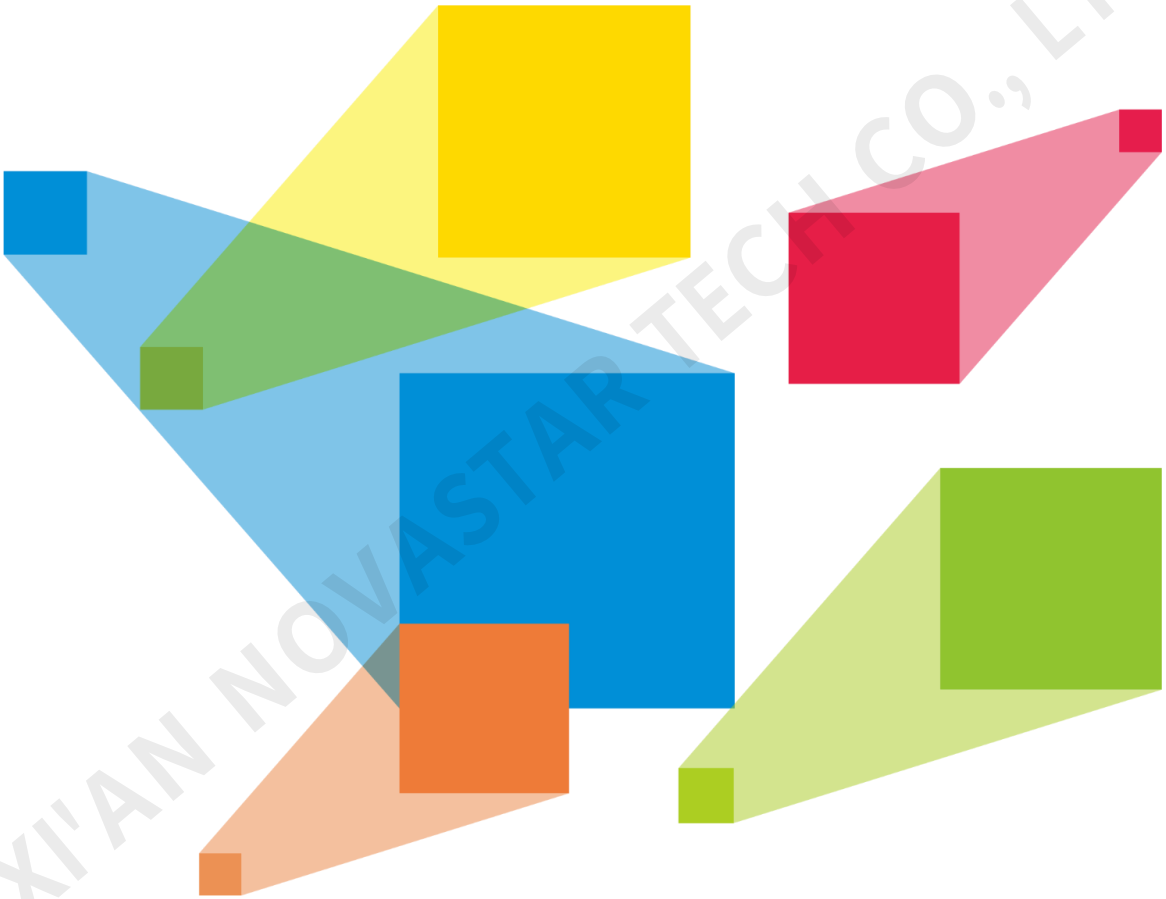
VX1000

All-in-One Controller

V1.0



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Control Protocol

Change History

Version	Modified By	Description	Modified On
V1.0	Zhang Tao	Initialized the VX1000 control protocol.	2021-07-29

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Contents

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1. Privacy Statement

a) This protocol is strictly confidential, and shall not be distributed outside NovaStar or uploaded to the Internet. Anyone who breaks these rules and therefore causes any loss to the company shall be investigated according to law.

b) Developers must strictly follow the instructions in this document for related development.

2. Overview

The communication protocol format of this NovaStar video processor product includes request frames and response frames. Each request packet corresponds to only one response packet so as to form a closed-loop communication. The VX1000 supports USB and TCP/IP communication protocols. The Ethernet is based on the TCP/IP protocol, where relevant control data frames should be added after the protocol frame and then sent to the device to realize related functions.

3. Communication Settings

3.1 Network Port and Communication Format

3.1.1 UDP Searching

(1) UDP port: 3800

(2) UDP searching

The software sends the "rqProMI:" data in UDP message format for searching. When the data saved in the device is the same as the data sent by the software, the device will reply with the following data format, indicating that the UDP has identified the NovaStar device.

{0X72, 0x70, 0x50, 0x72, 0x6F, 0x4D, 0x49, 0x3A, 0x41, 0x70, 0x70, 0x2C, 0x30, 0x31, 0x36, 0x31}

3.1.2 TCP Communication

The communication between the software and the device uses the standard TCP protocol.

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(1) TCP port: 5200

(2) Reconnecting device and reading the device ID

Command to read ModeID of the VX1000:

55 aa 00 00 fe 00 00 00 00 00 00 00 02 00 00 00 02 00 57 56

If the response packet is in the following format, the device is successfully connected.

aa 55 00 00 00 fe 00 00 00 00 00 00 02 00 00 00 02 00 0C 62 c5 56

3.2 System Parameters

3.2.1 Screen Brightness Control

(1) Command to adjust screen brightness

Set the brightness value to "XX":

55 aa 00 00 fe ff 01 ff ff ff 01 00 01 00 00 02 01 00 XX SUM_L SUM_H

The command data is in hexadecimal format and XX stands for the desired screen brightness (0–255). "SUM_L" and "SUM_H" constitute the checksum of this command frame, which is the sum of the underlined data and 0x5555. The calculation formula is as below.

SUM = 0x00 + 0x00 + 0xFE + 0xFF+ 0x01 + 0xFF + 0xFF + 0xFF + 0x01 + 0x00 + 0x01 + 0x00 + 0x00 + 0x02 + 0x01 + 0x00 + XX + 0x5555, SUM = SUM_H << 8 + SUM_L ("SUM_L" stands for the lower 8 bits of SUM, while "SUM_H" stands for the higher 8 bits of SUM).

The following table lists the command data for some commonly-used brightness values.

Brightness Value	Command Data
0%	55 aa 00 00 fe ff 01 ff ff ff 01 00 01 00 00 02 01 00 00 55 5a
10%	55 aa 00 00 fe ff 01 ff ff ff 01 00 01 00 00 02 01 00 19 6e 5a
20%	55 aa 00 00 fe ff 01 ff ff ff 01 00 01 00 00 02 01 00 33 88 5a
30%	55 aa 00 00 fe ff 01 ff ff ff 01 00 01 00 00 02 01 00 4c a1 5a
40%	55 aa 00 00 fe ff 01 ff ff ff 01 00 01 00 00 02 01 00 66 bb 5a
50%	55 aa 00 00 fe ff 01 ff ff ff 01 00 01 00 00 02 01 00 7f d4 5a
60%	55 aa 00 00 fe ff 01 ff ff ff 01 00 01 00 00 02 01 00 99 ee 5a
70%	55 aa 00 00 fe ff 01 ff ff ff 01 00 01 00 00 02 01 00 b2 07 5b
80%	55 aa 00 00 fe ff 01 ff ff ff 01 00 01 00 00 02 01 00 cc 21 5b

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90%	55 aa 00 00 fe ff 01 ff ff ff 01 00 01 00 00 02 01 00 e5 3a 5b
100%	55 aa 00 00 fe ff 01 ff ff ff 01 00 01 00 00 02 01 00 ff 5a 5b

(2) Response packet

After the brightness adjustment command is sent, if the response packet is in the following format, it represents the screen brightness is successfully adjusted.

aa 55 00 00 ff fe 01 ff ff ff 01 00 01 00 00 02 00 00 54 5a

3.2.2 Switch between Primary and Backup Modes

(1) Command to switch between primary and backup modes

① Set the device as primary device

55 aa 00 00 fe 00 00 00 00 00 01 00 18 00 00 02 04 00 00 00 00 00 72 56

55 aa 00 00 fe 00 00 00 00 00 01 00 98 00 00 02 04 00 00 00 00 00 f2 56

55 aa 00 00 fe 00 00 00 00 00 01 00 00 01 00 02 02 00 00 00 5f 56

② Set the device as backup device

55 aa 00 00 fe 00 00 00 00 00 01 00 18 00 00 02 04 00 80 80 80 80 72 58

55 aa 00 00 fe 00 00 00 00 00 01 00 98 00 00 02 04 00 80 80 80 80 f2 58

55 aa 00 00 fe 00 00 00 00 00 01 00 00 01 00 02 02 00 80 80 59 57

(2) Response packet

If the response packet is in the following format, the device mode is successfully switched.

aa 55 00 00 00 fe 00 00 00 00 01 00 18 00 00 02 00 00 6e 56

aa 55 00 00 00 fe 00 00 00 00 01 00 98 00 00 02 00 00 ee 56

aa 55 00 00 00 fe 00 00 00 00 01 00 00 01 00 02 00 00 57 56

Note: The primary and backup modes switching requires sending of three packets of data. The next packet of data will only be sent when the previous one gets a valid response packet. The data sending and responding order is the same as the order of the data package described above (from top to bottom).

3.2.3 Test Pattern

(1) Command to set the display mode

① Normal

55 aa 00 00 fe 00 00 00 00 00 01 00 04 00 00 13 02 00 03 00 70 56

② Freeze

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55 aa 00 00 fe 00 00 00 00 00 01 00 04 00 00 13 02 00 04 00 71 56

③ FTB

55 aa 00 00 fe 00 00 00 00 00 01 00 04 00 00 13 02 00 05 00 72 56

④ Test Pattern

Set the test pattern type to XX:

55 aa 00 00 fe 00 00 00 00 00 01 00 04 00 00 13 02 00 06 XXSUM_L SUM_H

The command data is in hexadecimal format and XX stands for the desired test pattern type. For details of the test pattern types, see Appendix 1. "SUM_L" and "SUM_H" constitute the checksum of this command frame, which is the sum of the underlined data and 0x5555. The calculation formula is as below.

SUM = 0x00 + 0x00 + 0xfe + 0x00 + 0x00 + 0x00 + 0x00 + 0x00 + 0x01 + 0x00 + 0x04 + 0x00 + 0x00 + 0x13 + 0x02 + 0x06 + 0x00 + XX + 0x5555, SUM = SUM_H<<8 + SUM_L ("SUM_L" stands for the lower 8 bits of SUM, while "SUM_H" stands for the higher 8 bits of SUM).

(2) Response packet

aa 55 00 00 00 fe 00 00 00 00 01 00 04 00 00 13 00 00 6b 56

3.2.4 Factory Reset

(1) Command to do factory reset:

55 aa 00 00 fe 00 00 00 00 00 01 00 02 00 00 01 01 00 00 58 56

(2) Response packet

If the response packet is in the following format, the device is successfully reset.

aa 55 00 00 00 fe 00 00 00 00 01 00 02 00 00 01 00 00 57 56

3.3 Input Parameters

3.3.1 Set Input Source Resolution

(1) Command to set input source resolution

Set the input source resolution parameters, including the input source number, card slot number, horizontal width, vertical height, and frame rate, which are represented by Source, CardNo, Width, Height and Frame, respectively.

55 aa 00 00 fe 00 00 00 00 00 01 00 00 42 01 13 08 00 Source CardNo Width_L Width_H Height_L Height_H Frame_L Frame_H SUM_L SUM_H

The command data is hexadecimal. "Source" indicates the input source number (for details

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on the definition of the source number values, see Appendix 2). "CardNo" indicates the card slot number (for details on the slot number values, see Appendix 3). "Width" indicates the horizontal width of resolution (Width = Width_H<<8 + Width_L). "Hight" indicates the vertical height of resolution (Hight = Hight_H<<8 + Hight_L). "Frame" indicates the frame rate (unit: 0.01 Hz, Frame = Frame_H<<8 + Frame_L). "SUM_L" and "SUM_H" constitute the checksum of this command frame, which is the sum of the underlined data and 0x5555. The calculation formula is as below.

SUM = 0x00 + 0x00 + 0xfe + 0x00 + 0x00 + 0x00 + 0x00 + 0x00 + 0x01 + 0x00 + 0x00 + 0x42 + 0x01 + 0x13 + 0x08 + 0x00 + Source + CardNo + Width_L + Width_H + Height_L + Height_H + Frame_L + Frame_H + 0x5555, SUM = SUM_H<<8 + SUM_L ("SUM_L" stands for the lower 8 bits of SUM, while "SUM_H" stands for the higher 8 bits of SUM).

Explanation of parameters:

For example, to set the resolution of HDMI 1 source to 1920*1080@60Hz, write the parameter values as follows.

a. Source: For the Source codes, please refer to Appendix II. For example, the code for HDMI 1 source is 0x61, and then write 0x61 for "Source".

b. CardNo: For the CardNo codes, please refer to Appendix III. For example, the code for HDMI 1 source is 0x00, and then write 0x00 for "CardNo".

c. Width: The input source Width = 1920 = 0x780. Width_L stands for the lower 8 bits of Width and Width_H stands for the higher 8 bits of Width. Here, Width_L = 0x80 and Width_H = 0x07.

d. Height: Height of the input source = 1080 = 0x438. Height_L stands for the lower 8 bits of Height and Height_H stands for the higher 8 bits of Height. Here, Height_L = 0x38 and Height_H = 0x04.

e. Frame: Frame rate of the input source (unit: 0.01 Hz) = 60 * 100 = 6000 = 0x1770. Frame_L stands for the lower 8 bits of Frame and Frame_H stands for the higher 8 bits of Frame. Here, Frame_L = 0x70 and Frame_H = 0x17.

Note: The VX1000 supports input resolution settings for HDMI 1, HDMI 2, DVI 1 and DVI 2 only.

(2) Response packet

If the response packet is in the following data format, the input resolution is set successfully.

aa 55 00 00 00 fe 00 00 00 00 01 00 00 42 01 13 00 00 aa 56

3.3.2 Obtain Input Source Resolution

(1) Command to obtain the input source resolution

55 aa 00 00 fe 00 00 00 00 00 00 00 01 00 01 13 00 01 69 56

(2) Response packet

The following table describes the commands since the response packet of obtaining input source resolution is complex and has many parameters.

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aa	55	00	00	00	fe	00	00
00	00	00	00	01	00	01	13
00	01	Reserved	Source1 Interlaced	Source1 State	Source1 Width_L	Source1 Width_H	Source1 Height_L
Source1 Height_H	Source1 Framerate count_L	Source1 Framerate count_H	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved	Reserved	Reserved	Source2 Interlaced	Source2 State	Source2 Width_L	Source2 Width_H	Source2 Height_L
Source2 Height_H	Source2 Framerate count_L	Source2 Framerate count_H	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved	Reserved	Reserved	Source3 Interlaced	Source3 State	Source3 Width_L	Source3 Width_H	Source3 Height_L
Source3 Height_H	Source3 Framerate count_L	Source3 Framerate count_H	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved	Reserved	Reserved	Source4 Interlaced	Source4 State	Source4 Width_L	Source4 Width_H	Source4 Height_L
Source4 Height_H	Source4 Framerate count_L	Source4 Framerate count_H	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved	Reserved	Reserved	Source5 Interlaced	Source5 State	Source5 Width_L	Source5 Width_H	Source5 Height_L
Source5 Height_H	Source5 Framerate count_L	Source5 Framerate count_H	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved	Reserved	Reserved	Source6	Source6	Source6	Source6	Source6

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			Interlaced	State	Width_L	Width_H	Height_L
Source6 Height_H	Source6 Framerate count_L	Source6 Framerate count_H	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved	Reserved	Reserved	Source7 Interlaced	Source7 State	Source7 Width_L	Source7 Width_H	Source7 Height_L
Source7 Height_H	Source7 Framerate count_L	Source7 Framerate count_H	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved	Reserved	Reserved	Source8 Interlaced	Source8 State	Source8 Width_L	Source8 Width_H	Source8 Height_L
Source8 Height_H	Source8 Framerate count_L	Source8 Framerate count_H	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved	Reserved	SUM_L	SUM_H				

The command data is hexadecimal. "Interlaced" indicates whether the input source is an interlaced signal or not (0: progressive; 1: interlaced). "State" indicates the input source availability (0: The input source has no signal; 1: The input source has signal). "Width" indicates the horizontal width of resolution (Width = Width_H<<8 + Width_L). "Height" indicates the vertical height of resolution (Height = Height_H<<8 + Height_L). "Framerate count" indicates the frame rate count (unit: us; Frame rate count = Frame rate count _H<<8 + Frame rate count_L; The actual input source frame rate is calculated by the frame rate count, that is, Frame rate = 100000000 / Frame rate count; The unit of frame rate is 0.01 Hz). "SUM_L" and "SUM_H" constitute the checksum of this command frame, which is the sum of the data in red and 0x5555.

3.4 Layer Parameters

3.4.1 Switch Layer Input Source

(1) Command to switch the layer input source

Switch the input source of the layer to CardNo:

55 aa 00 00 fe 00 00 00 00 00 01 00 Addr0 Addr1 Addr2 Addr3 03 00 CardNo 00 00

SUM_L SUM_H

The command data is in hexadecimal format. The parameter descriptions are as follows.

a. CardNo stands for the slot number (refer to Appendix III). For example, CardNo of HDMI 2.0 is 0x00.
b. "SUM_L" and "SUM_H" constitute the checksum of this command frame, which is the sum of the underlined data and 0x5555. The calculation formula is as below. SUM = 0x00 + 0x00 + 0xfe + 0x00 + 0x00 + 0x00 + 0x00 + 0x00 + 0x01 + 0x00 + Addr0 + Addr1 + Addr2 + Addr3 + 0x03 + 0x00 + CardNo + Priority + Source + 0x5555, SUM_H<<8 + SUM_L ("SUM_L" stands for the lower 8 bits of SUM, while "SUM_H" stands for the higher 8 bits of SUM).
c. Addr: Addr stands for the layer parameter address (Addr = Addr3<<24 + Addr2<<16 + Addr1<<8 + Addr0). Different layers have different parameter addresses. The calculation formula for Addr is Addr = 0x13020012 + WindowNo * 0x30. For example, if you want to adjust the parameters of layer 1, then Addr = 0x13020012 + 0 * 0x30 = 0x13020012, that is, Addr0 = 0x12, Addr1 = 0x00, Addr2 = 0x02, Addr3 = 0x13.

The following table lists the command data for switching the layer input source.

Switch Input Source for Layer 1	Command Data
HDMI 1	55 aa 00 00 fe 00 00 00 00 00 01 00 12 00 02 13 03 00 00 00 00 7e 56
HDMI 2	55 aa 00 00 fe 00 00 00 00 00 01 00 12 00 02 13 03 00 01 00 00 7f 56
DVI 1	55 aa 00 00 fe 00 00 00 00 00 01 00 12 00 02 13 03 00 02 00 00 80 56
DVI 2	55 aa 00 00 fe 00 00 00 00 00 01 00 12 00 02 13 03 00 03 00 00 81 56
SDI	55 aa 00 00 fe 00 00 00 00 00 01 00 12 00 02 13 03 00 04 00 00 82 56
OPT 1	55 aa 00 00 fe 00 00 00 00 00 01 00 12 00 02 13 03 00 05 00 00 83 56
OPT 2	55 aa 00 00 fe 00 00 00 00 00 01 00 12 00 02 13 03 00 06 00 00 84 56
MOSAIC	55 aa 00 00 fe 00 00 00 00 00 01 00 12 00 02 13 03 00 07 00 00 85 56
Switch Input Source for Layer 2	Command Data
HDMI 1	55 aa 00 00 fe 00 00 00 00 00 01 00 42 00 02 13 03 00 00 00 00 ae 56
HDMI 2	55 aa 00 00 fe 00 00 00 00 00 01 00 42 00 02 13 03 00 01 00 00 af 56
DVI 1	55 aa 00 00 fe 00 00 00 00 00 01 00 42 00 02 13 03 00 02 00 00 b0 56

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DVI 2	55 aa 00 00 fe 00 00 00 00 00 01 00 42 00 02 13 03 00 03 00 00 b1 56
SDI	55 aa 00 00 fe 00 00 00 00 00 01 00 42 00 02 13 03 00 04 00 00 b2 56
OPT 1	55 aa 00 00 fe 00 00 00 00 00 01 00 42 00 02 13 03 00 05 00 00 b3 56
OPT 2	55 aa 00 00 fe 00 00 00 00 00 01 00 42 00 02 13 03 00 06 00 00 b4 56
MOSAIC	55 aa 00 00 fe 00 00 00 00 00 01 00 42 00 02 13 03 00 07 00 00 b5 56
Switch Input Source for Layer 3	Command Data
HDMI 1	55 aa 00 00 fe 00 00 00 00 00 01 00 72 00 02 13 03 00 00 00 00 de 56
HDMI 2	55 aa 00 00 fe 00 00 00 00 00 01 00 72 00 02 13 03 00 01 00 00 df 56
DVI 1	55 aa 00 00 fe 00 00 00 00 00 01 00 72 00 02 13 03 00 02 00 00 e0 56
DVI 2	55 aa 00 00 fe 00 00 00 00 00 01 00 72 00 02 13 03 00 03 00 00 e1 56
SDI	55 aa 00 00 fe 00 00 00 00 00 01 00 72 00 02 13 03 00 04 00 00 e2 56
OPT 1	55 aa 00 00 fe 00 00 00 00 00 01 00 72 00 02 13 03 00 05 00 00 e3 56
OPT 2	55 aa 00 00 fe 00 00 00 00 00 01 00 72 00 02 13 03 00 06 00 00 e4 56
MOSAIC	55 aa 00 00 fe 00 00 00 00 00 01 00 72 00 02 13 03 00 07 00 00 e5 56

(2) Response packet

If the response packet is in the following format, the layer parameters are set successfully.

aa 55 00 00 00 fe 00 00 00 00 01 00 Addr0 Addr1 Addr2 Addr3 00 00 SUM_L SUM_H

"SUM_L" and "SUM_H" constitute the checksum of this command frame, which is the sum of the underlined data and 0x5555. The calculation formula is as below.

SUM = 0x00 + 0x00 + 0x00 + 0xfe + 0x00 + 0x00 + 0x00 + 0x00 + 0x01 + 0x00 + Addr0 + Addr1 + Addr2 + Addr3 + 0x00 + 0x00 + 0x5555, SUM = SUM_H<<8 + SUM_L ("SUM_L" stands for the lower 8 bits of SUM, while ""SUM_H" stands for the higher 8 bits of SUM).

3.4.2 Set Layer Switch, Size, Position and Priority

(1) Command to set the layer parameters

Turn on or turn off the layer, adjust the layer parameters, including the layer number, card slot

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number, layer priority, input source number, layer H offset, V offset, H width and V height, which are represented by Switch, WindowNo, CardNo, Priority, Source, StartX, StartY, Width and Height, respectively.

55 aa 00 00 fe 00 00 00 00 00 01 00 Addr0 Addr1 Addr2 Addr3 30 00 Switch WindowNo CardNo Priority Source StartX0 StartX1 StartX2 StartX3 StartY0 StartY1 StartY2 StartY3 Width0 Width1 Width2 Width3 Height0 Height1 Height2 Height3 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 Opacity SUM_L SUM_H

When you send the layer parameters, all the properties parameters of the layer must be included. For example, when you open a layer, all the right parameters of the layer must be included, including "Addr", "Switch", "WindowNo", "CardNo", "Priority", "Source", "StartX", "StartY", "Width", "Hight". If you want to change the value of only one parameter, the values of other parameters must not be changed. The command data is in hexadecimal format. The parameter descriptions are as follows.

a. Switch stands for the layer switch. Turn on the layer: Switch = 0x01. Turn off the layer: Switch = 0x00.
b. WindowNo stands for the layer number (for details on the layer number codes, see Appendix 4). For example, for Main layer, WindowNo = 0x00. For PIP 1 layer, WindowNo = 0x01.
c. CardNo stands for the slot number (refer to Appendix III). For example, CardNo of HDMI 2.0 is 0x00.
d. Priority stands for layer priority (for details on layer priority codes, see Appendix V). If the layer priority is 1, Priority = 0x00. If the window priority is 2, Priority = 0x01.
e. Source stands for input source number (for details on input source number codes, see Appendix II). For example, the code for HDMI 1 source is 0x61, and then write 0x61 for "Source".
f. StartX stands for horizontal offset of layer (StartX= StartX3<<24 + StartX2<<16 + StartX1<<8 + StartX0). For example, StartX = 800 = 0x320 = StartX3<<24 + StartX2<<16 + StartX1<<8 + StartX0 = 0x00<<24 + 0x00<<16 + 0x03<<8 + 0x20, then StartX0 = 0x20, StartX1 = 0x03, StartX2 = 0x00, StartX3 = 0x00.
g. StartY stands for vertical offset of layer (StartY= StartY3<<24 + StartY2<<16 + StartY1<<8 + StartY0). For example, StartY = 600 = 0x258 = StartY3<<24 + StartY2<<16 + StartY1<<8 + StartY0 = 0x00<<24 + 0x00<<16 + 0x02<<8 + 0x58, then StartY0= 0x58, StartY1 = 0x02, StartY2 = 0x00, StartY3 = 0x00.
h. Width stands for layer width (Width= Width3<<24 + Width2<<16 + Width1<<8 + Width0). For example, Width = 1920 = 0x780 = Width3<<24 + Width2<<16 + Width1<<8 + Width0 = 0x00<<24 + 0x00<<16 + 0x07<<8 + 0x80, then Width0 = 0x80, Width1= 0x07, Width2= 0x00, Width3= 0x00.
i. Height stands for layer height (Height = Height3<<24 + Height2<<16 + Height1<<8 + Height0). For example, Height = 1080 = 0x438 = Height3<<24 + Height2<<16 + Height1<<8 + Height0 = 0x00<<24 + 0x00<<16 + 0x04<<8 + 0x38, then Height0= 0x38, Height1= 0x04, Height2= 0x00, Height3= 0x00.
j. "SUM_L" and "SUM_H" constitute the checksum of this command frame, which is the sum of the underlined data and 0x5555. The calculation formula is as below. SUM = 0x00 +

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0x00 + 0xfe + 0x00 + 0x00 + 0x00 + 0x00 + 0x00 + 0x01 + 0x00 + Addr0 + Addr1 + Addr2 + Addr3 + 0x30 + 0x00 + Switch + WindowNo + CardNo + Priority + Source + StartX0 + StartX1 + StartX2 + StartX3 + StartY0 + StartY1 + StartY2 + StartY3 + Width0 + Width1 + Width2 + Width3 + Height0 + Height1 + Height2 + Height3 + 0x00+ 0x00 + 0x00 + 0x5555, SUM = SUM_H<<8 + SUM_L ("SUM_L" stands for the lower 8 bits of SUM, while "SUM_H" stands for the higher 8 bits of SUM).

k. Addr: Addr stands for the layer parameter address (Addr = Addr3<<24 + Addr2<<16 + Addr1<<8 + Addr0). Different layers have different parameter addresses. The calculation formula for Addr is Addr = 0x13020010 + WindowNo * 0x30. For example, if you want to adjust the parameters of PIP1 layer, then Addr = 0x13020010 + 1 * 0x30 = 0x13020040 = Addr3<<24 + Addr2<<16 + Addr1<<8 + Addr0 = 0x13<<24 + 0x02<<16 + 0x00<<8 + 0x40, that is, Addr0 = 0x40, Addr1 = 0x00, Addr2 = 0x02, Addr3 = 0x13.

l. Opacity stands for the layer opacity degree. The value ranges from 0x00 (0, totally transparent) to 0x64 (100%, nontransparent).

(2) Response packet

If the response packet is in the following format, the layer parameters are set successfully.

aa 55 00 00 00 fe 00 00 00 00 01 00 Addr0 Addr1 Addr2 Addr3 00 00 SUM_L SUM_H

"SUM_L" and "SUM_H" constitute the checksum of this command frame, which is the sum of the underlined data and 0x5555. The calculation formula is as below.

SUM = 0x00 + 0x00 + 0x00 + 0xfe + 0x00 + 0x00 + 0x00 + 0x00 + 0x01 + 0x00 + Addr0 + Addr1 + Addr2 + Addr3 + 0x00 + 0x00 + 0x5555, SUM = SUM_H<<8 + SUM_L ("SUM_L" stands for the lower 8 bits of SUM, while "SUM_H" stands for the higher 8 bits of SUM).

3.5 Preset

3.5.1 Load Presets

(1) Command to load a preset

Load Preset XX:

55 aa 00 00 fe 00 00 00 00 00 01 00 00 01 51 13 01 00 XX SUM_L SUM_H

The command data is in hexadecimal format and XX stands for the preset number. The number range is 0x00-0x09 which represents Preset 1-10. For the exact preset numbers, see Appendix 6. "SUM_L" and "SUM_H" constitute the checksum of this command frame, which is the sum of the underlined data and 0x5555. The calculation formula is as below.

SUM = 0x00 + 0x00 + 0xfe + 0x00 + 0x00 + 0x00 + 0x00 + 0x00 + 0x01 + 0x00 + 0x00 + 0x01 + 0x51 + 0x13 + 0x01 + 0x00 + XX + 0x5555, SUM = SUM_H<<8 + SUM_L ("SUM_L" stands for the lower 8 bits of SUM, while "SUM_H" stands for the higher 8 bits of SUM).

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The following table lists the command data for loading the presets.

Preset Number	Command Data
1	55 aa 00 00 fe 00 00 00 00 00 01 00 00 01 51 13 01 00 00 ba 56
2	55 aa 00 00 fe 00 00 00 00 00 01 00 00 01 51 13 01 00 01 bb 56
3	55 aa 00 00 fe 00 00 00 00 00 01 00 00 01 51 13 01 00 02 bc 56
4	55 aa 00 00 fe 00 00 00 00 00 01 00 00 01 51 13 01 00 03 bd 56
5	55 aa 00 00 fe 00 00 00 00 00 01 00 00 01 51 13 01 00 04 be 56
6	55 aa 00 00 fe 00 00 00 00 00 01 00 00 01 51 13 01 00 05 bf 56
7	55 aa 00 00 fe 00 00 00 00 00 01 00 00 01 51 13 01 00 06 c0 56
8	55 aa 00 00 fe 00 00 00 00 00 01 00 00 01 51 13 01 00 07 c1 56
9	55 aa 00 00 fe 00 00 00 00 00 01 00 00 01 51 13 01 00 08 c2 56
10	55 aa 00 00 fe 00 00 00 00 00 01 00 00 01 51 13 01 00 09 c3 56

(2) Response packet

If the response packet is in the following format, the preset is successfully loaded.

aa 55 00 00 00 fe 00 00 00 00 01 00 00 01 51 13 00 00 b9 56

3.5.2 Save Presets

(1) Command to save a preset

Save Preset XX:

55 aa 00 00 fe 00 00 00 00 00 01 00 02 01 51 13 01 00 XX SUM_L SUM_H

The command data is in hexadecimal format and XX stands for the preset number. The number range is 0x00-0x09 which represents Preset 1-10. For the exact preset numbers, see Appendix 6. "SUM_L" and "SUM_H" constitute the checksum of this command frame, which is the sum of the underlined data and 0x5555. The calculation formula is as below.

SUM = 0x00 + 0x00 + 0xfe + 0x00 + 0x00 + 0x00 + 0x00 + 0x00 + 0x01 + 0x00 + 0x02 + 0x01 + 0x51 + 0x13 + 0x01 + 0x00 + XX + 0x5555, SUM = SUM_H<<8 + SUM_L ("SUM_L" stands for the lower 8 bits of SUM, while "SUM_H" stands for the higher 8 bits of SUM).

The following table lists the command data for saving the presets.

Preset Number	Command Data
1	55 aa 00 00 fe 00 00 00 00 00 01 00 02 01 51 13 01 00 00 bc 56
2	55 aa 00 00 fe 00 00 00 00 00 01 00 02 01 51 13 01 00 01 bd 56
3	55 aa 00 00 fe 00 00 00 00 00 01 00 02 01 51 13 01 00 02 be 56
4	55 aa 00 00 fe 00 00 00 00 00 01 00 02 01 51 13 01 00 03 bf 56
5	55 aa 00 00 fe 00 00 00 00 00 01 00 02 01 51 13 01 00 04 c0 56
6	55 aa 00 00 fe 00 00 00 00 00 01 00 02 01 51 13 01 00 05 c1 56
7	55 aa 00 00 fe 00 00 00 00 00 01 00 02 01 51 13 01 00 06 c2 56
8	55 aa 00 00 fe 00 00 00 00 00 01 00 02 01 51 13 01 00 07 c3 56

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9	55 aa 00 00 fe 00 00 00 00 00 01 00 02 01 51 13 01 00 08 c4 56
10	55 aa 00 00 fe 00 00 00 00 00 01 00 02 01 51 13 01 00 09 c5 56

(2) Response packet

If the response packet is in the following format, the preset is successfully saved.

aa 55 00 00 00 fe 00 00 00 00 01 00 02 01 51 13 00 00 bb 56

3.5.3 Delete Presets

(1) Command to delete a preset

Delete Preset XX:

55 aa 00 00 fe 00 00 00 00 00 01 00 04 01 51 13 02 00 00 XX SUM_L SUM_H

The command data is in hexadecimal format and XX stands for the preset number. The number range is 0x00-0x09 which represents Preset 1-10. For the exact preset numbers, see Appendix VI. "SUM_L" and "SUM_H" constitute the checksum of this command frame, which is the sum of the underlined data and 0x5555. The calculation formula is as below.

SUM = 0x00 + 0x00 + 0xfe + 0x00 + 0x00 + 0x00 + 0x00 + 0x00 + 0x01 + 0x00 + 0x04 + 0x01 + 0x51 + 0x13 + 0x02 + 0x00 + 0x00 + XX + 0x5555, SUM = SUM_H<<8 + SUM_L ("SUM_L" stands for the lower 8 bits of SUM, while "SUM_H" stands for the higher 8 bits of SUM).

The following table lists the command data for deleting the presets.

Preset Number	Command Data
1	55 aa 00 00 fe 00 00 00 00 00 01 00 04 01 51 13 02 00 00 00 bf 56
2	55 aa 00 00 fe 00 00 00 00 00 01 00 04 01 51 13 02 00 00 01 c0 56
3	55 aa 00 00 fe 00 00 00 00 00 01 00 04 01 51 13 02 00 00 02 c1 56
4	55 aa 00 00 fe 00 00 00 00 00 01 00 04 01 51 13 02 00 00 03 c2 56
5	55 aa 00 00 fe 00 00 00 00 00 01 00 04 01 51 13 02 00 00 04 c3 56
6	55 aa 00 00 fe 00 00 00 00 00 01 00 04 01 51 13 02 00 00 05 c4 56
7	55 aa 00 00 fe 00 00 00 00 00 01 00 04 01 51 13 02 00 00 06 c5 56
8	55 aa 00 00 fe 00 00 00 00 00 01 00 04 01 51 13 02 00 00 07 c6 56
9	55 aa 00 00 fe 00 00 00 00 00 01 00 04 01 51 13 02 00 00 08 c7 56
10	55 aa 00 00 fe 00 00 00 00 00 01 00 04 01 51 13 02 00 00 09 c8 56

(2) Response packet

If the response packet is in the following format, the preset is successfully deleted.

aa 55 00 00 00 fe 00 00 00 00 01 00 04 01 51 13 00 00 bd 56

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3.6 Appendix

3.6.1 Appendix I

Appendix I: Test pattern types

Type	Value
Full Black	0x00
Red	0x01
Green	0x02
Blue	0x03
White	0x04
Vertical Bars	0x05
Horizontal Bars	0x06
Chessboard	0x07
Horizontal Lines	0x10
Vertical Lines	0x11
Backward Slashes	0x12
Forward Slashes	0x13
Grid	0x14
Cross Hatch	0x15
Red Gradient (H)	0x20
Green Gradient (H)	0x21
Blue Gradient (H)	0x22
White Gradient (H)	0x23
Red Gradient (V)	0x24
Green Gradient (V)	0x25
Blue Gradient (V)	0x26
White Gradient (V)	0x27

3.6.2 Appendix II

Appendix II: Video connector codes

Connector Type	Connector Code
HDMI1	0x61
HDMI2	0x62
DVI1	0x69
DVI2	0x6A
SDI	0x30
OPT-1	0xE9
OPT-2	0xEA

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Connector Type	Connector Code
MOSAIC	0xE0

3.6.3 Appendix III

Appendix III: Card slot number codes

Type	Value
HDMI1	0x00
HDMI2	0x01
DVI1	0x02
DVI2	0x03
SDI	0x04
OPT-1	0x05
OPT-2	0x06
MOSAIC	0x07

3.6.4 Appendix IV

Appendix IV: Layer number codes

Layer Number	Code
Layer 1	0x00
Layer 2	0x01
Layer 3	0x02

3.6.5 Appendix V

Appendix V: Layer priority codes

Layer Priority	Code	Remarks
Layer priority: 1	0x00	The layer is at the bottom.
Layer priority: 2	0x01	The layer is in the middle.
Layer priority: 3	0x02	The layer is at the top.

3.6.6 Appendix VI

Appendix VI: Preset number codes

Preset Number	Code
Preset 1	0x00
Preset 2	0x01
Preset 3	0x02

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Preset Number	Code
Preset 4	0x03
Preset 5	0x04
Preset 6	0x05
Preset 7	0x06
Preset 8	0x07
Preset 9	0x08
Preset 10	0x09

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