Section 4. Display Connector

Display Connector Introduction 4-2
Signal Timing 4-3
VGA Mode Display Timing 4-4
Extended Graphics Mode Display Timing 4-8

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Display Connector Introduction

The synchronization and monitor ID signals are TTL levels. The video signals are analog signals ranging from 0 to 0.7 volts.

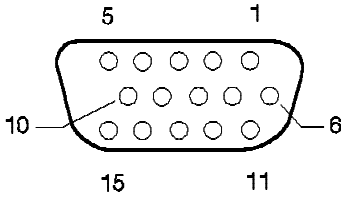


Figure 4-1. Display Connector

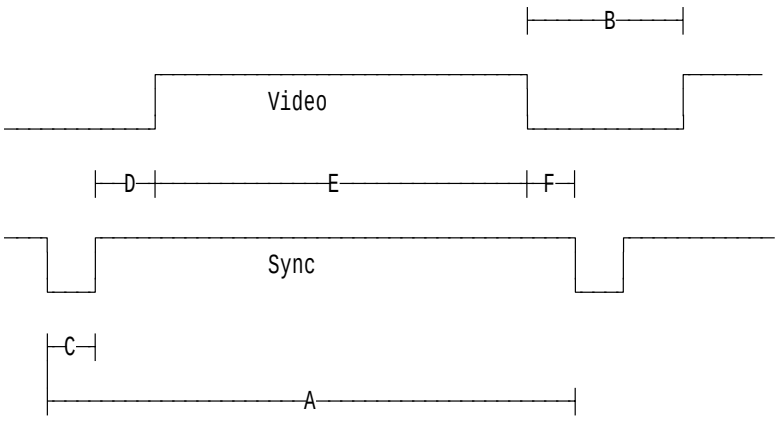
Pin	Signal Description	Display Pins	
		Monochrome	**Color**
1	Red	N/C	Red
2	Green	Mono	Green
3	Blue	N/C	Blue
4	Monitor ID 2		
5	Ground	Self Test	Self Test
6	Red Ground	N/C	Red Ground
7	Green Ground	Mono Ground	Green Ground
8	Blue Ground	N/C	Blue Ground
9	Plug	No Pin	No Pin
10	Ground	Ground	Ground
11	Monitor ID 0		
12	Monitor ID 1		
13	Horizontal Synchronization	Hsync	Hsync
14	Vertical Synchronization	Vsync	Vsync
15	Monitor ID 3		

Figure 4-2. Display Connector Signals

Signal Timing

This section provides details of the display connector signal timing that the video subsystem supports.

The section is divided into VGA mode timing followed by Extended Graphics mode Display timing information. The symbols used in the following sections are defined as follows:



Note: In the above diagram, the Sync signal is shown as a Negative active signal. Depending upon the mode of operation, this signal may be positive active. The timing information is still valid however.

A = Period
B = Blanking
C = Sync Width
D = Back Porch
E = Active Video
F = Front Porch

The sync polarities define the display mode as follows:

VSYNC Polarity	HSYNC Polarity	Vertical Size
–	+	Mode 1 (350 lines)
+	–	Mode 2 (400 lines)
–	–	Mode 3 (480 lines)
+	+	Mode 4 (Other -- not available on all displays)

Figure 4-3. Vertical Size of Display

VGA Mode Display Timing

Display modes 1, 2, and 3 are supported under VGA mode. All displays that are to be used as a single display on an IBM video subsystem must be able to display in these modes.

There are three unique sets of timing values supported. The timing set which is driven by the video subsystem depends upon the monitor ID of the attached display as follows:

VGA Mode Display Timing Set #1 This set of timings are the only timings driven by the IBM VGA and the IBM XGA video subsystems. On the IBM XGA-2 video subsystem, these timings are driven when bit 2 of the Display ID is equal to a fixed '0'b or a fixed '1'b in the display connector. Example IBM displays which support this timing set are:

- 8503
- 8504
- 8512
- 8513
- 8514
- 8515
- 8516
- 8517
- 8518

VGA Mode Display Timing Set #2 This set of timings is NOT supported by the IBM VGA and the IBM XGA video subsystems. On the IBM XGA-2 video subsystem, these timings are driven when bit 2 of the Display ID is tied to the Vertical Sync signal in the display connector.

VGA Mode Display Timing Set #3 This set of timings is NOT supported by the IBM VGA and the IBM XGA video subsystems. On the IBM XGA-2 video subsystem, these timings are driven when bit 2 of the Display ID is tied to the Horizontal Sync signal in the display connector. Example IBM displays which support this timing set are:

See “Display ID and Comparator Register (Index 52)” on page 3-76 and “Display Type Detection” on page 3-213

VGA Mode Display Timing Set #1					
	Vertical (ms)			Horizontal (us)	
	Mode 1 (350 Lines)	Mode 2 (400 Lines)	Mode 3 (480 Lines)	Border	No Border
A = Period	14.268	14.268	16.683	31.778	31.778
B = Blanking	2.765	1.112	0.922	5.720	6.356
C = Sync Width	0.064	0.064	0.064	3.813	3.813
D = Back Porch	1.684	0.858	0.763	1.589	1.907
E = Active Video	11.503	13.156	15.762	26.058	25.422
F = Front Porch	1.017	0.191	0.095	0.318	0.636

VGA Mode Display Timing Set #2					
	Vertical (ms)			Horizontal (us)	
	Mode 1 (350 Lines)	Mode 2 (400 Lines)	Mode 3 (480 Lines)	Border	No Border
A = Period	11.874	11.874	13.884	26.446	26.446
B = Blanking	2.301	0.926	0.767	4.760	5.298
C = Sync Width	0.053	0.053	0.053	3.174	3.174
D = Back Porch	1.402	0.714	0.635	1.322	1.587
E = Active Video	9.574	10.949	13.117	21.686	21.157
F = Front Porch	0.846	0.159	0.079	0.264	0.529

VGA Mode Display Timing Set #3					
	Vertical (ms)			Horizontal (us)	
	Mode 1 (350 Lines)	Mode 2 (400 Lines)	Mode 3 (480 Lines)	Border	No Border
A = Period	11.403	11.403	13.333	25.397	25.397
B = Blanking	2.210	0.889	0.737	4.571	5.079
C = Sync Width	0.051	0.051	0.051	3.048	3.048
D = Back Porch	1.346	0.686	0.610	1.270	1.524
E = Active Video	9.194	10.514	12.597	20.825	20.317
F = Front Porch	0.813	0.152	0.076	0.254	0.508

When in VGA mode, BIOS should be used to set the video subsystem into the desired mode.

The PEL frequency for a given display mode is dependent upon the number of horizontal PELs to be displayed. As an example, Display Mode 1 can be used for VGA 80 Column Text mode (720 PELs wide) or for 132 column text mode (1056 or 1188 PELs wide). The following Table provides example PEL frequencies (rounded up to nearest 0.25MHz):

PEL Frequencies (MHz) for Example Horizontal Resolutions									
	Mode 1 (Width In PELs)			Mode 2 (Width In PELs)			Mode 3 (Width In PELs)		
	720	1056	1188	720	1056	1188	640	1056	1188
Display Timing Set 1	28.25	41.5	46.5	28.25	41.5	46.5	25.25	41.5	46.5
Display Timing Set 2	34.0	50.0	56.0	34.0	50.0	56.0	30.25	50.0	56.0
Display Timing Set 3	35.5	52.0	58.0	35.5	52.0	58.0	31.5	52.0	58.0

A given resolution should only be displayed on a display which is specified to accept the resulting pixel rate. The following table provides an example list of IBM displays and the maximum PEL rate (and Horizontal resolution) supported for each display:

Display Modes 1, 2 and 3		
Display	Maximum Horizontal Resolution (PELs)	Maximum PEL Rate (MHz)
8503	720	28.32
8504	720	28.32
8512	720	28.32
8513	720	28.32
8514	720	46.50
8515	1188	46.50
8516	1188	46.50
8517	1188	46.50
8518	720	28.32

Display Mode 4: Display Mode 4 is defined to be any other resolution. On the IBM 8515 display is it used for 1024*768 43.5Hz Interlaced, however, it could be any other resolution. This mode is not available using video BIOS, but is used in Extended Graphics Modes. See “Extended Graphics Mode Display Timing” on page 4-8.

Extended Graphics Mode Display Timing

The XGA Display Adapter/A or the XGA subsystem on the system board can display in two resolutions when in Extended Graphics Modes:

- 640x480 Non-Interlaced
- 1024x768 Interlaced.

The Display timing for the 640x480 resolution is defined above in the "VGA Mode Display Timing Set #1". No border is used.

The 1024x768 interlaced mode display timing information is provided below. These are the only two display timings supported. Not all IBM displays support the 1024*768 Interlaced mode. The following are example IBM displays which do support this mode:

- 8514
- 8515
- 8516
- 8517

Extended Graphics Mode 1024*768 Interlaced Display Timing		
	Vertical (mS)	Horizontal (uS)
A = Period	23.000	28.15
B = Blanking	0.690	5.35
C = Sync Width	0.113	3.92
D = Back Porch	0.577 / 0.563 (Odd/Even Fields)	1.25
E = Active Video	21.620 (Frame); 10.81 (Field)	22.80
F = Front Porch	0.000 / 0.014 (Odd/Even Fields)	0.18

Notes: 1. The Odd field displays lines 1, 3, 5, 7 (where Line 1 is the first line on the screen)

2. The Even field displays lines 2, 4, 6, 8 etc

3. A Frame is is made up of an Odd and an Even field

4. The PEL Frequency for the above mode is 44.9MHz

This mode has a Frame Rate of 43.5 Hz and it is displayed using the interlaced scanning technique. No Extended Graphics modes are set by BIOS, but require an XGA application or device driver.

XGA-2 Subsystem Display Timing: The XGA-2 Display Adapter/A or the XGA-2 subsystem on the system board do not have fixed resolutions. They are completely programmable, thereby supporting a wide range of display timings. The resolutions available to an application or device driver are dependant upon the display attached rather than a function of the subsystem.

The following are examples of the resolutions that are available with the XGA-2 subsystem when running XGA applications or Device Drivers which exploit DMQS. (See “XGA Display Mode Query and Set (DMQS)” on page 3-192 for details of DMQS Display Information Files.) The fixed display timings above as well as a variety of other resolutions are supported. The specific timings of each resolution listed below are not provided here. The XGA-2 Subsystem is limited only by a maximum PEL clock rate of 90MHz.

Horizontal * Vertical PELS	Frame Rate (Hz)	Line Rate (KHz)	PEL Rate (MHz)	I or NI	Number Of Colors / Shades of Gray (Max)	IBM Display Support		
						8503 8504 8512 8513 8518	8507 8514 8515 8516 7554	8517
640x480	60	31.6	25.25	NI	65536 / 256	X	X	X
640x480 *	72	37.9	31.50	NI	65536 / 256			
640x480	72	37.8	30.25	NI	65536 / 256			
640x480	75	39.4	31.50	NI	65536 / 256			
800x600 **	56	35.2	36.00	NI	65536 / 256			
800x600 **	60	37.9	40.00	NI	65536 / 256			
800x600 *	72	48.1	50.00	NI	256 / 256			
800x600	75	50.0	52.00	NI	256 / 256			
1024x768	43.5	35.6	45.00	I	256 / 256		X	X
1024x768 **	60	48.4	65.00	NI	256 / 256			
1024x768	70	57.0	78.00	NI	256 / 256			X
1024x768 *	70	56.5	75.00	NI	256 / 256			
1024x768	72	58.1	80.00	NI	256 / 256			
1024x768	75	61.1	86.00	NI	256 / 256			
1280x1024	50	53.4	90.00	I	16 / 256			

* = Video Electronic Standards Association (VESA) Standard
** = VESA Guideline
I = Interlaced
NI = Non-Interlaced

The software supplied with the XGA-2 subsystem automatically exploits IBM monitors at the best resolution and refresh rate possible for the monitor attached.

Supported resolutions detailed above that are not available on IBM displays, are available with some non-IBM (OEM) displays. These displays range in capability from low cost/low function to high cost/high function. Most of these displays respond as an IBM 8514 display when queried by the software supplied with the XGA-2 subsystem. As a result, IBM 8514 resolutions and refresh rates are used as default.

The software supplied with the IBM XGA-2 Display Adapter/A or a system with the IBM XGA-2 subsystem on the system board, allows the user to override the default screen resolution.

Overriding with a resolution which does not meet (or exceeds) the capability of the attached display, can yield unpredictable results.

Warning: Some Multisync displays may appear to function correctly, however damage may occur over time.

Notes:

1. The user must only select resolutions which are suitable for the display attached to the XGA-2 subsystem.
2. The use of the resolution override should be avoided if the display attached to the XGA-2 subsystem is to be changed frequently with displays of varying characteristics.

The IBM XGA-2 subsystem along with certain IBM displays, computers and some software has been certified to meet the International Standards Organization (ISO) standard 9241/3. IBM cannot guarantee that all OEM displays attached to the XGA-2 subsystem will provide acceptable front of screen characteristics or meet other health and safety standards.

Index

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DSMLBR529E 'KP' WOULD EXCEED MAXIMUM SIZE.
DSMMOM395I 'JWXGATR1' LINE 302: .LB
DSMMOM397I 'JWXGATR1' WAS IMBEDDED AT LINE 670 OF '.EDFIM'
DSMMOM397I '.EDFIM' WAS IMBEDDED AT LINE 10 OF '.IM'
DSMMOM397I '.IM' WAS IMBEDDED AT LINE 104 OF 'GMDMASEX'
DSMTB2451W TABLE SPLIT ON PAGE 3-201.
DSMMOM397I '.EDFETABL' WAS IMBEDDED AT LINE 786 OF 'JWXGATR1'
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