PLANAR

EL640.480-A SB Series 640 x 480 Pixel, True Gray Scale Displays

USER'S MANUAL

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Product Profile

The EL640.480-A SB series displays are VGA compatible high-resolution electroluminescent (TFEL) flat panel displays. They replace the bulky CRT in control and instrument product designs. They feature an integrated DC/DC converter, and their compact dimensions save space that can allow addition of features or reduction in overall size. The displays are mechanically identical.

The display format of EL640.480-A SB series displays is VGA compatible (640 columns by 480 rows) with sixteen true shades of gray. The display supports and automatically detects all standard VGA modes.

The displays require a single +12Vdc power source and five basic types of input signals to operate :

1. Video Data or pixel information
2. Video Clock, pixel clock, or dot clock
3. Horizontal Sync
4. Vertical Sync
5. Blanking

EL Technology

The display consists of an electroluminescent glass panel and a mounted circuit board with addressing electronics.

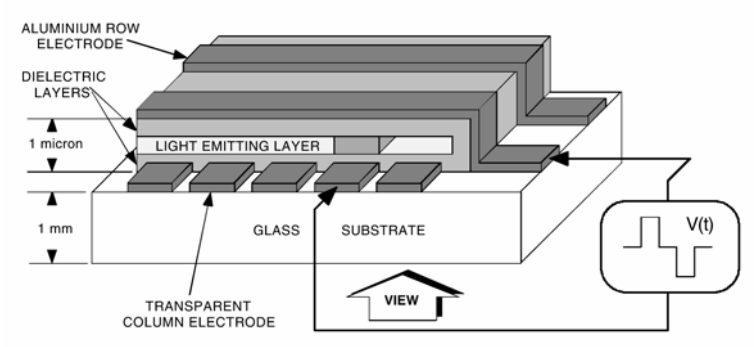

Figure 1. EL Technology.

The EL glass panel is a solid-state device with a thin film luminescent layer sandwiched between transparent dielectric layers and a matrix of row and column electrodes. The row electrodes, in back, are aluminium; the column electrodes, in front, are transparent. The entire thin film device is deposited on a single glass substrate. The glass panel is mounted with an elastic spacer to an assembly support carrying the electronic circuit assembly board (ECA) mounted on the support. The driver electronics is connected to the EL glass panel with soldered lead frame interconnects. The result is a flat, compact, reliable and rugged display device.

The EL640.480-AD4 SB display includes a dark ICE (Integrated Contrast Enhancement) background in the display glass. ICE background significantly improves the luminance contrast of the display in bright ambients. ICE also removes the halo around the lit pixels in dark ambient making the appearance of each pixel crisp and clear.

The 640 column electrodes and 480 row electrodes are arranged in an X-Y formation with the intersecting areas performing as pixels. Voltage is applied to both the correct row electrode and the correct column electrode to cause a lit pixel. Operating voltages required are provided by an integrated DC/DC converter.

Electrical Characteristics

Connector Layout

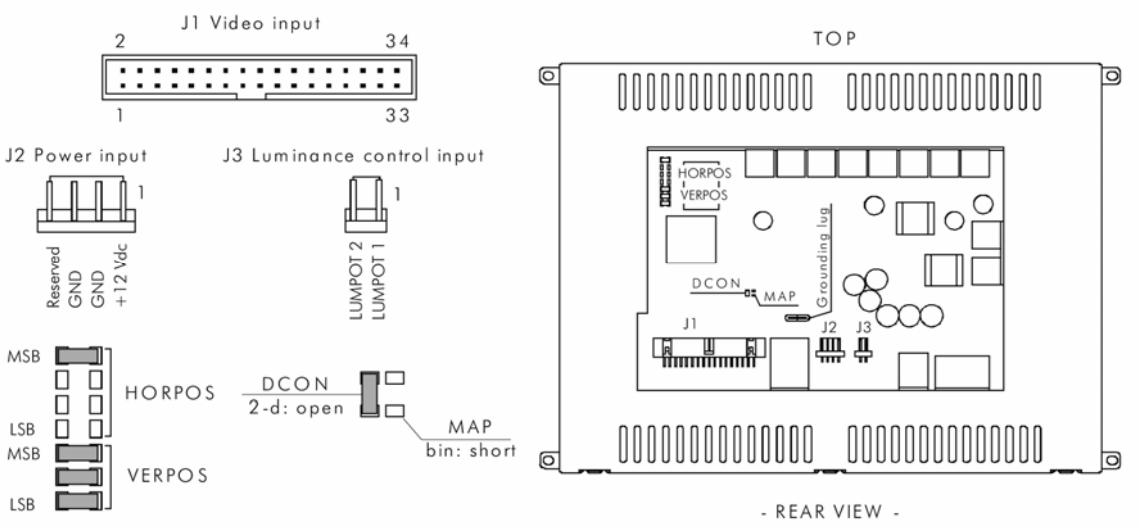

Fig 2. The input connectors and programmable jumpers with their factory settings.

Signal Inputs

Table1. Signal Inputs: J1 (Video Interface Connector).

Pin No	Signal	Symbol	Description
1, 3, 5, 15 17, 19, 21	Ground	GND	Signal return
2	Video data (LSB)	D0	Primary video data. In two data parallel mode even video data
4	Video data	D1	(see note below and "Two-Data-Parallel" on page 9).
6	Video data	D2	
8	Video data (MSB)	D3	
10	Video data (LSB)	D4	Odd video data used in two data parallel mode
12	Video data	D5	(see note below and “Two-Data-Parallel” on page 9).
14	Video data	D6	
16	Video data (MSB)	D7	
18	Video Clock	VCLK	Synchronizing signal for data lines, HS, VS and _BLANK. Data inputs are read at the rising edge of VCLK.
20	Blanking	_BLANK	Used in VGA modes. In NORMAL mode should be high or left disconnected.
22	Horizontal Sync	HS	The horizontal sync signal HS controls the internal row counter and in the NORMAL mode the horizontal position of the picture.
24	Vertical Sync	VS	The vertical sync signal VS controls the vertical position of the picture.
26	Self test	SELFTST	If high or left disconnected, self test is performed (see page 8).
27	Colour map	COLMAP	If high, data bits are interpreted as colours (see page 8). If low, data bits are interpreted as binary data. If left disconnected, interpretation depends on MAP jumper.
28	Enable	ENABLE	Display operation is enabled when high or left disconnected
30	Low power	_LOWPOW	If low, display brightness and contrast is reduced for lower power consumption.
29, 33, 34	Reserved		These pins are reserved for future use
7, 9, 11, 13	Not used	N/C	Not connected
23, 25, 31, 32	Not used	N/C	Not connected

Note: Two data parallel mode is selected when DCON '2-d' bridge is open. On default setting the bridge is set and 4 bits wide data is input to D0...D3 and does NOT require D4...D7 to be connected.

Power and Control Inputs

Table 2. Power and Control Inputs

Pin	Signal	Symbol	Description
J2 (Power input connector)			
1	Voltage	Vcc2	Supply voltage (+12 Vdc) converted to required internal voltages
2	Ground	GND	Power return
3	Ground	GND	Power return (same as pin 2)
4	Reserved		Reserved for compatibility with Vcc1 input in other Planar displays. Do not use.
J3 (Luminance control input)			
1	Luminance control	LUMPOT1	The inputs for an external 50 kΩ log potentiometer to adjust the luminance of the display. If left disconnected, the luminance is at the max level. See page 9 for details.
2	Luminance control	LUMPOT2	

Control Basics

The EL panel is a matrix structure, with column and row electrodes arranged in X-Y formation. Light is emitted when an AC voltage of sufficient amplitude is applied at a row-column intersection. The display operation is based on the symmetric, line at a time data addressing scheme. Input thresholds to the display are 74ACT CMOS compatible (TTL thresholds).

Power Input

The only required supply voltage for the display is +12Vdc (Vcc2). All internal high voltages are generated from Vcc2.

Connectors

Table 3. Connectors.

J1	34-pin header Mating Locking clip	ODU 511.266.003.034 or eq. ODU 517.065.003.034 or eq. ODU 511.065.734.700 or eq.
J2	4-pin header Mating Protector	Hirose DF1–4P–2.5 DS or eq. Hirose DF1–4S–2.5 R 24 Hirose DF1–4A 1.33
J3	2-pin header Mating Protector	Hirose DF1–2P–2.5 DS or eq. Hirose DF1–2S–2.5 R 24 Hirose DF1–2A 1.33

Programmable Features

Two data parallel input mode is selected when bridge DCON on the ECA is open (see fig. 2). In default configuration the DCON bridge is set. See page 9 for more details.

The method of gray scale coding can be selected either with COLMAP control input (J1/27) (see Signal Inputs on page 5) or with solderable bridge MAP on the ECA (see fig. 2). If COLMAP is left disconnected, MAP brigde defines the mode. If MAP is left open (default), colour mapping is selected. If MAP is bridged, binary coding is the method. Note that if COLMAP control input is used MAP has to be open. See page 8 for more details on colour mapping.

Notice: Only binary coding of input data can be used with Two Data Parallel mode. See Gray Shades and Two Data Parallel Mode in page 9.

For compatibility to previous versions of A series displays the horizontal and vertical positioning of the image can be adjusted with solderable bridges on the ECA of the display. VERPOS0–VERPOS2 (MSB) are for vertical positioning and HORPOS0–HORPOS3 (MSB) are for horizontal positioning (see Fig. 2). Both settings form a binary number where a set bridge is a "0" and open bridge a "1". The adjustment range for VERPOS is 0 to 7 upwards (default 000 for no shift) and HORPOS 7 right (0000) to 8 left (1111) (default 0111 for no shift).

Notice: Due to the fact that picture positioning is not supported by Planar multi-colour VGA displays and may not be supported by some future Planar VGA displays, the use of this feature should be avoided.

Input Specifications

Table 4. Input Specifications.

Parameter	Symbol	Min.	Typ.	Max.	Absolute min./max.
Logic input HIGH		2 V	—	Vcc1	+5.5 V abs. max.
Logic input LOW			—	0.8 V	-0.5 V abs. min.
Supply voltage	Vcc1	11.4 V	12 V	13.2 V	15 V abs. max.
Supply current at 12V	Icc1	—	1.3 A	2.6 A	
Supply current at 12V LowPow	Icc2	—	0.9 A	1.5 A	

Operating conditions: Ambient temperature 25°C

Note: Absolute maximum ratings are those values beyond which damage to the device may occur. The minimum and maximum specifications in this Operations Manual should be met, without exception, to ensure the long-term reliability of the display. Planar does not recommend operation of the display outside these specifications.

Display Features

The EL640.480-A SB series displays are timing and pin compatible with the feature connector on VGA display controller cards. Pins 1–26 on the feature connector connect directly to corresponding pins on data input connector J1 of the display. Pins 27–34 may be left disconnected.

Video Data

Input signals D0, D1, D2, D3 (and D4, D5, D6, D7 in two data parallel mode) contain the four bit serial video data to be displayed on the screen. Pixel information is supplied from left to right and from top to bottom. The four data bits can be interpreted as colour data or binary gray shade codes.

Gray Shades

The display is capable of displaying sixteen true levels of luminance. The four bit video input data can either be mapped to colour coding or binary gray shade coding. Colour coding is selected by pulling COLMAP control input HIGH. A LOW state in COLMAP control input selects binary coding. See 'Programmable Features' in page3 for setting the coding if COLMAP input is left disconnected.

Table 5. 16 levels of gray when colour mapping is used.

D3	D2	D1	D0	Colour	Gray Level
0	0	0	0	Black	0
0	0	0	1	Blue	1
0	0	1	0	Green	5
0	0	1	1	Cyan	8
0	1	0	0	Red	2
0	1	0	1	Magenta	3
0	1	1	0	Brown	6
0	1	1	1	White	11
1	0	0	0	Gray	4
1	0	0	1	Lt. Blue	7
1	0	1	0	Lt. Green	12
1	0	1	1	Lt. Cyan	13
1	1	0	0	Lt. Red	9
1	1	0	1	Lt. Magenta	10
1	1	1	0	Yellow	14
1	1	1	1	White(High Int)	15

For maximum text readability, the default text brightness level is mapped in text modes 2+, 3+, 7 and 7+ to high intensity white (level 15). If colour coding is selected levels 11 and 15 are changed. If binary coding is selected, levels 7 and 15 are changed respectively. Please find complete description of VGA modes in page 11.

Self Test

The operation of the display can be tested using the SELFTST control input (J1/26). Self test is performed if SELFTST is HIGH or left disconnected. By applying power to the display without any other input, the display starts scanning, displaying all pixels with full brightness except a pattern of unlit pixels in the center of the topmost row.

Display Enable

The operation of the display can be shut off for screen save or minimal power consumption by a LOW state on ENABLE control input (J1/28). When disabled power consumption of the display drops to appr. 2 W. In normal operation ENABLE input should be pulled HIGH or left disconnected (internal pull-up)

Brightness Control

The brightness of the display can be adjusted from below 20% up to full brightness by a 50kΩ external logarithmic potentiometer between LUMPOT1 and LUMPOT2 control inputs (J3/1 and /2 respectively). The control function is achieved by sinking a small (<0.5 mA typ.) current from LUMPOT1 to LUMPOT2 (When open, the voltages are at 5 V and 0 V respectively).

If the two inputs are left disconnected, the brightness is at its maximum level.

Low Power Mode

The Low Power function reduces power consumption of the display to typically 11 W. The function reduces slightly the contrast and average brightness of the display. The function is selected by LOW state in _LOWPOW control input (J1/30). If the input is pulled HIGH or left disconnected, normal operation is selected.

Two Data Parallel Mode

For compatibility with flat panel controllers, it is possible to input the data of two pixels simultaneously by using the secondary data input lines D4–D7. This mode is selected when solderable bridge DCON is open. In default configuration bridge DCON is set.

Notice: Only binary coding of input data can be used with Two Data Parallel mode. See Gray Shades.

EMC

The conductive metal assembly support between the display glass and the electronics as well as the metal back cover act as a ground plane for EMI signals. In conjunction with data input connector J1, there is a connection lug from assembly support through the ECA. This lug can be used to ground the shield of the signal input cable. Note that the assembly support is also connected to the signal ground of the display (GND in J1).

For best EMC performance, the four display mounting ears should be tied to customer chassis ground. Care should be taken to avoid loops in system grounding.

The EMC of the end product can be additionally improved using the four layer board version of the display. One of the additional layers of this version is dedicated to signal ground. It provides an efficient ground path for high frequency interferences present in the system. See Ordering Information on page 23.

For more details on improving the EMC of the end product please contact Planar.

Display Operation Modes

The display supports all standard VGA display modes. It also supports the NORMAL mode which is similar to that used by most other Planar products. Mode selection is automatically performed by the display detecting the state of _BLANK at rising edge of VS and the polarities of the VS and HS input signals at the rising edge of the _BLANK signal. See timing diagrams on pages 12-14 for more details.

VGA Modes: In VGA modes _BLANK signal is used to frame the valid video data. The number of active pixels in each VGA mode is determined by calculating the number of VCLK pulses during the HS LOW time (T8 on timing diagrams). The 320 column modes are detected additionally by the amount of VCLK pulses during the front porch (T7 on VGA mode timing diagrams). In 320 and 360 column VGA modes each pixel data is displayed in two successive pixels.

In 720 and 360 column VGA text modes the data of every ninth pixel is omitted to be able to display the whole data line with 640 pixels. There is no data loss due to blank data in the ninth column of the text box.

The border timing included in _BLANK is taken into account in the interpretation of this signal and the video data during vertical borders is displayed in 350 and 400 line modes but ignored in 480 line modes. See details on setup and hold timing on page 15 and the timing of different VGA modes on page 12-13.

Normal Mode: In this mode only seven input signals are needed: video data (D0, D1, D2 and D3), video clock (VCLK), horizontal sync (HS) and vertical sync (VS). _BLANK is not used and should be pulled HIGH or left disconnected.

In Normal Mode the last 640 pixels before the fall of the HS are displayed. The topmost row displayed is the first HS HIGH time ending after HS Hold from VS time (T3 in Normal Mode page 14) from the rising edge of the VS. See details on setup and hold timing on page 15 and Normal Mode timing on page 14.

Timing Compatibility with Planar displays

The VGA mode detection of EL640.480-A SB series displays is compatible with Planar EL640.480-AM series displays and EL7768MS display and is downwards compatible with Planar EL640.400-C and -CB series displays (350 line and 400 line modes).

Display Operation Modes

Table 6. Display Operation Modes.

VGA Mode	Type	Text format	Char. box	Vsync Freq. (Hz)	Pixels (software)	Double Scan	Hor/Ver Border
0, 1	text	40 x 25	8 x 8	70	320 x 200	Yes	L 8/7
2, 3	text	80 x 25	8 x 8	70	640 x 200	Yes	R 8/7
0*, 1*	text	40 x 25	8 x 14	70	320 x 350	No	L 8/6
2*, 3*	text	80 x 25	8 x 14	70	640 x 350	No	R 8/6
0+, 1+	text	40 x 25	9 x 16	70	360 x 400	No	L 9/7
2+, 3+	text	80 x 25	9 x 16	70	720 x 400	No	R 9/7
4, 5	graphics	40 x 25	8 x 8	70	320 x 200	Yes	L 8/7
6	graphics	80 x 25	8 x 8	70	640 x 200	Yes	R 8/7
7	text	80 x 25	9 x 14	70	720 x 350	No	R 9/6
7+	text	80 x 25	9 x 16	70	720 x 400	No	R 9/7
D	graphics	40 x 25	8 x 8	70	320 x 200	Yes	L 8/7
E	graphics	80 x 25	8 x 8	70	640 x 200	Yes	R 8/7
F	graphics	80 x 25	8 x 14	70	640 x 350	No	R8/6
10	graphics	80 x 25	8 x 14	70	640 x 350	No	R8/6
11	graphics	80 x 30	8 x 16	60	640 x 480	No	R 8/T 8
12	graphics	80 x 30	8 x 16	60	640 x 480	No	R 8/T 8
13	graphics	40 x 25	8 x 8	70	320 x 200	Yes	L 4/7
NORMAL	graphics			65 max	640 x 480	No	

NOTES:

1. In VGA-modes 0+, 1+, 2+, 3+, 7 and 7+ the box size is narrowed to 8 pixels wide by omitting every 9th pixel.
2. In VGA-modes 0, 1, 2, 3, 4, 5, 6, D, E and 13 rows are automatically double scanned by the VGA card.
3. The border values used to fit the image to the fixed matrix size is marked by letters R=right border, L=left border, T=top border.
4. To improve text brightness, the gray level of the default text foreground colour is changed to level 15 in VGA-text modes 2+, 3+, 7 and 7+. If colour mapping is selected gray levels 11 and 15 are changed, and if binary coding is selected, levels 7 15 are changed.

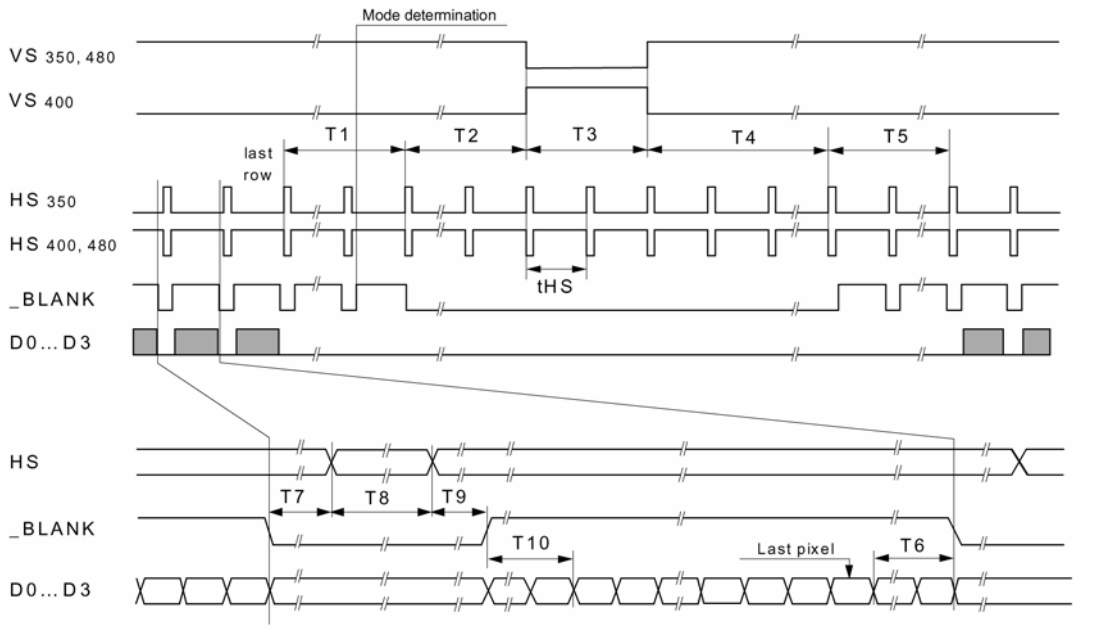

Figure 3. VGA Mode

Table 7. 350 Row VGA Modes.

Description			Unit	Note
T1 Vertical Border	6		tHS	1
T2 Vertical Front Porch	31/32		tHS	2
T3 VS Pulse Width	2		tHS	3
T4 Vertical Back Porch	53/54		tHS	
T5 Vertical Border	6		tHS	1
HS pulses / VS	449			
VS frequency	70		Hz	

Description	320	640	720	Unit	Note
T6 Horizontal Border	8	8	9	tVCLK	4
T7 Horizontal Front Porch	1-7	8/11	9	tVCLK	5
T8 HS Pulse Width	32-51	64-103	104-111	tVCLK	6
T9 Horizontal Back Porch	12	37/40	45	tVCLK	
T10 Horizontal Border	8	8	9	tVCLK	7
VCLK pulses / HS	400	800	900		
HS period	31.8	31.8	31.8	µs	

1. Borders are displayed but otherwise ignored by the display controller, value is for typical system timing.
2. Min. 2 HS-pulses + (130-T1-T4-T5 [in tHS]) x 3 µs + 60 µs.
3. Min. 1 x tVCLK.
4. Ignored in 320 column mode.
5. Used for 320 column mode sensing. Typical value there is 4.
6. Used for column mode sensing. Typical values are 48, 96 and 108 for 320, 640 and 720 column modes respectively.
7. Size of removed border in 320 mode.

Table 8. 400 Row VGA Modes.

Description		Unit	Note
T1 Vertical Border	7	tHS	1
T2 Vertical Front Porch	6	tHS	2
T3 VS Pulse Width	2	tHS	3
T4 Vertical Back Porch	27	tHS	
T5 Vertical Border	7	tHS	1
HS pulses / VS	449		
VS frequency	70	Hz	

Description	320	320(13)	360	640	720	Unit	Note
T6 Horizontal Border	8	4	9	8	9	tVCLK	4
T7 Horizontal Front Porch	1-3	5-7	4	8/11	9/13	tVCLK	5
T8 HS Pulse Width	32-51	32-51	52-60	64-103	104-111	tVCLK	6
T9 Horizontal Back Porch	13	18	14	37/40	40/45	tVCLK	
T10 Horizontal Border	8	4	9	8	9	tVCLK	7
VCLK pulses / HS	400	400	450	800	900		
HS period	31.8		31.8	31.8	31.8	µs	

1. Borders are displayed but otherwise ignored by the display controller, value is for typical system timing.
2. Min. (80-T1-T3-T4-T5 [in tHS]) x 3.3 µs + 50 µs.
3. Min. 1 x tVCLK.
4. Size of removed border in 640 and 720 column modes.
5. Used to detect 320,320(13) and 360 column modes. Typical values are 3, 6 and 4 respectively.
6. Used to detect column mode. Typical values are 48, 96 and 108 for 320, 320(13), 640 and 720 column modes respectively.
7. Size of removed border in 320, 320(13) and 360 modes.

Table 9. 640 Columns x 480 Rows VGA Modes.

Description		Unit	Note
T1 Vertical Border	8	tHS	1
T2 Vertical Front Porch	3	tHS	1
T3 VS Pulse Width	2	tHS	2
T4 Vertical Back Porch	24	tHS	1
T5 Vertical Border	8	tHS	3
HS pulses / VS	525		
VS frequency	60	Hz	
T6 Horizontal Border	8	tVCLK	3
T7 Horizontal Front Porch	8/11	tVCLK	1
T8 HS Pulse Width	64…103	tVCLK	4
T9 Horizontal Back Porch	37/40	tVCLK	1
T10 Horizontal Border	8	tVCLK	1
VCLK pulses / HS	800		
HS period	31.8	µs	

1. Value is for typical system timing
2. Min. 1 x tVCLK.

3. Size of removed border.

4. Used to detect column mode. Typical value is 96.

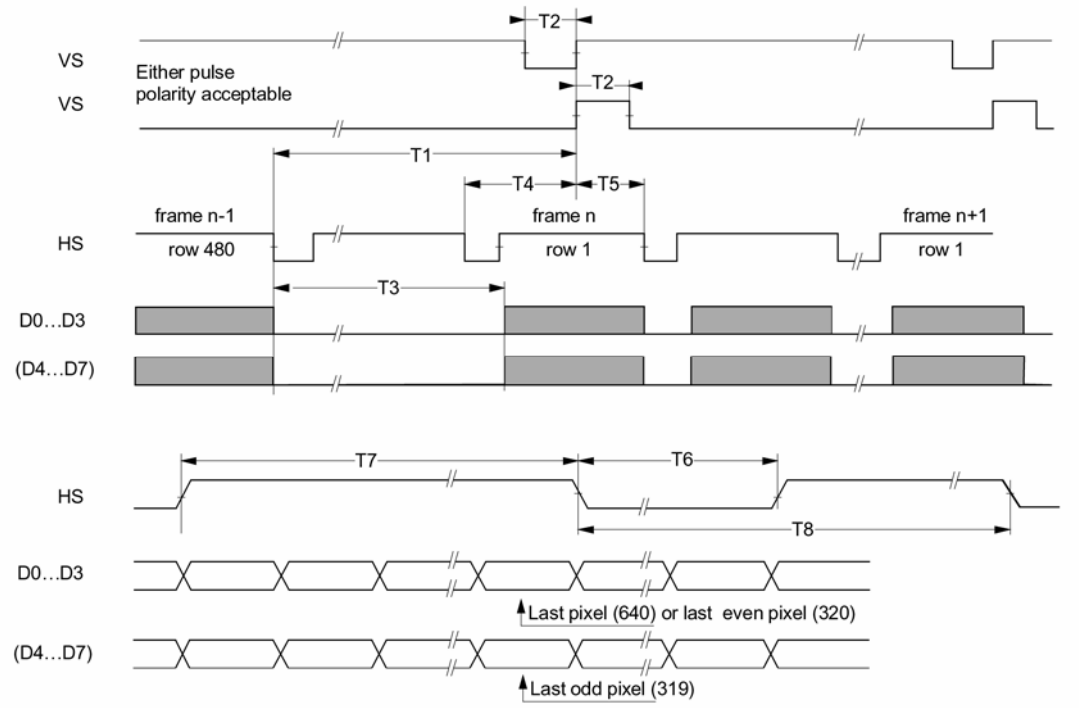

Figure 4. 640 Columns x 480 Rows NORMAL Mode. *(See note 1)*

Table 10. 640 Columns x 480 Rows NORMAL Mode.

Description	Min.	Typ.	Max.	Unit	Note
T1 Vertical Front Porch	60			µs	
T2 VS High/Low time	1			tVCLK	2
T3 Vertical Blank	40			µs	
VS frequency			65	Hz	
T4 HS setup to VS	0			tVCLK	
T5 HS hold from VS	2			µs	
T6 HS Low Time	4			tVCLK	3
T7 HS High Time	640 (320) 640 (320)			tVCLK	4
T8 HS period	31			µs	

NOTES:

1. _BLANK must be high or left unconnected
2. Only rising edge is used.
3. Video Clock VCLK should be kept running.
4. The number of VCLK pulses during HS high time should be even. Values in brackets are for two data parallel Mode

Setup and Hold Timing

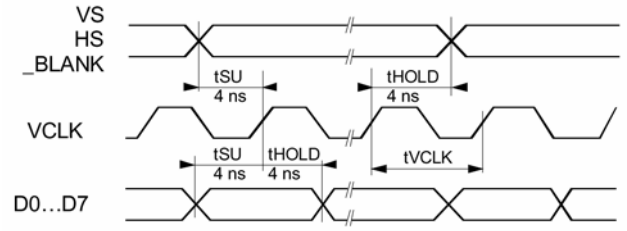

Fig 5. Setup and Hold Timing

Table 11. Setup and Hold Timing.

Mode	**tVCLK** ns	**fVCLK** MHz
2+, 3+, 7, 7+	35.31	28.322
2, 3, 2*, 3*, 6, E, F, 10, 11, 12	39.72	25.175
0+, 1+	70.62	14.161
0, 1, 0*, 4, 5, D, 13	79.44	12.588
NORMAL	33 min.	30 max.

Installation and Handling

Mounting

Mounting of the EL640.480-A4 and -AD4 displays should be done using the four mounting ears of the metal assembly support. Note that all four mounting points are connected to the signal ground (GND in J1) through the assembly support.

Handling and Cleaning

Before handling the display, necessary precaution must be taken to prevent application of static charges to the display from the operator or tools.

The display is made of glass material and should be handled with proper care. Do not drop, bend or flex the display or allow hard objects to strike its surface.

Video Signal Input

For trouble-free data transfer from data transmitter to display input connector, a maximum cable length of 600 mm (24 in.) is recommended. In the case of VGA Feature Connector use, proper signal buffering should be ensured. In order to lower signal reflections, the connecting cable should be terminated with a matching series resistor at each of the eleven outputs of the signal source. Data input thresholds of the display are 74ACT CMOS compatible, and data lines have 4.7 kΩ pull up resistors and 100 Ω series resistors connected at their inputs.

Avoiding Burn-in

As with any other light emitting display, luminance variation may be noticed if fixed patterns are displayed on the screen for extended periods. It is prudent to use a screen saver or image inversion to avoid burn-in.

Caution: Properly mounted, this display can withstand high shock loads as well as severe vibration in aggressive environments. However, the glass panel used in this display will break when subjected to bending stresses, high impact or excessive loads

To prevent injury in the event of glass breakage, a protective overlay should be used on the viewer side of the display.

Cleaning Caution: Clean the display glass with mild, water based detergants only. Apply the cleaner sparingly.

Warning: The product generates potentially dangerous voltages capable of causing personal injury (high voltage pulses up to 230Vac). Do not touch the display electronics during operation!

Automatic Overheat Protection: The display is provided with an overheating sensor to protect the display in the case of temporary overheating. When the temperature in the display rises over specified limits, the automatic circuitry limits the power consumption of the display and prevents the temperature to rise critical. When using a typical power consumption of 16W within the specified operating temperature range, the overheat protection is not needed.

Electrostatic Caution: The Planar display uses CMOS and power MOS-FET devices. These components are electrostatic sensitive. Unpack, assemble and examine this assembly in a static-controlled area only. When shipping use packing materials designed for protection of electrostatic-sensitive components.

Operational Specifications

Environmental

Table 12. Environmental Characteristics.

Temperature	
Operating	0…+55°C
Storage	–40…+85°C
Operating Survival	–20…+70°C (no permanent damage)
Test duration 24 h at -20°C and +70°C (no condensation)	
Humidity	
Relative Humidity	+40°C, 93% RH, Operating (IEC 68-2-3)
Damp Heat	+25…+55°C, 95% RH, Non operative (IEC 68-2-30)
Altitude	
Operative	15,000 m (50,000 ft.) above sea level
Vibration	
	20…500 Hz
ASD level	0.05 g^2/Hz
Random Vibration wide band	IEC 68–2–36, Test Fdb
Shock	
Magnitude	100 g
Duration	4 ms (half sine wave)
Number of shocks	18 (3 on each of the 6 surfaces)
	IEC 68-2-27, test Ea

Reliability

MTBF > 50,000 h @ 25°C

Safety

The display will not inhibit the end product from obtaining any of the following certifications: UL544, IEC 950.

EMC

The display will not inhibit the end product from obtaining any of the following certifications: EN55022 B, FCC 15 J B.

Optical

Determined at 25°C ambient @60 Hz frame rate.

Display Colour

Wide band amber (ZnS:Mn)

Table 13. Optical Characteristics.

Areal Luminance		
On luminance	A4	56 cd/m^2 (16.3 fL) typ.
	AD4	22 cd/m^2 (6.4 fL) typ.
	A4	40 cd/m^2 (12.2 fL) min.
	AD4	16 cd/m^2 (5.0 fL) min.
Average of the center and four corners of the screen, at GL 15.		
Non-uniformity		
Maximum	35% (GL 15)	= (1- min. luminance/max luminance) x 100. Maximum difference between any two of five points (center and four corners).
Luminance Variation (Time)		
Maximum	20%	10,000 h at 25°C (GL 15)
Luminance Variation (Temperature)		
Maximum	15%	over 0…+55°C range. Measured with full field at GL 15.
Luminance Contrast Ratio		
MInimum	AD4	12:1 @ 500lx 3:1 @ 2500lx
Viewing Angle		
Minimum	160°	

Illuminance	Classification
1 … 10 lx	dark
10 … 100 lx	dim
100 … 1000 lx	office
1000 … 10000 lx	bright
10000 … 100000 lx	sunlight

Filter

The luminance contrast of the ICE version of the display EL640.480-AD4 is sufficient for operation without any contrast enhancement. For best overall performance in high or low ambient luminance levels, a neutral gray circular polarizing filter with anti-glare coating or etch is the usual choice. This filter will make the reflecting electrodes of the display darker and will improve the contrast ratio. The anti-glare coating on the filter should be facing the user. The ICE display -AD4 is as option available with a protectective film with an anti glare coating optically bonded directly on the display glass.

Mechanical Characteristics

Fig. 6 shows the mechanical dimensions of a EL640.480-A SB series display unit.

Table 14. Display External Dimensions.

Height	192 mm	7.56 in.
Width	263 mm	10.35 in.
Depth	20 mm	0.82 in.
Weight	800 g	28 oz. max.

EL640.480-ASB series displays are mounting compatible with Planar EL640.480-AM series displays and EL7768MS displays.

Table 15. Display Viewing Area Characteristics.

EL640.480-A3 SB		
Active Area millimeters (inches)	height	154.8 (6.09)
	width	206.4 (8.13)
Pixel Pitch millimeters (inches)	height	0.3226 (0.0127)
	width	0.3226 (0.0127)
Pixel Size millimeters (inches)	height	0.208 (0.082)
	width	0.210 (0.083)
Pixel fill factor	42%	
Pixel Matrix	640 horizontal by 480 vertical.	
EL640.480-A4 SB and –AD4 SB		
Active Area millimeters (inches)	height	158.3 (6.24)
	width	211.1 (8.31)
Pixel Pitch millimeters (inches)	height	0.33 (0.0129)
	width	0.33 (0.0129)
Pixel Size millimeters (inches)	height	0.219 (0.086)
	width	0.219 (0.086)
Pixel fill factor	44%	
Pixel Matrix	640 horizontal by 480 vertical.	

CAUTION: The ambient temperature of the display should not be allowed to exceed the environmental specifications (see page 5). In most applications, an air gap of min 5 mm is recommended. Some applications may require, however, a larger air gap for cooling of the display unit in the system. Note that this may slightly increase the total depth of the design.

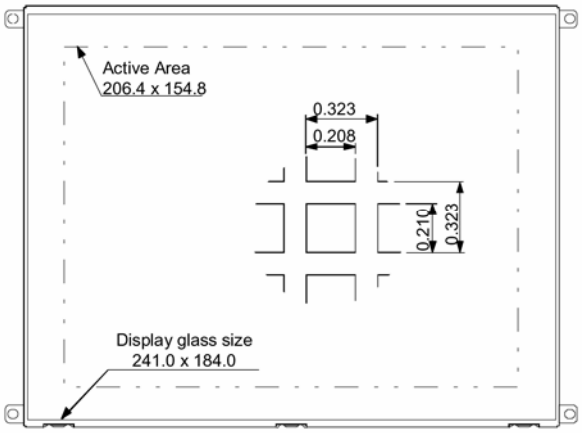

Fig 6. EL640.480-A3 SB Viewing Area Characteristics.

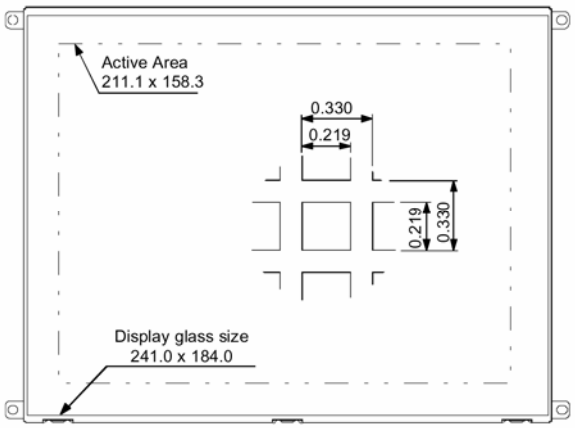

Fig 7. EL640.480-A4 SB and –AD4 SB Viewing Area Characteristics.

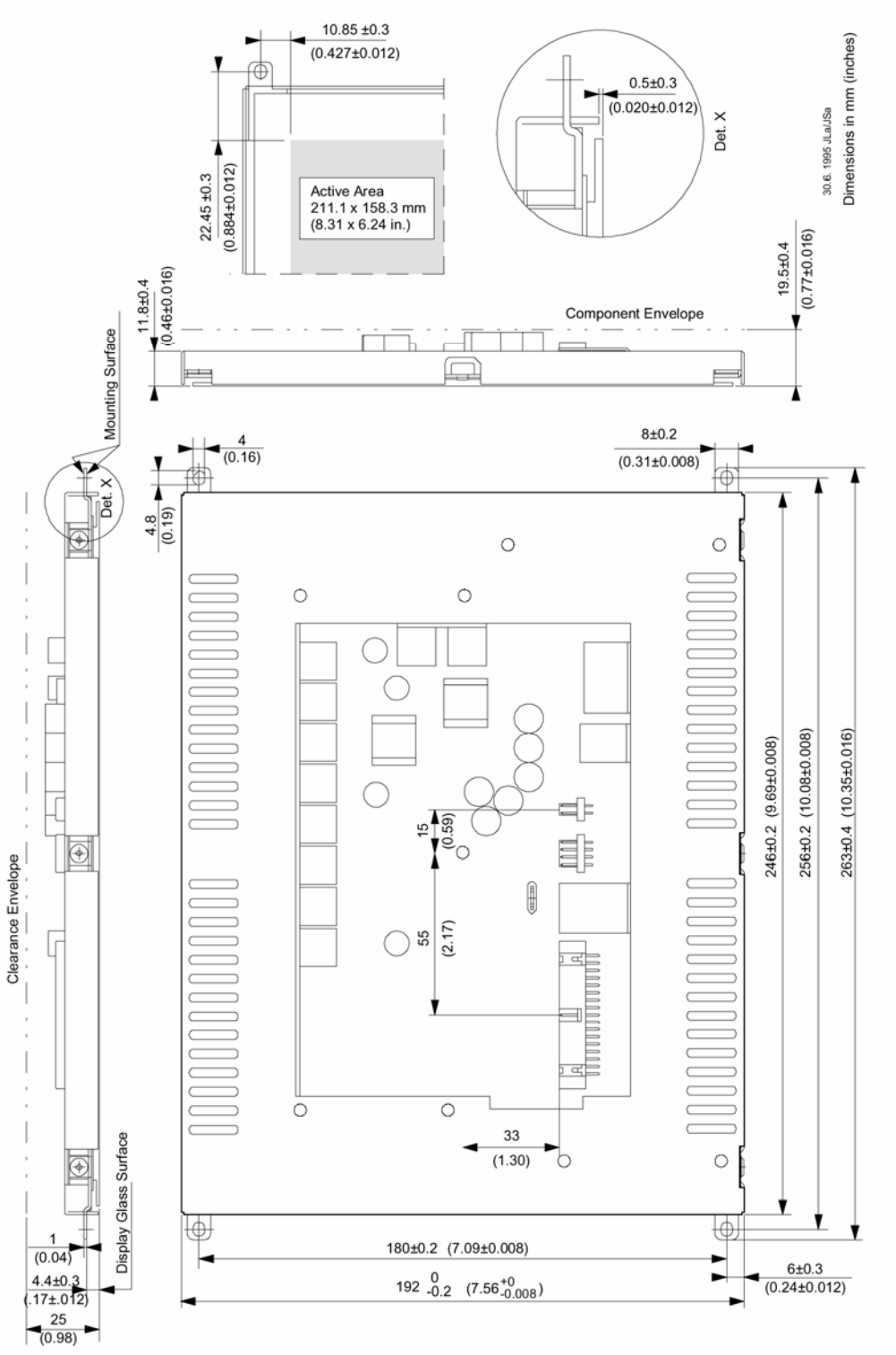

Fig 8. Back and Side Views. *All dimensions in mm.*

Description of Warranty

Seller warrants that the Goods will conform to published specifications and be free from defects in material for 12 months from delivery. To the extent that Goods incorporate third-party-owned software, Seller shall pass on Seller's licensor's warranty to Buyer subject to the terms and conditions of Seller's license.

Warranty repairs shall be warranted for the remainder of the original warranty period. Buyer shall report defect claims in writing to Seller immediately upon discovery, and in any event, within the warranty period. Buyer must return Goods to Seller within 30 days of Seller's receipt of a warranty claim notice and only after receiving Seller's Return Goods Authorization. Seller shall, at its sole option, repair or replace the Goods.

If Goods were repaired, altered or modified by persons other than Seller, this warranty is void. Conditions resulting from normal wear and tear and Buyer's failure to properly store, install, operate, handle or maintain the Goods are not within this warranty. Repair or replacement of Goods is Seller's sole obligation and Buyer's exclusive remedy for all claims of defects. If that remedy is adjudicated insufficient, Seller shall refund Buyer's paid price for the Goods and have no other liability to Buyer.

All warranty repairs must be performed at Seller's authorized service center using parts approved by Seller. Buyer shall pay costs of sending Goods to Seller on a warranty claim and Seller shall pay costs of returning Goods to Buyer. The turnaround time on repairs will usually be 30 working days or less. Seller accepts no added liability for additional days for repair or replacement.

If Seller offers technical support relating to the Goods, such support shall neither modify the warranty nor create an obligation of Seller. Buyer is not relying on Seller's skill or judgment to select Goods for Buyer's purposes. Seller's software, if included with Goods, is sold as is, and this warranty is inapplicable to such software.

SELLER DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Easy to Use

There are many options available which make Planar flat panel displays easy to use, easy to interface, and easy to package. Call Planar for complete information.

Ordering Information

Product	Part Number	Description
EL640.480-A4 SB		VGA display (0.33 pitch)
EL640.480-A4 SBS		VGA display with enhanced EMC properties (0.33 pitch)
EL640.480-AD4 SB		ICE VGA display (0.33 pitch)
EL640.480-AD4 SBS		ICE VGA display with enhanced EMC properties (0.33 pitch)
EL640.480-AD4 AG		ICE VGA display with optically bonded anti-glare film (0.33 pitch)
EL640.480-AD4 AGS		ICE VGA display with enhanced EMC properties and optically bonded anti-glare film (0.33 pitch)

Design and specifications are subject to change without notice.

Support and Service

Planar is a U.S. company based in Beaverton, Oregon and Espoo, Finland, with a world-wide sales distribution network. Full application engineering support and service are available to make the integration of Planar displays as simple and quick as possible for our customers.

RMA Procedure: Applying for a Returned Material Authorization number, please contact Planar Systems, Inc., with the model number(s) and original purchase order number(s). When returning goods for repair, please include a brief description of the problem, and be sure to mark the outside of the shipping container with the RMA number.

Planar Systems, Inc.

Customer Service

24x7 Online Technical Support: http://www.planar.com/support

Americas Support

1195 NW Compton Drive

Beaverton, OR 97006-1992

Tel: 1-866-PLANAR1 (866) 752-6271

Hours: M-F, 5am - 5pm Pacific Time

Europe and Asia-Pacific Support

Olarinluoma 9 P.O. Box 46

FIN-02201 Espoo, Finland

Tel: +358-9-420-01

Hours: M-F, 7:00am - 4pm CET

020-0358-00A