Nova M3 Control System COM Protocol

Ver. 1.5

Revision of History

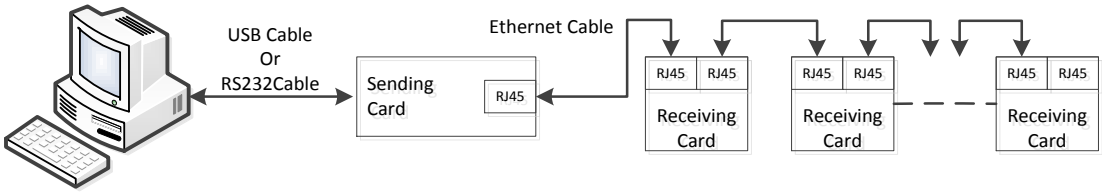
Version	Revised By	Modification	Date
1.3	Wade	**Add Chapter:** 3.11 Sending Card resolution setting 3.12 Display Control 3.13 Calibration Control 3.14 Reconnect Sending Card/Receiving Card	2014-8-15
1.4	Wade	**Add Chapter:** 1.2 RS232 Software setting; Add “3.3 Brightness Adjustment” example (1) Set all receiving cards on the same Ethernet port overall brightness (2) Set all receiving cards on all Ethernet ports overall brightness **Update Chapter:** 3.5 Gamma Value and Table 3.8.3 Protocol for accessing NS048C through function card	2015-3-18
1.5	Wade	**3.1.1 Basic monitoring data** Add command package example to acquire temperature data and voltage data **3.1.2 DVI signal checking** Add command package to check when there is DVI signal input **3.3 Brightness Adjustment** Add note **3.4 Reset Sending Cards/Controllers to Factory Setting** Add command package example **3.5.1 Gamma Value** Add command package example **3.5.2 Gamma Table** Add note **3.6 Sending cards / Controllers Firmware Version Information** Add command package example **3.7.2 Controller** Add command package example **3.7.3 Function card** Add command package example	2015-5-15

		3.8.2 Protocol for accessing MTH300 Modify Temperature Unit to 0.10℃ **3.8.5 Protocol for stand-alone light sensor** Add command package example **3.12.1 Display control register setting** Add command package example **3.15 Parameter Store** Add parameter save command	

1 Initial

1.1 Data Transmission Direction

- The command transmission is through serial port.
- The command is accepted and acknowledged by sending cards.



1.2 RS232 Software setting

Different sending unit/card has different baud rate.

For MSD300/MCTRL300/MCTRL500

- Baud rate: 115200 bps
- Data Bits: 8
- Parity: NONE
- Stop Bits: 1
- Flow Type: OFF

For MSD600/MCTRL600/MCTRL660

- Baud rate: 1048576 bps
- Data Bits: 8
- Parity: NONE
- Stop Bits: 1
- Flow Type: OFF

2 Data Package Format For Command

2.1 Format of Request Data Package

- Byte Definition For the Data Package Format

No.	1	2	3	4	5
Byte Counts	2	1	1	1	1
Content	Head	ACK	Serial Number	Source Address	Destination Address

No.	6	7	8	
Length (Byte)	1	1	2	
Content	Device Type	Port Address	Board Address[7:0]	Board Address[15:8]

No.	9	10	11	
Length (Byte)	1	1	4	
Content	Code	Reserved	Register Unit Address[7:0]	Register Unit Address[15:8]

No.			12
Length (Byte)			2
Content	Register Unit Address[23:16]	Register Unit Address[31:24]	Valid Data Length[7:0]

No.		13	14	
Length (Byte)		N	2	
Content	Valid Data Length[15:8]	Write Data [0:N]	Checkout[7:0]	Checkout[15:8]

➢ Notation

No.	Content	Meaning	Remark
1	Head	Data package head	55H，AAH
2	ACK	Not used for Request Command	00H
3	Serial Number	Serial number of a command. Should not be used again before the command with this serial number has been finished.	
4	Source Address	Address of the computer or sending card that generates and starts the command.	This address for a computer is fixed to be: FEH.
5	Destination Address	Address of the computer or sending card that the command is to be sent to. For computer, the address is fixed to be FEH. The first device with Com port properties (could accept and	Devices connected in daisy chain to a

		process command.) connected to the com port has the address of 0, the second device has the address of 1, and so on.		computer serial port should be of the same type.
6	Device Type	00H	Devices with Com port properties, like sending cards, TV cards.	
		01H	Receiving card	
		02H	Function card	
7	Port Address	RJ45 output port address of the sending card		[0,1,2,3]
8	Board Address[7:0]	Low 8 bits of the address of a device connected in daisy chain on a CAT5 data cable.		The first device connected on the cable has the address of 0, the second device has the address of 1, and so on. Note that different type of devices will be assigned address respectively.
	Board Address[15:8]	High 8 bits of the address of a device connected in daisy chain on a CAT5 data cable.		
9	Code	00H	Indicating this is a Read data package (command)	Both read and write are defined from the aspect of the device that starts the command.
		01H	Indicating this is a Write data package (command)	
		02H-FFH	Reserved	
10	Reserved	Reserved		
11	Register Unit Address[7:0]	The first byte (low) of the address of the register unit on a device		The register unit address is 4 bytes long. Low at the front and high at the end.
	Register Unit Address[15:8]	The second byte of the address of the register unit on a device		
	Register Unit Address[23:16]	The third byte of the address of the register unit on a device		
	Register Unit Address[31:24]	The forth byte (high) of the address of the register unit on a device		
12	Valid Data Length[7:0]	Low 8 bits of the length of valid data.		This is the length of the data to be written to the destination device when
	Valid Data Length[15:8]	High 8 bits of the length of valid data.		

			Code is 01H. And when Code is 00H, this will be the length of the data to be read from the destination device.
13	Write Data [0:N]	Data to be written to the destination device. The length N is given by Valid Data Length.	When Code is 01H, this section is the data to written. When Code is 00H, this section does not exist.
14	Checkout[7:0]	Low 8 bits of the checksum	The sum of all data in byte except the packet Head and then plus 0x5555.
	Checkout[15:8]	High 8 bits of the checksum	

➢ Example

Command (Data package) good to be sent

55 AA 00 32 FE 00 01 00 00 00 00 00 00 00 00 0A 00 01 91 56

1 2 3 4 5 6 7 8 9 10 11 12 14

Note:

- ✧ The numbers pointed by the arrows are the No. in the tables above.
- ✧ There no number 13 because the Code is 00, and the Write Data does not exist.
- ✧ Checksum = 32 + FE + 01 + 0A + 01 + 5555 = 5691, so checkout[7:0]=91, checkout[15:8]=56.

2.2 Format of the Acknowledge Data Package

➢ Byte Definition of the Data Package Format

No.	1	2	3	4	5
Length (Byte)	2	1	1	1	1
Content	Head	ACK	Serial Number	Source Address	Destination Address

No.	6	7	8	
Length (Byte)	1	1	2	
Content	Device Type	Port Address	Board Address[7:0]	Board Address[15:8]

No.	9	10	11	
Length (Byte)	1	1	4	
Content	Code	Reserved	Register Unit Address[7:0]	Register Unit Address[15:8]

No.			12
Length (Byte)			2
Content	Register Unit Address[23:16]	Register Unit Address[31:24]	Valid Data Length[7:0]

No.		13	14	
Length (Byte)		N	2	
Content	Valid Data Length[15:8]	Write Data [0:N]	Checkout[7:0]	Checkout[15:8]

➢ Notation

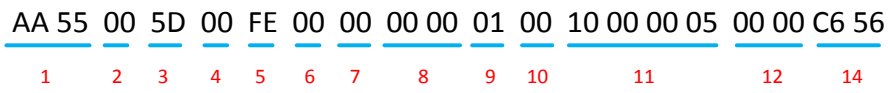
No.	Content	Meaning		Remark
1	Head	Head of the data package		AAH，55H
2	ACK	00H	Command Succeeded	Different ACK value indicates different result.
		01H	Command failed due to time out (time out on trying to access devices connected to a sending card)	
		02H	Command failed due to check error on request data package	
		03H	Command failed due to check error on acknowledge data package	
		04H	Command failed due to invalid command	
		05H	Reserved	
		06H-FFH	Reserved	
3	Serial Number	Serial number of a command. Should not be used again before the command with this serial number has been finished.		

4	Source Address	Address of the computer or sending card that generates and starts the command.		This address for a computer is fixed to be : FEH.
5	Destination Address	Address of the computer or sending card that the command is to be sent to. For computer, the address is fixed to be FEH. The first device with Com port properties (could accept and process command.) connected to the com port has the address of 0, the second device has the address of 1, and so on.		Devices connected in daisy chain to a computer serial port should be of the same type.
6	Device Type	00H	Devices with Com port properties, like sending cards, TV cards.	
		01H	Receiving card	
		02H	Function card	
7	Port Address	RJ45 output port address of the sending card		
8	Board Address[7:0]	Low 8 bits of the address of a device connected in daisy chain on a CAT5 data cable.		The first device connected on the cable has the address of 0, the second device has the address of 1, and so on. Note that different type of devices will be assigned address respectively.
	Board Address[15:8]	High 8 bits of the address of a device connected in daisy chain on a CAT5 data cable.		
9	Code	00H	Indicating this is a Read data package (command)	
		01H	Indicating this is a Write data package (command)	
		02H-FFH	Reserved	
10	Reserved	Reserved		
11	Register Unit Address[7:0]	The first byte (low) of the address of the register unit on a device		The register unit address is 4 bytes long. Low at the front and high at the end.
	Register Unit Address[15:8]	The second byte of the address of the register unit on a device		
	Register Unit Address[23:16]	The third byte of the address of the register unit on a device		
	Register Unit Address[31:24]	The forth byte (high) of the address of the register unit on a device		
12	Valid Data	Low 8 bits of the length of valid data.		When Code is

	Length[7:0]		00H, this is the length of the data read for the destination device. When Code is 00H, this will be 0.
	Valid Data Length[15:8]	High 8 bits of the length of valid data.	
13	Write Data [0:N]	Data to be written to the destination device. The length N is given by Valid Data Length.	When Code is 00H, this is the data read from the destination device. When Code is 01H, this section does not exist.
14	Checkout[7:0]	Low 8 bits of the checksum	The sum of all data in byte except the packet Head and then plus 0x5555.
	Checkout[15:8]	High 8 bits of the checksum	

➢ Example:

Data package retrieved from the Com port.



Note:

✧ The numbers pointed by the arrows are the No. in the tables above.

✧ There no number 13 because the Code is 01, and the Write Data does not exist.

✧ Chechsum = 5D + FE + 01 + 10 + 05 + 5555 = 56C6, so checkout[7:0] = C6, checkout[15:8] = 56.

3 Commands

3.1 Command for acquiring monitoring data

Monitor card may be required for some of the data.

3.1.1 Basic monitoring data

- Device: Receiving Card
- Base Address: 0a000000 H
- Data Length: 100H

Offset	Name	Attribute	Description	Realize Status	Remark
0x000000	TempValidOfScanCard	R	This byte is for the temperature sensor on the receiving card. The highest bit is used to indicate valid temperature data. 1 for data valid and 0 for data invalid. The lowest bit is for negative/positive temperature. 0 for positive and 1 for negative.		
0x000001	TempOfScanCard	R	Temperature output by the sensor on the receiving card. Unit: 0.5 ^{o}C		
0x000002	HumiOfScanCard	R	This byte is for humidity measured by sensor on the receiving card. The highest bit is for valid data. 1 for valid and 0 for invalid. The rest 7 bits are for the humidity value. Value range: 0~100 Unit: %RH		No humidity sensor on all Nova Receiving card at this moment.
0x000003	VoltageOfScanCard	R	This byte is for power supply voltage of the receiving card. The highest bit is for valid data. 1 for valid and 0 for invalid.		

			The rest 7 bits are for the voltage value. Value range: 0~127 Unit: 0.1V		
0x000004 ... 0x00001f	Reserved	R	Reserved		
0x000020	AttachedMonitorCardExist	R	This byte is used to indicate whether the monitor card is existed. 0xff for monitor card existing and other values for not existing.		
0x000021	AttachedMonitorCardModle	R	Module information of the monitor card		
0x000022					
0x000023	AttachedMonitorCardProgramVersion	R	Firmware version of the monitor card		
0x000024					
0x000025					
0x000026					
0x000027	TempValidOfMonitorCard	R	This byte is for the temperature sensor on the monitor card. The highest bit is used to indicate valid temperature data. 1 for data valid and 0 for data invalid. The lowest bit is for negative/positive temperature. 0 for positive and 1 for negative.		
0x000028	Reserver	R	Reserved		
0x000029	HumiOfMonitorCard	R	This byte is for humidity measured by sensor on the monitor card. The highest bit is for valid data. 1 for valid and 0 for invalid. The rest 7 bits are for the humidity value. Value range: 0~100 Unit: %RH		
0x00002a		R	This byte is for the smoke sensor on the monitor card. The lowest bit is used to indicate whether smoke is detected. 0 for no smoke detected and 1 for smoke detected.		
0x00002b	FanSpeed0OfMonitorCard	R	The speed of Fan 1 monitored by the monitor card. The highest bit is for data validation. The rest 7 bits are for the speed, ranging form 0 to 127 with unit 50rpm.		
0x00002c	FanSpeed1OfMoni	R	The speed of Fan 2 monitored by the		

	torCard		monitor card. The highest bit is for data validation. The rest 7 bits are for the speed, ranging form 0 to 127 with unit 50rpm.		
0x00002d	FanSpeed2OfMonitorCard	R	The speed of Fan 3 monitored by the monitor card. The highest bit is for data validation. The rest 7 bits are for the speed, ranging form 0 to 127 with unit 50rpm.		
0x00002e	FanSpeed3OfMonitorCard	R	The speed of Fan 4 monitored by the monitor card. The highest bit is for data validation. The rest 7 bits are for the speed, ranging form 0 to 127 with unit 50rpm.		
0x00002f	Voltage0OfMonitorCard	R	Power supply voltage of the monitor card. The highest bit is for data validation. The rest 7 bits are for the voltage value, ranging form 0 to 127 with unit 0.1V.		
0x000030	Voltage1OfMonitorCard	R	The Voltage 1 monitored by the monitor card. The highest bit is for data validation. The rest 7 bits are for the voltage value, ranging form 0 to 127 with unit 0.1V.		
0x000031	Voltage2OfMonitorCard	R	The Voltage 2 monitored by the monitor card. The highest bit is for data validation. The rest 7 bits are for the voltage value, ranging form 0 to 127 with unit 0.1V.		
0x000032	Voltage3OfMonitorCard	R	The Voltage 3 monitored by the monitor card. The highest bit is for data validation. The rest 7 bits are for the voltage value, ranging form 0 to 127 with unit 0.1V.		
0x000033	Voltage4OfMonitorCard	R	The Voltage 4 monitored by the monitor card. The highest bit is for data validation. The rest 7 bits are for the voltage value, ranging form 0 to 127 with unit 0.1V.		
0x000034	Voltage5OfMonitorCard	R	The Voltage 5 monitored by the monitor card. The highest bit is for data validation. The rest 7 bits are for the voltage value, ranging form 0 to 127 with unit 0.1V.		

0x000035	Voltage6OfMonitorCard	R	The Voltage 6 monitored by the monitor card. The highest bit is for data validation. The rest 7 bits are for the voltage value, ranging form 0 to 127 with unit 0.1V.		
0x000036	Voltage7OfMonitorCard	R	The Voltage 7 monitored by the monitor card. The highest bit is for data validation. The rest 7 bits are for the voltage value, ranging form 0 to 127 with unit 0.1V.		
0x000037	Voltage8OfMonitorCard	R	The Voltage 8 monitored by the monitor card. The highest bit is for data validation. The rest 7 bits are for the voltage value, ranging form 0 to 127 with unit 0.1V.		
0x000038 ... 0x000040	Reserved	R	Reserved		
0x000041	GeneralStatusOfMonitorCard	R	This byte is for cabinet door opening checking. Bit 0 is for the first cabinet and Bit1 is for the second cabinet. 0 for door closed and 1 for door open.		
0x000042 ... 0x0000ff	Reserved	R	Reserved		

Note:
Only when a monitor card is connected to the control system will the data of the monitor card be valid. So when get the data, the first step is to check whether the monitor card is existed by analyzing data at 0x000020. If the monitor card does not exist, do not use the monitor card data.

- Example

  To acquire monitoring data of the first receiving card

Request command: 55 AA 00 32 FE 00 01 00 00 00 00 00 00 00 00 0A 00 01 91 56
Acknowledge Data Package：AA 55 00 32 00 FE 01 00 00 00 00 00 00 00 00 0A 00 01 80 36 00 B1 00 00 00 00 00 00 00 08 01 04 04 05 00 10 32 54 76 00 00 00 00 E4 00 00 00 00 00 00 FF 01 00 04 00 00 00 00 00 B2 80 80 80 80 80 B1 80 80 80 80 80 80 80 80 00 00 00 00 00 00 00 00 00 03 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF 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 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 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 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 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 00 00 D8 72

➢ Example

To acquire temperature data of the first receiving card

Request command: 55 AA 00 32 FE 00 01 00 00 00 00 00 00 00 0A 02 00 92 56

Acknowledge Data Package：AA 55 00 32 00 FE 01 00 00 00 00 00 00 00 0A 02 00 80 56 68 57

Note:

80: means the data is valid

56: means the temperature is 43 ℃

➢ Example

To acquire voltage data of the first receiving card

Request command: 55 AA 00 32 FE 00 01 00 00 00 00 00 03 00 00 0A 01 00 94 56

Acknowledge Data Package： AA 55 00 32 00 FE 01 00 00 00 00 00 03 00 00 0A 01 00 A9 3D 57

Note:

A9: MSB is '1', means the data is valid; low 7bit value is "29", means the voltage is 4.1 V.

3.1.2 DVI signal checking

- Device: Sending Card
- Base Address: 02000000 H
- Data Length: 1H

Offset	Attribute	Description
0x000017	R	This byte is for valid DVI signal. 01： DVI signal is good 00： No DVI signal

➢ Example

To check whether a sending card has DVI signal in.

There is no DVI signal input:

Request Command： 55 AA 00 16 FE 00 00 00 00 00 00 00 17 00 00 02 01 00 83 56

Acknowledge Data Package： AA 55 00 16 00 FE 00 00 00 00 00 00 17 00 00 02 01 00 00 83 56

There is DVI signal input:

Request Command： 55 AA 00 16 FE 00 00 00 00 00 00 00 17 00 00 02 01 00 83 56

Acknowledge Data Package： AA 55 00 16 00 FE 00 00 00 00 00 00 17 00 00 02 01 00 01 84 56

3.2 Power Supply Control

A function card should be connected to the com port of the computer.

- Device: Function Card
- Base Address: 05000000 H
- Data Length: 1H

Offset	Name	Attribute	Description	Value
0x000010H	PowerPortCtrl1	R/W	Status of the 1st power supply switch	0 for on 1 for off
0x000011H	PowerPortCtrl2	R/W	Status of the 2nd power supply switch	0 for on 1 for off
0x000012H	PowerPortCtrl3	R/W	Status of the 3rd power supply switch	0 for on 1 for off
0x000013H	PowerPortCtrl4	R/W	Status of the 4th power supply switch	0 for on 1 for off
0x000014H	PowerPortCtrl5	R/W	Status of the 5th power supply switch	0 for on 1 for off
0x000015H	PowerPortCtrl6	R/W	Status of the 6th power supply switch	0 for on 1 for off
0x000016H	PowerPortCtrl7	R/W	Status of the 7th power supply switch	0 for on 1 for off
0x000017H	PowerPortCtrl8	R/W	Status of the 8th power supply switch	0 for on 1 for off

➢ Example

To turn the 1st power supply on.

Request Command：55 AA 00 5D FE 00 00 00 00 00 01 00 10 00 00 05 01 00 00 C7 56

Acknowledge Data Package：AA 55 00 5D 00 FE 00 00 00 00 01 00 10 00 00 05 00 00 C6 56

3.3 Brightness Adjustment

- Device: Receiving Card
- Base Address: 02000000 H
- Data Length: 5H

Offset	Name	Attribute	Description
0x000001	Global Brightness	R/W	The overall brightness
0x000002	Red Brightness	R/W	Brightness of the red component
0x000003	Green Brightness	R/W	Brightness of the green component
0x000004	Blue Brightness	R/W	Brightness of the blue component
0x000005	V Red Brightness	R/W	Brightness of the virtual red component

Note:

The range of brightness is 0 ~ 255. 0 represents the minimum brightness, while 255 represents the maximum brightness.

➢ Example

Read the brightness of the first receiving card.

Request Command：55 AA 00 14 FE 00 01 00 00 00 00 00 01 00 00 02 05 00 70 56

Acknowledge Data Package：AA 55 00 14 00 FE 01 00 00 00 00 00 01 00 00 02 05 00 FF FF FF FF FF 6B 5B

➢ Example

Set the overall brightness and brightness of all five components as 128.

Request Command：55 AA 00 15 FE 00 01 00 00 00 01 00 01 00 00 02 05 00 80 80 80 80 80 F2 58

Acknowledge Data Package：AA 55 00 15 00 FE 01 00 00 00 01 00 01 00 00 02 00 00 6D 56

➢ Example

Set the overall brightness of one component as 128.

Request Command：55 AA 00 15 FE 00 01 00 00 00 01 00 01 00 00 02 01 00 80 EE 56

Acknowledge Data Package：AA 55 00 15 00 FE 01 00 00 00 01 00 01 00 00 02 00 00 6D 56

Broadcasting the commands on one Ethernet port, set the response device's number as FF. Such as set scan board address as FF FF, means that all the receiving cards connected on the same Ethernet port would receive the write data command.

➢ Example

Set all receiving cards on the same Ethernet port overall brightness and brightness of all five components as 128

Request Command：55 AA 00 15 FE 00 01 00 FF FF 01 00 01 00 00 02 05 00 80 80 80 80 80 F0 5A
Acknowledge Data Package：AA 55 00 15 00 FE 01 00 FF FF 01 00 01 00 00 02 00 00 6B 58

Broadcasting the commands on all Ethernet ports, set the response device's number as FF. Such as set port address as FF and board address as FF FF, means that all the receiving cards of the screen would receive the write data command.

➢ Example

Set all receiving cards on all Ethernet ports overall brightness and brightness of all five components as 128

Request Command：55 AA 00 15 FE 00 01 FF FF FF 01 00 01 00 00 02 05 00 80 80 80 80 80 EF 5B
Acknowledge Data Package：AA 55 00 15 00 FE 01 FF FF FF 01 00 01 00 00 02 00 00 6A 59

Note:
To store the parameters into the flash, there is a parameter store operation must be implemented. For more details, please refer to Chapter 3.15.

3.4 Reset Sending Cards/Controllers to Factory Setting

- Device: Sending Card
- Base Address: 0100_0000H
- Data Length: 1H

Register Unit Base Address: 0100_0000H

Offset(H)	Name	Bits	Attribute	Description	Default(H)
02H	Command for resetting to factory setting	8	R/W	Writing any value to this register will activate the operation of reset all sending cards / controllers to factory setting.	00

➢ Example

Request Command：55 AA 00 32 FE 00 00 00 00 00 01 00 02 00 00 01 01 00 01 8B 56
Acknowledge Data Package：AA 55 00 32 00 FE 00 00 00 00 01 00 02 00 00 01 00 00 89 56

3.5 Gamma Value and Table

3.5.1 Gamma Value

- Device: Receiving Card
- Base Address: 02000000 H
- Data Length: 1H

The Gamma value is one of the parameters in the gamma transform equation. It is stored in the receiving card.

Offset	Name	Attribute	Description
0x000000	Gamma	R/W	Gamma value

Note:

Gamma transform equation

$$y = (2^m - 1) \times (\frac{x}{2^n - 1})^\gamma$$

y: output value of gamma transform

m: data width of output value

x: input value of gray scale

n: data width of input value, normally n=8

γ: *the gamma value*

➢ Example

Request Command：55 AA 00 15 FE 00 01 00 00 00 00 00 00 00 00 02 01 00 6C 56

Acknowledge Data Package：AA 55 00 15 00 FE 01 00 00 00 00 00 00 00 00 02 01 00 1C 88 56

Note：

1C：means the gamma value is 2.0.

3.5.2 Gamma Table

- Device: Receiving Card
- Base Address: 0x0500_0000H
- Data Length: 400H

Gamma table is used for data transform. It is based on look-up table method. When the receiving card receives the video data from sending card, it will finish the transformation through look-up table method. Offset addresses 0x000100~0x0003ff are reserved.

Offset	Name	Bits	Attribute	Description
0x000000 … 0x0003ff	GammaTable	16	R/W	The gamma table is saved here.

Note:

To store the parameters into the flash, there is a parameter store operation must be implemented. For more details, please refer to Chapter 3.15.

3.6 Sending cards / Controllers Firmware Version Information

- Device: Sending Card
- Base Address: 0x0400_0000H
- Data Length: 4H

Offset(H)	Name	Bits	Attribute	Description
10_0004	FPGA program version	8	R/W	The version number has four parts. Each part is represent by one byte.
10_0005		8	R/W	
10_0006		8	R/W	
10_0007		8	R/W	

➢ Example

Request Command：55 AA 00 15 FE 00 00 00 00 00 00 00 04 00 10 04 04 00 84 56

Acknowledge Data Package：AA 55 00 15 00 FE 00 00 00 00 00 00 04 00 10 04 04 00 04 03 00 00 8B 56

Note:

04 03 00 00: means the FPGA program version is 4.3.0.0

3.7 Hardware Reference

Each device has a Model ID. The Model ID is represented by two bytes.

3.7.1 Receiving card

All types of receiving cards have the same Model ID. It is as follow

- Device: Receiving Card
- Data Length: 1H

Device Type	Model ID (High byte)	Model ID(Low byte)
All types	0x41	0x01

3.7.2 Controller

- Device: Sending Card
- Base Address: 0x0000_0000H
- Data Length: 2H

Offset(H)	Name	Bits	Attribute	Description	Default(H)
2H	Controller/Sender Model ID	8	R	Lowe byte of the controller model ID	
3H		8	R	High byte of the controller model ID	

Sending Cards / Controllers Model ID Table

Device Type	ModelID (High byte)	ModelID(low byte)
MCRL500	0x01	0x01
MSD300/MCTRL300	0x00	0x01
MSD600/MCTRL600/MCTRL610	0x11	0x01

➢ Example

Request Command：55 AA 00 32 FE 00 00 00 00 00 00 00 02 00 00 00 02 00 87 56

Acknowledge Data Package：AA 55 02 32 00 FE 00 00 00 00 00 00 02 00 00 00 02 00 01 00 8C 56

3.7.3 Function Card

- Device: Function Card
- Base Address: 0x0000_0000H
- Data Length: 2H

Offset	Name	Attri.	Description
2H	FuncCardModle ID	R	Function card Model ID
3H			

Function Card Model ID Table

Device Type	ModelID (High byte)	ModelID(Low byte)
MFN300	0x81	0x01

➢ Example

Request Command：55 AA 00 32 FE 00 02 00 00 00 00 00 02 00 00 00 02 00 8B 56

Acknowledge Data Package：AA 55 00 32 00 FE 02 00 00 00 00 00 02 00 00 00 02 00 01 81 0D 57

3.8 Environment Temperature&Humidity and Brightness

The environment temperature and humidity information is from thermal/humidity sensor MTH300. A MTH300 shall be connected to a function card through RS485 port. The following information is for how to read temperature and humidity from a MTH300.

To read data from a MTH300, one sends a command to the function card first (write certain data to the function card). After receiving the command, the function will acquire temperature and humidity data from the MTH300 and put them at special address. One can then get the temperature and humidity data by reading data from that special address of the function card.

In the table below are the address of the function card to send command to and read temperature and humidity from.

Note that when a light sensor NS048C is connected to the system through a function card, the environment brightness measured by it can be read back in the similar way like a MTH300.

A light sensor can also be connected to a sending card/box directly. Please refer to 3.8.4 for the protocol for accessing a light sensor directly connected to a sending card/box.

3.8.1 Function card RS485 external device Management

- Device: Function Card
- Base Address: 0x0600_0000H
- Data Length:

Offset	Name	Attri.	Description	Remark
0H	Address of the external device to be accessed	W	There are 4 RS485 ports on a function card. Their addresses are from 0 to 3. This can be found form the function card.	
1H	Data transmission speed (between function card and external device)	W	Set as 0	Baud Rate 115200bps
2-3H	Reserved	W	Set as 0	Reserved
4H-……		W	Write or read these bytes according to the protocol for accessing external device.	Protocol for accessing external device

3.8.2 Protocol for accessing MTH300

The following should be written to the address starting from 4H. After these 3 bytes are written, the function card can acquire data from the MTH300 when the request command is sent.

Offset	Name	Attri.	Description	Remark
0H		W	0x55	
1H		W	0xAA	
2H		W	0x82	
			END	

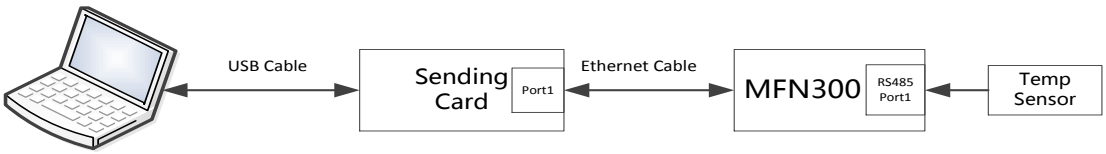
Read the 7 bytes starting from 4H. Temperature and humidity data is in them.

Offset	Name	Attribute	Description	Remark
0H	Package Head	R	0xaa	
1H	Package Head	R	0x55	
2H	Package Head	R	0x82	
3H	Low byte of temperature	R	xx	Temperature Unit: 0.10℃
4H	High byte of temperature	R	xx	The highest bit is for the validation of the value. 1 means that the data is valid.
5H	Humidity	R	xx	Humidity Unit: 1%.

				The highest bit is for the validation of the value. 1 means that the data is valid.
6H	Checksum	R	xx	Package head shall not be included when calculate the checksum.

➢ Example

In order to acquire the data from MTH300 through function card, two request commands need to be sent for one time. The two commands need to be pairs used. The first request command is to refresh the register data of MTH300 in function card. The second command is to read the data from function card.



Data refresh command:

Request Command: 55 AA 00 15 FE 00 02 00 00 00 01 00 00 00 00 06 07 00 00 00 00 00 55 AA 82 F9 57

Acknowledge Data Package: AA 55 00 15 00 FE 02 00 00 00 01 00 00 00 00 06 00 00 71 56

Note:

02: commands to function card

00: commands output from sending card port 1

01: write data

00 00 00 00 06: base address

07: data length

00: RS485 port 1

00: set baud rate, the data transmission speed between function card and external device

00: reserved

00: reserved

55 AA 82: protocol for accessing MTH300

Data read command:

Request Command: 55 AA 00 15 FE 00 02 00 00 00 00 00 00 00 00 06 07 00 77 56

Acknowledge Data Package: AA 55 00 15 00 FE 02 00 00 00 00 00 00 00 00 06 07 00 AA 55 82 25 81 00 28 C6 58

Note:

02: commands to function card

00: commands output from sending card port 1

00: read data

00 00 00 00 06: base address

07: data length

AA 55 82: package head of result

25: low byte of environment temperature. The unit for the brightness data is 0.1℃.

81: high byte of environment temperature. The highest bit is for data validation. And 1 means the data is valid.

00: Humidity value. The highest bit is for the validation of the value. 1 means that the data is valid.

28: check sum

3.8.3 Protocol for accessing NS048C through function card

The following should be written to the address starting from 4H. After these 7 bytes are written, the function card will acquire data from the light sensor NS048C.

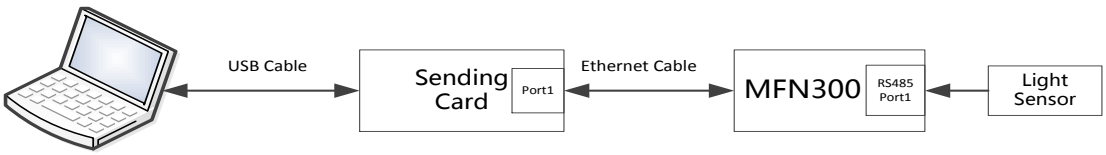
Offset	Name	Attri.	Description	Remark
0H		W	0x55	
1H		W	0xAA	
2H		W	0x01	
3H		W	0x02	
4H		W	0x80	
5H		W	0xFF	
6H		W	0x81	
			END	

Read the 5 bytes starting from 4H. Environment brightness data is in them. The unit for the brightness data is 2Lux.

Offset	Name	Attri.	Description	Remark
0H	Package Head		0x01	
1H	Data Length		0x02	
2H	High byte of environment brightness		xx	The highest bit is for data validation. And 1 means the data is valid.
3H	Low byte of environment brightness		xx	
4H	Check Sum		xx	

➢ Example

In order to acquire the data from NS048C through function card, two request commands need to be sent for one time. The two commands need to be pairs used. The first request command is to refresh the register data of NS048 in function card. The second command is to read the data from function card.



Data refresh command:

Request Command: 55 AA 00 15 FE 00 02 00 00 00 01 00 00 00 00 06 0B 00 00 00 00 00 55 AA 01 02 80 FF 81 7E 59

Acknowledge Data Package: AA 55 00 15 00 FE 02 00 00 00 01 00 00 00 00 06 00 00 71 56

Note:

02: commands to function card

00: commands output from sending card port 1

01: write data

00 00 00 00 06: base address

0B: data length

00: RS485 port 1

00: set baud rate, the data transmission speed between function card and external device

00: reserved

00: reserved

55 AA 01 02 80 FF 81: protocol for accessing NS048C

Data read command:

Request Command: 55 AA 00 15 FE 00 02 00 00 00 00 00 00 00 00 06 05 00 75 56

Acknowledge Data Package: AA 55 00 15 00 FE 02 00 00 00 00 00 00 00 00 06 05 00 01 02 80 5F E1 38 58

Note:

02: commands to function card

00: commands output from sending card port 1

00: read data

00 00 00 00 06: base address

05: data length

01: package head of result

02: package length of result

80: high byte of environment brightness. The highest bit is for data validation. And 1 means the data is valid.

5F: low byte of environment brightness. The unit for the brightness data is 2Lux.

E1: check sum

3.8.4 Protocol for accessing NS048C directly

- Device: Sending Card
- Base Address: 0x0200_0000H
- Data Length: 2H

Offset(H)	Name	Bits	Attribute	Description	Remark
0FH	Brightness	8	R	Low 8 bits of Environment brightness	the unit of the data is 2Lux
10H	Brightness	8	R	High 8 bits of environment brightness	The highest bit is for data validation. And 1 means the data is valid.

➢ Example

Read the environment brightness measured by a light sensor connected to a sending card directly. The value is 80H 38H. 80H means the data is valid. 38H is the brightness measured. As the unit of the data is 2Lux, so the environment brightness is 112Lux.

Request Command：55 AA 00 5B FE 00 00 00 00 00 00 00 0F 00 00 02 02 00 C1 56
Acknowledge Data Package：AA 55 00 5B 00 FE 00 00 00 00 00 00 0F 00 00 02 02 00 38 80 7C 57

Note: although we put **Lux** behind the data, the value should not be looked at as an absolute value. The glass window and the infrared filter in front of the sensor make the incident radiation intensity different from that outside the light probe. But as the relation of the light sensor output and the absolute environment brightness is fixed, the light sensor output can be used to represent the environment brightness.

3.8.5 Protocol for stand-alone light sensor

To set a light sensor into stand-alone mode, finish the settings for auto-brightness adjustment first, and then enable stand-alone mode for the light sensor. To set the light sensor back to manual mode, just disable the stand alone mode.

3.8.5.1 Enable stand-alone mode of a light sensor

- Device: Sending Card
- Base Address: 0x0A00_0000H
- Data Length: 1H

Offset(H)	Name	Bits	Attribute	Description	Default(H)
00H	Enable stand-alone mode of the light sensor	8	R/W	Set this byte as 0x7D to enable stand-alone mode of the light sensor. To disable stand-alone mode, set this byte as 0xFF.	FF

➢ Example

Enable stand-alone mode

Request Command：55 AA 00 5B FE 00 00 00 00 00 01 00 00 00 00 0A 01 00 7D 37 57

Acknowledge Data Package：AA 55 00 5B 00 FE 00 00 00 00 01 00 00 00 00 0A 00 00 B9 56

Disable stand-alone mode

Request Command：55 AA 00 5B FE 00 00 00 00 00 01 00 00 00 00 0A 01 00 FF B9 57

Acknowledge Data Package：AA 55 00 5B 00 FE 00 00 00 00 01 00 00 00 00 0A 00 00 B9 56

➢ Example

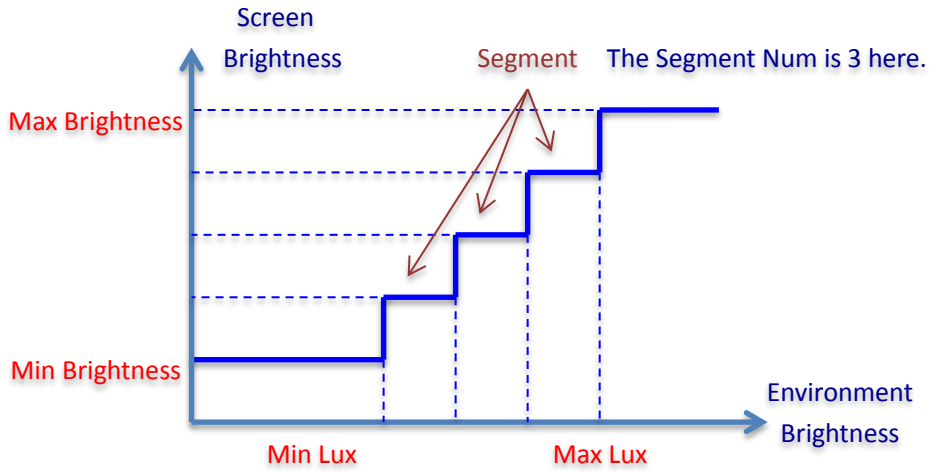
Read stand-alone mode

Request Command：55 AA 00 5B FE 00 00 00 00 00 00 00 00 00 00 0A 01 00 B9 56

Acknowledge Data Package：AA 55 00 5B 00 FE 00 00 00 00 00 00 00 00 00 0A 01 00 7D 36 57

3.8.5.1 Settings for auto-brightness adjustment

When in auto-brightness adjustment mode, the controller will adjust the screen brightness in the way shown in the figure bellow. If the environment brightness is lower than the Min Lux, the controller will set the screen brightness as Min Brightness; or if the environment brightness is higher than Max Lux, the controller will set the screen brightness as Max Brightness. In between Min Lux and Max Lux, the environment brightness interval is evenly divided into Segment Num parts. So is the screen brightness interval. If the environment brightness is within certain segment, the controller will set the screen brightness to be corresponding brightness value.



Following is the address of the values to be set for auto-brightness adjustment.

- Device: Sending Card
- Base Address: 0x0A00_0000H
- Data Length: 2FH

Offset(H)	Name	Bits	Attribute	Description	Default(H)
01H	The number of light sensors	8	R/W	The maximum value could be 8. As one controller, such as MCTRL300, can have one light sensor only. So if the light sensor is connected to a controller, set this value as 1. If function card is used, this value could be up to 8.	FF
02H	Reserved	8	R/W		FF
03H	Reserved	8	R/W		FF
04H	Reserved	8	R/W		FF
05H	Max Lux(Low Byte)	8	R/W	Low byte of the maximum environment brightness	FF
06H	Max Lux(High Byte)	8	R/W	High byte of the maximum environment brightness	FF
07H	Min Lux(Low Byte)	8	R/W	Low byte of the minimum environment brightness	FF
08H	Min Lux(High Byte)	8	R/W	High byte of the minimum environment brightness	FF
09H	Maximum brightness	8	R/W	Max Brightness to be set for the screen	FF
0AH	Minimum brightness	8	R/W	Min Brightness to be set for	FF

				the screen	
0BH	Segment Num	8	R/W	Segment number	FF
0CH	Reserved	8	R/W	Reserved	FF
.....	Reserved			Reserved	
1FH	Reserved	8	R/W	Reserved	FF
20H	Light sensor position	8	R/W	If the light sensor is connected to a sending card/ sending box (controller), set this value as 0x01; otherwise, if the light sensor is connected with a function card, set this value as 0x00	FF
21H	Port Address Pos	8	R/W	The RJ45 port of a controller/ sending card that is connected with the function card. (If the light sensor is connected to a function card. To locate the light sensor, the system needs to know the function card is connected with which RJ45 port of the controller.)	FF
22H	Function Card Pos(Low)	8	R/W	Low byte of the index of the function card.	FF
23H	Function Card Pos(High)	8	R/W	High byte of the index of the function card.	FF
24H	Address of the light sensor on the function card	8	R/W	If the light sensor is connected with the first port of the function card, the address is 0; if connected with the second port, the address is 1…if the light sensor is connected with the forth port, the address is 3.	FF
25H	Reserved	8	R/W	Reserved	FF
.....					
2FH	Reserved	8	R/W	Reserved	FF

3.9 Receiving Card Working Status

Just try reading the receiving card model ID. If the ID can be read back, it means the receiving card is working normally. Otherwise, the receiving card might not work.

- Device: Receiving Card
- Base Address: 0x0000_0000H
- Data Length: 2H

Offset	Name	Attribute	Description
0x000000	ScanCardModle	R	A valid Model ID is a value other than 00.
0x000001			

➢ Example

Request Command：55 AA 00 15 FE 00 01 00 00 00 00 00 00 00 00 00 02 00 6B 56

3.10 Redundant Status Checking

To check the redundant status of the control system, both sending unit and receiving cards status should be checked. First, check whether the sending unit output ports are working as redundant. If certain output port is working as redundant, then check how many receiving cards connected to this output port are working in the redundant line.

3.10.1 Sending Unit Output Port Redundant Status Checking

- Device: Sending Card
- Base Address: 0x0200_0000H
- Data Length: 1H

Offset(H)	Name	Bits	Attribute	Description	Default(H)
1E	RedundantStatus	8	R	Bit[1:0] is used to represent the redundant status of the sending unit output port 1. If Bit[1:0] 2'b is 10 (Bit[1]=1, Bit[0]=0), output port 1 of the sending unit is working as redundant. For values other than 10, the port is not working as redundant. Bit[3:2] is used for output port 2; Bit[5:4] is for output port 3; Bit[7:6] is for output port 4. Values for Bit[3:2], Bit [5:4] and Bit[7:6] means the same as Bit[1:0].	FF

3.10.2 Receiving Card Working in Redundant Line

Try to read the receiving card Model ID with the address based on the redundant output port of the sending unit. If the Model ID can be read back, it means the corresponding receiving card is working in the redundant line.

To read the Model ID of a receiving card, please refer to Section **3.9 Receiving Card Working Status**.

3.11 Sending Card resolution setting

To set the resolution and refresh rate of sending card, the specified content should be written into EDID register. This document describes the basic 128-byte data structure "EDID 1.3". To obtain the latest standard and any support documentation, contact VESA.

3.11.1 EDID Register Setting

The EDID space address is 0x0800_0000H –0x0800_00FFH. For EDID structure 1.3，128 bytes data should be written into specified address.

- Device: Sending Card
- EDID Base Address: 0x0800_0000H
- Data Length: 128H

Offset(H)	Bits	Attribute	Description
0x00	8	R/W	EDID Register0
……	……	……	……
0x7F	8	R/W	EDID Register127

➢ Example

To set the resolution as 1440×900 @60Hz, the EDID content of 128 Bytes as below:

00 FF FF FF FF FF FF 00 39 F6 05 04 13 06 28 00

10 17 01 03 81 1E 17 B4 EA C1 E5 A3 57 4E 9C 23

1D 50 54 21 08 00 01 01 01 01 01 01 01 01 01 01

01 01 01 01 01 01 10 23 A0 A0 50 84 23 30 30 20

36 00 CB 28 11 00 00 1E 00 00 00 FF 00 4E 4F 56

41 53 54 41 52 4D 33 00 00 00 00 00 00 FC 00 4D

41 52 53 A3 44 49 53 50 4C 41 59 00 00 00 00 FD

00 30 7B 1C C8 11 00 0A 20 20 20 20 20 20 00 E9

To set the resolution as 1920×1080 @60Hz, the EDID content of 128 Bytes as below:

00 FF FF FF FF FF FF 00 39 F6 05 04 13 06 28 00

10 17 01 03 81 1E 17 B4 EA C1 E5 A3 57 4E 9C 23

1D 50 54 21 08 00 01 01 01 01 01 01 01 01 01 01

01 01 01 01 01 01 5B 36 80 A0 70 38 23 40 30 20

36 00 CB 28 11 00 00 1E 00 00 00 FF 00 4E 4F 56
41 53 54 41 52 4D 33 00 00 00 00 00 00 FC 00 4D
41 52 53 A3 44 49 53 50 4C 41 59 00 00 00 00 FD
00 30 7B 1C C8 11 00 0A 20 20 20 20 20 20 00 C7

3.12 Display Control

Display control setting can make the screen display kinds of images, such as red, green, blue and white. Additionally, the aging and normal working mode can be setting.

3.12.1 Display control register setting

- Device: Receiving Card
- Base Address: 0x0200_0000H
- Data Length: 1H

Offset(H)	Name	Bits	Attribute	Description
0x000101	SelfTestMode	8	R/W	SelfTestMode register, its default value is 0x00. The value of each function refers to the following table.

Receiving Card Display Function Table

Register Value	Description
0x00	Reserved
0x01	Reserved
0x02	Red
0x03	Green
0x04	Blue
0x05	White
0x06	Horizon line
0x07	Vertical line
0x08	Incline line
0x08	Auto Grayscale Increasing (256 Grade)

0x0a	Aging (Loop all kinds of test mode above)

➢ Example

Blue image setting for the first receiving card

Request Command： 55 AA 00 80 FE 00 01 00 00 00 01 00 01 01 00 02 01 00 04 DE 56

Acknowledge Data Package：AA 55 00 80 00 FE 01 00 FF FF 01 00 01 01 00 02 00 00 D7 58

➢ Example

Red image setting for all receiving card on the same sending card Ethernet port

Request Command： 55 AA 00 80 FE 00 01 00 FF FF 01 00 01 01 00 02 01 00 02 DA 58

Acknowledge Data Package：AA 55 00 80 00 FE 01 00 FF FF 01 00 01 01 00 02 00 00 D7 58

➢ Example

Horizon line setting for all receiving card on the same sending card Ethernet port

Request Command： 55 AA 00 80 FE 00 01 00 FF FF 01 00 01 01 00 02 01 00 06 DE 58

Acknowledge Data Package：AA 55 00 80 00 FE 01 00 FF FF 01 00 01 01 00 02 00 00 D7 58

3.13 Calibration Control

- Device: Receiving Card
- Base Address: 0x0200_0000H
- Data Length: 1H

Offset(H)	Name	Bits	Attribute	Description
0x000051	CorrectionOn	8	R/W	Bit[0]: calibration on/off ’1’, calibration on; ‘0’, calibration off Bit[1]: calibration type ‘1’, brightness calibration; ‘0’, color calibration Bit[7:2]: Reserved, “000000” Example: 0x00: calibration off 0x03: brightness calibration on 0x01: color calibration on

➢ Example

Calibration off Setting:

Request Command： 55 AA 00 7F FE 00 01 00 FF FF 01 00 51 00 00 02 01 00 00 26 59

3.14 Reconnect Sending Card/Receiving Card

- Device: Sending Card/Receiving Card
- Base Address: 0x0000_0000H
- Data Length: 2H

Offset(H)	Name	Bits	Attribute	Description	Default(H)
2H	Controller/Sender Model ID	8	R	Low byte of the controller model ID	Acknowledge data is not equal to zero means in connected status.
3H		8	R	High byte of the controller model ID	

➢ Example

Request Command：55 AA 00 AA FE 00 00 00 00 00 00 00 02 00 00 00 02 00 01 57

Acknowledge Data Package：AA 55 00 AA 00 FE 00 00 00 00 00 00 02 00 00 00 02 00 01 00 02 57

3.15 Parameter Store

- Device: Receiving Card
- Base Address: 0x0100_0000H
- Data Length: 1H

Offset(H)	Name	Bits	Attribute	Description
11H	Parameter Store	8	W	Write down any value(such as 0x11) into the address to finish the parameter store operation

➢ Example

Set all receiving cards on all Ethernet ports overall brightness and brightness of all five components as 128, 0, 128, 128.

Request Command：55 AA 00 15 FE 00 01 FF FF FF 01 00 01 00 00 02 05 00 80 00 80 80 80 6F 5B

Acknowledge Data Package：AA 55 00 15 00 FE 01 FF FF FF 01 00 01 00 00 02 00 00 6A 59

The brightness on all receiving cards will recover to last value when the screen power off and power on. Because the parameters setting are not stored into the flash. In order to do that, the parameter store operation must be implemented.

Request Command：55 AA 00 15 FE 00 01 FF FF FF 01 00 11 00 00 01 01 00 11 8B 59

Acknowledge Data Package：AA 55 00 15 00 FE 01 FF FF FF 01 00 11 00 00 01 00 00 79 59