \frac{2\ m/s}{150\ lines/s} = 0.013\ m/line$$

i.e., During 100% mirror rotation, which takes 6.6 ms, target moves d = 0.013 m (0.51 in.)
During 25% mirror rotation (target viewing time), which takes 1.6 ms, target moves d_1 = 0.003 m (0.12 in.)

For MP300 linescanners, two lines are sampled per mirror revolution. This halves the distance between two lines at the same target speed.

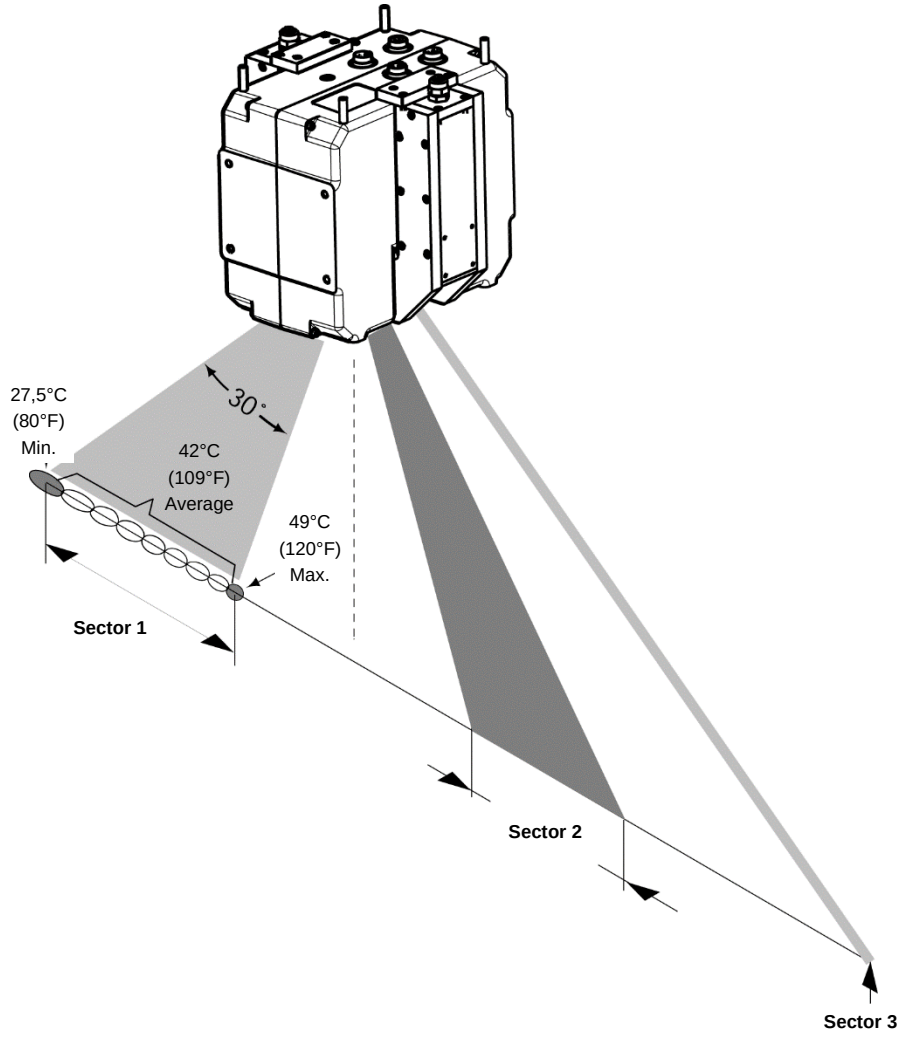
The MP300 linescaner works with two mirrors that cannot be matched 100% exactly due to mechanical deviations. This can result in a slight local offset of the pixels of two consecutive lines. This deviation should be less than one pixel. This can become visible in a thermal image by the fact that originally sharp edges are "slightly frayed".

6.2 Sectors

The linescanner is equipped with three analog outputs. Each output can be assigned to a ”sector” within the 90° scan angle. For each sector, the type of output (maximum, minimum, or mean value) can be selected. The output range can be configured for either 0 ... 20 mA, 4 ... 20 mA, or custom configured by user settings. The sector size and the emissivity value can be set for each sector, even if the sectors overlap. (In the case of overlapping sectors, the higher emissivity is given priority.) To use the sector function, the linescanner must run in the continuous mode.

Note
Use the Configurator of the scanner software to configure the analog outputs!

Figure 6-2: Monitoring of Sectors



- The maximum size of a sector is 90°.
- The corresponding analog output will remain inactive if the sector size is 0.
- Each sector can have either a maximum, minimum, or mean output value.
- Each sector is assigned to an analog interface.
- The output range can be adjusted to any value between 0-20mA.
- The analog interfaces are potential-free, but have a common ground connection

6.3 Data Transfer Modes

After each scan, the temperature values are transferred through the serial or the Ethernet interface to a computer. This computer will require either DataTemp software or custom software for data analysis. The data transfer can be achieved through one of two methods (selected by the user):

- **Snapshot mode (discontinuous mode)**: The lines are scanned at the set sampling rate and are subsequently stored in the internal memory of the linescanner (capacity: 700 lines). After completing the snapshot, all lines are transferred through the digital interface. When measuring discrete objects, it may be advantageous to use the trigger input of the linescanner to initiate the image capture. The trigger signal can be generated by a voltage/switch indicating the approach of an object from the production process into the linescanner field-of-view, see section 5.10 Inputs and Outputs, page 38.
- **Image mode (continuous mode)**: One line is scanned and transferred through the digital interface immediately. The duration of the data transfer is determined by the maximum interface speed. These factors determine whether every line is transferred.

6.4 Scanner as Stand-Alone Device

The scanner is equipped with internal sectors supporting three analog outputs and the alarm relay. To configure the scanner as stand-alone device without having a computer software running follow the steps given below:

1. Launch the DTDP Configurator.
2. Configure the scanner's standard settings like scan speed and pixel count.
3. Configure the internal sectors on the Configurator's <Device Sector> page.
4. Please note, the software sectors under the <Sector> page are not supported with a scanner in the stand-alone mode.
5. The DTDP software sends a <PS> command automatically to the scanner if at least one scanner internal sector is detected.
6. Launch the DTDP software one times to transfer all the parameters into the scanner. Afterwards, the DTDP software can be exit and the scanner runs as stand-alone device.

7 Accessories

7.1 Overview

A full range of accessories for various applications and industrial environments are available. Accessories include items that may be ordered at any time and added on-site. These include the following:

Mechanical:

- Mounting Plate (A-MP-MP)
- Adjustable Mounting Base (A-MP-RMB)
- Tube Fittings (A-MP-FS-xxx)
- Thermostat (A-MP-THERM)
- Spare Window Kit (S-MP-WK-xx)
- Air Purge Kit including 2 fittings and mounting material (A-MP-AP)

Electrical:

- Power Supply Cable (A-CB-xx-PS-xx)
- Ethernet Cable (A-CB-xx-M12-W04-xx)
- Alarm trigger cable, 7.50 m (25 ft), up to 180°C (356°F) (A-CB-HT-M16-W06-07)
- Current output cable, 7.50 m (25 ft), up to 180°C (356°F) (A-CB-HT-M16-W04-07)
- Coupling socket PG7 4-pin connector (A-CON-M16-P04)
- Coupling socket PG7 6-pin connector (A-CON-M16-P06)
- Power Supply DIN Rail (A-PS-DIN-24V)
- Portable power supply 100 – 240 VAC / 24 VDC / 1 A (A-MP-PS-PORT-24V)
- RS485 Interface Kit (A-MP-CONV-SERIAL-xxx)
- USB/RS485/RS232 converter (A-CONV-USB485)

Fiber Optic:

- Fiber-Optic/RJ45 Converter (A-CON-xFO-xRJ45)
- Fiber Optic Cable (A-CB-FO-xxx)
- Connection box with Ethernet/fiber optic converter and power supply (A-CONV-2FO-4RJ45-ENC)

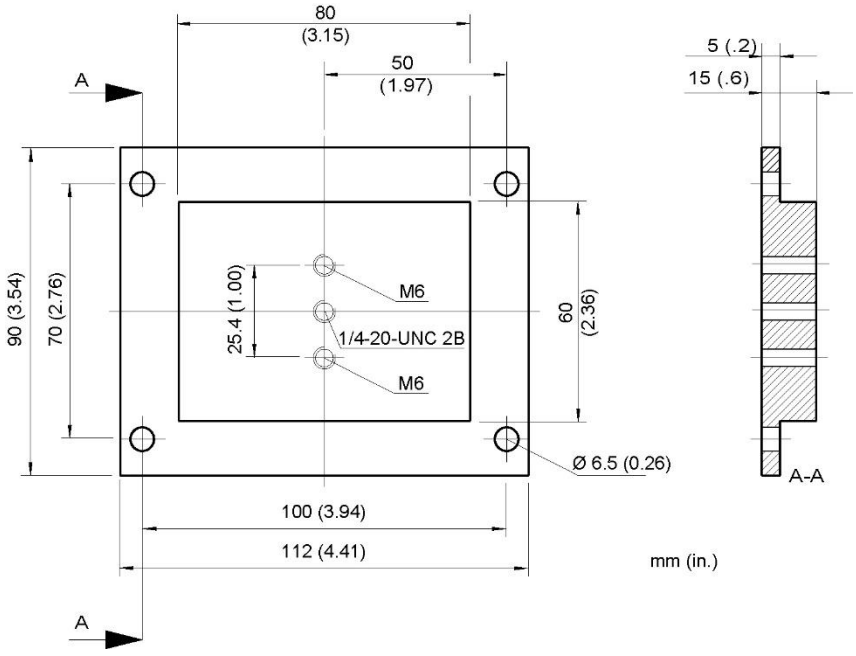
Ethernet based Input / Output Modules:

- Basic Kit (A-IO-BASICKIT), contains:
  Fieldbus Coupler 750-352, Supply Module 750-602, End Module 750-600
- Digital Input Module 750-1406, 16 channels (A-IO-16DI)
- Digital Output Module 750-1504, 16 channels (A-IO-16DO)
- Passive Isolator 857-452 (A-IO-2A-ISO)
- Analog Current Output Module 750-563, preset to 0 – 20 mA, 2 channels (A-IO-2AOC-0)
- Analog Current Output Module 750-563, preset to 4 – 20 mA, 2 channels (A-IO-2AOC-4)
- Analog Voltage Output Module 750-562, preset to 0 – 10 V, 2 channels (A-IO-2AOV)
- Relay Output Module 750-513, normally open, 2 channels (A-IO-2R-NO)
- Relay Output Module750-517, change over, 2 channels (A-IO-2R-CO)

For more details, see the dedicated manual „I/O Module System for Infrared Linescanners“.

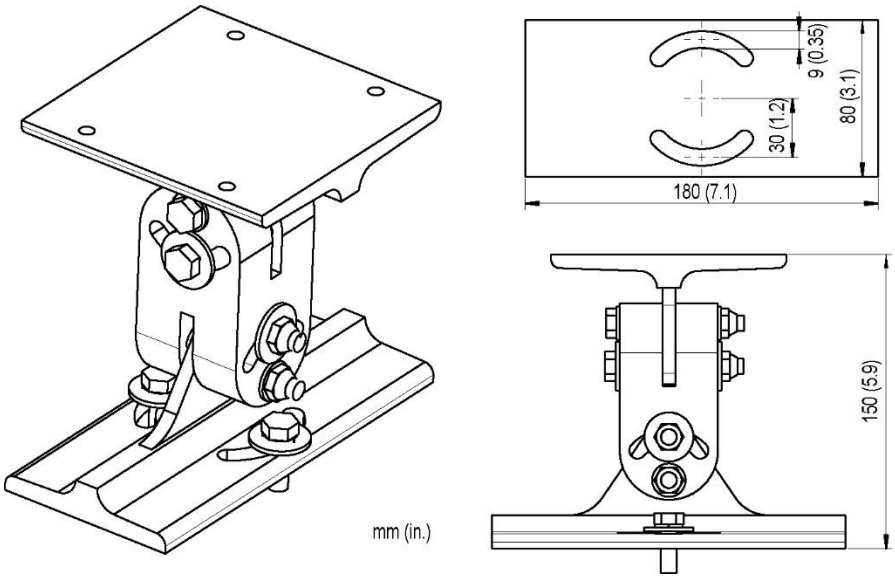
7.2 Mounting Plate (A-MP-MP)

Figure 7-1: Mounting Plate for Tripod



7.3 Adjustable Mounting Base (A-MP-RMB)

Figure 7-2: Adjustable Mounting Base



7.4 Tube Fittings (A-MP-FS-xxx)

Description: 4x tube fittings - female adapter union (connects 6 mm outer diameter tube to conical thread Rc 1/8" (ISO7/1)) or 6 mm outer diameter tube to conical thread 1/8" NPT

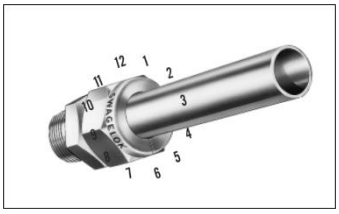
The tube fittings are available in two versions:

- A-MP-FS-ISO with ISO threads
- A-MP-FS-NPT with NPT threads

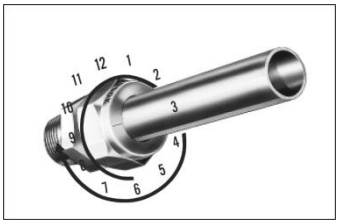
7.4.1 Installation of the Tube Fittings

The following steps explain the installation of the tube fittings to the stainless steel cooling tubes of the linescanner.[7]

- Insert tubing into the Swagelok tube fitting.
- Make sure that the tubing rests firmly on the shoulder of the tube fitting body and that the nut is finger-tight.



- Scribe the nut at the 6 o'clock position.



- While holding the fitting body steady with a back-up wrench, tighten the nut 1 ¼ turns to the 9 o'clock position.

[7] Illustrations: © Swagelok

7.4.2 Reassembly of the Tube Fittings

You may disassemble and reassemble a Swagelok tube fitting as often as required.

- Insert tubing with pre-swaged ferrules into the fitting body until the front ferrule seats.

- Rotate the nut with a wrench to the previously pulled-up position. At this point, a significant increase in resistance will be encountered.

- Tighten slightly with a wrench.

7.5 Thermostat (A-MP-THERM)

The thermostat is an accessory which helps keep the housing temperature over the dew point thereby avoiding damage due to condensed water in the interior of the housing. The thermostat needs no further electrical installation.

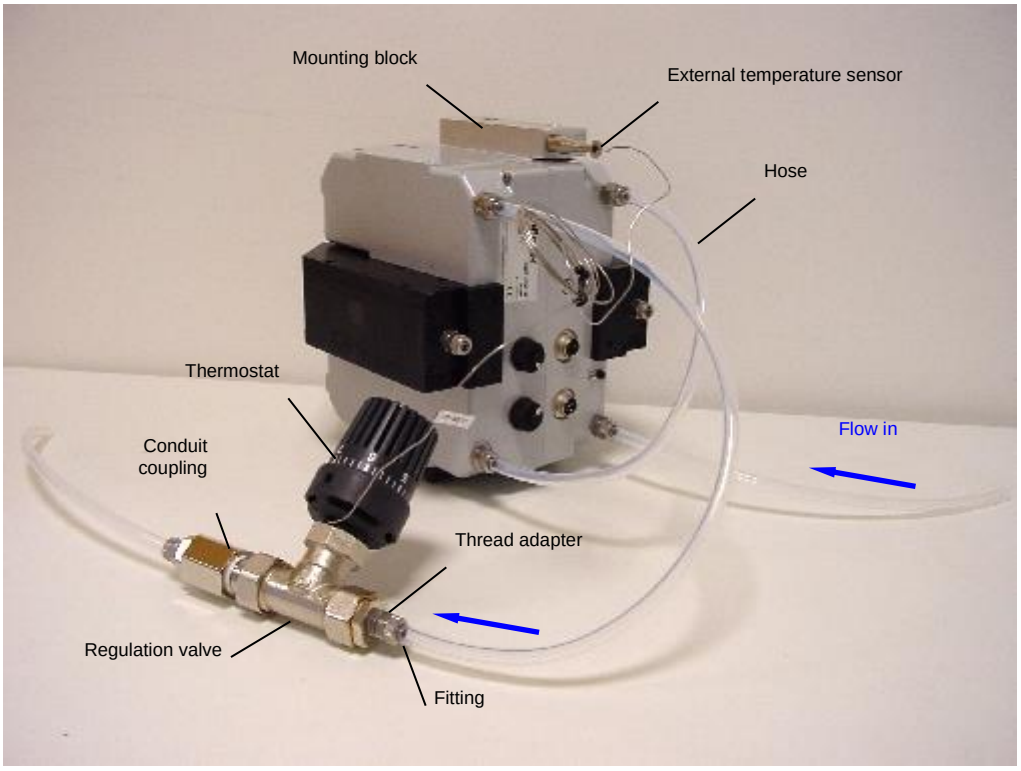
When ordering a thermostat, the shipment contains the following parts:

- thermostat, already mounted with one regulation valve, one conduit coupling ½“, two thread adapter ½“ to ⅛“, two fittings ⅛“
- external sensitive element for the thermostat, 2 m (6.6 ft) capillary tube length
- mounting block for external sensitive element
- 2x hex screws M6x16
- 2x hex screws M3x8
- 5 m (16.4 ft) cooling hose, PA 8x1, max. pressure 12 bar (174 PSI) at 70°C (158°F)

For the thermostat, the following accessories are available:

- Water Flow Regulator (A-TJ-WFR)
- Air Flow Regulator (A-TJ-AFR)

Figure 7-3: Installation of the Thermostat



Installation:

- Before mounting the mounting block, ensure that the mating surface is completely clean, Fix the mounting block either on the upper or on the lower side of the scanner’s housing using the supplied M6x16 hex screws.
- Mount the thermostat close to the scanner within a distance of 1.5 m (4.9 ft).
- Cut the cooling hose to lengths according to your needs, see figure above.

- Fix the cooling hoses as shown in the figure above. Ensure that the thermostat (arrow on the housing's side) is installed according to the flow direction.

  Note: The fittings needed to connect the inner taper thread of the linescanner tube fitting (Rc 1/8") and the cooling hose of the Thermostat are not supplied as standard components! We recommend a Swagelok® Stainless Reducing Union (8 mm / 0.31 in. outer diameter – 6 mm / 0.24 in. inner diameter) and Swagelok Stiffener Sleeve.
- Move the external temperature sensor into the mounting block and fix it using the M3x8 hex screws Take care not to damage the sensor when tightening the screws! Do not bend the connection line between sensitive element and thermostat at a radius tighter than 5 mm (0.2 in)!
- Adjust the thermostat according to the table below.

Table 7-1: Thermostat Adjustment

Ambient Temperature [°C/°F] \ Relative Humidity [%]	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
0/32	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
5/41	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
10/50	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
15/59	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	0
20/68	+	+	+	+	+	+	+	+	+	+	+	+	+	0	0	0	0	0	1
25/77	+	+	+	+	+	+	+	+	+	+	0	0	0	1	1	1	1	1	2
30/86	+	+	+	+	+	+	+	0	0	0	1	1	1	1	2	2	2	2	3
35/95	+	+	+	+	+	0	0	1	1	1	2	2	2	2	3	3	3	3	4
40/104	+	+	+	+	0	1	1	1	2	2	2	3	3	3	4	4	4	4	5
45/113	+	+	0	0	1	2	2	2	3	3	4	4	4	4	5	5	5	5	6
50/122	+	+	0	1	2	2	3	3	4	4	4	5	5	5	6	6	6	6	7
60/140	0	1	2	3	3	4	5	5	5	6	6	7	7	7	7	7	7	7	–
70/158	1	2	4	4	5	6	6	7	7	7	7	7	–	–	–	–	–	–	–
80/176	2	4	5	6	7	7	7	–	–	–	–	–	–	–	–	–	–	–	–
90/194	4	5	7	7	7	–	–	–	–	–	–	–	–	–	–	–	–	–	–
100/212	5	7	7	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

+	thermostat not necessary
0	thermostat recommended
1 – 7	thermostat necessary, 1 – 7: recommended adjustment of the thermostat
–	housing temperature out of specification

- Check the system functionality. After a few minutes the internal housing temperature should reach the minimum device temperature as follows:

Thermostat adjustment	Minimum device temperature
0	15°C / 59°F
1	20°C / 68°F
2	25°C / 77°F
3	30°C / 86°F
4	35°C / 95°F
5	40°C / 104°F
6	45°C / 113°F
7	50°C / 122°F

7.6 Spare Window Kit (S-MP-WK-xx)

The available spare window kits are listed in the table below. Each kit includes two windows and a gasket. For replacing the spare window see the procedure described in section 8.3 Window Replacment, page 59.

Table 7-2: Spare Windows depending on the Spectral Model

Spare Window Kit	Spectral Model
S-MP-WK-1M	1M
S-MP-WK-2M	2M
S-MP-WK-3M	3M

Each spare window comes with a dedicated factor for the transmissivity. The transmissivity needs to be set in the scanner via the scanner system software under the menu <Scanner> <Transmissivity of the scanner window> or by using the dedicated scanner command <TAW>.

7.7 Power Supply Cable (A-CB-xx-PS-xx)

The power supply cable comes with a three-socket female M16 connector, assigned to the scanner rear three pin male M16 connector. The corresponding end of the power supply cable is carried out as a pig tail, to connect to an external power supply device.

The power supply cable is provided in different lengths. The LT version of the cable withstands ambient temperatures up to 80°C (176°F), the HT version withstands ambient temperatures up to 180°C (356°F).

For information about installation, see section 5.8 Power Supply, page 32.

Figure 7-4: Power Supply Cable

Figure 7-5: Pinout

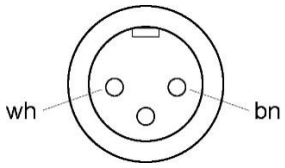


Table 7-3: Available Power Supply Cables

P/N	Length	Ambient Temperature
A-CB-LT-PS-07	7.5 m (25 ft)	80°C (176°F)
A-CB-LT-PS-25	25 m (82 ft)	80°C (176°F)
A-CB-LT-PS-50	50 m (164 ft)	80°C (176°F)
A-CB-HT-PS-08	7.5 m (25 ft)	180°C (356°F)
A-CB-HT-PS-10	10 m (33 ft)	180°C (356°F)

7.8 Ethernet Cable (A-CB-xx-M12-W04-xx)

The Ethernet cable comes with a four-pin male M12 D-coded connector, assigned to the scanners rear female M12 connector. The corresponding end of the Ethernet cable is equipped with a general RJ45 snap-in connector.

The LT version of the cable is PUR coated and withstands ambient temperatures up to 80°C (176°F).

The HT version is Teflon coated and withstands ambient temperatures up to 180°C (356°F).

Figure 7-6: Ethernet Cable

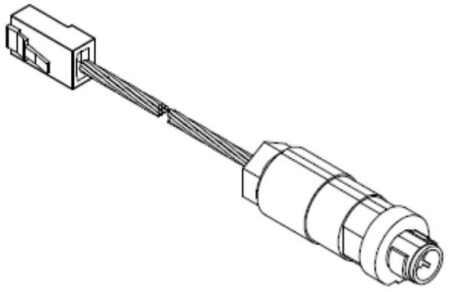


Figure 7-7: Pin Assignment

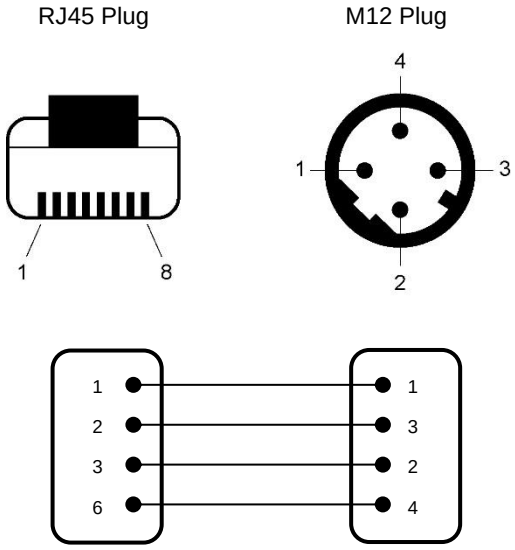


Table 7-4: Available Ethernet Cables

P/N	Length	Ambient Temperature
A-CB-LT-M12-W04-07	7.5 m (25 ft)	80°C (176°F)
A-CB-LT-M12-W04-25	25 m (82 ft)	80°C (176°F)
A-CB-LT-M12-W04-50	50 m (164 ft)	80°C (176°F)
A-CB-HT-M12-W04-07	7.5 m (25 ft)	180°C (356°F)
A-CB-HT-M12-W04-10	10 m (33 ft)	180°C (356°F)

7.9 Power Supply DIN Rail (A-PS-DIN-24V)

The DIN-rail mount industrial power supply delivers isolated DC power and provides short circuit and overload protection.

Risk of Personal Injury

To prevent electrical shocks, the power supply must be used in protected environments (cabinets)!

Technical data:

Protection class	prepared for class II equipment
Environmental protection	IP20
Operating temperature range	-25°C to 55°C (-13°F to 131°F)
AC Input	100 – 240 VAC 44/66 Hz
DC Output	24 VDC / 1.3 A
Cross sections	input/output 0.08 to 2.5 mm² (AWG 28 to 12)

Figure 7-8: Industrial Power Supply

[8]

[8] Copyright Wago®

7.10 RS485 Interface Kit (A-MP-CONV-SERIAL-xxx)

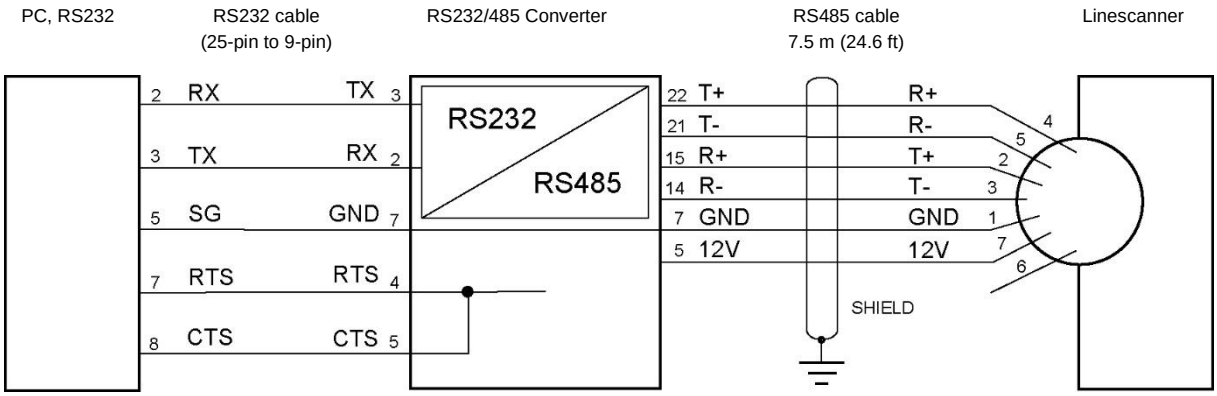
The RS232/485 interface provides a serial data transfer to the PC. However, the PC will have to be capable of communicating at a sufficiently high baud rate. Most standard PC's communicate at speeds up to 115 kBaud which is capable of communication with the linescanner at a scan speed of 36 Hz and at 256 pixel per scan data sampling rate. For faster scan frequencies or for a higher pixel count the Ethernet connection should be used.

The RS485 Interface Kit comes with the following items:

- RS232/485 converter
- RS232 adapter 25 to 9-pin
- RS485 cable rated at an maximal ambient temperature of 180°C (356°F) and in a length of 7.5 m / 25 ft (A-MP-CONV-SERIAL-CB7) or 10 m / 33 ft (A-MP-CONV-SERIAL-CB10)

To use the RS232/485 connection, connect the linescanner to the PC with the RS485 cable. First, insert the 7-pin DIN-round plug (IP65) into the socket on the back side of the linescanner, then tighten the locking cap carefully. Next, connect the RS232/485 converter to the RS232 serial interface of the PC. Use the RS232 25 to 9-pin adapter cable if needed. The RS232/485 converter is powered by the linescanner, and no separate power supply is required.

Figure 7-9: RS232/485 Interface between PC and Linescanner



RS232 Signals:

TX	transmission data
RX	received data
SG	system ground
RTS	transmission request
CTS	ready for transmission

RS485 Signals:

Twisted pairs:	T+	data transmission +
	T-	data transmission -
Twisted pairs:	R+	data reception +
	R-	data reception -

Power supply for the RS232/485 converter:

Twisted pairs: 12 V

GND

To program the linescanner via its serial interface (see linescanner protocol manual), the serial interface settings needs to be:

8 data bits,

no parity bit,

1 stop bit,

no flow control

Allowed baud rates:

9600 Baud (linescanner factory default)

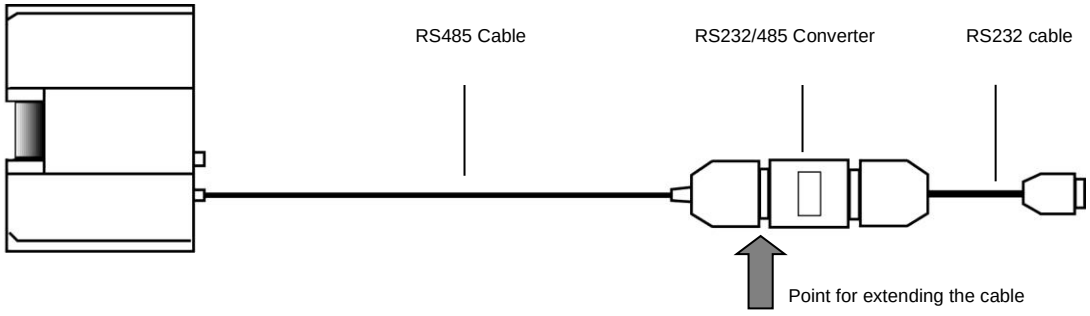
57.6 kBaud

115 kBaud

230 kBaud

7.10.1 RS485 Cable Extension

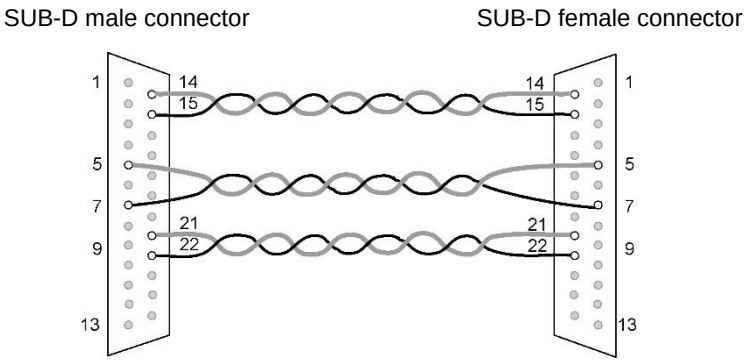
Figure 7-10: RS485 Cable Extension



When using an extension, separate the high-temperature communication cable only at the location indicated (see arrow in the figure above) from the RS232/485 converter. To extend the communication cable, a 6-wire cable is needed.

Note
Be sure to use twisted pair cables as signal wires!

Figure 7-11: Extension of Communication Cable



7.11 Fiber-Optic/RJ45 Converter (A-CON-xFO-xRJ45)

The Fiber-Optic/RJ45 Converter is an industrial Ethernet switch with Ethernet and fiber optic ports. The converter is DIN-rail or wall mountable:

- 1x Fibre optic, 1x Ethernet (A-CON-1FO-1RJ45)
- 2x Fibre optic, 4x Ethernet (A-CON-2FO-4RJ45)

Specification

Fiber optic connector	SC, multi-mode
Ethernet connector	RJ45
ower supply	12 to 48 VDC
Operating temperature	-10 to 60°C (14 to 140°F)
Humidity	5 to 95% non-condensing

7.12 Fiber Optic Cable (A-CB-FO-xxx)

Use fiber optic communication for Ethernet cable runs beyond 90 m (295 ft). The cables are available in the following lengths:

- 150 m (492 ft), part number A-CB-FO-150
- 300 m (984 ft), part number A-CB-FO-300

Specification

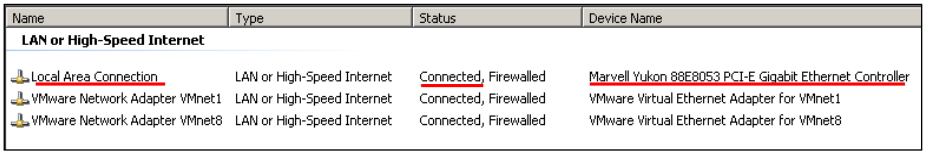
Connector	SC
Application	outdoor
Armoring	armoring plus PE protective sheath
Cable type	multimode (graded index)
Fiber core	50 µm
Cladding	125 µm

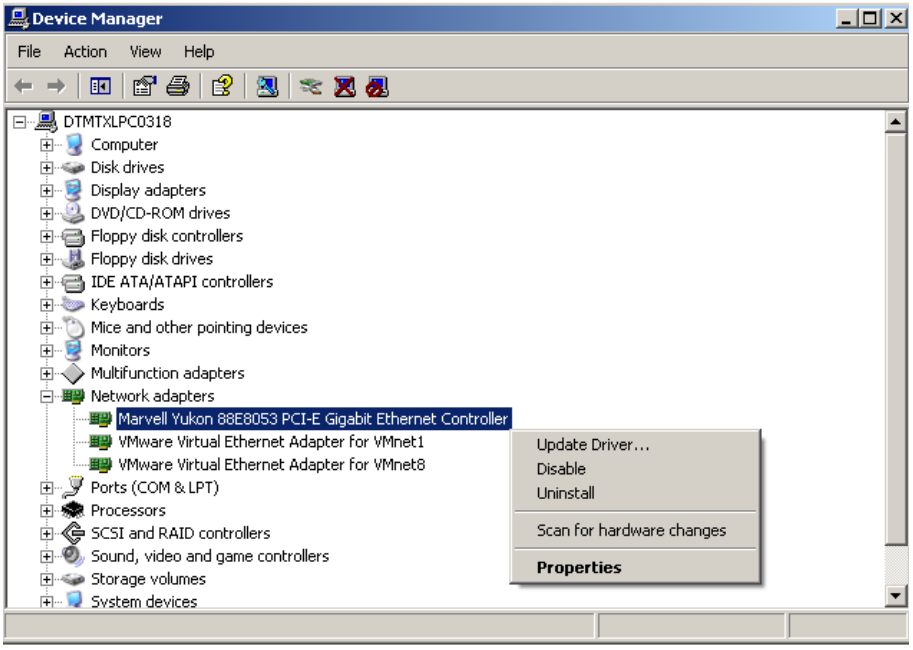
8 Maintenance

Our sales representatives and customer service staff are always at your disposal for questions regarding applications, calibration, repair, and solutions to specific problems. Please contact your local sales representative if you need assistance. In many cases, problems can be solved over the telephone. If you need to return equipment for servicing, calibration or repair, please contact our Service Department before shipping. Phone numbers are listed at the beginning of this document.

8.1 Troubleshooting

Table 8-1: Troubleshooting

Checkpoint	Possible Cause / Solution
Scanner	• Check the wiring of the whole system (correctly fitted connectors, cable damage). • Check the power for the scanner on scanner's backside LED: MP50: red LED is "on" MP150/300: green LED is "on" • Check the rotation of the internal scanner mirror assuming the power is on (viewing or hearing test). • The main power for scanner and PC should be provided at the same location. • Avoiding scanner overheating. Maximum internal housing temperature: 60°C (140°F). The internal housing temperature is displayed in the status bar of the scanner software. • In case of the scanner's cooling, check for condensation in the scanner's housing → condensation can cause the total outage of the unit. To avoid condensation see section 5.6.1 Avoidance of Condensation, page 29. • Mount the scanner and the cables away from motors or heaters that produce strong electrical fields. • A dirty measurement window or an obstructed field of view could cause erroneous temperature values
Ethernet Communication	• Make sure that the scanner's Ethernet settings are setup correctly, see section 5.9.2 Scanner Addressing, page 33. • Make sure that the PC network adapter is setup correctly, see section 5.9.4 PC Network Adapter, page 36. • <Start> <Settings> <Network & Internet> <Status> <Change adapter options> provides a list of all available network connections. The desired network connection needs to be related to your real adapter device (and no wireless or virtual adapter). The status for the connection needs to be <Connected>. 

Checkpoint	Possible Cause / Solution
	• Disable the PC network adapter temporarily: <Start> <Settings> <Control panel> <System> <Hardware> <Device Manager> <Network adapters>  • Switch on/off the scanner's power. • Software is not to be launched during the initialization time of the scanner (about 120 s). • Use the network administration utility **Ping** to test the reachability of the scanner. Call the Windows <Command Prompt> and execute ping 192.168.42.30 (exemplary IP address) • Use the network protocol **Telnet** to provide a bidirectional text-oriented communication to the scanner by using the scanner specific commands. Call the Windows <Command Prompt> and execute telnet 192.168.42.30 2727 (exemplary IP address and port). Note: Telnet is not available on all Windows computers by default!
Serial Communication via COM port	• Verify correct COM port. If existing use another COM port on the computer. • To avoid communication problems the properties of all used COM ports must be changed as follows: <Start> <Settings> <Control Panel> <System> <Hardware> <Device Manager> <Ports (COM & LPT)> <Communications Port COMx> <Ports Settings> <Advanced> <Receive Buffer>: Low • In case of using plug-in serial cards, disable <CTS/RTS> for the Auto Flow Control. <Start> <Settings> <Control Panel> <System> <Hardware> <Device Manager> <Ports (COM & LPT)> <Communications Port COMx> <Ports Settings> <Advanced> • Avoid the use of third party USB/RS232 converters! • Ensuring the RS232/485 converter is close to the PC (and not to the scanner) • In case of communication errors, the baud rate should be reduced step by step. • Software is not to be launched during the initialization time of the scanner (about 120 s).
PC	• On some computers, the performance of the software can be increased dramatically by switching off the hardware graphic acceleration: <Start> <Settings> <Control Panel> <Display> <Settings> <Advanced> <Troubleshooting> <Hardware acceleration>: None • A too high display resolution can cause problems. Test temporarily a setting of 800x600 pixel at high color (16 bit). • For several reasons the PC can be overloaded. This can be checked by running the scanner software and pushing CTRL+ALT+DEL at the same time. In the task manager a window for the system performance can be selected. The value must be every time much below 100%. • In some cases, the graphic card of the computer can interrupt serial communications for too long a time. S3-graphic cards are known to exhibit this problem. The only solution is to exchange the S3-graphic card.

8.2 Window Cleaning

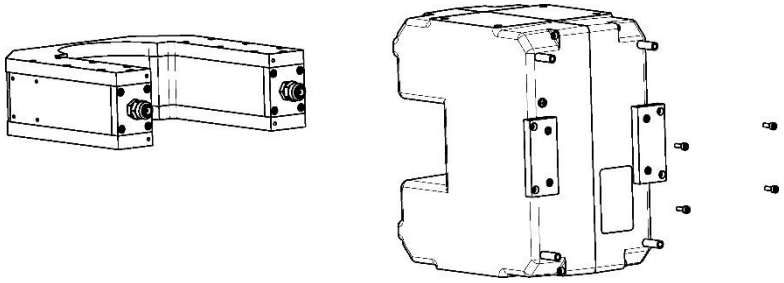
The linescanner's window must be kept as clean as possible. Any foreign matter on the window will affect the accuracy of the measurements. Take care when cleaning the window as it can easily be scratched. Please observe the following guidelines:

- Lightly blow off loose particles.
- Gently brush off remaining particles with a soft camel hair brush.
- Clean remaining dirt using a soft cotton cloth dampened in distilled water. Don't rub.
- To remove finger prints or other grease, gently wipe with a soft cloth dampened in a mild soap or distilled water (or ethanol or alcohol) solution.
- You should avoid getting any liquid in areas surrounding the window material.

8.3 Window Replacment

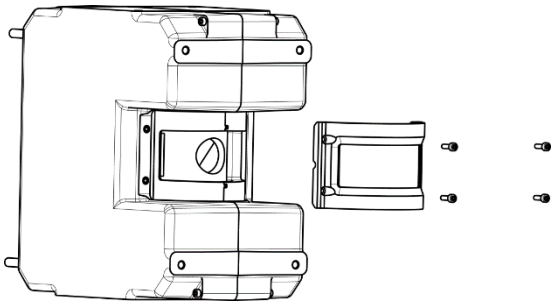
1. Remove the 4 hex screws on the back side using a 2.5 mm allen wrench. Slide the collar forward to separate it from the housing!

Figure 8-1: Removing the Air Purge Collar



2. Remove the 4 hex screws on the front side separating the window frame from the housing. Separate the window from the frame!
3. The window assembly consists of a frame (holder), the window material (mica) and a gasket. The gasket lies close to the housing, followed by the window material. If necessary, exchange the window material. Window size: 114 x 60 mm (4.49 x 2.36 inches).

Figure 8-2: Separating the Window



4. The four mounting screws must be placed in the holder´s corners before reassembling! Center the new film on the housing's gasket!

5. Check for even tension of the film. Remove the film and repeat the steps if there are wrinkles on the film!
6. Install the window assembly on the housing by alternating between the four screws. Do not over-tighten!
7. Install the air purge collar on the housing!

Note

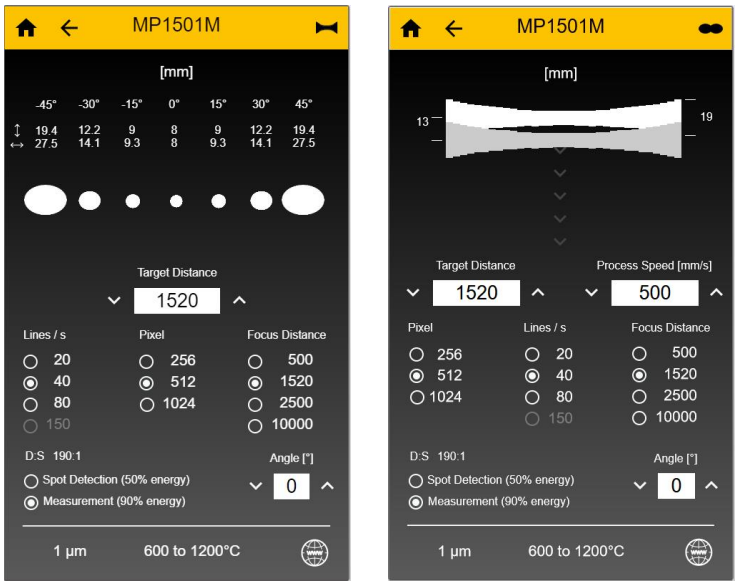
For correct temperature readings, the transmission factor for the new window must be set via the scanner runtime software, see software menu <Scanner> <Transmissivity of the scanner window>!

9 Appendix

9.1 Spot Size Calculator

It is important that the sensor is mounted at a distance from the target, sufficient to be able to “see” the entire area of interest. For this reason, the manufacturer provides a field of view calculating software called “Spot Size Calculator”, which allows the calculation of the resulting spot size for a given sensor model and based on a specific mounting distance.

Figure 9-1: Pixel Size Calculation (left) and Line-to-Line Calculation (right) with Spot Size Calculator



The “Spot Size Calculator” tool is available via the following stores and locations:

As app for Windows 10 based desktop computers, see Windows Store		Download from Windows Store
As app for Android mobiles, see Google Play Store		GET IT ON Google Play
As App for the iOS mobiles (iPhone and iPad), see App Store		Download on the App Store
As html5 web page, see https://www.flukeprocessinstruments.com/SpotSizeCalculator/index.html		

9.2 Determination of Emissivity

Emissivity is a measure of an object's ability to absorb and emit infrared energy. It can have a value between 0 and 1.0. For example, a mirror has an emissivity of < 0.1, while the so-called *blackbody* reaches an emissivity value of 1.0. If a higher than actual emissivity value is set, the output will read low, provided the target temperature is above its ambient temperature. For example, if you have set 0.95 and the actual emissivity is 0.9, the temperature reading will be lower than the true temperature.

An object's emissivity can be determined by one of the following methods:

- Determine the actual temperature of the material using an RTD (PT100), a thermocouple, or any other suitable contact temperature method. Next, measure the object's temperature and adjust emissivity setting until the correct temperature value is reached. This is the correct emissivity for the measured material.
  The manufacturer's support software may support you via an automated function for determining the emissivity. For more information, refer to the documentation of the support software.
- For relatively low temperatures (up to 260°C / 500°F) place a plastic sticker on the object to be measured. This sticker should be large enough to cover the target spot. Next, measure the sticker's temperature using an emissivity setting of 0.95. Finally, measure the temperature of an adjacent area on the object and adjust the emissivity setting until the same temperature is reached. This is the correct emissivity for the measured material.
- If possible, apply flat black paint to a portion of the surface of the object. The emissivity of the paint is 0.95. Next, measure the temperature of the painted area using an emissivity setting of 0.95. Finally, measure the temperature of an adjacent area on the object and adjust the emissivity until the same temperature is reached. This is the correct emissivity for the measured material.
-

9.3 Typical Emissivity Values

The following table provides a brief reference guide for determining emissivity and can be used when one of the above methods is not practical. Emissivity values shown in the table are only approximate, since several parameters may affect the emissivity of a material. These include the following:

- Temperature
- Angle of measurement
- Geometry (plane, concave, convex)
- Thickness
- Surface quality (polished, rough, oxidized, sandblasted)
- Spectral range of measurement
- Transmission (e.g. thin films plastics)

To optimize surface temperature measurements, consider the following guidelines:

- Determine the object's emissivity using the instrument, which is also to be used for temperature measurements.
- Avoid reflections by shielding the object from surrounding temperature sources.
- For higher temperature objects, use instruments with the shortest wavelength possible.
- For translucent materials such as plastic foils or glass, ensure that the background is uniform and lower in temperature than the object.
- Mount the instrument perpendicular to the surface, if possible. In all cases, do not exceed angles more than 45° from incidence.

Table 9-1: Typical Emissivity Values for Metals

	Metals Emissivity		
Material	**1 µm**	**1.6 µm**	**2.3 µm**
Aluminum			
Unoxidized	0.1-0.2	0.02-0.2	0.02-0.2
Oxidized	0.4	0.4	0.2-0.4
Alloy A3003, Oxidized		0.4	0.4
Roughened	0.2-0.8	0.2-0.6	0.2-0.6
Polished	0.1-0.2	0.02-0.1	0.02-0.1
Brass			
Polished	0.1-0.3	0.01-0.05	0.01-0.05
Burnished			0.4
Oxidized	0.6	0.6	0.6
Chromium	0.4	0.4	0.05-0.3
Oxidized			
Copper			
Polished		0.03	0.03
Roughened		0.05-0.2	0.05-0.2
Oxidized	0.2-0.8	0.2-0.9	0.7-0.9
Gold	0.3	0.01-0.1	0.01-0.1
Haynes			
Alloy	0.5-0.9	0.6-0.9	0.6-0.9
Inconel			
Oxidized	0.4-0.9	0.6-0.9	0.6-0.9
Sandblasted	0.3-0.4	0.3-0.6	0.3-0.6
polished	0.2-0.5	0.25	0.25
Iron			
Oxidized	0.4-0.8	0.5-0.8	0.7-0.9
Unoxidized	0.35	0.1-0.3	0.1-0.3
Rusted		0.6-0.9	0.6-0.9
Molten	0.35	0.4-0.6	0.4-0.6
Iron, Cast			
Oxidized	0.7-0.9	0.7-0.9	0.7-0.9
Unoxidized	0.35	0.3	0.1-0.3
Molten	0.35	0.3-0.4	0.3-0.4
Iron, Wrought			
Dull	0.9	0.9	0.95
Lead			
Polished	0.35	0.05-0.2	0.05-0.2
Rough	0.65	0.6	0.5
Oxidized		0.3-0.7	0.3-0.7
Magnesium	0.3-0.8	0.05-0.3	0.05-0.2
Mercury		0.05-0.15	0.05-0.15
Molybdenum			
Oxidized	0.5-0.9	0.4-0.9	0.4-0.9
Unoxidized	0.25-0.35	0.1-0.35	0.1-0.3

Metals
Emissivity

Material	**1 µm**	**1.6 µm**	**2.3 µm**
Monel (Ni-Cu)	0.3	0.2-0.6	0.2-0.6
Oxidized			
Nickel			
Oxidized	0.8-0.9	0.4-0.7	0.4-0.7
Electrolytic	0.2-0.4	0.1-0.3	0.1-0.2
Platinum			
Black		0.95	0.95
Silver		0.02	0.02
Steel			
Cold-Rolled	0.8-0.9	0.8-0.9	
Ground Sheet			0.6-0.7
Polished Sheet	0.35	0.25	0.2
Molten	0.35	0.25-0.4	0.25-0.4
Oxidized	0.8-0.9	0.8-0.9	0.8-0.9
Stainless	0.35	0.2-0.9	0.2-0.9
Tin (Unoxidized)	0.25	0.1-0.3	0.1-0.3
Titanium			
Polished	0.5-0.75	0.3-0.5	0.2-0.5
Oxidized		0.6-0.8	0.6-0.8
Tungsten			0.1-0.6
Polished	0.35-0.4	0.1-0.3	0.1-0.3
Zinc			
Oxidized	0.6	0.15	0.15
Polished	0.5	0.05	0.05

Table 9-2: Typical Emissivity Values for Non-Metals

	NON-METALS Emissivity		
Material	**1 µm**	**1.6 µm**	**2.3 µm**
Asbestos	0.9		0.8
Asphalt			
Basalt			
Carbon			
Unoxidized	0.8-0.95		0,8-0,9
Graphite	0.8-0.9		0.8-0.9
Carborundum			0.95
Ceramic	0.4		0.8-0.95
Clay			0.8-0.95
Coke	0.95-1.00	0.95-1.00	0.95-1.00
Concrete	0.65		0.9
Cloth			
Glass			
Plate			0.2
“Gob”			0.4-0.9
Gravel			
Gypsum			
Ice			
Limestone			
Paint (non-al.)			
Paper (any color)			
Plastic, opaque at 500 µm thickness (20 mils)			
Rubber			
Sand			
Snow			
Soil			
Water			
Wood, Natural			