DLPC6540

Programmer's Guide

TEXAS INSTRUMENTS

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Chapter Programmer's Guide

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This guide provides details of the software interface requirements for a DLPC6540 controller based system. This descriptions includes the communication protocol, initialization, default settings, common use cases and command descriptions.

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Scope

This guide provides details of the software interface requirements for a DLPC6540 controller based system. This descriptions includes the communication protocol, initialization, default settings, common use cases and command descriptions.

Figure 1-1 shows a typical projector system using DLPC6540 controller that includes the DLPA3005 power management IC and the .47 4K HSSI DMD.

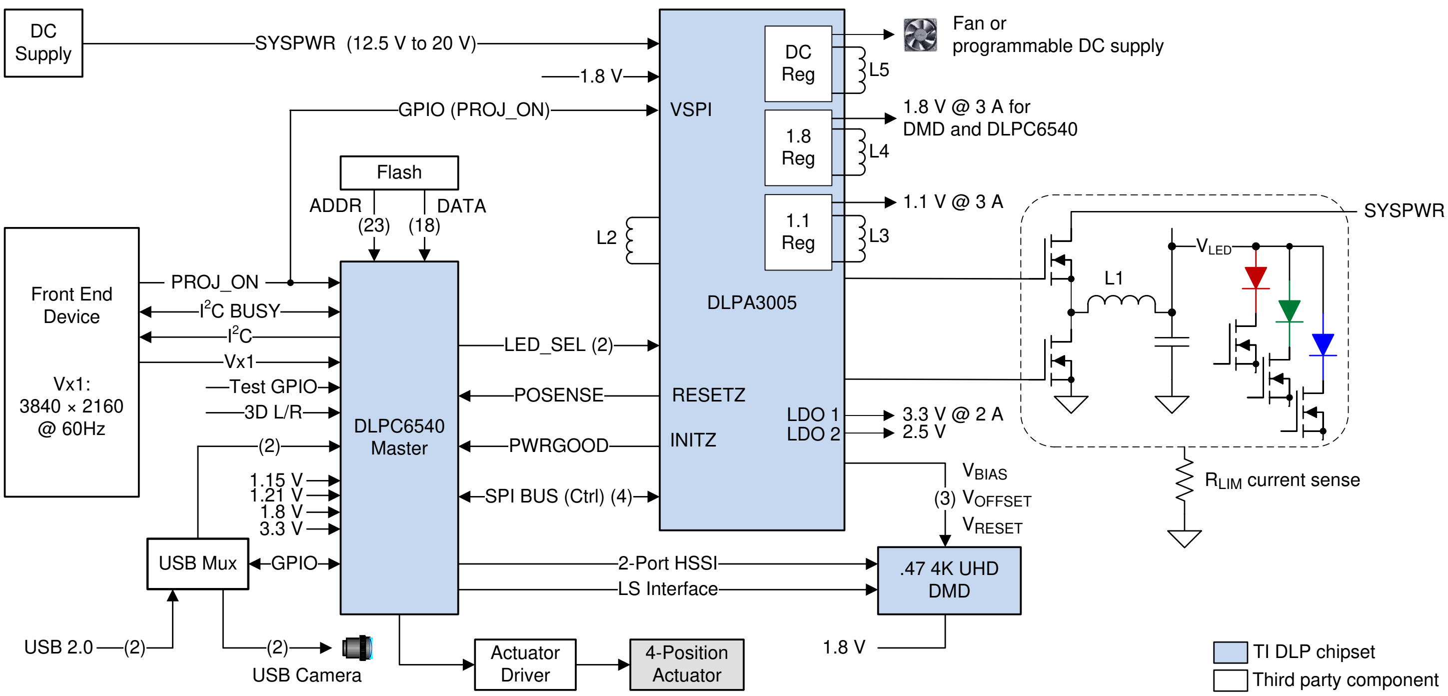

Figure 1-1. Typical Projector System Block Diagram

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Chapter 2
References

1. DLPC6540 Datasheet.
2. I²C Bus Specification - Philips Semiconductor 1994 Desktop Video Data Handbook.
3. DLP® Composer™ Tool User's Guide.

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Chapter 3
Acronyms

CCA - Color Co-ordinate Adjustment

CFI - Common Flash Interface

CSC - Color Space Conversion

DB – Dynamic black

DLPC – DLP controller

HSG - Hue Saturation Gain

SFG – Solid field generator

GPIO – General purpose input/output

LUT - Lookup Table

PWM – Pulse width modulation

SSI - Solid State Illumination

TPG - Test Pattern Generator

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Chapter 4
System Boot

The DLP controller boots from the parallel flash connected at the PM_CSZ_0 line. There is no ROM code built into the controller. It is mandatory to have parallel flash connected on the CS0 chip select line.

4.1 Data In flash

These are the major sections of data present in the flash memory.

- Bootloader Application
- Main Application
- Configuration data
- Display sequences
- Splash image(s)
- Auto-init batch file

4.2 Bootloader Application

The bootloader is the first application that runs from the flash memory when the system is turned on or reset. The bootloader application copies itself from flash to internal RAM for execution. This application performs flash update (erase, program). It also identifies a valid main application in the flash and only then begins to run the main application. This application reads the GPIO_64 (HOLD_BOOTZ) signal at the startup and if the signal reads 0, the application remains in the boot application mode. This useful option forces the firmware to update in case the main application on the flash is corrupted. Use the DLP Control Program to update the flash firmware.

Table 4-1 lists all commands supported by the booloader application for flash update. Figure 4-1 depicts the example usage of bootloader commands for updating the flash contents.

Table 4-1. Supported Flash Update Commands

Command	Description
Boot Hold Reason	Reason for controller to be in Boot Application mode.
Get Flash ID	Returns the Flash ID
Get Flash Sector Info	Retrieve flash number of sectors and sector size information
Flash Lock/Unlock	User must send this command to unlock the flash for erase/program access. This is to prevent accidental erase/programming of flash data.
Erase Sector	Command to erase sector – user to provide sector address as input
Initialize Flash Read/Write	Command to specify start address on the flash along with # of bytes to be written or readback
Get Checksum	Command to compute checksum and return it. Command takes flash address and number of bytes to compute the checksum.

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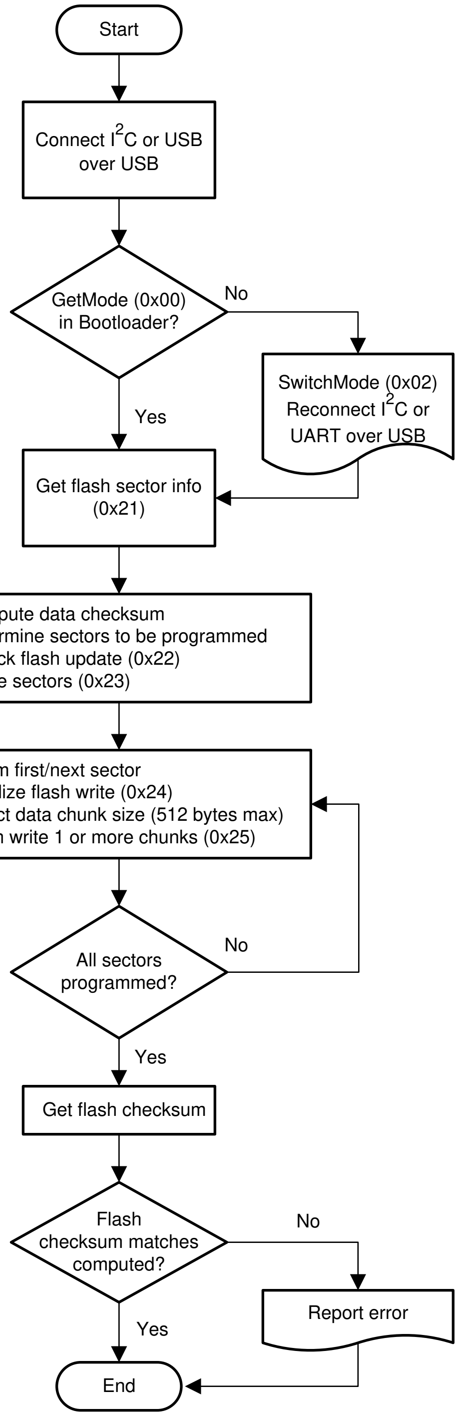

Figure 4-1. Flash Update Flow Diagram

4.3 Main Application

This application runs during the normal projector operation and performs full system initialization including DMD, illumination sub-system and peripherals. It responds to all the control commands from host controller and takes appropriate actions and sends responses.

4.4 Commands supported by Bootloader and Main Applications

The bootloader application and main application support these commands:

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Command Name	Description
Get Mode	Returns the current mode – Bootloader or Main Applicaiton
Get Version	Retuns software version information
Switch Mode	Switch between bootloader mode and main application mode

4.5 Debug Terminal

The application prints several status messages and debug information onto its UART Port0. User has the option to configure that to a different port using DLP Composer tool. The default settings for this UART port is set to 115200 baud rate, 8-bit data, no parity, 1-stop bit and no flow control. These parameters may be changed as per user preference using DLP Composer tool.

The level of messages on the debug terminal is configurable via Set Debug Message Mask command. User may choose to route the debug messages to USB port instead of UART port using Enable USB Debug Log command.

4.6 HOST_IRQ/SYSTEM_BUSY

GPIO_58 acts as HOST_IRQ/SYSTEM_BUSY signal, configured as open drain GPIO from the controller side. The GPIO indicates when the controller is free or busy. During power-on-reset, the front-end communication device must wait until the signal goes to LOW state when host processor is available to receive commands. When the signal remains continuously HIGH, this indicates problem with controller boot-sequence. In this case it is important that the issue resolved before proceeding. (Try reading Get Boot Hold Reason command to narrow down the issue.)

4.7 Heartbeat

After a successful boot-up, the controller begins toggling the GPIO_28. Typical operation reflects 1 Hz, 50% duty-cycle. If the device detects an error, the signal changes to 5 Hz, 50% duty-cycle. The front-end component can figure out the error via System Status command. In addtion, the GPIO_28 signal can be send as an input to the front-end to detect any issues.

4.8 Low-level Fault

When the controller starup sequence encounters some error condition, it transitions to bootloader mode and sets GPIO_23 (connected to an LED) HIGH to indicate a low-level fault condition. See the debug message printed in the UART debug terminal or via the Get Boot Hold Reason command to get more details about the cause of error. When the ARM processor detects one of the data abort, pre-fetch abort or undefined instruction exceptions, it starts blinking GPIO_23 in specific hex code format. During this error condition, communication with the controller is not possible. The only way to communicate with the controller is to analyze the hex error code from the pattern and then debug the hardware to fix the issue.

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Chapter 5

System Status

The front-end controller can poll Get System Status command to get information related to system status and error conditions.

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Chapter 6
Version

The front-end can query the version information of application sofware and the underlying API library using the Get Version command.

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Chapter 7
Power Modes

The DLP Controller can operate in Normal or Standby power modes. Use Set Power command to toggle between the two modes. In the standby state the controller will be consuming the minimal power. When the system is not in use, user can set system in Standby state. Note the state transition may take several hundred milliseconds to complete. User shall ensure power mode transition is complete using Get Power command.

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Chapter 8
Display Modes

When the system is operating in normal power mode, the user can change the display mode of the system using Set Display command. Display of contents from different sources such as Test Pattern (internal pre-programmed), Solid Field, Splash (logo image), Curtain, and External Source are supported. Controller firmware is designed to hide mode transition artifacts. However, where the transition artifacts are not completely hidden, user has the option to freeze the display (using Enable Freeze command), display a blank curtain or turn off illuminator (using Set Illumiantion Enable command) to hide those artifacts.

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Chapter 9

Source Detection and Configuration

Follow specific steps to configure the controller to display a source properly. When operating in External display mode, the controller automatically scans the connectors for activity and runs the automatic source detection and locking algorithm.

The front-end controller gets information about scan status using Get Datapath Scan Status command. After a source is detected, all information about the source can be queried using Get Source Configuration command. Anytime after source detection, the user may override any of the auto-detected parameters via Set Source Configuration command.

If the source detection is incorrect or if any source parameters have changed, initiate a re-sync using Autolock Setup command.

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Chapter 10

Internal sources

This section discusses multiple internal source options to display by using Set Display command.

10.1 Test Patterns (TPG)

The controller has several pre-defined patterns that the user can select using TPG Pre-defined Pattern command. Use the DLP Composer tool to configure these pre-defined patterns The controller TPG block generates the pattern data. This option is useful for:

- Testing the DLP hardware without an external source
- Isolating whether an issue is arising from front-end source or related to image processing by the controller

These are additional configuration commands specific to test patterns:

Command Name	Description
Set TPG Border	Set border around selected TPG, border width can be 0 – 20; and border color programmable (R,G,B) value in the range of 0 - 1023.
Set TPG Resolution	Set the TPG pattern resolution. In case the resolution of the pattern is smaller than the display resolution of the DMD, controller will fill the area with pleasing color.
Set TPG FrameRate	Configure TPG frame-rate between 30Hz – 120Hz. There is dependency of the TPG resolution with respect to frame-rate; for example in case of 4K resolution max frame-rate will be limited to 60Hz and in case of 1080p resolution max frame-rate will be limited to 240Hz

10.2 Solid Field (SFG) Color

When operating in SFG mode, the controller fills the entire display image area with a solid color. Use the Set SFG Color command to choose the color.

10.3 Curtain

Curtain color is similar to SFG color, but generated at the last block of the controller datapath processing unit. This is ideally suited for hiding any or all artifacts up the line. The command can generate fixed colors as defined in the Set Curtain Color command.

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Chapter 11

Display Formatting

The controller provides several functions related to formatting the displayed image that are summarized in the table below.

Command Name	Description
Image Flip	Flip image in Horizontal and/or Vertical direction.
Keystone Angles	Controller adjust the display image automatically as per the 3D keystone settings where it takes three co-ordinates Pitch, Yaw, Roll; for 1D keystone user can set the Yaw and Roll to 0. This feature is useful when projecting on surfaces/screens non-orthogonal to projector.
Keysone Corners	Configures the 2D Keystone correction when the corners of the corrected image are known.
Display Image Size	Define a custom displayed image size.
Manual Warp Table	Send warp points to be used for image warping.
Manual Warp Control Points	Define the width and height of two dimensional point array sent using Manual Warp Table command. This command also enables/disables manual warping feature.

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Image Processing

The controller has multiple digital image processing optins summarized in the table below:

Command Name	Description
Image Brightness	Provides ability to add or subtract fixed bias from each of the input R,G, B channels.
Image Contrast	Provides option apply gain to the pixel data.
Image Hue And Color Control	Provides option to apply Hue adjustment in degrees and Gain in % for each input channels.
Image Sharpness	Provides option to apply both Horizontal and Vertical sharpness filters.
Image RGB Offset	Offset the levels of the RGB channels in the datapath after Brightness, Contrast, Hue&Color, Gain, CSC (Color Space Conversion)
Image RGB Gain	Adjusts individual R, G & B gains of the source image. This function adjusts R, G, and B gains by altering the Color Space Conversion Coefficients.
Image CCA Coordinates	Color co-ordinate adjustment (CCA) takes both desired and measured individual color xyY information for the color adjustment.
Image HSG	Same as CCA but the colors expressed in Hue Saturation Gain (HSG) color space.

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Chapter 13

Illumination Control

The controller has built-in driver functions to control different types of Solid State Illumination (SSI) systems. Following signals go into the illumination system:

- Current control signals: Current control signals meant for driving specified illumination module with specific level of current. The current levels can be specified by the user using Set DLPA3005 Illumination Current command. In case algorithms like LED WPC (White Point Control) and/or Dynamic Black are enabled, then the illumination current values are determined by these algorithms.

Use the Set Illumination Enable command to turn the illuminators ON or OFF.

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Chapter 14

Peripherals

Commands listed in this section are provided to control and configure peripherals such as GPIO, PWM and UART.

14.1 GPIO

There are 88 GPIO pins in the system. Some of these pins are dedicated for system specific operations. Refer to DLPC6540 controller datasheet for the freely available GPIOs. The functionslisted below can be used to setup the available GPIOs.

Command Name	Description
GPIO Pin Config	Configure GPIO as input or output; incase of output, configure as Standard or OpenDrain type, with default value as HIGH or LOW.
GPIO Pin	Change the state of the output GPIO to HIGH or LOW and to Read the state of input GPIO pin.

Users are advised to have proper (default) pullup resistance and and pulldown resistance on the GPIO pins to avoid problems especially when the controller is in reset or boot-up state. By default all the freely avaialble GPIOs are configured as INPUT and tri-stated. The system reconfigures them only upon receiving these commands.

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Interface Protocol

15.1 Supported Interfaces

The communication interfaces supported for DLP controller include a serial data bus conforming to the Philips I^2C specification up to 400 KHz, USB 2.0 and UART interfaces. In addition to control commands, parallel flash programming is also supported over these interfaces.

15.2 I^2C Target

While writing to the DLPC operating in the I^2C target configuration, the first byte following the start condition should be the DLPC device write address (34h). It is possible to change the device address to any other desired value using DLP Composer tool. The remaining bytes are sent as specified in the Chapter 16 below.

While reading from the DLPC in I^2C target configuration, the first byte following the start condition should be DLPC device write address +1 (35h default) followed by header and opcode bytes as explained later in the document. All reads from DLPC via I^2C interface starts with a write as explained above specifying the opcode for read. The host should then continue the I^2C transaction with a Restart-Read followed by the number of bytes associated with the command and finally the Stop.

15.3 USB

The DLPC6540 controller has USB OTG 2.0 compliant hardware. When connected to a USB host, the controller configures as USB device (target) mode operating at high speed (480 Mbit/s).The controller enumerates one of the interfaces as a generic WinUSB device with two bulk endpoints. A USB bulk transfer sends the command and response packets through these endpoints. The OUT endpoint is used for command packet and the IN endpoint is used for response packet. The USB transfer size can vary from 1 byte to 512 bytes. When the host sends the USB IN request, the controller responds with NAK until there is a response packet ready from the software.

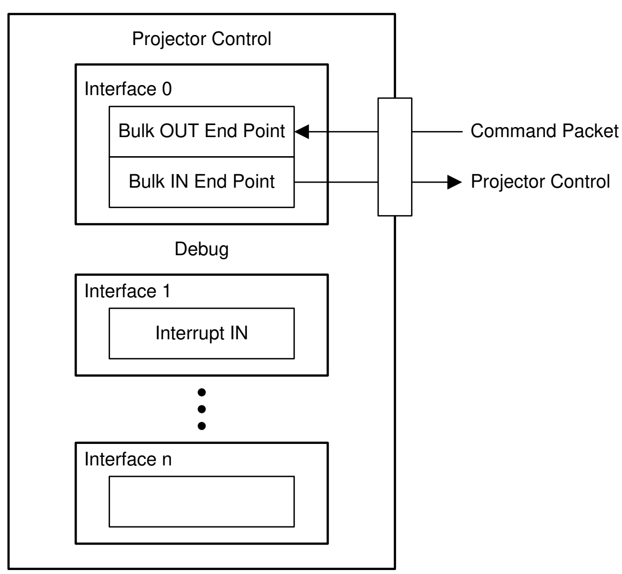

Figure 15-1. USB Core

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Chapter 16

Command Protocol

This section describes the command protocol implemented in DLPC6540. This is the protocol to be used by any external controller to control the DLPC6540 controller using any of the supported commands. The same protocol is applicable across all supported peripheral interfaces (USB, I^{2}C, UART) and application types (bootloader, reference application).

This protocol specifies a flexible length header. The minimum header length is one byte. The first header byte indicates how to interpret the remaining bytes such as opcode, data and checksum (for error detection). There is also a destination parameter in the header that directs the command to different entities within the projector application.

Use this flexible header length method for application that require a minimum of overhead bytes can opt for the one byte header. For a more robust application, configure a larger header that includes data length and/or checksum.

16.1 Command Packet

The command packet defines the packet format to follow when commands are sent to the DLP Controller. Fields that are always present are indicated in **bold**, and optional fields are indicated in normal font.

The definition of which fields are present is based on the 1-byte header field. The length field is mandatory if a command is defined as having variable data size.

Table 16-1. Command Packet format

<table>
<tr><th>Field</th><th>Size (bytes)</th><th>Description</th></tr>
<tr><td>Header</td><td>1</td><td>See Table 16-2 below.</td></tr>
<tr><td>Opcode</td><td>1 or 2 based on opcode length field in the header</td><td>Command opcode. Command opcode number greater than 0xFF should be sent using 2 bytes. Other opcodes can be sent with 1 byte or 2 bytes. In case of 2-byte opcode, first byte is the LSB.</td></tr>
<tr><td>Length</td><td>2 or 0
based on data length present field in the header</td><td>Length of the command data in bytes following this byte. Checksum is not included in length.
For example length=10 means there are 10 bytes of data) after this length field.
LSB of length shall be sent first followed by MSB.</td></tr>
<tr><td>Data</td><td>0-511 (total of maximum 512 bytes in the whole message including header and checksum)</td><td>Parameters/data</td></tr>
<tr><td>Checksum</td><td>1 or 0
(optional as checksum present field of header byte)</td><td>Checksum of all bytes in the message including header bytes. Fletcher's checksum is implemented as below:-<pre>
uint32 SimpleChecksum = 0;
uint32 SumofSumChecksum = 0;
uint08 *Addr = (uint08 *) StartAddress;
while (NumBytes--)
{
    SimpleChecksum += *Addr++;
    SumofSumChecksum += SimpleChecksum;
}
</pre></td></tr>
</table>

Table 16-2. Command Header Byte

Bits	Field name	Values
0:2	Destination	See Section 16.3

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Table 16-2. Command Header Byte (continued)

Bits	Field name	Values
3	Opcode Length	1 = Two byte opcode 0 = One byte opcode
4	Datalength Present	1 = Length field present in the extended header 0 = No length field
5	Checksum Present	1 = Checksum present after data bytes 0 = Checksum not present
6	Reply Requested	1 = Device will send a response packet to every write command. This field is applicable only for write commands 0 = Response packet not sent for write commands
7	Read Command	1 = Read Command 0 = Write Command

16.2 Response Packet

The Response packet is the format in which the DLP Controller replies to the host. The Response packet format is followed for both Write Response and Read Response. For write commands, the Response packet is sent only if the "reply requested" bit is set in the command header.

The DLP Controller matches the response header to the same format as the incoming command packet header. There is however an exception - if the Response packet is for a command that expects variable number of data bytes, the Response packet will always include the length field (irrespective of whether the command packet had length mentioned or not). See also Section 16.6 section related to variable sized commands.

Similar to the definition of command packet, fields in **bold** represents fields that are always present.

Table 16-3. Response packet format

Field	Size (bytes)	Description
Header	1	See Table 16-4 below
Length	2 or 0 (Optional as per DataLength Present field in the header)	Length of the command data in bytes following this byte. Checksum is not included in length. For example length=10 means there are 10 bytes of data) after this length field. LSB of length shall be sent first followed by MSB.
Data	0-511 (total of max 512 bytes in the whole message including header and checksum)	Response data bytes depends on the command code. If error bit in the header is set, there will only be a single data byte. This byte will indicate the error code that caused the command to nack. The error code definitions are listed Table 16-5.
Checksum	1 or 0 (optional as per Checksum Present field of header byte)	Checksum of all bytes in the message including header bytes. Fletcher's checksum.

Table 16-4. Response Header Byte

Bits	Field name	Values
0:2	Destination	See Section 16.3
3	Reserved	NA
4	Datalength Present	1 = Length field present in the extended header 0 = No length field
5	Checksum Present	1 = Checksum present after data bytes 0 = Checksum not present
6	Error	1 = Error. First data byte will have the error code that gives more information about the failure 0 = No error
7	Busy	1=system busy/response not ready; 0=response ready. Applicable only for I2C based communication

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Table 16-5. Error code definitions

Error Code	Meaning
1	Invalid Destination
2	Invalid/Unknown command
3	Invalid length
4	Allocated buffer is not enough to store a command
5	Length Information missing for a variable sized command
6	Checksum Mismatch
7	Controller not compatible to run the application
8	Read not supported
9	Write not supported
10	Execution Failed
11	Invalid Response Length
12	Buffer Full

Write responses are optional as described in the command header description above. If response is requested, it is imperative to read the response (both Write Response and Read Response) immediately following the respective Command Packet. The response of a command is lost as soon as the DLP Controller receives another set of bytes from the host.

16.3 Destination Details

The table below lists the mapping of destination number to application. Destination value 0 is reserved and shall not be used by any application. Both bootloader and application software implement Destination 1. This implementation allows for sharing common commands between applications. The first 32 command IDs (0 to 31) are reserved for this purpose. Bootloader can use the command IDs outside of the reserved command range to provide specific commands that it supports. See Command Descriptions for more details.

Table 16-6. Destination Numbers

Destination No	Destination
0	Reserved
1	Commands common to bootloader and reference application.
2	Extended commands/projector control
3	Reserved
4	System commands
5-7	Reserved

16.4 Error Handling and Recovery

As all physical interfaces support the same protocol, it is difficult to support the start conditions that each interface supports. Also, depending on payload size, a command packet may be sent over multiple packets.

It is also important for the DLP Controller to know the start of a command to be able to parse and execute the command successfully. This means the host and DLP Controller should always be in sync. This will be the case if both host and DLP controller gets reset and powers on together. However, if an error occurs in either side, or if one of host/DLP Controller asynchronously resets then the sync is lost. Since the start conditions specific to physical interfaces are not monitored, we need another mechanism to recover when such an error occurs.

To support this use case, the DLP Controller monitors the time of arrival of each group of bytes. If any group of bytes come outside of a defined timeout (750 ms) compared to the last group, it is treated as the start of a new command.

The timeout is always measured from the last received group of byte and not from the group of byte where it encountered an error. This means, if the host keeps sending command one after the other without a timeout, all of it will be discarded.

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It is valid to include multiple commands in a single group, or send commands back to back without waiting for the defined timeout. Both of these cases are controlled by the command handler which execute all such chained commands in the order they are received.

16.5 System Busy - I^{2}C scenarios

When using I^{2}C protocol, the target component pulls the clock line low when it needs to indicate it is busy processing and cannot accept any more data from host. Be aware that when there are multiple target devices on the same bus, the entire communication on the bus gets halted until the busy slave component releases the bus. To prevent this undesirable effect, the controller supports following options for the host:

16.5.1 GPIO implementation

A separate GPIO line (GPIO 58 by default) reports to the host component that the controller is busy or not busy. Upon power-on-reset, the front-end communication device must wait until the signal goes to LOW state. A signal that remains HIGH continuously idicatesa problem with controller boot-sequence. The source of the problem must be resolve before proceeding.

When a command is sent, the I^{2}C Busy GPIO is pulled HIGH until the command completes execution. If the device attempts to send another command while execution of the first command is ongoing, system confirms whether the I^{2}C Busy GPIO is HIGH or LOW and then takes the decision to send the command. This process ensures that there is no clock stretching, and other devices on the I^{2}C bus are not affected, but it ensures that the command handler is occupied and no other command can be sent at this point. Use the DLP Composer tool to assign a GPIO for this purpose.

16.5.2 Short Status response

When the I^{2}C host requests a data read, the Busy flag (7 the bit in the header byte) indicates the short status. If it is set, it means that the DLPC is busy and does not have a response to send back yet. The host can use the System busy pin as a check for the controller's availability to receive. When this bit is set, the rest of the bits of the response header shall be treated as don't care and no further bytes to be read. The expectation is that the host will keep reading from the Controller for response until this bit is cleared. When that occurs the response header is valid, and remaining data is as per the command.

If the host abandons a read command midway or sends another command immediately after sending read command, the response bytes in the controller buffer gets discarded and the new command gets processed.

For USB communication layer, the controller indicates the busy status by NAK response to the read request.

16.6 Support for Variable Data Size

For large data handling commands such as flash download and flash read, the user can allow some commands to support variable number of data bytes. To support this use case, the commands that require variable data size, is mandated to include length as part of the Command packet header. The Command Handler uses the given length to decode the received Command packet and execute correctly. Similar to the Command packet, the data in the Response packet may also be variable. The Command Handler includes length in the Response packet header for such commands.

The command protocol is designed to support commands up to a length of 65535 bytes (2-byte length field). However, due to memory limitations, the command handler implementation limits it to a maximum size of 512 bytes in a Command packet (this includes all bytes in the command like header, checksum etc.).

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Chapter 17

Auto-Initilization Batch File

The DLPC6540 systems provide the option of an auto-initialization batch file that can be included in the flash image using the advanced mode of DLP Control Program. The auto-initialization batch file allows the user to specify a set of commands (as described in this document) to be executed at system startup (such as booting up in Splash display mode or fixed video input for fast boot up time etc).The firmware executes the command specified in this batch-file in the specified order after it completes its own initialization procedure.

This feature provides allows the user to pre-configure the system to consistent set of powerup conditions.

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Chapter 18

Command Descriptions

Please consider these guidelines applicable to all the command descriptions that follow in this document.

- Byte order. Wherever a parameter is specified as more than 1 byte in length, the order in which it must be sent/read is LSB first and MSB last.
- Parameter for read commands: All read commands where a read parameter is not explicitly mentioned in the comand description, means those commands don't accept a read parameter. A Read parameter is defined only for certain read commands to specify the details of what is being sought to be read.
- When the input parameter(s) to a command are in fixed point format, it is specified such as format = s8.2 or format = u12.4 etc. where s stands for signed and u stands for unsigned.

Fixed-Point Representation:

This representation has fixed number of bits for integer part and for fractional part. Negarive numbers are represented in two's complement format.

Fixed Point representation - [Integer][Fraction]

Example: Assuming the format is signed and using 32-bit format, with16 bits for the integer part and 16 bits for the fractional part. This will be refered to as s15.16 format.

In this case, -43.625 and 43.625 are represented as follows:

[1111111111010101][1010000000000000] = 0xFFD5A000 = -43.625

[0000000000101011][1010000000000000] = 0x002BA000 = +43.625

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Chapter 19

System Commands

The commands described in this guide are compatible with Software version v4.5.0

19.1 3D

3D

Table 19-1. Enable Three D [Opcode: B1h | Destination: 4]

Set Enable Three D	
Write Parameter(s)	
Byte	**Description**
Byte 0	Enable bit 0: TRUE - Enable Processing, FALSE - Disable Processing.
Enables 3D functionality.	

Get Enable Three D
Data returned is in the same format as the Write Parameter(s).
Returns whether 3D is enabled or not.

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Table 19-2. Three D Source Configuration [Opcode: B2h | Destination: 4]

Set Three D Source Configuration	
Write Parameter(s)	
Byte	**Description**
Byte 0	Format 0 = Reserved. 1 = VSync separated (frame sequential progressive) format. 2 = Reserved. 3 = Reserved. 4 = Reserved. 5 = Reserved. 6 = Undefined format.
Byte 1	LR Reference 0 = 3D LR from frame determines L/R (High=Left). 1 = GPIO determines L/R (High=Left). 2 = Vsync/Hsync alignment determines L/R. 3 = LR 1st Frame 4 = LR reference is embedded in video data. 5 = Undefined LR reference.
Byte 2	Frame Dominance 0 = VSync separated sources only Left Eye is 1st frame in 3D image pair. 1 = VSync separated sources only Right Eye is 1st frame in 3D image pair. 2 = Undefined Frame Dominance.
Byte 3	LR Encoding 0 = Single colored line(s) encoding. 1 = No Encoding 2 = L/R 75 25 Encoding 3 = Undefined L/R encoding.
Byte 4	TB Reference 0 = Top is Left Eye. 1 = Top is Right Eye. 2 = No Top/Bottom reference is available. 3 = Undefined Top/Bottom reference.
Byte 5	OE Reference 0 = Odd field is Left Eye. 1 = Odd field is Right Eye. 2 = No Odd/Even reference is available. 3 = Undefined Odd/Even reference.
Byte 6	Num Active Blank Lines
Byte 7	Number Of Encoded Lines
Bytes 8-9	Left Encoded Line Location
Bytes 10-11	Right Encoded Line Location

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Table 19-2. Three D Source Configuration [Opcode: B2h | Destination: 4] (continued)

Set Three D Source Configuration	
Byte 12	Blanking Color 0 = ChannelA=0 ChannelB=1023 ChannelC=0 for RGB sources. YUV sources will be converted. 1 = ChannelA=1023 ChannelB=0 ChannelC=0 for RGB sources. YUV sources will be converted. 2 = ChannelA=0 ChannelB=0 ChannelC=1023 for RGB sources. YUV sources will be converted. 3 = ChannelA=1023 ChannelB=0 ChannelC=1023 for RGB sources. YUV sources will be converted. 4 = ChannelA=0 ChannelB=1023 ChannelC=1023 for RGB sources YUV sources will be converted. 5 = ChannelA=1023 ChannelB=1023 ChannelC=0 for RGB sources. YUV sources will be converted. 6 = ChannelA=1023 ChannelB=1023 ChannelC=1023 for RGB sources. YUV sources will be converted. 7 = ChannelA=0 ChannelB=0 ChannelC=0 for RGB sources. YUV sources will be converted. 8 = 75% of the line is Blue 25% is black 9 = 25% of the line is Blue 75% is black 10 = Undefined color.

Get Three D Source Configuration
Data returned is in the same format as the Write Parameter(s).

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Table 19-3. Left Right Signal Polarity [Opcode: B3h | Destination: 4]

Set Left Right Signal Polarity	
Write Parameter(s)	
Byte	**Description**
Byte 0	Left Right Polarity Is Inverted bit 0: TRUE Left / Right Frame are swapped FALSE Left / Right Frame are normal
This command inverts the L/R signal polarity.	

Get Left Right Signal Polarity
Data returned is in the same format as the Write Parameter(s).
This command tells whether L/R signal polarity is inverted or not.

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19.2 Administrative

Administrative

Table 19-4. Mode [Opcode: 00h | Destination: 1]

Get Mode	
Return Parameter(s)	
Byte	**Description**
Byte 0	Mode Info bit 0: Application Mode 0 = Bootloader 1 = Main Application bit 1: Controller Configuration 0 = Single 1 = Multiple
This command returns whether we are in Bootloader or in Main Application.	

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Table 19-5. Controller Info [Opcode: 00h | Destination: 4]

Get Controller Info	
Return Parameter(s)	
Byte	**Description**
Bytes 0-3	Controller ID
Bytes 4-12	Controller Name
Returns DLP Controller Information.	

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Table 19-6. Version [Opcode: 01h | Destination: 1]

Get Version	
Return Parameter(s)	
Byte	**Description**
Byte 0	App Major
Byte 1	App Minor
Bytes 2-3	App Patch
Byte 4	0-Production; A-Alpha; B-Beta
Byte 5	(0-Production; 1-255-Alpha/Beta)
Byte 6	(0-Not a test build; 1-255-Test-build-number)
Byte 7	API Major
Byte 8	API Minor
Bytes 9-10	API Patch
Byte 11	0-Production; A-Alpha; B-Beta
Byte 12	(0-Production; 1-255-Alpha/Beta)
Byte 13	(0-Not a test build; 1-255-Test-build-number)
This command returns the version of the currently active Application and the version of the underlying API library. The currently active application can be queried using Get Mode command.	

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Table 19-7. DMD Info [Opcode: 01h | Destination: 4]

Get DMD Info	
Return Parameter(s)	
Byte	**Description**
Bytes 0-3	DMD device ID
Bytes 4-7	DMD Fuse ID
Bytes 8-25	Fuse Bit String
Bytes 26-33	DMD Name
Returns the DMD information.	

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Table 19-8. Switch Mode [Opcode: 02h | Destination: 1]

Set Switch Mode	
Write Parameter(s)	
Byte	**Description**
Byte 0	Application to switch to 0 = Switch to bootloader 1 = Via reset 2 = Switch to application regardless of the BOOT_HOLD GPIO State. This option is provided for debug purposes only 3 = Switch to application with DMD True Global Enabled regardless of the BOOT_HOLD GPIO State.
This command is used to switch between bootloader and application mode.	

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Table 19-9. DMD Resolution [Opcode: 02h | Destination: 4]

Get DMD Resolution	
Return Parameter(s)	
Byte	**Description**
Bytes 0-1	Effective width of DMD in pixels.
Bytes 2-3	Effective height of DMD in lines.
Returns the DMD width and height in number of pixels and lines respectively.	

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Table 19-10. Flash Version [Opcode: 03h | Destination: 4]

Get Flash Version	
Return Parameter(s)	
Byte	**Description**
Byte 0	Flash Version Major
Byte 1	Flash Version Minor
Byte 2	Flash Version Subminor
Returns version number that uniquely identifies the flash image.	

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Table 19-11. Flash Layout Version [Opcode: 04h | Destination: 4]

Get Flash Layout Version	
Return Parameter(s)	
Byte	**Description**
Bytes 0-1	Flash Config Layout Version
Bytes 2-33	Flash Config Layout Hash
Bytes 34-35	Application Config Layout Version
Bytes 36-67	Application Config Layout Hash
Returns supported Layout revision numbers and hash for flash config and app config layout.	

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Table 19-12. Product Configuration Failure Cause [Opcode: 05h | Destination: 4]

Get Product Configuration Failure Cause	
Return Parameter(s)	
Byte	**Description**
Byte 0	Cause of product configuration failure. 0 = Invalid Controller for the product configuration 1 = Invalid DMD for the product configuration 2 = DMD project data does not match the actual DMD 3 = PAD cannot be used to drive SSI or DMD in ECD system 4 = Invalid Pad Configuration
Use this command to get the cause of product configuration failure if Product Configuration Failed is set in system status command.	

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Table 19-13. System Status [Opcode: 06h | Destination: 4]

Get System Status	
Return Parameter(s)	
Byte	**Description**
Bytes 0-3	System Status Word 0 bit 0: Reserved bit 1: Reserved bit 2: Reserved bit 3: Reserved bit 4: Memory test of internal DRAM passed bit 10: Frame Rate Conversion Enable bit 11: Sequence Phase Lock bit 12: Sequence Frequency Lock bit 13: Sequence search bit 29: System Color Point Calibration Enable bit 30: Variable Illumination Calibration Enable bit 31: Brilliant color Calibration Enable
Bytes 4-7	System Status Word 1 bit 0: Sequence Error bit 1: Pixel clock out of range bit 2: Vsync valid bit 6: UART port 0 communication error (If Port Enabled) bit 7: UART port 1 communication error (If Port Enabled) bit 8: UART port 2 communication error (If Port Enabled) bit 9: SSP port 0 communication error (If Port Enabled) bit 10: SSP port 1 communication error (If Port Enabled) bit 11: SSP port 1 communication error (If Port Enabled) bit 12: I2C port 0 communication error (If Port Enabled) bit 13: I2C port 1 communication error (If Port Enabled) bit 14: I2C port 2 communication error (If Port Enabled) bit 15: DLPC Initialization Error bit 16: Reserved bit 17: Reserved bit 19: No frequency bin found for the selected mode bit 20: DLPA3005 Communication error (If DLPA3005 present) bit 21: UMC refresh bandwidth underflow bit 22: DMD initialization error bit 23: DMD power down error bit 24: Source definition not present bit 25: Sequence binary not present bit 26: Product configuration failed bit 27: Dither mask not loaded
Bytes 8-11	System Status Word 2 bit 0: EEPROM initialization failure
Command to read status information from DLP Controller. If status interrupt is enabled (configurable via default UI tool in DLP Composer), reading back this command will acknowledge/deactivate the interrupt pin until the next change in status.	

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Table 19-14. EEPROM Data Present [Opcode: 07h | Destination: 4]

Get EEPROM Data Present	
Return Parameter(s)	
Byte	**Description**
Bytes 0-1	Calibration Data Blocks bit 0: Reserved bit 1: SSI Calibration Data Present bit 2: ADC Calibration Data Present bit 3: WPC Sensor Calibration Data Present bit 4: WPC Brightness Table Data Present bit 5: XPR Calibration Data Present bit 6: XPR Waveform Calibration Data Present bit 7: Edge Blend Data Present bit 8: Surface Correction Data Present
Reports which of the calibration data blocks are present in EEPROM. Use this command before sending EEPROM Invalidate command (0x0A).	

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Table 19-15. General Delay Command [Opcode: 08h | Destination: 4]

Set General Delay Command	
Write Parameter(s)	
Byte	**Description**
Bytes 0-3	Delay In Milliseconds
On receipt of this command controller wait for specified period before executing the next command. This command to be used in Auto Initialization batchfile configuration. Use this command to insert delay between execution of two commands.	

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Table 19-16. EEPROM Invalidate [Opcode: 0Ah | Destination: 4]

Set EEPROM Invalidate	
Write Parameter(s)	
Byte	**Description**
Byte 0	Invalidate Settings Data bit 0: Invalidate Settings
Bytes 1-2	Invalidate Calibration Data bit 0: Reserved bit 1: Invalidate SSI Calibration Data bit 2: Invalidate ADC Calibration Data bit 3: Invalidate WPC Sensor Calibration Data bit 4: Invalidate WPC Brightness Table Data bit 5: Invalidate XPR Calibration Data bit 6: Invalidate XPR Waveform Calibration Data bit 7: Invalidate Edge Blend Data bit 8: Invalidate Surface Correction Data
Invalidates the user settings portion of EEPROM data or calibration portion of EEPROM data or both as per input arguments and restarts the system. If none of the settings or calibration data is selected, then the command does nothing. Note : Chose valid flags as returned in Get EEPROM Data Present command. command.	

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Table 19-17. Splash Capture [Opcode: 0Bh | Destination: 4]

Set Splash Capture
Write Parameter(s)
Captures the current external image displayed on the screen and stores it into the Flash memory as a Splash image.

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Table 19-18. Splash Capture Status [Opcode: 0Ch | Destination: 4]

Get Splash Capture Status	
Return Parameter(s)	
Byte	**Description**
Byte 0	Capture State 0 = Image Capture Terminated because of error or Timeout 1 = External Image is being written into the internal DRAM Splash buffer 2 = Image is successfully captured into internal DRAM Splash buffer 3 = Image is being programmed into the Flash memory 4 = Image is successfully programmed into Flash memory
Byte 1	Completion Status (percentage)
Returns the current status of splash capture.	

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Table 19-19. Terminate Splash Capture [Opcode: 0Dh | Destination: 4]

Set Terminate Splash Capture
Write Parameter(s)
Terminates any ongoing Splash Capture

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19.3 Autolock

Autolock

Table 19-20. Autolock Control [Opcode: 24h | Destination: 4]

Set Autolock Control	
Write Parameter(s)	
Byte	**Description**
Byte 0	Autolock Control 0 = Resync 1 = Start 2 = Stop
This command provides user control to relock to a source or to start/stop autolock algorithm.	

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19.4 Blending

Blending

Table 19-21. Blend Map Gain Values [Opcode: 2Bh | Destination: 4]

Set Blend Map Gain Values	
Write Parameter(s)	
Byte	**Description**
Byte 0	Compressed Values Passed bit0: 1 = Compressed data is passed below for Gain values. 0 = Uncompressed data is passed below for Gain values.
Byte 1	Color Channel Select 0 = Broadcast 1 = Green 2 = Red 3 = Blue
Bytes 2-3	Here the total number of compressed values needs to be passed only when CompressionEnable is Enabled otherwise pass 0 here
Bytes 4-5	Starting Index for filling the Gain values in array of Gain
Bytes 6 - *	Gain of control points .The format of input should be such that required gain which is a value between 0 to 1.99 be multiplied by 4096 before passing it in command.
This command takes the user given gain values of control points as part of the Blend Map. Using this command user passes the Gain values for the 2016 (63x32) control points. The gain values needs to be specified for each of the color channel. There are two features here for using the command. User can select the broadcast values option from the Color Channel Select. What broadcast does is that user needs to pass values only once and it will broadcasted to all the three color channels R,G,B. Otherwise user needs to pass value for R, G, B color channels separately. So the command will then be required to use 3 times one time for each color channel Another feature supported is passing compressed values. The compression used is RLE2 compression. For passing compressed values user needs to enable the Compression Enabled bit	

Get Blend Map Gain Values	
Read Parameter(s)	
Byte	**Description**
Byte 0	Color Channel Select 0 = Broadcast 1 = Green 2 = Red 3 = Blue
Bytes 1-2	Start index in the Blend map channel gain values from which the data is to be read
Bytes 3-4	Number of entries to be read

Return Parameter(s)	
Byte	**Description**
Byte 0	This tells whether the gain values obtained are compressed data or not.
Bytes 1 - *	Selected Color Channel gain values
This command reads from the blend map table already loaded using Set Blend Map Gain Values command. N Blend map gain values (that does not exceed the command packet size) can be read at a time from anywhere within the table.	

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Table 19-22. Apply Blend Map [Opcode: 2Ch | Destination: 4]

Set Apply Blend Map	
Write Parameter(s)	
Byte	**Description**
Byte 0	Blend Map Upload bit0: 1 = Blend Map values is enabled and applied. 0 = Blend Map values is disabled.
This command is used to apply the Blend map with the given configuration	

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Table 19-23. Blend Map Offset Values [Opcode: 2Dh | Destination: 4]

Set Blend Map Offset Values	
Write Parameter(s)	
Byte	**Description**
Byte 0	Compressed Values Passed bit0: 1 = Compressed data is passed below for Offset values. 0 = Uncompressed data is passed below for Offset values.
Byte 1	Color Channel Select 0 = Broadcast 1 = Green 2 = Red 3 = Blue
Bytes 2-3	Here the total number of compressed values needs to be passed only when the first parameter is 1 otherwise pass 0 here
Bytes 4-5	Starting Index for filling the Offset values in array
Bytes 6 - *	Offset of control points.The format of input should be such that the offset values are in the internal floating point format of s1m8e4 .
Using this command user passes the Offset values for the 2016 (63x32) control points. The Offset values needs to be specified for each of the color channel R,G,B. The range of offset values in the standard floating point format is -255 to +255. There are two features here for using the command. User can select the broadcast values option from the Color Channel Select. What broadcast does is that user needs to pass values only once and it will broadcasted to all the three color channels R,G,B. Otherwise user needs to pass value for R, G, B color channels separately. So the command will then be required to use 3 times one time for each color channel. Another feature supported is passing compressed values. The compression used is RLE2 compression. For passing compressed values user needs to enable the Compression Enabled bit	

Get Blend Map Offset Values	
Read Parameter(s)	
Byte	**Description**
Byte 0	Color Channel Select 0 = Broadcast 1 = Green 2 = Red 3 = Blue
Bytes 1-2	Start index in the Blend map channel Offset values from which the data is to be read
Bytes 3-4	Number of entries to be read

Return Parameter(s)	
Byte	**Description**
Byte 0	This tells whether the offset values obtained are compressed data or not.
Bytes 1 - *	Selected Color Channel Offset
This command reads from the blend map compressed offset values already loaded using Set Blend Map Offset Values command. N Blend map offset values (that does not exceed the command packet size) can be read at a time from anywhere within the table.	

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Table 19-24. Blend Map Control Points [Opcode: 2Eh | Destination: 4]

Set Blend Map Control Points	
Write Parameter(s)	
Byte	**Description**
Bytes 0-1	Horizontal Display Resolution of Projector
Bytes 2-3	Vertical Display Resolution of Projector
Bytes 4 - *	Blend Map Horizontal control points position array Number of points in this array equal to 63.These control points are 0 based.
Bytes 4 - *	Blend Map Vertical control points position array Number of points in this array equal to 32.These control points are 0 based.
This command takes input of the user defined control points location in horizontal and vertical direction as part of the Blend Map	

Get Blend Map Control Points	
Return Parameter(s)	
Byte	**Description**
Bytes 0-125	Blend map Horizontal control points position array. Number of points in this array equal to IMG_BLENDMAP_CTL_POINTS_X
Bytes 126-189	Blend map Vertical control points position array. Number of points in this array equal to IMG_BLENDMAP_CTL_POINTS_Y
This command gets the user defined blend map control points location stored in EEPROM.	

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Table 19-25. Enable Edge Blending [Opcode: 2Fh | Destination: 4]

Set Enable Edge Blending	
Write Parameter(s)	
Byte	**Description**
Byte 0	EBF State bit0: 1 = Edge blending is enabled 0 = Edge blending is disabled
This command enables or disables the Edge blending function	

Get Enable Edge Blending
Data returned is in the same format as the Write Parameter(s).
Returns whether the Edge blending function is enabled or not.

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Table 19-26. Edge Blending System Params [Opcode: 3Dh | Destination: 4]

Set Edge Blending System Params	
Write Parameter(s)	
Byte	**Description**
Bytes 0-1	Number of columns of projectors in blending system Range = 1 to 32 with step size 1
Bytes 2-3	Number of rows of projectors in blending system Range = 1 to 32 with step size 1
Bytes 4-5	Column index of self in blending system Range = 0 to 31 with step size 1
Bytes 6-7	Row index of self in blending system Range = 0 to 31 with step size 1
Bytes 8 - *	White and black luminance levels of projectors in blending system, raster scan order. Format is fixed point 16.16 (nits)
This command sets the blending system parameters for semi-manual edge blending. This command does not change the state of the warping map or the blending map	

Get Edge Blending System Params
Data returned is in the same format as the Write Parameter(s).
This command gets the blending system parameters for semi-manual edge blending

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Table 19-27. Edge Blending Configuration [Opcode: 3Eh | Destination: 4]

Set Edge Blending Configuration	
Write Parameter(s)	
Byte	**Description**
Bytes 0-1	Horizontal Overlap with other projectors (pixels)
Bytes 2-3	Vertical Overlap with other projectors (pixels)
Byte 4	Geometric Adjustment Type 0 = No Geometric Correction 1 = Keystone Corners
Byte 5	Storage Options 0 = Dont Store 1 = Write To Storage 2 = Write To Storage Apply At Startup
Bytes 6 - *	Geometric adjustment parameters. Dependent on adjustment type used
This command sets overlap and geometry parameters for semi-manual edge blending, creates and applies blending and warping maps for given blending inputs. It is necessary to call commands to enable manual warping and enable edge blending separately, for the results to take effect. Geometry parameters are dependent on geometric adjustment type. For no geometric correction, no parameters are used. For correction by keystone corners, the 8 parameters are the (x,y) coordinates (zero based) of the keystone corners in raster scan order : top-left, top-right, bottom-left, bottom-right.	

Get Edge Blending Configuration
Data returned is in the same format as the Write Parameter(s).
This command gets geometry and overlap parameters for semi-manual edge blending. Geometry parameters are dependent on geometric adjustment type. For no geometric correction, no parameters are used. For correction by keystone corners, the 8 parameters are the (x,y) coordinates (zero based) of the keystone corners in raster scan order : top-left, top-right, bottom-left, bottom-right.

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19.5 Bootloader

Bootloader

Table 19-28. Boot Hold Reason [Opcode: 12h | Destination: 1]

Get Boot Hold Reason	
Return Parameter(s)	
Byte	**Description**
Byte 0	Reason code 0x00 BOOT_HOLD jumper in HOLD position 0x01 Switched to programming mode initated by main app 0x02 Reading flash info failed 0x03 Flash layout mismatch 0x04 Can't initialize ARM peripherals 0x05 Can't allocate memory pool 0x06 Failure in initialization task 0x07 Controller is invalid to run the application 0x08 Error in USB initialization 0x09 Error in i2c initialization 0x0A Error getting app configuration 0x0B App configuration layout mismatch
Returns the code that specifies the reason for being in bootloader mode.	

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Table 19-29. Flash Info [Opcode: 20h | Destination: 1]

Get Flash Info	
Read Parameter(s)	
Byte	**Description**
Byte 0	Chip Select of Flash Device 0 = Flash chip select 0 memory domain 1 = Flash chip select 1 memory domain 2 = Flash chip select 2 memory domain

Return Parameter(s)	
Byte	**Description**
Bytes 0-1	Manufacturer ID
Bytes 2-9	Device ID
Bytes 10-13	Device size in bytes
Bytes 14 - *	Sector Information bits 0-31: Sector Size bits 32-47: Num Sectors
Byte 14	Availability bit 0: 0 = Flash can be used for programming; 1 = Flash cannot be used for programming.
This command returns the flash device and manufacturer IDs. Only CFI compliant flash devices are supported. The system can have multiple flash devices. The command returns the info for the flash present at the given chip select. Note : Chip Select 0 Flash is required for system operation. Other Flash Chip Selects are technically optional but required for Splash Capture and Warp Operations.	

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Table 19-30. Programmable Flash Sector Information [Opcode: 21h | Destination: 1]

Get Programmable Flash Sector Information	
Return Parameter(s)	
Byte	**Description**
Bytes 0 - *	Sector Information bits 0-31: Sector Size bits 32-47: Num Sectors
This command returns the flash sector information read from CFI compliant flash devices. If the flash is non-CFI compliant, this command will fail. The sectors returned by this command are the only ones available for programming a flash image. The system is designed such that the flash image is in a contiguous memory space. If a system has multiple flash parts, then the software checks the size of the flash at ChipSelect 0. If this is equal to the maximum supported size (32MB), then a flash device at ChipSelect 1 (if present) will also be supported for flash programming. Similarly, if the size of flash devices at both ChipSelect 0 and 1 are 32MB, then a flash device at ChipSelect 2 (if present) will be supported for flash programming as well. The command appends the sector information for each part, which is supported for flash programming, and provides them as output.	

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Table 19-31. Unlock Flash For Update [Opcode: 22h | Destination: 1]

Set Unlock Flash For Update	
Write Parameter(s)	
Byte	**Description**
Bytes 0-3	Flash Update lock/unlock 0 = Lock 4154802215 = Unlock
This command unlocks the flash update operation (Download, Erase). By default the flash update operations are locked. This is to prevent accidental modification of flash contents. To unlock, the pre-defined key shall be send as the unlock code. Calling this command with any other parameter will lock the flash update commands.	

Get Unlock Flash For Update	
Return Parameter(s)	
Byte	**Description**
Byte 0	0 = Locked 1 = Unlocked
This command returns whether the flash is in unlocked state.	

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Table 19-32. Erase Sector [Opcode: 23h | Destination: 1]

Set Erase Sector	
Write Parameter(s)	
Byte	**Description**
Bytes 0-3	Sector Address
This command erases the sector of the flash where the given address falls in. This command is a flash update command, and requires flash operations to be unlocked using Unlock Flash for Update command. The sector address shall be specified as an offset from flash start address. For example in a flash device where all sectors are 64KB of size, sector addresses shall be specified as follows : Sector 0 = 0 Sector 1 = 0x10000 Sector 2 = 0x20000 and so on...	

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Table 19-33. Initialize Flash Read Write Settings [Opcode: 24h | Destination: 1]

Set Initialize Flash Read Write Settings	
Write Parameter(s)	
Byte	**Description**
Bytes 0-3	Start Address offset to program data to where Offset 0 refers to first byte in the flash, 1 refers to second byte and so on. This offset must be an even number.
Bytes 4-7	This specifies the number of bytes Flash Write command should expect or the number of bytes Flash Read command should return.This must be an even number.
This command initializes flash read/write operation. This command shall be called before Flash Write command is sent. Note: For Flash Write, the Address and download size set up shall both be even.	

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Table 19-34. Flash Write [Opcode: 25h | Destination: 1]

Set Flash Write	
Write Parameter(s)	
Byte	**Description**
Bytes 0 - *	Data to write to flash memory
This command is used to program data to flash. This command shall be called only after setting the start address and size using the Initialize Flash Read/Write Settings command. This command is a flash update command, and requires flash operations to be unlocked using Unlock Flash for Update command. Flash write commands can be chained till the initialized number of bytes are programmed. The bootloader will auto-increment the address and size for each command. Only the initialized number of bytes will be programmed even if more data is provided. It is important to send only even number of bytes per flash write command to ensure all bytes are written. This is done so that all flash writes are optimized as per the multi-word write supported by the flash device. This command supports variable sized payload.	

Get Flash Write	
Read Parameter(s)	
Byte	**Description**
Bytes 0-1	Num bytes to read in this command

Return Parameter(s)	
Byte	**Description**
Bytes 0 - *	The bytes read from the flash
This command is used to read data from flash. This command shall be called only after setting the start address and size using the Initialize Flash Read/Write Settings command. Flash read commands can be chained until the initialized number of bytes are returned. The bootloader will auto-increment the address and size for each command. Only the initialized number of bytes will be returned. Calling the function after returning requested data will return in command failure. This command supports variable sized response.	

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Table 19-35. Checksum [Opcode: 26h | Destination: 1]

Get Checksum	
Read Parameter(s)	
Byte	**Description**
Bytes 0-3	Start Address offset for checksum computation where Offset 0 refers to first byte in the flash, 1 refers to second byte and so on.
Bytes 4-7	Number of bytes to compute checksum

Return Parameter(s)	
Byte	**Description**
Bytes 0-3	Simple additive checksum
Bytes 4-7	Sum of simple additive checksum calculated at each address

This command computes and returns the checksum starting at the given address for the specified number of bytes. Checksum is calculated as below :
uint32 SimpleChecksum = 0;
uint32 SumofSumChecksum = 0;
uint08 *Addr = (uint08 *) StartAddress;
while (NumBytes--)
{
SimpleChecksum += *Addr++;
SumofSumChecksum += SimpleChecksum;
}	

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Table 19-36. Reset Flash [Opcode: 27h | Destination: 1]

Set Reset Flash	
Write Parameter(s)	
Byte	**Description**
Byte 0	Chip Select 0 = Flash chip select 0 memory domain 1 = Flash chip select 1 memory domain 2 = Flash chip select 2 memory domain
This command resets the Flash device connected to the given chip select. Any partial commands given gets reset and the flash is put in read mode.	

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19.6 Calibration

Calibration

Table 19-37. XPR Calibration Pattern Display [Opcode: ABh | Destination: 4]

Set XPR Calibration Pattern Display
Write Parameter(s)
This command loads a pre-defined XPR Calibration pattern as a splash image and displays it on the screen. A 64x64 pattern is repeated over a 3840x2160 display area.

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Table 19-38. XPR 4Way Orientation [Opcode: B4h | Destination: 4]

Set XPR 4Way Orientation	
Write Parameter(s)	
Byte	**Description**
Byte 0	Orientation number. Range 0 - 23.
This command sets the orientation number of the actuator position (which gets stored in EEPROM) There are 24 possible options 0 - 23; use this commmand while performing XPR calibration using TI provided XPR calibration splash image. Note : Use Display Image Size command to make sure the display area is 3840x2160 If the reported display resolution is less than or equal to 1080p this command will not have any influence on the displayed image.	

Get XPR 4Way Orientation
Data returned is in the same format as the Write Parameter(s).
This command retrieves the last set orientation number or the subframe order

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Table 19-39. XPR Actuator Waveform Control Parameter [Opcode: B5h | Destination: 4]

Set XPR Actuator Waveform Control Parameter	
Write Parameter(s)	
Byte	**Description**
Byte 0	XPR Command 0 = Fixed Output Enable 1 = DAC Gain 2 = Subframe delay 3 = Actuator Type (READ ONLY) 4 = Output Enable/Disable 5 = Clock Width 6 = DAC Offset 7 = Number of Segments 8 = Segment Length 9 = Invert PWM A 10 = Invert PWM B 11 = Subframe Filter Value 12 = Subframe Watch Dog 13 = Fixed Output Value
Byte 1	Channel number (0 or 1) of Actuator waveform control for which the command parameter has to be applied
Bytes 2-5	Data that needs to be passed to the command

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Table 19-39. XPR Actuator Waveform Control Parameter [Opcode: B5h | Destination: 4] (continued)

Set XPR Actuator Waveform Control Parameter
This command configures/sets up the Actuator Waveform Control(AWC) block. Here, AWCx can be AWC 0 or 1. Bytes 2-5 contains the XPR command data as mentioned in Byte 0. Byte 1 contains AWC channel number, possible values are 0 or 1. **Fixed Output Enable** : Configures Actuator in fixed output mode. Byte 2 : 0x00 - Disable 0x01 - Enable Bytes 3-5 : Reserved must be set to 0x000000 **Gain** : Set Waveform Generator DAC/PWM Gain. Byte 2 : Range 0 - 255 format u1.7 (0 to 1.9921875) Bytes 3-5 : Reserved must be set to 0x000000 **Subframe delay** : Subframe delay Bytes 2-5; Range 0 - 262143 and lsb = 133.333ns **Actuator Type (READ ONLY)** : Actuator type Byte 2 : 0x00 - NONE 0x01 - Optotune (XPR-25 Model) 0x80 - TI Actuator Interface (EEPROM) 0x81 - TI Actuator Interface (MCU) Bytes 3-5 : Reserved must be set to 0x000000 **Output Enable/Disable** : Actuator output enable/disable Byte 2 : 0x00 - Disable 0x01 - Enable Bytes 3-5 : Reserved must be set to 0x000000 Note : Both AWC0 and AWC1 disabled/enabled together **Clock Width** : Defines the high and low width for the output clock (the clock period will be 2*(ClkWidth+1)) 0 = 1 (Clock period is two clocks); lsb = 8.33ns Bytes 2-5 : ClkWidth Example : ClkWidth = 0; will generate clock of 2*(0+1)*8.33 = 16.66ns **Offset** : DAC/PWM Output Offset Byte 2 : Range -128 - +127 format S7 (-128 to +127) Bytes 3-5 : Reserved must be set to 0x000000 **Number of Segments** : Defines number of segments Byte 2 : Range 2 - 255 Bytes 3-5 : Reserved must be set to 0x000000 **Segments Length** : Defines size of the segments Bytes 2-3 : Range 19 - 4095 Bytes 4-5 : Reserved must be set to 0x0000 **Invert PWM A** : Applicable when AWC is configured to PWM type instead of DAC Byte 2 : 0x00 - No inversion 0x01 - Inverted Bytes 3-5 : Reserved must be set to 0x000000 **Invert PWM B** : Applicable when AWC is configured to PWM type instead of DAC Byte 2 : 0x00 - No inversion 0x01 - Inverted Bytes 3-5 : Reserved must be set to 0x000000 **Subframe Filter Value** : Sets Subframe Filter Value - defines the minimum time between Subframe edges. Edges closer than the set value will be filtered out Byte 2 : 0 = Filter disabled, 0 = Filter time will be Val x 60us, Range : 0 - 255 Bytes 3-5 : Reserved must be set to 0x000000 **Subframe Watch Dog** : Defines the maximum time between Subframe edges; if timer expires, then the WG will automatically output the Fixed Output value, and the normal output will resume on the next subframe edge. Bytes 2-3 : 0 = Subframe watchdog disabled, 0 = Watchdog time will be Time x 60us, Range : Range : 0 - 1023 Bytes 4-5 : Reserved must be set to 0x0000 **Fixed Output Value** : Defines the value to be output on DAC/PWM when fixed output mode is selected. Byte 2 : Value to be output on DAC/PWM, Range -128 to 127 Bytes 3-5 : Reserved must be set to 0x000000 **Note** : To use **Subframe Filter Value** and **Subframe Watch Dog** care must be taken to set a value which aproximately 10% more than 2x of the operating frequency.

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Table 19-39. XPR Actuator Waveform Control Parameter [Opcode: B5h | Destination: 4] (continued)

Set XPR Actuator Waveform Control Parameter
For example - 4K @ 60Hz, the value can be set as (1/(60*2))*1.10*10^6 = 9166us.

Get XPR Actuator Waveform Control Parameter	
Read Parameter(s)	
Byte	**Description**
Byte 0	XPR Command 0 = Fixed Output Enable 1 = DAC Gain 2 = Subframe delay 3 = Actuator Type (READ ONLY) 4 = Output Enable/Disable 5 = Clock Width 6 = DAC Offset 7 = Number of Segments 8 = Segment Length 9 = Invert PWM A 10 = Invert PWM B 11 = Subframe Filter Value 12 = Subframe Watch Dog 13 = Fixed Output Value
Byte 1	Channel number of Actuator waveform control block for which the command parameter to be readback

Return Parameter(s)	
Byte	**Description**
Bytes 0-3	Parameter value obtained for the command passed
This command gets the parameter set to the AWC waveform generator. Note: This command is supposed to be used only during the normal operating mode and not during the standby state.	

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Table 19-40. DB Border Configuration [Opcode: BBh | Destination: 4]

Set DB Border Configuration	
Write Parameter(s)	
Byte	**Description**
Bytes 0-1	number of lines top of border. Range 0 - 4095
Bytes 2-3	number of lines bottom of border. Range 0 - 4095
Bytes 4-5	number of pixels of left border. Range 0 - 4095
Bytes 6-7	number of pixels of right border. Range 0 - 4095
This command configures area of the DynamicBlack border region for the border exclusion function. The border exclusion function allows the user to reduce the letterbox (black border) effect on a primarily bright image where letterbox area reduces the overall scene brightness for the algorithm. It also helps the algorithm better handle images with bright subtitles where the subtitles increase the overall scene brightness. This command will also be used in a multi-controller configuration to exclude any image overlap required for other image processing algorithms.	

Get DB Border Configuration
Data returned is in the same format as the Write Parameter(s).
This Command returns the border region area for the DynamicBlack border exclusion function.

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Table 19-41. DB Border Weight [Opcode: BCh | Destination: 4]

Set DB Border Weight	
Write Parameter(s)	
Byte	**Description**
Byte 0	Weight value of border pixels 0 = 0% weighted; 1 = 25% weighted; 2 = 50% weighted; 3 = 75% weighted 0 = Weighted 0% 1 = Weighted 25% 2 = Weighted 50% 3 = Weighted 75%

Get DB Border Weight
Data returned is in the same format as the Write Parameter(s).
Sets weight value of the DynamicBlack border region for the border exclusion function

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Table 19-42. DB Clip Pixels [Opcode: BDh | Destination: 4]

Set DB Clip Pixels	
Write Parameter(s)	
Byte	**Description**
Bytes 0-1	Number of pixels that can be clipped. Range = 0 to 65535.
This command returns currently configured number of steps to allow the DynamicBlack aperture to move.	

Get DB Clip Pixels
Data returned is in the same format as the Write Parameter(s).
This command returns the currently selected number of pixels that can be clipped.

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Table 19-43. DB Gain [Opcode: BEh | Destination: 4]

Set DB Gain	
Write Parameter(s)	
Byte	**Description**
Bytes 0-1	Gain value. Typical value range is 1.0 to 8.0. Format = u4.12
This command controls the DynamicBlack gain value. Typical value range is 1.0 to 8.0. Manual Mode needs to be enabled to set the gain as it will override the gain value that is calculated every frame.	

Get DB Gain
Data returned is in the same format as the Write Parameter(s).
This command gets the DynamicBlack gain value. Typical value range is 1.0 to 8.0

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Table 19-44. DB Histogram [Opcode: C2h | Destination: 4]

Get DB Histogram	
Return Parameter(s)	
Byte	**Description**
Bytes 0-135	Start address of the DB histogram array. Array size is 34. The LSB of each bin represents 32 pixels. Each bin saturates at 0x0003FFFF.
This command returns the start address of the DynamicBlack(DB) histogram data. The histogram contains scene brightness data from the previous frame. The DB histogram contains 34 bins measuring non-overlapping intensity ranges in the displayed image. The value of each bin equals the number of pixels within the bin's intensity range. Each pixel's intensity is calculated as the maximum of its red, green, and blue values. In other words, pixel intensity = MAX(R, G, B). Each pixel has a format of unsigned 8.8, making 16 bit values. Bins 32 and 33 are special bins that represent pixels that have values of exactly zero and only fractional values respectively. This function can be used independently of aperture control for image improvement in dark scenes.	

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Table 19-45. Current Led Color Point [Opcode: C4h | Destination: 4]

Get Current Led Color Point	
Return Parameter(s)	
Byte	**Description**
Bytes 0-1	Chromatic x coordinate in (Transmitted in u1.15 format) Format = u1.15
Bytes 2-3	Chromatic y coordinate in (Transmitted in u1.15 format) Format = u1.15
Bytes 4-7	Luminance Y coordinate
Gets x,y coordinates of system's current white point. WPC should be initialized and calibration data should be set before calling this command.	

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Table 19-46. WPC Optimal Duty Cycle [Opcode: C5h | Destination: 4]

Set WPC Optimal Duty Cycle
Write Parameter(s)
Searches available duty cycles and sets the optimal one for corerct LED white point. Sensor calibration Data should be set before using this command.

Get WPC Optimal Duty Cycle	
Return Parameter(s)	
Byte	**Description**
Bytes 0-1	Red Ideal Duty Cycle (Transmitted in u8.8 format) Format = u8.8
Bytes 2-3	Green Ideal Duty Cycle (Transmitted in u8.8 format) Format = u8.8
Bytes 4-5	Blue Ideal Duty Cycle in (Transmitted in u8.8 format) Format = u8.8
Bytes 6-7	Red Optimal Duty Cycle (Transmitted in u8.8 format) Format = u8.8
Bytes 8-9	Green Optimal Duty Cyclee (Transmitted in u8.8 format) Format = u8.8
Bytes 10-11	Blue Optimal Duty Cycle in (Transmitted in u8.8 format) Format = u8.8
Gets Ideal Duty Cycle for Current Target Color Point and the closest Duty Cycle Avaialable. Sensor calibration Data should be set before using this command.	

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Table 19-47. WPC Calibration Data [Opcode: C6h | Destination: 4]

Set WPC Calibration Data	
Write Parameter(s)	
Byte	**Description**
Byte 0	LED Color 0 = Red 1 = Green 2 = Blue
Bytes 1-2	Chromatic x coordinate in u1.15 format
Bytes 3-4	Chromatic y coordinate in u1.15 format
Bytes 5-8	Luminance Y coordinate
Set WPC sensor calibration data through this command. WPC_Init() should complete succesfully before invoking this command.	

Get WPC Calibration Data	
Read Parameter(s)	
Byte	**Description**
Byte 0	LED Color 0 = Red 1 = Green 2 = Blue

Return Parameter(s)	
Byte	**Description**
Bytes 0-1	Chromatic x coordinate in u1.15 format
Bytes 2-3	Chromatic y coordinate in u1.15 format
Bytes 4-7	Luminance Y coordinate
Bytes 8-11	Red Sensor Output
Bytes 12-15	Green Sensor Output
Bytes 16-19	Blue Sensor Output
Bytes 20-21	Duty Cycle Format = u8.8
Gets WPC sensor calibration data through this command	

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Table 19-48. WPC Sensor Output [Opcode: CDh | Destination: 4]

Get WPC Sensor Output	
Return Parameter(s)	
Byte	**Description**
Bytes 0-3	Red
Bytes 4-7	Green
Bytes 8-11	Blue
Returns Output of Integrating Sensor for Red, Blue and Green	

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Table 19-49. Enable XPR Calibration Mode [Opcode: D1h | Destination: 4]

Set Enable XPR Calibration Mode	
Write Parameter(s)	
Byte	**Description**
Byte 0	1 - Calibration mode enabled
This command sets the system in bypass mode. Setting the system in bypass mode disables any image processing to establish one to one correspondence between pixels on input source image and display image. Desirable for seeing clear splits of XPR subframes. There is no exit from calibration mode. Please restart the system.	

Get Enable XPR Calibration Mode
Data returned is in the same format as the Write Parameter(s).
This command gets the state of XPR calibration mode. Whether enabled or not.

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Table 19-50. WPC Calibration Structure Override [Opcode: D2h | Destination: 4]

Set WPC Calibration Structure Override	
Write Parameter(s)	
Byte	**Description**
Byte 0	LED Color 0 = Red 1 = Green 2 = Blue
Bytes 1-2	Chromatic x coordinate in u1.15 format
Bytes 3-4	Chromatic y coordinate in u1.15 format
Bytes 5-8	Luminance Y coordinate
Bytes 9-12	Red Sensor Output
Bytes 13-16	Green Sensor Output
Bytes 17-20	Blue Sensor Output
Bytes 21-22	Duty Cycle Format = u8.8
Set the entire WPC sensor calibration data structure through this command. WPC_Init() should complete succesfully before invoking this command.	

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19.7 Debug Internal

Debug Internal

Table 19-51. Vx1 Hw Status [Opcode: 3Fh | Destination: 4]

Get Vx1 Hw Status	
Return Parameter(s)	
Byte	**Description**
Byte 0	Is Source Locked bit 0: Source Locked
Byte 1	Is Bit Locked bit 0: Bit Locked
Byte 2	Is Byte Locked bit 0: Byte Locked
Byte 3	Is Data Locked bit 0: Data Locked
Byte 4	Is V Sync Stable bit 0: V Sync Stable
Byte 5	Is H Sync Stable bit 0: H Sync Stable
Bytes 6-7	Acitve Pixels Per Line (APPL) (Pixels)
Bytes 8-9	Active Lines Per Frame (ALPF) (Lines)
Bytes 10-11	Total Pixels Per Line (TPPL) Largest (Pixels)
Bytes 12-13	Total Lines Per Frame (TLPF) (Lines)
Bytes 14-15	TPPL Smallest (Pixels)
Bytes 16-17	Vertical Front Porch (VFP) (Lines)
Bytes 18-19	Vertical Back Porch (VBP) (Lines)
Bytes 20-21	Vsync Pulse Width (VSW) (Lines)
Bytes 22-23	Horizontal Front Porch (HFP) (Pixels)
Bytes 24-25	Horizontal Back Porch (HBP) (Pixels)
Bytes 26-27	Hsync Pulse Width (HSW) (Pixels)
Bytes 28-29	HSync To VSync Pixel clock count (Hs2Vs)
Bytes 30-31	VSync To HSync Pixel clock count (Vs2Hs)
Byte 32	H Sync Polarity bit 0: H Sync Polarity Is Positive
Byte 33	V Sync Polarity bit 0: V Sync Polarity Is Positive
Bytes 34-37	Freq Captured (kHz)
Reports Vx1 source HW interface status.	

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19.8 Debug

Debug

Table 19-52. Memory [Opcode: 10h | Destination: 1]

Set Memory	
Write Parameter(s)	
Byte	**Description**
Bytes 0-3	Memory Address, must be a multiple of 4.
Bytes 4-7	Value to write
This command attempts a direct write of the given 32-bit value to the given 32-bit memory address. The memory address is not verified whether it is a valid location.	

Get Memory	
Read Parameter(s)	
Byte	**Description**
Bytes 0-3	Memory Address, must be a multiple of 4.

Return Parameter(s)	
Byte	**Description**
Bytes 0-3	Value read from address
This command returns the 32-bit value stored at the given 32-bit memory address.	

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Table 19-53. Memory Array [Opcode: 11h | Destination: 1]

Set Memory Array	
Write Parameter(s)	
Byte	**Description**
Bytes 0-3	Start Address from which data is to be written
Byte 4	Access Info bits 0-5: Address increment steps. 0 - No increment bits 6-7: Write access width 0 = Uint32 1 = Uint16 2 = Uint08
Bytes 5-6	Number of words to be written
Byte 7	The number of bytes per word Range = 1 to 2 with step size 4
Bytes 8 - *	Data to be written
Writes a stream of words into the RAM memory (DRAM or IRAM) starting from the address specified. Performs no checks whether the specified memory address given is valid.	

Get Memory Array	
Read Parameter(s)	
Byte	**Description**
Bytes 0-3	Start Address from which data is to be read
Byte 4	Access Info bits 0-5: Address increment steps. 0 - No increment bits 6-7: Read access width 0 = Uint32 1 = Uint16 2 = Uint08
Bytes 5-6	Number of words to be read
Byte 7	The number of bytes per word Range = 1 to 4 with step size 1

Return Parameter(s)	
Byte	**Description**
Bytes 0 - *	Data
Reads a stream of words from memory starting from the address specified. Performs no checks whether the specified memory address given is valid.	

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Table 19-54. Debug Message Mask [Opcode: E0h | Destination: 4]

Set Debug Message Mask	
Write Parameter(s)	
Byte	**Description**
Bytes 0-3	Debug Mask bits 0-10: Reserved bit 11: Communication related bit 13: 3D bit 14: RFC messaging bit 15: I2C Handler bit 17: Reserved bit 18: Reserved bit 19: GUI bit 20: Environment bit 21: Illumination bit 22: System functions bit 23: EEPROM bit 24: Datapath bit 25: Autolock bit 26: Projector Control bit 27: Peripheral bit 28: IR bit 29: USB bit 30: Mailbox
Set enable mask for debug messages. The mask identifies the sources of debug messages which are to be enabled for printing at the UART debug port. The mask bit corresponding to the source has to be set to enable it.	

Get Debug Message Mask	
Return Parameter(s)	
Byte	**Description**
Bytes 0-3	Debug Mask bit 11: Communication related bit 13: 3D bit 14: RFC messaging bit 15: I2C Handler bit 17: Closed Captioning bit 18: DDC CI bit 19: GUI bit 20: Environment bit 21: Illumination bit 22: System functions bit 23: EEPROM bit 24: Datapath bit 25: Autolock bit 26: Projector Control bit 27: Peripheral bit 28: IR bit 29: USB bit 30: Mailbox
Retrieves the current debug message mask. The mask decides which sources of debug messages are enabled. A value of 1 in the mask bit corresponding to a source means that the source is enabled.	

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Table 19-55. Enable USB Debug Log [Opcode: E1h | Destination: 4]

Set Enable USB Debug Log	
Write Parameter(s)	
Byte	**Description**
Byte 0	1 = Enable debug log on USB port 0 = Disable debug log on USB port
Enables or disables the USB logging of messages. When USB logging is enabled, UART logging is stopped.	

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Table 19-56. DLPA3005 Register [Opcode: E3h | Destination: 4]

Set DLPA3005 Register	
Write Parameter(s)	
Byte	**Description**
Byte 0	Register Address
Byte 1	Register Value
Command that writes specified value to the specified register address. Refer to DLPA30005 datasheet for more information. (https : //www.ti.com/product/DLPA3005)	

Get DLPA3005 Register	
Read Parameter(s)	
Byte	**Description**
Byte 0	Register Address

Return Parameter(s)	
Byte	**Description**
Byte 0	Register Value
Returns specified register value from DLPA3005. Refer to DLPA30005 datasheet for more information. (https : //www.ti.com/product/DLPA3005)	

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Table 19-57. TI Actuator Interface Debug [Opcode: E4h | Destination: 4]

Set TI Actuator Interface Debug	
Write Parameter(s)	
Byte	**Description**
Byte 0	Query type 0 = Query N number of bytes from offset address provided in next two bytes i.e., Bytes 1-2 1 = Query Actuator information also print on UART debug port 2 = Query AWG Data Set for index number provided in next two bytes i.e., Bytes 1-2 3 = Query AWG Edge table header for index number in next two bytes i.e., Bytes 1-2
Bytes 1-2	Query type provided in Byte 0; not applicable when Query type = 1
Bytes 3-4	Number of bytes to be read when Query type = 0. Note maximum 32 bytes can be read at a time.
Command used to query actuator related information for debugging purpose. Use this command to retrieve information when actuator not running or system is in standby state.	

Get TI Actuator Interface Debug	
Return Parameter(s)	
Byte	**Description**
Bytes 0-31	Actuator Data
Command returns queried data as per the settings made in the set command	

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Table 19-58. DMD Power [Opcode: E8h | Destination: 4]

Get DMD Power	
Return Parameter(s)	
Byte	**Description**
Byte 0	Enable State bit 0: 0 = Disable;1 = Enable
Returns DMD power enable state	

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Table 19-59. DMD Park [Opcode: E9h | Destination: 4]

Set DMD Park	
Write Parameter(s)	
Byte	**Description**
Byte 0	Park State bit 0: 0 = Unpark; 1 = Park
Parks/Unparks DMD	

Get DMD Park
Data returned is in the same format as the Write Parameter(s).
Returns 1 if DMD is Parked, else returns 0

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Table 19-60. DMD True Global Reset [Opcode: EBh | Destination: 4]

Set DMD True Global Reset	
Write Parameter(s)	
Byte	**Description**
Byte 0	True Global Mode bit 0: 0 = True Global Reset Mode Disabled; 1 = True Global Reset Mode Enabled.
The TrueGlobalMode should be set to TRUE only during factory/assembly operation.	

Get DMD True Global Reset
Data returned is in the same format as the Write Parameter(s).

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Table 19-61. Int Stack [Opcode: F0h | Destination: 4]

Get Int Stack	
Return Parameter(s)	
Byte	**Description**
Bytes 0-3	Stack Size
Bytes 4-7	Stack Used
Bytes 8-11	Stack Free
Gives the current stack usage information	

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Table 19-62. Print All Task Information [Opcode: F1h | Destination: 4]

Set Print All Task Information
Write Parameter(s)
Prints(on UART) information of all tasks defined/created with RTOS.

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Table 19-63. Resource [Opcode: F2h | Destination: 4]

Get Resource	
Return Parameter(s)	
Byte	**Description**
Byte 0	Tasks High Count
Byte 1	Events High Count
Byte 2	Group Events High Count
Byte 3	Mailbox High Count
Byte 4	Memory Pools High Count
Byte 5	Semaphore High Count
Byte 6	Tasks Current Count
Byte 7	Events Current Count
Byte 8	Group Events Current Count
Byte 9	Mailbox Current Count
Byte 10	Memory Pools Current Count
Byte 11	Semaphore Current Count
Gives the maximum RTOS resource usage by the application.	

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Table 19-64. EEPROM Free Area Offset [Opcode: FFh | Destination: 4]

Get EEPROM Free Area Offset	
Return Parameter(s)	
Byte	**Description**
Bytes 0-1	Free Area Offset
This function idicates the EEPROM address offset which corresponds to the start of free area.	

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19.9 General Operation

General Operation

Table 19-65. Power [Opcode: 10h | Destination: 4]

Set Power
Write Parameter(s)
This commands toggles current power mode from standby to active or from active to power down. The Standby state corresponds to Low Power Mode.

Get Power	
Return Parameter(s)	
Byte	**Description**
Byte 0	Power State 0 = Reset 1 = Standby 2 = Active
Returns current system power state.	

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Table 19-66. Display [Opcode: 11h | Destination: 4]

Set Display	
Write Parameter(s)	
Byte	**Description**
Byte 0	Source 0 = Display External 1 = Test Pattern 2 = Solid Field 3 = Splash 4 = Curtain
Displays the specified source. Note : If Display External projection mode is selected and if there is no source present it will show Splash or Solid Field depending on the default settings in the system.	

Get Display
Data returned is in the same format as the Write Parameter(s).
Returns the source which is currently being displayed.

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Table 19-67. Enable Low Latency Mode [Opcode: 12h | Destination: 4]

Set Enable Low Latency Mode	
Write Parameter(s)	
Byte	**Description**
Byte 0	Enable State bit 0: 1 = Low latency mode is enabled, 0 = Low latency mode is disabled
Enables or disables the Low latency mode of operation in which processing delay (from the input source to the frame sent to DMD) by the Controller is limited to a maximum of one and a half frame delays.	

Get Enable Low Latency Mode
Data returned is in the same format as the Write Parameter(s).
Returns whether low latency mode is enabled or not.

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Table 19-68. System Look [Opcode: 13h | Destination: 4]

Set System Look	
Write Parameter(s)	
Byte	**Description**
Bytes 0-1	Look Index
This command sets the current system look. System looks shall be designed and configured via DLP Composer tool. System look determines the current group of sequences and color points to be loaded. This command also initiates the source definition change that corresponds to new look index.	

Get System Look
Data returned is in the same format as the Write Parameter(s).
This command gets the current system look.

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Table 19-69. TPG Predefined Pattern [Opcode: 14h | Destination: 4]

Set TPG Predefined Pattern	
Write Parameter(s)	
Byte	**Description**
Byte 0	Predefined test pattern number to be displayed
This command will set one of the pre-defined test patterns. The function selects the pattern settings to load from flash into the test pattern generator hardware. The information retrieved from the flash includes pattern definition, color definition, and the resolution. The pre-defined patterns are included in the flash configuration data. Set Display command must be called to switch the display mode from other modes to TPG prior to or after this command .	

Get TPG Predefined Pattern
Data returned is in the same format as the Write Parameter(s).
Returns the current selection for pre-defined test patterns.

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Table 19-70. TPG Border [Opcode: 15h | Destination: 4]

Set TPG Border	
Write Parameter(s)	
Byte	**Description**
Byte 0	Width of the Border Range = 0 to 20 with step size 1
Bytes 1-2	Border Color Red Value Range = 0 to 1023 with step size 1
Bytes 3-4	Border Color Green Value Range = 0 to 1023 with step size 1
Bytes 5-6	Border Color Blue Value Range = 0 to 1023 with step size 1
Draws a border around the test pattern of given width and color. This supports debug of optics for clipping of image. Note : To be used only when the Display is set as Test Pattern.	

Get TPG Border
Data returned is in the same format as the Write Parameter(s).
Returns Width in number of pixels and Color of Border for a test Pattern.

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Table 19-71. TPG Resolution [Opcode: 16h | Destination: 4]

Set TPG Resolution	
Write Parameter(s)	
Byte	**Description**
Bytes 0-1	Horizontal resolution of test pattern(Pixels) Range = 640 to 4096 with step size 1
Bytes 2-3	Vertical resolution of test pattern(Lines) Range = 480 to 2400 with step size 1
Sets horizontal and vertical resolution in number of pixels for current test pattern.	

Get TPG Resolution
Data returned is in the same format as the Write Parameter(s).
Returns horizontal and vertical resolution in number of pixels for current test pattern.

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Table 19-72. TPG Frame Rate [Opcode: 17h | Destination: 4]

Set TPG Frame Rate	
Write Parameter(s)	
Byte	**Description**
Byte 0	Frame rate of test pattern(Hz) Range = 30 to 240 with step size 1
Sets frame rate in Hz for current test pattern.	

Get TPG Frame Rate
Data returned is in the same format as the Write Parameter(s).
Returns frame rate in Hz for current test pattern.

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Table 19-73. SFG Color [Opcode: 18h | Destination: 4]

Set SFG Color	
Write Parameter(s)	
Byte	**Description**
Bytes 0-1	Red color level. Range = 0 to 1023 with step size 1
Bytes 2-3	Green color level. Range = 0 to 1023 with step size 1
Bytes 4-5	Blue color level. Range = 0 to 1023 with step size 1
Configures the solid color to be displayed when display is set to solid field generator (SFG). This command only sets the SFG color and does NOT display it. In order to display the SFG, Display needs to be set with SFG as source(Use Set Display command).	

Get SFG Color
Data returned is in the same format as the Write Parameter(s).
Returns the solid color which is programmed to be displayed when display is set to SFG.

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Table 19-74. SFG Resolution [Opcode: 19h | Destination: 4]

Get SFG Resolution	
Return Parameter(s)	
Byte	**Description**
Bytes 0-1	Horizontal resolution of SFG(Pixels) Range = 0 to 4096 with step size 1
Bytes 2-3	Vertical resolution of SFG(Lines) Range = 0 to 2160 with step size 1
Gets the resolution of the displayed SFG image.	

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Table 19-75. Curtain Color [Opcode: 1Ah | Destination: 4]

Set Curtain Color	
Write Parameter(s)	
Byte	**Description**
Byte 0	The background color to be set as curtain. 0 = Black color 1 = Reserved 2 = White color 3 = Green color 4 = Red color 5 = Blue color 6 = Yellow color 7 = Cyan color 8 = Magenta color 9 = Reserved 10 = Reserved
Command to set the color to be used in curtain mode. Use Set Display command to switch to curtain mode. Note: Curtain processing happens at the backend in the controller datapath and overides freeze video data to hide artifacts.	

Get Curtain Color
Data returned is in the same format as the Write Parameter(s).
Command that returns the color used in curtain mode.

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Table 19-76. Splash Load Image [Opcode: 1Bh | Destination: 4]

Set Splash Load Image	
Write Parameter(s)	
Byte	**Description**
Byte 0	The 0-based index of Splash Image (0xff for captured splash). Range = 0 to 255 with step size 1
Sets the index of the splash image to be loaded and displayed. If already in Splash mode the requested splash image is displayed. Note: Splash image should be set before transition to display as changing while already displaying will cause transitional image artifcats.	

Get Splash Load Image
Data returned is in the same format as the Write Parameter(s).
Gets the index of the splash image to be loaded and displayed.

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Table 19-77. Enable Image Flip [Opcode: 1Ch | Destination: 4]

Set Enable Image Flip	
Write Parameter(s)	
Byte	**Description**
Byte 0	Flip bit 0: 0 = Vertical Flip of the image is disabled; 1 = Vertical Flip of the image is enabled. bit 1: 0 = Horizontal Flip of the image is disabled; 1 = Horizontal Flip of the image is enabled.
Flips the data output to the display vertically or horizontally. This feature is provided to support use cases like ceiling mount, rear projection etc.	

Get Enable Image Flip
Data returned is in the same format as the Write Parameter(s).
Returns whether image flipping is enabled.

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Table 19-78. Enable Freeze [Opcode: 1Dh | Destination: 4]

Set Enable Freeze	
Write Parameter(s)	
Byte	**Description**
Byte 0	Freeze State bit 0: 0 = Display freeze is disabled; 1 = Display freeze is enabled.
It enables or disables display freeze which freezes the current frame being displayed on the screen. Caution: Set Curtain or any operation that requires curtain will override Freeze and frozen image on the wall will be lost. The following operations require curtain (and will override Freeze) : Source Type Switch (Standard - XPR - 3D) Source Type Switch (interlaced - non-interlaced) Switch to Splash Display Splash Capture Low Latency Mode Switch Source Relocking Switch to Stand-By/Low-Power mode	

Get Enable Freeze
Data returned is in the same format as the Write Parameter(s).
Returns whether the current display is frozen.

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Table 19-79. Keystone Angles [Opcode: 1Eh | Destination: 4]

Set Keystone Angles	
Write Parameter(s)	
Byte	**Description**
Bytes 0-1	Pitch angle in degrees Range = -128 to 127.9960375 with step size 0.00390625 Format = s8.8
Bytes 2-3	Yaw angle in degrees Set to 0 for 1D correction Range = -128 to 127.9960375 with step size 0.00390625 Format = s8.8
Bytes 4-5	Roll angle in degrees Set to 0 for 1D/2D correction Range = -128 to 127.9960375 with step size 0.00390625 Format = s8.8
Configures the Keystone correction when the pitch, yaw, roll, throw ratio and vertical offset of corrected image are known. Keystone correction is used to remove the distortion caused when the projector is not orthogonal to the projection surface (screen). Keystone feature will be automatically enabled when this command is executed. Note : The actual range of these parameters depends on the light engine (projection optics); the range of Pitch, Yaw and Roll is derived from optical engine Vertical offset and Throw Ratio.(Maximum range : -40 to +40 degrees)	

Note

Not all keystone angles are supported. Refer to the below tables to find out the range that is supported.

Automated 3D Keystone Test Criteria										
	TR: 0.153 to < 0.2		TR: 0.2 to < 0.4		TR: 0.4 to < 0.75		TR: 0.75 < 1.5		TR: 1.5 <= 2.0	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Throw Ratio	0.153	0.19	0.2	0.39	0.4	0.74	0.75	1.49	1.5	2
Vertical Offset	0	1.5	-1.5	1.5	-1.5	1.5	-1.5	1.5	-1.5	1.5
Pitch Angle	-40	5	-40	10	-40	15	-40	25	-40	40
Yaw Angle	-5	5	-10	10	-20	20	-30	30	-40	40
Roll Angle	-3	3	-5	5	-10	10	-20	20	-25	25

Automated 1D Keystone Test Criteria [Roll Only]										
	TR: 0.153 to < 0.2		TR: 0.2 to < 0.4		TR: 0.4 to < 0.75		TR: 0.75 < 1.5		TR: 1.5 <= 2.0	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Throw Ratio	0.153	0.19	0.2	0.39	0.4	0.74	0.75	1.49	1.5	2
Vertical Offset	0	1	0	1	0	1	0	1	0	1
Roll Angle	-60	60	-60	60	-60	60	-60	60	-60	60

Get Keystone Angles
Data returned is in the same format as the Write Parameter(s).
Returns the keystone configuration parameters currently set.

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Table 19-80. Keystone Config Override [Opcode: 1Fh | Destination: 4]

Set Keystone Config Override	
Write Parameter(s)	
Byte	**Description**
Bytes 0-1	Throw Ratio Format = u8.8
Bytes 2-3	Vertical Offset Format = s8.8

Get Keystone Config Override
Data returned is in the same format as the Write Parameter(s).

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Table 19-81. Enable Anamorphic Scaling [Opcode: 20h | Destination: 4]

Set Enable Anamorphic Scaling	
Write Parameter(s)	
Byte	**Description**
Byte 0	Enable State bit 0: 0 = Anamorphic Scaling is disabled; 1 = Anamorphic Scaling is enabled.
Enables or disables the anamorphic scaling	

Get Enable Anamorphic Scaling
Data returned is in the same format as the Write Parameter(s).
Returns whether anamorphic scaling is enabled.

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Table 19-82. Display Image Size [Opcode: 21h | Destination: 4]

Set Display Image Size	
Write Parameter(s)	
Byte	**Description**
Byte 0	Image Size Type 0 = Fill (uses DMD image size) 1 = Native (same as source size) 2 = Manual 3 = Image size maintains the aspect ratio of source and fills the DMD in at least one direction 4 = Image size maintains the aspect ratio of 5 = Image size maintains the aspect ratio of
Bytes 1-2	Cropped Area First Pixel
Bytes 3-4	Cropped Area First Line
Bytes 5-6	Cropped Area Pixels Per Line
Bytes 7-8	Cropped Area Lines Per Frame
Bytes 9-10	Display Area First Pixel
Bytes 11-12	Display Area First Line
Bytes 13-14	Display Area Pixels Per Line
Bytes 15-16	Display Area Lines Per Frame
Configures the cropping of input image and resizing of image that is displayed. Cropped area can be equal to or less than the input image size. The display area has has to be within DMD effective number of pixels and lines. Note : 1. Cropped Area and Display Area parameters are valid only when image size type is set to Manual. 2. For TPG, SFG and Splash, Cropped Area parameter is ignored. For those sources, cropped area is automatically set as explained below : a. For TPG, cropped area is set to TPG resolution. b. For Splash, cropped area is set to Splash image size. c. For SFG, cropped area is set to SFG resolution which is equal to source area of last stable external source or TPG.	

Get Display Image Size
Data returned is in the same format as the Write Parameter(s).
Returns current image size, cropping and display settings.

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Table 19-83. Source Configuration [Opcode: 22h | Destination: 4]

Set Source Configuration	
Write Parameter(s)	
Byte	**Description**
Byte 0	0 = Input port sync is not modified(passed through). 1 = Input port sync is inverted. 2 = ALF Sync is selected as the Port sync source. Use when Autolock is used for source detection. 3 = Applicable for Topfield only. The TopField is decoded from HSync and VSync.
Byte 1	H Sync Configuration 0 = Input port sync is not modified(passed through). 1 = Input port sync is inverted. 2 = ALF Sync is selected as the Port sync source. Use when Autolock is used for source detection. 3 = Applicable for Topfield only. The TopField is decoded from HSync and VSync.
Byte 2	Top Field Configuration 0 = Input port sync is not modified(passed through). 1 = Input port sync is inverted. 2 = ALF Sync is selected as the Port sync source. Use when Autolock is used for source detection. 3 = Applicable for Topfield only. The TopField is decoded from HSync and VSync.
Byte 3	Down Sample Configuration - When downsampling is enabled, the Pixel Clock Freq (kHz) is halved by the Controller. This affects other parameters in the source structure such as Total Area Pixels Per Line, Active Area Pixels Per Line and Active Area First Pixel. 0 = Down Sample Operation disabled (data pass through unmodified). 1 = Down Sample Operation enabled. Select First Data Sample Positions from Sample Position Reference. 2 = Down Sample Operation enabled. Select Second Data Sample Positions from Sample Position Reference.
Byte 4	3D Enable bit 0: 0 = 3D Disabled 1 = 3D Enabled
Byte 5	Clock Polarity bit 0: 0 = Data is clocked in on falling edge of the port clock 1 = Data is clocked in on rising edge of the port clock
Byte 6	Pixel Format 0 = RGB 1 = YUV444 2 = YUV422 3 = YUV420
Byte 7	External Data Enable bit 0: 0 = External Data Enable is not used 1 = External Data Enable is used (typical for digital sources)
Byte 8	Interlaced bit 0: 0 = Non Interlaced 1 = Interlaced
Byte 9	Offset Binary bit 0: 0 = Incoming data is signed 2s complement; typical for RGB sources 1 = offset binary; typical for YUV sources
Byte 10	Top Field Inverted - Applicable only for interlaced sources that use field dependent scaling. Set to 0 for analog interlaced Graphics. Set to 1 for DVI Sources. bit 0: 0 = Top field not inverted at scaler 1 = Top field inverted at scaler
Bytes 11-12	Total Area Pixels Per Line

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Table 19-83. Source Configuration [Opcode: 22h | Destination: 4] (continued)

Set Source Configuration	
Bytes 13-14	Total Area Lines Per Frame
Bytes 15-16	Active Area First Pixel
Bytes 17-18	Active Area First Line
Bytes 19-20	Active Area Pixels Per Line
Bytes 21-22	Active Area Lines Per Frame
Bytes 23-24	Bottom Field First Line - Applicable for Interlaced Sources only. This term specifies the first(starting) active line in the Bottom Field. Valid range is Top Field First Line to Active Number of Lines per Frame. For Field dependent framing, Bottom Field First Line >= Top Field First Line (= Active Area First Line)
Bytes 25-28	Pixel Clock Freq (kHz)
Bytes 29-30	Color Space Conversion coefficient 0 - Coefficients used for converting YUV sources to RGB. For RGB Sources, this should be an Identity Matrix. All coefficients are defined to be signed, 2's complement values with 2 significant bits and 10 fractional bits (s2.10). For example, 1.0 = 0x0400.
Bytes 31-32	Color Space Conversion Coefficients 1
Bytes 33-34	Color Space Conversion Coefficients 2
Bytes 35-36	Color Space Conversion Coefficients 3
Bytes 37-38	Color Space Conversion Coefficients 4
Bytes 39-40	Color Space Conversion Coefficients 5
Bytes 41-42	Color Space Conversion Coefficients 6
Bytes 43-44	Color Space Conversion Coefficients 7
Bytes 45-46	Color Space Conversion Coefficients 8
Bytes 47-48	Offset Red - Also referred to as Black Level Adjustment. Range : -256 to 255.75 in signed 8.2 format(sign + 8 integer and 2 fractional bits). Adjusts the black level for the removal of controller induced bias and/or a pedestal embedded in the Source. For changing only the offset, call the Set Image Offset command.
Bytes 49-50	Offset Green
Bytes 51-52	Offset Blue
Byte 53	Is Video
Byte 54	Is High Definition Video
Bytes 55-58	Frame Rate Range = 0 to 65536 with step size 0.00390625 Format = u16.16
Configures the characteristics of the source on the Current active port. Notes : 1. After sending Set Source Configuration command, Set Display Image Size command must be sent for the changes to take effect. 2. CSC (color space conversion) will take effect only after sending the Set Display Image Size command. 3. Set Source Configuration command should not be used when the Display is set as TPG.	

Get Source Configuration	
Return Parameter(s)	
Byte	**Description**
Byte 0	0 = Input port sync is not modified(passed through). 1 = Input port sync is inverted. 2 = ALF Sync is selected as the Port sync source. Use when Autolock is used for source detection. 3 = Applicable for Topfield only. The TopField is decoded from HSync and VSync.

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Get Source Configuration	
Byte 1	H Sync Configuration 0 = Input port sync is not modified(passed through). 1 = Input port sync is inverted. 2 = ALF Sync is selected as the Port sync source. Use when Autolock is used for source detection. 3 = Applicable for Topfield only. The TopField is decoded from HSync and VSync.
Byte 2	Top Field Configuration 0 = Input port sync is not modified(passed through). 1 = Input port sync is inverted. 2 = ALF Sync is selected as the Port sync source. Use when Autolock is used for source detection. 3 = Applicable for Topfield only. The TopField is decoded from HSync and VSync.
Byte 3	Down Sample Configuration 0 = Down Sample Operation disabled (data pass through unmodified). 1 = Down Sample Operation enabled. Select First Data Sample Positions from Sample Position Reference. 2 = Down Sample Operation enabled. Select Second Data Sample Positions from Sample Position Reference.
Byte 4	3D Enable bit 0: 0 = 3D Disabled 1 = 3D Enabled
Byte 5	Clock Polarity bit 0: 0 = Clock Polarity Negative 1 = Clock Polarity Positive
Byte 6	Pixel Format 0 = RGB 1 = YUV444 2 = YUV422 3 = YUV420
Byte 7	External Data Enable bit 0: 0 = External Data Disabled 1 = External Data Enabled
Byte 8	Interlaced bit 0: 0 = Non Interlaced 1 = Interlaced
Byte 9	Offset Binary bit 0: 0 = Incoming data is signed 2s complement; typical for RGB sources 1 = offset binary; typical for YUV sources
Byte 10	Top Field Inverted - Applicable only for interlaced sources that use field dependent scaling. Set to 0 for analog interlaced Graphics. Set to 1 for DVI Sources. bit 0: 0 = Top field not inverted at scaler 1 = Top field inverted at scaler
Bytes 11-12	Total Area Pixels Per Line
Bytes 13-14	Total Area Lines Per Frame
Bytes 15-16	Active Area First Pixel
Bytes 17-18	Active Area First Line
Bytes 19-20	Active Area Pixels Per Line
Bytes 21-22	Active Area Lines Per Frame

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Get Source Configuration	
Bytes 23-24	Bottom Field First Line - Applicable for Interlaced Sources only. This term specifies the first(starting) active line in the Bottom Field. Valid range is Top Field First Line to Active Number of Lines per Frame. For Field dependent framing, Bottom Field First Line >= Top Field First Line (= Active Area First Line)
Bytes 25-28	Pixel Clock Freq (kHz)
Bytes 29-30	Color Space Conversion Coefficients 0
Bytes 31-32	Color Space Conversion Coefficients 1
Bytes 33-34	Color Space Conversion Coefficients 2
Bytes 35-36	Color Space Conversion Coefficients 3
Bytes 37-38	Color Space Conversion Coefficients 4
Bytes 39-40	Color Space Conversion Coefficients 5
Bytes 41-42	Color Space Conversion Coefficients 6
Bytes 43-44	Color Space Conversion Coefficients 7
Bytes 45-46	Color Space Conversion Coefficients 8
Bytes 47-48	Offset Red - Also referred to as Black Level Adjustment. Range : -256 to 255.75 in signed 8.2 format(sign + 8 integer and 2 fractional bits). Adjusts the black level for the removal of controller induced bias and/or a pedestal embedded in the Source. For changing only the offset, call the SetImageOffset command.
Bytes 49-50	Offset Green
Bytes 51-52	Offset Blue
Byte 53	Is Video
Byte 54	Is High Definition Video
Bytes 55-58	Frame Rate Range = 0 to 65536 with step size 0.00390625 Format = u16.16
Retrieves the source characteristics for the current active port.	

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Table 19-84. Datapath Scan Status [Opcode: 25h | Destination: 4]

Get Datapath Scan Status	
Return Parameter(s)	
Byte	**Description**
Byte 0	Scan Status 0 = Detect Stable Video 1 = Searching 2 = Sync detected 3 = Locked 4 = Suspended
Byte 1	Datapath State 0 = Standby 1 = Initalizing 2 = Splash At Startup 3 = Idling 4 = Scanning 5 = Autolock 6 = Monitoring
Returns Current status of source detection.	

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Table 19-85. Frame Rate Parameters [Opcode: 26h | Destination: 4]

Get Frame Rate Parameters	
Return Parameter(s)	
Byte	**Description**
Bytes 0-3	Input Frame Rate Format = u16.16
Bytes 4-7	Output Frame Rate Format = u16.16
Byte 8	Frame Rate Conversion (FRC) Mode 0 = Fixed output frame rate range of 47-63Hz. 1 = FRC in sync with the incoming frame rate. 2 = FRC doubles the incoming frame rate. 3 = FRC triples the incoming frame rate. 4 = FRC 4 X incoming frame rate. 5 = FRC 6 X incoming frame rate. 6 = FRC 8 X incoming frame rate. 7 = FRC 10 X incoming frame rate.
Returns current Input Frame Rate, Output Frame rate and FRC mode	

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Table 19-86. VBO Configuration [Opcode: 30h | Destination: 4]

Set VBO Configuration	
Write Parameter(s)	
Byte	**Description**
Byte 0	Data Map Mode 0 = 36bpp/30bpp RGB/YCbCr444 1 = 27bpp RGB/YCbCr444 2 = 24bpp RGB/YCbCr444 3 = 32bpp/24bpp/20bpp YCbCr422 4 = 18bpp YCbCr422 5 = 16bpp YCbCr422 6 = 12bpp/10bpp YCbCr420 Config 1 7 = 8bpp YCbCr420 Config 1 8 = 10bpp YCbCr420 Config 2 9 = 8bpp YCbCr420 Config 2 10 = Not a valid V-by-one data mode or mode is not used
Byte 1	Byte Mode 1 = 8bit mode (=3Byte mode) 2 = 10bit mode (=4Byte mode) 3 = 12bit mode (=5Byte mode)(12bit mode is reduced internally for 10bit processing)
Byte 2	Number of lanes can be 1 or 2 or 4 or 8
Byte 3	Enable Pixel Repeat bit 0: Enable Pixel Repeat
Configures the characteristics of the Vx1 source.	

Get VBO Configuration
Data returned is in the same format as the Write Parameter(s).
Retruns the characteristics of the Vx1 source.

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Table 19-87. Keystone Corners [Opcode: 3Ah | Destination: 4]

Set Keystone Corners	
Write Parameter(s)	
Byte	**Description**
Bytes 0-1	X position of the top left corner
Bytes 2-3	Y position of the top left corner
Bytes 4-5	X position of the top right corner
Bytes 6-7	Y position of the top right corner
Bytes 8-9	X position of the bottom left corner
Bytes 10-11	Y position of the bottom left corner
Bytes 12-13	X position of the bottom right corner
Bytes 14-15	Y position of the bottom right corner
Configures the 2D Keystone correction when the corners of the corrected image are known. Keystone correction is used to remove the distortion caused when the projector is not orthogonal to the projection surface (screen). For the effects to take place, the Keystone feature has to be enabled.	

Get Keystone Corners
Data returned is in the same format as the Write Parameter(s).
Returns the keystone configuration parameters currently set. This command should be used when the keystone correction has been configured using the four corners of the corrected image. The keystone correction is observed only if the keystone feature is enabled, even if the parameters are configured correctly.

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Table 19-88. Warp Timing Validation Enable Adjust Wrp [Opcode: 3Bh | Destination: 4]

Set Warp Timing Validation Enable Adjust Wrp	
Write Parameter(s)	
Byte	**Description**
Byte 0	Enable state bit 0: 1 = Automatic warp geometry adjustment is enabled 0 = Automatic warp geometry adjustment is disabled
This commands sets whether automatic warp geometry adjustment should be allowed or not.	

Get Warp Timing Validation Enable Adjust Wrp
Data returned is in the same format as the Write Parameter(s).
Returns whether Automatic Warp Adjustment is enabled or not.

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Table 19-89. Is Warp Geometry Modified [Opcode: 3Ch | Destination: 4]

Get Is Warp Geometry Modified	
Return Parameter(s)	
Byte	**Description**
Byte 0	Anonymous 1 bit 0: 1 = True 0 = False
Returns whether the Warp geomtery got modified or not.	

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19.10 Illumination

Illumination

Table 19-90. Illumination Enable [Opcode: 80h | Destination: 4]

Set Illumination Enable	
Write Parameter(s)	
Byte	**Description**
Byte 0	0 - Disabled 1 - Only Red LED Enabled 2 - Only Green LED Enabled 3 - Red and Green LEDs Enabled 4 - Only Blue LED Enabled 5 - Red and Blue LEDs Enabled 6 - Green and Blue LEDs Enabled 7 - All LEDs Enabled
Enables or Disables the illumination.	

Get Illumination Enable
Data returned is in the same format as the Write Parameter(s).
Gets the enable state of illumination.

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Table 19-91. DLPA3005 Illumination Current [Opcode: 84h | Destination: 4]

Set DLPA3005 Illumination Current	
Write Parameter(s)	
Byte	**Description**
Bytes 0-1	Drive Level Red
Bytes 2-3	Drive Level Green
Bytes 4-5	Drive Level Blue
Sets DLPA3005 Drive Current Levels input as 10-bit Drive Level per LED in the range 0 - 874 (actual range is 0-1023 but the value is limited to reduce the changes of damaging reference LEDs). Command should not be used if Dynamic Black or White Point Correction is enabled. Current output in Amps is calculated as described below. OutputCurrent = ((DriveLevel + 1)/1024)*((0.15/0.004)) Amps Example : For DriveLevel = 874; OutputCurrent = 32.04345703Amps Note: Calculation is based on a max drive of 32A using 4mOhm RLIM resistor, refer to DLPA3005 datasheet to optimize for the LED being driven.	

Get DLPA3005 Illumination Current
Data returned is in the same format as the Write Parameter(s).
Gets DLPA3005 Drive Current Levels.

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19.11 Image Processing

Image Processing

Table 19-92. Image Algorithm Enable [Opcode: 40h | Destination: 4]

Set Image Algorithm Enable	
Write Parameter(s)	
Byte	**Description**
Byte 0	Chroma Transient Improvement Enable bit 0: Chroma Transient Improvement Enable Bit
Byte 1	Gamma Correction Enable bit 0: Gamma Correction Enable Bit
Byte 2	Color Coordinate Adjustment Enable bit 0: Color Coordinate Adjustment Enable Bit
Byte 3	Brilliant Color Enable bit 0: Brilliant Color Enable Bit
Byte 4	White Point Correction Enable bit 0: White Point Correction Enable Bit
Byte 5	Dynamic Black Enable bit 0: Dynamic Black Enable Bit
Byte 6	HDR Enable bit 0: HDR Enable Bit

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Table 19-92. Image Algorithm Enable [Opcode: 40h | Destination: 4] (continued)

Set Image Algorithm Enable
Sets enable flag for all Image Algorithms. 0 = Disable 1 = Enable **Chroma Transient Improvement** : This function enables/disables the Chroma Transient Improvement (CTI) function which filters the 4 : 4 : 4 sampled, chrominance (Cr and Cb) data on the B and C data channels. The chroma transient functions performs band pass filtering (supports two center frequencies) and median filtering for ringing minimization. It performs limiting and coring functions for the filtered output. **Gamma Correction** : This function enables/disables the Gamma Correction function which implements the removal of gamma transfer function applied at the source, via table lookup process called de-gamma. When enabled, perform de-gamma translation of the 10-bit RGB input to the common 12-bit floating point (S0M8E4) RGB output. When disabled, the full 10 bits of each data input to the Gamma Correction function are zero padded and MSB-aligned to 12-bits and passed through unmodified. **Color Coordinate Adjustment** : This function enables/disables the Spatially Adaptive Seven Primaries Color Correction Function Enable. When Disable forces 3x3 CSC (Color Space Conversion) with identity. **Brilliant Color** : This function enables/disables the BrilliantColor technology, Brilliant Color uses up to five colors, instead of just the three primary colors, red, green and blue, to improve color accuracy and brightens of secondary colors. This results in a new level of color performance that increases the brightness of the colors. **White Point Correction** : This function enables/disables the White Point Correction, typically used on LED type illumination systems. Sometimes due to increase in LED operating temperature or LED aging the LEDs output wavelentgh drifts, therefore white point of the system shifts. This algorithm using active light sensor feedback and factory calibrated values help maintaing white point of the system. **Dynamic Black** : Dynamic Black (DB) is an algorithm that reduces the amount of light reaching the projection path by means of LED output power through current control and compensates for reduced light by gaining up the RGB signals. **HDR** : High Dynamic Range (HDR) is an algorithm that maps wider brightness and color range of HDR source to the projector display range. HDR is affected by several factors such as illuminiation characterstics, duty cycle distribution and current running sequence. A valid HDR source should be set by HDR_SetHdrSourceConfiguration() before enabling HDR processing. Note: **Chroma Transient Improvement** is applicable to Analog SDTV sources only. DLPC6540 controller doesn't support Analog sources. Even if enabled on DLPC6540 controller, there is no changes in the displayed image when enabled.

Get Image Algorithm Enable
Data returned is in the same format as the Write Parameter(s).
Returns enable flag for all Image Algorithms '0' - Disabled or algorithm feature not available. '1' - Enabled

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Table 19-93. Image Brightness [Opcode: 41h | Destination: 4]

Set Image Brightness	
Write Parameter(s)	
Byte	**Description**
Bytes 0-1	Brightness Adjustment Range = -256.00 to 255.75 with step size .25 Format = s14.2
The brightness control provides the ability to add or subtract a fixed bias from each of the input channels. This may be used to remove any inherent offsets and/or adjust the brightness level. The brightness coefficients are signed, 11-bit (s8.2), 2's complement values between -256 and 255.75, inclusive. Brightness Control is used after Color Space Conversion.	

Get Image Brightness
Data returned is in the same format as the Write Parameter(s).
Returns Image Brightness Level.

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Table 19-94. Image Contrast [Opcode: 42h | Destination: 4]

Set Image Contrast	
Write Parameter(s)	
Byte	**Description**
Bytes 0-1	Contrast (%) Range = 0 to 200 with step size 1
Sets Image Contrast in percentage. Each contrast byte controls the gain applied to the input image data for a given data channel. The contrast gain has a range from 0 to 200 (0% to 200%) with 100 (100%) being nominal (default).	

Get Image Contrast
Data returned is in the same format as the Write Parameter(s).
Returns Image Contrast in percentage.

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Table 19-95. Image Hue And Color Control [Opcode: 43h | Destination: 4]

Set Image Hue And Color Control	
Write Parameter(s)	
Byte	**Description**
Byte 0	Hue Adjustment Angle (degrees) Range = -45 to 45 with step size 1
Bytes 1-2	Color Control Gain (%) Range = 0 to 200 with step size 1
Sets Image Hue Adjustment angle in degrees and Color Control Gain in percentage.	

Get Image Hue And Color Control
Data returned is in the same format as the Write Parameter(s).
Returns Image Hue Adjustment angle in degrees and Color Control Gain in percentage.

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Table 19-96. Image Sharpness [Opcode: 44h | Destination: 4]

Set Image Sharpness	
Write Parameter(s)	
Byte	**Description**
Byte 0	Sharpness value to apply. Range = 0 to 31 with step size 1
Configures the sharpness filter. A value of 0 is the least sharp (smoothest), while a value of 31 is the sharpest. This filter is in the back end of the data path, so both video and graphics are affected. TI recommends that the sharpness filters be disabled (sharpness=16) for graphics sources.	

Get Image Sharpness
Data returned is in the same format as the Write Parameter(s).
Returns the current sharpness value

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Table 19-97. Image RGB Offset [Opcode: 45h | Destination: 4]

Set Image RGB Offset	
Write Parameter(s)	
Byte	**Description**
Bytes 0-1	Red channel offset setting. Range = -256.00 to 255.75 with step size .25 Format = s14.2
Bytes 2-3	Green channel offset setting. Range = -256.00 to 255.75 with step size .25 Format = s14.2
Bytes 4-5	Blue channel offset setting. Range = -256.00 to 255.75 with step size .25 Format = s14.2
Offsets the levels of the RGB channels at a point in the data path after the following image processing functions have been applied - source offset, contrast, RGB Gain, Brightness and Color Space Conversion (including Hue and Color Adjustment).	

Get Image RGB Offset
Data returned is in the same format as the Write Parameter(s).
Returns Red, Green and Blue channel offset settings.

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Table 19-98. Image RGB Gain [Opcode: 46h | Destination: 4]

Set Image RGB Gain	
Write Parameter(s)	
Byte	**Description**
Bytes 0-1	Red channel gain setting. Range = 0 to 200 with step size 1
Bytes 2-3	Green channel gain setting. Range = 0 to 200 with step size 1
Bytes 4-5	Blue channel gain setting. Range = 0 to 200 with step size 1
Adjusts individual R, G and B gains of the source image. Gain is specified as a percentage from 0% - 200%, with 100% being nominal (no gain change). 0% will zero out the channel. This function adjusts R, G and B gains by altering the Color Space Conversion (CSC) coefficients. This function is only applicable to RGB sources.	

Get Image RGB Gain
Data returned is in the same format as the Write Parameter(s).
Returns gain setting for Red, Green and Blue color channels in percentage.

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Table 19-99. CSC Table [Opcode: 47h | Destination: 4]

Set CSC Table	
Write Parameter(s)	
Byte	**Description**
Byte 0	Index of the pre-defined CSC table in flash. Range = 0 to 7 with step size 1 0 = Table Fullrange Rgb 1 = Table Bt601 Yuv Videodecoder 2 = Table Fullrange Yuv1 3 = Table Offset Rgb 4 = Table Bt601 Offset Yuv 5 = Table Fullrange Yuv 6 = Table Bt709 Offset Yuv 7 = Table Smpte 240m 8 = Table Bt2020 9 = Maxtable
Sets the Color Space Conversion Matrix with one of the CSC tables stored in flash.	

Get CSC Table
Data returned is in the same format as the Write Parameter(s).
Gets the index of the Color Space Conversion Matrix that is currently cofigured for use.

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Table 19-100. Image CCA Coordinates [Opcode: 48h | Destination: 4]

Set Image CCA Coordinates	
Write Parameter(s)	
Byte	**Description**
Bytes 0-1	Original Coordinate Red x Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 2-3	Original Coordinate Red y Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 4-5	Original Coordinate Red Lum Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 6-7	Original Coordinate Green x Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 8-9	Original Coordinate Green y Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 10-11	Original Coordinate Green Luminance Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 12-13	Original Coordinate Blue x Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 14-15	Original Coordinate Blue y Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 16-17	Original Coordinate Blue Luminance Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 18-19	Original Coordinate White x Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 20-21	Original Coordinate White y Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 22-23	Original Coordinate White Luminance Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 24-25	Original Coordinate C1 x Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 26-27	Original Coordinate C1 y Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 28-29	Original Coordinate C1 Luminance Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15

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Table 19-100. Image CCA Coordinates [Opcode: 48h | Destination: 4] (continued)

Set Image CCA Coordinates	
Bytes 30-31	Original Coordinate C2 x Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 32-33	Original Coordinate C2 y Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 34-35	Original Coordinate C2 Luminance Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 36-37	Original Coordinate DRA A x Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 38-39	Original Coordinate DRA A y Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 40-41	Original Coordinate DRA A Luminance Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 42-43	Original Coordinate DRA B x Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 44-45	Original Coordinate DRA B y Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 46-47	Original Coordinate DRA B Luminance Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 48-49	Original Coordinate DRA C x Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 50-51	Original Coordinate DRA C y Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 52-53	Original Coordinate DRA C Luminance Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 54-55	Target Coordinate Red x Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 56-57	Target Coordinate Red y Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 58-59	Target Coordinate Red Gain Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15

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Table 19-100. Image CCA Coordinates [Opcode: 48h | Destination: 4] (continued)

Set Image CCA Coordinates	
Bytes 60-61	Target Coordinate Green x Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 62-63	Target Coordinate Green y Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 64-65	Target Coordinate Green Gain Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 66-67	Target Coordinate Blue x Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 68-69	Target Coordinate Blue y Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 70-71	Target Coordinate Blue Gain Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 72-73	Target Coordinate Cyan x Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 74-75	Target Coordinate Cyan y Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 76-77	Target Coordinate Cyan Gain Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 78-79	Target Coordinate Magenta x Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 80-81	Target Coordinate Magenta y Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 82-83	Target Coordinate Magenta Gain Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 84-85	Target Coordinate Yellow x Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 86-87	Target Coordinate Yellow y Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 88-89	Target Coordinate Yellow Gain Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15

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Table 19-100. Image CCA Coordinates [Opcode: 48h | Destination: 4] (continued)

Set Image CCA Coordinates	
Bytes 90-91	Target Coordinate White x Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 92-93	Target Coordinate White y Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
Bytes 94-95	Target Coordinate White Gain Range = 0.0 to 1.99996948242 with step size 0.00003051757 Format = u1.15
This Command allows independent adjustment of the primary, secondary and white coordinates. Note: This call will override any CCA settings performed by prior calls.	

Get Image CCA Coordinates
Data returned is in the same format as the Write Parameter(s).
Returns the current color coordinate configuration.

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Table 19-101. Image HSG [Opcode: 49h | Destination: 4]

Set Image HSG	
Write Parameter(s)	
Byte	**Description**
Bytes 0-1	HSG Red Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 2-3	HSG Red Saturation Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 4-5	HSG Red Hue Range = -1.0 to 1.0 with step size 0.00006103515 Format = s2.14
Bytes 6-7	HSG Green Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 8-9	HSG Green Saturation Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 10-11	HSG Green Hue Range = -1.0 to 1.0 with step size 0.00006103515 Format = s2.14
Bytes 12-13	HSG Blue Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 14-15	HSG Blue Saturation Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 16-17	HSG Blue Hue Range = -1.0 to 1.0 with step size 0.00006103515 Format = s2.14
Bytes 18-19	HSG Cyan Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 20-21	HSG Cyan Saturation Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 22-23	HSG Cyan Hue Range = -1.0 to 1.0 with step size 0.00006103515 Format = s2.14
Bytes 24-25	HSG Magenta Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 26-27	HSG Magenta Saturation Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 28-29	HSG Magenta Hue Range = -1.0 to 1.0 with step size 0.00006103515 Format = s2.14

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Table 19-101. Image HSG [Opcode: 49h | Destination: 4] (continued)

Set Image HSG	
Bytes 30-31	HSG Yellow Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 32-33	HSG Yellow Saturation Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 34-35	HSG Yellow Hue Range = -1.0 to 1.0 with step size 0.00006103515 Format = s2.14
Bytes 36-37	HSG White Red Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 38-39	HSG White Green Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 40-41	HSG White Blue Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
This command applies the given Hue, Saturation and Gain values for all colors. It does not affect colors having a gain of zero. Note: This call will override any CCA settings performed by prior calls.	

Get Image HSG
Data returned is in the same format as the Write Parameter(s).
This command returns the currently applied Hue, Saturation and Gain values for all the colors. If Gain for a color is zero then the HSG is not applied on the color.

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Table 19-102. Image Gamma LUT [Opcode: 4Ah | Destination: 4]

Set Image Gamma LUT	
Write Parameter(s)	
Byte	**Description**
Byte 0	Gamma look-up table to load.
This command loads the specified Gamma look-up table into memory from flash. A single load is accomplished by loading data for red, green and blue look-up tables.	

Get Image Gamma LUT
Data returned is in the same format as the Write Parameter(s).
Returns the table number of the Gamma look-up table currently loaded in memory.

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Table 19-103. Image Gamma Curve Shift [Opcode: 4Bh | Destination: 4]

Set Image Gamma Curve Shift	
Write Parameter(s)	
Byte	**Description**
Byte 0	Red Gamma curve shift. Range = -128 to 127 with step size 1
Byte 1	Green Gamma curve shift. Range = -128 to 127 with step size 1
Byte 2	Blue Gamma curve shift. Range = -128 to 127 with step size 1
Byte 3	Broadcasted shift to Gamma curves of all color. Range = -128 to 127 with step size 1
Used to specify the shifts in the Gamma curve of Red, Green and Blue. A left shift is a positive offset and a right shift is a negative offset. The effective brightness is increased with a left shift and decreased with a right shift.	

Get Image Gamma Curve Shift
Data returned is in the same format as the Write Parameter(s).
Returns Image Gamma Shift for red, green and blue as well as shift to be broadcasted to all colors

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Table 19-104. Img White Peaking Factor [Opcode: 4Ch | Destination: 4]

Set Img White Peaking Factor	
Write Parameter(s)	
Byte	**Description**
Byte 0	Amount of white processing. Range 0 to 10).

Get Img White Peaking Factor
Data returned is in the same format as the Write Parameter(s).

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Table 19-105. XPR Filter Strength Command [Opcode: 4Dh | Destination: 4]

Set XPR Filter Strength Command	
Write Parameter(s)	
Byte	**Description**
Byte 0	Filter Strength setting determines how much of high frequency content is filtered out. Valid range 0-7Setting of 0 means least filtering of high frequency content (sharpest image; more flicker) Setting of 7 means most filtering of high frequency content (smoothest image; least flicker)

Get XPR Filter Strength Command
Data returned is in the same format as the Write Parameter(s).

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Table 19-106. HDR Source Configuration [Opcode: 4Eh | Destination: 4]

Set HDR Source Configuration	
Write Parameter(s)	
Byte	**Description**
Byte 0	Transfer Function 0 = Reserved 1 = Reserved 2 = PQ 3 = HLG
Bytes 1-4	Master Display Black Level (nits) Range = 0.0000 to 10000.0 Format = u16.16
Bytes 5-8	Master Display White Level (nits) Range = 0.0000 to 10000.0 Format = u16.16
Bytes 9-10	Master Display Color Gamut Red x Range = 0.0000 to 1.0000 Format = u1.15
Bytes 11-12	Master Display Color Gamut Red y Range = 0.0000 to 1.0000 Format = u1.15
Bytes 13-14	Master Display Color Gamut Green x Range = 0.0000 to 1.0000 Format = u1.15
Bytes 15-16	Master Display Color Gamut Green y Range = 0.0000 to 1.0000 Format = u1.15
Bytes 17-18	Master Display Color Gamut Blue x Range = 0.0000 to 1.0000 Format = u1.15
Bytes 19-20	Master Display Color Gamut Blue y Range = 0.0000 to 1.0000 Format = u1.15
Bytes 21-22	Master Display Color Gamut White x Range = 0.0000 to 1.0000 Format = u1.15
Bytes 23-24	Master Display Color Gamut White y Range = 0.0000 to 1.0000 Format = u1.15
HDR maps wider brightness and color range of HDR sources to projector brightness and color range. The mapping requires multiple source groups and system groups to define the HDR source and projection device properties respectively. This command sets the source properties and based on this information selects nearest source group for mapping.	

Get HDR Source Configuration
Data returned is in the same format as the Write Parameter(s).
Includes the metadata information.

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Table 19-107. HDR Strength Setting [Opcode: 4Fh | Destination: 4]

Set HDR Strength Setting	
Write Parameter(s)	
Byte	**Description**
Byte 0	HDR Strength Range = 0 to 10
Sets HDR strength which adjusts the electro-optical transfer function that is applied on the input HDR video signal. HDR strength can vary with the ambient brightness level.HDR strength is not applicable for HLG transfer function set by HDR source configuration.	

Get HDR Strength Setting
Data returned is in the same format as the Write Parameter(s).

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Table 19-108. System Brightness Range Setting [Opcode: 50h | Destination: 4]

Set System Brightness Range Setting	
Write Parameter(s)	
Byte	**Description**
Bytes 0-3	Min Brightness (nits) Range = 0.0000 to 10000.0 Format = u16.16
Bytes 4-7	Max Brightness (nits) Range = 0.0000 to 10000.0 Format = u16.16
Sets the system brightness range in nits. These are used in determining the appropriate EOTF and OOTF function to be applied on the HDR source. This need to set only for HDR functionality.	

Get System Brightness Range Setting
Data returned is in the same format as the Write Parameter(s).

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Table 19-109. Image Color Profile [Opcode: 51h | Destination: 4]

Set Image Color Profile	
Write Parameter(s)	
Byte	**Description**
Byte 0	Color Profile
Sets pre-configured Gamma table index and HSG settings as stored in the flash image.	

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Table 19-110. Image Point HSG [Opcode: 52h | Destination: 4]

Set Image Point HSG	
Write Parameter(s)	
Byte	**Description**
Byte 0	Point 0 = Row0 Col0 1 = Row0 Col1 2 = Row0 Col2 3 = Row0 Col3 4 = Row0 Col4 5 = Row1 Col0 6 = Row1 Col1 7 = Row1 Col2 8 = Row1 Col3 9 = Row1 Col4 10 = Row2 Col0 11 = Row2 Col1 12 = Row2 Col2 13 = Row2 Col3 14 = Row2 Col4
Bytes 1-2	HSG Red Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 3-4	HSG Red Saturation Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 5-6	HSG Red Hue Range = -1.0 to 1.0 with step size 0.00006103515 Format = s2.14
Bytes 7-8	HSG Green Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 9-10	HSG Green Saturation Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 11-12	HSG Green Hue Range = -1.0 to 1.0 with step size 0.00006103515 Format = s2.14
Bytes 13-14	HSG Blue Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 15-16	HSG Blue Saturation Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 17-18	HSG Blue Hue Range = -1.0 to 1.0 with step size 0.00006103515 Format = s2.14
Bytes 19-20	HSG Cyan Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14

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Table 19-110. Image Point HSG [Opcode: 52h | Destination: 4] (continued)

Set Image Point HSG	
Bytes 21-22	HSG Cyan Saturation Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 23-24	HSG Cyan Hue Range = -1.0 to 1.0 with step size 0.00006103515 Format = s2.14
Bytes 25-26	HSG Magenta Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 27-28	HSG Magenta Saturation Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 29-30	HSG Magenta Hue Range = -1.0 to 1.0 with step size 0.00006103515 Format = s2.14
Bytes 31-32	HSG Yellow Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 33-34	HSG Yellow Saturation Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 35-36	HSG Yellow Hue Range = -1.0 to 1.0 with step size 0.00006103515 Format = s2.14
Bytes 37-38	HSG White Red Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 39-40	HSG White Green Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 41-42	HSG White Blue Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
This command applies the given hue, saturation and gain values for all colors, for a specified sample point. Point is a number 0-15 corresponding to one of the the 5 x 3 PCC sample points in raster scan order. It does not affect colors having a gain of zero. Note : This call will override any CCA settings performed by prior calls.	

Get Image Point HSG	
Read Parameter(s)	
Byte	**Description**

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Get Image Point HSG	
Byte 0	Point 0 = Row0 Col0 1 = Row0 Col1 2 = Row0 Col2 3 = Row0 Col3 4 = Row0 Col4 5 = Row1 Col0 6 = Row1 Col1 7 = Row1 Col2 8 = Row1 Col3 9 = Row1 Col4 10 = Row2 Col0 11 = Row2 Col1 12 = Row2 Col2 13 = Row2 Col3 14 = Row2 Col4

Return Parameter(s)	
Byte	**Description**
Bytes 0-1	HSG Red Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 2-3	HSG Red Saturation Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 4-5	HSG Red Hue Range = -1.0 to 1.0 with step size 0.00006103515 Format = s2.14
Bytes 6-7	HSG Green Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 8-9	HSG Green Saturation Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 10-11	HSG Green Hue Range = -1.0 to 1.0 with step size 0.00006103515 Format = s2.14
Bytes 12-13	HSG Blue Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 14-15	HSG Blue Saturation Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 16-17	HSG Blue Hue Range = -1.0 to 1.0 with step size 0.00006103515 Format = s2.14
Bytes 18-19	HSG Cyan Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14

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Bytes 20-21	HSG Cyan Saturation Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 22-23	HSG Cyan Hue Range = -1.0 to 1.0 with step size 0.00006103515 Format = s2.14
Bytes 24-25	HSG Magenta Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 26-27	HSG Magenta Saturation Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 28-29	HSG Magenta Hue Range = -1.0 to 1.0 with step size 0.00006103515 Format = s2.14
Bytes 30-31	HSG Yellow Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 32-33	HSG Yellow Saturation Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 34-35	HSG Yellow Hue Range = -1.0 to 1.0 with step size 0.00006103515 Format = s2.14
Bytes 36-37	HSG White Red Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 38-39	HSG White Green Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
Bytes 40-41	HSG White Blue Gain Range = 0.0 to 1.99993896485 with step size 0.00006103515 Format = s2.14
This command returns the currently applied hue, saturation and gain values for all the colors, for a specified sample point. Point is a number 0-15 corresponding to one of the the 5 x 3 PCC sample points in raster scan order. If gain for a color is zero then the HSG is not applied on the color.	

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Table 19-111. Spcc Control Points [Opcode: 53h | Destination: 4]

Set Spcc Control Points	
Write Parameter(s)	
Byte	**Description**
Bytes 0-1	Sets vertical position for (row, col) sample points (1,0), (1,1), (1,2), (1,3), (1,4) (pixels)
Bytes 2-3	Sets horizontal position for (row, col) sample points (0,1), (1,1), (2,1) (pixels)
Bytes 4-5	Sets horizontal position for (row, col) sample points (0,3), (1,3), (2,3) (pixels)
Sets positions of control points for Multipoint sPCC.	

Get Spcc Control Points
Data returned is in the same format as the Write Parameter(s).
Returns positions of control points for Multipoint sPCC

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Table 19-112. Pcc Coefficients Direct [Opcode: 54h | Destination: 4]

Set Pcc Coefficients Direct	
Write Parameter(s)	
Byte	**Description**
Byte 0	Point 0 = Row0 Col0 1 = Row0 Col1 2 = Row0 Col2 3 = Row0 Col3 4 = Row0 Col4 5 = Row1 Col0 6 = Row1 Col1 7 = Row1 Col2 8 = Row1 Col3 9 = Row1 Col4 10 = Row2 Col0 11 = Row2 Col1 12 = Row2 Col2 13 = Row2 Col3 14 = Row2 Col4
Bytes 1-2	Pcc Red R Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 3-4	Pcc Red G Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 5-6	Pcc Red B Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 7-8	Pcc Green R Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 9-10	Pcc Green G Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 11-12	Pcc Green B Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 13-14	Pcc Blue R Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 15-16	Pcc Blue G Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 17-18	Pcc Blue B Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 19-20	Pcc Cyan R Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14

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Table 19-112. Pcc Coefficients Direct [Opcode: 54h | Destination: 4] (continued)

Set Pcc Coefficients Direct	
Bytes 21-22	Pcc Cyan G Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 23-24	Pcc Cyan B Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 25-26	Pcc Magenta R Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 27-28	Pcc Magenta G Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 29-30	Pcc Magenta B Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 31-32	Pcc Yellow R Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 33-34	Pcc Yellow G Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 35-36	Pcc Yellow B Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 37-38	Pcc White R Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 39-40	Pcc White G Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 41-42	Pcc White B Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
This command applies raw PCC Coefficients for all colors through direct access, for a specified sample point. Point is a number 0-15 corresponding to one of the the 5 x 3 PCC sample points in raster scan order. Note : This call will override any CCA settings performed by prior calls.	

Get Pcc Coefficients Direct	
Read Parameter(s)	
Byte	**Description**

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Get Pcc Coefficients Direct	
Byte 0	Point 0 = Row0 Col0 1 = Row0 Col1 2 = Row0 Col2 3 = Row0 Col3 4 = Row0 Col4 5 = Row1 Col0 6 = Row1 Col1 7 = Row1 Col2 8 = Row1 Col3 9 = Row1 Col4 10 = Row2 Col0 11 = Row2 Col1 12 = Row2 Col2 13 = Row2 Col3 14 = Row2 Col4

Return Parameter(s)	
Byte	**Description**
Bytes 0-1	Pcc Red R Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 2-3	Pcc Red G Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 4-5	Pcc Red B Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 6-7	Pcc Green R Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 8-9	Pcc Green G Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 10-11	Pcc Green B Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 12-13	Pcc Blue R Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 14-15	Pcc Blue G Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 16-17	Pcc Blue B Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 18-19	Pcc Cyan R Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14

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Bytes 20-21	Pcc Cyan G Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 22-23	Pcc Cyan B Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 24-25	Pcc Magenta R Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 26-27	Pcc Magenta G Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 28-29	Pcc Magenta B Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 30-31	Pcc Yellow R Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 32-33	Pcc Yellow G Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 34-35	Pcc Yellow B Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 36-37	Pcc White R Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 38-39	Pcc White G Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
Bytes 40-41	Pcc White B Range = 0.0 to 1.99951171875 with step size 0.00006103515 Format = s2.14
This command gets raw PCC Coefficients for all colors through direct access, for a specified sample point. Point is a number 0-15 corresponding to one of the the 5 x 3 PCC sample points in raster scan order. Note : This call will override any CCA settings performed by prior calls.	

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19.12 Peripherals

Peripherals

Table 19-113. GPIO Pin Config [Opcode: 60h | Destination: 4]

Set GPIO Pin Config	
Write Parameter(s)	
Byte	**Description**
Byte 0	GPIO to select. Range = 0 to 87.
Byte 1	Input Output bit 0: 1 = Output (Output buffer enabled) 0 = Input (Output buffer High Z)
Byte 2	Logic Value bit 0: 1 = LogicVal 1 0 = LogicVal 0
Byte 3	Open Drain Configuration bit 0: 1 = Open Drain output 0 = Standard output
Programs the direction, logic value and open drain characteristics of a single general purpose I/O pin.	

Get GPIO Pin Config	
Read Parameter(s)	
Byte	**Description**
Byte 0	GPIO to select. Range = 0 to 87.

Return Parameter(s)	
Byte	**Description**
Byte 0	Input Output bit 0: 1 = Output (Output buffer enabled) 0 = Input (Output buffer High Z)
Byte 1	Logic Value bit 0: 1 = LogicVal 1 0 = LogicVal 0
Byte 2	Open Drain Configuration bit 0: 1 = Open Drain output 0 = Standard output
Returns the direction, logic value and open drain configuration for a single general purpose I/O pin.	

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Table 19-114. GPIO Pin [Opcode: 61h | Destination: 4]

Set GPIO Pin	
Write Parameter(s)	
Byte	**Description**
Byte 0	GPIO to select. Range = 0 to 87.
Byte 1	Logic Value bit 0: 1 = LogicVal 1 0 = LogicVal 0
Sets the output logic value for the specified GPIO Pin.	

Get GPIO Pin	
Read Parameter(s)	
Byte	**Description**
Byte 0	GPIO to select. Range = 0 to 87.

Return Parameter(s)	
Byte	**Description**
Byte 0	Logic Value bit 0: 1 = LogicVal 1 0 = LogicVal 0
Returns the logic value for the specified GPIO pin.	

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Table 19-115. General Purpose Clock Enable [Opcode: 63h | Destination: 4]

Set General Purpose Clock Enable	
Write Parameter(s)	
Byte	**Description**
Byte 0	Clock to Configure
Byte 1	TRUE = Enable clock FALSE = Disable clock.
Bytes 2-5	Amount to divide the selected clock. This parameter is ignored if the clock is to be disabled. Range 2-127.

Get General Purpose Clock Enable	
Read Parameter(s)	
Byte	**Description**
Byte 0	DLPC Clock Output.

Return Parameter(s)	
Byte	**Description**
Byte 0	Is Enabled

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Table 19-116. Gen Purpse Clock Frequency [Opcode: 64h | Destination: 4]

Get General Purpose Clock Frequency	
Read Parameter(s)	
Byte	**Description**
Byte 0	Clock for which the frequency configuration needs to be returned.

Return Parameter(s)	
Byte	**Description**
Bytes 0-3	Clock frequency in kHz. Range = 787 to 50,000 kHz.

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Table 19-117. I2C Passthrough [Opcode: 67h | Destination: 4]

Set I2C Passthrough	
Write Parameter(s)	
Byte	**Description**
Byte 0	Port 0 = I2C Port 0 1 = I2C Port 1 2 = I2C Port 2 3 = Only three Ports are supported
Byte 1	7-bit Address - 0 = 10-bit Address; 1 = 7-bit Address
Byte 2	Sub-address Present 0 = No sub-address present; 1 = sub-address present
Bytes 3-6	Clock Rate - 100Khz or 400Khz supported
Bytes 7-8	Device Address
Bytes 9- Number of bytes passed	Sub-address (if present)
Bytes 9 - *	Data Bytes
Writes data to specified I2C device address.	

Get I2C Passthrough	
Read Parameter(s)	
Byte	**Description**
Byte 0	Port 0 = I2C Port 0 1 = I2C Port 1 2 = I2C Port 2 3 = Only three Ports are supported
Byte 1	7-bit Address 0 = 10-bit Address 1 = 7-bit Address
Byte 2	Sub-address Present 0 = No sub-address present; 1 = sub-address present
Bytes 3-6	Clock Rate
Bytes 7-8	Device Address
Bytes 9-10	Byte Count
Bytes 11- Number of bytes passed	Sub-address (if present)

Return Parameter(s)	
Byte	**Description**
Bytes 0- Number of bytes passed	Data Bytes
Reads data from specified I2C device address.	

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Table 19-118. DMD Temperature [Opcode: 69h | Destination: 4]

Get DMD Temperature	
Return Parameter(s)	
Byte	**Description**
Bytes 0-1	Value in degree Celcius Note: As a default condition, the firmware is configured to read TMP411A outputs using I2C port 2. Range = -256 to 255 with step size 1
This command applicable only if TMP411A temperature sensor is installed in the system.	

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Table 19-119. EEPROM Lock State [Opcode: 6Ch | Destination: 4]

Set EEPROM Lock State	
Write Parameter(s)	
Byte	**Description**
Byte 0	0 - Unlocked 1 - Locked
Sets the lock state of EEPROM. When lock is set, all writes to EEPROM settings and/or calibration data from application software will not be saved to the EEPROM. The locked mode is to be used only in factory where user wants to test with various settings without actually recording them in the EEPROM. In normal use mode, the lock state parameters should not be modified.	

Get EEPROM Lock State
Data returned is in the same format as the Write Parameter(s).
Gets the lock state of EEPROM.

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Table 19-120. UART Configuration [Opcode: 6Dh | Destination: 4]

Set UART Configuration	
Write Parameter(s)	
Byte	**Description**
Byte 0	UART Port 0 = Port 0 1 = Port 1 2 = Port 2
Byte 1	Enable State bit 0: 0 = Disable 1 = Enable
Byte 2	Baud Rate 0 = 1200 1 = 2400 2 = 4800 3 = 9600 4 = 14400 5 = 19200 6 = 38400 7 = 57600 8 = 115200 9 = 230400 10 = 460800 11 = 921600
Byte 3	Data Bits 0 = 5 1 = 6 2 = 7 3 = 8
Byte 4	Stop Bits 0 = 1 1 = 2
Byte 5	Parity 0 = Parity bit is neither transmitted or checked 1 = Even parity is transmitted and checked 2 = Odd parity is transmitted and checked
Byte 6	Flow Control 0 = Off 1 = Hardware flow control
Byte 7	Rx Trig Level 0 = One Eighth Full 1 = One Fourth Full 2 = One Half Full 3 = Three Fourths Full 4 = Seven Eighths Full
Byte 8	Tx Trig Level 0 = One Eighth Full 1 = One Fourth Full 2 = One Half Full 3 = Three Fourths Full 4 = Seven Eighths Full

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Table 19-120. UART Configuration [Opcode: 6Dh | Destination: 4] (continued)

Set UART Configuration	
Byte 9	Rx Data Polarity 0 = Supply non-inverted version of UART_RXD input 1 = Supply inverted version of UART_RXD input
Byte 10	Rx Data Source 0 = UART_x.RXD is sourced by UART_x_RXD pin 1 = UART_x.RXD is sourced by LAMPSTAT pin
Initializes all programmable parameters for the specified UART port.	

Get UART Configuration	
Read Parameter(s)	
Byte	**Description**
Byte 0	UART Port 0 = Port 0 1 = Port 1 2 = Port 2

Return Parameter(s)	
Byte	**Description**
Byte 0	Enable State bit 0: 0 = Disable 1 = Enable
Byte 1	Baud Rate 0 = 1200 1 = 2400 2 = 4800 3 = 9600 4 = 14400 5 = 19200 6 = 38400 7 = 57600 8 = 115200 9 = 230400 10 = 460800 11 = 921600
Byte 2	Data Bits 0 = 5 1 = 6 2 = 7 3 = 8
Byte 3	Stop Bits 0 = 1 1 = 2
Byte 4	Parity 0 = Parity bit is neither transmitted or checked 1 = Even parity is transmitted and checked 2 = Odd parity is transmitted and checked
Byte 5	Flow Control 0 = Off 1 = Hardware flow control

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Byte 6	Rx Trig Level 0 = One Eighth Full 1 = One Fourth Full 2 = One Half Full 3 = Three Fourths Full 4 = Seven Eighths Full
Byte 7	Tx Trig Level 0 = One Eighth Full 1 = One Fourth Full 2 = One Half Full 3 = Three Fourths Full 4 = Seven Eighths Full
Byte 8	Rx Data Polarity 0 = Supply non-inverted version of UART_RXD input 1 = Supply inverted version of UART_RXD input
Byte 9	Rx Data Source 0 = UART_x.RXD is sourced by UART_x_RXD pin 1 = Reserved
Gets current configuration for the specified UART port.	

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Table 19-121. Actuator EEPROM Free Memory Access [Opcode: 6Eh | Destination: 4]

Write to Actuator EEPROM Free Memory	
Write Parameter(s)	
Byte	**Description**
Byte 0 -1	Offset
Byte 2 - 3	Size
Sets the lock state of EEPROM. When lock is set, all writes to EEPROM settings and/or calibration data from application software will not be saved to the EEPROM. The locked mode is to be used only in factory where user wants to test with various settings without actually recording them in the EEPROM. In normal use mode, the lock state parameters should not be modified.	

Get EEPROM Lock State
Data returned is in the same format as the Write Parameter(s).
Gets the lock state of EEPROM.

Table 19-122. Actuator EEPROM Free Memory Info [Opcode: 6Fh | Destination: 4]

Get Actuator EEPROM Free Memory Info	
Return Parameter(s)	
Byte	**Description**
Bytes 0-1	Offset
Bytes 2-3	Size
This command returns the XPR EEPROM address offset which corresponds to the start of free memory area and size available	

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19.13 Warping

Warping

Table 19-123. Manual Warp Table [Opcode: 34h | Destination: 4]

Set Manual Warp Table	
Write Parameter(s)	
Byte	**Description**
Bytes 0-1	Start index in the table for the data to be written
Bytes 2 - *	Warp map points in X, Y pairs where X, Y are are in 13.3 fixed point format
This command writes to the warp map table that can be enabled using warping can be loaded at a time to anywhere within the table. Maximum number of points that can be set using this command is 62 in the horizontal direction and 32 in the vertical direction. Overall max 1984 points. The number of points set by this command should match the number of control points specified using the warping command. Each point is passed as two 13.3 fixed point numbers that represents X and Y coordinates. Since the total command packet size cannot exceed 512 bytes, the table shall be loaded by invoking the command multiple times with different start index.	

Get Manual Warp Table	
Read Parameter(s)	
Byte	**Description**
Bytes 0-1	Start index in the table from which the data is to be read
Bytes 2-3	Number of entries to be read

Return Parameter(s)	
Byte	**Description**
Bytes 0 - *	Warp map points in X, Y pairs where X, Y are in 13.3 fixed point format
This command reads from the warp map table already loaded using Set Manual Warp table. N warp map points (that does not exceed the command packet size) can be read at a time from anywhere within the table. Maximum table size is 1952.	

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Table 19-124. Manual Warp Control Points [Opcode: 35h | Destination: 4]

Set Manual Warp Control Points	
Write Parameter(s)	
Byte	**Description**
Byte 0	Indicates if the warp control points are explicitly defined by array of horizontal and vertical control points. 0 = Input image is uniformly divided to create equally spaced warp control points of dimension ((Number of Horizontal Control Points) x (Number of Vertical Control Points)). Warping map table loaded by the Set Manual Warp Table command is used as a two dimensional array with dimension (Warp Columns x Warp Rows). 1 = Warp control points are defined by Horizontal Control Points and Vertical Control Points parameters of this command. Warping map table loaded by the Set Manual Warp Table command is used as a two dimensional array with dimension (62 x 32).
Bytes 1 - *	if Control Points Defined By Array = 0, Send Number of Horizontal Control Points here. if Control Points Defined By Array = 1, Send 62 horizontal control points here in uint16 format
Bytes 1 - *	if Control Points Defined By Array = 0, Send Number of Vertical Control Points here. if Control Points Defined By Array = 1, Send 32 vertical control points here in uint16 format.
This command sets up the user defined control points of the warp map that shall be applied on top of the keystone correction, anamorphic scaling and other warp dependent feature settings if they are enabled. The warping map table loaded by the manual warp table write command is used as a two dimensional array with dimension which is defined based on the first argument of this command : TRUE = (Number of Horizontal Control Points) x (Number of Vertical Control Points) FALSE = (62 x 32) The points in the map should lie within the display area defined by display image size command. Any points lying outside the display area shall get cropped.	

Get Manual Warp Control Points	
Return Parameter(s)	
Byte	**Description**
Byte 0	Indicates if the warp control points are explicitly defined by array of horizontal and vertical control points.
Bytes 1 - *	if Control Points Defined By Array = 0, Number of Horizontal control points followed by Number of Vertical control points are returned here if Control Points Defined By Array = 1, Actual(62) Horizontal control points followed by Actual(32) Vertical control points are returned here
This command gets up the user defined warping map control points.	

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Table 19-125. Apply Manual Warping [Opcode: 36h | Destination: 4]

Set Apply Manual Warping	
Write Parameter(s)	
Byte	**Description**
Byte 0	Enable bit 0: Warp Enabled
This command applies the manual warping control points and map table to the Warp HW defined by Set Manual Warp Control Points and Set Manual Warp Table respectively.	

Get Apply Manual Warping	
Return Parameter(s)	
Byte	**Description**
Byte 0	Enable bit0: Manual Warp Enabled bit1: Surface Correction Warp Enabled bit2: Lens Correction Warp Enabled
This command returns whether warping feature is enabled or disabled for various use cases.	

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Table 19-126. Smooth Warp Table [Opcode: 38h | Destination: 4]

Set Smooth Warp Table	
Write Parameter(s)	
Byte	**Description**
Byte 0	Number of columns in the smooth warp matrix specified below (Range 3-5)
Byte 1	Number of rows in the smooth warp matrix specified below (Range 3-5)
Bytes 2 - *	Warp map points in X, Y pairs where X, Y are are in 13.3 fixed point format
This command sets up the user defined MxN warping map that creates a parametric smooth curve. The edges connecting two warp points in this case are not straight lines but are 'smoother' ie, At the Warp Point, edge is continuous and does not form a vertex (except for corners). This is done by fitting a 2nd degree polynomial curve to warp points, contrary to Write Manual Warp Table command which fits straight line to warp points.	

Get Smooth Warp Table
Data returned is in the same format as Write Parameter(s) above.
This command returns the user defined MxN warping map points

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Table 19-127. Manual Warp Table Update Mode [Opcode: 39h | Destination: 4]

Set Manual Warp Table Update Mode	
Write Parameter(s)	
Byte	**Description**
Byte 0	0 = Overwrite Existing 1 = Merge with Existing
This command configures the warping engine warp points update mode. Only one manual warp can be applied to the warping engine. Hence, if multiple manual warp maps are required, they should be merged before applying. This Command enables or disables 'Manual Warp Merge Mode' In Merge mode, any new map written will be merged with existing manual warp map. Maps can be merged one after the other. For each map, control points need to be set-up using Set Manual warp control points command and warp poins should be written using Write Manual Warp Command.	

Get Manual Warp Table Update Mode
Data returned is in the same format as Write Parameter(s) above.
This command returns the set warp table write mode.

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19.14 Manual WPC

Manual WPC

Table 19-128. WPC Target Manual Mode [Opcode: D4h | Destination: 4]

Set WPC Target Manual Mode	
Write Parameter(s)	
Byte	**Description**
Byte 0	0 = Manual Mode Disable 1 = Manual Mode Enable
Sets/Resets the manual mode for speciying WPC target color point at run-time. When manual mode is set, all target color points specified in the project will be ignored. Software will set only the user specified target color point until the manual mode is reset using this same command.	

Get WPC Target Manual Mode
Data returned is in the same format as the Write Parameter(s).
Gets whether the manual mode for speciying WPC target color point at run-time is active. When manual mode is set, all target color points specified in the project will be ignored. Software will set only the user specified target color point until the manual mode is reset.

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Table 19-129. WPC Target Color Point [Opcode: D5h | Destination: 4]

Set WPC Target Color Point	
Write Parameter(s)	
Byte	**Description**
Bytes 0-1	CIE X Range = 0.0000 to 1.0000 Format = u0.16
Bytes 2-3	CIE Y Range = 0.0000 to 1.0000 Format = u0.16
Sets the target color point while in WPC Target Manual Mode.	

Get WPC Target Color Point
Data returned is in the same format as the Write Parameter(s).
Gets the currently active target color point for WPC.

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Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision A (February 2022) to Revision B (August 2022) **Page**

Changes from Revision * (April 2021) to Revision A (February 2022) **Page**

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