OLEI LR-16F 3D LiDAR Sensor Communication Data Protocol User Manual

Contents

OLEI LR-16F 3D LiDAR Sensor Communication Data Protocol

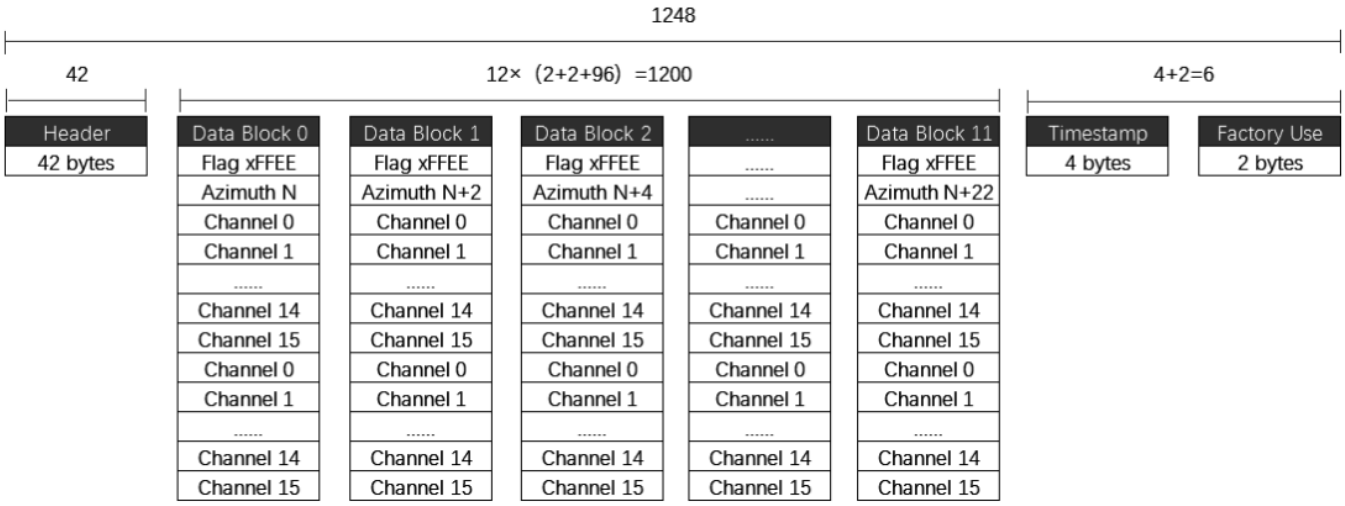
Please read this manual before using the product for the best product performance.
Be sure to keep this manual for future reference.

Type of Connector

1. Connector: RJ-45 standard internet connector
2. Basic protocol: UDP/IP standard internet protocol, Data are in little-endian format, lower byte first

Data Packet Format

Overview



The total length of a data frame is 1248 bytes, including:

- **Frame header:** 42 bytes
- **Data block:** 12X(2+2+96) = 1,200 bytes
- **Time stamp**: 4 Bytes

- **Factory mark:** 2 Bytes

Header

Offset	Length	Description
0	14	Ethernet II include: Destination MAC (6 Byte) Sourse MAC (6 Byte) Type: (2 Byte)
14	20	Internet Protocol include: Version & Header Length :(1 Byte) Differentiated Services Field: (1 Byte) Total Length:(2 Byte) Identification: (2 Byte) Flags: (1 Byte) Fragment Offse: (1 Byte) Time to Live: (1 Byte) Protocol: (1 Byte) Header Checksum: (2 Byte)

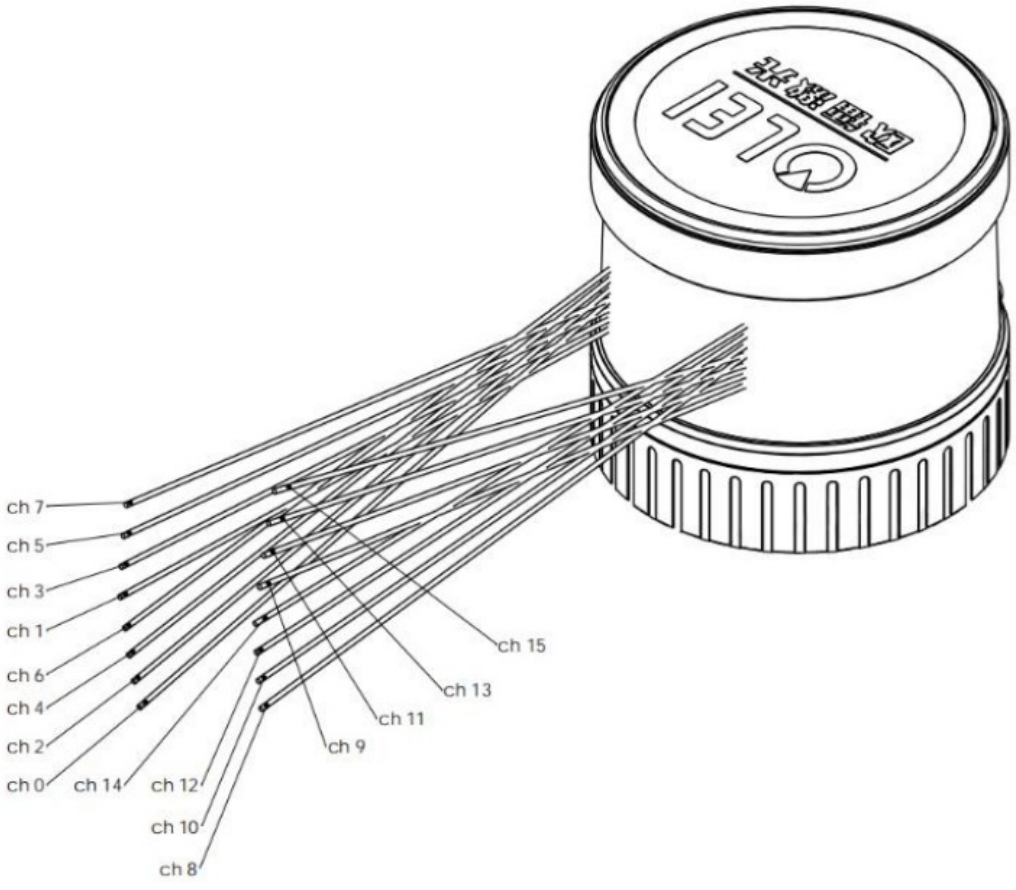
		Destination IP: (4 Byte) Sourse IP: (4 Byte)
34	8	User Datagram Protocol include: Sourse Port (2 Byte) Destination Port: (2 Byte) Data Length:(2 Byte) Checksum: (2 Byte)

Data block definition
The laser returned data consists of 12 data blocks. Each data block starts with a 2-byte identifier 0xFFEE, followed by a 2-byte azimuth angle and a total of 32 data points. The lase returned value of each channel contains a 2-byte distance value and a 1-byte calibration reflectivity value.

Offset	Length	Description
0	2	Flag, it is always 0xFFEE
2	2	Angle Data
4	2	Ch0 Ranging Data
6	1	Ch0 Reflectivity Data
7	2	Ch1 Ranging Data
9	1	Ch1 Reflectivity Data
10	2	Ch2 Ranging Data
12	1	Ch2 Reflectivity Data
–	–	–
49	2	Ch0 Ranging Data
51	1	Ch15 Reflectivity Data
52	2	Ch0 Ranging Data
54	1	Ch0 Reflectivity Data
55	2	Ch1 Ranging Data
57	1	Ch1 Reflectivity Data
58	2	Ch2 Ranging Data
60	1	Ch2 Reflectivity Data
–	–	–
97	2	Ch15 Ranging Data
99	1	Ch15 Reflectivity Data

The vertical angle is defined as following:

Laser ID	Vertical Angle
0	-15°
1	1°
2	-13°
3	3°
4	-11°
5	5°
6	-9°
7	7°
8	-7°
9	9°
10	-5°
11	11°
12	-3°
13	13°
14	-1°
15	15°



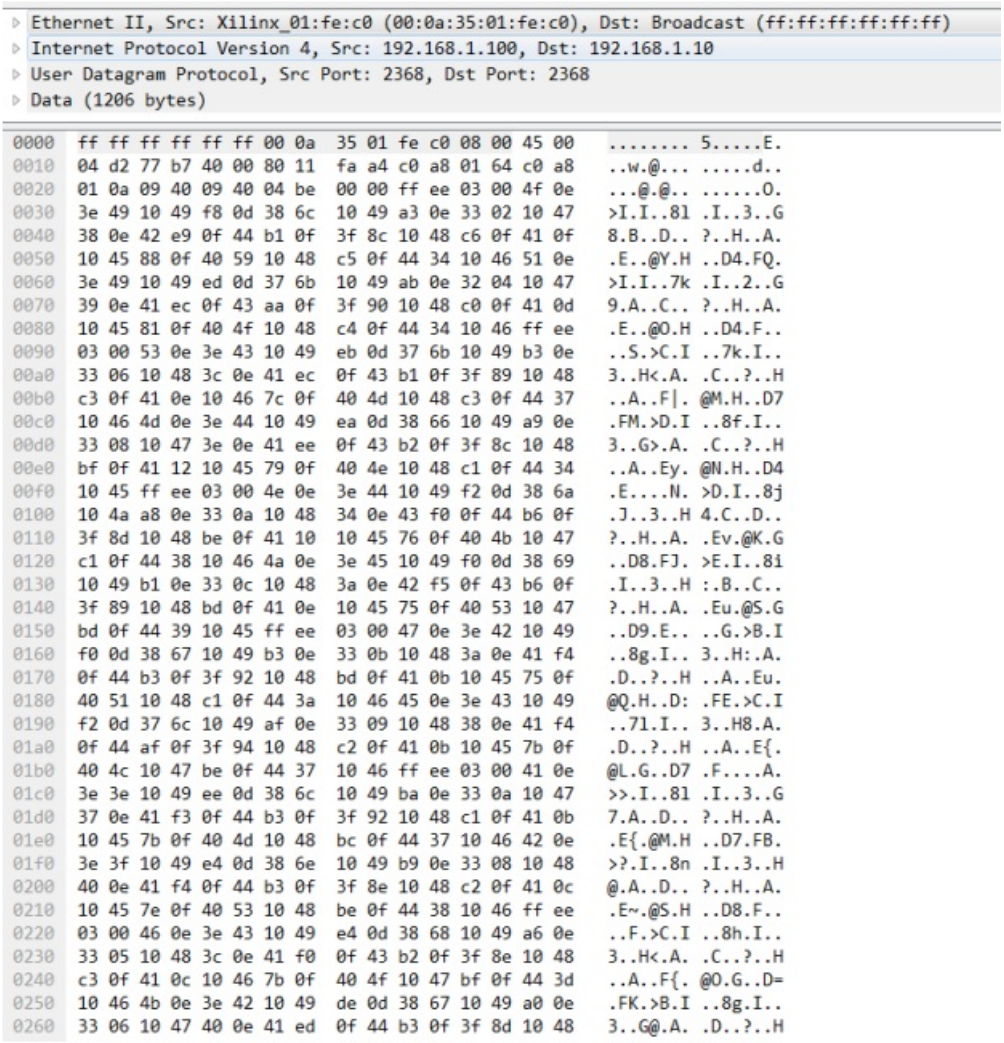
Time stamp

Offset	Length	Description
0	4	Timestamp [31:0]: [31:20] count of Seconds [19:0] count of Microsecond

Factory mark

Offset	Length	Description
0	2	Factory:(2 Byte)0x00,0x10

Example



```
0270  c6 0f 41 0b 10 45 7c 0f  40 51 10 48 bd 0f 44 3c   ..A..E|. @Q.H..D<
0280  10 46 ff ee 03 00 4a 0e  3e 48 10 49 e2 0d 37 67   .F....J. >H.I..7g
0290  10 49 a8 0e 33 06 10 48  40 0e 41 f1 0f 44 b3 0f   .I..3..H @.A..D..
02a0  3f 91 10 48 cc 0f 41 0b  10 45 7c 0f 40 53 10 47   ?..H..A. .E|.@S.G
02b0  be 0f 44 37 10 46 49 0e  3e 47 10 49 ee 0d 38 67   ..D7.FI. >G.I..8g
02c0  10 49 c2 0e 33 06 10 48  3f 0e 42 f2 0f 44 b9 0f   .I..3..H ?.B..D..
02d0  3f 91 10 48 c3 0f 41 0f  10 45 78 0f 40 51 10 47   ?..H..A. .Ex.@Q.G
02e0  bb 0f 44 3b 10 46 ff ee  03 00 48 0e 3e 44 10 49   ..D;.F.. ..H.>D.I
02f0  ef 0d 38 69 10 49 b9 0e  33 04 10 48 3b 0e 42 f3   ..8i.I.. 3..H;.B.
0300  0f 44 b9 0f 3e 94 10 48  c6 0f 41 0c 10 45 7a 0f   .D..>..H ..A..Ez.
0310  40 4e 10 47 bf 0f 44 38  10 46 4d 0e 3e 3f 10 49   @N.G..D8 .FM.>?.I
0320  e9 0d 37 71 10 49 b7 0e  33 0a 10 48 38 0e 41 f1   ..7q.I.. 3..H8.A.
0330  0f 44 b4 0f 3f 8e 10 48  c2 0f 41 0b 10 46 74 0f   .D..?..H ..A..Ft.
0340  40 50 10 47 c7 0f 44 3b  10 46 ff ee 03 00 50 0e   @P.G..D; .F....P.
0350  3e 41 10 49 e9 0d 37 6b  10 49 a9 0e 33 04 10 48   >A.I..7k .I..3..H
0360  39 0e 41 ee 0f 43 b3 0f  3f 92 10 48 bd 0f 41 09   9.A..C.. ?..H..A.
0370  10 46 6e 0f 40 4e 10 47  c4 0f 44 37 10 46 50 0e   .Fn.@N.G ..D7.FP.
0380  3e 40 10 49 ec 0d 38 68  10 49 ae 0e 33 09 10 47   >@.I..8h .I..3..G
0390  42 0e 41 ef 0f 43 b5 0f  3f 96 10 48 bc 0f 41 0c   B.A..C.. ?..H..A.
03a0  10 45 75 0f 40 48 10 47  c0 0f 44 39 10 46 ff ee   .Eu.@H.G ..D9.F..
03b0  03 00 49 0e 3e 3e 10 49  f0 0d 37 6a 10 49 af 0e   ..I.>>.I ..7j.I..
03c0  33 09 10 47 3c 0e 41 f2  0f 43 b5 0f 3f 93 10 48   3..G<.A. .C..?..H
03d0  bc 0f 41 09 10 46 75 0f  40 4f 10 48 c0 0f 44 36   ..A..Fu. @O.H..D6
03e0  10 46 4f 0e 3e 42 10 49  e9 0d 38 69 10 49 b8 0e   .FO.>B.I ..8i.I..
03f0  33 05 10 47 3f 0e 42 f2  0f 44 b4 0f 3f 96 10 48   3..G?.B. .D..?..H
0400  b9 0f 41 10 10 45 76 0f  40 4e 10 48 c0 0f 44 37   ..A..Ev. @N.H..D7
0410  10 46 ff ee 03 00 49 0e  3e 43 10 49 ed 0d 38 6a   .F....I. >C.I..8j
0420  10 49 aa 0e 32 06 10 48  3d 0e 42 f3 0f 43 b5 0f   .I..2..H =.B..C..
0430  3f 90 10 48 c0 0f 41 11  10 45 79 0f 40 4f 10 47   ?..H..A. .Ey.@O.G
0440  c2 0f 44 3a 10 46 4b 0e  3e 43 10 49 e7 0d 38 69   ..D:.FK. >C.I..8i
0450  10 49 a5 0e 32 08 10 48  40 0e 41 f3 0f 44 b0 0f   .I..2..H @.A..D..
0460  3f 8a 10 48 c2 0f 41 0d  10 46 76 0f 40 57 10 48   ?..H..A. .Fv.@W.H
0470  c1 0f 44 3b 10 46 ff ee  03 00 4f 0e 3e 46 10 49   ..D;.F.. ..O.>F.I
0480  e6 0d 38 69 10 49 a4 0e  33 09 10 47 3f 0e 42 f1   ..8i.I.. 3..G?.B.
0490  0f 44 b0 0f 3e 86 10 48  c0 0f 41 0a 10 45 7b 0f   .D..>..H ..A..E{.
04a0  40 58 10 48 c0 0f 44 3b  10 45 49 0e 3e 43 10 49   @X.H..D; .EI.>C.I
04b0  e7 0d 37 6d 10 49 b8 0e  32 06 10 48 3d 0e 43 f1   ..7m.I.. 2..H=.C.
04c0  0f 44 ac 0f 3f 86 10 48  c2 0f 41 0b 10 45 75 0f   .D..?..H ..A..Eu.
04d0  40 53 10 48 c2 0f 44 3c  10 46 98 6a 62 55 37 22   @S.H..D< .F.jbU7"
```

Communication protocol-information package

Overview

Header	Lidar Info	GPS Info
42 Bytes	768Bytes	74 Bytes

Length of data package: 884 Bytes
Note: The port number of the information package cannot be changed, the local and target ports are both 9866

Definition of header

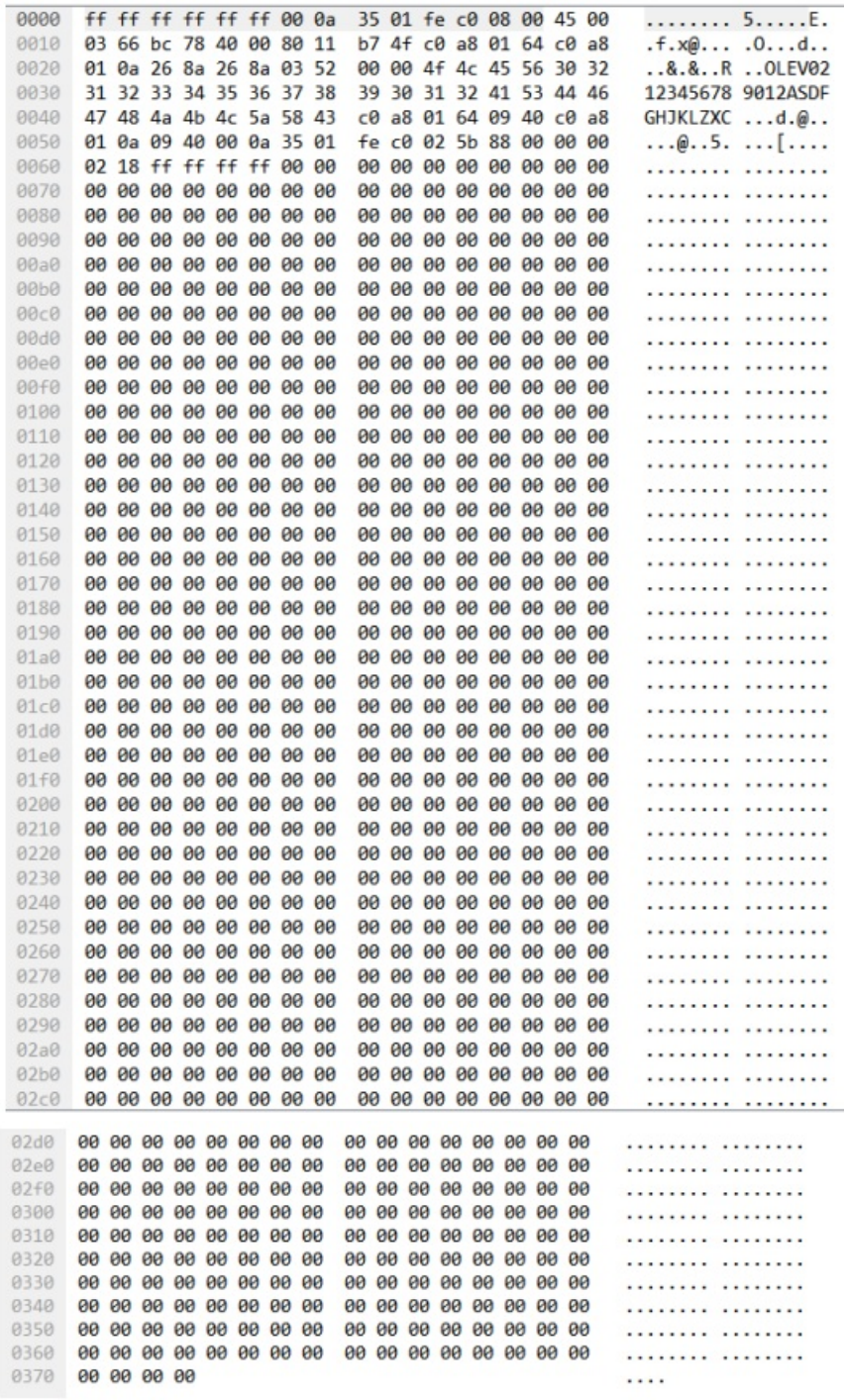
Offset	Length	Description
0	14	Ethernet II Include: Destination MAC (6 Byte) Sourse MAC (6 Byte) Type: (2 Byte)
14	20	Internet Protocol Include: Version & Header Length :(1 Byte) Differentiated Services Field: (1 Byte) Total Length:(2 Byte) Identification: (2 Byte)

		Flags: (1 Byte) Fragment Offse: (1 Byte) Time to Live: (1 Byte) Protocol: (1 Byte) Header Checksum: (2 Byte) Destination IP: (4 Byte) Sourse IP: (4 Byte)
34	8	User Datagram Protocol Include: Sourse Port (2 Byte) Destination P ort: (2 Byte) Data Length:(2 Byte) Checksum: (2 Byte)

Definition of Lidar Info

Offset	Length	Description
0	6	Factory Code
6	12	Model Number
18	12	Series Number
30	4	Sourse IP
34	2	Sourse data Port
36	4	Destination IP
40	2	Destination data Port
42	6	Source MAC
48	2	Motor Speed
50	1	[7] GPS Connection, 0: Connected, 1: No connection [6] Top circuit error flag 0: Normal, 1: Error [5:0] Reserve
51	1	GPS Enable & Baud rate 0x00:GPS GPS Power Off 0x01:GPS Power On, Baud rate 4800 0x02:GPS Power On, Baud rate 9600 0x03:GPS Power On, Baud rate 115200
52	1	Reserve
53	1	Reserve
54	2	Top circuit Temperature, DataX0.0625℃
56	2	Bottom circuit Temperature, DataX0.0625℃
58	2	Reserve
60	32	CH0-CH15 Channel static offset
92	4	Reserve
96	672	Reserve
768	74	GPS Information

Example



```
0000  ff ff ff ff ff ff 00 0a  35 01 fe c0 08 00 45 00   ........ 5.....E.
0010  03 66 bc 78 40 00 80 11  b7 4f c0 a8 01 64 c0 a8   .f.x@... .O...d..
0020  01 0a 26 8a 26 8a 03 52  00 00 4f 4c 45 56 30 32   ..&.&..R ..OLEV02
0030  31 32 33 34 35 36 37 38  39 30 31 32 41 53 44 46   12345678 9012ASDF
0040  47 48 4a 4b 4c 5a 58 43  c0 a8 01 64 09 40 c0 a8   GHJKLZXC ...d.@..
0050  01 0a 09 40 00 0a 35 01  fe c0 02 5b 88 00 00 00   ...@..5. ...[....
0060  02 18 ff ff ff ff 00 00  00 00 00 00 00 00 00 00   ........ ........
0070  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0080  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0090  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
00a0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
00b0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
00c0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
00d0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
00e0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
00f0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0100  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0110  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0120  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0130  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0140  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0150  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0160  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0170  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0180  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0190  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
01a0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
01b0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
01c0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
01d0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
01e0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
01f0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0200  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0210  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0220  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0230  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0240  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0250  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0260  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0270  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0280  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0290  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
02a0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
02b0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
02c0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
02d0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
02e0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
02f0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0300  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0310  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0320  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0330  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0340  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0350  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0360  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
0370  00 00 00 00                                       ....
```

Setup the protocol

Follow the UDP protocol, user setup protocol, upper computer sends 8 bytes

Name	Address	Data
Number of bytes	2 Bytes	6 Bytes

Address	Name	Byte Definition [31:0]
F000	Local IP	[47:16]=local_ip [15:0] =local_port
F001	Remote IP	[31:0]=remote_ip [15:0]= remote_port
F002	Speed, GPS enable, baud rate	[47:32] =rom_speed_ctrl [31:24]=GPS_en 0x00 = off 0x01 = enabled and the baud rate is 4800 0x02= enabled and the baud rate is 9600 0x03 = enabled and 115200 baud rate [23:0]Reserved

Example:		
Local ip and port	F0 00 C0 A8 01 64 09 40	192.168.1.100 2368
Target ip and port	F0 01 C0 A8 01 0A 09 40	192.168.1.10 2368
Rotating speed	F0 02 02 58 00 00 00 00	speed 600

Example:

- Local ip and port F0 00 C0 A8 01 64 09 40 192.168.1.100 2368
- Target ip and port F0 01 C0 A8 01 0A 09 40 192.168.1.10 2368
- Rotating speed F0 02 02 58 00 00 00 00 speed 600
- Restart the 3D LiDAR each time the modification is completed.
- Optional rotating speed: 300 or 600. optional baud rate:4800/9600/115200 .

Coordinate conversion

The information in the LR-16F data package is the azimuth value and distance value established in the polar coordinate system. It’s more convenient to construct three-dimensional scene through the point cloud data by converting polar coordinate value to Cartesian coordinate system.
The above values corresponding to each channel is shown in the following table:

Channel#	Vertical angle (ω)	Horizontal angle (α)	Horizontal offset (A)	Vertical offset (B)
CH0	-15°	α	21mm	5.06mm
CH1	1°	α+1*0.00108*H	21mm	-9.15mm
CH2	-13	α+2*0.00108*H	21mm	5.06mm
CH3	3°	α+3*0.00108*H	21mm	-9.15mm
CH4	-11	α+4*0.00108*H	21mm	5.06mm
CH5	5°	α+5*0.00108*H	21mm	-9.15mm
CH6	-9	α+6*0.00108*H	21mm	5.06mm
CH7	7°	α+7*0.00108*H	21mm	-9.15mm
CH8	-7	α+8*0.00108*H	-21mm	9.15mm
CH9	9°	α+9*0.00108*H	-21mm	-5.06mm
CH10	-5	α+10*0.00108*H	-21mm	9.15mm
CH11	11°	α+11*0.00108*H	-21mm	-5.06mm
CH12	-3	α+12*0.00108*H	-21mm	9.15mm
CH13	13°	α+13*0.00108*H	-21mm	-5.06mm
CH14	-1	α+14*0.00108*H	-21mm	9.15mm
CH15	15°	α+15*0.00108*H	-21mm	-5.06mm

Note: Under normal accuracy, the horizontal angle α only needs to increase the parameters in the table above.

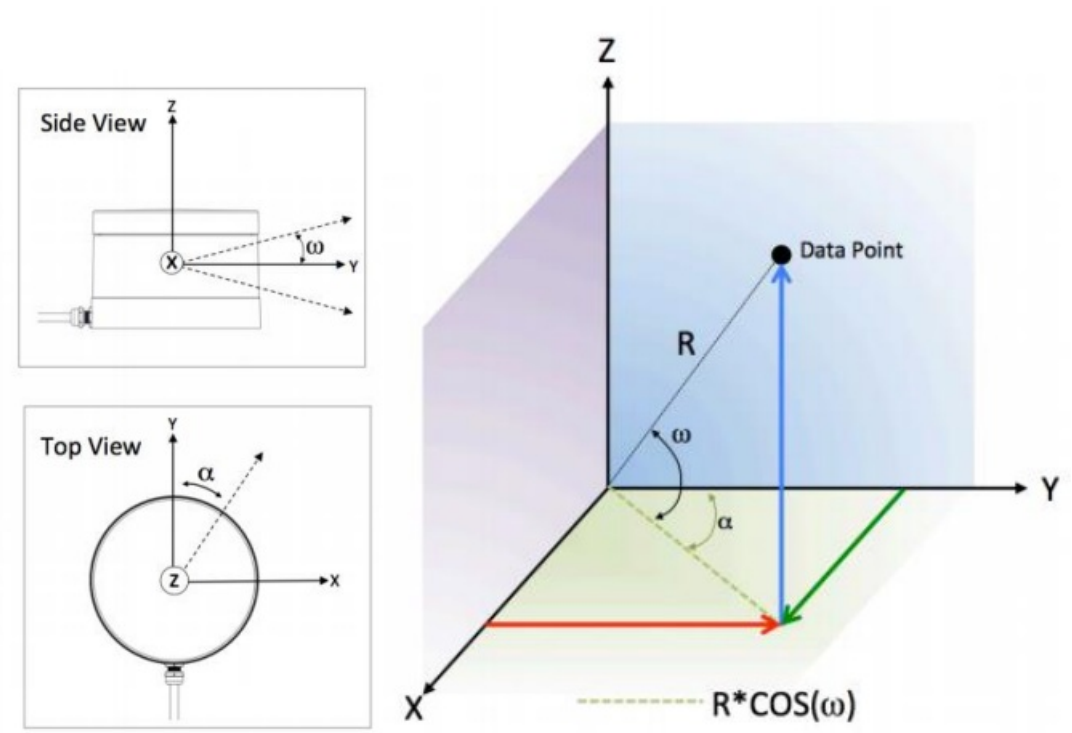
The calculation formula for space coordinates is

$$X = R * \cos(\omega) * \sin(\alpha) + A * \cos(\alpha)$$
$$Y = R * \cos(\omega) * \cos(\alpha) - A * \sin(\alpha)$$
$$Z = R * \sin(\omega) + B$$

Definitions:

- The measured distance output by each channel of the LiDAR is set as R. Note that the unit of the LiDAR input is 2mm, please convert to 1mm first
- Rotating speed of LiDAR is set as H (usually 10Hz)
- The vertical angle of each channel of the LiDAR is set as ω

- The horizontal angle output by the LiDAR is set as α
- The horizontal offset of each channel of the LiDAR is set as A
- The vertical offset of each channel of the LiDAR is set as B
- The spatial coordinate system of each channel of the LiDAR is set to X, Y, Z



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Documents / Resources

	OLEI LR-16F 3D LiDAR Sensor Communication Data Protocol [pdf] User Manual LR-16F, 3D LiDAR Sensor Communication Data Protocol, Communication Data Protocol, 3D LiDAR Sensor, LiDAR Sensor, 3D LiDAR, Sensor, LiDAR

References

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