LZR®-U910
Protocol

1. Introduction

This application note contains useful information for communication with the LZR®-U910 raw data laser scanner from BEA.

2. Overview of all functions

2.1 Reminder: The laser scanner platform LZR

The following picture (Figure 1) shows how the laser scanner (LZR) is generally installed when used vertically. However, it can also be used horizontally.

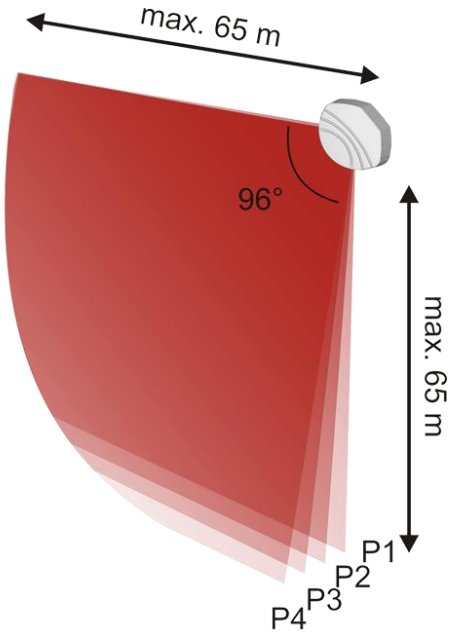


Figure 1

The LZR's main characteristics are:

Technology	TOF (Time of Flight)
Number of planes	4
Tilt angle shift between planes	approximately 2°
Number of measurement points per plane	274
Optical angular opening area	96°
Angular resolution	96°/273= 0,3516°
Speed of motor rotation	900 rpm
Scanning frequency	15 Hz
Measurement area	max. 65 m

The following picture (Figure 2) shows the correlation between the spots and the angular scanning position.

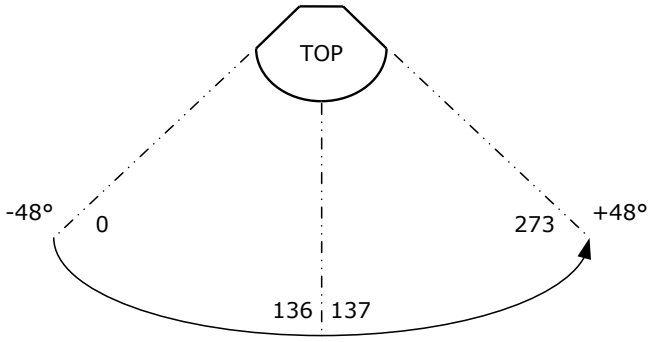


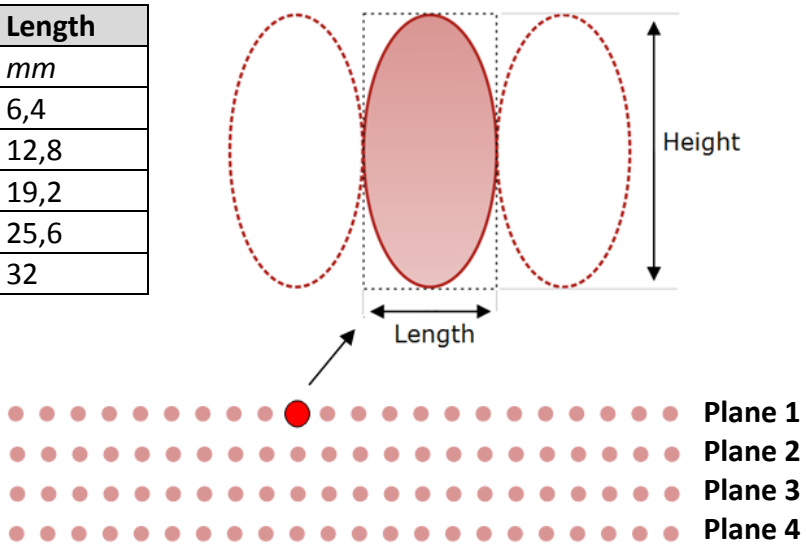
Figure 2

Distance measurement of spot 0	-48°
Distance measurement of spot 273	+48°

Characteristics of the laser spot:

Spot size depending on scanning distance:

Distance	Height	Length
m	*mm*	*mm*
1	16	6,4
2	32	12,8
3	48	19,2
4	64	25,6
5	80	32



Basic relation spot length vs spot height: 1 x 2,5 (length x height)

Characteristics of the distance measurement:
The maximum measurement distance range of the LZR-U910 is 65m. Therefore, all objects at 65m or at any distance higher than 65m will lead to a measurement distance value of 65m.
The detection of a target with min. 2% remission factor is ensured until 10 m (in clear conditions).

2.2 Communication protocol

2.2 a) Serial communication

The main characteristics of the serial communication are:

Type	Asynchronous
Electrical interface	RS-485
Communication mode	Simplex
Data transmission speed	460.8 kbps
Topology	Point to point
Encoding	1 start bit, 1 stop bit, no parity bit
Data word length	8 bits
Bytes order	little-endian, LSB (Least Significant Byte) first

2.2 b) Structure of the data stream

A complete transmitted data stream is composed mainly of three different kinds of information: "header", "message" and "footer".

The following figure shows the structure of the complete data stream:

	Header		Message						Footer
Code	SYNC 0xFFFE FDFC	SIZE 2208	CMD 50011	Id + Frame counter	Data Plane n° 2 (2°)	Data Plane n° 4 (6°)	Data Plane n° 1 (0°)	Data Plane n° 3 (4°)	CHK
Length (byte)	4	2	2	6	548	548	548	548	2

The length of a data stream is 2208 bytes.

4 Synchronization bytes
2 Size bytes
2 Command bytes
4 CAN number (Id) bytes
2 Frame Counter bytes
2192 Data bytes:
- 2 bytes per distance measurement
- 4 planes
- 274 distance measurements per plane

2 Checksum bytes

Please refer to the first picture concerning the plane numbers

2.2 c) Basic symbols

The communication symbols used in a transmitted data stream are:

"Header"

SYNC

This symbol is used to allow the synchronization between the laser scanner and the host.

Size	4 bytes
Value	0xFFFE FDFC
Structure	LSB first, MSB last

SIZE

This symbol is used to transmit the length of the block "message".

Size	2 bytes
Value	Serial number (decimal value): 2208
Structure	LSB first, MSB last

"Message"

CMD

This symbol is used to transmit the command relative to the "data sending" mode.

Size	2 bytes
Value	Serial number (decimal value): 50011
Structure	LSB first, MSB last

Identification + Frame Counter

This symbol is used to transmit two information: the unique identification number of the LZR in use (CAN number) and the number of frames transmitted since the last power on.
The latter one is limited to 2 bytes. Therefore, once 65000 frames counted, this value will start from 0 on again.

ID:

Size	4 bytes
Value	Identification number (CAN number) of the laser scanner
Structure	LSB first, MSB last

Frame Counter:

Size	2 bytes
Value	number of complete communication frames sent (max. 65000)
Structure	LSB first, MSB last

Data

This symbol is used to transmit any distance information to the controller.

Size	2 bytes
Value	Distance (decimal value)
Structure	LSB first, MSB last

NB: All distance measurements made by the LZR are expressed in mm.
Maximum distance: 65000 mm.

"Footer"

CHK

This symbol is used to transmit the checksum (CHK), which is the sum of all bytes of the "message" part of the communication frame.

Size	2 bytes
Principle	The calculation of the CHK is performed on all bytes of the "message" part of the data stream
Structure	LSB first, MSB last

2.2 d) How does it work?

The laser scanner always works in "transmission" mode and sends out the measurement data as soon as he is powered and as soon as the data of a complete scanning cycle is available. The operator should always work in "reception" mode.

2.3 Additional functions

Standby mode (Heartbeat mode)

The infrared laser diode that is pulsed in the distance measurement process can be switched ON/OFF by using the external input signal (pin 6 & pin 7; see UG).

The input signal is de-bounced in a way that a pulse signal shorter than 100ms will not change the state of the laser diode.
In order to activate the heartbeat mode (i.e. to switch off the infrared laser diode) a voltage signal between 10 and 35 V should be applied.

Distance data frames are only sent on serial link when the infrared laser diode is pulsing.

When the infrared laser diode is switched OFF, no data is available, so no data frame is sent. In this standby mode, a "heartbeat" message is sent on the serial link informing the host system monitoring that the LZR is still alive but idle.

The "heartbeat" message follows the same structure as the data frame but with all data values set to 0.

	Header		Message						Footer
Code	SYNC	SIZE	CMD	Id + Frame counter	Data Plane n° 2 (2°)	Data Plane n° 4 (6°)	Data Plane n° 1 (0°)	Data Plane n° 3 (4°)	CHK
Value	0xFFFE FDFC	2208	50011		0	0	0	0	

The repeat rate of the "heartbeat" transmission is 5 seconds.