LED control card Communication Protocol

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Version History:

Version	date	AMD	author	description
V1.0	2018-12-29	A	Li Piao	1.The original version of the finish.
V1.1	2022-12-12	A	Guo Si quan	1.Organize the Change Catalog section. 2.Modify the protocol example and protoc ol parsing. 3.Added voice broadcast protocol. 4.Added brightness adjustment protocol. 5.Addd a protocol for switching the displa y screen. 6.Added QR code generation protocol.
V1.2	2023-03-06	M	Guo Si quan	1.Integrate TCP client communication prot ocol.
V1.3	2023-07-14	M	Guo Si quan	1.Corrected some errors. 2.Added the protocol control command typ e table.
V1.4	2024-07-09	M	Guo Si quan	1.Corrected some errors. 2.Added the CRC16 verification algorithm. 3.Added the XOR sum verification algorit hm.

(A-Add, M-Modify, D-Delete)

If there are any errors or omissions in the document, please cont act us to correct it

Directory

1. Overview

1.1 LED control card overview

Our control card for asynchronous single-color, dual-color, triple-color seven-color grey-free LED control card, designed for industrial data real-time refresh occasions, synchronous reception and real-time display of external data. The control card contains large graphics font, text-based protocol communication, communication data is very small, convenient for multiple displays centralised management, real-time docking communication. Control card integrated RJ45, RS232, RS485 communication interface, providing users with a variety of communication options. At the same time with the computer, industrial PLC, data acquisition card, configuration software docking, receive all kinds of data, no delay in the display. Control card external optional data acquisition card, production line production data acquisition can be sent to the display; optional PLC commonly used MODBUS protocol conversion board, docking with the PLC, real-time transmission of data and information, optional TTS voice card to play the text synthesised voice and other functions.

- **LED control card features.**

1) Support single base color, dual base color, triple base color conventional LED screen driver.
2) Support network, serial and 485 port communication.
3) Supports the display of time, positive/countdown time, in-code text, pictures, tables, GIF animation, real-time data, queuing call numbers and other information materials.
4) Real-time data support power-down save, power-down no save mode, power-down no save mode update times greater than 10 times / sec, data update without flicker phenomenon.
5) Support display page, picture group command mode, IO port mode on-demand.
6) Comes with 12, 16, 24, 32, 48, 64, 80, 96 points, Song, Bold and other GB2312 graphic fonts, also supports the download of custom fonts.
7) With its own temperature and humidity module socket, 4-channel relay control output port, IO signal on-demand programme input port.
8) Support stacking TTS text-to-speech cards, switching volume acquisition cards, analogue volume acquisition cards and protocol conversion cards to achieve various needs.
9) Support external wireless transmission modules, such as: WIFI \4G \433M micro-power module.
10) Customise a set of instructions for secondary development, dynamic libraries, easy to interface with a variety of equipment, computer software environment, but also support the protocol conversion card for a variety of protocols and then send the data to the LED card display.

1.2 Protocol overview

LED display control card communication protocol (hereinafter referred to as "communication protocol") is the host computer software through the network, serial, 485 and other communication methods and LED control card to communicate with the use of protocol documents.

Based on the communication protocol, it can realise the data transmission function between the host computer software and the control card, such as refreshing the real-time data, displaying the internal code text with moving effect, etc.; and it can control the LED control card through the host computer software to display the content on-demand, broadcasting the voice, controlling the relay and other functions.

Before docking the communication protocol, you need to use the supporting software to modify the parameters of the control card, so that the control card can drive the normal display of the LED display; and then modify the communication parameters of the control card, such as the IP address of the control card or the server address, the baud rate of the communication of the 232/485, etc. and finally, use the editing software to create a display template, which will be sent down to the control card for preservation.

1.3 Communication mode

- **Serial port:** baud rate 9600/19200/38400/57600/115200, 8 data bits, no parity, 1 stop bit.
- **485:** Baud rate 9600/19200/38400/57600/115200, 8 data bits, no parity, 1 stop bit.
- **UDP:** Configure the control card IP address, netmask, default gateway, and default listening port 8800.
- **TCP Client:** Configure the IP address, netmask, default gateway, server IP address and server port of the control card.
- **TCP server:** Configure the IP address, network mask, default gateway, and server port of the control card.

1.4 Preparation work

1) Use editing software (serial/485) or parameter configuration software (network) to configure the display parameters of the control card so that the control card can drive the display normally.
2) Referring to 1.2 Communication method description, use the editing software (serial/485) or parameter configuration software (network) to configure the communication method of the control card.
3) Use editing software to create a display template, referring to the protocol formatting instructions for specific steps.

   Display page: The full screen display of the display is a display page. When multiple d

isplay pages are set, the contents of the clips in each display page will be played in tur n.

Display Area: Multiple display areas can be added to the display page, and various disp lay materials can be added to the display area. The display area can be customised in w idth, height and coordinates, and the display material will be shown in the corresponding display area.

Display material: the type of display content, such as single line text, internal code tex t, time and other kinds of material.

4) Test the communication process according to the DEMO programme provided by the sec ondary development, then write the customer-specific programme according to the format of the communication protocol, select the appropriate command function to communicate and interact with the control card, and control the board to achieve the required function s.

1.5 Protocol convention

- The protocol data format in this document is hexadecimal data if not otherwise specified.
- Data lengths mentioned in this document are in bytes (byte) unless otherwise specified.
- The Character encodings covered in this document are ASCII and GB2312.

2. Protocol format

- The request protocol is a packet sent from the host computer to the control card.
- The reply protocol is the receive acknowledgement packet returned by the control card after it receives the request protocol from the host computer.

2.1 Request protocol format

2.1.1 Network/ Serial port mode

Name	Byte Number	Data Type	Description
Frame header	4	Numerical	Fixed byte values is 0xFE 0x5C 0x4B 0x89.
Packet length	4	Numerical	Byte length from the Frame header to the Frame end. The low byte comes first, and the high byte comes last.
Protocol type	1	Numerical	The type byte of the protocol.
Send ID	4	Numerical	A custom packet ID number that is carried in the reply packets sent back by the controller card to distinguish multiple reply packets.
Control instruction content length	4	Numerical	Byte length of the Control instruction content. The low byte comes first, and the high byte comes last.
Control instruction content	Several	--	Protocol-specific control instruction content.
Frame end	2	Numerical	Fixed byte values is 0xFF 0xFF.

2.1.2 485 mode

Name	Byte Number	Data Type	Description
Frame header	1	Numerical	Fixed byte values is 0xFE.
Target device ID	1	Numerical	Fixed byte values is 0x98.
Packet length	2	Numerical	Byte length from the Target device ID to the Control instruction content. The high byte comes first, the low byte comes last.
Source device ID	1	Numerical	Fixed byte values is 0x97.
Protocol type	1	Numerical	The type byte of the protocol.
Reserved word	1	Numerical	Fixed byte values is 0x00.
Device communi-cation address	8	Numerical	Mode 1: Enter the internal code of the control card to specify that the control card can receive the packet.

			Mode 2: The first 7 bytes are filled with 0x00, and the last 1 byte is filled with the 485 communication address of the control card. Mode 3: Fill 8 bytes 0x00 for broadcast mode. All control cards can receive packets.
Control instruction content	Several	--	The specific control content of the packet.
Xor sum packet check	1	Numerical	All bytes of the Target device ID to the Control instruction content are verified. The XOR sum check algorithm is shown in Annex 3

2.2 Reply protocol format

2.2.1 Network mode

Name	Byte Number	Data Type	Description
Frame header	4	Numerical	Fixed byte values is 0xFE 0x5C 0x4B 0x89.
Packet length	4	Numerical	Byte length from the Frame header to the Frame end. The low byte comes first, and the high byte comes last.
Protocol type	1	Numerical	The type byte of the protocol.
Message ID	4	Numerical	The Send ID set for the request packet.
Message content length	4	Numerical	Byte length from the Message content to the Separator.The low byte comes first, and the high byte comes last.
Message content	1	Numerical	0x31-The control card successfully received the packet. 0x32-The control card received data packet abnormally or incorrectly. 0x33-A subpacket transmission error occurs and the subpacket needs to be retransmitted.The latter byte is the sequence number of the data subpacket to be retransmitted.
Separator	1	Numerical	Fixed byte values is 0x23.
Frame end	2	Numerical	Fixed byte values is 0xFF 0xFF.

2.2.2 Serial port mode

Name	Byte Number	Data Type	Description
Frame header	4	Numerical	Fixed byte values is 0xFE 0x5C 0x4B 0x89.

Packet length	4	Numerical	Byte length from the Frame header to the Frame end. The low byte comes first, and the high byte comes last.
Protocol type	1	Numerical	The type byte of the protocol.
Message ID	4	Numerical	The Send ID set for the request packet.
Message content length	4	Numerical	Byte length from the Message content to the Separator.The low byte comes first, and the high byte comes last.
Message content	1	Numerical	0x31-The control card successfully received the packet. 0x32-The control card received data packet abnormally or incorrectly. 0x33-A subpacket transmission error occurs and the subpacket needs to be retransmitted.The latter byte is the sequence number of the data subpacket to be retransmitted.
Separator	1	Numerical	Fixed byte values is 0x23.
CRC16 packet check	2	Numerical	All bytes of the Frame header to the Separator are verified. The CRC16 check algorithm is shown in Annex 2
Frame end	2	Numerical	Fixed byte values is 0xFF 0xFF.

2.2.3 485 mode

Name	Byte Number	Data Type	Description
Frame header	1	Numerical	Fixed byte values is 0xFE.
Target device ID	1	Numerical	Fixed byte values is 0x97.
Packet length	2	Numerical	Byte length from the Target device ID to the Reserved word. The high byte comes first, the low byte comes last.
Source device ID	1	Numerical	Fixed byte values is 0x98.
Protocol type	1	Numerical	The type byte of the protocol.
Message content	1	Numerical	0x31-The control card successfully received the packet. 0x32-The control card received data packet abnormally or incorrectly. 0x33-A subpacket transmission error occurs and the subpacket needs to be retransmitted.The latter byte is the sequence number of the data subpacket to be retransmitted.
485 Address	1	Numerical	The 485 address of the control card.
Reserved word	3	Numerical	Fixed byte values is 0x00 0x00 0x00.
Xor sum packet check	1	Numerical	All bytes of the Target device ID to the Control instruction content are verified. The XOR sum check algorithm is shown in Annex 3

3. Control instruction format

3.1 ★Real-time collection data(Dynamic data)

- This directive is mainly applicable to the use of scenarios where the display content is frequently refreshed, and the data update speed is extremely fast.
- Real-time collection data only supports static display, and other mobile modes are not supported.
- A real-time collection data can store a maximum of 16 Characters, if data more than 16 Characters can be sent together by multiple real-time collection data.
- The data number of real-time collection item is used to distinguish multiple real-time collection data. The data number ranges from 1 to 70 (in decimal notation) and cannot be repeated.

◆ **Steps for creating a display template:**

1) Add a display page.
2) Add two areas to the display page.
3) Add a real-time collection material to each area.
4) Modify data number of the two real-time collection data to 41 and 42.
5) Save and send the display template.

3.1.1 Network/Serial port mode

Name	Byte Number	Data Type	Description
Frame header	4	Numerical	Fixed byte values is 0xFE 0x5C 0x4B 0x89.
Packet length	4	Numerical	Byte length from the Frame header to the Frame end. The low byte comes first, and the high byte comes last.
Protocol type	1	Numerical	The type byte of the protocol. Fixed byte values is 0x65.
Send ID	4	Numerical	A custom packet ID number that is carried in the reply packets sent back by the controller card to distinguish multiple reply packets.
Control instruction content length	4	Numerical	Byte length of the Control instruction content. The low byte comes first, and the high byte comes last.
Control instruction content start			
Real-time collection data control instruction content (from Data No. to Display content)			
Data No.	1	Numerical	The data number of real-time collection item is used to distinguish multiple real-time collection data. The data number ranges from 1 to 70 (in decimal notation) and cannot be repeated.
Special property	1	Numerical	When the high 4 bits of the byte is 0101, it means that this data is saved by power down. This method

			needs to write the data into flash memory, and cannot send power-down saved data packets frequently, which will cause the memory of the control card to be corrupted! The high 4 bits of the byte are other values then it means that the data is not saved by power down, and the power down is not saved packets can be sent frequently. When the lower 4 bits of the byte are 0101, it means that the data of this item is blinking, while other values are not blinking.
Character color	1	Numerical	The high 4 bits of the byte set the Character color and the low 4 bits are reserved. If the byte is 0xFF, the Character color is pre-set by the display template. 1-red 2-green 3-yellow 4-blue 5-purple 6-cyan 7-white
Character attribute	1	Numerical	The high 4 bits of the byte set the font and the low 4 bits set the font size. A byte of 0xFF indicates that the font size is pre-set by the display template. **Font:** 0-Custom font library 1-Song script 2-Regular script 3-Boldface 4-Official script 5-Running script **Font size:** 0-12*12 1-16*16 2-24*24 3-32*32 4-48*48 5-64*64 6-80*80 7-96*96
Display content length	1	Numerical	Byte length of the Display content.
Display content	≤16	Character	Display content sent with Characters in ASCII and GB2312 encoding.
Next real-time collection data control instruction content (from Data No. to Display content)			
Control instruction content end			
Frame end	2	Numerical	Fixed byte values is 0xFF 0xFF.

- **Request protocol example:**

FE 5C 4B 89 2C 00 00 00 65 00 00 00 00 19 00 00 00 29 00 FF FF 0B 74 65 6D 70 65 72 61 74 75 72 65 2A 00 21 31 04 32 36 2E 35 FF FF

✓ **Request protocol parse:**

FE 5C 4B 89 Frame header (fixed)
2C 00 00 00 Packet length (from Frame header to Frame end)
65 Protocol type (fixed)
00 00 00 00 Send ID (custom)
19 00 00 00 Control instruction content length
(from data1 Data No. to data2 Display content)
**Real-time collection data 1 **
29 Data No. (41)

00 Special property (0-power down data lose 0-No flicker)
FF Character color (pre-set by the display template)
FF Character attribute (pre-set by the display template
0B Display content length (display content byte length 4)
74 65 6D 70 65 72 61 74 75 72 65 Display content (temperature)

Real-time collection data 2

2A Data No. (42)
00 Special property (0-power down data lose 0-No flicker)
21 Character color (Character color green)
31 Character attribute (font:Boldface size:16)
04 Display content length (display content byte length 4)
32 36 2E 35 Display content (26.5)
FF FF Frame end (fixed)

3.1.2 485 mode

Name	Byte Number	Data Type	Description
Frame header	1	Numerical	Fixed byte values is 0xFE.
Target device ID	1	Numerical	Fixed byte values is 0x98.
Packet length	2	Numerical	Byte length from the Target device ID to the Control instruction content. The high byte comes first, the low byte comes last.
Source device ID	1	Numerical	Fixed byte values is 0x97.
Protocol type	1	Numerical	The type byte of the protocol. Fixed byte values is 0x37.
Reserved word	1	Numerical	Fixed byte values is 0x00.
Device communication address	8	Numerical	Mode 1: Enter the internal code of the control card to specify that the control card can receive packets. Mode 2: The first 7 bytes are filled with 0x00, and the last 1 byte is filled with the 485 communication address of the control card. Mode 3: Fill 8 bytes 0x00 for broadcast mode. All control cards can receive packets.
Control instruction content start			
Real-time collection data control instruction content (from Data No. to Display content)			
Data No.	1	Numerical	The data number of real-time collection item is used to distinguish multiple real-time collection data. The data number ranges from 1 to 70 (in decimal notation) and cannot be repeated.
Special property	1	Numerical	When the high 4 bits of the byte is 0101, it means that this data is saved by power down. This method needs to write the data into flash memory, and cannot send power-down saved data packets frequently, which will cause the memory of the control card to

			be corrupted! The high 4 bits of the byte are other values then it means that the data is not saved by power down, and the power down is not saved packets can be sent frequently. When the lower 4 bits of the byte are 0101, it means that the data of this item is blinking, while other values are not blinking.
Character color	1	Numerical	The high 4 bits of the byte set the Character color and the low 4 bits are reserved. If the byte is 0xFF, the Character color is pre-set by the display template. 1-red 2-green 3-yellow 4-blue 5-purple 6-cyan 7-white
Character attribute	1	Numerical	The high 4 bits of the byte set the font and the low 4 bits set the font size; A byte of 0xFF indicates that the font size is pre-set by the display template; **Font:**0-Custom font library 1- Song script 2- Regular script 3-Boldface 4-Official script 5-Running script **Font size:** 0-12*12 1-16*16 2-24*24 3-32*32 4-48*48 5-64*64 6-80*80 7-96*96
Display content length	1	Numerical	Byte length of the Display content.
Display content	≤16	Character	Display content sent with Characters in ASCII and GB2312 encoding.
Next Real-time collection data control instruction content (from Data No. to Display content)			
Control instruction content end			
Xor sum packet check	1	Numerical	All bytes of the Target device ID to the Control instruction content are verified. The XOR sum check algorithm is shown in Annex 3

- **Request protocol example:**

FE 98 00 27 97 37 00 00 00 00 00 00 00 00 29 00 FF FF 0B 74 65 6D 70 65 72 61 74 75 72 65 2A 00 21 31 04 32 36 2E 35 70

✓ **Request protocol parse:**

FE Frame header (fixed)
98 Target device ID (control card 0x98)
00 27 Packet length (from Target device ID to data 2 Display content)
97 Source device ID (upper computer 0x97)
37 Protocol type (fixed)
00 Reserved word (fixed)
00 00 00 00 00 00 00 Device communication address (broadcast mode)
**Real-time collection data 1 **
29 Data No. (41)

00	Special property (0-power down data lose 0-No flicker)
FF	Character color (pre-set by the display template)
FF	Character attribute (pre-set by the display template
0B	Display content length (display content byte length 4)
74 65 6D 70 65 72 61 74 75 72 65	Display content (temperature)

Real-time collection data 2

2A	Data No. (42)
00	Special property (0-power down data lose 0-No flicker)
21	Character color (Character color green)
31	Character attribute (font:Boldface size:16*16)
04	Display content length (display content byte length 4)
32 36 2E 35	Display content (26.5)
70	Xor sum packet check (from Target device ID to data 2 Display content)

3.2 Read Real-time collection data

➢ This instruction is mainly used to read the real-time collection data stored in the control card.

3.2.1 Network/Serial port mode

Name	Byte Number	Data Type	Description
Frame header	4	Numerical	Fixed byte values is 0xFE 0x5C 0x4B 0x89.
Packet length	4	Numerical	Byte length from the Frame header to the Frame end. The low byte comes first, and the high byte comes last.
Protocol type	1	Numerical	The type byte of the protocol. Fixed byte values is 0x65.
Send ID	4	Numerical	A customised message ID number, which is carried on reply messages returned by the control card to distinguish between multiple reply messages.
Control instruction content length	4	Numerical	Byte length of the Control instruction content. The low byte comes first, and the high byte comes last.
Control instruction content start			
Function code	1	Numerical	Fixed byte values is 0xFF.
Number of reads	1	Numerical	Read the number of real-time collected data
Data No.	several	Numerical	The data number of real-time collection item is used to distinguish multiple real-time collection data. The data number ranges from 1 to 70 (in decimal notation) and cannot be repeated. The data number is filled in sequentially, one byte for each data number.
Control instruction content end			
Frame end	2	Numerical	Fixed byte values is 0xFF 0xFF.

● **Request protocol example (Data No. 41 42):**

FE 5C 4B 89 17 00 00 00 65 00 00 00 00 04 00 00 00 FF 02 29 2A FF FF

✓ **Request protocol parse:**

FE 5C 4B 89	Frame header (fixed)
17 00 00 00	Packet length (from Frame header to Frame end)
65	Protocol type (fixed)
00 00 00 00	Send ID (custom)
04 00 00 00	Control instruction content length (from Function Code to Data No.)
FF	Function code (fixed)
02	Number of reads (reads two real-time collection data)

29 2A Data No. (41 and 42)
FF FF Frame end (fixed)

- **Reply protocol example:**

FE 5C 4B 89 27 00 00 00 00 65 00 00 00 00 12 00 00 00 29 00 FF FF 04 CE C2 B6 C8 2A 00 21 11 04 32 36 2E 35 98 F9 FF FF

✓ **Reply protocol parse:**

FE 5C 4B 89 Frame header (fixed)
2E 00 00 00 Packet length (from Frame header to Frame end)
65 Protocol type (fixed)
00 00 00 00 Send ID (custom)
19 00 00 00 Control instruction content length
(from data1 Data No. to data2 Display content)
**Real-time collection data 1 **
29 Data No. (41)
00 Special property (0-power down data lose 0-No flicker)
FF Character color (pre-set by the display template)
FF Character attribute (pre-set by the display template
0B Display content length (display content byte length 4)
74 65 6D 70 65 72 61 74 75 72 65 Display content (temperature)
Real-time collection data 2
2A Data No. (42)
00 Special property (0-power down data lose 0-No flicker)
21 Character color (green)
31 Character attribute (font:Boldface size:16*16)
04 Display content length (display content byte length 4)
32 36 2E 35 Display content (26.5)
98 F9 CRC16 packet check *Serial port reply message*
(from Frame header to data2 Display content)
FF FF Frame end (fixed)

3.2.2 485 mode

Name	Byte Number	Data Type	Description
Frame header	1	Numerical	Fixed byte values is 0xFE.
Target device ID	1	Numerical	Fixed byte values is 0x98.
Packet length	2	Numerical	Byte length from the Target device ID to the Control instruction content. The high byte comes first, the low byte comes last.
Source device ID	1	Numerical	Fixed byte values is 0x97.
Protocol type	1	Numerical	The type byte of the protocol.

			Fixed byte values is 0x37.
Reserved word	1	Numerical	Fixed byte values is 0x00.
Device communi-cation address	8	Numerical	Mode 1: Enter the internal code of the control card to specify that the control card can receive packets. Mode 2: The first 7 bytes are filled with 0x00, and the last 1 byte is filled with the 485 communication address of the control card. Mode 3: Fill 8 bytes 0x00 for broadcast mode. All control cards can receive packets.
Control instruction content start			
Function code	1	Numerical	Fixed byte values is 0xFF.
Number of reads	1	Numerical	Read the number of real-time collected data.
Data No.	several	Numerical	The data number of real-time collection item is used to distinguish multiple real-time collection data. The data number ranges from 1 to 70 (in decimal notation) and cannot be repeated. The data number is filled in sequentially, one byte for each data number.
Control instruction content end			
Xor sum packet check	1	Numerical	All bytes of the Target device ID to the Control instruction content are verified. The XOR sum check algorithm is shown in Annex 3

- **Request protocol example (Data No. 41 42):**

FE 98 00 12 97 37 00 00 00 00 00 00 00 00 00 FF 02 29 2A D4

✓ **Request protocol parse:**

FE	Frame header (fixed)
98	Target device ID (control card 0x98)
00 12	Packet length (from Target device ID to Data No.)
97	Source device ID (upper computer 0x97)
37	Protocol type (fixed)
00	Reserved word (fixed)
00 00 00 00 00 00 00	Device communication address (broadcast mode)
FF	Function code (fixed)
02	Number of reads (reads two real-time collection data)
29 2A	Data No. (41 and 42)
46	Xor sum packet check (from Target device ID to Data No.)

- **Reply protocol example**:

FE 97 00 1F 98 37 31 29 00 FF FF 0B 74 65 6D 70 65 72 61 74 75 72 65 2A 00 21 31 04 32 36 2E 35 79

✓ **Reply protocol parse:**

FE	Frame header (fixed)
97	Target device ID (upper computer 0x97)
00 1F	Packet length (from Target device ID to data 2 Display content)

98 Source device ID (control card 0x98)
37 Protocol type (fixed)
31 Confirm content (success)
**Real-time collection data 1 **
29 Data No. (41)
00 Special property (0-power down data lose 0-No flicker)
FF Character color (pre-set by the display template)
FF Character attribute (pre-set by the display template
0B Display content length (display content byte length 4)
74 65 6D 70 65 72 61 74 75 72 65 Display content (temperature)
Real-time collection data 2
2A Data No. (42)
00 Special property (0-power down data lose 0-No flicker)
21 Character color (green)
31 Character attribute (font:Boldface size:16*16)
04 Display content length (display content byte length 4)
32 36 2E 35 Display content (26.5)
79 Xor sum packet check
(from Target device ID to data 2 Display content)

✓ **Confirm content** (Receive processing status)
0x31-The control card successfully received the packet.
0x32-The controller card receives data packets abnormally or incorrectly.
0xFF-The Xor sum packet check error.

3.3 ★Inner code text(Dynamic content)

- This instruction is mainly applicable to the use scenarios where the display content needs to be moved and the display update speed is not quick.
- If the internal code text is sent frequently, it is recommended to use the power-down without saving mode. Frequent sending of power-down save packets will damage the memory chip of the control card, causing the control card to write memory protection without updating the contents of the phenomenon.
- The byte length of the inner code text data can not exceed 1KB, more than the packet needs to be intercepted and sent in packets.
- The display content of a single internal code text data is up to 1KB, beyond which the content will not be displayed.
- The inner code text data has a variety of display methods, can customize the Character color font font size, moving mode and other parameters.
- It supports encapsulating multiple inner code words into a data packet and sending it to the control card.
- Material UID is the material number set by the inner code text in the display template, which is used to distinguish data and cannot be repeated.

◆ **Steps for creating a display template:**

1) Add a display page.
2) Add two areas to the display page.
3) Add an inner code text material to each area.
4) Modify data number of the two inner code text data to 1 and 2.
5) Save and send the display template.

3.3.1 Network/Serial port mode

Name	Byte Number	Data Type	Description
Frame header	4	Numerical	Fixed byte values is 0xFE 0x5C 0x4B 0x89.
Packet length	4	Numerical	Byte length from the Frame header to the Frame end. The low byte comes first, and the high byte comes last.
Protocol type	1	Numerical	The type byte of the protocol. Fixed byte values is 0x31.
Send ID	4	Numerical	A custom packet ID number that is carried in the reply packets sent back by the controller card to distinguish multiple reply packets.
Control instruction content length	4	Numerical	Byte length of the Control instruction content. The low byte comes first, and the high byte comes last.
Control instruction content start			
Inner code text control instruction content(from Data No. to Reserved word 4)			
Data No.(UID)	9	Character	The data number set by the inner code text in the display template is used to distinguish multiple data and

			cannot be repeated. The material number is 9 digits, and the ASCII code of the numeric Characters is filled in in order.
Separator	1	Numerical	Fixed byte values is 0x2C
Display mode	1	Numerical	Display content move mode: 1-Move right to left 2-Move left to right 3-Move down to up 4-Move up to down 5-Unfold right to left 6-Unfold left to right 7-Unfold down to up 8-Unfold up to down 9-Static display 10-Unfold from the center to both sides 11-Unfold from both sides to the centre 12-Unfold from the middle to up and down 13-Unfold from up and down to the middle 14-Flashing 15-Right louvre 16-Lower louvre
Move speed	1	Numerical	Display content moving speed, range: 0~8. The higher the value, the slower the movement speed.
Stay time	1	Numerical	Displays the pause time after the content has moved one page. unit: 5sec 0-keep moving 1-stay1*5s 255-static display
Playout time	12	Character	Displays the time period during which the content is allowed to play. Default is 0x30 0x31 0x30 0x31 0x30 0x31 0x39 0x39 0x31 0x32 0x33 0x31 (from 01 January 2001 to 12 December 2099)
Property length	4	Numerical	Byte length from Start flag to reserved word 3. Fixed byte values is 0x13 0x00 0x00 0x00. The low byte comes first, and the high byte comes last.
Start flag	2	Numerical	Fixed byte values is 0x55 0xAA
Reserved word 1	1	Numerical	Fixed byte values is 0x00
Text rotation mode	1	Numerical	Display rotation mode for content characters: 0x00-no rotation 0x01-single character rotation 0x02-area rotation
Material properties	1	Numerical	Fixed byte values is 0x37, indicate the inner code text material.
Material storage mode	1	Numerical	0x31-power down save data 0x32-power down without save data It is recommended to select the power-down without save data mode for frequent sending of display contents. The power-down save data mode needs to writedata into flash memory, and the data saved by power-down cannot be sent frequently, which will cause damage to the memory of the control card!
Material update mode	1	Numerical	0x31-All materials updated immediately 0x32-This material is updated immediately and does not affect the display of other material

			0x33-This material will be updated later!
Transmission flag	1	Numerical	Fixed byte values is 0x31.
Pixel base color	1	Numerical	Displays the base color of the LED cell board pixels. 0x31-single base color 0x32-double base color 0x33-triple base color The new version of the control card will automatically identify the parameters of this field.
Image encode mode	1	Numerical	Fixed byte values is 0x31.
Reserved word 2	2	Numerical	Fixed byte values is 0x00 0x00
Area width	2	Numerical	The width of the inner code area divided by 8.The low byte comes first, and the high byte comes last. If the area width is 128/8 = 16, the byte field is 0x10 0x00 The new version of the control card will automatically identify the parameters of this field.
Area height	2	Numerical	The height of the area in which the text is located.The low byte comes first, and the high byte comes last. If the area height is 32, the byte field is 0x20 0x00. The new version of the control card will automatically identify the parameters of this field.
Character color	1	Numerical	The color of the displayed content characters: 0x01-red 0x02-green 0x03-yellow 0x04-blue 0x05-purple 0x06-cyan 0x07-white
Character attribute	1	Numerical	The high 4 bits of the byte set the font and the low 4 bits set the font size; **Font:** 0-Custom font library 1-Song script 2-Regular script 3-Boldface 4-Official script 5-Running script **Font size:** 0-12*12 1-16*16 2-24*24 3-32*32 4-48*48 5-64*64 6-80*80 7-96*96
Reserved word 3	1	Numerical	Fixed byte values is 0x00.
Material content 1 ength	4	Numerical	Byte length from the Material content to Reserved word 4. The low byte comes first, and the high byte comes last.
Material content	certain	Character	Display content text, characters using ASCII, GB2312 encode mode.
Control code 1	2	Numerical	Fixed byte values is 0xFF 0x00.
Control code 2	2	Numerical	The serial number of the inner code text material in the entire protocol transmission, the serial number starts from 1. The low byte comes first, and the high byte comes last.
Control Code 3	4	Numerical	Fixed byte values is 0x01 0x00 0x01 0x00.
Reserved word 4	2	Numerical	Fixed byte values is 0x00 0x00.

Next inner code text control instruction content(from Data No. to Reserved word 4)			
Control instruction content end			
Update now flag	3	Numerical	(Optional)This field needs to be added if the inner code text material is to be updated immediately.Fixed byte values is 0x2D 0x31 0x2C. The flag tells the control card to update all the materials content immediately.
Frame end	2	Numerical	Fixed byte values is 0xFF 0xFF.

- **Request protocol example:**

FE 5C 4B 89 C2 00 00 00 31 00 00 00 00 AF 00 00 00 30 30 30 30 30 30 30 30 31 2C 09 01 FF 30 31 30 31 30 31 39 39 31 32 33 31 13 00 00 00 55 AA 00 00 37 32 31 31 31 31 00 00 08 00 20 00 01 11 00 1A 00 00 00 48 65 6C 6C 6F 20 6D 79 20 66 72 69 65 6E 64 21 FF 00 01 00 01 00 01 00 00 00 30 30 30 30 30 30 30 30 32 2C 01 01 00 30 31 30 31 30 31 39 39 31 32 33 31 13 00 00 00 55 AA 00 00 37 32 31 31 31 31 00 00 08 00 20 00 01 11 00 2A 00 00 00 57 65 6C 63 6F 6D 65 20 74 6F 20 75 73 65 20 4C 65 64 20 63 6F 6E 74 72 6F 6C 20 63 61 72 64 21 FF 00 02 00 01 00 01 00 00 00 2D 31 2C FF FF

✓ **Request protocol parse:**

FE 5C 4B 89 Frame header (fixed)
C2 00 00 00 Packet length (from Frame header to Frame end)
31 Protocol type (fixed)
00 00 00 00 Send ID (custom)
AF 00 00 00 Control instruction content length (from Data 1 Data No.to Update now flag)

Inner code text data 1

30 30 30 30 30 30 30 30 30 30 31 Data No. (UID:000000001)
2C Delimiter (fixed)
09 Display mode (Static display)
01 Move speed (1)
FF Stay time (static display)
30 31 30 31 30 31 30 31 39 39 31 32 33 31 Playout time (01-01-01 to 99-12-31)
13 00 00 00 Property length (fixed)
55 AA Start flag (fixed)
00 Reserved word 1 (fixed)
00 Text rotation mode (00-no rotation)
37 Material properties (fixed)
32 Material storage method (power down without save data)
31 Material update mode (all materials updated immediately)
31 Transmission flag (fixed)
31 Pixel base color (single base color)
31 Image encode mode (fixed)
00 00 Reserved word 2 (fixed)
08 00 Area width (64/8 = 8)

20 00 Area height (32)
01 Character color (red)
11 Character attribute (Font-Song script Size-16)
00 Reserved word 3 (fixed)
1A 00 00 00 Material content length (Material content to Reserved word 4)
48 65 6C 6C 6F 20 6D 79 20 66 72 69 65 6E 64 21 Material content (Hello my friend!)
FF 00 Control code 1 (fixed)
01 00 Control code 2 (serial number 1)
01 00 01 00 Control code 3 (fixed)
00 00 Reserved word 4 (fixed)

** Inner code text data 2**

30 30 30 30 30 30 30 30 30 32 Data No. (000000002)
2C Delimiter (fixed)
01 Display mode (move right to left)
01 Move speed (1)
00 Stay time (keep moving)
30 31 30 31 30 31 30 31 39 39 31 32 33 31
Playout time (01-01-01 to 99-12-31)
13 00 00 00 Property length (fixed)
55 AA Start flag (fixed)
00 Reserved word 1 (fixed)
00 Text rotation mode (00-no rotation)
37 Material properties (fixed)
32 Material storage method (power down without save data)
31 Material update mode (all materials updated immediately)
31 Transmission flag (fixed)
31 Pixel base color (single base color)
31 Image encode mode (fixed)
00 00 Reserved word 2 (fixed)
08 00 Area width (64/8 = 8)
20 00 Area height (32)
01 Character color (red)
11 Character attribute (Font-Song script Size-16)
00 Reserved word 3 (fixed)
2A 00 00 00 Material content length (Material content to Reserved word 4)
57 65 6C 63 6F 6D 65 20 74 6F 20 75 73 65 20 4C 65 64 20 63 6F 6E 74 72 6F 6C 2
0 63 61 72 64 21 Material Content (Welcome to use Led control card!)
FF 00 Control code 1 (fixed)
02 00 Control code 2 (serial number 02)
01 00 01 00 Control code 3 (fixed)
00 00 Reserved word 4 (fixed)
2D 31 2C Update now flag (optional)
FF FF Frame end (fixed)

3.3.2 485 mode

- The 485 communication protocol is encapsulated outside the data packet of the network serial communication protocol, please refer to the previous section for the content format of the control commands.
- When the length of the internal code text network packet exceeds 256 bytes, it is necessary to divide the packet into multiple sub-packets, each sub-packet of up to 256 bytes, respectively, with 485 protocol format encapsulation to send.
- The display content of a single internal code text is up to 1024 Characters, the exceeding part will not be displayed.
- After the sub-packets are transmitted, the control card will all return the reply message for the sub-packets. When all sub-packets have been transmitted, the control card will assemble all the sub-packets into a complete packet for processing, and then send back the reply message to the whole packet.
- Considering the instability of 485 wireless communication, the CRC16 check is added on the basis of compatibility with the original heterodyne check.

Name	Byte Number	Data Type	Description
Frame header	1	Numerical	Fixed byte values is 0xFE
Target device ID	1	Numerical	Fixed byte values is 0x98.
Packet length	2	Numerical	Byte length from the Target device ID to the CRC16 packet check. The high byte comes first, the low byte comes last.
Source device ID	1	Numerical	Fixed byte values is 0x97.
Protocol type	1	Numerical	The type byte of the protocol. Fixed byte values is 0x54.
Reserved word 5	1	Numerical	Fixed byte values is 0x00.
Device communi-cation address	8	Numerical	Mode 1: Enter the internal code of the control card to specify that the control card can receive packets. Mode 2: The first 7 bytes are filled with 0x00, and the last 1 byte is filled with the 485 communication address of the control card. Mode 3: Fill 8 bytes 0x00 for broadcast mode. All control cards can receive packets.
Reserved word 6	1	Numerical	Fixed byte values is 0x01.
Subpacket Totle number	1	Numerical	The number of control instruction contents split into multiple subpackets. If the byte length of the control instruction content is more than 256 bytes, the data packet needs to be delivered in multiple subpackets, and each subpacket does not exceed 256 bytes.
Subpackage No.	1	Numerical	The sequence number of the subpacket in all the sub-packets, the first subpacket sequence number is 1.
Control instruction content	certain	Character	The content of the control instruction is the net work serial port mode protocol.

CRC16 packet check	2	Numerical	All bytes of the Target device ID to the Control instruction content are verified. The CRC16 check algorithm is shown in Annex 2
Xor sum packet check	1	Numerical	All bytes of the Target device ID to the CRC16 packet check are verified. The XOR sum check algorithm is shown in Annex 3

- **Request protocol example:**

FE 98 00 D5 97 54 00 00 00 00 00 00 00 00 01 01 01 FE 5C 4B 89 C2 00 00 00 31 00 00 00 00 AF 00 00 00 30 30 30 30 30 30 30 30 31 2C 09 01 00 30 31 30 31 30 31 39 39 31 32 33 31 13 00 00 00 55 AA 00 00 37 32 31 31 31 31 00 00 08 00 20 00 01 11 00 1A 00 00 00 48 65 6C 6C 6F 20 6D 79 20 66 72 69 65 6E 64 21 FF 00 01 00 01 00 01 00 00 00 30 30 30 30 30 30 30 30 32 2C 01 01 00 30 31 30 31 30 31 39 39 31 32 33 31 13 00 00 00 55 AA 00 00 37 32 31 31 31 31 00 00 08 00 20 00 01 11 00 2A 00 00 00 57 65 6C 63 6F 6D 65 20 74 6F 20 75 73 65 20 4C 65 64 20 63 6F 6E 74 72 6F 6C 20 63 61 72 64 21 FF 00 02 00 01 00 01 00 00 00 2D 31 2C FF FF A2 FB 9A

✓ **Request message parsing:**

FE	Frame header (fixed)
98	Target device ID (control card 0x98)
00 D5	Packet length (from Target device ID to CRC16 packet check)
97	Source device ID (upper computer 0x97)
54	Protocol type (fixed)
00	Reserved word 5 (fixed)
00 00 00 00 00 00 00 00	Device communication address (broadcast mode)
01	Reserved word 6 (fixed)
01	Subpacket Totle number (total length not exceed 256 bytes)
01	Subpackage No. (first subpacket)

Network serial port mode protocol

FE 5C 4B 89	Frame header (fixed)
C2 00 00 00	Packet length (from Frame header to Frame end)
31	Protocol type (fixed)
00 00 00 00	Send ID (custom)
AF 00 00 00	Control instruction content length (from Data 1 Data No.to Update now flag)

Inner code text data 1

30 30 30 30 30 30 30 30 30 30 31	Data No. (UID:000000001)
2C	Delimiter (fixed)
09	Display mode (static display)
01	Move speed (1)
FF	Stay time (static display)
30 31 30 31 30 31 30 31 39 39 31 32 33 31	Playout time (01-01-01 to 99-12-31)
13 00 00 00	Property length (fixed)
55 AA	Start flag (fixed)

00 Reserved word 1 (fixed)
00 Text rotation mode (00-no rotation)
37 Material properties (fixed)
32 Material storage method (power down without save data)
31 Material update mode (all materials updated immediately)
31 Transmission flag (fixed)
31 Pixel base color (single base color)
31 Image encode mode (fixed)
00 00 Reserved word 2 (fixed)
08 00 Area width (64/8 = 8)
20 00 Area height (32)
01 Character color (red)
11 Character attribute (Font-Song script Size-16)
00 Reserved word 3 (fixed)
1A 00 00 00 Material content length
(from Material content to Reserved word 4)
48 65 6C 6C 6F 20 6D 79 20 66 72 69 65 6E 64 21 Material content (Hello my friend!)
FF 00 Control code 1 (fixed)
01 00 Control code 2 (serial number 1)
01 00 01 00 Control code 3 (fixed)
00 00 Reserved word 4 (fixed)

** Inner code text data 2**

30 30 30 30 30 30 30 30 30 32 Data No. (000000002)
2C Delimiter (fixed)
01 Display mode (Move right to left)
01 Move speed (1)
00 Stay time (keep moving)
30 31 30 31 30 31 30 31 39 39 31 32 33 31
Playout time (01-01-01 to 99-12-31)
13 00 00 00 Property length (fixed)
55 AA Start flag (fixed)
00 Reserved word 1 (fixed)
00 Text rotation mode (00-no rotation)
37 Material properties (fixed)
32 Material storage method (power down without save data)
31 Material update mode (all materials updated immediately)
31 Transmission flag (fixed)
31 Pixel base color (single base color)
31 Image encode mode (fixed)
00 00 Reserved word 2 (fixed)
08 00 Area width (64/8 = 8)
20 00 Area height (32)
01 Character color (red)
11 Character attribute (Font-Song script Size-16)

00	Reserved word 3 (fixed)
2A 00 00 00	Material content length (from Material content to Reserved word 4)
57 65 6C 63 6F 6D 65 20 74 6F 20 75 73 65 20 4C 65 64 20 63 6F 6E 74 72 6F 6C 20 63 61 72 64 21	Material Content (Welcome to use Led control card!)
FF 00	Control code 1 (fixed)
02 00	Control code 2 (serial number 02)
01 00 01 00	Control code 3 (fixed)
00 00	Reserved word 4 (fixed)
2D 31 2C	Update now flag (optional)
FF FF	Frame end (fixed)
A2 FB	CRC16 packet check (from Target device ID to Frame end)
9A	Xor sum packet check (fromTarget device ID to CRC16 packet check)

- **Reply protocol format:**

Name	Byte Number	Data Type	Description
Frame header	1	Numerical	Fixed byte values is 0xFE.
Target device ID	1	Numerical	Fixed byte values is 0x97.
Packet length	2	Numerical	Byte length from the Target device ID to the CRC16 packet check. The high byte comes first, the low byte comes last.
Source device ID	1	Numerical	Fixed byte values is 0x98.
Protocol type	1	Numerical	The type byte of the protocol: 0x54-Acknowledgment of the reception status of a data subpacket. 0x55-Acknowledgment of the reception status of the complete packet.
Receive results	1	Numerical	0x00- Receive successful 0xFF-Receive failed
Internal code	8	Numerical	LED control card unique identification code.
Reserved word	3	Numerical	Fixed byte values is 0x01 0x01 0x01.
Control instruction content	certain	Character	If protocol type is 0x54, this value is 0x00. If protocol type is 0x55, this value is reply protocol of network serial port mode.
CRC16 packet check	2	Numerical	All bytes of the Target device ID to the Control instruction content are verified. The CRC16 check algorithm is shown in Annex 2
Xor sum packet check	1	Numerical	All bytes of the Target device ID to the Control instruction content are verified. The XOR sum check algorithm is shown in Annex 3

① Subpackage reply protocol example:

FE 97 00 14 98 54 00 05 00 00 06 16 07 1E 01 01 01 01 00 90 D5 06

② Complete packet reply protocol example:

FE 97 00 28 98 55 00 05 00 00 06 16 07 1E 01 01 01 01 FE 5C 4B 89 15 00 00 00 81 00 00 00 00 02 00 00 00 31 23 FF FF EC 94 E2

✓ **Subpacket reply protocol parse:**

FE	Frame header (fixed)
97	Target device ID (upper computer 0x97)
00 14	Packet length (from Target device ID to CRC16 packet check)
98	Source device ID (control card 0x98)
54	Protocol type (acknowledgement reply of sub-packet)
00	Receive results (received successfully)
05 00 00 06 16 07 1e 01	Internal code (control card unique identification code)
01 01 01	Reserved word (fixed)
00	Control instruction content (subpacket 0x00)
90 D5	CRC16 packet check (from Target device ID to Control instruction content)
06	Xor sum packet check (from Target device ID to CRC16 packet check)

✓ **Complete packet reply protocol parse:**

FE	Frame header (fixed)
97	Target device ID (upper computer 0x97)
00 28	Packet length (from Target device ID to CRC16 packet check)
98	Source device ID (control card 0x98)
55	Protocol type (acknowledgement of complete packet)
00	Receive results (received successfully)
05 00 00 06 16 07 1e 01	Internal code (control card unique identification code)
01 01 01	Reserved word (fixed)
Network serial communications protocol reply message	
FE 5C 4B 89	Frame header (fixed)
15 00 00 00	Packet length (from Frame header to Frame end)
81	Protocol type (fixed)
00 00 00 00	Send ID (send ID)
02 00 00 00	Message content length (from Message content to Separator)
31	Message content (success)
23	Separator (fixed)
FF FF	Frame end (fixed)
485 communication protocol package	
EC 94	CRC16 packet check (from Target device ID to Control instruction content)
E2	Xor sum packet check (from Target device ID to CRC16 packet check)

3.4 Switch display

◆ The main function of this command is used to turn on or turn off the display, the control card is still in the power on state.

3.4.1 Network/Serial port mode

Name	Byte Number	Data Type	Description
Frame header	4	Numerical	Fixed byte values is 0xFE 0x5C 0x4B 0x89.
Packet length	4	Numerical	Byte length from the Frame header to the Frame end. The low byte comes first, and the high byte comes last.
Protocol type	1	Numerical	The type byte of the protocol: If control the screen turn on, this byte value is 0x51. If control the screen is turn off, the byte value is 0x52.
Send ID	4	Numerical	A custom packet ID number that is carried in the reply packets sent back by the controller card to distinguish multiple reply packets.
Reserved word	4	Numerical	Fixed byte values is 0x00 0x00 0x00 0x00
Frame end	2	Numerical	Fixed byte values is 0xFF 0xFF.

● **Request protocol example 1 (turn on the screen):**

FE 5C 4B 89 13 00 00 00 51 00 00 00 00 00 00 00 00 FF FF

● **Request protocol example 2 (turn off the screen):**

FE 5C 4B 89 13 00 00 00 52 00 00 00 00 00 00 00 00 FF FF

✓ **Request protocol parse: (turn off)**

FE 5C 4B 89	Frame header (fixed)
13 00 00 00	Packet length (from Frame header to Frame end)
52	Protocol type (turn off the screen)
00 00 00 00	Send ID (custom)
00 00 00 00	Reserved word (fixed)
FF FF	Frame end (fixed)

3.5 Display page on demand

➢ When there are multiple display pages in a display template, the content of the clips in these display pages will be played in turn. Through the display page on-demand protocol, you can on-demand one of the display pages to display the material content of the current page, and the material content of the unon-demanded display page will not be displayed.

◆ **Steps for creating a display template:**

1) Add multiple display pages.
2) Each display page adds a region.
3) Add a single-line text material to each area.
4) Enter the display content text into the single-line text material.
5) Save and send the display template.

3.5.1 Network/Serial port mode

Name	Byte Number	Data Type	Description
Frame header	4	Numerical	Fixed byte values is 0xFE 0x5C 0x4B 0x89.
Packet length	4	Numerical	Byte length from the Frame header to the Frame end. The low byte comes first, and the high byte comes last.
Protocol Type	1	Numerical	The type byte of the protocol. Fixed byte value is 0x66.
Send ID	4	Numerical	A custom packet ID number that is carried in the reply packets sent back by the controller card to distinguish multiple reply packets.
Control instruction content length	4	Numerical	Byte length of the Control instruction content. The low byte comes first, and the high byte comes last.
Control instruction content start			
Display page number	1	Numerical	The number of the display page that needs to be on-demand, starting at 0x01. If the display page number is 0x00, it means that the on-demand function is disengaged.
Display page number inverse code	1	Numerical	The inverse code of the Display page number t hat needs to be on-demand. (Inverse code = 0xFF - display page code) If the display page code is 0x03 and the inverse code is 0xFC.
Control instruction content end			
Frame end	2	Numerical	Fixed byte values is 0xFF 0xFF.

✓ **Request protocol example:**

FE 5C 4B 89 15 00 00 00 00 66 92 79 95 72 02 00 00 00 00 02 FD FF FF

- **Request protocol parse:**

FE 5C 4B 89	Frame header (fixed)
15 00 00 00	Packet length (from Frame header to Frame end)
66	Protocol Type (fixed)
92 79 95 72	Send ID (custom)
02 00 00 00	Control instruction content length (from Display page number to Display page number inverse code)
02	Display page number (on-demand display page 2)
FD	Display page number inverse code (0x02 inverse code is 0xFD)
FF FF	Frame end (fixed)

3.5.2 485 mode

Name	Length (Byte)	numbers typology	Description
Frame header	1	Numerical	Fixed byte values is 0xFE.
Target device ID	1	Numerical	Fixed byte values is 0x98.
Packet length	2	Numerical	Byte length from the Target device ID to the Control instruction content. The high byte comes first, the low byte comes last.
Source device ID	1	Numerical	Fixed byte values is 0x97.
Protocol type	1	Numerical	The type byte of the protocol. Fixed byte value is 0x36.
Reserved word	1	Numerical	Fixed byte values is 0x00.
Device communication address	8	Numerical	Mode 1: Enter the internal code of the control card to specify that the control card can receive packets. Mode 2: The first 7 bytes are filled with 0x00, and the last 1 byte is filled with the 485 communication address of the control card. Mode 3: Fill 8 bytes 0x00 for broadcast mode. All control cards can receive packets.
Control instruction content start			
Display page number	1	Numerical	The number of the display page that needs to be on-demand, starting at 0x01. If the display page number is 0x00, it means that the on-demand function is disengaged.
Display page number inverse code	1	Numerical	The inverse code of the Display page number t hat needs to be on-demand. (Inverse code = 0xFF - display page code) If the display page code is 0x03 and the inverse code is 0xFC.
Control instruction content end			
Xor sum packet check	1	Numerical	All bytes of the Target device ID to the Control instruction content are verified.

			The XOR sum check algorithm is shown in Annex 3

✓ **Request protocol example:**

FE 98 00 10 97 36 00 00 00 00 00 00 00 00 00 02 FD D6

● **Request protocol parse:**

FE	Frame header (fixed)
98	Target device ID (control card 0x98)
00 10	Packet length (from Target device ID to Display page number inverse code)
97	Source device ID (upper computer 0x97)
36	Protocol type (fixed)
00	Reserved word (fixed)
00 00 00 00 00 00 00	Device communication address (broadcast mode)
02	Display page number (on-demand display page 2)
FD	Display page number inverse code (0x02 inverse code is 0xFD)
D6	Xor sum packet check (from Target device ID to Display page number inverse code)

3.6 Multi-line text/Image group material on demand

- Multi-line text is converted to image format and sent to the control card, each line of text content can be treated as a picture. Each line of text will be displayed in turn in the unplayed state. Through the picture material on-demand protocol can be on-demand one of the lines of text content display, the other text content is not on-demand will not be displayed.
- If there are multiple images in the display page material and they are not on-demand, the images will be displayed in turn. You can display one of the images on-demand via the image clip on-demand protocol.
- This command only applies to on-demand picture clips of the first display page. Supports dividing the display into several zones, and at the same time, separately playback the picture material of multiple zones under one display page

◆ **Steps for creating a display template:**

1) Add a display page.
2) Add multiple areas to the display page.
3) Add a multi-line text or image group to each area.
4) Input more than two lines of text in the multi-line text or add more than two picture in the image group.
5) Save and send the display template.

3.6.1 Network/Serial port mode

Name	Byte Number	Data Type	Description
Frame header	4	Numerical	Fixed byte values is 0xFE 0x5C 0x4B 0x89.
Packet length	4	Numerical	Byte length from the Frame header to the Frame end. The low byte comes first, and the high byte comes last.
Protocol type	1	Numerical	The type byte of the protocol. Fixed byte values is 0x67.
Send ID	4	Numerical	A custom packet ID number that is carried in the reply packets sent back by the controller card to distinguish multiple reply packets.
Control instruction content length	4	Numerical	Byte length of the Control instruction content. The low byte comes first, and the high byte comes last.
Control instruction content start			
On-demand number	1	Numerical	Number of areas requiring on-demand.
On-demand number inverse code	1	Numerical	The inverse code of the number of areas that need to be on-demand. (Inverse code = 0xFF - number of regional spots) If the number of areas is 0x03, the inverse code is 0xFC.

Update time	1	Numerical	0x00-Update Now.
Reserved word	2	Numerical	Fixed byte values is 0x00 0x00.
Area on demand control instruction content (from Area serial number to Stay time)			
Area serial number	1	Numerical	The area where this on-demand material is located, **the serial number of the area where the on-demand material is located** within the display template, starts from 0; On-demand material includes single/multi-line text, image group and tables. Single-line text and tables are not on-demand, but they do take up a area number.
Material serial number	2	Numerical	The starting serial number of the on-demand image, the serial number starts from 0; The low byte comes first, and the high byte comes last.
Material on-demand number	2	Numerical	The number of on-demand images; The low byte comes first, and the high byte comes last.
Display mode	1	Numerical	Display content move mode: If this field is 0x00, the Display mode, Move speed and Stay time fields are disabled and the parameters follow the display template settings. 1-Move right to left 2-Move left to right 3-Move down to up 4-Move up to down 5-Unfold right to left 6-Unfold left to right 7-Unfold down to up 8-Unfold up to down 9-Static display 10-Unfold from the center to both sides 11-Unfold from both sides to the centre 12-Unfold from the middle to up and down 13-Unfold from up and down to the middle 14-Flashing 15-Right louvre 16-Lower louvre
Move speed	1	Numerical	Display content moving speed, range: 0~8. The higher the value, the slower the movement speed. If the Display Method field is 0x00, the field is invalidated.
Stay time	1	Numerical	Displays the pause time after the content has moved one page. unit: 5sec 0-keep moving 1-stay1*5s 255-static display If the Display Method field is 0x00, the field is invalidated.
Next area on demand Control instruction content (from Area serial number to Stay time)			
Control instruction content end			
Frame end	2	Numerical	Fixed byte values is 0xFF 0xFF.

✓ **Request protocol example:**

FE 5C 4B 89 28 00 00 00 00 67 00 00 00 00 00 15 00 00 00 02 FD 00 00 00 01 00 00 03 00 00 01 01 04 03 00 02 00 01 08 00 FF FF

✓ **Request protocol parse:**

FE 5C 4B 89	Frame header (fixed)
28 00 00 00	Packet length (from Frame header to Frame end)
67	Protocol type (fixed)
00 00 00 00	Send ID (custom)
15 00 00 00	Control instruction content length (from On-demand number to spot 2 dwell time)
02	On-demand number (two areas on demand)
FD	On-demand number inverse code (0xFF - 0x02 = 0xFD)
00	Update Time (update now)
00 00	Reserved word (fixed)
Material on demand 1	
01	Area serial number (area on-demand serial number)
00 00	Material serial number (material on-demand serial number)
03 00	Material on-demand number (material on-demand number)
00	Display mode (invalid, follows display template settings)
01	Move speed (invalid, follows display template settings)
01	Stay time (invalid, follows display template settings)
Material on demand 2	
04	Area serial number (area on-demand serial number)
03 00	Material serial number (material on-demand serial number)
02 00	Material on-demand number (material on-demand number)
01	Display mode (move right to left)
08	Move speed (8 - slowest)
00	Stay time (keep moving)
FF FF	Frame end (fixed)

3.6.2 485 mode

Name	Length (Byte)	numbers typology	Description
Frame header	1	Numerical	Fixed byte values is 0xFE.
Target device ID	1	Numerical	Fixed byte values is 0x98.
Packet length	2	Numerical	Byte length from the Target device ID to the Control instruction content. The high byte comes first, the low byte comes last.
Source device ID	1	Numerical	Fixed byte values is 0x97.
Protocol type	1	Numerical	The type byte of the protocol. Fixed byte values is 0x35.
Reserved word	1	Numerical	The Fixed byte value is taken as 0x00.
Device communi-cation address	8	Numerical	Mode 1: Fill in the internal code of the control card to specify the control card to receive the message. Mode 2: The first 7 bytes are filled with 0x00, and the last 1 byte is filled with the 485 communication

			address of the control card, which specifies that the control card can only receive the message. Mode 3: Fill 8 bytes 0x00 for broadcast mode, all control cards can receive the message.
Control instruction content start			
On-demand number	1	Numerical	Number of areas requiring on-demand.
On-demand number inverse code	1	Numerical	The inverse code of the number of areas that need to be on-demand. (Inverse code = 0xFF - number of regional spots) If the number of areas is 0x03, the inverse code is 0xFC.
Update time	1	Numerical	0x00-Update Now.
Reserved word	2	Numerical	Fixed byte values is 0x00 0x00.
Area on demand control instruction content (from Area serial number to Stay time)			
Area serial number	1	Numerical	The area where this on-demand material is located, **the serial number of the area where the on-demand material is located** within the display template, starts from 0; On-demand material includes single/multi-line text, image group and tables. Single-line text and tables are not on-demand, but they do take up a area number.
Material serial number	2	Numerical	The starting serial number of the on-demand image, the serial number starts from 0; The low byte comes first, and the high byte comes last.
Material on-demand number	2	Numerical	The number of on-demand images; The low byte comes first, and the high byte comes last.
Display mode	1	Numerical	Display content move mode: If this field is 0x00, the Display mode, Move speed and Stay time fields are disabled and the parameters follow the display template settings. 1-Move right to left 2-Move left to right 3-Move down to up 4-Move up to down 5-Unfold right to left 6-Unfold left to right 7-Unfold down to up 8-Unfold up to down 9-Static display 10-Unfold from the center to both sides 11-Unfold from both sides to the centre 12-Unfold from the middle to up and down 13-Unfold from up and down to the middle 14-Flashing 15-Right louvre 16-Lower louvre
Move speed	1	Numerical	Display content moving speed, range: 0~8. The higher the value, the slower the movement speed. If the Display Method field is 0x00, the field is invalidated.

Stay time	1	Numerical	Displays the pause time after the content has moved one page. unit: 5sec 0-keep moving 1-stay1*5s 255-static display If the Display Method field is 0x00, the field is invalidated.
Next area on demand Control instruction content (from Area serial number to Stay time)			
Control instruction content end			
Xor sum packet check	1	Numerical	All bytes of the Target device ID to the Control instruction content are verified. The XOR sum check algorithm is shown in Annex 3

✓ **Request protocol example:**

FE 98 00 23 97 35 00 00 00 00 00 00 00 00 00 02 FD 00 00 00 00 01 00 00 03 00 00 00 01 01 04 03 00 02 00 01 08 00 E8

● **Request protocol parse:**

FE	Frame header (fixed)
98	Target device ID (control card 0x98)
00 23	Packet length (from Target device ID to on demand 2 Stay time)
97	Source device ID (upper computer 0x97)
35	Protocol type (fixed)
00	Reserved word (fixed)
00 00 00 00 00 00 00	Device communi-cation address (broadcast mode)
02	On-demand number (two regions on demand)
FD	On-demand number inverse code (0xFF - 0x02 = 0xFD)
00	Update Time (update now)
00 00	Reserved word (fixed)
Material on demand 1	
01	Area serial number (area on-demand serial number)
00 00	Material serial number (material on-demand serial number)
03 00	Material on-demand number (material on-demand number)
00	Display mode (invalid, follows display template settings)
01	Move speed (invalid, follows display template settings)
01	Stay time (invalid, follows display template settings)
Material on demand 2	
04	Area serial number (area on-demand serial number)
03 00	Material serial number (material on-demand serial number)
02 00	Material on-demand number (material on-demand number)
01	Display mode (move right to left)
08	Move speed (8 - slowest)
00	Stay time (keep moving)
E8	Xor sum packet check (from Target device ID to on demand 2 Stay time)

3.7 Network forwarding packets

- The LED card acts as a forwarding device to receive data from the upper computer and then forwards the packet to the receiving device via serial port, 485. The upper computer needs to encapsulate the forwarded data content in the following protocol format and send it to the control card through TCP/UDP network. After the control card receives it, it will disassemble the forwarded data content and send it to the serial port output.
- Similarly, the receiving device can encapsulate the data content in the following protocol format and send it to the control card, which forwards the data packet to the host computer through the network.

3.7.1 Network forward to Serial port

Name	Byte Number	Data Type	Description
Frame header	4	Numerical	Fixed byte values is 0xFE 0x5C 0x4B 0x89.
Packet length	4	Numerical	Byte length from the Frame header to the Frame end. The low byte comes first, and the high byte comes last.
Protocol type	1	Numerical	The type byte of the protocol. Fixed byte value is 0x68.
Forwarding port	1	Numerical	1-Forward serial port 1 2-Forward serial port 2
Send ID	3	Numerical	A custom packet ID number that is carried in the reply packets sent back by the controller card to distinguish multiple reply packets. The default send ID is 3 bytes 0x00.
Forwarding data length	4	Numerical	The length of the protocol content that needs to be forward serial port through the network; The low byte comes first, and the high byte comes last.
Forwarding data content	≤4K	--	Protocol content that requires 232 to be forwarded over the network.
Frame end	2	Numerical	Fixed byte values is 0xFF 0xFF.

- **Request protocol example:**

FE 5C 4B 89 36 00 00 00 00 68 01 00 00 00 00 23 00 00 00 FD 00 1E 01 00 5B 6D 35 32 5D 5B 73 35 5D 5B 76 31 30 5D D3 EF D2 F4 B2 E2 CA D4 61 62 63 31 32 33 00 00 00 FF FF

✓ **Request protocol parse:**

FE 5C 4B 89	Frame header (fixed)
36 00 00 00	Packet length (from Frame header to Frame end)
68	Protocol type (fixed)
01	Forwarding port (forward serial port 1)
00 00 00	Send ID (fixed)

23 00 00 00 Forwarding data length
FD 00 1E 01 00 5B 6D 35 32 5D 5B 73 35 5D 5B 76 31 30 5D D3 EF D2 F4 B2 E2 CA D4 61 62 63 Forwarding data content
31 32 33 00 00
FF FF Frame end (fixed)

- **Serial port output packet:**

FD 00 1E 01 00 5B 6D 35 32 5D 5B 73 35 5D 5B 76 31 30 5D D3 EF D2 F4 B2 E2 CA D4 61 62 63 31 32 33 00 00

3.7.2 Network forward to 485

- The upper computer uses Table 1 protocol format to package the data content that needs to forward 485 output, and sends it to the control card through the TCP/UDP network. After receiving, the control card disassembs the forwarding data content, adds the packet header before forwarding the data content, adds 2-3 0x00 bytes at the tail, and outputs it through 485.
- The 485 sends the data content to the control card through the encapsulation of the protocol format in Table 2, and the control card receives it, removes the packet header 0xFE, encapsulates the remaining data content through the encapsulation of the protocol format in Table 1, and then forwards the packet to the host computer through the network.

Table 1 network forward to 485 protocol format

Name	Byte Number	Data Type	Description
Frame header	4	Numerical	Fixed byte values is 0xFE 0x5C 0x4B 0x89.
Packet length	4	Numerical	Byte length from the Frame header to the Frame end. The low byte comes first, and the high byte comes last.
Protocol type	1	Numerical	The Fixed byte value is taken as 0x68.
Forwarding port	1	Numerical	0x03-Forward 485.
Send ID	3	Numerical	The server sends down the packet to the client (display), and the client returns an acknowledgement message to the server's send ID; If it is a client-initiated message sent to the server, fill in 3 bytes of 0 for the sender ID.
Forwarding data length	4	Numerical	Length of protocol content that needs to be forwarded over the network for 485. The low byte comes first, and the high byte comes last.
Forwarding data content	≤4K	--	Need to forward 485 protocol content over the network.
Frame end	2	Numerical	Fixed byte values is 0xFF 0xFF.

- **Request protocol example:**

FE 5C 4B 89 3C 00 00 00 00 68 03 00 00 00 29 00 00 00 00 00 26 99 73 FD 00 1E 01 00 5B 6D 35 32 5D 5B 73 35 5D 5B 76 31 30 5D D3 EF D2 F4 B2 E2 CA D4 61 62 63 31 32 33 77 00 00 FF FF FF

✓ **Request protocol parse:**

FE 5C 4B 89 Frame header (fixed)
3C 00 00 00 Packet length (from Frame header to Frame end)
68 Protocol type (fixed)
03 Forwarding port (forward 485)
00 00 00 Send ID (fixed)
29 00 00 00 Forwarding data length
00 00 26 99 73 FD 00 1E 01 00 5B 6D 35 32 5D 5B 73 35 5D 5B 76 31 30 5D D3 EF D2 F4 B2 E2 CA D4 61 62 63 31 32 33 77 00 00 00 Forwarding data content
FF FF Frame end (fixed)

● **485 output packet:**

FE 00 00 26 99 73 FD 00 1E 01 00 5B 6D 35 32 5D 5B 73 35 5D 5B 76 31 30 5D D3 EF D2 F4 B2 E2 CA D4 61 62 63 31 32 33 77 00 00 00 00 00

Table 2 485 forward network protocol format

Name	Byte Number	Data Type	Description
Frame header	4	Numerical	Fixed byte values is 0xFE.
Target device ID	1	Numerical	Fixed byte values is 0x99, control card forwards to host computer
Packet length	2	Numerical	Byte length from the Target device ID to the Forwarding data content. The high byte comes first, the low byte comes last.
Source device ID	1	Numerical	485 address range 0x01~0x90.
Protocol type	1	Numerical	The Fixed byte value is taken as 0x68.
Forwarding data content	≤4K	--	Need to forward the protocol content of the host computer via 485.
Frame end	2	Numerical	Fixed byte values is 0xFF 0xFF.

3.8 Count and Countdown timing

- Through the Count and Countdown timing protocol, you can control the control card to perform flexible timing operations such as count or countdown timing, pause or resume timing.
- If there are multiple Count timing and Countdown timing materials, only the external control of the first material of the Count timing and Countdown timing is supported
- It only supports the external control of timing within 24 hours, and does not support the control of days.
- The control card supports two sets of independent timing operations, timing operations set by the display template and external command-controlled timing operations. When an external control command is issued, the external timing operation is executed, and when the external command control timing operation is cancelled, the timing operation of the display template is executed.

◆ **Steps for creating a display template:**

1) Add a display page.
2) Add a area to the display page.
3) Add a count timing or countdown timing material to the area.
4) Save and send the display template.

3.8.1 Network/Serial port mode

Name	Byte Number	Data Type	Description
Frame header	4	Numerical	Fixed byte values is 0xFE 0x5C 0x4B 0x89.
Packet length	4	Numerical	The byte length from Frame header to Frame end; The low byte comes first, and the high byte comes last.
Protocol type	1	Numerical	The type byte of the protocol. Fixed byte values is 0x6A.
Send ID	4	Numerical	A custom packet ID number that is carried in the reply packets sent back by the controller card to distinguish multiple reply packets.
Control instruction content length	4	Numerical	Byte length of the Control instruction content. The low byte comes first, and the high byte comes last.
Control instruction content start			
Timing mode	1	Numerical	0x00-Countdown timing mode 0x01-Count timing mode
External control	1	Numerical	0x00- External control is not allowed, control by the display template program. 0x01-Allow for external control
Timing action	1	Numerical	0x00-Timing reset 0x01-Start Timing 0x02-Pause Timing 0x03-Resume Timing 0x02, 0x03 mode, the content of the control instruction that follows is invalid

Timing reset display	1	Numerical	0x00-Not displayed 0x01-Displayed
Timing reset action	1	Numerical	0x00-No action 0x01-Startup timing This parameter is valid in Countdown timing mode. when The countdown timing is complete, if permitted, the count timing will be initiated according to the externally set mode of the prior count timing.
Character color	1	Numerical	The high 4 bits of the byte set the number color and the low 4 bits set the Character color. If the byte is 0xFF, the Character color is pre-set by the display template. 1-red 2-green 3-yellow 4-blue 5-purple 6-cyan 7-white
Character attribute	1	Numerical	The high 4 bits of the byte set the font and the low 4 bits set the font size; A byte of 0xFF indicates that the font size is pre-set by the display template. **Font:** 0-Custom font library 1-Song script 2-Regular script 3-Boldface 4-Official script 5-Running script **Font size:** 0-12*12 1-16*16 2-24*24 3-32*32 4-48*48 5-64*64 6-80*80 7-96*96
Start count time	4	Numerical	The start count time of the timer,Unit: second. The low byte comes first, and the high byte comes last.
Maximum timer value	4	Numerical	This parameter is valid in Count timing mode and stops timing when the count reaches this value. Unit: second.The low byte comes first, and the high byte comes last.
Reserved word	4	Numerical	Fixed byte values is 0x00 0x00 0x00 0x00 0x00.
Control instruction content end			
Frame end	2	Numerical	Fixed byte values is 0xFF 0xFF.

- **Request protocol example 1:**

① **Count timing protocol** (start count time 30 seconds, stop count timing until 3*60 seconds)

FE 5C 4B 89 26 00 00 00 6A 00 00 00 00 13 00 00 00 01 01 01 01 00 11 11 1E 00 00 00 B4 00 00 00 00 00 00 00 FF FF

② **Countdown timing protocol** (countdown time 30 seconds):

FE 5C 4B 89 26 00 00 00 6A 00 00 00 00 13 00 00 00 00 01 01 01 00 11 11 1E 00 00 00 00 00 00 00 00 00 00 00 FF FF

✓ **Count timing protocol parse:**

FE 5C 4B 89	Frame header (fixed)
26 00 00 00	Packet length (from Frame header to Frame end)
6A	Protocol type (fixed)
00 00 00 00	Send ID (custom)
13 00 00 00	Control instruction content length

	(from Timing mode to Reserved word)
01	Timing mode (count timing mode)
01	External control (external control permitted)
01	Timing action (start timing)
01	Timing reset display (display)
00	Timing reset action (No)
11	Character color (numbers and Characters color red)
11	Character attribute (Song script and 16)
1E 00 00 00	Start count time (30s)
B4 00 00 00	Maximum timer value (180s)
00 00 00 00	Reserved word (fixed)
FF FF	Frame end (fixed)

- **Request protocol example 2:**

(countdown timing 30 seconds, count timing starts after countdown timing complete, count timing stops at 3*60 seconds)

①Count timing setting

FE 5C 4B 89 26 00 00 00 6A 00 00 00 00 13 00 00 00 01 01 00 00 00 FF FF 00 00 00 00 B4 00 00 00 00 00 00 00 FF FF

②Countdown timing setting

FE 5C 4B 89 26 00 00 00 6A 00 00 00 00 13 00 00 00 00 01 01 00 01 FF FF 1E 00 00 00 B4 00 00 00 00 00 00 00 FF FF

3.8.2 485 mode

Name	Byte Number	Data Type	Description
Frame header	1	Numerical	Fixed byte values is 0xFE.
Target device ID	1	Numerical	Fixed value taken as 0x98.
Packet length	2	Numerical	Byte length from the Target device ID to the Control instruction content. The high byte comes first, the low byte comes last.
Source device ID	1	Numerical	Fixed byte values is 0x97.
Protocol type	1	Numerical	The type byte of the protocol. Fixed byte values is 0x33.
Reserved word	1	Numerical	Fixed byte values is 0x00.
Device communication address	8	Numerical	Mode 1: Fill in the internal code of the control card to specify the control card to receive the message; Mode 2: The first 7 bytes are filled with 0x00, and the last 1 byte is filled with the 485 communication address of the control card, which specifies that the control card can only receive the message; Mode 3: Fill 8 bytes 0x00 for broadcast mode, all

			control cards can receive the message.
Control instruction content start			
Timing mode	1	Numerical	0x00-Countdown timing mode 0x01-Count timing mode
External control	1	Numerical	0x00- External control is not allowed, control by the display template program. 0x01-Allow for external control
Timing action	1	Numerical	0x00-Timing reset 0x01-Start Timing 0x02-Pause Timing 0x03-Resume Timing 0x02, 0x03 mode, the content of the control instruction that follows is invalid
Timing reset display	1	Numerical	0x00-Not displayed 0x01-Displayed
Timing reset action	1	Numerical	0x00-No action 0x01-Startup timing This parameter is valid in Countdown timing mode. when The countdown timing is complete, if permitted, the count timing will be initiated according to the externally set mode of the prior count timing.
Character color	1	Numerical	The high 4 bits of the byte set the number color and the low 4 bits set the Character color. If the byte is 0xFF, the Character color is pre-set by the display template. 1-red 2-green 3-yellow 4-blue 5-purple 6-cyan 7-white
Character attribute	1	Numerical	The high 4 bits of the byte set the font and the low 4 bits set the font size; A byte of 0xFF indicates that the font size is pre-set by the display template. **Font:** 0-Custom font library 1-Song script 2-Regular script 3-Boldface 4-Official script 5-Running script **Font size:** 0-12*12 1-16*16 2-24*24 3-32*32 4-48*48 5-64*64 6-80*80 7-96*96
Start count time	4	Numerical	The start count time of the timer,Unit: second. The low byte comes first, and the high byte comes last.
Maximum timer value	4	Numerical	This parameter is valid in Count timing mode and stops timing when the count reaches this value. Unit: second.The low byte comes first, and the high byte comes last.
Reserved word	4	Numerical	Fixed byte values is 0x00 0x00 0x00 0x00 0x00.
Control instruction content end			
Xor sum packet check	1	Numerical	All bytes of the Target device ID to the Control instruction content are verified. The XOR sum check algorithm is shown in Annex 3

- **Request protocol example 1:**

② **Count timing protocol** (start count time 30 seconds, stop count timing until 3*60 seconds)

FE 98 00 21 97 33 00 00 00 00 00 00 00 00 00 01 01 01 01 00 11 11 00 00 00 00 1E

00 00 00 00 00 00 00 03

③ **Countdown timing protocol** (countdown time 30 seconds)

FE 98 00 21 97 33 00 00 00 00 00 00 00 00 00 00 01 01 01 00 FF FF 1E 00 00 00 1E 00 00 00 00 00 00 00 1C

✓ **Countdown timing protocol parse:**

FE	Frame header (fixed)
98	Target device ID (control card 0x98)
00 21	Packet length (from Target device ID to Reserved word)
97	Source device ID (upper computer 0x97)
33	Protocol type (fixed)
00	Reserved word (fixed)
00 00 00 00 00 00 00	Device communication address (broadcast mode)
00	Timing mode (countdown timing mode)
01	External control (external control permitted)
01	Timing action (start timing)
01	Timing reset display (display)
00	Timing reset action (No)
FF	Character color (follows display template settings)
FF	Character attribute (follows display template settings)
1E 00 00 00	Start count time (30s)
1E 00 00 00	Maximum timer value (invalid)
00 00 00 00	Reserved word (fixed)
1C	Xor sum packet check (from Target device ID to Reserve word)

- **Request protocol example 2:**

(countdown timing 30 seconds, count timing starts after countdown timing complete, count timing stops at 3*60 seconds)

① **Count timing setting**

FE 98 00 21 97 33 00 00 00 00 00 00 00 00 00 00 01 01 00 00 00 FF FF 00 00 00 00 B4 00 00 00 00 00 00 00 00 A9

②**Countdown timing setting**

FE 98 00 21 97 33 00 00 00 00 00 00 00 00 00 00 00 01 01 00 01 FF FF 1E 00 00 00 B4 00 00 00 00 00 00 00 00 B6

3.9 Time calibration

➢ This instruction is mainly used to read or calibrate the system time of the LED control card.

◆ **Steps for creating a display template:**

1) Add a display page.
2) Add a area to the display page.
3) Add a time material to the area.
4) Modify the material property parameters.
5) Save and send the display template.

3.9.1 Network/Serial port mode

Name	Byte Number	Data Type	Description
Frame header	4	Numerical	Fixed byte values is 0xFE 0x5C 0x4B 0x89.
Packet length	4	Numerical	Byte length from the Frame header to the Frame end. The low byte comes first, and the high byte comes last.
Protocol type	1	Numerical	The type byte of the protocol. Fixed byte values is 0x63.
Send ID	4	Numerical	A custom packet ID number that is carried in the reply packets sent back by the controller card to distinguish multiple reply packets.
Control instruction content length	4	Numerical	Byte length of the Control instruction content. The low byte comes first, and the high byte comes last.
Control instruction content start			
Operation flag	1	Numerical	0x31=Write 0x32=Read (Only serial port are supported)
Separator	1	Numerical	Fixed byte values is 0x23.
System time	16	Character	ASCII code for year, month, day, week, hour, minute and second. 4 Characters for year, 2 Characters for others.
Separator	1	Numerical	Fixed byte values is 0x23.
Control instruction content end			
Frame end	2	Numerical	Fixed byte values is 0xFF 0xFF.

● **Request protocol example 1** (Time correction) **:**

FE 5C 4B 89 26 00 00 00 63 00 00 00 00 13 00 00 00 31 23 32 30 32 32 31 31 30 31 30 35 31 36 33 30 32 30 23 FF FF

✓ **Request protocol parse :**

FE 5C 4B 89 Frame header (fixed)

26 00 00 00 Packet length (from Frame header to Frame end)

63	Protocol type (fixed)
00 00 00 00	Send ID (custom)
13 00 00 00	Control instruction content length (Operation flag to Separator)
31	Operation flag (write)
23	Separator (fixed)
32 30 32 32 31 31 30 31	Year month day (01 November 2022)
30 32	Week (Tuesday)
31 36 33 30 32 30	Hours, minutes and seconds (16:30:20)
23	Separator (fixed)
FF FF	Frame end (fixed)

- **Request protocol example 2** (read the control card time) **:**

FE 5C 4B 89 26 00 00 00 63 00 00 00 00 13 00 00 00 32 23 32 30 32 32 31 31 30 31 30 35 31 36 33 30 32 30 23 FF FF

- **Reply protocol example 2:**

FE 5C 4B 89 1D 00 00 00 63 00 00 00 00 08 00 00 00 31 16 0B 01 05 10 1F 33 AF C2 FF FF

✓ **Reply protocol parse:**

FE 5C 4B 89	Frame header (fixed)
1D 00 00 00	Packet length (from Frame header to Frame end)
63	Protocol type (fixed)
00 00 00 00	Message ID (Send ID)
08 00 00 00	Message content length (from Message content to Second)
31	Message content (success)
16	Year (22-2022)
0B	Month (11)
01	Date (1)
05	Week (Friday)
10	Hour (16)
1F	Minute (31)
33	Second (51)
AF C2	CRC16 packet check (from Frame header to Second)
FF FF	Frame end (fixed)

3.9.2 485 mode

Name	Byte Number	Data Type	Description
Frame header	1	Numerical	Fixed byte values is 0xFE.
Target device ID	1	Numerical	Fixed value taken as 0x98.

Packet length	2	Numerical	Byte length from the Target device ID to the Control instruction content. The high byte comes first, the low byte comes last.
Source device ID	1	Numerical	Fixed byte values is 0x97.
Protocol type	1	Numerical	The type byte of the protocol. Fixed byte values is 0x34.
Control instruction content start			
Operation flag	1	Numerical	0x01=Write
Device communi-cation address	8	Numerical	Mode 1: Fill in the internal code of the control card to specify the control card to receive the message; Mode 2: The first 7 bytes are filled with 0x00, and the last 1 byte is filled with the 485 communication address of the control card, which specifies that the control card can only receive the message; Mode 3: Fill 8 bytes 0x00 for broadcast mode, all control cards can receive the message.
System time	16	Character	ASCII code for year, month, day, week, hour, minute and second. 4 Characters for year, 2 Characters for others.
Control instruction content end			
Xor sum packet c heck	1	Numerical	All bytes of the Target device ID to the Control in-struction content are verified. The XOR sum check algorithm is shown in Annex 3

- **Request protocol example 1** (Time correction) **:**

FE 98 00 15 97 34 01 00 00 00 00 00 00 00 00 16 0B 01 05 10 1E 14 2C

✓ **Request protocol parse:**

FE	Frame header (fixed)
98	Target device ID (control card 0x98)
00 15	Packet length (from Target device ID to Second)
97	Source device ID (upper computer 0x97)
34	Protocol type (fixed)
01	Operation flag (fixed)
00 00 00 00 00 00 00	Device communication address (broadcast mode)
16	Year (22-2022)
0B	Month (11)
01	Date (1)
05	Week (Friday)
10	Hour (16)
1E	Minute (30)
14	Second (20)
2C	Xor sum packet check(from Target device ID to Second)

- **Request protocol example 2** (read the control card time) **:**

FE 98 00 15 97 34 02 00 00 00 00 00 00 00 00 16 0B 01 05 10 1E 14 2F

- **Reply protocol example 2:**

FE 97 00 0D 98 34 31 16 0B 01 05 10 20 16 38

✓ **Reply protocol parse:**

FE	Frame header (fixed)
97	Target device ID (upper computer 0x97)
00 0D	Packet length (target device identification word to reserved word)
98	Source device ID (control card 0x98)
34	Message type (fixed)
31	Confirmation of content (success)
16	Year (22-2022)
0B	Month (11)
01	Date (1)
05	Week (Friday)
10	Hour (16)
20	Minute (32)
16	Second (22)
38	Xor sum packet check (from Target device ID to Second)

3.10 Coordinate Text

- The coordinate text does not need to be add the area, the control card uses the coordinate position of the protocol to display a single line of text, the control card receives the information directly decoded and written to the control card display video area.
- Coordinate text needs to send a fixed length of text each time, and the non-displayed content uses space. If you send a message of variable length, the last message will be left at the end of the display when it is refreshed.
- After flipping the page to another display page, the host computer must resend the data packet to refresh the display, the control card does not save the information of this command and will not recover by itself.
- Coordinate text support for custom setting of text coordinates, Character colors, fonts and font sizes.
- Coordinate text does not support text content line breaks, does not support mobile display, does not support power down to save the content.

◆ **Steps for creating a display template:**

1) Add a display page.
2) Add a area to the display page.
3) Add an inner code text material to the area.
4) Set the stay time of the inner code text material property to 255.
5) Save and send the display template.

3.10.1 Network/Serial port mode

Name	Byte Number	Data Type	Description
Frame header	4	Numerical	Fixed byte values is 0xFE 0x5C 0x4B 0x89.
Packet length	4	Numerical	Byte length from the Frame header to the Frame end. The low byte comes first, and the high byte comes last.
Protocol type	1	Numerical	The type byte of the protocol. Fixed byte values is 0x60.
Send ID	4	Numerical	A custom packet ID number that is carried in the reply packets sent back by the controller card to distinguish multiple reply packets.
Control instruction content length	4	Numerical	Byte length of the Control instruction content. The low byte comes first, and the high byte comes last.
Control instruction content start			
Coordinate text control instruction content (from Separator to Display content)			
Separator	1	Numerical	Fixed byte values is 0x80.
X coordinate	2	Numerical	The x-coordinate of the text content to display.The low byte comes first, and the high byte comes last.

Y coordinate	2	Numerical	The y-coordinate of the text content to display.The low byte comes first, and the high byte comes last.
Display mode	1	Numerical	The high seven bits of the byte are reserved as 0. The lowest bit is the display marker: 0-normal display 1-display reverse
Character color	1	Numerical	1-red 2-green 3-yellow 4-blue 5-purple 6-cyan 7-white
Character attribute	1	Numerical	The high 4 bits of the byte set the font and the low 4 bits set the font size. **Font:** 0-Custom font library 1-Song script 2-Regular script 3-Boldface 4-Official script 5-Running script **Font size:** 0-12*12 1-16*16 2-24*24 3-32*32 4-48*48 5-64*64 6-80*80 7-96*96
Display content length	1	Numerical	Byte length of Display content.
Display content	several	Character	Display content sent with Characters in ASCII and GB2312 encoding. The display does not support line breaks.
Next coordinate text control instruction content (from Separator to Display content)			
Control instruction content end			
Frame end	2	Numerical	Fixed byte values is 0xFF 0xFF.

- **Request protocol example:**

FE 5C 4B 89 34 00 00 00 60 00 00 00 00 21 00 00 00 80 00 00 00 00 00 01 11 0B 74 65 6D 70 65 72 61 74 75 72 65 80 00 00 10 00 00 01 11 04 32 36 2E 35 FF FF

✓ **Request protocol parse:**

FE 5C 4B 89 Frame header (fixed)
34 00 00 00 Packet length (from Frame header to Frame end)
60 Protocol type (fixed)
00 00 00 00 Send ID (custom)
21 00 00 00 Control instruction content length
(from data 1 Separator to data 2 Display content)
** Coordinate text data 1**
80 Separator (fixed)
00 00 X coordinate (0 pixel)
00 00 Y coordinate (0 pixel)
00 Display mode (normal display)
01 Character color (character color: red)
11 Character attribute (font: Song script size:16)
0B Display content length (Data 1 display content length)
74 65 6D 70 65 72 61 74 75 72 65 Display content (temperature)
** Coordinate text data 2**
80 Separator (fixed)
00 00 X coordinate (0 pixel)

10 00	Y coordinate (16 pixel)
00	Display mode (normal display)
01	Character color (character color: red)
11	Character attribute (font: Song script size:16)
04	Display content length (Data 2 Display content length)
32 36 2E 35	Display content (26.5)
FF FF	Frame end (fixed)

3.10.2 485 mode

Name	Byte Number	Data Type	Description
Frame header	1	Numerical	Fixed byte values is 0xFE.
Target device ID	1	Numerical	Fixed byte values is 0x98.
Packet length	2	Numerical	Byte length from the Target device ID to the Control instruction content. The high byte comes first, the low byte comes last.
Source device ID	1	Numerical	Fixed byte values is 0x97.
Protocol type	1	Numerical	The type byte of the protocol. Fixed byte values is 0x31.
Reserved word	1	Numerical	Fixed byte values is 0x00.
Device communi-cation address	8	Numerical	Mode 1: Fill in the internal code of the control card to specify the control card to receive the message. Mode 2: The first 7 bytes are filled with 0x00, and the last 1 byte is filled with the 485 communication address of the control card, which specifies that the control card can only receive the message. Mode 3: Fill 8 bytes 0x00 for broadcast mode, all control cards can receive the message.
Control instruction content start			
Coordinate text control instruction content (from Separator to Display content)			
Separator	1	Numerical	Fixed byte values is 0x80.
X coordinate	2	Numerical	The x-coordinate of the text content to display.The low byte comes first, and the high byte comes last.
Y coordinate	2	Numerical	The y-coordinate of the text content to display.The low byte comes first, and the high byte comes last.
Display mode	1	Numerical	The high seven bits of the byte are reserved as 0. The lowest bit is the display marker: 0-normal display 1-display reverse
Character color	1	Numerical	1-red 2-green 3-yellow 4-blue 5-purple 6-cyan 7-white
Character attribute	1	Numerical	The high 4 bits of the byte set the font and the low 4 bits set the font size. **Font:** 0-Custom font library 1-Song script 2-Regular script 3-Boldface 4-Official script 5-Running script **Font size:** 0-12*12 1-16*16 2-24*24 3-32*3

			2 4-48*48 5-64*64 6-80*80 7-96*96
Display content length	1	Numerical	Byte length of Display content.
Display content	several	Character	Display content sent with Characters in ASCII and GB2312 encoding. The display does not support line breaks.
Next coordinate text control instruction content (from Separator to Display content)			
Control instruction content end			
Xor sum packet check	1	Numerical	All bytes of the Target device ID to the Control instruction content are verified. The XOR sum check algorithm is shown in Annex 3

- **Request protocol example:**

FE 98 00 2F 97 31 00 00 00 00 00 00 00 00 00 80 00 00 00 00 00 01 11 0B 74 65 6D 70 65 72 61 74 75 72 65 80 00 00 10 00 00 01 11 04 32 36 2E 35 7D

✓ **Request protocol parse:**

FE — Frame header (fixed)
98 — Target device ID (control card 0x98)
00 2F — Packet length (from Target device ID to data 2 Display content)
97 — Source device ID (upper computer 0x97)
31 — Protocol type (fixed)
00 — Reserved word (fixed)
00 00 00 00 00 00 00 — Device communication address (broadcast mode)
** Coordinate text data 1**
80 — Separator (fixed)
00 00 — X coordinate (0 pixel)
00 00 — Y coordinate (0 pixel)
00 — Display mode (normal display)
01 — Character color (character color: red)
11 — Character attribute (font: Song script size:16)
0B — Display content length (Data 1 display content length)
74 65 6D 70 65 72 61 74 75 72 65 — Display content (temperature)
** Coordinate text data 2**
80 — Separator (fixed)
00 00 — X coordinate (0 pixel)
10 00 — Y coordinate (16 pixel)
00 — Display mode (normal display)
01 — Character color (character color: red)
11 — Character attribute (font: Song script size:16)
04 — Display content length (Data 2 Display content length)
32 36 2E 35 — Display content (26.5)
7D — Xor sum packet check (from Target device ID to data 2 Display content)

3.11 Relay output control

- The main function of relay output control instruction is to control the relay on the board to absorb and release, IO port output high and low TTL level or passive switching signals, while supporting the automatic switching of the output signal function with time delay.
- Relay output control protocol support simultaneous control of up to 4 relays.

3.11.1 Network/Serial port mode

Name	Byte Number	Data Type	Description
Frame header	4	Numerical	Fixed byte values is 0xFE 0x5C 0x4B 0x89.
Packet length	4	Numerical	Byte length from the Frame header to the Frame end. The low byte comes first, and the high byte comes last.
Protocol type	1	Numerical	The type byte of the protocol. Fixed byte values is 0x61.
Send ID	4	Numerical	A custom packet ID number that is carried in the reply packets sent back by the controller card to distinguish multiple reply packets.
Control instruction content length	4	Numerical	Byte length of the Control instruction content. The low byte comes first, and the high byte comes last.
Control instruction content start			
IO/Relay control instruction content (from Control code and Control code inverse)			
Control code	1	Numerical	①0xFF - Keep the state the same. ②0xFD - Relay release or IO port output high level. ③0xFC - Relay pull-in or IO port output low. ④0xB0~0xCF - The relay is automatically disconnected after a delayed period of time after it is activated.The delay time is the control code minus 0xAF in 500ms. e.g. 0xCF - 0xAF = 0x20 converted to decimal is 32 32*500ms = 16s (maximum delay time)
Control code inverse	1	Numerical	Inverse code of the control code for this circuit (inverse code = 0xFF - control code) If the control code is 0x03 and the inverse code is 0xFC.
Next IO/Relay control instruction content (from Control code and Control code in-verse)			
Control instruction content end			
Frame end	2	Numerical	Fixed byte values is 0xFF 0xFF.

- **Request protocol example:**

FE 5C 4B 89 1B 00 00 00 61 00 00 00 00 08 00 00 00 FF 00 FC 03 FD 02 B1 4E FF FF

✓ **Request protocol parse:**

FE 5C 4B 89	Frame header (fixed)
1B 00 00 00	Packet length (from Frame header to Frame end)
61	Message type (fixed)
00 00 00 00	Send ID (custom)
08 00 00 00	Control instruction content length (first to fourth control code)
FF 00	First control code (unchanged)
FC 03	Second control code (immediate close up)
FD 02	Third control code (immediate release)
B1 4E	Fourth control code (released after a delay of 1s)
FF FF	Frame end (fixed)

3.11.2 485 mode

Name	Byte Number	Data Type	Description
Frame header	1	Numerical	Fixed byte values is 0xFE.
Target device ID	1	Numerical	Fixed value taken as 0x98.
Packet length	2	Numerical	Byte length from the Target device ID to the Control instruction content. The high byte comes first, the low byte comes last.
Source device ID	1	Numerical	Fixed byte values is 0x97.
Protocol type	1	Numerical	The type byte of the protocol. Fixed byte values is 0x32.
Reserved word	1	Numerical	ixed byte values is 0x00.
Device communication address	8	Numerical	Mode 1: Fill in the internal code of the control card to specify the control card to receive the message. Mode 2: The first 7 bytes are filled with 0x00, and the last 1 byte is filled with the 485 communication address of the control card, which specifies that the control card can only receive the message. Mode 3: Fill 8 bytes 0x00 for broadcast mode, all control cards can receive the message.
Control instruction content start			
IO/Relay control instruction content (from Control code and Control code inverse)			
Control code	1	Numerical	①0xFF - Keep the state the same. ②0xFD - Relay release or IO port output high level. ③0xFC - Relay close up or IO port output low. ④0xB0~0xCF - The relay is automatically disconnected after a delayed period of time after it is activated.The delay time is the control code minus 0xAF in 500ms. e.g. 0xCF - 0xAF = 0x20 converted to decimal is 32 32*500ms = 16s (maximum delay time)

Control code in-verse	1	Numerical	Inverse code of the control code for this circuit (inverse code = 0xFF - control code) If the control code is 0x03 and the inverse code is 0xFC.
Next IO/Relay control instruction content (from Control code and Control code in-verse)			
Control instruction content end			
Xor sum packet c heck	1	Numerical	All bytes of the Target device ID to the Control in-struction content are verified. The XOR sum check algorithm is shown in Annex 3

- **Request protocol example:**

FE 98 00 16 97 32 00 00 00 00 00 00 00 00 00 FF 00 FC 03 FD 02 B1 4E 2B

✓ **Request protocol parse:**

FE	Frame header (fixed)
98	Target device ID (control card 0x98)
00 16	Packet length (from Target device ID to Fourth control code)
97	Source device identification word (upper 0x97)
32	Message type (fixed)
00	Reserved word (fixed)
00 00 00 00 00 00 00	Device communication address (broadcast mode)
FF 00	First control code (unchanged)
FC 03	Second control code (immediate close up)
FD 02	Third control code (immediate release)
B1 4E	Fourth control code (released after a delay of 1s)
2B	Xor sum packet check (from Target device ID to Fourth control code)

3.12 Queuing call data

- This command is mainly applicable to the use of queuing call scenarios, to be able to control several of the Characters to change the color or part of the Character blinking.
- Queuing call only static display display, support automatic line display.
- Queuing information can only be placed in the first display page, with priority display, if the queuing command is received, it will be able to immediately jump to the first display page from other display pages.

◆ **Steps for creating a display template:**

1) Add a display page.
2) Add a area to the display page.
3) Add a Queuing and calling material to the area.
4) Set the window address of the Queuing and calling material attribute to 1.
5) Save and send the display template.

3.12.1 Network/Serial port mode

Name	Byte Number	Data Type	Description
Frame header	4	Numerical	Fixed byte values is 0xFE 0x5C 0x4B 0x89.
Packet length	4	Numerical	Byte length from the Frame header to the Frame end. The low byte comes first, and the high byte comes last.
Protocol type	1	Numerical	The type byte of the protocol. Fixed byte values is 0x64.
Send ID	4	Numerical	A custom packet ID number that is carried in the reply packets sent back by the controller card to distinguish multiple reply packets.
Forwarding data length	4	Numerical	Byte length of the Forwarding data content; The low byte comes first, and the high byte comes last.
Forwarding data content start			
Target address	1	Numerical	The address of the window queued to call.
Reserved word	1	Numerical	Fixed byte values is 0x00.
Attribute content length	1	Numerical	Byte length from Reserved word to Xor sum packet check.
Source address	1	Numerical	Fixed byte values is 0x00.
Characteristic flag	1	Numerical	Fixed byte values is 0x53.
Control flag	1	Numerical	Fixed byte values is 0x00.
Stay time	1	Numerical	Displays the pause time after the content has moved one page. unit: 5sec 0-keep moving 1-stay1*5s 255-static display
	certain	Character	The display content characters are encoded by ASCII and GB2312, and color mark characters and flashing

Display content			mark characters are added for control. **Color mark characters:** The default color is red if no color marker character is present in the display. If a color marker character appears in the display content, the content starting from the color marker character displays that color until another color marker character appears. **0x1E-color 0x1F-red 0x0A-yellow** **Flashing mark characters:** The display content flashing between the flashing start mark and t he flashing end mark. **0x1D-Flashing start mark** **0x1C- Flashing end mark**
Xor sum packet c heck	2	Numerical	All bytes of the Target address to the Display content are verified.After get the packet check byte,the high 4 bits of a byte are taken as the first byte and the low 4 bits of a byte as the second byte. If the Xor sum packet check is 0x5B, this field bytes is 0x05 0x0B.
Forwarding data content end			
Frame end	2	Numerical	Fixed byte values is 0xFF 0xFF.

- **Request protocol example:**

FE 5C 4B 89 31 00 00 00 64 00 00 00 00 1E 00 00 00 01 00 1D 00 53 00 01 C7 EB 1D 0A 33 32 BA C5 1F 1C B5 BD 1E 30 31 BA C5 B4 B0 BF DA 00 01 FF FF

✓ **Request protocol parse:**

FE 5C 4B 89	Frame header (fixed)
31 00 00 00	Packet length (from Frame header to Frame end)
64	Protocol type (fixed)
00 00 00 00	Send ID (custom)
1E 00 00 00	Forwarding data length (from Target address to Xor sum packet check)
01	Target address (window address 1)
00	Reserved word (fixed)
1D	Attribute content length (from Reserved word to Xor sum packet check)
00	Source address (fixed)
53	Characteristic flag (fixed)
00	Control flag (fixed)
01	Stay time (5 seconds)
C7 EB 1D 0A 33 32 BA C5 1F 1C B5 BD 1E 30 31 BA C5 B4 B0 BF DA	Display content (请(Flashing start)(yellow)32 号(red)(Flashing end)到(green)01 号窗口)
00 01	Xor sum packet check (from Target address to Display content)
FF FF	Frame end (fixed)

3.13 Synchronous video display

- Directly send the grey-scale video image to the control card, the control card receives the data and writes it directly to the display video buffer, instead of writing it to flash, so that more than 10 frames per second can be transmitted to the control card to display the image.
- Mostly used for complex chart display occasions, from the host computer to form a picture to send led display display. Support synchronous/asynchronous display content switching
- Supports synchronised video commands in some areas, while other areas continue to display programmes retained on the original control card.

3.13.1 Network/Serial port mode

Name	Byte Number	Data Type	Description
Frame header	4	Numerical	Fixed byte values is 0xFE 0x5C 0x4B 0x89.
Packet length	4	Numerical	Byte length from the Frame header to the Frame end. The low byte comes first, and the high byte comes last.
Protocol type	1	Numerical	The type byte of the protocol. Fixed byte values is 0x6C.
Send ID	4	Numerical	Fixed byte values is 0x19 0x32 0x5E 0x00.
Control instruction content length	4	Numerical	Byte length of the Control instruction content. The low byte comes first, and the high byte comes last.
Control instruction content start			
Display mode	1	Numerical	0x01-Synchronous display mode 0x02-Asynchronous display mode.
Stay time	1	Numerical	Synchronised playback of content stay time, after the time is up no new content will switch to asynchro-nous mode to play the display content; 255- Permanent display Unit: 5 seconds
Reserved word	2	Numerical	Fixed byte values is 0x00.
Subpackage num-ber	2	Numerical	If the packet is longer than 960 bytes, it needs to be sent for multiple subpackets. When only one packet or the last subpacket can be less than 960 bytes long, the other subpackets must be 960 bytes long. The low byte comes first, and the high byte comes last.
Subpacket sequence number	2	Numerical	All the data packets of each video frame must be transmitted within the dwell time, otherwise it will be automatically restored to the asynchronous dis-play mode. Sequence number starting at 0. The low byte comes first and the high byte comes last.
	960	Numerical	①The byte order is red, green, and blue. If the dis-play does not have this color, there is no need to fill

Display content			in the corresponding color byte. A byte of 8 bits corresponds to the 8 pixels of the display from left to right in order from high to low. ②A bit of 0 indicates that the pixel point displays the color. A bit of 1 indicates that the pixel point does not display the color. ③Example: **Single base color:** 0x7F (red-black-black-black-black-black-black) **Dual base color:** 0x5F 0x9F (red, green, yellow, black, black, black, black) **Three primary colors:** 0x65 0xA9 0xD1 (red green blue yellow purple cyan white black)
Control instruction content end			
Frame end	2	Numerical	Fixed byte values is 0xFF 0xFF.

- **Request protocol example (double base color 64*32):**

```
FE 5C 4B 89 1B 02 00 00 6C 19 32 5E 00 08 02 00 00 01 FF 00 00 01 00 00 00 7F
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
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FF FF FF FF FF FF FF FF FF FF FE FF FF
```

✓ **Request protocol parse:**

FE 5C 4B 89	Frame header (fixed)
1B 02 00 00	Packet length (from Frame header to Frame end)
6C	Protocol type (fixed)

19 32 5E 00 — Send ID (fixed)

08 02 00 00 — Control command content length (from Display mode to Display content)

01 — Display mode (Synchronous display mode)

FF — Stay time (Permanent display)

00 00 — Reserved word (fixed)

01 00 — Subpackage numbers (one subpackage)

00 00 — Subpacket sequence number (first subpackage)

7F FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
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FF FF FF FF FF FF FF FF FF FF FF FF

Display content (first pixel point red, last green)

FF FF — Frame end (fixed)

3.14 Brightness Adjustment

◆ The main function of this instruction is used to adjust the brightness of the LED screen, the control card brightness adjustment is divided into 32 levels, able to adjust the brightness of the display in detail.

3.14.1 Network/Serial port mode

Name	Byte Number	Data Type	Description
Frame header	4	Numerical	Fixed byte values is 0xFE 0x5C 0x4B 0x89.
Packet length	4	Numerical	Byte length from the Frame header to the Frame end. The low byte comes first, and the high byte comes last.
Protocol type	1	Numerical	The type byte of the protocol. Fixed byte values is 0x76.
Send ID	4	Numerical	A custom packet ID number that is carried in the reply packets sent back by the controller card to distinguish multiple reply packets.
Control instruction content length	4	Numerical	Byte length of the Control instruction content. The low byte comes first, and the high byte comes last.
Control instruction content start			
Control mode	1	Numerical	Level 0: The display brightness is the brightness parameter set by the control card. Level 1 (Default mode): The control card determines day and night according to the current time, and automatically adjusts the corresponding brightness. Level 2: Use this command to control the brightness.
Control mode inverse code	1	Numerical	The inverse code of the Control mode. (Inverse code = 0xFF - Control mode) If the Control mode is 0x02, the inverse code is 0xFD.
Brightness level	1	Numerical	Brightness range: 0~31, total 32 levels. The larger the value, the darker the brightness.
Brightness level inverse code	1	Numerical	he inverse code of the Brightness level. (Inverse code = 0xFF - Brightness level) If the Brightness level is 0x03, the inverse code is 0xFC.
Control instruction content end			
Frame end	2	Numerical	Fixed byte values is 0xFF 0xFF.

● **Request protocol example:**

FE 5C 4B 89 17 00 00 00 76 00 00 00 00 04 00 00 00 02 FD 03 FC FF FF

✓ **Request protocol parse:**

FE 5C 4B 89	Frame header (fixed)
17 00 00 00	Packet length (from Frame header to Frame end)
76	Protocol type (fixed)
00 00 00 00	Send ID (fixed)
04 00 00 00	Control instruction length (from Control mode to Brightness level inverse code)
02	Control mode (level 2, command control)
FD	Control mode inverse code (inverse code of 0x02 is 0xFD)
03	Brightness level (Brightness 3)
FC	Brightness level inverse code (inverse code of 0x03 is 0xFC)
FF FF	Frame end (fixed)

3.14.2 485 mode

Name	Byte Number	Data Type	Description
Frame header	1	Numerical	Fixed byte values is 0xFE.
Target device ID	1	Numerical	Fixed value taken as 0x98.
Packet length	2	Numerical	Byte length from the Target device ID to the Control instruction content. The high byte comes first, the low byte comes last.
Source device ID	1	Numerical	Fixed byte values is 0x97.
Protocol type	1	Numerical	The type number of the message, a fixed value of 0x76.
Reserved word	1	Numerical	Fixed byte values is 0x00.
Device communication address	8	Numerical	Mode 1: Enter the internal code of the control card to specify that the control card can receive packets. Mode 2: The first 7 bytes are filled with 0x00, and the last 1 byte is filled with the 485 communication address of the control card. Mode 3: Fill 8 bytes 0x00 for broadcast mode. All control cards can receive packets.
Control instruction content start			
Control mode	1	Numerical	Level 0: The display brightness is the brightness parameter set by the control card. Level 1 (Default mode): The control card determines day and night according to the current time, and automatically adjusts the corresponding brightness. Level 2: Use this command to control the brightness.
Control mode inverse code	1	Numerical	The inverse code of the Control mode. (Inverse code = 0xFF - Control mode) If the Control mode is 0x02, the inverse code is 0xFD.

Brightness level	1	Numerical	Brightness range: 0~31, total 32 levels. The larger the value, the darker the brightness.
Brightness level inverse code	1	Numerical	he inverse code of the Brightness level. (Inverse code = 0xFF - Brightness level) If the Brightness level is 0x03, the inverse code is 0xFC.
Control instruction content end			
Xor sum packet check	1	Numerical	All bytes of the Target device ID to the Control instruction content are verified. The XOR sum check algorithm is shown in Annex 3

- **Request protocol example:**

FE 98 00 12 97 76 00 00 00 00 00 00 00 00 00 02 FD 03 FC 6B

✓ **Request protocol parse:**

FE	Frame header (fixed)
98	Target device ID (control card 0x98)
00 14	Packet length (from Target device ID to Brightness level inverse code)
97	Source device ID (upper computer 0x97)
32	Protocol type (fixed)
00	Reserved word (fixed)
00 00 00 00 00 00 00	Device communication address (broadcast mode)
02	Control mode (level 2, command control)
FD	Control mode inverse code (inverse code of 0x02 is 0xFD)
03	Brightness level (Brightness 3)
FC	Brightness level inverse code (inverse code of 0x03 is 0xFC)
6B	Xor sum packet check (from Target device ID to Brightness level inverse code)

3.15 QR Code Generation

- The main function of this instruction is to generate QR code on the display, scan the QR code to show the information content or jump to the URL, you can set the QR code position, size and color.
- Only some control cards support QR code generation function.

◆ **Steps for creating a display template:**

1) Add a display page.
2) Add a area to the display page.
3) Add an inner code text material to the area.
4) Set the stay time of the inner code text material property to 255.
5) Save and send the display template.

3.15.1 Network/Serial port mode

Name	Byte Number	Data Type	Description
Frame header	4	Numerical	Fixed byte values is 0xFE 0x5C 0x4B 0x89.
Packet length	4	Numerical	Byte length from the Frame header to the Frame end. The low byte comes first, and the high byte comes last.
Protocol type	1	Numerical	The type byte of the protocol. Fixed byte values is 0x50.
Send ID	4	Numerical	A custom packet ID number that is carried in the reply packets sent back by the controller card to distinguish multiple reply packets.
Control instruction content length	4	Numerical	Byte length of the Control instruction content. The low byte comes first, and the high byte comes last.
Control instruction content start			
X coordinate	2	Numerical	X coordinate of the display area in pixel points. The low byte comes first, and the high byte comes last.
Y coordinate	2	Numerical	Y coordinate of the display area in pixel points. The low byte comes first, and the high byte comes last.
Decode method	1	Numerical	0x00-not folding 0x01-folding
Display color	1	Numerical	The high 4 bits of the byte set the border color and the low 4 bits set the internal color 1-red 2-green 3-yellow 4-blue 5-purple 6-cyan 7-white
Generate version	1	Numerical	Range: 0-10 0 - Indicates that the version is automatically recog-nised based on the length of the string. The version value is related to the display image

			pixel point size: Version value * 4 + 17 = width of generated pixel point.
Error correction level	1	Numerical	0–7% 1-15% 2-25% 3-30%
Reserved word	8	Numerical	Fixed byte values is 8 bytes 0x00.
QR code content	certain	Character	Scanning QR code display information, the length can not exceed 256 bytes. The Characters using GB2312 code, ASCII code.
Control instruction content end			
Frame end	2	Numerical	Fixed byte values is 0xFF 0xFF.

- **Request protocol example:**

FE 5C 4B 89 38 00 00 00 50 00 00 00 00 25 00 00 00 00 00 00 00 00 77 05 00 00 00 00 00 00 00 00 00 68 74 74 70 73 3A 2F 2F 77 77 77 2E 62 61 69 64 75 2E 63 6F 6D FF FF

✓ **Request protocol parse:**

FE 5C 4B 89 Frame header (fixed)
30 00 00 00 Packet length (from Frame header to Frame end)
50 Protocol type (fixed)
00 00 00 00 Send ID (fixed)
1D 00 00 00 Control instruction content length
(from X coordinate to QR code content)
00 00 X coordinate (0 pixel point)
00 00 Y coordinate (0 pixel point)
00 Decode method (no folding)
77 Display color (white)
05 Generate version (width 5*4+17 = 37 pixel dots)
00 Error correction level (30%)
00 00 00 00 00 00 00 Reserved words (fixed)
68 74 74 70 73 3A 2F 2F 77 77 77 77 2E 62 61 69 64 64 75 2E 63 6F 6D
QR code content (https://baidu.com)
FF FF Frame end (fixed)

3.15.2 485 mode

Name	Byte Number	Data Type	Description
Frame header	1	Numerical	Fixed byte values is 0xFE.
Target device ID	1	Numerical	Fixed byte values is 0x98.
Packet length	2	Numerical	Byte length from the Target device ID to the Control instruction content. The high byte comes first, the low byte comes last.

Source device ID	1	Numerical	Fixed byte values is 0x97.
Protocol type	1	Numerical	The type byte of the protocol. Fixed byte values is 0x50.
Reserved word 1	1	Numerical	Fixed byte values is 0x00.
Device communi-cation address	8	Numerical	Mode 1: Enter the internal code of the control card to specify that the control card can receive packets. Mode 2: The first 7 bytes are filled with 0x00, and the last 1 byte is filled with the 485 communication address of the control card. Mode 3: Fill 8 bytes 0x00 for broadcast mode. All control cards can receive packets.
Control instruction content start			
X coordinate	2	Numerical	X coordinate of the display area in pixel points. The low byte comes first, and the high byte comes last.
Y coordinate	2	Numerical	Y coordinate of the display area in pixel points. The low byte comes first, and the high byte comes last.
Decode method	1	Numerical	0x00-not folding 0x01-folding
Display color	1	Numerical	The high 4 bits of the byte set the border color and the low 4 bits set the internal color 1-red 2-green 3-yellow 4-blue 5-purple 6-cyan 7-white
Generate version	1	Numerical	Range: 0-10 0 - Indicates that the version is automatically recog-nised based on the length of the string. The version value is related to the display image pixel point size: Version value * 4 + 17 = width of generated pixel point.
Error correction level	1	Numerical	0–7% 1-15% 2-25% 3-30%
Reserved word 2	8	Numerical	Fixed byte values is 8 bytes 0x00.
QR code content	certain	Character	Scanning QR code display information, the length can not exceed 256 bytes. The Characters using GB2312 code, ASCII code.
Control instruction content end			
Xor sum packet c heck	1	Numerical	All bytes of the Target device ID to the Control in-struction content are verified. The XOR sum check algorithm is shown in Annex 3

- **Request protocol example:**

FE 98 00 33 97 50 00 00 00 00 00 00 00 00 00 00 00 00 00 00 77 05 00 00 00 00 00 00 00 00 00 00 68 74 74 70 73 3A 2F 2F 77 77 77 2E 62 61 69 64 75 2E 63 6F 6D 22

✓ **Request protocol parse:**

FE Frame header (fixed)

98 Target device ID (control card 0x98)

00 33	Packet length (from Target device ID to QR code content)
97	Source device ID (upper computer 0x97)
50	Protocol type (fixed)
00	Reserved word 1 (fixed)
00 00 00 00 00 00 00	Device communication address (broadcast mode)
00 00	X coordinate (0 pixel point)
00 00	Y coordinate (0 pixel point)
00	Decode method (not folding)
77	Display color (white)
05	Generate version (width 5*4+17 = 37 pixel dots)
00	Error correction level (level 0)
00 00 00 00 00 00 00	Reserved word 2 (fixed)
68 74 74 70 73 3A 2F 2F 77 77 77 77 2E 62 61 69 64 64 75 2E 63 6F 6D	QR code content (https://baidu.com)
22	Xor sum packet check (from Target device ID to QR code content)

3.15.3 Version and Capacity Correspondence

Releases	Length and Width	Error correction level 0	Error correction level 1	Error correction level 2	Error correction level 3
0	23*23	19	16	13	6
1	27*27	34	28	22	16
2	31*31	55	44	34	26
3	35*35	80	64	48	36
4	39*39	108	86	62	46
5	43*43	136	108	76	60
6	47*47	154	124	88	66
7	51*51	194	154	110	86
8	55*55	232	182	132	100
9	59*59	274	216	154	122
10	63*63	324	254	180	140

3.16 Voice broadcast

- N1T control card and Y1 voice card with built-in voice function, the host computer can send 4.16.1 network/serial port communication protocol and 4.16.2 485 communication protocol to control the board to play speech.
- When the Y1 voice card and the control card both need to communicate with the host computer at the same time, the control card can be used as a medium between the voice card and the host computer server, the Y1 voice card is connected to the control card via 232/485 to realise the host computer to control the display content and voice playback function at the same time, for details, refer to 4.16.3 Control card forwarding communications.
- Voice playback content can be added to the control markers to modify the voice of the voice, speech rate, tone and other parameters, you can also add a tone to increase the richness of the voice, for details, refer to 4.16.4 Voice Control Marker List and 4.16.5 Tones.
- A text-to-speech message cannot be larger than 256 Characters.

3.16.1 Network/Serial port mode

Name	Byte Number	Data Type	Description
Frame header	4	Numerical	Fixed byte values is 0xFE 0x5C 0x4B 0x89.
Packet length	4	Numerical	Byte length from the Frame header to the Frame end. The low byte comes first, and the high byte comes last.
Protocol type	1	Numerical	The type byte of the protocol. Fixed byte values is 0x68.
Forwarding port	1	Numerical	Forward serial port 2. Fixed byte values is 0x02.
Send ID	3	Numerical	A custom packet ID number that is carried in the reply packets sent back by the controller card to distinguish multiple reply packets.
Control instruction content length	4	Numerical	Byte length of the Control instruction content. The low byte comes first, and the high byte comes last.
Control instruction content start			
Header	1	Numerical	Fixed byte values is 0xFD.
Voice content length	2	Numerical	The byte length from the Voice command word to the Voice text content.The high byte comes first, and the low byte comes last.
Voice command word	1	Numerical	0x01-Start synthesising speech. 0x02-Stop synthesising speech. 0x03-Pause synthesised speech. 0x04-Resume synthesised speech.
Voice text encoding format	1	Numerical	0x00-GB2312 code 0x01-GBK code 0x02-BIG5 code 0x03-UNICODE code

Voice text content	≤240	Character	Text content, control markers, and prompt phonetic notation of the broadcast voice. Refer to Sections 3.4.4 and 3.4.5 for the use of control markers and tones.
Control instruction content end			
Frame end	2	Numerical	Fixed byte values is 0xFF 0xFF.

- **Request protocol example:**

FE 5C 4B 89 39 00 00 00 68 02 00 00 00 26 00 00 00 FD 00 23 01 00 5B 6D 35 32 5D 5B 73 35 5D 5B 68 32 5D 76 6F 69 63 65 20 74 65 73 74 5B 73 6F 75 6E 64 32 30 31 5D FF FF

✓ **Request protocol parse:**

FE 5C 4B 89	Frame header (fixed)
39 00 00 00	Packet length (from Frame header to Frame end)
68	Protocol type (fixed)
02	Forwarding port (serial port 2)
00 00 00	Send ID (custom)
24 00 00 00	Control instruction content length (from Frame header to Voice text content)
FD	Header (fixed)
00 23	Voice content length (from Voice command word to Voice text content)
01	Voice command word (start synthesis)
00	Voice text encoding format (GB2312 code)
5B 6D 35 32 5D	Voice control markers 1 ([m52] male 2 voices, ASCII code)
5B 73 35 5D	Voice control markers 2 ([s5] Level five speaking speed, ASCII code)
5B 68 32 5D	Voice control markers 3 ([h2] Pronounce the words in English, ASCII code)
76 6F 69 63 65 20 74 65 73 74	Voice text content (voice test, ASCII code)
5B 73 6F 75 6E 64 32 30 31 5D	Voice tone ([sound201], ASCII code)
FF FF	Frame end (fixed)

- **Reply protocol example:**

FE 5C 4B 89 14 00 00 00 68 02 00 00 00 01 00 00 00 4F FF FF

✓ **Reply protocol parse:**

FE 5C 4B 89	Frame header (fixed)
14 00 00 00	Packet length (from Frame header to Frame end)
68	Protocol type (fixed)
02	Forwarding port (serial port 2)
00 00 00	Message ID (Send ID)
01 00 00 00	Message content length (acknowledgement content length)

4F	Message content (success)
FF FF	Frame end (fixed)

✓ **Acknowledgement content** (1 byte, indicating reception processing status)
0x4F -- Indicates success and initiates playback.
0x4E -- Indicates busy, in synthesis phase.
0x45 -- Indicates that an error command frame was received.

3.16.2 485 mode

Name	Byte Number	Data Type	Description
Frame header	1	Numerical	Fixed byte values is 0xFE.
485 Communication Address	1	Numerical	0x00 is broadcast mode and is received by all addresses.Address range 0x01~0xF0.
Packet length	2	Numerical	The byte length from 485 communication address to the Speech text content. The high byte comes first, and the low byte comes last.
Source address	1	Numerical	Fixed byte values is 0x99.
Protocol type	1	Numerical	Fixed byte values is 0x73.
Control instruction content start			
Header	1	Numerical	Fixed byte values is 0xFD.
Voice content length	2	Numerical	The byte length from the Voice command word to the Voice text content.The high byte comes first, and the low byte comes last.
Voice command word	1	Numerical	0x01-Start synthesising speech. 0x02-Stop synthesising speech. 0x03-Pause synthesised speech. 0x04-Resume synthesised speech.
Voice text encoding format	1	Numerical	0x00-GB2312 code 0x01-GBK code 0x02-BIG5 code 0x03-UNICODE code
Voice text content	≤240	Character	Text content, control markers, and prompt phonetic notation of the broadcast voice. Refer to Sections 3.4.4 and 3.4.5 for the use of control markers and tones.
Control instruction content end			
Xor sum packet check	1	Numerical	All bytes of the Target device ID to the Control instruction content are verified. The XOR sum check algorithm is shown in Annex3

- **Request protocol example:**

FE 00 00 2B 99 73 FD 00 23 01 00 5B 6D 35 32 5D 5B 73 35 5D 5B 68 32 5D 76 6F 69 63 65 20 74 65 73 74 5B 73 6F 75 6E 64 32 30 31 5D 78

✓ **Request protocol parse:**

FE	Frame header (fixed)
00	485 communication address (broadcast mode)
00 2B	Packet length (from 485 communication address to Voice text content)
99	Source address (fixed)
73	Protocol type (fixed)
FD	Header (fixed)
00 23	Voice content length (from Voice command word to Voice text content)
01	Voice command word (start synthesis)
00	Voice text encoding format (GB2312 encoding)
5B 6D 35 32 5D	Voice control markers 1 ([m52] male 2 voices, ASCII code)
5B 73 35 5D	Voice control markers 2 ([s5] Level five speaking speed, ASCII code)
5B 68 32 5D	Voice control markers 3 ([h2] Pronounce the words in English, ASCII code)
76 6F 69 63 65 20 74 65 73 74	Voice text content (voice test, ASCII code)
5B 73 6F 75 6E 64 32 30 31 5D	Voice tone ([sound201], ASCII code)
78	Xor sum packet check (from 485 communication address to Voice text content)

✓ **Reply protocol parse:**

FE 99 00 06 01 73 4F A2

✓ **Reply protocol parse:**

FE	Frame header (fixed)
99	Target device ID (upper computer)
00 06	Packet length (from Target device ID to Message content)
01	Source device ID (control card)
73	Protocol type (fixed)
4F	Message content (successful)
A2	Xor sum packet check (from Target device ID to Message content)

✓ **Acknowledgement content** (1 byte, indicating reception processing status)

0x4F -- Indicates success and initiates playback.

0x4E -- Indicates busy, in synthesis phase.

0x45 -- Indicates that an error command frame was received.

3.16.3 Control card forwarding communication

3.16.3.1 Network forwarding serial port

Name	Byte Number	Data Type	Description
Frame header	4	Numerical	Fixed byte values is 0xFE 0x5C 0x4B 0x89.
Packet length	4	Numerical	Byte length from the Frame header to the Frame end. The low byte comes first, and the high byte comes last.
Protocol type	1	Numerical	The type byte of the protocol. Fixed byte values is 0x68.
Forwarding port	1	Numerical	Forward serial port 1. Fixed byte values is 0x01.
Send ID	3	Numerical	A custom packet ID number that is carried in the reply packets sent back by the controller card to distinguish multiple reply packets.
Forwarding data length	4	Numerical	Byte length of the Forwarding data content. The low byte comes first, and the high byte comes last.
Forwarding data content start			
Header	1	Numerical	Fixed byte values is 0xFD.
Voice content length	2	Numerical	The byte length from the Voice command word to the Voice text content.The high byte comes first, and the low byte comes last.
Voice command word	1	Numerical	0x01-Start synthesising speech. 0x02-Stop synthesising speech. 0x03-Pause synthesised speech. 0x04-Resume synthesised speech.
Voice text encoding format	1	Numerical	0x00-GB2312 code 0x01-GBK code 0x02-BIG5 code 0x03-UNICODE code
Voice text content	≤240	Character	Text content, control markers, and prompt phonetic notation of the broadcast voice. Refer to Sections 3.4.4 and 3.4.5 for the use of control markers and tones.
Forwarding data content end			
Frame end	2	Numerical	Fixed byte values is 0xFF 0xFF.

- **Request protocol example:**

FE 5C 4B 89 39 00 00 00 68 01 00 00 00 26 00 00 00 FD 00 23 01 00 5B 6D 35 32 5D 5B 73 35 5D 5B 68 32 5D 76 6F 69 63 65 20 74 65 73 74 5B 73 6F 75 6E 64 32 30 31 5D FF FF

✓ **Request protocol parse:**

FE 5C 4B 89 Frame header (fixed)
39 00 00 00 Packet length (from Frame header to Frame end)
68 Protocol type (fixed)

01	Forwarding port (serial port 1)
00 00 00	Send ID (custom)
26 00 00 00	Forwarding data length (from Header to reserved word)
FD	Header (fixed)
00 23	Voice content length (from Voice command word to Voice text content)
01	Voice command word (start synthesis)
00	Voice text encoding format (GB2312 encoding)
5B 6D 35 32 5D	Voice control markers 1 ([m52] male 2 voices, ASCII code)
5B 73 35 5D	Voice control markers 2 ([s5] Level five speaking speed, ASCII code)
5B 68 32 5D	Voice control markers 3 ([h2] Pronounce the words in English, ASCII code)
76 6F 69 63 65 20 74 65 73 74	Voice text content (voice test, ASCII code)
5B 73 6F 75 6E 64 32 30 31 5D	Voice tone ([sound201], ASCII code)
FF FF	Frame end (fixed)

- **Reply protocol example:**

FE 5C 4B 89 14 00 00 00 00 68 01 00 00 00 00 01 00 00 00 4F FF FF FF

✓ **Reply protocol parse:**

FE 5C 4B 89	Frame header (fixed)
14 00 00 00	Packet length (from Frame header to Frame end)
68	Protocol type (fixed)
01	Forwarding port (serial port 1)
00 00 00	Message ID (Send ID)
01 00 00 00	Message content length (length of acknowledgement content)
4F	Message content (success)
FF FF	Frame end (fixed)

✓ **Acknowledgement content** (1 byte, indicating reception processing status)

0x4F -- Indicates success and initiates playback;

0x4E -- Indicates busy, in synthesis phase;

0x45 -- Indicates that an error command frame was received;

3.16.3.2 Network forwarding 485

Name	Byte Number	Data Type	Description
Frame header	4	Numerical	Fixed byte values is 0xFE 0x5C 0x4B 0x89.
Packet length	4	Numerical	The byte length from Frame header to Frame end.

			The low byte comes first, and the high byte comes last.
Protocol type	1	Numerical	The type byte of the protocol. Fixed byte values is 0x68.
Forwarding port	1	Numerical	Forwarding 485. Fixed byte values is 0x03.
Send ID	3	Numerical	A custom packet ID number that is carried in the reply packets sent back by the controller card to distinguish multiple reply packets.
Forwarding data length	4	Numerical	Byte length of the Forwarding data content. The low byte comes first, and the high byte comes last.
Forwarding data content start			
485 Communication address	1	Numerical	0x00 is broadcast mode and is received by all addresses.Address range 0x01~0xF0.
Control command content length	2	Numerical	The byte length from 485 Communication Address to Voice text content.The high byte comes first, and the low byte comes last.
Source address	1	Numerical	Fixed byte values is 0x99.
Message type	1	Numerical	Fixed byte values is 0x73.
Header	1	Numerical	Fixed byte values is 0xFD.
Voice content length	2	Numerical	The byte length from the Voice command word to the Voice text content.The high byte comes first, and the low byte comes last.
Voice command word	1	Numerical	0x01-Start synthesising speech. 0x02-Stop synthesising speech. 0x03-Pause synthesised speech. 0x04-Resume synthesised speech.
Voice text encoding format	1	Numerical	0x00-GB2312 code 0x01-GBK code 0x02-BIG5 code 0x03-UNICODE code
Voice text content	≤240	Character	Text content, control markers, and prompt phonetic notation of the broadcast voice. Refer to Sections 3.4.4 and 3.4.5 for the use of control markers and tones.
Xor sum packet check	1	Numerical	All bytes of the Target device ID to the Control instruction content are verified. The XOR sum check algorithm is shown in Annex3
Forwarding data content end			
Frame end	2	Numerical	Fixed byte values is 0xFF 0xFF.

- **Request protocol example:**

FE 5C 4B 89 3F 00 00 00 68 03 00 00 00 2C 00 00 00 00 00 2B 99 73 FD 00 23 01 00 5B 6D 35 32 5D 5B 73 35 5D 5B 68 32 5D 76 6F 69 63 65 20 74 65 73 74 5B 73 6F 75 6E 64 32 30 31 5D 78 FF FF

✓ **Request protocol parse:**

FE 5C 4B 89 Frame header (fixed)

3F 00 00 00	Packet length (from Frame header to Frame end)
68	Protocol type (fixed)
03	Forwarding port (forwarding 485)
00 00 00	Send ID (custom)
2C 00 00 00	Forwarding data length (from Frame header to Voice text content)
00	485 communication address (broadcast mode)
00 2B	Control command content length (from 485 communication address to Voice text content)
99	Source address (fixed)
73	Message type (fixed)
FD	Header (fixed)
00 23	Voice content length (from Voice command word to Voice text content)
01	Voice command word (start synthesis)
00	Voice text encoding format (GB2312 encoding)
5B 6D 35 32 5D	Voice control markers 1 ([m52] male 2 voices, ASCII code)
5B 73 35 5D	Voice control markers 2 ([s5] Level five speaking speed, ASCII code)
5B 68 32 5D	Voice control markers 3 ([h2] Pronounce the words in English, ASCII code)
76 6F 69 63 65 20 74 65 73 74	Voice text content (voice test, ASCII code)
5B 73 6F 75 6E 64 32 30 31 5D	Voice tone ([sound201], ASCII code)
78	Xor sum packet check (from 485 communication address to Voice text content)
FF FF	Frame end (fixed)

- **Reply protocol example:**

FE 5C 4B 89 1A 00 00 00 68 03 00 00 00 07 00 00 00 99 00 06 01 73 4F A2 FF FF

✓ **Reply protocol parse:**

FE 5C 4B 89	Frame header (fixed)
1A 00 00 00	Packet length (from Frame header to Frame end)
68	Protocol type (fixed)
03	Forwarding port (forwarding 485)
00 00 00	Message ID (Send ID)
07 00 00 00	Forwarding data length (from Target address to Xor sum packet check)
99	Target address (upper computer)
00 06	Control command content length (from Target address to Message content)
01	Source address (control card)
73	Message type (fixed)
4F	Message content (success)

A2	Xor sum packet check (from Target address to Message content)
FF FF	Frame end (fixed)

✓ **Acknowledgement content** (1 byte, indicating reception processing status)
0x4F -- Indicates success and initiates playback.
0x4E -- Indicates busy, in synthesis phase.
0x45 -- Indicates that an error command frame was received.

3.16.4 List of voice control tags

The potentiometer knob on the board can only adjust the speaker volume, and the volume of the audio port output can only be adjusted by the control identifier;

The speech synthesis function supports a variety of text control tags, which can meet the user's settings for speech synthesis pronouncer, volume, speech rate, and intonation.

The format of the text control mark is generally a lowercase letter and an Arabic numeral in half-angle brackets ("[]"), e.g., [m3], the use of markers and synthetic text is identical.

The user can send the markers to the board as text alone, e.g., send "[v3]" to indicate that the volume is set to level 3, or synthesise the markers with the text content and send them to the board, e.g., send "[v3] I'm whispering, [v10] I'm talking loudly ".

The markers are only used as control markers to realise the setting function, they will not synthesise the sound output, for example, if you send "[s1] I'm slow and methodical, [s8] I'm quick to speak", after the markers have been set up, the speech rate of the first sentence will be very slow, and the synthesis of the second sentence will be very fast, but it will not be read out "s1" and "s8"; the markers are only used as control markers to realise the setting function, and will not synthesize the voice output. " and "s8".

Action	containment	Detailed description	Default
Synthesis Style Settings	[f?]	? for 0, one-word style	[f1]
		? is 1, normal synthesis	
Synthesised language settings	[g?]	? is 0, the language is automatically determined	[g1]
		? is 1, and Arabic numerals, units of measure, special symbols, etc. are synthesised into Chinese.	
		? for 2, one-word style	
Setting how words are pronounced	[h?]	? is 0, automatically determines how the word is pronounced	[h1]
		? is 1, the way the letters are pronounced	
		? is 2, the way the word is pronounced	
Setting up recognition of Hanyu Pinyin	[i?]	? is 0, hanyu pinyin is not recognised	[i0]
		? is 1, which recognises "Pinyin + 1 digit (tone) " as hanyu pinyin, e.g. hao3	

Select Pronunciator	[m?]	? is 3, set the speaker to Xiao Yan (female voice, recommended)	[m3]
		? is 51, set the speaker to Hsu Ku (male voice, recommended)	
		? is 52, set the speaker to many (male voice)	
		? is 53, set the pronouncer to Pim (female voice)	
Setting the digital processing strategy	[n?]	? is 0, automatic judgement	[n0]
		? is 1 and the numbers are treated as numbers	
		? is 2 and the numbers are treated Numerically	
How the number "0" is pronounced in English and numbers	[o?]	? is zero, pronounced "zero."	[o0]
		? is 1, pronounced "o".	
A pause in the synthesis process	[p?]	? is an unsigned integer indicating the length of the pause in ms	
Setting the name pronunciation policy	[r?]	? is 0, automatically determines the pronunciation of the surname	[r0]
		? is 1, forcing the use of surname pronunciation rules	
Setting the speed of speech	[s?]	? is the speed of speech value, taking the value of 0~10	[s5]
Setting the tone	[t?]	? is the intonation value, taking the value of 0~10	[t5]
Setting the volume	[v?]	? is the volume value, takes the value 0~10	[v5]
Setting the Beep Handling Policy	[x?]	? is 0, no beep is used	[x1]
		? is 1, use the beep	
Setting the reading of the "1" in the number	[y?]	The word "young" is pronounced as 0, and is pronounced as "young". is 0, pronounced as "young"	[y0]
		? is 1, pronounced as "one".	
Whether to use the rhyming marks "*" and "#"	[z?]	? is 0, "*" and "#" read out symbols	[z0]
		? is 1, processed into rhyme, "*" for word breaks, "#" for pauses	
Forced pinyin assignment for individual Characters	[=?]	? is the pinyin + tones (1~5 indicates yinping, yangping, shangsheng, deheng, and lilt) of the previous Chinese Character marked with 5 tones. For example: "着[zhuo2]手" (着[zhuo2]手)	
Restore default synthesis parameters	[d]	All settings (except Pronunciator Settings and Language Settings) are restored to their default values.	

Tips:

1) All control identifiers are half-width Characters;

2) The control identifier needs to be sent in the format of a speech synthesis command, wit h the control Character acting as a text to synthesise speech;

3) The control identifier is a global control, sent to the board once, without resetting and po wering down the chip, the text that follows is out of its control;

4) When the board is powered down or reset, the originally set control logo will become us eless and will be restored to the default;

✓ **Control command example:**

FD 00 1E 01 00 5B 6D 35 32 5D 5B 73 35 5D 5B 76 31 30 5D D3 EF D2 F4 B2 E2 CA D4 61 62 63 31 32 33

✓ **Control command parse:**

FD	Header (fixed)
00 1E	Voice content length (voice playback command word to voice text content)
01	Voice command word (start synthesis)
00	Voice text encoding format (GB2312 encoding)
5B 6D 35 32 5D	Voice control markers 1 ([m52] male 2 voices, ASCII)
5B 73 35 5D	Voice control markers 2 (speech rate in [s5], ASCII code)
5B 76 31 30 5D	Voice control markers 3 ([v10] high volume, ASCII code)
D3 EF D2 F4 B2 E2 CA D4 61 62 63 31 32 33	Voice text content (speech test abc123, GB2312 encoding)

3.16.5 Tones

1 Information tones (25 in total)

sound101 ~ sound125

2 Ringing tones (25 in total)

sound201 ~ sound225

3 Alarm tones (30 in total)

sound301 ~ sound330

Tips:

The prompts are synthesised in the same way as the control marks and voice content. However, it should be noted that when the prompt name is preceded or immediately followed by English letters, it needs to be separated by a form symbol, space, carriage return, or other Characters in order to be recognised;

For example, if the voice content is "sound217, hello", you can synthesise a tone;

If it's "sound217hello", you can't synthesise a tone;

✓ **Control command example:**

FD 00 12 01 00 73 6F 75 6E 64 32 31 37 BB B6 D3 AD B9 E2 C1 D9

✓ **Control command parse:**

FD	Header (fixed)
00 12	Voice content length (voice playback command word to voice text content)
01	Voice command word (start synthesis)
00	Voice text encoding format (GB2312 encoding)
73 6F 75 6E 64 32 31 37	Voice prompt tone (sound217, ASCII code)
BB B6 D3 AD B9 E2 C1 D9	Voice text content (Welcome, GB2312 encoding)

4. TCP client communication protocol

① When the control card sends a request login packet to the server, the server returns a login verification message to pass the authentication and establish the connection.
② When the service end passes through the authentication, the control card will report 0x91 packets at regular intervals, which is used to judge the online status.

4.1 Login Request

- **Request login protocol Format (0x61):**

FE 5C 4B 89	Frame header (fixed)
41 00 00 00	Packet length (from Frame header to Frame end)
61	Protocol type (fixed)
00 00 00 00	Send ID (custom)
2E 00 00 00	Control instruction length (from Device internal code to Separator)
05 00 00 08 00 05 03 09	Device internal code (control card unique ID)
23 30 30 33 32	Screen width (32 pixels)
23 30 30 31 36	Screen height (16 pixels)
23 31	Pixel base color (31-single base color, 32-double base color, 33-triple base color)
23 36 36	Software version (66)
23 31	Display status (31-normal, 30-abnormal)
23 30	Display template status (30-normal, 31-no display template, 32 display template expired)
23 30	Material status (30- normal, 31 no material, 32 material expired)
23 30 30	Bad memory chip blocks number (0)
23 35 37 3B 2F 38 31 32 34 32	Reserved word 1 (fixed)
23 30 30	Reserved word 2 (fixed)
23	Separator (fixed)
FF FF	Frame end (fixed)

4.2 Authentication login

- **Authentication login protocol format (0x62):**

FE 5C 4B 89	Frame header (fixed)
2A 00 00 00	Packet length (from Frame header to Frame end)
62	Protocol type (fixed)
00 00 00 00	Send ID (custom)
17 00 00 00	Control instruction content length (from Request result to End separator)

31	Request result (0x31-pass, 0x30- refuse)
23	Start separator (fixed)
/**Server time**/	
32 30 30 38	Year (2008)
30 32	Month (02)
32 39	Day (29)
30 35	Week (Friday)
31 31	Hours (11 a.m.)
30 34	Minutes (04)
31 35	Seconds (15)
23	Separator (fixed)
30 35 30	Time between heartbeats (50 seconds)
23	End separator (fixed)
FF FF	Frame end (fixed)

4.3 Heartbeat packet

- **Heartbeat packet protocol format (0x91):**

FE 5C 4B 89	Frame header (fixed)
41 00 00 00	Packet length(from Frame header to Frame end)
91	Protocol type (fixed)
00 00 00 00	Send ID (custom)
2E 00 00 00	Control instruction length (from Device internal code to Separator)
05 00 00 08 00 05 03 09	Device internal code (control card unique ID)
23 30 30 33 32	Screen width (32 pixels)
23 30 30 31 36	Screen height (16 pixels)
23 31	Pixel base color (31-single base color, 32-double base color, 33-triple base color)
23 36 36	Software version (66)
23 31	Display status (31-normal, 30-abnormal)
23 30	Display template status (30-normal, 31-no display template, 32 display template expired)
23 30	Material status (30- normal, 31 no material, 32 material expired)
23 30 30	Bad memory chip blocks number (0)
23 35 37 3B 2F 38 31 32 34 32	Reserved word 1 (fixed)
23 30 30	Reserved word 2 (fixed)
23	Separator (fixed)
FF FF	Frame end (fixed)

4.4 Get control card parameters

- **Get control card parameter protocol format (0x71):**

FE 5C 4B 89	Frame header (fixed)
14 00 00 00	Packet length (from Frame header to Frame end)
71	Protocol type (fixed)
00 00 00 00	Send ID (custom)
01 00 00 00	Control instruction length (fixed)
30	Control instruction (fixed)
FF FF	Frame end (fixed)

- **Control card parameter reply message format (0x72):**

FE 5C 4B 89	Frame header (fixed)
41 00 00 00	Packet length (from Frame header to Frame end)
72	Message type (fixed)
00 00 00 00	Send ID (custom)
2E 00 00 00	Control instruction length (from Device internal code to Separator)
05 00 00 05 00 00 03 F8	Device internal code (control card unique identifier)
23 30 30 36 34	Screen width (64 pixels)
23 30 30 39 36	Screen height (96 pixels)
23 32	Pixel base color (31-single base color, 32-double base color, 33-triple base color)
23 36 36	Software version (66)
23 31	Display status (31-normal, 30-abnormal)
23 30	Display template status (30-normal, 31-no display template, 32 display template expired)
23 30	Material status (30- normal, 31 no material, 32 material expired)
23 30 30	Bad memory chip blocks number (0)
23 32 33 3B 2F 38 31 32 31 36	Reserved word 1 (fixed)
23 30 30	Reserved word 2 (fixed)
23	Separator (fixed)
FF FF	Frame end (fixed)

Appendix 1: Control instructions type

Features	Message type		Command Description
	Net-work/RS232	RS485	
Real-time collection data	0x65	0x37	Dynamic data display,no movement mode.
Inner code text	0x31	0x54	Dynamic content display,have movement mode.
Screen turn on	0x51		Enable screen display.
Screen turn off	0x52		The extinguish screen shows that the control card is still on.
Display page on demand	0x66	0x36	Display template display page, one page on demand display.
Image group material on demand	0x67	0x35	Multi-line text, picture group on demand display.
Network forwarding packets	0x68		The network forwards 232, 485 send the data packet.
Count and Countdown timing	0x6A	0x33	Count and Countdown timing control.
Time calibration	0x63	0x34	Control card time correction.
Coordinate Text	0x60	0x31	Coordinate dynamic data, does not support line wrapping, do not need to plan the area.
Relay output control	0x61	0x32	Control IO output and relay pull-in, up to four.
Queuing call data	0x64	0x49	Queuing call information display.
Synchronous video dis-play	0x6C		Send synchronous video picture, write to control card video buffer.
Brightness Adjustment	0x76	0x76	Control card display brightness 32 adjust-ment.
QR Code Generation	0x50	0x50	Generate QR code display, only support some models control card.
Color light control	0x77	0x77	Control the color light bar display.
Font burning	0x6E		Burn a custom font for the control card.
Login Request (TCP)	0x61		The client requests a login command to es-tablish a connection with the server.
Authentication login (TCP)	0x62		The server authenticates the client connec-tion request and establishes the connection.
Heartbeat packet (TCP)	0x91		The heartbeat packet sent by the client peri-odically determines that the device is online.
Get control card parame-ters (TCP)			The server reads the client device parame-ters.
Send display templates	0x22		The host computer sends the display pro-gram list.
Send materials	0x31		The host computer sends and displays the material content in the program.

Appendix 2: CRC16 check algorithm

```
/*****************************************************************************
@funciton:  【Function Name】 uint16_t CRC16_RTU( uint8_t * pucFrame, uint16_t usLen )
@brief      【Function Description】 CRC16 check
@param [in]【Parameter Description】 pucFrame:Check the data address, usLen:Check data length
@return     【Return value】     Returns the CRC16 checksum
@retval     【Return value】
@remarks    【Notes】
@note       【Notes】
@see        【Other References】
*****************************************************************************/

uint16_t CRC16_RTU( uint8_t * pucFrame, uint16_t usLen )
{
    uint16_t i,j;
    uint16_t c, crc = 0xFFFF;
    for (i = 0; i < usLen; i++)
    {
        c = *(pucFrame+i) & 0x00FF;
        crc^=c;
        for(j=0;j<8;j++)
        {
            if (crc & 0x0001)
            {
                crc>>=1;
                crc^=0xA001;
            }
            else crc>>=1;
        }
    }
    return(crc);
}
```

Appendix 3: Xor sum packet check Algorithm

```
/*****************************************************************************
@funciton:  【Function Name】 uint8_t check_sum(uint8_t *s_addr,uint16_t len)
@brief      【Function Description】 Xor sum packet check
@param [in]【Parameter Description】 s_addr:Check the data address, len:Check data length
@return     【Return value】      Returns XOR sum check values
@retval     【Return value】
@remarks    【Notes】
@note       【Notes】
@see        【Other References】
*****************************************************************************/

uint8_t check_sum(uint8_t *s_addr,uint16_t len)
{
    uint8_t checksum;
    uint16_t i;
    checksum=0;
    for(i=0;i<len;i++)
        checksum = checksum ^ *(s_addr+i);
    return(checksum);
}
```