DIGITAL PROJECTION

iVision

RS-232

communication protocol

and

command set

1 Revision History

Document	Rev	Release Date	Revised	Owner
RS232 Protocol and Command Structure.pdf	1.0	18/12/02	Valid from firmware revision xxxx-01	AL
RS232 Protocol and Command Structure.pdf	1.1	09/01/03	Added functionality; valid from firmware revision xxxx-20	AL
RS232 Protocol and Command Structure.pdf	1.2	12/02/03	Added “Lamp On” Monitoring Functionality, valid from xxxx-29	AL
RS232 Protocol and Command Structure.pdf	1.3	03/03/03	Added “Blank Display” function, valid on all firmware. Added “Secondary Color Boost” function, valid from xxxx-34 Added “Select Component HD”, valid from xxxx-30 Changed “Source Get” parameters. Changes in section 2.1.1 and 2.1.2.	AJ
RS232 Protocol and Command Structure.pdf	1.4	29/03/03	Correct writing errors in Source Get values. Corrected writing errors in Blank Display values. Added “Adjusting Custom Colour Temp via RS232” example.	AL
RS232 Protocol and Command Structure.pdf	1.5	11/06/03	Added new functionality, Auto_Adjust and OSD_on/off Added description on INC / DEC commands	AL

2 Establish communication

1.1 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.

1.2 RS232 Communication parameters

Parameter	Data
Baudrate	19200
Parity	N
Databits	8
Stopbits	1
Flowcontrol	None

2 Send and receive packets

2.1 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 C and D have one row for each command. (See Appendix C for hexadecimal values and Appendix D for decimal values).

The packet consists of a header, 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 C and D 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.

2.1.1 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 C and D, 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 2.1.3)

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.

2.1.2 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.

2.1.3 INCREMENT_ and DECREMENT_operations

These operations are used when you want to increment or decrement the current value by steps of 1.

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

2.1.4 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 2.1.3).

2.1.5 Example of setting protocol and sending command in CMD window

Setting up the COM port, and sending a “power on” command. “PowerOn” is simply a binary-file with the appropriate values:

This returns, when successful, acknowledgement as described in chapter 2.1.2 a)
It also turns the projector on.

Appendix A, 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.

Operation Packet Payload Format

Byte	Field Name	Field Value	Description
1-7			Header, see Excel sheet
8	Operation Type	1	OPERATION_SET
		2	OPERATION_GET
		3	OPERATION_INCREMENT
		4	OPERATION_DECREMENT
		5	OPERATION_EXECUTE
9-10	Operation		Operation ID.
11-12	Operation Validation		n/a (not available for use).
13-16	Operation Target		n/a (not available for use).
17-18	Operation Value		Value of the Set on a set or the Value of the Get on a Return.
19-20	Operation Value		n/a (not available for use)
21-24	Lower Limit		Lower Parameter limit
25-28	Upper Limit		Upper Parameter limit.
29-32	Increment		n/a (not available for use)

Appendix B, CRC Calculation Algorithm

The following 'C' code can be used to calculate the 16-bit CRC required for all packets. The CRC is contained in the packet header and is calculated for the entire packet (header plus payload). The CRC calculation is performed with the CRC bytes of the packet header initialized to zero.

```
// Using two 256 byte lookup tables, quickly calculate a 16-bit CRC on
// a block of data.
// Params:
// pcData : Pointer to data to calculate CRC on.
// nCount : Number of data bytes.
// Return: 16-bit CRC value.
WORD CalculateCRC16(BYTE *pcData, int nCount)
{
	BYTE cCRCHi = 0xFF;	// high byte of CRC initialized
	BYTE cCRCLo = 0xFF;	// low byte of CRC initialized
	BYTE cIndex;		// will index into CRC lookup table
	while (nCount--)	// step through each byte of data
	{
		cIndex = cCRCHi ^ *pcData++; // calculate the CRC
		cCRCHi = cCRCLo ^ cCRCHiArray[cIndex];
		cCRCLo = cCRCLoArray[cIndex];
	}
	return (cCRCHi << 8) + cCRCLo;
}

// Lookup table used for hi-byte of CRC
static const BYTE cCRCHiArray[] = {
	0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0,
	0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
	0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0,
	0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
	0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1,
	0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
	0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1,
	0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
	0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0,
	0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40,
	0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1,
	0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
	0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0,
	0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40,
	0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0,
	0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
	0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0,
	0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
	0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0,
	0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
	0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0,
	0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40,
	0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1,
	0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
	0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0,
	0x80, 0x41, 0x00, 0xC1, 0x81, 0x40
};
// Lookup table used for low-byte of CRC
static const BYTE cCRCLoArray[] = {
	0x00, 0xC0, 0xC1, 0x01, 0xC3, 0x03, 0x02, 0xC2, 0xC6, 0x06,
	0x07, 0xC7, 0x05, 0xC5, 0xC4, 0x04, 0xCC, 0x0C, 0x0D, 0xCD,
	0x0F, 0xCF, 0xCE, 0x0E, 0x0A, 0xCA, 0xCB, 0x0B, 0xC9, 0x09,
	0x08, 0xC8, 0xD8, 0x18, 0x19, 0xD9, 0x1B, 0xDB, 0xDA, 0x1A,
	0x1E, 0xDE, 0xDF, 0x1F, 0xDD, 0x1D, 0x1C, 0xDC, 0x14, 0xD4,
	0xD5, 0x15, 0xD7, 0x17, 0x16, 0xD6, 0xD2, 0x12, 0x13, 0xD3,
	0x11, 0xD1, 0xD0, 0x10, 0xF0, 0x30, 0x31, 0xF1, 0x33, 0xF3,
	0xF2, 0x32, 0x36, 0xF6, 0xF7, 0x37, 0xF5, 0x35, 0x34, 0xF4,
	0x3C, 0xFC, 0xFD, 0x3D, 0xFF, 0x3F, 0x3E, 0xFE, 0xFA, 0x3A,
	0x3B, 0xFB, 0x39, 0xF9, 0xF8, 0x38, 0x28, 0xE8, 0xE9, 0x29,
	0xEB, 0x2B, 0x2A, 0xEA, 0xEE, 0x2E, 0x2F, 0xEF, 0x2D, 0xED,
	0xEC, 0x2C, 0xE4, 0x24, 0x25, 0xE5, 0x27, 0xE7, 0xE6, 0x26,
	0x22, 0xE2, 0xE3, 0x23, 0xE1, 0x21, 0x20, 0xE0, 0xA0, 0x60,
	0x61, 0xA1, 0x63, 0xA3, 0xA2, 0x62, 0x66, 0xA6, 0xA7, 0x67,
	0xA5, 0x65, 0x64, 0xA4, 0x6C, 0xAC, 0xAD, 0x6D, 0xAF, 0x6F,
	0x6E, 0xAE, 0xAA, 0x6A, 0x6B, 0xAB, 0x69, 0xA9, 0xA8, 0x68,
	0x78, 0xB8, 0xB9, 0x79, 0xBB, 0x7B, 0x7A, 0xBA, 0xBE, 0x7E,
	0x7F, 0xBF, 0x7D, 0xBD, 0xBC, 0x7C, 0xB4, 0x74, 0x75, 0xB5,
```

```
        x77, 0xB7, 0xB6, 0x76, 0x72, 0xB2, 0xB3, 0x73, 0xB1, 0x71,
        x70, 0xB0, 0x50, 0x90, 0x91, 0x51, 0x93, 0x53, 0x52, 0x92,
        0x96, 0x56, 0x57, 0x97, 0x55, 0x95, 0x94, 0x54, 0x9C, 0x5C,
        0x5D, 0x9D, 0x5F, 0x9F, 0x9E, 0x5E, 0x5A, 0x9A, 0x9B, 0x5B,
        0x99, 0x59, 0x58, 0x98, 0x88, 0x48, 0x49, 0x89, 0x4B, 0x8B,
        0x8A, 0x4A, 0x4E, 0x8E, 0x8F, 0x4F, 0x8D, 0x4D, 0x4C, 0x8C,
        0x44, 0x84, 0x85, 0x45, 0x87, 0x47, 0x46, 0x86, 0x82, 0x42,
        0x43, 0x83, 0x41, 0x81, 0x80, 0x40
};
```

Appendix C, Operations in Hexadecimal values

Byte	1	2	3	4	5	6	7	8	9	10	11,12	13	14-16	17	18	19-32	Rev.
Command Name						crc_lo	crc_hi	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 Component	0xBE	0xEF	0x03	0x19	0x00	0x1B	0xA9	0x01	0x01	0x44	0x00	0x00	0x00	0x03	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 HD	0xBE	0xEF	0x03	0x19	0x00	0x48	0x6A	0x01	0x01	0x44	0x00	0x00	0x00	0x06	0x00	0x00	.30
Source scan off	0xBE	0xEF	0x03	0x19	0x00	0x8A	0x48	0x01	0x23	0x44	0x00	0x00	0x00	0x02	0x00	0x00	
Source scan on	0xBE	0xEF	0x03	0x19	0x00	0xEB	0xC9	0x01	0x23	0x44	0x00	0x00	0x00	0x00	0x00	0x00	
Power off	0xBE	0xEF	0x03	0x19	0x00	0x82	0x14	0x01	0x9C	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
Power on	0xBE	0xEF	0x03	0x19	0x00	0x12	0xD5	0x01	0x9C	0x02	0x00	0x00	0x00	0x01	0x00	0x00	
Mute On	0xBE	0xEF	0x03	0x19	0x00	0x05	0x3A	0x01	0x69	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
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 FillAspectRatio	0xBE	0xEF	0x03	0x19	0x00	0xC5	0x73	0x01	0x16	0x44	0x00	0x00	0x00	0x01	0x00	0x00	
Select Scaling FillAll	0xBE	0xEF	0x03	0x19	0x00	0x34	0x33	0x01	0x16	0x44	0x00	0x00	0x00	0x02	0x00	0x00	
Select Gamma Video Video	0xBE	0xEF	0x03	0x19	0x00	0xB8	0x1D	0x01	0x91	0x02	0x00	0x00	0x00	0x01	0x00	0x00	
Select Gamma Video Photographic	0xBE	0xEF	0x03	0x19	0x00	0x49	0x5D	0x01	0x91	0x02	0x00	0x00	0x00	0x02	0x00	0x00	
Select Gamma Video High Brightness	0xBE	0xEF	0x03	0x19	0x00	0xD9	0x9C	0x01	0x91	0x02	0x00	0x00	0x00	0x03	0x00	0x00	
Select Gamma Data Video	0xBE	0xEF	0x03	0x19	0x00	0x2D	0x40	0x01	0x90	0x02	0x00	0x00	0x00	0x01	0x00	0x00	
Select Gamma Data Photographic	0xBE	0xEF	0x03	0x19	0x00	0xDC	0x00	0x01	0x90	0x02	0x00	0x00	0x00	0x02	0x00	0x00	
Select Gamma Data High Brightness	0xBE	0xEF	0x03	0x19	0x00	0x4C	0xC1	0x01	0x90	0x02	0x00	0x00	0x00	0x03	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 Search Picture Off	0xBE	0xEF	0x03	0x19	0x00	0xFC	0x1E	0x01	0xA6	0x02	0x00	0x00	0x00	0x00	0x00	0x00	.20
Select Search Picture Logo	0xBE	0xEF	0x03	0x19	0x00	0x6C	0xDF	0x01	0xA6	0x02	0x00	0x00	0x00	0x01	0x00	0x00	.20
Select Search Picture Blue	0xBE	0xEF	0x03	0x19	0x00	0x9D	0x9F	0x01	0xA6	0x02	0x00	0x00	0x00	0x02	0x00	0x00	.20
Select Search Picture White	0xBE	0xEF	0x03	0x19	0x00	0x0D	0x5E	0x01	0xA6	0x02	0x00	0x00	0x00	0x03	0x00	0x00	.20
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	
INCREMENT/DECREMENT																	
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	.20
Frequency Decrement	0xBE	0xEF	0x03	0x19	0x00	0x10	0x38	0x04	0x14	0x40	0x00	0x00	0x00	0x00	0x00	0x00	.20
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	
AudioBass Decrement	0xBE	0xEF	0x03	0x19	0x00	0x4C	0x66	0x04	0x68	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
Red Brightness Increment [i]	0xBE	0xEF	0x03	0x19	0x00	0x7E	0x02	0x03	0x05	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Red Brightness Decrement [i]	0xBE	0xEF	0x03	0x19	0x00	0x10	0xA8	0x04	0x05	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Red Contrast Increment [i]	0xBE	0xEF	0x03	0x19	0x00	0x81	0xE6	0x03	0x06	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Red Contrast Decrement [i]	0xBE	0xEF	0x03	0x19	0x00	0xEF	0x4C	0x04	0x06	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Green Brightness Increment [i]	0xBE	0xEF	0x03	0x19	0x00	0x14	0xBB	0x03	0x07	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Green Brightness Decrement [i]	0xBE	0xEF	0x03	0x19	0x00	0x7A	0x11	0x04	0x07	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Green Contrast Increment [i]	0xBE	0xEF	0x03	0x19	0x00	0xD4	0xCA	0x03	0x08	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Green Contrast Decrement [i]	0xBE	0xEF	0x03	0x19	0x00	0xBA	0x60	0x04	0x08	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Blue Brightness Increment [i]	0xBE	0xEF	0x03	0x19	0x00	0x41	0x97	0x03	0x09	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Blue Brightness Decrement [i]	0xBE	0xEF	0x03	0x19	0x00	0x2F	0x3D	0x04	0x09	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Blue Contrast Increment [i]	0xBE	0xEF	0x03	0x19	0x00	0xBE	0x73	0x03	0x0A	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
Blue Contrast Decrement [i]	0xBE	0xEF	0x03	0x19	0x00	0xD0	0xD9	0x04	0x0A	0x40	0x00	0x00	0x00	0x00	0x00	0x00	
GET:																	
Lamp Ignition Get [ii]	0xBE	0xEF	0x03	0x19	0x00	0x62	0x93	0x02	0xA2	0x02	0x00	0x00	0x00	0x00	0x00	0x00	.20
Thermal Monitor Get [iii]	0xBE	0xEF	0x03	0x19	0x00	0xDC	0xE8	0x02	0x97	0x02	0x00	0x00	0x00	0x00	0x00	0x00	.20
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	
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	
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 [iv]	0xBE	0xEF	0x03	0x19	0x00	0x07	0x7F	0x02	0x00	0x04	0x00	0x00	0x00	0x00	0x00	0x00	.29
Software Version Get	0xBE	0xEF	0x03	0x19	0x00	0x08	0x2A	0x02	0xA0	0x02	0x00	0x00	0x00	0x00	0x00	0x00	
EXECUTE:																	
Auto Adjust	0xBE	0xEF	0x03	0x19	0x00	0x2F	0xAE	0x05	0x03	0x42	0x00	0x00	0x00	0x00	0x00	0x00	

Appendix D, Operations in Decimal values

Byte	1	2	3	4	5	6	7	8	9	10	11,12	13	14-16	17	18	19-32	
Command Name						crc_lo	crc_hi	operation type	operation_lo	operation_hi		Target		operation value lo	operation value hi		
SET																	
Select VGA1	190	239	3	25	0	234	233	1	1	68	0	0	0	0	0	0	
Select VGA2	190	239	3	25	0	122	40	1	1	68	0	0	0	1	0	0	
Select DVI	190	239	3	25	0	139	104	1	1	68	0	0	0	2	0	0	
Select Component	190	239	3	25	0	27	169	1	1	68	0	0	0	3	0	0	
Select S-video	190	239	3	25	0	41	235	1	1	68	0	0	0	4	0	0	
Select Composite video	190	239	3	25	0	185	42	1	1	68	0	0	0	5	0	0	
Select Component HD	190	239	3	25	0	72	106	1	1	68	0	0	0	6	0	0	
Source scan off	190	239	3	25	0	138	72	1	35	68	0	0	0	2	0	0	
Source scan on	190	239	3	25	0	235	201	1	35	68	0	0	0	0	0	0	
Power off	190	239	3	25	0	130	20	1	156	2	0	0	0	0	0	0	
Power on	190	239	3	25	0	18	213	1	156	2	0	0	0	1	0	0	
Mute On	190	239	3	25	0	5	58	1	105	2	0	0	0	0	0	0	
Mute Off	190	239	3	25	0	149	251	1	105	2	0	0	0	1	0	0	
Select Scaling 1:1	190	239	3	25	0	85	178	1	22	68	0	0	0	0	0	0	
Select Scaling 16:9	190	239	3	25	0	164	242	1	22	68	0	0	0	3	0	0	
Select Scaling Anamorphic	190	239	3	25	0	49	54	1	22	68	0	0	0	14	0	0	
Select Scaling FillAspectRatio	190	239	3	25	0	197	115	1	22	68	0	0	0	1	0	0	
Select Scaling FillAll	190	239	3	25	0	52	51	1	22	68	0	0	0	2	0	0	
Select Gamma Video Video	190	239	3	25	0	184	29	1	145	2	0	0	0	1	0	0	
Select Gamma Video Photographic	190	239	3	25	0	73	93	1	145	2	0	0	0	2	0	0	
Select Gamma Video High Brightness	190	239	3	25	0	217	156	1	145	2	0	0	0	3	0	0	
Select Gamma Data Video	190	239	3	25	0	45	64	1	144	2	0	0	0	1	0	0	
Select Gamma Data Photographic	190	239	3	25	0	220	0	1	144	2	0	0	0	2	0	0	
Select Gamma Data High Brightness	190	239	3	25	0	76	193	1	144	2	0	0	0	3	0	0	
Select Orientation Desktop Front	190	239	3	25	0	17	137	1	81	2	0	0	0	0	0	0	

Select Orientation Ceiling Front	190	239	3	25	0	224	201	1	81	2	0	0	0	3	0	0	
Select Orientation Desktop Rear	190	239	3	25	0	112	8	1	81	2	0	0	0	2	0	0	
Select Orientation Rear Ceiling	190	239	3	25	0	129	72	1	81	2	0	0	0	1	0	0	
Select Search Picture Off	190	239	3	25	0	252	30	1	166	2	0	0	0	0	0	0	.20
Select Search Picture Logo	190	239	3	25	0	108	223	1	166	2	0	0	0	1	0	0	.20
Select Search Picture Blue	190	239	3	25	0	157	159	1	166	2	0	0	0	2	0	0	.20
Select Search Picture White	190	239	3	25	0	13	94	1	166	2	0	0	0	3	0	0	.20
Blank Display On (picture mute)	190	239	3	25	0	189	189	1	59	2	0	0	0	1	0	0	
Blank Display Off (picture mute)	190	239	3	25	0	45	124	1	59	2	0	0	0	0	0	0	
OSD on	190	239	3	25	0	135	136	1	157	2	0	0	0	1	0	0	
OSD off	190	239	3	25	0	23	73	1	157	2	0	0	0	0	0	0	
INCREMENT/DECREMENT																	
Brightness Increment	190	239	3	25	0	193	201	3	3	64	0	0	0	0	0	0	
Brightness Decrement	190	239	3	25	0	175	99	4	3	64	0	0	0	0	0	0	
Contrast Increment	190	239	3	25	0	235	95	3	4	64	0	0	0	0	0	0	
Contrast Decrement	190	239	3	25	0	133	245	4	4	64	0	0	0	0	0	0	
Vertical Keystone Increment	190	239	3	25	0	148	117	3	28	64	0	0	0	0	0	0	
Vertical Keystone Decrement	190	239	3	25	0	250	223	4	28	64	0	0	0	0	0	0	
Horizontal Keystone Increment	190	239	3	25	0	138	68	3	33	2	0	0	0	0	0	0	
Horizontal Keystone Decrement	190	239	3	25	0	228	238	4	33	2	0	0	0	0	0	0	
Color Saturation Increment	190	239	3	25	0	1	184	3	12	64	0	0	0	0	0	0	
Color Saturation Decrement	190	239	3	25	0	111	18	4	12	64	0	0	0	0	0	0	
Volume Increment	190	239	3	25	0	119	224	3	102	2	0	0	0	0	0	0	
Volume Decrement	190	239	3	25	0	25	74	4	102	2	0	0	0	0	0	0	
Horizontal Position Increment	190	239	3	25	0	107	1	3	14	64	0	0	0	0	0	0	
Horizontal Position Decrement	190	239	3	25	0	5	171	4	14	64	0	0	0	0	0	0	
Vertical Position Increment	190	239	3	25	0	254	92	3	15	64	0	0	0	0	0	0	
Vertical Position Decrement	190	239	3	25	0	144	246	4	15	64	0	0	0	0	0	0	
Hue Increment	190	239	3	25	0	43	46	3	11	64	0	0	0	0	0	0	
Hue Decrement	190	239	3	25	0	69	132	4	11	64	0	0	0	0	0	0	
Sharpness Increment	190	239	3	25	0	148	229	3	13	64	0	0	0	0	0	0	

Sharpness Decrement	190	239	3	25	0	250	79	4	13	64	0	0	0	0	0	0	
Phase Increment	190	239	3	25	0	171	224	3	16	64	0	0	0	0	0	0	
Phase Decrement	190	239	3	25	0	197	74	4	16	64	0	0	0	0	0	0	
Frequency Increment	190	239	3	25	0	126	146	3	20	64	0	0	0	0	0	0	.20
Frequency Decrement	190	239	3	25	0	16	56	4	20	64	0	0	0	0	0	0	.20
AudioTreble Increment	190	239	3	25	0	226	189	3	103	2	0	0	0	0	0	0	
AudioTreble Decrement	190	239	3	25	0	140	23	4	103	2	0	0	0	0	0	0	
AudioBass Increment	190	239	3	25	0	34	204	3	104	2	0	0	0	0	0	0	
AudioBass Decrement	190	239	3	25	0	76	102	4	104	2	0	0	0	0	0	0	
Red Brightness Increment [i]	190	239	3	25	0	126	2	3	5	64	0	0	0	0	0	0	
Red Brightness Decrement [i]	190	239	3	25	0	16	168	4	5	64	0	0	0	0	0	0	
Red Contrast Increment [i]	190	239	3	25	0	129	230	3	6	64	0	0	0	0	0	0	
Red Contrast Decrement [i]	190	239	3	25	0	239	76	4	6	64	0	0	0	0	0	0	
Green Brightness Increment [i]	190	239	3	25	0	20	187	3	7	64	0	0	0	0	0	0	
Green Brightness Decrement [i]	190	239	3	25	0	122	17	4	7	64	0	0	0	0	0	0	
Green Contrast Increment [i]	190	239	3	25	0	212	202	3	8	64	0	0	0	0	0	0	
Green Contrast Decrement [i]	190	239	3	25	0	186	96	4	8	64	0	0	0	0	0	0	
Blue Brightness Increment [i]	190	239	3	25	0	65	151	3	9	64	0	0	0	0	0	0	
Blue Brightness Decrement [i]	190	239	3	25	0	47	61	4	9	64	0	0	0	0	0	0	
Blue Contrast Increment [i]	190	239	3	25	0	190	115	3	10	64	0	0	0	0	0	0	
Blue Contrast Decrement [i]	190	239	3	25	0	208	217	4	10	64	0	0	0	0	0	0	
GET:																	
Lamp Ignition Get [ii]	190	239	3	25	0	98	147	2	162	2	0	0	0	0	0	0	.20
Thermal Monitor Get [iii]	190	239	3	25	0	220	232	2	151	2	0	0	0	0	0	0	.20
Source Get	190	239	3	25	0	161	22	2	1	68	0	0	0	0	0	0	
Orientation Get	190	239	3	25	0	90	118	2	81	2	0	0	0	0	0	0	
Power Get	190	239	3	25	0	201	235	2	156	2	0	0	0	0	0	0	
Brightness Get	190	239	3	25	0	56	157	2	3	64	0	0	0	0	0	0	
Contrast Get	190	239	3	25	0	18	11	2	4	64	0	0	0	0	0	0	
Light On Time Hours Get	190	239	3	25	0	45	242	2	4	16	0	0	0	0	0	0	
Light On Time Minutes Get	190	239	3	25	0	184	175	2	5	16	0	0	0	0	0	0	

Unit On Time Hours Get	190	239	3	25	0	146	57	2	2	16	0	0	0	0	0	0	
Lamp On[iv]	190	239	3	25	0	7	127	2	0	4	0	0	0	0	0	0	.29
Software Version Get	190	239	3	25	0	8	42	2	160	2	0	0	0	0	0	0	
EXECUTE:																	
Auto Adjust	190	239	3	25	0	47	174	5	3	66	0	0	0	0	0	0	

Appendix E, Adjusting Custom Color Temp using RS232

Note: It is important to select ”custom color temp” *before* adjusting R/G/B temps, otherwise these commands will not work!

E.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
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
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
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

E.2 Adjust color temp by using 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
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
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
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
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
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

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

[i] Sub-Brightness and Sub-Contrast adjustment settings apply only to analog RGB (VGA) input sources.

[ii]

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

[iii]

Thermal Monitor states:
00 – OK
01 – Tempe rature too high
02 – Temperature warning
03 – Fan 70 x 70 stopped 04 – Fan 60 x 60 stopped
05 – Fan Blower stopped

[iv]

Lamp On States
00 – Lamp is not lit
01 – Lamp is lit