ELT160.80.50-SPI

Operation Manual

Beneq Oy
Olarinluoma 9
FI-02200 Espoo
Finland

Tel. +358 9 7599 530
Fax +358 9 7599 5310
lumineq@beneq.com

VAT ID FI19563372
www.beneq.com
www.lumineq.com

Table of contents:

1 ELT160.80.50-SPI display

The ELT160.80.50-SPI from Lumineq® Displays is a transparent thin film electroluminescent TASEL® display for demonstration purposes to showcase TASEL technology. The display consists of a transparent glass panel and control electronics that are connected to the glass panel with a flexible flat cable. The ELT160.80.50-SPI SPI is easily interfaced using the Serial Peripheral Interface (SPI) bus. Each of the 12,800 pixels is individually addressable to clearly display high information content graphics and text. The display is equivalent to a 10 x 26 character display in text mode (assuming 5 x 7 characters).

1.1 Features and benefits

- Wide viewing angle ~360^0, fully transparent
- Rapid display response < 1 ms
- SPI interface
- Dimming capability

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.

2.1 Mounting

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

Avoid bending the display. Stresses are often introduced when a display is mounted into a product; improper mounting could cause the glass to break. The instrument enclosure or frame should not flex or distort in such a way that during use the bending loads might be transferred to the display.

Avoid causing stress to the display flex cable connection. Extensive stress to the cable connection could damage the cable connection.

Avoid bending sharp edges to the display flex cable as this could break the flex cable internally.

CAUTION: Properly mounted TASEL display can withstand high shock loads and 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.

WARNING: These products generate voltages capable of causing personal injury (high voltage up to 235 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.

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, and 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. Particular care should be taken when cleaning displays with anti-glare and anti-reflective films.

2.4 Avoiding burn-in

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

3 Specifications

Performance characteristics are guaranteed when measured at 25 °C with rated input voltage unless otherwise specified.

3.1 Control basics

The TASEL 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.

3.2 Power

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. Beneq does not recommend operation of the display outside these specifications.

Table 1. DC input voltage requirements

Parameter	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			40 mA	
Display supply voltage	V_H	10 V	12 V	15 V	15 V
Supply current at +12 V	I_H		0.4 A	0.5 A	
Power consumption 5 V/12 V					
@ 60 Hz Frame Rate			1.6 W	2.2 W	
@ 120 Hz Frame Rate			2.3 W	3.2 W	
@ 240 Hz Frame Rate			4.1 W	5.4 W	

CAUTION: Damage to the device may occur if operated beyond the Absolute Maximum Ratings.

Table 2. SPI input requirements

Description	Symbol	Min	Max	Units
SPI logic high voltage	VI_H	2	5.5	V
SPI logic low voltage	VI_L	0	0.8	V
SPI logic input current	II_L	-10	+10	µA

There is no overcurrent protection on either the V_H or V_L inputs to protect against catastrophic faults. Beneq recommends the use of a series fuse on the 12 volt supply (V_H). A general guideline is to rate the fuse at 1.8 to 2 times the display maximum current rating.

3.3 Connectors

3.3.1 Standard data and power connector

The 160.80.50-SPI display uses the Samtec EHT-110-01-T-D or equivalent connector. The suitable mating connector can be found from the Samtec TCSD family of cable strips. For proper mating connector/cable options consult your Samtec representative. Compatibility with non-Samtec equivalents should be verified before use.

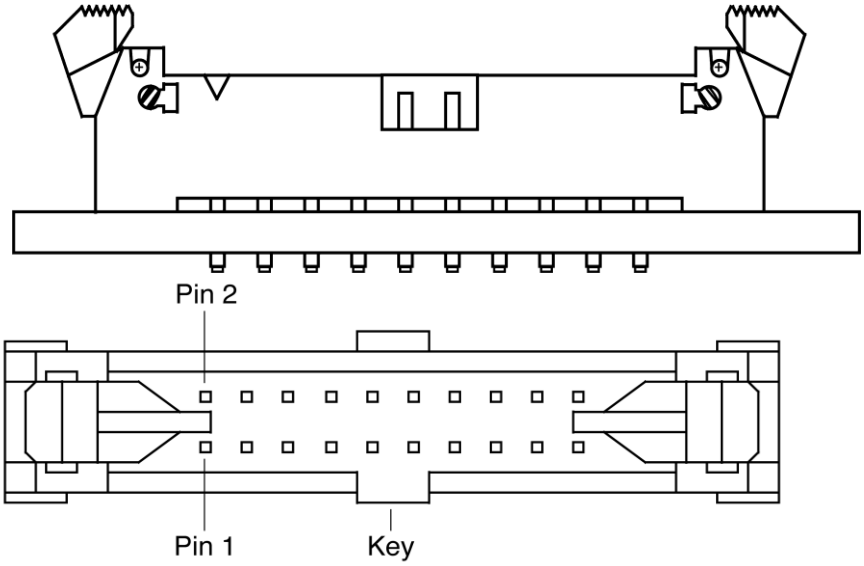


Figure 1. Data/power connector

Table 3. J1 Connector Pin outs

Pin	Signal	Description	Pin	Signal	Description
1	V_H	+12 V Power	2	V_H	+12 V Power
3	Self-test	Self-test Input [1]	4	GND	Ground
5	V_L	+5 VDC Power	6	GND	Ground
7	SS	Slave Select	8	GND	Ground
9	Reserved	Do not connect	10	GND	Ground
11	SCLK	Clock from master	12	GND	Ground
13	MOSI	Master Out Slave In	14	GND	Ground
15	Reserved	Do not connect	16	GND	Ground
17	Reserved	Do not connect	18	GND	Ground
19	Reserved	Do not connect	20	GND	Ground

[1] Connect pin 3 to ground for normal display operation.

3.3.2 Dimming connector J2

The dimming connector is a Leoco part number 2011P02V000, which is a 2-pin, 2 mm, header. The recommended mate is a Leoco part number 2010S020000 (housing) with Leoco part number 2O33TPB0000 (contact).

For more information on the dimming feature, refer to the Dimming section 3.8.

3.4 Interface information

Beneq ELT160.80.50-SPI TASEL Display incorporates a SPI interface that is similar to many LCD modules. This SPI video interface provides a low-cost, flexible method for controlling display brightness and power consumption. Designers should select the chip set or embedded board that best suits their particular architecture.

3.4.1 Video input signals

The SPI is driven with the rising edge of SCLK. A falling edge on SS signal indicates the beginning of an access on the SPI, the rising edge of SS signal ends an access on SPI. An access must consist of exactly 8 bits for write operation.

The SPI interface Clock polarity (CPOL) and clock phase (CPHA) are 0. At CPOL=0 the base value of the clock is zero for CPHA=0 and data are captured on the clock's rising edge (low to high transition) and data is propagated on a falling edge (high to low clock transition).

The timing restrictions on SPI are defined in figure 2 and table 4.

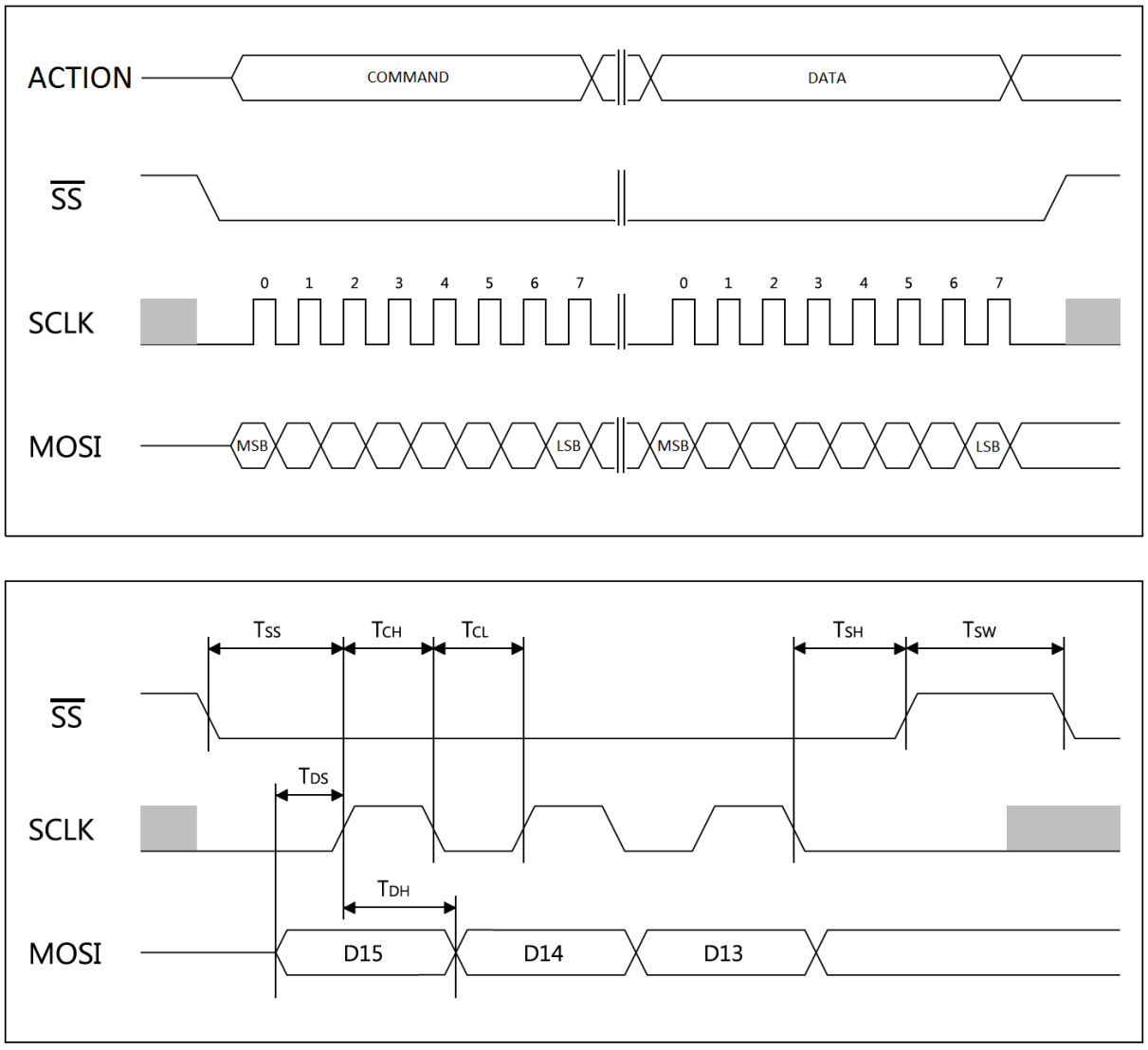


Figure 2. Video input timing diagram

Table 4. Timing restrictions

Description	Symbol	Minimum value (ns)
SCLK high time	T_{CH}	100
SCLK low time	T_{CL}	100
SS -> SCLK setup time	T_{SS}	100
SCLK -> SS hold time	T_{SH}	100
SS disabled between cycles	T_{SW}	100
Data setup time	T_{DS}	100
Data hold time	T_{DH}	100

3.4.2 Initial Power-up

On initial power-up, the display registers are reset to their default values and all pixels are blanked. At this time all registers must be programmed for normal operations.

3.5 SPI protocol

3.5.1 Commands

Command	**Hex #**	**Binary**							
Write complete display data	01h	0	0	0	0	0	0	0	1
Write display block (multiple rows)	02h	0	0	0	0	0	0	1	0
Write one row	03h	0	0	0	0	0	0	1	1
Clear screen (full black)	11h	0	0	0	1	0	0	0	1
All pixels ON (full yellow)	12h	0	0	0	1	0	0	1	0
Invert display image	13h	0	0	0	1	0	0	1	1
Write frame frequency, 100% (1)	81h	1	0	0	0	0	0	0	1
Write frame frequency, 75%	82h	1	0	0	0	0	0	1	0
Write frame frequency, 50%	83h	1	0	0	0	0	0	1	1
Write frame frequency, 25%	84h	1	0	0	0	0	1	0	0

Note: 1. Default luminance

3.5.2 Write complete display data

Command	**Data1 (1)**	**---**	**Data N (2)**
01_h	8 bits	8 bits	8 bits

Notes: (1) First bits of first row
(2) Last bits of last row. N=(Number of rows/8) * Number of columns
(3) Pixels are going from left to right from top to bottom. A first pixel in a byte is the most significant one. See Figure 3. for reference.

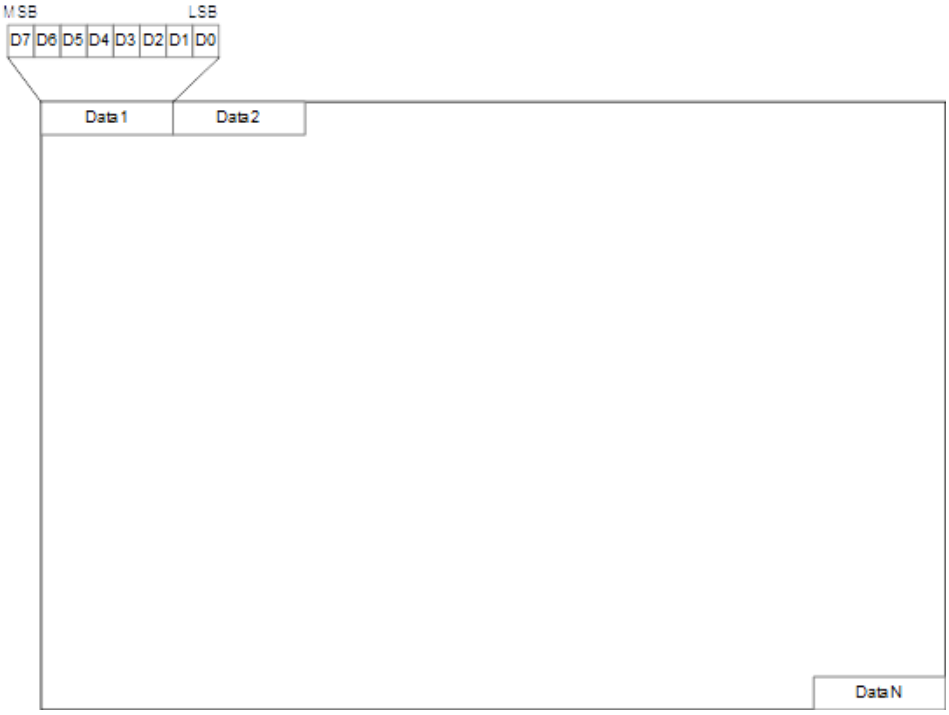


Figure 3. Display pixel locations on image data mapping.

3.5.3 Write display block (multiple rows)

Command	First row number	Last row number	First bits of first row	----	Last bits of last row
02_h	8 bits	8 bits	8 bits	8 bits	8 bits

3.5.4 Write one row

Command	Row number	First bits of row	----	Last bits of row
03_h	8 bits	8 bits	8 bits	8 bits

3.5.5 Clear screen (full black)

Command
11_h

3.5.6 All pixels ON (full yellow)

Command
12_h

3.5.7 Invert display image

Invert command only inverts visible display picture and does not manipulate picture data on display frame memory. Consecutive invert commands toggle displayed image between inverted and non-inverted mode.

Command
13_h

3.5.8 Write frame frequency

Command	Relative Luminance
81h	100 %
82h	75 %
83h	50 %
84h	30 %

3.6 Self-test mode

The display incorporates a self-test mode composed of a loop of three patterns: Full On, checkerboard and inverted checkerboard. The self-test mode is entered by leaving pin 3 unconnected or pulled high.

NOTE: Pin 3 must be connected to Ground for normal display operation.

3.7 Optical

Table 4. Optical characteristics

Luminance		
L_{on} (areal), typ	22 cd/m²	screen center, 60 Hz frame rate
L_{on} (areal), typ	89 cd/m²	screen center, 240 Hz frame rate
L_{off} (areal), max	0.3 cd/m²	3 points: center plus two ends measured 0.75 ± 0.25" from adjacent display edges, @ 240 Hz
Non-uniformity		
All pixels fully lit	35%	Maximum difference two of five points, using the formula: LNU%=[1- (min_lum/max_lum)] x 100%
Luminance variation (Temperature)		
Maximum	±20%	Across operating temperature range
Luminance variation (Time)		
Maximum	<20%	10,000 hours at 25 °C ambient
Viewing angle		
Both sides	179°	

3.8 Dimming

There are two standard methods for dimming the EL160.80.50-SPI display.

Analog dimming control circuitry allows manual analog dimming of the brightness from 100% to approximately 5% of the full brightness. The display luminance can be adjusted by connecting a 100 kΩ logarithmic external potentiometer to the dimming port. Alternatively, an external voltage or current mode D/A converter may be used to facilitate dimming by sinking a maximum of 250 µA (for maximum dimming) from pin 1 to pin 2 of the dimming connector.

The display can be also dimmed by changing the display frame rate controller register value. Please see chapter 3.5 "SPI protocol" for more information.

3.9 Environmental

Table 5. Environmental characteristics

	Operating	**Non-operating**
Temperature		
Standard	Room temperature	Not specified
Humidity		
Non-condensing	Not specified	
Condensing		Not specified
Altitude		
Operating/non-operating	Not specified	
Vibration		
Random	Not specified	
Operating/non-operating	Not specified	
Shock		
Operating/non-operating	Not specified	

No environmental tests have been performed, since this display is designed for demonstration purposes only.

3.10 Reliability

The display MTBF is not specified.

3.11 Mechanical characteristics

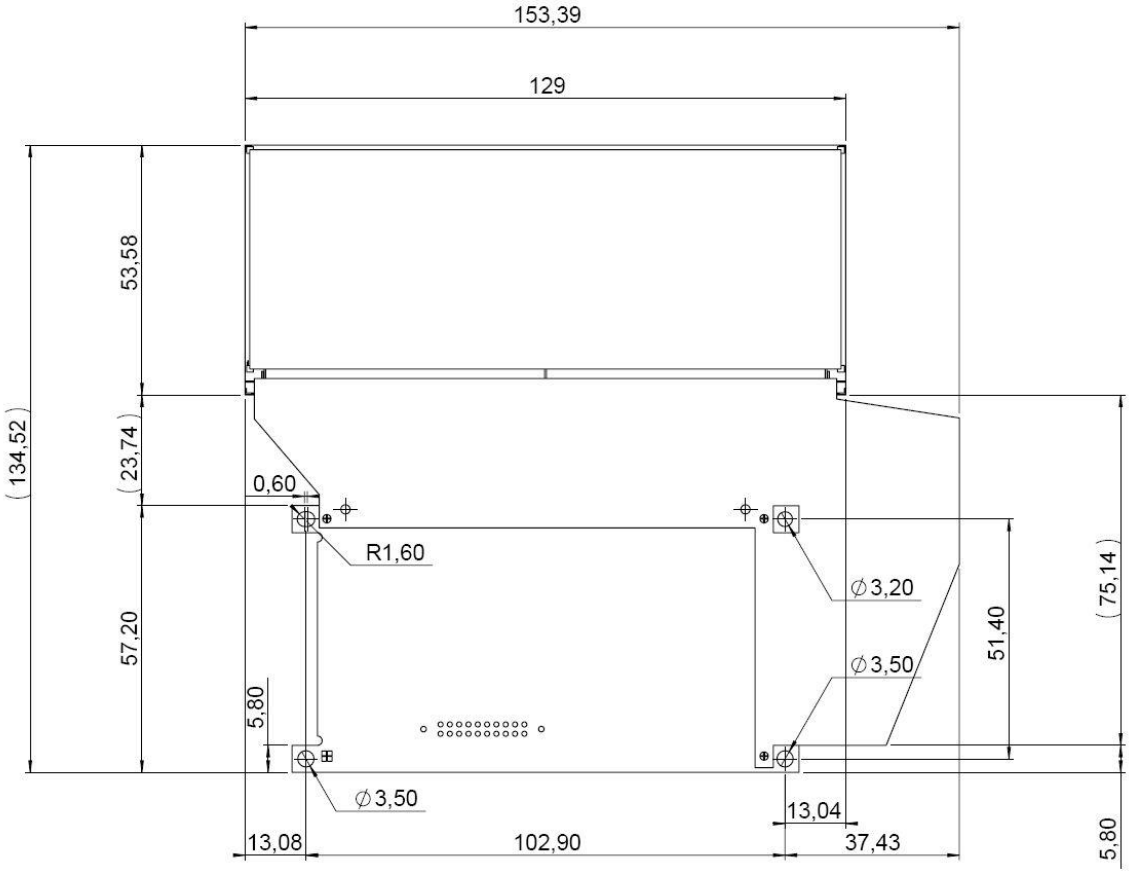
Table 6. Mechanical characteristics

Display external dimensions		
millimeters	width	153.4
	height	134.5
	depth	12.8
Weight (typical)		71 g
Fill factor		64.0% nominal
Display active area		
millimeters (inches)	width	79.9 (3.15)
	height	39.9 (1.57)
Pixel size		
	width	0.50 (.0197)
	height	0.50 (.0197)

3.12 Component envelope

Display dimensions are shown in Figure 4. The component envelope is 13 mm high area back of the display component board. 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.

Device designers will need to consider their specific system requirements to determine the spacing necessary to maintain the specified ambient temperature. Air flow and surrounding component materials will affect the depth of the air gap.



Dimensions are in millimeters.
Tolerances unless specified

x.	±1
.x	±0.50
.xx	±0.25

Figure 2. 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
ELT160.80.50-SPI	EL00047800	Transparent TASEL display with SPI 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.