

EL480.240-PR3

Operation Manual

Table of contents:

1	EL480.240-PR3 display	3
1.1	Features and benefits	3
2	Installation and handling	3
2.1	Mounting TFEL displays	4
2.2	Cable length	4
2.3	Cleaning	4
2.4	Avoiding burn-in	4
3	Specifications	5
3.1	Power	5
3.2	Connector	6
3.3	Interface information	7
3.3.1	Video input signals	7
3.4	Self-test mode	9
3.5	Optical	10
3.6	Generating greyscales	10
3.7	Environmental	11
3.8	Reliability	11
3.9	Safety and EMI performance	11
3.10	Mechanical characteristics	12
3.11	Component envelope	12
4	Description of warranty	14
5	Ordering information	15
6	Support and service	15
7	RoHS II	15

1 EL480.240-PR3 display

The EL480.240-PR3 thin film electroluminescent (TFEL) displays is high-performance alternative to industry-standard monochrome LCDs. The EL480.240-PR3 utilizes Lumineq® Displays' proprietary Integral Contrast and Brightness Enhancement (ICEBrite™) technology to achieve unparalleled image quality without the use of expensive filters. This small graphics display excels in a wide range of ambient lighting environments while effectively eliminating the blooming common to other high-bright displays.

The EL480.240-PR3 consists of a TFEL glass panel and control electronics assembled into a space-saving, rugged package for easy mounting. The EL480.240-PR3 is easily interfaced using standard 4-bit LCD control signals. Each of the 115,200 pixels has an aspect ratio of 1:1 (V:H) and is individually addressable to clearly display high information content graphics and text.

The EL480.240-PR3 model is identical to the EL480.240-PR2 model with the exception of series resistors included on selected internal signals on the EL480.240-PR3. There are no fit, form, or function differences between the two models. The specifications in this manual apply to both the EL480.240-PR2 and the EL480.240-PR3.

1.1 Features and benefits

- Excellent visual performance
 - High brightness and contrast
 - Wide viewing angle > 179°
- Rapid display response < 1 ms
- Space-efficient mechanical package
- Low EMI emissions
- Extremely rugged and durable
- Reliable, long operating life with > 100,000 MTBF
- 4-bit LCD-type interface

2 Installation and handling

Do not drop, bend, or flex the display. Do not allow objects to strike the surface of the display.

CAUTION: The 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.

CAUTION: To prevent injury in the event of a glass breakage, an impact resistant shield or a protective overlay should be used on the viewer side of the display.

2.1 Mounting TFEL displays

Properly mounted, TFEL displays can withstand high shock loads as well as severe vibration found in demanding applications. However, the glass panel used in a TFEL display will break if subjected to bending stresses, high impact, or excessive loads.

Stresses are often introduced when a display is mounted into a product. Ideally, the mounting tabs of the display should be the only point of contact with the system. Use a spacer or boss for support; failure to do so will bend the display and cause the glass to break. The instrument enclosure or frame should not flex or distort in such a way that the bending loads might be transferred to the display during use. Mounting surfaces should be flat to within ± 0.6 mm (± 0.25 "). Use all the mounting holes provided. Failure to do so will impair the shock and vibration resistance of the final installation.

The EL480.240-PR3 is a tab-mounted display. Use appropriate length stand-offs to assure that screws through the mounting tabs do not introduce bending stresses into the display. Do not deflect the ECB out of its normal plane. The EL480.240-PR2/PR3 mounting tabs are designed for 3 mm screws.

WARNING: These products generate voltages capable of causing personal injury (high voltage up to 230 V_{AC}). Do not touch the display electronics during operation.

2.2 Cable length

A maximum cable length of 600 mm (24 in.) is recommended. Longer cables may cause data transfer problems between the data transmitted and the display input connector. Excessive cable lengths can pick up unwanted EMI. There are third party products, which allow this maximum cable length to be exceeded. Contact Beneq Application Engineering for more information.

2.3 Cleaning

As with any glass or coated surface, care should be taken to minimize scratching. Clean the display glass with mild, water-based detergents only. Apply the cleaner sparingly to a soft cloth, then wipe the display. Disposable cleaning cloths are recommended to minimize the risk of inadvertently scratching the display with particles embedded in a re-used cloth.

2.4 Avoiding burn-in

As with other light-emitting displays, displaying fixed patterns on the screen can cause burn-in where luminance variations can be noticed. Use a screensaver or image inversion to avoid causing burn-in on the display.

3 Specifications

The TFEL panel is a matrix structure with column and row electrodes arranged in an 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.

3.1 Power

This display requires both 12 V and 5 V in addition to video signals for proper operation. The display is designed to accept simultaneous application of V_L , V_H , and the input logic signals. If these signals are not simultaneous, they must meet the sequential timing shown in Figure 1 below.

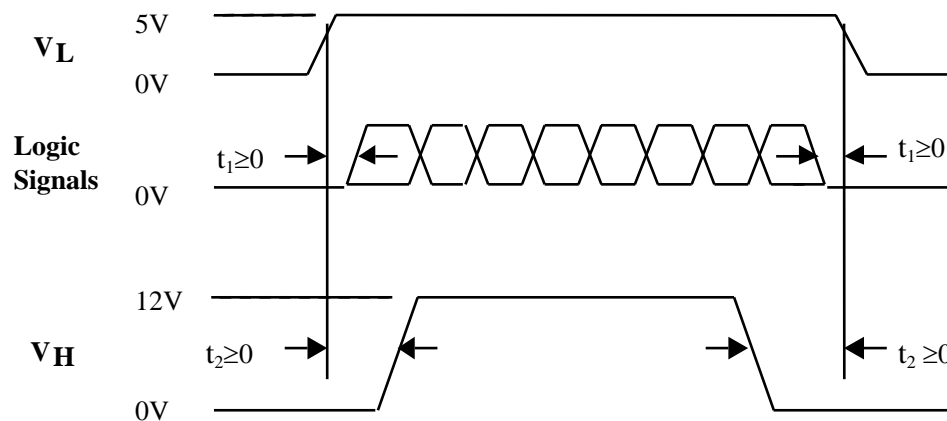


Figure 1. Data/power connector

The supply voltages are shown in Table 1. All internal high voltages are generated from the display supply voltage (V_H). The logic supply voltage (V_L) should be present whenever video input signals or V_H is applied. The minimum and maximum specifications in this manual should be met, without exception, to ensure the long-term reliability of the display.

Performance characteristics are guaranteed when measured at 25 °C with rated input voltage unless otherwise specified. Beneq does not recommend operation of the display outside these specifications.

Table 1. DC input voltage requirements

Parameter ¹	Symbol	Min	Typ.	Max	Absolute max
Logic supply voltage	V_L	4.75 V	5 V	5.25 V	6 V
Logic supply current at +5 V	I_L			0.1 A	
Display supply voltage	V_H	10 V	12 V	15 V	15 V
Supply current at +10 V	I_H		0.5 A	1.05 A	
Power consumption 5 V/12 V			6.5 W	10.5 W	

¹Operating conditions: ambient temperature 25°C, 120 Hz frame rate.

CAUTION: Absolute maximum ratings are those values beyond which damage to the device may occur.

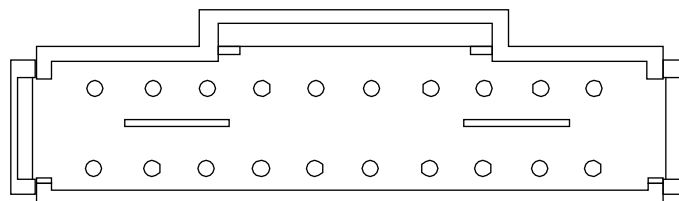
Table 2. Video input requirements

Description	Min	Max	Units	Notes
Absolute Input Voltage Range	-0.3	5.5	V	$V_L = 5.0$ V
Video logic high voltage	70%	100%	V_L	All input thresholds are CMOS
Video logic low voltage	0	20%	V_L	
Video logic input current	–	± 10	μA	
Input capacitance	–	15	pF	

There is a fuse on the V_H input to protect against catastrophic faults, and no overcurrent protection on the V_L input.

3.2 Connector

Video signals and DC power are connected to the display through a dual-row, 0.050-inch square-pin connector, AMP part number 104549-2. For flexible cable connection to the display, use AMP part number 111196-4.



AMP 104549-2

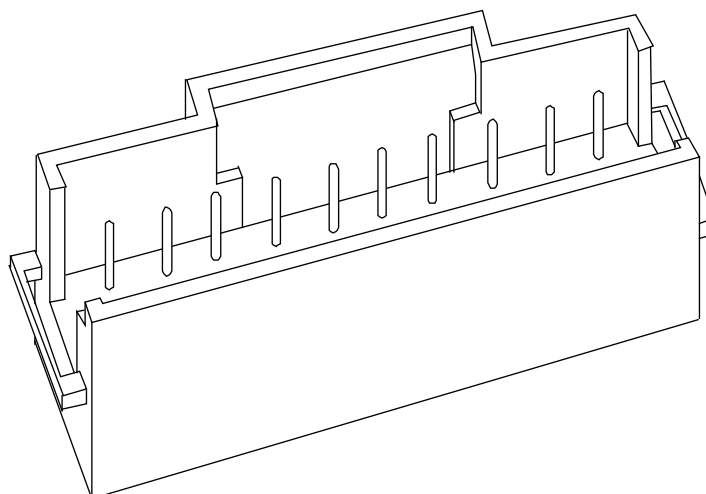


Table 3. Connector pinouts

Pin	Signal	Description	Pin	Signal	Description
1	V _H	+12 V Power	2	V _H	+12 V Power
3	NC	No Connect	4	GND	Ground
5	V _L	+5 V Power	6	GND	Ground
7	VS	Vertical Sync	8	GND	Ground
9	HS	Horizontal Sync	10	GND	Ground
11	VCLK	Video Clock	12	GND	Ground
13	VID ₀	Video Data	14	GND	Ground
15	VID ₁	Video Data	16	GND	Ground
17	VID ₂	Video Data	18	GND	Ground
19	VID ₃	Video Data	20	GND	Ground

3.3 Interface information

Beneq TFEL Small Graphics Displays (SGD) incorporates an interface that is similar to many LCD interfaces. This interface is supported by a variety of off-the shelf chip sets, which take care of all the display control functionality, freeing the system processor for other tasks. Designers select the chip set that best suits their particular architecture and price point. This 4-bit LCD-type video interface provides a low-cost, flexible method for controlling display brightness and power consumption.

3.3.1 Video input signals

The end of the top line of a frame is marked by VS, vertical sync, signal as shown Table 4. The end of each row of data is marked by HS.

The VS signal may be independently set to a CMOS low level at any time for longer than one frame period. During the time of VS inactivity, the display is blank. Halting VS results in a standby condition to minimize power usage.

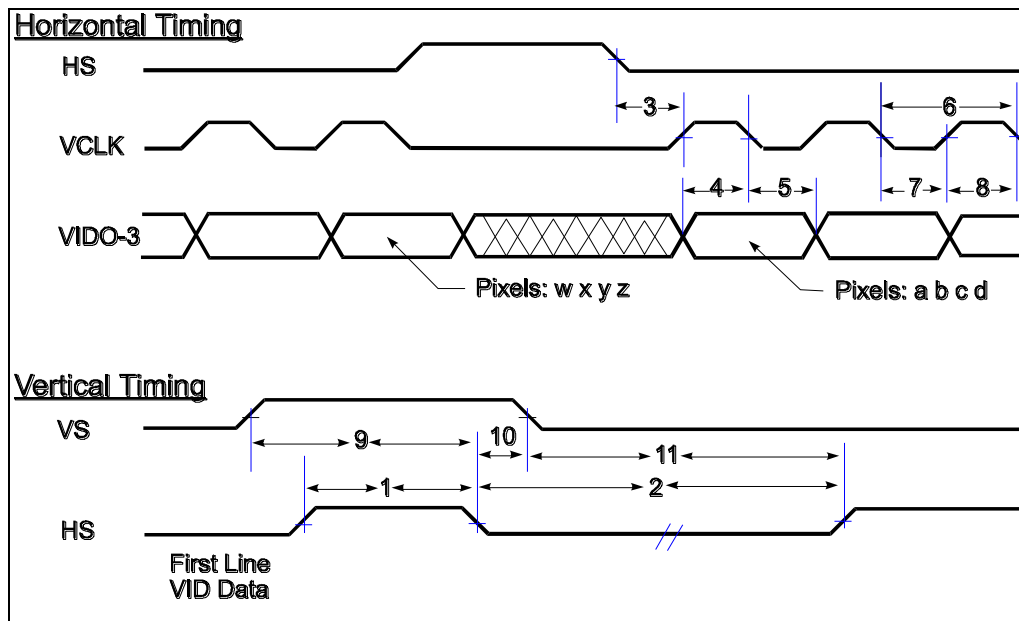


Figure 2. Video input timing diagram

Timing is compatible with LCD graphics controllers, such as the SMOS display controller.

Table 4. Video input descriptions

Num	Description	Symbol	Min.	Typ.	Max.	Units
1	HS high time	tHSh	100			ns
2	HS low time	tHSI	120			tVCLK
3	HS to VCLK	tHSsu	130			ns
4	VID setup to VCLK	tVIDsu	50			ns
5	VID hold from VCLK	tVIDhd	50			ns
6	Video clock period	tVCLK	140			ns
	VCLK rise, fall time	tVCLKrf		10	15	ns
7	VCLK low width	tVCLKl	15	70		ns
8	VCLK high width	tVCLKh	15	70		ns
9	VS high setup to HS low	tVShsu	140			ns
10	VS hold after HS	tVShd	140			ns
11	VS low setup to HS high	tVSlsu	140			ns
12	HS period	tHS	34			µs
	VS period	tVS	242			tHS
	Frame Rate	fVS	50		120	Hz

Input signals VID₀ through VID₃ contain the video data for the screen. Pixel information is supplied from left to right and from top to bottom, four pixels at a time. Video data for one row is latched on the fall of HS.

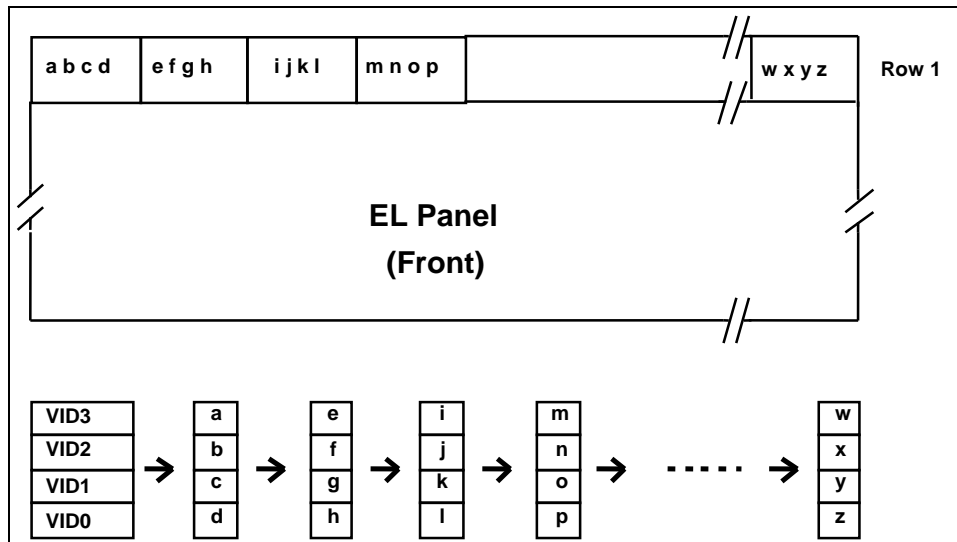


Figure 3. Pixel location versus sequence of data

3.4 Self-test mode

The display incorporates a self-test mode composed of five patterns displayed for approximately 30 seconds each, and then repeated. The patterns are as follows: Diagonal Lines, Diagonal Lines Inverted, Full On, 1 x 1 Checkerboard, and 1 x 1 Checkerboard Inverted. The self-test mode is entered by resetting or applying power to the display with the VCLK signal static. The display will remain in the self-test mode until two edges of VCLK are detected.

3.5 Optical

Table 5. Optical characteristics

Luminance		
L _{on} (areal), min	30 cd/m ²	Screen center, 120 Hz frame rate
L _{on} (areal), typ	50 cd/m ²	Screen center, 120 Hz frame rate
L _{off} (pixel), max	0.3 cd/m ²	5 points: center plus four corners measured 1.0 ±0.25" from adjacent display edges, 120 Hz
Non-uniformity		
All pixels fully lit	26%	Maximum difference two of five points, using the formula: LNU%=[1- (min_lum/max_lum)] x 100
Luminance variation (temperature)		
Maximum	±15%	Across the operating temperature range
Luminance variation (time)		
Maximum	<10%	15,000 hours at 25 °C ambient
Viewing angle		
Minimum	160°	
Contrast ratio		
Minimum	19:1	@ 500 lux ambient, 120 Hz frame rate
Typical	50:1	

3.6 Generating greyscales

Some applications may benefit from using greyscales. The PR3 has a maximum frame rate frequency of 120 Hz. Using the higher frame rate, combined with flat panel controllers designed for this faster display, it is possible to generate usable grays through frame rate control and dithering.

The fast response time of ICEBrite displays may cause loss of usable greyscales generated by the video controller. Many of the greyscales may flicker or swim. Careful testing is necessary to select appropriate greyscales for an application, especially when the electroluminescent displays are driven at less than their maximum frame rate. For additional information, contact Beneq's Application Engineers.

3.7 Environmental

Table 6. Environmental characteristics

	Operating	Non-operating
Temperature	-25°C to +65 °C	-40 °C to +75 °C
Survival	-25 °C to +75 °C	
Humidity		
Non-condensing	to 93% RH max @ 40°C, per IEC 68-2-3	
Condensing		to 95% RH max @ 55 °C, per IEC 68-2-30
Altitude		
Tested per IEC 68-2-13	-1,000 to 16,000 ft (-3,048 to 48,768 m)	-1,000 to 58,000 ft (-3,048 to 176,784 m)
Vibration		
Random Operating/non-operating	0.02 g ² /Hz, 20-500 Hz, 30 minutes on each axis, per IEC 68-2-36, test Fdb.	
Shock		
Operating/non-operating	100 g, 6 ms, half sine wave per IEC 68-2-27, test Ea.	

3.8 Reliability

The display MTBF is demonstrated to be greater than 100,000 hours at 25 °C with a 90% confidence level.

3.9 Safety and EMI performance

The display will not inhibit the end product from obtaining these safety certifications: IEC 601-1, UL544 or CSA 22.2 #601-M89.

The display will not inhibit the end product from complying with FCC Docket, Part 15, Subpart J, Class B; CISPR 11, Class B; and VDE 871/VFG 243, Class B when housed in a suitable enclosure.

3.10 Mechanical characteristics

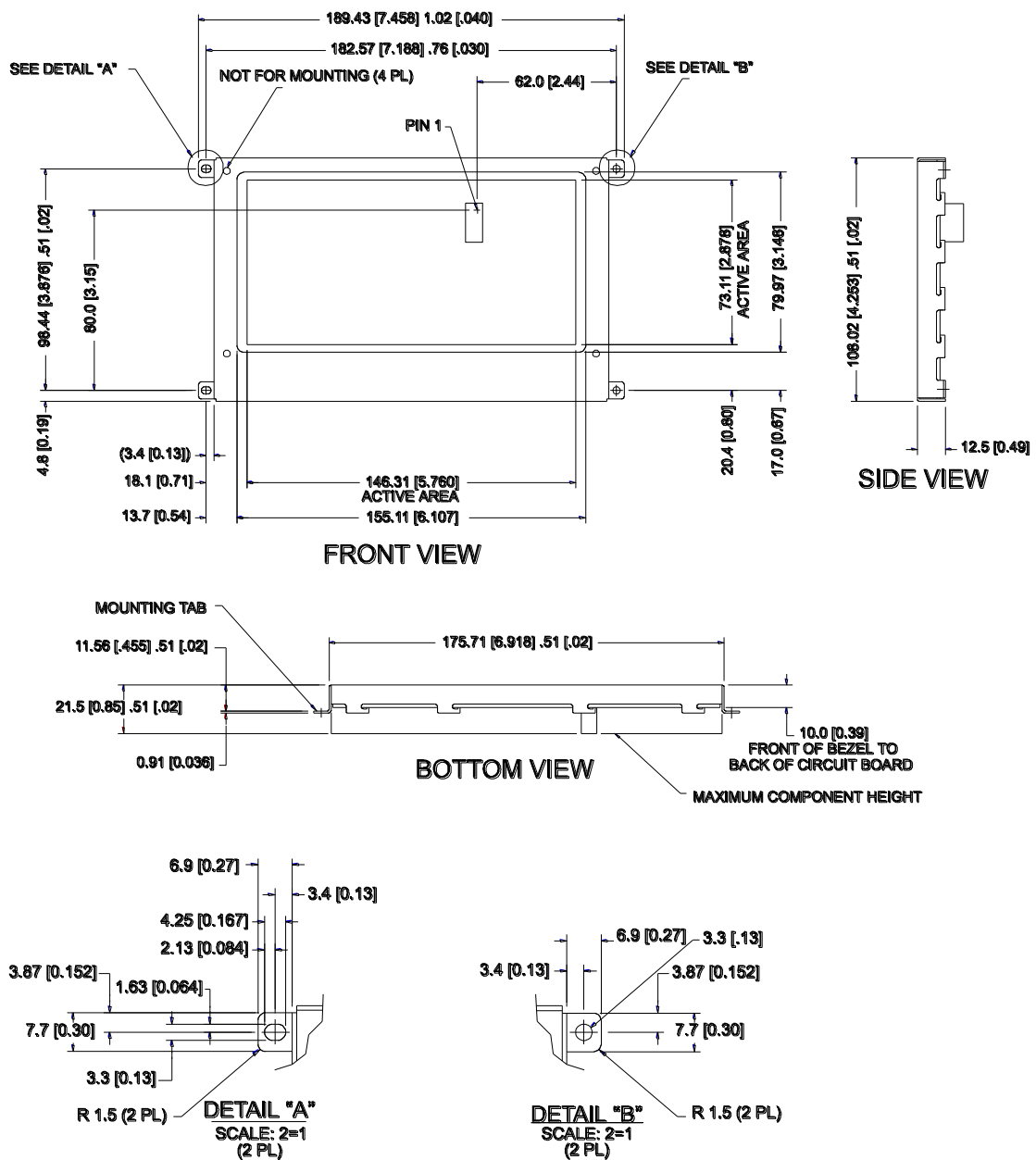
Table 7. Mechanical characteristics

Display external dimensions		
millimeters (inches)	width	189.4 (6.91) nominal
	height	108.0 (4.14) nominal
	depth	21.5 (0.85) nominal
Weight (typical)		310 g (10.9 oz), nominal
Fill factor		50.2%
Display active area		
millimeters (inches)	width	146.31 (5.76) nominal
	height	73.11 (2.88) nominal
Pixel size		
	width	0.22 (0.0085) nominal
	height	0.22 (0.0085) nominal
Pixel pitch		
	horizontal	31 (0.012) nominal
	vertical	31 (0.012) nominal

3.11 Component envelope

The component envelope shown in Figure 4 illustrates the distance the components extend behind the display. Tall components do not necessarily fill this area. Beneq reserves the right to relocate components within the constraints of the component envelope without prior customer notification. For this reason, Beneq advises users to design enclosure components to be outside the component envelope.

An air gap of at least 5 mm is recommended to dissipate heat from display components. Device designers will need to consider their specific system requirements to determine the necessary spacing.



Dimensions are in millimeters; inches in brackets.
Some hidden lines omitted for clarity.

Tolerances unless specified:

.x +/10.50 [0.02]

.xx +/0.25 [0.01]

Figure 4. Display dimensions

4 Description of warranty

Seller warrants that the Goods will conform to published specifications and be free from defects in material during warranty time 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.

5 Ordering information

Product	Part number	Description
EL480.240-PR3	996-0247-07LF	EL480.240 flat panel display assembly with integrated power supply and 4-bit FPD interface.

Design and specifications are subject to change without notice.

Beneq continues to provide optional, and in many cases custom, features to address the specific customer requirements. Consult Beneq Sales for pricing, lead time and minimum quantity requirements.

6 Support and service

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

RMA Procedure: For a Returned Material Authorization number, please contact Beneq Products Oy by email (rma.lumineq@beneq.com) with the model number(s), serial number(s) and brief description of the problem. When returning goods for repair, please include a brief description of the problem, and mark the outside of the shipping container with the RMA number.

7 RoHS II

Beneq Products OY is committed to continuous improvement. As part of this process we are fully in support of EU directive 2011/65/EU, the Restriction of Hazardous Substances, commonly known as RoHS II or RoHS Recast, which, compared to RoHS, keeps the restrictions on the original six hazardous substances, including lead (Pb) in electronic equipment. It also expands these restrictions to previously exempted categories including medical devices and monitoring and control instruments.

Beneq part number with an "LF" suffix designation indicates RoHS compliance, as shown on the part number label affixed to the display and on the box containing the display.

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