InfraScan®5000
Series E

with

BeamStream
Digital Signal Equalization

User's Manual

Contents

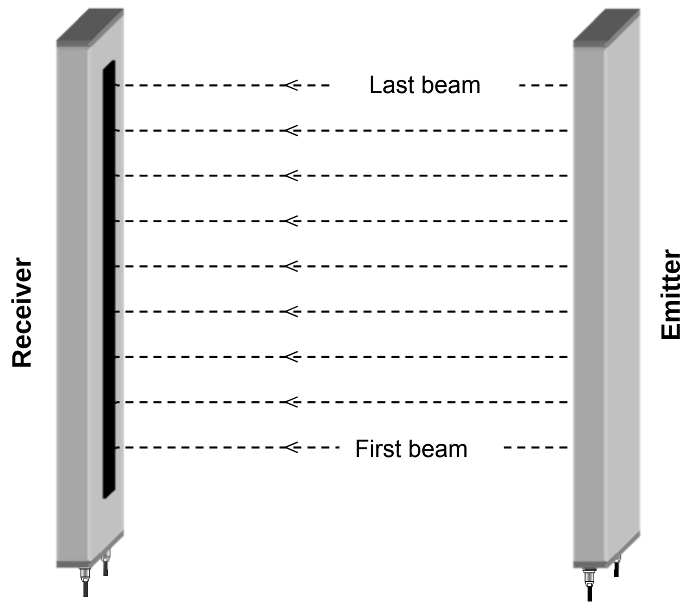
1. DESCRIPTION

1.1 Working Principle

The InfraScan®5000 E-line series photoelectric light curtains are electronic precision measurement instruments, which operate on the basis of infrared light beams. Each measuring system comprises two casings, one containing the emitters the other the receivers together with the electronics for light pulse and data output control.

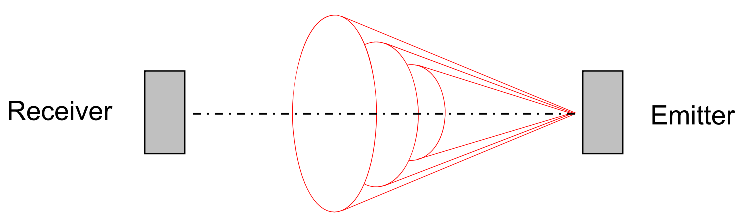
1.1.1 Parallel Scanning

Together with the facing receivers, the infrared LEDs, which are lined up next to one another inside the emitter unit, form a grid of absolutely parallel beams. This principle permits the recognition and measurement of all objects, which attenuate infrared light or are impervious to it. The surface of the object or the distance between the emitter and receiver has no effect on the measurement.

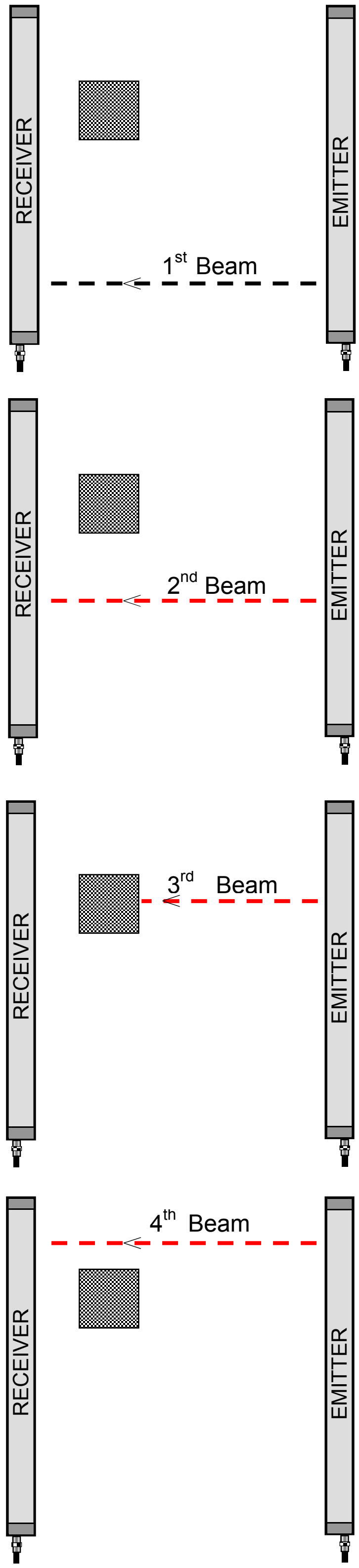


To perform the measurement, the individual infrared LED's are activated in succession and the associated receivers are scanned at the same time. In other words, light beam "1" is interrupted at the moment the imaginary line from emitter "1" to receiver "1" is interrupted, since only the first receiver is scanned at the moment the first light beam is transmitted. This also applies accordingly to the following beams, resulting in the formation of a "light grid" comprising invisible light beams arranged in parallel to one another.

As only the associated receiver of each infrared LED is activated, wide-angle radiation is possible. The conical light beams ensure fault-free operation of the InfraScan® photoelectric barriers, even if they are exposed to severe vibration, which greatly simplifies adjustment when mounted.



Depending on the version, between 24 and 672 beams with a resolution of 2.5 mm are available. This is equivalent to a measuring range (= distance between first and last beam) of 230 – 1.677.5 mm. The resolutions of 2.5 mm permit a measurement accuracy of ± 0.5 mm.[1]



In short, the measurement procedure can be described as follows:

Assuming that an object is located within the measuring range of the photoelectric barrier, the individual beams are activated in succession during a measurement cycle as described previously. The number of interrupted beams is indicative of the size of the test object.

The measured value is provided in the form of "DATA". In addition, the number of the first interrupted beam - and hence the position of the test object - can be output as the "POSITION" parameter. Since the individual light beams are parallel to one another, it is of no relevance to the measurement result whether the object is closer to the emitter or the receiver.

In the double scan mode the enhanced resolution is only available in the centre between emitter and receiver.

The system's high clock rate (100 kHz), permitting up to 2500 measurements per second, ensures high measurement accuracy. This is all the more important the quicker the target object is moved through the photoelectric barrier and the more variable its shape is.

The evaluating logic of the receiver unit includes several arithmetic functions, with the aid of which the measured data can be pre-processed in real time[2].

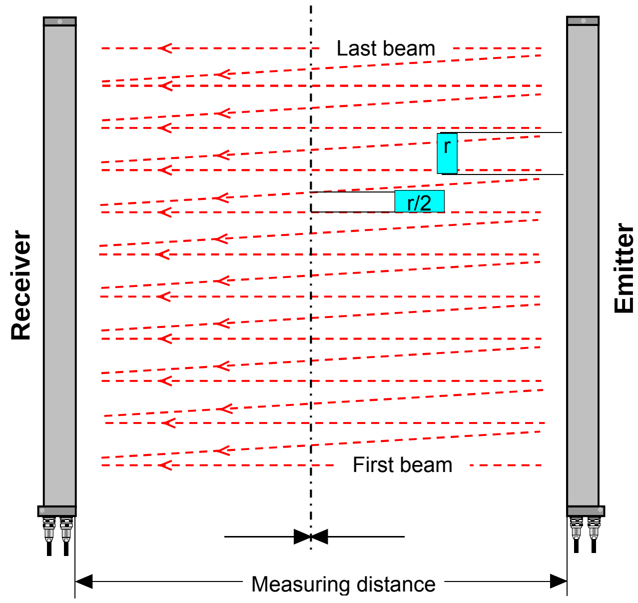
All these functions and data processing as well as data output via standard interfaces are incorporated. **No external units** are required.

[1] Arithmetic mean calculated over 10 measurements.

[2] A (non)-received beam is evaluated within the time frame for the corresponding measuring beam. The clock rate of 100 kHz – corresponding to 10 µs per beam - is maintained irrespective of the selected arithmetic function.

1.1.2 Double Scanning (enhanced resolution)

For some applications a higher measuring accuracy or improved capability to detect very small objects may be desirable. For this purpose the function „double scanning“ or „enhanced resolution“ is available. The method used is to insert an additional beam, as it were, diagonally between the parallel beams.



The first beam runs, as with parallel scanning, from emitter „1“ to receiver „1“, the second beam, however, from emitter „2“ to receiver „1“, the third beam from emitter „2“ to receiver „2“ (i.e. is parallel again), and so forth. If we call n_p the number of beams for parallel scanning, then the number of beams n_d for double scanning can be calculated by means of the formula $n_d = 2\ n_p - 1$, i.e. 288 beams would result in 575 beams with a resolution of 1,25 mm (as against 2,50 mm for parallel scanning).

It should be noted, however, that this doubled resolution, as well as the corresponding smallest detectable object size, only apply to the **centre of the measuring distance (between emitter and receiver).**

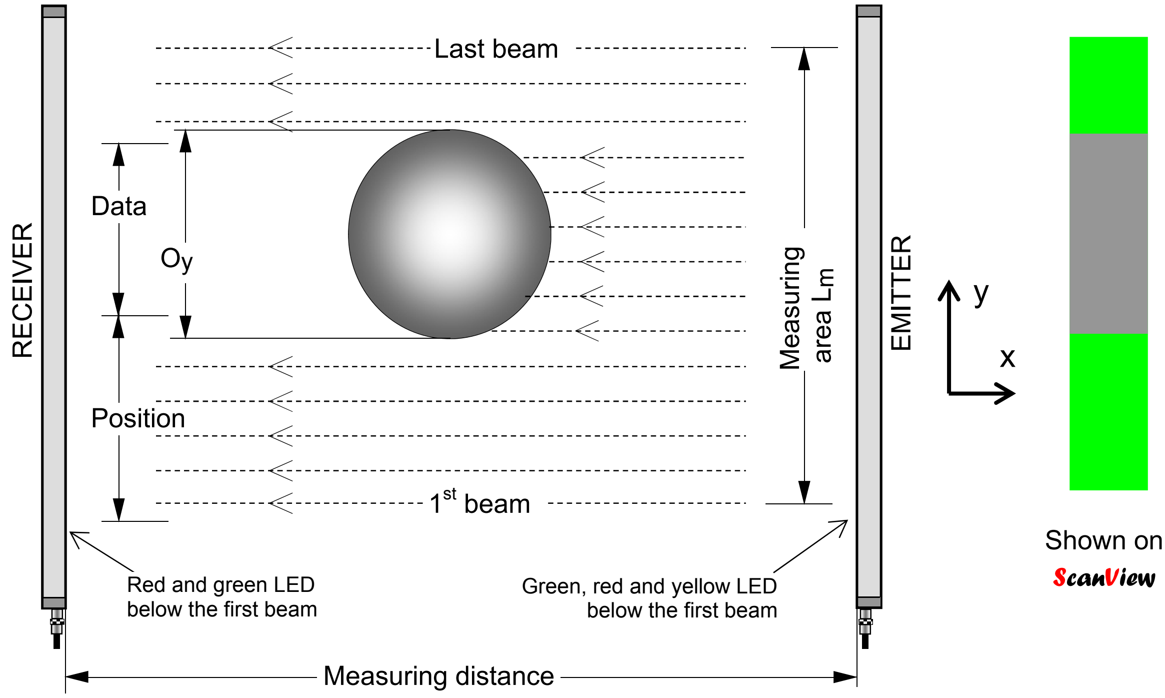
By means of the ***ScanView*** software it is possible to change between parallel- and double scanning. The appropriate point in the menu is „**Specials** □ **Double Scan**“. By clicking on the checkbox you can activate the Double Scan function. Description see chapter 4.2.2.

Light curtains of the series ***InfraScan***®5000 are basically intended to serve as measuring devices. However, in special cases they are used for detection of objects. In such a case it should be noted that, although certain defects, e.g. broken cables or defects occurring in electronic devices, will lead to an output signal, these light curtains are not "self-protecting".

Please note that these light curtains are not designed for safety applications!

1.2 System Description and Definitions

Looking at the measuring system as shown below, emitter and receiver vertical and connectors at the bottom, the ***bottom*** beam is designated the ***first*** measuring beam and the ***top*** beam as the ***last*** measuring beam, according to the sequence of scanning.



In addition, the optically active area is designated the **measuring area,** the number of interrupted beams is output as **DATA**. Alternatively, if preferred, the number of the first interrupted beam can be output and is designated as **POSITION.** By definition, the first beam is situated at the end nearer to the connecting sockets. The distance between emitter and receiver is designated the **measuring distance**.

The object size is named Oy and the difference to DATA is the measuring deviation. In the parallel scanning mode this will not change even when the object is moving in the x direction.

All units have the emitter equipped with a green, red and yellow LED. Units with serial output have the receiver equipped with a red and a green LED. Receivers with a parallel or SSI-interface are equipped with an LED display. These LEDs serve as indicators for various defects. A detailed description of the functions of the LEDs and the display can be found in chapter 3. "Mounting and commissioning" and 5.2 "Parallel data interface".

The measuring data can be "pre-processed". In addition to the **"NORMAL"**-mode described previously (DATA is the **sum of all broken beams**, independent of their "distribution" within the measuring area) the mode **"LARGEST BLOCKED AREA"** is available which is, e.g. particularly interesting in the forest industry for measuring logs. It outputs the **largest continuously darkened area** as DATA and the number of the LED at which this area begins as "POSITION".

The mode **„OVER ALL",** on the other hand**,** outputs DATA as the area from **the very first to the very last broken beam**, disregarding possible "free" areas in between.

The "SMOOTHING" function can be used to define a minimum number of interrupted beams from which an interrupted area is evaluated. As a result, separate soiled areas remain suppressed without any noticeable effect on measurement accuracy.

The standard method of data output is via a serial interface RS422. This interface permits bi-directional data traffic, thus offering the option of adapting the various parameters when installing the scanner of even during operation.

Another option is the **analog** interface (one or two channels) with either current or voltage output which can be programmed to output DATA or POSITION.

Optionally (and additionally to the serial interface) the scanners can be equipped with a 10 bit **parallel** interface or a Synchronous Serial Interface – short **SSI interface**. Both the parallel and the SSI interface offer an LED display to indicate the data value or certain faults if applicable.

Data can be provided in BINARY, GRAY or BCD code, either as number of beams or in mm.

Moreover the signal "SUM OUT" is provided with the parallel output. This will be active, when a number of beams - at least corresponding to the SMOOTHING value – are interrupted. In case SMOOTHING 1 is programmed, the output will be active, if only one beam is interrupted. The outputs "1st LED" and "last LED", corresponding to "first beam broken" and "last beam broken", are only provided with the serial output. Further features as, e.g. "Active Scan Area" or "Valid Data Value" add to the possibilities.

A more detailed description of these options and their programming you will find in chapter „4. FIRMWARE OPTIONS". By means of the software ScanView and an interface cable, which allows communication with the serial or USB interface of a PC, all these parameters can be easily set.

1.3 Maintenance

The InfraScan®5000 light curtains require practically no maintenance. Occasionally, particularly if one or more beams are dark because of soiled windows (which will be indicated by a flashing green LED on the receiver), just wipe the window surface with a soft cloth, if necessary use warm water or a mild detergent. Avoid scratching tools, hot water or steam.

1.4 Scope of Supply

The InfraScan®5000 light curtain system comprises the following components:

1. Emitter,
2. Receiver,
3. Synchronization cable (connecting emitter and receiver),
4. Supply connector power supply (optionally a supply cable),
5. Data connector for the serial interface (optionally a data cable RS422 or an interface cable with converter RS422→RS232).

Optionally can be ordered:

6. Data cable for the parallel, the SSI or the analog interface in case the units are equipped with one of these interfaces. In these cases the serial interface cable or the data connector respectively is not required.
7. Interface cable with converter RS422-RS232 or RS422-USB – PC. Description see chapter 5.1.6 „The ScanView Software".

2. PRODUCT SELECTION

Depending on the application different demands on the scanner will be in the foreground. In most cases these will be the decisive criteria:

1. **Measuring range:** Will be determined by the variation in size and position of the measuring object. Standard units and their measuring ranges are listed in the following tables.

2. **Resolution:** The series InfraScan®5000 offers two different beam spacings, namely 2.5 mm at parallel scanning and. 1.25 mm respectively at double scanning.[3]

Directly connected to the resolution is the **maximum measuring deviation** for a single measurement. This value will be cut to half when the measured object always moves on the same level (e.g. on a conveyor belt).

For continuous measuring usually the **average measuring accuracy** is of interest. The following tables show the arithmetic mean calculated over 10 measurements in the case the object moves freely up and down within the measuring area (in the y-direction). A typical case would be measuring logs in the sawmill industry.

2.1 Measuring Accuracy and Cycle Time Parallel Scanning

The following types of light curtains series InfraScan®5000 are available as standard. Previously listed 5 and 10 mm types are **not to be used for new installations!**

Type	No. of beams	Resolution r [mm]	Measuring area L_m [mm]	Deviation single mmt. max. [mm]*	Average accuracy [mm]**	Cycle time [ms]
5096/2.5	96	2.5	237.5	4.0	± 0.5	1.16
5192/2.5	192	2.5	477.5	4.0	± 0.5	2.12
5288/2.5	288	2.5	717.5	4.0	± 0.5	3.08
5384/2.5	384	2.5	957.5	4.0	± 0.5	4.04
5480/2.5	480	2.5	1197.5	4.0	± 0.5	5.00
5576/2.5	576	2.5	1437.5	4.0	± 0.5	5.96
5672/2.5	672	2.5	1677.5	4.0	± 0.5	6.92

* Measuring area "free" on both ends of object. In case that POSITION is output or scanner is used for "height" measurement, half of this value applies.

** Arithmetic mean of 10 measurements.

[3] In the centre between emitter and receiver

2.2 Measuring accuracy and cycle time double scanning

The following table is list of light curtains series InfraScan®5000 with Double Scan[4] which are available as standard.

Type	No. of beams	Resolution r [mm]	Measuring area L_m [mm]	Deviation single mmt. max. [mm]*	Average accuracy [mm]***	Cycle time [ms]
5096/2.5	191	1.25**	237.5	3.0**	± 0.5**	2.11
5192/2.5	383	1.25**	477.5	3.0**	± 0.5**	4.03
5288/2.5	575	1.25**	717.5	3.0**	± 0.5**	5.95
5384/2.5	767	1.25**	957.5	3.0**	± 0.5**	7.87
5480/2.5	959	1.25**	1197.5	3.0**	± 0.5**	9.79
5576/2.5[5]	1151	1.25**	1437.5	3.0**	± 0.5**	11.71
5672/2.5[6]	1343	1.25**	1677.5	3.0**	± 0.5**	13.63

* Measuring range "free" on both ends of object. In case that POSITION is output or scanner is used for "height" measurement, half of this value applies.
** In the centre of the measuring distance.
*** Arithmetic mean of 10 measurements.

2.3 Distance Ranges (variable gain)

Due to the fact that the measuring scanners are used at differing measuring distances, the various signal strengths have to be adapted accordingly in order to ensure correct operation of the receiver amplifier.

This can be achieved by specifying the measuring distance when ordering the scanner or by adapting gain to operating requirements via the serial interface, aided by the ScanView software, as described in chapter “4. Software Options”.

2.3.1 Series C

32 possible gain settings are available, from 0.2 m … 6.0 m. resulting from the combination of 4 emitter and 8 receiver settings.

Under no circumstances should the actual measuring distance (at which the scanners are mounted) be smaller than the set measuring distance, in order to avoid “over-modulation” (see also chapter “3.5 Hints for use regarding mounting”.

A table showing the dependence on different emitter and receiver settings can be found in chapter “**4.1 Programming Measuring Distance**”.

2.3.2 Series E with Digital Signal Equalization

Besides the 32 distance settings described for the series C, the Series E offers a “fine tuning” which allows the detection and measuring **transparent objects**. This you will find described in chapter **“4.1.2 Scanner with DSE”.**

[4] Double Scan is a firmware option. The ordering number does not change
[5] Double Scan is not available for this type
[6] Double Scan is not available for this type

2.4 Ordering code

2.4.1 Emitter and receiver with accessories

InfraScan **5288/02.5-S**

Emitter and receiver of series InfraScan®5000

No. of beams (parallel scanning)

02.5 resolution **2.5 mm** (parallel scanning)

S **S**erial interface
SB with BeamStream and DSE
P **P**arallel + serial interface
I SS**I** interface + serial interface
A **A**nalog output (1 channel) + serial
Z Analog output (2 channels) + serial
K... customer specific ..no.

These details are only related to the scanner *hardware*. Please check with the following table, whether the standard scope of supply meets your requirement. All other parameters can be adapted by means of the ScanView software (see chapter “4. Software options”) or can be specified in the list below. The settings will then be done in the factory.

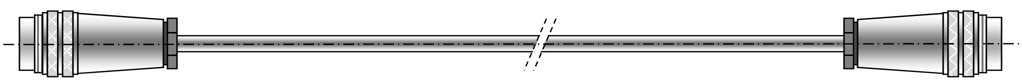
Accessories	**Standard supply**	**Options**[7]
Synchronization cable	Length 5 m	□ 8m □ ....m[8]
Connectors and cables	See chapter 2.4.2	See chapter 2.4.2
Software Options	Standard settings	Options
Scanning method	Parallel scanning	□ Double scanning
Measuring distance	0,6 - 1 m	□ ...... m
Data format	NORMAL	□ Largest Blocked Area □ OVER ALL
Coding	BINARY[9]	□ GRAY □ BCD
Output mode	No. of beams	□ mm
SMOOTHING	1	□ …….
First analog output	0-10 V	□ 4-20 mA □ 0-20 mA □ 0-24 mA
Output of:	DATA	□ POSITION
Active scan area	First and Last LED Offset: 0	□ First LED Offset ….□ Last LED Offset ….
Valid data value	Low: 0 High: 65535	□ Low: ….. □ High: ....

2.4.2 Cables and Connectors

Synchronization cable **SK50-7/... m**

Synchronization cable, shielded

Required length in m



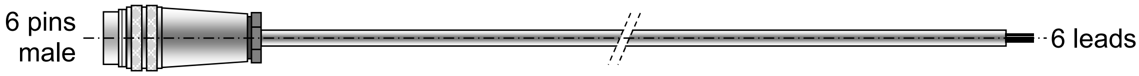
[7] Please tick where applicable.
[8] For cables longer than 8 m there is a surcharge.
[9] For scanners with SSI interface GRAY is the standard coding.

Data cable, serial

DK50-6/... m

Data cable, shielded
for serial data output RS422

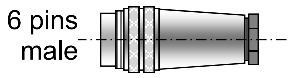
Required length in m
Standard length is 3 m



The standard scope of supply – providing no other interface is provided – comprises a round connector. In case it needs to be ordered the ordering code is:

Data connector, serial

DS50-6

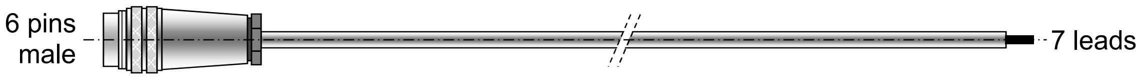


Supply cable

AK50-7/... m

Supply cable, shielded, for
power supply and sequencing

Required length in m
Standard length is 3 m

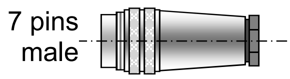


The standard scope of supply comprises a round connector. In case it needs to be ordered separately, the ordering code is:

Supply connector

AS50-7

The connector comprises 7 pins.

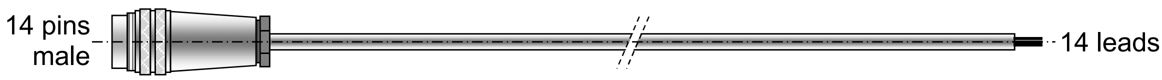


Data cable, parallel

DK5-14/... m

Data cable, shielded,
for parallel data output

Required length in m
Standard length is 3 m

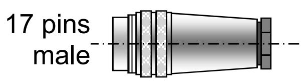


Scanners with a parallel interface are being delivered without the serial connector.

The standard scope of supply comprises a round connector. In case it needs to be ordered separately, the ordering code is:

Data connector

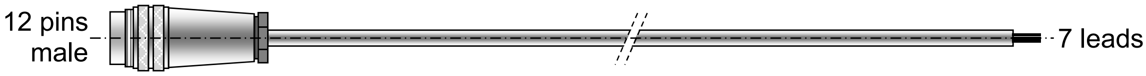
DS5-14



Data cable, SSI **DK50-7/... m**

Data cable, shielded,
for SSI data output

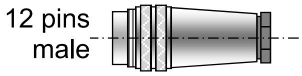
Required length in m
Standard length is 3 m



Scanners with an SSI interface are being delivered without the serial connector.

The standard scope of supply comprises a round connector. In case it needs to be ordered separately, the ordering code is:

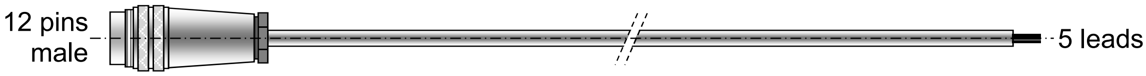
Data connector SSI **DS5-12**



Data cable, analog **DK50-5/... m**

Data cable, shielded,
for analog data output

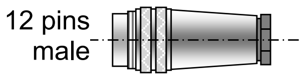
Required length in m
Standard length is 3 m



Scanners with an analog interface are being delivered without the serial connector.

The standard scope of supply comprises a round connector. In case it needs to be ordered separately, the ordering code is:

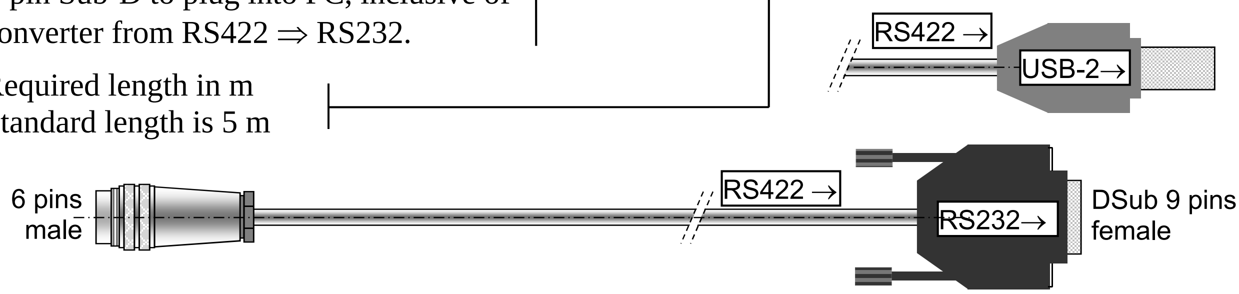
Data connector analog **DS5-12**



Interface cable **IK50-6/... m** **IK50-5/5m**

Data cable (for serial data output) with connector 6-pin and connector housing 9-pin Sub-D to plug into PC, inclusive of converter from RS422 ⇒ RS232.

Required length in m
Standard length is 5 m



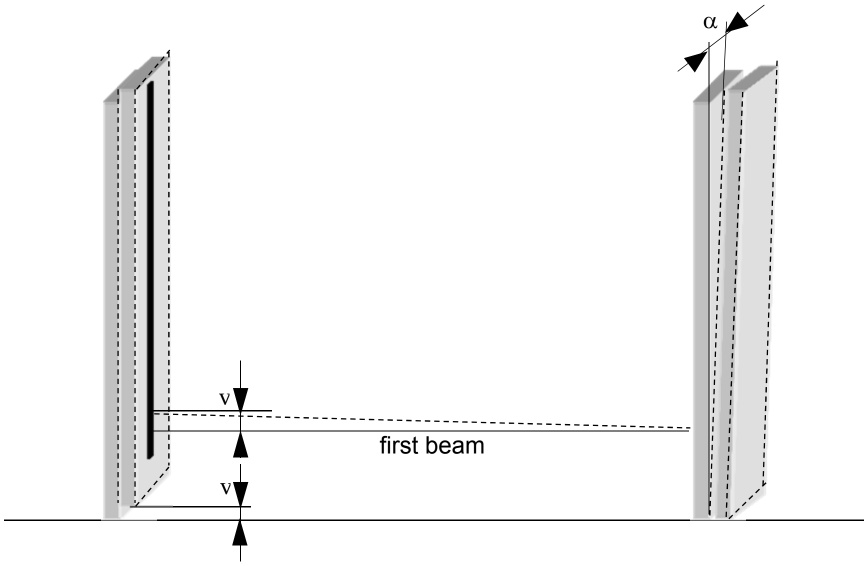
This cable serves also for programming the scanners by means of the ScanView software. A detailed description can be found in chapter “4. Software options”.

3. MOUNTING and COMMISSIONING

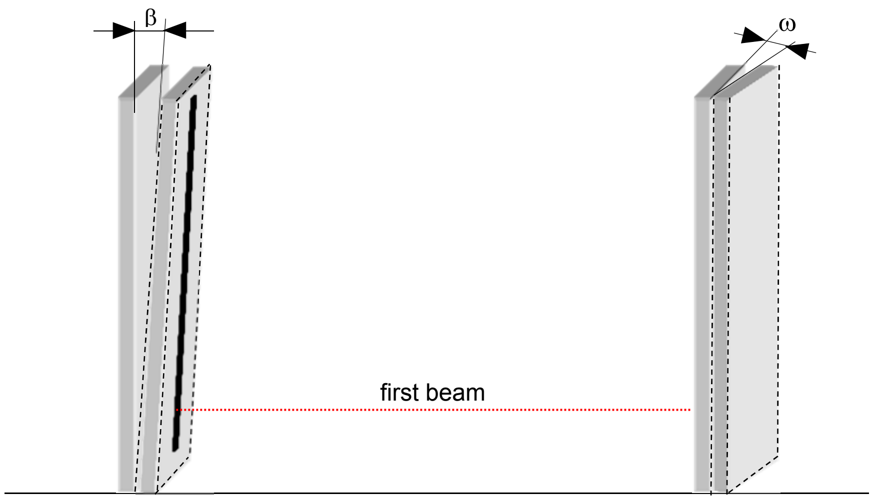
3.1 Mechanical Preparations

The dimensions of the casings, required to prepare for the mounting, are shown under technical data (chapter 7.1).

Emitter and receiver should be mounted parallel to each other and at the same height in order to achieve the optimum in functioning particularly, however, to ensure the best alignment of the optical axis of the beams. Thereby the vertical position is of the utmost importance as a shift would lead to a vertical misalignment by the value "v" and a twist of the angle α would lead to a shift sideways.



An inclination of the angle β or a twist by the angle ω has hardly influence on the optical axis, however, a twist (particularly of the emitter) can reduce the measuring distance, which cannot always be compensated (see also chapter 2.3).

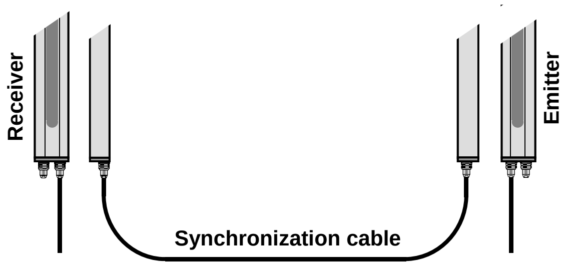


Then make the electrical connections according to the following description.

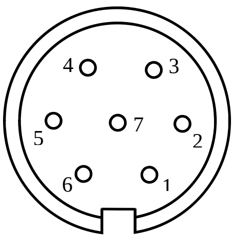
3.2 Electrical Connection

The measuring system can be connected in just a few operations:

1. Connect emitter and receiver by means of the provided synchronization cable. The appropriate socket on the emitter is marked SYNC.

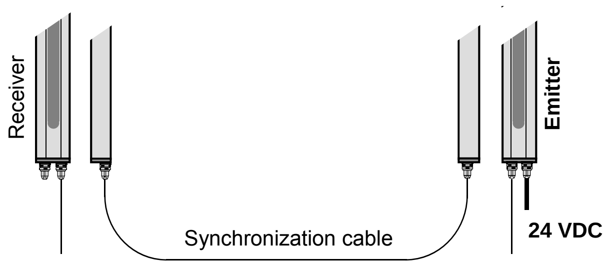


2. Connect **24V power supply** on the **emitter.**
If more than one scanner is in use, which needs to be sequenced, please note the connector wiring described in chapter 6.2.

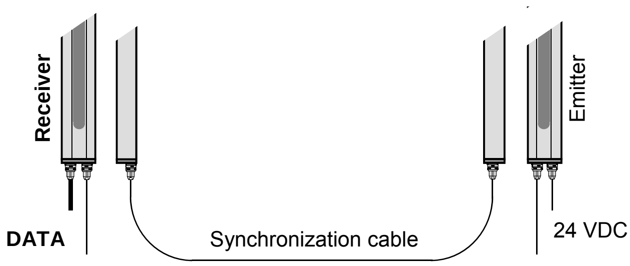


Signal	Socket	Cable*
+24 V	1	red
	2	
	3	
	4	
	5	
	6	
GND	7	black

*Colour of individual wires can vary depending on producer. Valid is the wiring diagram packed with the scanner.



3. Connect **data cable** to the corresponding connector of the **receiver**.
Wiring of the connectors, depending on the type of interface, is described in the appropriate chapter (either 5.1, 5.2, 5.3 or 5.4).



4. Switch on voltage supply. The **green** LED on the **emitter** should be "on" now.

Attention: Never connect or disconnect synchronization cable or data cable when power is ON!

To allow to check the basic functions regarding electrical connection, there are LEDs located at the emitter and receiver, providing the following indications.

Receiver (without LED display	
Red LED **is on**	Faulty synchronization or short circuit at data output(s)
Red LED flashes	Communication problem with scanner or error message from DA converter (e.g. no load at output)

Emitter	
Green LED **is on**	Voltage supply is o.k.
Green LED **flashes**	Voltage supply too low
Red LED **flashes once**	Communication problem with receiver
Red LED **flashes twice**	Internal error
Yellow LED **is on**	Emitter sequencing is o.k.

3.3 Adjusting

First of all make sure there is **no object within the measuring range. Receivers** with a **serial interface** are equipped with a red LED, just underneath the first infrared LED. This LED serves as adjusting aid and provides the following indications:

Receivers without LED display	
Green LED	**Information**
is on	All beams "free", scanner well adjusted
flashes	At least 1 beam has a bad signal, alignment not at optimum or programmed measuring distance exceeded
is dark	At least 1 beam is completely interrupted

Scanners with a parallel or an SSI interface are equipped with a 4-digit display, which shows the various adjustments. The functions of this display are described in chapter 5.2.

In order to detect even a single beam missing or with a bad signal, it is necessary to set the SMOOTHING value to 1 when checking the correct adjustment. However, independently of the programmed value, SMOOTHING will be set to 1 automatically for approximately 60 seconds after switching on power (scanners with parallel or SSI interface have a 50 seconds period after the measuring scale on the display comes on). After this period SMOOTHING will be set back to the originally programmed value.

In case no proper functioning of the scanner can be obtained it is either necessary to reduce the measuring distance or – if this is not possible – to adjust emitter or the receiver settings to a larger measuring distance. This is easily done via the serial interface by means of the ScanView software.

In case the scanner is equipped with a parallel or SSI interface the bottom cover of the receiver is provided with 3 sockets (instead of two).

The serial output can be used as such (permanently) or only for configuration (by means of the ScanView software) or for visualization of measuring data respectively of the scanner.

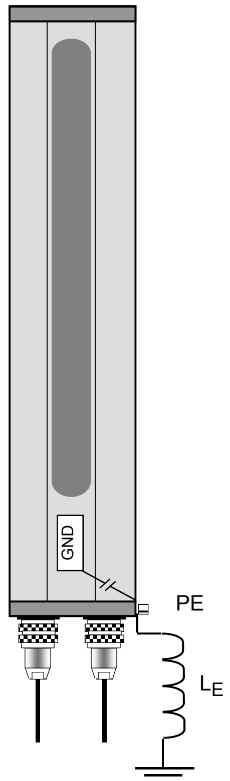
3.4 How to Earth the System

3.4.1 General

To comply with the standards for electro magnetic compatibility, the measuring system **InfraScan®5000** in its structure, electronic circuitry, connectors and casing was designed in such a way as to achieve the highest standards in this respect. However, to make use and to maintain this standard, the system must be installed according to the rules outlined in this chapter.

Both emitter and receiver electronics are mounted into hermetically sealed aluminum casings. They are connected to the casings by electronic filters. Therefore no direct connection exists between signal ground (GND) and protection earth (PE) when the casings are earthed.

For this purpose a copper screw is provided near to the cable connectors of each casing.



This connection to earth, however, must not only have a cross section large enough to avoid any tension on the casings which could be dangerous. Rather it should be taken care of **reducing the inductivity** (L_E) **of the earthing cable**. If inductivity of the earthing cable is too high this can lead to the undesirable effect, that particularly high frequency currents are not shunt to earth but are rather diverted via the electronics.

This measure is not only to be taken to avoid disturbances fed in via the casing but particularly also disturbances induced via the supply-/data-, or synchronization cable. Although the latter will be shunt to the casings via the filters, a connection to earth with low inductivity is an absolute necessity.

Means to reduce the inductivity of cables

1. The length of the cable is proportional to the inductivity (approximately 10nH/cm). Therefore the earth cable should be as short as possible.
2. Parallel switching of wires, insulated against each other (HF-cable with insulated wires), reduces inductivity (parallel switching of inductivities), whereas increasing the cross section will not reduce the inductivity of the cable.

To earth use an HF-cable as short as possible.

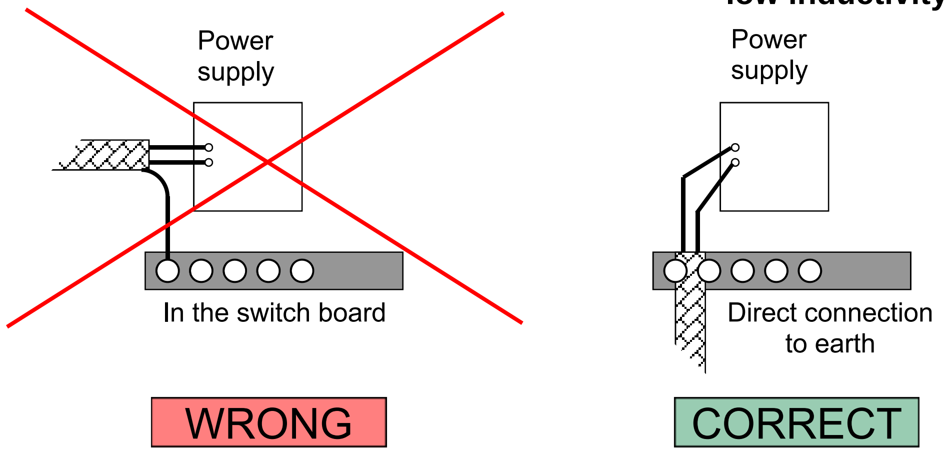
3.4.2 Shielding of supply and data cable

In case the supply and/or data cable is not ordered together with the scanner, make sure that **only shielded cables** are used for this purpose. The concept to earth the **InfraScan®5000** series scanners is based on **single sided shielding.**

The connection of shield and earth of each cable to be made in the switchboard.

When doing the round connectors (plugs) be careful to avoid the shield touching the connector casing. The connector is of metal and is directly connected with earth via the casing.

To ensure that high frequency currents which are induced into the cable are shunt to earth safely even with single sided shielding, the connection from shield to protection earth should have a low inductivity. The previously mentioned measures for optimizing inductivity should be applied just as carefully. Make sure the connection to earth is of **low inductivity**.



As most users produce their own supply-/data cable another aspect for selecting the cable should be mentioned here. The power consumption of a scanner system is roughly 1200 mA. Care should be taken for a large enough cross section of the supply cable to avoid an undesired voltage drop, particularly when the cable is long. If necessary, use more thin wires in parallel,

Take care for a large enough cross section of the power supply cable!

3.4.3 Power Supply

Relays, magnetic valves or similar devices with their voltage supply parallel to the scanner can produce considerable voltage peaks which should be blocked off by suitable free wheeling diodes. In such a case **it is advisable to provide a separate power unit for the scanner.**

Besides, it should be emphasized to use only high quality power supplies providing the voltage with a maximum ripple of 200 mV.

Attention should be paid to choosing a sufficient cross section of the supply cable in order to avoid a too high voltage drop. The following table shows the recommended square sections in accordance with the single length of the cable.

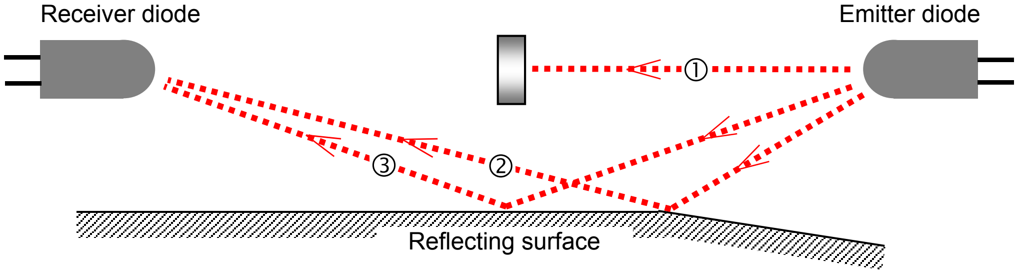
Recommended cross section mm^2	Cable length Maximum
0,25	10 m
0,34	14 m
0,50	21 m
0,75	32 m
1,00	42 m
1,50	64 m
2,50	106 m

3.5 Hints for Use Regarding Mounting

Certain ambient conditions or circumstances can influence the light curtain. By taking suitable measures on site problems can be avoided. In the following points some guidelines should be provided.

3.5.1 Reflections

Due to the wide-angle radiation of the infrared emitters - with the advantages described before, like ease of adjustment and immunity against vibration - problems may occur with reflections. E.g. it could happen that not only the direct light of the infrared beam is picked up by the receiver, but also a reflection of it. Particularly this can happen when a reflecting surface is situated near to the measuring system.

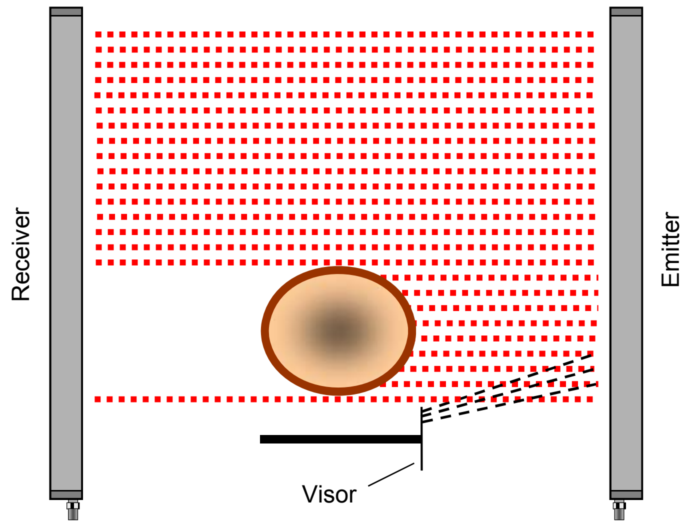


If an object would interrupt the direct light of a beam ① but its reflections via a shiny surface reaches the corresponding receiver, the beam would not be detected as "dark" (beams ② or ③). This beam, or adjacent ones respectively, would not be registered. The output value is **too small or the object will not be detected at all.**

The further away the reflecting surface is from the beams level the wider is the angle of reflection and the less is the danger of an influence by reflections.

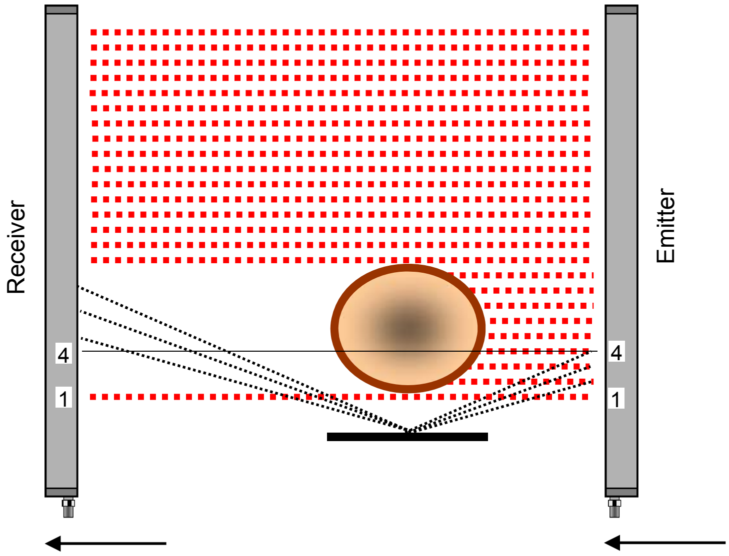
Be aware of shiny or highly reflective surfaces near to the scanner, which could lead to reflections onto the receiver.

In case it is not possible to move the scanner further away from the reflecting surface other measures have to be taken to avoid reflections to reach the receiver, as in the following examples. Occasionally conveyor belts or similar transport devices are causing reflections.



In such cases visors are the solution which should be mounted as near as possible to the reflecting surface. These guard plates shield off the reflecting beams, particularly the bottom beams. The reflections of the top beams are not critical because the signals reaching the receiver are very weak.

Another possibility to avoid reflections is to mount emitter and receiver asymmetrically".



The latter method makes use of the fact that at any time only one emitter and the corresponding receiver is activated. The reflection of a beam would have to aim at exactly the corresponding receiver to influence the measurement. The "asymmetrical" positioning of the scanner in respect to the reflecting surface suppresses this effect. It should be tried, however, to stay within the same distance range.

3.5.2 Influence of ambient light

Fundamentally the scanner system only accepts light **impulses.** The sensitivity for ambient light (e.g. sunlight) is greatly reduced by adequate electronic circuits, however, it cannot (and in fact should not) completely be eliminated.

The infrared receiver diodes are equipped with daylight filters. Light sources with a high content of infrared light (e.g. sunlight), however, can influence the receivers in such a way that the affected beams become interrupted. On the other hand is this an important function. Otherwise it could possibly happen that a real interruption is not detected.

Make sure no intensive infrared light sources (particularly morning or evening sunlight) can shine directly or indirectly into the receiver.

To overcome such a problem it is in most cases sufficient to change the position of emitter and receiver or to move the receiver out of the reflective zone. Again please observe to stay within the range (see chapter 2.3.).

Also other infrared beams can cause problems when they shine into the receivers of the INFRASCAN or when two INFRASCANs operate near to each other. In this case make sure that receivers and emitters are not mounted adjacent to one another.

Do not mount emitters and receivers adjacent to one another in multiple installations!

Multi-direction (x-y-systems) operation is described in chapter 6.

3.5.3 Over-modulation of receiver

To adapt the light curtains ***InfraScan*®*5000*** to the distances they are used at the receivers are equipped with variable gain (see chapter 2.3).

As a matter of principle each gain factor corresponds to a certain measuring distance to guarantee the best functioning of the measuring system. Programming differing to these standards must be carried out with great care and the necessity to do so is in many cases an indication of a different problem. Increasing the gain value above the recommended setting leads to a higher signal, however, enhances the danger of over modulation, possibly leading to false readings.

Adjust gain factor according to the recommended measuring distance!

Programming a too high a gain factor additionally supports faulty measurement by reflected beams, as these are also higher amplified than they normally would be. This way beams may not be interrupted as they would be if the setting was correct.

A too high a gain factor favours faulty measurements caused by reflections!

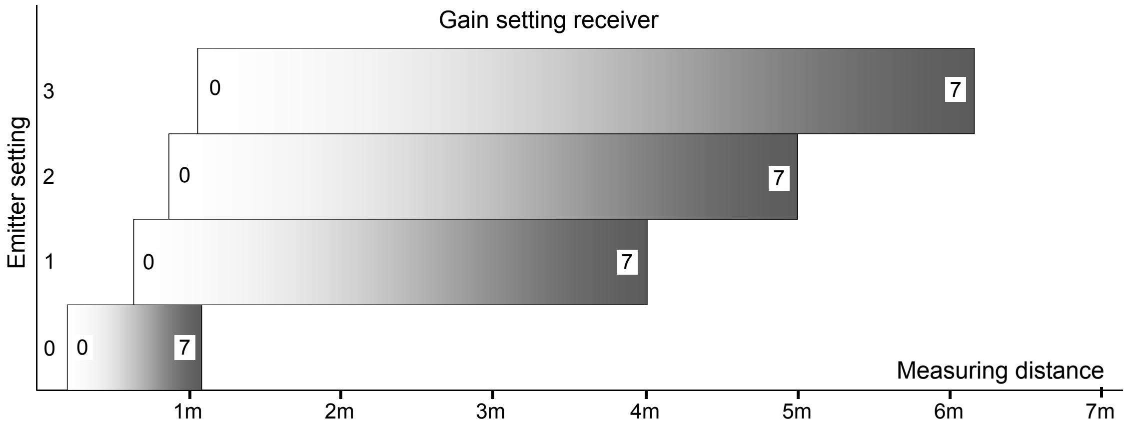
4. SOFTWARE OPTIONS

4.1 Setting of measuring distance

As described before in chapter 2.3, 4 options for the emitter (emitter power, so to speak) and 8 options for the receiver gain are available, which can be combined in any way. This results in 32 different measuring ranges, which partly overlap.

When looking for the ideal combination, one should start from the lowest possible emitter setting, which allows attaining the required measuring distance and set the emitter gain in the medium range, if possible. Exceptions are of course the lowest and highest measuring ranges.

The following table is only a guideline. The ideal setting for the application has possibly to be checked by tests or can be pre-set in the factory as required.



By means of the ***ScanView*** software the scanners can easily be programmed. The appropriate point in the menu is **„Receiver [Gain 0-7]**" und **„Emitter Gain [0-3]".** Just enter values into the box.

With button [Set Config] the value is sent to the scanner,
button [Store Config] will memorize the setting.

4.1.2 Scanners with DSE (Digital Signal Equalizer) (Series B)

As with series C, series E too offers 4 options for the emitter and 8 options on the receiver, which can be combined in any way. This again results in 32 different measuring ranges, which partly overlap

Moreover, with series E comes a „fine tuning", which allows the detection or measuring of transparent or partly transparent objects respectively. This will be described in the following chapter.

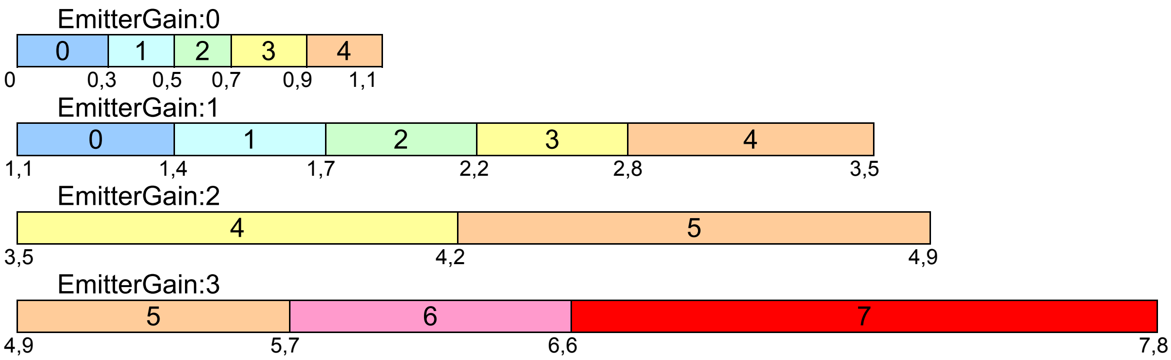
For Series C little different guidelines are applicable as compared to those for Series E. The ideal setting for the given application has possibly to be verified by tests. It is also possible to order factory settings.

First select suitable combination of emitter and receiver gain for the required measuring distance in [m]. Please refer to the table below.

By means of the ***ScanView*** software the programming can be done very easily. The appropriate point in the menu is „**Receiver [Gain 0-7]**" and „**Emitter Gain [0-3]**". Just enter values into the box.

With button [Set Config] the value is sent to the scanner,
button [Store Config] will memorize the setting.

Recommended Settings:



Then – again by means of the ***ScanView*** Software (version 1.9 or higher) - with ***Options*** > ***Calibration*** > ***Gap*** the "fine tuning" can be done:

Enter the required value for ***Gap*** in the window. With button [Set] it needs to be sent to the scanner. Before continuing, make sure that all beams are „free" and the window is not soiled in any way.

With button [Start Calibration] the fine tuning with ***InfraScan*** will be executed (recognizable by a short flash of the red LED on the receiver).

With button [Store Config] the setting will be saved.

The value for „Gap" should be within 20...80. The higher the value, the more transparent the object can be. It should be born in mind, however, that the sensitivity regarding electro magnetic compatibility will increase.

⚠ Button [Restore Defaults] will erase these data!

Before starting the fine tuning make sure the measuring area is unobstructed and either Parallel Scan or Double Scan is selected. If there is a change from Parallel Scan to Double Scan or vice versa, the fine tuning must be repeated!

4.2 Special Settings

4.2.1 Inverted mode

„Normally“, when measuring by means of the „through-beam-method“, the size of an object is determined by the number of ***interrupted beams***.

In the case, however, that cut outs in an object should be measured (also in the case of detecting holes in an object), it is exactly contrary. Here the number of ***not interrupted beams*** determines the size (Ill. 2).

The same applies for reflecting (though even transparent) objects, as e.g. glass or plastic foils. In this case too the reflected (hence ***not interrupted beams***) determines the size (Ill. 3).

The so-called „Inverted mode“ serves to „reverse” the function. Other functions, (e.g. Output modes, Smoothing, Double scanning, etc.) remain active. However, setting of measuring distance may be different than in the „normal” case.

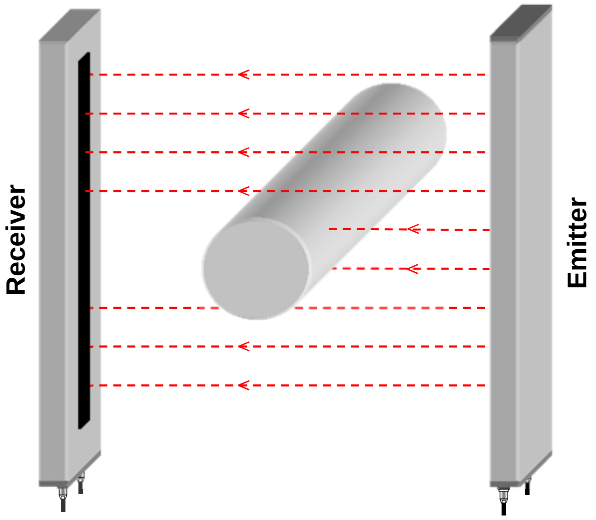


Illustration 1:
Through-beam-principle
The number of interrupted beams is being counted

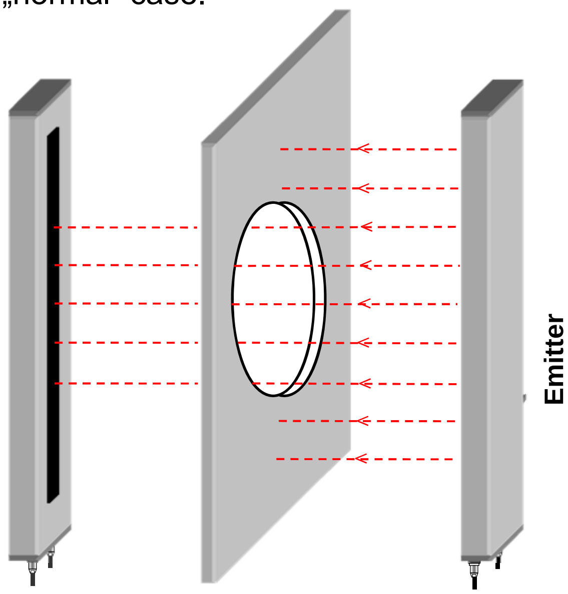


Illustration 2:
Through-beam-principle – „inverted“
The number of ***not interrupted*** beams in being counted

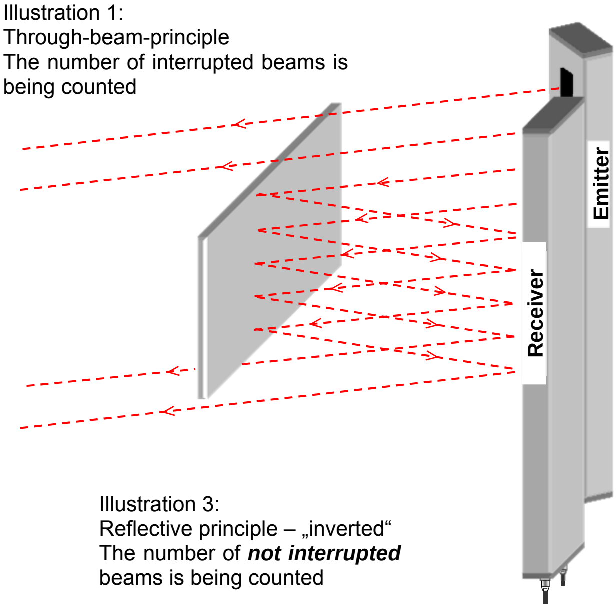


Illustration 3:
Reflective principle – „inverted“
The number of ***not interrupted*** beams is being counted

The **ScanView** software allows to select ***“inverted mode”***. The appropriate menu point is „**Specials ☐ Inverted Mode**“. To activate this feature click on the Checkbox.

With button [Set Config] the value is sent to the scanner,
button [Store Config] will memorize the setting.

4.2.2 Parallel-/Double Scanning

By means of the ScanView software it is possible to switch from parallel to double scanning (description see chapter „1.1 Working principle“).

Select „**Specials** ☐ **Double Scan**“ in the main menu. Click on the checkbox to activate the double-scan function or to de-activate it.

With button [Set Config] the value is sent to the scanner,
button [Store Config] will memorize the setting.

The evaluation/output of DATA or POSITION respectively changes automatically.

4.2.3 Switching off display information

Scanners with parallel or SSI interface are equipped with an LED display, which shows details of the configuration. By means of the ScanView software this information can be „suppressed“. The appropriate menu point is „**Specials** ☐**Display Info**“. Click on the Checkbox to activate or deactivate this function.

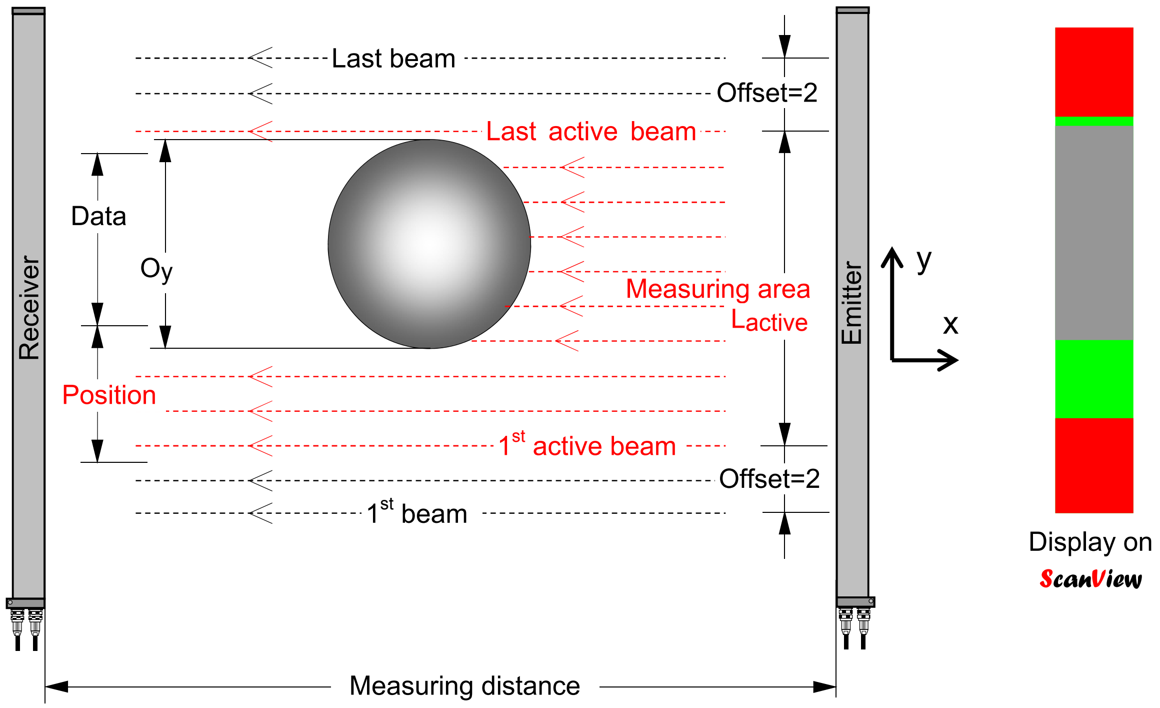
The initial testing phase, whereby all data lines are tested consecutively, is also suppressed.

With button [Set Config] the value is sent to the scanner
button [Store Config] will memorize the setting.

4.3 Active Scan Area

This function allows specifying a ***certain section*** of the measuring area to be “active” and within which the actual measuring (or detecting) takes place. For this purpose the „first active diode“ and the „last active diode“ need to be defined. This can be done by means of the ScanView software via the serial interface.

In this connection we speak of LEDs rather than beams. One could also speak of the first and last ***parallel*** beam. Within this defined ***active*** area parallel or double scanning can be applied.



Programming is done by means of the ScanView software. The appropriate menu points are „**First LED Offset [0-254]**“ and „**Last LED Offset [0-254]**“. E.g.: „First LED Offset“ = 2 means that the active scanning area begins at the 3rd LED. „Last LED Offset“ = 2“ means that the active scanning area ends at the 3rd beam from „top“.

POSITION is now counted from the **first active beam**. Information **FIRST_LED a**nd **LAST_LED** (1st. beam and last beam respectively dark), refer as well to the 1st and last **active** beam.

With button [Set Config] the value is sent to the scanner,
button [Store Config] will memorize the setting.

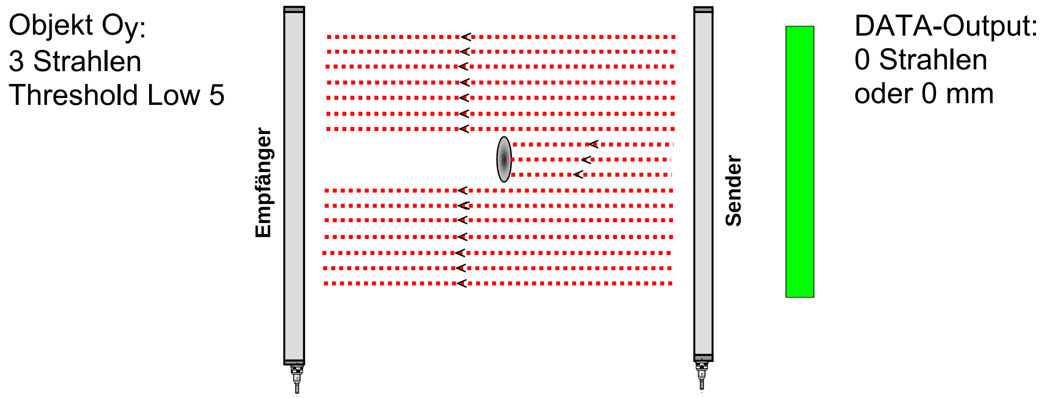
4.4 Valid Data (Threshold)

This function allows stipulating, which ***minimum data value*** in **number of beams** or up to which ***maximum data value*** data should be output at all.

Threshold Low means data output ≥ the stipulated value, **Threshold High** means data output ≤ the stipulated value.

This value is related to the actual output (DATA or POSITION), depending on the evaluation method used (possibly influenced by the output mode, as e.g. **L**argest **B**locked **A**rea mode or Smoothing).

Data values < **Threshold Low** and > **Threshold High** will be output as 0.



The Threshold value can be programmed by means of the ScanView Software. Simply enter the value under „**Threshold Low [0-65535]**“ or **Threshold High [0-65535]**“.

With button [Set Config] the value is sent to the scanner,
button [Store Config] will memorize the setting.

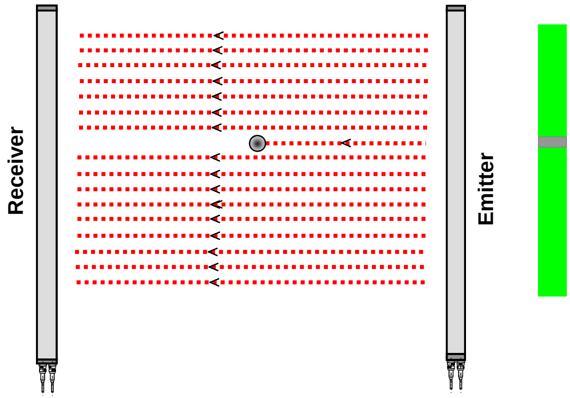
The Threshold value is defined by the **number of beams**, even when the measurement is output in mm.

4.5 Smoothing

By means of the function Smoothing it is possible to "blank" a certain number of **adjacent** beams.

Smoothing „1“ means that any object of a minimum size[10] on will be measured or detected respectively.

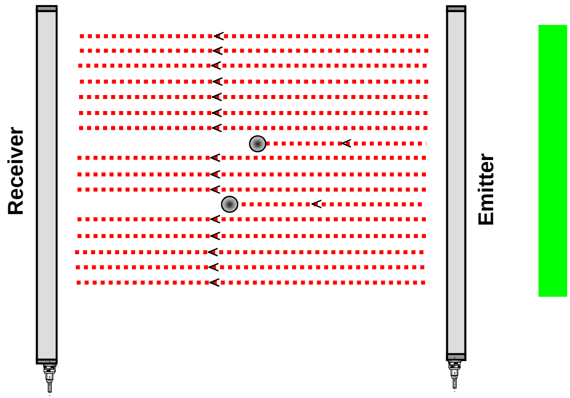
Object Oy:
< 2 beams
Smoothing 1



DATA-Output:
1 beam
or 10 mm

If the Smoothing value in this example is set to Smoothing 2, the result "0 beams interrupted" is obtained. Other objects smaller than “beams” will not be measured either.

Object 2:
< 2 beams
Smoothing 2

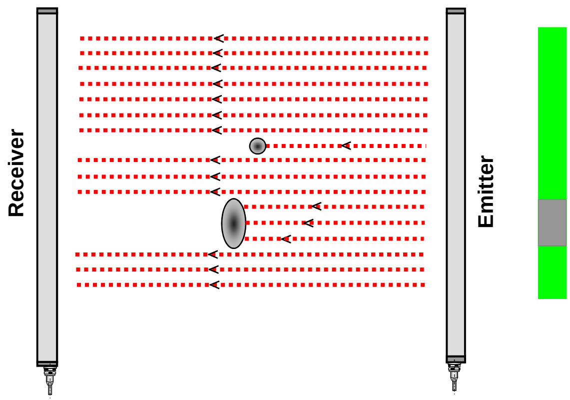


DATA-Output:
0 beams
or 0 mm

An object, however, above this ***Smoothing value*** will be output with the exact result.[11]

Object 2:
< 2 beams
Smoothing 2

Object 1:
≥ 2 Strahlen
(3 beams)
Smoothing 2

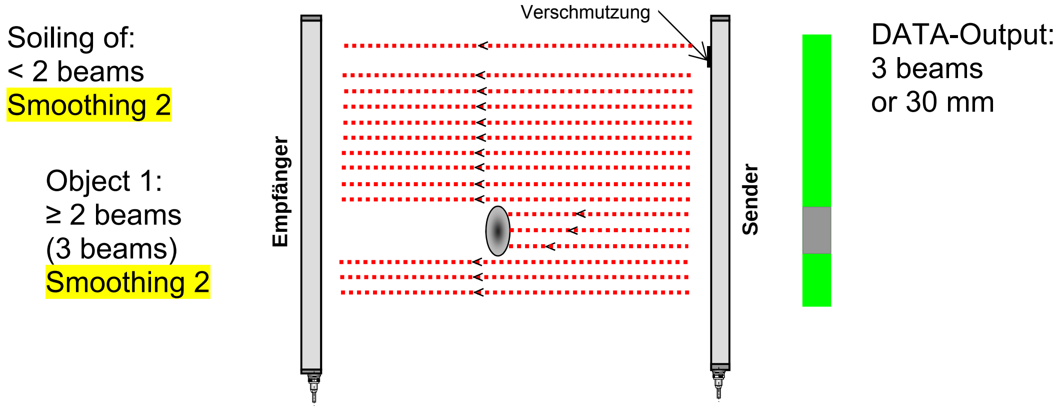


DATA-Output:
3 beams
or 30 mm

[10] See tables in chapter 2.1 and 2.2 “maximum deviation for single measurements.

[11] As soon as two objects are recognized (at least one measuring beam is passing in between them), the scanner applies the Smoothing function to both objects separately.

A possible application is, e.g. the “blanking” of soiled or defective parts of the measuring area[12]



In short, the **Smoothing** feature of the InfraScan®4000/10 measuring system can be used to pre-define a threshold value between 1 and 255 by selecting a suitable Smoothing value. As a result, "broken beams" are **only evaluated as "interrupted"** if the number of **directly adjacent** interrupted measuring beams is greater than, or equal to, the Smoothing value.

Isolated LED failures therefore do not affect the measurement result. Only when a number of (**successive!**) beams is interrupted, which is pre-set by means of the Smoothing function, this is recognized as "valid" by the receiver.

By means of the ScanView software a suitable Smoothing value can be programmed very easily. In the main menu go to „**Smoothing** [1−254]“. Enter the required value into the Box.

With button Set Config the value is sent to the scanner,
button Store Config will memorize the setting.

The Smoothing value is defined by the number or beams, independent whether Data output is in number of beams or mm.

[12] To detect whether soiling within the measuring area has occurred, it is only necessary to set the Smoothing value to 1. A new start of the system (switching OFF and ON of power) will have the same effect. Smoothing will then be set to 1 for about one minute.

4.6 Output Formats and Coding

The scanner can be programmed to provide several different data formats. Each format again can be coded in three different ways:

BINARY **BCD** **GRAY.**

The following output formats (modes) are available:

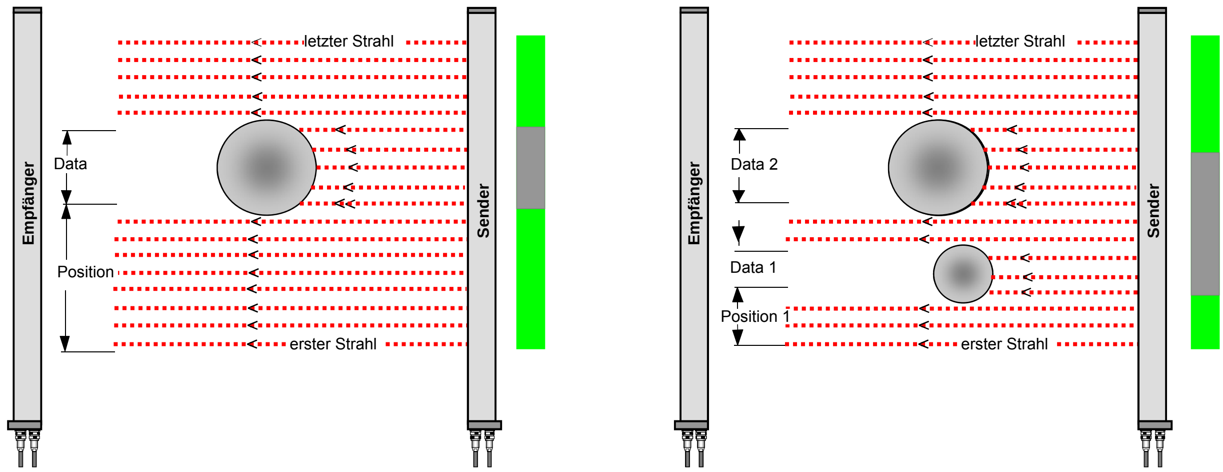
1. DATA/POSITION **"Normal":** The scanner outputs the number of interrupted beams as DATA and the position of the first interrupted beam as POSITION.

2. DATA/POSITION **"Over All":** In this mode, the beam counts the number of interrupted beams, but adds the number of uninterrupted beams within blocked areas to the value obtained and outputs the result as DATA. The number of beams from the **first to the last interrupted** beam is therefore added up. The number of the first interrupted beam is output as POSITION.

3. DATA/POSITION **"Largest Blocked Area":** The scanner outputs the largest continuously interrupted block as DATA and the number of the beam at which this block begins as POSITION.

4.6.1 DATA/POSITION - Normal

In this configuration, the number of interrupted beams is added up and the value is output as DATA. The start address of this block is output as POSITION.



The left figure shows the *normal case* in which an object is located in the measuring range. The scanner determines the DATA and POSITION data of this object accordingly.

If two (or more) objects are located in the measuring range, then two (or more) DATA areas result. In this output mode, the data are evaluated as follows:

$$DATA = \sum DATA_n$$

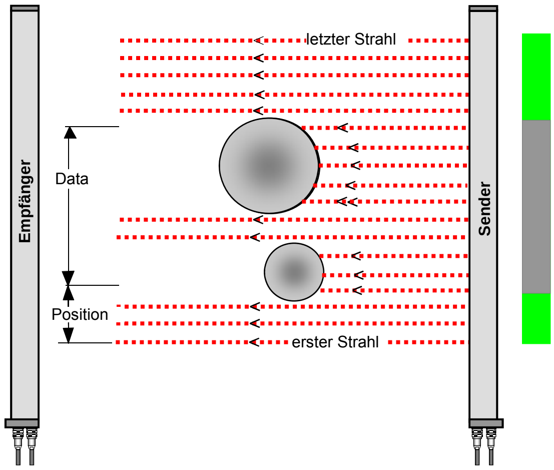
POSITION = POSITION 1

By means of the ScanView software this format can be selected. Go to **„Data Mode"** in the main menu, select from the list

Normal Bin **Normal BCD** **Normal Gray**

and confirm by mouse click. With button Set Config the setting will be sent to the scanner. Button Store Config will memorize the setting.

4.6.2 DATA/POSITION - Over All



In this configuration, the number of beams between the **first and the last interrupted beam** is added up and the value is output as DATA. The start address of this block is output as POSITION.

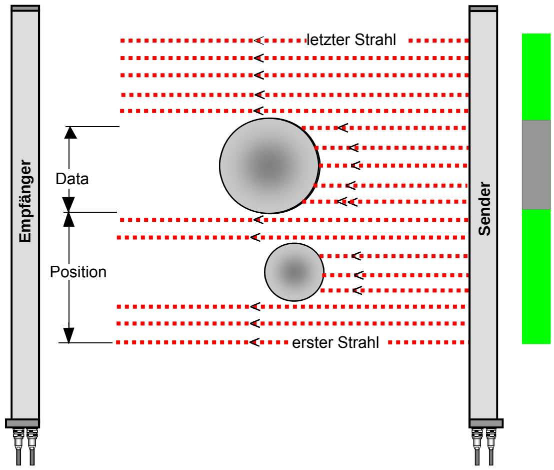
If more than one objects are within the measuring area, the „space" between the objects will be added to the DATA value.

By means of the ***ScanView*** software this format can be selected. Go to **„Data Mode"** in the main menu, select from the list

Over All Bin **Over All BCD** **Over All Gray**

and confirm by mouse click. With Button Set Config the setting will be sent to the scanner. Button Store Config will memorize the setting.

4.6.3 DATA/POSITION - Largest Blocked Area



In this configuration, the **largest continuously interrupted** block is evaluated. The number of beams is output as DATA. The start address of this block is output as POSITION.

This means that from several objects within the measuring area only the largest of them will be detected and measured.

By means of the ***ScanView*** software this format can be selected. Go to **„Data Mode"** in the main menu, select from the list

Largest Block Bin **Largest Block BCD** **Largest Block Gray**

and confirm by mouse click. With Button Set Config the setting will be sent to the scanner. Button Store Config will memorize the setting.

4.7 Output Mode Beams/mm

In any version DATA as well as POSITION can either be output as **Number of Beams** or in **mm**.

By means of the ScanView software one can easily switch between **Number of Beams** and **mm**. The appropriate sub menu is:

„**Result Type** ◉ **Beam count** ○ **mm**".

Clicking on the checkbox will activate the appropriate function.

With button [Set Config] the selection is sent to the scanner,
button [Store Config] will memorize the setting.

The calculation/output of DATA and POSITION respectively changes automatically.

4.8 Remote Diagnosis (Error Messages)

By means of the [Get Error…] button on the ScanView main menu an error record can be called. The error messages remain in the record until this is deleted. To delete the error record, click on the [Reset Error] button (even when the error has been found and mended).

Error record data are volatile, which means that clicking on the [Reset] button or switching off the supply voltage also deletes the record.

The individual bits indicate the following error messages:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
x	x	Defective analog output (available only from series „C" onward): Cause: E.g. open current loop.	Number of beams non congruent with number of emitter beams. Cause: Emitter module defective or emitter does not match with receiver.	No communication with emitter. Cause: Sync- and supply cable mixed up or emitter is of an older generation.	Faulty communication between emitter and receiver. Cause: E.g. defective synchronization cable.	Short circuit on one of the outputs of the parallel interface.	One or more weak receiver signal.

4.9 Original Configuration

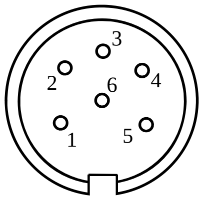
By means of this function of the ScanView software it is possible to return to the original setting (factory settings), after having made alterations to one or more of the parameters. All the alterations made will be deleted.

To return to the original settings, click on the [Restore Defaults] button.

5. OUTPUTS, EVALUATION

5.1 Serial Interface and BeamStream Format

This interface allows for the connection between scanner and controllers with an RS422 port or – with the use of a so-called Interface cable - an RS232 port (e.g. PC interface) or USB-2 port.



View of solder side of connector

Signal	Socket	Cable*
RxD	1	White
/RxD	2	Brown
TxD	3	Green
/TxD	4	Yellow
+24 V	5	Pink
GND	6	Grey

*Colour of individual wires can vary depending on producer. Valid is the wiring diagram packed with the scanner.

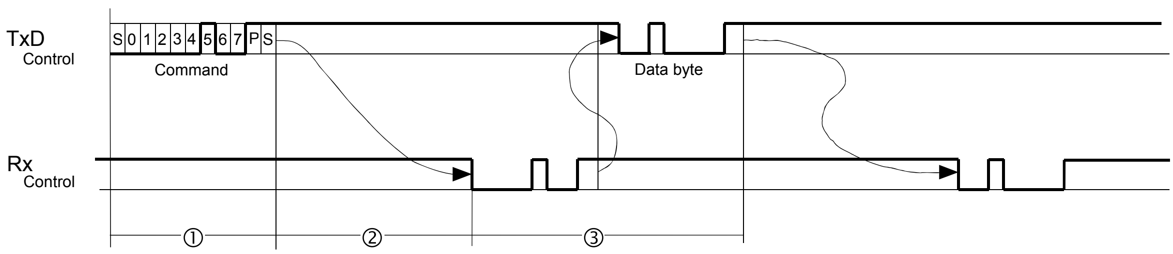
The UART interface comprises two TxD and RxD signal lines.

Interface protocol:
Baud rate [Bd]:9600/19200/38400/115200/230400
Number of Data bits: 8
Number of stop bits: 1
Parity: even

The command set of the InfraScan®5000 measuring system is not only suitable for data transmission; it can also be used for configuring the receiver. It is worth emphasizing that simultaneous operation of the serial and (if provided) the parallel or SSI interface is possible.

5.1.1 Message format and timing

Communication is always initiated by the connected controller. At the same time, the first byte to be transmitted is always a command. If this command is recognized as "valid", it is confirmed by the receiver, which returns the same code (ECHO).

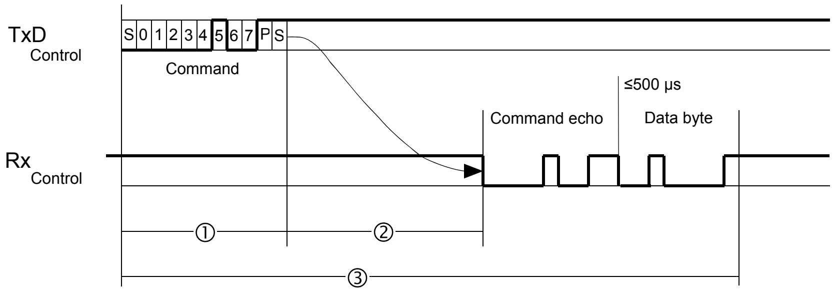


① Byte transfer time (at 38,4kBaud): 290 µs
② Time delay: max..1500 µs[13]
③ Waiting time for subsequent data (command): max. 50 ms

In the write operation described above - ***write_gain*** to receiver - the controller transmits the new gain value as a data value on arrival of the echo. The receiver checks its UART for the presence of the data value and confirms this with an additional echo 3 ms after transmission of the command echo has begun (!).

[13] For the commands ***write_transmitter_gain*** and ***write_special*** delay can be up to 50 ms.

In the read operation shown below, ***read_gain*** supplies the current gain value of the receiver: The controller initiates the transfer with this command. This is re-confirmed, then the requested data value is transferred.



①	Byte transfer time:	290 µs
②	Time delay:	max. 150 µs
③	Total transfer time:	max. 1310 µs

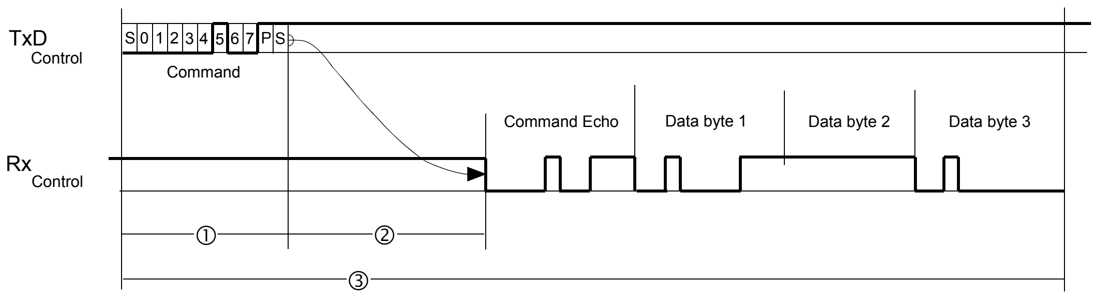
5.1.2 „*BeamStream*“ – Format of Serial Data Transmission

This format represents a special type of data transmission via the serial interface. Its purpose is to show the **condition of each individual beam,** independent of Smoothing, Threshold and Data Mode.

Each bit of this “Beamstream“ constitutes a beam. An interrupted („dark“) beam is represented by a logic „0“ and an uninterrupted („clear“) beam is represented by a logic „1“. As the UART transmits the DATA in form of Bytes, the Beamstream is transmitted in packages of 8 bits.

For a scanner with, e.g. **288 beams, 37 consecutive bytes** will be transmitted. The first byte, following the Echo, contains the information for the beams 1 - 8, the consecutive bytes beams 9 - 16 and so forth. Within one byte the lower digit represents the lower beams (in number).

The control initiates the data transfer with the command ***dx84***. This will be confirmed by a command echo, followed then by the requested Beamstream. If, after transmission of a Beamstream, another command is sent, then after completion of the next measuring cycle, this new data (Beamstream) will be sent, in real time so to speak.



①	Byte transfer time (at ***230400 Bd***):	47.7743 µs
②	Delay:	max.150 µs
③	Total transfer time (288 beams):	max. 1966 µs

For a data transfer in „real time“ (transfer of every one measuring cycle), the data rate of the interface must be set to 230400 Baud (bps)!

For output in the *BeamStream* format, the scanner must be set to ***Beam Count.***

5.1.3 Command group *write_configuration*_data

As described previously, the command byte has to be sent by the controller first. Once the receiver has returned the echo, the desired new configuration data value - which is also returned as an echo - must be transmitted within approx. 1 - 2.5 ms.

Command	Hex code	Valid data range	Remarks
write_receiver_gain	10h	0…7	Setting receiver gain value, 8 steps
write_emitter_gain	D0h	0…3	Setting emitter power, 4 steps
write_smoothing	11h	1…254	Setting of SMOOTHING value
write_first_led	19h	0…254	Setting the offset for the beginning of the active scanning area. Offset 2 means, scanning starts at 3rd LED
write_last_led	1Ah	0…254	Setting the offset for the end of the active scanning area. Offset 2 means, active scanning ends at the 94th LED when the scanner comprises 96 diodes
write_threshold_low	1Bh	0…65535	Setting the low threshold value
write_threshold_high	1Ch	0…65535	Setting the high threshold value
write_mode	12h	1…15h	Setting the output format 0x01: Output mode: over_all, BCD code 0x02: Output mode: over_all, binary code 0x11: Output mode: over_all, Gray code 0x03: Output mode: normal, BCD code 0x04: Output mode: normal, binary code 0x13: Output mode: normal, Gray code 0x05: Output mode: largest_block, BCD code 0x06: Output mode: largest_block, binary code 0x15: Output mode: largest_block, Gray code
write_result_type	14h	0...1	Setting the output of measured data to be supplied as number of beams or as mm value. 0: output as number of beams 1: output as mm value

5.1.4 Command group *read_configuration_data*

In accordance with the protocol, the command byte is sent first by the controller. Once the receiver has returned the echo, the current configuration data value is immediately transmitted by the receiver.

Command	Hex code	Valid data range	Remarks
read_receiver_gain	20h	0…7	Read current receiver gain value
read_emitter_gain	D8h	0…3	Read current emitter power value
read_smoothing	21h	1…254	Read current SMOOTHING value
read_first_led	29h	0…254	Read offset of begin of active scanning area
read_last_led	2Ah	0…254	Read offset of end of active scanning area
read_threshold_low	2Bh	0…65535	Read low threshold value
read_threshold_high	2Ch	0…65535	Read high threshold value
read_mode	22h	1h…15h	Read set output format 0x01: Output mode: over_all, BCD code 0x02: Output mode: over_all, binary code 0x11: Output mode: over_all, Gray code 0x03: Output mode: normal, BCD code 0x04: Output mode: normal, binary code 0x13: Output mode: normal, Gray code 0x05: Output mode: largest_block, BCD code 0x06: Output mode: largest_block, binary code 0x15: Output mode: largest_block, Gray code
read_resolution	23h	0…1	0: scanner has 2.5 mm resolution 1: scanner has 5 mm resolution 2: scanner has 10 mm resolution
read_error	88h	0…255	Read error codes
read_result_type	24h	0…1	Read current measuring data mode 0: output as number of beams 1: output as mm value
read_release	27h	-	Release number of software (hex value)
read_diod_count	25h	1h…ffffh	Number of diods (not beams!)

5.1.5 Command group *read_datasets*

Command	Hex code	Valid data range	Remarks
Read_all	81h	-	Read DATA **and** POSITION. 1st data byte: DATA, lo 2nd data byte: DATA, high* 3rd data byte: POSITION, lo 4th data byte: POSITION, high
Read_data	82h	-	Read DATA. 1st data byte: DATA, lo 2nd data byte: DATA, high*
Read_pos	83h	-	Read POSITION. 1st data byte: POSITION, lo 2nd data byte: POSITION, high

* The data byte DATA, high also contains the information LAST_LED as bit 7 (MSB) and the information FIRST_LED as bit 6.

5.1.6 System commands

The commands in this group only consist of the command itself. The command is in turn confirmed by the measuring system.

Command	Hex code	Valid data range	Remarks
change_baudrate	00h	-	The control sends the command 00h using the desired Baud rate. 9600 Baud, 19200 Baud and 38400 Baud are supported. If the scanner has already set the correct baud rate, it sends a 00h echo in response. Otherwise, the receiver increments / decrements the set baud rate by 1 increment and re-initialises the UART (≈ 2s). As a result, the scanner sends the 00h echo in response after a maximum of 3 increments.
reset scanner	8fh	-	The receiver is re-initialised (≈ 3s). At the same time, the configuration values are reloaded from the EEPROM.
reset_error	89h	-	Reset all error codes
restore_defaults	8Eh	-	Restore factory settings
store_config	80h	-	This command saves the current configuration data in the EEPROM[14]. This operation takes approx. 10 ms per data value. This concerns the following data values: 1. Gain 2. Smoothing value 3. Output mode 4. Output format (beams ⇔ mm) 5. Baud rate

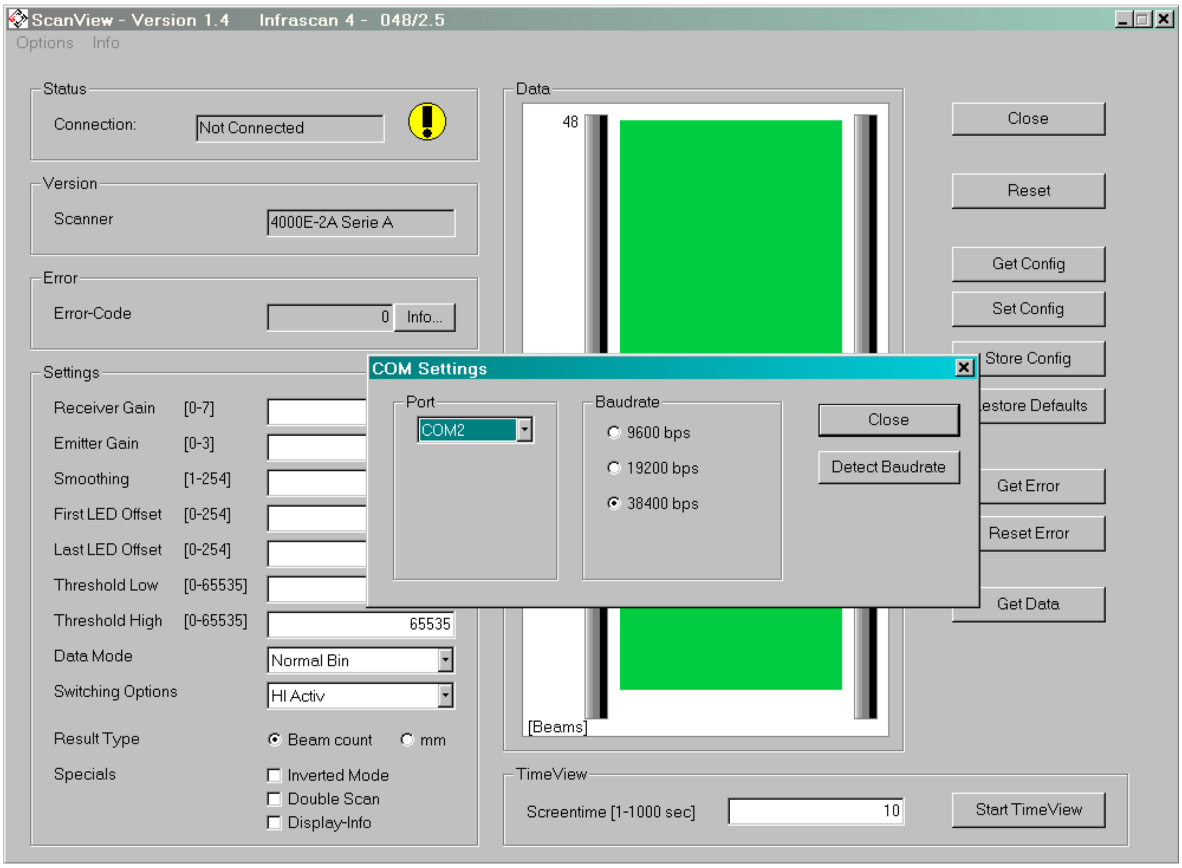
[14] Note the limited programming life of the EEPROM (it can be reprogrammed approx. 100,000 times).

5.1.7 *ScanView* Software

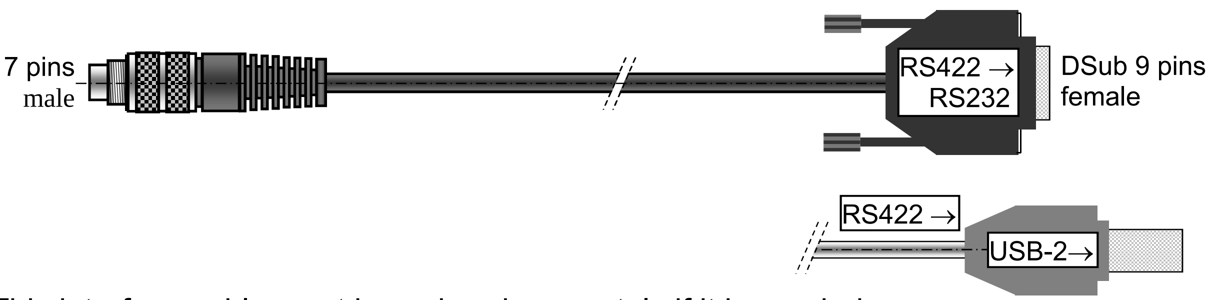
By means of this software it is possible to program all aforementioned parameters via the serial interface of the scanner and a temporarily connected PC/Laptop/Notebook. For this purpose an interface cable connecting the scanner with the serial interface of the PC is required.

The following image shows the *ScanView* main menu. A more detailed description of the functions you can find in the manual. The *ScanView* software, as well as the manual you can download from our homepage

www.sitronic.at/service/service_dl.php4?sprache=en



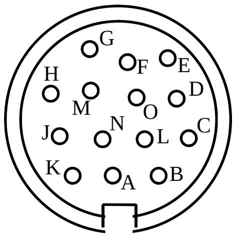
Conversion of the RS422 signal to an RS232C signal, required for the RS232C interface of the PC is performed in the housing of the connector on the PC. As a result, the signals are routed as immune RS422 signals along the entire cable and are not converted until they actually reach the connector housing.



This interface cable must be ordered separately if it is needed (see also chapter 2.4 Ordering Code)

This interface cable is also available with USB-2 converter.

5.2 Parallel Interface



View of solder side of connector

*Colour of individual wires can vary, depending on producer. Valid is the wiring diagram packed with the scanner.

Signal	Socket	Cable*
DATA 0	A	White
DATA 1	B	Brown
DATA 2	C	Green
DATA 3	D	Yellow
DATA 4	E	Grey
DATA 5	F	Pink
DATA 6	G	Blue
DATA 7	H	Violet
DATA 8	J	Grey+pink
DATA 9	K	Blue+red
SUM OUT	L	White+green
DATA ready	M	Brown+green
HOLD	N	Red
DATA/POSITION	O	Black

The parallel interface comprises the following signal lines:

1. DATA-0...DATA-9 (OUTPUT):

These lines provide the data selected by *DATA / POSITION* as a 10-bit word. The data are valid as long as the *DATA-READY signal = 1*. The data can be frozen via the control input *HOLD*, thus ensuring the acceptance of data from slow controllers.

2. HOLD (INPUT):

The data originating from the two data records can be frozen (*HOLD* = 1) via this control line, as a result of which slower controllers can also read all data records originating from the same scan cycle.

The signal SUM OUT is **not** affected by *HOLD.*

3. DATA / POSITION (INPUT):

The control line DATA / POSITION defines whether the output is DATA (number of covered beams of a block) or POSITION (number of beam at which data block retrievable under DATA begins):

DATA / POSITION = 0 ...DATA
DATA / POSITION = 1 ...POSITION

In case the inputs HOLD or DATA / POSITION respectively are not connected then HOLD or POSITION respectively are **not active.**

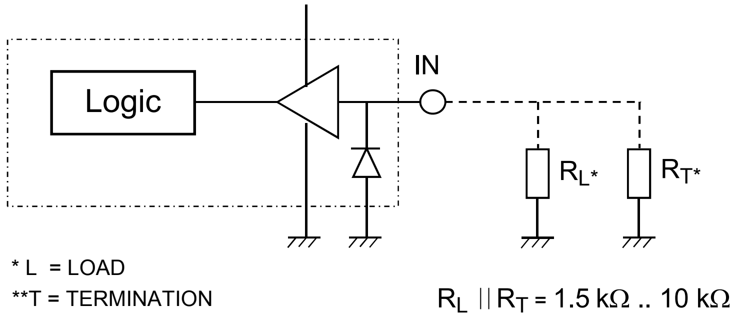
4. DATA-READY (OUTPUT):

Data lines *DATA-0...9* are declared valid BA means of *DATA-ready = 1.* This signal cannot be frozen by means of *HOLD*, to make it is possible to detect whether a scan cycle has been completed when a *HOLD* is applied (*DATA-ready* from HI to LO).

5. SUM OUT

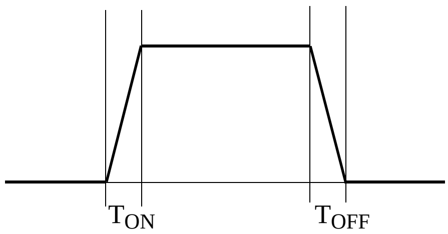
This signal is =1 (HI-level), if a number of beams is broken h at least equals the SMOOTHING-value. If SMOOTHING 1 is programmed the output will be active when only one beam is interrupted.

The *open-emitter outputs* are limited to 20 mA and are equipped with a *short circuit protection* and should be terminated with 1,5kΩ...10kΩ.



$U_{HIGH} \geq U_V^* - 2V$
$U_{LOW} \leq 5V$
$I_{max} = 20$ mA
$T_{OFF} \cong 40$ µs at 2 mA load
$T_{OFF} \cong 4$ µs at 20 mA load

* U_V = supply voltage



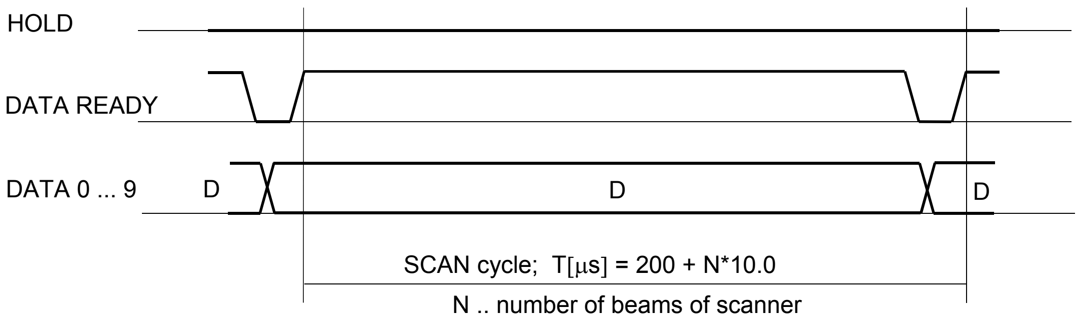
The ***inputs*** are designed for 24 V ± 20 %. Power consumption is approximately 3 mA at 24 V.

Two possible methods of evaluating the measured data are described below:

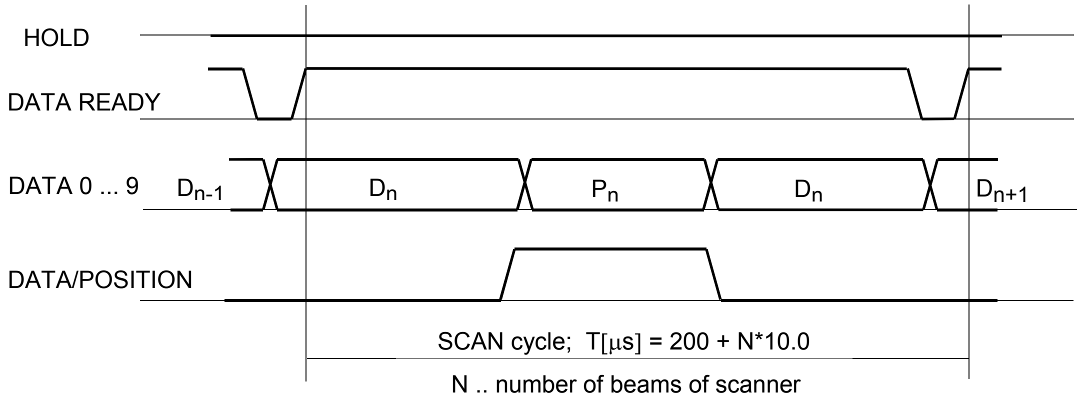
5.2.1 Synchronization using DATA-READY signal

The more frequently used (and simpler) method, which involves the user evaluating only the DATA signal, will be dealt with first:

During a SCAN cycle, the micro controller is busy evaluating the analog signal. On completion of the cycle, the DATA-READY line is deactivated, with the result that the existing data from the preceding cycle are declared invalid, after which the current data are prepared for output and transferred to the parallel output. The DATA-READY signal is then activated (tied to +24 V), with the result that the new data are declared valid. This DATA-READY signal can therefore be used to buffer the DATA information.



If POSITION should be evaluated additionally, the following diagram is applicable.

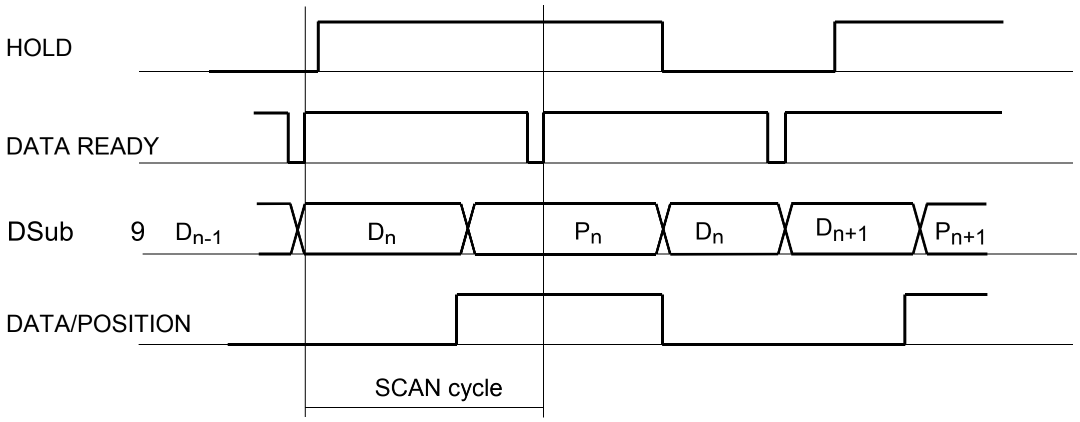


A new data record is output when the signal on the DATA-READY control line is changed. In the case of DATA / POSITION = 0 the DATA value D_n is then read out. By changing the signal on the control line (DATA / POSITION = 1) the POSITION value P_n can be read in by the interface.

NOTE: This method of evaluating DATA **and** POSITION represents the quickest means of data transfer, but calls for a faster controller. Naturally, both types of information should originate from the same cycle. However, the measuring system does not know when the controller reads the data in. Although the scanner sends out the DATA-READY synchronization signal, it receives no feedback regarding the actual interchange of data[15].

5.2.2 Freezing data records using HOLD control line

This procedure ensures that the two data records for DATA and POSITION originate from the same SCAN cycle. To this end, the HOLD line is activated before the first data record is read in. This prevents the data values from being updated by new SCAN data. The first data record can then be read out. The second data record is selected and read out together with the DATA/POSITION control line. Finally, the HOLD line is deactivated again.



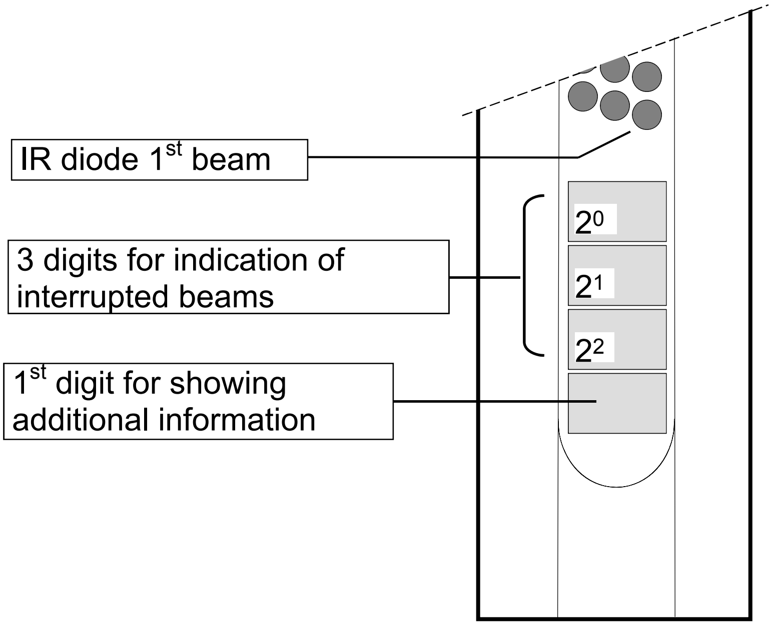
To ensure that an updated data record is available when the next read-in operation is performed, the HOLD line must not be re-activated until the DATA-READY line has declared the next measured data as valid[16]. This data can then be "frozen" again.

[15] If the measured data are read-in by a slow controller, the two data values D_n and P_{n+1} may well be received!

[16] The maximum duration of this period is: T = 200 µs + no. LEDs * 10.0 µs. If the DATA-READY line is not used, the control program must be designed in such a way that the measuring system is allowed this period of time T for updating the measured data.

5.2.3 LED display

INFRASCAN models with parallel or SSI interface comprise of an LED display in the receiver casing. The functions of this display are described below:



1. **3-digit display of interrupted beams**

   The display of interrupted beams is **independent** of the output modes mm, BCD or GRAY and **depending** on the programmed output modes OVER ALL, Largest Blocked Area, Smoothing, HOLD and DATA / POSITION.

2. **1-digit display for additional information**

Display	Information
No display	All beams "free"
?	Weak signal at one or more beams
∨	1st beam interrupted (other beams may be interrupted additionally)
∧	Last beam interrupted (other beams may be interrupted additionally)
+	Beams interrupted (apart from 1st and last beam)
×	First **and** last beam interrupted (other beams in between can be "free")

3. 4-digit-display of defects

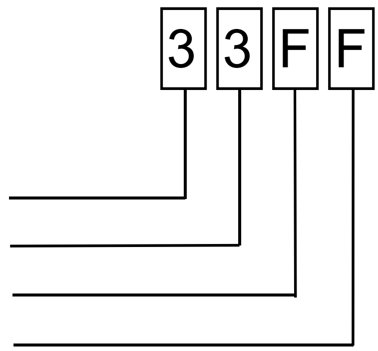
The display describes the following errors:

SIZE	INIT	SYNC	E-01	?000
Number of beams non congruent with number of emitter beams. Cause: Emitter module defective or emitter does not match with receiver.	No communication with emitter. Cause: Sync- and supply cable mixed up or emitter is of an older generation.	Faulty communication between emitter and receiver. Cause: E.g. defective synchronization cable.	Short circuit on one of the outputs of the parallel interface. The alternating display serves for identification.	Weak receiver signal(s).

In the case of a **short circuit** or **overload** on one or any the **outputs** the display will show alternating **E-01** and an indication of the output, shown in HEX-Code. The following table shows how the various short circuits can be identified.

Example: Display **0003** indicates short circuits on outputs OUT 0 and OUT 1.

Value	2^0	2^1	2^2	2^3
Outputs	DATA Ready	SUM OUT		
	OUT 8	OUT 9		
	OUT 4	OUT 5	OUT 6	OUT 7
	OUT 0	OUT 1	OUT 2	OUT 3



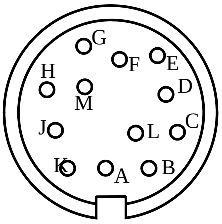
4. During the **initialization phase** (approximately 10 seconds after switching on the power supply or after a reset) consecutively the following data will be shown on the display:

	Function	Display example
1.	Display of version	V-2b
2.	Display of Data coding	BIN, BCD, GRAY
3.	Display of output unit	BEAM, MM
4.	Display of data format	NORM, ALL, LARG

After this initialization phase the display switches over to show DATA or POSITION, whereby for approximately 50 seconds **Smoothing** will be set to 1, independent of what might be programmed (see also chapter 3.3 Adjusting).

5.3 SSI Interface

As an option and additionally to the serial interface a Synchronous Serial Interface, short SSI-Interface, is available. In this case a 4-digit LED-Display serves to show the measuring results and as an adjusting aid, as described for the parallel interface (see chapter 4.1.3).



View of solder side of connector

*Colour of individual wires can vary depending on producer. Valid is the wiring diagram packed with the scanner.

Signal	Socket	Cable*
Clock +	A	White
Clock -	B	Brown
Data +	C	Green
Data -	D	Yellow
GND	E	Grey
	F	
	G	
	H	
	J	
	K	
HOLD	L	Pink
DATA/POSITION	M	Blue

The SSI-Interface comprises the following signal lines:

1. Data + / Data - (OUTPUT):

The DATA-line of the SSI-interface (RS422-signal level). Usually DATA is output in GRAY code , beginning with MSB.

2. Clock + / Clock - (INPUT):

The clocking line of the SSI interface (RS422 signal level).

Additionally the following control lines are included:

3. DATA / POSITION (INPUT):

With this control line, the user can select whether the output data is DATA (number of interrupted beams of a block) or POSITION (the beam number at which the data block retrievable under DATA begins):

DATA / POSITION = 0V (or open) ...DATA
DATA / POSITION = 24V ...POSITION

4. HOLD (INPUT):
This control line can be used to freeze data from the two data records DATA **and** POSITION (HOLD = 24V), enabling slower controllers to scan DATA **and** POSITION data records from the same (!) SCAN cycle.

The two SSI signal line pairs CLOCK +, CLOCK - and DATA +, DATA - are processed as RS422 signals.

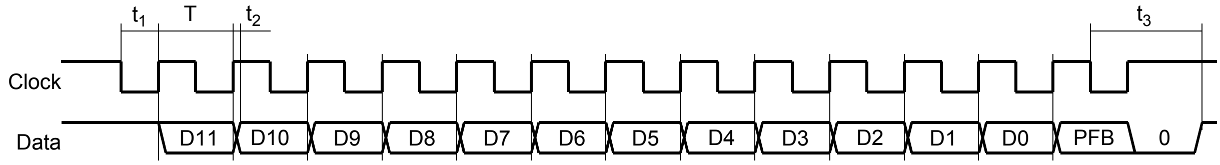
In accordance with the applicable standard, the protocol uses **no parity bit**.

The HOLD and POSITION / DATA inputs are rated for a controller with 24 V level

In most cases, "DATA" information output is sufficient. In this case, the user needs only to connect the SSI signals and can ignore the additional control signals.

5.3.1 SSI data transfer protocol

In the idle state, clock and data lines are high. The first falling edge of the clock signal initiates the transfer of the measured current value to a shift register, from where it is output bit by bit by subsequent rising clock edges.



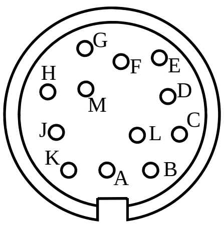
Pulse timing:	t1...	0.45 - 5 µs
	t2...	< 0.2 µs
	t3...	12 - 25 µs
	T...	0.9 - 10 µs

In addition to the data bits, the power failure bit (PFB) is transferred as the 13th bit, a logical "1" indicating that a voltage fade has occurred during data transfer.

The SSI unit used also supports **ring circuit operation**. At the same time a data value for increasing data integrity can be transferred several times.

Data are output in binary code, BCD code or Gray code, depending on what output mode is set. The SSI interface normally sends out data in the form of Gray-coded information, so you should bear this point in mind when using this interface.

5.4 Analog interface



View of solder side of connector

*Colour of individual wires can vary depending on producer. Valid is wiring diagram packed with the scanner.

Signal	Socket	Cable*
	A	
	B	
	C	
	D	
GND	E	Grey
I_{out} 1	F	White
U_{out} 1	G	Brown
I_{out} 2	H	Green
U_{out} 2	J	Yellow
	K	
	L	
	M	

The scanners can be equipped with either one (output 1) or two analog data outputs (outputs 1 and 2). The analog interface comprises the following data lines:

1. I_{out} 1 - (OUTPUT):

On this line data will be output, if the interface is programmed to **„current output“** (or was pre-programmed this way). In this case there are 3 options to choose from:

4-20 mA, 0-20 mA and 0-24 mA

2. U_{out} 1 - (OUTPUT):

On this line data will be output 0-10 V, if the interface is programmed to **„voltage output“** (or was pre-programmed this way).

3. I_{out} 2- (OUTPUT):

On this line data will be output, when two channels are provided and if the interface is programmed to **„current output“** (or was pre-programmed this way). This means that both channels are programmed the same – either voltage or current –, also the options 4-20 mA, 0-20 mA and 0-24 mA are identical for both channels.

Output of DATA or POSITION is „inverted“ to channel 1, i.e. when channel 1 is programmed to output DATA, channel 2 is necessarily programmed to output POSITION.

	Iout 1	Iout 2
OUTPUT	DATA POS	POS DATA

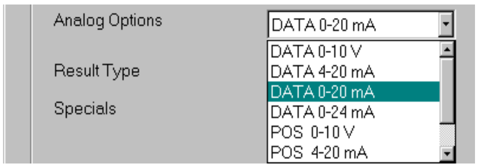
4. U_{out} 2 - (OUTPUT):

On this line data will be output 0-10 V, when two channels are provided and if the interface is programmed to **„voltage output“** (or was pre-programmed this way.

Output of DATA or POSITION is „inverted“ to channel 1, i.e. when channel 1 is programmed to output DATA, then channel 2 is necessarily programmed to output POSITION.

	Uout 1	Uout 2
OUTPUT	DATA POS	POS DATA

These settings can be adapted by means of the ScanView software. Go to „Analog Options“ in the main menu and select



a suitable combination of:

Current or voltage output,
output of DATA or POSITION

Specification of **voltage output:**
R_{out} = < 1 Ω, I_{out} = 10 mA max.

Specfication of **current output:**

Recommended load resistance	R_L = ≥220 Ω ≤680 Ω
Output impedance	25 MΩ
Accuracy[17]	
Monotonicity	16 bits
Integral non-linearity	typ. ±0.002, max. ±0.012 %
Offset (T_A = 25°C)	±0.05 %
Offset drift	typ. 20, max. 50 ppm/°C
Total output error (T_A = 25°C)	±0.15 %
Total output error drift	typ. 20, max. 50 ppm/°C
PSRR[18]	typ. 5, max. 10 μA/V

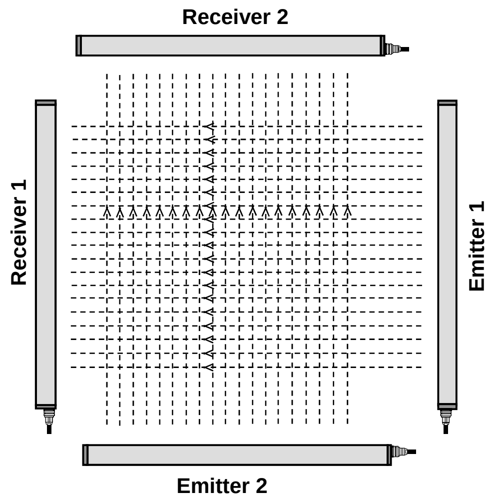
These data are based on the AD420 specification and are subject to change without notice.

[17] Total Output Error includes Offset and Gain Error. Total Output Error and Offset Error are with respect to the Full-Scale Output and are measured with an ideal +5V reference.
[18] PSRR (Power Supply Rejection Time) is measured by varying V_{CC} from 12 V to its maximum 32 V

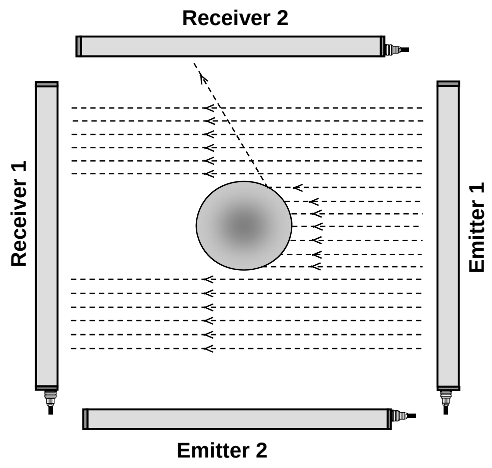
6. MULTI-DIRECTION OPERATION

6.1 Problem Definition

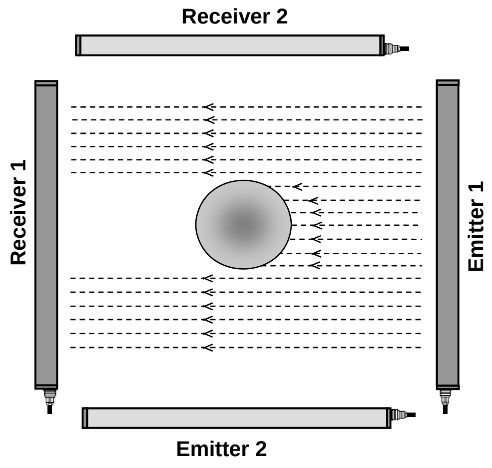
So far only the function, installation and configuration of **one** scanner system have been dealt with. However, the INFRASCAN®5000 measuring system also permits ***multi-direction*** measurement (e.g. horizontal and vertical at 90°).



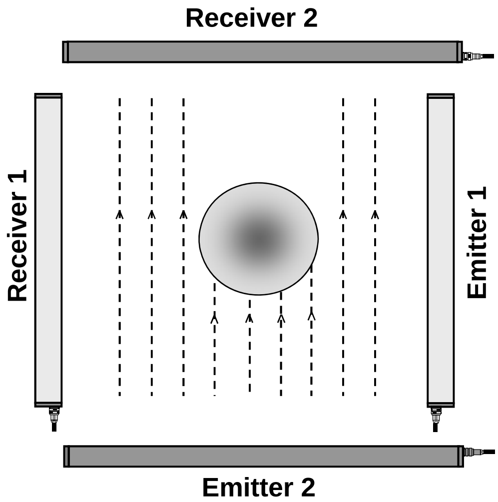
In such a measuring configuration problems may occur when light beams from emitter 1 are reflected onto receiver 2 or vice versa.



This type of interference may prevent effective application of the measuring system. For this reason, the emitters of the individual measuring directions must be "***sequenced***". In other words, only one measuring level is active at a time.

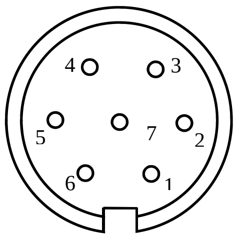


The next measuring level is not activated until the measuring cycle has been completed. As a result, interfering reflections cannot affect the remaining deactivated measuring scanners.



6.2 Sequencing Signals

Each emitter provides sequencing signals for multi-direction measuring at the socket for connecting the voltage supply (7-pin plug).



View of solder side of connector

Signal	Socket	Cable*
+24 V	1	red
MASTER/SLAVE	2	white
SEC-IN	3	brown
/SEC-IN	4	green
SEC-OUT	5	yellow
/SEC-OUT	6	blue
GND	7	black

*Colour of individual wires can vary depending on producer. Valid is the wiring diagram packed with the scanner.

1. SEC-IN, / SEC-IN (Input):
The emitter can be activated and de-activated via these differential input signals (RS-422 standard). They are scanned at the beginning of each measurement cycle.[19]

SEC-IN = 1 and / SEC-IN = 0 ⇒ Emitter active
SEC-IN = 0 and / SEC-IN = 1 ⇒ Emitter inactive

2. SEC-OUT, / SEC-OUT (Output):

After every complete measurement cycle, the emitter outputs a pulse via these differential signals (RS-422 standard), activating the downstream measuring system currently in the wait state.

3. MASTER/SLAVE (Input):

In the mode AUTO START one of the emitters starts to clock and sequence the other(s). Should the process be started by an external controller, the input must be active. Contact manufacturer.

MASTER/SLAVE	AUTO-START
Not connected	**Active**
Connected with GND	Inactive

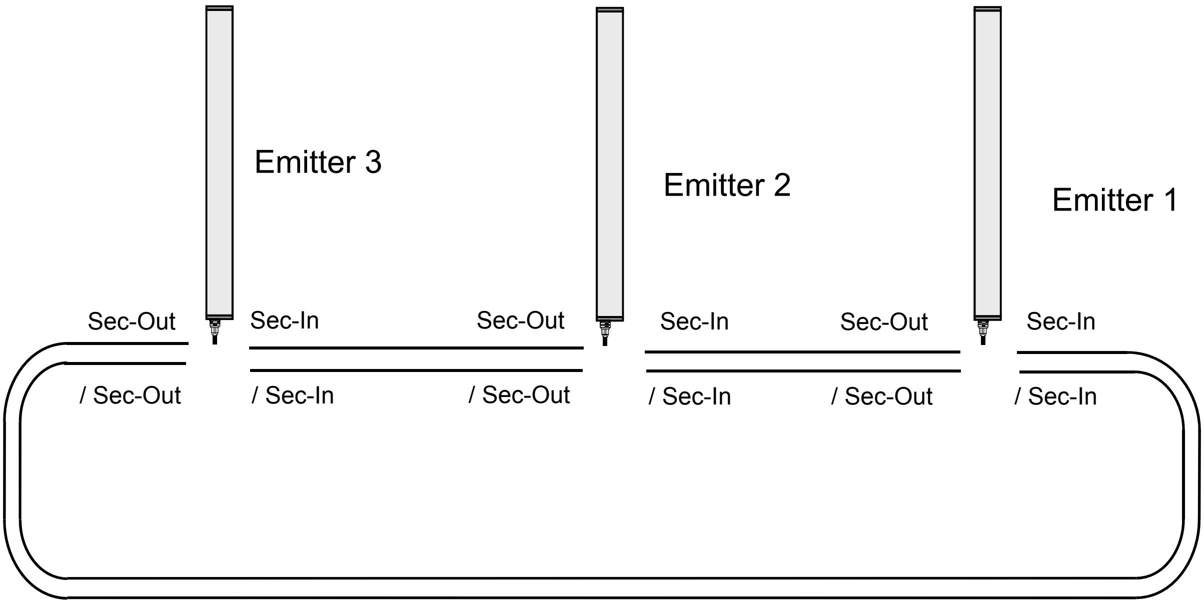
[19] When in progress, a measuring cycle cannot be interrupted.

6.3 Commissioning a Multi-Direction Measuring System

The signals the emitter provides for sequencing are already conditioned to operate a multi-direction measuring system. Each INFRASCAN®5000 scanner is already designed for this mode of operation, i.e. no auxiliary unit is required.

Install the systems of the individual levels according to the instructions given in Chapter 3. First install and adjust each system separately, then check the functioning of the individual systems.[20]

After this, make the additional connections for sequencing of the individual measuring levels (as shown below for the configuration of 3 measuring systems):

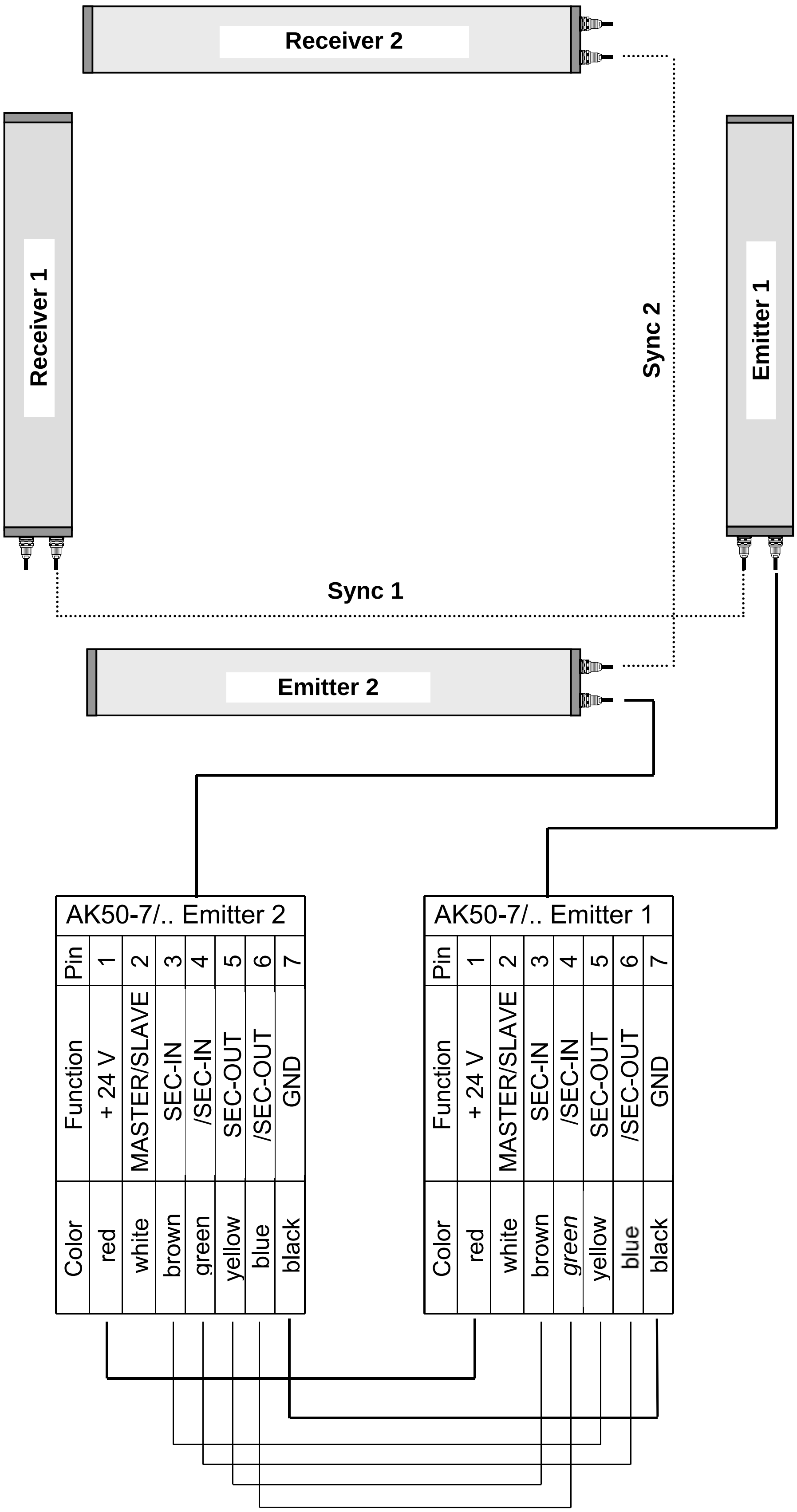


Connect the output sequencing signals of the emitters to the respective input sequencing signals of the downstream emitters to create a loop. This type of sequencing permits the operation of up to 6 scanners in the multi-direction mode.

Note: When the supply cables are very long, overloading of the sequencing in- and outputs may occur. In such cases it is recommended to keep the sequencing leads as short as possible and only to lead the power supply over the long distance (see also chapter 3.4.3 Power supply).

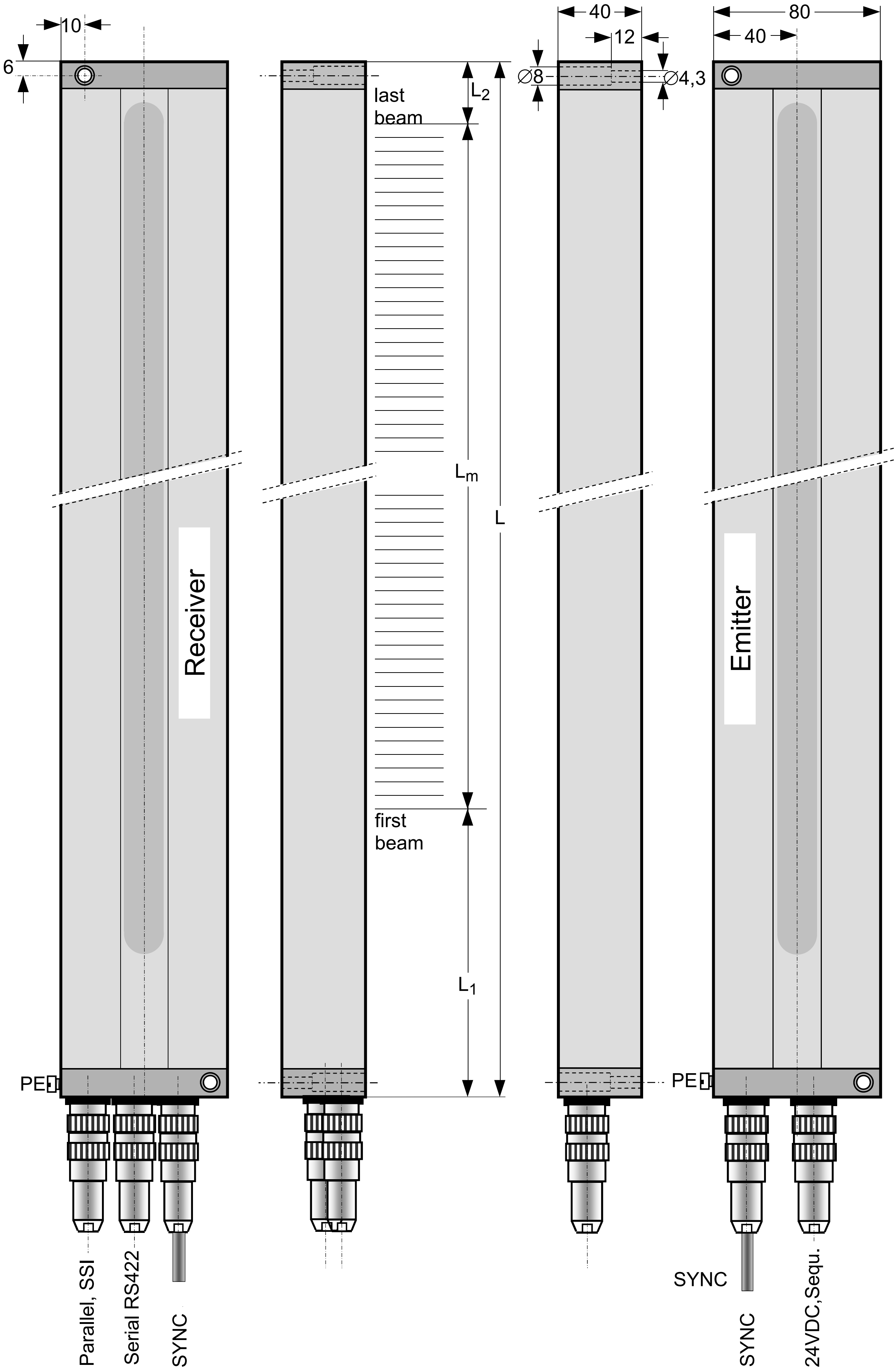
[20] All non-applicable measuring levels must therefore be switched off in order that interference from other levels can be eliminated with absolute certainty.

Example: Emitter-Sequencing of a 2 axis measuring system



7. TECHNICAL DATA

7.1 Dimensions



7.2 Standard-Types

The following types of series **InfraScan®5000** are available as standard:

Modell	Strahlen	Auf-lösung	Lm [mm]	L1 [mm]	L2 [mm]	L [mm]	Gewicht [kg]
5096/2.5	96	2.5	237.5	128.5	24.0	390.0	3.0 kg
	191*	1.25*					
5192/2.5	192	2.5	477.5	128.5	24.0	630.0	4.5 kg
	383*	1.25*					
5288/2.5	288	2.5	717.5	128.5	24.0	870.0	6.0 kg
	575*	1.25*					
5384/2.5	384	2.5	957.5	128.5	24.0	1110.0	7.5 kg
	767*	1.25*					
5480/2.5	480	2.5	1197.5	128.5	24.0	1350.0	9.0 kg
	959*	1.25*					
5576/2.5	576	2.5	1437.5	128.5	24.0	1590.0	10.5 kg
	1151*	1.25*					
5672/2.5	672	2.5	1677.5	128.5	24.0	1830.0	12.0 kg
	1343*	1.25*					

*In Double Scan Mode, in the centre of measuring distance

Product Overview and Data Outputs

Type*	Resolution	In Double Scanning Mode	Measuring Mode [mm]	Measuring Distance [m]	Data Outputs					Smoothing
					Switching Output	Serial	Parallel	SSI	Analog	
5024/10	10 mm[20]	5 mm[21]	230	32 Ranges from ca. 0,2 ... 6 m	Integrated in parallel Data Output	RS 422 Binary, BCD, Gray coded or BeamStream Format	**Optional** 10 bit Data width, BINARY, BCD, Gray SUM OUT	**Optional**	**Optional** One or two channels Voltage or current programmable	Programmable
5048/10			470							
5072/10			710							
5096/10			950							
5120/10			1190							
5144/10			1430							
5168/10			1670							
5048/	5 mm[20]	2,5 mm[21]	235							
5096/5			475							
5144/5			715							
5192/5			955							
5240/5			1195							
5288/5			1435							
5336/5			1675							
5096/2.5	2,5 mm[21]	1,25 mm[22]	237.5							
5192/2.5			477.5							
5288/2.5			717.5							
5384/2.5			957.5							
5480/2.5			1197.5							
5576/2.5			1437.5							
5672/2.5			1677.5							

* 10 mm und 5 mm Versions not to be used for new installations!

[21] At parallel scanning
[22] In the centre of the measuring distance

7.4 Technical Data

Housing material:	anodized aluminum window of glass protection IP 67
OPTICAL DATA	
Number of beams:	96 - 672
Beam spacing:	2.5 mm 1.25 mm with double scanning*
Measuring range:	230 – 1678 mm
Distance emitter ⇔ receiver:	32 ranges from 0.2 – 6.5 m
Wave length:	950 nm, infrared
ELECTRICAL DATA	
Power supply:	24 V ± 20%, ca. 1 A; max. ripple < 200 mV
Scanning frequency:	100 kHz
DATA modes	Normal, Largest Blocked Area, Over All, Smoothing 1 ... n
Output modes:	BINARY, BCD or GRAY coded, DATA and/or POSITION output In number of broken beams or in mm or in BeamStream format
INTERFACES	
Serial UART interface:	RS422 9.6 / 19.2 / 38.4 / 115.2 / 230.4 kBaud 8 data bits 1 stop bit even parity converter to RS232 or USB-2 available
Optional:	
Parallel Data Output:	10 bit, max. 20 mA, 24 V short circuit proof
Synchron Serial Interface (SSI):	12 bit, TTL level, 24 V
Analog output:	Programmable by software
Voltage output:	0-10 V or ***alternatively***
Current output:	4-20 mA, 0-20 mA, 0-24 mA DATA or POSITION
Control inputs:	
DATA or POSITION	24 V, ca. 3 mA at 24 V
Storage temperature:	-40°C ... 80°C
Ambient temperature:	-25°C ... 50°C

**In the centre between emitter and receiver*
Specifications are subject to change without notice.
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