YDLIDAR

YDLIDAR X2
DEVELOPMENT MANUAL
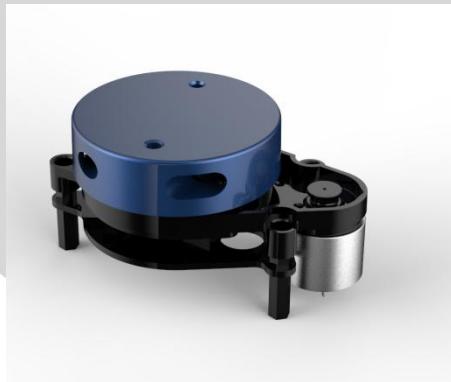
Doc#：01.13.000101

  https://www.facebook.com/ydlidar/

目录

WORKING MECHANISM

After the X2 is powered on, the system automatically starts the ranging. The following is the work-flow of the X2 system:
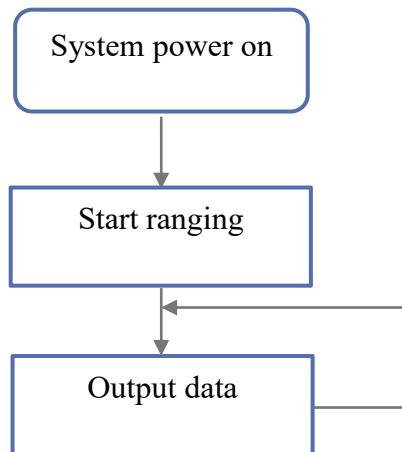

FIG 1 YDLIDAR X2 SYSTEM WORKFLOW

SCAN COMMAND

After power-on, the system will automatically start the ranging and output the message data for starting the scan to the serial port: A5 5A 05 00 00 40 81. The specific meaning of the message is as follows:
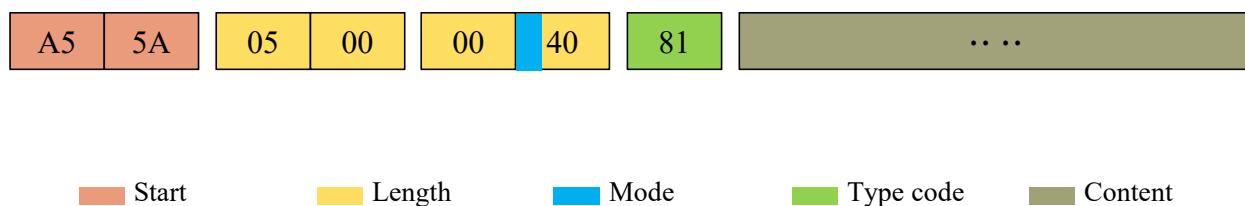

FIG 2 YDLIDAR X2 SCAN COMMAND

➢ **Start sign**：The message start sign of X2 is unified to 0xA55A;

➢ **Length**：The response length indicates the length of the response content, but when the response mode is continuous response, the length should be infinite, so the value is invalid, and the message response length for starting the scan is infinite;

➢ **Response mode**：This bit is only 2 bits, which means that the message is a single response or a continuous response. The response mode for starting the scan is 1, and its value and corresponding mode are as follows:

CHART 1 X2 MODE VALUE AND CORRESPONDING MODE

Mode value	0x0	0x1	0x2	0x3
Response mode	Single	Continuous	Undefined	

> **Type code**：Start scan type code is 0x81；
> **Response content**：Scan data, see data protocol for details.

DATA PROTOCOL

After the system starts scanning, the scanned data is output in the subsequent messages. The data protocol is sent to the external device in hexadecimal to the serial port according to the following data structure.
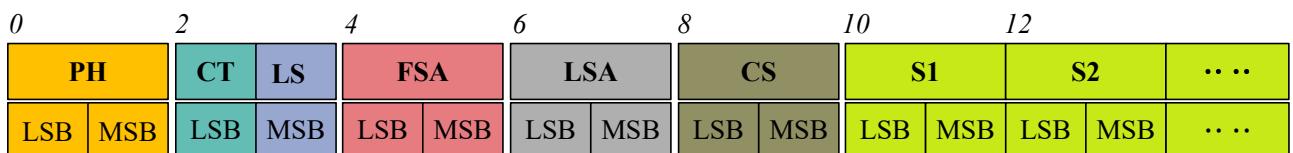
Byte offset

0		2			4		6		8		10		12		
PH		CT	LS	FSA		LSA		CS		S1		S2		····
LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB	····

FIG 3 SCAN COMMAND RESPONSE CONTENT DATA STRUCTURE

CHART 2 SCAN COMMAND DESCRIPTIONS

Item	Name	Description
PH(2B)	Packet header	The length is 2B, fixed at 0x55AA, with the low position in the front and the high position in the back.
CT(1B)	Packet type	Indicates the type of the current packet; 0x00: Point cloud packet 0x01: Start packet
LSN(1B)	Number of samples	Indicates the number of sampling points contained in the current packet; there is only one starting point in the starting packet, and the value is 1.
FSA(2B)	Starting angle	Angle data corresponding to the first sample point in the sampled data
LSA(2B)	End angle	Angle data corresponding to the last sample point in the sampled data
CS(2B)	Check code	The current data packet check code, using double-byte XOR to verify the current data packet
Si(2B)	Sampled data	The sampling data of the system test is the distance data of the sampling point, and the interference flag is also integrated in the LSB of the Si node.

> **Start bit analysis**：

When CT=1, that means the packet is a start data packet. In the packet , you can see LSN = 1(the number of Si is 1). The specific values of distance and angle are as follows.

> **Distance resolution:**

Distance calculation formula：$Distance_i = \dfrac{Si}{4}$

$\overline{Si}$ is sampling data. Set the sampling data to E5 6F. Since this system is a little-endian mode, the

sampling point S = 0x6FE5, substitute the formula to get Distance = 7161.25mm.

➢ **Angle analysis:**

Angle data is stored in the FSA and LSA. Each angle data has the following data structure, C is a parity bit, and its value is fixed at 1. There are two levels of angle resolution: first level analysis and second level analysis. The first-level analysis initially obtains the initial value of the angle, and the second-level analysis corrects the initial value of the angle. The specific process is as follows:

First level analysis：

Starting angle solution formula： $Angle_{FSA} = \dfrac{Rshiftbit(FSA,1)}{64}$

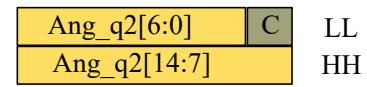| Ang_q2[6:0]	C	LL
Ang_q2[14:7]		HH

FIG 4 ANGLE DATA

End angle solution formula： $Angle_{LSA} = \dfrac{Rshiftbit(LSA,1)}{64}$

Intermediate angle solution formula： $Angle_i = \dfrac{diff(Angle)}{LSN-1} * (i-1) + Angle_{FSA}$ $(i = 2,3,...,LSN-1)$

$Rshiftbit(data,1)$ means shifting the data to the right by one bit. $diff(Angle)$ means the clockwise angle difference from the starting angle (uncorrected value) to the ending angle (uncorrected value), and LSN represents the number of packet samples in this frame.

Second-level analysis：

Angle correction formula： $Angle_i = Angle_i + AngCorrect_i$ $(i = 1,2,...,LSN)$

AngCorrect is the angle correction value, and its calculation formula is as follows, $tand^{-1}$ is an inverse trigonometric function, and the return angle value is:

IF $Distance_i == 0$ $AngCorrect_i = 0$

ELSE $AngCorrect_i = tand^{-1}(21.8 * \dfrac{155.3 - Distance_i}{155.3 * Distance_i})$

In the data packet, the 4th to 8th bytes are 28 E5 6F BD 79, so LSN = 0x28 = 40(dec), FSA = 0x6FE5, LSA = 0x79BD, and bring in the first-level solution formula, and get：

$Angle_{FSA} = 223.78°$，$Angle_{LSA} = 243.47°$，$diff(Angle) = 19.69°$

$Angle_i = \dfrac{19.69°}{39} * (i-1) + 223.78°$ $(i = 2,3,...,39)$

Assume that in the frame data, Distance_1 = 1000，Distance_{LSN} = 8000，and bring in the second-level solution formula, you get:

$\text{AngCorrect}_1 = -6.7622°$，$\text{AngCorrect}_{LSN} = -7.8374°$, so:

$Angle_{FSA} = Angle_1 + \text{AngCorrect}_1 = 217.0178°$

$Angle_{LSA} = Angle_{LSA} + \text{AngCorrect}_{LSA} = 235.6326°$

Similarly, $Angle_i$ $(i = 2,3,...,LSN - 1)$，can be obtained sequentially.

➤ **Check code:**

The check code uses a two-byte XOR to verify the current data packet, and does not participate in the exclusive OR operation itself, and the XOR sequence is not strictly in byte order. The XOR sequence is shown in the figure. It should be noted that since the sampled data Si has 3 bytes, the upper 8 bits of the first byte of Si need to be complemented by 0, such as C_3 and C_5 on the left. Therefore, the checksum solving formula is:

$$\text{CS} = \text{XOR}_1^{end}(C_i) \qquad i = 1,2,...,end$$

XOR_1^{end} indicates the XOR of the element from subscript 1 to end. However, XOR satisfies the exchange law, and the actual solution may not need to follow the XOR sequence.

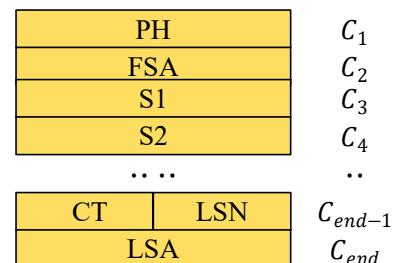| PH		C_1
FSA		C_2
S1		C_3
S2		C_4
.. ..		..
CT	LSN	C_{end-1}
LSA		C_{end}

FIG 5 CS XOR SEQUENCE

MOTOR SPEED CONTROL

Users can change the scanning frequency to meet the needs according to actual needs. The motor speed can be adjusted by changing the input voltage of the M_SCTP pin or changing the duty cycle of the input PWM signal (refer to the data sheet for specific control methods).

REVISION

Date	version	content
2019-04-24	1.0	First written