ETHERNET PROTOCOL

LD-MRS
Laser Scanner

SICK
Sensor Intelligence.

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1. Introduction

This document describes how data is received and transmitted from repectively to the LD - MRS via the Ethernet connection. Addressed systems are LD - MRS 400001 and LD - MRS 400102 sensors or applications using the software versions (e.g. LD - MRS View).

2. Ethernet configuration

The LD - MRS uses default ethernet configurations until changed by the user.

Default ethernet settings	
IP address	192.168.0.1
Subnet mask	255.255.255.0
Port	12002

3. Data encoding

⚠ See the data type description if little or big endian byte order is used!

Timestamps represent the time encoded in 8 bytes. The higher 4 bytes are the number of seconds. The lover 4 bytes represent the fractional seconds with a resolution of 2^{-32} s. These 2 values must be interpreted as two unsigned 32 bit values.

4. Data header

Each message always starts with a data header. To resync just search for the magic word.

Data header					
Bytes	Offset	Field	Type	Byte order	Description
4	0	Magic word (0xAFFEC0C2)	uint32	Big endian	The magic word is used for searching messages and to distinguish between different versions
4	4	Size of previous messages	uint32	Big endian	Helps to navigate backwards through a file. Unused in live data
4	8	Size of this message	uint32	Big endian	Helps to read the message data. Size of message content without this header
1	12	Reserved	uint8	Big endian	–
1	13	Device ID	uint8	Big endian	ID of the connected device. Unused in data received directly from scanner
2	14	Data type	uint16	Big endian	Specifies the data type within message
8	16	Timestamp	uint64	Big endian	Time when this message was created
Total: 24 bytes					

5. Scan data

Each scan data block starts with with a header followed by the scan point list. For angle information the unit angle ticks is used. A LD - MRS uses 11520 ticks per rotation. Thus the angular resolution $\frac{1}{32^{\circ}}$. This value is needed to convert angle ticks: $angle = 2\pi \cdot \frac{angle\ ticks}{angle\ ticks\ per\ rotation}$.

Angles are given in the ISO 8855 / DIN 70000 scanner coordinate system.

Scan header (data type: 0x2202)					
Bytes	Offset	Field	Type	Byte order	Description
2	0	Scan number	uint16	Little endian	The number of this scan. The number will be increased from scan to scan
2	2	Scanner status	uint16	Little endian	**0x0007**: reserved **0x0008**: set frequency reached **0x0010**: external sync signal **0x0020**: sync ok **0x0040**: sync master **0xFF80**: reserved
2	4	Sync phase offset	uint16	Little endian	Phase difference (conversion factor 409.6 ns) between sync signal and scanner mirror crossing the synchronization angle
8	6	Scan start time	uint64	Little endian	Time when first measurement was done
8	14	Scan end time	uint64	Little endian	Time when first measurement was done
2	22	Angle ticks per rotation	uint16	Little endian	Number of angle ticks per rotation

2	24	Start angle	int16	Little endian	Start angle in angle ticks of this scan
2	26	End angle	int16	Little endian	End angle in angle ticks of this scan
2	28	Scan points	uint16	Little endian	Number of scan point transmitted in this scan
2	30	Reserved	int16	Little endian	–
2	32	Reserved	int16	Little endian	–
2	34	Reserved	int16	Little endian	–
2	36	Reserved	int16	Little endian	–
2	38	Reserved	int16	Little endian	–
2	40	Reserved	int16	Little endian	–
2	42	Reserved	uint16	Little endian	–
Total: 44 bytes					

6. Scan point

An array of points follows the scan header. See number of scan points in the scan header description above.

Scan point					
Bytes	Offset	Field	Type	Byte order	Description
1	0	Echo and layer	uint8	Little endian	**Bits 0 – 3**: scan layer of point **Bits 4 – 7**: echo number of point (both zero – based)
1	1	Flags	uint8	Little endian	**0x01**: transparent point **0x02**: clutter (atmospheric) **0x08**: dirt **0xF**: reserved
2	2	Horizontal angle	int16	Little endian	Angle of point in angle ticks in the scanner coordinate system
2	4	Radial distance	uint16	Little endian	Distance of point in angle ticks in the scanner coordinate system
2	6	Echo pulse width	uint16	Little endian	Detected width of this echo pulse in cm
2	8	Reserved	uint16	Little endian	–
Total: 10 bytes					

7. Errors and warnings

As soon LD - MRS detects an error or wants to emit a warning, this message is sent. Errors and warnings bits are reset after sending this message. This message will be sent periodically as long as errors or warnings persist.

Errors and warnings (data type: 0x2030)					
Bytes	Offset	Field	Type	Byte order	Description
2	0	Error register 1	uint16	Little endian	**Bits 0 – 1**: contact support **Bit 2**: scan buffer transmitted incompletely, decrease scan resolution, frequency or range; contact support **Bit 3**: scan buffer owerflow, decrease scan resolution, frequency, range, contact support **Bits 4 – 13**: contact support **Bits 5 – 7**: reserved **Bit 9**: APD over temperature, provide cooling **Bit 8**: APD under temperature, provide heating **Bits 8 – 9**: APD temperature sensor defect, contact support **Bits 14 – 15**: reserved

2	2	Error register 2	uint16	Little endian	**Bits 0 – 3**: contact support **Bit 4**: incorrect configuration data, load correct values **Bit 5**: configuration containts incorrect parameters, load correct values **Bit 6**: data processing timeout, decrease scan resolution or frequency **Bit 7**: contact support **Bit 8 – 15**: reserved
2	4	Warning register 1	uint16	Little endian	**Bit 0**: internal communication error **Bits 1 – 2**: internal warning **Bit 3**: temperature very low **Bit 4**: temperature very high **Bits 5 - 6**: internal warning **Bit 7**: synchronization error, check synchronization and scan frequency **Bits 8 – 15**: reserved

2	6	Warning register 2	uint16	Little endian	**Bit 0**: reserved **Bit 1**: Ethernet interface blocked, check Ethernet connection **Bit 2**: reserved **Bit 3**: contact support **Bit 4**: error receiving Ethernet data, check Ethernet connection or data **Bit 5**: incorrect or forbidden command received, check command **Bit 6**: memory access failure, restart scanner, contact support **Bits 7 – 15**: reserved
2	8	Reserved	uint16	Little endian	–
2	10	Reserved	uint16	Little endian	–
2	12	Reserved	uint16	Little endian	–
2	14	Reserved	uint16	Little endian	–
Total: 16 bytes					

8. Command interface

Commands are used for configuring scanner parameters. Data structures below shows how messages are formed and transmitted.