CPower Communication Protocol

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Contents

Synergy House, Knights Court, Magellan Close, Walworth Business Park, Andover, SP10 5NT

Introduction

Communication between the PC and CPower control card can take place over RS232, RS485, wired ethernet or WiFi. The protocol for sending data varies slightly between RS232/RS485 and the ethernet variants but the data portion of the packets are the same.

For ethernet variants, a TCP connection (normally to port 5200) is required before sending any commands. The basic packet formats shown below are the same for data both sent to and received from the display.

RS232 / RS485 Packet Format

Name	Value	Length (Bytes)	Description
Start Sentinel	0xa5	1	Identifier for the start of a packet. This byte value cannot appear anywhere else in the packet
Packet Type	0x68 / 0xe8	1	Identifier for this type of packet. Packets sent to the control card, this byte should be set to 0x68 Packets received from the control card will have this byte set to 0x68 for early control cards with App Version 3.2 or earlier or set to 0xe8 for App Version 3.3 or later.
Card Type	0x32	1	Constant Code
Card ID	0x01 – 0xff	1	Control Card ID. Values 1 – 254 (0xfe) address a specific control card Value 255 (0xff) is a broadcast address to be received by all control cards
Command Data		Variable	See section on Command Data
Packet Checksum	0x0000 – 0xffff	2	16bit sum of all bytes from Packet Type to Command Data (inclusive), sent Low Byte first
End Sentinel	0xae	1	Identifier for the end of the packet. This byte value cannot appear anywhere else in the packet

Above is the format of data packets sent/received between a PC and the control card via RS232 or RS485. If any byte within the packet (except for the Start and End Sentinels) contain any of the values 0xa5, 0xaa or 0xae, those values should be used in the checksum calculation as they are, then replaced in the packet with the following 2-byte sequences: -

0xa5 replace with 0xaa, 0x05

0xaa replace with 0xaa, 0x0a

0xae replace with 0xaa, 0x0e

Any length data within the packet is not affected by the above substitutions.

This will ensure that the 0xa5 and 0xae characters will always mean the start and end of a packet and can be used to help ensure data transmission is correct.

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Ethernet Packet Format

Name	Value	Length (Bytes)	Description
ID Code	0x00000000 – 0xffffffff	4	Must match the ID code set in the control card, but as IP address is used to identify the control card this is mostly left set to 0xffffffff. Sent High Byte first
Network Data Length	0x0000 – 0xfff	2	The length in bytes of this packet from Packet Type to Packet Checksum (inclusive). Sent Low Byte first
Reserved	0x0000	2	Reserved Bytes, set to 0x00
Packet Type	0x68 / 0xe8	1	Identifier for this type of packet. Packets sent to the control card, this byte should be set to 0x68 Packets received from the control card will have this byte set to 0x68 for early control cards with App Version 3.2 or earlier or set to 0xe8 for App Version 3.3 or later.
Card Type	0x32	1	Constant Code
Card ID	0x01 – 0xff	1	Control Card ID. Values 1 – 254 (0xfe) address a specific control card Value 255 (0xff) is a broadcast address to be received by all control cards. This byte can mostly be set to 0xff
Packet Data		Variable	See section on Packet Data
Packet Checksum	0x0000 – 0xffff	2	16bit sum of all bytes from Packet Type to Packet Data (inclusive), sent Low Byte first

Above is the format of packets sent/received between a PC and the control card via ethernet. All ID bytes can be set to 0xff as IP addressing is used to address different control cards.

Packet Data

Name	Value	Length (Bytes)	Description
Command		1	Identifier for the type of packet being sent
Response Request	1 / 0	1	1: Requests a response to show if the command was received correctly 0: No Response will be sent
Command Data		variable	Data specific to the command, starting with a subcommand where applicable

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If the Response Request byte is set to 1, the display will respond with a packet if it receives the packet correctly. The format of the returned packet is as follows: -

Name	Value	Length (Bytes)	Description
Command		1	Identifier for the type of packet received
Acknowledge		1	**0x7b Command (Display Messages)** 0x00: Success 0x01: Checksum Error 0x02: Packet Sequence Error **All Other Commands** 0x01: Packet Received Correctly
Command Data		variable	Data specific to the command,

The following commands are used to control the displays, an example for each command is given showing the data for an ethernet packet:-

Command	Name
0x29	Query Free Disk Space
0x2c	Remove File
0x2d	Restart Hardware
0x30	Open File to write
0x32	Write Data to File
0x33	Close Written File
0x45	Power Schedule
0x46	Brightness Control
0x47	Time Control
0x4b	Query Version Info
0x76	Power Control
0x7b	Display Messages

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Restart Hardware (Command 0x2d)

Performs a system restart of the display. If a default program is loaded, that will be run. This command has 1 byte of data which is always 0x00.

Packet Data: -

Value	Field Name	Description
0x2d	Command	Identifier for Restart Hardware Command
0x01	Response Request	Request Acknowledgement from display
0x00	Data	Constant (always 0x00)

Full Packet to reset the display hardware: -

0xff 0xff 0xff 0xff	ID Code
0x08 0x00	Network Data Length
0x00 0x00	Reserved
0x68	Packet Type
0x32	Card Type
0xff	Card Id
0x2d	Command
0x01	Request Response
0x00	Data
0xc7 0x01	Checksum

Response Packet Data: -

Value	Field Name	Description
0x2d	Command	Identifier for Restart Hardware Command
0x01	Response Request	Request Acknowledgement from display
0x01	Data	0x00: Failed 0x01: Success

Brightness Control (Command 0x46)

Requests or sets the screen brightness.

Query Brightness

Get Brightness Packet Data: -

Value	Field Name	Description
0x46	Command	Identifier for Brightness Command
0x01	Response Request	Request Acknowledgement from display
0x01	Get Brightness	Constant (always 0x01)

Full Packet to request the brightness setting: -

0xff 0xff 0xff 0xff	ID Code
0x08 0x00	Network Data Length
0x00 0x00	Reserved
0x68	Packet Type
0x32	Card Type
0xff	Card Id
0x46	Command
0x01	Request Response
0x01	Query Brightness
0xe1 0x01	Checksum

Response Packet Data: -

Value	Field Name	Description
0x46	Command	Identifier for Brightness Command
0x01	Response Request	Request Acknowledgement from display
0x01	Data	Query Brightness Identifier
0x00 – 0xff	Brightness Values (24 Bytes)	24 Bytes of Brightness values (1 per hour) Values 0x00 – 0x1f represent fixed brightness values Values 0x20 – 0xff set automatic brightness based on a light sensor Byte 0 – Brightness for time period 00:00 -> 00:59 Byte 1 – Brightness for time period 01:00 -> 01:59 ….. Byte 23 – Brightness for time period 23:00 -> 23:59

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Set Brightness

Set Brightness Packet Data: -

Value	Field Name	Description
0x46	Command	Identifier for Brightness Command
0x01	Response Request	Request Acknowledgement from display
0x00	Set Brightness	Constant (always 0x00)
0x00 – 0xff	Brightness Value (24 bytes)	Brightness values (1 per hour, 24 bytes in total) Values 0x00 – 0x1f represent fixed brightness values Values 0x20 – 0xff set automatic brightness based on a light sensor

Full Packet to set the brightness to 50%: -

0xff 0xff 0xff 0xff	ID Code
0x20 0x00	Network Data Length
0x00 0x00	Reserved
0x68	Packet Type
0x32	Card Type
0xff	Card Id
0x46	Command
0x01	Request Response
0x00	Set Brightness
0x10	Brightness Value (00:00 -> 00:59)
0x10	Brightness Value (01:00 -> 01:59)
0x10	Brightness Value (02:00 -> 02:59)
0x10	Brightness Value (03:00 -> 03:59)
0x10	Brightness Value (04:00 -> 04:59)
0x10	Brightness Value (05:00 -> 05:59)
0x10	Brightness Value (06:00 -> 06:59)
0x10	Brightness Value (07:00 -> 07:59)
0x10	Brightness Value (08:00 -> 08:59)
0x10	Brightness Value (09:00 -> 09:59)
0x10	Brightness Value (10:00 -> 10:59)
0x10	Brightness Value (11:00 -> 11:59)
0x10	Brightness Value (12:00 -> 12:59)
0x10	Brightness Value (13:00 -> 13:59)
0x10	Brightness Value (14:00 -> 14:59)
0x10	Brightness Value (15:00 -> 15:59)
0x10	Brightness Value (16:00 -> 16:59)
0x10	Brightness Value (17:00 -> 17:59)
0x10	Brightness Value (18:00 -> 18:59)
0x10	Brightness Value (19:00 -> 19:59)
0x10	Brightness Value (20:00 -> 20:59)
0x10	Brightness Value (21:00 -> 21:59)
0x10	Brightness Value (22:00 -> 22:59)
0x10	Brightness Value (23:00 -> 23:59)
0x60 0x03	Checksum

Time Control (Command 0x47)

Requests or sets the time on the control card clock.

Query Time

Get Time Packet Data: -

Value	Field Name	Description
0x47	Command	Identifier for Time Command
0x01	Response Request	Request Acknowledgement from display
0x01	Get Time	Constant (always 0x01)

Full Packet to request the current time on the control card: -

0xff 0xff 0xff 0xff	ID Code
0x08 0x00	Network Data Length
0x00 0x00	Reserved
0x68	Packet Type
0x32	Card Type
0xff	Card Id
0x47	Command
0x01	Request Response
0x01	Query Time
0xe2 0x01	Checksum

Response Packet Data: -

Value	Field Name	Description
0x47	Command	Identifier for Time Command
0x01	Response Request	Request Acknowledgement from display
0x01	Data	Query Time Identifier
0x00 – 0x3b	Seconds	Time – Seconds Value
0x00 – 0x3b	Minutes	Time – Minutes Value
0x00 – 0x17	Hours	Time – Hours Value
0x00 – 0x06	Day	Day of week (0 : Sunday … 6 : Saturday)
0x00 – 0x1f	Date	Date – Day of Month
0x01 – 0x0c	Month	Date - Month
0x00 – 0x63	Year	Date - 2-Digit Year Value

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Set Time

Set Time Packet Data: -

Value	Field Name	Description
0x47	Command	Identifier for Time Command
0x01	Response Request	Request Acknowledgement from display
0x00	Set Time	Constant (always 0x00)
0x00 – 0x3b	Seconds	Time – Seconds Value
0x00 – 0x3b	Minutes	Time – Minutes Value
0x00 – 0x17	Hours	Time – Hours Value
0x00 – 0x06	Day	Day of week (0 : Sunday … 6 : Saturday)
0x00 – 0x1f	Date	Date – Day of Month
0x01 – 0x0c	Month	Date – Month Value
0x00 – 0x63	Year	Date – 2-Digit Year Value

Full Packet to set the time to 15:46:41 – Friday 26th January 2024: -

0xff 0xff 0xff 0xff	ID Code
0x0F 0x00	Network Data Length
0x00 0x00	Reserved
0x68	Packet Type
0x32	Card Type
0xff	Card Id
0x46	Command
0x01	Request Response
0x00	Set Time
0x29	Seconds Value (41)
0x2e	Minutes Value (46)
0x0f	Hours Value (15)
0x05	Day of Week (Friday)
0x1a	Date Value (26)
0x01	Month Value (01)
0x18	Year Value (24)
0x7f 0x02	Checksum

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Query Version Info (Command 0x4b)

Requests the versions of the various pieces of internal software running on the display.

Packet Data: -

Value	Field Name	Description
0x4b	Command	Identifier for Query Version Info Command
0x01	Response Request	Request Acknowledgement from display
0x00	Data	Constant (always 0x00)

Full Packet to request the display software version information: -

0xff 0xff 0xff 0xff	ID Code
0x08 0x00	Network Data Length
0x00 0x00	Reserved
0x68	Packet Type
0x32	Card Type
0xff	Card Id
0x4b	Command
0x01	Request Response
0x00	Data
0xe5 0x01	Checksum

Response Packet: -

Value	Field Name	Description
0x4b	Command	Identifier for command being responded to
0x01	Response	0x01: Acknowledge
0x01	Success/Failure	0x00: Failed 0x01: Success
	Boot Version	2 Bytes (Low Byte first)
	Reserved	2 Bytes (Set to 0x0000)
	NXP Version	2 Bytes (Low Byte first)
	Reserved	2 Bytes
	BIOS Version	2 Bytes (Low Byte first)
	Reserved	2 Bytes
	App Version	2 Bytes (Low Byte first)
	Reserved	6 Bytes
	Net Version	2 Bytes (Low Byte first)
	Reserved	2 Bytes
	Logic Version	2 Bytes (Low Byte first)
	Reserved	4 Bytes

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Power On/Off Control (Command 0x76)

Turns the screen display on or off.

Query Power Status

Get Power Status Packet Data: -

Value	Field Name	Description
0x76	Command	Identifier for Power On/Off Command
0x01	Response Request	Request Acknowledgement from display
0x01	Get Power Status	Constant (always 0x01)

Full Packet to request the current power status setting: -

0xff 0xff 0xff 0xff	ID Code
0x08 0x00	Network Data Length
0x00 0x00	Reserved
0x68	Packet Type
0x32	Card Type
0xff	Card Id
0x76	Command
0x01	Request Response
0x01	Query Power Status
0x11 0x02	Checksum

Response Packet Data: -

Value	Field Name	Description
0x76	Command	Identifier for Power On/Off Command
0x01	Response Request	Request Acknowledgement from display
0x01	Data	Query Power Status Identifier
0x00 – 0x01	Power Status	Value 0x00 – Display Currently Off Value 0x01 – Display Currently On
0x00 – 0x17		
0x00 – 0x3b		
0x00 – 0x17		
0x00 – 0x3b		
0x00	Reserved	4 Bytes – all 0x00

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Set Power On/Off Status

Set Power On/Off Status Packet Data: -

Value	Field Name	Description
0x76	Command	Identifier for Brightness Command
0x01	Response Request	Request Acknowledgement from display
0x00	Set Power Status	Constant (always 0x00)
0x00 – 0x01	Power Status	Value 0x00 – Turn Display Off Value 0x01 – Turn Display On
0x00	Reserved	8 Bytes - Fill with 0x00

Full Packet to turn the display ON: -

0xff 0xff 0xff 0xff	ID Code
0x11 0x00	Network Data Length
0x00 0x00	Reserved
0x68	Packet Type
0x32	Card Type
0xff	Card Id
0x76	Command
0x01	Request Response
0x00	Set Power Status
0x01	New Power Status
0x00	
0x00	
0x00	
0x00	
0x00	
0x00	
0x00	
0x00	
0x11 0x02	Checksum

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Display Messages (Command 0x7b)

This command has its own packet protocol built into the command data. It is used to send data to be displayed on the screen and to configure the layout of that data.

Name	Value	Length (bytes)	Description
Data Length	0x0000 – 0xffff	2	Length in bytes of the subcommand data including the subcommand byte itself. Sent Low Byte first
Packet Number	0x00 – 0xff	1	Packet sequence number initially 0x00, incrementing for each packet sent when sending large amounts of data to the display. Each packet can only contain up to 512 bytes.
Last Packet Number	0x00 – 0xff	1	The packet sequence number of the last packet of data to be expected for this command.
Subcommand		1	One of the values from the Subcommand table
Subcommand Data		0 - 500	See sections on relevant sub-commands

If the Response Request byte is set, each command will be responded to with an acknowledgement packet

Subcommands for the 0x7b command are shown in the table below: -

Subcommand Value	Description
0x01	Create windows within the display
0x02	Send Text to Window (7 Colour choice per character)
0x03	Send Image to Window
0x04	Send Text to Window Area (Single 24-bit colour for whole string)
0x05	Display Time in Window (Single 24-bit colour for whole string)
0x06	Play Default Stored Program
0x12	Send Pure Text to Window

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Create Windows (Subcommand 0x01)

Creates windows within the display. There can be up to 8 windows, but the display functions all write to a window so there needs to be at least one. Often there is just one which is defined as the same size as the display itself. Once the windows have been created, they are referred by the zero-based index of the list sent in the command.

Name	Value	Length (bytes)	Description
Subcommand	0x01	1	Create Windows subcommand
Window Count	N	1	Valid values are 0x01 – 0x08
Window 0 (Left Edge Coordinate)	0x0000 – 0xffff	2	Start position of Window 0 on the horizontal axis (0 is the left-most pixel) Sent high byte first
Window 0 (Top Edge Coordinate)	0x0000 – 0xffff	2	Start position of Window 0 on the vertical axis (0 is the top-most pixel) Sent high byte first
Window 0 Width	0x0000 – 0xffff	2	Width of Window 0 in pixels Sent high byte first
Window 0 Height	0x0000 – 0xffff	2	Height of Window 0 in pixels Sent high byte first
……			
Window N-1 (Left Edge Coordinate)	0x0000 – 0xffff	2	Start position of Window N-1 on the horizontal axis (0 is the left-most pixel) Sent high byte first
Window N-1 (Top Edge Coordinate)	0x0000 – 0xffff	2	Start position of Window N-1 on the vertical axis (0 is the top-most pixel) Sent high byte first
Window N-1 Width	0x0000 – 0xffff	2	Width of Window N-1 in pixels Sent high byte first
Window N-1 Height	0x0000 – 0xffff	2	Height of Window N-1 in pixels Sent high byte first

Full Packet to split a 96 x 32 display into 2 windows: -

0xff 0xff 0xff 0xff	ID Code
0x1d 0x00	Network Data Length (29)
0x00 0x00	Reserved
0x68	Packet Type
0x32	Card Type
0xff	Card Id
0x7b	Command
0x01	Response Request
0x12 0x00	Data Length (18)
0x00	Packet Id
0x00	Max Packet Id
0x01	Subcommand
0x02	Number of Windows
0x00 0x00 0x00 0x00 0x00 0x30 0x00 0x20	Window 0 Data
0x00 0x30 0x00 0x00 0x00 0x30 0x00 0x20	Window 1 Data
0xfa 0x02	Checksum

Send Text to Window (Subcommand 0x02)

Displays a text string in a specific window. Each character is sent as 3 bytes allowing font size and colour information to be set for each one. This command always uses the default font style.

Name	Value	Length (bytes)	Description
SubCommand	0x02	1	Send Text to Window subcommand
Window Index	N	1	Valid values are 0x00 – (Number of Windows – 1)
Mode		1	See Appendix 2 (Display / Transition Effects)
Horizontal Alignment	0x00 – 0x02	1	0: Left Aligned 1: Centred 2: Right Aligned
Speed	1 – 100	1	Transition Time (lower value = faster transition)
Display Time	0x0000 – 0xffff	2	Time in seconds that the data is displayed before being refreshed. Sent high byte first.
Text Data		3 bytes per displayed character	See Appendix 3 (Formatted Text Format) Always end with 3 null bytes to terminate

Full packet to display “Hello” in different colours and increasing sizes centred in Window 0: -

0xff 0xff 0xff 0xff	ID Code
0x24 0x00	Network Data Length
0x00 0x00	Reserved
0x68	Packet Type
0x32	Card Type
0xff	Card Id
0x7b	Command
0x01	Response Request
0x19 0x00	Data Length
0x00	Packet Id
0x00	Max Packet Id
0x02	Subcommand
0x00	Target Window Index
0x00	Display Mode (Instant)
0x01	Alignment (Centre)
0x01	Speed (Fastest)
0x00 0x03	Display Time (3 Seconds)
0x10 0x00 0x48	‘H’ - red, 8 point
0x21 0x00 0x65	‘e’ – green, 12 point
0x62 0x00 0x6c	‘l’ – cyan, 16 point
0x43 0x00 0x6c	‘l’ – blue, 24 point
0x54 0x00 0x6f	‘o’ – magenta, 32 point
0x00 0x00 0x00	Null Termination
0x50 0x05	Checksum

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Send Image to Window (Subcommand 0x03)

Displays an image in a specific window. Images must be the correct size for the window or smaller. The image data can only be sent in chunks of up to 500 bytes of data, so it is sent as multiple packets, the first packet format is shown below, subsequent packets only contain image data.

The 'Packet Number' and 'Last Packet Number' need to be set in the header part of the 0x7b Command packet

Name	Value	Length (bytes)	Description
SubCommand	0x03	1	Send Image to Window subcommand
Window Index	N	1	Valid values are 0x00 – (Number of Windows – 1)
Mode	0x00	1	
Speed	1 – 100	1	Transition Time (lower value = faster transition)
Display Time	0x0000 – 0xffff	2	Time in seconds that the data is displayed before being refreshed. Sent high byte first.
Image Data Format	0x01 – 0x04	1	0x01: Gif format data 0x02: Filename of gif file stored on the control card 0x03: Filename of a package of images and the image index stored on the control card 0x04: Simple image format data See Appendix 4 (Simple Image Data Format)
Image Display Position (X)	0x0000	2	Required position of the left edge of the image, relative to the left edge of the window in pixels. Sent high byte first
Image Display Position (Y)	0x0000	2	Required position of the top edge of the image, relative to the top edge of the window in pixels. Sent high byte first
Image Data		Variable	

Full first packet to display a small image (between 500 and 1000 bytes) to window 0: -

0xff 0xff 0xff 0xff	ID Code
0x0a 0x02	Network Data Length
0x00 0x00	Reserved
0x68	Packet Type
0x32	Card Type
0xff	Card Id
0x7b	Command
0x01	Response Request
0xff 0x10	Data Length
0x00	Packet Id
0x01	Max Packet Id
0x03	Subcommand
0x00	Window Index
0x00	Mode
0x01	Speed
0x00 0x05	Display Time (5 Seconds)
0x01	Image Data Format (GIF data)

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0x00 0x00	Left Edge Location in pixels
0x00 0x00	Top Edge Location in pixels
…….	Image Data (first 500 bytes)
0xe6 0xd3	Checksum

The second packet would contain the remainder of the GIF data in the following format: -

0xff 0xff 0xff 0xff	ID Code
0x0a 0x01	Network Data Length
0x00 0x00	Reserved
0x68	Packet Type
0x32	Card Type
0xff	Card Id
0x7b	Command
0x01	Response Request
0xff 0x00	Data Length
0x01	Packet Id (Packet Id incremented)
0x01	Max Packet Id (matches Packet Id so this is the last packet)
……..	Remaining GIF data
0xfe 0x38	Checksum

Each packet sent should have the Response Request byte set and the response should be received before the next packet is sent.

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Send Text to Window Area (Subcommand 0x04)

Clears the area of the window defined by parameters and displays text in the rectangle. This will effectively overlay the 'text block' on whatever the screen is currently displaying (either existing text or image)

<table>
<tr><th>Name</th><th>Value</th><th>Length (bytes)</th><th>Description</th></tr>
<tr><td>SubCommand</td><td>0x04</td><td>1</td><td>Send Text to Window subcommand</td></tr>
<tr><td>Window Index</td><td>N</td><td>1</td><td>Valid values are 0x00 – (Number of Windows – 1)</td></tr>
<tr><td>Data Type</td><td>0x01</td><td>1</td><td>Simple Text only</td></tr>
<tr><td>Horizontal Alignment</td><td>0x00 – 0x02</td><td>1</td><td>0: Left Aligned
1: Centred
2: Right Aligned</td></tr>
<tr><td>Area Left</td><td></td><td>2</td><td>Left edge of the text area in pixels, referenced from the left edge of the window being written to.
Sent high byte first</td></tr>
<tr><td>Area Top</td><td></td><td>2</td><td>Top edge of the text area in pixels, referenced from the top edge of the window being written to.
Sent high byte first</td></tr>
<tr><td>Area Width</td><td></td><td>2</td><td>Width of the text area in pixels
Sent high byte first</td></tr>
<tr><td>Area Height</td><td></td><td>2</td><td>Height of the text area in pixels
Sent high byte first</td></tr>
<tr><td>Font</td><td></td><td>1</td><td>Bits 7 and 3 should always be 0
Bits 6 to 4 – Font Style
<table>
<tr><td>000</td><td>0</td><td>Default</td></tr>
<tr><td>001</td><td>1</td><td>Style 1</td></tr>
<tr><td>010</td><td>2</td><td>Style 2</td></tr>
<tr><td>011</td><td>3</td><td>Style 3</td></tr>
<tr><td>100</td><td>4</td><td>Style 4</td></tr>
<tr><td>101</td><td>5</td><td>Style 5</td></tr>
<tr><td>110</td><td>6</td><td>Style 6</td></tr>
<tr><td>111</td><td>7</td><td>Style 7</td></tr>
</table>
Bits 2 to 0 – Font Size
<table>
<tr><td>000</td><td>0</td><td>8 point</td></tr>
<tr><td>001</td><td>1</td><td>12 point</td></tr>
<tr><td>010</td><td>2</td><td>16 point</td></tr>
<tr><td>011</td><td>3</td><td>24 point</td></tr>
<tr><td>100</td><td>4</td><td>32 point</td></tr>
<tr><td>101</td><td>5</td><td>40 point</td></tr>
<tr><td>110</td><td>6</td><td>48 point</td></tr>
<tr><td>111</td><td>7</td><td>56 point</td></tr>
</table></td></tr>
<tr><td>Red Level</td><td>0x00 – 0xff</td><td>1</td><td>Value of the Red component of the required display colour</td></tr>
<tr><td>Green Level</td><td>0x00 – 0xff</td><td>1</td><td>Value of the Green component of the required display colour</td></tr>
<tr><td>Blue Level</td><td>0x00 – 0xff</td><td>1</td><td>Value of the Blue component of the required display colour</td></tr>
<tr><td>Text Data</td><td></td><td>Variable</td><td>Text string to display, terminated by 0x00</td></tr>
</table>

Synergy House, Knights Court, Magellan Close, Walworth Business Park, Andover, SP10 5NT

Full packet to display “123” in yellow in a 26 x 8 pixel box with its top left corner 35 pixels in from the left and 4 pixels down from the top in Window 0: -

0xff 0xff 0xff 0xff	ID Code
0x1f 0x00	Network Data Length
0x00 0x00	Reserved
0x68	Packet Type
0x32	Card Type
0xff	Card Id
0x7b	Command
0x01	Response Request
0x14 0x00	Data Length
0x00	Packet Id
0x00	Max Packet Id
0x04	Subcommand
0x00	Target Window Index
0x01	Data Type (Simple Text)
0x01	Horizontal Alignment (Centre)
0x00 0x23	Left Edge of Text Area (35)
0x00 0x04	Top Edge of Text Area (4)
0x00 0x1a	Width of Text Area (26)
0x00 0x08	Height of Text Area (8)
0x00	Font (8 point, default style)
0xff	Red Component
0xff	Green Component
0x00	Blue Component
0x31	First Text Character (‘1’)
0x32	Second Text Character (‘2’)
0x33	Third Text Character (‘3’)
0x00	String Termination Byte
0x0c 0x05	Checksum

Synergy House, Knights Court, Magellan Close, Walworth Business Park, Andover, SP10 5NT

Display Time in Window (Subcommand 0x05)

Displays the current time held in the display in the specified window. The format and fields displayed can be varied.

Name	Value	Length (bytes)	Description
SubCommand	0x05	1	Send Text to Window subcommand
Window Index	N	1	Valid values are 0x00 – (Number of Windows – 1)
Display Time	0x0000 – 0xffff	2	Time in seconds that the data is displayed before being refreshed. Sent high byte first.
Calendar	0x00 – 0x02	1	0: Gregorian Calendar
Format		1	Bit 0: Hour Mode 0: 12H 1: 24H Bit 1: Year Mode 0: 4 Digit 1: 2 Digit Bit 2: Lines 0: Single line 1: Multiline Bits 3..7: Reserved (set to 0)
Content		1	Each bit that is set to 1 enables an item of content to be displayed Bit 0: Year Bit 1: Month Bit 2: Date Bit 3: Hours Bit 4: Minutes Bit 5: Seconds Bit 6: Day Bit 7: Analogue Clock Hands
Font		1	Bits 2 to 0 – Font Size 000 0 8 point 001 1 12 point 010 2 16 point 011 3 24 point 100 4 32 point 101 5 40 point 110 6 48 point 111 7 56 point
Red Level	0x00 – 0xff	1	Value of the Red component of the required display colour
Green Level	0x00 – 0xff	1	Value of the Green component of the required display colour
Blue Level	0x00 – 0xff	1	Value of the Blue component of the required display colour
Suffix Text		Variable	Text string to add to time/date string, terminated by 0x00

Full packet to display hours, minutes and seconds in red in Window 0: -

0xff 0xff 0xff 0xff	ID Code
0x17 0x00	Network Data Length
0x00 0x00	Reserved

Synergy House, Knights Court, Magellan Close, Walworth Business Park, Andover, SP10 5NT

0x68	Packet Type
0x32	Card Type
0xff	Card Id
0x7b	Command
0x01	Response Request
0x0c 0x00	Data Length
0x00	Packet Id
0x00	Max Packet Id
0x05	Subcommand
0x00	Target Window Index
0x00 0x03	Display Time (3 Seconds)
0x00	Calendar (Gregorian)
0x01	Format (24 Hour)
0x38	Content (Hours, Minutes and Seconds)
0x00 0x1a	Width of Text Area (26)
0x00 0x08	Height of Text Area (8)
0x02	Font (Size 2, 16 point)
0xff	Red Component
0x00	Green Component
0x00	Blue Component
0x00	String Termination Byte
0x63 0x03	Checksum

Synergy House, Knights Court, Magellan Close, Walworth Business Park, Andover, SP10 5NT

Return to Play Default Playlist (Subcommand 0x06)

Aborts any display commands and returns to playing the default playlist stored within the display.

Name	Value	Length (bytes)	Description
SubCommand	0x06	1	Return to default program

Full packet to return the display to playing its default program: -

0xff 0xff 0xff 0xff	ID Code
0x0c 0x00	Network Data Length
0x00 0x00	Reserved
0x68	Packet Type
0x32	Card Type
0xff	Card Id
0x7b	Command
0x01	Response Request
0x01 0x00	Data Length
0x00	Packet Id
0x00	Max Packet Id
0x06	Subcommand
0x1c 0x02	Checksum

Synergy House, Knights Court, Magellan Close, Walworth Business Park, Andover, SP10 5NT

Play Stored Program - Single Byte (Subcommand 0x08)

Play a program or a collection of programs stored within the controller referenced by a single byte id number. Each program may contain a simple single page or multiple pages of images or text.

Name	Value	Length (bytes)	Description
SubCommand	0x08	1	Play Stored Program subcommand
Set As Default	0x00 – 0x01	1	0x00 – Leave existing start-up message 0x01 – Play this list as the default on start-up
Program Count	N	1	Number of programs to play
Program List		Variable	A list of N single byte program numbers

Full packet to play programs 1 and 2 and set them to play when the display powers up : -

0xff 0xff 0xff 0xff	ID Code
0x10 0x00	Network Data Length
0x00 0x00	Reserved
0x68	Packet Type
0x32	Card Type
0xff	Card Id
0x7b	Command
0x01	Response Request
0x05 0x00	Data Length
0x00	Packet Id
0x00	Max Packet Id
0x08	Subcommand
0x01	Set this program list to play by default on power up
0x02	Count of programs to play
0x01 0x02	List of programs to play
0x28 0x02	Checksum

Synergy House, Knights Court, Magellan Close, Walworth Business Park, Andover, SP10 5NT

Send Pure Text to Window (Subcommand 0x12)

Displays a simple null terminated string in a specific window. Each character of the string will be displayed in the same colour at the same font size.

<table>
<tr><th>Name</th><th>Value</th><th>Length (bytes)</th><th>Description</th></tr>
<tr><td>SubCommand</td><td>0x12</td><td>1</td><td>Send Pure Text to Window subcommand</td></tr>
<tr><td>Window Index</td><td>N</td><td>1</td><td>Valid values are 0x00 – (Number of Windows – 1)</td></tr>
<tr><td>Mode</td><td></td><td>1</td><td>See Appendix 2 (Display / Transition Effects)</td></tr>
<tr><td>Text Alignment</td><td>Sum of Vertical and Horizontal values</td><td>1</td><td>Bits 1 to 0 – Horizontal Alignment
0: Left Aligned
1: Centred
2: Right Aligned

Bits 3 to 2 – Vertical Alignment
0: Top Aligned
4: Vertical Centre
8: Bottom Aligned</td></tr>
<tr><td>Speed</td><td>1 – 100</td><td>1</td><td>Transition Time (lower value = faster transition)</td></tr>
<tr><td>Display Time</td><td>0x0000 – 0xffff</td><td>2</td><td>Time in seconds that the data is displayed before being refreshed. Sent high byte first.</td></tr>
<tr><td>Font</td><td>0x00 – 0x07</td><td>1</td><td>Bits 7 and 3 should always be 0
Bits 6 to 4 – Font Style
<table>
<tr><td>000</td><td>0</td><td>Default</td></tr>
<tr><td>001</td><td>1</td><td>Style 1</td></tr>
<tr><td>010</td><td>2</td><td>Style 2</td></tr>
<tr><td>011</td><td>3</td><td>Style 3</td></tr>
<tr><td>100</td><td>4</td><td>Style 4</td></tr>
<tr><td>101</td><td>5</td><td>Style 5</td></tr>
<tr><td>110</td><td>6</td><td>Style 6</td></tr>
<tr><td>111</td><td>7</td><td>Style 7</td></tr>
</table>
Bits 2 to 0 – Font Size
<table>
<tr><td>000</td><td>0</td><td>8 point</td></tr>
<tr><td>001</td><td>1</td><td>12 point</td></tr>
<tr><td>010</td><td>2</td><td>16 point</td></tr>
<tr><td>011</td><td>3</td><td>24 point</td></tr>
<tr><td>100</td><td>4</td><td>32 point</td></tr>
<tr><td>101</td><td>5</td><td>40 point</td></tr>
<tr><td>110</td><td>6</td><td>48 point</td></tr>
<tr><td>111</td><td>7</td><td>56 point</td></tr>
</table></td></tr>
<tr><td>Red Component</td><td>0x00 – 0xff</td><td>1</td><td>Red Component of the colour of the text</td></tr>
<tr><td>Green Component</td><td>0x00 – 0xff</td><td>1</td><td>Green Component of the colour of the text</td></tr>
<tr><td>Blue Component</td><td>0x00 – 0xff</td><td>1</td><td>Blue Component of the colour of the text</td></tr>
<tr><td>Text Data</td><td></td><td>Variable</td><td></td></tr>
</table>

Synergy House, Knights Court, Magellan Close, Walworth Business Park, Andover, SP10 5NT

Full packet to display “AB20CDE” in red, font-size 16pt, centred in Window 0: -

0xff 0xff 0xff 0xff	ID Code
0x1e 0x00	Network Data Length
0x00 0x00	Reserved
0x68	Packet Type
0x32	Card Type
0xff	Card Id
0x7b	Command
0x01	Response Request
0x13 0x00	Data Length
0x00	Packet Id
0x00	Max Packet Id
0x12	Subcommand
0x00	Target Window Index
0x00	Display Mode (Instant)
0x05	Alignment (Centred Vertically and Horizontally)
0x01	Speed (Fastest)
0x00 0x03	Display Time (3 Seconds)
0x02	Default Font, Size 2 (16 pt)
0xff	Red Component
0x00	Green Component
0x00	Blue Component
0x41	‘A’
0x42	‘B’
0x32	‘2’
0x30	‘0’
0x43	‘C’
0x44	‘D’
0x45	‘E’
0x00	Null Termination of text string
0xF7 0x04	Checksum

Synergy House, Knights Court, Magellan Close, Walworth Business Park, Andover, SP10 5NT

Appendix 1 (Example - Football Scoreboard)

To give some example commands, the following would set up a simple football scoreboard on a 224 x 32 pixel display.

1. Create 4 windows for Home Team Name, Home Team Score, Visitors Team Name and Visitors Team Score

0xff 0xff 0xff 0xff	ID Code
0x2d 0x00	Network Data Length (45)
0x00 0x00	Reserved
0x68	Packet Type
0x32	Card Type
0xff	Card Id
0x7b	Command
0x01	Response Request
0x22 0x00	Data Length (34)
0x00	Packet Id
0x00	Max Packet Id
0x01	Subcommand
0x04	Number of Windows
0x00 0x00 0x00 0x00 0x00 0x60 0x00 0x10	Window 0 Data (Home Team Name – 192 x 16 px)
0x00 0x60 0x00 0x00 0x00 0x20 0x00 0x10	Window 1 Data (Home Team Score – 32 x 16 px)
0x00 0x00 0x00 0x10 0x00 0x60 0x00 0x10	Window 2 Data (Visitors Team Name – 192 x 16 px)
0x00 0x60 0x00 0x10 0x00 0x20 0x00 0x10	Window 3 Data (Visitors Team Score – 32 x 16 px)
0x6c 0x04	Checksum

2. Write the home team name to window 0 in red

0xff 0xff 0xff 0xff	ID Code
0x1b 0x00	Network Data Length
0x00 0x00	Reserved
0x68	Packet Type
0x32	Card Type
0xff	Card Id
0x7b	Command
0x01	Response Request
0x10 0x00	Data Length
0x00	Packet Id
0x00	Max Packet Id
0x12	Subcommand
0x00	Target Window Index
0x00	Display Mode (Instant)
0x04	Alignment (Centred Vertically, Left Justified)
0x01	Speed (Fastest)
0x00 0x00	Display Time (Permanent)
0x02	Default Font, Size 2 (16 pt)

Synergy House, Knights Court, Magellan Close, Walworth Business Park, Andover, SP10 5NT

0xff	Red Component
0x00	Green Component
0x00	Blue Component
0x48 0x6f 0x6d 0x65	'Home'
0x00	Null Termination of text string
0xc6 0x04	Checksum

3. Write the home team score to window 1 in yellow

0xff 0xff 0xff 0xff	ID Code
0x18 0x00	Network Data Length
0x00 0x00	Reserved
0x68	Packet Type
0x32	Card Type
0xff	Card Id
0x7b	Command
0x01	Response Request
0x0d 0x00	Data Length
0x00	Packet Id
0x00	Max Packet Id
0x12	Subcommand
0x01	Target Window Index
0x00	Display Mode (Instant)
0x06	Alignment (Centred Vertically, Right Justified)
0x01	Speed (Fastest)
0x00 0x00	Display Time (Permanent)
0x02	Default Font, Size 2 (16 pt)
0xff	Red Component
0xff	Green Component
0x00	Blue Component
0x30	'0'
0x00	Null Termination of text string
0x6c 0x04	Checksum

4. Write the visitors team name to window 2 in blue

0xff 0xff 0xff 0xff	ID Code
0x1b 0x00	Network Data Length
0x00 0x00	Reserved
0x68	Packet Type
0x32	Card Type
0xff	Card Id
0x7b	Command
0x01	Response Request
0x10 0x00	Data Length
0x00	Packet Id
0x00	Max Packet Id

Synergy House, Knights Court, Magellan Close, Walworth Business Park, Andover, SP10 5NT

0x12	Subcommand
0x02	Target Window Index
0x00	Display Mode (Instant)
0x04	Alignment (Centred Vertically, Left Justified)
0x01	Speed (Fastest)
0x00 0x00	Display Time (Permanent)
0x02	Default Font, Size 2 (16 pt)
0x00	Red Component
0x00	Green Component
0xff	Blue Component
0x41 0x77 0x61 0x79	'Away'
0x00	Null Termination of text string
0xd1 0x04	Checksum

5. Write the visitors team score to window 3 in yellow

0xff 0xff 0xff 0xff	ID Code
0x18 0x00	Network Data Length
0x00 0x00	Reserved
0x68	Packet Type
0x32	Card Type
0xff	Card Id
0x7b	Command
0x01	Response Request
0x0d 0x00	Data Length
0x00	Packet Id
0x00	Max Packet Id
0x12	Subcommand
0x01	Target Window Index
0x00	Display Mode (Instant)
0x06	Alignment (Centred Vertically, Right Justified)
0x01	Speed (Fastest)
0x00 0x00	Display Time (Permanent)
0x02	Default Font, Size 2 (16 pt)
0xff	Red Component
0xff	Green Component
0x00	Blue Component
0x30	'0'
0x00	Null Termination of text string
0x6e 0x04	Checksum

Scores would then be able to be updated by just sending new data to windows 1 and 3.

Synergy House, Knights Court, Magellan Close, Walworth Business Park, Andover, SP10 5NT

Appendix 2 (Display / Transition Effects)

The following table lists the many different display and transition modes available.

Value	Effect Description
0x00	Instant
0x01	Open from left (display is revealed from the left edge)
0x02	Open from right (display is revealed from the right edge)
0x03	Open horizontally from centre (display is revealed from the centre, starting with a thin vertical line and expanding out in both directions horizontally)
0x04	Open vertically from centre (display is revealed from the centre, starting with a thin horizontal line and expanding out in both directions vertically)
0x05	Vertical shutter
0x06	Move to left (display is scrolled in from the right edge and stops when it hits the left edge)
0x07	Move to right (display is scrolled in from the left edge and stops when it hits the right edge)
0x08	Move up (display is scrolled in from the bottom and stops when it hits the top)
0x09	Move down (display is scrolled in from the top and stops when it hits the bottom)
0x0a	Scroll up (display is scrolled in from the bottom and continues scrolling until it has fully cleared the screen, then restarts from the bottom)
0x0b	Scroll left (display is scrolled in from the right and continues scrolling until it has fully cleared the screen, then restarts from the right)
0x0c	Scroll right (display is scrolled in from the left and continues scrolling until it has fully cleared the screen, then restarts from the left)
0x0d	Flicker (display flashes on and off continuously)
0x0e	Continuous scroll to left
0x0f	Continuous scroll to right
0x10	Horizontal shutter
0x11	Clockwise open
0x12	Anti-clockwise open
0x13	Clockwise windmill
0x14	Anti-clockwise windmill
0x15	Increasing rectangle
0x16	Decreasing rectangle
0x17	Increasing diamond
0x18	Decreasing diamond
0x19	Increasing circle
0x1a	Decreasing circle
0x1b	Open from top left corner
0x1c	Open from top right corner
0x1d	Open from bottom left corner
0x1e	Open from bottom right corner
0x1f	Open from top left and bottom right
0x20	Open from top right and bottom left
0x21	Slide in from top left corner
0x22	Slide in from top right corner
0x23	Slide in from bottom left corner
0x24	Slide in from bottom right corner

Synergy House, Knights Court, Magellan Close, Walworth Business Park, Andover, SP10 5NT

Appendix 3 (Formatted Text Format)

Each character is sent as 3 bytes. The first is a formatting character giving the font size and colour of the character. The second and third are the text character, though in almost all cases fonts only contain a maximum of 256 characters so the upper byte of the character is almost always 0.

<table>
<tr><th>Byte No.</th><th>Description</th></tr>
<tr><td>1</td><td>Colour and Font Information (Sent first)
Bits 7 and 3 should always be 0
Bits 6 to 4 – Colour
<table>
<tr><td>000</td><td>0</td><td>Black</td></tr>
<tr><td>001</td><td>1</td><td>Red</td></tr>
<tr><td>010</td><td>2</td><td>Green</td></tr>
<tr><td>011</td><td>3</td><td>Yellow</td></tr>
<tr><td>100</td><td>4</td><td>Blue</td></tr>
<tr><td>101</td><td>5</td><td>Magenta</td></tr>
<tr><td>110</td><td>6</td><td>Cyan</td></tr>
<tr><td>111</td><td>7</td><td>White</td></tr>
</table>
Bits 2 to 0 – Font Size
<table>
<tr><td>000</td><td>0</td><td>8 point</td></tr>
<tr><td>001</td><td>1</td><td>12 point</td></tr>
<tr><td>010</td><td>2</td><td>16 point</td></tr>
<tr><td>011</td><td>3</td><td>24 point</td></tr>
<tr><td>100</td><td>4</td><td>32 point</td></tr>
<tr><td>101</td><td>5</td><td>40 point</td></tr>
<tr><td>110</td><td>6</td><td>48 point</td></tr>
<tr><td>111</td><td>7</td><td>56 point</td></tr>
</table></td></tr>
<tr><td>2</td><td>High byte of character (Mostly this will be 0)</td></tr>
<tr><td>3</td><td>Low byte of character</td></tr>
</table>

Synergy House, Knights Court, Magellan Close, Walworth Business Park, Andover, SP10 5NT

Appendix 4 (Simple Picture Data Format)

The simple picture format consists of an 8 byte header followed by blocks of data for red, green and blue (depending upon which colours are enabled in the header).

The header block is formatted as follows: -

Byte	Value	Length (bytes)	Description
0x00 – 0x01	0x31, 0x31	2	Identifier (Always “11”)
0x02 – 0x03	0x0000 – 0xffff	2	Width of picture in pixels. Sent low byte first
0x04 – 0x05	0x0000 – 0xffff	2	Height of picture in pixels. Sent low byte first
0x06	N	1	**Bits 0 - 2 determine whether a data block will follow for each primary colour.** **0 – Data is not present** **1 - Data follows** Bit 0: Data for red is present Bit 1: Data for green is present Bit 2: Data for blue is present Bit 3: Always set to 0 **Bits 4 – 6 – Colour Depth** 000 – 1 bit per pixel per colour 111 – 8 bits per pixel per colour Bit 7: Always set to 0
0x07	0x00	1	Reserved (Always 0x00)

The data for each colour can either be 1 or 8 bit colour depth per primary colour giving either 8 colour or 16.7 million colour options

Data is sent line by line (left to right, top to bottom). If 1 bit colour depth is selected, the last byte of each line is zero filled to make the line byte aligned.

Synergy House, Knights Court, Magellan Close, Walworth Business Park, Andover, SP10 5NT