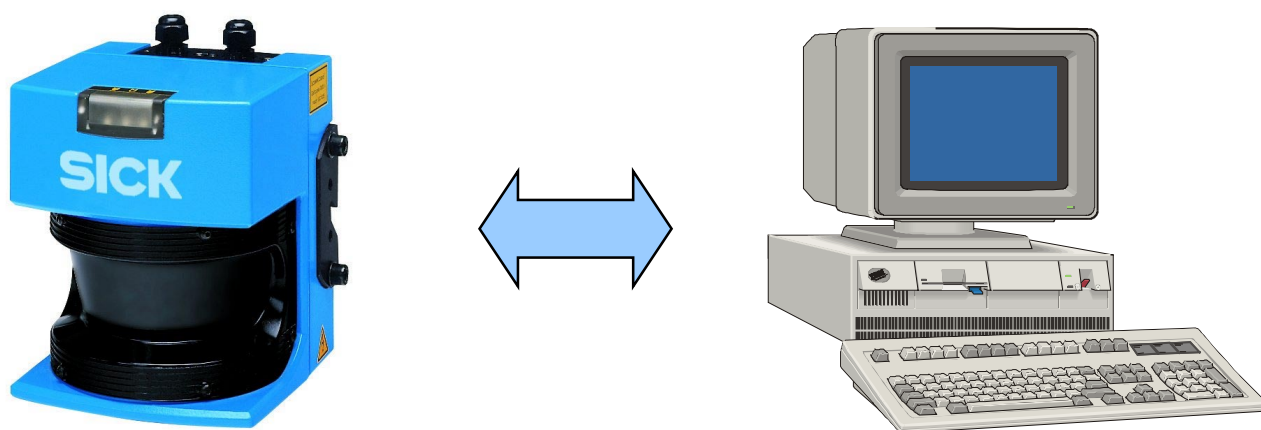


Quick Manual for LMS communication setup



Hardware setup and measurement mode configuration

Version 1.1 March 2002 (HW/MV)

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.....

! This is a quick start manual. For extended information please refer to the documents listed in section D.4. !

A. Introduction

1. Basics of the LMS System

The Laser Measurement System LMS 200, LMS 220, LMS 211, LMS 221, LMS 291 is based on a **time-of-flight** measurement principle (Laser Radar). A single Laser pulse is sent out and reflected by an object surface within the range of the sensor. The elapsed time between emission and reception of the Laser pulse serves to calculate the distance between object and LMS.

Via a integrated rotating mirror the Laser pulses sweep a radial range in front of the LMS unit. A 2-dimensional measurement field / detection area is defined.

(For further details please refer to the Technical Description Laser Measurement Systems SICK order no.: 8008970)

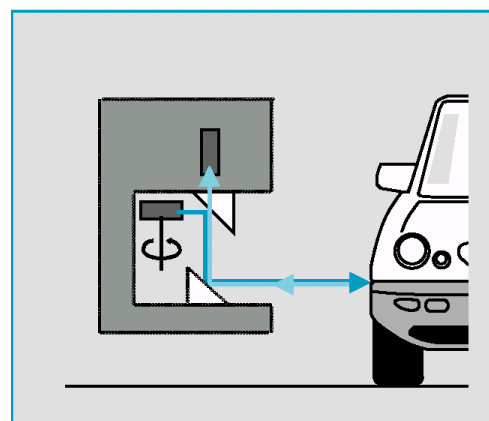


Fig.1: Measurement principle LMS

Main benefits of this measurement principle are:

- Detection of objects independent of object color and surface structure
- Reliable detection of object presence

The Laser Measurement System LMS offers a solution for a **large range of applications**:

- Determining the volumes of objects (measuring packages, pallets, containers)
- Determining the position of objects (pallets, containers, transport vessels)
- Collision prevention for vehicles or cranes
- Controlling docking processes (positioning)
- Classification of objects (vehicle detection, camera trigger)
- Process automation (e.g. calander rollers)
- Checking overhang/area monitoring in automated multi-storey car parks
- Determining the volumes or contours of bulk materials
- Monitoring open spaces for building security (facades, grounds, shafts)
- ... and many more

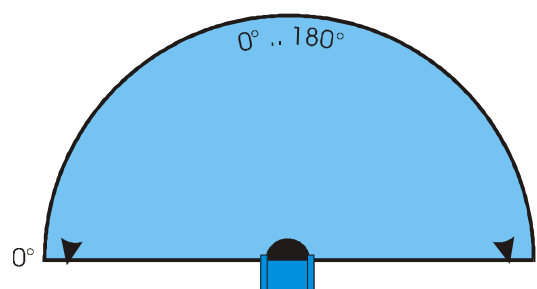
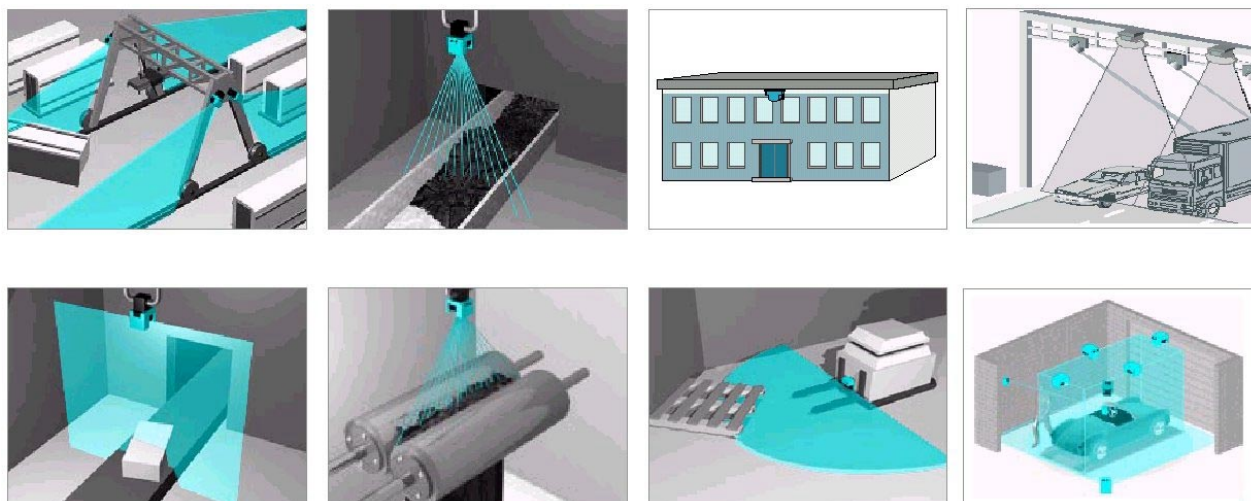


Fig.2: Angular range LMS



B. Hardware setup

1. Before you start ... : Required components

As a minimum requirement to set up an LMS sensor with a data connection to a PC, the following components are required:

For LMS200/LMS291:

Item/Specification	Description	SICK order number
1 x LMS unit with cable connectors	LMS200-30106	1015850
	LMS291-S05	1018028
1 x power supply 24 V DC +/- 15%, min. 2.5 A	Power supply DC 24V / 2.5 A	6010361
1 x cable for power supply and output signals (open cable ends) 1 x cable for data interface	Cable set 1: 5 m length	2018964
	Cable set 2: 10 m length	2018965

For LMS211/LMS220/LMS221:

Item/Specification	Description	SICK order number
1 x LMS unit with cable connectors	LMS211-30206	1018023
	LMS220-30106	1015945
	LMS221-30206	1018022
1 x power supply 24 V DC +/- 15%, min. 2.5 A for LMS electronics	Power supply DC 24V / 2.5 A	6010361
1 x power supply 24 V DC +/- 15%, min. 5 A for LMS heating	Power supply DC 24V / 10 A	6011156
1 x cable for power supply and output signals (open cable ends) 1 x cable for data interface	Cable set: 5 m length	2019561

Note: In case of longer cables, please source your own cable. Please make sure to use correct cable diameters to avoid voltage drops along large cable lengths.

- Suitable brackets, mounting.

A **laptop or desktop computer** serves as user interface with the LMS unit. The computer is connected via a serial interface:

- RS232 interface (up to 10 m cable length) (standard COM1 or COM2 in most computers)
- RS422 interface (up to 1200 m cable length) (special interface card required)

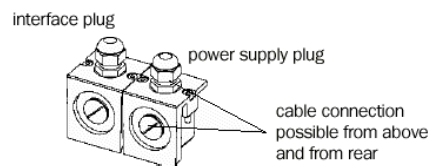
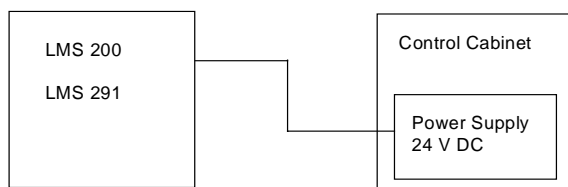
In case a high-speed data transmission is required, SICK offers special interface boards for 500 kBaud transmission rate. For details and information please refer to section D.2.

2. Power supply

The LMS unit is supplied with 24 V DC +/- 15%. Depending on the length of the power supply cable, the power supply needs to provide sufficient current.

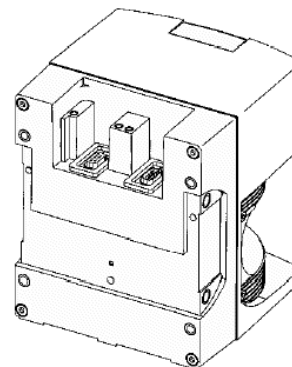
Due to the LMS models, connection diagrams are different for LMS200/LMS291 and LMS220/211/221.

a. For LMS 200 / LMS 291



Pin assignment:

Pin No.	Signal designation	Input/ Output	Wire color
1	GND_EXT (ground)	Supply	brown
2	Restart	Input	blue
3	VCC_EXT (24V DC +/- 15%)	Supply	red
4	Not connected	-	-
5	OUT C (for field detection)/ weak signal	Output	grey
6	Not connected	-	-
7	Not connected	-	-
8	OUT B (for field detection)	Output	turquoise
9	OUT A (for field detection)	Output	orange



Note: Minimum connections marked in bold

PIN 5 / 8 / 9 cannot be used for data processing purposes with the LMS sensor

b. For LMS 211 / LMS 220 / LMS 221

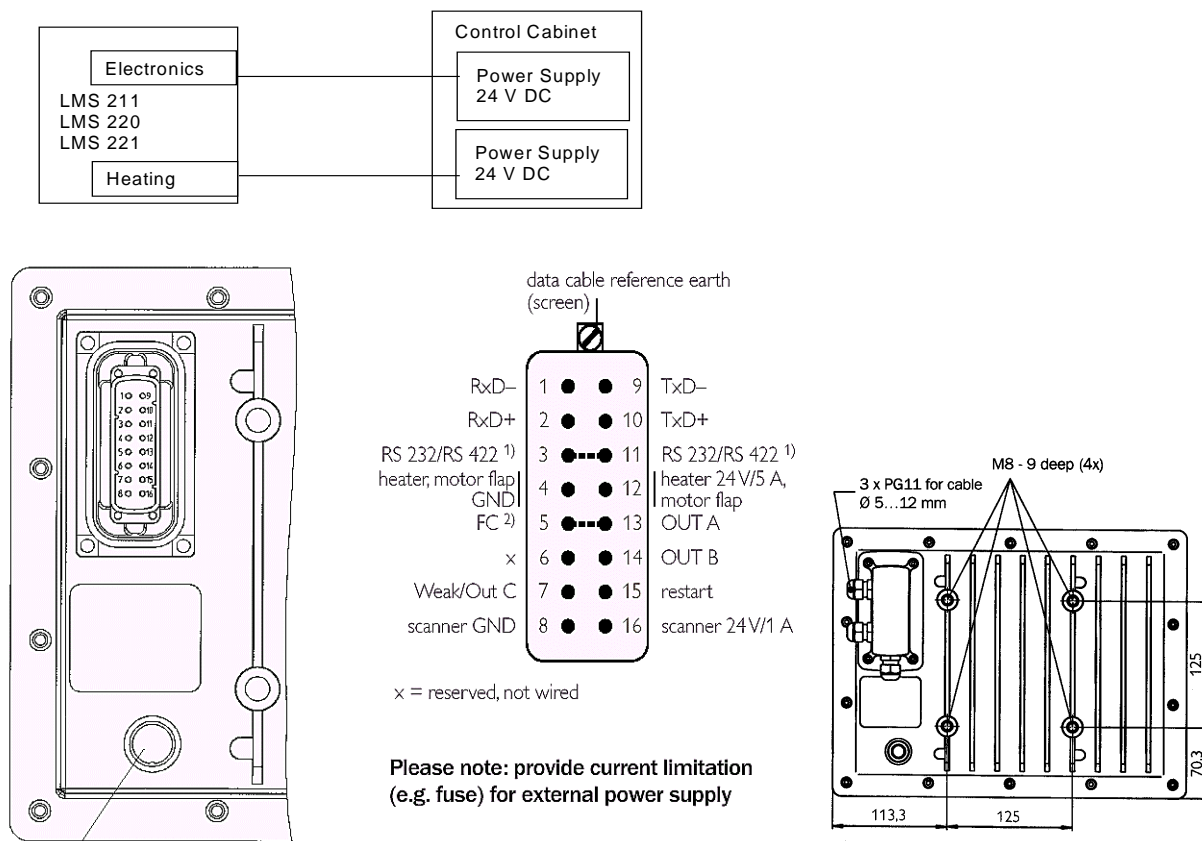


Fig.2: Connections on backplane of LMS211/LMS220/LMS221

Pin assignment:

Pin No.	Signal designation	Input/ Output	Remark
1	RxD-	Interface	
2	RxD+	Interface	
3	RS232/RS422 Jumper 1		With jumper → RS422 Without jumper → RS232 (default)
4	GND_EXT for heating	Supply	
5	Flap control	Input	For flap control details please refer to technical description
6	Not connected	-	
7	OUT C (for field detection)/ weak signal	Output	
8	GND_EXT for electronics	Supply	
9	TxD-	Interface	
10	TxD+	Interface	
11	RS232/RS422 Jumper 2		
12	VCC_EXT for heating	Supply	
13	OUT A (for field detection)	Output	
14	OUT A (for field detection)	Output	
15	Restart		
16	VCC_EXT for electronics	Supply	

Note: Minimum connections marked in bold
Use separate cables for connecting the scanner electronics and the heating.

3. Serial interface for data exchange

For data exchange in measuring tasks, the LMS is equipped with a serial RS 232 / RS 422 interface.

By setting a jumper, RS422 or RS232 can be enabled. Default setting is RS232.

a. Connection of the RS 232 interface.

1. For LMS 200 / LMS 291:

Pin assignment:

LMS			PC	
Signal designation	PIN No.		PIN No.	Signal designation
Not connected	1	————	1	NC
RxD	2	X	2	RxD
TXD	3		3	TXD
Not connected	4	————	4	Not connected
GND	5	————	5	GND
Not connected	6		6	Not connected
Not connected	7		7	Not connected
Not connected	8		8	Not connected
Not connected	9		9	Not connected

Note: PINs 2 and 3 are crossed in the cable.
The connector at the PC side is a 9 pin DSub

2. For LMS 211 / LMS 220 / LMS 221

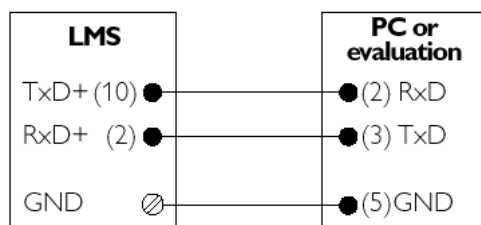


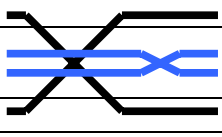

Fig.3: Wiring of the RS232 for LMS211/LMS220/LMS221

Note: The connector at the PC side is a 9 pin DSub

b. Connection of the RS 422 interface

1. For LMS 200 / LMS 291

Pin assignment:

LMS			PC	
Signal designation	PIN No.		PIN No.	Signal designation
RxD-	1		1	RxD-
RxD+	2		2	RxD+
TxD-	3		3	TxD-
TxD+	4		4	TxD+
GND	5		5	GND
Not connected	6		6	Not connected
Jumper 1	7		7	Not connected
Jumper 2	8		8	Not connected
Not connected	9		9	Not connected

Note: As there is no standard for RS422 connector pinning, please check the signal assignments of your RS422 interface card to the respective PINs. Refer to the documentation of your RS422 interface board manufacturer.
In case of deviations, change the cable assignments accordingly.

For selection of the RS422, there needs to be a jumper connection between between PINs 7 and 8 on the LMS side inside the cable connector.
PINs 2 and 3 are crossed in the cable, PINs 1 and 4 are crossed in the cable. It is recommended to use twisted pair cables for RS422 connections.

2. For LMS 211 / LMS 220 / LMS 221

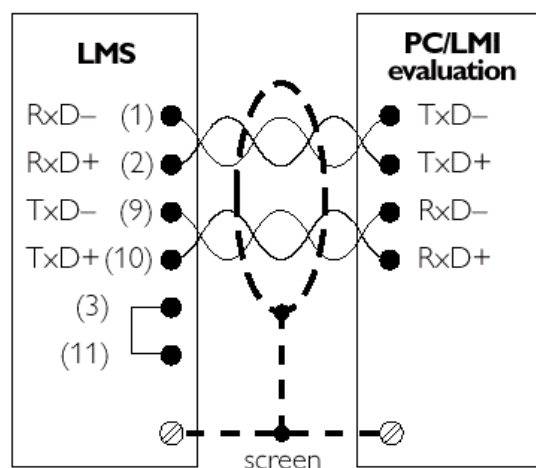
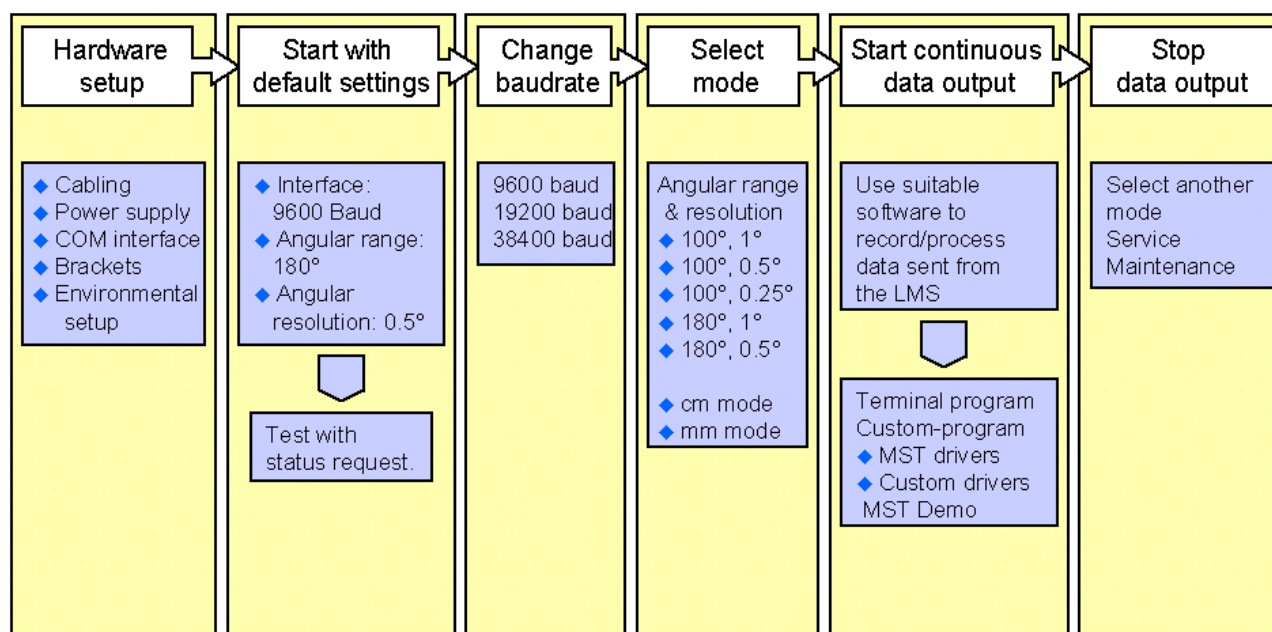


Fig.3: Wiring of the RS232 for LMS211/LMS220/LMS221

Note: For selection of the RS422, there needs to be a jumper connection between between PINs 3 and 11 on the LMS side in the cable connector.
PINs 2 and 3 are crossed in the cable, PINs 1 and 4 are crossed in the cable. It is recommended to use twisted pair cables for RS422 connections.

C. Communication setup, software

1. Overview Schematic for LMS communication setup



2. Establish communication with LMS

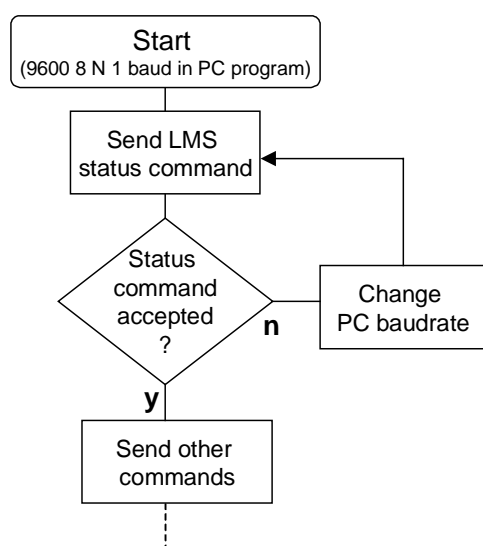
After power connection of the LMS, the yellow AND red indicators are active until the start-up procedure has been completed.

When ONLY either the **green** OR the **red** LED indicator is active, the unit is ready for communication.

Additionally, a startup message is sent with 9600 baud via the serial interface to the connected PC. (Note: The transmission rate is reset to 9600 baud after a power down)

LMS start-up message in hex LMS → PC

```
02 80 17 00 90 4C 4D 53 32 30 30 3B 33 30 31 30 36 33 3B 56 30 32 2E 31 30 20 10 72 D0
```



To test the communication link to the connected LMS, it is recommended to send the LMS status request command.

Command for LMS status request:

Telegram code in hex PC → LMS	Telegram code in hex LMS → PC
02 00 01 00 31 15 12	06 02 81 ... a jumble of bytes containing the LMS version number etc. Refer to section D.5.

Note: The permanent or temporary red indicator shows an infringement of one of the fields defined in the internal LMS memory. This quick manual does not address field programming of the LMS. If no fields are defined or no field is infringed, the green indicator will be permanently active.

3. LMS default settings

When the LMS leaves the factory, the following parameters apply as the default:

Parameter	Value		Remark
	LMS200/LMS220	LMS211/LMS221/LMS291	
Serial interface	9600 baud 8 data bits no parity 1 stop bit no flow control		Selection of RS232 or RS422 is done via a jumper in the LMS cable connector (refer to section B.3.) Commands see section 4.
Angular range	0° .. 180°	0° .. 100° (LMS211) 0° .. 180° (LMS221/291)	Commands see section 5.
Angular resolution	0.5°	0.5°	Commands see section 5.
Distance measurement mode	mm	cm	Commands see section 6.

These defaults may be changed with the commands described in this manual. Most applications can be served by changing/adaptation of the above defaults. In case more details are required, please contact your local SICK representative.

4. Changing the baudrate

After a power-down of the LMS unit, the transmission baudrate is reset to 9600 baud. To access the LMS measurement data at a higher baudrate, it is required to change to a higher baudrate **after each power-down** with one of the following commands:

LMS baudrate setting	Telegram code in hex PC → LMS	Reply telegram in hex LMS → PC
9600 baud	02 00 02 00 20 42 52 08	06 02 81 03 00 A0 00 10 36 1A
19200 baud	02 00 02 00 20 41 51 08	06 02 81 03 00 A0 00 10 36 1A
38400 baud	02 00 02 00 20 40 50 08	06 02 81 03 00 A0 00 10 36 1A

Note: Changing the baudrate with the above commands disrupts the communication link between LMS and PC. To resume communication with the LMS, it is necessary to change to the new baudrate in the PC program as well.

5. Setting different LMS resolution modes

The LMS can supply distance data in the following formats:

- Angular range: 0° ... 100° or 0°... 180°
- Angular resolution: 1°, 0.5°, 0.25° (only for 100°)

Depending on the selected format, different numbers of distance data values will be supplied.

Angular range	Angular resolution	Number of data values
0° .. 100°	1°	101
0° .. 100°	0.5°	201
0° .. 100°	0.25°	401
0° .. 180°	1°	181
0° .. 180°	0.5°	361

For the output data string format syntax, please refer to appendix A.

The different modes can be selected by sending a corresponding settings telegram from the PC to the LMS.

Note:

After each settings telegram, an ACK acknowledgement AND a reply telegram from the LMS need to be received by the PC. Only after having received the complete reply telegram, the setting has been successfully implemented in the LMS and the next telegram can be sent. Intermediate telegram will be ignored.

LMS mode		Telegram code in hex PC → LMS	Reply telegram in hex LMS → PC
Angular range	Angular resolution		
0°..100°	1°	02 00 05 00 3B 64 00 64 00 1D 0F	06 02 81 07 00 BB 01 64 00 64 00 10 4A 3F
0°..100°	0.5°	02 00 05 00 3B 64 00 32 00 B1 59	06 02 81 07 00 BB 01 64 00 32 00 10 12 92
0°..100°	0.25°	02 00 05 00 3B 64 00 19 00 E7 72	06 02 81 07 00 BB 01 64 00 19 00 10 BE C4
0°..180°	1°	02 00 05 00 3B B4 00 64 00 97 49	06 02 81 07 00 BB 01 B4 00 64 00 10 5E B2
0°..180°	0.5°	02 00 05 00 3B B4 00 32 00 3B 1F	06 02 81 07 00 BB 01 B4 00 32 00 10 06 1F

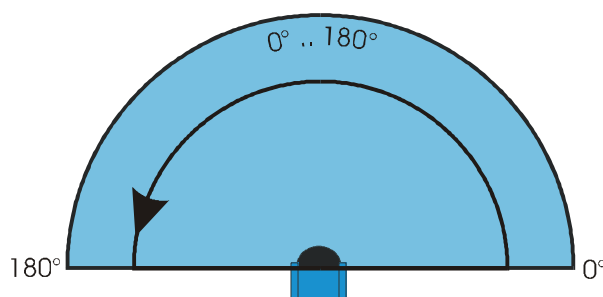


Fig.: Measurement range 0° .. 180°
(View from above, scan from right to left)

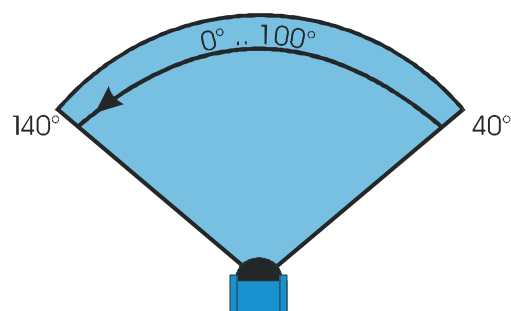


Fig.: Measurement range 0° .. 100°
(View from above, scan from right to left)

6. Setting the LMS measurement mode

Depending on the application, the LMS can be set to measure the distance in two different ways.

Mode	Measurement/ detection range
mm mode	0 .. 8191 mm = 8.191 meters
cm mode	0 .. 8191 cm = 81.91 meters

Note: Measurements in the cm mode are not as accurate as in the mm mode. Please refer to the Technical Description for details on the estimation of accuracies in specific application environments.

a. Switch to mm mode

To switch to different measurement modes, it is necessary to enable the LMS "Settings Mode".

LMS distance mode	Telegram code in hex PC → LMS	Reply telegram in hex LMS → PC
1. Settings mode	02 00 0A 00 20 00 53 49 43 4B 5F 4C 4D 53 BE C5	06 02 81 03 00 A0 00 10 36 1A
2. Switch to mm mode	02 00 21 00 77 00 00 00 00 00 01 00 00 02 02 00 FC 7E	06 02 81 23 00 F7 00 00 00 46 00 00 00 01 00 00 02 02 00 10 FA EA

b. Switch to cm mode

To switch to different measurement modes, it is necessary to enable the LMS "Settings Mode".

LMS distance mode	Telegram code in hex PC → LMS	Reply telegram in hex LMS → PC
1. Settings mode	02 00 0A 00 20 00 53 49 43 4B 5F 4C 4D 53 BE C5	06 02 81 03 00 A0 00 10 36 1A
2. Switch to cm mode	02 00 21 00 77 00 00 00 00 00 00 00 00 00 02 02 00 E8 72	06 02 81 23 00 F7 00 00 00 46 00 00 0D 00 00 00 02 02 00 10 D2 F2

Note:

After each settings telegram, an ACK acknowledgement AND a reply telegram from the LMS need to be received by the PC. Only after having received the complete reply telegram, the setting has been successfully implemented in the LMS and the next telegram can be sent. For the change between cm and mm mode, it can take up to **7 sec** until the reply telegram is sent from the LMS. Intermediate telegrams will be ignored.

7. Starting continuous data output from the LMS

Once all required settings are completed, the LMS needs a command to send the measurement data to the PC.

In contrast to data-polling applications, the LMS sends a continuous stream of data via the serial interface.

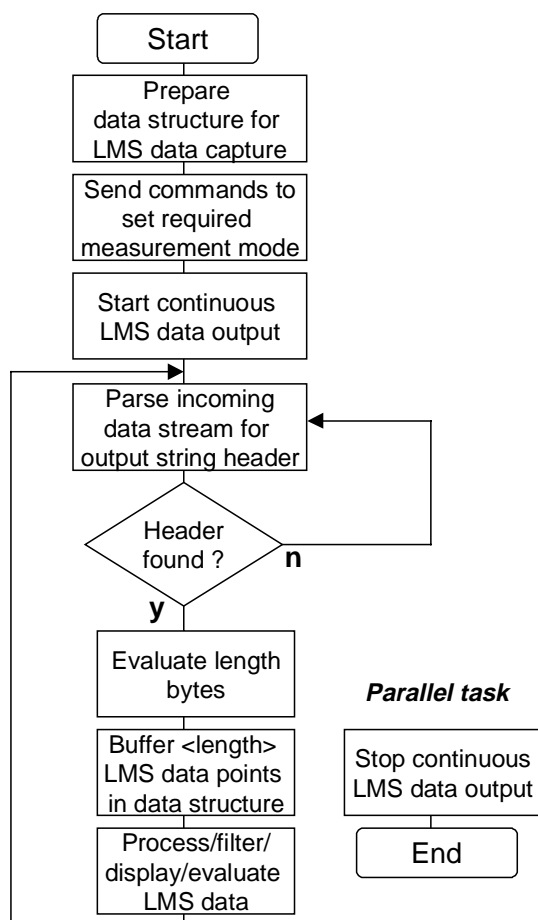
The data output is formatted according to the syntax described in section D.2. of this manual.

LMS continuous data output	Telegram code in hex PC → LMS	Data stream in hex LMS → PC
Start	02 00 02 00 20 24 34 08	06 02 81 03 00 A0 00 10 36 1A <output string header> < LMS data > (refer to section D.2.)

Note: Before any further settings telegrams can be sent to the LMS, the continuous data output needs to be stopped by a special command.
(→ refer to section C.9.)

8. Interpreting/parsing the received data

A typical PC program for monitoring and processing tasks needs to perform the following operations:



LMS data evaluation programs have been written in different programming environments. For basic sending of command telegrams and monitoring of PC \leftrightarrow LMS communications, a standard terminal program can be used. For sophisticated applications, Windows-based packages, like Visual C++, Delphi, etc. have been used.

In an event-driven programming environment, it should be possible to do parallel tasks:

- Data string parsing
- Buffering
- Processing of LMS data

Depending on the processing results, the PC program can control outputs on special PC cards or other interfaces to communicate with other peripheral devices.

While the data output is streaming, it is possible to send the "Stop continuous data output" command.

To determine the start of an LMS out data string, it is necessary to identify a specific header in the incoming data stream. The output data string header is different for each measurement mode:

LMS mode		LMS output data string header	Number of transferred measurement data values
Angular range	Angular resolution		
0°..100°	1°	02 81 CE 00 B0 65 00 ...	101
0°..100°	0.5°	02 81 96 01 B0 C9 00 ...	201
0°..100°	0.25°	02 81 26 03 B0 91 01 ...	401
0°..180°	1°	02 81 6E 01 B0 B5 00 ...	181
0°..180°	0.5°	02 81 D6 02 B0 69 01 ...	361

Note: Although there is an STX character at the start of the output data string, there is no ETX character at the end. The actual data string needs to be identified by

- Parsing for the next output data string header
- or**
- Buffering a fixed number of data values calculated from the length information in the output string data header

As a support tool, SICK supplies the MST software package, which is a Visual C++ v6.00-based software driver library. A compact software program "MSTDemo" demonstrates the capabilities of the LMS in combination with MST-driver-based programming.

For details and order information, please contact your local SICK representative.

9. Stopping the continuous data output

Before any further settings telegrams can be sent to the LMS, the continuous data output needs to be stopped.

LMS continuous data output	Telegram code in hex PC → LMS	Reply telegram in hex LMS → PC
Stop	02 00 02 00 20 25 35 08	06 02 81 03 00 A0 00 10 36 1A

D. Appendices:

1. LMS data output format syntax

In section C.5. continuous data output was started. The following table lists some details about the format of the resulting data stream from the LMS.

STX	ADR	LenL Low byte	LenH High byte	CMD	Data LenL	DataL enH	Data 0° Low byte	Data 0° High byte	Data 1° Low byte	Data 1° High byte (more data)	Status	CRC Low byte	CRC High byte

Fig.: Output data string in byte units

Designation	Data size (number of bits)	Remarks
STX	8	Start byte (STX = 02 hex)
ADR	8	Address of the subscriber (in this case the PC) addressed. Typically, the value is (81 hex).
Len	16	Length of the total LMS output data string. Number of following output data string bytes excluding the checksum (CRC = 2 bytes)
CMD	8	Command byte, in this case (B0 hex), which is the command for continuous data output.
DataLen	16	Number of measurement data bytes (depending on measurement mode, refer to section C.8.)
Data ...	n x 16	Measurement data values (2 bytes each) according to the measurement mode settings. Please refer to the note below)*
Status	8	Status byte Indication of system error, pollution etc. Refer to telegram listing for exact information.
CRC	16	CRC Checksum

Table : Designation and description of output data string elements

)* Note: Format of measurement data output values:

Starting with 0°, the sequence of measurement values is incremented according to the measurement mode:

LMS mode		Angular assignation of LMS measurement value sequence	Number of transferred measurement data values
Angular range	Angular resolution		
0°..100°	1°	0° 1° 2° 3° 4° ... 99° 100°	101
0°..100°	0.5°	0° 0.5° 1° 1.5° 2° 2.5° ... 99.5° 100°	201
0°..100°	0.25°	0° 0.25° 0.5° 0.75° 1° 1.25° 99.5° 99.75° 100°	401
0°..180°	1°	0° 1° 2° 3° 4° ... 179° 180°	181
0°..180°	0.5°	0° 0.5° 1° 1.5° 2° 2.5° ... 179.5° 180°	361

To get the correct measurement value, it is necessary **to strip the upper 3 bits** of each measurement data value (except measurement mode 32m / mm, strip only **last bit!**):

LMS measurement data value: Bits [0..12] max. value 8191													13	14	15
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

The upper three bits have a different function which is not required for basic LMS data capture.

2. LMS in High-Speed Mode

Warning: Only use the following commands if you have a high-speed serial interface card (MOXA, 500 kBaud) as supplied by SICK. Once the LMS baudrate is changed to 500 kBaud, it is **not possible to communicate** with the LMS without the MOXA high-speed serial interface card!

To return to the default baud setting of 9600 baud, it is necessary to restart the LMS (power off/on).

To use the high-speed LMS communication mode, it is necessary to use one of the following special serial communication boards as supplied by SICK:

Item/Specification	Description	SICK order number
MOXA card for 500 kBaud (ISA bus (old PC standard))	2 x RS422, opto-decoupled, high-speed (500 kBaud)	6011807
Quatech card for 500 kBaud (PCI bus (new PC standard))	????	????
PCMCIA card for 500 kBaud SIO-card RS485-SICK	Order at: CSM GmbH Raiffeisenstrasse 34, 70794 Filderstadt Germany, Tel.: ++49 71177964-0	

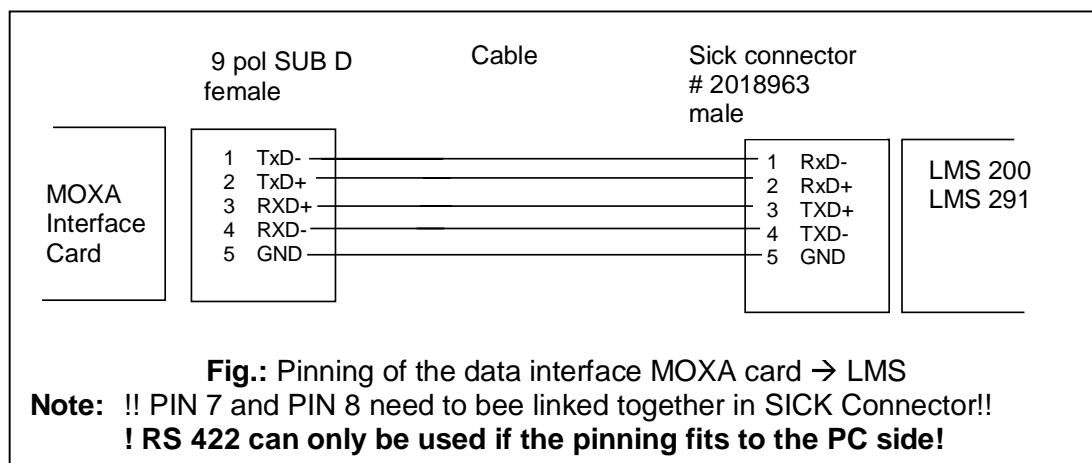
Connection to the LMS data interface cable:

Both PC cards have 9 pin connectors to connect a data interface cable.

However different pinnings apply for the MOXA and the Quatech cards!

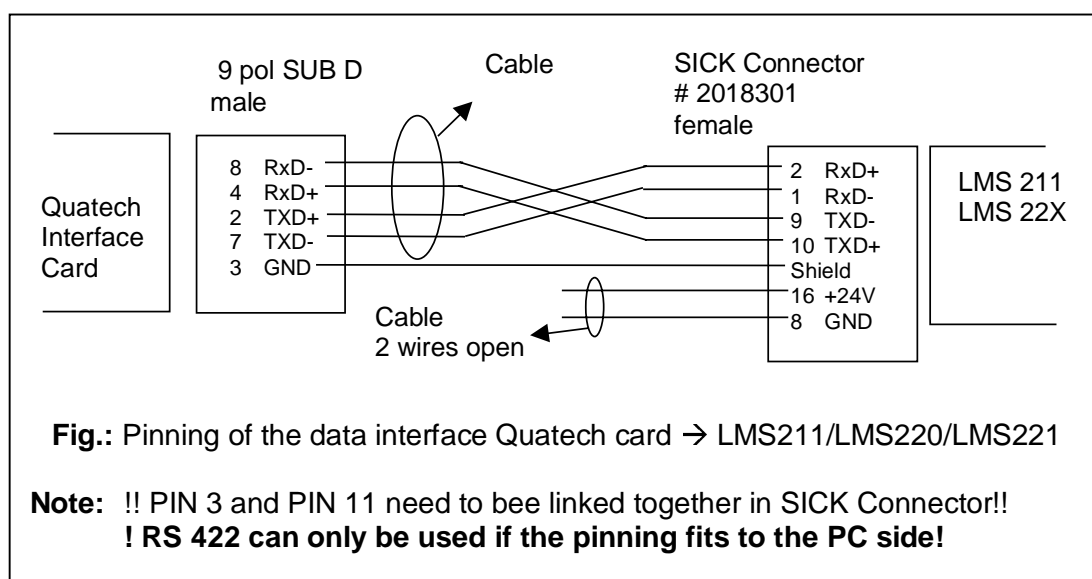
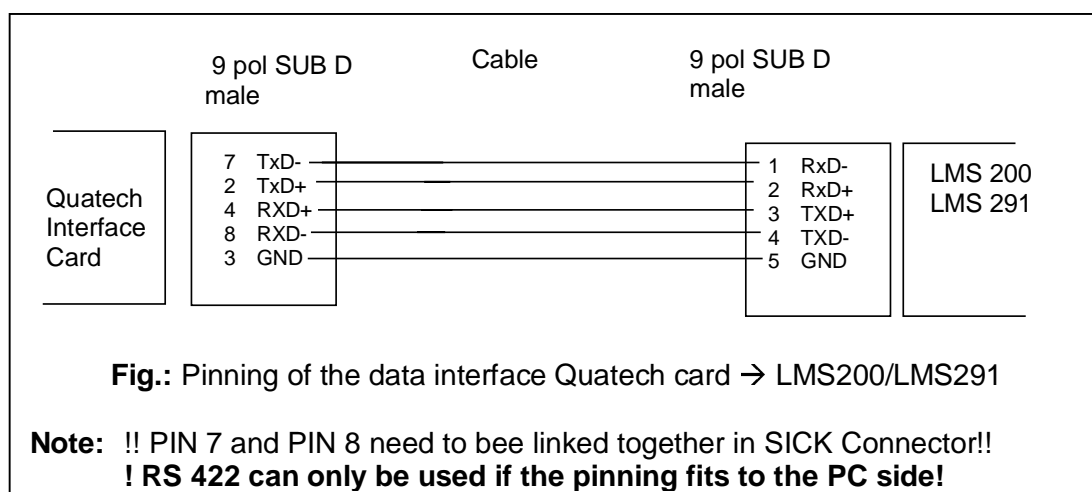
a. MOXA card

The MOXA card provides 2 serial RS422 interfaces for 500 kBaud. The card can be installed in PCs which have a free ISA-bus adaptor.



b. Quatech card

The Quatech card provides two serial RS422 interfaces for 500 kBaud. The card can be installed in PCs which have a free PCI-bus adaptor.



To enter the high-speed mode, use the following command to set 500 kBaud.

LMS baudrate Setting	Telegram code in hex PC → LMS	Reply telegram in hex LMS → PC
500 kBaud	02 00 02 00 20 48 58 08	06 02 81 03 00 A0 00 10 36 1A

Note: After setting the LMS baudrate of 500 kBaud, change your PC program to access to the LMS via the MOXA high-speed serial interface card. It is required to use the MOXA card to change the baudrate back to a lower value. Another possible way to reset the LMS back to 9600 baud is power off/on.

The MOXA, Quatech and PCMCIA cards operate with a NON-STANDARD baudrate. When using own software (i.e. setcom() routines in C++) to set the baudrate of these cards, it is not possible to use the standard setting values. To set the target baudrate of 9600,19200, 38400 or 500k, use the respective baudrate values as indicated in the table below.

Target baudrate →		9600	19200	38400	500k
Use baudrate value	MOXA and Quatech card	1075	2212	4300	56000
	PCMCIA SIO-RS485-SICK	2150	4301	8602	115000

Note: When using SICK software for LMS (LMSIBS or MST driver) the above values are already implemented.

Benefit of the 500 kBaud communications mode:

The LMS collects measurement data of the defined scan range 75 times per second. In the 180°/0.5° resolution mode, there are 361 measurement values (2 bytes per value plus framing) per scan. (refer to D.2. LMS output format for details)

Due to the large quantity of data generated by the LMS, it is ONLY possible to transfer all acquired data in the 500 kBaud communications mode. In lower speed communications modes, only a subset of the actually acquired data is transferred via the serial interface.

This means, to use the **full capabilities** of the LMS, it is necessary to use the MOXA high-speed serial interface card for PC communication.

3. Status Byte Information

During continuous data output, the LMS sends a status byte at the end of each output data string (3rd last byte, refer to section D.1.).

With suitable programming, the status byte can be evaluated to monitor the LMS status during the data capture.

Bit 0	Bit 1	Bit 2	
0	0	0	No error (this is the OK state)
1	0	0	Info
0	1	0	Warning
1	1	0	Error
0	0	1	Fatal error

Bit 6	Implausible measured value
Bit 7	Pollution

Bits 3 .. 5 are not important for LMS data capture purposes.

4. Further information and documentation

For more detailed information on LMS, the following documents are available from SICK.

- **Technical Description Laser Measurement Systems**
SICK order no.: 8 008 970
- **Telegram listing**
(only on request)
- **Technical Description Measurement Software Tool MST 200 for PC Version 2.0**
SICK order no.: 8 008 464
- **MST Demo Manual and Software**
(only on request)

In case of questions or orders, please do not hesitate to contact your local SICK representative.