M5Stack Chain Mono Protocol		All packets start with 0xAA 0x55 and end with 0x55 0xAA										V1.0 (Version) 2026/1/19
Instruction set	Byte / Instruction format	0	1	2	3	4	5	6	7	8	9	10
		Length_low	Length_high	Index	Cmd	Data1	Data2	Data3	Data4	Data5	Data6	Data7
Set display mode	Command packet format	0x04	0x00	Index_id	0x10	Mode	CRC					
	Response packet format	0x04	0x00	Index_id	0x10	Operation_status	CRC					
	Command Details	(1) Function Description: Set display mode (2) Input Parameters: Index_id (Device Index ID), Mode (Display Mode) (3) Return Parameter: Operation_status (4) Instruction Code: 0x10 Note 1: Operation_status Operation status 0: Operation failed 1: Operation successful Note 2: Mode Display mode (default 0) 0: Pixel control mode (directly set pixel display) 1: Scrolling character mode (scrolling display of strings)										
Get display mode	Command packet format	0x03	0x00	Index_id	0x11	CRC						
	Response packet format	0x04	0x00	Index_id	0x11	Mode	CRC					
	Command Details	(1) Function Description: Get display mode (2) Input Parameter: Index_id (Device Index ID) (3) Return Parameter: Mode (Display Mode) (4) Instruction Code: 0x11 Note 1: Mode Display Mode (Default 0) 0: Pixel Control Mode (Directly set pixel display) 1: Scrolling Character Mode (Scroll display string)										
Set pixels	Command packet format	0x04 + Num	0x00	Index_id	0x30	Num	Draw_pixel0	Draw_pixel1	Draw_pixel2	Draw_pixel3	...	CRC
	Response packet format	0x04	0x00	Index_id	0x30	Operation_status	CRC					
	Command Details	(1) Function description: Set pixel. (2) Input parameters: Index_id (device index ID), Num (number of pixels to be set), Draw_pixel (pixel value setting, including XY coordinates) (3) Return parameter: Operation_status (4) Instruction code: 0x30 Note 1: Operation_status Operation status 0: Operation failed 1: Operation successful 2: Mode mismatch (needs to be configured as pixel control mode) Note 2: Num range: 1~64 Note 3: Draw_pixel bit [7]: Reserved bit [6]: Status (0=off, 1=on) bit [5:3]: X coordinate (0-7) bit [2:0]: Y coordinate (0-7)										
Fullscreen display cache refresh	Command packet format	0x0B	0x00	Index_id	0x31	Display_buffer0	Display_buffer1	Display_buffer2	Display_buffer3	...	Display_buffer7	CRC
	Response packet format	0x04	0x00	Index_id	0x31	Operation_status	CRC					
	Command Details	(1) Function Description: Full-screen display cache refresh (2) Input Parameters: Index_id (Device Index ID), Display_buffer (Full-screen display cache) (3) Return Parameter: Operation_status (4) Instruction Code: 0x31 Note 1: Operation_status Operation status 0: Operation failed 1: Operation successful 2: Mode mismatch (requires configuration as pixel control mode) Note 2: Display_buffer Display_buffer0 → Y: Data in row 0 Display_buffer1 → Y: Data in row 1... Bit7 → Bit0 corresponds to X coordinate 0 → 7, high-order bits first 0 = off, 1 = on										
Get pixel value	Command packet format	0x04 + Num	0x00	Index_id	0x32	Num	Coordinate_xy0	Coordinate_xy1	Coordinate_xy2	Coordinate_xy3	...	CRC
	Response packet format	0x03 + Num	0x00	Index_id	0x32	Pixel_state0	Pixel_state1	Pixel_state2	Pixel_state3	...	CRC	
	Command Details	(1) Function Description: Get pixel value. (2) Input Parameters: Index_id (Device Index ID), Num (Number of pixels to be obtained), Coordinate_xy (Pixel coordinates) (3) Return Parameter: Pixel_state (Pixel value) (4) Instruction Code: 0x32 Note 1: Coordinate_xy bit[7:6]: Reserved bit[5:3]: X coordinate (0-7) bit[2:0]: Y coordinate (0-7) Note 2: Pixel_state 0: Off 1: On										
Get fullscreen display cache	Command packet format	0x03	0x00	Index_id	0x33	CRC						
	Response packet format	0x0B	0x00	Index_id	0x33	Display_buffer0	Display_buffer1	Display_buffer2	Display_buffer3	...	Display_buffer7	CRC
	Command Details	(1) Get the full screen refresh status: Get the full-screen display buffer (2) Input parameter: Index_id (device index ID) (3) Return parameter: Display_buffer (full-screen display buffer) (4) Instruction code: 0x33 Note 1: Display_buffer Display_buffer0 → Y: Data in row 0 Display_buffer1 → Y: Data in row 1... Bit7 → Bit0 corresponds to X coordinate 0 → 7, high-order bits first 0 = off, 1 = on										
Display characters	Command packet format	0x05	0x00	Index_id	0x34	Char	Offset	CRC				
	Response packet format	0x04	0x00	Index_id	0x34	Operation_status	CRC					
	Command Details	(1) Function Description: Displays characters (2) Input Parameters: Index_id (Device Index ID), Char (ASCII code of the character to be displayed), Offset (offset of the display position) (3) Return Parameter: Operation_status (4) Instruction Code: 0x34 Note 1: Operation_status Operation status 0: Operation failed 1: Operation successful 2: Mode mismatch (requires configuration as pixel control mode) Note 2: Char The ASCII code of the character to be displayed, supports English letters, numbers and symbols between ASCIIC 32 and 127, font size is 5x7 Note 3: Offset [7:4]: x-axis offset, 0~7 [3:0]: y-axis offset, 0~7										

Display scrolling text	Command packet format	0x07+String_length	0x00	Index_id	0x40	Scroll_mode	Scroll_interval_low	Scroll_interval_high	String_length	char1	...	CRC
	Response packet format	0x04	0x00	Index_id	0x40	Operation_status	CRC					
	Command Details	(1) Function Description: Displays scrolling strings (2) Input Parameters: Index_id (Device ID), Scroll_mode (Scrolling Mode), Scroll_interval (Scrolling Speed), String_length (String Length), char (Character) (3) Return Parameter: Operation_status (4) Instruction Code: 0x40 Note 1: Operation_status Operation status 0: Operation failed 1: Operation successful 2: Mode mismatch (Scrolling string mode needs to be configured) Note 2: Scroll_mode [7:4]: Scrolling direction 0: Scroll to the right, 1: Scroll to the left, 2: Scroll up, 3: Scroll down [3:0]: Scrolling mode 0: Play once and stop, 1: Scroll in a loop, 2: Bounce back and forth Note 3: Scroll_interval Scroll_interval is the unit of movement speed in ms/pixel, and moves one pixel in each Scroll_interval time Scroll_interval = (uint16_t)((Scroll_interval_high << 8) | Scroll_interval_low) Range 0～65535, unit ms/pixel Note 4: String_length Length of the scrolling string Note 5: char The character displayed, supporting ASCIIC 32~127 English letters, numbers and symbols, font size 5x7										
Get the scrolling string	Command packet format	0x03	0x00	Index_id	0x41	CRC						
	Response packet format	0x07+String_length	0x00	Index_id	0x41	Scroll_mode	Scroll_interval_low	Scroll_interval_high	String_length	Char1	...	CRC
	Command Details	(1) Function Description: Get the scrolling string. (2) Input Parameters: Index_id (Device Index ID) (3) Return Parameters: Scroll_mode (Scrolling Mode), Scroll_interval_low, Scroll_interval_high (Scrolling Speed), String_length (String Length), char (Character) (4) Instruction Code: 0x41 Note 1: Scroll_mode [7:4]: Scrolling Direction 0: Scroll to the right, 1: Scroll to the left, 2: Scroll up, 3: Scroll down [3:0]: Scrolling Mode 0: Play once and stop, 1: Scroll in a loop, 2: Bounce back and forth Note 2: Scroll_interval Scroll_interval is the movement speed in ms/pixel, and moves one pixel in Scroll_interval time Scroll_interval = (uint16_t)((Scroll_interval_high << 8) | Scroll_interval_low) Range 0～65535, unit ms/pixel Note 3: String_length The length of the scrolling string Note 4: Char The displayed characters support ASCII characters between 32 and 127, including English letters, numbers, and symbols, with a font size of 5x7.										
Set scroll string status	Command packet format	0x04	0x00	Index_id	0x42	Scroll_state	CRC					
	Response packet format	0x04	0x00	Index_id	0x42	Operation_status	CRC					
	Command Details	(1) Function Description: Sets the scrolling string status. (2) Input Parameters: Index_id (Device Index ID), Scroll_state (Scrolling Status) (3) Return Parameter: Operation_status (4) Command Code: 0x42 Note 1: Operation_status 0: Operation failed 1: Operation successful 2: Mode mismatch (Scrolling character mode needs to be configured) Note 2: Scroll_state 0: Start/Continue scrolling 1: Pause scrolling (The screen keeps the current character still) 2: Stop and clear (Clear the displayed characters, and the next time you set it, it will start from the beginning)										
Get the scroll string status	Command packet format	0x03	0x00	Index_id	0x43	CRC						
	Response packet format	0x04	0x00	Index_id	0x43	Scroll_state	CRC					
	Command Details	(1) Function Description: Sets the scrolling string state. (2) Input Parameter: Index_id (Device Index ID) (3) Return Parameter: Scroll_state (Scrolling State) (4) Instruction Code: 0x43 Note 1: Scroll_state 0: Scrolling in progress 1: Paused state 2: Idle/Stopped state										
Set screen rotation angle	Command packet format	0x05	0x00	Index_id	0xE0	Screen Rotation	Save_to_flash	CRC				
	Response packet format	0x04	0x00	Index_id	0xE0	Operation_status	CRC					
	Command Details	(1) Function description: Set the screen rotation angle. (2) Input parameters: Index_id (device index ID), Screen_Rotation (screen rotation angle), Save_to_flash (whether to save to internal Flash) (3) Return parameters: Operation_status (4) Instruction code: 0xE0 Note 1: Operation_status Operation status 0: Operation failed 1: Operation successful Note 2: Screen_Rotation 0: Default display angle 1: Rotate 90° clockwise 2: Rotate 180° clockwise 3: Rotate 270° clockwise (90° counterclockwise) Note 3: Save_to_flash Whether to save to internal Flash 0: Do not save 1: Save Note 4: The setting takes effect immediately upon success Note 5: Save to internal Flash The page needs to be erased, which takes a relatively long time (about 20ms). During this process, the serial port interrupt will be turned off, and frequent operations will affect the lifespan of the device.										
Get screen rotation angle	Command packet format	0x03	0x00	Index_id	0xE1	CRC						
	Response packet format	0x04	0x00	Index_id	0xE1	Screen Rotation	CRC					
	Command Details	(1) Function Description: Get the screen rotation angle. (2) Input Parameter: Index_id (Device Index ID) (3) Return Parameter: Screen_Rotation (Screen Rotation Angle) (4) Instruction Code: 0xE1 Note 1: Screen_Rotation 0: Default display angle 1: Rotate 90° clockwise 2: Rotate 180° clockwise 3: Rotate 270° clockwise (90° counterclockwise)										

Set screen brightness level	Command packet format	0x05	0x00	Index_id	0xE2	Brightness level	Save_to_flash	CRC				
	Response packet format	0x04	0x00	Index_id	0xE2	Operation_status	CRC					
	Command Details	(1) Function Description: Set the screen brightness level. (2) Input Parameters: Index_id (Device ID), Brightness_level (Screen brightness level), Save_to_flash (Whether to save to internal Flash) (3) Return Parameter: Operation_status (4) Command Code: 0xE2 Note 1: Operation_status Operation status 0: Operation failed 1: Operation successful Note 2: Brightness_level 0-7: 7 brightness levels, default 7 Note 3: Save_to_flash Whether to save to internal Flash 0: Do not save 1: Save Note 4: Setting takes effect immediately upon success Note 5: Saving to internal Flash requires erasing the page, which takes a relatively long time (about 20ms). During this process, the serial port interrupt will be turned off, and frequent operations will affect the lifespan of the device.										
Get screen brightness level	Command packet format	0x03	0x00	Index_id	0xE3	CRC						
	Response packet format	0x04	0x00	Index_id	0xE3	Brightness level	CRC					
	Command Details	(1) Function Description: Get the screen rotation angle. (2) Input Parameter: Index_id (Device Index ID) (3) Return Parameter: Brightness_level (Screen Brightness Level) (4) Instruction Code: 0xE3 Note 1: Brightness_level 0-7: 7 brightness levels, default 7										
clear screen	Command packet format	0x03	0x00	Index_id	0xE4	CRC						
	Response packet format	0x04	0x00	Index_id	0xE4	Operation_status	CRC					
	Command Details	(1) Function Description: Clear screen. (2) Input Parameter: Index_id (Device Index ID) (3) Return Parameter: Operation_status (4) Command Code: 0xE4 Note 1: Operation_status Operation status 0: Operation failed 1: Operation successful										
Query device unique UID	Command packet format	0x04	0x00	Index_id	0xF8	UID_Type	CRC					
	Response packet format	0x04+4/12	0x00	Index_id	0xF8	Operation_status	UID (multi-byte)	CRC				
	Command Details	(1) Function Description: Query the unique UID of the device. (2) Input Parameters: Index_id (Device Index ID), UID_Type (3) Return Parameters: Operation_status, UID (4) Command Code: 0xF8 Note 1: Operation_status Operation status 0: Operation failed 1: Operation successful Note 2: UID_Type UID type 0: 4-byte UID 1: 12-byte UID										
Check the upgrade program version number	Command packet format	0x03	0x00	Index_id	0xF9	CRC						
	Response packet format	0x04	0x00	Index_id	0xF9	Bootloader_version	CRC					
	Command Details	(1) Function Description: Query the upgrade program version number. (2) Input Parameter: Index_id (Device Index ID) (3) Return Parameter: Bootloader_version (4) Command Code: 0xF9										
Query device software version number	Command packet format	0x03	0x00	Index_id	0xFA	CRC						
	Response packet format	0x04	0x00	Index_id	0xFA	Firmware_version	CRC					
	Command Details	(1) Function Description: Query the device software version number. (2) Input Parameter: Index_id (Device Index ID) (3) Return Parameter: Firmware_version (4) Instruction Code: 0xFA										
Query device type	Command packet format	0x03	0x00	Index_id	0xFB	CRC						
	Response packet format	0x05	0x00	Index_id	0xFB	Device_type_low	Device_type_high	CRC				
	Command Details	(1) Function Description: Query device type. (2) Input Parameter: Index_id (Device Index ID) (3) Return Parameter: Device_type (4) Instruction Code: 0xFB Note 1: Device_type = (uint16_t)((Device_type_high << 8) | Device_type_low) Note 2: Mono's device type code is 0x000D										
Enumeration requests	Command packet format	None										
	Response packet format	0x03	0x00	0xFF	0xFC	CRC						
	Command Details	(1) Function Description: Enumerate requests, send requests from the end device of the chain link change, and send requests when the device powers on, to notify the host to update the link device status. (2) Input Parameter: none (3) Return Parameter: none (4) Instruction Code: 0xFC										
Heartbeat Pack	Command packet format	0x03	0x00	0xFF	0xFD	CRC						
	Response packet format	0x03	0x00	0xFF	0xFD	CRC						
	Command Details	(1) Function Description: Heartbeat packet, a timed communication between chain devices, can detect whether it is a terminal device. The host can also use the heartbeat packet to determine whether there is a chain device connected. (2) Input Parameter: none (3) Return Parameter: none (4) Instruction Code: 0xFD										
enumerate	Command packet format	0x04	0x00	0xFF	0xFE	Send_num	CRC					
	Response packet format	0x04	0x00	0xFF	0xFE	Receive_num	CRC					
	Command Details	(1) Function Description: Enumerates and obtains the number of cascaded devices. (2) Input Parameter: Send_num (default 0, used to record the number of devices) (3) Return Parameter: Receive_num (value represents the number of devices) (4) Instruction Code: 0xFE										

Note 1: The maximum data packet length is 256 bytes.
Note 2: Data length is from Index_id to CRC, including Index_id and CRC, but excluding the data length itself.
Note 3: When calculating CRC, the packet header, packet trailer, length, and the CRC field itself need to be excluded; only the remaining data is summed.
Note 4: Serial communication baud rate is 115200, 8 data bits, 1 stop bit, no parity bit.

```
uint8_t calculateCRC(const uint8_t *buffer, uint16_t size)
{
   uint8_t crc8 = 0;
   for (uint8_t i = 4; i < (size - 3); i++) {
      crc8 += buffer[i];
   }
   return crc8;
}
```