PLANAR

EL640.480-AA1 640 (x2) x 480 Pixel
RGY Multicolour Display

USER'S MANUAL

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Product Profile

The EL640.480-AA1 display is a VGA compatible high-resolution electroluminescent (TFEL) display. It delivers eight different hues of red, green and yellow with excellent image clarity. The EL640.480-AA1 is designed to function in extreme environments and is totally service free. Its image contrast and colours remain constant over a wide viewing angle and without the need for an additional polarizing filter under most lighting conditions.

The EL640.480-AA1 features a 640 (x 2) column by 480 row matrix with each pixel composed of a red and green subpixel. Each subpixel has three intensity levels. The digital flat panel interface is designed to match the needs of most systems.

For operation the EL640.480-AA1 display requires +5 Vdc and +12 Vdc (Vcc1, Vcc2) power and seven basic input signals:

1. Four bit serial Video Data (D0…D3)

2. Video Clock, pixel clock, or dot clock (VCLK)

3.   Horizontal Sync (HS) or Blanking (_BLANK)

4.   Vertical Sync (VS)

EL Technology

The display consists of an electroluminescent glass panel, a mounted circuit board with driving electronics and an integrated DC/DC converter.

Figure 1. EL Technology.

The multicolour EL display panel is based on a new innovative structure, in which red, green and yellow colours are obtained using a patterned colour filter in front of a monochrome light emitting thin-film EL device. The structure is fully solid-state, with the colour filter laminated on top of the display. The light is emitted in a luminescent layer sandwiched between two transparent

dielectric layers and a matrix of row and column electrodes. The display glass and the electronic circuit assembly board (ECA) is mounted to a metal support by elastic spacers. The row electrodes are connected to the ECA with soldered lead frames. Column electrodes are connected via column driver TAB tapes. The result is a display with excellent visual characteristics in a compact, reliable and rugged structure.

In the EL640.480-AA1, the 640 (x 2) column and 480 row electrodes are arranged in a X-Y formation with the intersecting areas performing as pixels. Voltages applied to both the correct row and column electrodes to cause a lit sub-pixel. Operating voltages required are provided by the integrated DC/DC converter.

Electrical Characteristics

Connector Layout

Fig 2. Input Connectors and Their Location.

Signal and Power Inputs

Table 1. J1 (Video Interface Connector).

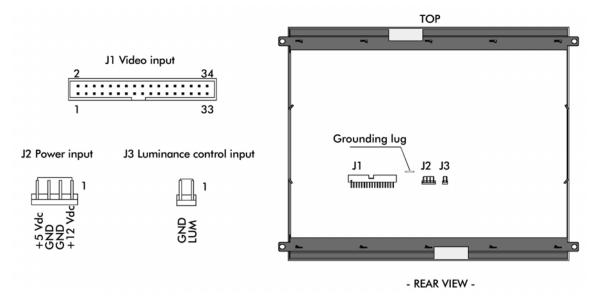| Pin No	Signal	Symbol	Description
1, 3, 5, 15 17, 19, 21	Ground	GND	Signal return
2	Video data (LSB)	D0	Video Data
4	Video data	D1	Video Data
6	Video data	D2	Video Data
8	Video data (MSB)	D3	Video Data
18	Video Clock	VCLK	Synchronizing signal for data lines, HS, VS and _BLANK. See setup and hold timings for the various modes on page 15.
20	Blanking	_BLANK	Frames data in VGA and TFT modes. For Normal mode should be high or left disconnected.
22	Horizontal Sync	HS	Frames data in Normal mode
24	Vertical Sync	VS	Controls the vertical position of the picture
28	Enable	ENABLE	Display operation is enabled when high or left disconnected
29	Interface mode	VMODE	If high or left disconnected, Normal or VGA mode is selected. If low, TFT LCD mode is selected.
10, 12, 14	Reserved		These pins are reserved for future use
16, 33, 34	Reserved		These pins are reserved for future use
7, 9, 11, 13	Not used	N/C	Not connected
23, 25, 26, 27	Not used	N/C	Not connected
30, 31, 32	Not used	N/C	Not 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	Voltage	Vcc1	Supply voltage (+5 Vdc)
J3 (Luminance control input)			
1	Luminance control	LUM	The inputs for an external 50 kΩ log potentiometer or a 0…5 V DC voltage to adjust the luminance of the display. If left disconnected, the luminance is at the max level.
2	Ground	GND	Signal return

Connectors

Table 3. Connectors.

J1	34-pin header Mating Locking clip	ODU 511.066.003.034 or eq. ODU 517.065.003.034 or eq. ODU 511.065.734.700
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

Connector Description

User video signals are brought onto the display via connector J1. The pin layout of J1 is compatible with Planar EL640.480-A series and EL7768MS display. Additionally the pin layout of the first 26 pins is also compatible with the feature connector on a VGA display controller. The +5 Vdc and +12 Vdc power input to the display is via connector J2.

For easy interfacing with VGA display controllers the data and control input signals on J1 are VGA timing compatible. The display automatically determines the mode of operation.

Additional Grounding for Low EMI

For best EMI attenuation performance, the metal assembly support should be tied to system ground via the four corner mounting ears or the grounding lug near the data input connector J1. The grounding lug can also be used for grounding the shield of the video signal cable.

Control Basics

The EL glass 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 a symmetric, line-at-a-time addressing scheme. User signals VCLK, HS or _BLANK, and VS control loading of pixel data into the display's internal frame buffer. Output of the pixel data from the frame buffer as well as the generation of the display scanning signals are controlled by internal logic. Input thresholds to the display are 74AC CMOS compatible.

Input Specifications

Table 4. Input Specifications.

Parameter	Symbol	Min.	Typ.	Max.	Absolute max. rating
Logic input voltage		0	—	Vcc1	Vcc1 + 0.5V
Logic input HIGH		3.9 V			
Logic input LOW				0.9 V	
Logic supply voltage	Vcc1	4.75 V	5.0 V	5.25 V	+7.5 V
Logic supply current at 5V	Icc1	—	0.25 A	0.35 A	
Display Supply voltage	Vcc2	10.8 V	12 V	13.2 V	15 V
Supply current at 12V	Icc2	—	0.75 A	2.25 A	
Power consumption 5V/12V		—	10 W	26 W	

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-AA1 has an internal frame buffer. The display scan and display brightness is independent of user timing.

Video Data

Input signals D0…D3 contain the serial video data to be displayed on the screen. Pixel information is supplied from left to right and from top to bottom. For each pixel, D0…D3 select one of the three intensity levels for each of the two subpixels to form the appropriate pixel colour. Note that Vcc1 supply voltage should be present whenever data input signals are applied.

Colour Mapping

Colour mapping is as follows mode:

Table 5. Colour Mapping.

D3	D2	D1	D0	VGA Colour	AA1 Colour
0	0	0	0	Black	Black
0	0	0	1	Blue	Black
0	0	1	0	Green	Green
0	0	1	1	Cyan	Green
0	1	0	0	Red	Red
0	1	0	1	Magenta	Red
0	1	1	0	Brown	Yellow
0	1	1	1	White	Lt. Yellow
1	0	0	0	Grey	Yellow
1	0	0	1	Lt. blue	Yellow
1	0	1	0	Lt. Green	Lt. Green
1	0	1	1	Lt. Cyan	Green-Yellow
1	1	0	0	Lt. Red	Lt. Red
1	1	0	1	Lt. Magenta	Orange
1	1	1	0	Yellow	Lt. Yellow
1	1	1	1	White(High Int)	Lt. Yellow

Display Enable

The display scanning can be shut off for screen save or minimal power operation by a LOW state on the ENABLE control input. When disabled, the display is totally dark and only the display internal logic remains operating. In normal operation, the ENABLE input should be pulled HIGH or left disconnected.

Self Test

The operation of the display can be easily checked without any external signals by utilizing the self-scan nature of the display. By applying power to the display without any other input, the display starts scanning, displaying the undefined data that is present in the frame buffer memory.

Luminance Control

The brightness of the display can be controlled with an external, user supplied 50 kΩ logarithmic potentiometer or a DC-voltage ranging from 0 to 5 V connected to control input J3. Minimum luminance is obtained with a short circuit or 0 V between the pins. Open circuit voltage is +5 V nominal, short circuit current is 0,3 mA max.

Display Operation Modes

The EL640.480-AA1 features three video interface modes. The first is Normal mode which is similar to that used by most other Planar display products. The second mode supports 640x400, 720x400 and 640 x 480 subsets of the VGA video interface standard. Mode selection is automatically performed by the display using _BLANK, HS and VS. The third mode is compatible with the interface timings used in most TFT LCD displays.

Normal mode: This mode is pin and timing compatible with the Normal mode of the EL640.480-A series displays. In this mode only seven input signals are needed: video data (D0…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 first 640 pixels after the rise of HS are displayed. The top most row displayed is the HS high time which is marked by the rise of VS. See details on setup and hold timing on page 15 and Normal Mode timing on page 13.

VGA mode: This input timing mode is compatible with feature connector signals from a VGA video board. The display supports VGA modes 2, 3, 6, E, 2+, 3+, 7+, 11 and 12.

VGA mode operation is similar to Normal mode except that _BLANK is used to frame valid video data. The border timing included in _BLANK is taken into account in the interpretation of this signal. Similarly the border timing included in VS is taken into account in the placement of the top displayed row. _BLANK must be LOW during the rise of VS for VGA mode to be selected. See details on setup and hold timing on page 15 and VGA Mode timing on page 12.

TFT LCD Mode: This input timing mode is similar to 640x480 pixel VGA mode except that _BLANK signal frames only the active pixels in each row. Selection of TFT mode is done with the VMODE input signal on J1 pin 29. See details on setup and hold timing on page 15 and TFT LCD mode timing on page 14.

Supported VGA Modes

Table 6. Supported VGA Modes.

VGA Mode	Type	Text format	Char. box	Vsync Freq. (Hz)	Pixels (software)	Double Scan	Border size H	V
2, 3	text	80 x 25	8 x 8	70	640 x 200	Yes	R 8/7	
2+, 3+	text	80 x 25	9 x 16	70	720 x 400	No	R 9/7	
6	graphics	80 x 25	9 x 16	70	720 x 200	Yes	R 8/7	
7+	text	80 x 25	9 x 16	70	720 x 400	No	R 9/7	
E	graphics	80 x 25	8 x 8	70	640 x 200	Yes	R 8/7	
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	

NOTES:

In modes 2+, 3+, 7+ the box width is narrowed to 8 pixels by omitting every 9th pixel.

In modes 2, 3, 6, E rows are automatically double scanned by a VGA controller.

Installation and Handling

Mounting

Mounting of the EL640.480-AA1 should be done using the four corner mounting ears.

Handling

Before handling the display, necessary precaution must be taken to prevent the 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.

The TAB leads between the electronics and the glass of the display are very sensitive to handling. Do not remove the bezel. A protective sheet with optional antiglare coating is highly recommended for use over the display.

Cleaning

Clean the display glass with mild, water-based detergents only. Apply the cleaner sparingly to a soft cloth, then wipe the display.

Cable Length

For trouble-free data transfer from the video source to the display input connector, a maximum cable length of 600 mm (24 in.) is recommended. When driving the display from a VGA Feature Connector, proper signal buffering should be ensured. In order to lower signal reflections, suitable series resistors which approximately match the cable impedance may be placed at the source end of the video signals. The display input thresholds are 74AC CMOS. _BLANK, VMODE and ENABLE inputs have 1 kΩ pull-up resistors. All video lines have 100 Ω series resistors.

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.

Electrostatic Caution: The Planar display uses CMOS and power MOSFET 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.

Handling Caution: The TAB leads between the electronics and the glass of the display are very sensitive to handling. The bezel of the display should not be removed, and when cleaning the edges of the display glass, special care should be taken not to touch the unprotected leads.
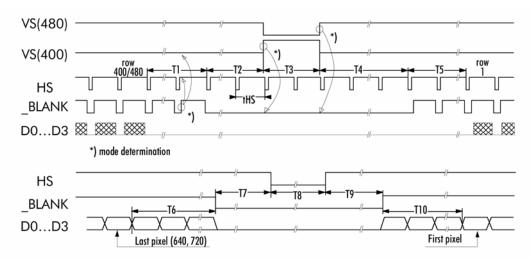
Timing Characteristics

Figure 3. VGA Mode (640 x 400, 720 x 400 and 640 x 480 subsets).

Table 7. VGA Mode (640 x 400, 720 x 400 and 640 x 480 subsets).

Description	640x400	720x400	640x480	Unit
T1 Vertical Border [1]	7	7	8	tHS
T2 Vertical Front Porch [1]	6	6	3	tHS
T3 VS Pulse Width [1]	2	2	2	tHS
T4 Vertical Back Porch [1]	27	27	24	tHS
T5 Vertical Border [2]	7	7	8	tHS
VS frequency	70	70	60	Hz
T6 Horizontal border [1]	8	9	8	tVCLK
T7 Horizontal front porch [1]	8/11	9/13	8/11	tVCLK
T8 HS pulse width	≤ 103	>104	≤ 103	tVCLK
T9 Horizontal back porch	37/40	40/45	40	tVCLK
T10 Horizontal border [2]	8	9	8	tVCLK
VCLK pulses per HS	800	900	800	tVCLK
HS pulses per VS	449	449	525	tHS
HS period (tHS)	31.8	31.8	31.8	µs

Notes
[1] Ignored by display controller. Values by typical system timing
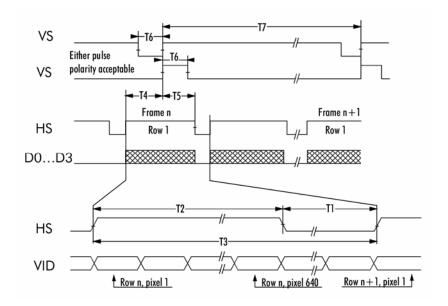[2] These parameters are critical for correct image centering.

Figure 4. Normal Mode.

Table 8. Normal Mode.

Description	Min.	Max.	Unit
T1 HS low time [3]	4		tVCLK
T2 HS high time [1, 2]	640		tVCLK
T3 HS period [1] (tHS)	31		µs
T4 VS hold from HS	0		ns
T5 VS setup to HS	0		ns
T6 VS high/low width	1		tVCLK
T7 VS period (tVS)	481		tHS
Frame Rate		65	Hz

Notes
[1] HS high time must be an even multiple of 2 tVCLK.
[2] The first 640 pixels after the rise of HS will be displayed.
[3] VCLK must continue running when HS is low.

Figure 5. TFT LCD Mode Timing.

Table 9. TFT LCD Mode Timing.

Description	Min.	Max.	Unit
T1 Blank low time [3]	4		tVCLK
T2 Blank high time [1, 2]	640		tVCLK
T3 Blank period [1] (tBlank)	31		μs
T4 VS hold from Blank	0		ns
T5 VS setup to Blank	2		ns
T6 VS high/low width	1		tVCLK
T7 VS period (tVS)	481		tBlank
Frame Rate		80	Hz

Notes
[1] Blank high time must be an even multiple of 2 tVCLK.
[2] The first 640 pixels after the rise of HS will be displayed.
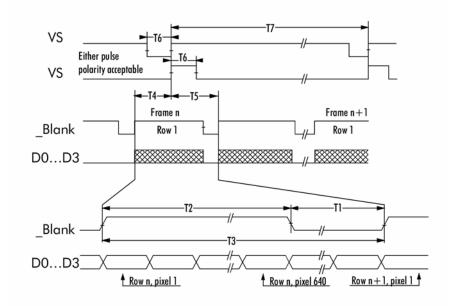[3] VCLK must continue running when Blank is low.

Caution: The EL640.480-AA1 display includes an internal frame buffer. The display image is not automatically cleared in the absence of input video signals. The ENABLE control input signal can be used to blank the display in the event of system malfunction.
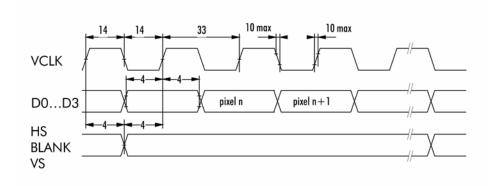
Setup and Hold Timing

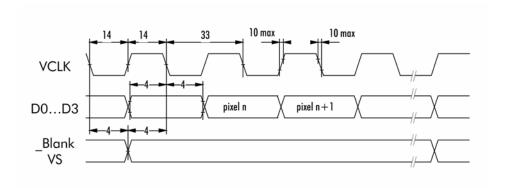*Figure 6. Normal and VGA Mode.* *Minimum values in ns.*

Figure 7. TFT Mode. *Minimum values in ns.*

Operational Specifications

Environmental

Table 10. Environmental Characteristics.

Temperature	
Operating	−25…+65°C
Storage	−40…+85°C
Humidity	
Relative Humidity	+40°C, 93% RH, Operating (IEC 68-2-3)
Damp Heat	+25…+55°C, 95% RH, Non operating (IEC 68-2-30)
Altitude	
Operating	5,000 m (16,000 ft.) above sea level
Non-operating	18,000 m (58,000 ft.) above sea level
Vibration	
	20…500 Hz
ASD level	0.05 g^2/Hz
Standard	IEC 68−2−36, Test Fdb, Random Vibration
Shock	
Magnitude	100 g
Duration	4 ms (half sine wave)
Number of shocks	18 (3 on each of the 6 surfaces)
Standard	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 (emissions)

Optical

Determined at 25°C ambient.

Table 11. Optical Characteristics.

Areal Luminance

On brightness	18 cd/m^2 (5.2 fL) min	
	21 cd/m^2 (6.7 fL) typical	
Measured at the center of the screen.		

Luminance Non-uniformity

Maximum	35%	= (1- min. luminance/max luminance) x 100. Maximum difference between any two of five points (center and four corners) all pixels on.

Luminance Variation (Time)

Maximum	20%	10,000 h at 25°C

Luminance Variation (Temperature)

Maximum	15%	over over -25…+65°C range

Luminance Contrast Ratio

MInimum	10:1	@ 500lx

Viewing Angle

Minimum	140°

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

Optional Filter

Due to the unique display structure, no circular polarizing (CP) filter is required in most applications. However, a protective sheet with anti-reflective coating is recommended to avoid reflections from the display surface.

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

Mechanical Characteristics

Figs. 9 shows the mechanical dimensions of a EL640.480-AA1 display unit.

Table 12. Display External Dimensions.

Height	205 mm	8.1 in.
Width	263 mm	10.4 in.
Depth	20 mm	0.79 in.
Weight	800 g	28.2 oz.

CAUTION: The ambient temperature of the display should not be allowed to exceed the environmental specifications (see table 10). 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.

Table 13. Display Viewing Area Characteristics.

Active Area millimeters (inches)	height width	158.3 (6.232) 211.1 (8.311)
Pixel Pitch millimeters (inches)	height width	0.33 (0.013) 0.33 (0.013)
Subpixel Size millimeters (inches)		
Red	height width	0.27 (0.011) 0.08 (0.003)
Green	height width	0.27 (0.011) 0.15 (0.006)
Pixel fill factor	57%	
Pixel Matrix	640 (x2) horizontal by 480 vertical. Green/Red striped.	

CAUTION: To prevent injury in the event of glass breakage, the use of an impact resistant shield or a protective overlay should be used on the viewer side of the display.
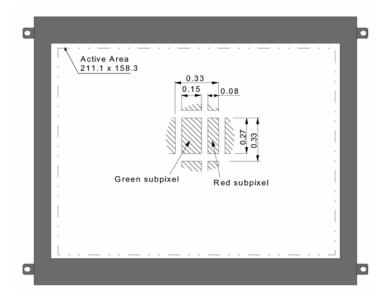
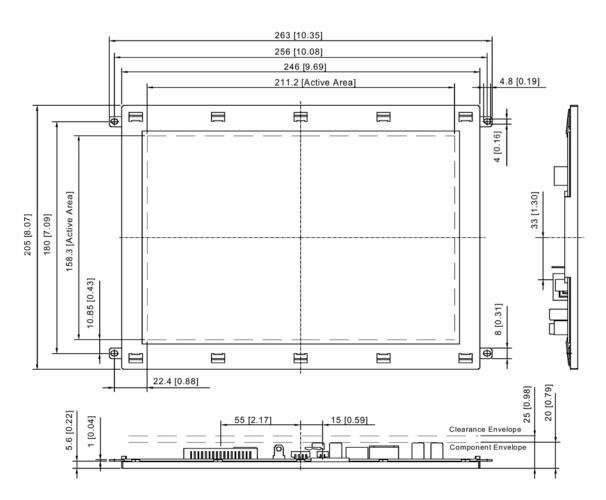Fig 8. *Viewing Area Characteristics.* All dimensions in mm.

Fig 9. *Front and Side Views.* All dimensions in mm [inch].

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-AA1	996-5088-00	EL640.480 multi-colour VGA display

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

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Beaverton, OR 97006-1992

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