Industrial Computer Source
Product Manual

Model EXM-13A
Reference Manual

MANUAL NO. 41417-155-01A

Industrial Computer Source 10180 Scripps Ranch Blvd., San Diego, CA 92131 (619) 271-9340

Industrial Computer Source Europe (1)69.07.28.22 Industrial Computer Source Asia Pte. Ltd. 65-749-0800
Industrial Computer Source (UK) Ltd. 0243-533900 Industrial Computer Source (Deutschland) GmbH (2234)

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FORWARD

This instruction manual provides the necessary user information for the referenced product(s) manufactured or distributed by Industrial Computer Source for the user to install, operate and/or program the product properly. Please refer to the following pages for information regarding the warranty and repair policies.

Technical assistance is available at (619) 271-9340.

Manual Errors, Omissions and Bugs: A Bug Sheet is included as the last page of this manual. Please use it if you find a problem with the manual you believe should be corrected.

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REVISION HISTORY

July	1993	New Release

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CHAPTER 1

PRODUCT DISCRIPTION

The EXM-13A expansion module is a Super VGA video controller using the NCR 77C22E+ controller chip. Two diskettes of video drivers and utilities are included For resolutions beyond the standard 640 x 480 x 16 colors; up to 1280 x 1024 x 256 colors. The EXM-13A is available in two memory sizes; 1 MByte which supports resolutions up to 1024 x 768 and 2 MBytes which supports resolutions up to 1280 x 1024.

The EXM-13A implements the Full VGA video standard, as well as a number of "Super VGA" resolutions. It has a standard DB-15 VGA connector For attachment to an analog VGA or multiscan monitor. It also has an auxiliary video connector similar to the auxiliary video extension in the IBM PS/2 and the Feature connector on many VGA cards; this contains auxiliary video signals that can be used For connection to other types of dis plays, such as certain Flat-panel displays.

For current users of the EXM-13 video adapter using standard VGA mode (640 x 480 x 16), the EXM-13A is a "drop-in" replacement. No additional drivers are required For this mode. The user may notice a slight delay on power-up because the EXM-13A has both more memory to check and performs a more extensive test of that memory.

The EXM-13A uses standard video memory and I/O addresses and thus cannot be used in systems with other video controllers also using these addresses. ThereFore the EXM-13A cannot be used in an EPC-2 or EPC-3 system, since these have integrated VGA controllers. Also, more than one video controller cannot be used in a single system unless the application software ensures that no more than one video controller is enabled at any point in time.

WARNING!

DO NOT PLUG IN ANY CABLE OR CONNECTOR INTO THE FRONT PANEL CONNECTORS WHILE THE SYSTEM IS POWERED UP. IN GENERAL, ELECTRONICS EQUIPMENT IS NOT DESIGNED TO WITHSTAND POTENTIAL DAMAGE THAT COULD ARISE FROM FLUCTUATIONS IN POWER. **NEVER** PLUG IN A SERIAL OR PARALLEL DEVICE, KEYBOARD, TRANSCEIVER, MONITOR OR OTHER COMPONENT WHILE THE SYSTEM IS ON.

SPECIFICATIONS

The following table defines the power and environmental specifications of the EXM-13A.

Environmental		
Temperature	operating	0 to 60°C ambient
	storage	-40 to 125°C
Humidity	operating	0 - 90% noncondensing
	storage	0 - 95% noncondensing
Altitude	operating	10,000 Ft (3000 m)
	storage	50,000 Ft (15,000 m)
Vibration	operating	0.015 inch (0.38 mm) P-P displacement with 2.5 g peak (max) acceleration over 5-2000 Hz
	storage	0.030 inch (0.76 mm) P-P displacement with 5.0 g peak (max) acceleration over 5-2000 Hz
Shock	operating	30 g, 11 ms duration, half-sine shock pulse
	storage	50 g, 11 ms duration, half-sine shock pulse
Electrical		
Power	maximum	8 W
	typical	3.5 W
Current	maximum	5V @ 1.6A
	typical	5V @ 0.7A
Other		
Weight		3.5 oz (105 g)
Addresses		
Memory		A0000h - C7FFh
I/O		3B4h - 3DEh

CHAPTER 2

INSTALLATION

Before installing the EXM-13A, unpack and inspect it for shipping dam age.

* Do not remove the module from its anti-static bag unless you are in a static-free environment. the EXM-13A, like most other electronic devices, is susceptible to esd dam age. esd damage is not always immediately ob vious, in that it can cause a partial breakdown in semicon ductor devices that might not immediately result in a failure.

* Ensure that the installation process as described herein is also performed in a static-free envi ronment.

INSERTION IN AN EXM CARRIER

Insertion of the EXM-13A into an EXM carrier, such as the EMC, EXP-MC or the integrated EXM carriers in the EPC-4 or EPC-5 is straightforward. Remove any blank EXM panel from the carrier (by unscrewing the thumb screws) and insert the EXM-13A into the cardguides. Firmly press the EXM-13A front panel to ensure that it has mated with the rear connector, and secure it with the thumbscrews.

* Make sure that power to your system is off. the exm is not designed to be inserted or removed from a livesys tem.

* When inserting the exm, avoid touching the cir cuit board, and make sure the environ ment is static-free.

CONFIGURING THE BIOS SETUP

The EXM configuration data in the EPC to which the EXM-13A is connected needs to be modified to recognize and enable the card and select from the available options. Invoke the BIOS setup function. This is done by pressing the CTRL-ALT-ESC keys simultaneously.

Enabling the EXM module

Once in the setup program, a menu will be displayed specifying which function keys are available for further configuration. Press the F2 function key to invoke the EXM menu. The screen looks something like

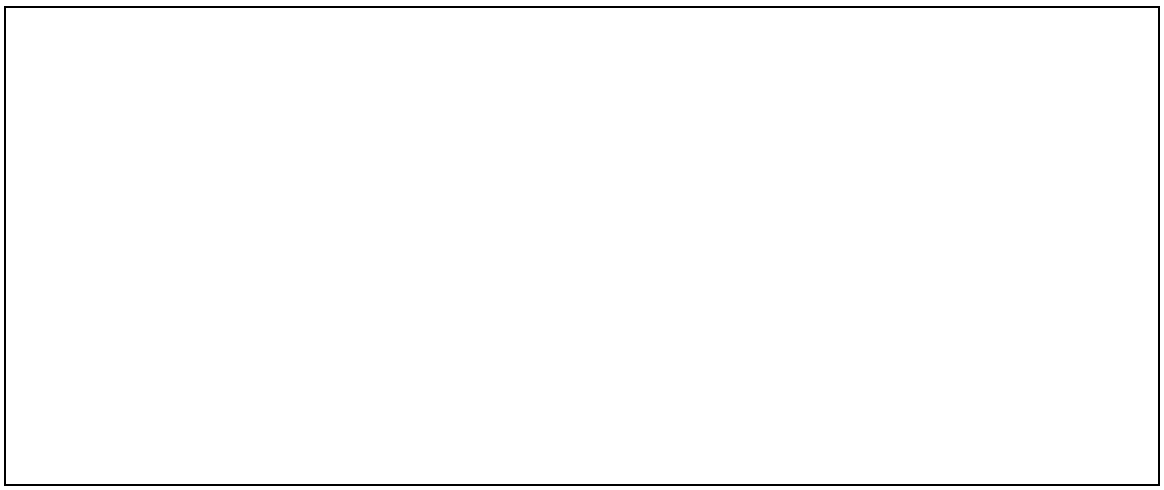
EXM Setup Screen

	ID	OB1	OB2
Slot 0	ED	01	00
1	FF	00	00
2	FF	00	00
3	FF	00	00
4	FF	00	00
5	FF	00	00

This displays the EXM configuration data (in hexadecimal) stored in nonvolatile memory which the EPC uses at power-up to recognize and configure each installed EXM. The displayed data shows SLOT, ID, OB1 and OB2. These are defined as follows:

SLOT indicates the slot in which the EXM is installed. See the diagram below to determine which slot the EXM occupies. Dotted lines indicate EXM slots that may not exist on all chassis.

ID is a hard-wired ID value. Each EXM has a uni que ID value.



OB1/OB2 are two bytes of option information.

Note that all slots are listed even if the system configuration does not have all the possible EXM slots. All slots not

occupied by an EXM module should show an ID of FF and OB1/OB2 of 00 00 indicating that no EXM is present.

To add or change an EXM configuration, use the cursor keys (arrows) to move between the fields on the screen. Move the cursor to the appropriate slot entry and type in the correct value.

The ID for the EXM-13A should be set to ED. For upward compatibility, this is the same ID that is used on the EXM-13.

OB1 should be set to 01 to enable the card. OB1 of 00 disables the card.

OB2 is not used by the EXM-13A and should be set to 00.

DEFAULT INITIALIZATION OF VIDEO EXMS

For a variety of reasons, the BIOS in EPCs automatically enables a video EXM if it finds that none are enabled. The primary reason is the chicken-and-egg problem of configuring the EXM the first time; one needs to be able to see the video output of the setup program in order to configure the video EXM.

If the BIOS finds no enabled video EXM, it searches for the first video EXM by slot and enables it. If this occurs, use the setup program to configure the EXM properly to avoid receiving an EXM CONFIGURATION ERROR message every time the system is booted.

CONNECTING A MONITOR

A monitor is connected via the 15-pin D connector on the EXM-13A front panel. The EXM-13A, being a VGA graphics controller, produces analog color signals, meaning that old-style EGA, CGA, and monochrome monitors cannot be used. VGA monitors may be color or gray scale; the EXM-13A automatically senses the differ ence between the two. If using a multi scan monitor, make sure to set the monitor's switch to analog (not TTL).

The monitor type cannot be detected correctly if the monitor is disconnected or pow ered off when the EPC is powered on or reset. Typical symptoms are lack of color on a color monitor and an error message about lack of a suitable video adapter when invoking Windows. If a color monitor is not detected correctly under MS-DOS, the command

```
mode co80
```

can be used to switch the controller into color mode.

To ensure a reliable connection, the monitor's cable should be screwed into the EXM-13A's connector.

Connecting a monitor is not absolutely necessary; its presence or absence does not af fect the operation of the system.

INSTALLING SUPER VGA DRIVERS

The EXM-13A supports certain video modes beyond standard VGA mode (see Appendix A for a complete list of supported modes under Windows). Use of these modes re quires a Super VGA or multis can monitor, as well as special software drivers. Drivers are provided on accompanying diskettes for Microsoft Windows, OS/2, SCO Unix and several other software packages. Updated video drivers are available on the NCR Bulletin Board System (BBS) at (719) 596-1649.

Other operating systems may or may not have Super VGA driver support for the NCR 77C22E+ chip. When using an operating system other than DOS, OS/2, or SCO Unix consult the operating system manual for details on supported video modes and

drivers.

Installing the Windows Drivers

The video drivers supplied on the accompanying diskettes are in compressed form. Insert Disk #1 into the Floppy drive. Make that drive the active drive. Then type INSTALL. This expands the files and copies them to the local hard disk. Follow the instructions on the screen carefully. When prompted, highlight both SOFTMODE & UTILITIES and the appropriate Windows version drivers. Softmode is a device driver that works with the Windows driver and is required for Windows to display high resolution graphics.

After running the INSTALL program, change to the sub-directory containing SOFTMODE & UTILITIES and invoke SOFTSET. This program tests the system and monitor for compatible video modes. Not all Super VGA monitors support all modes. SOFTSET then adds a line to the CONFIG.SYS file listing the supported modes; something similar to the following:

DEVICE=.....\SOFTMODE.SYS /m:2,15,16,3,.....

Reboot the system so SOFTMODE is loaded.

To install the actual Windows driver, run the Windows setup program from the DOS prompt. Change to the Windows sub-directory and, at the DOS prompt, type SETUP. The executable will display a list of hardware recognized by Windows. Use the cursor arrows to highlight the video display line and press ENTER. This will display a list of supported video drivers. At the end of the list is an entry something like "OTHER (requires hardware vendor diskette)". The setup program will ask for a driver diskette. Enter the name of the drive and sub-directory where the Windows drivers were copied.

Installing the OS/2 Drivers

To install the OS/2 drivers, OS/2 must be loaded using the FAT file structure. This procedure does not work with the HPFS file structure.

Fisrt the driver must be installed to the hard disk under DOS, either using a DOS wondow or by booting from a DOS floppy dosk. Run the INSTASLL program on the software driver diskette. When prompting, highlight the OS/2 drivers for installation. By default, the drivers are installed on the hard disk under the PM directory.

If OS/2 is running, perform a SHUTDOWN. OS/2 locks the video driver files when running, so the system must be rebooted under DOS. At the DOS prompt, copy all the .DLL files in the PM directory to the \OS2\DLL directory. Change directories to \OS2\DLL.

Rename DISPLAY.DLL to DISPLAY.OLD. Rename BVHVGA.DLL to BVHVGA.OLD.

Copy BVH77C22.DLL to BVHVGA.DLL.

NCR800.DLL is the 800 x 600 driver. NCR1024.DLL is the 1024 x 768 driver. Copy the appropriate driver to DISPLAY.DLL.

Reboot the system to OS/2.

Installing the SCO Unix Driver

To install the SCO Unix driver, run the INSTALL program on a DOS machine. When prompted, highlight the SCO Unix driver to be installed. After installation, copy the driver to a floppy disk.

Boot SCO ODT as normal. Open a shell window. Type the following commands:

```
cd /usr/lib/grafinfo
mkdir ncr
cd ncr
doscp /def/fd0:pc3433.xgi
mkdev graphics
```

Select Update. Select the NCR 3433 driver from the video card list. Select the desired resolution and then the type of monitor that is connected.

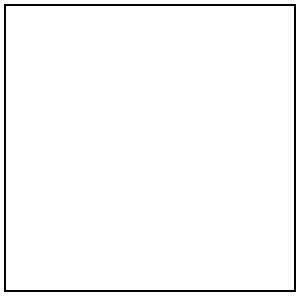
Quit and save the configuration.

Reboot SCO ODT.

FLAT-PANEL DISPLAYS

Flat-panel displays have a number of different conventions for interfacing to a VGA controller. Most require some of the signals on the auxiliary connector. Some connect to the analog color signals; others do not. Some "non-color" Flat panels operate best with the video controller in gray-scale mode; others have their own color-to-gray-scale conversion logic and require color mode. The latter may require that the EXM be "tricked" into thinking that an analog color monitor is connected.

The EXM-13A detects the type of monitor in use at the time of system reset by sensing the three analog color signals on the DB-15 VGA connector. If it senses a 75 ohm load on all three color signals, it initializes to color mode. All other conditions initialize the controller to gray-scale mode.



When using a Flat-panel display that requires color mode (e.g., it does its own con version) and either doesn't connect to the analog signals or doesn't provide the 75-ohm load on the analog signals, it may be necessary to build a terminating connector that plugs into the DB-15 connector. The terminating connector contains three 75-ohm resistors. The resistors connect the red, green, and blue color signals (pins 1-3) to one of the ground pins (e.g., pin 5).

CHAPTER 3

PROGRAMMING INTERFACE

This chapter contains information needed to write custom software drivers for the EXM-13A. Anyone using the standard software drivers shipped with the EXM-13A can skip this chapter.

The EXM-13A is mapped into both the memory space and I/O space. In the memory space, the mapping is as follows:

Range		Content
000A0000	000BFFFF	Video RAM
000C0000	000C7FFF	Video BIOS ROM

The EXM-13A defines the following registers in the I/O space.

Port	Functional Group	Usage
100	EXM Configuration	Device ID
102		Option byte 1
3B4	Vedio Controller	CRT index register (mono)
3B5		CRT ctlr data reg (mono)
		0 Horizontal total register
		1 Horiz display enable end
		2 Start Horiz blanking
		3 End Horiz blanking
		4 Start horiz retrace pulse
		5 End horiz retarace pulse
		6 Vertical total register
		7 Overflow
		8 Preset row scan
		9 Max scan line/other
		A Cursor start
		B Cursor end
		C Start address high
		D Start address low
		E Cursor location high
		F Cursor location low

Port	Functional Group[	Usage
		10 Vertical trace start
		11 Vertical retrace end
		12 Vert display enable end
		13 Offset
		14 Underline location
		15 Start vertical blank
		16 End vertical blank
		17 CRTC mode control
		18 Line compare
3B8		Mode control reg (mono) (W)
3B9		Preset light pen (mono) (W)
3BA		Input line status reg 0 (mono) (W)
		Feature control (mono) (W)
3BB		Clear light pen (mono) (W)
3BF		Hercules register
3C0		Attribute index register
		Attribute data register (W)
3C1		Attribute data register (R)
		0X Palette register
		10 Attribute mode control
		11 Overscan control
		12 Color plane enable
		13 Horizontal PEL panning
		14 Color select
3C2		Misc output register (W)
		Input status register 0 (R)
3C3		Video subsystem enable reg
3C4		Sequencer index register
3C5		Sequencer data register
		0 Reset register
		1 Clocking mode register
		2 Map mask register
		3 Memory mode register
3CA		Feature control register (R)4
3CC		Misc output register (R)
3CE		Graphics controller index reg
3CF		Graphics data register
		0 Set/reset

Port	Functional group	Usage	
		1	Enable set/reset
		2	Color compare
		3	Data rotate
		4	Read map select
		5	Graphics mode
		6	Miscellaneous
		7	Color don't care
		8	Bit mask
		9	Address offset A (PROA)
		A	Address offset B (PROB)
		B	Memory size (PR1)
		C	Video select (PR2)
		D	CRT control (PR3)
		E	Video control (PR4)
		F	Lock/status (PR5)
3D4		CRT index register (color)	
3D5		CRT controller data (color)	
		0	Horizontal total
		1	Horiz display enable
		2	Start horizontal blanking
		3	End horizontal blanking
		4	Start horiz retrace mode
		5	End horizontal retrace
		6	Vertical total register
		7	Overflow
		8	Preset row scan
		9	Max scan line/ others
		A	Cursor start
		B	Cursor end
		C	Start address high
		D	Start address low
		E	Cursor location high
		F	Cursor location low
		10	Vertical retrace start
		11	Vertical retrace end
		12	Vertical display enable
		13	Offset
		14	Undeline location

Port	Functional group	Usage
		15 Start vertical blank
		16 End vertical blank
		17 CRTC mode control
		18 Line compare
3D8		Mode control reg (color) (W)
3D9		Color select register (W)
3DA		Input status reg0 (color) (R)
		Feature control (color) (W)
3DB		Clear light pen (color) (W)
3DC		Preset light pen (color) (W)
3DE		AT&T/M24 (W)

All but the first two registers are standard VGA registers. For further explanation consult the manual of the NCR 77C22E+ video controller chip, the text *EGA/VGA A Programmer's Reference Guide* by B. D. Kliewer (McGraw-Hill), or the text *Programmer's Guide to PC and PS/2 Video Systems* by R. Wilton (Microsoft Press).

The other two registers are

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	I/O port
Device ID Reg	1	1	1	0	1	1	0	1	100
Config Option Byte 1 Reg								Cden	102

These are standard EXM registers for device identification and configuration. The EXM-13A re sponds to accesses to these ports only if EXMbus line -EXMID isasserted. An 8-bit read from I/O address 100h returns the device ID value ED. A read/write configuration register appears at I/O address 102h.

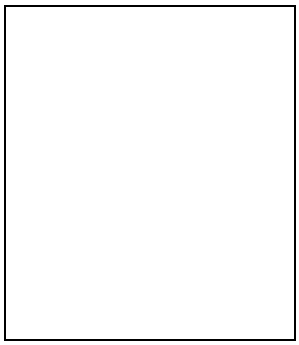
CDEN specifies whether the EXM is disabled or enabled. If disabled, the EXM does not respond to any I/O or memory addresses and does not assert an interrupt output; it only responds to reads from I/O port 100h and reads from and writes to I/O port 102h, and then only if EXMbus line -EXMID is asserted.

CHAPTER 4

CONNECTORS

The DB-15 monitor connector is defined as

Pin	Signal	Pin	Signal
1	Red	9	(key)
2	Green	10	Ground
3	Blue	11	(not used)
4	(not used)	12	(not used)
5	Ground	13	Horizontal sync
6	Ground	14	Vertical sync
7	Ground	15	(not used)
8	Ground		



The EXM-13A contains an auxiliary connector. Its 36-pin connector is a shielded female 3M 10236-5212VE (or equivalent). The mating connector is a 3M 10136-6000EE male connector (or equivalent).

The pins on the auxiliary video connector on the EXM-13A are defined below.

Pin	Signal	Pin	Signal
1	EVIDEO	19	Ground
2	P7	20	P0
3	Ground	21	P1
4	DCLK	22	P2
5	EDCLK	23	Ground
6	P6	24	P3
7	Ground	25	P4
8	-BLANK	26	P5
9	HSYNC	27	Ground
10	VSYNC	28	ESYNC
11	Ground	29	Ground
12	reserved	30	Ground
13	reserved	31	Ground
14	reserved	32	Ground
15	Ground	33	Ground
16	RED	34	Ground
17	GREEN	35	Ground
18	BLUE	36	Ground

The signals on the auxiliary connector are described below.

BLANK	This input/output signal is an alternate blanking signal to the digital-o-nalog converter (DAC) in the EXM-3A. When enabled (see ESYNC), a low input causes the DAC to drive its analog color outputs to OV. When disabled, this pin outputs the internal blanking signal.
BLUE	This analog output is the same as the blue output on the DB-15 con nector.
DCLK	This input/output signal is the dot clock to the DAC. When enabled (see EDCLK), it is an input whose rising edge causes the DAC to latch the digital video signals. When disabled, it outputs the internal dot clock.
EDCLK	This input signal controls the source of the dot clock. When high (or unconnected), the clock is internal. When low, the DCLK input is enabled. Also, when EDCLK is low, the internal dot clock is disconnected and DCLK used in its place. While EDCLK is high or unconnected, the VGA miscellaneous output register must be configured so that it is not selected clock source 2.
EVIDEO	This input signal controls the source of the digital video information to the DAC. When high (or unconnected), the digital signals are obtained internally. When low, the digital signals are sourced from P0-P7 on the connector.
ESYNC	This input signal controls the source of the blanking and synchro nization signals. When high (or unconnected), they are obtained internally. When low, the inputs -BLANK, HSYNC, and VSYNC are enabled as the source.
GREEN	This analog output is the same as the green output on the DB-15 con nector.
HSYNC	This input/output signal is the horizontal sync signal on the VGA monitor connector. When enabled (see ESYNC), it is an input and drives the horizontal sync signal on the VGA monitor connector. When disabled, it outputs the horizontal sync signal.
P0-P7	These input/output signals are the digital video inputs to the EXM-13A's DAC. When enabled (see EVIDEO), they are inputs that drive the DAC. When disabled, they output the internal digital video sig nals. P0-P5 represent, respectively, blue, green, red, secondary blue, secondary green, and secondary red.
RED	This analog output is the same as the red output on the DB-15 con nector.
VSYNC	This input/output signal is the vertical sync signal on the VGA monitor connector. When enabled (see ESYNC), it is an input and drives the vertical sync signal on the VGA monitor connector. When disabled, it outputs the vertical sync signal.

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APPENDIX A

SUPPORTED VIDEO MODES

Microsoft Windows 3.x Video Modes

Supported by Softmode.Sys

Format	Colors	Mode	Vertical Refresh Rate (Hz)	Horizontal Refresh Rate (KHz)	Dot Clock (Mhz)	Remarks
640 x 400	256	5Eh	60.055	31.469	28.322	non-interlaced
640 x 480	16	12h	72.814	37.967	32.500	non-interlaced
			60.004	35.403	28.322	non-interlaced
640 x 480	256	5Fh	72.814	37.791	32.500	non-interlaced
			59.940	31.469	25.175	non-interlaced
640 x 480	32K	70h	59.974	31.486	50.000	non-interlaced
640 x 480	64K	78h	59.974	31.486	50.000	non-interlaced
640 x 480	16M	50h	60.024	31.513	75.000	non-interlaced
800 x 600	16	58h	71.971	48.077	50.000	non-interlaced
			60.317	37.879	40.000	non-interlaced
			56.021	35.461	40.000	non-interlaced
800 x 600	256	5Ch	71.971	48.077	50.000	non-interlaced
			60.317	37.879	40.000	non-interlaced
			56.021	35.461	40.000	non-interlaced
800 x 600	32K	71h	56.230	36.550	75.000	non-interlaced
800 x 600	64K	79h	56.230	36.550	75.000	non-interlaced
1024 x 768	2	5Ah	87.064	35.522	44.900	interlaced

Format	Colors	Mode	Vertical ReFresh Rate (Hz)	Horizontal ReFresh Rate (KHz)	Dot Clock (Mhz)	Remarks
1024 x 768	16	5Dh	70.069	56.476	75.000	non-interlaced
			70.059	56.818	75.000	non-interlaced
			60.530	48.363	65.000	non-interlaced
			87.064	35.522	44.900	interlaced
1024 x 768	256	62h	70.099	56.991	75.000	non-interlaced
			60.004	48.363	65.000	non-interlaced
			87.064	35.522	44.900	interlaced
1280 x 1024*	16	6Ch	86.938	48.077	75.000	interlaced
1280 x 1024*	256	6Ah	86.938	48.077	75.000	interlaced

* 1280 x 1024 resolutions require 2 MBytes of VRAM

BUG REPORT

While we have tried to assure this manual is error free, it is a fact of life that works of man have errors. We request you to detail any errors you find on this BUG REPORT and return it to us. We will correct the errors/problems and send you a new manual as soon as available. Please return to:

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Product: **EXM-13A**

Manual Revision: **41417-15S-01A**

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