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VESA Monitor Control Command Set Standard

Version 2.2a

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Purpose

The purpose of this revision is to incorporate VCP codes and the document format adopted in MCCS_v3.0 while maintaining full compatibility with MCCS_v2.1. This revision also defines compliance requirements for all MCCS VCP codes. These changes are intended to enhance performance in Direct Drive Monitors (DDM) displays.

Summary

This document describes a standardized list of commands and controls used in identifying and controlling displays by means of an application running on a connected host. This list of commands and controls, while kept to a minimum, supports the control of virtually all parameters related to the screen settings in the display. This standard does not describe how these commands are communicated using any particular video interface protocol.

Further, this document assumes the video interface connecting the display to a host can issue an unsolicited attention call (interrupt or HPD) to alert the host that something has happened outside the control of the host. The targeted display devices are displays attached to the video output of PCs, industrial display controllers or consumer electronic sources; however, not restricted to these areas.

Version 3 had several purposes, including the correction of known errors, clarification of the use of certain VCP codes, new definitions for some VCP codes and the introduction of new VCP codes. This revision incorporates those corrections, clarifications, and new definitions but redefined as required to maintain backward compatibility with MCCS_v2.1. This revision additionally withdraws the support for, and reserves from future use, VCP code $C7_h$ (Display Enable Key) and VCP code 13_h (Backlight Control), which have not achieved their intended purpose. In addition, the compliance requirements added in_v3 are included for all of the defined VCP codes except for the DPVL support group.

Table of Contents

Preface 8
Acknowledgements 10
Revision History 11
1 Introduction 12
1.1 Acronyms 12
1.2 Glossary 13
1.3 References 13
1.4 Terminology Conventions 14
1.4.1 Keywords 14
1.4.2 VCP Code Type 14
1.4.3 VCP Code Function 14
1.4.4 VCP Code Compliance 14
1.4.5 Use of 'Horizontal', 'Top' and 'Bottom' 14
1.4.6 Data Byte Designations 14
1.5 Overview of MCCS_v2.2 15
1.5.1 Summary 15
1.5.2 Background 16
2 Co-existence of Local and Remote Adjustment Options 17
2.1 Remote Adjustment Always Takes Priority 17
2.2 Remote and Local Adjustment May be Active Simultaneously 17
3 Functional Characteristics 18
3.1 Operational Model 18
3.2 Implementation of MCCS on Different Interfaces 19
4 Display VCP Codes 20
4.1 VCP Codes That Return More Than 2 Bytes 20
4.2 Control Grouping 20
4.2.1 Preset Operations (see Section 8.1) 20
4.2.2 Image Adjustment (see Section 8.2) 20
4.2.3 Display Control (see Section 8.3) 20
4.2.4 Geometry (see Section 8.4) 20
4.2.5 Miscellaneous Functions (see Section 8.5) 20
4.2.6 Audio Functions (see Section 8.6) 20
4.2.7 DPVL Functions (see Section 0) 20
4.2.8 Manufacturer Specific (see Section 8.8) 21
4.3 Control Function 21
4.3.1 Continuous Controls 21
4.3.2 Non-continuous Controls 21
4.3.3 Table Controls 21
4.3.4 Manufacturer-specific Controls. 21
5 Required VCP Codes 22
6 Capability String Format & Terminology 23
6.1 Capability String Compliance 24
7 Functional Grouping of VCP Codes 25
7.1 Image Adjustments 26
7.2 Color Adjustments 27
7.3 Image Geometry Adjustment 28
7.4 Audio Adjustments 29
7.5 Window Operations 29
7.6 DPVL Support 30
8 VCP Code Definitions 31

8.1 Preset Operations VCP Codes 31
8.2 Image Adjustment VCP Codes 33
8.3 Display Control VCP Codes 57
8.3.1 Source Timing Mode 57
8.3.2 OSD / Button Event Control 64
8.4 Geometry VCP Codes 71
8.5 Miscellaneous Functions VCP Codes 76
8.6 Audio Function VCP Codes 90
8.7 DPVL Support VCP Codes 96
8.8 Manufacturer Specific VCP Codes 98
9 Compliance 99
9.1 Overview 99
9.2 Compliance of Manufacturer VCP Codes 99
9.3 Summary of Compliance 99
9.4 Compliance Testing – General Points 99
10 Compliance Procedures 101
10.1 Introduction 101
10.2 Organization of Compliance Procedures 101
10.3 Compliance Procedure for VCP Code 02_h – New Control Value 102
10.3.1 Buttonless Display – Verify Read and Write Operation of VCP Code 02_h 102
10.3.2 Display with Manual Controls – Verify Read and Write of VCP Code 02_h 102
10.4 Compliance Procedure for VCP Code DF_h – VCP Version 103
10.5 Compliance Procedure for Capability String 103
10.6 Compliance Procedure for Controls with a Continuous Range of Adjustment 104
10.7 Compliance Procedure for Controls with a Non-Continuous Range of Adjustment 105
10.8 Compliance Procedure for Preset VCP Codes 106
10.9 Compliance Procedures for Auto Set-up and Auto Color Set-up VCP Codes 107
10.10 Compliance for 6-axis Color Adjustments 108
10.10.1 Compliance for 6-axis Saturation VCP Codes 108
10.10.2 Compliance for 6-axis Hue VCP Codes 108
10.11 Compliance for Read only VCP Codes 109
10.11.1 Compliance Procedure for Horizontal and Vertical Frequency VCP Codes 109
10.11.2 Compliance Procedure for Display Usage Time VCP Code 109
10.11.3 Compliance Procedure for Miscellaneous Read Only VCP Codes 109
10.11.4 Compliance for Write Only VCP Codes 110
10.11.5 Compliance Procedure for Degauss VCP Code 110
10.12 Compliance for Table VCP Codes 110
10.12.1 Compliance Procedure for Input Source and Output Select VCP Codes 110
10.12.2 Compliance Procedure for Source Timing Mode VCP Codes 111
10.12.3 Compliance Procedure for EDID Operation 111
10.12.4 Compliance Procedure for Auxiliary Display Data VCP Code 112
10.12.5 Compliance Procedure for Transmit Display Descriptor VCP Code 112
10.12.6 Compliance Procedure for Asset Tag VCP Code 113
10.12.7 Compliance Procedure for LUT Size VCP Code 113
10.12.8 Compliance Procedure for Single Point LUT Operation VCP Code 113
10.12.9 Compliance Procedure for Block LUT Operation VCP 114
10.12.10 Compliance Procedure for Code Remote Procedure Call VCP Code 114
10.12.11 Compliance procedure for TV-channel Up/Down VCP Code 115
10.12.12 Compliance Procedure for Auto Set-up On/Off VCP Code 116
10.12.13 Compliance Procedure for Window Size, VCP Code 116
11 VCP Code Index 117
Appendix A: Drawings of Display Geometry 124
Appendix B: Implementation Guidance 127
B.1 Support for Multiple Window Operation 127
B.1.1 Window Position VCP Codes ($95_h \rightarrow 98_h$) 127

B.1.2 Window Mask Control VCP Code ($A4_h$) 127
B.1.3 Window Select VCP Code ($A5_h$) 127
B.1.4 Picture in Picture (PIP) 127
B.2 Keeping Local and Remote Operations in Synchronization 127
Appendix C: Main Contributor History (Previous Versions) 130

Tables

Table 1-1: List of Acronyms 12
Table 1-2: Glossary of Terms 13
Table 1-3: Reference Documents 13
Table 1-4: Keyword Conventions 14
Table 3-1: Generalized Host Requests 19
Table 6-7: Capability String Abbreviations 23
Table 8-1: Preset Functions VCP Code Cross-reference 31
Table 8-2: Preset Operations VCP Codes 31
Table 8-3: Image Adjustment VCP Code Cross-reference 33
Table 8-4: Image Adjustment VCP Codes 34
Table 8-5: Display Control VCP Code Cross-reference 57
Table 8-6: Source Timing mode 58
Table 8-7: CEA DTV Timing Codes 62
Table 8-8: OSD / Button Event Control 64
Table 8-9: Display Control VCP Codes 67
Table 8-10: Geometry VCP Codes Cross-reference 71
Table 8-11: Geometry VCP Codes 72
Table 8-12: Miscellaneous Function VCP Code Cross-reference 76
Table 8-13: Miscellaneous Functions VCP Codes 76
Table 8-14: Audio Function VCP Code Cross-reference 90
Table 8-15: Audio Function VCP Codes 90
Table 8-16: DPVL Support Cross-reference 96
Table 8-17: DPVL Support VCP Codes 97
Table 8-18: Manufacturer Specific VCP Codes 98
Table 10-1: Compliance Procedures Purpose and Scope 101
Table 10-2: Compliance Procedure (buttonless) for VCP Code 02_h 102
Table 10-3: Compliance Procedure for VCP Code 02_h 103
Table 10-4: Compliance Procedure for VCP Code DF_h 103
Table 10-5: Compliance Procedure for Capability String 103
Table 10-6: Compliance Procedure for Continuous Range VCP Codes 104
Table 10-7: Compliance Procedure for Non-Continuous Range VCP Codes 105
Table 10-8: Compliance Procedure for displays that support VCP 00_h 106
Table 10-9: Compliance Procedure for Preset VCP Codes 106
Table 10-10: Compliance Procedure for Auto Set-up VCP Codes 107
Table 10-11: Compliance Procedure for 6-axis Color Saturation Adjustment VCP Codes 108
Table 10-12: Compliance Procedure for 6-axis Color Hue VCP Codes 108
Table 10-13: Compliance Procedure for Horizontal and Vertical Frequency VCP Codes 109
Table 10-14: Compliance Procedure for Display Usage Time VCP Code 109
Table 10-15: Compliance Procedure for Other Read only VCP Codes 109
Table 10-16: Compliance Procedure for Write Only VCP Codes 110
Table 10-17: Compliance Procedure for Degauss VCP Codes 110
Table 10-18: Compliance Procedure for Input Source and Output Select VCP Codes 110
Table 10-19: Compliance Procedure for Source Timing Mode VCP Code 111
Table 10-20: Compliance Procedure for EDID Operation VCP Code 111
Table 10-21: Compliance Procedure for Auxiliary Display Data VCP Code 112
Table 10-22: Compliance Procedure for Transmit Display Descriptor VCP Code 112
Table 10-23: Compliance Procedure for Asset Tag VCP Code 113
Table 10-24: Compliance Procedure for LUT Size VCP Code 113

Table 10-25: Compliance Procedure for Single Point LUT VCP Code 113
Table 10-26: Compliance Procedure for Block LUT VCP Code 114
Table 10-27: Compliance Procedure for Remote Procedure Call VCP Code 115
Table 10-28: Compliance Procedure for TV-channel Up/Down VCP Code 115
Table 10-29: Compliance Procedure for Auto Setup On/Off VCP Code 116
Table 10-30: Compliance Procedure for Window Size, VCP Code 116
Table 11-1 : VCP Code Numeric Index 117

Figures

Figure 1-1: Basic Architectural Model 15
Figure 7-1: Image Adjustments 26
Figure 7-2: Color Adjustments 27
Figure 7-3: Image Geometry Adjustment 28
Figure 7-4: Audio Adjustments 29
Figure 7-5: Windows Operations 29
Figure 7-6: DPVL Support 30

Preface

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Table 0-1: Main Contributors to Version 2.2a

Name	Company	Contribution
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Maciej Maciesowicz	Apple	
Colin Whitby-Strevens	Apple	
Vishnu Balraj	Intel	
Jim Webb	Luxtera	Subgroup Leader & Editor

Revision History

MCCS Version 1, September 11, 1998

Initial release of the standard

MCCS Version 2, October 17, 2003

A major update, in particular to provide support for flat panel displays and the VESA DPVL (Digital Packet Video Link) standard. It extends the scope and range of controls for television functions and introduces commands to permit individual control of multiple windows on a display. Many of the existing VCP codes have expanded functionality and/or clearer definitions. To ensure that the requirements of compatibility and an intuitive user interface can be readily achieved, support for two commands (see Section 5) is a compliance requirement for MCCS Version 2.

Additionally, new classes of VCP codes associated with asset management, secondary displays (for information, status, etc.) and remote program calls to the display processor are introduced. It is expected that these will become important to the industry over time.

MCCS Version 2, Revision 1, May 28, 2005

A revision and update that reflects industry experience with the version 2 standard and also adds support for new functionality that is being introduced in products.

Additionally, includes significant effort to improve the clarity and usability of the standard.

MCCS Version 3, July 27, 2006

A revision and update that reflects industry experience with the Version 2, Revision 1 standard and also adds support for new functionality that is being introduced in products. It also introduces compliance requirements for each VCP code.

MCCS Version 2, Revision 2, January 26, 2009

A revision and update incorporating VCP codes and document format adopted in MCCS_v3.0 while maintaining full compatibility with MCCS_v2.1.

VCP 02_h, 52_h, and 03_h have been enhanced, each now include a FIFO.

VCP CC_h (OSD Language), VCP 60_h (Input Select) and VCP $D0_h$ (Output Select) have been expanded.

New VCP codes ($6D_h$ $6F_h$ 71_h and $6B_h$) have been added to support separate control of Red, Green, Blue, and White backlights.

VCP 13_h (Backlight control) and $C7_h$ (Display Enable Key) have been deprecated.

MCCS Version 2, Revision 2a, January 13, 2011

Update adding support for VCP code 65_h Audio: Jack Connection Status.

Removed compliance column in VCP tables.

Updated VCP 63_h Audio: Speaker Select to include new channels.

Added limit fields in ML and MH in VCP 66_h and $8D_h$

1 Introduction

This standard provides a standard list of display controls and commands, for use, irrespective of the specific interface used to support the necessary communications between the host and the display.

The VCP code list is chosen to be the minimum list necessary to support virtually all parameters related to the display product set-up and operation. A number of VCP codes are reserved for manufacturers to use where they have design features not covered by the standard VCP codes – these codes must be considered proprietary, since generally the purpose of these unique VCP codes will only be known to the manufacturer and accessing these VCP codes may have unknown effects.

1.1 Acronyms

Table 1-1: List of Acronyms

Acronym	Stands For
C	Continuous
CRC	Cyclic Redundancy Check
CRT	Cathode Ray Tube
DP HPD	DisplayPort Hot Plug Detect
DPM	Display Power Management
DPMS	Display Power Management Signaling
DPVL	Digital Packet Video Link
EL	Electroluminescent
FC	Front Center
FCH	Front Center High
FED	Field Emission Device
FL/FR	Front Left / Front Right
FLC/FRC	Front Left of Center / Front Right of Center
FLH/FRH	Front Left High / Front Right High
FLW/FRW	Front Left Wide / Front Right Wide
HPD	Hot Plug Detect
LCD	Liquid Crystal Display
LCoS	Liquid Crystal on Silicon
LFE	Low Frequency Effect [Sub-Woofer]
LUT	Look Up Table
MEM	Micro Electro-Mechanical
MH	High order bytes when using four data bytes
ML	Low order bytes when using four data bytes
NC	Not Continuous
OLED	Organic Light Emitting Diode
OSD	On Screen Display
R / W	Read / Write
RC	Rear Center
RL/RR	Rear Left / Rear Right
RLC/RRC	Rear Left of Center / Rear Right of Center
RO	Read-only
SH	High order bytes when using two data bytes
SL	Low order bytes when using two data bytes

Table 1-1: List of Acronyms

Acronym	Stands For
SL/SR	Side Left/ Side Right
T	Table
TC	Top Center
VCP	Virtual Control Panel
WO	Write-only

1.2 Glossary

Table 1-2: Glossary of Terms

Terminology	Definition
Display Controller	Generic term used to indicate the function (usually provided by an integrated circuit and/or firmware) that controls all the functions of the display.
Orbiting	A technique applied to some displays which periodically moves the image by small amounts. This to minimize the visual effects of image burn-in.
Plasma	Plasma gas is used to excite phosphors that generate the visual image.

1.3 References

Versions identified here are current, but users of this standard should ensure they have the latest versions of referenced standards and documents.

Table 1-3: Reference Documents

Source	Name	Version/Date	
VESA	Policy 200B Intellectual Property Rights	Version B	Dec 2004
VESA	Glossary of Terms (www.vesa.org)	Current	
VESA	Display Identification Data (DisplayID) Standard	Version 1.1	Mar 2009
VESA	Digital Packet Video Link (DPVL) Standard	Version 1	Apr 2004
VESA	Discrete Monitor Timing (DMT) Standard	Revision 12	Nov 2008
VESA	Display Data Channel Command Interface (DDC/CI) Standard	Version 1, Rev 1	Oct 2004
VESA	Display Information Extension Block (DI-EXT) Standard	Release A	Aug 2001
VESA	Display Power Management (DPM) Standard	Release A	Mar 2003
VESA	Display Power Management Signaling (DPMS) Standard	Version 1.1	Aug 1993
VESA	Enhanced Display Data Channel (E-DDC) Standard	Version 1.2	Mar 2007
VESA	Enhanced Extended Display Identification (E-EDID) Standard	Release A, Rev 1	Feb 2000
VESA	Flat Panel Display Measurement (FPDM) Standard	Version 2	June 2001
VESA	MCCS Update Document	Latest	
VESA	Video Timing Block Extension Data (VTB-EXT) Standard	Release A	Nov 2003
ACCESS.bus Industry Group	ACCESS bus	Revision 3	Sept 1995
CEA	CEA-861C, A DTV profile for Uncompressed High Speed Digital Interfaces	Revision C	Sept 2005

1.4 Terminology Conventions

1.4.1 Keywords

Table 1-4: Keyword Conventions

Term	Definition
May	A keyword that indicates a choice with no expressed or implied preference
Should	A keyword that indicates a choice with a strong, expressed preference – equivalent to "is strongly recommended"
Must	A keyword that indicates a mandatory requirement for compliance with this standard
Required	A keyword that indicates a mandatory element required for compliance with this standard

1.4.2 VCP Code Type

The 'Type' column in Table 8-2, Table 8-4, Table 8-6, Table 8-8, Table 8-9, Table 8-11, Table 8-13, Table 8-15, and Table 8-17, and Table 8-18 refer to the permissible action(s) with each VCP code:

WO : Write-only
RO : Read-only
R / W : Read or Write

1.4.3 VCP Code Function

The 'Function' column in Table 8-2, Table 8-4, Table 8-6, Table 8-8, Table 8-9, Table 8-11, Table 8-13, Table 8-15, Table 8-17, and Table 8-18 refer to the permissible action(s) with each VCP code:

C : Continuous
NC : Non-continuos
T : Table

1.4.4 VCP Code Compliance

The 'Compliance' column in Table 8-2, Table 8-4, Table 8-6, Table 8-8, Table 8-9, Table 8-11, Table 8-13, Table 8-15, Table 8-17, and Table 8-18 provides a reference to the appropriate compliance procedure.

1.4.5 Use of 'Horizontal', 'Top' and 'Bottom'

In Table 8-2, Table 8-4, Table 8-6, Table 8-8, Table 8-9, Table 8-11, Table 8-13, Table 8-15, and Table 8-17, 'horizontal' refers to the axis of the display parallel to the local horizon (usually the floor, ceiling or work surface) when the display is in its normal, intended orientation.

In Table 8-2, Table 8-4, Table 8-6, Table 8-8, Table 8-9, Table 8-11, Table 8-13, Table 8-15, and Table 8-17, 'top' refers to the first image line addressed at the start of each frame regardless of the display orientation. Similarly 'bottom' refers to the last image line addressed in each frame.

1.4.6 Data Byte Designations

For consistency with the DDC/CI standard, the designations SH and SL will be used to indicate the high order and low order bytes respectively on both read and write operations involving two data bytes (e.g. GetMax or GetCurrent) will designate the two data bytes as SH-SL.

Read operations involving four data bytes (e.g. GetVCPFeature) will designate the four data bytes as MH-ML-SH-SL.

Other read and write operations (e.g. GetTable and SetTable) will designate the data bytes sequentially as byte0-byte1-byte2-byte3- ….-byteN.

In summary, except in the case of Table operations, write commands (host → display) involve two data bytes (designated SH and SL) and read commands (display → host) involve four data bytes (designated MH, ML, SH and SL), Each Table command defines the number of data bytes associated with write and read operations (designated byte0, byte1, byte2, … byteN).

If using a communications interface other than DDC/CI then these terms should be appropriately mapped to the protocol being used.

1.5 Overview of MCCS_v2.2

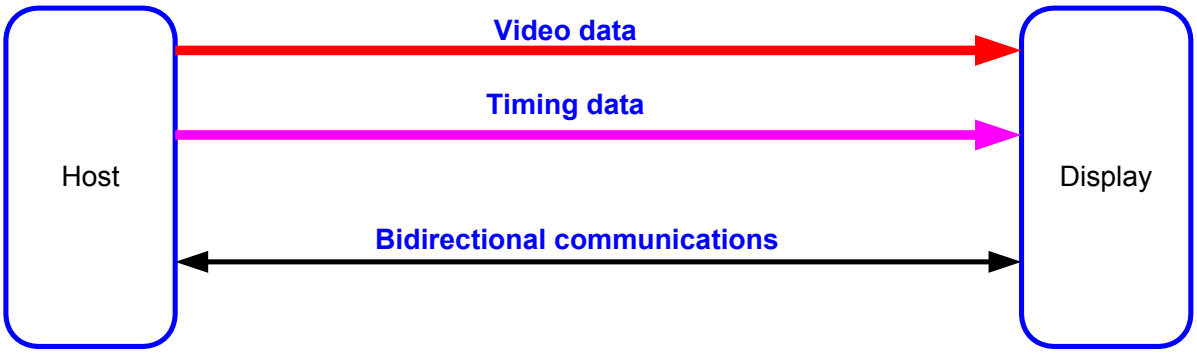


Figure 1-1: Basic Architectural Model

1.5.1 Summary

This standard describes the standardized list of control commands used to control a display by means of an application running on a host. This concept is referred to a 'virtual control panel' or VCP and the individual commands are referred to as 'VCP codes'.

The list of commands and controls is kept to a minimum while supporting the control of all common parameters related to the image settings on the display and other common features.

This standard does not specify how particular commands are implemented with a particular interface protocol nor does this document describe the way a particular protocol queries and changes the settings of the controls, see appropriate interface standard for these details e.g. VESA DDC/CI standard.

This standard also contains the requirements and procedures to achieve and verify compliance for each VCP code: see section 10 for details.

A companion document will be maintained, called MCCS_UP.pdf. It will include such things as correction of known errors, extensions of VCP code value definitions and new VCP codes proposed for inclusion in the next MCCS revision.

1.5.2 Background

Due to the emergence of bidirectional communication interfaces (Analog Interface or DVI using an I^2C bus, USB, etc.) on hosts such as PCs, workstations and set-top boxes, it has become possible to control the settings of the display by means of an application running on the host Soft OSD.

Historically, displays have provided hardware control panels (on screen display or Hard OSD) to accomplish these adjustments. Using the computer in addition, or instead of, to these manual controls increases user convenience and provides the opportunity for a standardized user interface regardless of the manufacturer of a particular display.

Although there are different communication paths, the basic content of the information communicated can be standardized offering everyone the same experience in accomplishing the same goal.

The scope of MCCS is not limited to traditional 'computer ⇔ monitor' applications. Digital television products have suitable bidirectional communication paths (I^2C based) built into DVI and HDMI interface. Additionally some VCP codes are specifically for television applications.

In general, this standard will use the term 'host' to refer to the video signal source (PC, workstation, set-top-box, etc.) and the term 'display' to refer to any device that receives a signal from the source and converts that signal to a visible image (e.g. computer monitor, television, etc.).

The following drawing illustrates the basic architectural model. Note that the video data and timing data are the generalized common element of all video interfaces. The bidirectional communication between a host and display may be part of a standard video interface (e.g. DDC/CI) or an external interface (e.g. USB, RS232).

2 Co-existence of Local and Remote Adjustment Options

A display may have the facility to be adjusted both in the conventional manner (hardware/firmware OSD) with user controls on the display bezel (usually), known as local adjustment, and also over an interface (e.g. DVI with DDC/CI) using the MCCS command set, known as remote adjustment. In that case, there is a possibility that the local adjustment and remote adjustment options may lose synchronization causing user confusion and loss of confidence.

The following implementation recommendations provide ways to avoid this situation:

2.1 Remote Adjustment Always Takes Priority

Whenever the software based adjustment system is active, the hardware based adjustment system is disabled without user intervention.

- If the hardware-based system is active and the software-based system is active, then the hardware based adjustment system should be closed.
- If the software-based system is active and the user, attempts to activate the hardware-based system then the user should only get a message indicating that the software-based system is active.

2.2 Remote and Local Adjustment May be Active Simultaneously

If it is desired that the local and remote adjustment options can be used interactively, care must be used to ensure that the local and remote adjustment options remain synchronized, particularly the current control values. VCP codes 02_h and 52_h are designed to allow this synchronization to be maintained without user intervention or knowledge.

3 Functional Characteristics

Display devices enable the user of an application to view the results of the actions taken. The primary purpose of a display device is to present to the user the image supplied by the host system. Display devices typically include a number of user controls, the details vary from model to model and between technologies. However, many allow the user to set luminance, contrast, picture size, position, and color balance. In addition, displays frequently have a number of internal settings that are changed to optimize operation with different video display formats. Some display devices have other features, e.g. audio, which may also be controlled using VCP codes.

It is desirable for the host system to be able to control these settings directly, as well as to be able to read data regarding the current set-up of the display.

3.1 Operational Model

The VCP coded controls are characterized as being continuous, non-continuous or table controls.

- Continuous controls allow for all values between zero and a maximum value, generally these values may be either read or written.
- The non-continuous controls only support a limited number of values and may be read-only, write-only or read and write.
- Table commands support the transfer of blocks of data and may be read-only, write-only or read and write.

The communication between the host and the display consists of VCP codes and associated data along with the particular protocol overhead of the interface being used.

To enable the host to issue requests, the display has to be able to specify the supported VCP codes and associated data such as:

- For continuous controls: the maximum value supported by the display (the minimum value is zero by definition)
- For non-continuous control: the specific values supported by the display

NOTE:

- The terminology used in this section (Table 3-1) contained in Version 2.2, is generalized and not specific to any particular communications channel. Refer to the specification/standard for the particular communications channel being used for precise terminology.
- See individual VCP code definitions for details.
- Requests are issued by the host and may be followed by a data transfer. Some requests need further specification, in those cases the parameters are indicated in the brackets in Table 3-1.

Table 3-1: Generalized Host Requests

Control	Description
"GetSupportedControls"	This request from the host must cause the display to respond with a "capability string" that defines supported VCP codes.
"GetMax" (VCP code)	Requests the possible range of values of the VCP codes supported by the display device. The display responds with either the maximum possible value (in case of a continuous control) or the maximum number of different values of the control (in case of a non-continuous control).
"GetPossible" (VCP code)	Requests the possible values of the non-continuous VCP codes supported by the display. The display responds with the supported values for the specified non-continuous VCP code.
"GetCurrent" (VCP code)	Requests the current value of the specified VCP code. The display responds with the current value of the specified VCP code.
"SetCurrent" (VCP code)	Sets the current values of the virtual controls supported by the display device. The display must overwrite the currently stored value of the specified VCP code with the new value supplied.
"GetEDID"	This request is issued by the host to get the EDID information (in the binary format specified in the E-EDID standard) of the display.
"GetControlRelation" (VCP code)	This request asks for the identification of any other VCP codes affected by the alteration of the control indicated by the VCP code. Required for cases where there is interaction between controls.
"GetTable" (VCP code)	Requests that a block of data, specified by the control code, is transferred to the host
"SetTable" (VCP code)	Transfers a block of data to the display, storage location is defined in the definition of the control code.

3.2 Implementation of MCCS on Different Interfaces

MCCS provides a standard set of controls for use over a bidirectional interface between the host and the display. If duplication of these controls occurs within the same physical interface, the support of duplicated controls by MCCS needs careful consideration by the implementer.

Depending on the interface used, duplication of functionality may occur, providing the host with multiple ways to control the same aspect of the display. It is recommended that duplication of support using MCCS VCP codes be avoided.

Caution: When multiple methods of control for a display function exist, synchronization must be addressed.

4 Display VCP Codes

All control codes are listed in Section 8, including name, code, and definition. They are organized in functional groups defined in Section 4.2; Section 0 contains cross-reference charts for all VCP codes.

NOTE: All VCP codes between 00_h and DF_h inclusive that are not defined here are reserved for future use and may become active in future revisions of this standard. VCP codes between $E0_h$ and FF_h are reserved for manufacturer use to enable support for a capability not defined in the standard.

4.1 VCP Codes That Return More Than 2 Bytes

Some VCP codes - e.g. AC_h (Horizontal Frequency) and $C8_h$ (Display Controller ID) - return more than 2 bytes and are not 'table' type commands. The organization of the returned bytes is defined in the DDC/CI standard (see Get VCP Feature & VCP Feature Reply), but is included here for completeness.

The four bytes available for return are labeled MH, ML, SH and SL. If only 3 bytes are returned, for example, the MH byte must be set = 00_h. MH and ML, are the two high bytes, SH and SL, are the two low bytes.

For table commands, the number of bytes written or read depends on the particular VCP code but in all cases the first byte transmitted is designated "byte 0", the second byte transmitted is designated "byte 1", etc.

4.2 Control Grouping

Controls are grouped by area of applicability into:

4.2.1 Preset Operations (see Section 8.1)

This group relates to the selection from a number of preset options.

4.2.2 Image Adjustment (see Section 8.2)

This group relates to the adjustment of the displayed image excluding geometric adjustments.

e.g. luminance and color

4.2.3 Display Control (see Section 8.3)

This group covers items relating to information and overall control of the display. e.g. the number of hours that display has been in use and the OSD (On Screen Display) language.

4.2.4 Geometry (see Section 8.4)

This group provides support for image geometry and spatial adjustments.

4.2.5 Miscellaneous Functions (see Section 8.5)

This group covers items not included elsewhere.

4.2.6 Audio Functions (see Section 8.6)

This group covers items relating to the audio (input and output) of the display device.

4.2.7 DPVL Functions (see Section 0)

This group is for the commands required to support the VESA DPVL standard.

4.2.8 Manufacturer Specific (see Section 8.8)

This group is reserved for manufacturer specific codes.

NOTE: In some cases, a VCP code does not fit exactly into one of these groups. In this case they have been classified according to their typical usage.

4.3 Control Function

4.3.1 Continuous Controls

Continuous controls are controls that accept any value from zero to a maximum value specific for each control. All continuous controls are read and write enabled. Continuous controls are indicated by C in the 'function' column.

4.3.2 Non-continuous Controls

The non-continuous controls accept only specific values. The valid values of these controls do not need to be continuous in value. Non-continuous controls can be "read and write", "read-only" or "write-only". Indicated by NC in the 'function' column.

4.3.3 Table Controls

These controls are typically associated with a block of data where only the overall structure is explicitly defined but not the contents. Table controls can be "read and write", "read-only" or "write-only. Table controls are indicated by 'T' in the 'function' column.

4.3.4 Manufacturer-specific Controls.

The 32 control codes E0h through FFh have been allocated to allow manufacturers to issue their own specific controls either where the defined VCP codes do not provide a required function or where the added function is considered proprietary.

Caution: Use of these codes has the risk of causing incompatibility and / or unpredictable behavior.

Example: Consider the case when two display manufacturers choose to use the same 'manufacturer VCP code' for different functions (or different implementations of the same function) but the user chooses not to use the specific software support supplied or recommended for his particular display – he may use a general purpose MCCS support application, native support built into the operating system or a MCCS support application intended for a different display model. In this case, the resulting behavior is unpredictable, ranging from no support for the function which uses a 'manufacturer VCP code' to incorrect control and adjustment of the function. In all cases this will likely result in an annoyed user and a service call, in extreme cases it may result in a situation where the user cannot return the display to normal operation.

It is recommended that these codes are used with caution and only when strictly necessary.

5 Required VCP Codes

MCCS Version 2 and MCCS Version 2 Revision 1, require that the VCP code DF_h, 'VCP Version' and VCP code 02_h, 'New control value', are supported.

MCCS Version 2 Revision 2 adds the required VCP codes $C8_h$ 'Display Controller ID'.

- Support of DF_h (VCP Version) allows application code to correctly interpret responses from the display and provide an intuitive user interface.
  - Use of this VCP code enables correct forward and backward compatibility between the display and any host code seeking to remotely control the display.
    - The host code must ensure that it does not try to utilize features or functions that are not supported at the reported display MCCS version and revision level.
    - Higher revision levels of the MCCS standard indicate that backward compatible change(s) have been made so if the display supports a higher revision level than the host code, the host code must handle all supported display VCP codes defined at its version and revision level.
    - Higher version levels indicate that some degree of incompatibility has been introduced. However, the host codes should attempt to decode the capability string and handle all possible VCP codes.
- Support of 02_h (New Control Value) enables a simple way to maintain synchronization between a software display control application and the hardware/firmware based control in the display.
  - See Section 2 for a discussion of the issues involved and section B.2 for a recommended implementation.
- Support of $C8_h$ (Display Controller ID) enables the host to better identify the sink and its controller. This can be useful during customer service to identify unique versions of firmware and hardware.

Additionally, all unassigned VCP codes are reserved for future use and MCCS compliant products must not use them. If an undefined function is required then one of the VCP codes reserved as 'manufacturer's specific codes' must be used - the sole exception being when the VESA Control Subgroup has decided to include a new VCP code function in the MCCS update document (see Section 0) and specifies the VCP code that is proposed for a future MCCS standard revision.

6 Capability String Format & Terminology

The capability string delineates display information and supported VCP codes. The following format is recommended to obtain display industry consistency. Table 6-1 lists the capability string abbreviations. More complete definitions can be found in Section 7 of the Access Bus Specification except for window() which is introduced here.

Table 6-1: Capability String Abbreviations

Terminology	Definition
prot()	Used to specify the protocol class
type()	Identifies type of display
cmds()	An ASCII string listing supported VCP codes
vcp()	A list of the supported VCP codes in ASCII. Also contains a list of the supported values for each non-continuous VCP code
model()	The display model number (may be alpha-numeric)
mccs_ver()	Specifies the supported version and revision of the MCCS standard.
window()	Specifies the window#, window type (PIP or Zone) safe area size (bounded safe area) maximum size of the window, minimum size of the window, and window supports VCP codes for control/adjustment.
vcpname()	Allows a display to specify an alternative name to be used for a control

The capability string header may contain information about the display for prot(), type(), model(), cmds(), vcp(), mccs_ver(x.x), window()

NOTE: If the host receives a capability string with non-standard abbreviations, the non-standard portions of the capability string should be ignored.

Example:

Prot(display) type(lcd) model(xxxxx) cmds(xxxxx) vcp(02 03 10 12 C8 DC(00 01 02 03 07) DF) mccs_ver(2.2) window1(type (PIP) area(25 25 1895 1175) max(640 480) min(10 10) window(10)) vcpname(10(Brightness))

The above string explicitly states that New Control Value, Factory Restore, Luminance, Contrast, Display Application Presets, and VCP Version are supported VCP codes but that only Luminance adjustments are supported within a window. It also lists the non-continuous values that are supported by the 'Display Application' VCP code. The vcpname string indicates that 'Brightness' should be used instead of Luminance when referring to adjustments using VCP code 10_h.

VCP 02_h: New Control Value

VCP 04_h: Factory Restore

VCP 10_h: Luminance

VCP 12_h: Contrast

VCP DC_h: Select Display Application

Display Application presets available using VCP DC_h

00_h: Standard / default mode

01_h: Productivity (office applications)

02_h: Mixed (e.g. internet browsing)

03_h: Movie

07_h: Professional (no signal processing in display)

VCP DF_h: VCP Version

Each display input source should have its own capability string, i.e. LCD analog and digital inputs should have independent unique capability strings since there will be, generally, a different set of VCP codes supported on each input.

VCP codes with bit-mapped functions must not report the bits in the capability string; the host must read the individual VCP code to get the details of the supported function set.

When the window() string reports support of non-continuous VCP codes then it is the responsibility of the software application to determine the actual values supported.

6.1 Capability String Compliance

Section 10.5 contains the compliance procedure for the capability string.

7 Functional Grouping of VCP Codes

This section provides a number of tree structures; each covers the VCP codes that may affect a specific area of the display operation.

Example:

A restore function may clear a window or change one or more of the attributes of the image within that window.

NOTE:

Some VCP codes appear in several trees.

VCP codes have been placed in tree(s) based on the common perception of the effect of the VCP code and not necessarily a technically accurate interpretation.

Some trees reference other tree(s)

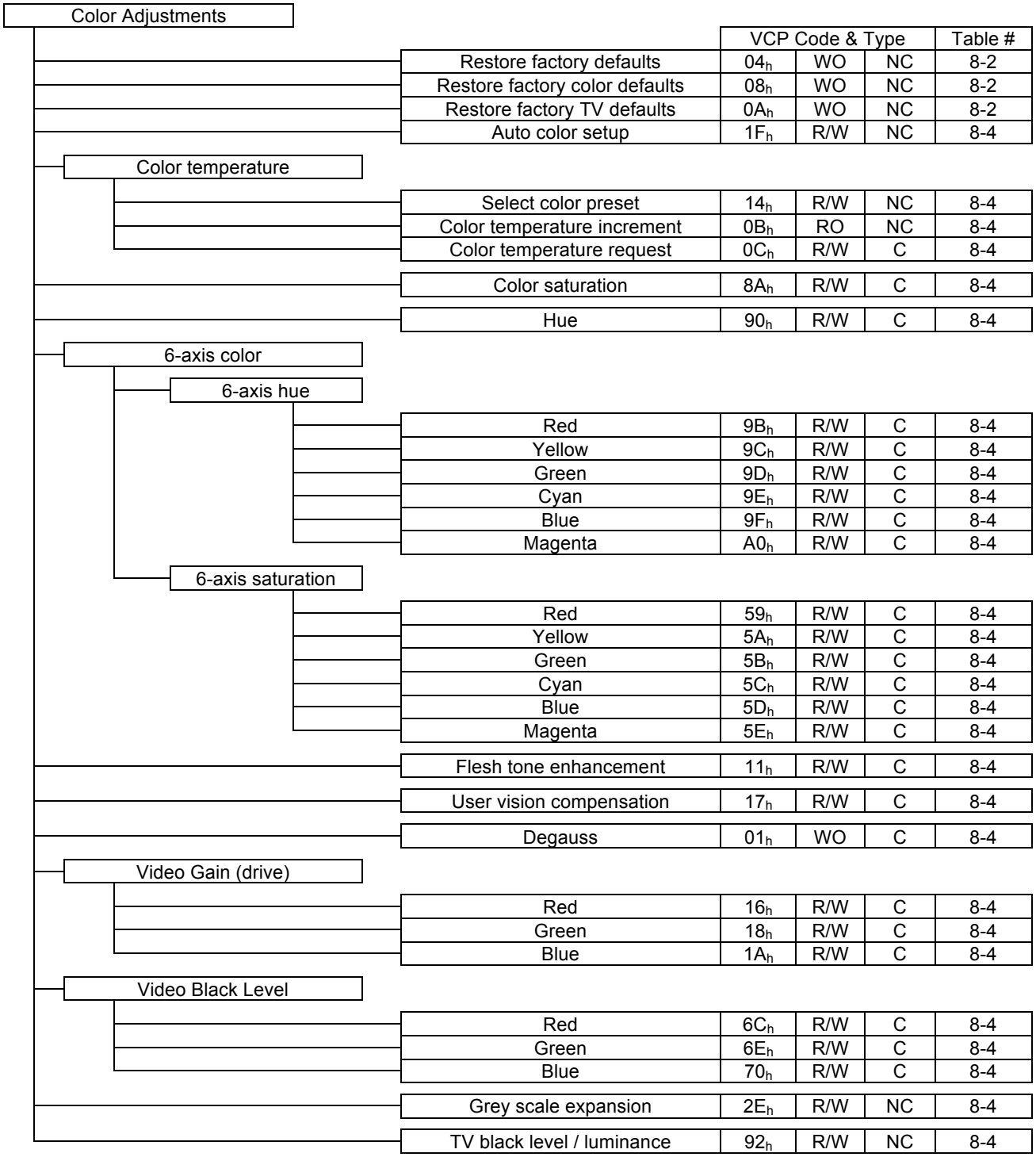
7.1 Image Adjustments

Image

	VCP code & type			Table #
Restore factory defaults	04_h	WO	NC	8-2
Restore factory luminance / contrast values	05_h	WO	NC	8-2
Restore factory TV defaults	06_h	WO	NC	8-2
Degauss	01_h	WO	NC	8-13
Auto setup on/off	$A2_h$	WO	NC	8-4
Auto setup	$1E_h$	R/W	NC	8-4
Clock	$0E_h$	R/W	C	8-4
Clock phase	$3E_h$	R/W	C	8-4
Luminance	10_h	R/W	C	8-4
Backlight control				
Backlight Level: White	$6B_h$	R/W	C	8-4
Backlight Level: Red	$6D_h$	R/W	C	8-4
Backlight Level: Green	$6F_h$	R/W	C	8-4
Backlight Level: Blue	71_h	R/W	C	8-4
Contrast	12_h	R/W	C	8-4
Focus	$1C_h$	R/W	C	8-4
TV Sharpness	$8C_h$	R/W	C	8-4
Active control	52_h	RO	NC	8-13
Performance preservation	54_h	R/W	NC	8-13
Gamma	72_h	R/W	NC	8-4
H moiré	56_h	R/W	C	8-4
V moiré	58_h	R/W	C	8-4
Adjust zoom	$7C_h$	R/W	C	8-4
Display scaling	86_h	R/W	NC	8-8
Horizontal mirror (flip)	82_h	R/W	NC	8-8
Vertical mirror (flip)	84_h	R/W	NC	8-8
Screen orientation	AA_h	RO	NC	8-4
Velocity scan modulation	88_h	R/W	NC	8-4
TV channel up / down	$8B_h$	WO	NC	8-13
TV sharpness	$8C_h$	R/W	C	8-4
TV contrast	$8E_h$	R/W	C	8-4
TV black level / luminance	92_h	R/W	C	8-4
Store / Restore Settings	$B0_h$	WO	NC	8-2
OSD	CA_h	R/W	NC	8-8
OSD Language	CC_h	R/W	NC	8-8
Stereo video mode	$D4_h$	R/W	NC	8-4
Scan mode	DA_h	R/W	NC	8-11
Image mode	DB_h	R/W	NC	8-8
Display application	DC_h	R/W	NC	8-4

Figure 7-1: Image Adjustments

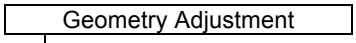
7.2 Color Adjustments



	VCP Code & Type			Table #
Restore factory defaults	04_h	WO	NC	8-2
Restore factory color defaults	08_h	WO	NC	8-2
Restore factory TV defaults	$0A_h$	WO	NC	8-2
Auto color setup	$1F_h$	R/W	NC	8-4
Select color preset	14_h	R/W	NC	8-4
Color temperature increment	$0B_h$	RO	NC	8-4
Color temperature request	$0C_h$	R/W	C	8-4
Color saturation	$8A_h$	R/W	C	8-4
Hue	90_h	R/W	C	8-4
Red	$9B_h$	R/W	C	8-4
Yellow	$9C_h$	R/W	C	8-4
Green	$9D_h$	R/W	C	8-4
Cyan	$9E_h$	R/W	C	8-4
Blue	$9F_h$	R/W	C	8-4
Magenta	$A0_h$	R/W	C	8-4
Red	59_h	R/W	C	8-4
Yellow	$5A_h$	R/W	C	8-4
Green	$5B_h$	R/W	C	8-4
Cyan	$5C_h$	R/W	C	8-4
Blue	$5D_h$	R/W	C	8-4
Magenta	$5E_h$	R/W	C	8-4
Flesh tone enhancement	11_h	R/W	C	8-4
User vision compensation	17_h	R/W	C	8-4
Degauss	01_h	WO	C	8-4
Red	16_h	R/W	C	8-4
Green	18_h	R/W	C	8-4
Blue	$1A_h$	R/W	C	8-4
Red	$6C_h$	R/W	C	8-4
Green	$6E_h$	R/W	C	8-4
Blue	70_h	R/W	C	8-4
Grey scale expansion	$2E_h$	R/W	NC	8-4
TV black level / luminance	92_h	R/W	NC	8-4

Figure 7-2: Color Adjustments

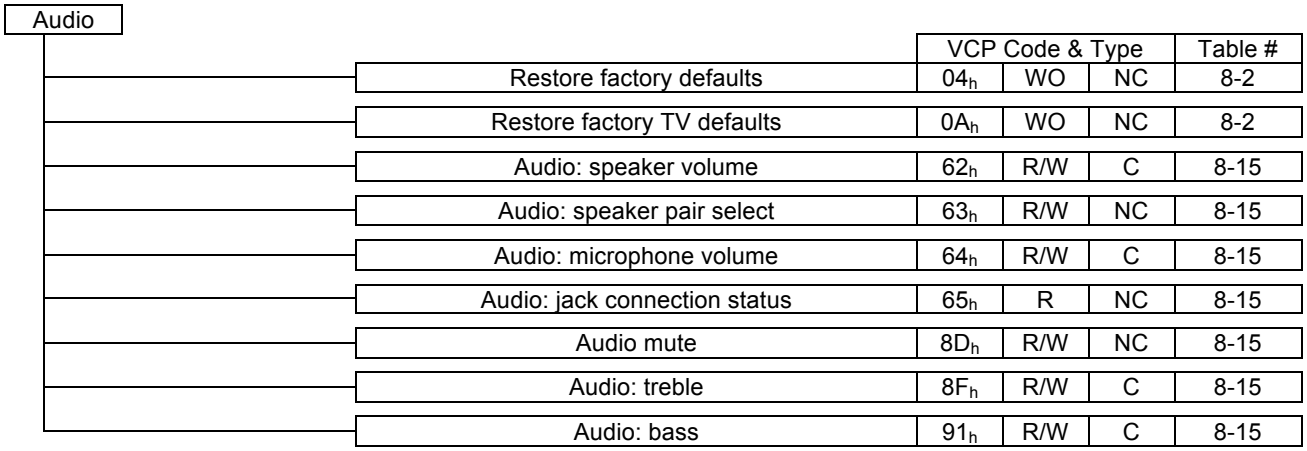
7.3 Image Geometry Adjustment



	VCP Code & Type			Table #
Restore factory defaults	04_h	WO	NC	8-2
Restore factory geometry defaults	06_h	WO	NC	8-2
Restore factory TV defaults	$0A_h$	WO	NC	8-2
Auto setup	$1E_h$	R/W	NC	8-4
Clock	$0E_h$	R/W	C	8-4
Clock phase	$3E_h$	R/W	C	8-4
Horizontal				
Keystone	42_h	R/W	C	8-11
Linearity	$2A_h$	R/W	C	8-11
Linearity balance	$2C_h$	R/W	C	8-11
Mirror (flip)	82_h	R/W	NC	8-11
Parallelogram	40_h	R/W	C	8-11
Pincushion	24_h	R/W	C	8-11
Pincushion balance	26_h	R/W	C	8-11
Position (phase)	20_h	R/W	C	8-11
Size	22_h	R/W	C	8-11
Convergence R/B	28_h	R/W	C	8-11
Convergence M/G	29_h	R/W	C	8-11
Vertical				
Keystone	43_h	R/W	C	8-11
Linearity	$3A_h$	R/W	C	8-11
Linearity balance	$3C_h$	R/W	C	8-11
Mirror (flip)	84_h	R/W	NC	8-11
Parallelogram	41_h	R/W	C	8-11
Pincushion	34_h	R/W	C	8-11
Pincushion balance	36_h	R/W	C	8-11
Position (phase)	30_h	R/W	C	8-11
Size	32_h	R/W	C	8-11
Convergence R/B	38_h	R/W	C	8-11
Convergence M/G	39_h	R/W	C	8-11
Rotation	44_h	R/W	NC	8-11

Figure 7-3: Image Geometry Adjustment

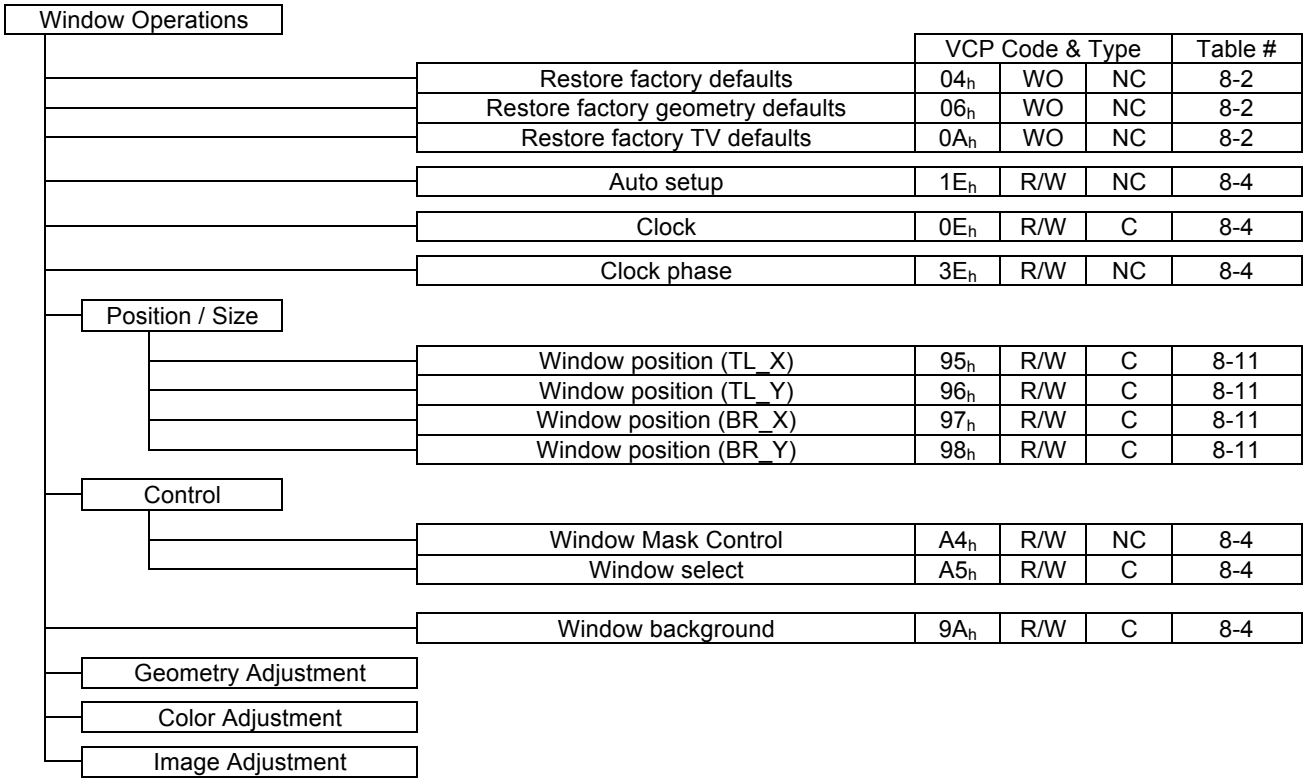
7.4 Audio Adjustments



	VCP Code & Type			Table #
Restore factory defaults	04_h	WO	NC	8-2
Restore factory TV defaults	$0A_h$	WO	NC	8-2
Audio: speaker volume	62_h	R/W	C	8-15
Audio: speaker pair select	63_h	R/W	NC	8-15
Audio: microphone volume	64_h	R/W	C	8-15
Audio: jack connection status	65_h	R	NC	8-15
Audio mute	$8D_h$	R/W	NC	8-15
Audio: treble	$8F_h$	R/W	C	8-15
Audio: bass	91_h	R/W	C	8-15

Figure 7-4: Audio Adjustments

7.5 Window Operations



	VCP Code & Type			Table #
Restore factory defaults	04_h	WO	NC	8-2
Restore factory geometry defaults	06_h	WO	NC	8-2
Restore factory TV defaults	$0A_h$	WO	NC	8-2
Auto setup	$1E_h$	R/W	NC	8-4
Clock	$0E_h$	R/W	C	8-4
Clock phase	$3E_h$	R/W	NC	8-4
Window position (TL_X)	95_h	R/W	C	8-11
Window position (TL_Y)	96_h	R/W	C	8-11
Window position (BR_X)	97_h	R/W	C	8-11
Window position (BR_Y)	98_h	R/W	C	8-11
Window Mask Control	$A4_h$	R/W	NC	8-4
Window select	$A5_h$	R/W	C	8-4
Window background	$9A_h$	R/W	C	8-4

Figure 7-5: Windows Operations

7.6 DPVL Support

DPVL Support

	VCP Code & Type			Table #
Monitor status	$B7_h$	RO	NC	8-16
Packet count	$B8_h$	R/W	C	8-16
Monitor X origin	$B9_h$	R/W	C	8-16
Monitor Y origin	BA_h	R/W	C	8-16
Header error count	BB_h	R/W	C	8-16
Bad CRC error count	BC_h	R/W	C	8-16
Client ID	BD_h	R/W	C	8-16
Link control	BE_h	R/W	NC	8-16

Figure 7-6: DPVL Support

8 VCP Code Definitions

The following tables of this section define the VCP Code functions and usage. The compliance column of the tables contains a reference to the appropriate compliance procedure for each VCP Code.

8.1 Preset Operations VCP Codes

Table 8-1: Preset Functions VCP Code Cross-reference

VCP Code Name	Code	Compliance
Restore Factory Color Defaults	08_h	10.8
Restore Factory Defaults	04_h	10.8
Restore Factory Geometry Defaults	06_h	10.8
Restore Factory Luminance / Contrast Defaults	05_h	10.8
Restore Factory TV Defaults	$0A_h$	10.8
Save / Restore Settings	$B0_h$	10.8
VCP Code Page	00_h	10.8

Table 8-2: Preset Operations VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>00_h</td><td>Code Page</td><td>R/W</td><td>T
Mandatory</td><td><u>READ:</u>
Returns the Code Page ID number Byte SL.

<u>WRITE:</u>
Sets the Code Page ID number.
<table>
<tr><th>Byte: SL</th><th></th></tr>
<tr><td>00_h</td><td>Default (BASE) Code Page</td></tr>
<tr><td>$01_h \rightarrow DF_h$</td><td>Reserved</td></tr>
<tr><td>$E0_h \rightarrow FF_h$</td><td>Factory Defined Code Pages</td></tr>
<tr><th>Bytes: SH, ML, MH…</th><th></th></tr>
<tr><td>00_h</td><td>All other values reserved</td></tr>
</table>
VCP Code ‘00_h’ has been undefined and must be ignored, in all MCCS versions prior to version 2.2 including version 3.0!
Starting with this revision VCP 00_h shall be set to 00_h until otherwise defined in a future revision:
Code Pages 01_h thru DF_h are reserved and values in this range shall be considered invalid.
Code Pages $E0_h$ thru FF_h may be used for Factory code definitions and values in this range may be supported by factory applications.
On power up or display reset, the value of VCP 00_h shall be set to 00_h.

<u>NOTE:</u>
<u>This and future MCCS versions:</u></td></tr>
</table>

Table 8-2: Preset Operations VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td></td><td></td><td></td><td></td><td>This VCP code can extend the number of available VCP commands beyond those on code page 00_h by declaring new code pages.
In such a case the capabilities string will include 00_h followed by XX_h XX_h XX_h … indicating the additional active code pages.
To access VCP codes on page 1 the host must first write the value 01_h to VCP 00_h. The host can verify the current code page # by reading a value of 01_h at VCP 00_h. To return to access the (base) VCP codes on page 0, the host must write 00_h to VCP 00_h.
If no additional code pages are defined, the value of VCP 00_h shall read 00_h and shall not change if written to by the host.
Multiple applications must verify the code page before changing VCP code values.</td></tr>
<tr><td>04_h</td><td>Restore Factory Defaults</td><td>WO</td><td>NC</td><td>Restore all factory presets including luminance / contrast, geometry, color and TV defaults.
Any non-zero value causes defaults to be restored.
A value of zero must be ignored</td></tr>
<tr><td>05_h</td><td>Restore Factory Luminance / Contrast Defaults</td><td>WO</td><td>NC</td><td>Restores factory defaults for luminance and contrast adjustments.
Any non-zero value causes defaults to be restored.
A value of zero must be ignored.</td></tr>
<tr><td>06_h</td><td>Restore Factory Geometry Defaults</td><td>WO</td><td>NC</td><td>Restore factory defaults for geometry adjustments.
Any non-zero value causes defaults to be restored.
A value of zero must be ignored.</td></tr>
<tr><td>08_h</td><td>Restore Factory Color Defaults</td><td>WO</td><td>NC</td><td>Restore factory defaults for color settings.
Any non-zero value causes defaults to be restored.
A value of zero must be ignored.</td></tr>
<tr><td>$0A_h$</td><td>Restore Factory TV Defaults</td><td>WO</td><td>NC</td><td>Restore factory defaults for TV functions.
Any non-zero value causes defaults to be restored.
A value of zero must be ignored.</td></tr>
<tr><td>$B0_h$</td><td>Settings</td><td>WO</td><td>NC</td><td>Store/Restore the user saved values for current mode.
<table>
<tr><th>Byte: SL</th><th></th></tr>
<tr><td>01_h</td><td>Store current settings in the monitor.</td></tr>
<tr><td>02_h</td><td>Restore factory defaults for current mode. If no factory defaults exist, then restore user values for current mode.</td></tr>
<tr><td>$\geq 03_h$</td><td>Reserved and must be ignored.</td></tr>
</table></td></tr>
</table>

8.2 Image Adjustment VCP Codes

Table 8-3: Image Adjustment VCP Code Cross-reference

VCP Code Name	Code	Compliance
6 Axis Hue Control: Blue	$9F_h$	10.10
6 Axis Hue Control: Cyan	$9E_h$	10.10
6 Axis Hue Control: Green	$9D_h$	10.10
6 Axis Hue Control: Magenta	$A0_h$	10.10
6 Axis Hue Control: Red	$9B_h$	10.10
6 Axis Hue Control: Yellow	$9C_h$	10.10
6 Axis Saturation Control: Blue	$5D_h$	10.10
6 Axis Saturation Control: Cyan	$5C_h$	10.10
6 Axis Saturation Control: Green	$5B_h$	10.10
6 Axis Saturation Control: Magenta	$5E_h$	10.10
6 Axis Saturation Control: Red	59_h	10.10
6 Axis Saturation Control: Yellow	$5A_h$	10.10
Adjust Zoom	$7C_h$	10.6
Auto Color Setup	$1F_h$	10.9
Auto Setup	$1E_h$	10.9
Auto setup On / Off	$A2_h$	10.12.6
Backlight Control (Legacy)	13_h	10.6
Backlight Level: White	$6B_h$	10.6
Backlight Level: Red	$6D_h$	10.6
Backlight Level: Green	$6F_h$	10.6
Backlight Level: Blue	71_h	10.6
Block LUT Operation	75_h	10.11.4
Clock	$0E_h$	10.6
Clock Phase	$3E_h$	10.6
Color Saturation	$8A_h$	10.6
Color Temperature Increment	$0B_h$	10.7
Color Temperature Request	$0C_h$	10.6
Contrast	12_h	10.6
Display Application	DC_h	10.7
Flesh Tone Enhancement	11_h	10.7
Focus	$1C_h$	10.6
Gamma	72_h	10.6
Gray Scale Expansion	$2E_h$	10.7
Horizontal Moiré	56_h	10.6
Hue	90_h	10.6
Luminance	10_h	10.6
LUT Size	73_h	10.11.4
Screen Orientation	AA_h	10.7
Select Color Preset	14_h	10.7
Sharpness	87_h	10.6
Single Point LUT Operation	74_h	10.11.4

Table 8-3: Image Adjustment VCP Code Cross-reference

VCP Code Name	Code	Compliance
Stereo Video Mode	$D4_h$	10.7
TV-Black Level / Luminance	92_h	10.6
TV-Contrast	$8E_h$	10.6
TV-Sharpness	$8C_h$	10.6
User Color Vision Compensation	17_h	10.6
Velocity Scan Modulation	88_h	10.6
Vertical Moiré	58_h	10.6
Video Black Level: Blue	70_h	10.6
Video Black Level: Green	$6E_h$	10.6
Video Black Level: Red	$6C_h$	10.6
Video Gain (Drive): Blue	$1A_h$	10.6
Video Gain (Drive): Green	18_h	10.6
Video Gain (Drive): Red	16_h	10.6
Window Background	$9A_h$	10.6
Window Control On / Off	$A4_h$	10.11.4
Window Select	$A5_h$	10.6
Window Size	$A6_h$	10.12.13
Window Transparency	$A7_h$	10.6

Table 8-4: Image Adjustment VCP Codes

Code	Name	Type	Function	Description
$0B_h$	User Color Temperature Increment	RO	NC Interactive with VCP 14_h	In Version 2.2 forward, except Version 3.0, VCP $0C_h$ defines the User Color Temperature when selected using VCP 14_h. Setting 14_h to User 1, 2, or 3, recalls values for and enables VCP codes $0B_h$ and $0C_h$. Sets the minimum increment in which the display can adjust the color temperature. Color temperature increment. **Bytes: SH SL** | 0000_h | Invalid $0001_h \rightarrow 1388_h$ | 1 to 5000°K Increment $\geq 1389_h$ | Invalid Values of 0 and > 5000 are invalid and must be ignored.

Table 8-4: Image Adjustment VCP Codes

Code	Name	Type	Function	Description
$0C_h$	User Color Temperature	R/W	C Interactive with VCP 14_h	In Version 2.2 forward, except Version 3.0, VCP codes $0B_h$ and $0C_h$ define the User Color Temperature when selected using VCP 14_h. If the display is unable to achieve the requested color temperature, then it must move to the closest possible temperature. A value of 0 must be treated as a request for a color temperature of 3000° K. Values greater than 0 must be used as a multiplier of the color temperature increment (read using VCP $0B_h$) and the result added to the base value of 3000° K **Example:** If VCP $0B_h$ returns a value of 50° K and VCP code $0C_h$ sends a value of 50 (decimal) then the display must interpret this as a request to adjust the color temperature to 5500° K (3000 + (50 * 50)) K = 5500° K **NOTE**: Applications using this function are recommended to read the actual color temperature after using this command and taking appropriate action. This control is only recommended if the display can produce a continuously (at defined increment, see VCP code $0B_h$) variable color temperature.
$0E_h$	Clock	R/W	C	Increasing (decreasing) this value will increase (decrease) the video sampling clock frequency
10_h	Luminance	R/W	C	Increasing (decreasing) this value will increase (decrease) the Luminance of the image.

Table 8-4: Image Adjustment VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>11_h</td><td>Flesh Tone Enhancement</td><td>R/W</td><td>NC</td><td>Data size: Write = 2 bytes / Read = 4 bytes
This control allows for selection of contrast enhancement algorithms. A possible value is selected by setting the corresponding bit = 1.
On a write a bit set = 1 in the SH-SL bytes must select the required level of enhancement.
<u>NOTE:</u> setting more than one bit = 1 is invalid and must be ignored by the display.
On a read the MH-ML bytes contain the flags corresponding to those functions that are supported by the display. The SH-SL bytes contain the bit field with the appropriate bit set to indicate the current status of the display.
The following table defines the SH byte, and the MH byte for read operations only.
<table><tr><th>Byte: SH / MH</th><th></th></tr><tr><td>Bit 7</td><td>No enhancement,</td></tr><tr><td>Bit 6</td><td>Enhancement 1: Enhancement except for automatically detected regions of “skin tone”</td></tr><tr><td>Bit 5</td><td>Enhancement 2: Enhancement including “skin tone” regions</td></tr><tr><td>Bit 4</td><td>Demo mode: Enhancement is applied to part of the displayed image only</td></tr><tr><td>Bit 3</td><td>User mode</td></tr><tr><td>Bits 2 → 0</td><td>Reserved, do not use</td></tr></table>The following table defines the SL byte and the ML byte for read operations only.
<table><tr><th>Byte: SL / ML</th><th></th></tr><tr><td>Bits 7 → 0</td><td>Reserved, do not use</td></tr></table></td></tr>
<tr><td>12_h</td><td>Contrast</td><td>R/W</td><td>C</td><td>Increasing (decreasing) this value will increase (decrease) the Contrast of the image.
<u>NOTE</u>:
1) The actual range of contrast over which this control applies is defined by the manufacturer.
2) Care should be taken to avoid the situation where the contrast ratio approaches 0 … this may be non-recoverable since user will not be able to see the image.</td></tr>
</table>

Table 8-4: Image Adjustment VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>13_h</td><td>Backlight Control</td><td>R/W</td><td>C</td><td><u>Caution:</u>
This VCP code has been deprecated.

It must NOT be implemented in new designs!

Support for separate Backlight Level controls are provided by VCP codes $6B_h$ $6D_h$ $6F_h$ and 71_h.

The following description of this VCP in versions prior to V2.2 is provided for reference ONLY!
Increasing (decreasing) this value in the SL byte will increase (decrease) the specified Backlight Control value.
The SH byte defines whether operation should be performed as a white adjustment or as a red / green or blue backlight adjustment when these are separate light sources (e.g. LEDs)
When read, the MH-Ml bytes contain the flags corresponding to those functions supported by the display. The SH-SL bytes contain the bit field with the appropriate bit set to indicate the current status of the display.
The following table defines the SH byte, and the MH byte for read operations only.

<table><tr><th>Byte: SH / MH</th><th></th></tr><tr><td>00_h</td><td>A white adjustment</td></tr><tr><td>01_h</td><td>A red adjustment</td></tr><tr><td>02_h</td><td>A green adjustment</td></tr><tr><td>03_h</td><td>A blue adjustment</td></tr><tr><td>$\geq 04_h$</td><td>Reserved, must be ignored</td></tr></table><u>NOTE:</u> The adjustment range (0 → 255) will be mapped to the actual adjustment range defined by the display manufacturer. A value of 0 corresponds to the lowest value and 255 the highest value.</td></tr>
</table>

Table 8-4: Image Adjustment VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>14_h</td><td>Select Color Preset</td><td>R/W</td><td>NC
Interactive with VCP 16_h 18_h $1A_h$ $6C_h$ $6E_h$ 70_h $0B_h$ and $0C_h$.</td><td>
Select a specified color temperature. This is a 2 byte value, the MH byte defines the tolerance associated with any preset … this is fixed by the display manufacturer. If no tolerance level is specified, the presets must be interpreted as relative values supporting a scale which can move to warmer (lower color temperature) or cooler (higher color temperature).
<table>
<tr><th>Byte: MH</th><th></th></tr>
<tr><td>00_h</td><td>No tolerance is specified, treat as relative scale.</td></tr>
<tr><td>01_h</td><td>A tolerance of 1% is specified</td></tr>
<tr><td>02_h</td><td>A tolerance of 2% is specified</td></tr>
<tr><td>03_h</td><td>⇓</td></tr>
<tr><td>09_h</td><td>A tolerance of 9% is specified</td></tr>
<tr><td>$0A_h$</td><td>A tolerance of 10% is specified</td></tr>
<tr><td>≥ $0B_h$</td><td>Reserved, must be ignored</td></tr>
</table>
<table>
<tr><th>Byte: SL</th><th></th><th></th></tr>
<tr><td></td><td>If MH byte ≠ 00_h</td><td>If MH byte = 00_h</td></tr>
<tr><td>00_h</td><td>Reserved, must be ignored</td><td>Reserved, must be ignored</td></tr>
<tr><td>01_h</td><td>sRGB</td><td>sRGB</td></tr>
<tr><td>02_h</td><td>Display native</td><td>Display native</td></tr>
<tr><td>03_h</td><td>4000° K</td><td>Warmer</td></tr>
<tr><td>04_h</td><td>5000° K</td><td>⇑</td></tr>
<tr><td>05_h</td><td>6500° K</td><td>⇑</td></tr>
<tr><td>06_h</td><td>7500° K</td><td>|</td></tr>
<tr><td>07_h</td><td>8200° K</td><td>|</td></tr>
<tr><td>08_h</td><td>9300° K</td><td>⇓</td></tr>
<tr><td>09_h</td><td>10000° K</td><td>⇓</td></tr>
<tr><td>$0A_h$</td><td>11500° K</td><td>Cooler</td></tr>
<tr><td>$0B_h$</td><td>User 1</td><td>User 1</td></tr>
<tr><td>$0C_h$</td><td>User 2</td><td>User 2</td></tr>
<tr><td>$0D_h$</td><td>User 3</td><td>User 3</td></tr>
<tr><td>≥ $0E_h$</td><td>Reserved, must be ignored</td><td>Reserved, must be ignored</td></tr>
</table>
<u>NOTE</u>: In all cases a read operation must return the nominal color temperature and tolerance associated with the value.
Setting 14_h to User 1, 2, or 3, recalls values for and enables VCP codes $0B_h$ and $0C_h$. In addition all VCP registers must reflect the register change required to match the color change. Consider 16_h 18_h $1A_h$ $6C_h$ $6E_h$ and 70_h. These changes must be reported using VCP 02_h and 52_h.
<u>Example:</u>
A tolerance specified as 5% and preset 09_h is selected then color temperature is specified as 10000° K ± 5%.
</td></tr>
</table>

Table 8-4: Image Adjustment VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>16_h</td><td>Video Gain (Drive): Red</td><td>R/W</td><td>C</td><td>Increasing (decreasing) this value will increase (decrease) the luminance of red pixels.
The value returned must be an indication of the actual red gain at the current color temperature and not be normalized.</td></tr>
<tr><td>17_h</td><td>User Color Vision Compensation</td><td>R/W</td><td>C</td><td>Increasing (decreasing) this value will increase (decrease) the degree of compensation.
<u>NOTE</u>: This is intended to help user suffering from the form of color deficiency in which red colors are poorly seen.</td></tr>
<tr><td>18_h</td><td>Video Gain (Drive): Green</td><td>R/W</td><td>C</td><td>Increasing (decreasing) this value will increase (decrease) the luminance of green pixels.
The value returned must be an indication of the actual green gain at the current color temperature and not be normalized.</td></tr>
<tr><td>$1A_h$</td><td>Video Gain (Drive): Blue</td><td>R/W</td><td>C</td><td>Increasing (decreasing) this value will increase (decrease) the luminance of blue pixels.
The value returned must be an indication of the actual blue gain at the current color temperature and not be normalized.</td></tr>
<tr><td>$1C_h$</td><td>Focus</td><td>R/W</td><td>C</td><td>Increasing (decreasing) this value will adjust the focus of the image.</td></tr>
<tr><td>$1E_h$</td><td>Auto Setup</td><td>R/W</td><td>NC</td><td>Perform auto setup function (H/V position, clock, clock phase, A/D converter, etc.)

<table><tr><th>Byte: SL</th><th></th></tr><tr><td>00_h</td><td>Auto setup is not active</td></tr><tr><td>01_h</td><td>Perform / performing auto setup</td></tr><tr><td>02_h</td><td>Enable continuous / periodic auto setup</td></tr><tr><td>≥ 03_h</td><td>Reserved, must be ignored</td></tr></table><u>NOTE:</u> A value of ‘02_h’ (when supported) must cause the display to either continuously or periodically (event or timer driven) perform an auto setup. Cancel by writing a value of either ‘01_h’ or ‘00_h’.</td></tr>
<tr><td>$1F_h$</td><td>Auto Color Setup</td><td>R/W</td><td>NC</td><td>Perform auto color setup function (R / G / B gain and offset, A/D setup, etc.)

<table><tr><th>Byte: SL</th><th></th></tr><tr><td>00_h</td><td>Auto color setup is not active</td></tr><tr><td>01_h</td><td>Perform / performing auto color setup</td></tr><tr><td>02_h</td><td>Enable continuous / periodic auto color setup</td></tr><tr><td>≥ 03_h</td><td>Reserved, must be ignored</td></tr></table><u>NOTE:</u> A value of ‘02_h’ (when supported) must cause the display to either continuously or periodically (event or timer driven) perform an auto color setup. Cancel by writing a value of either ‘01_h’ or ‘00_h’.</td></tr>
</table>

Table 8-4: Image Adjustment VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>$2E_h$</td><td>Gray Scale Expansion</td><td>R/W</td><td>NC</td><td>Expands the gray scale either in the near white region or the near black region (or both).

<table>
<tr><th>Byte: SH</th><th>Near white region</th></tr>
<tr><td>00_h</td><td>No white region expansion</td></tr>
<tr><td>01_h</td><td>First level of expansion</td></tr>
<tr><td>02_h</td><td>Second level of expansion</td></tr>
<tr><td>03_h</td><td>Third level of expansion</td></tr>
<tr><td>≥ 04_h</td><td>Reserved, must be ignored</td></tr>
</table>

<table>
<tr><th>Byte: SL</th><th>Near black region</th></tr>
<tr><td>00_h</td><td>No black region expansion</td></tr>
<tr><td>01_h</td><td>First level of expansion</td></tr>
<tr><td>02_h</td><td>Second level of expansion</td></tr>
<tr><td>03_h</td><td>Third level of expansion</td></tr>
<tr><td>≥ 04_h</td><td>Reserved, must be ignored</td></tr>
</table>
</td></tr>
<tr><td>$3E_h$</td><td>Clock Phase</td><td>R/W</td><td>C</td><td>Increasing (decreasing) this value will increase (decrease) the phase shift of the sampling clock.</td></tr>
<tr><td>56_h</td><td>Horizontal Moiré</td><td>R/W</td><td>C</td><td>Increasing (decreasing) this value controls the horizontal picture moiré cancellation.</td></tr>
<tr><td>58_h</td><td>Vertical Moiré</td><td>R/W</td><td>C</td><td>Increasing (decreasing) this value controls the vertical picture moiré cancellation.</td></tr>
<tr><td>59_h</td><td>6 Axis Saturation Control: Red</td><td>R/W</td><td>C</td><td>Adjust the red saturation for 6-axis color

<table>
<tr><th>Byte: SL</th><th></th></tr>
<tr><td>> $7F_h$</td><td>Causes an increase in red saturation</td></tr>
<tr><td>$7F_h$</td><td>The nominal (default) value</td></tr>
<tr><td>< $7F_h$</td><td>Causes a decrease in red saturation</td></tr>
</table>
If set = $7F_h$ then display must make no change to the red saturation of the incoming signal.
If set ≠ $7F_h$, then writing a value = $7F_h$ must cause the display to return to its nominal (default) setting for red saturation.
The ± $7F_h$ range must be linearly mapped to the actual adjustment range.</td></tr>
<tr><td>$5A_h$</td><td>6 Axis Saturation Control: Yellow</td><td>R/W</td><td>C</td><td>Adjust the yellow saturation for 6-axis color

<table>
<tr><th>Byte: SL</th><th></th></tr>
<tr><td>> $7F_h$</td><td>Causes an increase in yellow saturation</td></tr>
<tr><td>$7F_h$</td><td>The nominal (default) value</td></tr>
<tr><td>< $7F_h$</td><td>Causes a decrease in yellow saturation</td></tr>
</table>
If set = $7F_h$ then display must make no change to the yellow saturation of the incoming signal.
If set ≠ $7F_h$, then writing a value = $7F_h$ must cause the display to return to its nominal (default) setting for yellow saturation.
The ± $7F_h$ range must be linearly mapped to the actual adjustment range.</td></tr>
</table>

Table 8-4: Image Adjustment VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>$5B_h$</td><td>6 Axis Saturation Control: Green</td><td>R/W</td><td>C</td><td>Adjust the green saturation for 6-axis color

<table><tr><th>Byte: SL</th><th></th></tr><tr><td>$> 7F_h$</td><td>Causes an increase in green saturation</td></tr><tr><td>$7F_h$</td><td>The nominal (default) value</td></tr><tr><td>$< 7F_h$</td><td>Causes a decrease in green saturation</td></tr></table>If set = $7F_h$ then display must make no change to the green saturation of the incoming signal.
If set ≠ $7F_h$, then writing a value = $7F_h$ must cause the display to return to its nominal (default) setting for green saturation.
The ± $7F_h$ range must be linearly mapped to the actual adjustment range.</td></tr>
<tr><td>$5C_h$</td><td>6 Axis Saturation Control: Cyan</td><td>R/W</td><td>C</td><td>Adjust the cyan saturation for 6-axis color

<table><tr><th>Byte: SL</th><th></th></tr><tr><td>$> 7F_h$</td><td>Causes an increase in cyan saturation</td></tr><tr><td>$7F_h$</td><td>The nominal (default) value</td></tr><tr><td>$< 7F_h$</td><td>Causes a decrease in cyan saturation</td></tr></table>If set = $7F_h$ then display must make no change to the cyan saturation of the incoming signal.
If set ≠ $7F_h$, then writing a value = $7F_h$ must cause the display to return to its nominal (default) setting for cyan saturation.
The ± $7F_h$ range must be linearly mapped to the actual adjustment range.</td></tr>
<tr><td>$5D_h$</td><td>6 Axis Saturation Control: Blue</td><td>R/W</td><td>C</td><td>Adjust the blue saturation for 6-axis color

<table><tr><th>Byte: SL</th><th></th></tr><tr><td>$> 7F_h$</td><td>Causes an increase in blue saturation</td></tr><tr><td>$7F_h$</td><td>The nominal (default) value</td></tr><tr><td>$< 7F_h$</td><td>Causes a decrease in blue saturation</td></tr></table>If set = $7F_h$ then display must make no change to the blue saturation of the incoming signal.
If set ≠ $7F_h$, then writing a value = $7F_h$ must cause the display to return to its nominal (default) setting for blue saturation.
The ± $7F_h$ range must be linearly mapped to the actual adjustment range.</td></tr>
</table>

Table 8-4: Image Adjustment VCP Codes

Code	Name	Type	Function	Description
$5E_h$	6 Axis Saturation Control: Magenta	R/W	C	Adjust the magenta saturation for 6-axis color **Byte: SL** $> 7F_h$ — Causes an increase in magenta saturation $7F_h$ — The nominal (default) value $< 7F_h$ — Causes a decrease in magenta saturation If set = $7F_h$ then display must make no change to the magenta saturation of the incoming signal. If set ≠ $7F_h$, then writing a value = $7F_h$ must cause the display to return to its nominal (default) setting for magenta saturation. The ± $7F_h$ range must be linearly mapped to the actual adjustment range.
$6B_h$	Backlight Level: White	R/W	C	Increasing (decreasing) this value will increase (decrease) the White backlight level of the image. **NOTE**: 1) The actual range of white backlight level over which this control applies is defined by the manufacturer. 2) Care should be taken to avoid the situation where the white backlight level ratio approaches 0 … this may be non-recoverable since user will not be able to see the image.
$6C_h$	Video Black Level: Red	R/W	C	Increasing (decreasing) this value will increase (decrease) the black level of the red video.
$6D_h$	Backlight Level: Red	R/W	C	Increasing (decreasing) this value will increase (decrease) the Red backlight level of the image. **NOTE**: 1) The actual range of red backlight level over which this control applies is defined by the manufacturer. 2) Care should be taken to avoid the situation where the red backlight level ratio approaches 0 … this may be non-recoverable since user will not be able to see the image.
$6E_h$	Video Black Level: Green	R/W	C	Increasing (decreasing) this value will increase (decrease) the black level of the green video.
$6F_h$	Backlight Level: Green	R/W	C	Increasing (decreasing) this value will increase (decrease) the Green backlight level of the image. **NOTE**: 1) The actual range of green backlight level over which this control applies is defined by the manufacturer. 2) Care should be taken to avoid the situation where the green backlight level ratio approaches 0 … this may be non-recoverable since user will not be able to see the image.
70_h	Video Black Level: Blue	R/W	C	Increasing (decreasing) this value will increase (decrease) the black level of the blue video.
71_h	Backlight Level: Blue	R/W	C	Increasing (decreasing) this value will increase (decrease) the Blue backlight level of the image. **NOTE**: 1) The actual range of blue backlight level over which this control applies is defined by the manufacturer. 2) Care should be taken to avoid the situation where the blue backlight level ratio approaches 0 … this may be non-recoverable

Table 8-4: Image Adjustment VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td></td><td></td><td></td><td></td><td>since user will not be able to see the image.</td></tr>
<tr><td>72_h</td><td>Gamma</td><td>R/W</td><td>NC</td><td>This VCP code has two distinct modes, it may be used to select an absolute (within a defined tolerance) value for gamma, or it may be used to select a value of gamma relative to the default gamma of the display.
The SL byte defines whether the operation should be performed as a white adjustment or as a red / green or blue sub-channel adjustment or if the display should disable all gamma correction.
<table>
<tr><th>Byte: SL</th><th></th></tr>
<tr><td>00_h</td><td>A white absolute adjustment</td></tr>
<tr><td>01_h</td><td>A red absolute adjustment</td></tr>
<tr><td>02_h</td><td>A green absolute adjustment</td></tr>
<tr><td>03_h</td><td>A blue absolute adjustment</td></tr>
<tr><td>04_h</td><td>A white relative adjustment</td></tr>
<tr><td>05_h</td><td>Disable all gamma correction in the display</td></tr>
<tr><td>$\geq 06_h$</td><td>Reserved, must be ignored</td></tr>
</table>
<u>NOTE</u>:
If a white absolute or relative adjustment is sent to a display with separate red, green and blue sub-channel adjustment capability then the three sub-channels must be adjusted together.
<u>For absolute adjustments:</u>
The SH byte defines the actual operation value as follows:
The decimal value of the desired gamma is divided by 100 and then added to a base value of 1.
Examples:
A value of 0 results in a gamma of 1 (linear) {0/100+1=1}
A value of 120 results in a gamma of 2.20 {120/100+1=2.20}
<u>Capability string format:</u>
The format of capability string reporting for this VCP is very important, it must be in the following format for displays supporting absolute gamma adjustment:

1st #: Accuracy of gamma setting as a percentage of requested gamma value (range 00_h (ideal) → $0A_h$ (accuracy is equal to or worse than {requested gamma ± 10%}. A value > $0A_h$ and < FF_h indicates that there is no tolerance specified. The value of FF_h is reserved.

2nd#: The native gamma (default) of the display, expressed as the decimal value associated with a particular gamma value
e.g. a native gamma of 2.2 would be represented by a decimal value of 120

3rd #:and above:
<table>
<tr><th>3rd #</th><th>Definition of 3rd #</th><th>4th # & above</th></tr>
<tr><td>FF_h</td><td>Full range of absolute gamma adjustment is supported</td><td>Not applicable</td></tr>
<tr><td>FE_h</td><td>Full range of absolute</td><td>Not applicable</td></tr>
</table>
</td></tr>
</table>

Table 8-4: Image Adjustment VCP Codes

Code	Name	Type	Function	Description

	gamma adjustment is supported AND display has ability to bypass gamma correction.	
FD_h	Limited range of absolute gamma adjustment is supported	4th and 5th #'s define the lower and upper range limits respectively
FC_h	Limited range of absolute gamma adjustment is supported AND display has ability to bypass gamma correction.	4th and 5th #'s define the lower and upper range limits respectively
FB_h	Specific absolute gamma preset(s) follow	4th # and above are absolute gamma presets expressed as the decimal value associated with a particular gamma value
FA_h	Specific absolute gamma preset(s) follow AND display has ability to bypass gamma correction.	4th # and above are absolute gamma presets expressed as the decimal value associated with a particular gamma value
$\leq F9_h$	Reserved	

Example 1:
72(05 78 FB 50 64 78 8C) indicates that the display has a default gamma of 2.2 and presets of 1.8, 2.0, 2.2 and 2.4 with an accuracy at each preset of ± 5%

Example 2:
72(02 96 FE 50 A0) indicates that the display has a default gamma of 2.5 and is capable of adjusting the gamma within the range of 1.8 to 2.6 with an accuracy of ± 2%

For relative adjustments:

The SL byte is as previously defined.

The SH byte defines the actual operation value:

Byte: SH	
00_h	Display default gamma
01_h	Default gamma – 0.1
02_h	Default gamma – 0.2
⇓	⇓
09_h	Default gamma – 0.9
$0A_h$	Default gamma – 1.0
11_h	Default gamma + 0.1
12_h	Default gamma + 0.2

Table 8-4: Image Adjustment VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td></td><td></td><td></td><td></td><td>
<table>
<tr><td>⇓</td><td>⇓</td></tr>
<tr><td>19_h</td><td>Default gamma + 0.9</td></tr>
<tr><td>$1A_h$</td><td>Default gamma + 1.0</td></tr>
<tr><td>20_h</td><td>Disable all gamma correction in the display.</td></tr>
<tr><td>$\geq 21_h$</td><td>Reserved, must be ignored</td></tr>
</table>
Capability string format:
The format of capability string reporting for this VCP is very important, it must be of the following format for displays supporting relative gamma adjustment:

1st #: Set = FF_h to specify relative adjustment

2nd#: The native gamma (default) of the display, expressed as the decimal value associated with a particular gamma value
e.g. a native gamma of 2.2 would be represented by a decimal value of 120.

3rd #:and above:
<table>
<tr><th>3rd #</th><th>Definition of 3rd #</th><th>4th # & above</th></tr>
<tr><td>FF_h</td><td>Full range of relative gamma adjustment is supported</td><td>Not applicable</td></tr>
<tr><td>FE_h</td><td>Full range of relative gamma adjustment is supported AND display has ability to bypass gamma correction.</td><td>Not applicable</td></tr>
<tr><td>FD_h</td><td>Limited range of relative gamma adjustment is supported</td><td>4th and 5th #’s define the lower and upper range limits respectively.
NOTE: Undefined values in range have no meaning and must be ignored.</td></tr>
<tr><td>FC_h</td><td>Limited range of relative gamma adjustment is supported AND display has ability to bypass gamma correction.</td><td>4th and 5th #’s define the lower and upper range limits respectively.
NOTE: Undefined values in range have no meaning and must be ignored.</td></tr>
<tr><td>FB_h</td><td>Specific relative gamma preset(s) follow</td><td>4th # and above are relative gamma represented by the appropriate value for</td></tr>
</table>
</td></tr>
</table>

Table 8-4: Image Adjustment VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td></td><td></td><td></td><td></td><td>
<table>
<tr><td></td><td></td><td>the SL byte as defined above.</td></tr>
<tr><td>FA_h</td><td>Specific relative gamma preset(s) follow AND display has ability to bypass gamma correction.</td><td>4th # and above are relative gamma represented by the appropriate value for the SL byte as defined above.</td></tr>
<tr><td>≤ F9_h</td><td>Reserved</td><td></td></tr>
</table>
Example 3:
72(FF 00 01 03 05 07 09 11 13 15 17 19) indicates that the display can make relative adjustments of ± 0.1, ± 0.3, ± 0.5, ± 0.7 and ± 0.9.
Example 4:
72(FF 01 FE 05 15) indicates that the display can make relative adjustments up to ± 0.5 in increments of 0.1
</td></tr>
<tr><td>73_h</td><td>LUT Size</td><td>RO</td><td>T</td><td>Provides the size (number of entries and number of bits / entry) for the Red / Green and Blue LUT in the display
<table>
<tr><th>Byte</th><th>Definition</th></tr>
<tr><td>0 + 1</td><td>Number of Red LUT entries</td></tr>
<tr><td>2 + 3</td><td>Number of Green LUT entries</td></tr>
<tr><td>4 + 5</td><td>Number of Blue LUT entries</td></tr>
<tr><td>6</td><td>Number of bits / entry in Red LUT</td></tr>
<tr><td>7</td><td>Number of bits / entry in Green LUT</td></tr>
<tr><td>8</td><td>Number of bits / entry in Blue LUT</td></tr>
</table>
<u>NOTE:</u> Support for this command is a prerequisite for support of commands 74_h and 75_h.</td></tr>
<tr><td>74_h</td><td>Single Point LUT Operation</td><td>R/W</td><td>T</td><td>Allows a single point within a display’s color LUT (look up table) to be loaded.

<u>NOTE:</u> Only the offset called out in the header is used by firmware. The DDC/CI table command offset must be set to zero.

Write Operation (E7_h)
<table>
<tr><th>Byte</th><th>Definition</th></tr>
<tr><td>0</td><td>Value = 1 (write operation)</td></tr>
<tr><td>1 + 2</td><td>Offset into the LUT</td></tr>
<tr><td>3 + 4</td><td>Red LUT value to be loaded</td></tr>
<tr><td>5 + 6</td><td>Green LUT value to be loaded</td></tr>
<tr><td>7 + 8</td><td>Blue LUT value to be loaded</td></tr>
</table>
<u>Example:</u> E7 74 00 00 value(01) offset offset redLUT redLUT greenLUT greenLUT blueLUT blueLUT

Read Operation Request (E7_h)
<table>
<tr><th>Byte</th><th>Definition</th></tr>
<tr><td>0</td><td>Value = 2 (read operation)</td></tr>
</table>
</td></tr>
</table>

Table 8-4: Image Adjustment VCP Codes

Code	Name	Type	Function	Description
				1 + 2 | Offset into the LUT Example E7 74 00 00 value(02) offset offset **Read Operation Reply (Display reply)** **Byte** | **Definition** 0 + 1 | Red LUT value read 2 + 3 | Green LUT value read 4 + 5 | Blue LUT value read **NOTE:** If display LUT cannot store 16 bit values then least significant bits must be discarded. Support of VCP 73_h, LUT Size is a prerequisite for this VCP

Table 8-4: Image Adjustment VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>75_h</td><td>Block LUT Operation</td><td>R/W</td><td>T</td><td>
Provides an efficient method for loading multiple values into a display's LUT.

<u>NOTE:</u> Only the offset called out in the header is used by firmware. The DDC/CI table command offset must be set to zero.

Write Operation (E7_h)
<table>
<tr><th>Byte</th><th>Definition</th></tr>
<tr><td>0</td><td>Value = 1 (write operation)</td></tr>
<tr><td>1</td><td>Red / Green or Blue LUT follows
Value = 1 : Red LUT data
Value = 2 : Green LUT data
Value = 3 : Blue LUT data</td></tr>
<tr><td>2 + 3</td><td>Number of values to be read</td></tr>
<tr><td>4 + 5</td><td>Offset into Red or Green or Blue LUT</td></tr>
<tr><td>6 + 7</td><td>1st R or G or B LUT value to be loaded</td></tr>
<tr><td>8 + 9</td><td>2ndR or G or B LUT value to be loaded</td></tr>
<tr><td>10 + 11</td><td>3rd R or G or B LUT value to be loaded</td></tr>
<tr><td>≥ 12</td><td>Etc.</td></tr>
</table>
<u>Example:</u> E7 74 00 00 value(01) RGBLUT #ofLUTvalues offset offset data data data
Read Operation Request (E7_h)
<table>
<tr><th>Byte</th><th>Definition</th></tr>
<tr><td>0</td><td>Value = 2 (read operation)</td></tr>
<tr><td>1</td><td>Red / Green or Blue LUT follow
Value = 1 : Red LUT data
Value = 2 : Green LUT data
Value = 3 : Blue LUT data</td></tr>
<tr><td>2 + 3</td><td>Number of values to be read</td></tr>
<tr><td>4 + 5</td><td>Offset into Red or Green or Blue LUT</td></tr>
</table>
<u>Example:</u> E7 74 00 00 value(02) RGBLUT #ofLUTvalues offset offset
Read Operation Reply (Display reply)
<table>
<tr><th>Byte</th><th>Definition</th></tr>
<tr><td>0 + 1</td><td>1st Red or Green or Blue LUT contents</td></tr>
<tr><td>2 + 3</td><td>2nd Red or Green or Blue LUT contents</td></tr>
<tr><td>4 + 5</td><td>3rd Red or Green or Blue LUT contents</td></tr>
<tr><td>≥ 6</td><td>Etc.</td></tr>
</table>
<u>NOTE:</u>
If display LUT cannot store 16 bit values then least significant bits must be discarded
Support of VCP 73_h, LUT Size, is a prerequisite for this VCP
</td></tr>
<tr><td>7C_h</td><td>Adjust Zoom</td><td>R/W</td><td>C</td><td>Increasing (decreasing) this value will increase (decrease) the zoom function of the projection lens.</td></tr>
<tr><td>87_h</td><td>Sharpness</td><td>R/W</td><td>C</td><td>Allows one of a range of algorithms to be selected to suit the type of image being displayed and/or personal preference.</td></tr>
</table>

Table 8-4: Image Adjustment VCP Codes

Code	Name	Type	Function	Description
				Increasing (decreasing) the value must increase (decrease) the edge sharpness of image features.
88_h	Velocity Scan Modulation	R/W	C	Increasing (decreasing) this value will increase (decrease) the velocity modulation of the horizontal scan as a function of a change in the luminance level.
$8A_h$	Color Saturation	R/W	C	Increasing this control increases the amplitude of the color difference components of the video signal. The result is an increase in the amount of pure color relative to white in the video. This control applies to the currently active interface.
$8C_h$	TV-Sharpness	R/W	C	Increasing this control increases the amplitude of the high frequency components of the video signal. This allows fine details to be accentuated. This control does not affect the RGB input, only the TV video inputs.
$8E_h$	TV-Contrast	R/W	C	Increasing (decreasing) this control increases (decreases) the ratio between whites and blacks in the video. This control does not affect the RGB input, only the TV video inputs.
90_h	Hue	R/W	C	Also known as 'tint' Increasing (decreasing) this control increases (decreases) the wavelength of the color component of the video signal. The result is a shift towards red (blue) in the hue of all colors. This control applies to the currently active interface.
92_h	TV-Black Level / Luminance	R/W	C	Increasing this control increases the black level of the video, resulting in an increase of the luminance level of the video. A value of zero represents the darkest level possible. This control does not affect the RGB input, only the TV video inputs.
$9A_h$	Window Background	R/W	C	Changes the contrast ratio between the area of the window and the rest of the desktop Lower (higher) values will cause the desktop luminance to decrease (increase) **NOTE:** 1. This VCP code should be used in conjunction with VCP 99_h 2. This command structure is not recommended for new designs, see VCP $A5_h$ for alternate.
$9B_h$	6 Axis Hue Control: Red	R/W	C	Adjust the red hue for 6-axis color **Byte: SL** $> 7F_h$ — Causes an increase in red hue $7F_h$ — The nominal (default) value $< 7F_h$ — Causes a decrease in red hue If set = $7F_h$ then display must make no change to the red hue of the incoming signal. If set ≠ $7F_h$, then writing a value = $7F_h$ must cause the display to return to its nominal (default) setting for red hue. The ± $7F_h$ range must be linearly mapped to the actual adjustment range.

Table 8-4: Image Adjustment VCP Codes

Code	Name	Type	Function	Description
$9C_h$	6 Axis Hue Control: Yellow	R/W	C	Adjust the yellow hue for 6-axis color **Byte: SL** $> 7F_h$ — Causes an increase in yellow hue $7F_h$ — The nominal (default) value $< 7F_h$ — Causes a decrease in yellow hue If set = $7F_h$ then display must make no change to the yellow hue of the incoming signal. If set ≠ $7F_h$, then writing a value = $7F_h$ must cause the display to return to its nominal (default) setting for yellow hue. The ± $7F_h$ range must be linearly mapped to the actual adjustment range.
$9D_h$	6 Axis Hue Control: Green	R/W	C	Adjust the green hue for 6-axis color **Byte: SL** $> 7F_h$ — Causes an increase in green hue $7F_h$ — The nominal (default) value $< 7F_h$ — Causes a decrease in green hue If set = $7F_h$ then display must make no change to the green hue of the incoming signal. If set ≠ $7F_h$, then writing a value = $7F_h$ must cause the display to return to its nominal (default) setting for green hue. The ± $7F_h$ range must be linearly mapped to the actual adjustment range.
$9E_h$	6 Axis Hue Control: Cyan	R/W	C	Adjust the cyan hue for 6-axis color **Byte: SL** $> 7F_h$ — Causes an increase in cyan hue $7F_h$ — The nominal (default) value $< 7F_h$ — Causes a decrease in cyan hue If set = $7F_h$ then display must make no change to the cyan hue of the incoming signal. If set ≠ $7F_h$, then writing a value = $7F_h$ must cause the display to return to its nominal (default) setting for cyan hue. The ± $7F_h$ range must be linearly mapped to the actual adjustment range.
$9F_h$	6 Axis Hue Control: Blue	R/W	C	Adjust the blue hue for 6-axis color **Byte: SL** $> 7F_h$ — Causes an increase in blue hue $7F_h$ — The nominal (default) value $< 7F_h$ — Causes a decrease in blue hue If set = $7F_h$ then display must make no change to the blue hue of the incoming signal. If set ≠ $7F_h$, then writing a value = $7F_h$ must cause the display to return to its nominal (default) setting for blue hue.

Table 8-4: Image Adjustment VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td></td><td></td><td></td><td></td><td>The ± $7F_h$ range must be linearly mapped to the actual adjustment range.</td></tr>
<tr><td>$A0_h$</td><td>6 Axis Hue Control:
Magenta</td><td>R/W</td><td>C</td><td>Adjust the magenta hue for 6-axis color

<table><tr><th>Byte: SL</th><th></th></tr><tr><td>> $7F_h$</td><td>Causes an increase in magenta hue</td></tr><tr><td>$7F_h$</td><td>The nominal (default) value</td></tr><tr><td>< $7F_h$</td><td>Causes a decrease in magenta hue</td></tr></table>If set = $7F_h$ then display must make no change to the magenta hue of the incoming signal.
If set ≠ $7F_h$, then writing a value = $7F_h$ must cause the display to return to its nominal (default) setting for magenta hue.
The ± $7F_h$ range must be linearly mapped to the actual adjustment range.</td></tr>
<tr><td>$A2_h$</td><td>Auto Setup On / Off</td><td>WO</td><td>NC</td><td>Turn on / off the auto setup function (periodic or event driven).

<table><tr><th>Byte: SL</th><th></th></tr><tr><td>00_h</td><td>Reserved, must be ignored</td></tr><tr><td>01_h</td><td>Turn auto setup “off”</td></tr><tr><td>02_h</td><td>Turn auto setup ‘on’</td></tr><tr><td>≥ 03_h</td><td>Reserved, must be ignored</td></tr></table></td></tr>
<tr><td>$A4_h$</td><td>Window Mask Control</td><td>R/W</td><td>T</td><td>Data size: Write / Read = 10 bytes
This code has two sets of functions:
To retain compatibility with applications using VCP codes 95_h → 98_h to set the (x,y) coordinates of a window.
Provide a way to set all the window coordinates simultaneously – this is recommended for new designs.
For legacy operations:
The bits of byte 0 allow each window to be masked from the user e.g. while it is being resized.
The bits of byte 1 allow each window to be turned to an active or inactive state … note that only an active window will be visible to the user, assuming it has not been masked.
For new implementations:
Byte 2 and 3 provide the top left x coordinate of the window.
Byte 4 and 5 provide the top left y coordinate of the window.
Byte 6 and 7 provide the bottom right x coordinate of the window.
Byte 8 and 9 provide the bottom right y coordinate of the window.</td></tr>
</table>

Table 8-4: Image Adjustment VCP Codes

Code	Name	Type	Function	Description

Byte 0		
Bit 0	Set = 0	Window controls have no effect on the displayed image.
	Set = 1	Window controls affect the displayed image (full image area)
Bit 1	Set = 0	Window controls have no effect on the displayed image (window 1)
	Set = 1	Window controls affect the displayed image (window 1)
⇓	⇓	⇓
Bit 7	Set = 0	Window controls have no effect on the displayed image (window 7)
	Set = 1	Window controls affect the displayed image (window 7)
Byte 1		
Bit 0	Set = 0	Reserved, do not use
Bit 1	Set = 0	Window # 1 is inactive
	Set = 1	Window # 1 is active
⇓	⇓	⇓
Bit 7	Set = 0	Window # 7 is inactive
	Set = 1	Window # 7 is active
Byte 2		High order bits of top left x coordinate
Byte 3		Low order bits of top left x coordinate
Byte 4		High order bits of top left y coordinate
Byte 5		Low order bits of top left y coordinate
Byte 6		High order bits of bottom right x coordinate
Byte 7		Low order bits of bottom right x coordinate
Byte 8		High order bits of bottom right y coordinate
Byte 9		Low order bits of bottom right y coordinate

NOTE: This command structure is recommended, in conjunction with VCP $A5_h$, for all new designs.

Table 8-4: Image Adjustment VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>$A5_h$</td><td>Window Select</td><td>R/W</td><td>C</td><td>Change the selected window (as defined by 95_h – 98_h).
When a window is selected then all commands that the display controller supports for window operations are valid, this may include but is not limited to: luminance, contrast, R/G/B gain, 6-axis color, sharpness, etc.
<table>
<tr><th>Byte: SL</th><th></th></tr>
<tr><td>00_h</td><td>Full display image area is selected except for area(s) of active windows</td></tr>
<tr><td>01_h</td><td>Window 1 is selected</td></tr>
<tr><td>02_h</td><td>Window 2 is selected</td></tr>
<tr><td>03_h</td><td>Window 3 is selected</td></tr>
<tr><td>04_h</td><td>Window 4 is selected</td></tr>
<tr><td>05_h</td><td>Window 5 is selected</td></tr>
<tr><td>06_h</td><td>Window 6 is selected</td></tr>
<tr><td>07_h</td><td>Window 7 is selected</td></tr>
<tr><td>$\geq 08_h$</td><td>Reserved, must be ignored</td></tr>
</table>
<u>NOTE</u>: If this command is not supported then the ‘full image area’ must be the default.
This command structure is recommended, in conjunction with VCP $A4_h$, for all new designs.
The last window to be addressed is assumed to the top ‘layer’ of the displayed image.</td></tr>
</table>

Table 8-4: Image Adjustment VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>A6$_h$</td><td>Window Size</td><td>R/W</td><td>C</td><td>Increasing (decreasing) this value will increase (decrease) the size of the window called out by
VCP A5$_h$.

<table><tr><th>Byte: SL</th><th></th></tr><tr><td>00$_h$</td><td>Min “default”</td></tr><tr><td>00$_h$ ≤ Max</td><td>Control Range</td></tr><tr><td>Max ≤ FF$_h$</td><td>Value returned in Ca String</td></tr></table>All operations handling aspect ratio of the window when changing size will be handled by the scalar.
This VCP code must update the coordinates of the window. For implementations that support 95$_h$-98$_h$, the x:y coordinates of the upper right and lower left coordinates are updated for synchronization.
For implementations that support the x:y coordinate as part of A4$_h$ Window Mask Control, the x:y coordinates are updated byte 2 and 3 (top left x coordinate), byte 4 and 5 (top left y coordinate), byte 6 and 7 (bottom right x coordinate) and byte 8 an 9 (bottom right y coordinate).
Window capabilities will be called out in the capability string to provide size, safe area restrictions, type of window (PIP or Zone) with an entry for each window supported. The format for the capability string is:
Window # - Window number with associated requirements Type – PIP, Zone Area - Absolute value for bounded safe area of the window Max – Maximum size of the window Min – Minimum size of the window.
<u>NOTE:</u>
As part of 3.0 window () specifies the VCP codes that are supported within a window. This could be added to each window # to provide exact information as to the feature set for any given window supported through hardware.
<u>Example:</u>
Window 1(type(pip) area(25 25 1895 1175) max(640 480) min(10 10) window(XX XX XX))
Where XX = supported VCP codes.</td></tr>
<tr><td>A7$_h$</td><td>Window Transparency</td><td>R/W</td><td>C</td><td>Increasing (decreasing) this value will increase (decrease) the transparency of the window called out by A5$_h$.

<table><tr><th>Byte: SL</th><th></th></tr><tr><td>00$_h$</td><td>Fully opaque “default”</td></tr><tr><td>01$_h$ → FF$_h$</td><td>Increasing transparent</td></tr></table></td></tr>
</table>

Table 8-4: Image Adjustment VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>AA_h</td><td>Screen Orientation</td><td>RO</td><td>NC</td><td>Indicates the orientation of the screen.

<table>
<tr><th>Byte: SL</th><th></th><th></th></tr>
<tr><td>00_h</td><td>Reserved</td><td>Shall be ignored</td></tr>
<tr><td>01_h</td><td>0 degrees</td><td>The normal landscape mode</td></tr>
<tr><td>02_h</td><td>90 degrees</td><td>Portrait mode achieved by clockwise rotatio of the display 90 degrees.</td></tr>
<tr><td>03_h</td><td>180 degrees</td><td>Landscape mode achieved by rotation of the display 180 degrees.</td></tr>
<tr><td>04_h</td><td>270 degrees</td><td>Portrait mode achieved by clockwise rotation of the display 270 degrees.</td></tr>
<tr><td>$05_h \rightarrow FE_h$</td><td>Reserved</td><td>Shall be ignored</td></tr>
<tr><td>FF_h</td><td>Not applicable</td><td>Indicates that the display cannot supply the current orientation</td></tr>
</table>
<u>NOTE:</u> “Clockwise rotation” when viewing the display from user’s viewpoint.</td></tr>
<tr><td>$D4_h$</td><td>Stereo Video Mode</td><td>R/W</td><td>NC</td><td>Used to select the video mode with respect to 2D or 3D video.

<table>
<tr><th>Byte: SL</th><th></th></tr>
<tr><td>Bit 7</td><td>Reserved, must be ignored</td></tr>
<tr><td>Bit 6</td><td>Enable Field-Sequential Right Eye First</td></tr>
<tr><td>Bit 5</td><td>Enable Field-Sequential Left Eye First</td></tr>
<tr><td>Bit 4</td><td>Enable 2-Way Interleaved Right Eye First</td></tr>
<tr><td>Bit 3</td><td>Enable 2-Way Interleaved Left Eye First</td></tr>
<tr><td>Bit 2</td><td>Enable 4-Way Interleaved, Display Stereo Buffer 0 (even scan lines)</td></tr>
<tr><td>Bit 1</td><td>Enable 4-Way Interleaved, Display Stereo Buffer 1 (odd scan lines)</td></tr>
<tr><td>Bit 0</td><td>Enable Side-by-Side Interleaved</td></tr>
</table>
<u>NOTE:</u> It is permissible, during a read operation, for a display to indicate support for 2 or more stereo modes.</td></tr>
</table>

Table 8-4: Image Adjustment VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>DC_h</td><td>Display Application</td><td>R/W</td><td>NC</td><td>Permits the selection of a preset optimized by manufacturer for an application type or the selection of a user defined setting.

<table>
<tr><th>Byte: SL</th><th></th></tr>
<tr><td>00_h</td><td>Stand / default mode</td></tr>
<tr><td>01_h</td><td>Productivity (e.g. office applications)</td></tr>
<tr><td>02_h</td><td>Mixed (e.g. internet with mix of text and images)</td></tr>
<tr><td>03_h</td><td>Movie</td></tr>
<tr><td>04_h</td><td>User defined</td></tr>
<tr><td>05_h</td><td>Games (e.g. games console / PC game)</td></tr>
<tr><td>06_h</td><td>Sports (e.g. fast action)</td></tr>
<tr><td>07_h</td><td>Professional (all signal processing disabled)</td></tr>
<tr><td>08_h</td><td>Standard / default mode with intermediate power consumption</td></tr>
<tr><td>09_h</td><td>Standard / default mode with low power consumption</td></tr>
<tr><td>$0A_h$</td><td>Demonstration (used for high visual impact in retail etc.)</td></tr>
<tr><td>$0B_h$ - EF_h</td><td>Reserved, must be ignored</td></tr>
<tr><td>$F0_h$</td><td>Dynamic contrast</td></tr>
<tr><td>$\geq F1_h$</td><td>Reserved, must be ignored</td></tr>
</table>
<u>NOTE</u>: The condition(s) associated with options $00_h \rightarrow 0A_h$ (inclusive) are defined by the display manufacturer and may include all or some of luminance, contrast, gamma settings, etc.</td></tr>
</table>

8.3 Display Control VCP Codes

Table 8-5: Display Control VCP Code Cross-Reference

VCP Code Name	Code	Compliance
Display Controller ID	$C8_h$	10.11
Display Firmware Level	$C9_h$	10.11
Display Usage Time	$C6_h$	10.11
Horizontal Frequency	AC_h	10.11
Image Mode	DB_h	10.7
OSD / Button Event Control	CA_h	10.7
OSD Language	CC_h	10.7
Power Mode	$D6_h$	10.7
Source Color Coding	$B5_h$	10.11.4
Source Timing Mode	$B4_h$	10.12.2
VCP Version	DF_h	10.11
Vertical Frequency	AE_h	10.11

8.3.1 Source Timing Mode

This VCP declares the video timing that will next be sent to the display using either a new declared video input or a change to the current video timing. This value must be set prior to any change to the video timing either by changing the video input VCP 60_h or the current timing on the current input. The display can use this information to speed up the re-synchronization process when the timing actually changes.

Typical Usage of VCP $B4_h$, $8D_h$, AC_h and AE_h:

When changing the video timing sent to the display it is recommended to use these VCP codes to make a "clean" timing change with no visible artifacts on the screen.

Use VCP $8D_h$ to mute audio and blank the Screen.
Use VCP $B4_h$ to notify the display controller of the pending timing change.
Change the video timing.
Read VCP AC_h and AE_h to determine the display is in sink and at the right frequencies.
Use VCP $8D_h$ to un-Mute and un-Blank the display.

Some displays may not support "out of sync" indication using VCP AC_h and AE_h. Step 4 may be omitted. However the display may not un-blank immediately upon issuing an un-blank VCP $8D_h$, but only after it has fully synchronized to the new input signal.

There are two major industries that have defined video timings in use today. The first described here is the PC industry, defined by VESA. The second is the consumer electronics industry, defined by CEA. The major difference between these two is that timings used by the PC industry represent the timing designed to best drive a particular display technology, and timings used by the consumer electronics industry are designed for the transport of video over the national broadcast system.

This VCP lists the current DMT and CEA DTV timings available at the creation of this document. These lists show usage convention only and may not be current; it is highly recommended that the reader refer to the respective standard for the most up to date listings.

This VCP does NOT indicate preferred timing. It only allows a host to declare the video timing before a change is made.

This VCP also provides for declaring video timings using the CVT three-byte codes defined in the VESA CVT Standard.

NOTE:

- Certain Display Interfaces, i.e. DisplayPort, manage access to MCCS using the hosts' GPU display driver; it is highly recommended that the display driver manage all video timing changes using the procedure described above on behave of the application requesting the timing change.
- A third category of timing, that we will just mention here, is the timing used generating the original video stream. For example a movie filmed at 24 frames per second in a cinematic aspect ratio sampled at a certain resolution. In certain applications it would be nice to have this information when receiving this signal. This VCP does NOT address this use.

Table 8-6: Source Timing Mode

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>$B4_h$</td><td>Source Timing Mode</td><td>R/W</td><td>T</td><td>
Indicates the timing mode being sent by the host.
This command has a 5 byte data structure:
Byte 0: flags for DMT timing modes
Byte 1: flags for CEA DTV timing modes
Bytes 2 – 4: CVT descriptor bytes
<u>NOTE:</u>
Only one Timing Mode must be indicated, any combination with more than a single Timing Mode identified is invalid and must be ignored. Only Byte 0, 1 or Bytes 2, 3 and 4 shall be declared and set to a value other than 00_h at any single time.
'RB' in following table indicates 'reduced blanking' as defined by the VESA CVT standard
The aspect ratio (AR) identified in the following table is the physical aspect ratio of the image.
The DMT codes listed here may not be up to date. Refer to the most current DMT standard for current codes.
<table>
<tr><th>Byte 0</th><th>Pixel Format</th><th>Refresh Rate</th></tr>
<tr><td>00_h</td><td colspan="2">PC Timing is not declared</td></tr>
<tr><td>01_h</td><td>640 x 350</td><td>85 Hz</td></tr>
<tr><td>02_h</td><td>640 x 400</td><td>85 Hz</td></tr>
<tr><td>03_h</td><td>720 x 400</td><td>85 Hz</td></tr>
<tr><td>04_h</td><td>640 x 480</td><td>60 Hz</td></tr>
<tr><td>05_h</td><td></td><td>72 Hz</td></tr>
<tr><td>06_h</td><td></td><td>75 Hz</td></tr>
<tr><td>07_h</td><td></td><td>85 Hz</td></tr>
<tr><td>08_h</td><td>800 x 600</td><td>56 Hz</td></tr>
<tr><td>09_h</td><td></td><td>60 Hz</td></tr>
<tr><td>$0A_h$</td><td></td><td>72 Hz</td></tr>
<tr><td>$0B_h$</td><td></td><td>75 Hz</td></tr>
<tr><td>$0C_h$</td><td></td><td>85 Hz</td></tr>
<tr><td>$0D_h$</td><td></td><td>120 Hz (RB)</td></tr>
<tr><td>$0E_h$</td><td>848 x 480</td><td>60 Hz</td></tr>
<tr><td>$0F_h$</td><td>1024 x 768</td><td>43 Hz (Int.)</td></tr>
</table>
</td></tr>
</table>

				10_h		60 Hz
				11_h		70 Hz
				12_h		75 Hz
				13_h		85 Hz
				14_h		120 Hz (RB)
				15_h	1152 x 864	75 Hz
				16_h	1280 x 768	60 Hz (RB)
				17_h		60 Hz
				18_h		75 Hz
				19_h		85 Hz
				$1A_h$		120 Hz (RB)
				$1B_h$	1280 x 800	60 Hz (RB)
				$1C_h$		60 Hz
				$1D_h$		75 Hz
				$1E_h$		85 Hz
				$1F_h$		120 Hz (RB)
				20_h	1280 x 960	60 Hz
				21_h		85 Hz
				22_h		120 Hz (RB)
				23_h	1280 x 1024	60 Hz
				24_h		75 Hz
				25_h		85 Hz
				26_h		120 Hz (RB)
				27_h	1360 x 768	60 Hz
				28_h		120 Hz (RB)
				29_h	1400 x 1050	60 Hz (RB)
				$2A_h$		60 Hz
				$2B_h$		75 Hz
				$2C_h$		85 Hz
				$2D_h$		120 Hz (RB)
				$2E_h$	1440 x 900	60 Hz (RB)
				$2F_h$		60 Hz
				30_h		75 Hz
				31_h		85 Hz
				32_h		120 Hz (RB)
				33_h	1600 x 1200	60 Hz
				34_h		65 Hz
				35_h		70 Hz
				36_h		75 Hz
				37_h		85 Hz
				38_h		120 Hz (RB)
				39_h	1680 x 1050	60 Hz (RB)
				$3A_h$		60 Hz
				$3B_h$		75 Hz
				$3C_h$		85 Hz
				$3D_h$		120 Hz (RB)
				$3E_h$	1792 x 1344	60 Hz

$3F_h$		75 Hz
40_h		120 Hz (RB)
41_h	1856 x 1392	60 Hz
42_h		75 Hz
43_h		120 Hz (RB)
44_h	1920 x 1200	60 Hz (RB)
45_h		60 Hz
46_h		75 Hz
47_h		85 Hz
48_h		120 Hz (RB)
49_h	1920 x 1440	60 Hz
$4A_h$		75 Hz
$4B_h$		120 Hz (RB)
$4C_h$	2560 x 1600	60 Hz (RB)
$4D_h$		60 Hz
$4E_h$		75 Hz
$4F_h$		85 Hz
50_h		120 Hz (RB)
51_h	1366 x 768	60 Hz
52_h	1920 x 1080	60 Hz
53_h	1600 x 900	60 Hz (RB)
54_h	2048 x 1152	60 Hz (RB)
55_h	1280 x 720	60 Hz
56_h	1366 x 768	60 Hz (RB)
$\geq 57_h$	Reserved	

Byte 1	
00_h	No timing declared
$01_h \rightarrow FF_h$	See CEA DTV Timing code below

The following describes the contents of the 3-byte CVT descriptor, this is correct at the time of writing but for complete description and to verify accuracy the user should verify using the latest revision of the VESA VTB-EXT standard.

If the CVT descriptor is not being used then the three bytes must be set to 00_h.

Byte 2	
Bits 7 → 0	The lower 8 bits of VSize VSize = (# of vertical active lines / 2) – 1)

Byte 3	
Bits 7 → 4	The upper 4 bits of VSize
Bits 3 → 2	Aspect ratio 00 : 4:3 01 : 16:9 10 : 16:10 11 : Reserved

				Bits 1 → 0	Reserved, set to 00
				Byte 4	
				Bit 7	Reserved, set to 0
				Bits 6 → 5	Preferred refresh rate 00 : 50 Hz 01 : 60 Hz 10 : 75 Hz 11 : 85 Hz NOTE: 60Hz may indicate either standard or reduced blanking. If both are supported then reduced blanking is preferred.
				Bits 4 → 0	Supported refresh rates (standard blanking unless otherwise stated) Bit 4 set to 1 : 50 Hz supported Bit 3 set to 1 : 60 Hz supported, Bit 2 set to 1 : 75 Hz supported Bit 1 set to 1 : 85 Hz supported Bit 0 set to 1 : 60 Hz reduced blanking (per CVT standard) is supported

Table 8-7: CEA DTV Timing Codes

Byte 1	CEA VID	Image Format	Field Rate	Image Aspect Ratio (H:V)
00_h	CEA Timing is not declared			
01_h	1	640 x 480 p	59.94 Hz/ 60 Hz	4:3
02_h	2	720 x 480 p	59.94 Hz/ 60 Hz	4:3
03_h	3	720 x 480 p	59.94 Hz/ 60 Hz	16:9
04_h	4	1280 x 720 p	59.94 Hz/ 60 Hz	16:9
05_h	5	1920 x 1080 i	59.94 Hz/ 60 Hz	16:9
06_h	6	720(1440) x 480 i	59.94 Hz/ 60 Hz	4:3
07_h	7	720(1440) x 480 i	59.94 Hz/ 60 Hz	16:9
08_h	8	720(1440) x 240 p	59.94 Hz/ 60 Hz	4:3
09_h	9	720(1440) x 240 p	59.94 Hz/ 60 Hz	16:9
$0A_h$	10	2880 x 480 i	59.94 Hz/ 60 Hz	4:3
$0B_h$	11	2880 x 480 i	59.94 Hz/ 60 Hz	16:9
$0C_h$	12	2880 x 240 p	59.94 Hz/ 60 Hz	4:3
$0D_h$	13	2880 x 240 p	59.94 Hz/ 60 Hz	16:9
$0E_h$	14	1440 x 480 p	59.94 Hz/ 60 Hz	4:3
$0F_h$	15	1440 x 480 p	59.94 Hz/ 60 Hz	16:9
10_h	16	1920 x 1080 p	59.94 Hz/ 60 Hz	16:9
11_h	17	720 x 576 p	50 Hz	4:3
12_h	18	720 x 576 p	50 Hz	16:9
13_h	19	1280 x 720 p	50 Hz	16:9
14_h	20	1920 x 1080 i	50 Hz	16:9
15_h	21	720(1440) x 576 i	50 Hz	4:3
16_h	22	720(1440) x 576 i	50 Hz	16:9
17_h	23	720(1440) x 288 p	50 Hz	4:3
18_h	24	720(1440) x 288 p	50 Hz	16:9
19_h	25	2880 x 576 i	50 Hz	4:3
$1A_h$	26	2880 x 576 i	50 Hz	16:9
$1B_h$	27	2880 x 288 p	50 Hz	4:3
$1C_h$	28	2880 x 288 p	50 Hz	16:9
$1D_h$	29	1440 x 576 p	50 Hz	4:3
$1E_h$	30	1440 x 576 p	50 Hz	16:9
$1F_h$	31	1920 x 1080 p	50 Hz	16:9
20_h	32	1920 x 1080 p	23.97 Hz/ 24 Hz	16:9
21_h	33	1920 x 1080 p	25Hz	16:9
22_h	34	1920 x 1080 p	29.97 Hz/ 30 Hz	16:9
23_h	35	2880 x 480 p	59.94 Hz/ 60 Hz	4:3
24_h	36	2880 x 480 p	59.94 Hz/ 60 Hz	16:9
25_h	37	2880 x 576 p	50 Hz	4:3
26_h	38	2880 x 576 p	50 Hz	16:9
27_h	39	1920 x 1080 i	50 Hz	16:9
28_h	40	1920 x 1080 i	100 Hz	16:9

Table 8-7: CEA DTV Timing Codes

Byte 1	CEA VID	Image Format	Field Rate	Image Aspect Ratio (H:V)
29_h	41	1280 x 720 p	100 Hz	16:9
$2A_h$	42	720 x 576 p	100 Hz	4:3
$2B_h$	43	720 x 576 p	100 Hz	16:9
$2C_h$	44	720(1440) x 576 i	100 Hz	4:3
$2D_h$	45	720(1440) x 576 i	100 Hz	16:9
$2E_h$	46	1920 x 1080 i	119.88 Hz/ 120 Hz	16:9
$2F_h$	47	1280 x 720 p	119.88 Hz/ 120 Hz	16:9
30_h	48	720 x 480 p	119.88 Hz/ 120 Hz	4:3
31_h	49	720 x 480 p	119.88 Hz/ 120 Hz	16:9
32_h	50	720(1440) x 480 i	119.88 Hz/ 120 Hz	4:3
33_h	51	720(1440) x 480 i	119.88 Hz/ 120 Hz	16:9
34_h	52	720 x 576 p	200 Hz	4:3
35_h	53	720 x 576 p	200 Hz	16:9
36_h	54	720(1440) x 576 i	200 Hz	4:3
37_h	55	720(1440) x 576 i	200 Hz	16:9
38_h	56	720 x 480 p	239.76 Hz/ 240 Hz	4:3
39_h	57	720 x 480 p	239.76 Hz/ 240 Hz	16:9
$3A_h$	58	720(1440) x 480 i	239.76 Hz/ 240 Hz	4:3
$3B_h$	59	720(1440) x 480 i	239.76 Hz/ 240 Hz	16:9
$3C_h$	60	1280 x 720 p	23.97 Hz/ 24 Hz	16:9
$3D_h$	61	1280 x 720 p	25 Hz	16:9
$3E_h$	62	1280 x 720 p	29.97 Hz/ 30 Hz	16:9
$3F_h$	63	1920 x 1080 p	119.88 Hz/ 120 Hz	16:9
40_h	64	1920 x 1080 p	100 Hz	16:9
$\geq 41_h$	65 - 127	Reserved		

8.3.2 OSD / Button Event Control

A new feature added to V3.0 and expanded in V2.2.

Table 8-8: OSD / Button Event Control

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>CA_h</td><td>OSD / Button Control</td><td>R/W</td><td>NC</td><td>Sets and indicates the current operational state of the display OSD and buttons.
<table>
<tr><th>Byte: SL</th><th></th></tr>
<tr><td>00_h</td><td>Indicates that the display does not support Host control of its OSD and may NOT report button “events”</td></tr>
<tr><td>01_h</td><td>Sink OSD & display control disabled, soft and predefined button “Host OSD” events enabled using (VCP 02_h/52_h/03_h)</td></tr>
<tr><td>02_h</td><td>Sink OSD & display control enabled if supported, soft and predefined button ”Host OSD” events enabled using (VCP 02_h/52_h/03_h)</td></tr>
<tr><td>03_h</td><td>Sink OSD & display control disabled, soft and predefined buttons “Host OSD” events disabled</td></tr>
<tr><td>FF_h</td><td>Indicates that the display cannot supply this information</td></tr>
</table>
<table>
<tr><th>Byte: SH</th><th></th></tr>
<tr><td>00_h</td><td>Indicates that the display does not support Host control of its Power function and may NOT report Power “events”</td></tr>
<tr><td>01_h</td><td>Power button disabled,
power button events enabled using
(VCP 02_h/52_h/03_h)</td></tr>
<tr><td>02_h</td><td>Power button enabled,
power button events enabled using
(VCP 02_h/52_h/03_h)</td></tr>
<tr><td>03_h</td><td>Power button disabled,
power button events disabled</td></tr>
</table>
<table>
<tr><th>Bytes: ML, MH</th><th></th></tr>
<tr><td>00_h</td><td>All other values reserved</td></tr>
</table>
<u>NOTE:</u> VCP CA_h can be implemented for OSD-less displays, e.g. DDM, for buttons control only.
All unassigned values are reserved and must be ignored.</td></tr>
</table>

Button Event Handling Description

VCP 02_h / 52_h (and DP HPD interrupt) provide button "event" notifications

The Sink shall store 03_h in the 16 Byte VCP 52_h "event" FIFO for every button "event", make / break (press / release)

The Sink shall store the "event" code in the VCP 03_h FIFO until there is only one byte left

FF_h indicates the FIFO was been overrun

- The 03_h FIFO must be designed such that when there are no more bytes available to store event codes, a FF_h will be inserted before additional event codes when the FIFO can take new data
- Only one FF_h will be written when the FIFO has room for new event codes including the FF_h
- The FIFO should not be filled with overrun codes
- Host/sink synchronization has been broken if a FF_h is read from 03_h
- The host must take steps to re-synchronize with the sink before reading 03_h again

00_h indicates the FIFO is empty

- A code of 00_h should be read (returned) when the FIFO is "empty

Button events must be managed in accordance with the following VCP CA_h rules:

- SL 00_h : Indicates that the display does not support Host control of its OSD and may not report button "events"
  - The host must not try to control the OSD function
  - The host must not act on button "events" in VCP 52_h

SL 01_h : Sink OSD & display control disabled,
soft and predefined button "Host OSD" events enabled using (VCP 02_h/52_h/03_h)

- All button "events" reported!
- Host must provide all OSD functions including a GUI.

SL 02_h : Sink OSD & display control enabled if supported,
soft and predefined button "Host OSD" events enabled using (VCP 02_h/52_h/03_h)

- Only button "events" not supported by the Sink OSD are reported!
- All VCP register value changes, as a result of the Sink OSD, are to be reported using (VCP 02_h/52_h/) with the appropriate VCP register code
- Host must respond as required but not provide a GUI in most cases

SL 03_h : Sink OSD & display control disabled,
soft and predefined buttons "Host OSD" events disabled

- No button "events" reported
- Host response is required

SL FF_h : Indicates that the display cannot supply this information

- The display may or may not write button codes to VCP 03_h
- The Host must not act on the button codes found in VCP 03_h

SH 00_h : Indicates that the display does not support Host control of its Power function and may not report Power button "events"

- The Host must not try to control the Power function
- The Host must not act on Power button "events" in VCP 52_h

SH 01_h : Power button disabled,
power button events enabled using (VCP 02_h/52_h/03_h)

- Power button "events" reported

SH 02_h : Power button enabled,
power button events enabled using (VCP 02_h/52_h/03_h)

- Power button "events" reported
- Host may track "events" but must not adjust power on the display.

SH 03_h : Power button disabled,
power button events disabled
- No Power button "events" reported
- No host response is required

VCP CA_h can be implemented for OSD-less displays, e.g. DDM, for button control only

There is a 1 to 1 relation of event codes in the VCP 03_h FIFO to 03_h events in the VCP 52_h FIFO

Button make codes are not repeated at any rate when a button is held down - there is only a single make and a single break event recorded in the VCP 03_h FIFO

The Sink OSD may elect to use auto repeat as part of its functioning – VCP registers will be updated and reported as the repeat occurs – No button "events" are reported from buttons used by an active Sink OSD

Reading VCP 03_h automatically removes button's code from the FIFO, 00_h is returned when the FIFO is empty

Button's make code = button's code

Button's break code = button's code ORed with 80_h

Reporting Buttons Capabilities

Button events support is reported in the MCCS capabilities string under VCP abbreviation

Button events support cap contains VCP 03_h followed by a list of supported button codes

e.g. Soft button 1, Power, Brightness Up, Brightness Down

…VCP(02 04 10 03(01 10 11 12)…)…

Supplied list of supported button codes implies VCP 03_h FIFO support and predefined buttons extensions

Listing VCP 03_h without a list of supported button codes implies legacy implementation of VCP 03_h without 03_h FIFO support and without predefined buttons extensions

Other

A 03_h 'button active' value should only be reset to 00_h by host write operation in sinks using MCCS versions earlier than this revision MCCS 3.1.

From this version forward, 03_h is "read-only" and the sink will return a 00_h to the host when the FIFO is empty.

Table 8-9: Display Control VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>AC_h</td><td>Horizontal Frequency</td><td>RO</td><td>C</td><td>Horizontal synchronization signal frequency in Hz as determined by the display.
MH = ML = SH = SL = 00_h: Indicates that the display is NOT synchronized to the video input signal.
MH = ML = SH = SL = FF_h: Indicates that the display cannot synchronize or has determined the input frequency is out of range.
Example:
A reported value of 01_h, 21_h, 10_h indicates a Hz frequency of 74.0KHz (nominal for 1920 x 1200 @ 60Hz reduced blanking)</td></tr>
<tr><td>AE_h</td><td>Vertical Frequency</td><td>RO</td><td>C</td><td>Vertical synchronization signal frequency in 0.01Hz as determined by the display.
MH = ML = SH = SL = 00_h: Indicates that the display is NOT synchronized to the video input signal.
MH = ML = SH = SL = FF_h: Indicates that the display cannot synchronize or has determined the input frequency is out of range.
Example:
A reported value of 17_h, $7A_h$ indicates a Hz frequency of 60.1Hz.</td></tr>
<tr><td>$B5_h$</td><td>Source Color Coding</td><td>WO</td><td>NC</td><td>Allows the host to specify the color coding method that is being used.
<table>
<tr><th>Byte: SH</th><th></th></tr>
<tr><td>00_h</td><td>Default value</td></tr>
<tr><td>$01_h \rightarrow FF_h$</td><td>Reserved, must be ignored</td></tr>
<tr><th>Byte: SL</th><th></th></tr>
<tr><td>00_h</td><td>RGB 4:4:4</td></tr>
<tr><td>01_h</td><td>YCbCr / YPbPr 4:4:4</td></tr>
<tr><td>02_h</td><td>YCbCr / YPbPr 4:2:2</td></tr>
<tr><td>$\geq 03_h$</td><td>Reserved, must be ignored</td></tr>
</table></td></tr>
<tr><td>$C0_h$</td><td>Display Usage Time</td><td>RO</td><td>C</td><td>Returns the current value (in hours) of ‘active power on’ time accumulated by the display in the ML, SH and SL bytes. The MH byte must be set to 00_h. ‘Active power on’ time is defined as the period when the emissive elements(s) of the display – cathodes for a CRT, fluorescent lamps for a LCD, etc. – are active.</td></tr>
<tr><td>$C8_h$</td><td>Display Controller ID</td><td>RO</td><td>NC Manda-tory</td><td>This VCP code provides the host with knowledge of the controller manufacturer and unique chip ID used in a particular display. This information will enable a host to use a table-based approach (by applications) to identify what chip specific features and or limitations may apply to the attached display.

SL byte: Indicates manufacturer ID

MH, ML and SH bytes: Indicate a unique chip ID assigned by the controller manufacturer. These three bytes declare a unique numeric identification (fingerprint) each manufacturer assigns to his controller chip. This number should be based on firmware revision, silicon revision, chip model, panel identification, and or other pertinent factors that impact the performance and capabilities of the implementation.
<u>NOTE:</u> Each controller manufacturer supporting this command is</td></tr>
</table>

Table 8-9: Display Control VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td></td><td></td><td></td><td></td><td>required to publish and maintain an equivalence table between actual product identifier (alphanumeric marketing identifier) and simple numerical value here.
• A host application would use the combination of data from MH, ML and SH chip ID bytes together with the SL manufacturer ID byte to uniquely identify a particular controller.
<table>
<tr><th>Byte: SL</th><th></th></tr>
<tr><td>00_h</td><td>Reserved</td></tr>
<tr><td>01_h</td><td>Conexant</td></tr>
<tr><td>02_h</td><td>Genesis Microchip</td></tr>
<tr><td>03_h</td><td>Macronix</td></tr>
<tr><td>04_h</td><td>IDT (Integrated Device Technology)</td></tr>
<tr><td>05_h</td><td>Mstar Semiconductor</td></tr>
<tr><td>06_h</td><td>Myson</td></tr>
<tr><td>07_h</td><td>Philips</td></tr>
<tr><td>08_h</td><td>PixelWorks</td></tr>
<tr><td>09_h</td><td>RealTek Semiconductor</td></tr>
<tr><td>$0A_h$</td><td>Sage</td></tr>
<tr><td>$0B_h$</td><td>Silicon Image</td></tr>
<tr><td>$0C_h$</td><td>SmartASIC</td></tr>
<tr><td>$0D_h$</td><td>STMicroelectronics</td></tr>
<tr><td>$0E_h$</td><td>Topro</td></tr>
<tr><td>$0F_h$</td><td>Trumpion</td></tr>
<tr><td>10_h</td><td>Welltrend</td></tr>
<tr><td>11_h</td><td>Samsung</td></tr>
<tr><td>12_h</td><td>Novatek Microelectronics</td></tr>
<tr><td>13_h</td><td>STK</td></tr>
<tr><td>14_h</td><td>Silicon Optix Inc.</td></tr>
<tr><td>15_h</td><td>Texas Instruments</td></tr>
<tr><td>16_h</td><td>Analogix Semiconductor</td></tr>
<tr><td>17_h</td><td>Quantum Data</td></tr>
<tr><td>18_h</td><td>NXP Semiconductors</td></tr>
<tr><td>19_h</td><td>Chrontel</td></tr>
<tr><td>$1A_h$</td><td>Parade Technologies</td></tr>
<tr><td>$1B_h$</td><td>THine Electronics</td></tr>
<tr><td>$1C_h$</td><td>Trident</td></tr>
<tr><td>$1D_h$</td><td>Micronas</td></tr>
<tr><td>$1E_h \rightarrow FE_h$</td><td>Reserved, must be ignored</td></tr>
<tr><td>FF_h</td><td>Not defined – a manufacturer designed controller</td></tr>
</table>
For extensions to this list, check the MCCS_UP.pdf document at www.vesa.org.</td></tr>
<tr><td>$C9_h$</td><td>Display Firmware Level</td><td>RO</td><td>C</td><td>This VCP code results in two bytes of data being sent by the display.
<table>
<tr><th>Byte: SL</th><th></th></tr>
<tr><td>$\geq 00_h$</td><td>defines the firmware revision number</td></tr>
<tr><th>Byte: SH</th><th></th></tr>
<tr><td>$\geq 00_h$</td><td>defines the firmware version number</td></tr>
</table>
e.g. 03_h, 05_h defines a firmware level of 3.5</td></tr>
</table>

Table 8-9: Display Control VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>CC_h</td><td>OSD Language</td><td>R/W</td><td>NC</td><td>Allows the host to select the display OSD language.
The capability string must declare only the languages supported by the display.

<table>
<tr><th>Byte: SL</th><th></th></tr>
<tr><td>00_h</td><td>Reserved, must be ignored</td></tr>
<tr><td>01_h</td><td>Chinese (traditional / Hantai)</td></tr>
<tr><td>02_h</td><td>English</td></tr>
<tr><td>03_h</td><td>French</td></tr>
<tr><td>04_h</td><td>German</td></tr>
<tr><td>05_h</td><td>Italian</td></tr>
<tr><td>06_h</td><td>Japanese</td></tr>
<tr><td>07_h</td><td>Korean</td></tr>
<tr><td>08_h</td><td>Portuguese (Portugal)</td></tr>
<tr><td>09_h</td><td>Russian</td></tr>
<tr><td>$0A_h$</td><td>Spanish</td></tr>
<tr><td>$0B_h$</td><td>Swedish</td></tr>
<tr><td>$0C_h$</td><td>Turkish</td></tr>
<tr><td>$0D_h$</td><td>Chinese (simplified / Kantai)</td></tr>
<tr><td>$0E_h$</td><td>Portuguese (Brazil)</td></tr>
<tr><td>$0F_h$</td><td>Arabic</td></tr>
<tr><td>10_h</td><td>Bulgarian</td></tr>
<tr><td>11_h</td><td>Croatian</td></tr>
<tr><td>12_h</td><td>Czech</td></tr>
<tr><td>13_h</td><td>Danish</td></tr>
<tr><td>14_h</td><td>Dutch</td></tr>
<tr><td>15_h</td><td>Estonian</td></tr>
<tr><td>16_h</td><td>Finnish</td></tr>
<tr><td>17_h</td><td>Greek</td></tr>
<tr><td>18_h</td><td>Hebrew</td></tr>
<tr><td>19_h</td><td>Hindi</td></tr>
<tr><td>$1A_h$</td><td>Hungarian</td></tr>
<tr><td>$1B_h$</td><td>Latvian</td></tr>
<tr><td>$1C_h$</td><td>Lithuanian</td></tr>
<tr><td>$1D_h$</td><td>Norwegian</td></tr>
<tr><td>$1E_h$</td><td>Polish</td></tr>
<tr><td>$1F_h$</td><td>Romanian</td></tr>
<tr><td>20_h</td><td>Serbian</td></tr>
<tr><td>21_h</td><td>Slovak</td></tr>
<tr><td>22_h</td><td>Slovenian</td></tr>
<tr><td>23_h</td><td>Thai</td></tr>
<tr><td>24_h</td><td>Ukrainian</td></tr>
<tr><td>25_h</td><td>Vietnamese</td></tr>
<tr><td>$\geq 26_h$</td><td>Reserved, must be ignored</td></tr>
</table>

<table>
<tr><th>Byte: SH, ML, MH</th><th></th></tr>
<tr><td>00_h</td><td>All other values reserved</td></tr>
</table>

<u>NOTE:</u> Typo in Version 2.1, 10_h should read $0A_h$. If a parser encounters a display with MCCS v2.1 using 10_h it should auto-correct to $0A_h$.</td></tr>
</table>

Table 8-9: Display Control VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>D6_h</td><td>Power Mode</td><td>R/W</td><td>NC</td><td>Power Mode – DPM & DPMS standards are supported along with other power function(s).
<table>
<tr><th>Byte: SL</th><th>DPM</th><th>DPMS</th></tr>
<tr><td>00_h</td><td colspan="2">Reserved, must be ignored</td></tr>
<tr><td>01_h</td><td>On</td><td>On</td></tr>
<tr><td>02_h</td><td>Off</td><td>Standby</td></tr>
<tr><td>03_h</td><td>Off</td><td>Suspend</td></tr>
<tr><td>04_h</td><td>Off</td><td>Off</td></tr>
<tr><td colspan="3">Item(s) below are not part of the DPM or DPMS standards</td></tr>
<tr><td>05_h</td><td colspan="2">Power off the display – functionally equivalent to turning off power using the “power button”</td></tr>
<tr><td>≤ 06_h</td><td colspan="2">Reserved, must be ignored</td></tr>
</table>
<u>NOTE</u>:
• Following a MCCS command with a value of 01_h → 04_h, the display must respond to the appropriate DPM (or DPMS) protocols.
Following a MCCS command with a value of 05_h, user intervention at the display (pressing / toggling the power switch) may be required to restore operation.</td></tr>
<tr><td>DB_h</td><td>Image Mode</td><td>R/W</td><td>NC</td><td>Controls aspects of the displayed image.
<table>
<tr><th>Byte: SL</th><th>Name</th><th>Description</th></tr>
<tr><td>00_h</td><td>-</td><td>No effect</td></tr>
<tr><td>01_h</td><td>Full mode</td><td>Linear expansion (compression) of the image on horizontal axis.</td></tr>
<tr><td>02_h</td><td>Zoom mode</td><td>Linear expansion (compression) of the image on horizontal and vertical axes.</td></tr>
<tr><td>03_h</td><td>Squeeze mode</td><td>Display all of image content on visible screen. May result in unused areas of visible screen … bars at top, bottom, or sides.</td></tr>
<tr><td>04_h</td><td>Variable</td><td>Display all of image content by applying non-linear expansion (compression) to the horizontal axis.</td></tr>
<tr><td>≥ 05_h</td><td>-</td><td>Reserved, must be ignored</td></tr>
</table>
<u>NOTE:</u> This VCP code is intended for use with TV applications.
A more complete description of these modes may be found in the VESA DI-EXT standard.</td></tr>
<tr><td>DF_h</td><td>VCP Version</td><td>RO</td><td>NC
Manda-tory</td><td>Defines the version number of the MCCS standard recognized by the display.

SH byte: defines the MCCS version number

SL byte: defines the MCCS revision number

e.g. 02_h 02_h defines a MCCS level of 2.2 (this standard)

<u>NOTE:</u> Support of this code is a mandatory requirement for compliance with MCCS standard Version 2 and higher.</td></tr>
</table>

8.4 Geometry VCP Codes

See Section 0 for drawings to assist with interpretation of these VCP Codes.

Table 8-10: Geometry VCP Codes Cross-reference

VCP Code Name	Code	Compliance
Bottom Corner Flare	$4A_h$	10.6
Bottom Corner Hook	$4C_h$	10.6
Display Scaling	86_h	10.7
Horizontal Convergence M / G	29_h	10.6
Horizontal Convergence R / B	28_h	10.6
Horizontal Keystone	42_h	10.6
Horizontal linearity	$2A_h$	10.6
Horizontal Linearity Balance	$2C_h$	10.6
Horizontal Mirror (Flip)	82_h	10.7
Horizontal Parallelogram	40_h	10.6
Horizontal Pincushion	24_h	10.6
Horizontal Pincushion Balance	26_h	10.6
Horizontal Position (Phase)	20_h	10.6
Horizontal Size	22_h	10.6
Rotation	44_h	10.6
Scan Mode	DA_h	10.7
Top Corner Flare	46_h	10.6
Top Corner Hook	48_h	10.6
Vertical Convergence M / G	39_h	10.6
Vertical Convergence R / B	38_h	10.6
Vertical Keystone	43_h	10.6
Vertical Linearity	$3A_h$	10.6
Vertical Linearity Balance	$3C_h$	10.6
Vertical Mirror (Flip)	84_h	10.7
Vertical Parallelogram	41_h	10.6
Vertical Pincushion	34_h	10.6
Vertical Pincushion Balance	36_h	10.6
Vertical Position (Phase)	30_h	10.6
Vertical Size	32_h	10.6
Window Position (BR_X)	97_h	10.6
Window Position (BR_Y)	98_h	10.6
Window Position (TL_X)	95_h	10.6
Window Position (TL_Y)	96_h	10.6

Table 8-11: Geometry VCP Codes

Code	Name	Type	Function	Description
20_h	Horizontal Position (Phase)	R/W	C	Increasing (decreasing) this value moves the image toward the right (left) side of the display.
22_h	Horizontal Size	R/W	C	Increasing (decreasing) this value will increase (decrease) the width of the image.
24_h	Horizontal Pincushion	R/W	C	Increasing (decreasing) this value will cause the right and left sides of the image to become more (less) convex.
26_h	Horizontal Pincushion Balance	R/W	C	Increasing (decreasing) this value will move the center section of the image toward the right (left) side of the display.
28_h	Horizontal Convergence R/B	R/W	C	Increasing (decreasing) this value will shift the red pixels to the right (left) across the image and the blue pixels left (right) across the image with respect to the green pixels.
29_h	Horizontal Convergence M/G	R/W	C	Increasing (decreasing) this value will shift the magenta pixels to the right (left) across the image and the green pixels left (right) across the image with respect to the magenta pixels.
$2A_h$	Horizontal Linearity	R/W	C	Increasing (decreasing) this value will increase (decrease) the density of pixels in the image center.
$2C_h$	Horizontal Linearity Balance	R/W	C	Increasing (decreasing) this value shifts the density of pixels from the left (right) side to the right (left) side of the image.
30_h	Vertical Position {Phase}	R/W	C	Increasing (decreasing) this value moves the image toward the top (bottom) edge of the display.
32_h	Vertical Size	R/W	C	Increasing (decreasing) this value will increase (decrease) the height of the image
34_h	Vertical Pincushion	R/W	C	Increasing (decreasing) this value will cause the top and bottom edges of the image to become more (less) convex.
36_h	Vertical Pincushion Balance	R/W	C	Increasing (decreasing) this value will move the center section of the image toward the top (bottom) edge of the display.
38_h	Vertical Convergence R/B	R/W	C	Increasing (decreasing) this value shifts the red pixels up (down) across the image and the blue pixels down (up) across the image with respect to the green pixels.
39_h	Vertical Convergence M/G	R/W	C	Increasing (decreasing) this value will shift the magenta pixels up (down) across the image and the green pixels down (up) across the image with respect to the magenta pixels.
$3A_h$	Vertical Linearity	R/W	C	Increasing (decreasing) this value will increase (decrease) the density of scan lines in the image center.
$3C_h$	Vertical Linearity Balance	R/W	C	Increasing (decreasing) this value shifts the density of scan lines from the top (bottom) end to the bottom (top) end of the image.
40_h	Horizontal Parallelogram	R/W	C	Increasing (decreasing) this value shifts the top section of the image to the right (left) with respect to the bottom section of the image.

Table 8-11: Geometry VCP Codes

Code	Name	Type	Function	Description
41_h	Vertical Parallelogram	R/W	C	Increasing (decreasing) this value shifts the top section of the image to the right (left) with respect to the bottom section of the image.
42_h	Horizontal Keystone	R/W	C	Increasing (decreasing) this value will increase (decrease) the horizontal size at the top of the image with respect to the horizontal size at the bottom of the image.
43_h	Vertical Keystone	R/W	C	Increasing (decreasing) this value will increase (decrease) the vertical size at the left of the image with respect to the vertical size at the right of the image.
44_h	Rotation	R/W	C	Increasing (decreasing) this value rotates the image (counter) clockwise about the center point of the screen.
46_h	Top Corner Flare	R/W	C	Increasing (decreasing) this value will increase (decrease) the distance between the left and right sides at the top of the image.
48_h	Top Corner Hook	R/W	C	Increasing (decreasing) this value moves the top of the image to the right (left).
$4A_h$	Bottom Corner Flare	R/W	C	Increasing (decreasing) this value will increase (decrease) the distance between the left and right sides at the bottom of the image.
$4C_h$	Bottom Corner Hook	R/W	C	Increasing (decreasing) this value moves the bottom of the image to the right (left).
82_h	Horizontal Mirror (Flip)	R/W	NC	This VCP code allows the image to be mirrored horizontally. **Byte: SL** 00_h Normal mode 01_h Mirrored horizontally mode $\geq 02_h$ Reserved, must be ignored
84_h	Vertical Mirror (Flip)	R/W	NC	This VCP code allows the image to be mirrored vertically. **Byte: SL** 00_h Normal mode 01_h Mirrored vertically mode $\geq 02_h$ Reserved, must be ignored

Table 8-11: Geometry VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>86_h</td><td>Display Scaling</td><td>R/W</td><td>NC</td><td>Changing this value will affect the scaling (input versus output) function of the display.
<u>NOTE:</u> This VCP code can be used to scale up or down to the maximum screen size.
Controls values $02_h \rightarrow 06_h$ are primarily intended for use with computer displays and controls values $07_h \rightarrow 0A_h$ are primarily intended for use with TV applications.

<table>
<tr><th>Byte: SL</th><th>Name</th><th>Description</th></tr>
<tr><td>00_h</td><td>-</td><td>Reserved, must be ignored</td></tr>
<tr><td>01_h</td><td>No scaling</td><td>No effect, 1:1 relationship</td></tr>
<tr><td>02_h</td><td>Max Image</td><td>Scale to maximum image size with no aspect (AR) ratio distortion</td></tr>
<tr><td>03_h</td><td>Max Vt 1</td><td>Scale to maximum vertical image size with no AR distortion</td></tr>
<tr><td>04_h</td><td>Max Hz 1</td><td>Scale to maximum horizontal image size with no AR distortion</td></tr>
<tr><td>05_h</td><td>Max Vt 2</td><td>Scale to maximum vertical image size with AR distortion</td></tr>
<tr><td>06_h</td><td>Max Hz 2</td><td>Scale to maximum horizontal image size with AR distortion</td></tr>
<tr><td>07_h</td><td>Full mode</td><td>Linear expansion (compression) of the image on horizontal axis.</td></tr>
<tr><td>08_h</td><td>Zoom mode</td><td>Linear expansion (compression) of the image on horizontal and vertical axes.</td></tr>
<tr><td>09_h</td><td>Squeeze mode</td><td>Display all of image content on visible screen. May result in unused areas of visible screen … bars at top, bottom, or sides.</td></tr>
<tr><td>$0A_h$</td><td>Variable</td><td>Display all of image content by applying non-linear expansion (compression) to the horizontal axis.</td></tr>
<tr><td>$\geq 0B_h$</td><td>-</td><td>Reserved, must be ignored</td></tr>
</table>
<u>NOTE:</u>
A more complete description of modes $07_h \rightarrow 0A_h$ may be found in the VESA DI-EXT standard.</td></tr>
<tr><td>95_h</td><td>Window Position (TL_X)</td><td>R/W</td><td>C</td><td>Defines the top left X pixel of an area of the image. Specified in co-ordinates of incoming image before any scaling etc. in the display.</td></tr>
<tr><td>96_h</td><td>Window Position (TL_Y)</td><td>R/W</td><td>C</td><td>Defines the top left Y pixel of an area of the image. Specified in co-ordinates of incoming image before any scaling etc. in the display.</td></tr>
<tr><td>97_h</td><td>Window Position (BR_X)</td><td>R/W</td><td>C</td><td>Defines the bottom right X pixel of an area of the image. Specified in co-ordinates of the incoming image before any scaling etc. in the display.</td></tr>
</table>

Table 8-11: Geometry VCP Codes

Code	Name	Type	Function	Description
98_h	Window Position (BR_Y)	R/W	C	Defines the bottom right Y pixel of an area of the image. Specified in co-ordinates of the incoming image before any processing (e.g. scaling) in the display.
DA_h	Scan Mode	R/W	NC	Controls the scan characteristics. **NOTE:** This VCP code is intended for use with TV applications. **Byte: SL** 00_h Normal operation (no overscan or underscan) 01_h Underscan 02_h Overscan $\geq 03_h$ Reserved, must be ignored

8.5 Miscellaneous Functions VCP Codes

Table 8-12: Miscellaneous Function VCP Code Cross-reference

VCP Code Name	Code	Compliance
Active Control	52_h	10.11
Ambient Light Sensor	66_h	10.7
Application Enable Key	$C6_h$	10.7
Asset Tag	$D2_h$	10.11.4
Auxiliary Display Data	CF_h	10.11.4
Auxiliary Display Size	CE_h	10.11
Auxiliary Power Output	$D7_h$	10.7
Degauss	01_h	10.11.4
Display Descriptor Length	$C2_h$	10.11
Display Identification Data Operation	78_h	10.11.4
Display Technology Type	$B6_h$	10.11
Enable Display of 'Display Descriptor'	$C4_h$	10.7
Flat Panel Sub-Pixel Layout	$B2_h$	10.11
Input Source	60_h	10.11.4
New Control Value	02_h	10.7
Output Select	$D0_h$	10.11.4
Performance Preservation	54_h	10.7
Remote Procedure Call	76_h	10.11.4
Scratch Pad	DE_h	10.7
Soft Controls	03_h	10.7
Status Indicators (Host)	CD_h	10.7
Transmit Display Descriptor	$C3_h$	10.11.4
TV-Channel Up / Down	$8B_h$	10.11.4

Table 8-13: Miscellaneous Functions VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>01_h</td><td>Degauss</td><td>WO</td><td>NC</td><td>Causes a CRT display to perform a degauss cycle.

<table>
<tr><th>Byte: SL</th><th></th></tr>
<tr><td>00_h</td><td>Reserved, must be ignored</td></tr>
<tr><td>$\geq 01_h$</td><td>Degauss</td></tr>
</table>

<table>
<tr><th>Byte: SH, ML, MH</th><th></th></tr>
<tr><td>00_h</td><td>All other values reserved</td></tr>
</table>
</td></tr>
</table>

Table 8-13: Miscellaneous Functions VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>02h</td><td>New Control Value</td><td>R/W</td><td>NC
Mandatory</td><td>Indicates a display's MCCS VCP Code register value has changed.

<table><tr><th>Byte: SL</th><th></th></tr><tr><td>00h</td><td>Reserved, must be ignored</td></tr><tr><td>01h</td><td>No new control value(s)</td></tr><tr><td>02h</td><td>One or more new control value(s) has been changed</td></tr><tr><td>03h → FEh</td><td>Reserved, must be ignored</td></tr><tr><td>FFh</td><td>No user controls are present</td></tr></table>
<table><tr><th>Byte: SH, ML, MH</th><th></th></tr><tr><td>00h</td><td>All other values reserved</td></tr></table>
All VCP value changes, except those made by the host, must be reported to the host by setting VCP 02h to 02h in real time after the value changes regardless of whether the controller considers the change permanent or not.
The value of 02h will be automatically reset to 01h when the VCP 52h FIFO is empty (returns a value of 00h to the host).
The host may write the value of 01h to force a reset of VCP 02h and initialize the VCP 52h FIFO.
Initial values upon power ON:
• VCP 02h must be set to 01h
• VCP 52h must read 00h
MCCS 3.0, MCCS 2.1 and earlier:
A value of 02h must only be reset to a value of 01h by a host write operation and not by the display.
<u>NOTE:</u>
• A recommended implementation of this VCP code in conjunction with VCP code 52h is outlined in Section 8.3.2
• MCCS implemented over the DisplayPort AUX channel must initiate a DP HPD interrupt event. See the DisplayPort standard for details.
• VCP 02h and 52h allow a host/soft OSD to track a sink OSD but not the reverse.
• VCP CAh controls the sink OSD. It is recommended the sink OSD be disabled when using a host/soft OSD.</td></tr>
<tr><td>03h</td><td>Soft Controls</td><td>RO</td><td>NC</td><td>Allows applications running on the host to use control buttons on the display.

<table><tr><th>Byte: SL</th><th></th></tr><tr><td>00h</td><td>No button active</td></tr><tr><td>01h → 0Fh</td><td>Definable 'Soft' Buttons</td></tr></table></td></tr>
</table>

Table 8-13: Miscellaneous Functions VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td></td><td></td><td></td><td></td><td>
<table>
<tr><td>01h</td><td>Button 1 active</td></tr>
<tr><td>02h</td><td>Button 2 active</td></tr>
<tr><td>03h</td><td>Button 3 active</td></tr>
<tr><td>04h</td><td>Button 4 active</td></tr>
<tr><td>05h</td><td>Button 5 active</td></tr>
<tr><td>06h</td><td>Button 6 active</td></tr>
<tr><td>07h</td><td>Button 7 active</td></tr>
<tr><td>08h</td><td>Button 8 active</td></tr>
<tr><td>09h</td><td>Button 9 active</td></tr>
<tr><td>0Ah</td><td>Button 10 active</td></tr>
<tr><td>0Bh</td><td>Button 11 active</td></tr>
<tr><td>0Ch</td><td>Button 12 active</td></tr>
<tr><td>0Dh</td><td>Button 13 active</td></tr>
<tr><td>0Eh</td><td>Button 14 active</td></tr>
<tr><td>0Fh</td><td>Button 15 active</td></tr>
<tr><td>10h → 3Fh</td><td>Predefined Button Types</td></tr>
<tr><td>10h</td><td>Power</td></tr>
<tr><td>11h</td><td>Brightness Up</td></tr>
<tr><td>12h</td><td>Brightness Down</td></tr>
<tr><td>13h</td><td>Left</td></tr>
<tr><td>14h</td><td>Right</td></tr>
<tr><td>15h</td><td>Up</td></tr>
<tr><td>16h</td><td>Down</td></tr>
<tr><td>17h</td><td>Menu</td></tr>
<tr><td>18h</td><td>Enter (Select)</td></tr>
<tr><td>19h</td><td>Exit (Back)</td></tr>
<tr><td>1Ah → 3Fh</td><td>Reserved</td></tr>
<tr><td>40h → 7Eh</td><td>Predefined CE Button Types</td></tr>
<tr><td>40h</td><td>Volume Up</td></tr>
<tr><td>41h</td><td>Volume Down</td></tr>
<tr><td>42h</td><td>Channel (Stream #) Up</td></tr>
<tr><td>43h</td><td>Channel (Stream #) Down</td></tr>
<tr><td>44h</td><td>Input Select Up</td></tr>
<tr><td>45h</td><td>Input Select Down</td></tr>
<tr><td>46h</td><td>Mute Audio</td></tr>
<tr><td>47h → 7Eh</td><td>Reserved</td></tr>
<tr><td>7Fh</td><td>Reserved</td></tr>
<tr><td>80h → FEh</td><td>Release event codes</td></tr>
<tr><td>FFh</td><td>FIFO overrun</td></tr>
</table>
<table>
<tr><td>Byte: ML</td><td></td></tr>
<tr><td>00h → 0Fh</td><td>Number of definable ‘soft’ buttons</td></tr>
</table>
<table>
<tr><td>Bytes: SH, MH</td><td></td></tr>
<tr><td>00h</td><td>All other values reserved</td></tr>
</table>
</td></tr>
<tr><td>52h</td><td>Active Control</td><td>RO</td><td>NC
Mandatory</td><td>All VCP Codes that have new values must be added to this FIFO in the order they occur and VCP 02h must be set to = 02h when this FIFO is NOT empty.
Should VCP 02h be written with a value = 01h by the host this</td></tr>
</table>

Table 8-13: Miscellaneous Functions VCP Codes

Code	Name	Type	Function	Description
				FIFO must be emptied. Reading VCP 52_h removes the first VCP code from the FIFO. When the FIFO is empty, a value = 00_h must be readable and returned to the host A value of 00_h indicates that the FIFO is empty and NOT that the "code page" has changed. The value FF_h indicates that the FIFO has been overrun.

Table 8-13: Miscellaneous Functions VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>54_h</td><td>Perform-ance Preserv-ation</td><td>R/W</td><td>NC</td><td>
Data size: Write = 2 bytes / Read = 4 bytes
This command provides the capability to control up to 16 features aimed at maintaining the performance of a display.
e.g. Features designed to minimize image burn-in
The terms used here are generic, specific implementation details are left to the manufacturer.
A possible value is selected by setting the corresponding bit = 1.
<u>NOTE:</u> Setting more than one bit = 1 in either byte is invalid and must be ignored by the display.
On a read the MH-ML bytes contain the flags corresponding to those functions that are supported by the display. The SH/SL bytes contain the bit field with the appropriate bit(s) set to indicate the current status of the display.
The following table defines the SH and SL bytes, and the MH and ML bytes for read operations only.

<table>
<tr><th>Byte: SH / MH</th><th></th></tr>
<tr><td>Bit 7</td><td>Image “orbiting” mode</td></tr>
<tr><td>Bit 6</td><td>Low luminance mode with “active” video mode</td></tr>
<tr><td>Bit 5</td><td>Slow luminance reduction when a static image is detected mode</td></tr>
<tr><td>Bit 4</td><td>Slow luminance reduction when no user activity is detected mode</td></tr>
<tr><td>Bits 3 → 0</td><td>Reserved, must be ignored</td></tr>
</table>

<table>
<tr><th>Byte: SL / ML</th><th></th></tr>
<tr><td>Bit 7</td><td>A white vertical bar (or line) moving slowly horizontally across the screen on a black background.</td></tr>
<tr><td>Bit 6</td><td>A white image filling the display area.</td></tr>
<tr><td>Bit 5</td><td>A black vertical bar (or line) moving slowly horizontally across the screen on a black background.</td></tr>
<tr><td>Bit 4</td><td>Reverse video … the displayed image is the inverse color of the source image.</td></tr>
<tr><td>Bit 3</td><td>Display is active but video is blanked.</td></tr>
<tr><td>Bit 2</td><td>A gray scale pattern moving slowly horizontally across the screen.</td></tr>
<tr><td>Bits 1 → 0</td><td>Reserved, must be ignored</td></tr>
</table>
</td></tr>
</table>

Table 8-13: Miscellaneous Functions VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>60h</td><td>Input Select</td><td>R/W</td><td>NC</td><td>A one byte write/read (Byte 0), allows the host to set (write) one and only one input as ‘the source’ and identify (read) the current input setting.
<table>
<tr><th>Byte: SL</th><th>Input Definition</th></tr>
<tr><td>01h</td><td>Analog video (R/G/B) 1</td></tr>
<tr><td>02h</td><td>Analog video (R/G/B) 2</td></tr>
<tr><td>03h</td><td>Digital video (TMDS) 1 DVI 1</td></tr>
<tr><td>04h</td><td>Digital video (TMDS) 2 DVI 2</td></tr>
<tr><td>05h</td><td>Composite video 1</td></tr>
<tr><td>06h</td><td>Composite video 2</td></tr>
<tr><td>07h</td><td>S-video 1</td></tr>
<tr><td>08h</td><td>S-video 2</td></tr>
<tr><td>09h</td><td>Tuner 1</td></tr>
<tr><td>0Ah</td><td>Tuner 2</td></tr>
<tr><td>0Bh</td><td>Tuner 3</td></tr>
<tr><td>0Ch</td><td>Component video (YPbPr / YCbCr) 1</td></tr>
<tr><td>0Dh</td><td>Component video (YPbPr / YCbCr) 2</td></tr>
<tr><td>0Eh</td><td>Component video (YPbPr / YCbCr) 3</td></tr>
<tr><td>0Fh</td><td>DisplayPort 1</td></tr>
<tr><td>10h</td><td>DisplayPort 2</td></tr>
<tr><td>11h</td><td>Digital Video (TMDS) 3 HDMI 1</td></tr>
<tr><td>12h</td><td>Digital Video (TMDS) 4 HDMI 2</td></tr>
<tr><td>≥ 13h</td><td>Reserved and are un-assigned</td></tr>
</table>
<table>
<tr><td>Byte: SH, ML, MH</td><td></td></tr>
<tr><td>00h</td><td>All other values reserved</td></tr>
</table></td></tr>
<tr><td>66h</td><td>Ambient Light Sensor</td><td>R/W</td><td>NC</td><td>Used to control the action of an ambient light sensor
<table>
<tr><th>Byte: SL</th><th>Definitions</th></tr>
<tr><td>00h</td><td>Reserved, must be ignored</td></tr>
<tr><td>01h</td><td>Ambient light sensor is disabled</td></tr>
<tr><td>02h</td><td>Ambient light sensor is enabled</td></tr>
<tr><td>≥ 03h</td><td>Reserved, must be ignored</td></tr>
</table>
<table>
<tr><td>Byte: SH</td><td></td></tr>
<tr><td>00h</td><td>All other values reserved</td></tr>
</table>
<table>
<tr><td>Byte: ML</td><td></td></tr>
<tr><td>00h</td><td>Ambient Light Sensor NOT supported</td></tr>
<tr><td>02h</td><td>Ambient Light Sensor supported</td></tr>
</table>
<table>
<tr><td>Byte: MH</td><td></td></tr>
<tr><td>00h</td><td>All other values reserved</td></tr>
</table></td></tr>
</table>

Table 8-13: Miscellaneous Functions VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>76$_h$</td><td>Remote Procedure Call</td><td>WO</td><td>T</td><td>Allows initiation of a routine / macro resident in the display. Only one RPC is defined at this time:
<table>
<tr><th>Byte</th><th>Definition</th></tr>
<tr><td>0</td><td>Defines the operation (see below)</td></tr>
<tr><td>1 + 2</td><td>Offset into the LUT</td></tr>
<tr><td>3 + 4</td><td>1st Red LUT value</td></tr>
<tr><td>5 + 6</td><td>1st Green LUT value</td></tr>
<tr><td>7 + 8</td><td>1st Blue LUT value</td></tr>
<tr><td>9 + 10</td><td>Increment to next LUT entry</td></tr>
<tr><td>11 + 12</td><td>2nd Red LUT value</td></tr>
<tr><td>13 + 14</td><td>2nd Green LUT value</td></tr>
<tr><td>15 + 16</td><td>2nd Blue LUT value</td></tr>
<tr><td>17 + 18</td><td>Increment to next LUT entry</td></tr>
<tr><td>19 + 20</td><td>Etc.</td></tr>
</table>
<table>
<tr><th>Byte 0</th><th>Operation Definitions</th></tr>
<tr><td>00$_h$</td><td>Reserved, must be ignored</td></tr>
<tr><td>01$_h$</td><td>Indicates that a spline curve routine must be applied to the data (supplied in byte 1 and higher)) and the resulting data used to derive a full set of values for the display color LUT which must then be loaded.</td></tr>
<tr><td>02$_h$ → DF$_h$</td><td>Reserved, must be ignored</td></tr>
<tr><td>E0$_h$ → FF$_h$</td><td>Reserved for manufacturer specific operations</td></tr>
</table></td></tr>
<tr><td>78$_h$</td><td>Display Identification Data Operation</td><td>RO</td><td>T</td><td>This command allows a selected block (128 bytes) of Display Identification Data (e.g., EDID or DisplayID) to be read
<table>
<tr><th>Byte 0</th><th>EDID block number</th></tr>
<tr><td>00$_h$</td><td>Base EDID</td></tr>
<tr><td>01$_h$</td><td>First extension block</td></tr>
<tr><td>02$_h$</td><td>Second extension block</td></tr>
<tr><td>03$_h$</td><td>Third extension block</td></tr>
<tr><td>≥ 04$_h$</td><td>Etc.</td></tr>
</table>
NOTE: After receipt of the 128 bytes, users are advised to create a new checksum and verify that it matches the checksum in the last byte of the block.</td></tr>
<tr><td>8B$_h$</td><td>TV-Channel Up / Down</td><td>WO</td><td>NC</td><td>Used to increment / decrement between TV-channels, the exact behavior is implementation specific (e.g. increment / decrement to next numeric channel or increment / decrement to next channel with a signal).
<table>
<tr><th>Byte: SL</th><th></th></tr>
<tr><td>00$_h$</td><td>Reserved, must be ignored</td></tr>
<tr><td>01$_h$</td><td>Increment channel</td></tr>
<tr><td>02$_h$</td><td>Decrement channel</td></tr>
<tr><td>≥ 03$_h$</td><td>Reserved, must be ignored</td></tr>
</table></td></tr>
</table>

Table 8-13: Miscellaneous Functions VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>B2h</td><td>Flat Panel Sub-Pixel Layout</td><td>RO</td><td>NC</td><td>Indicates the type of LCD sub-pixel structure.
<table>
<tr><th>Byte: SL</th><th></th></tr>
<tr><td>00h</td><td>Sub-pixel layout is not defined</td></tr>
<tr><td>01h</td><td>Red / Green / Blue vertical stripe</td></tr>
<tr><td>02h</td><td>Red / Green / Blue horizontal stripe</td></tr>
<tr><td>03h</td><td>lue / Green / Red vertical stripe</td></tr>
<tr><td>04h</td><td>Blue/ Green / Red horizontal stripe</td></tr>
<tr><td>05h</td><td>Quad-pixel, a 2 x 2 sub-pixel structure with red at top left, blue at bottom right and green at top right and bottom left</td></tr>
<tr><td>06h</td><td>Quad-pixel, a 2 x 2 sub-pixel structure with red at bottom left, blue at top right and green at top left and bottom right</td></tr>
<tr><td>07h</td><td>Delta (triad)</td></tr>
<tr><td>08h</td><td>Mosaic with interleaved sub-pixels of different colors</td></tr>
<tr><td>≥ 09h</td><td>Reserved, must be ignored</td></tr>
</table></td></tr>
</table>

Table 8-13: Miscellaneous Functions VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>B6$_h$</td><td>Display Tech-nology Type</td><td>RO</td><td>NC</td><td>Indicates the base technology type.
<u>Caution:</u> Care should be taken that the information declared by this code is consistent with that provided elsewhere within the same display by DisplayID or EDID.

<table>
<tr><th>Byte: SL</th><th>Transducer</th></tr>
<tr><td>00$_h$</td><td>Reserved, must be ignored</td></tr>
<tr><td>01$_h$</td><td>CRT (shadow mask)</td></tr>
<tr><td>02$_h$</td><td>CRT (aperture grill)</td></tr>
<tr><td>03$_h$</td><td>LCD (active matrix)</td></tr>
<tr><td>04$_h$</td><td>LCoS</td></tr>
<tr><td>05$_h$</td><td>Plasma</td></tr>
<tr><td>06$_h$</td><td>OLED</td></tr>
<tr><td>07$_h$</td><td>EL</td></tr>
<tr><td>08$_h$</td><td>Dynamic MEM e.g. DLP</td></tr>
<tr><td>09$_h$</td><td>Static MEM e.g. iMOD</td></tr>
<tr><td>≥ 0A$_h$</td><td>Reserved, must e ignored</td></tr>
</table>

<table>
<tr><th>Byte: SH</th><th>Technology Implementation</th></tr>
<tr><td>00$_h$</td><td>Reserved, must be ignored</td></tr>
<tr><td>01$_h$</td><td>Direct View CRT</td></tr>
<tr><td>02$_h$</td><td>Direct View Flat Panel</td></tr>
<tr><td>03$_h$</td><td>Projection Rear</td></tr>
<tr><td>04$_h$</td><td>Projection Front</td></tr>
<tr><td>05$_h$</td><td>Glasses Mono</td></tr>
<tr><td>06$_h$</td><td>Glasses Stereo</td></tr>
<tr><td>≥ 07$_h$</td><td>Reserved, must be ignored</td></tr>
</table>

<table>
<tr><th>Byte: ML</th><th></th></tr>
<tr><td>≥ 00$_h$</td><td>Reserved, must be ignored</td></tr>
</table>

<table>
<tr><th>Byte: MH</th><th></th></tr>
<tr><td>≥ 00$_h$</td><td>Reserved, must be ignored</td></tr>
</table>
</td></tr>
<tr><td>C2$_h$</td><td>Display Descriptor Length</td><td>RO</td><td>C</td><td>Returns the length (in bytes) of non-volatile storage in the display available for writing a display descriptor – the maximum descriptor length is 256 bytes
See VCP code C3$_h$.</td></tr>
<tr><td>C3$_h$</td><td>Transmit Display Descriptor</td><td>R/W</td><td>T</td><td>Allows a display descriptor (up to maximum length defined by the display (see code C2$_h$) to be written (read) to (from) non-volatile storage in the display.
The data must conform to ISO 8859-2 (Latin 1) code set (ASCII code).
If an attempt is made to write beyond the maximum storage length, the descriptor must be truncated with the excess bytes being discarded.</td></tr>
</table>

Table 8-13: Miscellaneous Functions VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>C4_h</td><td>Enable Display of ‘Display Descriptor’</td><td>R/W</td><td>NC</td><td>If enabled, the display descriptor written to the display using VCP code C3_h must be displayed when no video is being received. The duration for which it is displayed is left to individual manufacturers.

<table><tr><th>Byte: SL</th><th></th></tr><tr><td>00_h</td><td>Reserved, must be ignored</td></tr><tr><td>01_h</td><td>Display is enabled</td></tr><tr><td>02_h</td><td>Display is disabled</td></tr><tr><td>≥ 03_h</td><td>Reserved, must be ignored</td></tr></table></td></tr>
<tr><td>C6_h</td><td>Appli-cation Enable Key</td><td>RO</td><td>NC</td><td>A 2-byte value used to allow an application to only operate with known products. The display manufacturer and application author agree to a code such that application will only run when a valid code is present in the display.</td></tr>
<tr><td>C7_h</td><td>Display Enable Key</td><td>WO</td><td>NC</td><td><u>Caution:</u> This VCP code has been deprecated. It must NOT be implemented in new designs!

The following description of this VCP in versions prior to V2.2 is provided for reference ONLY!

A 2-byte value used to provide display security. If the display does not receive a code that it recognizes to be valid then it shall cease normal operation and indicate to the user that there is a security violation.

In order to allow correct display of POST etc messages this will become effective some period (defined by the manufacturer) after the display is powered on. The key will remain valid until either the display is powered off or the interface is disconnected.</td></tr>
</table>

Table 8-13: Miscellaneous Functions VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>CD_h</td><td>Status Indicators (Host)</td><td>R/W</td><td>NC</td><td>This command provides the capability to control up to 16 LED (or similar) indicators which may be used to indicate aspects of the host system status. The capability string must report the functions supported by the display and these must be mapped to the 16 bits of the command in the sequence reported in the capability string starting with the most significant bit of the first byte.
Meaning of values reported in the capability string:
<table>
<tr><th>Byte: SH</th><th></th><th>Mapping #</th></tr>
<tr><td>Bit 7</td><td>Host power is ‘on’</td><td>1</td></tr>
<tr><td>Bit 6</td><td>Hard drive is active</td><td>2</td></tr>
<tr><td>Bit 5</td><td>New e-mail received</td><td>3</td></tr>
<tr><td>Bit 4</td><td>New voicemail received</td><td>4</td></tr>
<tr><td>Bit 3</td><td>Appointment reminder</td><td>5</td></tr>
<tr><td>Bit 2</td><td>Phone is busy</td><td>6</td></tr>
<tr><td>Bit 1</td><td>Speaker phone function active</td><td>7</td></tr>
<tr><td>Bit 0</td><td>Battery is charging</td><td>8</td></tr>
<tr><td>Byte: SL</td><td></td><td></td></tr>
<tr><td>Bit 7</td><td>LAN is active</td><td>9</td></tr>
<tr><td>Bits 6 → 0</td><td>Reserved, must be ignored</td><td>10 → 16</td></tr>
</table>
In all cases writing a “1” to the indicator must turn it ‘on’ and writing a “0” to the indicator must turn it ‘off’.</td></tr>
<tr><td>CE_h</td><td>Auxiliary Display Size</td><td>RO</td><td>NC</td><td>An ‘auxiliary display’ is a small alphanumeric display associated with the primary display and able to be accessed via the primary display.
This command returns a 1-byte value that defines the number of characters and the number of rows available. The format is:
<table>
<tr><th>Byte: SL</th><th></th></tr>
<tr><td>Bits 7 → 6</td><td>The number of rows + 1</td></tr>
<tr><td>Bits 5 → 0</td><td>The number of characters / row + 1</td></tr>
</table>
i.e. The maximum auxiliary display size is 5 rows each with 65 characters</td></tr>
<tr><td>CF_h</td><td>Auxiliary Display Data</td><td>WO</td><td>T</td><td>An ‘auxiliary display’ is a small alphanumeric display associated with the primary display and able to be accessed via the primary display.
This command transmits a number of bytes of alphanumeric data to be displayed on the auxiliary display. The data must conform to ISO 8859-2 (Latin 1) code set (ASCII code).
The auxiliary display will be written from the top left position, moving to right along each line and then starting at left end of the next line.</td></tr>
</table>

Table 8-13: Miscellaneous Functions VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>D0_h</td><td>Output Select</td><td>R/W</td><td>NC</td><td>A one byte write/read (Byte 0), allows the host to set (write) one and only one source to output and identify (read) the current output setting,

<table>
<tr><th>Byte: SL</th><th>Output Definition</th></tr>
<tr><td>01_h</td><td>Analog video (R/G/B) 1</td></tr>
<tr><td>02_h</td><td>Analog video (R/G/B) 2</td></tr>
<tr><td>03_h</td><td>Digital video (TMDS) 1 DVI 1</td></tr>
<tr><td>04_h</td><td>Digital video (TMDS) 2 DVI 2</td></tr>
<tr><td>05_h</td><td>Composite video 1</td></tr>
<tr><td>06_h</td><td>Composite video 2</td></tr>
<tr><td>07_h</td><td>S-video 1</td></tr>
<tr><td>08_h</td><td>S-video 2</td></tr>
<tr><td>09_h</td><td>Tuner 1</td></tr>
<tr><td>0A_h</td><td>Tuner 2</td></tr>
<tr><td>0B_h</td><td>Tuner 3</td></tr>
<tr><td>0C_h</td><td>Component video (YPbPr / YCbCr) 1</td></tr>
<tr><td>0D_h</td><td>Component video (YPbPr / YCbCr) 2</td></tr>
<tr><td>0E_h</td><td>Component video (YPbPr / YCbCr) 3</td></tr>
<tr><td>0F_h</td><td>DisplayPort 1</td></tr>
<tr><td>10_h</td><td>DisplayPort 2</td></tr>
<tr><td>11_h</td><td>Digital Video (TMDS) 3 HDMI 1</td></tr>
<tr><td>12_h</td><td>Digital Video (TMDS) 4 HDMI 2</td></tr>
<tr><td>13_h → FF_h</td><td>Reserved and are un-assigned</td></tr>
</table>
</td></tr>
</table>

Table 8-13: Miscellaneous Functions VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>D2_h</td><td>Asset Tag</td><td>R/W</td><td>T</td><td>
Data length: Read / write = 16 bytes
This VCP codes allows an Asset Tag to be written to a display or read from a display. It also allows for control by the display manufacturer of which applications may write an asset tag.

Read operation:
No key required, the 16 bytes returned by the display may contain any value in bytes 0 and 1. The key should not be returned.

Write operation:
A successful write operation requires that bytes 0 and 1 contain the correct key, if they do not then the display must take no action.

<table>
<tr><th>Byte</th><th>Definition</th></tr>
<tr><td>0</td><td>MSB of key</td></tr>
<tr><td>1</td><td>LSB of key</td></tr>
<tr><td>2</td><td>MSB of asset tag</td></tr>
<tr><td>3</td><td>↑</td></tr>
<tr><td>4</td><td>|</td></tr>
<tr><td>5</td><td>|</td></tr>
<tr><td>6</td><td>|</td></tr>
<tr><td>7</td><td>|</td></tr>
<tr><td>8</td><td>|</td></tr>
<tr><td>9</td><td>|</td></tr>
<tr><td>10</td><td>|</td></tr>
<tr><td>11</td><td>|</td></tr>
<tr><td>12</td><td>|</td></tr>
<tr><td>13</td><td>|</td></tr>
<tr><td>14</td><td>↓</td></tr>
<tr><td>15</td><td>LSB of asset tag</td></tr>
</table>
Data must be stored in ASCII (code page # 437) starting in byte 2 (MSB of the asset tag). If the stored asset tag is < 14 characters then the asset tag must be terminated with the ASCII character A0_h and, if required, the remainder of the asset tag bytes packed with ASCII character 20_h.
The 2-byte key may be as simple a “secret” number or be derived by taking certain required elements of the base EDID and manipulating the values of those elements by a mathematical formula – the formula used for a particular display (or family of displays) should only be released by the display manufacturer to users they trust.
<u>NOTE:</u> When shipped from the manufacturing location, the data field must be set=00_h unless an asset tag has been stored to meet a customer requirement.
</td></tr>
</table>

Table 8-13: Miscellaneous Functions VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>$D7_h$</td><td>Auxiliary Power Output</td><td>R/W</td><td>NC</td><td>Controls output of an auxiliary power output from a display to a host device.

<table><tr><th>Byte: SL</th><th></th></tr><tr><td>00_h</td><td>Reserved, must be ignored</td></tr><tr><td>01_h</td><td>Disable auxiliary output power</td></tr><tr><td>02_h</td><td>Enable auxiliary output power</td></tr><tr><td>$\geq 03_h$</td><td>Reserved, must be ignored</td></tr></table></td></tr>
<tr><td>DE_h</td><td>Scratch Pad</td><td>R/W</td><td>NC</td><td>Provides 2 bytes of volatile storage for use of software application(s) … leading to more efficient operation.
<u>NOTE:</u>
1. The display must set these bytes = 00_h following a power-on or power off/on cycle.
Aside from the actions of note 1, the display must not take any action with these bytes.</td></tr>
</table>

8.6 Audio Function VCP Codes

Table 8-14: Audio Function VCP Code Cross-reference

VCP Code Name	Code	Compliance
Audio: Balance L / R	93_h	10.7
Audio: Bass	91_h	10.7
Audio: Jack Connection Status	65_h	10.7
Audio: Microphone Volume	64_h	10.6
Audio: Mute (screen blank)	$8D_h$	10.7
Audio: Processor Mode	94_h	10.7
Audio: Speaker Select	63_h	10.7
Audio: Speaker Volume	62_h	10.7
Audio: Treble	$8F_h$	10.7

Table 8-15: Audio Function VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>62_h</td><td>Audio: Speaker Volume</td><td>R/W</td><td>NC</td><td>Allows the volume to be adjusted.

<table><tr><th>Byte: SL</th><th></th></tr><tr><td>00_h</td><td>Fixed (default) level</td></tr><tr><td>$01_h \rightarrow FE_h$</td><td>Volume level</td></tr><tr><td>FF_h</td><td>Mute</td></tr></table><u>NOTE:</u> The level will increase from a minimum at a value = 01_h to a maximum at a value = FE_h</td></tr>
<tr><td>63_h</td><td>Speaker Select</td><td>R/W</td><td>NC</td><td>Allows a “pair” (may be physically more than two speakers) of speakers to be selected.

<table><tr><th>Byte: SL</th><th></th></tr><tr><td>00_h</td><td>FL/FR</td></tr><tr><td>01_h</td><td>SL/SR</td></tr><tr><td>02_h</td><td>RL/RR</td></tr><tr><td>03_h</td><td>FC/LFE</td></tr><tr><td>04_h</td><td>RC</td></tr><tr><td>05_h</td><td>FLC/FRC</td></tr><tr><td>06_h</td><td>RLC/RRC</td></tr><tr><td>07_h</td><td>FLW/FRW</td></tr><tr><td>08_h</td><td>FLH/FRH</td></tr><tr><td>09_h</td><td>TC</td></tr><tr><td>$0A_h$</td><td>FCH</td></tr><tr><td>$0B_h \rightarrow FF_h$</td><td>Reserved</td></tr></table></td></tr>
<tr><td>64_h</td><td>Audio: Micro-phone Volume</td><td>R/W</td><td>C</td><td>Increasing (decreasing) this value will increase (decrease) the microphone gain.</td></tr>
</table>

Table 8-15: Audio Function VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>65_h</td><td>Audio: Jack Connection Status</td><td>RO</td><td>NC</td><td>
This bitmask allows the source to determine the capabilities as well as the current configuration of speakers/lineout connected to a display, or active in an audio only device.
This command provides the capability to identify up to 16 connections (pairs) of audio.
Hardware support for an audio channel/pair is identified by the bits in the mask that are set to 1 in bytes SL and SH. These bits are set by the manufacturer to identify the presence of audio hardware in the device. This does NOT indicate the presence of connected external speakers to the corresponding connector on the device.
The presence of connected audio channel/pair is identified by the bits in the mask that are set to 1 in bytes ML and MH. These bits are set or reset upon connecting or removing external speakers to the corresponding connector on the device.
If the device is a speaker/amp or audio only device, its location(s) can be determined by each bit that is set to 1.
Data size: 4 bytes. Read Only. The default value is 00 00 00 00_h

<table>
<tr><th>Byte: SL</th><th>Audio Channels Connected</th></tr>
<tr><td>Bit 0</td><td>FL/FR</td></tr>
<tr><td>Bit 1</td><td>LFE</td></tr>
<tr><td>Bit 2</td><td>FC</td></tr>
<tr><td>Bit 3</td><td>RL/RR</td></tr>
<tr><td>Bit 4</td><td>RC</td></tr>
<tr><td>Bit 5</td><td>FLC/FRC</td></tr>
<tr><td>Bit 6</td><td>RLC/RRC</td></tr>
<tr><td>Bit 7</td><td>FLW/FRW</td></tr>
</table>

<table>
<tr><th>Byte: SH</th><th>Audio Channels Connected</th></tr>
<tr><td>Bit 0</td><td>FLH/FRH</td></tr>
<tr><td>Bit 1</td><td>TC</td></tr>
<tr><td>Bit 2</td><td>FCH</td></tr>
<tr><td>Bit 3</td><td>Reserved</td></tr>
<tr><td>Bit 4</td><td>Reserved</td></tr>
<tr><td>Bit 5</td><td>SL/SR</td></tr>
<tr><td>Bit 6</td><td>SPDIF Out Jack</td></tr>
<tr><td>Bit 7</td><td>HDMI Out Jack</td></tr>
</table>
</td></tr>
</table>

Table 8-15: Audio Function VCP Codes

Code	Name	Type	Function	Description
				CONTINUED ON NEXT PAGE

Byte: ML	Audio Channels Supported
Bit 0	FL/FR
Bit 1	LFE
Bit 2	FC
Bit 3	RL/RR
Bit 4	RC
Bit 5	FLC/FRC
Bit 6	RLC/RRC
Bit 7	FLW/FRW

Byte: MH	Audio Channels Supported
Bit 0	FLH/FRH
Bit 1	TC
Bit 2	FCH
Bit 3	Reserved
Bit 4	Reserved
Bit 5	SL/SR
Bit 6	SPDIF Out Jack
Bit 7	HDMI Out Jack

NOTES:

1. The "New Control Value" register 02_h will be set and "Active Control" register 52_h updated when a connection state changes.
2. VCP 65_h, as returned with "GetVCPFeature" [VCP 65_h], returns a 4 byte bitmask, identifying both the "available" physical connections on the product, and the "currently" connected speakers/lineout to the device.
3. The capabilities string reports only support for VCP 65_h but includes NO data bytes. The host must use "GetVCPFeature" to read the four-byte information packet.

Table 8-15: Audio Function VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>8D$_h$</td><td>Audio Mute / Screen Blank</td><td>R/W</td><td>NC</td><td>Provides for the audio to be muted or un-muted. Also provides for blanking the screen of the display whether or not there is a valid video signal present.

<table>
<tr><th>Byte: SL</th><th></th></tr>
<tr><td>00$_h$</td><td>Reserved, must be ignored</td></tr>
<tr><td>01$_h$</td><td>Mute the audio</td></tr>
<tr><td>02$_h$</td><td>Un-mute the audio</td></tr>
<tr><td>≥ 03$_h$</td><td>Reserved, must be ignored</td></tr>
</table>
<table>
<tr><th>Byte: SH</th><th></th></tr>
<tr><td>00$_h$</td><td>Reserved, must be ignored</td></tr>
<tr><td>01$_h$</td><td>Blank the screen</td></tr>
<tr><td>02$_h$</td><td>Un-blank the screen</td></tr>
<tr><td>≥ 03$_h$</td><td>Reserved, must be ignored</td></tr>
</table>
<table>
<tr><th>Byte: ML</th><th></th></tr>
<tr><td>00$_h$</td><td>Audio Mute NOT supported</td></tr>
<tr><td>02$_h$</td><td>Audio Mute supported</td></tr>
</table>
<table>
<tr><th>Byte: MH</th><th></th></tr>
<tr><td>00$_h$</td><td>Screen Blanking NOT supported</td></tr>
<tr><td>02$_h$</td><td>Screen Blanking supported</td></tr>
</table></td></tr>
<tr><td>8F$_h$</td><td>Audio Treble</td><td>R/W</td><td>NC</td><td>Allows control of the high frequency component of the audio.

<table>
<tr><th>Byte: SL</th><th></th></tr>
<tr><td>00$_h$</td><td>Reserved, must be ignored</td></tr>
<tr><td>01$_h$ → 7F$_h$</td><td>Cut the treble</td></tr>
<tr><td>80$_h$</td><td>Neutral … no effect</td></tr>
<tr><td>81$_h$ → FF$_h$</td><td>Boost the treble</td></tr>
</table>
<u>NOTE:</u> As value is reduced below 80$_h$, the treble content will be increasingly cut.
As value is increased above 80$_h$, the treble content will be increasingly boosted</td></tr>
<tr><td>91$_h$</td><td>Audio Bass</td><td>R/W</td><td>NC</td><td>Allows control of the low frequency component of the audio.
<table>
<tr><th>Byte: SL</th><th></th></tr>
<tr><td>00$_h$</td><td>Reserved, must be ignored</td></tr>
<tr><td>01$_h$ → 7F$_h$</td><td>Cut the bass</td></tr>
<tr><td>80$_h$</td><td>Neutral … no effect</td></tr>
<tr><td>81$_h$ → FF$_h$</td><td>Boost the bass</td></tr>
</table>
<u>NOTE:</u> As value is reduced below 80$_h$, the bass content will be increasingly cut.
As value is increased above 80$_h$, the bass content will be increasingly boosted</td></tr>
</table>

Table 8-15: Audio Function VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>93_h</td><td>Audio Balance L / R</td><td>R/W</td><td>NC</td><td>This control affects the left – right balance of audio output. Increasing (decreasing) the value will cause the balance to move to the right (left).

<table><tr><th>Byte: SL</th><th></th></tr><tr><td>00_h</td><td>Reserved, must be ignored</td></tr><tr><td>$01_h \rightarrow 7F_h$</td><td>Left (L) channel dominates</td></tr><tr><td>80_h</td><td>Centered</td></tr><tr><td>$81_h \rightarrow FE_h$</td><td>Center / Sub-woofer</td></tr><tr><td>FF_h</td><td>Reserved, must be ignored</td></tr></table>
<u>NOTE:</u> As value is reduced below 80_h, the left channel will be increasingly dominant.
As value is increased above 80_h, the right channel will become increasingly dominant.</td></tr>
</table>

Table 8-15: Audio Function VCP Codes

Code	Name	Type	Function	Description
94_h	Audio Processor Mode	R/W	NC	This control allows one of several audio processing modes to be selected.

Byte: SL	Name	Definition
00_h	Audio processing is not supported.	
01_h	Mono	Both display audio channels use the left audio channel
02_h	Stereo	Incoming left and right audio channels feed separate display output audio channels.
03_h	Stereo expanded	As defined by the manufacturer.
$04_h \rightarrow 10_h$	Reserved	Must be ignored
11_h	SRS 2.0	SRS stereo
12_h	SRS 2.1	SRS stereo + subwoofer
13_h	SRS 3.1	SRS stereo + subwoofer + center
14_h	SRS 4.1	SRS stereo + subwoofer + rear
15_h	SRS 5.1	SRS stereo + subwoofer + rear + center
16_h	SRS 6.1	SRS stereo + subwoofer + side
17_h	SRS 7.1	SRS stereo + subwoofer + side + center
$18_h \rightarrow 20_h$	Reserved	Must be ignored
21_h	Dolby 2.0	Dolby stereo
22_h	Dolby 2.1	Dolby stereo + subwoofer
23_h	Dolby 3.1	Dolby stereo + subwoofer + center
24_h	Dolby 4.1	Dolby stereo + subwoofer + rear
25_h	Dolby 5.1	Dolby stereo + subwoofer + rear + center
26_h	Dolby 6.1	Dolby stereo + subwoofer + side
27_h	Dolby 7.1	Dolby stereo + subwoofer + side + center
$28_h \rightarrow 30_h$	Reserved	Must be ignored
31_h	THX 2.0	THX stereo
32_h	THX 2.1	THX stereo + subwoofer
33_h	THX 3.1	THX stereo + subwoofer + center
34_h	THX 4.1	THX stereo + subwoofer + rear
35_h	THX 5.1	THX stereo + subwoofer + rear + center
36_h	THX 6.1	THX stereo + subwoofer + side
37_h	THX 7.1	THX stereo + subwoofer + side + center
$\geq 38_h$	Reserved	Shall be ignored

8.7 DPVL Support VCP Codes

Table 8-16: DPVL Support Cross-reference

VCP Code Name	Code	Compliance
Body CRC Error Count	BC_h	n/a
Client ID	BD_h	n/a
Header Error Count	BB_h	n/a
Link Control	BE_h	n/a
Monitor Status	$B7_h$	n/a
Monitor X Origin	$B9_h$	n/a
Monitor Y Origin	BA_h	n/a
Packet Count	$B8_h$	n/a

NOTE:

- All DPVL data values are 2 bytes
- See the DPVL standard for details of the meaning and usage of each of these VCP codes.
- Compliance procedures for DPVL VCP Codes is beyond the scope of the current standard

Table 8-17: DPVL Support VCP Codes

<table>
<tr><th>Code</th><th>Name</th><th>Type</th><th>Function</th><th>Description</th></tr>
<tr><td>B7$_h$</td><td>Monitor Status</td><td>RO</td><td>NC</td><td>Video mode and status of a DPVL capable monitor.
<table>
<tr><th>Byte: SL</th><th>Value</th><th>Definition</th></tr>
<tr><td>Bits 7 → 3</td><td></td><td>Reserved, set = 0</td></tr>
<tr><td rowspan="2">Bit 2</td><td>= 0</td><td>No error detected in the last header received</td></tr>
<tr><td>= 1</td><td>Error detected in the last header received</td></tr>
<tr><td rowspan="2">Bit 1</td><td>= 0</td><td>Monitor is able to receive the next packet</td></tr>
<tr><td>= 1</td><td>Monitor is unable to accept another packet</td></tr>
<tr><td rowspan="2">Bit 0</td><td>= 0</td><td>Raster scan mode</td></tr>
<tr><td>= 1</td><td>DPVL mode</td></tr>
</table></td></tr>
<tr><td>B8$_h$</td><td>Packet Count</td><td>R/W</td><td>C</td><td>Counter for the DPVL packets received (valid and invalid ones). This value counts from 00 00$_h$ to FF FF$_h$ and then rolls over to 00 00$_h$.
The host can reset the value to 00 00$_h$.</td></tr>
<tr><td>B9$_h$</td><td>Monitor X Origin</td><td>R/W</td><td>C</td><td>The X origin of the monitor in the virtual screen. The support of this command indicates the multi-display support of the display. If a display supports this command, the monitor must also support Monitor Y Origin command.
“00 00$_h$” to “FF FF$_h$” or 0 to 65535</td></tr>
<tr><td>BA$_h$</td><td>Monitor Y Origin</td><td>R/W</td><td>C</td><td>The Y origin of the display in the virtual screen. The support of this command indicates the multi-display support of the display. If a display supports this command, the monitor must also support Monitor X Origin command.
“00 00$_h$” to “FF FF$_h$” or 0 to 65535</td></tr>
<tr><td>BB$_h$</td><td>Header Error Count</td><td>R/W</td><td>C</td><td>Error Counter for the DPVL header. The counter value saturates at FF FF$_h$. Host can reset to 00 00$_h$.</td></tr>
<tr><td>BC$_h$</td><td>Body CRC Error Count</td><td>R/W</td><td>C</td><td>CRC error Counter for the DPVL body (containing video data). The counter value saturates at FF FF$_h$. The Host can reset to 00 00$_h$</td></tr>
<tr><td>BD$_h$</td><td>Client ID</td><td>R/W</td><td>C</td><td>Assigned identification number for the monitor.
Valid range is 0000$_h$ to FF FE$_h$; FF FF$_h$ is reserved for broadcast.</td></tr>
<tr><td>BE$_h$</td><td>Link Control</td><td>R/W</td><td>NC</td><td>Indicates the status of the DVI link.
<table>
<tr><th>Byte: SL</th><th>Value</th><th>Definition</th></tr>
<tr><td>Bits 7 → 1</td><td></td><td>Reserved, set = 0</td></tr>
<tr><td rowspan="2">Bit 0</td><td>= 0</td><td>Link shutdown is disabled</td></tr>
<tr><td>= 1</td><td>Link shutdown is enabled</td></tr>
</table></td></tr>
</table>

8.8 Manufacturer Specific VCP Codes

Table 8-18: Manufacturer Specific VCP Codes

Code	VCP Code Name	Type	Function	Description
$E0_h$	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
$E1_h$	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
$E2_h$	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
$E3_h$	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
$E4_h$	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
$E5_h$	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
$E6_h$	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
$E7_h$	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
$E8_h$	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
$E9_h$	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
EA_h	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
EB_h	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
EC_h	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
ED_h	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
EE_h	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
EF_h	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
$F0_h$	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
$F1_h$	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
$F2_h$	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
$F3_h$	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
$F4_h$	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
$F5_h$	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
$F6_h$	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
$F7_h$	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
$F8_h$	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
$F9_h$	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
FA_h	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
FB_h	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
FC_h	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
FD_h	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
FE_h	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer
FF_h	Manufacturer Specific	TBD	TBD	May be defined by display manufacturer

9 Compliance

9.1 Overview

This section specifies the requirements and procedures to ensure that a display is compliant with VESA's MCCS Version 3.

Compliance may either be by visual assessment with a suitably trained and qualified operator or by instrumentation at varying levels up to and including a fully automatic implementation. The test patterns required at each stage of the compliance procedures will vary depending on the characteristics of the assessment / measurement system being used. This standard does not address the issue of suitable patterns. However, the VESA FPDM-2 standard (Flat Panel Display Measurements) should be used as both a guide to good metrology practice and a source of many suitable test patterns.

The appropriate compliance procedures depends on the VCP Codes supported by a particular display but a compliant display requires that all appropriate compliance procedures are performed with a 'Compliant' result at each stage of the compliance procedures for all supported VCP codes.

The test procedures assume that a software tool is available that can exercise the VCP Codes. It is the responsibility of the organization conducting the compliance procedure to verify that any software tool(s) and detailed compliance procedures are in conformance with the requirements of this standard.

9.2 Compliance of Manufacturer VCP Codes

Manufacturer VCP codes can be considered to have two sub-classes:

- Those that are public and extend the scope of the MCCS VCP code set in a manner that the manufacturer wishes to promote and have used, and
- Those that are private and perform functions that the manufacturer does not wish the end user to access.

All public manufacturer VCP codes (see Table 8-18) that are declared in the capability string must also be required to pass a test for compliance with the product design specification. The procedure(s) used to ensure the compliance of the manufacturer VCP Codes is (are) the responsibility of the display manufacturer.

Private manufacturer VCP codes are outside the scope of this compliance procedure.

9.3 Summary of Compliance

The appropriate compliance procedures depends on the VCP Codes supported by a particular display but a compliant display requires that all appropriate compliance procedures are performed with a 'Compliant' result at every stage.

9.4 Compliance Testing – General Points

4. VESA MCCS Standard Version 2.2 requires that VCP Codes 02_h (New Control Value) and DF_h (VCP Version) must be implemented. Compliance requires that these are supported, correctly reported in the Capability String and pass the appropriate compliance procedures.
5. Read and parse the Capability String to determine the VCP Codes that the display claims to support, this list must define the basic display feature set for compliance tests.
6. Verify that all elements of the display feature set (except Manufacturer Specific and DPVL Support VCP Codes) meet the requirements of the appropriate compliance test procedure.
7. Verify that unassigned VCP Codes (reserved) are not used by the display - use of these VCP Codes must result in non-compliance, except where the MCCS_UP.pdf document (www.vesa.org) has been used to indicate a new definition(s). In this case a display is

considered compliant if it does not use VCP Codes that are unassigned in either the MCCS standard or the MCCS_UP document.

8. The compliance test procedures defined are segregated into several sub-groups. In some cases a common compliance procedure for several of the VCP Codes of the sub-group is defined, in other cases there are specific compliance procedures for individual VCP Codes.
9. In some cases, the maximum or minimum value may set the display into an unfavorable mode which renders it inoperable to the casual user (e.g. no image is visible). Minimum and maximum values should be designed to avoid this problem.

10 Compliance Procedures

10.1 Introduction

This section gives a compliance procedure for each of the groups of VCP Codes that a display may support.

NOTE: Support for some VCP Codes is a requirement for compliance but most are optional allowing design flexibility.

10.2 Organization of Compliance Procedures

Wherever possible a compliance procedure is written to cover a group of VCP codes with common characteristics, however, this is not possible in all cases, and there are some compliance procedures that are only appropriate for a specific VCP code. The follow table summarizes the purpose and scope of the various compliance procedures.

Table 10-1: Compliance Procedures Purpose and Scope

VCP Group Description	Scope	Procedure(s)
Mandatory	VCP Code Page (00_h) New control value (02_h) Active Control (52_h) Display Controller ID ($C8_h$) VCP version (DF_h)	10.8 10.3 10.11 10.11 10.4
Capability String	All	10.5
Continuous "C"	All VCP codes of function "C" not identified explicitly	10.6
Non-continuous "NC"	All VCP codes of function "NC" not identified explicitly	10.7
Presets	Preset VCP codes defined in 8.1	10.8
Auto set-up	Auto Set-up ($1E_h$) and Auto Color Set-up ($1F_h$)	10.9
6 Axis Color	Saturation Hue	10.10.1 10.10.2
Read Only "RO"	Horizontal and Vertical frequency (AC_h and AE_h) Display usage time ($C0_h$) Others of type 'RO' 1. Display Controller Type, ($C8_h$) 2. Display Firmware Level, ($C9_h$) 3. Flat Panel Sub-Pixel layout, ($B2_h$) 4. Display technology Type, ($B6_h$) 5. Application Enable Key, ($C6_h$) Auxiliary Display Size, (CE_h)	10.11.1 10.11.2 10.11.3 10.11.4
Write only "WO"	Degauss (01_h)	10.11.5

Table 10-1: Compliance Procedures Purpose and Scope

VCP Group Description	Scope	Procedure(s)
Table "T"	Input source & output select (60_h & $D0_h$)	10.12.1
	Source timing mode ($B4_h$)	10.12.2
	Display Identification Data Operation (78_h)	10.12.3
	Auxiliary display data (CF_h)	10.12.4
	Transmit display descriptor ($C3_h$)	10.12.5
	Asset tag ($D2_h$)	10.12.6
	LUT size (73_h)	10.12.7
	Single point LUT operation (74_h)	10.12.8
	Block LUT (75_h)	10.12.9
	Remote procedure call (76_h)	10.12.10
	TV-channel up/down ($8B_h$)	10.12.11
	Auto set-up on/off ($A2_h$)	10.12.12
	Display enable key ($C7_h$)	10.12.13

10.3 Compliance Procedure for VCP Code 02_h – New Control Value

This VCP Code is used to determine if a display control has been used, this control allows for the synchronization of display hardware/firmware and a software utility.

For 'buttonless' displays, use compliance procedure 10.3.1. For displays with user controls to access the conventional OSD, use compliance procedure 10.3.2

10.3.1 Buttonless Display – Verify Read and Write Operation of VCP Code 02_h

The following compliance procedure verifies that the display accurately reports the absence of buttons or other manual controls to set adjustments via the conventional OSD.

Table 10-2: Compliance Procedure (buttonless) for VCP Code 02_h

Stage #	Action	Result
1	Set the display to 'factory default'	n/a
2	Read the current value at VCP Code 02_h	If value read = FF_h: Compliant If value read ≠ FF_h: Not compliant
3	Write any value other than FF_h to VCP Code 02_h	n/a
4	Read the current value at VCP Code 02_h	If value read = FF_h: Compliant If value read ≠ FF_h: Not compliant
5	Determination of compliance	All stage results are 'Compliant': VCP Code 02_h is compliant

10.3.2 Display with Manual Controls – Verify Read and Write of VCP Code 02_h

The following test verifies that the display supports the ability to read and write to VCP code 02_h for synchronization between hardware and software adjustments made to the display.

Table 10-3: Compliance Procedure for VCP Code 02_h

Stage #	Action	Result
1	Set the display to 'factory default'	n/a
2	Write a value of 01_h to VCP Code 02_h	If value read = FF_h: Compliant If value read ≠ FF_h: Not compliant
3	Read the current value at VCP Code 02_h	If value read = 01_h: Compliant and continue to stage 4 If value read ≠ 01_h: Not compliant
4	Activate first user control function with user display controls and OSD	n/a
5	Read the current value at VCP Code 02_h	If value read > 01_h AND < FF_h: Compliant and continue to stage 6 If value read = 00_h, 01_h OR FF_h: Not compliant
6	Repeat stages 4 and 5 with all other user control functions with user display controls and OSD	n/a
7	Determination of compliance	All stage results are 'Compliant': VCP Code 02_h is compliant

Caution: This procedure will verify the basic operation but does not verify that the operation will perform correctly in real-time. The requirement is that there is no discernable lag in synchronization to a user.

10.4 Compliance Procedure for VCP Code DF_h – VCP Version

Table 10-4: Compliance Procedure for VCP Code DF_h

Stage #	Action	Result
1	Read the current value at VCP Code DF_h	If value read matches the MCCS version and revision levels intended for this display design, then Compliant. If value read does not match either or both the MCCS version and revision level intended for this design then Not Compliant.

10.5 Compliance Procedure for Capability String

The supported VCP codes reported in the capability string must match the supported codes listed in the design specification for the display.

Table 10-5: Compliance Procedure for Capability String

Stage #	Action	Result
1	Verify the Capability String format matches the requirements of section 6.	If the Capability string matches the requirements of section 6, then Compliant. If the Capability string does not match the requirements of section 6, then Not Compliant.
2	Read and parse the Capability String	n/a
3	Verify that support for the required VCP codes is reported.	If VCP Codes 02_h, New Control Value and DF_h, VCP Version are supported then, Compliant

Table 10-5: Compliance Procedure for Capability String

Stage #	Action	Result
		If either or both VCP Codes 02_h, New Control Value and DF_h, VCP Version are not supported then, Not Compliant
4	Verify that all VCP Codes in range $00_h \rightarrow DF_h$ inclusive reported as supported are defined by the MCCS standard.	If all supported VCP Codes are defined, then Compliant. If one or more supported VCP Codes are not defined (i.e. are unassigned and reserved) then, Not Compliant.
5	Compare supported VCP Codes in Capability String with the list of supported VCP Codes from the display design specification.	If Capability String and design specification list of supported VCP codes match exactly then, Compliant. If Capability String and design specification list of supported VCP codes do not match then, Not Compliant. If options within a supported VCP code do not match in the Capability string and the design specification then, Not Compliant.
6	All "public" VCP Codes in $E0_h \rightarrow FF_h$ range	If the "vcpname" field(s) (see VESA DDC/CI Standard version 1.1, section 6.7.3) is present with an appropriate [1] name, then Compliant. If the "vcpname" field(s) (see VESA DDC/CI Standard version 1.1, section 6.7.3) is not present or contains a meaningless name, then Not Compliant.
7 [2]	All "public" VCP Codes in $E0_h \rightarrow FF_h$ range	If the operation of the VCP Code(s) is in compliance with the product engineering specification, then Compliant. If the operation of the VCP Code(s) is not in compliance with the product engineering specification, then not Compliant.

10.6 Compliance Procedure for Controls with a Continuous Range of Adjustment

Many VCP Codes are of function "C" meaning that the valid values constitute a continuous range from 0 (the minimum value) to a defined maximum of ≤ 65535 (FF FF_h).

Some VCP Codes will have a granularity which does not permit individual increments in step 5 (Table 10-6) to be visible. In these cases, the compliance requirement is for a smooth transition from the minimum condition to the maximum condition.

Table 10-6: Compliance Procedure for Continuous Range VCP Codes

Stage #	Action	Result
1	Use GetVCP command to obtain the maximum supported value.	n/a
2	Compare reported maximum value to design specification maximum value for this VCP Code.	If reported and design specification maximum values are equal then, Compliant.

[1] An 'appropriate name' is one that is descriptive of the function performed.
[2] Depending on the nature of the function, an existing compliance test procedure or a new, VCP Code specific, procedure may be required. Determination, and development when appropriate, of the correct procedure is the responsibility of the testing organization.

Table 10-6: Compliance Procedure for Continuous Range VCP Codes

Stage #	Action	Result
		If reported and design specification maximum values are not equal then, Not Compliant.
3	Set the display to factory default condition.	n/a
4	Use SetVCP to write a value of 00_h to the current VCP Code	Ensure that the appropriate display characteristic changed to minimum condition.
5	Use SetVCP to increment the adjustment value of the current VCP Code by 1.	Ensure that there is a visibly smooth change in the appropriate characteristic.
6	Repeat stage 5 until VCP Code is at maximum value	Ensure that appropriate display characteristic is at maximum condition.
7	Determine whether display is Compliant or Not Compliant	If stages 4 → 6 produce a smooth transition of the appropriate display characteristic from the minimum condition to the maximum condition then, Compliant If stages 4 → 6 do not produce a smooth transition of the appropriate display characteristic from the minimum condition to the maximum condition then, Not Compliant

10.7 Compliance Procedure for Controls with a Non-Continuous Range of Adjustment

Several VCP Codes are of function "NC" meaning that only a limited number of values are valid. The maximum number of valid values is defined in this standard but individual display designers may choose to implement a sub-set and report accordingly in the Capability String.

Table 10-7: Compliance Procedure for Non-Continuous Range VCP Codes

Stage #	Action	Result
1	Obtain the list of supported values form the Capability String.	NA
2	Compare reported supported values to design specification-supported values for this VCP Code.	If reported and design specification supported values are equal then, Compliant. If reported and design specification supported values are not equal then, Not Compliant.
3	Set the display to factory default condition.	NA
4	Use SetVCP to write the first supported value (lowest numerical value) to the current VCP Code	Ensure that the appropriate display characteristic changed accordingly.
5	Use SetVCP to write the next supported value (moving from lowest to highest numerical value) to the current VCP Code	Ensure that the appropriate display characteristic changed accordingly.
6	Repeat stage 5 until all supported values for this VCP Code have been exercised.	Ensure that the appropriate display characteristic changed accordingly.

Table 10-7: Compliance Procedure for Non-Continuous Range VCP Codes

Stage #	Action	Result
7	Determine whether display is Compliant or Not Compliant	If stages 4 → 6 produce changes in the appropriate display characteristic for each supported value then, Compliant If stages 4 → 6 do not produce changes in the appropriate display characteristic for each supported value then, Not Compliant

10.8 Compliance Procedure for Preset VCP Codes

There are a number of VCP Codes associated with presetting some or all adjustments to known (factory) defaults, these are write only commands defined in 8.1.

NOTE: The exact operation of each 'Preset VCP Code is defined by the display designer with the exception of VCP 00_h.

Table 10-8: Compliance Procedure for Displays that Support VCP 00_h

Stage #	Action	Result
1	Power ON, exit sleep mode, after HPD or after other reset	Display operational
2	Read and store capability string	If VCP 00_h is supported skip to stage 4
3	If VCP 00_h is not supported	Report ERROR and end test
4	Read VCP 00_h	If value = 00_h skip to stage 6
5	If value ≠ 00_h	Report ERROR and end test
6	Write declared values to VCP 00_h one by one ending with value = 00_h	IF value ≠ value written report ERROR and end test If value = value written = 00_h go to stage 7
7	Repeat all stages for Power OFF/ON, enter/exit sleep mode, trigger and exit a HPD or trigger and exit other reset	If all test initial conditions have been tested report PASS test

Table 10-9: Compliance Procedure for Preset VCP Codes

Stage #	Action	Result
1	Obtain, from the display design specification, the VCP Code(s) that the current Preset VCP Code is intended to affect, and the associated default values.	NA
2	Set all supported VCP Codes to their maximum value	NA
3	Issue the current Preset VCP Code	NA
4	Read the new value of all VCP Codes set to maximum value in stage 2	If the VCP Code(s) intended to be affected by current preset is (are) at default value then, Compliant. If the VCP Code(s) intended to be affected by current preset is (are) at not at default value then, Not Compliant.

Table 10-9: Compliance Procedure for Preset VCP Codes

Stage #	Action	Result
		If the VCP Code(s) not intended to be affected by the current preset VCP Code is (are) not at maximum value the, Not Compliant.

10.9 Compliance Procedures for Auto Set-up and Auto Color Set-up VCP Codes

There are two-auto set-up VCP Codes, ($1E_h$, Auto Set-up, and $1F_h$, Auto Color Set-up) which require a special compliance procedure.

NOTE: There may be an interaction between these tests and VCP Code $A2_h$, Auto setup On/Off.

Table 10-10: Compliance Procedure for Auto Set-up VCP Codes

Stage #	Action	Result
1	Set display to factory defaults.	NA
2	If VCP code $A2_h$ (Auto Set-up On/Off) is supported then set it "ON" (write a value of 02_h).	NA
3	Write a value of 01_h to VCP code $1E_h$	If auto set-up is performed then, Compliant If auto set-up is not performed then, Not Compliant
4	Write a value of 02_h to VCP Code $1E_h$	If auto set-up is performed then, Compliant If auto set-up is not performed then, Not Compliant
5	If display uses a timer, then wait for time period defined by the display specification OR If display operation is triggered by a mode change then force a mode change	If auto set-up is performed after the defined period then, Compliant If auto set-up is not performed after the defined period then, Not Compliant
6	Write a value of 00_h to VCP Code $1E_h$	If auto set-up is performed then, Not Compliant
7	If display uses a timer, then wait for time period defined by the display specification OR If display operation is triggered by a mode change then force a mode change	If auto set-up is performed after the defined period then, Not Compliant
8	Write a value > 02_h to the VCP Code $1E_h$	If auto set-up is performed after the defined period then, Not Compliant
9	Repeat stage 8 with a different value	If auto set-up is performed after the defined period then, Not Compliant
10	Repeat stages 3 → 9 substituting VCP code $1F_h$ for $1E_h$ at each stage.	NA

10.10 Compliance for 6-axis Color Adjustments

The 6-axis color saturation and hue adjustment VCP codes require separate compliance procedure since they allow adjustment about a mid-point.

10.10.1 Compliance for 6-axis Saturation VCP Codes

Table 10-11: Compliance Procedure for 6-axis Color Saturation Adjustment VCP Codes

Stage #	Action	Result
1	Set display to factory defaults.	NA
2	Write a value of 00_h to the current 6-axis Color Saturation VCP Code	If the current color moves to the minimum supported color saturation then, Compliant. If the current color does not move to the minimum supported color saturation then, Not Compliant.
3	Write a value of FF_h to the current 6-axis Color Saturation VCP Code	If the current color moves to the maximum supported color saturation then, Compliant. If the current color does not move to the maximum supported color saturation then, Not Compliant.
4	Write a value of $7F_h$ to the current 6-axis Color Saturation VCP Code	If the current color moves to the default color saturation then, Compliant. If the current color does not move to the default color saturation then, Not Compliant.
5	Repeat stages 1 → 5 for other 6-axis Color Saturation VCP Codes	NA

10.10.2 Compliance for 6-axis Hue VCP Codes

Table 10-12: Compliance Procedure for 6-axis Color Hue VCP Codes

Stage #	Action	Result
1	Set display to factory defaults.	NA
2	Write a value of 00_h to the current 6-axis Color Hue VCP Code	If the current color moves to the minimum supported color hue then, Compliant. If the current color does not move to the minimum supported color hue then, Not Compliant.
3	Write a value of FF_h to the current 6-axis Color Saturation VCP Code	If the current color moves to the maximum supported color hue then, Compliant. If the current color does not move to the maximum supported color hue then, Not Compliant.
4	Write a value of $7F_h$ to the current 6-axis Color Saturation VCP Code	If the current color moves to the default color hue then, Compliant. If the current color does not move to the default color hue then, Not Compliant.
5	Repeat stages 1 → 5 for other 6-axis Color Hue VCP Codes	NA

10.11 Compliance for Read only VCP Codes

There are a number of read only VCP Codes which require special compliance procedures.

10.11.1 Compliance Procedure for Horizontal and Vertical Frequency VCP Codes

Table 10-13: Compliance Procedure for Horizontal and Vertical Frequency VCP Codes

Stage #	Action	Result
1	Set display timing to a known condition	n/a
2	Read the Horizontal Frequency VCP Code	If the returned Horizontal Frequency matches the display input horizontal frequency to ± 0.5 % then, Compliant. If the returned Horizontal Frequency does not match the display input horizontal frequency to ± 0.5 % then, Not Compliant.
3	Read the Vertical Frequency VCP Code	If the returned Vertical Frequency matches the display input vertical frequency to ± 0.5 Hz then, Compliant. If the returned Vertical Frequency does not match the display input vertical frequency to ± 0.5 Hz then, Not Compliant.

10.11.2 Compliance Procedure for Display Usage Time VCP Code

Table 10-14: Compliance Procedure for Display Usage Time VCP Code

Stage #	Action	Result
1	Read the current display usage time at VCP Code $C0_h$	NOTE the reported time
2	Leave the display active for a minimum of 2 hours. **NOTE**: It will be necessary to disable any automatic shut-down timer in the host for this procedure	NA
3	Read the current time at VCP Code $C0_h$	If the time reported in stage 1 + delay time is correctly reported in stage 3 then, Compliant If the time reported in stage 1 + delay time is not correctly reported in stage 3 then, Not Compliant

10.11.3 Compliance Procedure for Miscellaneous Read Only VCP Codes

Table 10-15: Compliance Procedure for Other Read only VCP Codes

Stage #	Action	Result
1	Read the current value at the current VCP Code	If reported value matches the display specification then, Compliant. If reported value does not match the display specification then, Not Compliant.

10.11.4 Compliance for Write Only VCP Codes

Table 10-16: Compliance Procedure for Write Only VCP Codes

Stage #	Action	Result
1	Write a valid value to the display	If the display reacted appropriately then Compliant If the display did not react appropriately then Not Compliant
2	Write an invalid value to the display	If the display ignored the command then Compliant If the display did not ignore the command then Not Compliant
3	Repeat stage 1 with a different valid value	If the display reacted appropriately then Compliant If the display did not react appropriately then Not Compliant

10.11.5 Compliance Procedure for Degauss VCP Code

Table 10-17: Compliance Procedure for Degauss VCP Codes

Stage #	Action	Result
1	Write a value > 00_h	If a degauss cycle was performed then, Compliant. If a degauss cycle was not performed then, Not Compliant
2	Write a value of 00_h	If a degauss cycle was performed then, Not Compliant. If a degauss cycle was not performed then, Compliant
3	Repeat stage 1 with a different value > 00_h	If a degauss cycle was performed then, Compliant. If a degauss cycle was not performed then, Not Compliant

10.12 Compliance for Table VCP Codes

10.12.1 Compliance Procedure for Input Source and Output Select VCP Codes

NOTE: It is possible that a display will only support Input Source or the Output Select VCP Code; in that case only steps 1 and 2 or 3 and 4 (respectively) of Table 10-18 must be used.

Table 10-18: Compliance Procedure for Input Source and Output Select VCP Codes

Stage #	Action	Result
1	Write the appropriate value to select each supported Input Source	If the correct input was selected then, Compliant If an incorrect input was selected then, Not Compliant
2	Write the appropriate values for Input Sources that are not supported	If there is no change to the previously selected input then, Compliant If there is a change to the previously selected input then, Not Compliant

Table 10-18: Compliance Procedure for Input Source and Output Select VCP Codes

Stage #	Action	Result
3	Write the appropriate value to select each supported Output	If the correct output was selected then, Compliant If an incorrect output was selected then, Not Compliant
4	Write the appropriate values for Output that are not supported	If there is no change to the previously selected output then, Compliant If there is a change to the previously selected output then, Not Compliant

10.12.2 Compliance Procedure for Source Timing Mode VCP Codes

Table 10-19: Compliance Procedure for Source Timing Mode VCP Code

Stage #	Action	Result
1	Determine the VESA DMT and DTV timing modes supported by the display.	n/a
2	Select 3 supported timing modes from the VESA DMT and DTV lists. If possible, these must each have different pixel formats and refresh rates.	n/a
3	Write the appropriate value for the first timing mode	n/a
4	Read the current value of timing mode stored by the display	If the value read matches the value written then, Compliant If the value read does not match the value written then, Not Compliant
5	Repeat stages 3 & 4 for other timing modes selected in stage 2	n/a

10.12.3 Compliance Procedure for EDID Operation

Table 10-20: Compliance Procedure for EDID Operation VCP Code

Stage #	Action	Result
1	Determine the full EDID structure – base EDID and any extension blocks – that are part of the display design. Determine the intended content of base EDID and any EDID extensions that are present.	NA
2	Read base EDID	If the received contents match the design contents determined in step 1 then, Compliant If the received contents do not match the design contents determined in step 1 then, Not Compliant
3	Read first EDID extension	If the received contents match the design contents determined in step 1 then, Compliant If the received contents do not match the design contents determined in step 1 then, Not Compliant

Table 10-20: Compliance Procedure for EDID Operation VCP Code

Stage #	Action	Result
4	Repeat stage 3 as required for all further EDID extensions	If the received contents match the design contents determined in step 1 then, Compliant If the received contents do not match the design contents determined in step 1 then, Not Compliant

10.12.4

Compliance Procedure for Auxiliary Display Data VCP Code

Table 10-21: Compliance Procedure for Auxiliary Display Data VCP Code

Stage #	Action	Result
1	Determine the design size of the auxiliary display.	NA
2	Write an ASCII string of the appropriate length to fill the auxiliary display. **NOTE:** String content must be non-repetitive.	If the data send is correctly displayed then, Compliant If the data send is not correctly displayed then, Not Compliant
3	Write an ASCII string of the appropriate length to fill the auxiliary display + 2 bytes. NOTE: String content must be non-repetitive and different from data in stage 2	If the latest data sent that corresponds to the display length is correctly displayed then, Compliant If the latest data sent that corresponds to the display length is not correctly displayed then, Not Compliant

10.12.5 Compliance Procedure for Transmit Display Descriptor VCP Code

Table 10-22: Compliance Procedure for Transmit Display Descriptor VCP Code

Stage #	Action	Result
1	Determine the design length of the display descriptor storage.	NA
2	Write an ASCII string of the appropriate length to fill the display descriptor storage. **NOTE:** String content must be non-repetitive.	NA
3	Read the Display Descriptor VCP Code	If the data read matches the data written in stage 2 then, Compliant If the data read does not match the data written in stage 2 then, Not Compliant.
4	Write an ASCII string of the appropriate length to fill the display descriptor storage + 2 bytes **NOTE:** String content must be non-repetitive and different from data in stage 2	NA

Table 10-22: Compliance Procedure for Transmit Display Descriptor VCP Code

Stage #	Action	Result
5	Read the Display Descriptor VCP Code	If the data read matches the data written in stage 4 without the last 2 bytes then, Compliant If the data read does not match the data written in stage 4 without the last 2 bytes then, Not Compliant

10.12.6 Compliance Procedure for Asset Tag VCP Code

Table 10-23: Compliance Procedure for Asset Tag VCP Code

Stage #	Action	Result
1	Determine the appropriate key.	NA
2	Read the asset tag	If key is not present in bytes 0 and 1 then, Compliant If key is present in bytes 0 and 1 then, Not Compliant
3	Write the key and a test pattern that must completely fill the asset tag. Data should be non-repetitive.	NA
4	Read the asset tag	If key is not present in bytes 0 and 1 then, Compliant If key is present in bytes 0 and 1 then, Not Compliant If the asset tag data matches the data written in stage 3 then, Compliant If the asset tag data does not match the data written in stage 3 then, Not Compliant

10.12.7 Compliance Procedure for LUT Size VCP Code

Table 10-24: Compliance Procedure for LUT Size VCP Code

Stage #	Action	Result
1	Determine the display LUT size (number of entries and bits / entry) from the design specification.	NA
2	Read the LUT Size	If the reported values for Red, Green and Blue LUTS match the design specification then, Compliant. If the reported values for Red, Green and Blue LUTS do not match the design specification then, Not Compliant.

10.12.8 Compliance Procedure for Single Point LUT Operation VCP Code

Table 10-25: Compliance Procedure for Single Point LUT VCP Code

Stage #	Action	Result
1	Verify that display reports support for the LUT Size VCP Code (73_h)	If display report supports for LUT Size VCP Code then, Compliant. If display does not report support for LUT Size VCP Code then, Not Compliant.

Table 10-25: Compliance Procedure for Single Point LUT VCP Code

Stage #	Action	Result
2	Read the current contents of selected Red, Green, and Blue LUT entries (2 for each LUT). **NOTE**: LUT entries must be at different offsets	NA
3	Write a new Red LUT value to the first selected location. **NOTE:** Data must be chosen to be significantly different to data read from selected location in stage 2	If a display change is visible then, Compliant. If a display change is not visible then, Not Compliant
4	Repeat stage 3 for a second Red LUT entry and for each Green and Blue LUT entries. **NOTE:** Data values writer to each LUT entry must be different	NA
5	Read the current contents selected Red, Green, and Blue LUT entries.	NA
6	Compare the data read at stage 5 with that at stage 2	If data read at stage 5 matches the data read at stage 2 then, Compliant If data read at stage 5 does not match the data read at stage 2 then, Not Compliant

10.12.9 Compliance Procedure for Block LUT Operation VCP

Table 10-26: Compliance Procedure for Block LUT VCP Code

Stage #	Action	Result
1	Verify that display reports support for the LUT Size VCP Code (73_h)	If display report supports for LUT Size VCP Code then, Compliant. If display does not report support for LUT Size VCP Code then, Not Compliant.
2	Read the current values of the Red, Green and Blue LUT entries	NA
3	Write a new set of data to the Red LUT **NOTE:** Data must be chosen to be significantly different to data read from in stage 2	If a display change is visible then, Compliant. If a display change is not visible then, Not Compliant
4	Repeat stage 3 for the Green and Blue LUTs. **NOTE:** All LUTs must be written with different data.	NA
5	Read the current values of the Red, Green and Blue LUT entries	NA
6	Compare the data read at stage 5 with that at stage 2	If data read at stage 6 is different to data read at stage 2 then, Compliant If data read at stage 6 is not different to data read at stage 2 then, Not Compliant If data read at stage 6 matches the data written at stages 3 and 4 then, Compliant If data read at stage 6 does not match the data written at stages 3 and 4 then, Not Compliant.

10.12.10 Compliance Procedure for Code Remote Procedure Call VCP Code

Table 10-27: Compliance Procedure for Remote Procedure Call VCP Code

Stage #	Action	Result
1	Determine the current contents of the Red, green and Blue LUTs.	NA
2	Select six LUT offset locations to be used to generate a new set of LUT data. The data selected for these six locations must be significantly different to the values determined in step 1	NA
3	Write the data from stage 2 along with a value of 01_h in byte 0	If the display characteristic change appropriately for the data then, Compliant. If the display characteristic do not change appropriately for the data then, Not Compliant.
4	Write a new set of data, selected to be significantly different from that used in stage 2, with a value > 01_h	If the display characteristic do not change then, Compliant. If the display characteristic change then, Not Compliant.
5	Repeat stage 4 but with byte 0 set to a value of 01_h	If the display characteristic change appropriately for the data then, Compliant. If the display characteristic do not change appropriately for the data then, Not Compliant.

10.12.11 Compliance procedure for TV-channel Up/Down VCP Code

Table 10-28: Compliance Procedure for TV-channel Up/Down VCP Code

Stage #	Action	Result
1	Determine initial channel number	NA
2	Write a value of 01_h	If channel number was incremented by 1 then, Compliant. If channel number was not incremented by 1 then, Not Compliant.
3	Repeat stage 2 twice more	If channel number was incremented by 1 each time then, Compliant. If channel number was not incremented by 1 each time then, Not Compliant.
4	Write a value of 02_h, three times	If channel number is equal to initial channel number determined in step 1 then, Compliant If channel number is not equal to initial channel number determined in step 1 then, Not Compliant

10.12.12 Compliance Procedure for Auto Set-up On/Off VCP Code

Table 10-29: Compliance Procedure for Auto Setup On/Off VCP Code

Stage #	Action	Result
1	Write a value of 02_h (auto setup on)	n/a
2	Write a value of 01_h to $1E_h$, Auto Set-up, VCP Code	If Auto Set-up is performed then, Compliant If Auto Set-up is not performed then, Not Compliant
3	Write a value of 01_h (auto setup off)	n/a
4	Write a value of 01_h to $1E_h$, Auto Set-up, VCP Code	If Auto Set-up is performed then, Not Compliant If Auto Set-up is not performed then, Compliant

10.12.13 Compliance Procedure for Window Size, VCP Code

Table 10-30: Compliance Procedure for Window Size, VCP Code

Stage #	Action	Result
1	Obtain the Window characteristic(s) from the capability string to determine the minimum/maximum size of the Window and whether it's characterized as a Zone or PIP Window.	NA
2	Use GETVCP command to obtain the maximum value supported value.	NA
3	Set the display to factory default condition	NA
4	Initialize the Window. Refer to VCP codes $A4_h$ and $A5_h$ to initialize the Window.	NA
5	Use SetVCP to write a value of 00_h to $A6_h$	Ensure that the window is set to the minimum size as defined in the capability string
6	Use SetVCP to increment the adjustment value of the current VCP Code to 1.	Ensure that the size of the window has increased.
7	Repeat stage 6 until VCP Code is at a maximum value	Ensure that the window is set to the maximum size as defined in the capability string
8	Determine whether display is Compliant of Not Compliant	If stages 5 → 7 produce a smooth transition of the window size while maintaining the aspect ratio (i.e. 4:3, 16:9, 16:10) from the minimum to the maximum condition then Compliant. If stages 5 → 7 do not produce a smooth transition of the window size while maintaining the aspect ratio (i.e. 4:3, 16:9, 16:10) from the minimum to the maximum condition then Not Compliant.

11 VCP Code Index

NOTE:

- All unassigned codes are reserved for future use. To ensure predictable operation and interoperability any required control functions not assigned a specific VCP code must be implemented using a manufacturer's specific VCP code in range of $E0_h$ to FF_h.
- In the event of a conflict between these index tables and the VCP Code tables in section 8, the VCP codes defined in section 8 must be deemed to be correct.

Table 11-1 : VCP Code Numeric Index

Code	VCP Code Name	Preset Table 8-2	Image Table 8-4	Control Table 8-8	Geometry Table 8-11	Misc. Table 8-13	Audio Table 8-15	DPVL Table 8-17	Manuf. Table 8-18
00_h	VCP Code Page	√							
01_h	Degauss					√			
02_h	New Control Value					√			
03_h	Soft Controls					√			
04_h	Restore Factory Defaults	√							
05_h	Restore Factory Luminance/ Contrast Defaults	√							
06_h	Restore Factory Geometry Defaults	√							
07_h									
08_h	Restore Factory Color Defaults	√							
09_h									
$0A_h$	Restore Factory TV Defaults	√							
$0B_h$	Color Temperature Increment		√						
$0C_h$	Color Temperature Request		√						
$0D_h$									
$0E_h$	Clock		√						
$0F_h$									
10_h	Luminance		√						
11_h	Flesh Tone Enhancement		√						
12_h	Contrast		√						
13_h	Backlight Control		√						
14_h	Select Color Preset		√						
15_h									
16_h	Video Gain (Drive): Red		√						
17_h	User Color Vision Compensation		√						
18_h	Video Gain (Drive): Green		√						
19_h									
$1A_h$	Video Gain (Drive): Blue		√						
$1B_h$									
$1C_h$	Focus		√						
$1D_h$									

Table 11-1 : VCP Code Numeric Index

Code	VCP Code Name	Preset Table 8-2	Image Table 8-4	Control Table 8-8	Geometry Table 8-11	Misc. Table 8-13	Audio Table 8-15	DPVL Table 8-17	Manuf. Table 8-18
$1E_h$	Auto Setup		√						
$1F_h$	Auto Color Setup		√						
20_h	Horizontal Position (Phase)				√				
21_h									
22_h	Horizontal Size				√				
23_h									
24_h	Horizontal Pincushion				√				
25_h									
26_h	Horizontal Pincushion Balance				√				
27_h									
28_h	Horizontal Convergence R / B				√				
29_h	Horizontal Convergence M / G				√				
$2A_h$	Horizontal Linearity				√				
$2B_h$									
$2C_h$	Horizontal Linearity Balance				√				
$2D_h$									
$2E_h$	Gray Scale Expansion		√						
$2F_h$									
30_h	Vertical Position (Phase)				√				
31_h									
32_h	Vertical Size				√				
33_h									
34_h	Vertical Pincushion				√				
35_h									
36_h	Vertical Pincushion Balance				√				
37_h									
38_h	Vertical Convergence R/B				√				
39_h	Vertical Convergence M/G				√				
$3A_h$	Vertical Linearity				√				
$3B_h$									
$3C_h$	Vertical Linearity Balance				√				
$3D_h$									
$3E_h$	Clock Phase		√						
$3F_h$									
40_h	Horizontal Parallelogram				√				
41_h	Vertical Parallelogram				√				
42_h	Horizontal Keystone				√				
43_h	Vertical Keystone				√				
44_h	Rotation				√				

Table 11-1 : VCP Code Numeric Index

Code	VCP Code Name	Preset Table 8-2	Image Table 8-4	Control Table 8-8	Geometry Table 8-11	Misc. Table 8-13	Audio Table 8-15	DPVL Table 8-17	Manuf. Table 8-18
45_h									
46_h	Top Corner Flare				√				
47_h									
48_h	Top Corner Hook				√				
49_h									
$4A_h$	Bottom Corner Flare				√				
$4B_h$									
$4C_h$	Bottom Corner Hook				√				
$4D_h$									
$4E_h$									
$4F_h$									
50_h									
51_h									
52_h	Active Control					√			
53_h									
54_h	Performance Preservation					√			
55_h									
56_h	H Moiré		√						
57_h									
58_h	V Moiré		√						
59_h	6 Axis Saturation Control: Red		√						
$5A_h$	6 Axis Saturation Control: Yellow		√						
$5B_h$	6 Axis Saturation Control: Green		√						
$5C_h$	6 Axis Saturation Control: Cyan		√						
$5D_h$	6 Axis Saturation Control: Blue		√						
$5E_h$	6 Axis Saturation Control: Magenta		√						
$5F_h$									
60_h	Input Select					√			
61_h									
62_h	Audio: Speaker Volume						√		
63_h	Audio: Speaker Pair Select						√		
64_h	Audio: Microphone Volume						√		
65_h	Audio: Jack Connection Status						√		
66_h	Ambient Light Sensor					√			
67_h									
68_h									
69_h									
$6A_h$									
$6B_h$	Backlight Level: White		√						

Table 11-1 : VCP Code Numeric Index

Code	VCP Code Name	Preset Table 8-2	Image Table 8-4	Control Table 8-8	Geometry Table 8-11	Misc. Table 8-13	Audio Table 8-15	DPVL Table 8-17	Manuf. Table 8-18
$6C_h$	Video Black Level: Red		√						
$6D_h$	Backlight Level: Red		√						
$6E_h$	Video Black Level: Green		√						
$6F_h$	Backlight Level: Green		√						
70_h	Video Black Level: Blue		√						
71_h	Backlight Level: Blue		√						
72_h	Gamma		√						
73_h	LUT Size		√						
74_h	Single Point LUT Operation		√						
75_h	Block LUT Operation		√						
76_h	Remote Procedure Call					√			
77_h									
78_h	Display Identification Data Operation					√			
79_h									
$7A_h$									
$7B_h$									
$7C_h$	Adjust Zoom		√						
$7D_h$									
$7E_h$									
$7F_h$									
80_h									
81_h									
82_h	Horizontal Mirror (Flip)				√				
83_h									
84_h	Vertical Mirror (Flip)				√				
85_h									
86_h	Display Scaling				√				
87_h	Sharpness		√						
88_h	Velocity Scan Modulation		√						
89_h									
$8A_h$	Color Saturation		√						
$8B_h$	TV Channel Up / Down					√			
$8C_h$	TV Sharpness		√						
$8D_h$	Audio Mute / Screen Blank						√		
$8E_h$	TV Contrast		√						
$8F_h$	Audio Treble						√		
90_h	Hue		√						
91_h	Audio Bass						√		

Table 11-1 : VCP Code Numeric Index

Code	VCP Code Name	Preset Table 8-2	Image Table 8-4	Control Table 8-8	Geometry Table 8-11	Misc. Table 8-13	Audio Table 8-15	DPVL Table 8-17	Manuf. Table 8-18
92_h	TV Black Level / Luminance		√						
93_h	Audio Balance L / R						√		
94_h	Audio Processor Mode:						√		
95_h	Window Position (TL_X)				√				
96_h	Window Position (TL_Y)				√				
97_h	Window Position (BR_X)				√				
98_h	Window Position (BR_X)				√				
99_h									
$9A_h$	Window Background		√						
$9B_h$	6 Axis Color Control: Red		√						
$9C_h$	6 Axis Color Control: Yellow		√						
$9D_h$	6 Axis Color Control: Green		√						
$9E_h$	6 Axis Color Control: Cyan		√						
$9F_h$	6 Axis Color Control: Blue		√						
$A0_h$	6 Axis Color Control: Magenta		√						
$A1_h$									
$A2_h$	Auto Setup On / Off		√						
$A3_h$									
$A4_h$	Window Mask Control		√						
$A5_h$	Window Select		√						
$A6_h$	Window Size		√						
$A7_h$	Window Transparency		√						
$A8_h$									
$A9_h$									
AA_h	Screen Orientation		√						
AB_h									
AC_h	Horizontal Frequency			√					
AD_h									
AE_h	Vertical Frequency			√					
AF_h									
$B0_h$	Settings	√							
$B1_h$									
$B2_h$	Flat Panel Sub-Pixel Layout					√			
$B3_h$									
$B4_h$	Source Timing Mode			√					
$B5_h$	Source Color Coding			√					
$B6_h$	Display Technology Type					√			
$B7_h$	DPVL : Display status							√	

Table 11-1 : VCP Code Numeric Index

Code	VCP Code Name	Preset Table 8-2	Image Table 8-4	Control Table 8-8	Geometry Table 8-11	Misc. Table 8-13	Audio Table 8-15	DPVL Table 8-17	Manuf. Table 8-18
$B8_h$	DPVL : Packet count							√	
$B9_h$	DPVL : Display X origin							√	
BA_h	DPVL : Display Y origin							√	
BB_h	DPVL : Header CRC error count							√	
BC_h	DPVL : Body CRC error count							√	
BD_h	DPVL : Client ID							√	
BE_h	DPVL : Link control							√	
BF_h									
$C0_h$	Display Usage Time			√					
$C1_h$									
$C2_h$	Display Descriptor Length					√			
$C3_h$	Transmit Display Descriptor					√			
$C4_h$	Enable Display of 'Display Descriptor'					√			
$C5_h$									
$C6_h$	Application Enable Key					√			
$C7_h$	Reserved								
$C8_h$	Display Controller ID			√					
$C9_h$	Display Firmware Level			√					
CA_h	OSD			√					
CB_h									
CC_h	OSD Language			√					
CD_h	Status Indicators					√			
CE_h	Auxiliary Display Size					√			
CF_h	Auxiliary Display Data					√			
$D0_h$	Output Selection					√			
$D1_h$									
$D2_h$	Asset Tag					√			
$D3_h$									
$D4_h$	Stereo Video Mode		√						
$D5_h$									
$D6_h$	Power Mode			√					
$D7_h$	Auxiliary Power Output					√			
$D8_h$									
$D9_h$									
DA_h	Scan Mode				√				
DB_h	Image Mode			√					
DC_h	Display Application		√						
DD_h									

Table 11-1 : VCP Code Numeric Index

Code	VCP Code Name	Preset Table 8-2	Image Table 8-4	Control Table 8-8	Geometry Table 8-11	Misc. Table 8-13	Audio Table 8-15	DPVL Table 8-17	Manuf. Table 8-18
DE_h	Scratch Pad					√			
DF_h	VCP Version			√					
$E0_h$	Manufacturer Specific								√
$E1_h$	Manufacturer Specific								√
$E2_h$	Manufacturer Specific								√
$E3_h$	Manufacturer Specific								√
$E4_h$	Manufacturer Specific								√
$E5_h$	Manufacturer Specific								√
$E6_h$	Manufacturer Specific								√
$E7_h$	Manufacturer Specific								√
$E8_h$	Manufacturer Specific								√
$E9_h$	Manufacturer Specific								√
EA_h	Manufacturer Specific								√
EB_h	Manufacturer Specific								√
EC_h	Manufacturer Specific								√
ED_h	Manufacturer Specific								√
EE_h	Manufacturer Specific								√
EF_h	Manufacturer Specific								√
$F0_h$	Manufacturer Specific								√
$F1_h$	Manufacturer Specific								√
$F2_h$	Manufacturer Specific								√
$F3_h$	Manufacturer Specific								√
$F4_h$	Manufacturer Specific								√
$F5_h$	Manufacturer Specific								√
$F6_h$	Manufacturer Specific								√
$F7_h$	Manufacturer Specific								√
$F8_h$	Manufacturer Specific								√
$F9_h$	Manufacturer Specific								√
FA_h	Manufacturer Specific								√
FB_h	Manufacturer Specific								√
FC_h	Manufacturer Specific								√
FD_h	Manufacturer Specific								√
FE_h	Manufacturer Specific								√
FF_h	Manufacturer Specific								√

Appendix A: Drawings of Display Geometry

The drawings in this section are for information only and intended to aid in the interpretation of the function of VCP codes in section 8.4.

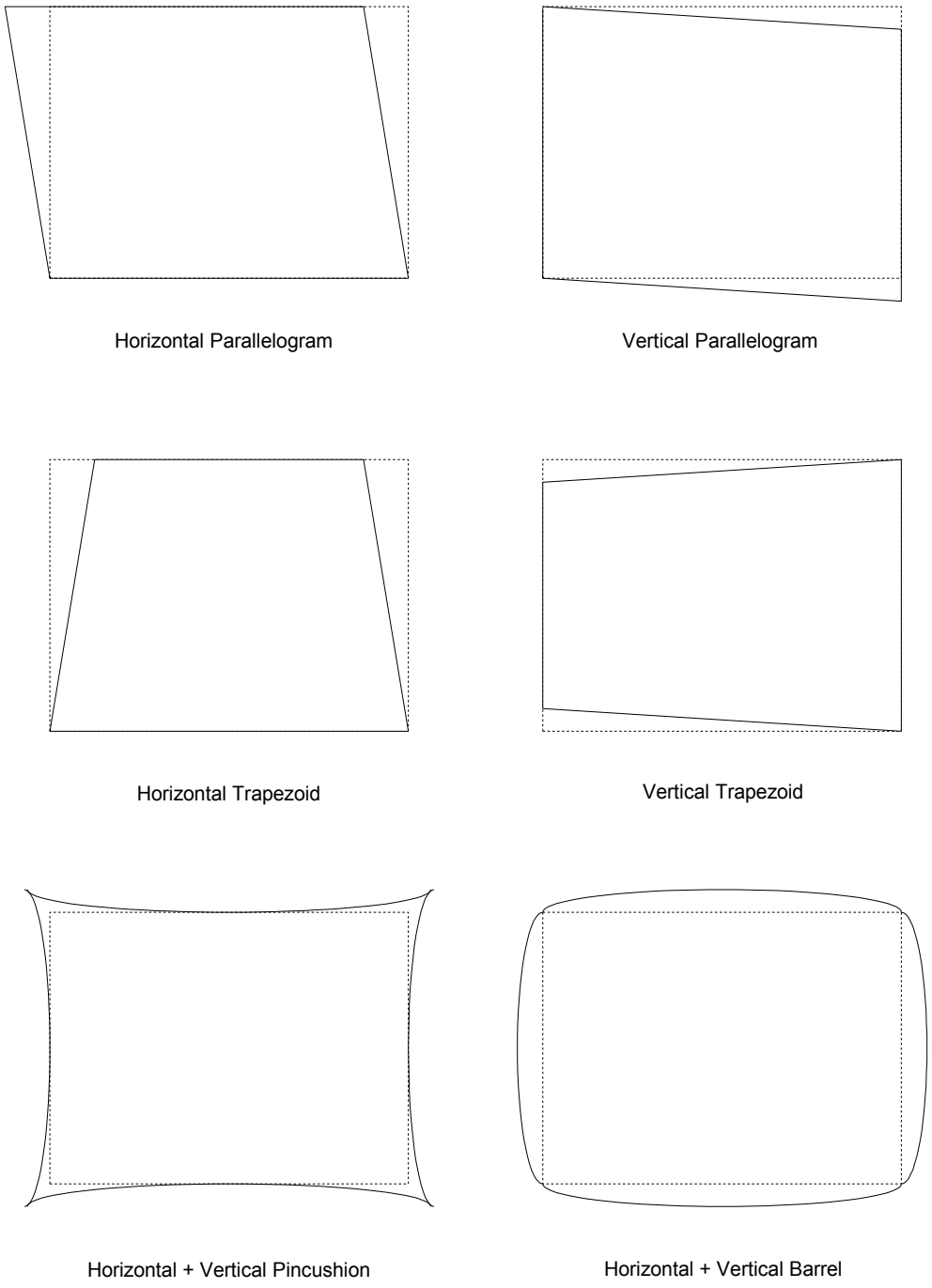
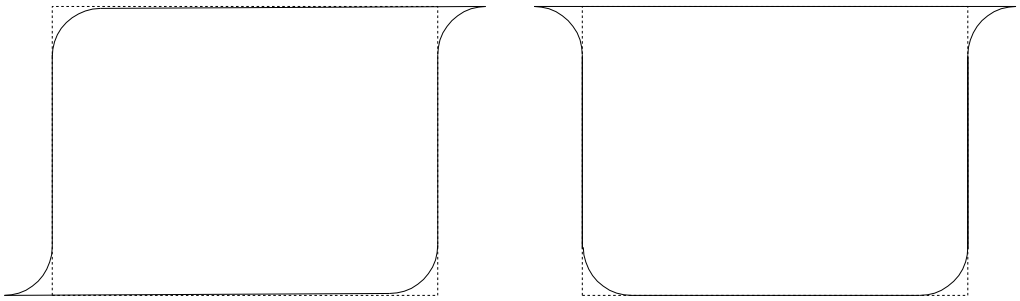
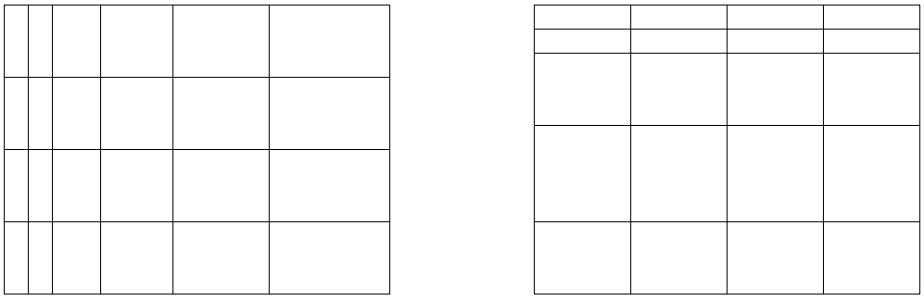


Figure A-1: Parallelogram, Trapezoid, Pincushion, and Barrel Distortion



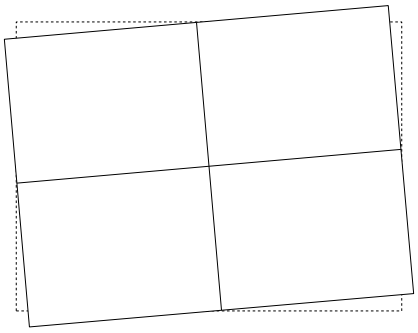
Top + Bottom Hook

Top + Bottom Flare



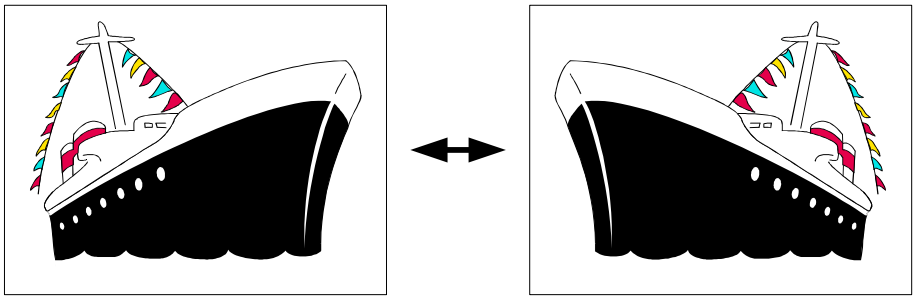
Horizontal Linearity

Vertical Linearity

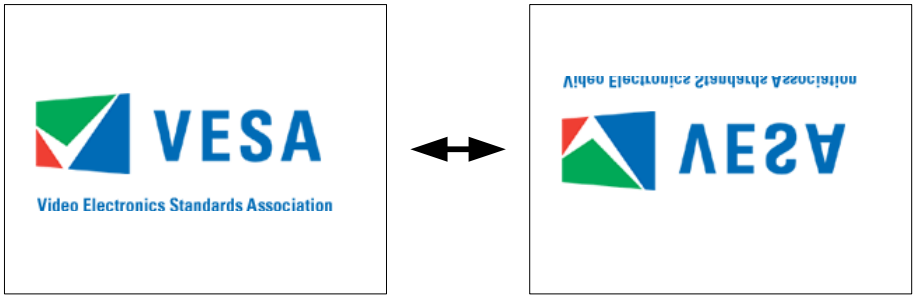


Rotation

Figure A-2: Hook, Flare, Linearity, and Rotation Distortion



Horizontal Mirror (Flip)



Vertical Mirror (Flip)

Figure A-3: Mirroring / Flip

Appendix B: Implementation Guidance

This section is for information only and is not part of the MCCS standard.

B.1 Support for Multiple Window Operation.

NOTE: The range of commands available to operate on a window may be different (usually a sub-set) from those available for full screen operation.

B.1.1 Window Position VCP Codes ($95_h \rightarrow 98_h$)

It is important to recognize that the defined X and Y coordinates apply before any scaling that takes place in the display … the display must make appropriate adjustments if scaling is active.

B.1.2 Window Mask Control VCP Code ($A4_h$)

This control has two functions:

It allows the effects of changes to be masked until all values have been updated. This permits intermediate effects on the image, which may result in objectionable effects to be selected. It also allows for each window to be set active or inactive

B.1.3 Window Select VCP Code ($A5_h$)

This control allows up to seven windows plus the background (full image area) to be selected.

If the selected window is not masked 'off' by the appropriate bit in Window Control (VCP code $A4_h$), then changes will have immediate effect.

B.1.4 Picture in Picture (PIP)

A PIP size and location may be defined using window commands and the appropriate input signal selected for the signal that is required to be inserted here. For example:

Set $A4_h \Rightarrow 00_h$ Mask all windows

Set $A5_h \Rightarrow 01_h$ Select window 1

Set $95_h \Rightarrow 00_h$ Top left X value = 0

Set $96_h \Rightarrow 00_h$ Top left Y value = 0

Set $97_h \Rightarrow 03_h, 20_h$ Bottom right X value = 800

Set $98_h \Rightarrow 01_h, C2_h$ Bottom right Y value = 450

Set $60_h \Rightarrow 07_h$ Select S-video # 1 as input source

Set $A4_h \Rightarrow C0_h$ Unmask the background and window # 1

This will result in a PIP window at the top left of the image with 800 x 450 pixels.

NOTE: The display must scale the PIP input signal to match the defined window.

B.2 Keeping Local and Remote Operations in Synchronization

Reference the discussion in Section 2.

This section outlines a recommended implementation and the following logical flow chart shows the operation of the host and display and how these interact.

If several control values have been changed then display must implement a 'FIFO (First In, First Out)' with the VCP codes of all changed controls and with the last entry set to 00_h. The host must perform successive reads until it receives a value of 00_h, it will then reset the New Control Value to 01_h.

NOTE:

- The display should ensure that only a single instance of a particular VCP code is placed on the 'FIFO'. In particular, if the same VCP code is used several times to make an adjustment, this should not result in multiple instance of that VCP code on the 'FIFO'. (i.e. several adjustments of the same feature before the software application has read the 'FIFO' should not result in multiple instances of the associated VCP code)
- The software application should read entries on the 'stack' using VCP code 52_h, a value of 00_h indicates that there are no more entries on the 'FIFO'. The application should reset the 'New Control value' to 01_h.

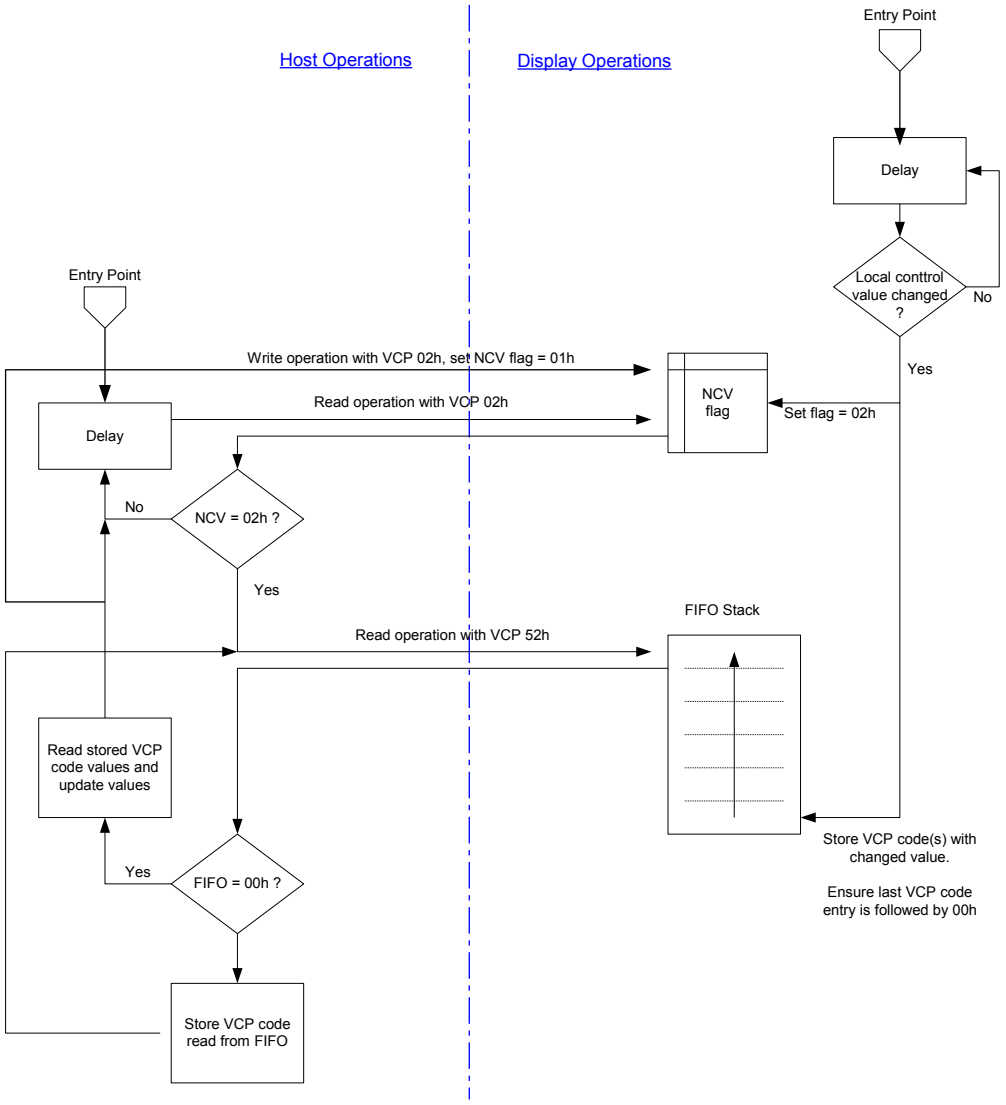


Figure B-1: Local and Remote Synchronization

Appendix C: Main Contributor History (Previous Versions)

Table C-1: Main Contributors to Version 2.2

Name	Company	Contribution
Mike Maciesowicz	Apple	
Colin Whitby-Strevens	Apple	
Syed A. Hussain	AMD	
Ashley Saldanha	EnTech Taiwan	
Bryan Speece	EnTech Taiwan	
Jim Webb	Luxtera	Task Group Chair & Editor
Randy Irvine	Portrait Displays	
Scott Anderson	Portrait Displays	
Alain d'Hautecourt	ViewSonic	

Table C-2: Main Contributors to Version 3.0

Name	Company	Contribution
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Bryan Speece	EnTech Taiwan	Task Group Secretary
Bob Myers	Hewlett-Packard	
Jeff Frankel	Genesis Microchip	
Mike Anderson	Portrait Displays	
Scott Anderson	Portrait Displays	
Bob McQuillan	Portrait Displays	
Ian Miller	Samsung Information Systems America	Task Group Chair & Editor
Alain d'Hautecourt	ViewSonic	

Table C-3: Main Contributors to Version 2.1

Name	Company	Contribution
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Eric Wogsberg	Jupiter Systems	
Glen Adler	Philips	
Mike Anderson	Portrait Displays	
Scott Anderson	Portrait Displays	
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Paul Doyle	Sony	
Jim Webb	Tech Source	
Alain d'Hautecourt	ViewSonic	Task Group Vice-chair & Secretary

Table C-4: Main Contributors to Version 2

Name	Company	Contribution
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Tamuka Ishida	EIZO NANAO	
Yuichiro Wada	Fujitsu	
John Frederick	Hewlett-Packard	
Bob Myers	Hewlett-Packard	
Youichi Igarashi	Hitachi	
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Hironobu Yasui	Mitsubishi Electric Corp.	
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Kazuaki Takamoto	NEC Mitsubishi Electric Visual Systems	
Hideki Tanizoe	NEC Mitsubishi Electric Visual Systems	
Yoshihisa Kudou	NEC Viewtechnology	
Seiji Kobayashi	Plus Vision	
George Wiley	Qualcomm	
Bryan Speece	Portrait Displays	
Ian Miller	Samsung Information Systems America	Workgroup leader
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Doug Gorny	Three-Five Systems	
Alain d'Hautecourt	ViewSonic	