

**RS232 and LAN**  
communication protocol



<b>1</b>	<b>REVISION HISTORY</b>	<b>4</b>
<b>2</b>	<b>SETTING UP LAN COMMUNICATION</b>	<b>5</b>
2.1	SETTING THE IP ADDRESS	5
2.2	CONNECTING TO THE PROJECTOR	6
<b>3</b>	<b>HOW TO USE THE PROJECTORS LAN FUNCTIONALITY</b>	<b>7</b>
<b>4</b>	<b>SETTING UP RS232 COMMUNICATION</b>	<b>8</b>
4.1	CONNECT TO THE PROJECTOR	<b>8</b>
4.2	RS232 COMMUNICATION PARAMETERS	<b>8</b>
<b>5</b>	<b>SEND AND RECEIVE BINARY PACKETS</b>	<b>8</b>
5.1	ABOUT THE PROTOCOL	<b>8</b>
5.2	SET_OPERATIONS	<b>8</b>
5.3	GET_OPERATIONS	<b>8</b>
5.4	INCREMENT_ AND DECREMENT_OPERATIONS	<b>9</b>
5.5	EXECUTE_OPERATIONS	<b>9</b>
5.6	DESCRIPTOR_OPERATIONS	<b>9</b>
5.7	EXAMPLE OF SETTING PROTOCOL PARAMETERS AND SENDING A COMMAND IN CMD WINDOW	<b>9</b>
5.8	OSD FEEDBACK	<b>9</b>
<b>6</b>	<b>SEND AND RECEIVE ASCII COMMANDS</b>	<b>10</b>
6.1	OVERVIEW	<b>10</b>
6.2	MESSAGE BODY	<b>10</b>
6.3	MNEMONIC	<b>10</b>
6.4	MODIFIER	<b>11</b>
6.5	ADDRESSING	<b>11</b>
6.6	ACKNOWLEDGE/RESPONSE	<b>11</b>
6.7	SUPPORTED COMMANDS	<b>12</b>
6.8	EXAMPLES	<b>16</b>
6.9	AMX/CRESTON	<b>20</b>
6.10	TRUTH-TABLES FOR ABS-VALUES	<b>20</b>

<b>APPENDIX A, BINARY OPERATION PACKET TYPE</b>	<b>21</b>
A.1 OPERATION PACKET TYPE	<b>21</b>
A.2 OPERATION PACKET PAYLOAD FORMAT	<b>21</b>
<b>APPENDIX B, BINARY PACKETS IN HEXADECIMAL VALUES</b>	<b>22</b>
<b>APPENDIX C, RS232 DAISY CHAINING</b>	<b>28</b>
C.1 ABOUT THE PROTOCOL	<b>28</b>
C.2 ADDRESS MODES	<b>28</b>
C.2.1 AUTO ADDRESS MODE	<b>28</b>
C.2.2 FIXED ADDRESS MODE	<b>28</b>
C.2.3 BROADCAST	<b>28</b>
C.3 BAUD RATE	<b>28</b>
C.4 SPECIAL SHORT MESSAGES	<b>29</b>
C.5 EXAMPLES	<b>29</b>
<b>APPENDIX D, ADJUSTING CUSTOM COLOR TEMP USING RS232</b>	<b>20</b>
D.1 CHOOSE "CUSTOM COLOR TEMP"	<b>20</b>
D.2 ADJUST THE COLOR TEMPERATURE BY USING THE INCREMENT / DECREMENT OPERATIONS:	<b>20</b>
<b>APPENDIX E, TRUTH TABLES</b>	<b>32</b>
E.1 OSD WARNING ON	<b>32</b>
E.2 LAMP IGNITION STATES	<b>32</b>
E.3 THERMAL MONITOR STATES	<b>32</b>
E.4 LAMP ON STATE S	<b>32</b>

## 1 REVISION HISTORY

<b>Document</b>	<b>Rev</b>	<b>Release Date</b>	<b>Revised</b>	<b>Owner</b>
LAN and RS-232 communication protocol and command set	1.0	1/6/04	Initial F1+	
	1.1	31/12/04	minor writing errors corrected	
	1.2	26/08/05	added ascii commands	
	1.3	01/02/06	new layout, minor changes	

The projector is shipped with a set of default settings, these are as follows:

Description	Value
IP address	192.168.1.90
Subnet mask	255.255.255.0
Default gateway	192.168.1.1
TCP port	1025
UDP port	1225
Username	admin
Password	admin

Before you connect the projector to your LAN make sure that the IP address 192.168.1.90 is not already in use. If you need to change it, you have to make sure that the computer you use is on the same subnet. This means that the computer need to have an IP address in the range from 192.168.1.1 to 192.168.1.254.

**2.1 Setting the IP address**

If you need to change the computers IP address, follow these steps:

1. Right click on “Network Neighborhood” / “My Network Places” on your computer, and then select “Properties”.



2. Doubleclick on the network connection that represents your LAN, select “properties”, then doubleclick “Internet Protocol (TCP/IP)”.



3. This will take you to a screen where you can set the computers IP address:

Set the IP address and click OK on this and the previous dialog when you’re done.



## 2.2 Connecting to the projector

You have two options regarding how to make the physical connection to the projector. You can either use a crossover twisted pair (TP) cable directly from the computer to the projector, or two straight-through TP cables with a HUB or a switch between them.

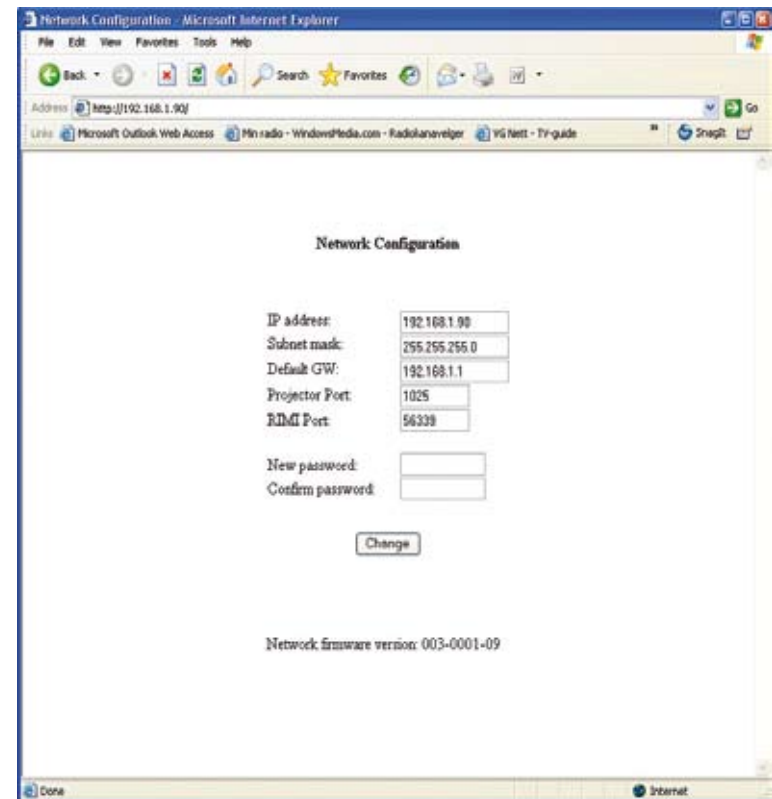
Now the computer should be on the same subnet as the projector, and you are ready to configure it. This is done by starting up an internet browser, like Internet Explorer, Opera, Firefox or similar. Then type the projectors default IP address (192.168.1.90) in the address bar.

You will then be presented with the login screen shown below:



Type in the projectors default login name (admin) and password (admin), both are case sensitive.

If both are correct, you will see a configuration website like this:



On this page you can setup the projectors IP address, subnet mask, default gateway, projector port (TCP), rmi port (UDP), and password. This page also displays the current version of network firmware the projector is running.

Once the projector is setup correctly and connected to the LAN, it's ready to receive commands. The LAN commands is exactly the same as for RS232 control, although you may have to pass on the commands to the projector with a different application.

HyperTerminal that comes with Windows, can be used for this.

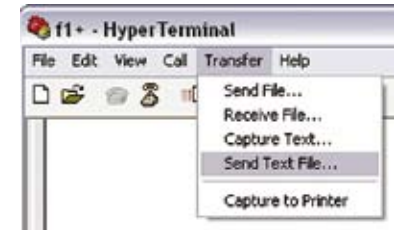
- Start up HyperTerminal, click "File" and then "New Connection". Give it a name and press OK. You will then see this dialog, here you choose TCP/IP (Winsock).



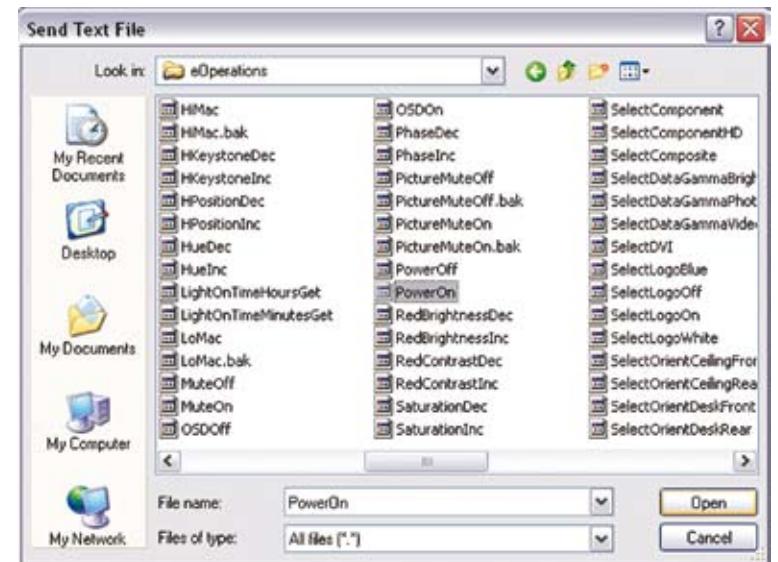
- Now type in the projectors IP address in the "Host address:" field, and the projectors TCP port in the "Port number:" field. Press OK when you're done.



To send an eOperation to the projector, select "Transfer" and then "Send Text File...".



You will then be presented with a dialog which you can choose the file you want to transfer. Choose your command, click "Open", and the command will be transferred.



#### Other network options:

As you can see from the default settings table, the projectors also support commands over the UDP protocol. HyperTerminal doesn't support UDP but there are other applications like the ones from SimpleComTools.

There is also quite easy to integrate this functionality if you are designing an application yourself.

With a Crestron, AMX and other control system you now have the option to control the projector via Ethernet in addition to RS232 using the same command set.

## 4 ESTABLISH COMMUNICATION

The projector may be controlled either through the LAN or the RS232 interfaces. Both interfaces can not be used at the same time. Select between LAN or RS232 control in the menus system (see the projector user guide for further information).

### 4.1 Connect to the projector

Connect the projector and host using a standard serial cable with 9-pin female to the host, and 9-pin male to the projector. Pin 2 connects to pin 2, pin 3 connects to pin 3 and pin 5 connects to pin 5.

The projectors can be daisy-chained using RS232. Please, refer to Appendix C for detailed information about RS232 daisy-chaining.

### 4.2 RS232 Communication parameters

Parameter	Data
Baud rate	4800, 9600, 19200
Parity	N
Databits	8
Stopbits	1
Flowcontrol	None

Table 1: RS232 parameters

Baud rate is configurable from the projector's menu system. Default baud rate is 19200.

This section applies to single projector control with no address information. Please, refer to Appendix B for detailed information about RS232 daisy-chaining.

### 5.1 About the protocol

The RS232 protocol is a binary protocol where each command is a series of 32 bytes in one packet. See Appendix A for command structure. The tables in appendix B have one row for each command.

The packet consists of a header with 7 bytes, and the packet payload, 11 bytes (see appendix A). It is important to complete the packet with an additional 14 bytes of padding, so that the total packet size reaches 32 bytes.

The bytes are numbered 1 through 32. Byte 1 is sent first, byte 32 last. Some columns in Appendix B show the value to be sent for several consecutive bytes. These are typically indicated by a range, ie. 14 - 16. This means that bytes 14-16 all have the same value.

The protocol allows for both SET and GET operations. To utilize GET operations the host needs a routine for receiving and interpreting incoming packets.

### 5.2 SET\_operations

SET\_operations are used to force the projector into different modes, like setting brightness and contrast setting, switching between sources, etc.

As seen in Appendix B, each packet is a series of 32 bytes. To control the projector, simply send the desired packet to the serial port. (An example of how to do this from a DOS-window is provided in chapter 5.7)

After receiving a packet and executing the operation, the projector will immediately send a packet in return. The returned packet will contain a PAK (0x1E) (PAK = Packet Acknowledge), followed by the initial SET\_operation sent from the host. Total packet size is 33 bytes.

### 5.3 GET\_operations

GET\_operations are used to acquire data or status from the projector, such as lamp usage hours, total on time, etc.

A response to a successful GET\_operation consists of a PAK (0x1E) followed by the initial GET\_operation sent from the host. The requested value resides as a WORD in byte 17 (low byte) and byte 18 (high byte). Total packet size is 33 bytes.



#### 5.4 INCREMENT\_ and DECREMENT\_operations

These operations are used when you want to increment or decrement the existing value.

The response consists of a PAK (0x1E) followed by the initial operation sent, except for byte 11, which carries an operation validation code, 0x01. Total packet size is 33 bytes.

#### 5.5 EXECUTE\_operations

An EXECUTE\_operation triggers a pre-programmed algorithm in the firmware to execute a certain chain of events. The EXECUTE\_operation does not contain any parameters to indicate a desired value, but simply executes the algorithm assigned to it.

The response is equal to that of the INCREMENT/DECREMENT\_operations (see 5.4).

#### 5.6 DESCRIPTOR\_operations

To acquire the valid range of an operation, set byte 8 (operation type) to 7 (DESCRIPTOR) fill in the operation number and send the packet. A successful response will consist of PAK (0x1E), followed by the standard 32 bytes.

#### 5.7 Example of setting protocol parameters and sending a command in CMD window

Setting up the COM port, and sending a “poweron” command, where “poweron” is simply a binary-file with the appropriate packet for turning the projector on:



```
C:\WINDOWS\System32\cmd.exe
C:\CRC>mode com1:19200,N,8,1
Status for device COM1:
-----
Baud:          19200
Parity:        None
Data Bits:     8
Stop Bits:     1
Timeout:      ON
XON/XOFF:     OFF
CTS handshaking: OFF
DSR handshaking: OFF
DSR sensitivity: OFF
DTR circuit:  ON
RTS circuit:  ON

C:\CRC>type poweron>com1_
```

This returns, when successful, an acknowledgement as described in chapter 5.2 , and turns the projector on.

#### 5.8 OSD feedback

RS232 control commands will not produce any OSD feedback. Only keypad and IR remote control will produce OSD feedback.

### 6.1 Overview

The protocol exists in parallel with the already existing 32/33-byte protocol.

The protocol has the following definition:

<HEADER>	[SEPARATOR]	ADDRESS	[SEPARATOR]	MESSAGE BODY
1 byte	1 byte	1-3 bytes	1 byte	N bytes

Field	Description	Comment
<HEADER>	ASCII character ':'	Required
Separator	ASCII character 'space'	Optional
Address	1-3 bytes address	Optional

### 6.2 Message body

The message body structure is as follows:

MNEMONIC	[SEPARATOR]	[MODIFIER]	[SEPARATOR]	VALUES	CR
4 byte	1 byte	1 or 2 bytes	1 byte	N bytes	1 byte

Field	Description	Comment
Mnemonic	4 bytes key identifier, not case sensitive	Required
Modifier	Single char symbol	Optional
Values	1-3 bytes address	Optional
TERM	Termination char 0x0D (CR)	Required

### 6.3 MNEMONIC

The Mnemonic is 4 bytes key identifier, known as the ASCII command.

Example: POWR, SABS, IVGA

#### 6.4 Modifier

R	Relative change. Value given will be relative to the existing value
A	Request an acknowledge. This modifier is the only that might be applied together with another modifier. It can be used to read back the result of the command.
?	? – current ?M – max ?N – min

#### 6.5 Addressing

The same address mechanisms as for the binary protocol is supported in the ASCII protocol.

#### 6.6 Acknowledge/Response

Acknowledge is optional and ON by default. Auto acknowledge can be turned on and off with ECHO commad. Also turned activated on a per command basis using modifier A.

ACK	ADDRESS	SEP	COMMAND	SEP	VALUE	TERM.
1 byte	3 bytes	1 byte	4 bytes	1 byte	6 bytes	1 byte

Field	Description	Comment
ACK	ASCII character '%'	Always
SEP	ASCII space	Always
VALUE	6 bytes return value	Always
TERM	Termination char 0x0D (CR)	Always

#### 6.7 SUPPORTED COMMANDS

Modifiers	
A	Request acknowledge
?	Get current value
?M	Get MAX value
?N	Get MIN value
R	Relative set

ASCII	Function	Operations supported	Legal modifiers
IVGA	Select VGA	Get, Set	A, ?
IDVI	Select DVI	Get, Set	A, ?
ISVI	Select S-video	Get, Set	A, ?
ICVI	Select Composite video	Get, Set	A, ?
IYPP	Select Component YPbPr	Get, Set	A, ?
IABS [0...6] See section 6.10	Set source abs value	Get, Set	A, R, ?, ?M, ?N
VRGB 0	RGB Video OFF	Get, Set	A, ?
VRGB 1	RGB Video Component	Get, Set	A, ?
SCAN 1	Source scan On	Get, Set	A, ?
SCAN 0	Source scan Off	Get, Set	A, ?
POWR 1	Power On	Get, Set	A, ?
POWR 0	Power Off	Get, Set	A, ?
S1T1	Select Scaling 1:1	Get, Set	A, ?
S169	Select Scaling 16:9	Get, Set	A, ?
SANA	Select Scaling Anamorphic	Get, Set	A, ?
SFLA	Select Scaling FillAll	Get, Set	A, ?
SFAR	Select Scaling FillAspectRatio	Get, Set	A, ?
SLET	Select Scaling Letterbox to 16:9	Get, Set	A, ?
SLST	Select Scaling Letterbox st to 16:9	Get, Set	A, ?
SZOM	Select Scaling Zoom	Get, Set	A, ?
SABS [0.3, 9-10, 13-14]See section 10	Set scaling abs value	Get, Set	A, R, ?, ?M, ?N
GAF1 1	Select Gamma Film 1	Get, Set	A, ?
GAF1 2	Select Gamma Film 2	Get, Set	A, ?
GAV1 1	Select Gamma Video 1	Get, Set	A, ?
GAV1 2	Select Gamma Video 2	Get, Set	A, ?
GACO 1	Select Gamma Computer 1	Get, Set	A, ?
GACO 2	Select Gamma Computer 2	Get, Set	A, ?
SZHZ	Resize Horizontally	Get, Set	A, R, ?, ?M, ?N
SZVT	Resize Vertically	Get, Set	A, R, ?, ?M, ?N

ASCII	Function	Operations supported	Legal modifiers
SZEN 0	Resize OFF Get, Set	Get, Set	A, ?
SZEN 1	Resize ON Get, Set	Get, Set	A, ?
DVST 0	DVI Setup OFF (BTB/WTW)	Get, Set	A, ?
DVST 1	DVI Setup ON	Get, Set	A, ?
WPEK [0-10]	WhitePeaking	Get, Set	A, R, ?, ?M, ?N
BRIG	Brightness	Get, Set	A, R, R, ?, ?M, ?N
CNTR	Contrast	Get, Set	A, R, ?, ?M, ?N
CT65*	Select colortemp 6500	Get, Set	A, ?
CT73*	Select colortemp 7300	Get, Set	A, ?
CT93*	Select colortemp 9300	Get, Set	A, ?
CTCU*	Select custom color temp	Get, Set	A, ?
CTRD*	Red color temperature	Get, Set	A, R, ?, ?M, ?N
CTGR*	Green color temperature	Get, Set	A, R, ?, ?M, ?N
CTBL*	Blue color temperature	Get, Set	A, R, ?, ?M, ?N
	<i>* Applies to uncalibrated units only</i>		
DPMS 1	DPMS On	Get, Set	A, ?
DPMS 0	DPMS Off	Get, Set	A, ?
FRZE 1	Freeze Frame On	Get, Set	A, ?
FRZE 0	Freeze Frame Off	Get, Set	A, ?
VRGB 1	RGB Video Component	Get, Set	A, ?
VRGB 0	RGB Video Off	Get, Set	A, ?
CSAT	Color/Saturation	Get, Set	A, R, ?, ?M, ?N

ASCII	Function	Operations supported	Legal modifiers
CMNA*	Color Management Not Corrected (native)	Get, Set	A, ?
CMCU*	▼ Color Management Custom	Get, Set	A, ?
	CCRG ▼ Select Custom RGB	Get, Set	A, ?
	CTRD Custom Red	Get, Set	A, R, ?, ?M, ?N
	CTGR Custom Green	Get, Set	A, R, ?, ?M, ?N
	CTBL Custom Blue	Get, Set	A, R, ?, ?M, ?N
	CCXY ▼ Select Custom Coordinates	Get, Set	A, ?
	CMXV X coordinate	Get, Set	A, R, ?, ?M, ?N
	CMYV Y coordinate	Get, Set	A, R, ?, ?M, ?N
CMTE*	▼ Color Management Temperature	Get, Set	A, ?
	CTMP Color Temperature	Get, Set	A, R, ?, ?M, ?N
<i>* Applies to uncalibrated units only</i>			
CRED	Red Gain		A, R, ?, ?M, ?N
BRED	Red Offset		A, R, ?, ?M, ?N
CGRE	Green Gain		A, R, ?, ?M, ?N
BGRE	Green Offset		A, R, ?, ?M, ?N
CBLU	Blue Gain		A, R, ?, ?M, ?N
BBLU	Blue Offset		A, R, ?, ?M, ?N
VPOS	Vertical position	Get, Set	A, R, ?, ?M, ?N
HPOS	Horizontal position	Get, Set	A, R, ?, ?M, ?N
VHUE	Hue video	Get, Set	A, R, ?, ?M, ?N
SHRP	Sharpness	Get, Set	A, R, ?, ?M, ?N
FREQ	Frequency	Get, Set	A, R, ?, ?M, ?N
PHSE	Phase	Get, Set	A, R, ?, ?M, ?N
VKEY	Vertical keystone	Get, Set	A, R, ?, ?M, ?N
HKEY	Horizontal keystone	Get, Set	A, R, ?, ?M, ?N
DESK	Select Orientation Desktop Front	Get, Set	A, ?
CEIL	Select Orientation Ceiling Front	Get, Set	A, ?
RDES	Select Orientation Desktop Rear	Get, Set	A, ?
RCEI	Select Orientation Rear Ceiling	Get, Set	A, ?
ORIE [0-3] See section 10	Select orientation abs value	Get, Set	A, R, ?, ?M, ?N
BKBK	Select Splash/Background Black/Black	Get, Set	A, ?
LGLG	Select Splash/Background Logo/Logo	Get, Set	A, ?
LGBL	Select Splash/Background Blue Logo/Blue	Get, Set	A, ?

ASCII	Function	Operations supported	Legal modifiers
LGWH	Select Splash/Background White Logo/White	Get, Set	A, ?
LGBK	Select Splash/Background Black Logo/Black	Get, Set	A, ?
VAUT	Select Video Format Auto (default)	Get, Set	A, ?
VNTC	Select Video Format NTSC	Get, Set	A, ?
VPAL	Select Video Format PAL	Get, Set	A, ?
VSEC	Select Video Format SECAM	Get, Set	A, ?
VDVD	Select Video Type DVD	Get, Set	A, ?
WCR	Select Video Type VCR	Get, Set	A, ?
TEST 1	Test Image On	Get, Set	A, ?
TEST 0	Test Image Off	Get, Set	A, ?
ECOM 1	Eco Mode On	Get, Set	A, ?
ECOM 0	Eco Mode Off	Get, Set	A, ?
RSAU	RS232 address mode auto	Get, Set	A, ?
RSFI	RS232 address mode fixed	Get, Set	A, ?
OSDC 1	OSD On	Get, Set	A, ?
OSDC 0	OSD Off	Get, Set	A, ?
OSDW 1	OSD Warning On	Get, Set	A, ?
OSDW 0	OSD Warning Off	Get, Set	A, ?
SWVR	Software Version Get	Get	A, ?
THRM	Thermal Monitor Get	Get	A, R, ?, ?M, ?N
AUTO	Execute auto adjust	Execute	A
ECHO 0	Turn acknowledge off	Get, Set	A, ?
ECHO 1	Turn acknowledge on	Get, Set	A, ?
LPW1	Lamp Power	Get, Set	A, ?,
LTR1	Lamp Runtime	Get	A, ?
LHO1	Lamp Total Light On Time Hours Get	Get	A, ?
LST1	Lamp Status Get	Get	A, ?
LRM1	Lamp Estimated Remaining Lamp Time	Get	A, ?

## 6.8 Examples

Responses/acknowledges are marked with green color. They can/will not be received if acknowledge is turned OFF (see section 6 ).

The protocol accepts one single SPACE between fields, or no SPACE between fields.

### SET-commands:

POWER ON:																
:		P		O		W		R		1						CR
:POWR 1#0x0D																
ACKNOWLEDGE POWER ON:																
%	0	0	1		P	O	W	R		0	0	0	0	0	1	CR
%001 POWR 000001CR																

POWER OFF with address 100:																		
:			1		0		0		P		O		W		R		0	CR
:100 POWR 0#0x0D																		
ACKNOWLEDGE POWER OFF from address 100:																		
%	0	0	1		P	O	W	R		0	0	0	0	0	0	1	CR	
%100 POWR 000000CR																		

SET current value BRIGHTNESS to value 60:																
:		B		R		I		G		6		0				CR
:BRIG 60#0x0D																
ACKNOWLEDGE BRIGHTNESS:																
%	0	0	1		B	R	I	G		0	0	0	0	6	0	CR
%001 BRIG 000060CR																



SET current value BRIGHTNESS to value 34 with address 45:																
:	0	4	5		B	R	I	G		3	4				CR	
:045 BRIG 34#0x0D																
or																
SET current value BRIGHTNESS to value 34 with address 45:																
:	4	5		B	R	I	G		3	4					CR	
:45 BRIG 34#0x0D																
ACKNOWLEDGE BRIGHTNESS from address 45:																
%	0	4	5		B	R	I	G		0	0	0	0	6	0	CR
%045 BRIG 000034CR																

INCREMENT value CONTRAST:																
:	C	N	T	R					R		1				CR	
:CNTR R1#0x0D																
ACKNOWLEDGE CONTRAST INCREMENT:																
%	0	0	1		C	N	T	R		0	0	0	1	8	0	CR
%001 CNTR 000180CR																

DECREMENT value CONTRAST:																
:	C	N	T	R					R		-		1		CR	
:CNTR R-1#0x0D																
ACKNOWLEDGE CONTRAST DECREMENT:																
%	0	0	1		C	N	T	R		0	0	0	1	7	9	CR
%001 CNTR 000179CR																

INCREASE value CONTRAST BY 21:																
:	C	N	T	R		R	2	1	CR							
:CNTR R21#0x0D																
ACKNOWLEDGE CONTRAST INCREASE:																
%	0	0	1		C	N	T	R		0	0	0	2	0	0	CR
%001 CNTR 000200CR																

DECREASE value CONTRAST BY 21:																
:	C	N	T	R		R	-	2	1	CR						
:CNTR R-21#0x0D																
ACKNOWLEDGE CONTRAST DECREASE:																
%	0	0	1		C	N	T	R		0	0	0	1	7	9	CR
%001 CNTR 000179CR																

**GET-commands:**

GET current value BRIGHTNESS:																
:		B		R		I		G		?					CR	
:BRIG?#0x0D																
ACKNOWLEDGE BRIGHTNESS GET:																
%	0	0	1		B	R	I	G		0	0	0	0	5	0	CR
%001 BRIG 000050CR																

GET current value BRIGHTNESS from address 123:																
:			1	2	3		B	R	I	G				?	CR	
:123 BRIG ?#0x0D																
ACKNOWLEDGE BRIGHTNESS from address 123:																
%	1	2	3		B	R	I	G		0	0	0	0	5	0	CR
%123 BRIG 000050CR																

GET MIN value VERTICAL KEYSTONE:																
:		V		K		E		Y					?	N	CR	
:VKEY ?N#0x0D																
ACKNOWLEDGE GET MIN value VERTICAL KEYSTONE:																
%	0	0	1		V	K	E	Y		0	0	0	0	0	0	CR
%001 VKEY 000000CR																

GET MAX value VERTICAL KEYSTONE:																
:		V		K		E		Y					?	M	CR	
:VKEY ?M#0x0D																
ACKNOWLEDGE GET MAX value VERTICAL KEYSTONE:																
%	0	0	1		V	K	E	Y		0	0	0	2	5	5	CR
%001 VKEY 000255CR																

## 6.9 AMX/Crestron:

Command:	AMX:	Crestron:
Power ON	':POWR1', \$0d	:POWR1\r
Power OFF address 100	':,\$20'POWR',\$20,'0',\$0d or ':100POWR0',\$0d or ': 100 POWR 0',\$0d	:x20100\x20POWR\x200\r or :100POWR0\r or : 100 POWR 0\r

SPACE characters should be used with hex notation or left out to avoid confusion/errors.

## 6.10 Truth-tables for abs-values

Mnemonic	Table	Comments
IABS [0..2, 4..6]	0 – VGA 1 1 – VGA 2 2 – DVI 3 – YPbPr interlace 4 – S-Video 5 – Composite Video 6 – YPbPr progressive	Ignore other values returned, no source is connected.
SABS[0..3, 9-10, 13-14]	0 – 1to1 (only VGA) 1 – fill all (only VGA) 2 – fill aspect ratio 3 – fill 16:9 9 – letterbox to 16:9 10 – letterbox subtitle to 16:9 13 – zoom (only Video) 14 – anamorphic	Use of other numbers may result in poor picture quality, and is not recommended.
ORIE[0..3]	0 – Desktop front 1 – Ceiling rear 2 – Desktop rear 3 – Ceiling front	

**A.1 Operation Packet Type**

The Operation packet is used by the host system to execute operations (such as Brightness, Contrast, Image Position, etc) in the target system. The Operation packet payload size is 11 bytes.

The source code definition of the Operation packet data structure is:

```
typedef struct
{
eOPERATION_TYPE eOpType;           // Operation type.
WORD             eOperation;        // Operation
WORD             bIsAvail;          // Operation validation.
DWORD            dwTarget;          // Operation target.
DWORD            dwValue;           // Operation value.
LONG             lwMin;             // Lower limit.
LONG             lwMax;             // Upper limit.
LONG             lwInc;             // Increment.
} OPERATION_MESSAGE;
```

This lets the user directly perform logical operations such as “Set Contrast = 80”. If the user performs an OPERATION\_GET, the returned packet will include operation and target along with the value.

**A.2 Operation Packet Payload Format**

Byte	Field Name	Field Value	Description
1-7		1-7	Header, which consists of: Byte 1-5: 0xBE 0xEF 0x03 0x19 0x00 Byte 6-7: CRC (not in use) (see appendix C for an example of a complete packet)
8	Operation Type	1	OPERATION_SET
		2	OPERATION_GET
		3	OPERATION_INCREMENT
		4	OPERATION_DECREMENT
		5	OPERATION_EXECUTE
		7	OPERATION_DESCRIPTOR
9-10	Operation Number		Operation ID.
11	Operation Validation		Operation is valid, return only.
12			n/a (not available for use).
13-16			n/a (not available for use).
17-18	Operation Value		Value to SET or the value of the GET on a return.
19-20	Operation Value		Not in use
21-24	Lower Limit		Lower Parameter limit.
25-28	Upper Limit		Upper Parameter limit
29-32	Increment		Increment steps within limits.

Table 2: Packet Payload format

APPENDIX B, BINARY PACKETS IN HEXADECIMAL VALUES

Note! All operations in this section apply to the 32-bytes non-address protocol. Please refer to Appendix C for instructions on how to use address information.

Byte	1	2	3	4	5	6	7	8	9	10	11,12	13	14-16	17	18	19-32	Rev.:
Command Name:								operation type	operation -lo	operation -hi		Target		oper value lo	oper value hi		

SET:																	
Select VGA1	0xBE	0xEF	0x03	0x19	0x00	0xEA	0xE9	0x01	0x01	0x44	0x00	0x00	0x00	0x00	0x00	0x00	
Select VGA2	0xBE	0xEF	0x03	0x19	0x00	0x7A	0x28	0x01	0x01	0x44	0x00	0x00	0x00	0x01	0x00	0x00	
Select DVI	0xBE	0xEF	0x03	0x19	0x00	0x8B	0x68	0x01	0x01	0x44	0x00	0x00	0x00	0x02	0x00	0x00	
Select S-video	0xBE	0xEF	0x03	0x19	0x00	0x29	0xEB	0x01	0x01	0x44	0x00	0x00	0x00	0x04	0x00	0x00	
Select Composite video	0xBE	0xEF	0x03	0x19	0x00	0xB9	0x2A	0x01	0x01	0x44	0x00	0x00	0x00	0x05	0x00	0x00	
Select Component YPbPr1	0xBE	0xEF	0x03	0x19	0x00	0x48	0x6A	0x01	0x01	0x44	0x00	0x00	0x00	0x06	0x00	0x00	
Source scan On	0xBE	0xEF	0x03	0x19	0x00	0xEB	0xC9	0x01	0x23	0x44	0x00	0x00	0x00	0x00	0x00	0x00	
Source scan Off	0xBE	0xEF	0x03	0x19	0x00	0x8A	0x48	0x01	0x23	0x44	0x00	0x00	0x00	0x02	0x00	0x00	
Power On	0xBE	0xEF	0x03	0x19	0x00	0x12	0xD5	0x01	0x9C	0x02	0x00	0x00	0x00	0x01	0x00	0x00	
Power Off	0xBE	0xEF	0x03	0x19	0x00	0x82	0x14	0x01	0x9C	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
Audio Mute On	0xBE	0xEF	0x03	0x19	0x00	0x05	0x3A	0x01	0x69	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
Audio Mute Off	0xBE	0xEF	0x03	0x19	0x00	0x95	0xFB	0x01	0x69	0x02	0x00	0x00	0x00	0x01	0x00	0x00	
Select Scaling 1:1	0xBE	0xEF	0x03	0x19	0x00	0x55	0xB2	0x01	0x16	0x44	0x00	0x00	0x00	0x00	0x00	0x00	
Select Scaling 16:9	0xBE	0xEF	0x03	0x19	0x00	0xA4	0xF2	0x01	0x16	0x44	0x00	0x00	0x00	0x03	0x00	0x00	
Select Scaling Anamorphic	0xBE	0xEF	0x03	0x19	0x00	0x31	0x36	0x01	0x16	0x44	0x00	0x00	0x00	0x0E	0x00	0x00	
Select Scaling FillAll	0xBE	0xEF	0x03	0x19	0x00	0xC5	0x73	0x01	0x16	0x44	0x00	0x00	0x00	0x01	0x00	0x00	
Select Scaling FillAspectRatio	0xBE	0xEF	0x03	0x19	0x00	0x34	0x33	0x01	0x16	0x44	0x00	0x00	0x00	0x02	0x00	0x00	
Select Scaling Letterbox to 16:9	0xBE	0xEF	0x03	0x19	0x00	0x03	0x74	0x01	0x16	0x44	0x00	0x00	0x00	0x09	0x00	0x00	
Select Scaling Letterbox st to 16:9	0xBE	0xEF	0x03	0x19	0x00	0xF2	0x34	0x01	0x16	0x44	0x00	0x00	0x00	0x0A	0x00	0x00	
Gamma Film 1	0xBE	0xEF	0x03	0x19	0x00	0x63	0x55	0x01	0x68	0x06	0x00	0x00	0x00	0x00	0x00	0x00	

Byte	1	2	3	4	5	6	7	8	9	10	11,12	13	14-16	17	18	19-32	Rev.:
Command Name:								operation type	operation -lo	operation -hi		Target		oper value lo	oper value hi		
Gamma Film 2	0xBE	0xEF	0x03	0x19	0x00	0xF3	0x94	0x01	0x68	0x06	0x00	0x00	0x00	0x01	0x00	0x00	
Gamma Video 1	0xBE	0xEF	0x03	0x19	0x00	0x02	0xD4	0x01	0x68	0x06	0x00	0x00	0x00	0x02	0x00	0x00	
Gamma Video 2	0xBE	0xEF	0x03	0x19	0x00	0x92	0x15	0x01	0x68	0x06	0x00	0x00	0x00	0x03	0x00	0x00	
Gamma Computer 1	0xBE	0xEF	0x03	0x19	0x00	0x51	0x17	0x01	0x68	0x06	0x00	0x00	0x00	0x07	0x00	0x00	
Gamma Computer 2	0xBE	0xEF	0x03	0x19	0x00	0xA5	0x52	0x01	0x68	0x06	0x00	0x00	0x00	0x08	0x00	0x00	
Select Orientation Desktop Front	0xBE	0xEF	0x03	0x19	0x00	0x11	0x89	0x01	0x51	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
Select Orientation Ceiling Front	0xBE	0xEF	0x03	0x19	0x00	0xE0	0xC9	0x01	0x51	0x02	0x00	0x00	0x00	0x03	0x00	0x00	
Select Orientation Desktop Rear	0xBE	0xEF	0x03	0x19	0x00	0x70	0x08	0x01	0x51	0x02	0x00	0x00	0x00	0x02	0x00	0x00	
Select Orientation Rear Ceiling	0xBE	0xEF	0x03	0x19	0x00	0x81	0x48	0x01	0x51	0x02	0x00	0x00	0x00	0x01	0x00	0x00	
Select Splash/Background Logo/Black	0xBE	0xEF	0x03	0x19	0x00	0xFC	0x1E	0x01	0xA6	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
Select Splash/Background Logo	0xBE	0xEF	0x03	0x19	0x00	0x6C	0xDF	0x01	0xA6	0x02	0x00	0x00	0x00	0x01	0x00	0x00	
Select Splash/Background Blue	0xBE	0xEF	0x03	0x19	0x00	0x9D	0x9F	0x01	0xA6	0x02	0x00	0x00	0x00	0x02	0x00	0x00	
Select Splash/Background White	0xBE	0xEF	0x03	0x19	0x00	0x0D	0x5E	0x01	0xA6	0x02	0x00	0x00	0x00	0x03	0x00	0x00	
Select Splash/Background Black	0xBE	0xEF	0x03	0x19	0x00	0x3F	0x1C	0x01	0xA6	0x02	0x00	0x00	0x00	0x04	0x00	0x00	
Blank Display On (picture mute)	0xBE	0xEF	0x03	0x19	0x00	0xBD	0xBD	0x01	0x3B	0x02	0x00	0x00	0x00	0x01	0x00	0x00	
Blank Display Off (picture mute)	0xBE	0xEF	0x03	0x19	0x00	0x2D	0x7C	0x01	0x3B	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
OSD On	0xBE	0xEF	0x03	0x19	0x00	0x87	0x88	0x01	0x9D	0x02	0x00	0x00	0x00	0x01	0x00	0x00	
OSD Off	0xBE	0xEF	0x03	0x19	0x00	0x17	0x49	0x01	0x9D	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
OSD Warning On	0xBE	0xEF	0x03	0x19	0x00	0x45	0x29	0x01	0xC7	0x02	0x00	0x00	0x00	0x01	0x00	0x00	
OSD Warning Off	0xBE	0xEF	0x03	0x19	0x00	0xD5	0xE8	0x01	0xC7	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
Freeze Frame On	0xBE	0xEF	0x03	0x19	0x00	0xFA	0x76	0x01	0x0B	0x44	0x00	0x00	0x00	0x01	0x00	0x00	
Freeze Frame Off	0xBE	0xEF	0x03	0x19	0x00	0x6A	0xB7	0x01	0x0B	0x44	0x00	0x00	0x00	0x00	0x00	0x00	
Select Video Format Auto (default)	0xBE	0xEF	0x03	0x19	0x00	0xD9	0x90	0x01	0x13	0x44	0x00	0x00	0x00	0x10	0x00	0x00	
Select Video Format NTSC	0xBE	0xEF	0x03	0x19	0x00	0x85	0x5C	0x01	0x13	0x44	0x00	0x00	0x00	0x01	0x00	0x00	
Select Video Format PAL	0xBE	0xEF	0x03	0x19	0x00	0xB7	0x1E	0x01	0x13	0x44	0x00	0x00	0x00	0x06	0x00	0x00	
Select Video Format SECAM	0xBE	0xEF	0x03	0x19	0x00	0xD3	0x9A	0x01	0x13	0x44	0x00	0x00	0x00	0x08	0x00	0x00	
Select Video Type DVD	0xBE	0xEF	0x03	0x19	0x00	0x00	0x0E	0x01	0x09	0x44	0x00	0x00	0x00	0x00	0x00	0x00	
Select Video Type VCR	0xBE	0xEF	0x03	0x19	0x00	0x90	0xCF	0x01	0x09	0x44	0x00	0x00	0x00	0x01	0x00	0x00	

Byte	1	2	3	4	5	6	7	8	9	10	11,12	13	14-16	17	18	19-32	Rev.:
Command Name:								operation type	operation -lo	operation -hi		Target		oper value lo	oper value hi		
RGB Video OFF	0xBE	0xEF	0x03	0x19	0x00	0x55	0xB6	0x01	0xCD	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
RGB Video Component	0xBE	0xEF	0x03	0x19	0x00	0x34	0x37	0x01	0xCD	0x02	0x00	0x00	0x00	0x02	0x00	0x00	
Test Image On	0xBE	0xEF	0x03	0x19	0x00	0xE3	0x44	0x01	0x1D	0x04	0x00	0x00	0x00	0x01	0x00	0x00	
Test Image Off	0xBE	0xEF	0x03	0x19	0x00	0x73	0x85	0x01	0x1D	0x04	0x00	0x00	0x00	0x00	0x00	0x00	
Eco Mode On	0xBE	0xEF	0x03	0x19	0x00	0x45	0xB9	0x01	0xD6	0x02	0x00	0x00	0x00	0x01	0x00	0x00	
Eco Mode Off	0xBE	0xEF	0x03	0x19	0x00	0xD5	0x78	0x01	0xD6	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
Select CCA mode RGB	0xBE	0xEF	0x03	0x19	0x00	0x98	0x0D	0x01	0x48	0x06	0x00	0x00	0x00	0x01	0x00	0x00	
Select CCA mode Coordinates	0xBE	0xEF	0x03	0x19	0x00	0x08	0xCC	0x01	0x48	0x06	0x00	0x00	0x00	0x00	0x00	0x00	
Resize On	0xBE	0xEF	0x03	0x19	0x00	0x67	0x0A	0x01	0x8E	0x04	0x00	0x00	0x00	0x01	0x00	0x00	
Resize Off	0xBE	0xEF	0x03	0x19	0x00	0xF7	0xCB	0x01	0x8E	0x04	0x00	0x00	0x00	0x00	0x00	0x00	
Secondary Color Boost ON	0xBE	0xEF	0x03	0x19	0x00	0xF9	0x12	0x01	0xB6	0x02	0x00	0x00	0x00	0x01	0x00	0x00	
Secondary Color Boost OFF	0xBE	0xEF	0x03	0x19	0x00	0x69	0xD3	0x01	0xB6	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
Projector Control Mode RiMi	0xBE	0xEF	0x03	0x19	0x00	0x21	0xA4	0x01	0xD7	0x02	0x00	0x00	0x00	0x02	0x00	0x00	
Projector Control Mode External	0xBE	0xEF	0x03	0x19	0x00	0x40	0x25	0x01	0xD7	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
RS232 Address Mode Auto	0xBE	0xEF	0x03	0x19	0x00	0xA2	0x4E	0x01	0x57	0x03	0x00	0x00	0x00	0x01	0x00	0x00	
RS232 Address Mode Fixed	0xBE	0xEF	0x03	0x19	0x00	0x32	0x8F	0x01	0x57	0x03	0x00	0x00	0x00	0x00	0x00	0x00	



Byte	1	2	3	4	5	6	7	8	9	10	11,12	13	14-16	17	18	19-32	Rev.:
Command Name:								operation type	operation -lo	operation -hi		Target		oper value lo	oper value hi		

<b>INCREMENT/DECREMENT:</b>																	
Brightness Increment	0xBE	0xEF	0x03	0x19	0x00	0xC1	0xC9	0x03	0x03	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Brightness Decrement	0xBE	0xEF	0x03	0x19	0x00	0xAF	0x63	0x04	0x03	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Contrast Increment	0xBE	0xEF	0x03	0x19	0x00	0xEB	0x5F	0x03	0x04	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Contrast Decrement	0xBE	0xEF	0x03	0x19	0x00	0x85	0xF5	0x04	0x04	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Vertical Keystone Increment	0xBE	0xEF	0x03	0x19	0x00	0x94	0x75	0x03	0x1C	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Vertical Keystone Decrement	0xBE	0xEF	0x03	0x19	0x00	0xFA	0xDF	0x04	0x1C	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Horizontal Keystone Increment	0xBE	0xEF	0x03	0x19	0x00	0x8A	0x44	0x03	0x21	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
Horizontal Keystone Decrement	0xBE	0xEF	0x03	0x19	0x00	0xE4	0xEE	0x04	0x21	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
Color Saturation Increment	0xBE	0xEF	0x03	0x19	0x00	0x01	0xB8	0x03	0x0C	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Color Saturation Decrement	0xBE	0xEF	0x03	0x19	0x00	0x6F	0x12	0x04	0x0C	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Volume Increment	0xBE	0xEF	0x03	0x19	0x00	0x77	0xE0	0x03	0x66	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
Volume Decrement	0xBE	0xEF	0x03	0x19	0x00	0x19	0x4A	0x04	0x66	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
Horizontal Position Increment	0xBE	0xEF	0x03	0x19	0x00	0x6B	0x01	0x03	0x0E	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Horizontal Position Decrement	0xBE	0xEF	0x03	0x19	0x00	0x05	0xAB	0x04	0x0E	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Vertical Position Increment	0xBE	0xEF	0x03	0x19	0x00	0xFE	0x5C	0x03	0x0F	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Vertical Position Decrement	0xBE	0xEF	0x03	0x19	0x00	0x90	0xF6	0x04	0x0F	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Hue Increment	0xBE	0xEF	0x03	0x19	0x00	0x2B	0x2E	0x03	0x0B	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Hue Decrement	0xBE	0xEF	0x03	0x19	0x00	0x45	0x84	0x04	0x0B	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Sharpness Increment	0xBE	0xEF	0x03	0x19	0x00	0x94	0xE5	0x03	0x0D	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Sharpness Decrement	0xBE	0xEF	0x03	0x19	0x00	0xFA	0x4F	0x04	0x0D	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Phase Increment	0xBE	0xEF	0x03	0x19	0x00	0xAB	0xE0	0x03	0x10	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Phase Decrement	0xBE	0xEF	0x03	0x19	0x00	0xC5	0x4A	0x04	0x10	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Frequency Increment	0xBE	0xEF	0x03	0x19	0x00	0x7E	0x92	0x03	0x14	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Frequency Decrement	0xBE	0xEF	0x03	0x19	0x00	0x10	0x38	0x04	0x14	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Lamp power increment	0xBE	0xEF	0x03	0x19	0x00	0x95	0x27	0x03	0x5C	0x03	0x00	0x00	0x00	0x00	0x00	0x00	
Lamp power decrement	0xBE	0xEF	0x03	0x19	0x00	0xFB	0x8D	0x04	0x5C	0x03	0x00	0x00	0x00	0x00	0x00	0x00	
AudioTreble Increment	0xBE	0xEF	0x03	0x19	0x00	0xE2	0xBD	0x03	0x67	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
AudioTreble Decrement	0xBE	0xEF	0x03	0x19	0x00	0x8C	0x17	0x04	0x67	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
AudioBass Increment	0xBE	0xEF	0x03	0x19	0x00	0x22	0xCC	0x03	0x68	0x02	0x00	0x00	0x00	0x00	0x00	0x00	

Byte	1	2	3	4	5	6	7	8	9	10	11,12	13	14-16	17	18	19-32	Rev.:
Command Name:								operation type	operation -lo	operation -hi		Target		oper value lo	oper value hi		
AudioBass Decrement	0xBE	0xEF	0x03	0x19	0x00	0x4C	0x66	0x04	0x68	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
Red Brightness Increment	0xBE	0xEF	0x03	0x19	0x00	0x7E	0x02	0x03	0x05	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Red Brightness Decrement	0xBE	0xEF	0x03	0x19	0x00	0x10	0xA8	0x04	0x05	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Red Contrast Increment	0xBE	0xEF	0x03	0x19	0x00	0x81	0xE6	0x03	0x06	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Red Contrast Decrement	0xBE	0xEF	0x03	0x19	0x00	0xEF	0x4C	0x04	0x06	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Resize Vertical Increment	0xBE	0xEF	0x03	0x19	0x00	0x2E	0x1A	0x03	0x6B	0x06	0x00	0x00	0x00	0x00	0x00	0x00	
Resize Vertical Decrement	0xBE	0xEF	0x03	0x19	0x00	0x40	0xB0	0x04	0x6B	0x06	0x00	0x00	0x00	0x00	0x00	0x00	
Resize Horizontal Increment	0xBE	0xEF	0x03	0x19	0x00	0xBB	0x47	0x03	0x6A	0x06	0x00	0x00	0x00	0x00	0x00	0x00	
Resize Horizontal Decrement	0xBE	0xEF	0x03	0x19	0x00	0xD5	0xED	0x04	0x6A	0x06	0x00	0x00	0x00	0x00	0x00	0x00	
Green Brightness Increment	0xBE	0xEF	0x03	0x19	0x00	0x14	0xBB	0x03	0x07	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Green Brightness Decrement	0xBE	0xEF	0x03	0x19	0x00	0x7A	0x11	0x04	0x07	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Green Contrast Increment	0xBE	0xEF	0x03	0x19	0x00	0xD4	0xCA	0x03	0x08	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Green Contrast Decrement	0xBE	0xEF	0x03	0x19	0x00	0xBA	0x60	0x04	0x08	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Blue Brightness Increment	0xBE	0xEF	0x03	0x19	0x00	0x41	0x97	0x03	0x09	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Blue Brightness Decrement	0xBE	0xEF	0x03	0x19	0x00	0x2F	0x3D	0x04	0x09	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Blue Contrast Increment	0xBE	0xEF	0x03	0x19	0x00	0xBE	0x73	0x03	0x0A	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Blue Contrast Decrement	0xBE	0xEF	0x03	0x19	0x00	0xD0	0xD9	0x04	0x0A	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
XCoordinates Increment	0xBE	0xEF	0x03	0x19	0x00	0x0F	0x2F	0x03	0xFD	0x05	0x00	0x00	0x00	0x00	0x00	0x00	
XCoordinates Decrement	0xBE	0xEF	0x03	0x19	0x00	0x61	0x85	0x04	0xFD	0x05	0x00	0x00	0x00	0x00	0x00	0x00	
YCoordinates Increment	0xBE	0xEF	0x03	0x19	0x00	0xF0	0xCB	0x03	0xFE	0x05	0x00	0x00	0x00	0x00	0x00	0x00	
YCoordinates Decrement	0xBE	0xEF	0x03	0x19	0x00	0x9E	0x61	0x04	0xFE	0x05	0x00	0x00	0x00	0x00	0x00	0x00	
White Boost Increment	0xBE	0xEF	0x03	0x19	0x00	0x44	0xA3	0x03	0xFE	0x06	0x00	0x00	0x00	0x00	0x00	0x00	
White Boost Decrement	0xBE	0xEF	0x03	0x19	0x00	0x2A	0x09	0x04	0xFE	0x06	0x00	0x00	0x00	0x00	0x00	0x00	
<b>GET:</b>																	
Lamp Ignition Get	0xBE	0xEF	0x03	0x19	0x00	0x62	0x93	0x02	0xA2	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
Thermal Monitor Get	0xBE	0xEF	0x03	0x19	0x00	0xDC	0xE8	0x02	0x97	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
Source Get	0xBE	0xEF	0x03	0x19	0x00	0xA1	0x16	0x02	0x01	0x44	0x00	0x00	0x00	0x00	0x00	0x00	
Orientation Get	0xBE	0xEF	0x03	0x19	0x00	0x5A	0x76	0x02	0x51	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
Power Get	0xBE	0xEF	0x03	0x19	0x00	0xC9	0xEB	0x02	0x9C	0x02	0x00	0x00	0x00	0x00	0x00	0x00	

Byte	1	2	3	4	5	6	7	8	9	10	11,12	13	14-16	17	18	19-32	Rev.:
Command Name:								operation type	operation -lo	operation -hi		Target		oper value lo	oper value hi		
Brightness Get	0xBE	0xEF	0x03	0x19	0x00	0x38	0x9D	0x02	0x03	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Contrast Get	0xBE	0xEF	0x03	0x19	0x00	0x12	0x0B	0x02	0x04	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Color Saturation Get	0xBE	0xEF	0x03	0x19	0x00	0xF8	0xEC	0x02	0x0C	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Light On Time Hours Get	0xBE	0xEF	0x03	0x19	0x00	0x2D	0xF2	0x02	0x04	0x10	0x00	0x00	0x00	0x00	0x00	0x00	
Light On Time Minutes Get	0xBE	0xEF	0x03	0x19	0x00	0xB8	0xAF	0x02	0x05	0x10	0x00	0x00	0x00	0x00	0x00	0x00	
Unit On Time Hours Get	0xBE	0xEF	0x03	0x19	0x00	0x92	0x39	0x02	0x02	0x10	0x00	0x00	0x00	0x00	0x00	0x00	
Lamp On	0xBE	0xEF	0x03	0x19	0x00	0x07	0x7F	0x02	0x00	0x04	0x00	0x00	0x00	0x00	0x00	0x00	
Software Version Get	0xBE	0xEF	0x03	0x19	0x00	0x08	0x2A	0x02	0xA0	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
Estimated Remaining Lamp Time	0xBE	0xEF	0x03	0x19	0x00	0x1E	0xD9	0x02	0xDC	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
Lamp Power Get	0xBE	0xEF	0x03	0x19	0x00	0x6C	0x73	0x02	0x5C	0x03	0x00	0x00	0x00	0x00	0x00	0x00	
<b>EXECUTE:</b>																	
Auto Adjust	0xBE	0xEF	0x03	0x19	0x00	0x2F	0xAE	0x05	0x03	0x42	0x00	0x00	0x00	0x00	0x00	0x00	
Set CCA Coords to D65	0xBE	0xEF	0x03	0x19	0x00	0x07	0x9F	0x05	0x5E	0x06	0x00	0x00	0x00	0x00	0x00	0x00	
Resize Reset	0xBE	0xEF	0x03	0x19	0x00	0x87	0x22	0x05	0x91	0x04	0x00	0x00	0x00	0x00	0x00	0x00	
Factory Reset	0xBE	0xEF	0x03	0x19	0x00	0x6F	0xB9	0x05	0x01	0x22	0x00	0x00	0x00	0x00	0x00	0x00	
<b>DESCRIPTOR:</b>																	
Range Brightness	0xBE	0xEF	0x03	0x19	0x00	0xE4	0x9C	0x07	0x03	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Range Contrast	0xBE	0xEF	0x03	0x19	0x00	0xCE	0x0A	0x07	0x04	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Range Color/Saturation	0xBE	0xEF	0x03	0x19	0x00	0x24	0xED	0x07	0x0C	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Range Red Brightness	0xBE	0xEF	0x03	0x19	0x00	0x5B	0x57	0x07	0x05	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Range Red Contrast	0xBE	0xEF	0x03	0x19	0x00	0xA4	0xB3	0x07	0x06	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Range Green Brightness	0xBE	0xEF	0x03	0x19	0x00	0x31	0xEE	0x07	0x07	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Range Green Contrast	0xBE	0xEF	0x03	0x19	0x00	0xF1	0x9F	0x07	0x08	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Range Blue Brightness	0xBE	0xEF	0x03	0x19	0x00	0x64	0xC2	0x07	0x09	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Range Blue Contrast	0xBE	0xEF	0x03	0x19	0x00	0x9B	0x26	0x07	0x0A	0x40	0x00	0x00	0x00	0x00	0x00	0x00	

**C.1 About the protocol**

The projectors can be daisy-chained and controlled independently by adding address information to the original 32 byte binary RS232 message.

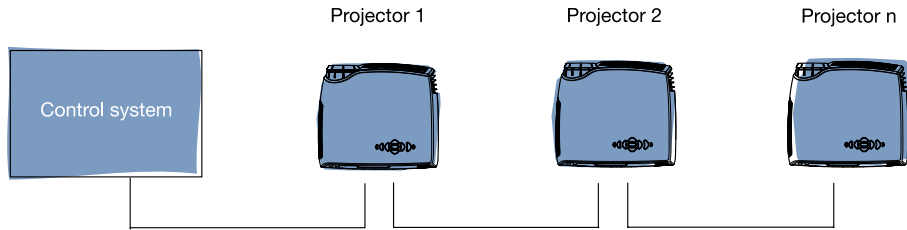


Figure 1: RS232 Daisy-Chaining

Figure 1 shows how to daisy-chain several projectors. The control system is connected to RS232 IN (female) in projector 1. The projector 1 RS232 OUT (male) is connected to projector 2 IN, and so on. Max numbers of projectors in a chain are 255.

To independently address and control each projector in the chain, the original 32-bytes protocol is extended with address information. The header size is increased from 7 to 8 bytes and the total packet is increased from 32 to 33 bytes. The acknowledge packet size is increased from 33 to 34 bytes.

Table 3 shows the original non-address 32-bytes message.

1	2	3	4	5	6	7	8-32
magic number		packet type	payload size lo	payload size hi	CRC lo	CRC hi	payload
0xBE	0xEF						

Table 3: 32-bytes non-address message

1	2	3	4	5	6	7	8	9-33
address magic number		address	packet type	payload size lo	payload size hi	CRC lo	CRC hi	payload
0xBA	0xDA	0x00-0xFF						

Table 4: 33-bytes address message

Legal message address range is 0-255, where 0 is broadcast address.

Table 5 shows the 34 bytes acknowledge message with address information. As for the non-address message, the acknowledge message consist of a PAK (0x1E) followed by the initial message sent from the host.

1	2	3	4	5	6	7	8	9	10-34
PAK	address magic number		ad- dress	type of msg	pay- load lo	pay- load hi	CRC lo	CRC hi	pay- load
0x1E	0xBA	0xDA	0x00-0xFF						

Table 5: 34-bytes acknowledge address message

**C.2 Address modes**

Two different addressing mechanisms are available, auto and fixed. The default mode is auto-addressing. It is important that all projectors in the chain are set to the same address mode. The address mode must be set from the projector’s menu system.

NOTE! The original 32-bytes non-address binary protocol does not support addressing, and commands using this protocol will only be executed by the first projector in the chain.

**C.2.1 Auto address mode**

In auto address mode, the address of the projector is based on its physical position in the chain. The first projector has address 1, the second has address 2 and so on.

**C.2.2 Fixed address mode**

In fixed mode, each projector needs to be programmed with a unique fixed address ir- respective of its position in the chain. The address must be specified for each projector by setting it from the projector’s menu system. If two or more projectors are equipped with the same address, then only one of the projectors will respond to a message addressed to that actual address.

Legal projector address range is 1 to 255 (0x01 – 0xFF).

**C.2.3 Broadcast**

Address 0 (zero) is broadcast address. A broadcast message is sent to all projectors in the chain regardless of the address mode. When a projector receives a broadcast message it will execute the command and send the message to the next projector in the chain. No acknowledge message will be sent in reply to a broadcast message.

**C.3 Baud rate**

The baud rate is configurable between 4800, 9600 and 19200. Default baud rate is 19200. If there are several projectors in the chain (>10) or high RS232 traffic it is strongly recommended that the baud rate is reduced to 4800. This will reduce the processing load at the first projectors in the chain.

#### C.4 Special short messages

If there are several projectors in the chain (>10) or high RS232 traffic, it is strongly recommended that an alternative shorter message is used. This will reduce the processing load at the first projectors in the chain.

In a short message byte number 20 (19 for non-address) to 33 (32 for non-address) is omitted. The message header must be updated with correct payload size, i.e byte 5 and byte 6 (4 and 5 for non-address). If only 19 (18 for non-address) bytes is in use then the payload size is set to 11 (0x0B). See example in section 2.5.

Note that a DESCRIPTOR message should not be sent with a short message, because that type of message use bytes 20 – 33 in the response. All other message types can be used.

#### C.5 Examples

All available RS232 operations are described in Appendix C, and apply to the 32 bytes non-address protocol. To use with the address information the two first bytes 0xBE 0xEF must be replaced with the 0xBA 0xDA and an address byte.

Figure 2 shows the conversion from 32 bytes non-address to 33 bytes address message for “select VGA1”.

32 bytes non-address message																
Byte	1	2	3	4	5	6	7	8	9	10	11,12	13	14-16	17	18	19-32
Select vga1	0xBE	0xEF	0x03	0x19	0x00	0xEA	0xE9	0x01	0x044	0x00	0x00	0x00	0x00	0x00	0x00	0x00

33 bytes address message																	
Byte	1	2	3	4	5	6	7	8	9	10	11	12-13	14	15-17	18	19	20-33
Select vga1	0xBA	0xDA	0x05	0x03	0x19	0x00	0x00	0x00	0x01	0x00	0x44	0x00	0x00	0x00	0x00	0x00	0x00

[addr] = address 0x00 - 0xFF

Figure 2: Convert from 32-bytes non-address message to 33 bytes address message

Figure 3 shows a 33-bytes address message and the corresponding 19 bytes short message. Address in this example is 5 (0x05, byte 3). Payload\_lo (byte 5) is set to 0x0B.

33 bytes address message

Byte	1	2	3	4	5	6	7	8	9	10	11	12-13	14	15-17	18	19	20-33
Select vga1	0xBA	0xDA	0x05	0x03	0x19	0x00	0x00	0x00	0x01	0x01	0x44	0x00	0x00	0x00	0x00	0x00	0x00

19 bytes address message

Byte	1	2	3	4	5	6	7	8	9	10	11	12-13	14	15-17	18	19
Select vga1	0xBA	0xDA	0x05	0x03	0x0B	0x00	0x00	0x00	0x01	0x01	0x44	0x00	0x00	0x00	0x00	0x00

Figure 3: Long (33 bytes) address message and corresponding short (19 bytes) address message.

Note that the CRC is not in use and can be left 0x00

Note: It is important to select "custom color temp" before adjusting R/G/B temps, otherwise these commands will not work! All values are hexadecimal.

**D.1 Choose "Custom color temp"**

Select Color Temp Custom:	BE	EF	03	19	00	96	20	01	07	44	00	00	00	00	00	00	04	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
Other choices are:																																		
Select Color Temp 6500:	BE	EF	03	19	00	34	A3	01	07	44	00	00	00	00	00	00	02	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
Select Color Temp 7300:	BE	EF	03	19	00	C5	E3	01	07	44	00	00	00	00	00	00	01	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
Select Color Temp 9300:	BE	EF	03	19	00	55	22	01	07	44	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	

**D.2 Adjust the color temperature by using the increment / decrement operations:**

Red Temp Increment:	BE	EF	03	19	00	14	2B	03	16	40	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
Red Temp Decrement:	BE	EF	03	19	00	7A	81	04	16	40	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
Green Temp Increment:	BE	EF	03	19	00	81	76	03	17	40	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
Green Temp Decrement:	BE	EF	03	19	00	EF	DC	04	17	40	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
Blue Temp Increment:	BE	EF	03	19	00	41	07	03	18	40	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
Blue Temp Decrement:	BE	EF	03	19	00	2F	AD	04	18	40	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

You may now bring the adjusted custom setting forward by selecting "custom color temp", either through keypad/remote or via RS232.

**E.1 OSD Warning On:**

When enabling OSD Warnings after being disabled, OSD is still disabled and must be set to ON to become visible again.

**E.2 Lamp Ignition states:**

00 – Lamp does not ignite

01 – Lamp is warming up

02 – Lamp ignited

03 – Lamp is off

04 – Lamp is cooling down

**E.3 Thermal Monitor states:**

00 – OK

01 – Temperature too high

02 – Temperature warning

03 – Fan 70 x 70 stopped

04 – Fan 60 x 60 stopped

05 – Fan Blower stopped

**E.4 Lamp On States**

00 – Lamp is not lit

01 – Lamp is lit



This page is left blank intentionally.

