YDLIDAR

YDLIDAR F4PRO
DEVELOPMENT MANUAL

CONTENTS

WORKING MECHANISM

The YDLIDAR F4PRO (F4PRO) sets 3 operating modes: Idle mode, Scan mode, and Stop mode. For some users' needs, a new power-off protection mode was added in the scan mode;

- ➢ **Idle Mode:** When F4PRO is powered on, the default is idle mode. In idle mode, the F4PRO's ranging unit does not work and the laser is not lit.
- ➢ **Scan mode:** When the F4PRO is in scan mode, the ranging unit turns on the laser and starts to work. It continuously performs laser sampling on the external environment and outputs it in real time after background processing.
- ➢ **Stop mode:** When the F4PRO is running in error, for example when the scanner is turned on, the laser is off and the motor does not turn on, the F4PRO will automatically turn off the distance measuring unit and feedback the error code.
- ➢ **Power-down protection mode:** In this mode, the lidar needs to continuously send scanning commands and the lidar will continue to scan. The command sending interval must be less than 3 seconds. If Lidar cannot receive a continuous scan command, the system will automatically shut down. This mode is off by default.
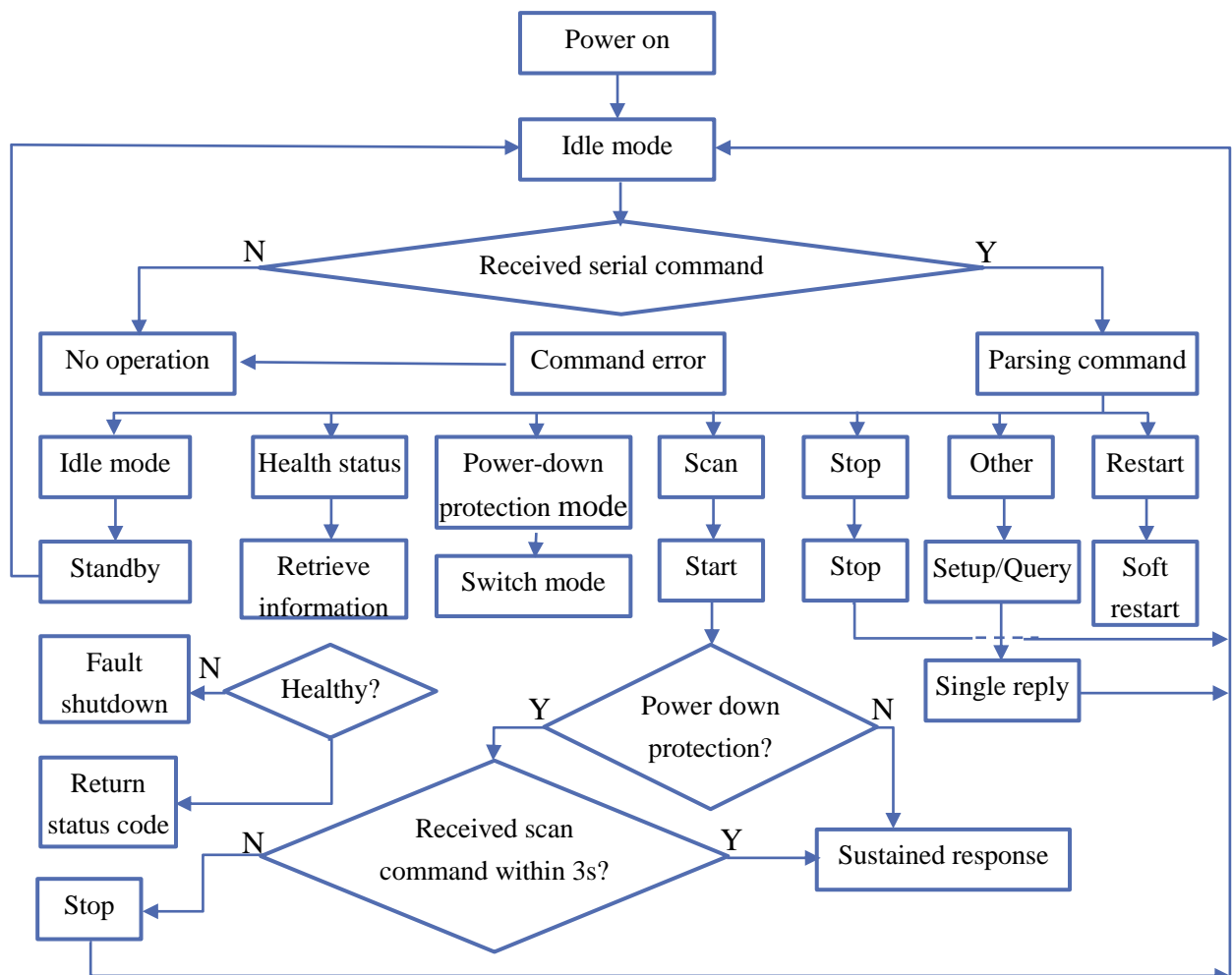
System workflow

FIG 1 YDLIDAR F4PRO WORKFLOW

SYSTEM COMMUNICATION

Communication mechanism

The F4PRO communicates commands and data with external devices through the serial port. When an external device sends a system command to F4PRO, F4PRO resolves the system command and returns a corresponding response message. According to the command content, F4PRO switches the corresponding working status. According to the content of the message, the external system can parse the message and obtain the response data.
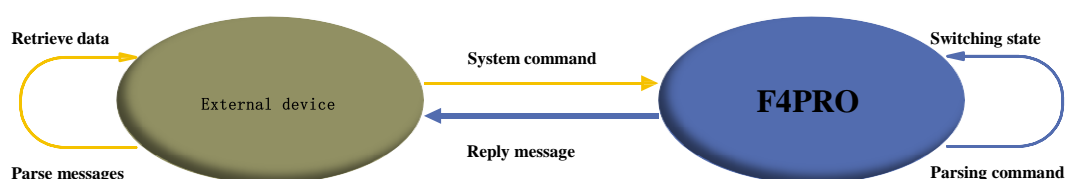

FIG 2 YDLIDAR F4PRO COMMUNICATION MECHANISM

System command

The external system can set the corresponding working status of F4PRO and send corresponding data by sending related system commands. The system commands of the F4PRO are unified to 2 bytes, where the start byte is unified to 0xA5, and the second byte is the command content. The system commands issued by F4PRO are as follows:

CHART 1 YDLIDAR F4PRO SYSTEM COMMAND

System command		Description	Mode	Response Mode
0xA5 (Start)	0x60	Start scanning, output point cloud data	Scan mode	Sustained response
	0x65	Stop and stop scanning	Stop mode	No response
	0x90	Get device information (model, firmware, hardware version)		Single response
	0x91	Get device health		Single response
	0x01	After the low power enable is enabled, the F4PRO does not work in the idle mode		Single response
	0x02	When the low-power shutdown is switched off, the F4PRO still operates in idle mode.		Single response
	0x06	Set the motor rotation direction clockwise		Single response

0x07	Set the direction of motor rotation counterclockwise		Single response
0x08	Get motor rotation direction information		Single response
0x09	Increase 0.1Hz scan frequency		Single response
0x0A	Reduce 0.1Hz scan frequency		Single response
0x0B	Increase 1Hz scanning frequency		Single response
0x0C	Reduce 1Hz scan frequency		Single response
0x0D	Get the currently set scan frequency		Single response
0x0E	Turn on constant frequency function, stable speed (default on)		Single response
0x0F	Turn off the constant frequency function		Single response
0xD0	Ranging frequency setting		Single response
0xD1	Get the current ranging frequency		Single response
0xD9	Power-down protection mode switch (off by default)		Single response
0x80	Soft restart	-	No response

System messages

The system responds to the received system command feedback message when the system message is sent. Different system commands, system message response mode and response content are not the same, there are three types of response modes: no response, single response, continuous response.。

No response means that the system does not return any messages. A single reply indicates that the system's message length is limited, and the response ends once. Sustained response means that the system's message length is infinite, and it needs to send data continuously, for example when entering the scan mode.

The single response and continuous response messages use the same data protocol. The contents of the protocol are: start flag, response length, response mode, type code, and response content. Content is output through the serial port.

CHART 2 YDLIDAR F4PRO SYSTEM MESSAGE DATA PROTOCOL

Start	Length	Response mode	Type code	Content
16bits	30bits	2bits	8bits	-

➢ **Response length:** The response length indicates the length of the response content. However, when the answer mode is continuous, the length should be infinite, so the value is invalid;

➢ **Response mode:** This bit is only 2 bits, indicating that the packet is a single response or continuous response. Its value and corresponding mode are as follows:

CHART 3 YDLIDAR F4PRORESPONSE MODE VALUE AND CORRESPONDING RESPONSE

Response mode	0x0	0x1	0x2	0x3
Response mode	Single response	Continuous	Undefined	

➢ **Type code:** Different system commands correspond to different type codes;

➢ **Response content:** Different system commands, feedback different data content, and their data protocols are also different.

Note 1: The data communication of F4PRO adopts the little-endian mode with the low-order first.

Note 2: In the response message, the lower 6 bits of the 6th byte belong to the response length and the upper 2 bits belong to the answer mode.。

DATA PROTOCOL

Different system commands have different packet contents. Different types of coded messages do not have the same data protocol for the response. Therefore, the user needs to parse the data in the response content according to the corresponding data protocol, such as point cloud data, device information, and the like.

Scan command [A5 60]

When an external device sends a scan command to F4PRO, F4PRO enters scan mode and feeds back point cloud data. The reply message is:

| A5 | 5A | 05 | 00 | 00 | 40 | 81 | · · · · |

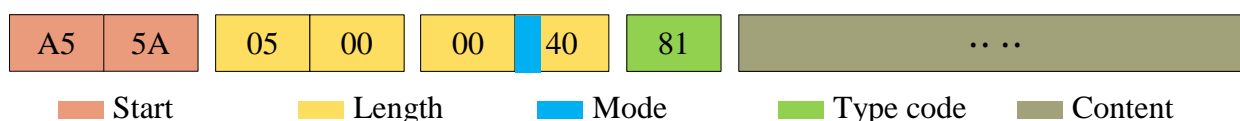■ Start   ■ Length   ■ Mode   ■ Type code   ■ Content

FIG 4 YDLIDAR F4PRO SCAN COMMAND

The 6th byte is high, which is 01, so the answer mode value is 0x1, which is a continuous response. The reply length is ignored and the type code is 0x81;

The response content is the point cloud data scanned by the system. According to the following data structure, it sends to the external device in hexadecimal to the serial port.

Byte offset：

0	2	4	6	8	10	12	
PH	CT	LSN	FSA	LSA	CS	S1	S2	· · · ·
LL	HH	LL	HH	LL	HH	LL	HH	LL	HH	LL	HH	LL	HH	· · · ·

FIG5 SCAN COMMAND RESPONSE CONTENT DATA STRUCTURE

CHART 4 SCAN COMMAND RESPONSE CONTENT DATA STRUCTURE DESCRIPTION

Content	Name	Description
PH(2B)	Packet header	The length is 2B, which is 0x55AA. The low one is in the front and the high one is in the back.
CT(1B)	Packet type	Indicates the type of the current packet; 0x00: Cloud packet 0x01: Zero packet.
LSN(1B)	Sample quantity	Indicates the number of sampling points contained in the current packet; there is only 1 zero point in the zero packet. The value is 1.
FSA(2B)	Starting angle	The angle data corresponding to the first sample point in the sampled data.
LSA(2B)	End angle	The angle data corresponding to the last sample point in the sampled data.
CS(2B)	Check code	The check code of the current data packet uses a two-byte XOR to check the current data packet.
Si(2B)	Sampling data	The system test sampling data is the distance data of the sampling point.

Stop command [A5 65]

When the system is in a scanning state, F4PRO always sends point cloud data. If you need to close the scan at this time, you can send this command to stop the system from scanning. After sending the stop command, the system will be in standby state. At this point, the device's ranging unit is in low power mode and the laser is off.

The command is unresponsive, so the system will not reply with any message after receiving the command.

Device Information [A5 90]

When an external device sends a Get Device Information command to the F4PRO (A5 90), F4PRO will feedback the device model, firmware version and hardware version, and the device's factory serial number. The reply message is:

A5	5A	14	00	00	00	04	. . . .

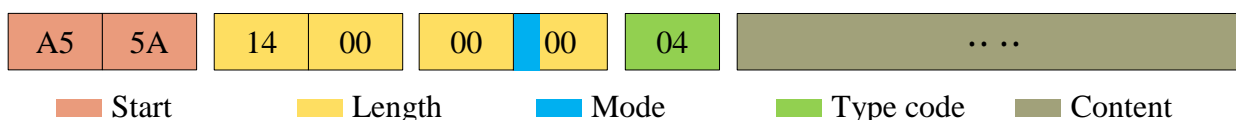■ Start　　■ Length　　■ Mode　　■ Type code　　■ Content

FIG8 YDLIDAR F4PRODEVICE INFORMATION

According to the protocol resolution: response length = 0x00000014, answer mode = 0x0, type code = 0x04.

That is, the number of response content bytes is 20. The response is a single response, the type code is 04, the type of response content meets the following data structure:

Byte offset | 0 | 1 | 2 | 3 | 4 | 5 | .. | 19

Model #   Firmware ver.   Hardware ver.   Serial number

FIG 9 YDLIDAR F4PRO DEVICE INFORMATION RESPONSE CONTENT DATA STRUCTURE

➢ **Model**：1 byte, F4PRO's model code is 04；
➢ **Firmware Ver.**：2 bytes. The low byte is the major version number, and the high byte is the minor version number;
➢ **Hardware Ver.**：1 byte, representing hardware version;
➢ **Serial number**：16 bytes, unique factory serial number.

Health status [A5 91]

When an external device sends a Get Device Health Status command to the F4PRO (A5 91), F4PRO will feedback the device's status code. The reply message is:

A5 | 5A | 03 | 00 | 00 | 00 | 06 | . . ..
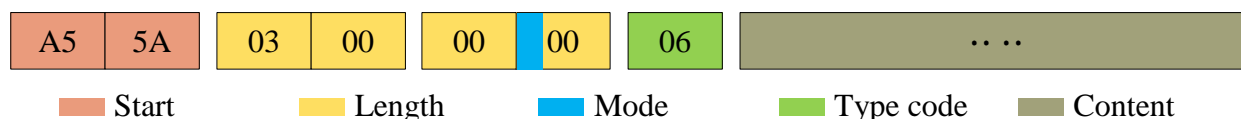
Start   Length   Mode   Type code   Content

FIG 10 YDLIDAR F4PRO HEALTH STATUS

According to the protocol resolution: response length = 0x00000003, answer mode = 0x0, type code = 0x06.

That is, the number of response content bytes is 3; this response is a single response, and the type code is 06. This type of answer content satisfies the following data structure:
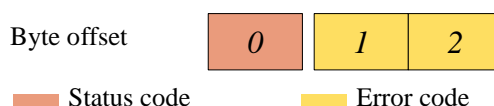

Byte offset | 0 | 1 | 2

Status code   Error code

FIG 11 YDLIDAR F4PRO HEALTH STATUS

➢ **Status code:** 1 byte, 0x0 means the device is operating normally. 0x1 indicates a device operation warning. 0x2 indicates a device operation error.
➢ **Error code:** 2 bytes. When a warning or error status occurs, the specific error code will be recorded in this field. 0x00 indicates that the device is running without error.

Low power consumption [A5 01]

When an external device sends a low-power enable command (A5 01) to the F4PRO, the F4PRO automatically enters a low-power state in idle mode (in standby: the motor is stopped and the ranging unit is powered down), reducing standby power consumption. The reply message is:

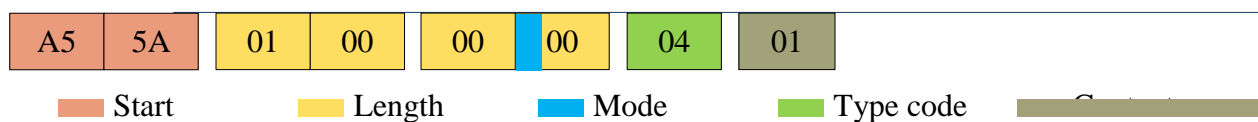| A5	5A	01	00	00	00	04	01

Start   Length   Mode   Type code   ~~Content~~

FIG 12 YDLIDAR F4PRO LOW POWER CONSUMPTION

According to the protocol: response length = 0x00000001, answer mode = 0x0, type code = 0x04.

That is, the number of response content bytes is 1; this response is a single response and the type code is 04. The command response is fixed at 0x01, indicating that the system is enabled for low power consumption. The F4PRO enables low power consumption by default.

Low power consumption off [A5 02]

When the external device sends a low-power shutdown command (A5 02) to the F4PRO, the F4PRO will not automatically enter a low-power state in idle mode (in standby: the motor runs, the ranging unit does not power down), and its reply message:

FIG 13 YDLIDAR F4PRO LOW POWER CONSUMPTION OFF

According to the protocol: response length = 0x00000001, answer mode = 0x0, type code = 0x04.

That is, the number of response content bytes is 1; this response is a single response and the type code is 04. The command response is fixed to 0x00, indicating that the low-power state of the system is turned off。

Motor rotation direction setting [A5 06/07/08]

F4 PRO supports motor forward/reverse setting. The default is clockwise rotation. The relevant commands are described as follows:

CHART 5 MOTOR DIRECTION SETTING COMMAND DESCRIPTION

Command	Description
0xA506	Set the motor to rotate clockwise
0xA507	Set the motor to rotate counterclockwise
0xA508	Get motor rotation direction

The above commands are the same type of commands and have the same message structure. The motor rotation direction is set with the following message structure:

FIG 14 YDLIDAR F4PRO MOTOR DIRECTION

According to the protocol: response length = 0x00000001, answer mode = 0x0, type code = 0x04.

That is, the number of response content bytes is 1; this response is a single response and the type code is 04. The response content indicates the currently set rotation direction, 00 indicates clockwise rotation, and 01 indicates counterclockwise rotation.

Scan frequency setting [A5 09/0A/0B/0C]

F4PRO provides multiple command interfaces for scanning frequency settings to increase or decrease the system scan frequency, as follows:

CHART 6 SCAN FREQUENCY SETTING COMMAND

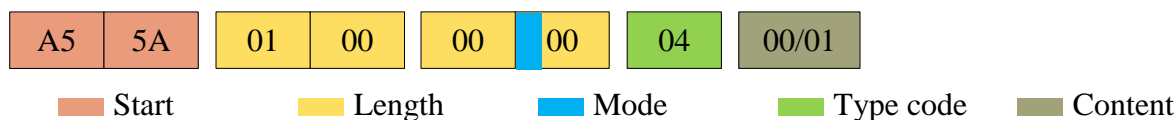| Command	Description
0xA509	Increase 0.1Hz scan frequency
0xA50A	Reduce 0.1Hz scan frequency
0xA50B	Increase 1Hz scanning frequency
0xA50C	Reduce 1Hz scan frequency

FIG 15 YDLIDAR F4PRO SCAN FREQUENCY SETTING

According to the protocol: response length = 0x00000004, answer mode = 0x0, type code = 0x04.

That is, the number of response content bytes is 4. This response is a single response with a type code of 04. The response content represents the currently set sweep frequency (unit: Hz), and its solution formula is:

AnswerData is converted to decimal data in reply (small-endian mode) in Hertz (Hz).

Get scan frequency [A5 0D]

This command is used to obtain the set scan frequency (note that it is not a real-time frequency). Its message structure and response content are the same as the sweep frequency setting command. You can refer to the command [A5 09/0A/0B/0C]. This section does not elaborate.

Constant frequency enable [A5 0E]

This command is used to enable the system constant frequency. After it is turned on, when the lidar is in scanning mode, it will automatically adjust the speed so that the scanning frequency is stable at the currently set scanning frequency. F4PRO enables constant frequency by default。

A5	5A	01	00	00	00	04	01

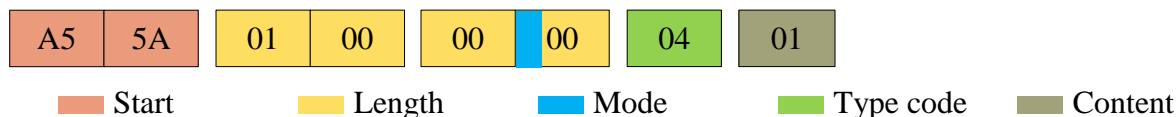| | Start | | Length | | Mode | | Type code | | Content |

FIG 16 YDLIDAR F4PRO CONSTANT FREQUENCY SETTING

According to the protocol resolution: response length = 0x00000001, answer mode = 0x0, type code = 0x04.

That is, the number of response content bytes is 1; this response is a single response, and the type code is 04. The command response is fixed to 0x01, indicating that the system is enabled to have a constant frequency.

Constant frequency mode off [A5 0F]

This command is used to shut down the system constant frequency. After the lidar is turned off, automatic speed adjustment will not be performed when the lidar is in scanning mode. The command's message:

A5	5A	01	00	00	00	04	00

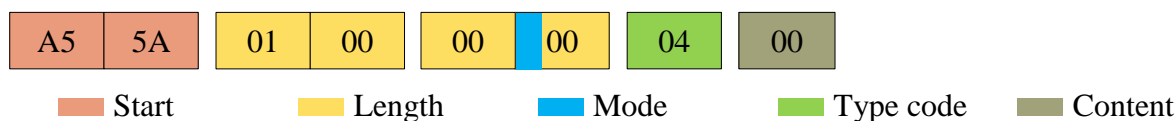| | Start | | Length | | Mode | | Type code | | Content |

FIG 17 YDLIDAR F4PRO SWITCH OFF CONSTANT FREQUENCY

According to the protocol: response length = 0x00000001, answer mode = 0x0, type code = 0x04.

That is, the number of response content bytes is 1. This response is a single response with a type code of 04. The command response is fixed to 0x00, indicating that the system constant frequency is turned off.

Ranging frequency setting [A5 D0]

This command is used to set the system's ranging frequency so that the ranging frequency can be switched between 4KHz and 6KHz. The default ranging frequency is 4KHz. The command's message is as follows:

A5	5A	01	00	00	00	04	00/01

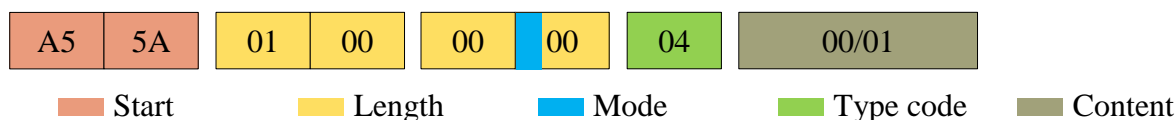| | Start | | Length | | Mode | | Type code | | Content |

FIG 18 YDLIDAR F4PRO RANGING FREQUENCY SETTING

According to the protocol: response length = 0x00000001, answer mode = 0x0, type code = 0x04.

That is, the number of response content bytes is 1. This response is a single response with a type code of 04. The response content of this command corresponds to the system ranging frequency, as follows:

CHART 7 RANGING FREQUENCY SETTING RESPONSE CONTENT DESCRIPTION

Content	0x00	0x01
Range frequency (KHz)	4	6

Get Ranging Frequency [A5 D1]

This command is used to obtain the current ranging frequency of the system. The message structure and response content of this command are consistent with the ranging frequency setting. The user can refer to the section on setting the ranging frequency. This section does not elaborate.

Power-down protection [A5 D9]

When the lidar and external equipment are not powered by a common power supply system, the power-down protection mode may need to be turned on. To prevent the lidar system from operating after the system shuts down, protection is provided from inside the lidar.

After this mode is turned on, it is necessary to continuously send scan commands with an interval less than 3 seconds so that the lidar will continue to work. If the command sends an interrupt or if the sending interval is too long, the system will determine that the control end has lost power and will trigger power-down protection. The lidar will stop. This command is a switch command. The command message is as follows:

A5	5A	01	00	00	00	04	00/01

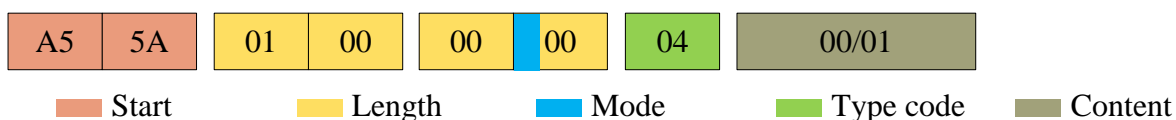🟥 Start 🟨 Length 🟦 Mode 🟩 Type code 🟫 Content

FIG 19 YDLIDAR F4PRO POWER DOWN PROTECTION

According to the protocol: response length = 0x00000001, answer mode = 0x0, type code = 0x04.

That is, the number of response content bytes is 1. This response is a single response with a type code of 04. The response content of this command corresponds to the power-off protection mode on and off, 00 is the power-off protection, and 01 is the power-off protection.

Note: In power-down protection mode, the structure of the scan command's message changes slightly. Only when the scan command is sent for the first time in the shutdown state will there be a complete message structure. There is no start flag, response length, answer mode, and type code in subsequent scan commands.

Restart [A5 80]

When an external device sends a command (A5 80) to F4PRO, F4PRO will enter a soft reboot and the system will restart. This command does not answer.

Standby control

The F4PRO integrates the power control of the system into the command interface of the system, not the hardware interface. Therefore, the user only needs to send the corresponding control command (A5 01/02) to enable/disable the low-power state of the system.

Motor speed control

The F4PRO integrates the speed control of the system into the command interface of the system, not the hardware interface. The user can change the speed of the motor by adjusting the scan frequency.

USE CAUTION

When interacting with the F4PRO, commands other than the scan command (A5 65) cannot be exchanged in the scan mode. Otherwise, the packets may be parsed incorrectly.