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YDLIDARTIA DEVELOPMENT MANUAL^{BETA}



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1 SYSTEM COMMUNICATION

1.1 Communication Mechanism

TIA uses the network to interact with external devices for commands and data. When an external device sends a system command to TIA, TIA resolves the system command and returns a corresponding reply message. According to the command content, TIA switches the corresponding working status. According to the content of the message, the external system can parse the message and obtain the response data.

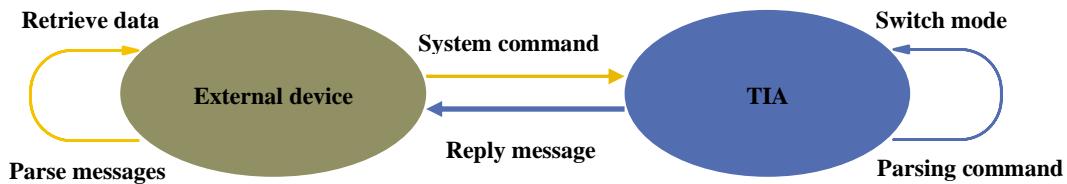


FIG 1 YDLIDAR TIA SYSTEM COMMUNICATION

1.2 System Command

The external system can set the corresponding working status of TEA and send corresponding data by sending related system commands. System commands can send JSON strings through TCP communication. The system commands issued by TEA are as follows:

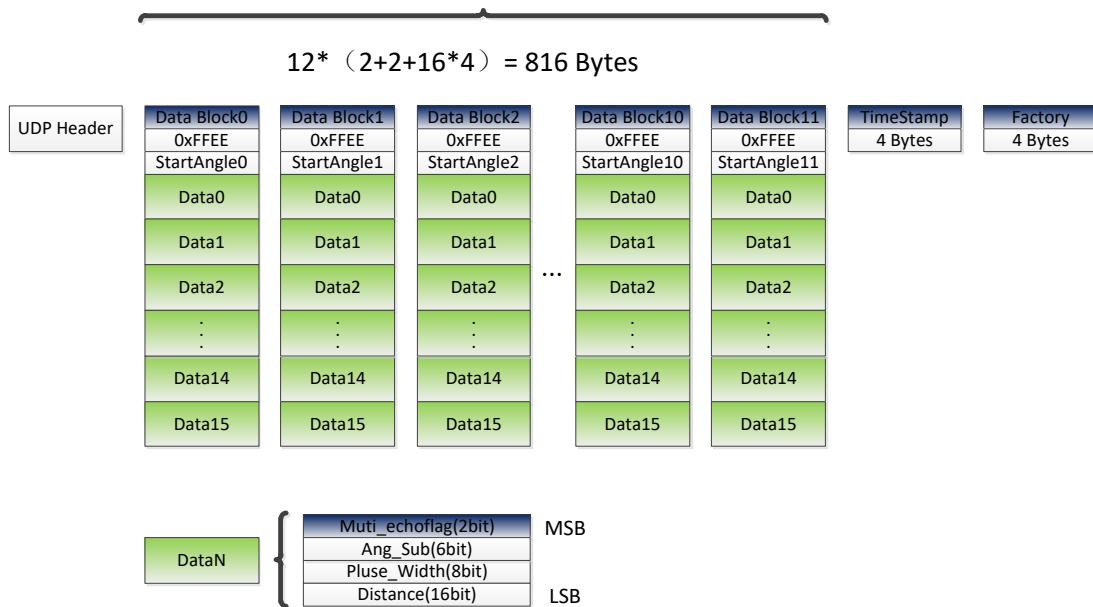
CHART 1 YDLIDAR TEA SYSTEM COMMAND

System Command	Description	Mode Switching	Answer Mode
{"scanType":0}	Start scanning and export point cloud data	Scan mode	Sustained response
{"scanType":-1}	Stop and stop scanning	Stop mode	No response
{"Read":"Software"}	Read software version	No	Single response
{"Read":"Hardware"}	Read firmware version	No	Single response
{"Read":"MAC"}	Read MAC	No	Single response
{"Read":"SN"}	Read SN	No	Single response
{"SetIP":"192.168.111.11"}	Configure IP	No	Single response
{"SetUpdPort":"9000"}	Configure UDP port	No	Single response
{"restart":1}	Soft restart	No	No response

2 DATA PROTOCOL

TIA point cloud data is transmitted based on UDP protocol packets over Ethernet. Each UDP packet has a total length of 832 Byte, including 8 UDP protocol information fields, 816 Byte point cloud information fields, 4 Byte timestamp fields and 4 Byte factory-defined fields.

The 816 Byte point cloud information field is divided into 12 groups of 68 Byte each, including 2 Byte of data header (0xFFEE), 2 Byte of start Angle information and 64 Byte of point cloud information (16 points). The point cloud information of each point contains 1 Byte of multi-echo flag & Angle value increment information, 1 Byte of intensity signal and 2 Byte of distance value.



Set Data Block0 in the data packet be:

```
FF EE 26 25 22 30 01 92 23 31 01 7F 26 30 01 8B 25 30 01 85 23 30 01 90 25 30
01 80 25 31 01 7B 23 30 01 7B 26 2F 01 7B 25 30 01 84 23 34 01 80 23 34 01 80
25 31 01 94 25 31 01 94 23 30 00 00 26 2F 00 00
```

According to the Data protocol, in Data Block0, the starting Angle is 26, 25, and Data0 is 22, 30, 01, 92.

2.1 Multi Echo Analysis

Multi-echo flag solution formula: $Muti_echoflag = DataN[30:31]$

TIA integrates multiple echo recognition algorithm, and the points of multiple echo signals will be in Muti_Echoflag is marked, and users can filter the points of multiple echo signals according to the actual use, as follows:

- 1) Muti_Echo flag=0, first echo
- 2) Muti_Echo flag=1, second echo

Data0 in the data package is 22 30 01 92, which is substituted into the formula, Muti_Echo flag=0, which is the first echo.

2.2 Angle Analysis

Angle solution formula: $Angle_i = StartAngle + \sum_{i=0}^{i+1} Ang_{sub_i}$ $(i = 0,1,2 \dots 15)$

Starting angle solution formula: $StartAngle = \frac{Si}{100}$

Angle increment solution formula: $Ang_{Sub_i} = \frac{DataN[24:29]}{100}$ $(i = n)$

In the data package, the starting angle is 26 25, and the Data0 is 22 30 01 92, which is substituted into the formula:

$$StartAngle_0 = 97.65^\circ, Ang_{Sub0} = 0.34^\circ$$

$$Angle_0 = 97.65^\circ + 0.34^\circ = 97.99^\circ$$

2.3 Intensity signal analysis

Intensity calculation formula: $Pluse_Width = DataN [16:23]$

Data0 in the data package is 22 30 01 92, which is substituted into the formula, Plus_Width = 48.

2.4 Distance Analysis

Distance calculation formula: $Distance = DataN [0:15]$

In the data package, Data0 is 22 30 01 92, which is substituted into the formula, Distance=402mm.

2.5 Timestamp Parsing

The timestamp is used to record system time with a resolution of 100ns.

347 10.946789	192.168.0.11	255.255.255.255	UDP	866 52668 → 8000 Len=824
348 10.959006	192.168.0.11	255.255.255.255	UDP	866 52668 → 8000 Len=824
349 10.968629	192.168.0.11	255.255.255.255	UDP	866 52668 → 8000 Len=824
> Frame 348: 866 bytes on wire (6928 bits), 866 bytes captured (6928 bits) on interface \Device\NPF_{...}				
> Ethernet II, Src: Xilinx_ea:00:00 (00:0a:35:ea:00:00), Dst: Broadcast (ff:ff:ff:ff:ff:ff)				
> Internet Protocol Version 4, Src: 192.168.0.11, Dst: 255.255.255.255				
> User Datagram Protocol, Src Port: 52668, Dst Port: 8000				
▼ Data (824 bytes)				
Data: ffee0bd53842000034440000373e0000383f00003443000037430000343a000037390000...				
0240	00 00 34 43 00 00 38 45	00 00 ff ee 26 f8 38 45	..4C..8E ..&.8E	
0250	00 00 34 45 00 00 38 45	00 00 34 47 04 35 34 48	..4E..8E ..4G.54H	
0260	04 3b 38 48 04 40 38 49	04 44 34 49 04 3b 38 4a	;8H@8I .D4I.;8J	
0270	04 25 38 4a 04 35 34 49	04 2a 34 47 04 30 38 46	.%8J.54I .*4G.08F	
0280	04 27 34 45 04 46 38 45	04 49 34 44 04 57 ff ee	.*4E.F8E .I4D.W..	
0290	2a 58 38 44 04 6b 35 44	04 62 37 45 04 68 38 45	*X8D.k5D .b7E.h8E	
02a0	04 68 35 45 04 6f 37 45	04 64 35 45 04 57 38 45	.h5E.07E .d5E.W8E	
02b0	04 5f 34 45 04 64 38 45	04 5a 38 45 04 51 34 45	.~4E.08E .Z8E.Q4E	
02c0	04 60 39 45 04 5a 38 45	04 5a 34 45 04 52 39 45	.~9E.Z8E .Z4E.R9E	
02d0	04 54 ff ee 2d c3 38 45	04 55 34 45 04 60 35 45	.T.~.8E .U4E.^5E	
02e0	04 4a 38 45 04 50 38 44	04 4c 31 45 04 4a 38 45	.J8E.P8D .L1E.J8E	
02f0	04 55 34 45 04 5a 38 44	04 50 38 45 04 51 34 45	.U4E.Z8D .P8E.Q4E	
0300	04 54 38 45 04 5a 34 45	04 5d 38 44 04 4a 34 44	.T8E.Z4E .]8D.J4D	
0310	04 51 38 43 04 50 ff ee	31 25 34 42 04 5a 38 41	.Q8C.P.. 1%4B.Z8A	
0320	04 55 34 41 04 6b 38 40	04 79 38 3d 04 74 34 37	.U4A.k8@ .y8=.t47	
0330	04 7f 38 24 04 88 40 3c	06 36 34 14 04 88 40 1e	.~8\$..@< .64...@.	
0340	0f a8 38 20 00 00 34 1f	00 00 38 20 00 00 34 20	.~8..4.. .~8..4..	
0350	00 00 34 17 0f ca 40 1c	0f c1 13 42 1f 55 0e 12	.~4...@. .~8.B.U..	
0360	34 56		4V	

Timestamp

FIG 2 UDP PACKET PARSING INSTANCE

According to the data protocol, in Figure 2, TimeStamp is 13 42 1f 55.

The time calculation information is as follows:

- 1) Extract the hexadecimal timestamp of UDP packets: 0x13, 0x42, 0x1f, 0x55.
- 2) Convert decimal to 32310050.1us.

3 REVISE

Date	Version	Content
2023-04-26	0.1.0	The 1st release
2023-07-19	0.1.1	Update section 2.1
2023-10-27	0.1.2	Add section 1.2