RUGGED DISPLAYS

The world’s most reliable displays for extreme conditions

Display information that matters

WWW.LUMINEQ.COM
ABOUT LUMINEQ®

LUMINEQ Rugged Displays are renowned for their robustness, ultra-reliability, and long product lifetime. They maintain an excellent performance even in the extreme conditions such as −60 °C cold or +105 °C hot weather, shock and vibration, high humidity, and high altitude. LUMINEQ rugged displays have been serving in critical applications since 1983, on land, at sea and in the air.

LUMINEQ displays are designed and manufactured by Beneq, an international technology company headquartered in Finland and a leading supplier of Atomic Layer Deposition (ALD) in the world.
MARKETS AND APPLICATIONS

LUMINEQ rugged displays are used in a wide array of demanding applications, such as radio, power supplies, instruments, and control platforms in extreme conditions. Since 1983, LUMINEQ displays have been serving in defense, industrial, marine, transportation, aviation, medical, oil & gas, and other outdoor instrumentation markets.
**BENEFITS AND FEATURES**

The *solid-state* design enables LUMINEQ Rugged Displays to tolerate extreme conditions such as cold, heat, pressure, shock, vibration, and humidity better than any other displays.

- **>179° viewing Angle**
  - Wide viewing angle across the entire operating temperature range

- **Solid-state**
  - Proven track record of reliable operation in the harshest environments

- **Contrast**
  - Delivers readability under sunlight and remains high contrast across the entire operating temperature range

- **Humidity tolerant**
  - Tolerate high humidity – ideal for demanding marine applications

- **Solar load**
  - Unaffected by solar loading - glass performs at +105 °C (+221 °F)

- **Altitude**
  - Solid glass is virtually immune to absolute pressure and low air pressure (tested operation at 18 km)

- **Long production lifetime**
  - Long-term availability to avoid redesigns caused by component obsolescence

- **Wide temperature range**
  - Operates reliably at extreme temperatures from -60 °C to 105 °C (-76 °F to 221 °F) with no need for heating or cooling

- **Shock and vibration tolerant**
  - 200G force shock durability for the glass and 100 g for the complete unit

- **Instant on**
  - <1 ms response time regardless of temperature

- **Long lifetime**
  - MTBF of over 250 000 hours. 85% of original brightness remains after 100 000 hours of usage regardless of environments
Compared to AMLCD and OLED displays, LUMINEQ solid-state displays are naturally much more rugged and reliable especially in harsh environments and extreme conditions.

Below is a comparison of these three industrial displays in terms of their lifetime and performance in various environments, such as operating temperatures, low and high altitude, high humidity, shock and vibration, and solar load.

<table>
<thead>
<tr>
<th></th>
<th>LUMINEQ Displays</th>
<th>AMLCD (TFT)</th>
<th>OLED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating at 105 °C (221 °F)</td>
<td>Operating survival</td>
<td>Not available</td>
<td>Not available</td>
</tr>
<tr>
<td>Operating at 85 °C (185 °F)</td>
<td>Operating with long lifetime. Not affected by solar loading.</td>
<td>Liquid crystal material may get damaged permanently. Sensitive to solar load.</td>
<td>Extremely short lifetime.</td>
</tr>
<tr>
<td>Operating at -50 °C (-58 °F)</td>
<td>Operating, instant “ON”.</td>
<td>Slow start-up. Heater is needed.</td>
<td>Not available</td>
</tr>
<tr>
<td>Operating at -60 °C (-76 °F)</td>
<td>Operating, instant “ON”.</td>
<td>Fast available.</td>
<td>Not available</td>
</tr>
</tbody>
</table>

**Shock & vibration**
- LUMINEQ: Inorganic solid-state structure, designed for rugged applications.
- AMLCD: Components may be damaged.
- OLED: Components may be damaged.

**High altitude**
- LUMINEQ: Solid glass is virtually immune to low air pressure.
- AMLCD: Components may be damaged.
- OLED: Components may be damaged.

**Low altitude**
- LUMINEQ: Solid glass is virtually immune to high altitude.
- AMLCD: Components may be damaged.
- OLED: Components may be damaged.

**Solar load**
- LUMINEQ: Unaffected by solar loading. Glass performs at +105 °C (221 °F).
- AMLCD: Components may be damaged.
- OLED: Components may be damaged.

**High humidity**
- LUMINEQ: The display glass is immune to humidity.
- AMLCD: Components may be damaged.
- OLED: Components may be damaged.

**Production lifetime**
- LUMINEQ: Typically over 20 years.
- AMLCD: Up to 15 years.
- OLED: Typically a few years.

**Product lifetime**
- LUMINEQ: Typically over 20 years. Low lifetime cost.
- AMLCD: Up to 10 years. Short lifetime, especially at high operating temperature.
- OLED: Low lifetime, especially at high operating temperature.

**Technology**

LUMINEQ Thin Film Electroluminescent (TFEL) displays comprise a solid-state glass panel, an electronic control circuit and a power supply. The TFEL glass panel, the heart of the assembly, consists of a luminescent phosphorous layer sandwiched between transparent dielectric layers and non-transparent row electrodes.

The circuit board, which contains the drive and control electronics, is connected directly to the back of the glass panel. A pixel on the display is lit by applying voltage to the row and column electrodes, thus causing the area of intersection to emit light.

The result of this compact and solid-state design is a flat, reliable and inherently rugged display with exceptionally fast response time of less than 1 ms, regardless of temperature.
### Products

<table>
<thead>
<tr>
<th>Model</th>
<th>EL640.480-AF</th>
<th>EL640.480-AG</th>
<th>EL640.480-AM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matrix size</td>
<td>640 × 480</td>
<td>640 × 480</td>
<td>640 × 480</td>
</tr>
<tr>
<td>Display size (in)</td>
<td>6.4</td>
<td>8.1</td>
<td>10.4</td>
</tr>
<tr>
<td>Pixel pitch (mm)</td>
<td>0.202</td>
<td>0.258</td>
<td>0.33</td>
</tr>
<tr>
<td>Brightness (cd/m²)</td>
<td>60 to 65</td>
<td>55 to 60</td>
<td>49 to 55</td>
</tr>
<tr>
<td>Power (max. brightness)</td>
<td>4.5 to 4.7 W</td>
<td>6.5 to 6.7 W</td>
<td>11 W</td>
</tr>
<tr>
<td>Supply voltages</td>
<td>12 VDC</td>
<td>12, 8-18 VDC</td>
<td>12, 12 or 24 VDC</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>-60 °C to 105 °C</td>
<td>-60 °C to 105 °C</td>
<td>-60 °C to 105 °C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-60 °C to 110 °C</td>
<td>-60 °C to 110 °C</td>
<td>-60 °C to 110 °C</td>
</tr>
<tr>
<td>Interface</td>
<td>8-bit, Dual-panel, LVDS</td>
<td>8-bit, Dual-panel, LVDS</td>
<td>8-bit, Dual-panel, LVDS</td>
</tr>
<tr>
<td>Vibration</td>
<td>5 to 500 Hz, 0.05 g²/Hz random</td>
<td>5 to 500 Hz, 0.05 g²/Hz random</td>
<td>5 to 500 Hz, 0.05 g²/Hz random</td>
</tr>
<tr>
<td>Altitude</td>
<td>18km (59ft)</td>
<td>18km (59ft)</td>
<td>18km (59ft)</td>
</tr>
<tr>
<td>Other feature</td>
<td>Gray scale support (LVDS Model), Locking connector, Dimming</td>
<td>Gray scale support (LVDS Model), Locking connector, Dimming</td>
<td>Gray scale support (LVDS Model), Locking connector, Dimming</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>EL320.240-FA3</th>
<th>EL320.240.36-ET</th>
<th>EL320.240.36-HB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matrix size</td>
<td>320 × 240</td>
<td>320 × 240</td>
<td>320 × 240</td>
</tr>
<tr>
<td>Display size (in)</td>
<td>4.9</td>
<td>5.7</td>
<td>5.7</td>
</tr>
<tr>
<td>Pixel pitch (mm)</td>
<td>0.31</td>
<td>0.36</td>
<td>0.36</td>
</tr>
<tr>
<td>Brightness (cd/m²)</td>
<td>95</td>
<td>50</td>
<td>150</td>
</tr>
<tr>
<td>Power (max. brightness)</td>
<td>4.7 W</td>
<td>70 W</td>
<td>5.5 W</td>
</tr>
<tr>
<td>Supply voltages</td>
<td>5, 8-18 VDC</td>
<td>5, 8-18 VDC</td>
<td>5, 8-18 VDC</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>-50 °C to 85 °C</td>
<td>-40 °C to 65 °C</td>
<td>-50 °C to 95 °C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-50 °C to 105 °C</td>
<td>-40 °C to 85 °C</td>
<td>-50 °C to 105 °C</td>
</tr>
<tr>
<td>Interface</td>
<td>Parallel and 4-bit</td>
<td>4-bit</td>
<td>4-bit, SPI</td>
</tr>
<tr>
<td>Vibration</td>
<td>5 to 500 Hz, 0.02 g²/Hz random</td>
<td>5 to 500 Hz, 0.02 g²/Hz random</td>
<td>5 to 500 Hz, 0.02 g²/Hz random</td>
</tr>
<tr>
<td>Altitude</td>
<td>18km (59ft)</td>
<td>18km (59ft)</td>
<td>18km (59ft)</td>
</tr>
<tr>
<td>Other feature</td>
<td>Multi-color (16 colors), Locking connector, Dimming</td>
<td>Locking connector, Dimming</td>
<td>Sunlight readable, Locking connector, Dimming, Broad input voltage range</td>
</tr>
</tbody>
</table>

### Available Options
- Conformal coating
- Anti-reflective coating
- Anti-glare film
- Tempered glass
- ITO glass: Conductive coated glass: 4 to 10 Ω/sq
- NVIS filter

### Specifications for all displays
- Shock, IEC68006-2-27, 100G-force, 4 ms
- MTBF > 50,000 hours
- Relative Humidity, Operating 93% RH at 40 °C, IEC 60068-2-78
- Damp heat, Non-operating, 95% RH max. from 25 °C to 55 °C, IEC60068-2-30
LUMINEQ PRODUCT LINES

To display information that matters where it matters, LUMINEQ offers reliable solutions for any conditions with three product lines: Rugged Displays, Transparent Displays, and In-Glass Displays.

COLORS OF RELIABILITY®

Since 1983, the yellow and black color of LUMINEQ rugged displays are known as the COLORS OF RELIABILITY®. They are military-grade displays that never fail to display what matters even in the toughest environments such as -60 °C whether with severe shock and humidity. LUMINEQ rugged displays for reliable performance and premium quality.

WWW.LUMINEQ.COM