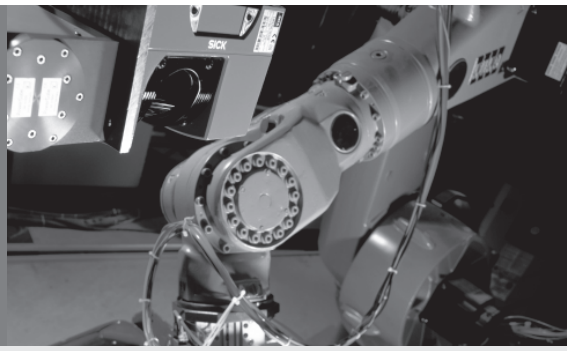
TELEGRAM LISTING

Telegrams for Configuring and Operating the LMS2xx Laser Measurement Systems



Firmware Version V2.30/X1.27

SICK
Sensor Intelligence.

Software Versions

Device model	Function	Version
LMS200/220	Firmware	V02.30 Q501
LMS211/221/291	Firmware	X01.27 Q501
LMS211/221-S19/-S20	Firmware	S01.31 Q393

Latest Manual Version

For the latest version of this manual (PDF), see **www.sick.com**.

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Abbreviations used

ADC **A**nalog **D**igital **C**ounter

LMS **L**aser **M**easurement **S**ystem

PLC **P**rogrammable **L**ogic **C**ontroller

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1 Notes on this Document

1.1 Purpose

This document shows you how to use and configure (parameterise) the following laser measurement systems:

INDOOR

- LMS200-30106
- LMS220-30106

OUTDOOR

- LMS211-30106/LMS211-30206/LMS211-S07/-S15
- LMS221-30106/LMS221-30206/LMS221-S07/-S15/-S16
- LMS291-S05/-S15
- LMS211/221/291-S14 (LMS Fast)
- LMS211/221-S19/-S20 (devices for security applications)

with a compact command language (telegrams).

All the laser measurement systems described have a measurement resolution of 10 mm (0.39 in) and are of the LMS type 6 series.

The document contains information on:

- The operating principle of the laser measurement system
- Measurements and data output
- Data communication between the host/driver and laser measurement system
- Configuration by means of telegrams
- Commands/responses in the telegrams
- The hardware required for communicating with the laser measurement system
- Scan sequence and data output
- Error messages

Note From now on, the laser measurement system will simply be referred to as the "LMS2xx" (unless a distinction is required).

1.2 Target Audience

This document is aimed at technicians and engineers.

1.3 Information Content

This document contains all the information required for communicating with the LMS2xx by means of telegrams.

Step-by-step instructions are provided for all the required activities.

Note The document *Telegram Listing LMS/LMI400,* **Version 12/97** (order no. 8007954) describes how to configure the **LMS2xx with a resolution of 50 mm (1.97 in) (type 1 to 5)** and the LMI400 (laser measurement interface).

The LMS2xx is **mounted and installed electrically** in accordance with the specifications in *Technical Description "LMS200 to LMS291 Laser Measurement Systems"* (order no. 8008970).

The *Operating Instructions "LMSIBS Configuration Software, Version 4.1"* (order no. 8009116) and the *Supplement to the Operating Instructions "LMSIBS Configuration Software, Version 4.2 to Version 5.2" (*order no. 8010121*)* explain how to operate and configure the LMS2xx for field monitoring and basic measurement data evaluation, as well as the basic configuration for outputting raw measurement data using the PC-based software "LMSIBS".

For further information on laser measurement technology, please contact the Auto Ident division at SICK AG or visit the Sick Web site at **www.sick.com**.

1.4 Symbols

Certain information in this documentation is specially highlighted to draw your attention:

Reference Italics are used to refer to more detailed information elsewhere

Note Provide information on special features.

Explanation Provide background information on technical aspects.

Tip Provide advice on how to carry out a task more effectively.

Default Lists the default factory settings for the LMS2xx.

This symbol indicates that further technical documentation is available for the subject in question.

This symbol indicates important information.

This symbol warns against improper use of the LMS2xx.

➢ This symbol provides instructions on a single action that you have to carry out. Multi-step instructions are provided in a numerical sequence.

2 Safety Information

2.1 Authorised Users

To ensure that the LMS2xx works properly and safely, it must be installed, parameterised, and operated by sufficiently qualified personnel.

The following qualifications are required for commissioning and operation:

- Basic, practical training in electrical engineering
- Knowledge of the relevant safety guidelines
- Knowledge of the hardware and software environment for the relevant application
- Basic data transfer knowledge
- Basic programming knowledge

2.2 Intended Use

The LMS2xx is a non-contact, stand-alone remote measuring system designed for use in industrial environments. The LMS2xx outputs different measured values via a serial data interface. Depending on the application, these can be:

- Displayed and evaluated manually either on the PC using the "LMSIBS" software (limited data volume) to detect objects in their relative position and size, for example
- Queried and evaluated in real time by a host computer with fast data communication by means of a driver provided by the customer (telegrams).

Integrated evaluation routines also enable the LMS2xx to be implemented directly as a sensor with the required switching outputs in programmable field monitoring applications (two-dimensional fields/contours). Up to two LMS2xx can be operated simultaneously as a master/slave configuration to cover larger monitoring areas.

The optional PC software development tool "MST200" (either in combination with the measurement technology interface LMI200 as a system enhancement or a PC with a RS 422 high-speed card) supports additional, more complex, customer-specific real-time measurement tasks for up to two LMS2xx.

Implementing the device in any other applications, modifying it in any way, whether during mounting and electrical installation, or making changes to the SICK software will result in an annulment of any warranty claims vis-à-vis SICK AG.

2.3 General Safety Instructions and Protection Measures

1. The LMS2xx uses a class 1 laser (eye-safe).
   Observe the laser safety standards to EN 60825-1 (latest version).
2. When using electrical systems, observe the standard safety precautions.
   (The LMS2xx requires 24 V DC).

The LMS2xx laser measurement systems are not devices for personnel protection in the sense of valid safety standards for machines.

3 Introduction

3.1 Design of the LMS2xx

The standard version of the LMS2xx laser measurement system comprises the following components:

- Laser scanner
- Digital switch inputs and outputs
- Data interface (RS 232/422, switchable)
- Visual indicators (LEDs) (LMS200/LMS291 only)
- Measurement and evaluation software (firmware)

3.2 Operating Principle

The laser scanners in the LMS2xx range operate according to the time-of-flight principle (LIDAR, or laser radar). A light pulse emitted for a defined length of time is reflected off a target object and is received via the same path along which it was sent. A counter starts as soon as the light pulse is transmitted and stops when the signal is received. The counter value correlates with the appropriate path.
The emitted pulse is diverted by a rotating mirror in the scanner. Since the time-of-flight measurement runs at the speed of light, the rotation of the mirror for an individual pulse measurement is not relevant.

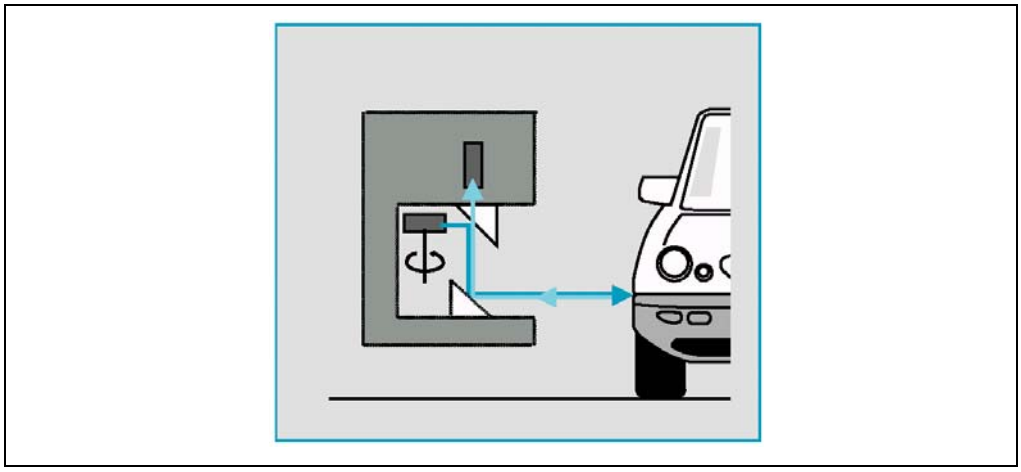


Fig. 3-1: Time-of-flight measurement with the LMS2xx

The devices in the LMS2xx range have a defined length and angular resolution. The LMS types available up to now are listed in *Chapter 3.3 Types in the LMS2xx Range, Page 17*.
The length resolution is defined by the increments of the internal counter. To ensure that the level of precision specified in the *Technical Description "LMS200 to LMS291 Laser Measurement Systems" (Chapter 13: "Technical Data")* is achieved, each individual LMS2xx is referenced against known measurement objects at various distances in the final inspection process. This results in two typical reference tables, a distance table, and an energy value table in each LMS2xx (device specific).

The current types in the range (except types LMS211/221/291-S14 (LMS Fast)) support a configurable angular resolution in steps of 1°, 0.5°, and 0.25°.
The corresponding setting options for the effective field of vision are listed in *Table 10-10, Page 123*.

The light beams emitted from laser scanner have a physical circumference, the diameter of which increases with distance. This can result in edge strikes (see *„Edge Strike/Halo Effect Around the Measured Object“, page 110*), which must be taken into account using evaluation software. The circumference of the laser pulse is known as a "spot" and is described under *„Spot“, page 114*. The laser scanners conform with laser class 1 and are eye-safe (see *Technical Description “LMS200 to LMS291 Laser Measurement Systems“*).

The LMS2xx communicates with host systems via a switchable RS 232/422 data interface (selectable via a jumper in the device connector). The telegrams described in the telegram listing (commands/responses) have been specially designed for the LMS2xx range.

All devices in the LMS2xx range (except types 211/221/291-S14) can monitor freely definable fields within the field of vision. The LMS2xx features internal functions to support applications where a configured (parameterised) field must be monitored. For standard devices, the results of a possible field infringement can be output via three digital switching outputs that must be parameterised. For special devices (LMS211-/221-S07 and LMS211-/221-S20), the results can be output via two relay outputs (normal position: contact closed) and one digital switching output that must be parameterised.

Each LMS2xx has a digital input that can be assigned different functions. These functions not only relate to the internal field applications but also the use of the LMS2xx as a measurement data source.

The LMS2xx functions can be configured (parameterised) and displayed using the "LMSIBS" user software supplied with the device. The applications for processing measurement data run on host systems. The "LMSIBS" software helps you carry out one-time configuration of the LMS2xx.

Note The following telegram descriptions apply to devices in series LMS2xx **type 6 (resolution: 10 mm (0.39 in))**. Devices in series type 1 to 5 (resolution: 50 mm (1.97 in)) are no longer available.

➢ If you have any questions regarding types 1 to 5, please contact your SICK AG representative.

To evaluate the raw data output by the LMS2xx, the **LMI200** evaluation unit and the PC software **MST200** are also available.

3.3 Types in the LMS2xx Range

The types highlighted in **bold** are devices that are currently available in the product range. The other types are older versions.

LMS type	Name	Order number
	**LMS200-30106**	**1017561**
	LMS200-20106	1012559
	LMS200-20203	1013868
	LMS200-30306	1016059

Table 3-1: LMS200 series (blue housing)

LMS type	Name	Order number
	LMS220-30106	1015945
	LMS220-30206	1017811

Table 3-2: LMS220 series (blue housing)

LMS type	Name	Order number
	**LMS291-S05**	**1018028**
	LMS291-S14	**1025329**
	LMS291-S15	**1026226**
	LMS291-S05	1016024

Table 3-3: LMS291 series (grey housing)

LMS type	Name	Order number
	**LMS211-30106**	**1025629**
	LMS211-30206	**1018023**
	LMS211-S07	**1018966**
	LMS211-S14	**1025487**
	LMS211-S15	**1026225**
	LMS211-S19	**1040061**
	LMS211-S20	**1040435**
	LMS211-20201	1013853
	LMS211-20202	1013854
	LMS211-20204	1013855

Table 3-4: LMS211 series (grey housing)

LMS type	Name	Order number
	**LMS 221-30106**	**1026000**
	LMS 221-30206	**1018022**
	LMS 221-S07	**1018965**
	LMS 221-S14	**1025328**
	LMS 221-S15	**1026224**
	LMS 221-S16	**1027192**
	LMS 221-S19	**1040060**
	LMS 221-S20	**1040434**
	LMS221-20203	101583

Table 3-5: LMS221 series (grey housing)

3.4 Measurement and Data Output Principle

The laser scanners in the LMS2xx range are optimised for distance measurements.
The basic operating principle of the system is the initial pulse evaluation, which means that the first return pulse received by the laser scanner triggers the distance measurement. Additional return pulses on the path are ignored.

Advantages:

- No interference caused by reflections.
- When an object is detected, this ensures that it is in the path.

The time-of-flight principle ensures that the theoretical accuracy of the measured value is the same along the entire measurement path (the time-of-flight within the scanner remains the same, irrespective of the measured distance).

Continuous measurement is another basic principle of the laser scanner, which means that one measurement cycle always takes place at the scan level during each rotation. Because of the physical mass of the mirror, the measurements must be carried out at the respective angular values. The mirror cannot be stopped. Reliable measurements take priority over data communication. *Section 4.3, page 24* describes the associated requirements regarding the time sequence of the log.

LMS2xx laser scanners require 13.32 ms for a standard rotation, which corresponds to a measurement rate of 75 Hz. With all LMS types (apart from 211/221/291-S14), the measurements are carried out in 1° steps, that is, if steps of 0.5° or 0.25° have been configured, 2 or 4 mirror rotations are required.
To achieve the appropriate angular resolution, the 1° steps are shifted by the appropriate angle (0.25° or 0.5°) at the start of a mirror wheel rotation. For this reason, a scan with a step width of 0.5° requires 26.64 ms (a step width of 0.25° requires 53.28 ms). All LMS2xx devices in standard mode output the measured values in ascending order of the angle measured. See also *Section 7.5.2, page 47*.

Note If either the LMS2xx or the scanned object moves while the measurement data is being recorded, the measured values of the full angle are delayed with respect to the fractional angle.

The LMS2xx can function in three different measuring modes:

- Measurements of the distance values
- Measurement of the energy values received (also known as "reflectivity")
- A combination of both options for a restricted scanning area

3.4.1 Coding the Distance Values

If the LMS2xx is measuring distances, it outputs each distance value in two data bytes.

Data Byte Structure

	More significant data byte								Less significant data byte							
Bit number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Binary value in 2^n	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Hex. value	00 to FF								00 to FF							
Dec. value	0 to 65535															

Table 3-6: Significance of the data bytes

In the standard measuring configuration, data bits 0 to 12 are used to represent the distance. These 13 data bits enable 2^{13}-1= 8191 coding options to be represented. Different

measurement ranges can be represented depending on the selected measured value resolution. If you select a measured value resolution of 1 mm (0.04 in), this will theoretically result in a maximum measuring distance of 8.191 m (26.87 ft), and a measured value resolution of 10 mm (0.39 in) will theoretically result in 81.91 m (268.7 ft).

Note The distance values are restricted to a defined maximum value depending on the selected measurement range. Values that exceed these maximum values are known as "overflow values". For more information on overflow values, see *Section 10.8, page 124*.

Available distance measurement ranges:

Measurement range	Data bits used	Max. representation Hex. value	Max. measurement range representation
8 m (26.2 ft)	13	1FF7h	8.183 m (26.84 ft)
16 m (52.49 ft)	14	3FF7h	16.385 m (53.75 ft)
32 m (104.98 ft)	15	7FF7h	32.759 m (107.47 ft)
80 m (262.64 ft)	13	1FF7h	81.83 m (268.46 ft)

Table 3-7: LMS2xx distance measurement ranges

3.4.2 Coding the Energy Values

Due to the physical principle of non-contact scanning measuring devices, a specific return energy of the carrier pulse is required to trigger the internal trigger threshold. In time-based time-of-flight measurements with light, the reflected light energy depends on how far away the measured object is from the scanner and also on the surface characteristics of the object (see *Technical Description "LMS200 to LMS291 Laser Measurement Systems"*, Chapter *"4 Conditions of use/Range"*, *Reflectivity in Relation to the Measuring Distance*).
The LMS2xx uses the received energy to evaluate the distance and compare this with an internal reference. The received energy values (also known as "reflectivity values") are calculated at a wavelength of 905 nm. The reflectivity is a property of the measured object that cannot be easily recorded. The reflectivity is the reflective quality of the object. The energy value level received from measured objects correlates with the reflectivity of the object, but it is **not** the same as its absolute reflectivity.

Note A dark test object in the immediate vicinity of the scanner can have the same energy value as a light test object some distance away.

The output of the reflectivity values (energy values) can help determine structure transitions at the **same** measuring distance. For example, the energy values (reflectivity values) can be used to determine black/white transitions at the same measuring distance.

The reflectivity value data can also be output in 2 bytes.

The value ranges that are output do not follow a linear curve. This means that the step widths are not represented by standardised, uniform distances. The curve is a characteristic of each LMS2xx. This can provide **qualitative** information about a change in brightness, but not a quantitative evaluation of the change.

The **LMS211/221/291-S14 (LMS Fast)** can measure distance **and** reflectivity values simultaneously. The reflectivity values have a value range of 0 to 255 and are output in the same telegram after the distance values.

4 Data Communication

4.1 Data Format, Transmission Rate, and Telegram Structure of the RS 232/422 Data Interface

4.1.1 Data Format and Transmission Rate

The data format for transmitting data via the RS 232/422 data interface is set as follows (settings cannot be changed):

- 1 start bit
- 8 data bits
- 1 stop bit

This means that each data byte that is transmitted is 10 bits long.

You can select the data transmission rate:

Data transmission rate	Interface	Notes
9,600 Bd	RS 232/RS 422	Default after "power-on"
19,200 Bd	RS 232/RS 422	
38,400 Bd	RS 232/RS 422	
500 KBd	RS 422	RS 422 only

Table 4-1: Data transmission rates on the RS 232/RS 422 data interface

In the delivery status (default setting), the LMS2xx starts with a data transmission rate of 9,600 Bd after the power has been switched on.

4.2 Telegram Structure

Some telegrams are sent by the host/driver to the LMS2xx, while others are sent to the host/driver by the LMS2xx. Because the commands are control commands sent to the LMS2xx or responses received from the LMS2xx, they are referred to below as "send telegrams" and "response telegrams". A send telegram always contains only **one** control command for the LMS2xx. A response telegram contains **one** response from the LMS2xx. Commands/responses are always **one byte** long. The LMS2xx normally responds to a send telegram with a response telegram.

Commands can be extended with an additional data string. The extensions (or SUB-commands) are also considered as data.

The entire telegram has an LMS2xx-specific frame around the commands and data.

To send the data to the LMS2xx, the telegram must be structured as follows. The LMS2xx responds using the same structure. The telegram itself is **binary**.

	Frame				Commands and data		Frame	
Description	STX	Address	Length		Command/ Response	Data	Checksum	
Byte position	1	2	3	4	5	6 to n	n+1	n+2
Described in...	*Table 4-4, page 23*	*Table 4-4, page 23*	*Table 4-4, page 23*		*Section 7, page 36 ff.* (Status *Section 8, page 106*)		*Section 9, page 107* (and *Table 4-4, page 23*)	

Table 4-2: Telegram structure

The "command/response" and "data" blocks are described in detail in the telegram listing section.

The length of the send telegrams to the LMS2xx and the corresponding response telegrams **varies** depending on the selected command. The telegram ends with a **checksum (CRC)** and **not** an **"End of Text"** symbol (ETX). In receive telegrams (response), a status byte is a fixed component of the data block. This byte is always located before the checksum.

Explanation In binary telegrams, the data block can contain the symbol values "End of Text" (ETX) and "Start of Text". An ETX would prevent the telegram from being transmitted.

In standard versions of the LMS2xx, a response telegram contains no more than **812 bytes**. During a single mirror wheel rotation (13.32 ms), a maximum of **508 bytes** are transmitted.

Exception: The special type LMS211/221/291-S14 (LMS Fast) transmits up to 559 bytes during one mirror wheel rotation.

Note Data is transmitted in accordance with the INTEL® standard (Little Endian). When a data word (comprising several data bytes) is transmitted, the less significant byte is sent (or received) first, followed by the more significant byte.

Example:
Data word 458 decimal from 2 bytes corresponds to 01h CAh,
and is transmitted in the sequence CAh 01h.

The following data classes have been defined for the LMS2xx range :

Data class	Value range	Length in bytes	Sign	Output sequence
BYTE	0 to 2^8-1	1	No	None
CHAR	-2^7 to 2^7-1	1	Yes	None
WORD	0 to 2^{16}-1	2	No	Low byte, high byte
SHORT	-2^{15} to 2^{15}-1	2	Yes	Low byte, high byte
DWORD	0 to 2^{32}-1	4	No	From low to high byte
LONG	-2^{31} to 2^{31}-1	4	Yes	From low to high byte

Table 4-3: Possible telegram data classes

Note A byte comprises 8 bits and can cover a value range of between 00h and FFh.
The BYTE data class, however, describes a variable.

The STRUCT data class also exists, which outputs a variable comprising data classes for the cell. This is described in the relevant command.

All telegrams sent to the LMS2xx result in two consecutive responses from the LMS2xx:

- With the correct mnemonic, the LMS2xx processes a send telegram received from the host/driver and sends an "Acknowledge" (ACK) (06h) in response.
- The LMS2xx then sends a corresponding response telegram.
  The response telegram confirms the request and can also contain the requested data.
  The response telegram contains a value increased by **80h** as a corresponding response command.
  Example:
  The LMS2xx responds to command 20h (switch operating mode) with A0h (response to "switch operating mode").
- If the send telegram is incorrect, only the "Not Acknowledge" response (NAK) (15h) is sent.

The following table provides more information on the structure of telegrams:

Description of the telegram components		**Data length in bits / data length in bytes / data class**	**Explanation**
STX (Start of Text)		8/1/ BYTE	Start byte (02h)
Address		8/1/ BYTE	Address of the subscriber. For a precise allocation of addresses, see *Table 10-11, page 124*. The LMS2xx are not busable. The address can be used, for example, to differentiate between various SICK measurement interfaces in the LMS2xx range.
Length		16/2/ WORD	Number of subsequent data bytes **excluding** the checksum.
Command/response		8/1/ BYTE	Command/response Description in *Section 7, page 36 ff.*
Data	Data for send telegrams	N x 8 (n x 1) (defined in *Section 7, page 36*)	Refers to the previous command (optional). With send telegrams, this can be command extensions and/or limit values. For a description, see *Section 7, page 36 ff.*
	Status (response telegram only)	8/1/ BYTE	LMS2xx communicates a status. The host must not send a status byte in the send telegram. For a description, see *Section 8, page 106*.
Checksum		16/2/ WORD	CRC checksum of the entire data package, starting with STX and up to and including the status byte. For a description of the calculation procedure, see *Section 9, page 107*.

Table 4-4: Detailed information on the telegram structure

Note In some cases, a correct telegram frame with a logically incorrect command may be sent to the LMS2xx (the start sequence of STX, address, length, and the checksum at the end are correct). This can occur with commands that the LMS2xx does not recognise or cannot process because the corresponding **preceding** telegram is missing.

Example:
The LMS2xx receives the corresponding command for "stop teach-in field", although it has not been set to this mode by the previous command. In this case, the LMS2xx responds with command 92h.

Section 7.3, page 38 describes the declarations for transmission errors.

The LMS2xx can send high data rates. To ensure that all scans (measured values) are processed in the host, the interface buffer of the host must be interrogated at short intervals. This interval depends on the selected angular resolution of the LMS2xx (see also *Section 10.10, page 126*).
To enable the host to be synchronised with the data received, various help functions are integrated in the telegram. The start of a data string is identified by the STX, address, telegram length evaluation, and response.

- In the response telegram, the LMS2xx sends an address increased by 80h with respect to the original address (for example, send address 20h has address A0h in the response).
- In the response telegram, the LMS2xx sends an address increased by 80h with respect to the original command (exception: "power up" and initialisation, see *Section 7.3, page 38*).

4.3 Time Conditions During Bi-Directional Communication

- No longer than 6 ms must elapse between two bytes within a telegram sent to the LMS2xx, otherwise a timeout is detected. The telegram is then ignored.
- An interval of up to 14 ms can elapse between two bytes sent from the LMS2xx within a telegram.
- The minimum interval between two bytes sent to the LMS2xx should be **at least** 55 µs.
- The response to a command sent by the host must be issued within a response time that depends on the telegram requested.
- The maximum response time of the LMS2xx for a request for the current measured values of a scan is 60 ms (angular resolution: 0.25°).
  The response to a **"change operating mode" can take up to 3 seconds**.
- The host is the communication master.
- Requests issued by the host interrupt all transmission procedures from the LMS2xx.
- The LMS2xx carries out a software handshake with ACK (06h) when it receives a correct request. If an error is detected, the LMS2xx responds with NAK (15h).
- Behaviour of the LMS2xx when it receives a command:
  - The LMS2xx does not respond (remains silent): The wrong address has been specified in the address part of the send telegram.
  - The LMS2xx sends a NAK: The address is correct, but the checksum in the send telegram is incorrect.
  - The LMS2xx sends an ACK: The address is correct and the checksum is correct.
- The maximum response time of the LMS2xx for NAK or ACK is 60 ms.
- Once it has received a NAK, the host must wait at least 30 ms before it retransmits the telegram.
- During a rotation cycle of the mirror wheel the LMS2xx can miss a request from the host on certain moments. It can be necessary to send a request more than only once.

4.4 Software Compatibility

The LMS2xx is configured by means of commands. A specific pattern is used to address the LMS2xx. Extensions and enhancements of the LMS2xx system software (firmware) result in extensions to the telegrams. Where technically possible, the downwards compatibility with the LMS2xx is checked. If a send command is extended, LMS2xx devices using an older software version ignore the additional bytes within the data part. If an older driver does not use the additional data extensions to communicate with the latest generation of LMS2xx, the settings that are relevant here are not made. In both cases, **no** error message is output.

4.5 Configuring the LMS2xx

The LMS2xx is configured in the following order:

Step	Activity	Note
1	Switch on the LMS2xx (power-on).	-
2	The LMS2xx sends a "power-on" string.	During switch-on only
3	The command "Switch to installation mode" is sent to the LMS2xx.	Command 20h
4	The LMS2xx responds with "Acknowledge".	06h
5	The LMS2xx responds to the command.	Response A0h
6	The command to set the parameters is sent to the LMS2xx.	Normally command 77h
7	The LMS2xx responds with "Acknowledge".	06h
8	The LMS2xx responds with "Parameters successfully changed".	Response F7h
9	The command "Switch to monitoring mode" is sent to the LMS2xx.	Command 20h
10	The LMS2xx responds with "Acknowledge".	06h
11	The LMS2xx responds with "Mode successfully changed".	Response A0h
12	Wait for the next request or (for example) start data transmission (measured value output).	Start the next action

Table 4-5: The parameterisation (configuration) process

For a detailed description, see *Section 6, page 29*.

The LMS2xx requires up to 3 s to switch between different modes (see Time Conditions, *Section 4.3, page 24*). You **must** wait for the response telegram from the LMS2xx after the acknowledgement.
Every parameterisation process results in a write cycle to the EPROM of the LMS2xx. The write cycles of an EPROM are limited (thousands). Once the parameters have been stored once in the EPROM, the configuration does not have to be changed every time the power is switched on. You may only have to adjust the communication parameters (data transmission rate, and so on) in the "switch operating mode" command.

Default Setting

The devices in the LMS200/220 and LMS211/221/291 series are shipped with the appropriate default settings. If the default setting or the LMS2xx parameters already saved in a configuration are suitable for the application, communication is much easier.

Step	Activity	Note
1	Switch on the LMS2xx (power-on).	-
2	LMS2xx sends a "power-on" string.	During switch-on only
3	The command "Send data" (or "Set operating mode") is sent to the LMS2xx.	In accordance with the required data (see *Section 7, page 36*).
4	The LMS2xx responds with "Acknowledge".	06 h
5	The LMS2xx responds to the command.	In accordance with the selected data output (see *Section 7, page 36*).
6	Wait for the next request or (for example) start data transmission (measured value output).	Start the next action

Table 4-6: Simplified parameterisation (configuration) process

Table 4-7 shows the most important ex-works default settings for the LMS types.

Parameter	**LMS200-30106** **LMS211-30106** **LMS221-30106** LMS220-30106	**LMS221-30206** **LMS221-S07/-S15** **LMS221-S16** **LMS221-S19/-S20** **LMS291-S05/-S15**	**LMS211-30206** **LMS211-S07/-S15** **LMS211-S19/-S20**	**LMS211-S14** **LMS221-S14** **LMS291-S14**
Data transmission rate at power-on	9,600 Bd			
Angular resolution	0.5°			
Aperture angle	180°	180°	100°	90°
Measurement range	8 m (26.25 ft)	80 m (262.5 ft)	80 m (262.5 ft)	80 m (262.5 ft)
Measured value resolution	10 mm (0.39 in)	100 mm (3.94 in)	100 mm (3.94 in)	10 mm (0.39 in)
Flag indicators	Field A, field B, and dazzle			
Address	00h			
SUB command setting for command 20h	25h (measured distance values are only output on request)			

Table 4-7: Overview: Default LMS2xx settings

For a detailed table, see *Section 10.6, page 124*.

5 Telegram Representation

(1)

	Frame				Commands and data		Frame	
Description	STX	Address	Length		Command/ Response	Data	Checksum	
Byte position	1	2	3	4	5	6 to n	n+1	n+2
Described in…	*Table 4-4, page 21*	*Table 4-4, page 21*	*Table 4-4, page 21*		*Section 7, page 34 ff.* (Status *Section 8, page 103*)		*Section 9, page 104* (and *Table 4-4, page 21*)	

(2)

	Command	**Parameter data**	
Data class	Data class of command	Data class of sub-command A	Data class of sub-command B
Content	Content of command	Content of sub-command A	Content of sub-command B
Hex. value	Hex. value of command	Hex. value of sub-command A	Hex. value of sub-command B

(a)

Parameter data
No further data

(b)

Parameter data		
BYTE	WORD	
Provides information on whether the variant switchover was successful: 00h: Switchover aborted. Previous variant still active. 01h: Switchover successful. New variant active.	Scanning angle in ° (degrees): 100° or 180°	Angular resolution in 1/100°: Three variants currently available: 100: Angular resolution 1° 50: Angular resolution 0.5° 25: Angular resolution 0.25°
xxh	xx xxh	xx xxh

(c)

Parameter data
See *Table 7-126*, (block A to D).

(d)

Block	**Parameter data for command 7Ch**	
A	**Data class**	BYTE
	Content	Bit 0: "Contour on plain" 1: "Contour on plain" activated 0: The contour is processed radially (LMS 211/221/291 only) For LMS 200/220, the flag must be deselected! **Default setting: 0** Bit 1 ... 7: reserved
	Hex. value	xxh
B	**Data class**	CHAR
	Content	Field A: Only applicable when "Contour on plain" is activated.

Example of a complete telegram:

(3)

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6 to 9	10	11
Hex. value	02	00	05	00	7C	00 00 00 00	8F	C4

Table 7-127: Complete telegram for 7Ch (*Table 7-125*)

Fig. 5-1: Explanation of the structure of the telegram listing (for legend, see *next page*)

Legend for *Fig. 5-1, Page 27*:

(**1**) Entire telegram structure:
In the following tables, the "command/response" and "data" blocks are described in detail.

(**2**) "Command/response" and "data":
The (main) command is always on the left-hand side, while the parameter data and/or sub-commands are always on the right-hand side.

The telegrams can be structured as follows:

(**a**) No parameter data or sub-commands exist.

(**b**) Between 1 and 3 sub-commands exist. In this case, they are in the same table from left to right (here: 2 sub-commands).

(**c**) If more than three sub-commands exist, a new table is displayed containing the sub-commands and parameter data to provide a better overview.
Each individual sub-command is uniquely defined by a "block" (see (**d**)).

Note: Due to the size of command 20h, the display differs from the structure described above (see *Section 7.4.1, page 40*).

(**3**) An example is used to illustrate the description.

6 Parameterisation

The following description follows the steps described in *Table 4-5, Page 25*.

6.1 Message After Power-On

Once you have switched on the LMS2xx, it responds with a power-on string (90h).
The string contains the device type and the system software version. A maximum of 60 s can elapse before the device is ready for operation after it has been switched on.

	Response	Parameter data
Data class	BYTE	One BYTE per ASCII character
Content	Power-on	For LMS type 6
Hex. value	90h	*Example:* LMS200;301063;V02.10 (in hex. values)

Table 6-1: Response 90h from the LMS2xx (message after power-on)

Example of a complete telegram (standard devices):

Description	STX	Address	Length		Response	Data		Checksum	
						Data	LMS status		
Byte position	1	2	3	4	5	6 to 26	27	28	29
Hex. value	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	63	56

Table 6-2: Complete telegram for response 90h (*Table 6-1*)

6.2 Installation Mode

To switch to installation mode, a command for switching the operating mode must always be issued. All the device parameters are configured in installation mode.

6.2.1 Command 20h to LMS2xx: Switch operating mode

Three operating modes are available:

- Installation mode
- Monitoring mode
- Calibration mode

A sub-command of command 20h (switch operating mode) is used to switch to installation mode. *Table 7-1, Page 36* provides information on the telegrams available in the different modes and device types.
To switch to installation mode, you have to enter a password. The "SICK_LMS" default value (with underscore) is converted to an ASCII value and entered as a hexadecimal value. This corresponds to the hexadecimal string "53 49 43 B4 5F 4C 4D 53". Because "BYTE" is defined as a data type here, the individual characters are written consecutively as byte values. The password is **always** 8 bytes long. The complete command is structured as follows:

	Command	Sub-command and parameter data							
Data class	BYTE								
Content	Switch operating mode	Installation mode	Password: "SICK_LMS"						
Hex. value	20h	00h	53h	49h	43h	B4h	5Fh	4Ch	4Dh	53h

Table 6-3: Command 20h (password word entry for switching operating mode)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6 to 14	15	16
Hex. value	02	00	0A	00	20	00 53 49 43 4B 5F 4C 4D 53	5F	B2

Table 6-4: Complete telegram for command 20h (*Table 6-3*)

For a complete description of command 20h, see *Section 7.4.1, page 40*.

6.2.2 Response A0h from the LMS2xx to "Switch Operating Mode"

When the LMS2xx successfully receives the command, it confirms it with an acknowledge (06h). After a pause, the corresponding telegram (A0h) is then sent.

The response is structured as follows:

	Response	Parameter data
Data class	BYTE	
Content	Response to 20h	Mode successfully switched
Hex. value	A0h	00 h

Table 6-5: Response A0h from the LMS2xx (confirmation of "switch operating mode")

Example of a complete telegram (standard devices):

Description	STX	Address	Length		Response	Data		Checksum	
						Data	LMS status		
Byte position	1	2	3	4	5	6	7	8	9
Hex. value	02	80	03	00	A0	00	10	16	0A

Table 6-6: Complete telegram for response A0h (*Table 6-5*)

For a complete description of response A0h, see *Section 7.4.2, page 45*.

6.3 Configuration Telegrams (77h and 7Ch)

ATTENTION

Every parameterisation process results in a write cycle to the EPROM of the LMS2xx. The write cycles of an EPROM are limited (thousands). Once the parameters have been stored once in the EPROM, the configuration does not have to be changed every time the power is switched on. You may only have to adjust the communication parameters (data transmission rate, and so on) in command 20h (switch operating mode).

The LMS2xx is normally configured by means of configuration telegrams 77h and 7Ch. With the system software V 2.10 (LMS200/220) and X 1.10 (LMS211/221/291), command 77h is frozen.
Future extensions to the parameterisation are also represented in command 7Ch. These telegrams transfer settings such as measured value resolution and measurement range. The data length after the command is 34 bytes for command 77h. Further telegrams are available that can be chosen in installation mode. These can be used for parameterizing the monitored fields, amongst other things. See the lists in *Section 7, page 36 ff*.

Note **Compatibility**

Older software versions in the LMS2xx required a shorter data length for command 77h. These software versions are also compatible with the latest driver versions. The response telegram can be used to check the configuration.

The command is structured as follows:

	Command	**Parameter data**
Data class	BYTE	WORD and BYTE (depending on the position)
Content	LMS configuration	BYTE 1 to 34
Hex. value	77h	xxh

Table 6-7: Command 77h (configure the LMS2xx)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6 to 39	40	41
Hex. value	02	00	23	00	77	00 00 70 00 00 00 01 00 00 02 02 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 02 00 See also *Table 6-9*	11	88

Table 6-8: Complete telegram for command 77h (*Table 6-7*)

Due to the length of the data, it is briefly described in the following sections for the relevant application. For a detailed description, see the telegram listing in *Section 7.46, page 96*.

Position in the data string	**Data class**		**Description**	**Default setting**	**Application**
6	WORD	Low byte	Blanking	00h	Fields
7		High byte		00h	
8	WORD	Low byte	Peak stop threshold	70h	Measuring
9		High byte		00h	
10	BYTE		Availability	00h	Fields and measuring
11	BYTE		Measuring mode	00h	Measuring: setting the measurement range, etc.
12	BYTE		Measured value unit	00h or 01h	Measuring: measured value resolution (depending on the device type) 00h = LMS211/LMS221/LMS291 01h = LMS200/LMS220
13	BYTE		Transient field set	00h	Fields
14	BYTE		Subtractive fields	00h	Fields

Table 6-9: Brief outline of the data string for command 77h

Position in the data string	Data class		Description	Default setting	Application
15	BYTE		Multiple evaluation	02h	Fields
16	BYTE		Restart	02h	Fields
17	BYTE		Restart time	00h	Fields
18	BYTE		Multiple evaluation for suppressed objects	00h	Fields
19	BYTE		Contour A as reference	00h	Fields
20	BYTE		Contour A as a positive tolerance band	00h	Fields
21	BYTE		Contour A as a negative tolerance band	00h	Fields
22	BYTE		Contour A start angle	00h	Fields
23	BYTE		Contour A stop angle	00h	Fields
24	BYTE		Contour B as reference	00h	Fields
25	BYTE		Contour B as a positive tolerance band	00h	Fields
26	BYTE		Contour B as a negative tolerance band	00h	Fields
27	BYTE		Contour B start angle	00h	Fields
28	BYTE		Contour B stop angle	00h	Fields
29	BYTE		Contour A as reference	00h	Fields
30	BYTE		Contour A as a positive tolerance band	00h	Fields
31	BYTE		Contour C as a negative tolerance band	00h	Fields
32	BYTE		Contour C start angle	00h	Fields
33	BYTE		Contour C stop angle	00h	Fields
34	BYTE		Pixel-oriented evaluation	00h	Fields
35	BYTE		Single measured value evaluation	00h	Measuring
36	WORD	Low byte	Restart time fields	00h	Fields
37		High byte		00h	
38	WORD	Low byte	Multiple blanking evaluation	02h	Fields
39		High byte		00h	

Table 6-9: Brief outline of the data string for command 77h (contd.)

6.3.1 Response F7h and FCh from the LMS2xx to the Configuration Telegram

The correct response from the LMS2xx to the configuration telegram is two bytes longer after the acknowledge (06h) has been received.

The response is structured as follows:

	Response	Parameter data	
Data class	BYTE	BYTE	Data from 77h repeated
Content	Response to 77h or 7Ch	Status	Parameter data for bytes 2 to 35
Hex. value	F7h or FCh	01h	xxh

Table 6-10: Response F7h or FCh from the LMS2xx to command 77h or 7Ch

Example of a complete telegram (standard devices):

Description	STX	Address	Length		Response	Data		Checksum	
						Data	LMS status		
Byte position	1	2	3	4	5	6 to 40	41	42	43
Hex. value	02	80	25	00	F7	01 00 00 70 00 00 00 01 00 00 02 02 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 02 00	10	C5	7A

Table 6-11: Complete telegram for response F7h (*Table 6-10*)

The status in the data at byte position 6 with content 01h indicates that the configuration has been successfully activated. The LMS2xx then immediately outputs the parameter set stored in the memory again.

Note If you are using an older software versions in the LMS2xx with the latest driver version, the LMS2xx only outputs the data record up to the length supported by the system software version you are using.
If you are using an older driver version with new system software, the response telegram also contains the additional bytes for the new functions.

➢ You must configure the driver in such a way that it checks the structure in accordance with the length specified in the receive telegram.

Irrespective of the software status of the LMS2xx, the send structure always shows the right telegram **length** (see *Section 4.2, page 21*).
For status output 00h (configuration rejected), the LMS2xx outputs its current configuration as a data record following the status byte.

6.3.2 Completing the Configuration Process

In installation mode, further configuration telegrams can now follow. You have to switch the LMS2xx to monitoring mode so that it can start taking measurements. To do so, the command for switching operating modes (20h) is resent to the LMS2xx.

The command is now structured as follows:

	Command	**Sub-command and parameter data**
Data class	BYTE	
Content	Operating mode switchover	Operating mode 20h to 50h
Hex. value	20h	xxh

Table 6-12: Command 20h (switch operating mode)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6	7	8
Hex. value	02	00	02	00	20	24	34	08

Table 6-13: Complete telegram for command 20h (*Table 6-12*)

Brief overview of the sub-commands:

Sub-command	Meaning	Particularities	Application
24h	The LMS2xx continuously outputs all the measured values of a scan.	none	Continuously sending measured distance values.
25h	The LMS2xx only outputs measured distance values if requested. (**default setting**)	none	Outputting measured distance values of single scans.
2Bh	The LMS2xx continuously outputs all the measured distance values of n partial scans (including reflectivity data).	The configuration in 77h must be chosen accordingly.	Outputting measured distance values and the energy value level of the signal received.

Table 6-14: Sub-commands for 20h (brief overview)

For a detailed description, see *Section 7.4, page 40*.

This is followed by an acknowledge (06h) and confirmation telegram A0h.

The next action can now be carried out depending on the chosen configuration. If you choose continuous data output as the monitoring mode, the LMS2xx outputs a constant data stream. The LMS2xx stops the continuous output when it receives telegram 20h and sub-command 25h.

6.4 Monitoring Mode

As described in *Section 6.2.1, page 29*, different operating modes are available. In the case of continuous data output, the telegram from the LMS2xx corresponds to the response to the request for a complete single scan.

The command for requesting an individual scan with distance values is:

	Command	Parameter data
Data class	BYTE	BYTE
Content	Request for measured values	Measured value mode
Hex. value	30h	01h

Table 6-15: Command 30h (request measured value)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6	7	8
Hex. value	02	00	02	00	30	01	31	18

Table 6-16: Complete telegram for command 30h (*Table 6-15*)

For a detailed description, see *Section 7.5.1, page 46*.

The response from the LMS2xx to the request or configuration "Send all data cont." is:

	Response	Parameter data
Data class	BYTE	Measured value data
Content	Response to 30h	Parameter data for byte 2 to n
Hex. value	B0h	xxh

Table 6-17: Response B0h from the LMS2xx to command 30h

Example of a complete telegram (standard devices):

Description	STX	Address	Length		Response	Data		Checksum	
						Data	LMS status		
Byte position	1	2	3	4	5	6 to 729	730	731	732
Hex. value	02	80	D6	02	B0	724 bytes	10	15	D4

Table 6-18: Complete telegram for response B0h (*Table 6-17*)

The data is structured as follows:

Byte position in the data string	**Data class**		**Description**	**Default setting**
1	WORD	Low byte	Number of measured values sent, coded in bits 0 to 9. This corresponds to a value range of 0 to 1023 dec. or 0h to 3FFh. In the upper bits (bits 14 and 15), the measured value units and the partial scan output are coded; the default setting described applies to LMS 200. See *Section 7.5.2, page 47*.	69h
2		High byte		41h
3	WORD	Low byte	Measured value 1	
4		High byte		
5	WORD	Low byte	Measured value 2	
6		High byte		
....n	WORD	Low byte	Measured value x (default setting: 361 values for LMS 200/220/221/291)	
..n+1		High byte		

Table 6-19: Brief summary of the data

The parameter data changes depending on the LMS2xx selected or if the configuration has been changed. Example: for an LMS 211, the default settings for positions 1 and 2 are low byte = 9h and high byte = 00h. For a detailed description, see *Section 7.5.2, page 47*.

6.5 Calibration Mode

This (SICK-internal) mode is not freely available.

7 Commands/Responses

As already described, some telegrams are sent by the driver to the LMS2xx (send telegrams) and some are received by the driver from the LMS2xx (receive telegrams).
A telegram for the LMS2xx is always structured as described in *Section 4.2, page 21*. The list below and the detailed descriptions of the telegrams contain the following information:

- Description of the send telegram from the driver.
- Description of the response telegram from the LMS2xx.

The commands 00 h to 8Fh are theoretically located in the send telegrams. As of 90h, the corresponding responses are located in the receive telegrams.

Table 7-1 provides an overview of the available commands/responses for the individual operating modes and LMS types:

Command/Action	Telegram no.: Command to LMS2xx	Telegram no.: Response from the LMS2xx	Operating mode			Device Type			See chapter/page
			Monitoring mode	Installation mode	Calibration mode	LMS type 1-5	LMS type 6	LMS special type 90°/0.5°	
Reserved	0Bh	-							*7.1 / 37*
Reserved	0Ch	-							*7.2 / 37*
Initialise and reset	10h	90h	X	X	X	X	X	X	*7.3 / 38*
Choose/switch operating mode	20h	A0h	X	X	X	X	X	X	*7.4 / 40*
Request measured values	30h	B0h	X	X	X	X	X	X	*7.5 / 46*
Request LMS status	31h	B1h	X	X	X	S	S	S	*7.6 / 52*
Request error/test message	32h	B2h	X	X	X	X	X	X	*7.7 / 58*
Reserved	33h	B3h							*7.8 / 59*
Reserved	34h	B4h							*7.9 / 59*
Request operating data counter	35h	B5h	X	X	X		X	X	*7.10 / 60*
Request mean measured values	36h	B6h	X	X	X	X	X	X	*7.11 / 61*
Request measured value sub-range	37h	B7h	X	X	X	X	X	X	*7.12 / 63*
Reserved	38h	B8h							*7.13 / 64*
Reserved	39h	B9h							*7.14 / 64*
Request LMS type	3Ah	BAh	X	X	X	X	X	X	*7.15 / 65*
Switch variant in the LMS2xx	3Bh	BBh	X	X	X		X	X	*7.16 / 66*
Reserved	3Ch	BCh							*7.17 / 67*
Reserved	3Dh	BDh							*7.18 / 67*
Request measured value with field values	3Eh	BEh	X	X	X		X		*7.19 / 68*
Request the mean measured value sub-range	3Fh	BFh	X	X	X	X	X	X	*7.20 / 70*
Configure fields A, B, or C	40h	C0h		X	X		X		*7.21 / 72*
Switch the active field set	41h	C1h	X	X	X		X		*7.22 / 76*
Change the password	42h	C2h		X	X	X	X	X	*7.23 / 77*
Request measured values and reflectivity value sub-range	44h	C4h	X	X	X			X	*7.24 / 78*
Request configured fields	45h	C5h	X	X	X		X		*7.25 / 80*

Table 7-1: Overview of the commands

Command/Action	Telegram no.: Command to LMS2xx	Telegram no.: Response from the LMS2xx	Operating mode			Device Type			See chapter/page
			Monitoring mode	Installation mode	Calibration mode	LMS type 1-5	LMS type 6	LMS special type 90°/0.5°	
Start teach mode for field configuration	46h	C6h		X	X		X		*7.26 / 83*
Reserved	48h	C8h							*7.27 / 84*
Request the status of the field outputs	4Ah	CAh	X	X	X		X	X	*7.28 / 85*
Reserved	4Bh	CBh							*7.29 / 85*
Reserved	4Ch	CCh							*7.30 / 85*
Reserved	4Dh	CDh							*7.31 / 85*
Reserved	4Eh	CEh							*7.32 / 86*
Reserved	4Fh	CFh							*7.33 / 86*
Reserved	50h	D0h							*7.34 / 86*
Reserved	51h	D1h							*7.35 / 86*
Reserved	52h	D2h							*7.36 / 86*
Define the permanent baud rate or LMS type	66h	E6h		X	X	X	X	X	*7.37 / 87*
Reserved	67h	E7h							*7.38 / 87*
Reserved	68h	E8h							*7.39 / 87*
Define the angular range for positioning aid	69h	E9h	X	X	X		X	X	*7.40 / 88*
Reserved	70h	F0h							*7.41 / 89*
Reserved	72h	F2h							*7.42 / 89*
Request the LMS configuration (part 1)	74h	F4h	X	X	X		X	X	*7.43 / 90*
Request measured value with reflectivity data	75h	F5h	X	X	X		X		*7.44 / 91*
Request measured values in cartesian coordinates	76h	F6h	X	X	X		X		*7.45 / 94*
Configure the LMS2xx (part 1)	77h	F7h		X	X		X	X	*7.46 / 96*
Reserved	78h	F8h							*7.47 / 102*
Reserved	79h	F9h							*7.48 / 102*
Reserved	7Ah	FAh							*7.49 / 102*
Request the LMS configuration (part 2, continued)	7Bh	FBh	X	X	X		X	X	*7.50 / 103*
Configure the LMS (part 2, continued)	7Ch	FCh		X	X		X	X	*7.51 / 104*

Table 7-1: Overview of the commands (contd.)

Key:

X: Telegram available

S: Telegram available, but note the device specifications.

7.1 Command 0Bh

Reserved

7.2 Command 0Ch

Reserved

7.3 Initialise and Reset

7.3.1 Command 10h to LMS2xx: Initialise and Reset

Initialising the LMS2xx has the same effect as a hardware reset:

- The configured fields remain active
- The fault memory is cleared
- The history memory for storing fatal errors is retained

Once the device has been initialised (max. 60 s for LMS200), response 90h is issued from the LMS2xx with the "power-on" string.

	Command	**Parameter data**
Data class	BYTE	No further data
Content	Start sequence	
Hex. value	10h	

Table 7-2: Command 10h (initialise and reset)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	-	6	7
Hex. value	02	00	01	00	10	-	34	12

Table 7-3: Complete telegram for command 10h (*Table 7-2*)

7.3.2 Response 90h from the LMS2xx: Message After Power-On

When the power is switched on, the LMS2xx informs the host that it is ready for operation.

The LMS2xx sends this telegram after a hardware reset and a requested software reset. In a software reset, however, the LMS2xx outputs response telegram 91h first.

The LMS2xx sends this telegram within 60 s of the power being switched on.

	Response	**Parameter data**
Data class	BYTE	BYTE, per ASCII character
Content	Message during power-on	For LMS type 6
Hex. value	90h	*Example:* LMS200;301063;V02.10 (in hex. values)

Table 7-4: Response 90h from LMS2xx (message after power-on)

Example of a complete telegram (standard devices):

Description	STX	Address	Length		Response	Data		Checksum	
						Data	LMS status		
Byte position	1	2	3	4	5	6 to 26	27	28	29
Hex. value	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	63	56

Table 7-5: Complete telegram for response 90h (*Table 7-4*)

7.3.3 Response 91h from the LMS2xx: Confirmation of the Software Reset Command

When the LMS2xx has received command 10h for a software reset, it sends an ACK and resets the software after approx. 10 ms.

	Response	**Parameter data**
Data class	BYTE	No further data
Content	Confirmation of software reset	
Hex. value	91h	

Table 7-6: Response 91h from the LMS2xx (confirmation of software reset)

Example of a complete telegram (standard devices):

Description	STX	Address	Length		Response	Data		Checksum	
						Data	LMS status		
Byte position	1	2	3	4	5	-	6	7	8
Hex. value	02	80	02	00	91	-	10	79	30

Table 7-7: Complete telegram for response 91h (*Table 7-6*)

Inconsistency in the response telegram:

The rule that the response from the LMS2xx is increased by 80h does not apply to command 10h.

The LMS2xx sends response 90h immediately after telegram 91h.

7.3.4 Response 92h from the LMS2xx: Not Acknowledge, Incorrect Command

Unlike the response "Not Acknowledge" (15h) for a telegram that has been sent incorrectly, this is a "Not Acknowledge" sent by the LMS2xx for an incorrect command in the correct telegram frame (for an impermissible operating mode switchover or invalid number of segments in a measured value request, for example).

	Response	**Parameter data**
Data class	BYTE	No further data
Content	Error message output	
Hex. value	92h	

Table 7-8: Response 92h from the LMS2xx (response to incorrect command in the sequence)

Example of a complete telegram (standard devices):

Description	STX	Address	Length		Response	Data		Checksum	
						Data	LMS status		
Byte position	1	2	3	4	5	-	6	7	8
Hex. value	02	80	02	00	92	-	10	7F	33

Table 7-9: Complete telegram for response 92h (*Table 7-8*)

7.4 Choosing the Operating Mode

7.4.1 Command 20h to LMS2xx: Choose/Switch Operating Mode

Command 20h is one of the most important commands. Choosing the data string accordingly determines whether the LMS2xx is in **monitoring mode**, **configuration mode**, or **calibration mode**. At the same time, this mode also adopts the data interface settings.

Note After a reset, operating mode 25h (output measured value on request only) is the default setting (on delivery) with a data transmission rate of 9,600 Bd.

The switching outputs are only blocked in installation and calibration mode.
To reset the password (if necessary), you first have to switch to diagnostic mode. A password is a string that is **exactly** 8 bytes long and comprises numbers from "0" to "9" and letters from "a" to "z" and "A" to "Z", as well as an underscore ("_").
Additional data is included depending on the sub-command.

Command/Sub-Command Declaration for 20h:
No more than one consecutive sub-command can be sent to the LMS2xx in command 20h. The sub-commands are all exclusive and have the same level of significance. They are divided into groups A, B, C, and D for clarity purposes.

	Command	Parameter data
Data class	BYTE	BYTE
Content	Choose/switch operating mode	Sub-command and parameter data
Hex. value	20h	Group A (*Table 7-11*) *or* Group B (*Table 7-13, page 41*) *or* Group C (*Table 7-15, page 44*) *or* Group D (*Table 7-17, page 44*)

Table 7-10: Command 20h (choose/switch operating mode)

Group A: "Mode selection":

Group A: sub-command and parameter for command 20h			
Installation mode 00h for configuration	**Data class**	BYTE	
	Content	Sub-command	Password string 1 (installation password): The default password is "SICK_LMS"; you can change this if required.
	Hex. value	00h	Default setting for LMS2xx: 53h 49h 43h 4Bh 5Fh 4Ch 4Dh 53h (must otherwise be defined)
01h	Reserved		
02h	Reserved		
Diagnosis Mode 10h	**Hex. value**	10h	No further data

Table 7-11: Group A for command 20h (*Table 7-10*)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6 to 14	15	16
Hex. value	02	00	0A	00	20	00 53 49 43 4B 5F 4C 4D 53	BE	C5

Table 7-12: Complete telegram for group A for command 20h (*Table 7-10*)

Group B: "Monitoring Mode":

Note If you choose sub-commands with continuous data output for measured distance values, the LMS2xx outputs the data directly after confirming command 20h. It is structured in the same way as response B0h.

Group B: sub-command and parameter for command 20h		
20h	**Data class**	BYTE
	Content	The LMS2xx outputs **minimum measured values for each segment continuously** (no additional parameter is required). The data output is structured in the same way as response B0h (*Section 7.5.2, page 47*).
	Hex. value	20h
21h	**Data class**	BYTE
	Content	The LMS2xx outputs **minimum measured values for each segment when it detects an object in the field in each scan** (the measured values can be requested; no additional parameter is required). The data output is structured in the same way as response B0h (*Section 7.5.2, page 47*).
	Hex. value	21h
22h	**Data class**	BYTE
	Content	The LMS2xx outputs the **minimum vertical distance between it and the object continuously** (no additional parameter is required). In a defined rectangular field, the LMS2xx views a corridor defined by the side dimensions of the rectangle. The LMS2xx calculates and transmits the minimum vertical distance. If only segmented fields are configured, the LMS2xx outputs the overflow values if the field is free. If the field is infringed, the minimum measured value in the field is output. The data output is structured in the same way as response B0h (*Section 7.5.2, page 47*).
	Hex. value	22h
23h	**Data class**	BYTE
	Content	The LMS2xx outputs the **minimum vertical distance when it detects an object in the field in each scan**. The measured values can be requested, although this is only advisable for a defined rectangular field; the device views a corridor defined by the side dimensions of the rectangle. In this corridor, the LMS2xx outputs the minimum vertical distance and outputs this value (no additional parameter is required). The data output is structured in the same way as response B0h (*Section 7.5.2, page 47*).
	Hex. value	23h
24h	**Data class**	BYTE
	Content	The LMS2xx outputs **all the measured values in a scan continuously** (no additional parameter is required). The data output is structured in the same way as response B0h (*Section 7.5.2, page 47*).
	Hex. value	24h
25h	**Data class**	BYTE
	Content	The LMS2xx only outputs **measured values if they are requested**. It does not output any data if the field is infringed (no additional parameter is required). The data output is structured in the same way as response B0h (*Section 7.5.2, page 47*).
	Hex. value	25h (**default setting**)

Table 7-13: Group B for command 20h (*Table 7-10, page 40*)

Group B: sub-command and parameter for command 20h					
26h	**Data class**	BYTE		BYTE	
	Content	The LMS2xx outputs **mean measured values continuously**. The data output is structured in the same way as response B6h (*Section 7.11.2, page 61*).		Number of mean values Range: 2 to 250	
	Hex. value	26h		xxh (value 02h to FAh)	
27h	**Data class**	BYTE	WORD		
	Content	The LMS2xx outputs **a measured value sub-range continuously**. The data output is structured in the same way as response B7h (*Section 7.12.2, page 63*).	Start of the range: Range: 1 to 401 Bit 15 is coded within these two bytes: 0: standard measured value sub-range 1: direct measured value sub-range		End of the range: Range: 1 to 401
	Hex. value	27h	xx xxh		xx xxh
28h	**Data class**	BYTE	WORD		
	Content	The LMS2xx outputs **a mean measured value sub-range continuously**. The data output is structured in the same way as response B7h (*Section 7.12.2, page 63*).	Number of mean values: Range: 2 to 250	Start of the mean value sub-range: 1 to 401	End of the mean value sub-range: 1 to 401
	Hex. value	28h	xx xxh (00 02h to 00 FAh)	xx xxh (00 01h to 01 91h)	xx xxh (00 01h to 01 91h)
29h	**Data class**	BYTE	WORD		
	Content	The LMS2xx outputs **a measured value along with the associated field values continuously**. The data output is structured in the same way as response BEh (*Section 7.19.2, page 68*).	Start: 1 to 401		End: 1 to 401
	Hex. value	29h	xx xxh (00 01h to 01 91h)		xx xxh (00 01h to 01 91h)
2Ah	**Data class**	BYTE			
	Content	The LMS2xx outputs **measured values of a partial scan directly after the measurement continuously** (no additional parameter required; data for rapid trigger). The data is output in measuring mode 15h (immediate data transmission) after the individual measurement. The partial scans comprise 180 or 181 measured values at 1° intervals (see *Description of Command 30h* (*Section 7.5.1, page 46*) and Response B0h (*Section 7.5.2, page 47*)).			
	Hex. value	2Ah			

Table 7-13: Group B for command 20h (*Table 7-10, page 40*) (contd.)

Group B: sub-command and parameter for command 20h					
2Bh	**Data class**	BYTE	WORD		
	Content	The LMS2xx outputs **all the measured values of n partial scans (including reflectivity data) continuously.** The data output is structured in the same way as response F5h (*Section 7.44.2, page 92*).	Number of ranges n [1 to 5]	in each case: x n	
				Start: Value range: 1 to 401	End: Value range: 1 to 401
	Hex. value	2Bh	xx xxh (00 01h to 00 05 h)	xx xxh (00 01h to 01 91h)	xx xxh (00 01h to 01 91h)
2Ch	**Data class**	BYTE	BYTE	WORD	
	Content	The LMS2xx outputs **minimum measured values for each segment in a measured value sub-range continuously**. The data output is structured in the same way as response B7h (*Section 7.12.2, page 63*).	Number of segments (n) Value range: 1 to 201	in each case: x n	
				Start of the mean value sub-range: Value range: 1 to 401	End of the mean value sub-range: Value range: 1 to 401
	Hex. value	2Ch	xxh (01h to C9h)	xx xxh (00 01h to 01 91h)	xx xxh (00 01h to 01 91h)
2Dh	Reserved				
2Eh	**Data class**	BYTE			
	Content	The LMS2xx outputs navigation data records.			
	Hex. value	2Eh			
2Fh	Reserved				
50h	**Data class**	BYTE	WORD		
	Content	The **LMS211/221/291-S14** outputs **all the measured values of a scan and the sub-range of the reflectivity values continuously.** Start and end of the reflectivity range follows as a parameter.	Start: Reflectivity value range 1 to 181		End: Reflectivity value range 1 to 181
	Hex. value	50h	xx xxh (00 01h to 00 B5h)		xx xxh (00 01h to 00 B5h)

Table 7-13: Group B for command 20h (*Table 7-10, page 40*) (contd.)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6 to 10	11	12
Hex. value	02	00	06	00	20	27 1B 00 2B 01	FF	FE

Table 7-14: Complete telegram for group B for command 20h (*Table 7-10, page 40*)

Group C: "Test Passwords":

Group C: sub-command and parameter for command 20h			
30h	**Data class**	BYTE	
	Content	Test the installation password (field monitoring remains active).	Password string 1: ASCII value of the string "SICK_LMS" converted to a hexadecimal value.
	Hex. value	30h	Default setting for LMS2xx: 53h 49h 43h 4Bh 5Fh 4Ch 4Dh 53h
31h	Reserved		

Table 7-15: Group C for command 20h (*Table 7-10, page 40*)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6 to 14	15	16
Hex. value	02	00	0A	00	20	30 53 49 43 4B 5F 4C 4D 53	EE	F5

Table 7-16: Complete telegram for group C for command 20h (*Table 7-10, page 40*)

Group D "Setting the Data Transmission Rate":

Note A password string is not required for changing the data transmission rate.

Group D: sub-command and parameter for command 20h		
40h	**Data class**	BYTE
	Content	Setting to 38,400 Bd
	Hex. value	40h
41h	**Data class**	BYTE
	Content	Setting to 19,200 Bd
	Hex. value	41h
42h	**Data class**	BYTE
	Content	Setting to 9,600 Bd
	Hex. value	42h
48h	**Data class**	BYTE
	Content	Setting to 500,000 Bd
	Hex. value	48h

Table 7-17: Group D for command 20h (*Table 7-10, page 40*)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6	7	8
Hex. value	02	00	02	00	20	48	58	08

Table 7-18: Complete telegram for group D for command 20h (*Table 7-10, page 40*)

7.4.2 Response A0h from the LMS2xx to "Switch Operating Mode"

The LMS2xx sends telegram A0h in response to command 20h.

	Response	**Parameter data**
Data class	BYTE	
Content	Response to "switch operating mode"	00h: Mode switchover successful 01h: Mode switchover not possible due to incorrect password 01h: Mode switchover not possible due to a fault in the LMS2xx
Hex. value	A0h	xxh

Table 7-19: Response A0h from the LMS2xx (confirmation of "switch operating mode")

Example of a complete telegram (standard devices):

Description	STX	Address	Length		Response	Data		Checksum	
						Data	LMS status		
Byte position	1	2	3	4	5	6	7	8	9
Hex. value	02	80	03	00	A0	00	10	16	0A

Table 7-20: Complete telegram for response A0h (*Table 7-19*)

7.5 Requesting Measured Values

7.5.1 Command 30h to LMS2xx: Request Measured Values

The introduction provided a description of how the LMS2xx functions in measuring mode. The way in which measured values are requested depends on the LMS type used and its configuration.

	Command	Parameter data
Data class	BYTE	See *Table 7-22*, (block A).
Content	Request measured values	
Hex. value	30h	

Table 7-21: Command 30h (request measured values)

Block	Parameter data for command 30h	
A	**Data class**	BYTE
	Content	00h: Reserved 01h: The LMS2xx outputs all the measured values of a scan. The measured value data record that is transmitted corresponds to operating mode 24h in command 20h. 02h: The LMS2xx sends the minimum vertical distance of the object (viewed from the LMS2xx). Between 1 and 3 measured values are sent, depending on the number of active fields. Only advisable for a rectangular field. The measured value data record that is transmitted corresponds to operating mode 22h or 23h in command 20h. 03h: The LMS2xx sends the taught-in data. 04h: Reserved 05h: Reserved 06h: The LMS2xx outputs every other measured value. 07h: The LMS2xx outputs every 20th measured value. 08h: Interlaced mode: The LMS2xx outputs unfiltered values directly after the measurement. The measured value data record that is transmitted corresponds to operating mode 2Ah in command 20h.
	Hex. value	xxh

Table 7-22: Parameter data for command 30h (*Table 7-21*)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6	7	8
Hex. value	02	00	02	00	30	01	31	18

Table 7-23: Complete telegram for group A for command 30h (*Table 7-21*)

In interlaced mode (for a description, see *Section 7.5.2, page 47*), mode 08h supplies the partial scan that is currently being measured with a scanning angle of 180°.
In an x° partial scan for integers, this amounts to 181 measured values; otherwise 180 measured values for angular resolution x.25°; x.50°, and x.75°. The LMS2xx outputs this number of measured values irrespective of the LMS variant that has been set (scanning angle, angular resolution). This means that even if the scanning angle is set to 100°, 181, or 180, measured values will still be sent.

7.5.2 Response B0h from the LMS2xx (Response to Measured Value Request)

If continuous data output is configured for the monitoring mode (20h to 25h, 2Ah), the response from the LMS2xx will also have the same structure as B0h.

The data length changes depending on the selected angular resolution and the available data output formats. For this reason, the **measured value length** is coded in the response telegram directly after the initial command byte.

The **scan index** and **telegram index** can be output in the same response telegram directly after the measured value data. Command 77h can be used to select whether or not the data is output. The scan index counter increases incrementally from 0 to 255 every time the mirror rotates, before starting again at 0.
The telegram index counter increases step by step from 0 to 255 every time a telegram is output, before starting again at 0.

For a description of the structure of the two measured value bytes, see *Section 3.4.1, page 19*.

Measured Value Output: Standard Mode

This section explains the standard mode for outputting measured values to provide a detailed description of the measured values.
The LMS2xx outputs data in ascending angular steps. The angular values themselves are **not** transmitted; instead, the **data field only comprises distance values**. Due to the position in which the angle is defined in the data field (if an angular resolution of 0.5° and a 180° field of vision are chosen, for example), 361 distance values are measured (0° to 360°). The LMS2xx outputs the distance values in the sequence 0°; 0.5°; 1°; 1.5° and so on to 360° in ascending order. In the default setting, an angular resolution of 0.25° only allows a restricted field of vision (100°). The LMS2xx then outputs 401 measured values.

With a selectable angular resolution of 0.25° and the associated 100° field of vision, the conditions regarding the available internal memory (max. 812 bytes) are fulfilled.

Measured Value Output: Interlaced Mode

"Interlaced" mode enables the maximum possible field of vision of the LMS2xx to be used, even with a higher angular resolution (0.25°). After **every** complete rotation of the mirror, the LMS2xx always outputs the measured distance data in raster 1°. With every subsequent mirror rotation, raster 1° shifts from the starting point by 0.25° as follows:

- First rotation: measured values for angles 0°; 1°; 2°; 3°, etc.
- Second rotation: measured values for angles 0.25°; 1.25°; 2.25°, etc.
- Third rotation: measured values for angles 0.5°; 1.5°; 2.5°; 3.5° , etc.
- Fourth rotation: measured values for angles 0.75°; 1.75°; 2.75°; 3.75° , etc.

With the fifth rotation, the distance measurement starts again with the angles 0°.

The response telegram for 30h (measured value output) displays which raster has been transmitted. You can use command 30h to switch the LMS2xx to this mode.

The devices in the LMS200/211/221/291 series always scan in 1° steps. In standard mode, they output the measured values in the correct, ascending angular sequence (for example, an angular resolution of 0.25° and a 100° field of vision: measured value for 0.25°; 0.5° to 100°).

If the LMS2xx or the scanned object moves while the measurement data is being recorded, there is a delay between the measured values of the full angle and the measured values of the fractional angle.

During one rotation of the mirror (13.32 ms), the **LMS211/221/291-S14** only measures in 0.5° steps and its field of vision is restricted to 90°.

When the distance values are output, you must check whether a 180° or 100° field of vision has been selected as the LMS variant: with a 100° field of vision, the measured value that was output first is the same as the 40° scan with a 180° field of vision. The last measured value in a 100° field of vision is the same as the 140° scan with a 180° field of vision (*Fig. 7-1* and *Fig. 7-2*).

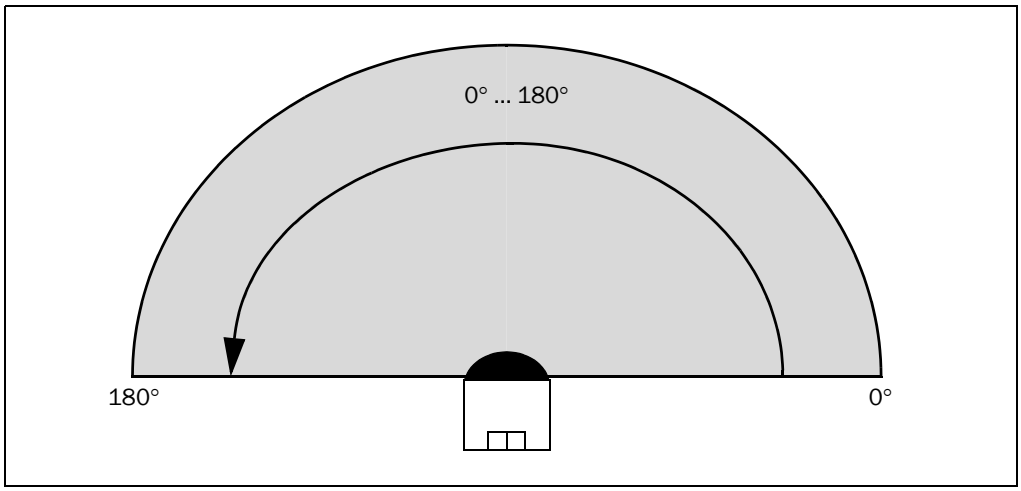


Fig. 7-1: 180° field of vision (top view, scan from right to left)

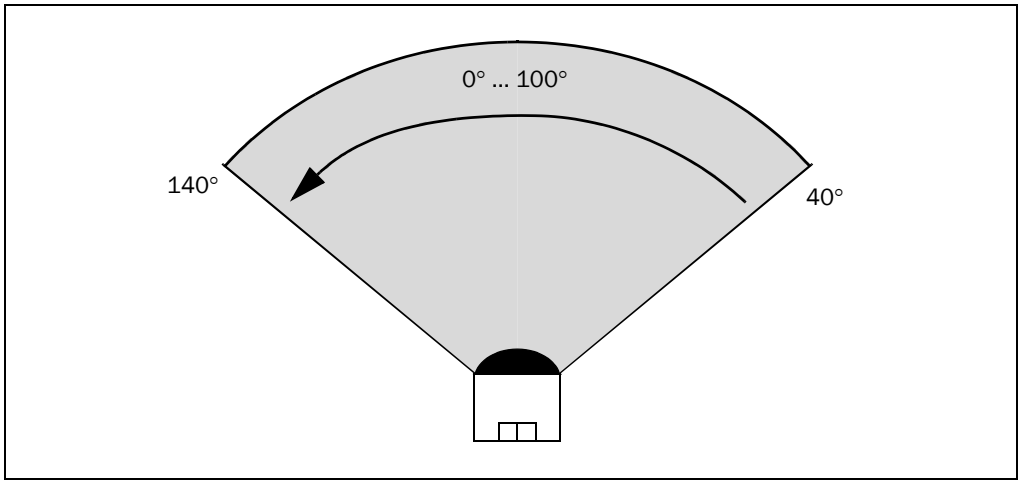


Fig. 7-2: 100° field of vision (top view, scan from right to left)

Response B0h from the LMS2xx:

	Response	Parameter data
Data class	BYTE	See *Table 7-25*, (block A to D).
Content	Response to request for measured values	
Hex. value	B0h	

Table 7-24: Response B0h from the LMS2xx (measured value output)

Block	Parameter data for response B0h	
A	**Data class**	WORD
	Content	See also *Table 7-26*. The "number of measured values sent" (AS=2 bytes) is stored in bit 0 to 9. Bits 15 and 14 code the measured value unit. Bit 15 Bit 14: 0 0: Unit in cm 0 1: Unit in mm (standard setting) 1 x : Reserved Bit 13: 0: Complete scan (standard) 1: Partial scan Bits 12 and 11 code the partial scan number. Bit 12 Bit 11: 0 0: Measured values belong to partial scan x.00° 0 1: Measured values belong to partial scan x.25° 1 0: Measured values belong to partial scan x.50° 1 1: Measured values belong to partial scan x.75°
	Hex. value	xx xxh
B ...	**Data class**	WORD
	Content	Measured value[1] flags and measured distance
	Hex. value	xx xxh
...to...		
B (cont.)		WORD
		Measured value[AS] flags and measured distance
		xx xxh
...if "Send real-time indices" (*see Table 7-122, Block C, 96***) is active:**		
C Scan index	**Data class**	BYTE
	Content	Continuously running scan counter (modulo 256) that is incremented with every mirror wheel rotation.
	Hex. value	xxh
D Telegram index	**Data class**	BYTE
	Content	Continuously running telegram counter (modulo 256) that is incremented every time a measured value telegram is sent.
	Hex. value	xxh

Table 7-25: Group A to E for response B0h (*Table 7-24*)

For block A from *Table 7-25*:

	More significant data byte								Less significant data byte							
Bit number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Binary value in 2^n	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Hex. value	00 to FF								00 to FF							

Table 7-26: Explanation of block A (from *Table 7-25*)

The individual bits code as follows:

- Bits 0 and 9 code the number of measured values. This corresponds to a value range of max. 511 measured values (01 FFh).
- Bits 11 and 12 code the transmitted partial scanning and indicate which scanning angle has been transmitted in interlaced mode. The bits are 0 if bit 13 is set to 0.
- Bit 13 indicates the status of the scan:
  0: Standard output
  1: Interlaced mode
- Bits 14 and 15 code the unit in which the measured values are measured.

In interlaced mode, the LMS2xx outputs a total of 181 measured values for full degree steps (0°; 1°; 2° to 180°). Partial scans in 0.25°, 0.5° or 0.75° steps result in 180 measured values (e.g.: 0.25°; 1.25°; 2.25° to 179.25°).

For block B: "Representing the measured value" from *Table 7-25, Page 49*:

	More significant data byte								Less significant data byte							
Bit number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Binary value in 2^n	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Hex. value	00 to FF								00 to FF							
Dec. value	0 to 65535															

Table 7-27: Significance of the data bytes from *Table 7-25*

The following measurement ranges can be coded:

Measurement range	Measured value resolution	Data bits used	Max. representation Hex. value	Max. measurement range representation
8 m (26.25 ft)	10 mm (0.39 in)	13	1FF7h	8.183 m (26.84 ft)
16 m (52.49 ft)	10 mm (0.39 in)	14	3FF7h	16.385 m (53.75 ft)
32 m (104.98 ft)	10 mm (0.39 in)	15	7FF7h	32.759 m (107.47 ft)
80 m (262.5 ft)	100 mm (3.94 in)	13	1FF7h	81.83 m (268.46 ft)

Table 7-28: Measured value output: distance measurement ranges coded by data bits

The measurement range is set using command 77h, which is described in *Section 7.46.1, page 96*.

As already explained in *Section 3.4.1, page 19*, different bits code the distance values in the response telegram:

- Bits 0 to 12 code the measured distance value for a measurement range of 8 m (26.25 ft)
- Bits 0 to 13 code the measured distance value for a measurement range of 16 m (52.49 ft)
- Bits 0 to 14 code the measured distance value for a measurement range of 32 m (104.98 ft)
- Bits 0 to 12 code the measured distance value for a measurement range of 80 m (262.5 ft) if 10 mm (0.39 in) has been chosen in command 77h as the measurement basis.

The remaining bits, which do not display the measured distance value, are called "flags". Their meaning is also defined in command 77h (*Section 7.46.1, page 96*) in block D.

Example:
For the measurement range of 8 m (26.25 ft) and the field monitoring application, bit 13 codes whether field A has been infringed. Bit 14 outputs an infringement of field B, and bit 15 codes field C.

Example of a complete telegram (standard devices):

Description	STX	Address	Length		Command	Data		Checksum	
						Data	LMS status		
Byte position	1	2	3	4	5	6 to 729	730	731	732
Hex. value	02	80	D6	02	B0	724 bytes	10	15	D4

Table 7-29: Complete telegram for response B0h (*Table 7-24, page 49*)

7.6 Request the LMS Status

7.6.1 Command 31h to LMS2xx: Request LMS Status

	Command	Parameter data
Data class	BYTE	No further data
Content	Request LMS status	
Hex. value	31h	

Table 7-30: Command 31h (request LMS status)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	-	6	7
Hex. value	02	00	01	00	31	-	15	12

Table 7-31: Complete telegram for command 31h (*Table 7-30*)

7.6.2 Response B1h from LMS2xx: Output the LMS Status

	Response	Parameter data (software version, operating mode, status, etc.)
Data class	BYTE	See *Table 7-33, page 52*, (block A to C7).
Content	Output LMS status	
Hex. value	B1h	

Table 7-32: Response B1h from the LMS2xx (output the LMS status)

Block	**Parameter data for response B1h**	
A Software version	**Data class**	CHAR[7]
	Content	System software version: ASCII characters, e.g. "V02.10_" (_ = space character)
	Hex. value	56 30 32 2E B1 30 20

Table 7-33: Parameter data for command 30h (*Table 7-32, page 52*)

Block	Parameter data for response B1h	
B Operating mode	**Data class**	BYTE
	Content	Operating mode: 00h: Installation mode for configuration 01h: Calibration mode: used for calibrating the LMS2xx in the plant. 02h: Reset password to the default setting for installing and maintaining the LMS2xx. Default password: "SICK_LMS" (not possible in monitoring mode). You have to switch to diagnostic mode beforehand. 10h: Diagnostic mode: carrying out tests 20h: Monitoring mode: the LMS2xx continuously outputs minimum measured values for each segment. 21h: Monitoring mode: for each segment, the LMS2xx outputs the minimum measured value for each scan every time it detects an object. Measured values can be requested. 22h: Monitoring mode: the LMS2xx continuously outputs the minimum vertical distance between itself and the object. In a defined rectangular field, the LMS2xx views a corridor defined by the side dimensions of the rectangle. The minimum vertical distance is calculated and transmitted in this corridor. If only segmented fields are configured, the LMS2xx outputs the overflow values if the field is free. If the field is infringed, the minimum measured value in the field is output. 23h: Monitoring mode: the LMS2xx outputs the minimum distance for each scan when it detects an object in the field. The minimum vertical distance to the LMS2xx is only output on request. This is only advisable for a defined rectangular field. The LMS2xx views a corridor defined by the side dimensions of the rectangle. The minimum vertical distance is calculated and transmitted in this corridor. Only possible LMS type 6! 24h: Monitoring mode: the LMS2xx continuously outputs all the measured values of a scan. 25h: Monitoring mode: the LMS2xx outputs measured values only on request, no data if a field is infringed. 26h: Monitoring mode: the LMS2xx continuously outputs mean measured values. The number of means values follows as a parameter. 27h: Monitoring mode: the LMS2xx continuously outputs the measured value sub-range. The start and end of the range follows as a parameter. 28h: Monitoring mode: the LMS2xx continuously outputs the mean measured value sub-range. The number of means values, as well as the start and end of the range follow as parameters. 29h: Monitoring mode: the LMS2xx continuously outputs a measured value with the associated field values. Measured value range (1 ... 401) follows as a parameter. 2Ah: Monitoring mode: the LMS2xx continuously outputs all the measured values of a partial scan immediately after they have been measured. 2Bh: Monitoring mode: the LMS2xx continuously outputs all the measured values from n partial scans (including reflectivity data). 2Ch: Monitoring mode: the LMS2xx continuously outputs minimum measured values for each segment in a measured value sub-range. 2Eh: Monitoring mode: the LMS2xx outputs the navigation data records.
	Hex. value	xxh (00h, 01h, 02h, 10h, 20h, 21h ...)
C Status	**Data class**	BYTE
	Content	Status: when > 0, LMS2xx defective (error or fatal error)
	Hex. value	xxh
D	**Data class**	WORD
	Content	Reserved
	Hex. value	xx xxh

Table 7-33: Parameter data for command 30h (*Table 7-32, page 52*) (contd.)

Block	Parameter data for response B1h	
E Variant type	**Data class**	BYTE
	Content	00h: Standard device LMS2xx, type 6 01h: Special device LMS211-/221-S19/-S20
	Hex. value	xxh (00h, 01h)
F Pollution values	**Data class**	WORD[8], array of 8 words
	Content	Pollution values: 8 integers with the current measured amplitudes through the front window
	Hex. value	xx xx xx xx xx xx xx xx xx xx xx xx xx xx xx xxh
G Reference pollution values	**Data class**	WORD[4], array of 4 words
	Content	Reference pollution values: 4 integers with the current measured amplitudes of the reference diodes
	Hex. value	xx xx xx xx xx xx xx xxh
H Calibrating the pollution channels	**Data class**	WORD[8], array of 8 words
	Content	Calibrating the pollution channels: 8 integers with the amplitudes measured through the front window during calibration
	Hex. value	xx xx xx xx xx xx xx xx xx xx xx xx xx xx xx xxh
I Calibrating the refer-ence pollution channels	**Data class**	WORD[4], array of 4 words
	Content	Calibrating the reference pollution channels: 4 integers with the reference channel amplitudes measured during calibration
	Hex. value	xx xx xx xx xx xx xx xxh
J No. of motor revolutions	**Data class**	WORD
	Content	No. of motor revolutions: 1 Integer value in microseconds for 1/90 duration of rotation
	Hex. value	xx xxh
K	**Data class**	WORD
	Content	Reserved
	Hex. value	xx xxh
L Reference scale 1, Dark signal 100 %	**Data class**	WORD
	Content	Receive signal amplitude in ADC incs when the reference signal is switched off
	Hex. value	xx xxh
M	**Data class**	WORD
	Content	Reserved
	Hex. value	xx xxh
N Reference scale 2, Dark signal 100 %	**Data class**	WORD
	Content	Receive signal amplitude in ADC incs when the reference signal is switched off
	Hex. value	xx xxh
O Reference scale 1, Dark signal 66 %	**Data class**	WORD
	Content	Receive signal amplitude in ADC incs when the reference signal is switched off
	Hex. value	xx xxh
P	**Data class**	WORD
	Content	Reserved
	Hex. value	xx xxh

Table 7-33: Parameter data for command 30h (*Table 7-32, page 52*) (contd.)

Block	Parameter data for response B1h	
Q Reference scale 2, Dark signal 66 %	**Data class**	WORD
	Content	Receive signal amplitude in ADC incs when the reference signal is switched off
	Hex. value	xx xxh
R Signal amplitude	**Data class**	WORD
	Content	Laser power in % of the calibration value
	Hex. value	xx xxh
S Current angle	**Data class**	WORD
	Content	Angle used for power measurement
	Hex. value	xx xxh
T Peak thresh-old	**Data class**	WORD
	Content	Peak threshold in ADC incs for power measurement
	Hex. value	xx xxh
U Angle of measure-ment	**Data class**	WORD
	Content	Angle used to reference target for power measurement
	Hex. value	xx xxh
V Calibration value of the signal ampli-tude	**Data class**	WORD
	Content	Calibration of the laser power (= 100%).
	Hex. value	xx xxh
W Target value of stop threshold	**Data class**	WORD
	Content	Target value of stop threshold in ADC incs
	Hex. value	xx xxh
X Target value of peak threshold	**Data class**	WORD
	Content	Target value of peak threshold in ADC incs
	Hex. value	xx xxh
Y Actual value of stop threshold	**Data class**	WORD
	Content	Actual value of stop threshold in ADC incs
	Hex. value	xx xxh
Z Actual value of peak threshold	**Data class**	WORD
	Content	Actual value of peak threshold in ADC incs
	Hex. value	xx xxh
A1	**Data class**	BYTE
	Content	Reserved
	Hex. value	xxh
A2 Measuring mode	**Data class**	BYTE
	Content	Measuring mode: See definition in command 77h, *Section 7.46.1, page 96*
	Hex. value	xxh
A3 Reference target single measured values	**Data class**	WORD
	Content	Reference target "single measured values" Low byte: current number of filtered single measured values High byte: maximum number of filtered single measured values since power-on
	Hex. value	xx xxh

Table 7-33: Parameter data for command 30h (*Table 7-32, page 52*) (contd.)

Block	Parameter data for response B1h	
A4 Reference target "mean measured values"	**Data class**	WORD
	Content	Reference target "mean measured values": Low byte: current number of filtered mean measured values High byte: maximum number of filtered mean measured values since power-on
	Hex. value	xx xxh
A5 Scanning angle	**Data class**	WORD
	Content	Scanning angle in ° (degrees)
	Hex. value	xx xxh
A6 Angular resolution	**Data class**	WORD
	Content	Angular resolution in 1/100°
	Hex. value	xx xxh
A7 Restart mode	**Data class**	BYTE
	Content	Restart mode: See definition in command 77h (*Section 7.46.1, page 96*)
	Hex. value	xxh
A8 Restart time	**Data class**	WORD
	Content	Restart time: See definition in command 77h (*Section 7.46.1, page 96*)
	Hex. value	xx xxh
A9 Offset for multiple evaluation of field set 2	**Data class**	CHAR
	Content	Offset or multiple evaluation of field set 2: see definition in command 7Ch (*Section 7.51.1, page 104*)
	Hex. value	xxh
B1	**Data class**	BYTE
	Content	Reserved
	Hex. value	xh
B2 Baud rate	**Data class**	WORD
	Content	Integer for the active LMS2xx data transmission rate: 0x8001 500,000 Bd 0x8019 38,400 Bd 0x8033 19,200 Bd 0x8067 9,600 Bd
	Hex. value	xx xxh (80 01h, 80 19h, 80 33h, 80 67h)
B3 Evaluation number	**Data class**	BYTE
	Content	Byte value for the number of evaluations when the field is infringed. Must be between 1 and 125.
	Hex. value	xxh (02h to 7Dh)
B4 Permanent baud rate	**Data class**	BYTE
	Content	Permanent data transmission rate: 00h: When the power is switched on, the data transmission rate is set to 9,600 Bd. 01h: When the power is switched on, the configured data transmission rate is retained.
	Hex. value	xxh (01h, 02h)
B5 LMS address	**Data class**	BYTE
	Content	LMS address: Range: 0 to 127
	Hex. value	xxh (00h to 7F)
B6 Field set number	**Data class**	BYTE
	Content	Active field set no.
	Hex. value	xxh

Table 7-33: Parameter data for command 30h (*Table 7-32, page 52*) (contd.)

Block	Parameter data for response B1h	
B7 Current measured value unit	**Data class**	BYTE
	Content	Current measured value unit: 0: Unit in cm 1: Unit in mm 2: Reserved
	Hex. value	xxh
B8 Laser switch-off	**Data class**	BYTE
	Content	00h: Laser is switched off 00h: Laser is switched on
	Hex. value	xxh (00h, 01h)
B9 Software version	**Data class**	CHAR[7]
	Content	Boot PROM software version: 7 ASCII characters, e.g. "V02.10_" (_ = space character)
	Hex. value	xx xx xx xx xx xx xxh
C1	**Data class**	DWORD
	Content	Calibration value 1 for counter 0 in counter units
	Hex. value	xx xx xx xxh
C2	**Data class**	DWORD
	Content	Calibration value 2 for counter 0 in counter units
	Hex. value	xx xx xx xxh
C3	**Data class**	DWORD
	Content	Calibration value 1 for counter 1 in counter units
	Hex. value	xx xx xx xxh
C4	**Data class**	DWORD
	Content	Calibration value 2 for counter 1 in counter units
	Hex. value	xx xx xx xxh
C5	**Data class**	WORD
	Content	M0 value counter 0
	Hex. value	xx xxh
C6	**Data class**	WORD
	Content	M0 value counter 1
	Hex. value	xx xxh
C7	**Data class**	WORD
	Content	Calibration interval period in nanoseconds
	Hex. value	xx xxh

Table 7-33: Parameter data for command 30h (*Table 7-32, page 52*) (contd.)

Example of a complete telegram (standard device):

Description	STX	Address	Length		Response	Data		Checksum	
						Data	LMS status		
Byte position	1	2	3	4	5	6 to 158	159	160	161
Hex. value	02	80	9A	00	B1	152 bytes	10	74	52

Table 7-34: Complete telegram for response B1h (*Table 7-32, page 52*)

7.7 Request Error/Test Message

7.7.1 Command 32h to LMS2xx: Request Error/Test Message

	Command	Parameter data
Data class	BYTE	No further data
Content	Request error/test message	
Hex. value	32h	

Table 7-35: Command 32h (request error/test message)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	-	6	7
Hex. value	02	00	01	00	32	-	16	12

Table 7-36: Complete telegram for command 32h (*Table 7-35*)

7.7.2 Response B2h from the LMS2xx: Output the Error/Test Message

When a test or error message is requested, this response provides a description of the errors that occurred.
With a test request, the LMS2xx only supplies the result of the test requested, whereas with an error request, it supplies all the data stored in the error memory. For an overview or errors that can occur in the LMS2xx, see *Section 10.11, page 130*.

	Response	Parameter data
Data class	BYTE	See *Table 7-38*, (block A to D).
Content	Output error/test message	
Hex. value	B2h	

Table 7-37: Response B2h from the LMS2xx (error/test message output)

Block	Parameter data for command B2h	
A Error type 1	**Data class**	BYTE
	Content	**Error type 1** provides information on the type of error: 0: No error, test OK 1: Info 2: Warning 3: Error 4: Fatal error The highest bit (15) describes an error that is old or no longer relevant: 0x81: Information no longer relevant 0x82: Warning no longer relevant 0x83: Error no longer relevant 0x82: Fatal error no longer relevant
	Hex. value	xxh
B Error number 1	**Data class**	BYTE
	Content	**Error number 1**: Describes the error
	Hex. value	xxh

Table 7-38: Parameter data for command B2h (*Table 7-37*)

Block	**Parameter data for command B2h**	
...to...		
C Error type n	**Data class**	BYTE
	Content	**Error type n** provides information on the type of error: 0: No error, test OK 1: Info 2: Warning 3: Error 4: Fatal error The highest bit (15) describes an error that is old or no longer relevant: 0x81: Information no longer relevant 0x82: Warning no longer relevant 0x83: Error no longer relevant 0x82: Fatal error no longer relevant
	Hex. value	xxh
D Error number n	**Data class**	BYTE
	Content	**Error number n**: Describes the error
	Hex. value	xxh

Table 7-38: Parameter data for command B2h (*Table 7-37*) (contd.)

Example of a complete telegram (standard devices):

Description	STX	Address	Length		Response	Data		Checksum	
						Data	LMS status		
Byte position	1	2	3	4	5	6 to ...			
Hex. value	02	80	02	00	3B2	Not applicable if no errors present	10	3F	13

Table 7-39: Complete telegram for response B2h (*Table 7-37*)

7.8 Command 33h / Response B3h

Reserved

7.9 Command 34h / Response B4h

Reserved

7.10 Request Operating Data Counter

This command is only valid for LMS2xx in the LMS211/221/291 series.

7.10.1 Command 35h to LMS2xx: Request Operating Data Counter

This command requests the status of the operating hours and switch-on counter of the LMS2xx. In response, the LMS2xx always sends the complete telegram 0xB5h.

	Command	**Parameter data**
Data class	BYTE	WORD
Content	Request for the operating data counter	0 Read the operating data counter
Hex. value	35h	00 00h

Table 7-40: Command 35h (request operating data counter)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	-	6	7
Hex. value	02	00	01	00	35	-	11	12

Table 7-41: Complete telegram for command 35h (*Table 7-40*)

7.10.2 Response B5h from the LMS2xx: Output the Statuses of the Operating Data Counters

	Response	**Parameter data**	
Data class	BYTE	WORD	
Content	Output operating data counters	Value of the operating hours counters Resolution: 2 hours	Value of the switch-on counter (incremented by one step with every switch-on)
Hex. value	B5h	xx xxh	xx xxh

Table 7-42: Response B5h from the LMS2xx (output the operating data counters)

Example of a complete telegram (standard devices):

Description	STX	Address	Length		Response	Data		Checksum	
						Data	LMS status		
Byte position	1	2	3	4	5	6 to 9	10	11	12
Hex. value	02	80	06	00	B5	0000 to 0100	10	04	42

Table 7-43: Complete telegram for response B5h (*Table 7-42*)

7.11 Requesting Mean Measured Values

7.11.1 Command 36h to LMS2xx: Request Mean Measured Values

This command requests the mean measured values recorded with n scans.
With a maximum of 250 mean values, the LMS2xx sends the response telegram after approx. 10 s at the earliest.

	Command	Parameter data
Data class	BYTE	BYTE
Content	Request for mean measured values	Number of mean values The number of mean scans must be between 2 and 250.
Hex. value	36h	xxh (02h to FAh)

Table 7-44: Command 36h (request mean measured values)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6	7	8
Hex. value	02	00	02	00	36	02	3E	1E

Table 7-45: Complete telegram for command 36h (*Table 7-44*)

7.11.2 Response B6h from the LMS2xx: Output Mean Measured Values

The LMS2xx outputs the mean measured values recorded with n scans. The measurement range/flags of a sent measured value are structured in accordance with the configuration.

	Response	Parameter data
Data class	BYTE	See *Table 7-47*, (block A to E).
Content	Mean measured value output	
Hex. value	B6h	

Table 7-46: Response B6h from the LMS2xx (output mean measured values)

Block	Parameter data for command B6h	
A	**Data class**	BYTE
	Content	Number of mean values [2 to 250]
	Hex. value	XXh (02h to FFh)
B	**Data class**	WORD
	Content	The number of measured values sent (2 bytes) is stored in bits 0 to 13. Bit 15 and bit 14 code the measured value units. Bit 15 Bit 14: 0 0: Unit in cm 0 1: Unit in mm (standard setting) 1 x : Reserved
	Hex. value	xx xxh
C	**Data class**	WORD
	Content	MV [1] to MV [AS] Mean measured distance. Flags are suppressed and set to 0.
	Hex. value	xx xxh

Table 7-47: Parameter data for command B6h (*Table 7-46*)

Block	**Parameter data for command B6h**	
...if "Send real-time indices" (*see Table 7-122, block C, on 96*) **is active:**		
D Scan index	**Data class**	BYTE
	Content	Continuously running scan counter (modulo 256) that is incremented with every mirror wheel rotation.
	Hex. value	xxh
E Tele-gram index	**Data class**	BYTE
	Content	Continuously running telegram counter (modulo 256) that is incremented every time a measured value telegram is sent.
	Hex. value	xxh

Table 7-47: Parameter data for command B6h (*Table 7-46*) (contd.)

Example of a complete telegram (standard devices):

Description	STX	Address	Length		Response	Data		Checksum	
						Data	LMS status		
Byte position	1	2	3	4	5	6 to 730	731	732	733
Hex. value	02	80	D7	02	B6	725 bytes	10	71	13

Table 7-48: Complete telegram for response B6h (*Table 7-46*)

7.12 Requesting the Measured Value Sub-Range

7.12.1 Command 37h to LMS2xx: Request Measured Value Sub-Range

This command requests the measured values of the specified measured value sub-range. The LMS2xx outputs response telegrams depending on the selected angular resolution (between 1 and 4).

	Command	Parameter data	
Data class	BYTE	WORD	
Content	Request for a measured value sub-range	1st measured value: Value between 1 and 401 with a 100° scanning angle and an angular resolution of 0.25°, or value between 1 and 361 with a 180° scanning angle and an angular resolution of 0.5°. Bit 15: 0: Combined sub-range (standard) 1: Direct output of the sub-ranges	Last measured value: Value between 1 and 401 with a 100° scanning angle and an angular resolution of 0.25°, or value between 1 and 361 with a 180° scanning angle and an angular resolution of 0.5°. This value must be greater than or equal to the 1st measured value.
Hex. value	37h	xx xxh (00 01h to 01 91h or 01 69h)	xx xxh (00 01h to 01 91h or 01 69h)

Table 7-49: Command 37h (request measured value sub-range)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6 to 9	10	11
Hex. value	02	00	05	00	37	01 00 69 01	EB	75

Table 7-50: Complete telegram for command 37h (*Table 7-49*)

7.12.2 Response B7h from the LMS2xx: Output the Measured Value Sub-Range

The LMS2xx outputs the measured values of a scan sub-range. The measurement range/flags of a sent measured value are structured in accordance with the configuration.

	Response	Parameter data
Data class	BYTE	See *Table 7-52*, (block A to F).
Content	Measured value sub-range output	
Hex. value	B7h	

Table 7-51: Response B7h from the LMS2xx (output of the measured value sub-range)

Block	Parameter data for response B7h	
A	**Data class**	WORD
	Content	1st measured value
	Hex. value	xx xxh
B	**Data class**	WORD
	Content	Last measured value
	Hex. value	xx xxh

Table 7-52: Parameter data for command B7h (*Table 7-51*)

Block	Parameter data for response B7h	
C	**Data class**	WORD
	Content	The number of measured values sent (2 bytes) is stored in bits 0 to 9. Bits 15 and14 code the measured value unit. Bit 15 Bit 14: 0 0: Unit in cm 0 1: Unit in mm 1 x : Reserved Bit 13: 0: Combined partial scans (standard) 1: Partial scan immediately after every scan Bits 12 and 11 code the partial scan number. Bit 12 Bit 11: 0 0: Measured values belong to partial scan x.00° 0 1: Measured values belong to partial scan x.25° 1 0: Measured values belong to partial scan x.50° 1 1: Measured values belong to partial scan x.75°
	Hex. value	xx xxh
D	**Data class**	WORD
	Content	MV [1] to MV [AS] Flags and measured distance
	Hex. value	xx xxh
...if "Send real-time indices" (*see Table 7-122, block C, on 96*) **is active:**		
E Scan index	**Data class**	BYTE
	Content	Continuously running scan counter (modulo 256) that is incremented with every mirror wheel rotation.
	Hex. value	xxh
F Tele-gram index	**Data class**	BYTE
	Content	Continuously running telegram counter (modulo 256) that is incremented every time a measured value telegram is sent.
	Hex. value	xxh

Table 7-52: Parameter data for command B7h (*Table 7-51*) (contd.)

Example of a complete telegram (standard devices):

Description	STX	Address	Length		Response	Data		Checksum	
						Data	LMS status		
Byte position	1	2	3	4	5	6 to 733	734	735	736
Hex. value	02	80	DA	02	B7	718 bytes	10	EB	87

Table 7-53: Complete telegram for response B7h (*Table 7-51*)

7.13 Command 38h / Response B8h

Reserved

7.14 Command 39h / Response B9h

Reserved

7.15 Request LMS Type

7.15.1 Command 3Ah to LMS2xx: Request LMS Type

This command requests the device ID from the LMS2xx.

	Command	Parameter data
Data class	BYTE	No further data
Content	Request LMS type	
Hex. value	3Ah	

Table 7-54: Command 3Ah (request LMS type)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	-	6	7
Hex. value	02	00	01	00	3A	-	1E	12

Table 7-55: Complete telegram for command 3Ah (*Table 7-54*)

7.15.2 Response BAh from the LMS2xx: Output the LMS Type

The LMS2xx outputs the required type ID.

	Response	Parameter data
Data class	BYTE	ASCII string in bytes
Content	Output of LMS type	ASCII string with the product ID; type key and system software version. (e.g.: "LMS211-302063;V02.10")
Hex. value	BAh	4C 4D 53 32 30 30 3B 33 30 31 30 36 33 3B 56 30 32 2E 31 30 20

Table 7-56: Response BAh from the LMS2xx (output the LMS type)

Example of a complete telegram (standard devices):

Description	STX	Address	Length		Response	Data		Checksum	
						Data	LMS status		
Byte position	1	2	3	4	5	6 to 26	27	28	29
Hex. value	02	80	17	00	BA	4C 4D 53 32 30 30 3B 33 30 31 30 36 33 3B 56 30 32 2E 31 30 20	10	22	61

Table 7-57: Complete telegram for response BAh (*Table 7-56*)

7.16 Switching the variant in the LMS2xx

7.16.1 Command 3Bh to LMS2xx: Switching variant

This command sends a variant definition with the scanning angle and angular resolution to the LMS2xx. **Default setting: scanning angle 180°, angular resolution 0.5°.**

This command is **not** valid for LMS211/221/291-S14 (LMS Fast).

	Command	Parameter data	
Data class	BYTE	WORD	
Content	Variant switch	Scanning angle in ° (degrees): Two variants are currently available: Value 100 = scanning angle 100° Value 180 = scanning angle 180°	Angular resolution in 1/100°: Three variants are currently available: Value 100 = angular resolution 1° Value 50 = angular resolution 0.5° Value 25 = angular resolution 0.25°
Hex. value	3Bh	xx xxh	xx xxh

Table 7-58: Command 3Bh (switch variant in the LMS2xx)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6 to 9	10	11
Hex. value	02	00	05	00	3B	B4 00 32 00	3B	1F

Table 7-59: Complete telegram for command 3Bh (*Table 7-58*)

7.16.2 Response BBh from the LMS2xx: Confirm the Variant Switching

The LMS2xx sends the variant definition with the scanning angle and angular resolution.

	Response	Parameter data		
Data class	BYTE	BYTE	WORD	
Content	Response to variant switch	Provides information on whether the variant switchover was successful: 00h: Switchover aborted. Previous variant still active. 01h: Switchover successful. New variant active.	Scanning angle in ° (degrees): 100° or 180°	Angular resolution in 1/100°: Three variants currently available: 100: Angular resolution 1° 50: Angular resolution 0.5° 25: Angular resolution 0.25°
Hex. value	BBh	xxh	xx xxh	xx xxh

Table 7-60: Response BBh from the LMS2xx (confirm the variant switch)

Example of a complete telegram (standard devices):

Description	STX	Address	Length		Response	Data		Checksum	
						Data	LMS status		
Byte position	1	2	3	4	5	6 to 10	11	12	13
Hex. value	02	80	07	00	BB	01 B4 00 32 00	10	03	9D

Table 7-61: Complete telegram for response BBh (*Table 7-60*)

7.17 Command 3Ch / Response BCh

Reserved

7.18 Command 3Dh / Response BDh

Reserved

7.19 Request Measured Value with Field Values

7.19.1 Command 3Eh to LMS2xx: Request Measured Value with Field Values

This command requests from the LMS2xx the required measured value range, including flags with the three field values currently being used in the evaluation. If the first measured value number matches the final measured value number, only one measured value along with the associated field values are transmitted. A range with a maximum of 100 measured value numbers can be requested.

	Command	**Parameter data**	
Data class	BYTE	WORD	
Content	Request for measured value with field values	Number of the 1st measured value between 1 and 401	Number of the last measured value between 1 and 401
Hex. value	3Eh	xx xxh (00 01h to 01 91h)	xx xxh (00 01h to 01 91h)

Table 7-62: Command 3Eh (request measured value with field values)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6 to 9	10	11
Hex. value	02	00	05	00	3E	01 00 91 01	8B	C4

Table 7-63: Complete telegram for command 3Eh (*Table 7-62*)

7.19.2 Response BEh from the LMS2xx: Output the Measured Value with Field Values

The LMS2xx outputs the requested measured value range with the associated field values. Maximum: 100 x 4 values (measured value, value of field A, value of field B, value of field C).

	Response	**Parameter data**
Data class	BYTE	See *Table 7-65*, (block A to M).
Content	Output of measured values with field values	
Hex. value	BEh	

Table 7-64: Response BEh from the LMS2xx (output of the measured value with field values)

Block	**Parameter data for response BEh**	
A First measured value number	**Data class**	WORD
	Content	Number of the 1st measured value between 1 and 401
	Hex. value	xx xxh
B Last measured value number	**Data class**	WORD
	Content	Number of the last measured value between 1 and 401
	Hex. value	xx xxh

Table 7-65: Parameter data for command BEh (*Table 7-64*)

Block	Parameter data for response BEh	
C	**Data class**	WORD
	Content	Number of subsequent values (total of mean value and field value) Bits 15 and 14 code the value unit. Bit 15 Bit 14: 0 0: Unit in cm 0 1: Unit in mm (standard setting) 1 x : Reserved
	Hex. value	xx xxh
D	**Data class**	WORD
	Content	1st measured value with flags
	Hex. value	xx xxh
E	**Data class**	WORD
	Content	1st value of field A
	Hex. value	xx xxh
F	**Data class**	WORD
	Content	1st value of field B
	Hex. value	xx xxh
G	**Data class**	WORD
	Content	1st value of field C
	Hex. value	xx xxh
...		
H	**Data class**	WORD
	Content	Last measured value with flags
	Hex. value	xx xxh
I	**Data class**	WORD
	Content	Last value of field A
	Hex. value	xx xxh
J	**Data class**	WORD
	Content	Last value of field B
	Hex. value	xx xxh
K	**Data class**	WORD
	Content	Last value of field C
	Hex. value	xx xxh
...if "Send real-time indices" (*see Table 7-122, block C, on 96*) **is active:**		
L Scan index	**Data class**	BYTE
	Content	Continuously running scan counter (modulo 256) that is incremented with every mirror wheel rotation.
	Hex. value	xxh
M Telegram index	**Data class**	BYTE
	Content	Continuously running telegram counter (modulo 256) that is incremented every time a measured value telegram is sent.
	Hex. value	xxh

Table 7-65: Parameter data for command BEh (*Table 7-64*) (contd.)

7.20 Request the Mean Measured Value Sub-Range

7.20.1 Command 3Fh to LMS2xx: Request the Mean Measured Value Sub-Range

This command requests the mean measured values of the specified measured value sub-range.

	Command	Parameter data		
Data class	BYTE	BYTE	WORD	
Content	Request for the mean measured value sub-range	Number of messages: The number of averaged scans can be between 2 and 250	1st measured value: Value between 1 and 401 with a scanning angle of 100° and an angular resolution of 0.25°, or value between 1 and 361 with a scanning angle of 180° and an angular resolution of 0.5°.	Last measured value: Value between 1 and 401 with a scanning angle of 100° and an angular resolution of 0.25°, or value between 1 and 361 with a scanning angle of 180° and an angular resolution of 0.5°. This value must be greater than or equal to the 1st measured value.
Hex. value	3Fh	xxh	xx xxh	xx xxh

Table 7-66: Command 3Fh (request mean measured value sub-range)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6 to 10	11	12
Hex. value	02	00	06	00	3F	02 01 00 2A 01	9D	4E

Table 7-67: Complete telegram for command 3Fh (*Table 7-66*)

7.20.2 Response BFh from the LMS2xx: Output the Averaged Measured Value Sub-Range

Measured value structure: the LMS2xx sends the averaged measured value without flags. If the average of more than 20 % of the measured values cannot be determined, an overflow value is output instead of the mean value. With a maximum of 250 mean values, the LMS2xx sends the response telegram after 14 s at the earliest. With 2 mean values, the minimum time is 26 ms with an angular resolution of 1°, 52 ms with an angular resolution of 0.5°, and 104 ms with an angular resolution of 0.25°.

	Response	Parameter data
Data class	BYTE	See *Table 7-69, page 71*, (block A to G).
Content	Output of mean measured value sub-range	
Hex. value	BFh	

Table 7-68: Response BFh from the LMS2xx (output of the averaged measured value sub-range)

Block	Parameter data for command BFh	
A Number of mean values	**Data class**	BYTE
	Content	Number of mean values: the number of averaged scans is between 2 and 250.
	Hex. value	xxh
B 1st measured value	**Data class**	WORD
	Content	1st measured value: Value between 1 and 401 with a scanning angle of 100° and a resolution of 0.25° or value between 1 and 361 with a scanning angle of 180° and a resolution of 0.5°
	Hex. value	xx xxh
C Last measured value	**Data class**	WORD
	Content	Last measured value: Value between 1 and 401 with a scanning angle of 100° and a resolution of 0.25° or value between 1 and 361 with a scanning angle of 180° and a resolution of 0.5° This value must be greater than or the same as the 1st measured value.
	Hex. value	xx xxh
D	**Data class**	WORD
	Content	The number of measured values sent (2 bytes) is stored in bit 0 to 13. Bits 15 and 14 code the value unit. Bit 15 Bit 14: 0 0: Unit in cm 0 1: Unit in mm (standard setting) 1 x : Reserved
	Hex. value	xx xxh
E	**Data class**	WORD
	Content	M[1] to MV[AS] averaged measured distance
	Hex. value	xx xxh
...if "Send real-time indices" (*see Table 7-122, block C, on 96*) **is active:**		
F Scan index	**Data class**	BYTE
	Content	Continuously running scan counter (modulo 256) that is incremented with every mirror wheel rotation.
	Hex. value	xxh
G Telegram index	**Data class**	BYTE
	Content	Continuously running telegram counter (modulo 256) that is incremented every time a measured value telegram is sent.
	Hex. value	xxh

Table 7-69: Parameter data for command BFh (*Table 7-68*)

7.21 Configure Fields A, B, or C

7.21.1 Command 40h to LMS2xx: Configure Fields A, B, or C

	Command	Parameter data
Data class	BYTE	See *Table 7-71*, (block A to M).
Content	Field configuration	
Hex. value	40h	

Table 7-70: Command 40h (configure fields A, B, or C)

Block	Parameter data for command 40h	
A Field set number	**Data class**	BYTE
	Content	Field set no. (1 or 2)
	Hex. value	xxh (01h to 02h)
B Field type	**Data class**	BYTE
	Content	Field type: 00h: Field A in cm, 40h: Field A in mm 01h: Field B in cm, 41h: Field B in mm 02h: Field C in cm, 42h: Field C in mm
	Hex. value	00h, 01h, 02h; 40h, 41h, 42h
C Scanning angle	**Data class**	WORD
	Content	Scanning angle in ° (degrees), i.e.: 100° or 180°
	Hex. value	xx xxh
D Angular resolution	**Data class**	WORD
	Content	Angular resolution in 1/100°: Three variants are currently available: Value 100 = 1° Value 50 = 0.5° Value 25 = 0.25°
	Hex. value	xx xxh
E Mode	**Data class**	BYTE
	Content	Mode: 00h: Rectangular field 01h: Radial field (semi-circle with radius r) 02h: Segmented field
	Hex. value	00h, 01h, 02h
F	**Data class**	BYTE[6], array of 6 bytes
	Content	Reserved
	Hex. value	00h, 00h, 00h, 00h, 00h, 00h
Depending on E - for RADIAL field		Description
+G Radius	**Data class**	WORD
	Content	Radius of the semi-circle of the field
	Hex. value	xx xxh

Table 7-71: Parameter data for command 40h (*Table 7-70, page 72*)

Block	Parameter data for command 40h		
Depending on E - for a RECTANGLE			Description
+H	**Data class**	WORD	The field is configured via three corner points of a rectangle with the distance (from left and right) and the height as viewed from the LMS2xx.
	Content	Distance (left) from the LMS2xx in mm or cm	
	Hex. value	xx xxh	
+I	**Data class**	WORD	
	Content	Distance (right) from the LMS2xx in mm or cm	
	Hex. value	xx xxh	
+J	**Data class**	WORD	
	Content	Height of the rectangle as viewed from the LMS2xx in mm or cm	
	Hex. value	xx xxh	
Depending on E - for a SEGMENTED field			Description
+K	**Data class**	BYTE	With this third option, you can specify between 9 and 180 segments or 10 to 181 segment point that are connected by straight, convergent lines. When the LMS2xx has a scanning angle of 100°, you can specify between 5 and 100 segments, or 6 to 101 segment points that are connected by straight, convergent lines.
	Content	Possible number of segments: **Scanning angle 180°** 9, 10, 15, 18, 30, 45, 90, 180, 360 (0xFE) **Scanning angle 100°** 5, 10, 50, 100, 400 (0xFF) Since only one byte is available, 0xFE = 360 segments, and 0xFF = 400 segments.	
	Hex. value	xxh	
+L	**Data class**	WORD	
	Content	Radius for the corner point [1] in units of mm or cm	
	Hex. value	xx xxh	
...to...			
+M	**Data class**	WORD	
	Content	Radius for the corner point [AS+1] in units of mm or cm	
	Hex. value	xx xxh	

Table 7-71: Parameter data for command 40h (*Table 7-70, page 72*) (contd.)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6 to 24	25	26
Hex. value	02	00	14	00	40	01 40 34 00 32 00 02 00 05 E8 03 D0 07 B8 0B A0 0F 88 13	EC	72

Table 7-72: Complete telegram for command 40h (*Table 7-70, page 72*)

7.21.2 Response C0h from the LMS2xx: Configure the Fields

This returns the data received for the configuration so that it can be confirmed.

	Response	**Parameter data**
Data class	BYTE	See *Table 7-74*, (block A to M).
Content	Output the field configuration	
Hex. value	C0h	

Table 7-73: Response C0h from the LMS2xx (configure the fields)

Block	Parameter data for response C0h	
A Status	**Data class**	BYTE
	Content	Provides information on whether or not the configuration was successful. 00h: Configuration aborted: previous fields remain active 01h: Configuration copied: new fields active.
	Hex. value	00h or 01 h
B Field set number	**Data class**	BYTE
	Content	Field set no. (1 or 2)
	Hex. value	xx h
C Field type	**Data class**	BYTE
	Content	Field type 00h: Field A in cm, 40h: Field A in mm 01h: Field B in cm, 41h: Field B in mm 02h: Field C in cm, 42h: Field C in mm
	Hex. value	00h, 01h 02h; 40h, 41h, 42h
D Scanning angle	**Data class**	WORD
	Content	Scanning angle n ° (degrees): e.g.: 100° or 180°
	Hex. value	xx xxh
E Angular resolution	**Data class**	WORD
	Content	Angular resolution in 1/100°: Three variants are currently available: Value 100 = 1° Value 50 = 0.5° Value 25 = 0.25°
	Hex. value	xx xxh
F Mode	**Data class**	BYTE
	Content	00h: Rectangular field 01h: Radial field (semi-circle with radius r) 02h: Segmented field
	Hex. value	00h, 01h, 02h
G	**Data class**	BYTE
	Content	Reserved
	Hex. value	xxh
Depending on block F or command 40h (*Table 7-71, page 72*, **block E) - RECTANGLE data**		
H	**Data class**	WORD
	Content	Distance (left) from the LMS2xx in set unit
	Hex. value	xx xxh
I	**Data class**	WORD
	Content	Distance (right) from the LMS2xx in set unit
	Hex. value	xx xxh
J	**Data class**	WORD
	Content	Height of the rectangle from the LMS2xx in set unit
	Hex. value	xx xxh

Table 7-74: Parameter data for response C0h (*Table 7-73, page 73*)

Block	Parameter data for response C0h	
Depending on block F or command 40h (*Table 7-71, page 72*, block E) - SEGMENT data		
K	**Data class**	BYTE
	Content	Possible number of segments: **Scanning angle 180°** 9, 10, 15, 18, 30, 45, 90, 180, 360 (0xFE) **Scanning angle 100°** 5, 10, 50, 100, 400 (0xFF) Since only one byte is available, 0xFE = 360 segments, and 0xFF = 400 segments.
	Hex. value	xxh
L	**Data class**	WORD
	Content	Radius for the corner point [1] in set unit
	Hex. value	xx xxh
...to...		
M	**Data class**	WORD
	Content	Radius for the corner point [AS+1] in set unit
	Hex. value	xx xxh

Table 7-74: Parameter data for response C0h (*Table 7-73, page 73*) (contd.)

7.22 Switch the Active Field Set

7.22.1 Command 41h to LMS2xx: Switch the Active Field Set

This command activates the evaluation of the corresponding field set.

Default setting Field set no. 1

	Command	Parameter data
Data class	BYTE	BYTE
Content	Switch the active field set	0: Request to determine which field set is active 1: Activate field set no. 1 2: Activate field set no. 2
Hex. value	41h	00h, 01h, 02h

Table 7-75: Command 41h (switch the active field set)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6	7	8
Hex. value	02	00	02	00	41	00	D2	69

Table 7-76: Complete telegram for command 42h (*Table 7-75*)

7.22.2 Response C1 h from the LMS2xx: Switch the Active Field Set

The field set has been activated. The response from the LMS2xx can take up to 200 ms.

	Response	Parameter data
Data class	BYTE	BYTE
Content	Confirmation of field set switchover	1: Field set 1 active 2: Field set 2 active
Hex. value	C1h	01h, 02h

Table 7-77: Response C1h from the LMS2xx (switch the active field set)

Example of a complete telegram (standard devices):

Description	STX	Address	Length		Response	Data		Checksum	
						Data	LMS status		
Byte position	1	2	3	4	5	6	7	8	9
Hex. value	02	80	00	00	C1	01	10	A0	D0

Table 7-78: Complete telegram for response C1h (*Table 7-77*)

7.23 Change the Password

7.23.1 Command 42h to LMS2xx: Change the Password

When you change the password, the driver must send this telegram twice (the status must change from 00h to 01h).

Default setting "SICK_LMS"

	Command	**Parameter data**		
Data class	BYTE	BYTE		Password string s1
Content	Password change	00h: New password 01h: Confirmation of the new password	00h: Password for SICK Service and authorised customers. 01h: Password for maintenance.	String with 8 characters comprising "0 ... 9", "a ... -z", "A ... Z", and "_".
Hex. value	42h	00h, 01h	00h, 01h	53 49 43 B4 5F 4C 4D 53h (**default setting**)

Table 7-79: Command 42h (change the password)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6 to 15	16	17
Hex. value	02	00	0B	00	42	00 00 53 49 43 B4 5F 4C 4D 53	E2	59

Table 7-80: Complete telegram for command 42h (*Table 7-79*)

7.23.2 Response C2h from the LMS2xx: Confirmation of the New Password

The LMS2xx provides information on whether or not the password has been changed successfully and/or requests that the new password be confirmed.

	Response	**Parameter data**	
Data class	BYTE	BYTE	
Content	Confirmation of the new password	00h: The new password has not been accepted. 01h: The new password has been accepted. 02h: The new password must be confirmed by the user.	00h: Password for SICK Service and authorised customers 01h: Password for maintenance
Hex. value	C2h	00h, 01h, 02h	00h, 01h

Table 7-81: Response C2h from the LMS2xx (change the password)

Example of a complete telegram (standard devices):

Description	STX	Address	Length		Response	Data		Checksum	
						Data	LMS status		
Byte position	1	2	3	4	5	6	7	8	9
Hex. value	02	80	00	00	C2	00	10	AC	D6

Table 7-82: Complete telegram for response C2h (*Table 7-81*)

7.24 Request Measured Values and Reflectivity Value Sub-Range

7.24.1 Command 44h to LMS2xx: Request Measured Values and Reflectivity Value Sub-Range

This command requests all the measured values of a scan and a scan for the reflectivity.

This command is only valid for LMS2xx in the LMS211/221/291-S14 series.

	Command	Parameter data	
Data class	BYTE	WORD	
Content	Request for measured vales and reflectivity value sub-range	Reflectivity value between 1 and 181	Reflectivity value between 1 and 181. This value must be greater than or equal to the first reflectivity value.
Hex. value	44h	xx xxh (00 01h to 00 B5h)	xx xxh (00 01h to 00 B5h)

Table 7-83: Command 44h (request measured values and reflectivity value sub-range)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6 to 9	10	11
Hex. value	02	00	05	00	44	01 00 B5 00	68	37

Table 7-84: Complete telegram for command 44h (*Table 7-83*)

7.24.2 Response C4h from the LMS2xx: Output the Measured Values with Reflectivity Data

The LMS2xx sends all the measured values of a scan and a sub-range of the scan for the reflectivity.

	Response	Parameter data
Data class	BYTE	See *Table 7-86*, (block A to M).
Content	Output of the measured values with reflectivity value sub-range	
Hex. value	C4h	

Table 7-85: Response C4h from the LMS2xx (Output of the measured values with reflectivity value sub-range)

Block	Parameter data for response C4h	
A	**Data class**	WORD
	Content	The number of measured values sent (2 bytes) is stored in bit 0 to 9. Bits 15 and 14 code the value unit. Bit 15 Bit 14: 0 0: Unit in cm 0 1: Unit in mm (standard setting) 1 x : Reserved Bits 10 to 13: reserved
	Hex. value	xx xxh
B	**Data class**	WORD
	Content	MV[1] Flags and measured distance
	Hex. value	xx xxh
...to...		
C	**Data class**	WORD
	Content	MV[181] Flags and measured distance
	Hex. value	xx xxh
D	**Data class**	WORD
	Content	The number of reflectivity values sent (2 bytes) is stored in bits 0 to 9. Bits 10 to 15: reserved
	Hex. value	xx xxh
E First reflectivity value	**Data class**	WORD
	Content	Value between 1 and 181
	Hex. value	xx xxh (00 01h to 00 B5h)
F Last reflectivity value	**Data class**	WORD
	Content	Value between 1 and 181. This value is greater than or equal to the first reflectivity value.
	Hex. value	xx xxh (00 01h to 00 B5h)
G	**Data class**	BYTE
	Content	RV[1] Reflectivity
	Hex. value	xxh
...to...		
H	**Data class**	BYTE
	Content	RV[AS] Reflectivity
	Hex. value	xxh
...if "Send real-time indices" (*see Table 7-122, block C, on 96*) **is active:**		
I Scan index	**Data class**	BYTE
	Content	Continuously running scan counter (modulo 256) that is incremented with every mirror wheel rotation.
	Hex. value	xxh
J Telegram index	**Data class**	BYTE
	Content	Continuously running telegram counter (modulo 256) that is incremented every time a measured value telegram is sent.
	Hex. value	xxh

Table 7-86: Parameter data for response C4h (*Table 7-85*)

7.25 Request Configured Fields

7.25.1 Command 45h to LMS2xx: Request Data for the Configured Fields

This command requests the data for the fields configured in the LMS2xx.

	Command	Parameter data	
Data class	BYTE	BYTE	
Content	Request for configured fields	Field set no.: 1 or 2	Field type: 00h: Field A 01h: Field B 02h: Field C
Hex. value	45h	xx (01h to 04h)	00h, 01h, 02h

Table 7-87: Command 45h (request configured fields)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6 to 7	8	9
Hex. value	02	0	02	00	45	00	DA	6D

Table 7-88: Complete telegram for command 45h (*Table 7-87*)

7.25.2 Response C5h from the LMS2xx: Output the Field Configuration Data

The LMS2xx sends the data for the configured fields.

	Response	Parameter data
Data class	BYTE	See *Table 7-90*, (block A to F).
Content	Output of field configuration data	
Hex. value	C5h	

Table 7-89: Response C5h from the LMS2xx

Block	Parameter data for response C5h	
A Field set number	**Data class**	BYTE
	Content	Field set no. (1 or 2)
	Hex. value	xx xxh
B Field type	**Data class**	WORD
		00h: Field A, rectangular configuration 01h: Field A: radial configuration 02h: Field A: configuration with n segments 03h: Field A: taught-in field 04h: Reserved 05h: Reserved 06h: Field B: rectangular configuration 07h: Field B: radial configuration 08h: Field B: configuration with n segments 09h: Field B: taught-in field 0Ah: reserved 0Bh: Reserved 0Ch: Field C: rectangular configuration 0Dh: Field C: radial configuration 0Eh: Field C: configuration with n segments 0Fh: Field C: taught-in field 10h: Reserved 11h: Reserved Bits 6 and 7 code the value unit. Bit 6 Bit 7: 0 0: Unit in cm 0 1: Unit in mm (standard setting) 1 x : Reserved
	Hex. value	xx xxh
C Scan angle	**Data class**	WORD
	Content	Scanning angle in ° (degrees): i.e. 100° or 180°
	Hex. value	xx xxh
D Angular resolution	**Data class**	WORD
	Content	Angular resolution in 1/100°: Three variants are currently available: Value 100 = 1° Value 50 = 0.5° Value 25 = 0.25°
	Hex. value	xx xxh
E	**Data class**	BYTE
	Content	Reserved
	Hex. value	xxh

Table 7-90: Parameter data for response C5h (*Table 7-89, page 80*)

Block	Parameter data for response C5h	
F Field data	**Data class**	(WORD / BYTE)
	Content	For field type 00h, 06h, 0Ch: LI, RE, HO as corner values of the rectangle in the unit supplied. TYPE: WORD For field type 01h, 07h, 0Dh: RADIUS of the field in the unit supplied. TYPE: WORD For field type 02h, 08h, 0Eh: n segments, TYPE: BYTE, n+1 radii of the equidistant segments of the field in the unit supplied. TYPE: WORD For field type 03h, 09h, 0Fh: n radii of the taught-in measurement points in the unit supplied TYPE: WORD n is calculated as follows: (scanning angle / angular resolution) +1 For field type 04h, 0Ah, 10h: data of the rectangular dynamic field For field type 05h, 0Bh, 11h: data of the segmented dynamic field
	Hex. value	(xxh / xx xxh)

Table 7-90: Parameter data for response C5h (*Table 7-89, page 80*) (contd.)

7.26 Start Teach Mode for Field Configuration

In teach mode, the LMS2xx stores the measured distances of the individual beams as target values for the field limits. When you exit teach mode, the LMS2xx adopts the field limit values and reduces the field limits by a defined distance.

7.26.1 Command 46h to LMS2xx: Start Teach Mode for Field Configuration

The host/driver informs the LMS2xx when teach mode is started/ended. The LMS2xx does not expect any confirmation when teach mode is aborted. The host can use the taught-in data as an editing basis for a field that has to be processed manually. The host/driver sends the date and time at which teach mode was started to the LMS2xx.

	Command	Parameter data
Data class	BYTE	See *Table 7-92*, (block A to M).
Content	Start teach mode for field configuration	
Hex. value	46h	

Table 7-91: Command 46h (start teach mode for field configuration)

Block	Parameter data for command 46h	
A Field set number	**Data class**	BYTE
	Content	Field set no.: 1 or 2
	Hex. value	xxh (00h to 02h)
B Field type	**Data class**	BYTE
	Content	Field type 00h: Field A in cm, 40h: Field A in mm 01h: Field B in cm, 41h: Field B in mm 02h: Field C in cm, 42h: Field C in mm
	Hex. value	00h, 01h, 02h; 40h, 41h, 42h
C Scanning angle	**Data class**	WORD
	Content	Scanning angle in ° (degrees): i.e.: 100° or 180°
	Hex. value	xx xxh
D Angular resolution	**Data class**	WORD
	Content	Angular resolution in 1/100°: Three variants are currently available: Value 100 = 1° Value 50 = 0.5° Value 25 = 0.25°
	Hex. value	xx xxh
E Action	**Data class**	BYTE
	Content	00h: Start teach mode 01h: End teach mode (normal) 02h: Abort teach mode
	Hex. value	00h, 01h, 02h
F Difference	**Data class**	WORD
	Content	Difference between the fields to be taught in and the contour in mm
	Hex. value	xx xxh
G	**Data class**	WORD
	Content	Reserved
	Hex. value	00 00h

Table 7-92: Parameter data for command 46h (*Table 7-91*)

Block	Parameter data for command 46h	
H Zero	**Data class**	WORD
	Content	The parameter must be zero so that the difference specified above is used. Otherwise, the difference is 70 mm (2.76 in).
	Hex. value	xx xxh (00 00h)

Table 7-92: Parameter data for command 46h (*Table 7-91*) (contd.)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6 to 18	19	20
Hex. value	02	00	0E	00	46	01 40 B4 00 32 00 00 05 00 00 00 00 00	CF	FF

Table 7-93: Complete telegram for command 46h (*Table 7-92*)

7.26.2 Response C6h from the LMS2xx: Teach In Field Configuration Status

The LMS2xx provides information on the status of the field configuration in teach mode.

	Response	**Parameter data**
Data class	BYTE	BYTE
Content	Output of teach mode status	00h: Teach mode not correctly terminated 01h: Teach mode terminated, verification can begin 03h: Teach mode is active
Hex. value	C6h	00h, 01h, 02h

Table 7-94: Response C6h from the LMS2xx (status output of the field configuration to be taught in)

7.27 Command 48h / Response C8h

Reserved

7.28 Requesting the Status of the Field Outputs

7.28.1 Command 4Ah to LMS2xx: Request the Status of Field Outputs

This command requests the current status of the field outputs.

	Command	Parameter data
Data class	BYTE	No further data
Content	Request for the status of the field outputs	
Hex. value	4Ah	

Table 7-95: Command 4Ah (request the status of the field outputs)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	-	6	7
Hex. value	02	00	01	00	4A	-	6E	12

Table 7-96: Complete telegram for command 4Ah (*Table 7-95*)

7.28.2 Response CAh from the LMS2xx: Status of the Field Outputs

The LMS2xx sends the current status of outputs A, B, and C.

	Response	Parameter data		
Data class	BYTE	BYTE		Password string 1
Content	Output the status of the field outputs	0: Output A LOW (field A infringed) ≠ 0: Output A HIGH	0: Output B LOW (field B infringed) ≠ 0: Output B HIGH	0: Output C LOW (field C infringed) ≠ 0: Output C HIGH
Hex. value	CAh	xxh	xxh	xxh

Table 7-97: Response CAh from the LMS2xx (output of the field output status)

Example of a complete telegram (standard devices):

Description	STX	Address	Length		Response	Data		Checksum	
						Data	LMS status		
Byte position	1	2	3	4	5	6 to 8	9	10	11
Hex. value	02	80	05	00	CA	01 01 01	10	2C	B8

Table 7-98: Complete telegram for response CAh (*Table 7-97*)

7.29 Command 4Bh / Response CBh

Reserved

7.30 Command 4Ch / Response CCh

Reserved

7.31 Command 4Dh / Response CDh

Reserved

7.32 Command 4Eh / Response CEh

Reserved

7.33 Command 4Fh / Response CFh

Reserved

7.34 Command 50h / Response D0h

Reserved

7.35 Command 51h / Response D1h

Reserved

7.36 Command 52h / Response D2h

Reserved

7.37 Define the Permanent Baud Rate or LMS Type

7.37.1 Command 66h to LMS2xx: Define the Permanent Baud Rate or LMS Type

This command is used for defining the behaviour of the LMS2xx at power-on for the current baud rate or LMS type. **Default setting:** Data transmission rate: 9,600 Bd at power-on.

	Command	Parameter data
Data class	BYTE	BYTE
Content	Permanent baud rate or permanent LMS type definition	00h: The baud rate is set to 9,600 Bd at power-on 01h: The configured baud rate is retained after power-on 02h: The configured LMS2xx type is retained after power-on
Hex. value	66h	00h, 01h, 02h

Table 7-99: Command 66h (define the permanent baud rate or permanent LMS type)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6	7	8
Hex. value	02	00	02	00	66	00	9C	4E

Table 7-100: Complete telegram for command 66h (*Table 7-99*)

7.37.2 Response E6h from the LMS2xx: Define Status of Permanent Data Transmission Rate/LMS Type

The LMS2xx provides information on whether or not the permanent baud rate/LMS type has been successfully defined.

Default setting 00h

	Response	Parameter data	
Data class	BYTE	BYTE	
Content	Response to definition of the permanent baud rate or permanent LMS type	00h: Definition of permanent baud rates/LMS type not accepted 01h: Definition of permanent baud rates/LMS type accepted	00h: Baud rate at power-on: 9,600 Bd 01h: Baud rate after power-on: unchanged 02h: LMS type after power-on: unchanged
Hex. value	E6h	00h, 01h	00h, 01h, 02h

Table 7-101: Response E6h from the LMS2xx (status of the permanent baud rate/LMS type)

Example of a complete telegram (standard devices):

Description	STX	Address	Length		Response	Data		Checksum	
						Data	LMS status		
Byte position	1	2	3	4	5	6	7	8	9
Hex. value	02	80	00	00	E6	01	10	3C	9E

Table 7-102: Complete telegram for response E6h (*Table 7-101*)

7.38 Command 67h / Response E7h

Reserved

7.39 Command 68h / Response E8h

Reserved

7.40 Define the Angular Range for Positioning Aid

7.40.1 Command 69h to LMS2xx: Define Angular Range for Positioning Aid

This command defines up to 3 angular ranges for positioning aid.

	Command	Parameter data
Data class	BYTE	See *Table 7-104*, (block A to H).
Content	Define angular range for positioning aid	
Hex. value	69h	

Table 7-103: Command 69h (define angular range for positioning aid)

Block	Parameter data for command 69h	
A Angular resolution	**Data class**	BYTE
	Content	Defines the angular resolution of the shots between start angle n and stop angle n in 1/100°: Degrees Dec. value Hex. value 0.25° 25 19 0.50° 50 32 1.00° 100 64
	Hex. value	xxh
B Number of ranges	**Data class**	BYTE
	Content	Specifies the number of positioning ranges: MIN 1, MAX 3
	Hex. value	xxh
C Start angle 1	**Data class**	WORD
	Content	Start angle 1 in ° (degrees)
	Hex. value	xx xxh
D Stop angle 1	**Data class**	WORD
	Content	Stop angle 1 in ° (degrees)
	Hex. value	xx xxh
E Start angle 2	**Data class**	WORD
	Content	Start angle 2 in ° (degrees)
	Hex. value	xx xxh
F Stop angle 2	**Data class**	WORD
	Content	Stop angle 2 in ° (degrees)
	Hex. value	xx xxh
G Start angle 3	**Data class**	WORD
	Content	Start angle 3 in ° (degrees)
	Hex. value	xx xxh
H Stop angle 3	**Data class**	WORD
	Content	Stop angle 3 in ° (degrees)
	Hex. value	xx xxh

Table 7-104: Parameter data for command 69h (*Table 7-103*)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6 to 19	20	21
Hex. value	00	02	0F	00	69	64 01 02 00 05 00 0A 00 14 00 19 00 2D 00	08	62

Table 7-105: Complete telegram for command 69h (*Table 7-103*)

7.40.2 Response E9h from the LMS2xx: Status for "Define Angular Range for Positioning Aid"

The LMS2xx provides information on whether or not the angular range for positioning aid was successfully defined.

	Response	Parameter data
Data class	BYTE	See *Table 7-107*, (block A to D).
Content	Confirm definition of the angular range for positioning aid	
Hex. value	E9h	

Table 7-106: Response E9h from the LMS2xx (status for "Define Angular Range for Positioning Aid")

Block	Parameter data for response E9h	
A Status	**Data class**	BYTE
	Content	00h: Definition not accepted 01h: Definition accepted
	Hex. value	xxh (00h, 01h)
B Angular resolution	**Data class**	BYTE
	Content	25, 50, or 100 depending on the resolution
	Hex. value	xxh (19h, 32h, or 64h)
C Start angle	**Data class**	WORD
	Content	Start angle in ° (degrees)
	Hex. value	xx xxh
D Stop angle	**Data class**	WORD
	Content	Stop angle in ° (degrees)
	Hex. value	xx xxh

Table 7-107: Parameter data for response E9h (*Table 7-106*)

7.41 Command 70h / Response F0h

Reserved

7.42 Command 72h / Response F2h

Reserved

7.43 Request the LMS Configuration (Part 1)

7.43.1 Command 74h to LMS2xx: Request the LMS Configuration Data (Part 1)

This command requests the saved LMS configuration.

Note For request the Extended LMS Configuration (continued) see *Chapter 7.50 Request the LMS Configuration (Part 2, Continued), Page 103*.

	Command	Parameter data
Data class	BYTE	No further data
Content	Request for the LMS configuration	
Hex. value	74h	

Table 7-108: Command 4Ah (request the LMS configuration)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	-	6	7
Hex. value	02	00	01	00	74	-	50	12

Table 7-109: Complete telegram for command 4Ah (*Table 7-108*)

7.43.2 Response F4h from the LMS2xx: Output the LMS Configuration (Part 1)

	Response	Parameter data
Data class	BYTE	Same parameter set as for command 77h (*Section 7.46.1, page 96*)
Content	Output of the current LMS configuration	
Hex. value	F4h	

Table 7-110: Response F4h from the LMS2xx (output the LMS configuration)

Example of a complete telegram (standard devices):

Description	STX	Address	Length		Response	Data		Checksum	
						Data	LMS status		
Byte position	1	2	3	4	5	6 to 39	40	41	42
Hex. value	02	80	24	00	F4	33 bytes	10	3C	FB

Table 7-111: Complete telegram for response F4h (*Table 7-110*)

7.44 Request Measured Values with Reflectivity Data

7.44.1 Command 75h to LMS2xx: Request Measured Values with Reflectivity Data

This command requests measured values and reflectivity values for the defined ranges.

	Command	Parameter data
Data class	BYTE	See *Table 7-113*, (block A to E).
Content	Request for measured values with reflectivity data	
Hex. value	75h	

Table 7-112: Command 75h (request measured values with reflectivity data)

Block	Parameter data for command 75h	
A Number of ranges	**Data class**	WORD
	Content	Number of ranges: value range n from 1 to 5
	Hex. value	xx xxh (00 01h to 00 05h)
B Start of range 1	**Data class**	WORD
	Content	Start of range 1: Measured value number from 1 to 401
	Hex. value	xx xxh (00 01h to 01 91h)
C End of range 1	**Data class**	WORD
	Content	End of range 1: Measured value number from 1 to 401
	Hex. value	xx xxh (00 01h to 01 91h)
...to...		
D Start of range n	**Data class**	WORD
	Content	Start of range n: Measured value number from 1 to 401
	Hex. value	xx xxh (00 01h to 01 91h)
E End of range n	**Data class**	WORD
	Content	End of range n: Measured value number from 1 to 401
	Hex. value	xx xxh (00 01h to 01 91h)

Table 7-113: Parameter data for command 75h (*Table 7-112*)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6 to 11	12	13
Hex. value	02	00	07	00	75	01 00 01 00 91 01	7D	B6

Table 7-114: Complete telegram for command 75h (*Table 7-113*)

7.44.2 Response F5h from the LMS2xx: Measured Value Output with Reflectivity Data

The LMS2xx transmits measured values and reflectivity values for the defined ranges.

	Response	Parameter data
Data class	BYTE	See *Table 7-116*, (block A to F).
Content	Output of measured values with reflectivity data	
Hex. value	F5h	

Table 7-115: Response F5h from the LMS2xx (measured value output with reflectivity data)

Block	Parameter data for response F5h	
A Number of ranges n	**Data class**	WORD
	Content	Number of ranges n: Value range n from 1 to 5
	Hex. value	xx xxh
B Start of range 1	**Data class**	WORD
	Content	Start of range 1: Measured value number from 1 to 401
	Hex. value	xx xxh (00 01h to 01 91h)
C End of range 1	**Data class**	WORD
	Content	End of range 1: Measured value number from 1 to 401
	Hex. value	xx xxh (00 01h to 01 91h)
D Number Value pairs m	**Data class**	WORD
	Content	Number of value pairs m end-start +1: A value pair comprises a measured distance value and a reflectivity value. The units of the measured values are coded in bits 14 and 15. Bit 15 Bit 14 0 0: Unit in cm 0 1: Unit in mm (standard setting) 1 x : Reserved
	Hex. value	
E Range 1 Measured value 1	**Data class**	WORD
	Content	Range 1: Measured value 1 in the defined unit
	Hex. value	xx xxh
F Range 1 Reflectivity value 1	**Data class**	WORD
	Content	Range 1: Reflectivity value 1 in the value range from 0 to approx. 13,000
	Hex. value	xx xxh
...to...		
G Range 1 Measured value m	**Data class**	WORD
	Content	Range 1: Measured value m in the defined unit
	Hex. value	xx xxh
H Range 1 Reflectivity value m	**Data class**	WORD
	Content	Range 1: Reflectivity value m in the value range from 0 to approx. 13,000
	Hex. value	xx xxh
...to...		

Table 7-116: Parameter data for response F5h (*Table 7-115, page 92*)

Block	Parameter data for response F5h	
I Start of range n	**Data class**	WORD
	Content	Start of range n: Measured value number from 1 to 401
	Hex. value	xx xxh (00 01h to 01 91h)
J End range n	**Data class**	WORD
	Content	End of range n: Measured value number from 1 to 401
	Hex. value	xx xxh (00 01h to 01 91h)
K Number Value pairs m	**Data class**	WORD
	Content	Number of value pairs m end-start+1: A value pair comprises a measured distance value a reflectivity value. The units of the measured values are coded in bits 14 and 15. Bit 15 Bit 14 0 0: Unit in cm 0 1: Unit in mm (standard setting) 1 x : Reserved
	Hex. value	xx xxh
L range n Measured value 1	**Data class**	WORD
	Content	Range n: Measured value 1 in the defined unit
	Hex. value	xx xxh
M Range n Reflectivity value 1	**Data class**	WORD
	Content	Range n: Reflectivity value 1 in the value range from 0 to approx. 13,000
	Hex. value	xx xxh
...to...		
N Range n Measured value m	**Data class**	WORD
	Content	Range n: Measured value m in the defined unit
	Hex. value	xx xxh
O Range n Reflectivity value m	**Data class**	WORD
	Content	Range n: Reflectivity value m in the value range from 0 to approx. 13,000
	Hex. value	xx xxh
...if "Send real-time indices" (*see Table 7-122, block C, on 96*) **is active:**		
P Scan index	**Data class**	BYTE
	Content	Continuously running scan counter (modulo 256) that is incremented with every mirror wheel rotation.
	Hex. value	xxh
Q Telegram index	**Data class**	BYTE
	Content	Continuously running telegram counter (modulo 256) that is incremented every time a measured value telegram is sent.
	Hex. value	xxh

Table 7-116: Parameter data for response F5h (*Table 7-115, page 92*) (contd.)

7.45 Request Measured Values in Cartesian Coordinates

7.45.1 Command 76h to LMS2xx: Request Measured Values in Cartesian Coordinates

The LMS2xx sends the measured value sub-range of a scan in cartesian coordinates.

A maximum of 200 measured values can be requested.

	Command	Parameter data	
Data class	BYTE	WORD	
Content	Request measured values in cartesian coordinates	Value between 1 and 401 with a scanning angle of 100° and a resolution of 0.25°, or value between 1 and 361 with a scanning angle of 180° and a resolution of 0.5°	Value between 1 and 401 with a scanning angle of 100° and a resolution of 0.25°, or value between 1 and 361 with a scanning angle of 180° and a resolution of 0.5° This value must be greater than or the same as the 1st measured value.
Hex. value	76h	xx xxh	xx xxh

Table 7-117: Command 76h (request measured values in cartesian coordinates)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6 to 9	10	11
Hex. value	02	00	05	00	76	01 00 2A 01	72	BA

Table 7-118: Complete telegram for command 76h (*Table 7-117*)

7.45.2 Response F6h from the LMS2xx: Measured Value Output in Cartesian Coordinates

The LMS2xx sends the measured value sub-range of a scan to the host in cartesian coordinates.

Structure of a measured value that is sent: **Y value**

Bit [0..12]: Measured distance for the measuring point in a parameterisable unit, value range from 0 to (213 ... 1).

Bit [13]: Dazzle flag. This flag is set if dazzling was detected in this segment.

Bit [14]: Field B flag. This flag is set if field B was infringed in this measuring point.

Bit [15]: Field A flag. This flag is set if field A was infringed in this measuring point.

Structure of a measured value that is sent: **X value**

Bit [0..12]: Measured distance for the measuring point in a parameterisable unit value range from 0 to (213 ... 1).

Bit [15]: Sign flag. This flag is set if the value is negative.

	Response	Parameter data
Data class	BYTE	See *Table 7-120*, (block A to I).
Content	Measured value output in cartesian coordinates	
Hex. value	F6h	

Table 7-119: Response F6h from the LMS2xx (measured value output in cartesian coordinates)

Block	Parameter data for response F6h	
A 1st measured value	**Data class**	WORD
	Content	1st measured value Value between 1 and 401 with a scanning angle of 100° and a resolution of 0.25° or value between 1 and 361 with a scanning angle of 180° and a resolution of 0.5°
	Hex. value	xx xxh
B Last measured value	**Data class**	WORD
	Content	Last measured value: Value between 1 and 401 with a scanning angle of 100° and a resolution of 0.25° or value between 1 and 361 with a scanning angle of 180° and a resolution of 0.5°. This value must be greater than or the same as the 1st measured value.
	Hex. value	xx xxh
C	**Data class**	WORD
	Content	Number of measured values sent (2 bytes)
	Hex. value	xx xxh
D	**Data class**	LONG
	Content	MVX[1] Measured distance (with sign) in x direction
	Hex. value	xx xxh
E	**Data class**	WORD
	Content	MVY[1] Flags and measured distance (always positive) in y direction
	Hex. value	xx xxh
...to...		
F	**Data class**	LONG
	Content	MVX[AS] Measured distance (with sign) in x direction
	Hex. value	xx xxh
G	**Data class**	WORD
	Content	MVY[AS] Flags and measured distance (always positive) in y direction
	Hex. value	xx xxh
...if "Send real-time indices" (*see Table 7-122, block C, on 96*) **is active:**		
H Scan index	**Data class**	BYTE
	Content	Continuously running scan counter (modulo 256) that is incremented with every mirror wheel rotation.
	Hex. value	xxh
I Telegram index	**Data class**	BYTE
	Content	Continuously running telegram counter (modulo 256) that is incremented every time a measured value telegram is sent.
	Hex. value	xxh

Table 7-120: Parameter data for response F6h (*Table 7-119*)

7.46 Configuring the LMS2xx (Part 1)

7.46.1 Command 77h to LMS2xx: Configure the LMS2xx (Part 1)

This command defines the configuration parameters in the LMS2xx.

Note For setting the Extended LMS Configuration (continued) see *Chapter 7.51 Configure the LMS2xx (Part 2, Continued), Page 104*

	Command	Parameter data
Data class	BYTE	See *Table 7-122*, (block A to A4).
Content	Define LMS configuration	
Hex. value	77h	

Table 7-121: Command 77h (configure the LMS2xx)

Block	Parameter data for command 77h	
A Blanking	**Data class**	WORD
	Content	Maximum diameter of objects that are not to be detected. Unit: 1 cm e.g. value 7: objects ≤ 70 mm are suppressed. **Default setting: 0**
	Hex. value	xx xxh
B Peak threshold/ Stop threshold	**Data class**	WORD
	Content	**LMS200/220:** LOW BYTE defines the stop threshold in mV. HIGH BYTE defines the peak threshold/black correction. The following constants exist for HIGH BYTE: 00h: Standard: peak threshold detection, no black extension 01h: Peak threshold detection, active black extension 02h: No peak threshold detection, no black extension 03h: No peak threshold detection, active black extension **LMS211/221/291:** LOW BYTE is not relevant. HIGH BYTE enables 4 different sensitivity thresholds to be set: 00h: Standard sensitivity: range approx. 30 m at 10 % reflectivity 01h: Medium sensitivity: range approx. 25 m at 10 % reflectivity 02h: Low sensitivity: range approx. 20 m at 10 % reflectivity 03h: High sensitivity: range approx. 42 m at 10 % reflectivity **Default setting for all types:** **LOW BYTE 46h** **HIGH BYTE 00h**
	Hex. value	xx 46h

Table 7-122: Parameter data for command 77h (*Table 7-121*)

Block	Parameter data for command 77h	
C Availability level	**Data class**	BYTE
	Content	Bit 0: Availability level 3 If set to 1, the LMS2xx functions with the highest possible availability. The availability can be compared with LMS types 1 to 5. **Default setting: 0** Bit 1: "Send real-time indices" If set to 1, the LMS2xx adds the real-time indices "scan counter" and "telegram counter" to each measured value telegram. For more detailed information, see the section on measured value telegrams. To ensure compatibility with host computers that cannot use these indices, this parameter must be set to 0. **Default setting: 0** Bit 2: Availability level 2 If set to 1, the dazzle evaluation has no effect on the switching outputs. **Default setting: 0** Bit 3 ... 7: Reserved
	Hex. value	xxh

Table 7-122: Parameter data for command 77h (*Table 7-121*) (contd.)

Block	Parameter data for command 77h	
D Measuring mode	**Data class**	BYTE
	Content	Declaration for representing the measured values (coding the measured value bytes) See *Section 3.4.1, page 19* and *Section 7.5.2, page 47*. 00h: Measurement range 8 m/80 m; field A, field B, and dazzle (**default setting**) *Bit 0 to bit 12* — *Bit 13* — *Bit 14* — *Bit 15* Measured value (8 m/80 m) — Field A — Field B — Dazzle 01h: Measurement range 8 m/80 m; reflector bits in 8 levels *Bit 0 to bit 12* — *Bit 13 to bit 15* Measured value (8 m/80 m) — 8 steps (2^3) of reflector values are coded 02h: Measurement range 8 m/80 m; field A, field B, and field C *Bit 0 to bit 12* — *Bit 13* — *Bit 14* — *Bit 15* Measured value (8 m/80 m) — Field A — Field B — Field C 03h: Measurement range 16 m/theoretically 160 m; reflector bits in 4 levels *Bit 0 to bit 13* — *Bit 14 to bit 15* Measured value (16 m) — 4 levels (2^2) of reflector values are coded 04h: Measurement range 16 m/theoretically 160 m; field A and field B *Bit 0 to bit 13* — *Bit 14* — *Bit 15* Measured value (16 m) — Field A — Field B 05h: Measurement range 32 m/theoretically 320 m, reflector bit in 2 levels *Bit 0 to bit 13* — *Bit 14 to bit 15* Measured value (32 m) — 2 levels (2^1) of reflector values are coded 06h: Measurement range 32 m/theoretically 320 m, field A *Bit 0 to bit 14* — *Bit 15* Measured value (32 m) — Field A 0Ah: Reserved 0Bh: Reserved 0Ch: Reserved 0Dh: Reserved 0Eh: Reserved 0Fh: Immediate data transmission, measurement range 32m/theoretically 320 m for block E and 00h, no flags. The LMS2xx outputs the measured value directly before the measurement before it measures the next value. 10h: Reserved 11h: Reserved Internal measuring modes: 61: 3Dh Reserved 62: 3Eh Reserved 63: 3Fh Reflectivity values instead of distance: instead of outputting measured distance values, the LMS2xx only outputs energy values. The structure of the energy values is described in *Section 3.4.2, page 20*.
	Hex. value	xxh (00h to 11h, 3Dh, 3Eh, 3Fh)
E Measured value and field value units	**Data class**	BYTE
	Content	Determining the distance resolution: 00h: Unit for all length dimensions is 1 cm (max. 80 m) 01h: Unit for all length dimensions is 1 mm (max. 8/16/32 m) **(default setting)** 02h: Reserved
	Hex. value	00h, 01h, 02h

Table 7-122: Parameter data for command 77h (*Table 7-121*) (contd.)

Block	Parameter data for command 77h	
F Temporary field	**Data class**	BYTE
	Content	00h: Temporary field is not used (**default setting**) 01h: Temporary field belongs to field set no. 1 02h: Temporary field belongs to field set no. 2
	Hex. value	00h, 01h, 02h
G Field A, Field B as subtractive fields	**Data class**	BYTE
	Content	00h: Fields are not to be evaluated subtractively (**default setting**) 01h: Fields must be evaluated subtractively. The monitored area is defined as follows: Value from field A minus the value from field B. The flag from field A represents the result.
	Hex. value	00h, 01h
H Multiple evaluation	**Data class**	BYTE
	Content	Minimum setting: 1 Maximum setting: 125 **Default setting: 2**
	Hex. value	xxh (01h to 7Dh)
I Restart	**Data class**	BYTE
	Content	00h: Restart when restart button is actuated 01h: Restart after a set time 02h: No restart block (**default setting**) 03h: Restart button switches field set, restart after a set time 04h: Restart button switches field set, no restart block 05h: LMS2xx operates as a slave, restart after a set time 06h: LMS2xx operates as a slave, immediate restart *Bit 5:* 0: No motor flap (**default setting**) 1: Use motor flap (output A controls the motor flap, output A cannot be used for evaluating the field) *Bit 6:* 0: No master (**default setting**) 1: Master (output C outputs the synchronisation cycle) *Bit 7:* 0: Time basis for restart 1 s (**default setting**) 1: Time basis for restart 1/10 s
	Hex. value	xxh
J Restart time	**Data class**	BYTE
	Content	In mode 01h, the time is transmitted in s or 1/10 s, after which LMS2xx frees the outputs if field A is free. This parameter is not relevant to the other two modes. **Default setting: 02h**
	Hex. value	xxh
K 2nd multiple evaluation for suppressed objects	**Data class**	BYTE
	Content	Multiple evaluation for objects that are smaller than the blanking size. Only effective when the "blanking" option has been selected. Not active: 0 (**default setting**) Minimum setting: 1 Maximum setting: 255
	Hex. value	xxh (00h to FFh)

Table 7-122: Parameter data for command 77h (*Table 7-121*) (contd.)

Block	Parameter data for command 77h	
L Contour A as reference	**Data class**	BYTE
	Content	0: 00h Function not active (**default setting**) 1 to 255: 01h to FFh Function is active and is monitoring field A in both directions within a tolerance band and angular range. The minimum object size (in cm) that is to be detected is defined here (same process as defining the blanking).
	Hex. value	xxh (00h to FFh)
M Contour A as a positive tolerance band	**Data class**	BYTE
	Content	When the contour function is active, the positive tolerance band is defined in cm. **Default setting: 0Ah**
	Hex. value	xxh
N Contour A as a negative tolerance band	**Data class**	BYTE
	Content	When the contour function is active, the negative tolerance band is defined in cm. **Default setting: 0Ah**
	Hex. value	xxh
O Contour A start angle	**Data class**	BYTE
	Content	When the contour function is active, the start angle of the area to be monitored is defined in ° (degrees). **Default setting: 50h**
	Hex. value	xxh
P Contour A stop angle	**Data class**	BYTE
	Content	When the contour function is active, the stop angle (incl.) of the area to be monitored is defined in ° (degrees). **Default setting: 64h**
	Hex. value	xxh
Q Contour B as reference	**Data class**	BYTE
	Content	0: 00h Function not active (**default setting**). 1 to 255: 01h to FFh Function is active and is monitoring field B in both directions within a tolerance band and angular range. The minimum object size (in cm) that is to be detected is defined here (same process as defining the blanking).
	Hex. value	xxh (00h to FFh)
R Contour B as a positive tolerance band	**Data class**	BYTE
	Content	When the contour function is active, the positive tolerance band is defined in cm. **Default setting: 0Ah**
	Hex. value	xxh
S Contour B as a negative tolerance band	**Data class**	BYTE
	Content	When the contour function is active, the negative tolerance band is defined in cm. **Default setting: 0Ah**
	Hex. value	xxh
T Contour B start angle	**Data class**	BYTE
	Content	When the contour function is active, the start angle of the area to be monitored is defined in ° (degrees). **Default setting: 50h**
	Hex. value	xxh
U Contour B stop angle	**Data class**	BYTE
	Content	When the contour function is active, the stop angle (incl.) of the area to be monitored is defined in ° (degrees). **Default setting: 64h**
	Hex. value	xxh

Table 7-122: Parameter data for command 77h (*Table 7-121*) (contd.)

Block	Parameter data for command 77h	
V Contour C as reference	**Data class**	BYTE
	Content	0: 00h Function not active (**default setting**). 1 to 255: 01h to FFh Function is active and is monitoring field C in both directions within a tolerance band and angular range. The minimum object size (in cm) that is to be detected is defined here (same process as defining the blanking).
	Hex. value	xxh (00h to FFh)
W Contour C as a positive tolerance band	**Data class**	BYTE
	Content	When the contour function is active, the positive tolerance band is defined in cm. **Default setting: 0Ah**
	Hex. value	xxh
X Contour C as a negative tolerance band	**Data class**	BYTE
	Content	When the contour function is active, the negative tolerance band is defined in cm. **Default setting: 0Ah**
	Hex. value	xxh
Y Contour C start angle	**Data class**	BYTE
	Content	When the contour function is active, the start angle of the area to be monitored is defined in ° (degrees). **Default setting: 50h**
	Hex. value	xxh
Z Contour C stop angle	**Data class**	BYTE
	Content	When the contour function is active, the stop angle (incl.) of the area to be monitored is defined in ° (degrees). **Default setting: 64h**
	Hex. value	xxh
A1 Pixel-oriented evaluation	**Data class**	BYTE
	Content	00h: Evaluation is not pixel-oriented (**default setting**) 01h: Pixel-oriented evaluation is active
	Hex. value	00h, 01h
A2 Mode for single measured value evaluation	**Data class**	BYTE
	Content	00h: Evaluation of single measurements without threshold fade-out (**default setting**) 00h: Evaluation of single measurements with threshold fade-out and a fixed amplitude. Requested mean values are always faded out.
	Hex. value	00h, 01h
A3 Restart times for fields B and C	**Data class**	WORD
	Content	Low byte: In restart mode 01h, the time is defined in s or 1/10 s, after which the LMS2xx frees the outputs if field B is free. High byte: In restart mode 01h, the time is defined in s or 1/10 s, after which the LMS2xx frees the outputs if field C is free. **Default setting: 00h**
	Hex. value	xx xxh
A4 Multiple evaluation of dazzling	**Data class**	WORD
	Content	Number of scans that take place before the LMS2xx switches the outputs when dazzling occurs. This parameter only applies to availability level 1. Range: 1 to 255 **Default setting: 2**
	Hex. value	xx xxh (00 00h to 00 FFh)

Table 7-122: Parameter data for command 77h (*Table 7-121*) (contd.)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6 to 39	40	41
Hex. value	02	00	23	00	77	00 00 46 00 00 00 01 00 00 02 02 02 00 00 0A 0A 50 64 00 0A 0A 50 80 00 0A 0A 50 64 00 00 00 00 02 00	7B	4B

Table 7-123: Complete telegram for command 77h (*Table 7-121, page 96*)

7.46.2 Response F7h from the LMS2xx: Confirmation of the Configuration (Part 1)

The LMS2xx provides information on the LMS configuration.

	Response	Parameter data	
Data class	BYTE	BYTE	Same parameter set as for command 77h, *Section 7.46.1, page 96*
Content	Confirmation of the definition of the LMS configuration	00h: LMS configuration not accepted. 01h: LMS configuration received the definition is activated in LMS2xx.	
Hex. value	F7h	00h, 01h	

Table 7-124: Response F7h from the LMS2xx (confirmation of the configuration)

Note For Confirmation of Extended LMS Configuration (continued) see *Chapter 7.51 Configure the LMS2xx (Part 2, Continued), Page 104*

7.47 Command 78h / Response F8h

Reserved

7.48 Command 79h / Response F9h

Reserved

7.49 Command 7Ah / Response FAh

Reserved

7.50 Request the LMS Configuration (Part 2, Continued)

7.50.1 Command 7Bh to LMS2xx: Request the LMS Configuration Data (Part 2)

This command requests the saved LMS configuration.

	Command	Parameter data
Data class	BYTE	No further data
Content	Request for the extended LMS configuration	
Hex. value	7Bh	

Table 7-125: Command 7Bh (request the LMS configuration)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	-	6	7
Hex. value	02	00	01	00	7B	-	5F	12

Table 7-126: Complete telegram for command 7Bh (*Table 7-108*)

7.50.2 Response FBh from the LMS2xx: Output the LMS Configuration (Part 2)

	Response	Parameter data
Data class	BYTE	Same parameter set as for command 7Ch (*Section 7.51.1, page 104*)
Content	Output of the current extended LMS configuration	
Hex. value	FBh	

Table 7-127: Response FBh from the LMS2xx (output the LMS configuration)

Example of a complete telegram (standard devices):

Description	STX	Address	Length		Response	Data		Checksum	
						Data	LMS status		
Byte position	1	2	3	4	5	6 to 89	90	91	92
Hex. value	02	80	56	00	FB	00 ... 00	10	59	B9

Table 7-128: Complete telegram for response FBh (*Table 7-110*)

7.51 Configure the LMS2xx (Part 2, Continued)

7.51.1 Command 7Ch to LMS2xx: Configure the LMS2xx (Part 2, Continued)

	Command	Parameter data
Data class	BYTE	See *Table 7-130*, (block A to D).
Content	LMS configuration (cont.)	
Hex. value	7Ch	

Table 7-129: Command 7Ch (configure the LMS2xx (continued))

Block	Parameter data for command 7Ch	
A Contour	**Data class**	BYTE
	Content	Bit 0: "Contour on plain" 1: "Contour on plain" activated 0: The contour is processed radially (LMS211/221/291 only) For LMS 200/220, the flag must be deselected! **Default setting: 0** Bit 1 ... 7: reserved
	Hex. value	xxh
B Pitch angle field A	**Data class**	CHAR
	Content	Field A: Only applicable when "Contour on plain" is activated. The pitch angle is entered in ° (degrees). Value range –90° to +90° For LMS200/220: must be 0! **Default setting: 0**
	Hex. value	xxh
C Pitch angle field B	**Data class**	CHAR
	Content	Field B: Only applicable when "Contour on plain" is activated. The pitch angle is entered in ° (degrees). Value range –90° to +90° For LMS200/220: must be 0! **Default setting: 0**
	Hex. value	xxh
D Pitch angle field C	**Data class**	CHAR
	Content	Field C: Only applicable when "Contour on plain" is activated. The pitch angle is entered in ° (degrees). Value range –90° to +90° For LMS200/220: must be 0! **Default setting: 0**
	Hex. value	xxh

Table 7-130: Parameter data for command 7Ch (*Table 7-129*)

Block	Parameter data for command 7Ch	
E Offset of multiple evaluation of field 2	**Data class**	CHAR
	Content	Offset for multiple evaluation of field set 2: Only applicable when field set 2 is activated. Value range –124 to +124. **ATTENTION: The addition of this parameter and the "Multiple evaluation" parameter (Block H in the command 77h) must be in the range of 1 to 125!** *Example 1*: E = 25, H = 10. This means, the number of multiple evaluation of field set 2 (offset) is by 15 higher as the number of multiple evaluation of field set 1. The addition of the multiple evaluation is 35. *Example 2*: E = –10, H = 25. This means, the number of multiple evaluation of field set 2 (offset) is by 1o smaller as the number of multiple evaluation of field set 1. The addition of the multiple evaluation is 15. Not allowed is e. g. E = –20, H = 10. As the result, the addition of the multiple evaluation would be –10. This does not meet the rule above. **Default setting: 0**
	Hex. value	xxh
F Indication of front window contamination on output C	**Data class**	BYTE
	Content	For special devices LMS211/221-S19/-S20 only! Indicates the contamination level of the front window via the switching output „OUT C" by changing the statical signal. If the master function for the synchronisation of two LMS2xx has been enabled, this setting has priority. 0: No contamination 1: Contamination warning 2: Contamination error Value range 0 to 2 **Default setting: 0**
	Hex. value	xxh
G	**Data class**	BYTE (78), array of 78 Bytes
	Content	Reserved for extentions in the future
	Hex. value	00 00 00 00 ... 00h (78 bytes consist of the same content "00")

Table 7-130: Parameter data for command 7Ch (*Table 7-129*)

Example of a complete telegram:

Description	STX	Address	Length		Command	Data	Checksum	
Byte position	1	2	3	4	5	6 to 89	90	91
Hex. value	02	00	55	00	7C	00 ... 00	0E	9E

Table 7-131: Complete telegram for 7Ch (*Table 7-129*)

7.51.2 Response FCh from the LMS2xx: Confirmation of the Configuration (Part 2, Continued)

	Response	**Parameter data**	
Data class	BYTE	BYTE	Same parameter set as for command 7Ch, *Section 7.51.1, page 104*
Content	Confirmation LMS configuration (continued)	00h: LMS configuration not accepted 01h: LMS configuration accepted and activated	
Hex. value	FCh	xxh (00h, 01h)	

Table 7-132: Response FCh from the LMS2xx (confirmation of the configuration (continued))

8 Receive Telegrams

8.1 Structure of the Status Bytes

The status byte comprises 8 bits.

Bit number	7	6	5	4	3	2	1	0
Binary value in 2^n	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Hex. value	00 to FF							

Table 8-1: Structure of the status bytes

Combining bits 0, 1, and 2 results in values from 0 to 4, which are evaluated as follows:

Bit 2	**Bit 1**	**Bit 0**	**Decimal value**	**Meaning**
0	0	0	**0**	No errors
0	0	1	**1**	Info
0	1	0	**2**	Warning
0	1	1	**3**	Error
1	0	0	**4**	Fatal Error

Table 8-2: Bits 0, 1, and 2 of the status byte

Bits 3 and 4 describe the data sources. The following matrix applies:

Bit 4	**Bit 3**	
0	0	Reserved
0	1	Reserved
1	0	LMS type 6
1	1	Special device

Table 8-3: Bits 3 and 4 of the status byte

Bit 5 Status of the RESTART input:
1: HIGH
0: LOW

Bit 6 Implausible measured values

Bit 7 Pollution

9 Structure of the Checksums

```
/************************************************************
FUNCTION: Signature formation via CRC16 polynomial generator

unsigned int build_crc16 (unsigned char * CommData, unsigned int len)

DESCRIPTION
   Forms the checksum by means of CRC16_GEN_POL.
   The following algorithm is used for a 16-bit checksum via the BYTE-oriented
   buffer:
   CRC_sum[High BYTE] = CRC_sum[Low BYTE]
   CRC_sum[Low BYTE] = new data BYTE
   Formation of the 16-bit CRC via CRC_sum

The following polynomial generator is used: x16 + x15 + x2 + 1
CRC16_GEN_POL         EQU 8005H      ;
This constant is equal to x15 + x2 + 1,  x16 is in the CARRY flag
Implementation in assembler for INTEL 80C196
************************************************************/

unsigned int build_crc16 (unsigned char *CommData, unsigned int uLen)
{
unsigned int uCrc16 = 0;                    /* Signature register */
unsigned int crc_data = 0;                  /* Current date */
static register unsigned int reg_len = uLen;
unsigned char *reg_data_ptr;                /* Pointer to transferred data */

  reg_data_ptr = CommData;  /* Load transfer values from stack to register RAM */

/* Calculate CRC16 checksum */
CONT_CRC16:
     asm SHL   crc_data, #8;                /*Shift low byte to high byte */
     asm LDB   crc_data, [reg_data_ptr]+;   /*Load next byte and auto-increment */
     asm SHL   uCrc16, #1;                  /* Shift signature register one place to the left */
     asm BNC   NO_CARRY_SET;                /* Interrogate the set CARRY flag */
     asm XOR   uCrc16, #CRC16_GEN_POL;  /* If CARRY is set, XOR with polynomial gen. */
NO_CARRY_SET:
     asm XOR   uCrc16, crc_data;            /* XOR the current date with signature reg. */
     asm DEC   reg_len;                     /* Continue loop until all data processed */
     asm BNE   CONT_CRC16;
END_CRC16:
     return (uCrc16);                  /*return value is CRC16 checksum of data flow. */
```



```
}
```

Irrespective of the implementation, this ANSI C function appears as follows:

```
#define CRC16_GEN_POL  0x8005
#define MKSHORT(a,b)   ((unsigned short) (a) | ((unsigned short)(b) << 8))
/* ::-----------------------------------------------------------------
:: FN: CreateCRC;  CRC in  ANSI - C
:: Synopsis: static void CreateCRC(BYTE *CommData,WORD uLen)
:: Function:  formation of the CRC16 checksum.
-----------------------------------------------------------------*/
static WORD  CreateCRC(unsigned char *CommData, unsigned int uLen )
{
unsigned short uCrc16:
unsigned char abData[2];

  uCrc16 = 0;
  abData[0] =  0;
  while (uLen-- )
  {
    abData[1] = abData[0];
    abData[0] = *CommData++;
    if(uCrc16 & 0x8000)
    {
      uCrc16  = (uCrc16 & 0x7fff) << 1;
      uCrc16 ^= CRC16_GEN_POL;
    }
    else
    {
      uCrc16 <<= 1;
    }
    uCrc16 ^=  MKSHORT (abData[0] , abData[1]);
  }
  return(uCrc16);
}
```

10 Appendix

10.1 Overview

The appendix contains the following additional information:

- Terminology
- Electrical Connection
- Overview: Command Availability List
- List of Standard Types Available
- Delivered Condition of the LMS2xx
- Overflow Values
- Data Transmission Rates/Number of Scans Transmitted
- Scan Time Sequence
- Error List for the LMS2xx

10.2 Terminology

Angular Resolution

The angular resolution is the scanning steps into which the field of vision can be divided. With laser scanners in the LMS2xx range (except types LMS211/221/291-S14), predefined angular resolutions of 0.25°; 0.5°, and 1° are possible.

Blanking

Set as a "blanking factor" in "cm". The blanking factor determines the minimum object size that triggers a message at the switching outputs.

Note Blanking is only possible in scan-oriented evaluations (not pixel-oriented evaluations, see *below*)

Contour as Reference

This function also monitors the area around a monitoring field (background). An object (e.g. wall of a building) is constantly checked to ensure that it still "exists". If the contour is missing, the switching output is activated, even if the field has not been infringed.
The validity range of the reference contour can be set as required: the minimum object size specifies how many consecutive centimetres of a reference contour can be "lost" before a switching signal is set. The positive/negative tolerance provides a corridor for the measured values of the LMS2xx to capture its tolerances or compensate for contour variations (positive = tolerance range for larger measured values = contour measured at a greater distance; negative = tolerance range for smaller measured values = contour measured at a closer distance). Measured values outside the corridor are evaluated as a loss of contour. This function can be used to protect against sabotage. The standard field evaluation is always used outside the defined corridor.

Distance Resolution

The resolution of a laser scanner specifies the level of precision with which a distance value is determined and output. With time-of-flight measurement, this largely depends on the counter resolution ("stopwatch").

Edge Strike/Halo Effect Around the Measured Object

The LMS2xx laser scanners have a defined spot diameter, the size of which increases with distance. As a non-contact scanning, light-based measuring device, the LMS2xx requires a specific return energy to stop the time-of-flight measurement. This results in a correlation between the reflectivity of the object and the measurable distance. The further away the measured object is, the brighter the object must be. When distances are measured, the system always assumes a full spot strike on the measured object. In theory, a brighter object a short distance away does not require the full spot area to trigger the distance measurement.

Example:

The LMS2xx requires a reflectivity value of 10 % at a measuring distance of 10 m (32.8 ft). For a measured object with a reflectivity value of 100 %, only 10 % of the spot area would theoretically be required to trigger the object measurement. In practice, a measurement is also triggered on a sufficiently bright object that is smaller than the spot diameter.

Due to the internal corrections to the raw measured values (see *" „Output Measured Value“", page 113*), distance values can arise that are outside the specified error tolerance limits (partial spots on the measured object).

This is also the case with edge strikes on an object. Because the energy values are also taken into account when the measured values are corrected, the measured distance values may be outside the specified measurement tolerance above the measured object. This occurs when the edge strike and the background are within the length of the measurement pulse (approx. 1 m (3.28 ft)). In this case, the received energy measured returns an "incorrect" correction value. The formula provided under *„Output Measured Value“ , page 113* shows that the correction factors influence the measured values. A definitive statement regarding the measurement accuracy cannot be made because of the different applications.

Edge strikes or objects smaller than the spot diameter can result in measured values that are above the measured object, on the measured object, between the measured object and the background, or on the background. Because it is not easy to determine the reflectivity value of a measured object, and the correction factors are device specific, no statement can be made regarding the accuracy of the LMS2xx with partial spots or thin objects.

ATTENTION

A distance measurement is triggered on a measuring beam if an object is located in the beam. The measured value lies exactly within the specified tolerances, provided that the beam hits the object with a full radial spot diameter.

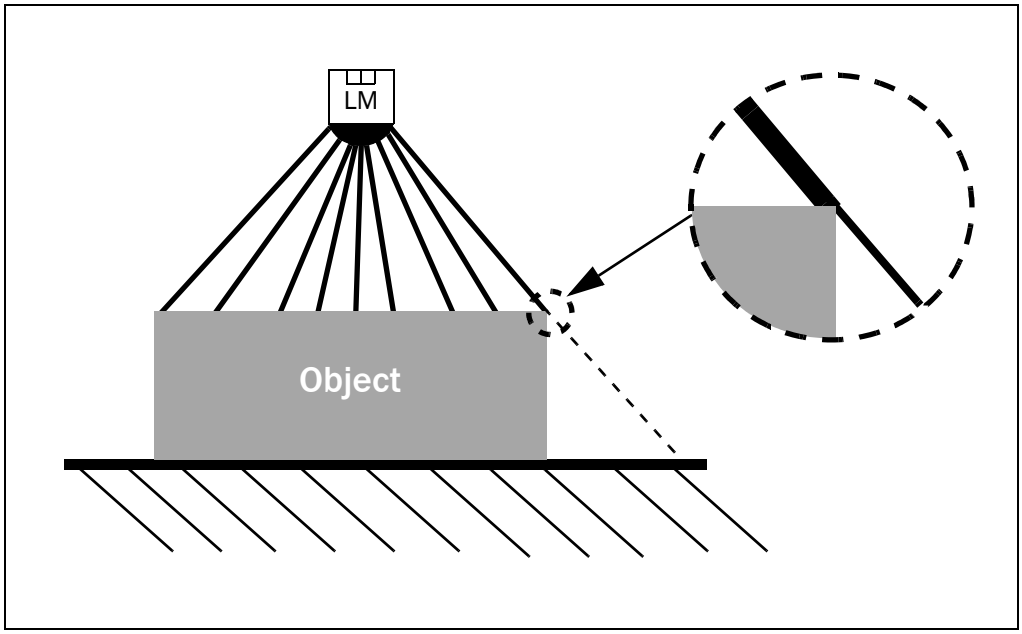


Fig. 10-1: Edge strike

Field (Temporary)

The shape of a field can be defined and activated online via the user interface by means of external data information. Transfer time approx. 200 ms (the field is described as "temporary" because the field data is lost as soon as the power supply is switched off).

Field Evaluation

To prevent interference from particles, for example, a number of different procedures are used to evaluate the fields (scan/pixel-oriented, see *below*).

Field Evaluation (Pixel Oriented)

Unlike scan-oriented evaluation, pixel-oriented evaluation involves evaluating and storing each individual beam from the laser scanner. If further infringements occur consecutively

in the stored beam (pixel), the associated switching signal is set. This method is ideally suited for increasing availability during rain or snow.

Field Evaluation (Scan Oriented)

In scan-oriented evaluation, a field infringement (wherever it occurs) is stored and verified by means of multiple readings. If further infringements are reported in subsequent scans, the corresponding field switching output is activated in accordance with the number of set multiple readings.

Field Infringement

An object is detected within a specified monitoring field.

Field of Vision

The field of vision is defined by means of the maximum aperture angle of the LMS2xx. The maximum distance is defined by the distance resolutions of 8 m (26.2 ft)/16 m (52.49 ft)/ 32 m (104.98ft)/80 m (262.64 ft). The angular resolution also determines the field of vision. At an angular resolution of 0.25°, the field of vision is reduced to 100°.

Fields/Monitoring Fields

Freely programmable zones (areas). Objects that the LMS2xx detects in a field trigger a switching signal at its outputs.

Fields, Teach In

Instead of programming fields, the data can be "taught in" with the "segmented fields" setting. The LMS2xx defines its entire free field of vision as a monitoring area. This function is very useful for protecting large fields, such as facades. The field limit follows the environment contour precisely and ensures the largest possible coverage. Field areas that are not required (e.g. the outermost edges) can be deleted with a few simple steps in the "LMSIBS" user software ("Cut" function).

Field Set

A field set comprises 3 individual monitoring fields (fields A, B, and C).

Field Set Switchover

Switchover between different field sets. Either field set 1 or field set 2 is active in the LMS2xx. The field set switchover is carried out via the restart input (24 V DC, static). You can also use commands (telegrams) to switch between field sets.

Fields (Subtractive)

When field B is subtracted from field A, this function enables the remaining area to be monitored.

Halo Effect Around the Measured Object

A halo effect occurs when the measured object is smaller than the spot diameter. The effects of this are described under *"Edge Strike/Halo Effect Around the Measured Object"*.

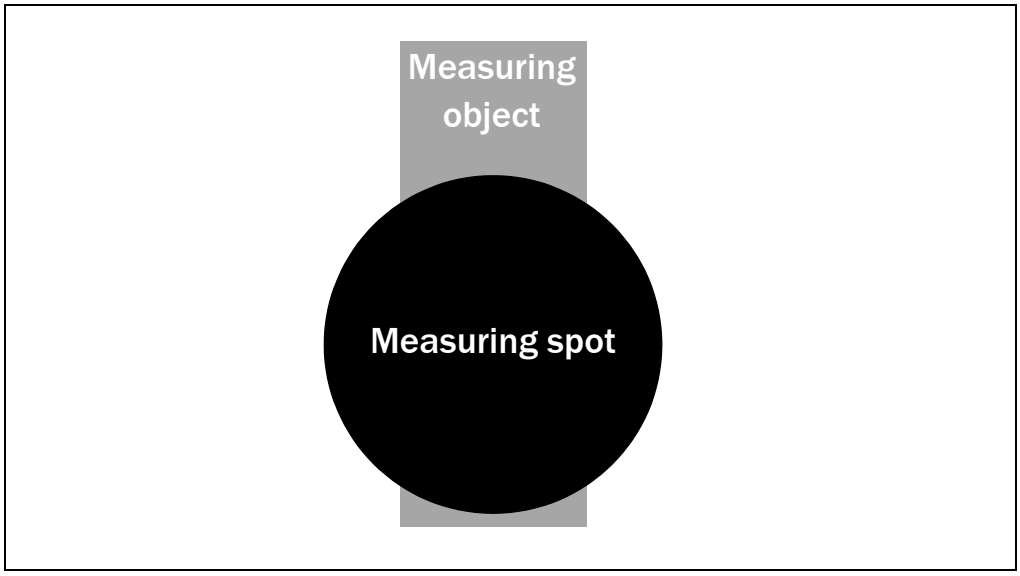


Fig. 10-2: Halo effect around the measured object due to a larger spot diameter

Master

Refers to the LMS2xx that is defined as the master in the configuration. The master outputs the synchronisation signal at output C.

Output Measured Value

The measured value that is output is the raw measured value that has been corrected internally.

Output measured value = raw measured value + distance correction in accordance with the internal distance table + correction in accordance with the internal received energy table.

Measured values are corrected by the system on the basis of the assumption that there is **always** one full spot strike.

Reflectivity

Refers to the reflective quality of an object and is based on the internationally recognised KODAK standard for photography (see also *Technical Description of the LMS 200 to LMS 291 Laser Measurement Systems*)

Restart, after a set time

The associated switching output is activated after a set time delay has elapsed (when the field is free).

Restart, automatic

The associated field switching output is activated as soon as the field becomes free.

Restart, with button

The associated switching output is activated when the external button is actuated (when the field is free).

Slave

Refers to the LMS2xx that is defined as the slave in the configuration. The slave receives the synchronisation signal from the master at its restart input.

Spot

The spot is the part of the object surface that the beam strikes. Ideally, it should be round.

- The following applies to devices in the LMS200/220 series:
  The spot diameter on the outlet disc is 12 mm (0.47 in), the divergence is 4.4 mrad.
- The following applies to devices in the LMS211/221/291 series:
  The spot diameter on the outlet disc is 16 mm (0.63 in), the divergence is 11.9 mrad.

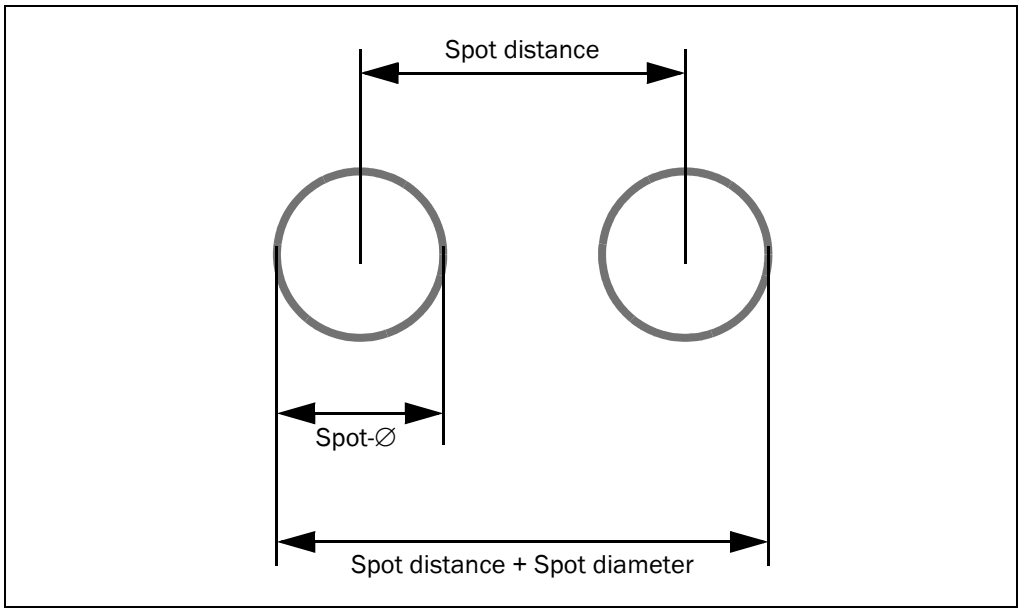


Fig. 10-3: Spot diameter and spot distance

Distance in m	Spot diameter in cm[1)]		Spot distance in cm[2)]		
	LMS200/220	LMS211/221/291	0.25°	0.5°	1°
1	2	3	0.5	0.9	1.8
2	3	4	0.9	1.8	3.5
3	3	6	1.4	2.7	5.3
4	3	7	1.8	3.5	7.0
5	4	8	2.2	4.4	8.8
6	4	9	2.7	5.3	10.5
7	5	10	3.1	6.2	12.3
8	5	12	3.5	7.0	14.0
9	6	13	4.0	7.9	15.8
10	6	14	4.4	8.8	17.5
15	8	20	6.6	13.1	26.2
20	10	26	8.8	17.5	35.0
25	13	32	11.0	21.9	43.7
30	15	38	13.1	26.2	52.4
40	19	50	17.5	35.0	69.9
50	24	62	21.9	43.7	87.3

Table 10-1: Device-specific spot diameter and distance

Distance in m	Spot diameter in cm[1)]		Spot distance in cm[2)]		
	LMS200/220	LMS211/221/291	0.25°	0.5°	1°
60	28	73	26.2	52.4	104.8
70	32	85	30.6	61.1	122.2
80	37	97	35.0	69.9	139.7
1) Rounded up to the next full cm 2) Rounded up to the next decimal point					

Table 10-1: Device-specific spot diameter and distance (contd.)

Synchronisation

If two LMS2xx are used next to one another (distance < 6 m (19.7 ft)), cross-interference may occur. Synchronisation ensures that the mirror wheels of the two LMS2xx are harmonised. The mirrors then rotate synchronously with an offset of 180°. In the user software, ("LMSIBS"), one LMS2xx is defined as the master, and one as the slave (for the electrical connections, see *Technical Description "LMS 200 to LMS 291 Laser Measurement Systems"*).

10.3 Electrical Connection

10.3.1 Required Components

The following device-specific accessories are required to ensure reliable data transmission:

LMS200/LMS291

Order number	Description	Product description
1015850	**LMS200-30106**	1 x LMS2xx with connector
1018028	**LMS291-S05**	
1025329	**LMS291-S14**	
1026226	**LMS291-S15**	
6022427	24 V DC/2.1 A power supply unit	1 x 24 V DC power supply unit ± 15 %, min. 2.1 A
2027786	Connection set 2: Length: 5 m (16.4 ft)	1 x cable for the power supply/switching outputs (open cable ends) 1 x data cable (configured to RS 232)
2027787	Connection set 3: Length: 10 m (32.8 ft)	

Table 10-2: Accessories for LMS200/LMS291

LMS211/LMS220/LMS221

Order number	Description	Product description
1025629	**LMS211-30106**	1 x LMS2xx with connector
1018023	**LMS211-30206**	
1018966	**LMS211-S07**	
1025487	**LMS211-S14**	
1026225	**LMS211-S15**	
1040061	**LMS211-S19**	
1040435	**LMS211-S20**	
1015945	LMS220-30106	
1026000	**LMS221-30106**	
1018022	**LMS221-30206**	
1018965	**LMS221-S07**	
1025328	**LMS221-S14**	
1026224	**LMS221-S15**	
1027192	**LMS221-S16**	
1040060	**LMS221-S19**	
1040434	**LMS221-S20**	
6022427	24 V DC/2.1 A power supply unit	1 x 24 V DC power supply unit ± 15 %, min. 2.1 A for the LMS2xx electronics
2027786	24 V DC/10 A power supply unit	1 x 24 V DC power supply unit ± 15 %, min. 5 A for the LMS2xx heater
2019561	Parameterisation cable, length 5 m (16.4 ft)	1 x cable for the power supply and switching outputs 1 x data line

Table 10-3: Accessories for LMS211/LMS220/LMS221

Note If longer cables are required, these must be supplied by the user.
Ensure that you use the appropriate cross-sections to prevent voltage drops along the cables!

A wide range of mounting accessories is available.

You require a laptop or PC as user interface with the LMS2xx.
A simple connection via the serial data interface enables communication.

- RS 232 interface (up to 10 m (32.8 ft)), standard COM1 or COM2 on most PCs
- RS 422 interface (up to 300 m (984.24 ft)), special interface card required for PC

If you require high-speed data transmission with 500 KBd, SICK offers the appropriate interface cards as accessories.

10.3.2 Power Supply

The LMS2xx are supplied with 24 V DC ± 15 %. The appropriate supply current must be provided in accordance with the length of the power supply cable.

Due to the shape of the housing, the connection diagrams for the LMS200/LMS291 and LMS220/LMS211/LMS221 are different.

LMS200/LMS291

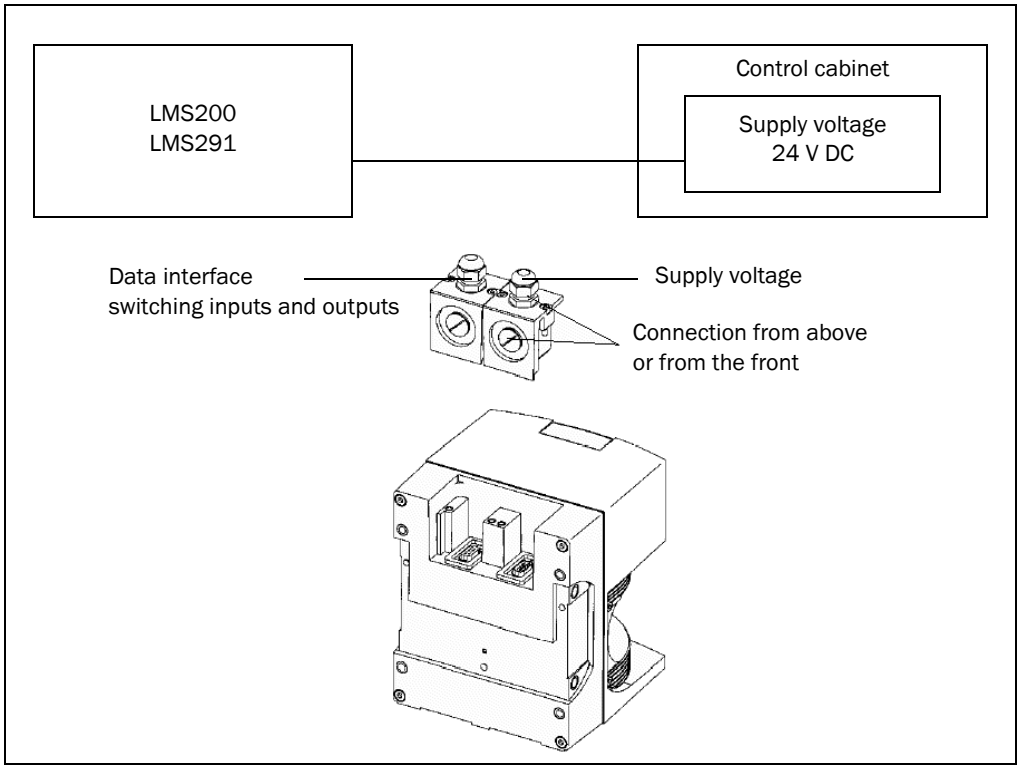


Fig. 10-4: Connecting the power supply to the LMS200/LMS291

Pin	Signal	Input/Output	Wire colour*)
1	**GND_EXT (ground)**	**Power supply**	**Brown**
2	**Restart**	**Input**	**Black**
3	**VCC_EXT (24 V DC ± 15 %)**	**Power supply**	**Red**
4	Not assigned	-	-
5	OUT C (with field assignment) or weak signal	Output	Yellow
6	Not assigned	-	-
7	Not assigned	-	-
8	OUT B (for fields)	Output	Green
9	OUT A (for fields)	Output	Orange
*) "Power supply/Switching inputs/outputs" cable of connection set 2 (no. 2027786) and set 3 (no. 2027787)			

Table 10-4: Pin assignment for LMS200/LMS291

Note The pins highlighted in grey must be connected for the minimum configuration.

LMS211/LMS220/LMS221 (Digital Switching Outputs)

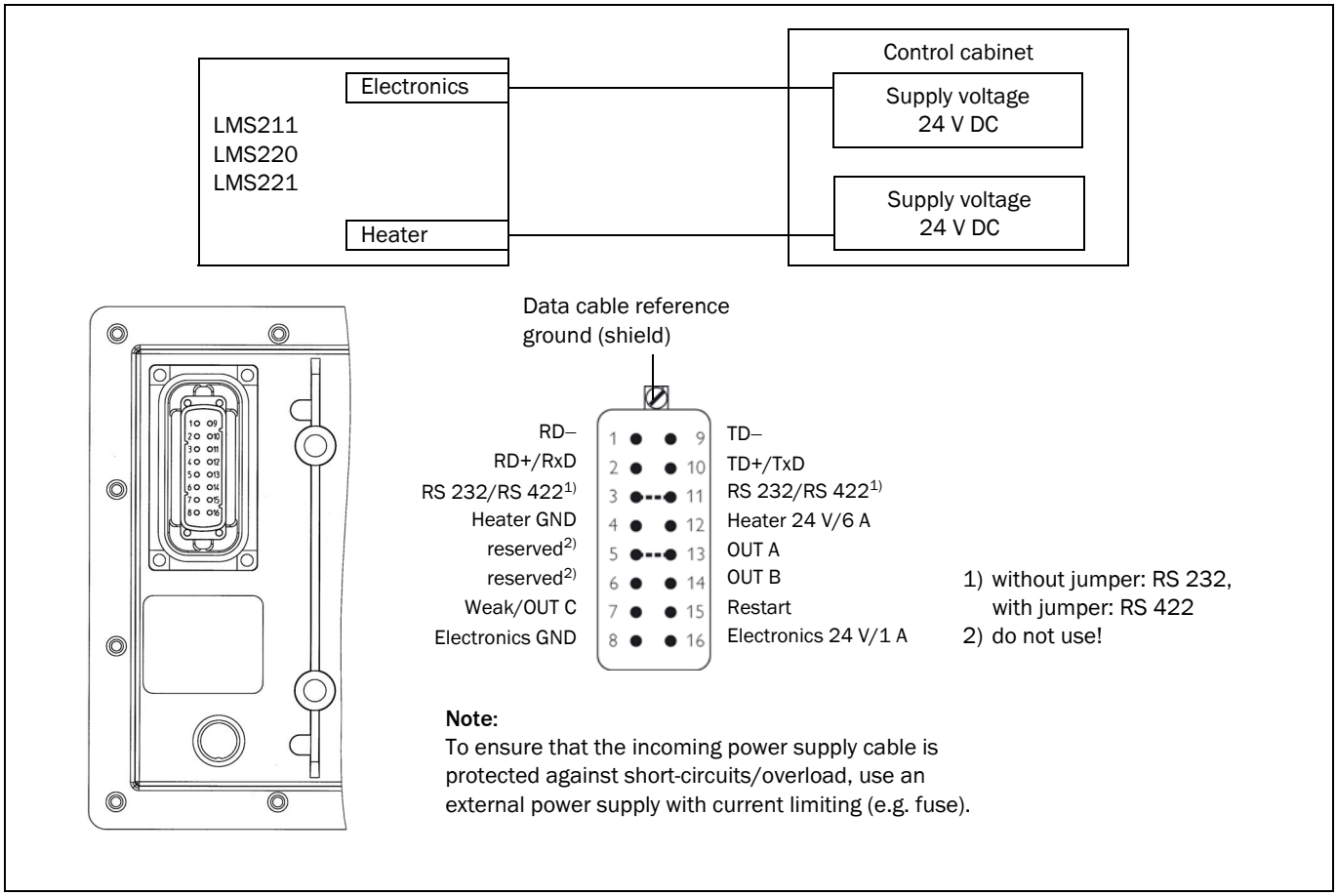


Fig. 10-5: Connecting the power supply to the LMS211/LMS220/LMS221 (digital switching outputs)

Pin	Signal	Input/Output	Note
1	RD–	Data interface	
2	RD+/RxD	Data interface	
3	RS 232/422 jumper 1		With jumper: RS 422 Without jumper: RS 232 (default)
4	GND_EXT for heater	Power supply unit	
5	Reserved	–	Do not use
6	Reserved	–	Do not use
7	OUT C (for field) or weak signal	Switching output	
8	**GND_EXT for electronics**	**Power supply unit**	
9	TD–	Data interface	
10	TD+/TxD	Data interface	
11	RS 232/422 jumper 2		
12	VCC_EXT for heater	Power supply unit	
13	OUT A (for field)	Switching output	
14	OUT B (for field)	Switching output	
15	Restart	Switching input	
16	**VCC_EXT for electronics**	**Power supply unit**	

Table 10-5: Pin assignment for LMS211/LMS220/LMS221 (digital switching outputs)

Note The pins highlighted in grey must be connected for the minimum configuration.

LMS211/LMS221-S07/-S20 (Relay Outputs/Digital Switching Output)

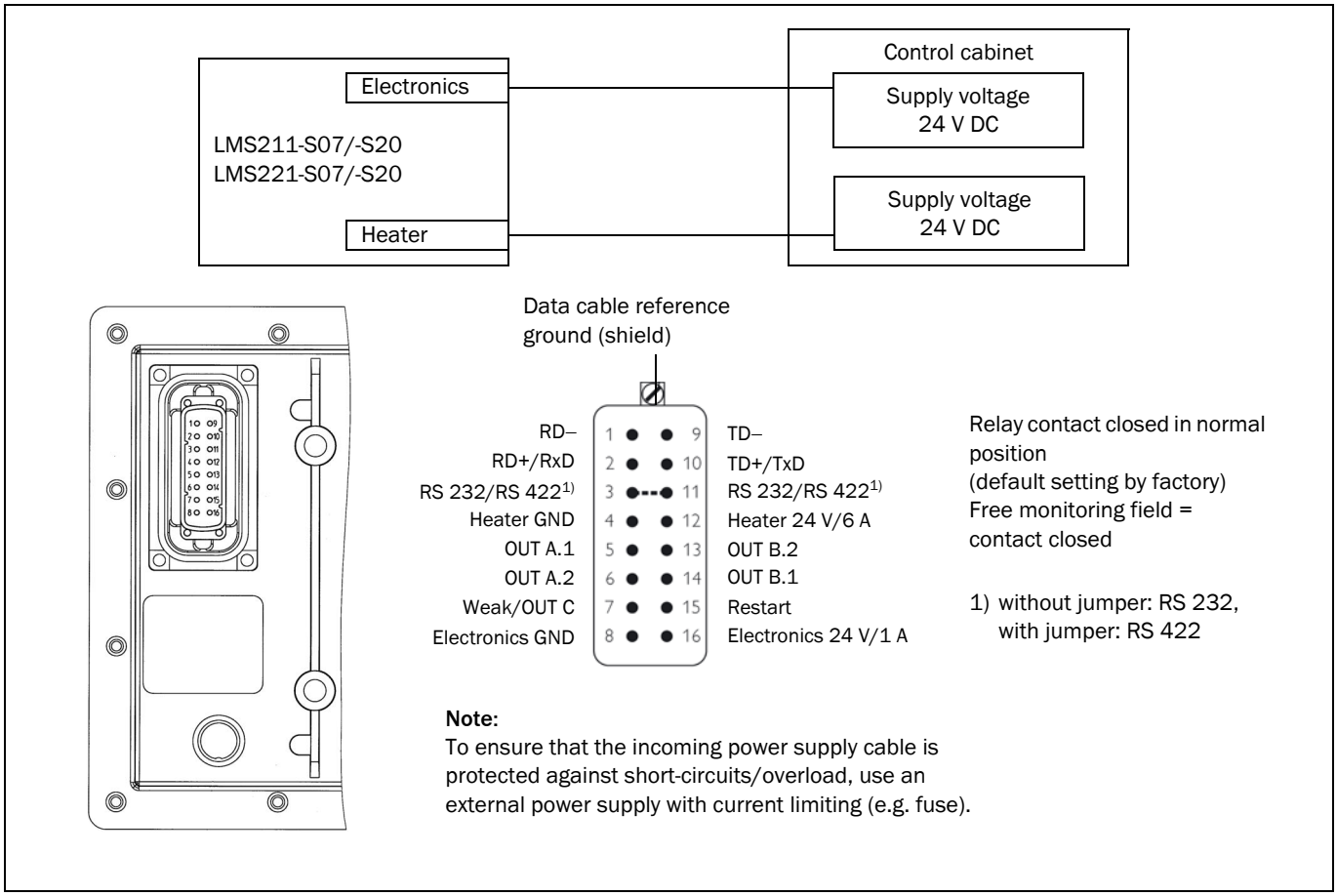


Fig. 10-6: Connecting the power supply to the LMS211/LMS221-S07/-S20 (relay outputs/digital switching output)

Pin	Signal	Input/Output	Note
1	RD–	Data interface	
2	RD+/RxD	Data interface	
3	RS 232/422 jumper 1		With jumper: RS 422 Without jumper: RS 232 (default)
4	GND_EXT for heater	Power supply unit	
5	OUT A.1 (for field)	Relay output	normal position: contact closed
6	OUT A.2 (for field)	Relay output	normal position: contact closed
7	OUT C (for field) or weak signal	Switching output	
8	**GND_EXT for electronics**	**Power supply unit**	
9	TD–	Data interface	
10	TD+/TxD	Data interface	
11	RS 232/422 jumper 2		
12	VCC_EXT for heater	Power supply unit	
13	OUT B.2 (for field)	Relay output	normal position: contact closed
14	OUT B.1 (for field)	Relay output	normal position: contact closed
15	Restart	Switching input	
16	**VCC_EXT for electronics**	**Power supply unit**	

Table 10-6: Pin assignment for LMS211/LMS221-S07/-S20 (relay outputs/digital switching output)

Note The pins highlighted in grey must be connected for the minimum configuration.

10.3.3 Data Interface for Serial Data Exchange

The LMS2xx range is equipped with an RS 232/422 data interface to support serial data exchange.

The RS 422 or RS 232 can be activated using the jumper in the connector.

➢ **Check whether the jumper is required.**

Connecting the RS 232 data interface

LMS200/LMS291:

LMS		Cable	PC	
Signal	**Pin**		**Pin**	**Signal**
Not assigned	1		1	NC
RxD	2		2	RxD
TXD	3		3	TXD
Not assigned	4		4	Not assigned
GND	5		5	GND
Not assigned	6		6	Not assigned
Not assigned	7		7	Not assigned
Not assigned	8		8	Not assigned
Not assigned	9		9	Not assigned

Table 10-7: LMS200/LMS291: connecting the RS 232 data interface to the PC

Note Pins 2 and 3 are crossed.
The connection on the PC is normally a 9-pin D Sub connector.

LMS211/LMS220/LMS221:

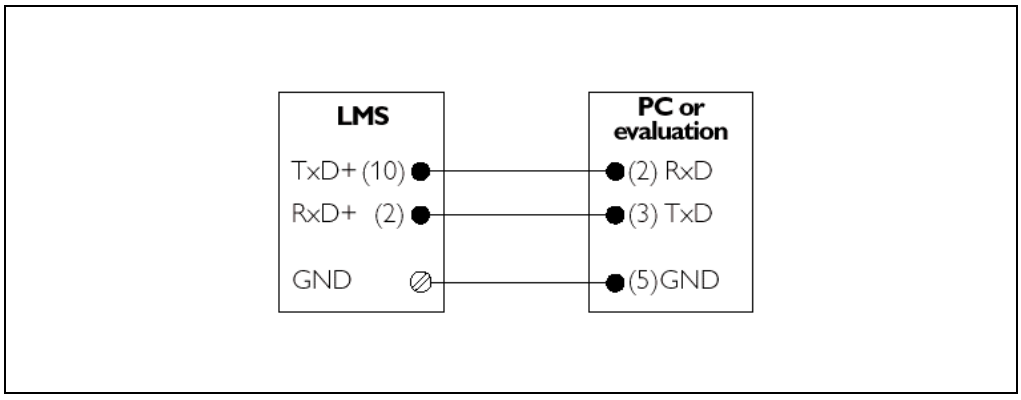


Fig. 10-7: LMS211/LMS220/LMS221: Connecting the RS 232 data interface to the PC

Note The connection on the PC is normally a 9-pin D Sub connector.

Connecting the RS 422 data interface

LMS200/LMS291:

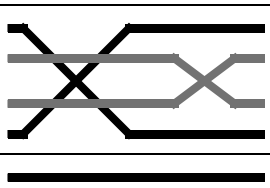
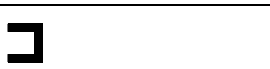
LMS		Cable	PC	
Signal	**Pin**		**Pin**	**Signal**
RxD–	1		1	RxD–
RxD+	2		2	RxD+
TxD+	3		3	TxD+
TxD–	4		4	TxD–
GND	5		5	GND
Not assigned	6		6	Not assigned
Jumper 1	7		7	Not assigned
Jumper 2	8		8	Not assigned
Not assigned	9		9	Not assigned

Table 10-8: LMS200/LMS291: Connecting the RS 422 data interface to the PC

Note No standard pin assignment exists for the RS 422 data interface.

- ➢ Check the signal designation and pin assignment of the RS 422 interface card. Refer to the manufacturer documentation for the RS 422 interface card.
- ➢ If you notice any discrepancies, alter the assignment accordingly.

To choose the RS 422 data interface, fit a jumper between pin 7 and 8 on the LMS side in the connector.
Pins 2 and 3, as well as 1 and 4 are crossed in the cable. You should use a twisted-pair cable.

LMS211/LMS220/LMS221:

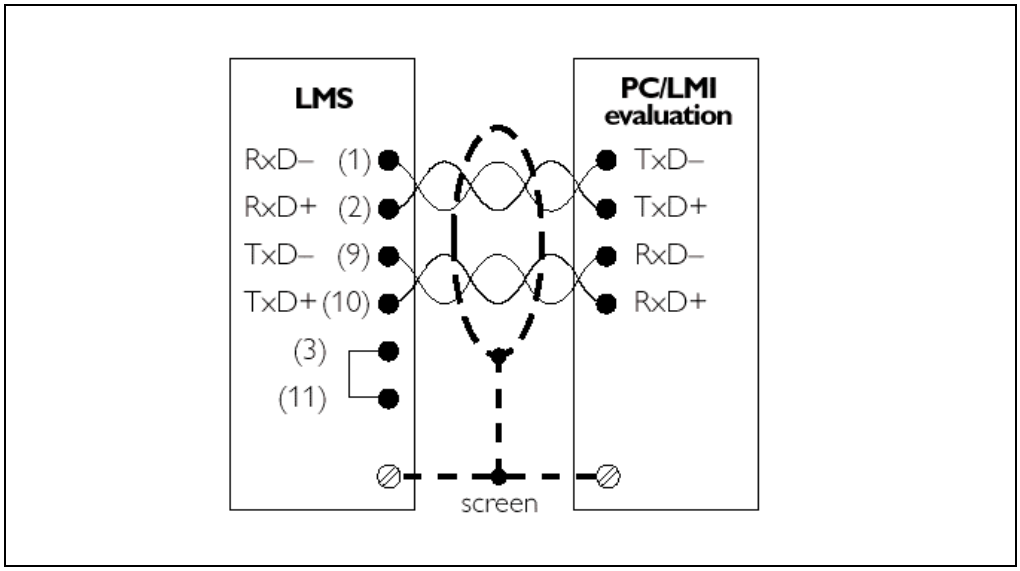


Fig. 10-8: LMS211/LMS220/LMS221: Connecting the RS 422 data interface to the PC

Note To choose the RS 422 data interface, you must fit a jumper between pin 3 and 11 on the LMS side in the connector.
Pins 2 and 3, as well as 1 and 4 are crossed in the cable. You should use a twisted-pair cable.

10.4 Availability of the Commands

Command/Action	Telegram no.: Command to LMS2xx	Telegram no.: Response from the LMS2xx	Operating mode			Device Type			See chapter/page
			Monitoring mode	Installation mode	Calibration mode	LMS type 1-5	LMS type 6	LMS special type 90°/0.5°	
Reserved	0Bh	-							7.1 / 37
Reserved	0Ch	-							7.2 / 37
Initialise and reset	10h	90h	X	X	X	X	X	X	7.3 / 38
Choose/switch operating mode	20h	A0h	X	X	X	X	X	X	7.4 / 40
Request measured values	30h	B0h	X	X	X	X	X	X	7.5 / 46
Request LMS status	31h	B1h	X	X	X	S	S	S	7.6 / 52
Request error/test telegram	32h	B2h	X	X	X	X	X	X	7.7 / 58
Reserved	33h	B3h							7.8 / 59
Reserved	34h	B4h							7.9 / 59
Request operating data counter	35h	B5h	X	X	X		X	X	7.10 / 60
Request mean measured values	36h	B6h	X	X	X	X	X	X	7.11 / 61
Request measured value sub-range	37h	B7h	X	X	X	X	X	X	7.12 / 63
Reserved	38h	B8h							7.13 / 64
Reserved	39h	B9h							7.14 / 64
Request LMS type	3Ah	BAh	X	X	X	X	X	X	7.15 / 65
Switch variant in the LMS2xx	3Bh	BBh	X	X	X		X	X	7.16 / 66
Reserved	3Ch	BCh							7.17 / 67
Reserved	3Dh	BDh							7.18 / 67
Request measured value with field values	3Eh	BEh	X	X	X		X		7.19 / 68
Request mean measured value sub-range	3Fh	BFh	X	X	X	X	X	X	7.20 / 70
Configure fields A, B, or C	40h	C0h		X	X		X		7.21 / 72
Switch active field set	41h	C1h	X	X	X		X		7.22 / 76
Change the password	42h	C2h		X	X	X	X	X	7.23 / 77
Request measured values and reflectivity value sub-range	44h	C4h	X	X	X			X	7.24 / 78
Request configured fields	45h	C5h	X	X	X		X		7.25 / 80
Start teach mode for configuring fields	46h	C6h		X	X		X		7.26 / 83
Reserved	48h	C8h							7.27 / 84
Request the status of the field outputs	4Ah	CAh	X	X	X		X	X	7.28 / 85
Reserved	4Bh	CBh							7.29 / 85
Reserved	4Ch	CCh							7.30 / 85
Reserved	4Dh	CDh							7.31 / 85
Reserved	4Eh	CEh							7.32 / 86
Reserved	4Fh	CFh							7.33 / 86
Reserved	50h	D0h							7.34 / 86
Reserved	51h	D1h							7.35 / 86
Reserved	52h	D2h							7.36 / 86
Define the permanent baud rate or LMS type	66h	E6h		X	X	X	X	X	7.37 / 87

Table 10-9: Overview of the commands

Command/Action	Telegram no.: Command to LMS2xx	Telegram no.: Response from the LMS2xx	Operating mode			Device Type			See chapter/page
			Monitoring mode	Installation mode	Calibration mode	LMS type 1-5	LMS type 6	LMS special type 90°/0.5°	
Reserved	67h	E7h							*7.38 / 87*
Reserved	68h	E8h							*7.39 / 87*
Define the angular range for positioning aid	69h	E9h	X	X	X		X	X	*7.40 / 88*
Reserved	70h	F0h							*7.41 / 89*
Reserved	72h	F2h							*7.42 / 89*
Request the LMS configuration (part 1)	74h	F4h	X	X	X		X	X	*7.43 / 90*
Request the measured value with reflectivity data	75h	F5h	X	X	X		X		*7.44 / 91*
Request the measured values in cartesian coordinates	76h	F6h	X	X	X		X		*7.45 / 94*
Configuring the LMS2xx (part 1)	77h	F7h		X	X		X	X	*7.46 / 96*
Reserved	78h	F8h							*7.47 / 102*
Reserved	79h	F9h							*7.48 / 102*
Reserved	7Ah	FAh							*7.49 / 102*
Request the LMS configuration (part 2, continued)	7Bh	FBh	X	X	X		X	X	*7.50 / 103*
Configure the LMS (part 2, continued)	7Ch	FCh		X	X		X	X	*7.51 / 104*

Table 10-9: Overview of the commands (contd.)

10.5 Standard/Special Delivery Types in the LMS2xx Range

LMS type	Order number	Counter resolution	Scanning angle	Angular resolution	Data interface
LMS200-30106	1017561	10 mm (0.39 in)	180°	0.25° ; 0.5°; 1°	RS 232/422
LMS220-20106	1015945	10 mm (0.39 in)	180°	0.25° ; 0.5°; 1°	
LMS291-S05	1018028	10 mm (0.39 in)	180°	0.25° ; 0.5°; 1°	
LMS291-S14	1025329	10 mm (0.39 in)	90°	0.5°	
LMS291-S15	1026226	10 mm (0.39 in)	180°	0.25° ; 0.5°; 1°	
LMS211-30106	1025629	10 mm (0.39 in)	100°	0.25° ; 0.5°; 1°	
LMS211-30206	1018023	10 mm (0.39 in)	100°	0.25° ; 0.5°; 1°	
LMS211-S07	1018966	10 mm (0.39 in)	100°	0.25° ; 0.5°; 1°	
LMS211-S14	1025487	10 mm (0.39 in)	90°	0.5°	
LMS211-S15	1026225	10 mm (0.39 in)	100°	0.25° ; 0.5°; 1°	
LMS211-S19	1040061	10 mm (0.39 in)	100°	0.25° ; 0.5°; 1°	
LMS211-S20	1040435	10 mm (0.39 in)	100°	0.25° ; 0.5°; 1°	
LMS221-30106	1026000	10 mm (0.39 in)	180°	0.25° ; 0.5°; 1°	
LMS221-30206	1018022	10 mm (0.39 in)	180°	0.25° ; 0.5°; 1°	
LMS221-S07	1018965	10 mm (0.39 in)	180°	0.25° ; 0.5°; 1°	
LMS221-S14	1025328	10 mm (0.39 in)	90°	0.5°	
LMS221-S15	1026224	10 mm (0.39 in)	180°	0.25° ; 0.5°; 1°	
LMS221-S16	1027192	10 mm (0.39 in)	180°	0.25° ; 0.5°; 1°	
LMS221-S19	1040060	10 mm (0.39 in)	180°	0.25° ; 0.5°; 1°	
LMS221-S20	1040434	10 mm (0.39 in)	180°	0.25° ; 0.5°; 1°	

Table 10-10: Standard delivery types

10.6 Address Allocation for the LMS2xx

Device	Address
Broadcast (universal address)	0
Individual device	1 to 0x 7Fh

Table 10-11: Address allocation

10.7 The LMS Configuration on Delivery

Parameter	**LMS200-30106** **LMS211-30106** **LMS221-30106** LMS220-30106	**LMS221-30206** **LMS221-S07/-S15** **LMS221-S16** **LMS221-S19/-S20** **LMS291-S05/-S15**	**LMS211-30206** **LMS211-S07/-S15** **LMS211-S19/-S20**	**LMS211-S14** **LMS221-S14** **LMS219-S14**
Start baud rate	9,600 Bd			
Angular resolution	0.5°			
Aperture angle	180°	180°	100°	90°
Measurement range	8 m (26.25 ft)	80 m (262.5 ft)	80 m (262.5 ft)	80 m (262.5 ft)
Counter resolution	10 mm (0.39 in)	100 mm (3.94 in)	100 mm (3.94 in)	10 mm (0.39 in)
Flag indicators	Field A, field B, and blanking			
Set address	00h			
SUB command setting for command 20h	25h (measured distance values are only output if required)			
SUB command setting for command 40h	Default field settings after calibration: Field set 1: Field A: 180°, 0.5°, mm, 10 segments, each with 50 mm (1.97 in) Field B: 180°, 0.5°, mm, 10 segments, each with 50 mm (1.97 in) Field C: 180°, 0.5°, mm, 10 segments, each with 50 mm (1.97 in) Field set 2: Field A: 180°, 0.5°, mm, 10 segments, each with 50 mm (1.97 in) Field B: 180°, 0.5°, mm, 10 segments, each with 50 mm (1.97 in) Field C: 180°, 0.5°, mm, 10 segments, each with 50 mm (1.97 in)			not relevant

Table 10-12: Excerpt: The LMS configuration on delivery (default setting)

10.8 Overflow Values

10.8.1 Scan overflow in the measurement range 8 m (26.25 ft)/80 m (262.5 ft)

Value		Meaning
8191	0x1FFF	Measured value not valid (counter did not receive a stop signal)
8190	0x1FFE	Dazzling (hardware reports dazzling)
8189	0x1FFD	Operation overflow (software calculation overflows, pulse width < start of table)
8187	0x1FFB	Signal-to-noise ratio too small (receive signal < peak & > stop threshold)
8186	0x1FFA	Error when reading channel 1
8183	0x1FF7	Measured value > Maximum value

Table 10-13: Scan overflow in the measurement range 8 m (26.25 ft)/80 m (262.5 ft)

10.8.2 Scan overflow in a max. measurement range of 16 m (52.5 ft)

Value		Meaning
16383	0x3FFF	Measured value not valid (counter did not receive a stop signal)
16382	0x3FFE	Dazzling (hardware reports dazzling)
16381	0x3FFD	Operation overflow (software calculation overflows, pulse width < start of table)
16379	0x3FFB	Signal-to-noise ratio too small (receive signal < peak & > stop threshold)
16378	0x3FFA	Error when reading channel 1
16385	0x3FF7	Measured value > Maximum value

Table 10-14: Scan overflow in a max. measurement range of 16 m (52.5 ft)

10.8.3 Scan overflow in a max. measurement range of 32 m (105 ft)

Value		Meaning
32767	0x7FFF	Measured value not valid (counter did not receive a stop signal)
32766	0x7FFE	Dazzling (hardware reports dazzling)
32765	0x7FFD	Operation overflow (software calculation overflows, pulse width < start of table)
32763	0x7FFB	Signal-to-noise ratio too small (receive signal < peak & > stop threshold)
32762	0x7FFA	Error when reading channel 1
32759	0x7FF7	Measured value > Maximum value

Table 10-15: Scan overflow in a max. measurement range of 32 m (105 ft)

10.9 Data Transmission Rates/Number of Scans Transmitted

Table 10-16 shows the maximum number of bytes for the corresponding resolution and the greatest possible field of vision.

Number of bytes transmitted	Angular resolution				
	0.25°	**0.5°**	**1°**	**0.25° interlaced**	**0.5° fix (LMS211/221/291-S14)**
Per scan	812	732	372	During each of the 4 mirror wheel rotations per scan, 362 (or 360) bytes are transmitted.	559
Per scan with indices	814	734	374	During each of the 4 mirror wheel rotations per scan, 364 (or 362) bytes are transmitted.	561

Table 10-16: Number of data bytes per scan

Table 10-17 shows the number of scans that are lost between two transmitted scans and with the corresponding transmission rate. These specifications are based on a "best-case" scenario and will nearly always be exceeded. Only a 500 kBd data connection can ensure that all the scans are transmitted.

Data transmission rate	Resolution				
	0.25°	**0.5°**	**1°**	**0.25° interlaced**	**0.5° fix (LMS211/221/291-S14)**
9,600 Bd	16	29	30	30	44
19,200 Bd	8	15	15	15	22
38,400 Bd	4	8	8	8	11
500,000 Bd	none	none	none	none	none

Table 10-17: Number of data bytes lost per scan

10.10 Scan Time Sequence

10.10.1 Resolution: 1°, Field of Vision: 180°, Transmission with 500 kBd

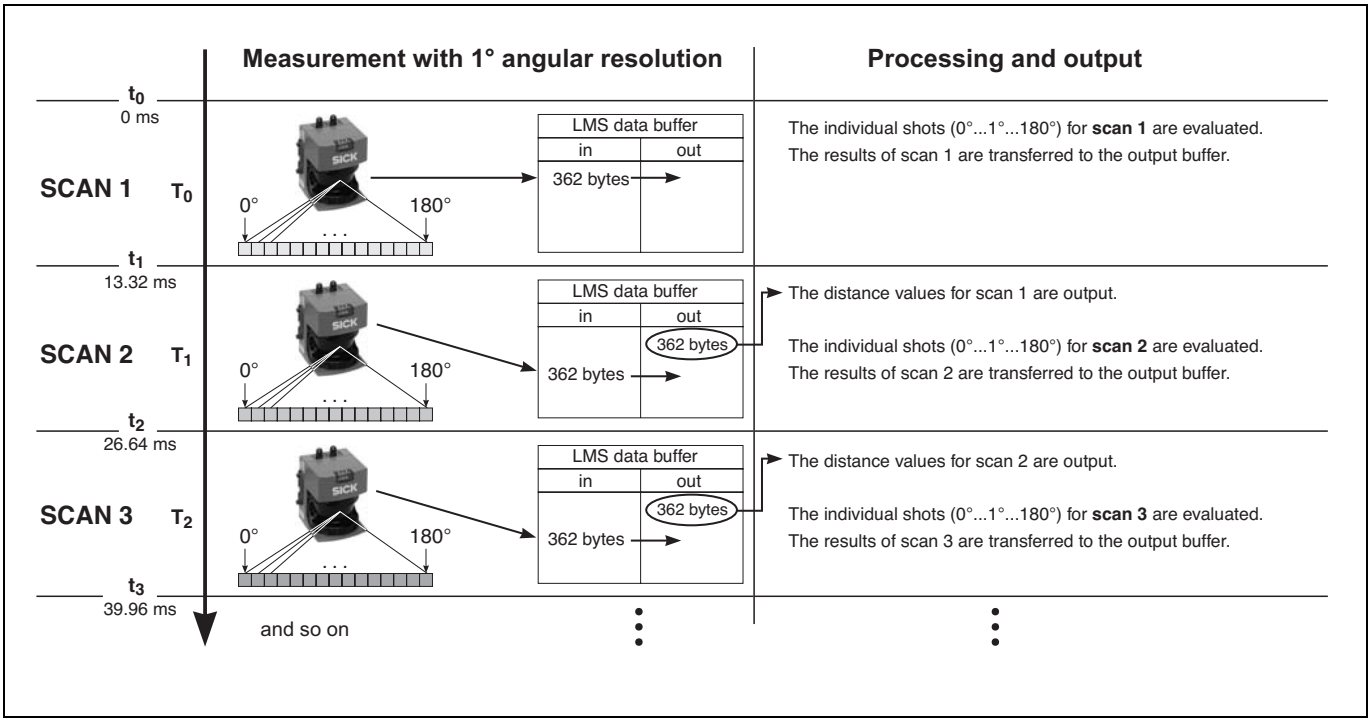


Fig. 10-9: Scan time sequence for an angular resolution of 1° and a 180° field of vision

10.10.2 Resolution: 0.5°, Field of Vision: 180°, Transmission with 500 kBd

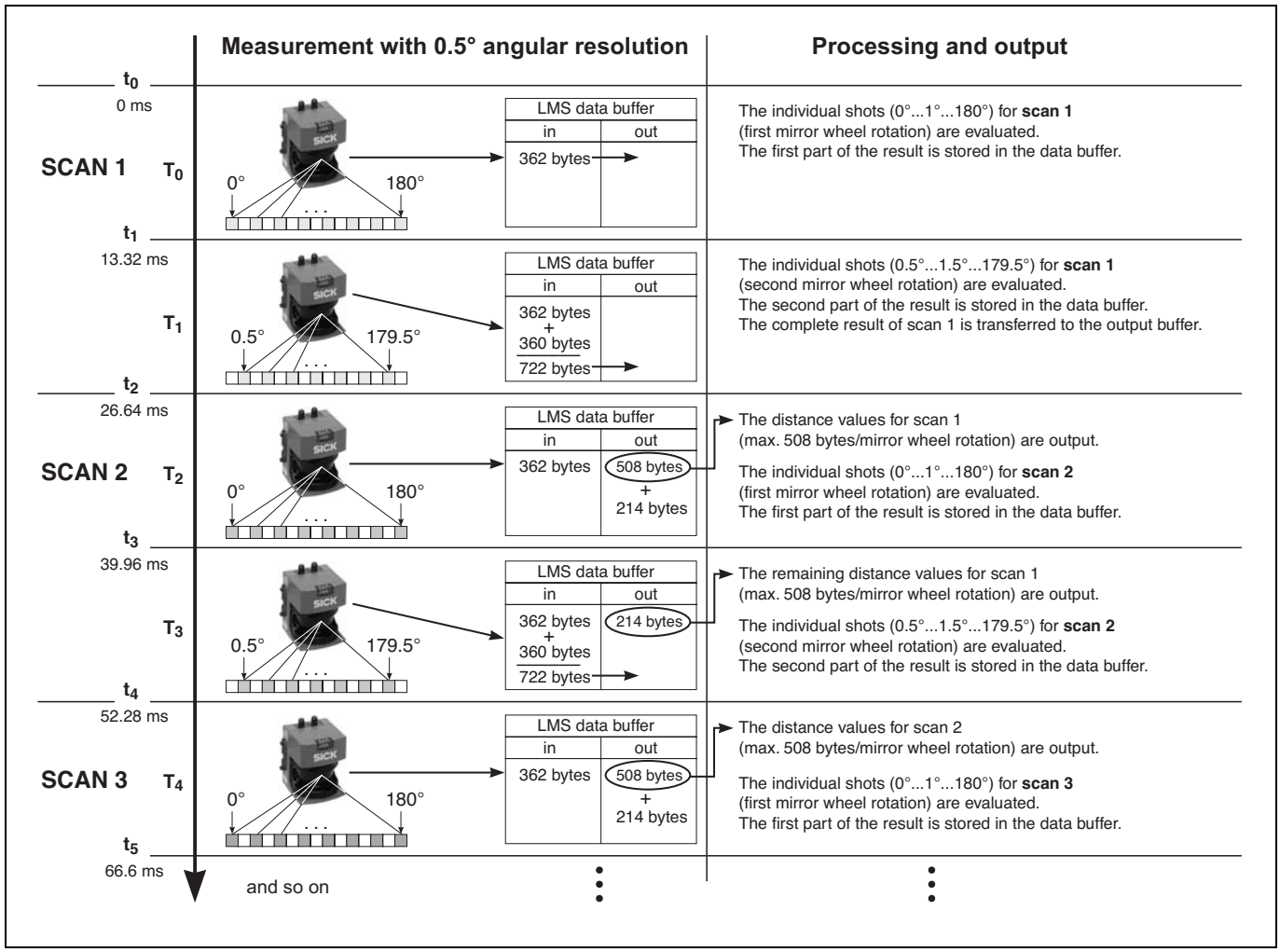


Fig. 10-10: Scan time sequence for an angular resolution of 0.5° and a 180° field of vision

10.10.3 Resolution: 0.25°, Field of Vision: 100°, Transmission with 500 kBd

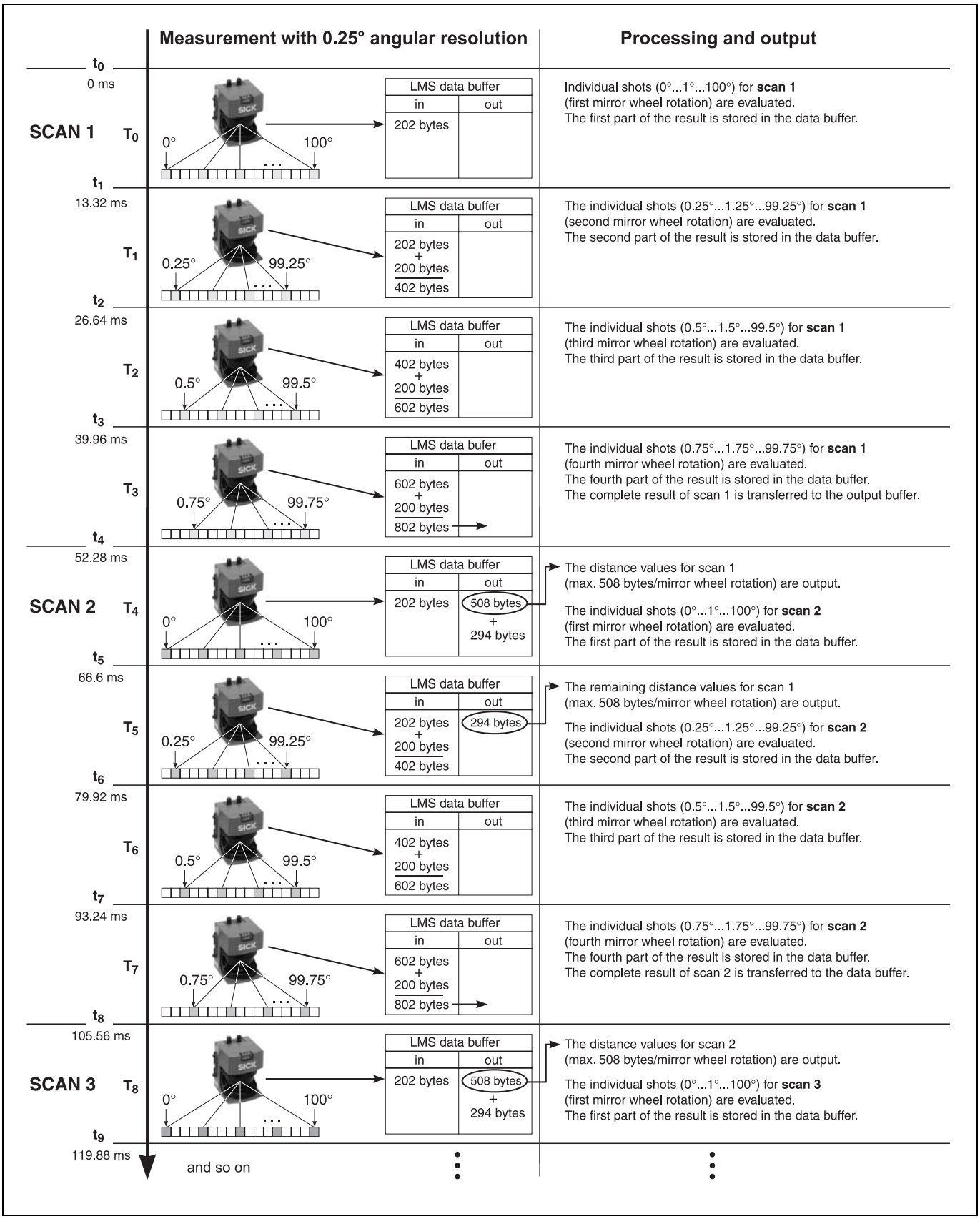


Fig. 10-11: Scan time sequence for an angular resolution of 0.25° and a 100° field of vision

10.10.4 Resolution: 0.25° Interlaced, Field of Vision: 180°, 500 kBd Transmission

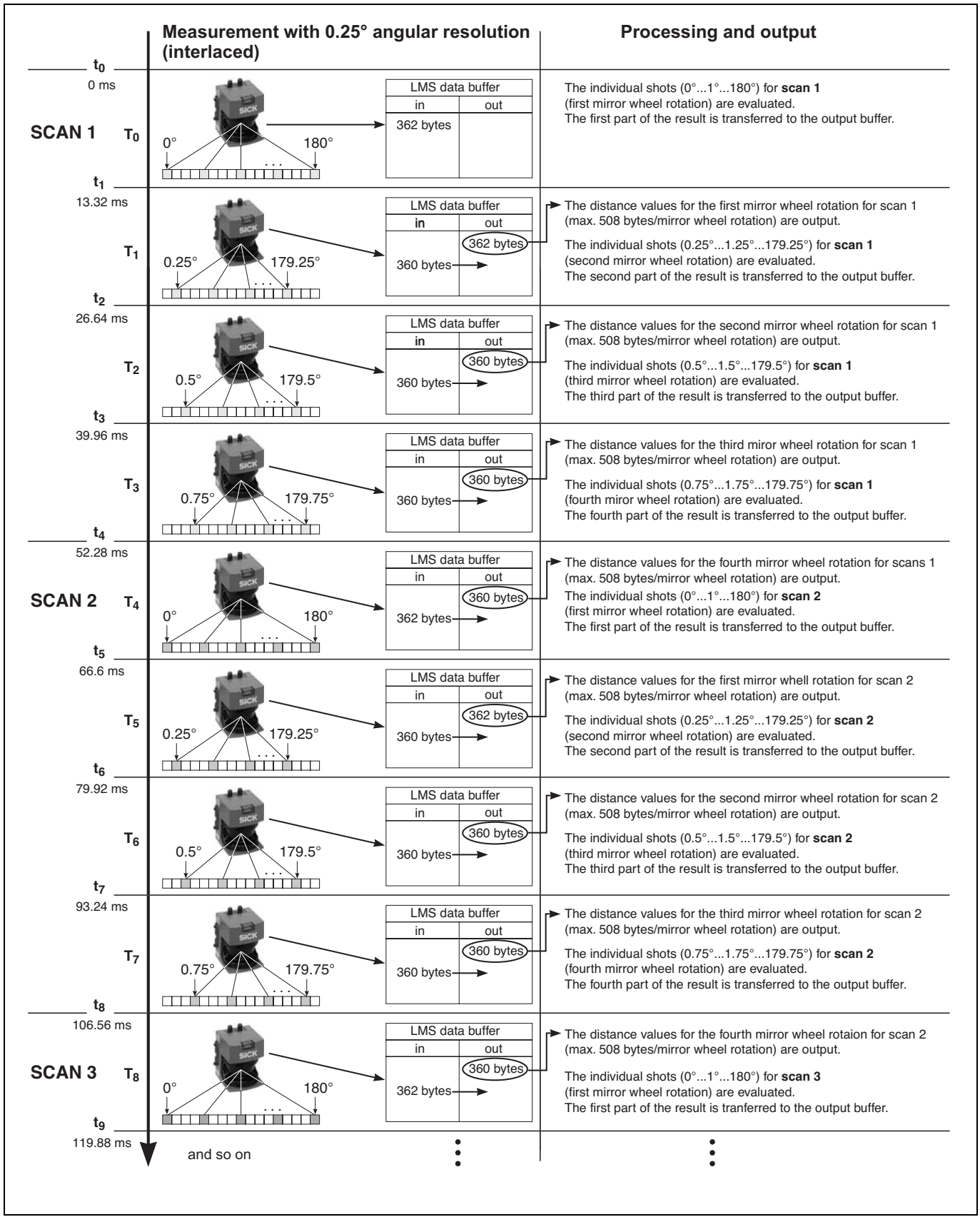


Fig. 10-12: Scan time sequence for an angular resolution of 0.25° interlaced, and a 180° field of vision

10.11 Error List

Error no.	Description	Weighting
05	Dazzle test	ERROR/INFO*
06	Peak comparator test	FATAL ERROR
07	Stop comparator test	FATAL ERROR
15	TDC initialisation and gate function test	FATAL ERROR
17	Front window pollution evaluation oil channel 1	> 120 %: WARNING/*INFO** > 125 %: ERROR/*INFO**
18	Front window pollution evaluation dirt channel 1	< 50 % or 75 %: WARNING < 30 %: ERROR
19	Front window pollution evaluation dirt channel 2	< 50 % bzw. 75 %: WARNING < 30 %: ERROR
20	Front window pollution evaluation oil channel 2	> 120 %: WARNING/*INFO** > 125 %: ERROR/*INFO**
21	Front window pollution evaluation reference channel 0	FATAL ERROR/*INFO**
22	Front window pollution evaluation reference channel 1	FATAL ERROR/*INFO**
27	Output A defective	FATAL ERROR
28	Output B defective	FATAL ERROR
29	No. of motor revolutions	ERROR
37	Calibration front window pollution	FATAL ERROR
39	Timeout on TDC Calibration	FATAL ERROR
45	1 measurement value missing	INFO
46	1 scan missing, scan lasts too long	INFO
47	Reference target: load/pulse width value implausible	FATAL ERROR
48	Calibration of laser power	WARNING
49	– Laser power: outside 50 % to 140 % for indoor devices, outside 70 % to 130 % for outdoor devices. – Laser power meets the upper or lower limit of measurability	– INFO – FATAL ERROR
50	Initialisation TDC M0 channel 0 and 1	ERROR
51	DA/AD test stop branch	FATAL ERROR
52	DA/AD test peak branch	FATAL ERROR
53	FLASH written	ERROR
54	Pollution channel measurement without active transmitter	INFO
55	No two different angles detected on laser power calibration	INFO
56	Watchdog (hardware) defective	FATAL ERROR
57	No zero index signal available	FATAL ERROR
58	Slave cannot synchronise itself to the master cycle during initialisation	ERROR/*INFO**
59	Synchronisation in operating state lost	≤30 s: INFO ≥30 s: ERROR/*INFO**
60	Synchronisation cycle from master missing	ERROR/*INFO**
61	Hardware is unsuitable for synchronisation (slave operating mode)	ERROR
62	Wrong DIP switch position	ERROR
86	*Reference target*: smallest pulse width too small	INFO
87	*Reference target*: largest pulse width too large	INFO
88	*Reference target*: pulse width spectrum (largest/smallest pulse width) too large	INFO, but if more than 12 measurements fail: FATAL ERROR
89	*Reference target*: reference target erroneous, ref. table less than 2 cycles update	FATAL ERROR
91	*Reference target*: reflectivity measurement cannot be calibrated	INFO

Table 10-18: Error list

Error no.	Description	Weighting
92	*Reference target*: teach-in mode is not completed	INFO
124	Out of memory: Measurement routine	FATAL ERROR
125	Out of memory: Reference target routine	FATAL ERROR
126	Out of memory: Reference target angular table	FATAL ERROR
* The values in *italics* apply when "availability level 3" is activated.		

Table 10-18: Error list (contd.)

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