Video Electronics Standards Association

VESA®

Multi-Display Interface Standard

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VESA Multi-Display Interface Standard

Version 1

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Purpose

To provide a standardized method to connect and support multiple monitors, digital or analog, to a low-profile PCI or AGP graphics card. The intent is that this document becomes an industry-wide standard for all multiple monitor graphic card applications, regardless of form factor.

Summary

Many video adapter cards available today allow a user to attach multiple monitors to a single video adapter. The use of more than one monitor is beneficial because it can increase the screen real estate available to the user for the application. This is easily accommodated in a standard sized AGP or PCI form factor by using multiple video connectors; however the low-profile PCI form factor does not accommodate multiple connectors.

Preface

Intellectual Property

While every precaution has been taken in the preparation of this standard, the Video Electronics Standards Association and its contributors assume no responsibility for errors or omissions, and make no warranties, expressed or implied, of functionality or suitability for any purpose.

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- DMS-59 is a trademark of Molex Inc.
- TMDS is a trademark of Silicon Image Inc.

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The connectors specified by this standard for the video output connector and the related cable connector are covered by one or more patents held by Molex Incorporated. Molex has provided VESA with a statement regarding their licensing policies for these designs, in keeping with the established VESA policy regarding the use of patented technology in VESA standards. A copy of this statement is available from the VESA office.

Support for this Standard

Clarifications and application notes to support this standard may be written. To obtain the latest standard and any support documentation, contact VESA.

If you have a product, which incorporates VESA Multi-Display Interface Standard, you should ask the company that manufactured your product for assistance. If you are a manufacturer, VESA can assist you with any clarification you may require. All comments or reported errors should be submitted in writing to VESA using one of the following methods.

- Fax: (408) 957-9270, *direct this note to Technical Support at VESA*
- E-mail: support@vesa.org
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Acknowledgments:

The VESA Multi-Display Interface Standard is the result of input from many sources. VESA particularly wishes to thank the VESA Display Committee and the committee members who contributed their combined industry expertise resulting in this proposal. In particular the following individuals and their companies contributed significant time and effort:

Name	Company	Name	Company
Brian Duckering	3DLabs	Josephine Meraz	JAE Electronics
Neil Trevett	3DLabs	Mitchel Furman	Matrox
Mark Fulton	Appian Graphics	Sherry Bakhshi	Matrox
Scott Swift	Appian Graphics	Dan Dawiedczyk	Molex
Dejan Banic	ATI Technologies	Gary Manchester	Molex
George Reesor	ATI Technologies	Jim Brodt	Molex
John Rankin	ATI Technologies	Scott Sommers	Molex
Nima Osqueizadeh	ATI Technologies	Jeff Brown	Nvidia
Richard Mulcahy	ATI Technologies	Keita Kitahama	Nvidia
Roumen Saltchev	ATI Technologies	Ray Lentz	Nvidia
Zhiling Lai	ATI Technologies	Rich Clark	Nvidia
Karl Kwiat	Hirose	Roger Green	Nvidia
Bob Wolford	IBM	Ujesh Desai	Nvidia
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Susan Luerich	IBM	Don Chambers	Total Technologies Ltd. WG Leader

Revision History

March 3, 2003
Initial release of the standard

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1. OVERVIEW

1.1 Summary

Many video adapters available today allow a user to attach multiple monitors to a single video adapter. The use of more than one monitor is beneficial because it increases the image size available to the user. For example, instead of having one screen running at 1280 x 1024 resolution, the user could stretch their desktop horizontally across two monitors and have an effective resolution of 2560 x 1024 or four monitors for 5120 x 1024.

Supporting multiple monitors with a single video adapter requires having multiple monitor connectors on the adapter. This is easily achieved today with the standard size AGP and PCI adapter form factors. Standard AGP and PCI form factors have enough space to accommodate 2 VGA-style 15 pin monitor connectors or 2 DVI-I monitor connectors. The low profile PCI form factor, however, does not have enough space to accommodate two monitor connectors.

There is no intent to restrict the usage of this specification to the low-profile adapter. The intent is that this specification becomes an industry-wide standard for all multi-display monitor graphic card applications, regardless of form factor.

1.2 Goals

The standardization of the connector interface and defining the signals for each contact for one interface to handle two video interfaces, either digital or analog, on a connector small enough to fit into the parameters set by the low-profile PCI form factor.

1.3 Reference Documents

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

- Digital Visual Interface (DVI), Revision 1.0, *Digital Display Working Group*, April 2, 1999
- AGP Design Guide, Revision 1.5, *Intel Corporation*, May 2001
- VESA Enhanced Display Data Channel (DDC), Version 1, Sept. 2, 1999
- VESA Video Signal Standard, Version 1, Rev 1, March 29, 2000
- VESA Enhanced Video Connector (P&D-A) Pinout & Signal Standard, Version 2, Revision 1, July 13, 1998
- PCI Local Bus Specification, Rev 2.2, *PCI-SIG*, December 18, 1998
- Low Profile PCI Card, PCI Engineering Change Notice, *PCI-SIG,* Feb 14, 2000

2. Connectors

2.1 Low Profile Adapter Constraints

The minimum space need to accommodate two video monitor connectors, must equal two connector widths. As shown in Figures 2-1 and 2-2, the low profile adapter only has 42.47 mm by 12.07 mm of space available for external connectors on the metal bracket.

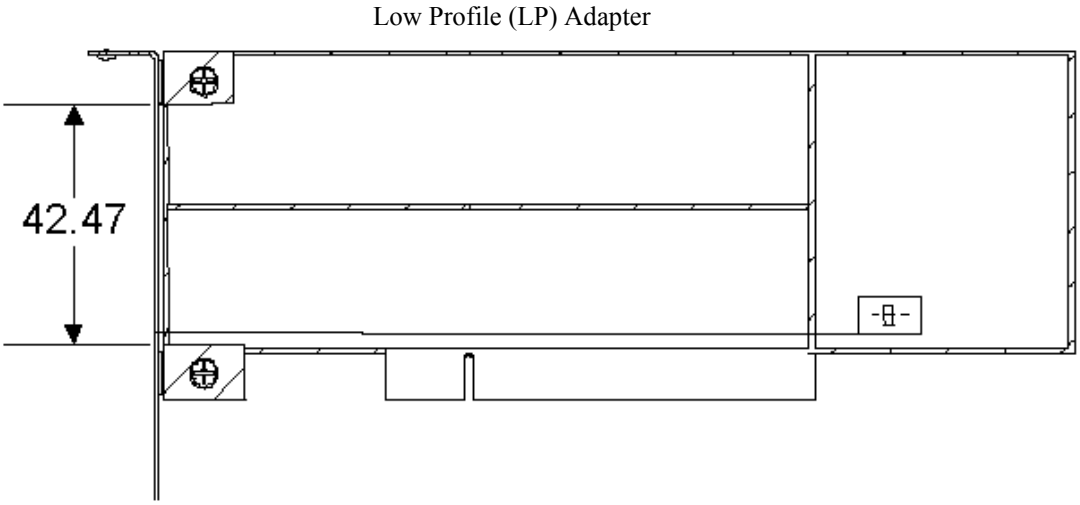


Figure 2-1 --- Vertical Space Available for Connector(s)

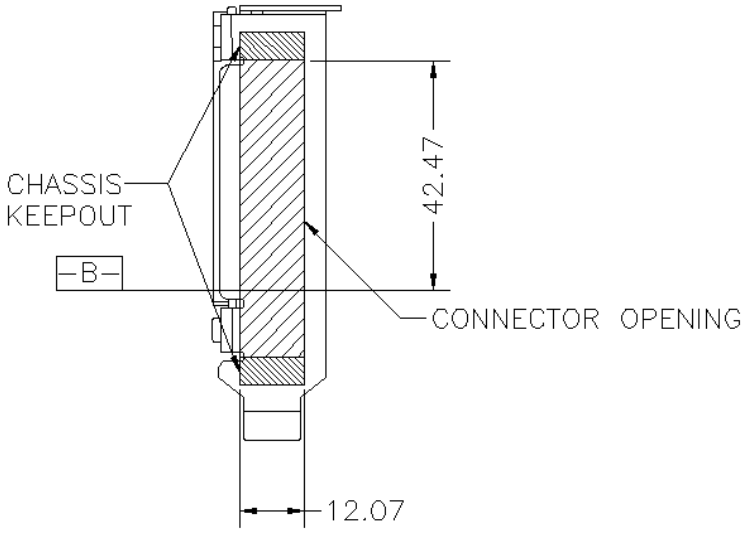


Figure 2-2 --- Horizontal Space Available for Connector(s)

2.2 Existing Connectors

The existing interfaces that need to be accommodated use either an analog VGA connector or digital and/or analog DVI connector to interface to the monitor. Figure 2-3, shows the maximum width for each type of monitor connector. Some additional space is often required, on either side or both sides of the connector, in order to accommodate human factors (room for fingers).

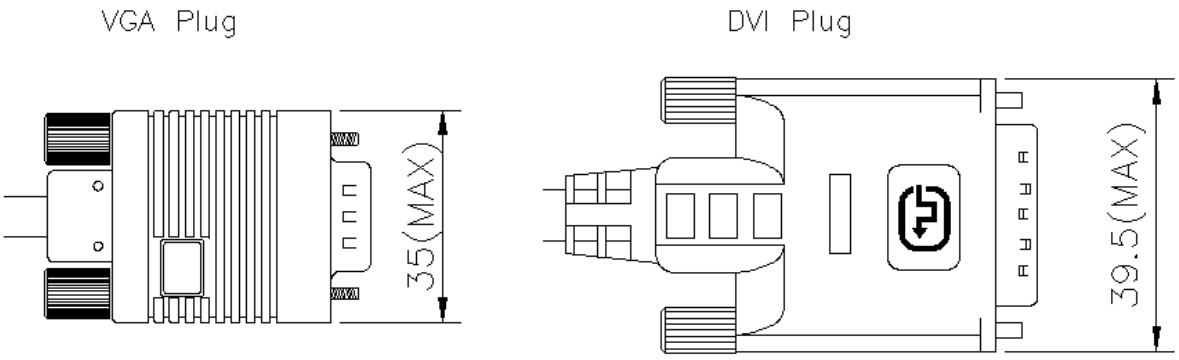


Figure 2-3 --- Space Required for External Connectors

Placing 2 VGA style monitor connectors on the adapter would require a minimum of 70 mm of space and placing 2 DVI monitor connectors on the adapter would require a minimum of 79 mm of space. Clearly there is not enough space to accommodate either 2 VGA style connectors or 2 DVI connectors on the graphics adapter or a VGA plus a DVI connector.

2.3 Connector Selected

The proposed DMS-59™ connector mating interface is covered by patent(s) issued to Molex, Incorporated. To obtain a license and additional connector interface design detail, companies should contact Molex Incorporated directly. General interface details are as follows:

Notes:
1. Dimensions are in mm.
2. Interpret dimensions per ASME Y14.5M – 1994
3. Illustrations are in third angle projection.
4. Drawings are not to scale

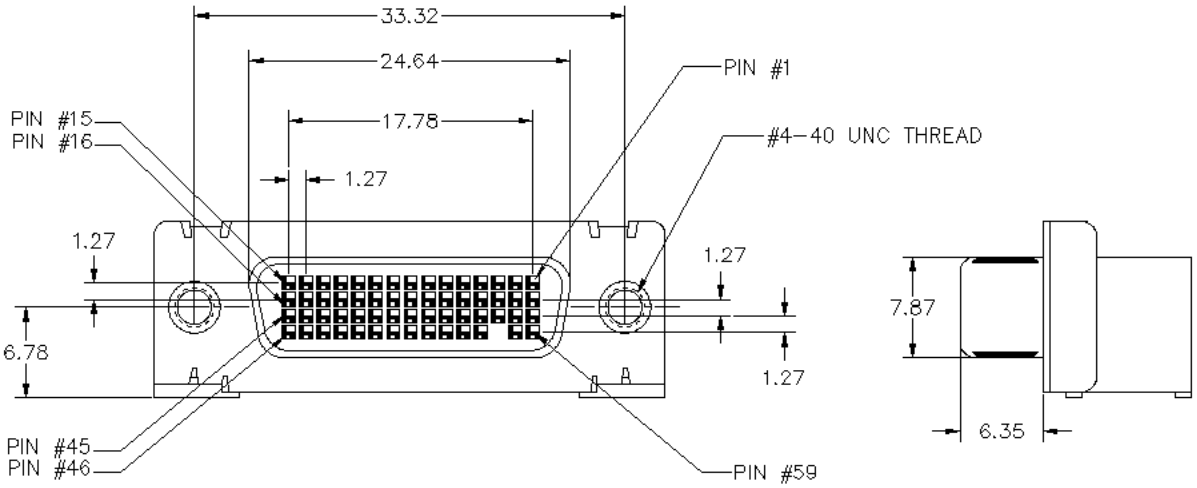
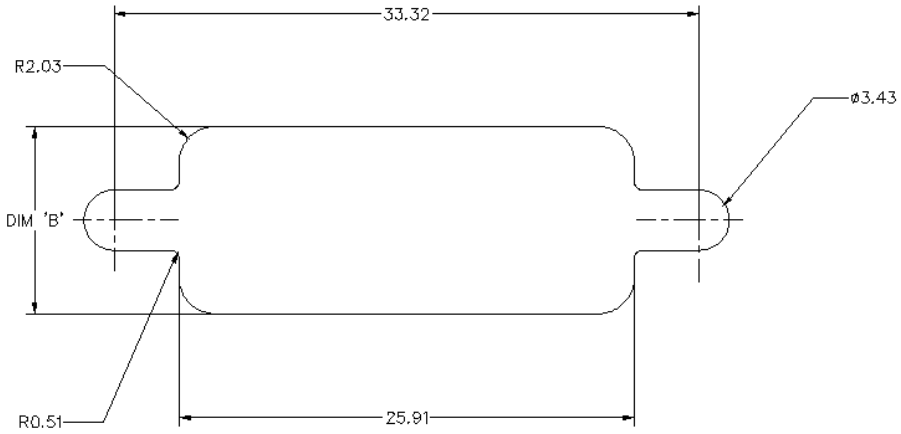


Figure 2-4 --- Receptacle Mating Features

Notes:
1. Dimensions are in mm.
2. Interpret dimensions per ASME Y14.5M – 1994
3. Illustrations are in third angle projection.
4. Drawings are not to scale



RECOMMENDED PANEL CUT-OUT

DIM. 'B'	PANEL THICKNESS
9.65	0.99
10.67	1.63

Figure 2-5 --- Recommended Panel Cut-out

Notes:
1. Dimensions are in mm.
2. Interpret dimensions per ASME Y14.5M – 1994
3. Drawing is not to scale

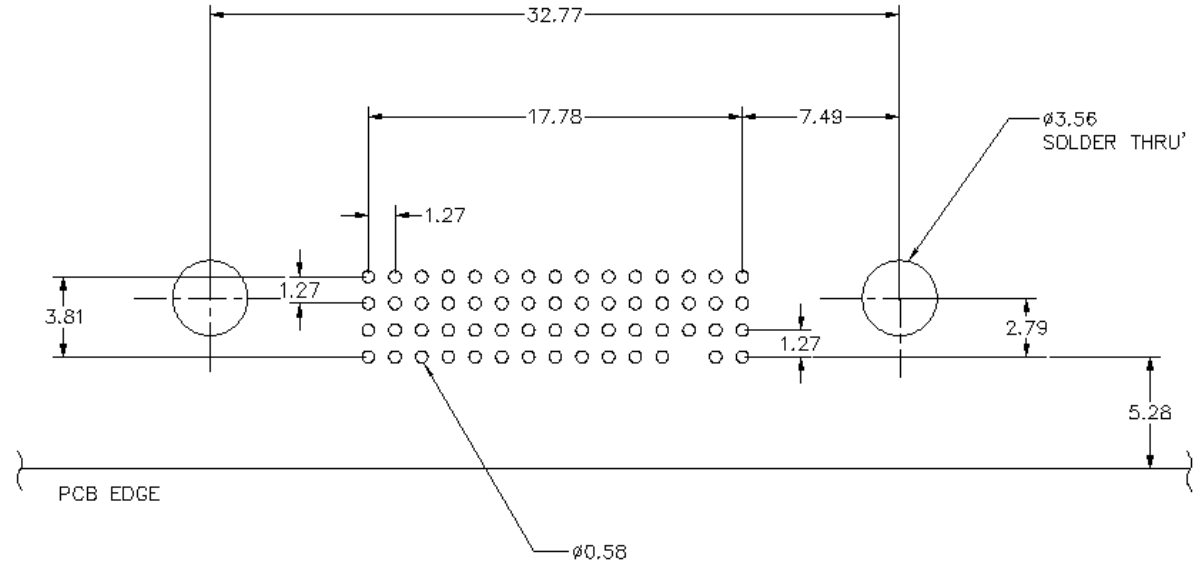


Figure 2-6 --- Reference Hole Pattern (Receptacle)

Notes:
1. Dimensions are in mm.
2. Interpret dimensions per ASME Y14.5M – 1994
3. Drawing is not to scale

3. Connector Performance Requirements

In order for the selected connector to perform in a manner consistent with the needs of this standard, the following performance attributes need to be met.

3.1 Mechanical Performance Requirements

Vibration	ANSI/EIA-364-28, Condition III, Method 5A, 15 minute/axis	No discontinuity of 1 us or longer (each contact) when continuity is tested per ANSI/EIA-364-46
Mechanical Shock	ANSI/EIA-364-27, Condition A, specified pulse	No discontinuity at 1 us or longer (each contact) when continuity is tested per ANSI/EIA-364-46
Durability	ANSI/EIA-364-09 Automatic cycling to 100 cycles. Rate: 100 +/- 50 cycles per hour	Low Level contact resistance per ANSI/EIA-364-23, 10 milli-ohm maximum change from initial per contact pair. All samples to be mated
Mating and Unmating Force	ANSI/EIA-364-13 Insert and extract at a speed of 20 mm/minute	Unmating force: 2 kg force minimum; 8 kg force maximum Mating foce: 9 kg force maximum
Cable Flexing	ANSI/EIA-364-41 Condition I, dimension X = 4.0 x cable diameter 100 cycles in each of two planes.	Dielectric Withstanding Voltage tested per requirements. Insulation Resistance tested per requirements. Continuity tested per ANSI/EIA-364-46 with no discontinuities on contacts or shield greater than 1us allowed during flexing.

Contact Resistance	ANSI/EIA-364-23	20 milli-ohm maximum, initial per contact mated pair. 10 milli-ohm maximum change from original per contact mated pair.
Shell Resistance	ANSI/EIA-364-06a-83 Contact resistance measured from receptacle shell leg to plug cable shield braid. Test current - 100 mA: Test voltage = 5VDC open circuit maximum.	50 milli-ohm maximum, initial. 50 milli-ohm maximum change from original measurement
Dielectric Withstanding Voltage	ANSI/EIA-364-20 Test voltage 500 VDC +/- 50V, Method C, unmated and unmounted. Atmospheric pressure of 15 psi.	No flashover. No sparkover. No excess leakage. No breakdown.
Insulation Resistance	ANSI/EIA-364-21, Test voltage 500 VDC +/- 50V, Method C, unmated and unmounted.	500 Meg-ohm minimum between adjacent contacts and contacts and shell.
Contact Current Rating	ANSI/EIA-364-70, 55 degree C, maximum ambient temperature, 85 degree C maximum temperature change.	1.5 A minimum
TMDS Signal Time Domain Impedance	ANSI/EIA-364-108 Risetime = 330 pS (10%-90%) S:G ratio = 2:1 Differential measurement Specimen environment impedance=100 ohm differential Source-side receptacle connector mounted on a controlled impedance PCB fixture.	100 ohm +/- 15%
TMDS Signal Time Domain Crosstalk: FEXT	ANSI/EIA-364-90 Risetime = 330 pS (10%-90%) S:G ratio = 2:1 Differential measurement Specimen environment impedance=100 ohm differential Source-side receptacle connector mounted on a controlled impedance PCB fixture. (1) Driven pair and (1) victim pair.	5% Maximum

3.2 Electrical Performance Requirements

TMDS Signal Rise Time Degradation	ANSI/EIA-364-102 S:G ratio = 2:1 Differential measurement Specimen environment impedance=100 ohm differential Source-side receptacle and load side plug connector mounted on a controlled impedance PCB fixture.	160 pS Maximum (Note: Converted bandwidth using BW=0.35/t_{rise} yields 2.2GHz)
Analog RGB Coaxial Signal Time Domain Impedance	ANSI/EIA-364-108 Risetime = 700 pS (10%-90%) S:G ratio = 1:1 Single-ended measurement Specimen environment impedance = 75 ohm Single-ended Source-side receptacle connector mounted on a controlled impedance PCB fixture.	75 ohm +/- 10%
Analog RGB Coaxial Signal Time Domain Crosstalk: FEXT	ANSI/EIA-364-90 Risetime = 700 pS (10%-90%) S:G ratio = 1:1 Single-ended measurement Specimen environment impedance = 75 ohm single-ended Source-side receptacle connector mounted on a controlled impedance PCB fixture and the load side plug is terminated to semi-rigid coax, (1) Driven line and (1) victim line.	3% Maximum
Analog RGB Coaxial Signal Rise Time Degradation	ANSI/EIA-364-102 S:G ratio = 1:1 Single-ended measurement Specimen environment impedance = 75 ohm single-ended Source-side receptacle connector mounted on a controlled impedance PCB fixture and the load side plug is terminated to semi-rigid coax.	140 pS Maximum (Note: Converted bandwidth using BW=0.35/t_{rise} yields 2.5GHz)

4. Signal Set

With insufficient room to physically accommodate two connectors, space can be found to accommodate the signal set needed for two monitors within one connector; the connector selected for this task is the Molex DMS-59™. This connector has been selected based upon the requirements set forth herein and the low likelihood that it would confuse by the end-user with any other application. The minimum signal set needed to allow for either two digital monitors or two analog monitors or one of each, needs to include: RGB analog video or single-link digital video, DDC, +5V and return and Hot Plug Detect as enumerated in Figure 4-1.

Monitor	Pins Required	Signal Names
VGA Connector 1	9	Red Video-1 & Shield, Blue Video-1 & Shield, Green Video-1 & Shield, VSync-1, HSync-1, Sync Rtn-1
TMDS Connector 1	12	TMDS-1 Data 0+/0-/0 Shld, TMDS-1 Data 1+/1-/1 Shld, TMDS-1 Data 2+/2-/2 Shld, TMDS-1 CLK +/ -/ Shld
Common Signals-1	4	HPD-1, SDA-1, SCL-1, VCC-1
RGBS/Composite/S-Video TV output-1	7	Luma, Chroma, Composite
VGA Connector 2	9	Red Video-2 & Shield, Blue Video-2 & Shield, Green Video-2 & Shield, VSync-2, HSync-2, Sync Rtn-2
TMDS Connector 2	12	TMDS-2 Data 0+/0-/0 Shld, TMDS-2 Data 1+/1-/1 Shld, TMDS-2 Data 2+/2-/2 Shld, TMDS-2 CLK +/ -/ Shld
Common Signals-2	4	HPD-2, SDA-2, SCL-2, VCC-2
Stereo Sync	2	Stereo sync and ground

Figure 4-1 --- Signal Requirements

The proposed connector pinout is as shown in Figure 4-2.

DMS-59	Signal Name		DMS-59	Signal Name
1	Red Video-1 Shield		31	TMDS-1 CLK +
2	Red Video-1		32	TMDS-1 CLK -
3	Blue Video-1		33	TMDS-1 Data 0 Shield
4	Blue Video-1 Shield		34	TMDS-1 Data 1 Shield
5	VCC +5V -1		35	TMDS-1 Data 2 Shield
6	SCL-1		36	Hot Plug Detect -1
7	SDA-1		37	Composite Video
8	Gnd		38	Luma Rtn
9	SDA-2		39	Chroma
10	SCL-2		40	Hot Plug Detect -2
11	VCC +5V -2		41	TMDS-2 Data 2 Shield
12	Blue Video-2 Shield		42	TMDS-2 Data 1 Shield
13	Blue Video-2		43	TMDS-2 Data 0 Shield
14	Red Video-2		44	TMDS-2 CLK -
15	Red Video-2 Shield		45	TMDS-2 CLK +
16	TMDS-2 Data 0 +		46	Green Video-2 Shield
17	TMDS-2 Data 0 -		47	Green Video-2
18	TMDS-2 Data 1 +		48	Stereo
19	TMDS-2 Data 1 -		49	TMDS-2 CLK Shield
20	TMDS-2 Data 2 +		50	HSync-2
21	TMDS-2 Data 2 -		51	VSync-2
22	Chroma Rtn		52	Sync Rtn -2
23	TV-Out		53	Luma
24	Composite Rtn		54	Sync Rtn -1
25	TMDS-1 Data 2 +		55	VSYNC-1
26	TMDS-1 Data 2 -		56	HSYNC-1
27	TMDS-1 Data 1 +		57	TMDS-1 CLK Shield
28	TMDS-1 Data 1 -		Key	
29	TMDS-1 Data 0 +		58	Green Video-1
30	TMDS-1 Data 0 -		59	Green Video-1 Shield
Case	Ground			

Figure 4-2 --- DMS-59™ Pinout for Multi-Display Support

Connections for two analog video monitors, compliant with VESA P&D-A requirements, would use the contacts in the DMS-59™ shown (grayed positions) in Figure 4-3. Connections for two digital video monitors, compliant with TMDS signaling, will use the contacts of the DMS-59™ shown (grayed positions) in Figure 4-4. Connections for television output, will use contacts of the DMS-59™ shown (grayed positions) in Figure 4-5.

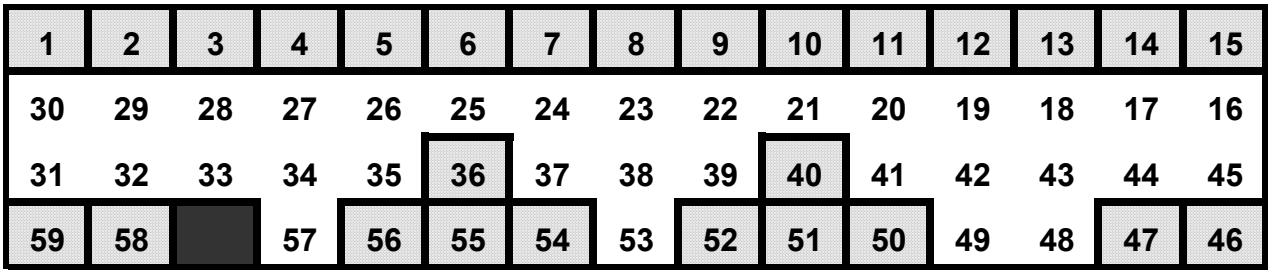


Figure 4-3 --- Contacts used for Analog Signal Set

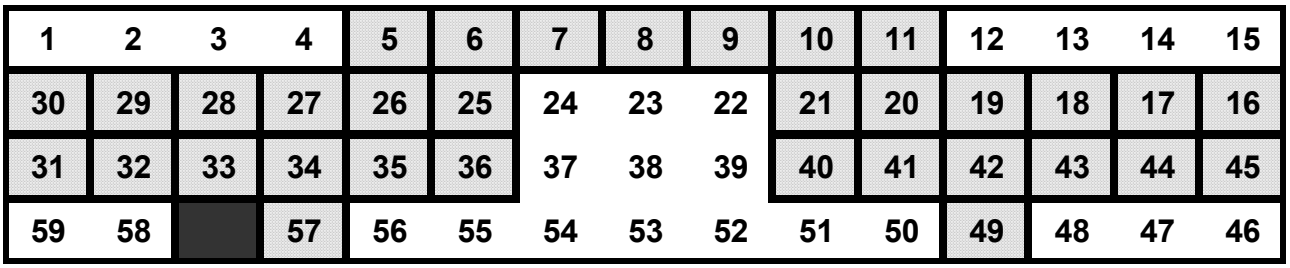


Figure 4-4 --- Contacts used for Digital Signal Set

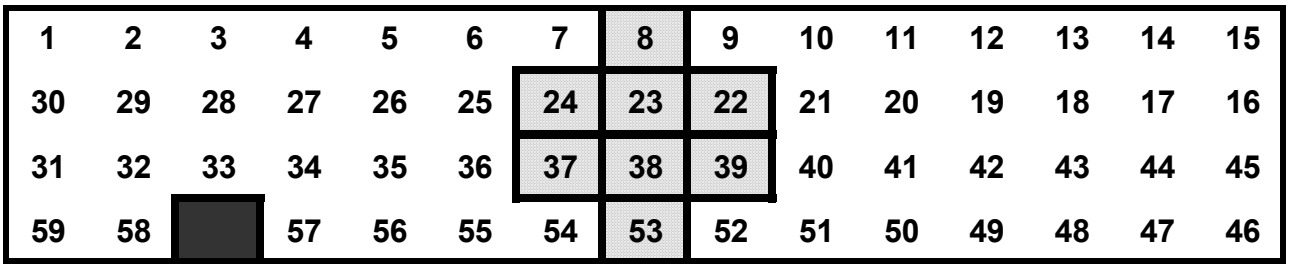


Figure 4-5 --- Contacts used for Television Signal Set

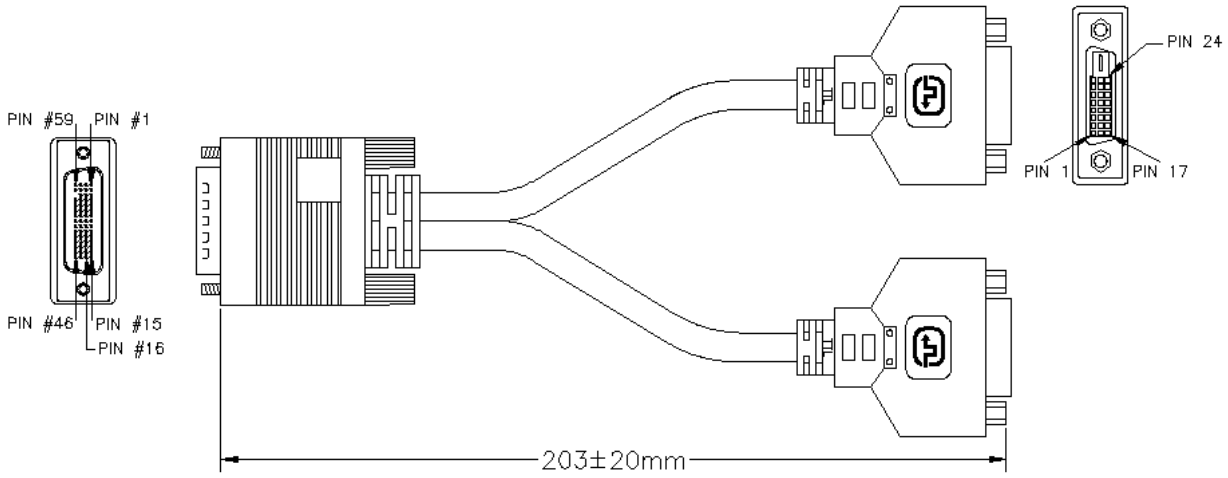
5. Appendix A – Possible Implementations

In order to accommodate multiple monitors from one connector on a graphics card, adapters are needed to divide the signals into the appropriate connector interfaces. In order to have least impact on the systems, these adapters should be short enough to not significantly degrade the signals, but long enough to facilitate ease of installation. For DVI receptacles, the DVI-I is used to allow either an analog DVI-I or a digital DVI-D plug to be connected, both are accommodated by the DVI-I receptacle. An overall assembly length is not defined because each implementation may vary; however, a length should be selected that has the minimum impact upon installation's signal quality.

5.1 Adapter Assemblies

These are the combinations of adapters that are to be defined:

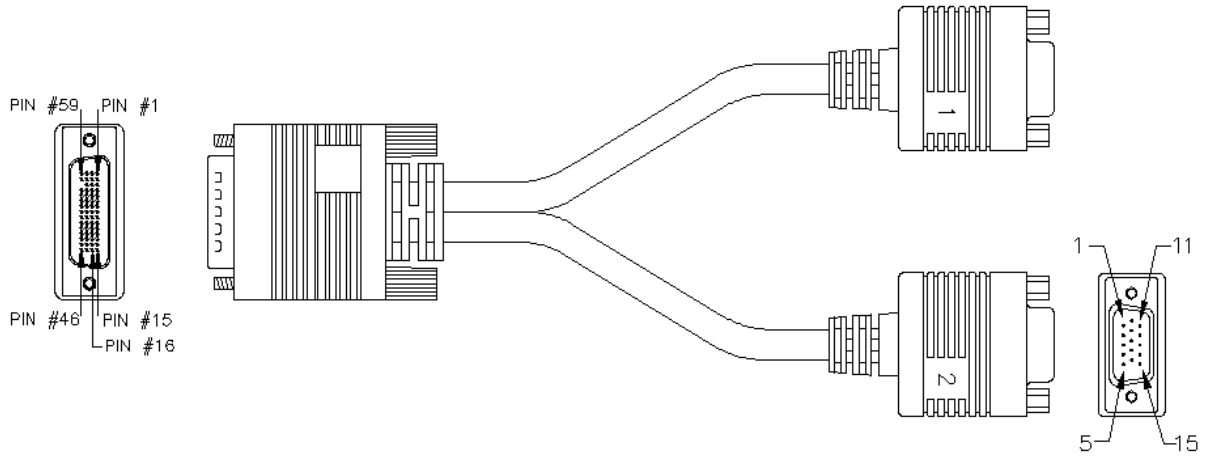
- Host to 2 DVI-D receptacles, see Figure 5-1
- Host to 2 VGA receptacles, see Figure 5-2
- Host to 1 DVI-I receptacle and 1 VGA receptacle, see Figure 5-3



Pin	Host Signal Name	Pin	TMDS #1 Signal Name
5	VCC-1	14	+5V Power
6	SCL-1	6	DDC Clock
7	SDA-1	7	DDC Data
25	TMDS-1 DATA2 +	2	TMDS Data 2+
26	TMDS-1 DATA2 -	1	TMDS Data 2-
27	TMDS-1 DATA1 +	10	TMDS Data 1+
28	TMDS-1 DATA1 -	9	TMDS Data 1-
29	TMDS-1 DATA0 +	18	TMDS Data 0+
30	TMDS-1 DATA0 -	17	TMDS Data 0-
31	TMDS-1 CLK +	23	TMDS Clock +
32	TMDS-1 CLK -	24	TMDS Clock -
33	TMDS-1 DATA0 RTN	19	TMDS Data 0 Shield
34	TMDS-1 DATA1 RTN	11	TMDS Data 1 Shield
35	TMDS-1 DATA2 RTN	3	TMDS Data 2 Shield
36	HPD-1	16	Hot Plug Detect
54	GROUND-1	15	Ground
57	TMDS-1 CLK SHLD	22	TMDS Clock Shield

Pin	Host Signal Name	Pin	TMDS #2 Signal Name
9	SDA-2	7	DDC Data
10	SCL-2	6	DDC Clock
11	VCC-2	14	+5V Power
16	TMDS-2 DATA0 +	18	TMDS Data 0+
17	TMDS-2 DATA0 -	17	TMDS Data 0-
18	TMDS-2 DATA1 +	10	TMDS Data 1+
19	TMDS-2 DATA1 -	9	TMDS Data 1-
20	TMDS-2 DATA2 +	2	TMDS Data 2+
21	TMDS-2 DATA2 -	1	TMDS Data 2-
40	HPD-2	16	Hot Plug Detect
41	TMDS-2 DATA2 RTN	3	TMDS Data 2 Shield
42	TMDS-2 DATA1 RTN	11	TMDS Data 1 Shield
43	TMDS-2 DATA0 RTN	19	TMDS Data 0 Shield
44	TMDS-2 CLK -	24	TMDS Clock -
45	TMDS-2 CLK +	23	TMDS Clock +
49	TMDS-2 CLK SHLD	22	TMDS Clock Shield
52	GROUND-2	15	Ground

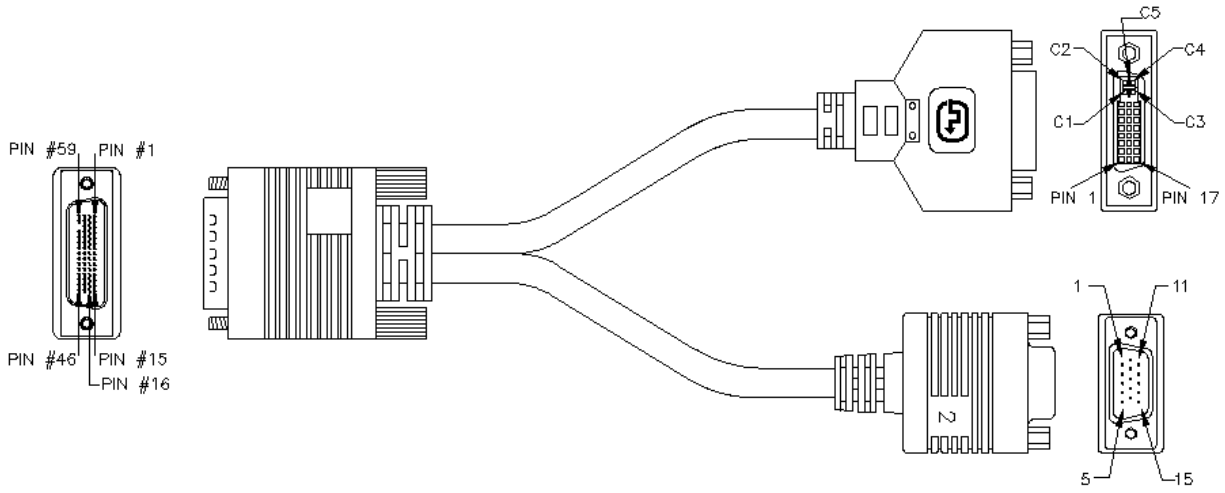
Figure 5-1 --- Host to 2 DVI-D



Pin	DMS-59 Signal Name	Pin	VGA #1 Signal Name
1	RED_A Shield	6	Red Video Return
2	RED_A	1	Red Video
3	BLUE_A	3	Blue Video
4	BLUE_A Shield	8	Blue Video Return
5	+5V	9	+5V
6	SCL_A	15	Data Clock
7	SDA_A	12	DDC Data
54	Ground	10	Sync return
55	VS_A	14	Vertical Sync
56	HS_A	13	Horiz. Sync
57	Ground	5	Ground
58	GREEN_A	2	Green Video
59	GREEN_A Shield	7	Green Video Return

Pin	DMS-59 Signal Name	Pin	VGA #2 Signal Name
9	SDA_B	12	DDC Data
10	SCL_B	15	Data Clock
11	+5V	9	+5V
12	BLUE_B Shield	8	Blue Video Return
13	BLUE_B	3	Blue Video
14	RED_B	1	Red Video
15	RED_B Shield	6	Red Video Return
46	GREEN_B Shield	7	Green Video Return
47	GREEN_B	2	Green Video
49	Ground	5	Ground
50	HS_B	13	Horiz. Sync
51	VS_B	14	Vertical Sync
52	Ground	10	Sync return

Figure 5-2 --- Host To 2 VGA



Pin	DMS-59 Signal Name	Pin	VGA Signal Name
9	SDA_B	12	DDC Data
10	SCL_B	15	Data Clock
11	+5V	9	+5V
12	BLUE_B Shield	8	Blue Video Return
13	BLUE_B	3	Blue Video
14	RED_B	1	Red Video
15	RED_B Shield	6	Red Video Return
47	GREEN_B	2	Green Video
49	GREEN_B Shield	7	Green Video Return
50	HSync_B	13	Horiz. Sync
51	VSync_B	14	Vertical Sync
52	Ground	10	Sync return

Pin	DMS-59 Signal Name	Pin	DVI-I Signal Name
1	Red_A Shield	C5	Red Video Return
2	Red_A	C1	Red Video
3	Blue_A	C3	Blue Video
4	Blue_A Shield	C5	Blue Video Return
5	+5V	14	+5V
6	SCL_A	6	Data Clock
7	SDA_A	7	DDC Data
25	TMDS Data 2+	2	TMDS Data 2+
26	TMDS Data 2-	1	TMDS Data 2-
27	TMDS Data 1+	10	TMDS Data 1+
28	TMDS Data 1-	9	TMDS Data 1-
29	TMDS Data 0+	18	TMDS Data 0+
30	TMDS Data 0-	17	TMDS Data 0-
31	TMDS Clock +	23	TMDS Clock +
32	TMDS Clock -	24	TMDS Clock -
33	TMDS Data 0 Shield	19	TMDS Data 0 Shield
34	TMDS Data 1 Shield	11	TMDS Data 1 Shield
35	TMDS Data 2 Shield	3	TMDS Data 2 Shield
36	HPD	16	Hot Plug Detect
54	Ground	15	Ground
55	VSnyc_A	8	Vertical Sync
56	HSync_A	C4	Horiz. Sync
57	TMDS Clock Shield	22	TMDS Clock Shield
58	Green_A	C2	Green Video
59	Green_A Shield	C5	Green Video Return

Figure 5-3 --- Host To DVI-I & VGA