Product Specifications

15.0” XGA Color TFT-LCD Module
Model Name: L150X1M-HB

Preliminary Specifications
1.0 General Description

This specification applies to the 15.0 inch Color TFT-LCD Module L150X1M-HB.
The display supports the XGA (1024(H) x 768(V)) screen format and 16.7M colors (RGB 8-bits data).
All input signals are 2 Channel TTL interface compatible.
This module does not contain an inverter card for backlight.

2.1 Display Characteristics

The following items are characteristics summary on the table under 25 °C condition:

<table>
<thead>
<tr>
<th>ITEMS</th>
<th>Unit</th>
<th>SPECIFICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screen diagonal</td>
<td>[mm]</td>
<td>381 (15&quot;)</td>
</tr>
<tr>
<td>Outline dimension</td>
<td>[mm]</td>
<td>352.5 x 263.5 x 16.5 (typ.)</td>
</tr>
<tr>
<td>Display Area</td>
<td>[mm]</td>
<td>304.128 (H) x 228.096(V)</td>
</tr>
<tr>
<td>Resolution</td>
<td>[mm]</td>
<td>1024(R,G,B x 3) x 768</td>
</tr>
<tr>
<td>Pixel Pitch</td>
<td>[mm]</td>
<td>0.297 x 0.297</td>
</tr>
<tr>
<td>Pixel Arrangement</td>
<td></td>
<td>R.G.B. Vertical Stripe</td>
</tr>
<tr>
<td>Display Mode</td>
<td></td>
<td>TN mode, Normally White</td>
</tr>
<tr>
<td>Average brightness</td>
<td>[cd/ m²]</td>
<td>450 (typ.) (note 1)</td>
</tr>
<tr>
<td>Brightness uniformity</td>
<td></td>
<td>80% (typ.) (note 2)</td>
</tr>
<tr>
<td>Luminance uniformity (TCO99)</td>
<td></td>
<td>1.7 (max.) (note 3)</td>
</tr>
<tr>
<td>Crosstalk</td>
<td></td>
<td>1.2% (max.) (note 4)</td>
</tr>
<tr>
<td>Contrast Ratio</td>
<td></td>
<td>400 : 1 (typ.)</td>
</tr>
<tr>
<td>Support color</td>
<td></td>
<td>Native 16.7 million(8-bit for R,G,B)</td>
</tr>
<tr>
<td>Color Gamut</td>
<td></td>
<td>62% (typ.)</td>
</tr>
<tr>
<td>Viewing angle CR=10</td>
<td></td>
<td>60(left),60(right),40(up),60(down)</td>
</tr>
<tr>
<td>Viewing angle CR=5</td>
<td></td>
<td>80(left),80(right),50(up),70(down)</td>
</tr>
<tr>
<td>Response Time</td>
<td>[msec]</td>
<td>35 (typ.)(Tr +Tf)</td>
</tr>
<tr>
<td>Nominal Input Voltage VDD</td>
<td>[Volt]</td>
<td>+3.3 V</td>
</tr>
<tr>
<td>Power Consumption (VDD line + CCFL line)</td>
<td>[Watt]</td>
<td>16 (typ.)</td>
</tr>
<tr>
<td>Electrical Interface</td>
<td></td>
<td>TTL 2 port (HSYNC,VSYNC,DCLK,DE,DATA)</td>
</tr>
<tr>
<td>Frame rate</td>
<td>[Hz]</td>
<td>60 (typ), 75 (max.)</td>
</tr>
<tr>
<td>Weight</td>
<td>[Grams]</td>
<td>1400 (typ.)</td>
</tr>
<tr>
<td>Temperature Range</td>
<td></td>
<td>Operating: 0 to +50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Storage (Shipping): -20 to +60</td>
</tr>
</tbody>
</table>
Note 1: Average brightness is the average of brightness value at location 1 to 5 with all pixels displaying white.

Note 2: Brightness uniformity of these 9 points is defined as below:
\[(\text{Min. brightness} / \text{Max. brightness}) \times 100\%\]

Note 3: TCO ’99 Certification Requirements and test methods for environmental labeling of Display Report No. 2 defines Luminance uniformity as below:
\[((\text{Lmax,+30deg.} / \text{Lmin,+30deg.}) + (\text{Lmax,-30deg.} / \text{Lmin,-30deg.})) / 2\]
Note 4:

Unit: percentage of dimension of display area

\[ \frac{L_A - L_A'}{L_A} \times 100\% \leq 1.2\% \text{ max.}, \quad L_A \text{ and } L_B \text{ are brightness at location A and B} \]

\[ \frac{L_B - L_B'}{L_B} \times 100\% \leq 1.2\% \text{ max.}, \quad L_A' \text{ and } L_B' \text{ are brightness at location A' and B'} \]
2.2 Functional Block Diagram
The following diagram shows the functional block of 15.0 inches Color TFT-LCD Module:

- **TFT ARRAY/CELL**
  - 1024(R/G/B) X 768
- **Backlight Unit**
  - 4CCFL
- **DC-DC Converter Ref circuit**
- **Y-Driver**
- **X-Driver**
- **Lamp Connector**
- **2 Port TTL** 8 bits data for R/G/B
- **DE**
- **Vsync**
- **Hsync**
- **DCLK**
- **VDD**
- **GND**
- **LCD Drive**
  - Hirose FX8-80S-SV
  - Mating Typ FX8-80P-SV
- **LCD DRIVE CARD**
- **LCD Controller**
- **2 Port TTL 8 bits data for R/G/B DE Vsync Hsync DCLK VDD GND**

**Lamp Connector**

**Hirose FX8-80S-SV**

**Mating Typ FX8-80P-SV**

**JST BHR-04VS-1**

**Mating Type SM04(4.0)B-BHS-1-TB**
### 2.3 Optical Characteristics

The optical characteristics are measured under stable conditions at 25°C (Room Temperature):

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Viewing Angle</strong></td>
<td>degree</td>
<td>Horizontal (Right)</td>
<td>50</td>
<td>60(80)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>degree</td>
<td>Vertical (Up)</td>
<td>30</td>
<td>40(50)</td>
<td></td>
</tr>
<tr>
<td>CR: Contrast Ratio</td>
<td>degree</td>
<td>CR = 10(5) (Left)</td>
<td>50</td>
<td>60(80)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>degree</td>
<td>CR = 10(5) (Down)</td>
<td>50</td>
<td>60(70)</td>
<td></td>
</tr>
<tr>
<td><strong>Contrast ratio</strong></td>
<td></td>
<td>Normal Direction</td>
<td>300</td>
<td>400</td>
<td>-</td>
</tr>
<tr>
<td><strong>Response Time</strong></td>
<td>[msec]</td>
<td>Raising Time Ton (10%-90%)</td>
<td>-</td>
<td>11</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>[msec]</td>
<td>Falling Time Toff (90%-10%)</td>
<td>-</td>
<td>24</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>[msec]</td>
<td>Raising + Falling</td>
<td>-</td>
<td>35</td>
<td>70</td>
</tr>
<tr>
<td><strong>Color / Chromaticity</strong></td>
<td></td>
<td>Red x</td>
<td>0.603</td>
<td>0.633</td>
<td>0.663</td>
</tr>
<tr>
<td>Coordinates (CIE)</td>
<td></td>
<td>Red y</td>
<td>0.306</td>
<td>0.336</td>
<td>0.366</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Green x</td>
<td>0.264</td>
<td>0.294</td>
<td>0.324</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Green y</td>
<td>0.574</td>
<td>0.604</td>
<td>0.634</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blue x</td>
<td>0.115</td>
<td>0.145</td>
<td>0.175</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blue y</td>
<td>0.067</td>
<td>0.097</td>
<td>0.127</td>
</tr>
<tr>
<td><strong>Color Coordinates (CIE) White</strong></td>
<td></td>
<td>White x</td>
<td>0.283</td>
<td>0.313</td>
<td>0.343</td>
</tr>
<tr>
<td></td>
<td></td>
<td>White y</td>
<td>0.299</td>
<td>0.329</td>
<td>0.359</td>
</tr>
<tr>
<td><strong>Brightness Uniformity</strong></td>
<td>[%]</td>
<td></td>
<td>75</td>
<td>80</td>
<td>-</td>
</tr>
<tr>
<td><strong>White Luminance at CCFL 6.0 mA (center point)</strong></td>
<td>[cd/m²]</td>
<td>400</td>
<td>450</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>
### 2.4 Pixel format image
Following figure shows the relationship of the input signals and LCD pixel format.

Odd: RO0~RO7, GO0~GO7, BO0~BO7
Even: RE0~RE7, GE0~GE7, BE0~BE7

<table>
<thead>
<tr>
<th>1st Line</th>
<th>768th Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Odd: RO0</td>
<td>Odd: RO0</td>
</tr>
<tr>
<td></td>
<td>RO7</td>
</tr>
<tr>
<td>Odd: GO0</td>
<td>Odd: GO0</td>
</tr>
<tr>
<td></td>
<td>GO7</td>
</tr>
<tr>
<td>Odd: BO0</td>
<td>Odd: BO0</td>
</tr>
<tr>
<td></td>
<td>BO7</td>
</tr>
<tr>
<td></td>
<td>-----------</td>
</tr>
<tr>
<td>Even: RE0</td>
<td>Even: RE0</td>
</tr>
<tr>
<td></td>
<td>RE7</td>
</tr>
<tr>
<td>Even: GE0</td>
<td>Even: GE0</td>
</tr>
<tr>
<td></td>
<td>GE7</td>
</tr>
<tr>
<td>Even: BE0</td>
<td>Even: BE0</td>
</tr>
<tr>
<td></td>
<td>BE7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>1023</th>
<th>1024</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>G</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>G</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>G</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>G</td>
<td>B</td>
<td></td>
</tr>
</tbody>
</table>

Pixel format image

[Diagram showing pixel format]
3.0 Electrical characteristics
3.1 Absolute Maximum Ratings

Absolute maximum ratings of the module is as following:

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic/LCD Drive Voltage</td>
<td>VDD</td>
<td>-0.3</td>
<td>+4.0</td>
<td>Volt</td>
<td></td>
</tr>
<tr>
<td>CCFL Inrush current</td>
<td>ICFLL</td>
<td>6</td>
<td>7</td>
<td>mA</td>
<td>Note 1</td>
</tr>
<tr>
<td>CCFL Current</td>
<td>ICFL</td>
<td>6</td>
<td>7.5</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>TOP</td>
<td>0</td>
<td>+50</td>
<td>°C</td>
<td>Note 2</td>
</tr>
<tr>
<td>Operating Humidity</td>
<td>HOP</td>
<td>20</td>
<td>85</td>
<td>% RH</td>
<td>Note 2</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>TST</td>
<td>-20</td>
<td>+60</td>
<td>°C</td>
<td>Note 2</td>
</tr>
<tr>
<td>Storage Humidity</td>
<td>HST</td>
<td>5</td>
<td>95</td>
<td>% RH</td>
<td>Note 2</td>
</tr>
</tbody>
</table>

Note 1: Duration=50 msec
Note 2: Maximum Wet-Bulb should be 39°C and No condensation.

3.2 Module Interface Connectors
3.2.1 Connector type

<table>
<thead>
<tr>
<th>Connector Name</th>
<th>Interface Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
<td>Hirose or compatible</td>
</tr>
<tr>
<td>Type / Part Number</td>
<td>FX8-80S-SV</td>
</tr>
<tr>
<td>Mating Housing/Part Number</td>
<td>FX8-80P-SV</td>
</tr>
</tbody>
</table>

3.2.2 Pin Configuration

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Symbol</th>
<th>Description</th>
<th>Pin No.</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
<td>ground</td>
<td>41</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>2</td>
<td>RO0</td>
<td>Red data 0(odd),LSB</td>
<td>42</td>
<td>GE0</td>
<td>Green data 0(even),LSB</td>
</tr>
<tr>
<td>3</td>
<td>RO1</td>
<td>Red data 1(odd)</td>
<td>43</td>
<td>GE1</td>
<td>Green data 1(even)</td>
</tr>
<tr>
<td>4</td>
<td>RO2</td>
<td>Red data 2(odd)</td>
<td>44</td>
<td>GE2</td>
<td>Green data 2(even)</td>
</tr>
<tr>
<td>5</td>
<td>RO3</td>
<td>Red data 3(odd)</td>
<td>45</td>
<td>GE3</td>
<td>Green data 3(even)</td>
</tr>
<tr>
<td>6</td>
<td>GND</td>
<td>Ground</td>
<td>46</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>7</td>
<td>RO4</td>
<td>Red data 4(odd)</td>
<td>47</td>
<td>GE4</td>
<td>Green data 4(even)</td>
</tr>
<tr>
<td>8</td>
<td>RO5</td>
<td>Red data 5(odd)</td>
<td>48</td>
<td>GE5</td>
<td>Green data 5(even)</td>
</tr>
<tr>
<td>9</td>
<td>RO6</td>
<td>Red data 6(odd)</td>
<td>49</td>
<td>GE6</td>
<td>Green data 6(even)</td>
</tr>
<tr>
<td>10</td>
<td>RO7</td>
<td>Red data 7(odd),MSB</td>
<td>50</td>
<td>GE7</td>
<td>Green data 7(even),MSB</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>11</td>
<td>GND</td>
<td>Ground</td>
<td>51</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>12</td>
<td>GO0</td>
<td>Green data 0(odd),LSB</td>
<td>52</td>
<td>BE0</td>
<td>Blue data 0(even),LSB</td>
</tr>
<tr>
<td>13</td>
<td>GO1</td>
<td>Green data 1(odd)</td>
<td>53</td>
<td>BE1</td>
<td>Blue data 1(even)</td>
</tr>
<tr>
<td>14</td>
<td>GO2</td>
<td>Green data 2(odd)</td>
<td>54</td>
<td>BE2</td>
<td>Blue data 2(even)</td>
</tr>
<tr>
<td>15</td>
<td>GO3</td>
<td>Green data 3(odd)</td>
<td>55</td>
<td>BE3</td>
<td>Blue data 3(even)</td>
</tr>
<tr>
<td>16</td>
<td>GND</td>
<td>Ground</td>
<td>56</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>17</td>
<td>GO4</td>
<td>Green data 4(odd)</td>
<td>57</td>
<td>BE4</td>
<td>Blue data 4(even)</td>
</tr>
<tr>
<td>18</td>
<td>GO5</td>
<td>Green data 5(odd)</td>
<td>58</td>
<td>BE5</td>
<td>Blue data 5(even)</td>
</tr>
<tr>
<td>19</td>
<td>GO6</td>
<td>Green data 6(odd)</td>
<td>59</td>
<td>BE6</td>
<td>Blue data 6(even)</td>
</tr>
<tr>
<td>20</td>
<td>GO7</td>
<td>Green data 7(odd),MSB</td>
<td>60</td>
<td>BE7</td>
<td>Blue data 7(even),MSB</td>
</tr>
<tr>
<td>21</td>
<td>GND</td>
<td>Ground</td>
<td>61</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>22</td>
<td>BO0</td>
<td>Blue data 0(odd),LSB</td>
<td>62</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>23</td>
<td>BO1</td>
<td>Blue data 1(odd)</td>
<td>63</td>
<td>DCLK</td>
<td>Data input clock</td>
</tr>
<tr>
<td>24</td>
<td>BO2</td>
<td>Blue data 2(odd)</td>
<td>64</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>25</td>
<td>BO3</td>
<td>Blue data 3(odd)</td>
<td>65</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>26</td>
<td>GND</td>
<td>Ground</td>
<td>66</td>
<td>HSYNC</td>
<td>Horizontal sync signal</td>
</tr>
<tr>
<td>27</td>
<td>BO4</td>
<td>Blue data 4(odd)</td>
<td>67</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>28</td>
<td>BO5</td>
<td>Blue data 5(odd)</td>
<td>68</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>29</td>
<td>BO6</td>
<td>Blue data 6(odd)</td>
<td>69</td>
<td>DE</td>
<td>Data enable signal</td>
</tr>
<tr>
<td>30</td>
<td>BO7</td>
<td>Blue data 7(odd),MSB</td>
<td>70</td>
<td>VSYNC</td>
<td>Vertical sync signal</td>
</tr>
<tr>
<td>31</td>
<td>GND</td>
<td>Ground</td>
<td>71</td>
<td>VDD</td>
<td>Power supply +3.3V</td>
</tr>
<tr>
<td>32</td>
<td>RE0</td>
<td>Red data 0(even),LSB</td>
<td>72</td>
<td>VDD</td>
<td>Power supply +3.3V</td>
</tr>
<tr>
<td>33</td>
<td>RE1</td>
<td>Red data 1(even)</td>
<td>73</td>
<td>VDD</td>
<td>Power supply +3.3V</td>
</tr>
<tr>
<td>34</td>
<td>RE2</td>
<td>Red data 2(even)</td>
<td>74</td>
<td>VDD</td>
<td>Power supply +3.3V</td>
</tr>
<tr>
<td>35</td>
<td>RE3</td>
<td>Red data 3(even)</td>
<td>75</td>
<td>VDD</td>
<td>Power supply +3.3V</td>
</tr>
<tr>
<td>36</td>
<td>GND</td>
<td>Ground</td>
<td>76</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>37</td>
<td>RE4</td>
<td>Red data 4(even)</td>
<td>77</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>38</td>
<td>RE5</td>
<td>Red data 5(even)</td>
<td>78</td>
<td>Reserved</td>
<td>Reserved for MFG test</td>
</tr>
<tr>
<td>39</td>
<td>RE6</td>
<td>Red data 6(even)</td>
<td>79</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>40</td>
<td>RE7</td>
<td>Red data 7(even),MSB</td>
<td>80</td>
<td>GND</td>
<td>Ground</td>
</tr>
</tbody>
</table>
3.3 Backlight Connectors

3.3.1 Connector type

<table>
<thead>
<tr>
<th>Connector Name / Designation</th>
<th>For Lamp Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
<td>JST or compatible</td>
</tr>
<tr>
<td>Type / Part Number</td>
<td>BHR-04VS-1</td>
</tr>
<tr>
<td>Mating Type / Part Number</td>
<td>SM04(4.0)B-BHS-1-TB</td>
</tr>
</tbody>
</table>

3.3.2 Pin Configuration

<table>
<thead>
<tr>
<th>Pin</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HV</td>
<td>Lamp High Voltage</td>
</tr>
<tr>
<td>2</td>
<td>LV</td>
<td>Lamp Low Voltage</td>
</tr>
<tr>
<td>3</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
<td>Ground</td>
</tr>
</tbody>
</table>

3.4 Signal Electrical Characteristics

Each signal characteristics are as follows:

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCD Drive voltage</td>
<td>VDD</td>
<td>+3.0</td>
<td>+3.3</td>
<td>+3.6</td>
<td>[V]</td>
</tr>
<tr>
<td>“High” input signal voltage</td>
<td>Vih</td>
<td>2.0</td>
<td>-</td>
<td>-</td>
<td>[V]</td>
</tr>
<tr>
<td>“Low” input signal voltage</td>
<td>Vil</td>
<td>-</td>
<td>-</td>
<td>0.8</td>
<td>[V]</td>
</tr>
</tbody>
</table>
### 3.5 Interface Timings

#### 3.5.1 Timing Characteristics

<table>
<thead>
<tr>
<th>Signal</th>
<th>Item</th>
<th>Symbol</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCLK</td>
<td>Frequency</td>
<td>1/TDCLK</td>
<td>-</td>
<td>32.5</td>
<td>40.0</td>
<td>MHz</td>
</tr>
<tr>
<td></td>
<td>Period</td>
<td>TDCLK</td>
<td>25</td>
<td>30.8</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td></td>
<td>High time</td>
<td>TCH</td>
<td>0.4</td>
<td>0.5</td>
<td>0.6</td>
<td>TDCLK</td>
</tr>
<tr>
<td></td>
<td>Low time</td>
<td>TCL</td>
<td>0.4</td>
<td>0.5</td>
<td>0.6</td>
<td>TDCLK</td>
</tr>
<tr>
<td>DATA</td>
<td>Setup time</td>
<td>TDS</td>
<td>5</td>
<td>-</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td></td>
<td>Hold time</td>
<td>TDH</td>
<td>5</td>
<td>-</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>Data Enable</td>
<td>Setup time</td>
<td>TES</td>
<td>5</td>
<td>-</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td></td>
<td>Hold time</td>
<td>TEH</td>
<td>5</td>
<td>-</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>Horizontal sync</td>
<td>Frequency</td>
<td>1/TH</td>
<td>-</td>
<td>48</td>
<td>60</td>
<td>KHz</td>
</tr>
<tr>
<td></td>
<td>Pulse width</td>
<td>THP</td>
<td>2</td>
<td>68</td>
<td>-</td>
<td>TDCLK</td>
</tr>
<tr>
<td>Horizontal</td>
<td>Back–porch</td>
<td>THB</td>
<td>1</td>
<td>80</td>
<td>-</td>
<td>TDCLK</td>
</tr>
<tr>
<td>Signal</td>
<td>Display period</td>
<td>THD</td>
<td>512</td>
<td>512</td>
<td>512</td>
<td>TDCLK</td>
</tr>
<tr>
<td></td>
<td>Front–porch</td>
<td>THF</td>
<td>0</td>
<td>12</td>
<td>-</td>
<td>TDCLK</td>
</tr>
<tr>
<td>Vertical sync</td>
<td>Frequency</td>
<td>1/TV</td>
<td>-</td>
<td>60</td>
<td>75</td>
<td>Hz</td>
</tr>
<tr>
<td></td>
<td>Pulse width</td>
<td>TVP</td>
<td>1</td>
<td>6</td>
<td>-</td>
<td>TH</td>
</tr>
<tr>
<td>Vertical</td>
<td>Back–porch</td>
<td>TVB</td>
<td>7</td>
<td>29</td>
<td>64</td>
<td>TH</td>
</tr>
<tr>
<td>Signal</td>
<td>Display period</td>
<td>TVD</td>
<td>768</td>
<td>768</td>
<td>768</td>
<td>TH</td>
</tr>
<tr>
<td></td>
<td>Front–porch</td>
<td>TVF</td>
<td>1</td>
<td>3</td>
<td>-</td>
<td>TH</td>
</tr>
</tbody>
</table>
3.5.2 Timing Definition
3.6 Power Consumption
Input power specifications are as follows:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDD</td>
<td>LCD Drive Voltage</td>
<td>3.0</td>
<td>3.3</td>
<td>3.6</td>
<td>[V]</td>
<td></td>
</tr>
<tr>
<td>IDD</td>
<td>LCD Drive Current</td>
<td>-</td>
<td>600</td>
<td>700</td>
<td>[mA]</td>
<td>VDD=3.3v, All Black Pattern</td>
</tr>
<tr>
<td>PDD</td>
<td>LCD Drive power consumption</td>
<td>-</td>
<td>2.0</td>
<td>2.3</td>
<td>[Watt]</td>
<td>VDD=3.3v, All Black Pattern</td>
</tr>
<tr>
<td>VDDrp</td>
<td>Allowable LCD Drive Ripple Voltage</td>
<td>100</td>
<td></td>
<td></td>
<td>[mV] p-p</td>
<td></td>
</tr>
<tr>
<td>VDDns</td>
<td>Allowable LCD Drive Ripple Noise</td>
<td>100</td>
<td></td>
<td></td>
<td>[mV] p-p</td>
<td></td>
</tr>
</tbody>
</table>

3.7 Power ON/OFF Sequence
VDD power and lamp on/off sequence is as follows. Interface signals are also shown in the chart.
4.0 Backlight Characteristics

4.1 Signal for Lamp connector

<table>
<thead>
<tr>
<th>Pin #</th>
<th>signal Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lamp High Voltage</td>
</tr>
<tr>
<td>2</td>
<td>Lamp High Voltage</td>
</tr>
<tr>
<td>3</td>
<td>No Connection</td>
</tr>
<tr>
<td>4</td>
<td>Ground</td>
</tr>
</tbody>
</table>

4.2 Parameter guide line for CCFL Inverter

<table>
<thead>
<tr>
<th>Symbole</th>
<th>Parameter</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>(L255)</td>
<td>White Luminance</td>
<td>400</td>
<td>450</td>
<td>-</td>
<td>[cd/m²]</td>
<td>(Ta=25°C)</td>
</tr>
<tr>
<td>ISCFL</td>
<td>CCFL standard current</td>
<td>5.5</td>
<td>6.0</td>
<td>8.0</td>
<td>[mA] rms</td>
<td>(Ta=25°C)</td>
</tr>
<tr>
<td>IRCFL</td>
<td>CCFL operation range</td>
<td>-</td>
<td>6.0</td>
<td>6.5</td>
<td>[mA] rms</td>
<td>(Ta=25°C)</td>
</tr>
<tr>
<td>ICFL</td>
<td>CCFL Inrush current</td>
<td>-</td>
<td>6.0</td>
<td>7.0</td>
<td>[mA]</td>
<td>Note 1</td>
</tr>
<tr>
<td>fCFL</td>
<td>CCFL Frequency</td>
<td>40</td>
<td>50</td>
<td>60</td>
<td>[KHz]</td>
<td>(Ta=25°C)</td>
</tr>
<tr>
<td>NCFL</td>
<td>CCFL Ignition Voltage</td>
<td>1250</td>
<td></td>
<td></td>
<td>[Volt] rms</td>
<td>(Ta= 0°C) Note 4</td>
</tr>
<tr>
<td>NCFL</td>
<td>CCFL Ignition Voltage (reference)</td>
<td>950</td>
<td></td>
<td></td>
<td>[Volt] rms</td>
<td>(Ta=25°C) Note 4</td>
</tr>
<tr>
<td>VCFL</td>
<td>CCFL Discharge Voltage (Reference)</td>
<td>585</td>
<td>650</td>
<td>715</td>
<td>[Volt] rms</td>
<td>(Ta=25°C) Note 3</td>
</tr>
<tr>
<td>PCFL</td>
<td>CCFL Power consumption</td>
<td>12</td>
<td>14.3</td>
<td>17.2</td>
<td>[Watt]</td>
<td>(Ta=25°C) Note 3</td>
</tr>
</tbody>
</table>

Note 1: Duration=50 [msec]
Note 2: CCFL Frequency should be carefully determined to avoid interference between inverter and TFT LCD
Note 3: Calculator value for reference (ICFL×VCFL=PCFL)
Note 4: CCFL inverter should be able to give out a power that has a generating capacity of over 1350 voltage. Lamp units need 1350 voltage minimum for ignition.