



Product Specification -

LC08 High-Bright Monitor

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Section 1 - Introduction

This document defines the electromechanical parameters and operating characteristics for an Active Matrix Liquid Crystal Display (LCD) Panel based color display, hereafter referred to as the Display. It is intended for operation under ambient light conditions ranging from darkness to full sunlight.

1.1 Description

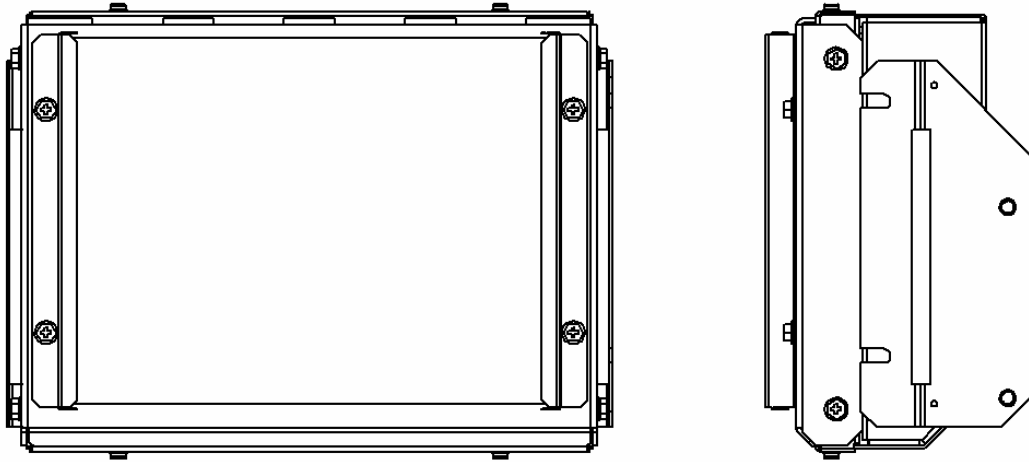


Figure 1. Display Illustration

The Display is a VGA compatible color display unit that can be driven directly from the standard analog Video Graphics Array (VGA) output on a personal computer (PC). It consists of a 8.4" viewable diagonal LCD Panel with optical elements, Cold Cathode Fluorescent Lamps (CCFL), Inverter Board, and LCD Controller Board . Cooling fans provide temperature stabilization within the Display's operating environment . Two (2) chassis mounted connectors at the rear provide for video signal and DC power input connection. These components will be mounted in a fully enclosed chassis.

1.2 Display Format

The Display must be compatible with IBM VGA 1 and VESA2 video standards. Its operating frequency range is 31.5 KHz to 48.1 KHz horizontal; 60 Hz to 72 Hz (non-interlaced) vertical. Supported video resolutions supported are as follows:

Video Resolution	Number of Bits/Color	Number of Colors
640 x 400	6	262,144
640 x 480	6	262,144
800 x 600	6	262,144

For IBM VGA1 modes, the Display will accept 640 dots horizontally; 400 or 480 lines vertically and 800 dots horizontal, 600 lines vertical for the VESA2 modes. VGA border(s) are excluded from the active display area definitions listed in this document. Figure 11 defines the IBM VGA 1 and VESA2 video signal timing requirements.

The LCD Controller Board (Section 2.3) will automatically program itself, sensing incoming horizontal/vertical frequencies and sync pulse polarities to completely “fill” the active display area of the Display with the video resolution being presented. Video Mode Definition parameters for video resolution detection by the video board are shown in Section 4.2.2.1.

Section 2 - Basic Construction

2.1 Connectors

There are two (2) connectors supplied as an integral part of the Display.

2.1.1 Video Signal Connector

The video input signal cable will connect to a chassis mounted 15-pin female mini D-Shell connector (AMP 748390-5 or equivalent) with socket contacts at the rear of the Display. Shielded for electromagnetic interference (EMI) purposes, it shall perform electrical interconnection between the Display and user logic. Refer to Section 4.1 for electrical connections.

2.1.2 DC Power Input Connector

The DC power input connector will be a chassis mounted 2-pin "MAT-N-LOK" style connector (AMP 1-480699-0 or equivalent) at the rear of the Display. The connector housing incorporates male pin contacts. Connections (Section 5.1) are insulated to insure no accidental contact.

2.2 Interface Cables

No interface cables are provided. Planar can provide suggestions on available cables.

2.3 LCD Controller Board

The LCD Controller Board incorporates components necessary to drive the LCD Panel (Section 6.5). Accepting VGA and VESA video standards (Section 1.2), these video signals are digitized and processed for the LCD Panel. Due to the LCD Panel's fixed video resolution (800 x 600), the LCD Controller Board performs independent horizontal and vertical zoom and shrink scaling of specified video resolutions less than or greater than the LCD Panel's video resolution to fully accommodate the LCD Panel's capability.

Magnification of specified video resolutions to match the native LCD Panel's resolution incorporates scaling algorithms minimizing aliasing and image distortion. The LCD Controller Board includes the following characteristics:

- Per pixel scaleable filters providing text sharpening and graphics smoothing for the highest possible image quality.
- Color depth enhancement by performing spatial-temporal dithering eliminating visual artifacts resulting in clear and crisp text and graphics.

2.4 Grounding

Two (2) types of ground are provided: *Chassis* and *Signal* ground.

2.4.1 Chassis Ground

The chassis ground is a conductor that is grounded to the earth within user circuitry. It may not be used for current carrying purposes. It is to be used only for non-current carrying purposes such as electromagnetic compatibility (EMC).

2.4.2 Signal Ground

Signal ground is electrically connected to chassis ground via the LCD Panel, video board and mounting screws. However, there are no DC currents carried through this interconnect.

2.5 External Controls

The display comes from the factory adjusted for the supported modes. When using these modes, adjustment should not be necessary. However, if it should become necessary, or a non-supported mode is selected, the following controls are available for adjustment.

There are 4 push buttons located on the back of the display, which allow adjustment of the displayed image. See figure below for button locations. The provided controls are:

<u>Name</u>	<u>Function</u>
Dot Clk -	Clock Frequency/Phase Decrease
Dot Clk +	Clock Frequency/Phase Increase
Horiz	Horizontal Position
Gain	Video Gain

The Clock Frequency /Phase adjustments are dual function buttons. The phase allows for 32 positions of phase control. If the button is held down, the clock frequency is adjusted up or down 1 clock each time the phase control register rolls over. To adjust the clock frequency further, continue to hold the button down. If phase adjustment is desired, it's best to use single presses.

The Horizontal Position is adjusted by holding down the Horiz button. The position will shift by 1 column for each press. If the button is held down, the position will continuously adjust until released. The direction of the adjustment depends on the direction of the last adjustment. The direction will continue to be true until the maximum or minimum adjustment is reached. At this point, the direction will reverse.

The Gain adjustment is to allow the full scale of the input video to be utilized. The direction of this adjustment will reverse when a limit is reached. For example, it will adjust from maximum to minimum, then reverse and go from minimum to maximum. The best way to make this adjustment is with a continuous gray scale pattern on the display. A proper adjustment will give continuous shading from black to white.

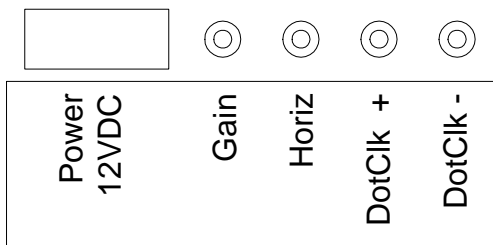


Figure 2. External Adjustments (Rear View)

Section 3 - Environmental

3.1 Temperature and Humidity

The Display shall withstand operating and storage environmental conditions listed in Table 1.

	General Operating	Shipping and Storage	Comments
Temperature	0°C to 60°C [32°F to 140°F]	-20°C to 60°C [-4°F to 140°F]	Note 2,3,4,5
Relative Humidity	Note 1,4	Note 1	Without Condensation

Table 1. Temperature / Humidity Limits

Note 1: Tair ≤32°C : 95% RH maximum.
Tair >32°C : Absolute humidity content not to exceed 100% at 32°C

Note 2: Tair @ 20°C < 48 hours
Tair @ 60° C < 168 hours

Note 3: Background color changes slightly depending on ambient temperature
This phenomenon is reversible.

Note 4: Tair @ -30°C : 15% RH (exterior face of Vandal Shield)
Tair @ 54°C : 100% RH (exterior face of Vandal Shield)

Note 5: The LCD Panel is not warranted above 50°C operating temperatures with a reduction in MTBCF specified in Section 9.2.

Reference to "room ambient" is defined as 25°C -30°C [77°F - 86°F] and shall apply throughout this specification unless otherwise noted.

This Display will not be subjected to environments outside of the limits of Table 1 for testing or any other purpose.

3.2 Altitude

Maximum operating altitude shall be 3,000 meters [9,850 feet]. Maximum shipping and storage altitude is 12,000 meters [39,400 feet].

3.3 Vibration and Shock

The packaged Display must comply to ASTM D4169, *Standard Practice for Performance Testing of Shipping Containers and Systems*. See Figure 3 below for orientation of axes.

3.3.1 Vibration (for non-packaged item)

The following Sections 3.3.1.1, 3.3.1.2, and 3.3.2 apply.

3.3.1.1 Sine Sweep

The Display withstands a vibration of 0.9G from 10 Hz - 200 Hz (120-second sweep cycle) for 15-minutes in each of three axes (x, y, z).

3.3.1.2 Random Vibration

The Display complies to ASTM D4728, *Standard Test Method for Random Vibration Testing of Shipping Containers*. This test uses: *truck level II*, for a one hour duration *on the Z axes*.

3.3.2 Shock (for non-packaged item)

The Display withstands a 76mm [3in] *equivalent* drop height with at least 2.5-msec duration pulse in all three axis. Approximately 30G's of shock are generated.

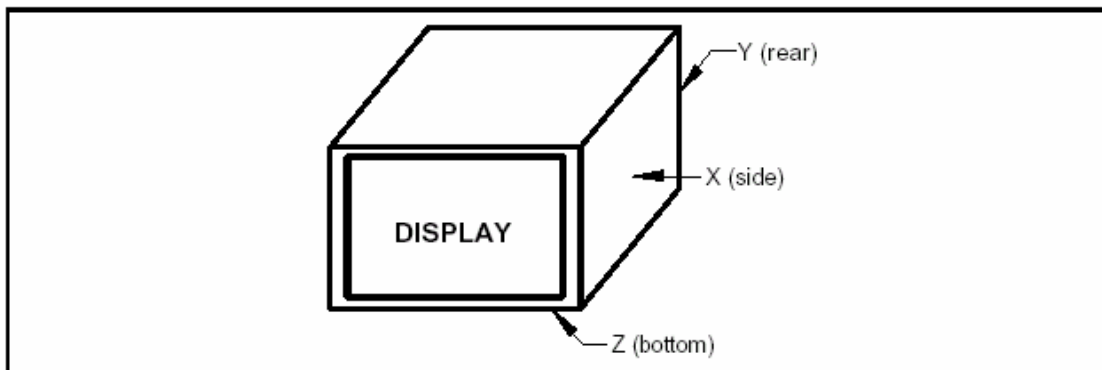


Figure3. Definition of Axes for Shock and Vibration

Section 4 - Video Signal Input Requirements

4.1 Video Input Lines

The Video Signal Connector will consist of fifteen (15) positions wired numerically and supplied attached to the Display as a chassis mounted connector per definitions listed in 3. The "No Pin" positions of this connector may not be used for any purpose.

Pin Number	Signal Name
1	Red Video Signal
2	Green Video Signal
3	Blue Video Signal
4	Monitor Sense Line 3 (Connected To Pin 10)
5	No Pin
6	Red Video Return
7	Green Video Return
8	Blue Video Return
9	No Pin
10	Signal Ground Reference
11	Monitor Sense Line 1 (Connected To Pin 10)
12	Monitor Sense Line 2 (No Pin)
13	Horizontal Sync Input
14	Vertical Sync Input
15	No Pin

Figure 4. Video Signal Connector - Pin Number Assignments

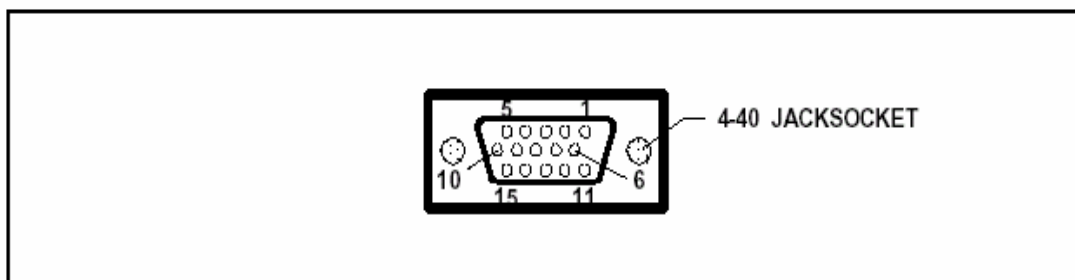


Figure 5. Video Signal Connector Illustration

4.2 Signal Functions

4.2.1 Video Parameters

As seen by the source, the display R, G and B input resistance is be 75-ohm, $\pm 10\%$; input capacitance at 50 MHz < 30 pF.

The video input signal will have a range of 0 mv to 714 mv (maximum) where 0 mv is minimum luminance. Rise and fall times for the input signal (10% - 90%) must be ≤ 8 ns (Figure 7).

When terminated with an ideal 75 ohm termination, the dark state (black input) is defined as a level between 0 mv and 10 mv. The white state (full white) is dependent on the VGA controller source driving the Display. Maximum output levels may range from 550 mv to 714 mv. Nominal 680 mv input voltage shall be defined as the default for setup requirements.

Displayed image intensity and color change follows visual linearity with the video analog input. This is necessary to provide a uniform user color change on the screen in response to a uniformly stepped analog input. The Display is capable of resolving a minimum color range of 262,144 displayable colors (6 bit resolution for Red, Green and Blue). This interpolates to 64 shades of gray (or color) at the Red, Green, and Blue analog video inputs. Accomplishing specified shades of gray requires a "Video Gain" control adjustment (Section 2.9) of Red, Green, and Blue analog input signals based on the maximum output level range previously specified.

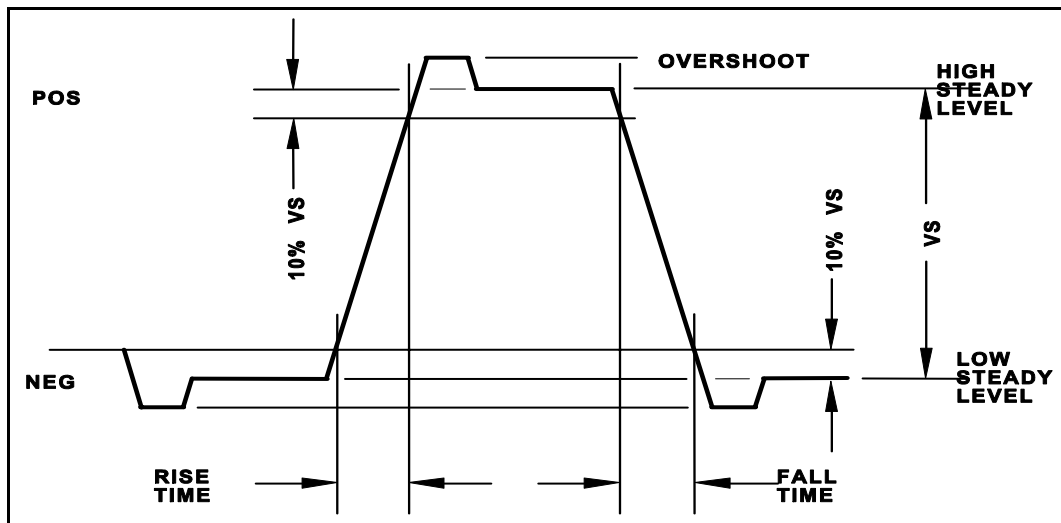


Figure 7. Rise / Fall Time

4.2.2 Synchronization

Sync pulses for horizontal and vertical are TTL levels. Figure 9 defines the allowable levels and drive current requirements.

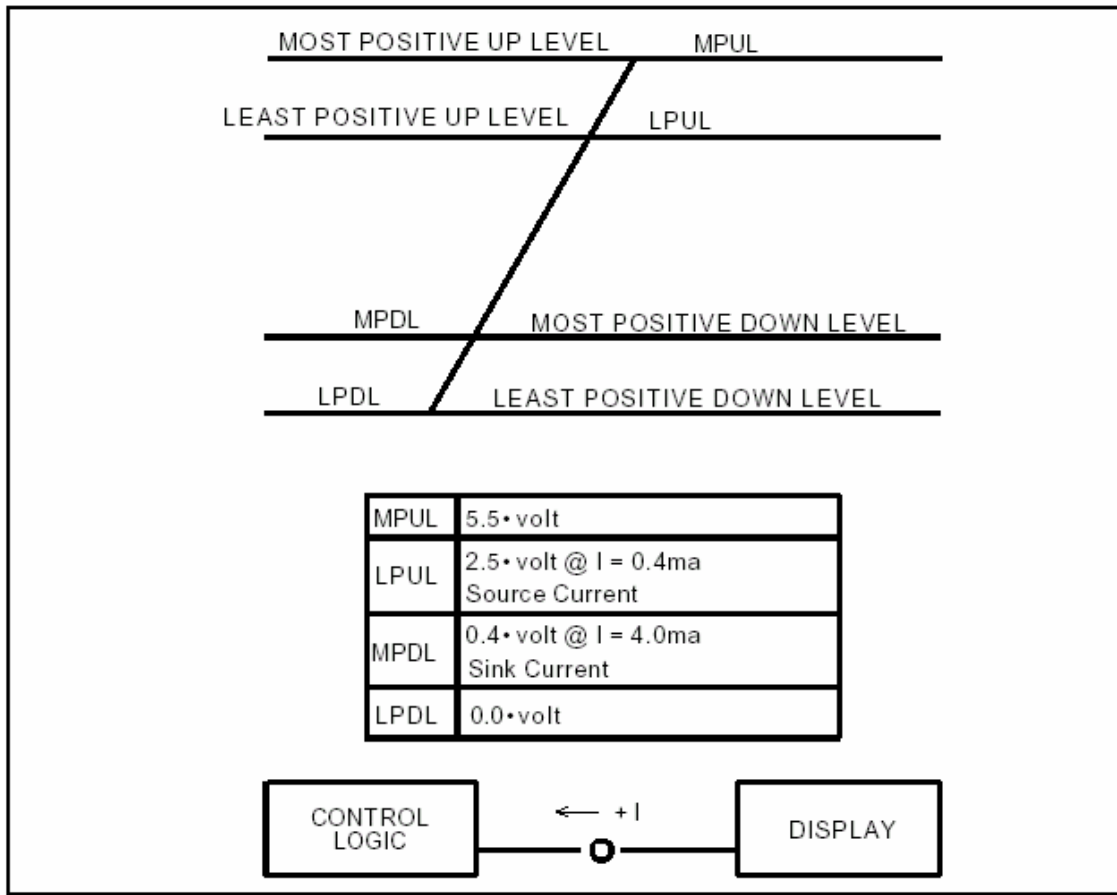


Figure 9. TTL Allowable Signal Levels

4.2.2.1 Mode Detection

The polarity of incoming horizontal/vertical frequencies and synchronization pulses define the video resolution being presented. Available video modes are listed in Table 2 below.

Video Mode	Displayed Image Resolution	Scanning Frequency		Sync Polarity	
		Horizontal	Vertical	Horizontal	Vertical
IBM VGA	640x400	31.468KHz	70Hz	-	+
IBM VGA	640x480	31.468KHz	60Hz	-	-
VESA	800x600	48.077KHz	72Hz	+	+

Table 2. Video Mode Definitions

4.2.2.2 Color Display Detection

The video signal source determines which type of display is connected to it based on the state of the Monitor Sense Lines. The Display will indicate to the source that it is a "color display" when Monitor Sense Line 1 (Pin 11) is physically connected to Signal Ground Reference (Pin 10) as defined by the wiring definitions of 3.

4.3 Signal Quality

4.3.1 Video Signal Duty Cycle

The duty cycle for the video signal(s) is 100%. It is a percentage ratio of T_a vs. T_b illustrated in Figure 10 as follows:

$$\text{Duty} = \frac{T_a}{T_b} \times 100 (\%)$$

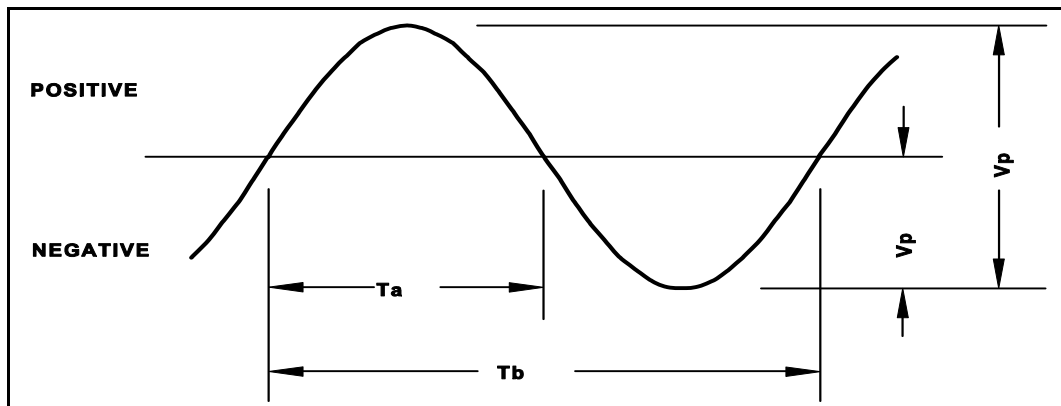


Figure 10. Duty Cycle

4.3.2 TTL Sync Pulse Signal Levels

Input levels for the horizontal and vertical sync pulses are defined in Figure 9, above.

4.3.3 Rise / Fall Time

Rise and fall times are the times required for signal transitions between 10% of V_s above Low Steady Level and 10% of V_s below High Steady Level where V_s is the peak-to-peak video input signal level. The overshoot, if present, are exempted from establishing these high/low levels referenced in Figure 7. Both rise and fall times of each input signal shall be as follows:

Video:	Less than 8 ns
Horizontal Sync:	Less than 50 ns
Vertical Sync :	Less than 100 ns

4.4 Timing And Frequency

4.4.1 Video, Horizontal and Vertical Sync

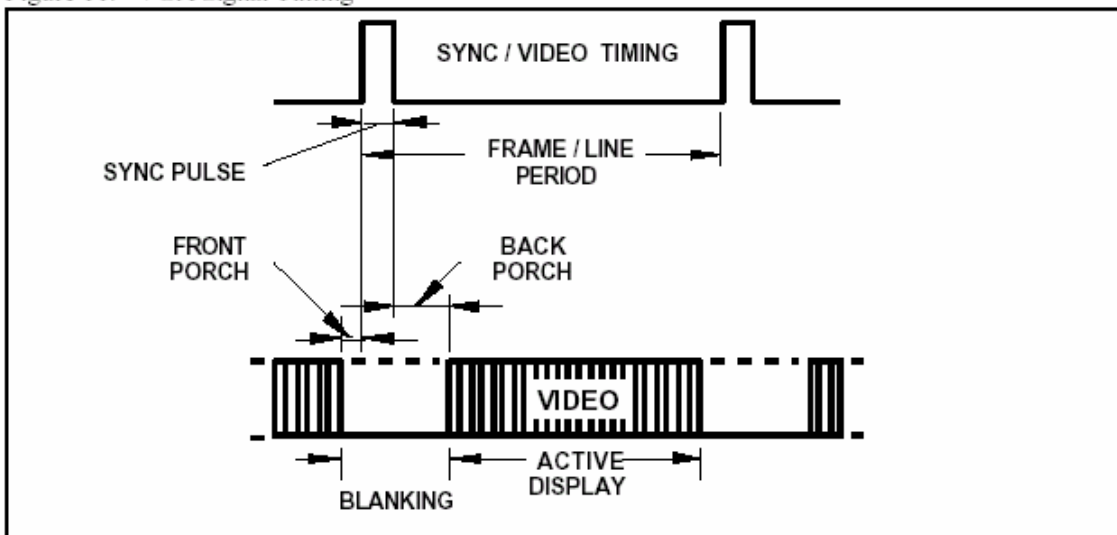
Table 3 and Figure 11 illustrate video timing relationships the Display operates within when the specified video mode is applied.

The incoming active video dot clock frequencies for the Display are:

Dots	Dot Time	Dot Frequency
800	20.000-ns	50.000 MHz
640	39.722-ns	25.175 MHz

Table 3. Dot Clock Frequencies

Figure 11. VGA Signal Timing



	VIDEO MODES							
	IBM VGA				VESA			
RESOLUTION	640 x 400		640 x 480		800 x 600			
Video Clock	25.175 MHz		25.175 MHz		50.000 MHz			
Horizontal Scan Frequency	31.468 KHz		31.468 KHz		48.077 KHz			
Horizontal Line Period	31.778 μ s	800 dots	31.778 μ s	800 dots	20.800 μ s	1040 dots		
Horizontal Blanking	6.356 μ s	160 dots	6.356 μ s	160 dots	4.800 μ s	240 dots		
Horizontal Sync Pulse	3.813 μ s	96 dots	3.813 μ s	96 dots	2.400 μ s	120 dots		
Horizontal Front Porch	0.636 μ s	16 dots	0.636 μ s	16 dots	1.120 μ s	56 dots		
Horizontal Back Porch	1.907 μ s	48 dots	1.907 μ s	48 dots	1.280 μ s	64 dots		
Horizontal Active Display	25.422 μ s	640 dots	25.422 μ s	640 dots	16.000 μ s	800 dots		
Horizontal Sync Polarity	-		-		+			
Vertical Scan Frequency	70.087 Hz		59.94 Hz		72.187 Hz			
Vertical Frame Period	14.268 ms	449 line	16.683 ms	525 line	13.853 ms	666 line		
Vertical Blanking	1.557 ms	49 line	1.430 ms	45 line	1.373 ms	66 line		
Vertical Sync Pulse	0.064 ms	2 line	0.064 ms	2 line	0.125 ms	6 line		
Vertical Front Porch	0.381 ms	12 line	0.318 ms	10 line	0.770 ms	37 line		
Vertical Back Porch	1.112 ms	35 line	1.049 ms	33 line	0.478 ms	23 line		
Vertical Active Display	12.711 ms	400 line	15.254 ms	480 line	12.480 ms	600 line		
Vertical Sync Polarity	+		-		+			

NOTE: VGA border is not included in the Active Display time described above.

Section 5 - DC Power Input Requirements

5.1 DC Power Input Lines

The DC Power Input Connector consists of two (2) positions wired numerically and supplied attached to the Display as a chassis mounted connector per definitions listed in Figure 12.

PIN NUMBER	SIGNAL NAME
1	Most Positive Input Voltage
2	Most Negative Input Voltage

Figure 12. DC Power Input Connector – Pin Assignments

The DC Power Input Connector which connects to the equipment shall be a 2-pin MATE-N-LOK type (Section 2.5.2) with male pin contacts. Pin number assignments are defined in Figure 12. Shown below is the physical layout as seen by the interface cable from the DC power source.

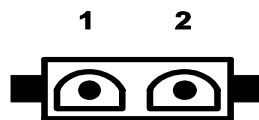


Figure 13. DC Power Input Connector Illustration

5.2 DC Input Voltage / Current

- DC Input Voltage: 12 Vdc nominal, ± 0.4 Vdc.
- DC Input Current: 3.0-amp maximum current draw (12.4 Vdc applied) steady-state conditions.
- Refer to Figure 14 for input current characteristics at “power-up” conditions.

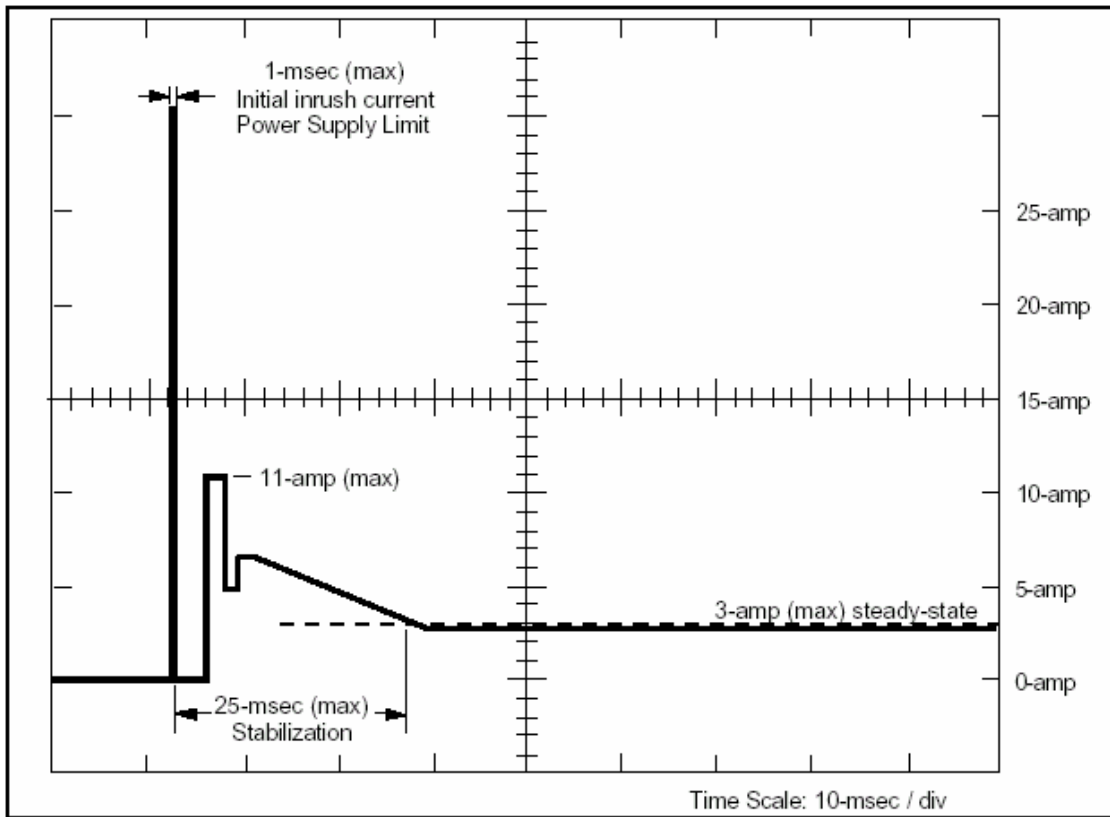


Figure 14. Current Profile

5.3 Power On-Off Sequences

The Display shall automatically return to normal operation upon resumption of power after a power loss.

Section 6 – Display Performance

6.1 Display Luminance

The Display will provide one level of luminance used for both daylight and night viewing. Minimum, initial, white-light luminance on the face of the Display face shall be 685 cd/m² [200 fL] in a darkened room environment with ambient light conditions less than 10 Lux [1 fC] incident illumination and at room temperature. Reference: MIL L 85762A (3.10.2.2.3).

6.2 Display Contrast

Display Contrast is a relationship between luminance levels and the ability to perceive a luminance difference. It is normally expressed as a ratio of ON white-light luminance to OFF black-background luminance generated by the Display.

$$C = \frac{\text{ON white - light luminance}}{\text{OFF black - background luminance}}$$

6.2.1 Room Ambient Contrast

Minimum Contrast of the Display under room ambient lighting conditions of 1076 LUX [100fC] direct incident illumination is 11:1.

Reference: MIL L 85762A (Table II).

6.2.2 High Ambient Contrast

Minimum Contrast of the Display in a diffuse off-axis illuminance (sun) of 86,080 LUX [8,000fC] and a specular on-axis luminance (sky) of 6,853cd/m² is 5:1.

Reference: MIL L 85762A (Table II).

6.3 Display Uniformity

Luminance Uniformity (UL) measured within 25mm [1.0in] from the edge of the Display image area is $\pm 70\%$, minimum of the luminance measured at the center of the image area while displaying a center block pattern measuring 50mm [2.0in] square.

6.4 Display Chromaticity

The metric used for color coordinate determination is the CIE 1976 UCS (Uniform Chromaticity Scale) u' , v' system.

Color determination is performed at the normal to the display in a dark room environment with ambient light conditions less than 10 LUX [1fC] incident illumination.

The measured u' , v' color coordinates at room temperature for White-light and the Red, Green, and Blue primaries are listed for reference purposes only.

Color	u'	v'	Perceived Color
Red	0.428	0.527	Reddish-Orange
Blue	0.130	0.330	Blue
Green	0.140	0.563	Yellowish-Green
White	0.216	0.514	White

White color is concentrated around 5000°K color temperature.

Table 4. Measured u', v' Color Coordinates

6.5 LCD Panel - Physical Image Characteristics

The Display is a matrix display with the following features:

- LCD Size: 210mm [8.4in] diagonal
- Active Area: 170.4mm [6.73in] by 127.8mm [5.10in]
- Pixel Format: 800 (H) x 600 (V)
(1 pixel = R + G + B dots)
- Pixel Pitch: 0.213mm [0.008in] horizontal x 0.213mm [0.008in] vertical
- Pixel Arrangement: R,G,B vertical stripe
- Aspect Ratio: 4:3

Section 7 – Display Cosmetics

The external visual inspection shall be conducted with the unaided eye at a minimum of 35 cm [14in] from the display surface. There are acceptable defects when the Display is in the Black Mode and in the White Mode.

7.1 Black Display Picture Mode

- Power up the Display. Display an all black screen via the video input.
- The LCD Panel is acceptable if there are 15 or less green, red, and blue dots visible from 35cm [14in] with the unaided eye.
- The LCD Panel is acceptable if no more than 5 dots are joined.

7.2 White Display Picture Mode

- Power up the Display. Display an all white screen via the video input.
- The LCD Panel is acceptable if there are 10 or less black dots visible from 35c [14in] with the unaided eye..
- The LCD Panel is acceptable if no more than 3 dots are joined.

Section 8 - Regulatory Agency Requirements

NOTE: Specified standards may change as market requirements dictate.

8.1 Safety Certification

The Display must be certified to the following safety standards:

- UL 1950/CAN/CSA C22.2 No. 950-95
Safety of Information Technology, including electrical business equipment
- UL 291 Standard for Automated Teller Machine
- IEC 950 Safety Information Technology, including electrical business equipment
- EN 60950 Safety of Information Technology, including electrical business equipment.

8.2 CE Marking (Declaration according to ISO/IEC Guide 22 and EN45014)

The Display shall conform to the following EC Directives:

Council Directive 73/23/EEC and 93/68/EEC (Latest Amendment) on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits is based on compliance with the following harmonized standards:

EN 60950:1992 + A1:1993 +A2:1993 +A3:1995 +A4:1997 +A11:1997
EN 41003:1991

Council Directive 89/336/EEC, 92/31/EEC and 93/68/EEC (Latest Amendment) on the approximation of the laws of the Member States relating to electromagnetic compatibility is based on compliance with the following harmonized standards:

Electromagnetic Emissions	EN 55022:1987
Electromagnetic Immunity	EN 50082:1992

8.3 RFI Emission Certification

The Display is certified to the following emissions standards:

- FCC, Part 15, Paragraph 15.107(b) and 15.109(b), Class A RFI emissions standard.
- EN 55022 – Limits and measurements of radio interference characteristics of information technology equipment.
- IEC 1000 3–2/1995; EN 61000–3–2 Current Harmonic Tests
- IEC 1000 3–3/1995; EN 61000–3–3 Voltage Fluctuation and Flicker Tests

8.4 System Transient Disturbance Requirements

The Display shall meet the following system transient disturbance requirements:

8.4.1 Electrostatic Discharge Requirements

The Display will perform normally when subjected to static electricity discharges from persons touching the external surfaces of the Display. Performance is verified by testing according to EN 50082-1 (Ref IEC 801-2:1984) at severity level 3 (4 Kv contact discharge, 8 Kv air discharge). Tests are conducted with service doors open. Testing is performed on points that are typically the first internal contact while performing routing servicing and replenishment operations.

8.4.2 Electromagnetic Energy Susceptibility Requirements

The Display will perform normally in an electromagnetic field with a strength of 10-volts per meter from 10 KHz to 1 GHz. (REF CISPR 22).

8.5 Labeling

IEC 417 – Graphical Symbols for Use on Equipment.

8.6 Color Coding

ISO 3864 – Safety Colors and Safety Signs.

Section 9 - Reliability

9.1 Design Workload

The Display is capable of operating 24 hours a day, 365 days a year under the specified environmental conditions of Section 3.

9.2 Critical Failures

Critical failures are defined as failures which render the Display inoperable to the end user, excluding Vandal Shield inflicted damage. Excluding the Mean Time Between Critical Failure (MTBCF) of the Fluorescent Backlight, the Display shall have a MTBCF of 40,000 hours. The MTBCF on subassembly components are:

- LCD Panel 50,000 hours
(see Note 5, Section 3.1, for MTBCF deviation)
- Fan 250,000 hours
- Video PCB 300,000 hours
- Backlight Inverter Board 4,752,852 hours

9.3 Failure Definition

In general, the term failure denotes a fully functional Display unit ceasing to function within its required performance capability because of conditions internal to the Display unit. The requirements of Section 9.2 refer to critical failures, defined and distinguished from others as follows:

- **Display Failure** - Display ceases full operation. The failure cannot be corrected without at least one of the following: tools, test equipment, replacement parts, checks of the Display unit, and knowledge beyond performing routine operations.
- **Nuisance Failure** - A component in the Display unit has ceased operation but does not impair the required operation of the unit.
- **Not Machine Failures** - Malfunctions attributable to the following causes shall not be classified as failures:
 - Improper installation or maintenance
 - Abuse or misuse
 - Exposure to environments outside the specified design range.
 - Lack of prescribed preventative maintenance.
 - Failures caused by test equipment used to control cycle and check the operation of Display units on test.

Appendix 1 - Glossary of Terms

Aspect Ratio – The ratio of width to height of a display surface. The standard television aspect ratio is 4:3.

Back Porch – The portion of a composite display signal which lies between the trailing edges of a horizontal sync pulse and the corresponding blanking pulse.

Black Level – The display-signal level corresponding to a specified limit for black peaks.

Blanking – The process of decreasing (or increasing) the display-signal level so that no visible retrace will appear on the display screen.

Blanking Level – The level of a composite display signal which separates the range containing display information from the range containing synchronizing information. Also called the pedestal level, or blacker-than-black.

Brightness – A psycho-physiological attribute of visual perception in which a source appears to emit or reflect more or less light. Its psycho-physical, photometric equivalence is luminance.

Candela-per-meter-squared [cd/m^2] – The international unit of luminance (nits).

Candle Power – Luminous intensity expressed in candelas.

CIE – Abbreviation for the Commission Internationale de l'Eclairage, formerly referred to as the International Commission on Illumination (ICI).

Chrominance – The colorimetric difference (dominant wavelength and purity) between any color and a reference "white" of equal luminance. In three-dimensional CIE color space, chrominance is a vector which lies in a plane of constant luminance.

Chromaticity – The color quality of light which is defined by its dominant wavelength and purity (see Chrominance).

Chromaticity Value – The scalar value of any one component of a three-component color (also called a tristimulus value). The unit value of each component is the amount of that component added to the other two components to produce a reference "white".

Color Data – The programmed values which determine the amplitudes of the signal which drive a color display.

Color Saturation – A psycho-physiological measurement of the degree to which a color appears to be free of white light.

Color Temperature – The temperature to which a black body must be heated to produce a color matching that of the source.

Contrast – The ratio between the maximum and minimum luminance values of a display.

dB (Decibel) – A measure of the ratio of two signals. The dB value is $20 \times \log_{10}$ of a voltage or current ratio or $10 \times \log_{10}$ of a power ratio.

Foot-Candle [fC] – A unit of illumination equal to the illumination which occurs when uniformly distributed luminous flux is impinging on an area at a rate of one lumen per square foot.

Foot-Lambert [fL] – A unit of luminance equal to the uniform luminance of a perfectly diffusing surface emitting or reflecting luminance flux at the rate of one lumen per square foot.

Front Porch – The portion of a composite display signal which lies between the leading edges of a horizontal blanking pulse and the corresponding sync pulse.

Gray Scale – Variations in the luminance value of "white" light, from black to white. Shades of gray are defined as gray-scale graduations that differ by the square root of 2.

Illuminance – The density of luminance flux impinging on a surface. It is the quotient of the flux divided by the "apparent" or projected area of the surface.

Image – A displayed view of one or more objects or parts of objects.

Lambert – A unit of luminance equal to the uniform luminance of a perfectly diffusing surface emitting or reflecting light at the rate of one lumen per square centimeter.

Luminance – Luminous intensity reflected or emitted by a surface in a given direction per unit of apparent area. Measured in nits.

Lumen – The unit of luminous flux or rate of luminous energy flow. It is equal to the flux radiating through a unit solid angle (steradian) from a uniform point source of one candela.

Luminous Flux – The time rate of luminous energy flow, measured by its capacity to evoke a visual sensation. It is expressed in lumens.

Luminous Intensity – The luminous flux radiated by a point source. It is expressed in candela.

LUX – The international unit of illumination. One LUX equals one lumen per square meter.

Photometer – Any optical device which uses a comparison technique to measure luminous intensity, luminance, or illumination. An equality-of-brightness photometer is based on simultaneous comparison of adjoining visual areas; a flicker photometer compares successive stimuli in the same visual area.

Resolution – The number of addressable, controllable display or picture elements, or the number of hypothetical coordinate locations which can be used to position graphic elements on a display surface.

Shades of Gray – A division of the gray scale from black to white into a series of discrete luminance shades with a square-root-of-2 difference between successive shades.

Sync – A contraction of synchronous or synchronization.

Tristimulus Value – See *Chromaticity Value* and *Color Data*.

Revision History

REV	REF	DATE	PAGE	DESCRIPTION OF CHANGE	BY
1	---	27 Feb. 2003	All	Draft Release	M. Brogger
2	---	25 Mar. 2003	All	Format Cleanup	L. Lewis
A	---	27 Mar. 2003	6	Added detailed button descriptions	L. Lewis
B	1230	5 May 2003	All	Removed Power supplies references	M. Nichols
C	1535	12 Dec 2003	All	Removed reference to customer in section 6.4; removed redundant equations in Section 6; corrected panel parameters in section 6.5; simplified section 4.4.1 by removing descriptions in favor of Figure 11 only; other minor corrections of figure numbers and pagination. Added new Brand logo.	M. Nichols