



OUR GLOBAL
COMPETENCE
CENTRES

 APOLLO DISPLAY
TECHNOLOGIES



 DISTEC



 DISPLAY
TECHNOLOGY



Datasheet

LG Display

LM315WR1-SSB2

HD-10-163

SPECIFICATION FOR APPROVAL

- () Preliminary specification
- (●) Final specification

| | |
|-------|-------------------|
| Title | 31.5" UHD TFT LCD |
|-------|-------------------|

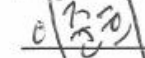
| | |
|-------|--|
| BUYER | |
| MODEL | |

| | |
|----------|----------------------|
| SUPPLIER | LG Display Co., Ltd. |
| *MODEL | LM315WR1 |
| SUFFIX | SSB2 |

*When you obtain standard approval, please use the above model name without suffix

| APPROVED BY | SIGNATURE DATE |
|-------------|----------------|
| / | |
| / | |
| / | |

Please return 1 copy for your confirmation with your signature and comments.

| APPROVED BY | SIGNATURE DATE |
|--------------------------|---|
| K.H. Hwang / G.Manager |  |
| REVIEWED BY | |
| S.H. Lee / Manager [C] |  |
| Y.H. Hwang / Manager [M] |  |
| S.H. Han / Manager [O] |  |
| J.H. Lee / Manager [P] |  |
| PREPARED BY | |
| H.C. Jung / Engineer |  |



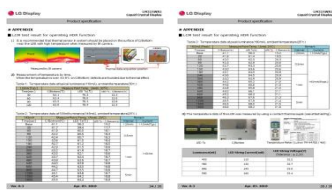
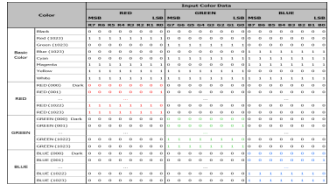
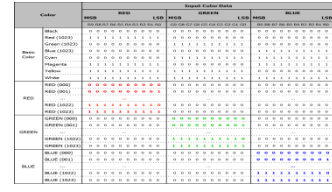
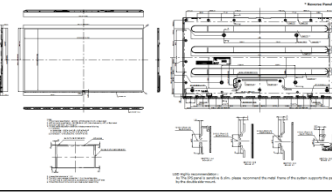
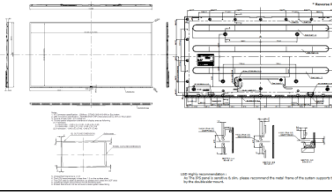
**Product engineering dept.
LG Display Co., Ltd**

Product specification
Contents

| No | ITEM | Page |
|-----------|--------------------------------------|-------------|
| | Cover | 1 |
| | Contents | 2 |
| | Record of revisions | 3 |
| 1 | General description | 5 |
| 2 | Absolute maximum ratings | 6 |
| 3 | Electrical specifications | 7 |
| 3-1 | Electrical characteristics | 7 |
| 3-2 | Interface connections | 10 |
| 3-3 | Signal timing specifications | 16 |
| 3-4 | Signal timing waveforms | 17 |
| 3-5 | Color input data reference | 18 |
| 3-6 | Power sequence | 19 |
| 3-7 | V _{LCD} Power dip condition | 20 |
| 4 | Optical specifications | 21 |
| 5 | Mechanical characteristics | 26 |
| 6 | Reliability | 29 |
| 7 | International standards | 30 |
| 7-1 | Safety | 30 |
| 7-2 | Environment | 30 |
| 8 | Packing | 31 |
| 8-1 | Designation of lot mark | 31 |
| 8-2 | Packing form | 32 |
| 9 | Precautions | 33 |

Product specification

Record of revisions

| Revision No. | Revision Date | Page | Before | After | Application Date | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------------------|---------------------|---------------|---|--|------------------------|---------------|------|------|------|------|------|------|-------|------|-------|------|----|--|-----------|--------|--------|--------|-----|--|-------|----|------|------|------|-----|--|----------------|-----|------|------|------|-----|--|------------------|-----|-----|-----|-----|--|--|------|----|----|----|-----|-------|-----------------------|------|----|----|----|--|--|-------|----|----|----|--|--|-------|----|------|------|------|----|--|-----------|-----|------|------|----|--|----------------|-----|----|----|-----|----|--|------|---|---|---|----|-----|-----------|----|--------|--------|--------|----|--|---------------------|------|----|----|-----|--|--|----------------------|-------|---|---|---|--|--|--|------|--------|------|------|------|------|------|------|-------|------|-------|------|----|--|-----------|--------|--------|--------|-----|--|-------|----|------|------|------|-----|--|----------------|-----|------|------|------|-----|--|------------------|-----|-----|-----|-----|--|--|------|----|----|----|-----|-------|-----------------------|------|----|----|-----|--|--|-------|----|----|----|--|--|-------|----|------|------|------|----|--|-----------|-----|------|------|----|--|----------------|-----|----|----|-----|----|--|------|---|---|---|----|-----|-----------|----|------|--------|-------|----|--|---------------------|------|----|----|-----|--|--|----------------------|-------|---|---|
| 0.1 | Jan. 2. 2018 | - | First Draft, Preliminary Specifications | - | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.2 | Jan. 23. 2018 | 5, 26 | Update the weight spec -. Typ. : TBD g / Max. : TBD g | -. Typ. : (3,250g) / Max. : (3,420g) | Jan. 23. 2018 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 16 | Update the timing table <table border="1" style="width: 100%; font-size: 8px;"> <thead> <tr> <th>ITEM</th> <th>Symbol</th> <th>Min.</th> <th>Typ.</th> <th>Max.</th> <th>Unit</th> <th>Note</th> </tr> </thead> <tbody> <tr> <td rowspan="2">DCLK</td> <td>Panel</td> <td>1.82</td> <td>1.875</td> <td>1.93</td> <td>Hz</td> <td></td> </tr> <tr> <td>Frequency</td> <td>537.63</td> <td>533.25</td> <td>538.56</td> <td>MHz</td> <td></td> </tr> <tr> <td rowspan="2">Panel</td> <td>SH</td> <td>4000</td> <td>4000</td> <td>4012</td> <td>CLK</td> <td></td> </tr> <tr> <td>Horizontal VdL</td> <td>SHL</td> <td>3840</td> <td>3840</td> <td>3840</td> <td>CLK</td> <td></td> </tr> <tr> <td rowspan="2">Horizontal Blank</td> <td>SHB</td> <td>140</td> <td>140</td> <td>172</td> <td></td> <td></td> </tr> <tr> <td>SHBL</td> <td>32</td> <td>32</td> <td>32</td> <td>CLK</td> <td>1,3,4</td> </tr> <tr> <td rowspan="2">Horizontal Back Porch</td> <td>SHSB</td> <td>80</td> <td>80</td> <td>86</td> <td></td> <td></td> </tr> <tr> <td>SHSBL</td> <td>48</td> <td>48</td> <td>52</td> <td></td> <td></td> </tr> <tr> <td rowspan="2">Panel</td> <td>SV</td> <td>2220</td> <td>2222</td> <td>2268</td> <td>Hz</td> <td></td> </tr> <tr> <td>Frequency</td> <td>100</td> <td>2160</td> <td>2260</td> <td>Hz</td> <td></td> </tr> <tr> <td rowspan="2">Vertical Blank</td> <td>SVB</td> <td>60</td> <td>62</td> <td>108</td> <td>Hz</td> <td></td> </tr> <tr> <td>SVBL</td> <td>3</td> <td>3</td> <td>3</td> <td>Hz</td> <td>2,4</td> </tr> <tr> <td rowspan="2">Frequency</td> <td>FV</td> <td>59.957</td> <td>59.957</td> <td>60.307</td> <td>Hz</td> <td></td> </tr> <tr> <td>Vertical Back Porch</td> <td>SVSB</td> <td>62</td> <td>64</td> <td>108</td> <td></td> <td></td> </tr> <tr> <td rowspan="2">Vertical Front Porch</td> <td>SVSBL</td> <td>3</td> <td>3</td> <td>3</td> <td></td> <td></td> </tr> </tbody> </table> | ITEM | | Symbol | Min. | Typ. | Max. | Unit | Note | DCLK | Panel | 1.82 | 1.875 | 1.93 | Hz | | Frequency | 537.63 | 533.25 | 538.56 | MHz | | Panel | SH | 4000 | 4000 | 4012 | CLK | | Horizontal VdL | SHL | 3840 | 3840 | 3840 | CLK | | Horizontal Blank | SHB | 140 | 140 | 172 | | | SHBL | 32 | 32 | 32 | CLK | 1,3,4 | Horizontal Back Porch | SHSB | 80 | 80 | 86 | | | SHSBL | 48 | 48 | 52 | | | Panel | SV | 2220 | 2222 | 2268 | Hz | | Frequency | 100 | 2160 | 2260 | Hz | | Vertical Blank | SVB | 60 | 62 | 108 | Hz | | SVBL | 3 | 3 | 3 | Hz | 2,4 | Frequency | FV | 59.957 | 59.957 | 60.307 | Hz | | Vertical Back Porch | SVSB | 62 | 64 | 108 | | | Vertical Front Porch | SVSBL | 3 | 3 | 3 | | | <table border="1" style="width: 100%; font-size: 8px;"> <thead> <tr> <th>ITEM</th> <th>Symbol</th> <th>Min.</th> <th>Typ.</th> <th>Max.</th> <th>Unit</th> <th>Note</th> </tr> </thead> <tbody> <tr> <td rowspan="2">DCLK</td> <td>Panel</td> <td>1.82</td> <td>1.875</td> <td>1.93</td> <td>Hz</td> <td></td> </tr> <tr> <td>Frequency</td> <td>537.63</td> <td>533.25</td> <td>538.56</td> <td>MHz</td> <td></td> </tr> <tr> <td rowspan="2">Panel</td> <td>SH</td> <td>3968</td> <td>4000</td> <td>4040</td> <td>CLK</td> <td></td> </tr> <tr> <td>Horizontal VdL</td> <td>SHL</td> <td>3840</td> <td>3840</td> <td>3840</td> <td>CLK</td> <td></td> </tr> <tr> <td rowspan="2">Horizontal Blank</td> <td>SHB</td> <td>136</td> <td>140</td> <td>170</td> <td></td> <td></td> </tr> <tr> <td>SHBL</td> <td>28</td> <td>32</td> <td>38</td> <td>CLK</td> <td>1,3,4</td> </tr> <tr> <td rowspan="2">Horizontal Back Porch</td> <td>SHSB</td> <td>32</td> <td>80</td> <td>108</td> <td></td> <td></td> </tr> <tr> <td>SHSBL</td> <td>48</td> <td>48</td> <td>48</td> <td></td> <td></td> </tr> <tr> <td rowspan="2">Panel</td> <td>SV</td> <td>2220</td> <td>2222</td> <td>2268</td> <td>Hz</td> <td></td> </tr> <tr> <td>Frequency</td> <td>100</td> <td>2160</td> <td>2260</td> <td>Hz</td> <td></td> </tr> <tr> <td rowspan="2">Vertical Blank</td> <td>SVB</td> <td>60</td> <td>62</td> <td>108</td> <td>Hz</td> <td></td> </tr> <tr> <td>SVBL</td> <td>3</td> <td>3</td> <td>3</td> <td>Hz</td> <td>2,4</td> </tr> <tr> <td rowspan="2">Frequency</td> <td>FV</td> <td>58.2</td> <td>59.957</td> <td>61.08</td> <td>Hz</td> <td></td> </tr> <tr> <td>Vertical Back Porch</td> <td>SVSB</td> <td>62</td> <td>64</td> <td>108</td> <td></td> <td></td> </tr> <tr> <td rowspan="2">Vertical Front Porch</td> <td>SVSBL</td> <td>3</td> <td>3</td> <td>3</td> <td></td> <td></td> </tr> </tbody> </table> | ITEM | Symbol | Min. | Typ. | Max. | Unit | Note | DCLK | Panel | 1.82 | 1.875 | 1.93 | Hz | | Frequency | 537.63 | 533.25 | 538.56 | MHz | | Panel | SH | 3968 | 4000 | 4040 | CLK | | Horizontal VdL | SHL | 3840 | 3840 | 3840 | CLK | | Horizontal Blank | SHB | 136 | 140 | 170 | | | SHBL | 28 | 32 | 38 | CLK | 1,3,4 | Horizontal Back Porch | SHSB | 32 | 80 | 108 | | | SHSBL | 48 | 48 | 48 | | | Panel | SV | 2220 | 2222 | 2268 | Hz | | Frequency | 100 | 2160 | 2260 | Hz | | Vertical Blank | SVB | 60 | 62 | 108 | Hz | | SVBL | 3 | 3 | 3 | Hz | 2,4 | Frequency | FV | 58.2 | 59.957 | 61.08 | Hz | | Vertical Back Porch | SVSB | 62 | 64 | 108 | | | Vertical Front Porch | SVSBL | 3 | 3 |
| ITEM | Symbol | Min. | Typ. | Max. | Unit | Note | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DCLK | Panel | 1.82 | 1.875 | 1.93 | Hz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Frequency | 537.63 | 533.25 | 538.56 | MHz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Panel | SH | 4000 | 4000 | 4012 | CLK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Horizontal VdL | SHL | 3840 | 3840 | 3840 | CLK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Horizontal Blank | SHB | 140 | 140 | 172 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | SHBL | 32 | 32 | 32 | CLK | 1,3,4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Horizontal Back Porch | SHSB | 80 | 80 | 86 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | SHSBL | 48 | 48 | 52 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Panel | SV | 2220 | 2222 | 2268 | Hz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Frequency | 100 | 2160 | 2260 | Hz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Vertical Blank | SVB | 60 | 62 | 108 | Hz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | SVBL | 3 | 3 | 3 | Hz | 2,4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Frequency | FV | 59.957 | 59.957 | 60.307 | Hz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Vertical Back Porch | SVSB | 62 | 64 | 108 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Vertical Front Porch | SVSBL | 3 | 3 | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ITEM | Symbol | Min. | Typ. | Max. | Unit | Note | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DCLK | Panel | 1.82 | 1.875 | 1.93 | Hz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Frequency | 537.63 | 533.25 | 538.56 | MHz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Panel | SH | 3968 | 4000 | 4040 | CLK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Horizontal VdL | SHL | 3840 | 3840 | 3840 | CLK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Horizontal Blank | SHB | 136 | 140 | 170 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | SHBL | 28 | 32 | 38 | CLK | 1,3,4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Horizontal Back Porch | SHSB | 32 | 80 | 108 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | SHSBL | 48 | 48 | 48 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Panel | SV | 2220 | 2222 | 2268 | Hz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Frequency | 100 | 2160 | 2260 | Hz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Vertical Blank | SVB | 60 | 62 | 108 | Hz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | SVBL | 3 | 3 | 3 | Hz | 2,4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Frequency | FV | 58.2 | 59.957 | 61.08 | Hz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Vertical Back Porch | SVSB | 62 | 64 | 108 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Vertical Front Porch | SVSBL | 3 | 3 | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 0.3 | Jan. 29. 2018 | 21 | Add the color gamut spec (sRGB Coverage) - | -. Typ. 99% / Min. 95% | Jan. 29. 2018 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.4 | Apr. 4. 2018 | 28 | Update the mechanical drawing (UDM Position)  |  | Apr. 4. 2018 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 35, 36 | Update LCM test result for operating HDR function (Appendix) - |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.5 | May. 2. 2018 | 18 | Update the spec of color input data reference  |  | May. 2. 2018 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.6 | May. 29. 2018 | 27, 28 | Update the mechanical drawing  |  | May. 29. 2018 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

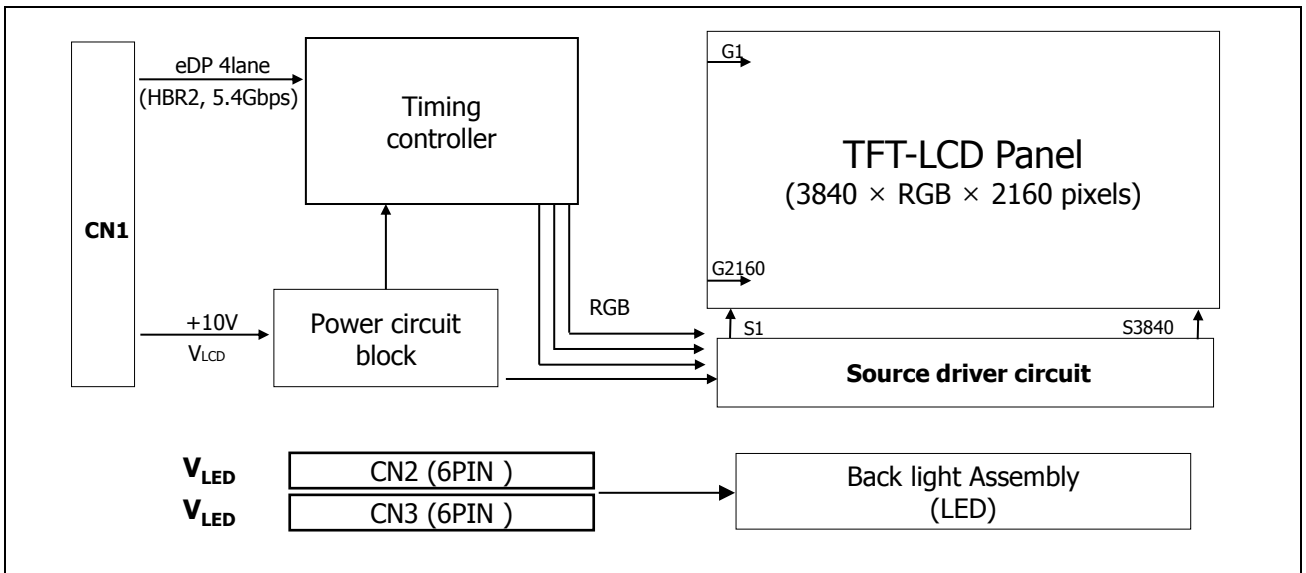
Product specification

Record of revisions

| Revision No. | Revision Date | Page | Before | After | Application Date |
|--------------|---------------|-------|--|--|------------------|
| 0.6 | May. 29. 2018 | 5, 25 | Update the spec of LCM weight - Typ. : 3,250g / Max. : 3,420g | - Typ. : 3,190g / Max. : 3,350g | May. 29. 2018 |
| | | 20 | Add the note of power sequence - | 7. When the LED power and the LCD VLCD are turned off simultaneously, the display may momentarily show abnormal screen | |
| 1.0 | Jun. 27. 2018 | - | Final Draft | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Product specification
1. General description

LM315WR1-SSB2 is a color active matrix liquid crystal display with a light emitting diode (WLED) backlight assembly without LED driver. The matrix employs a-Si thin film transistor as the active element. It is a transmissive type display operating in the normally black mode. It has a 31.5 inch diagonally measured active display area with UHD resolution.(3840 horizontal by 2160 vertical pixels array) Each pixel is divided into red, green and blue sub-pixels or dots which are arranged in vertical stripes. Gray scale or the brightness of the sub-pixel color is determined with a 10-bit gray scale signal for each dot, thus, presenting a palette of more than 1.07Billion colors. It has been designed to apply eDP(HBR2, 5.4Gbps) interface. It is intended to support displays where high brightness, super wide viewing angle, high color saturation, and high color are important.


[FIG. 1] Block diagram
General features

| | |
|------------------------|--|
| Active screen size | 31.5 inches(80.0051cm) (Aspect ratio 16:9) |
| Outline dimension | 709.4(H) x 405.85(V) x 14.2 mm (Typ.) |
| Pixel pitch | 0.18159(H)mm x 0.18159(V)mm |
| Pixel format | 3840(H) x 2160(V) Pixels. RGB stripes arrangement |
| Color depth | 1.07Billion colors (8bit + A-FRC) |
| Luminance (@White) | 400 cd/m ² (Center 1 Point, Typ.) |
| Viewing angle(CR>10) | View angle free (R/L 178(Typ.), U/D 178(Typ.)) |
| Power consumption | Total 36.9 Watt (8.5Watt @V _{LCD} , 28.4 Watt @I _s =110mA) |
| Weight | 3,190g (Typ.) |
| Display operating mode | Transmissive mode, normally black |
| Panel type | Reverse type |
| Surface treatment | Advanced Anti-glare treatment of the front polarizer (3H) |

Product specification

2. Absolute maximum ratings

The following are maximum values which, if exceeded, may cause faulty operation or damage to the unit.

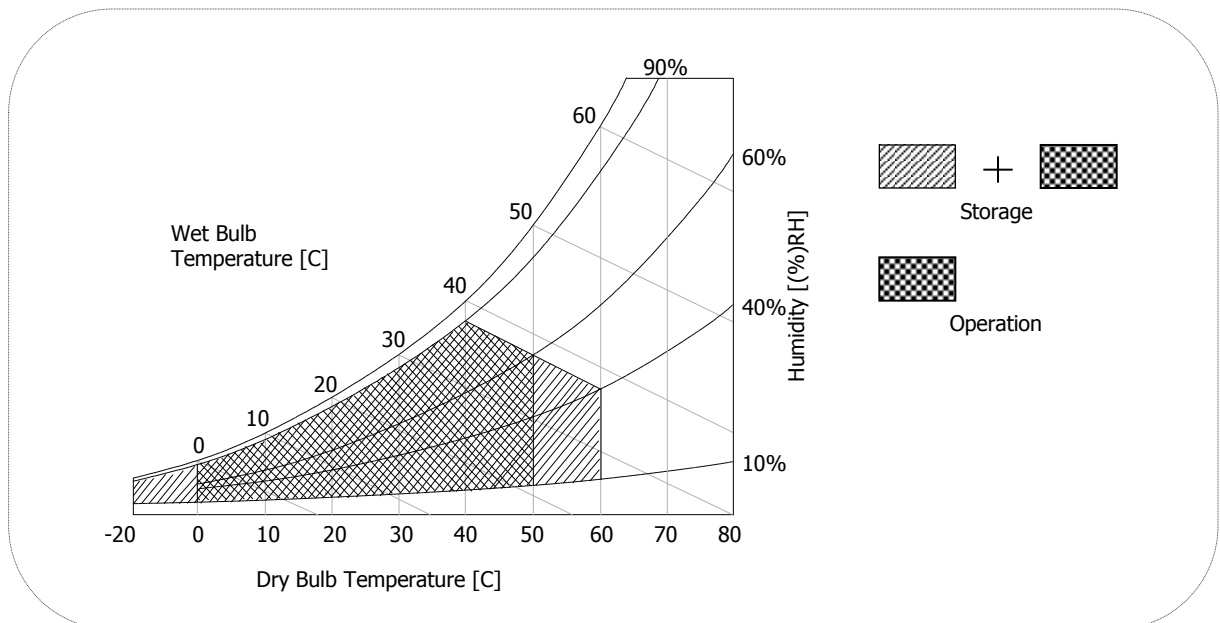
Table 1. Absolute maximum ratings

| Parameter | Symbol | Values | | Units | Notes |
|-------------------------------------|---------------|--------|------|----------|---------|
| | | Min. | Max. | | |
| Power supply input voltage | V_{LCD} | -0.3 | 12.0 | V_{DC} | At 25°C |
| Operating temperature | T_{OP} | 0 | 50 | °C | 1,2,3 |
| Storage temperature | T_{ST} | -20 | 60 | °C | |
| Operating ambient humidity | H_{OP} | 10 | 90 | %RH | |
| Storage humidity | H_{ST} | 10 | 90 | %RH | |
| LCM surface temperature (Operation) | $T_{Surface}$ | 0 | 65 | °C | 1, 4 |

Notes :

- Temperature and relative humidity range are shown in the figure below.
Wet bulb temperature should be 39 °C Max., and no condensation of water.
- Maximum storage humidity is up to 40 °C, 70% RH only for 4 corner light leakage mura.
- Storage condition is guaranteed under packing condition
- LCM surface temperature should be measured under the condition of $V_{LCD}=10.0V$, $f_v=60Hz$, $T_a=25°C$, no humidity and typical LED string current.
※. T_a = Ambient temperature

[FIG. 2] Temperature and relative humidity



Product specification
3. Electrical specifications
3-1. Electrical characteristics

It requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The other input power for the LED/Backlight, is typically generated by a LED Driver. The LED Driver is an external unit to the LCDs.

Table 2-1. Electrical characteristics

| Parameter | Symbol | Values | | | Units | Notes |
|-------------------------------|----------------|--------|------|------|-------|-------|
| | | Min | Typ | Max | | |
| MODULE : | | | | | | |
| Power supply input voltage | V_{LCD} | 9.5 | 10.0 | 10.5 | V | 4 |
| Permissive power input ripple | V_{ripple} | | | 400 | mVp-p | 1 |
| Power supply input current | I_{LCD} Typ. | - | 0.85 | 1.06 | A | 2 |
| | I_{LCD} Max. | - | 1.12 | 1.40 | A | |
| Power consumption | P_c Typ. | - | 8.5 | 10.6 | Watt | |
| | P_c Max. | - | 11.2 | 14.0 | Watt | |
| Rush current | I_{RUSH} | - | | 3 | A | 3 |

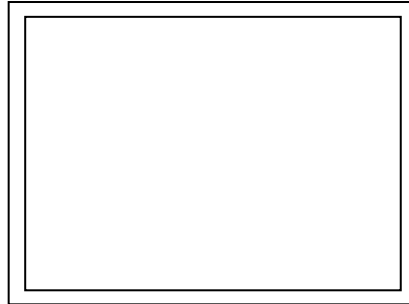
Notes :

- Permissive power ripple should be measured under the condition of $V_{LCD}=10.0V$, $25^{\circ}C$, $*fv=\max$. Refer to page 7 for the pattern and more information.
- The specified current and power consumption can be measured under the $V_{LCD}=10.0V$, $25^{\circ}C$, $f_v=60Hz$ and the pattern should be changed according to the typical or maximum power condition. The max. current can be measured only with the maximum power pattern. See the page 7 for details.
- Maximum condition of inrush current :
The duration of rush current is about 5ms and rising time of power input is $500\mu s \pm 20\%$. (min.).
- V_{LCD} level must be measured between two points on PCB of LCM [V_{LCD} (test point) ~ LCM Ground] (Test condition : maximum power pattern, $25^{\circ}C$, $f_v=60Hz$)

* f_v =frame frequency

Product specification

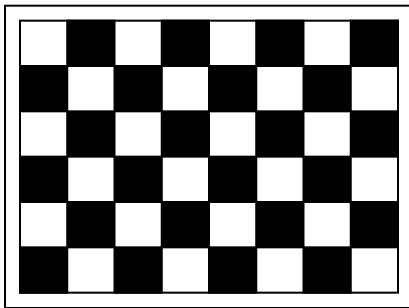
- **Permissive power input ripple** ($V_{LCD} = 10.0V$, $25^{\circ}C$, f_v (frame frequency)=Max. condition)



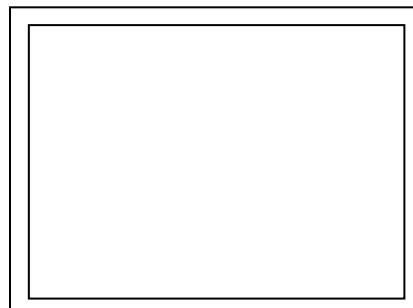
White pattern

For the exact ripple measurement, the condition of max. 20Mhz is recommended in the bandwidth configuration of oscilloscope.

- **Power consumption** ($V_{LCD} = 10V$, $25^{\circ}C$, f_v (frame frequency)=60Hz condition)



Typical power pattern



Maximum power pattern

[FIG. 3] Mosaic pattern & White pattern for power consumption measurement

Product specification
Table 2-2. Electrical characteristics of LED bar in normal operating condition

| Parameter | Symbol | Values | | | Units | Notes |
|--------------------|--------|--------|------|------|-------|---------|
| | | Min. | Typ. | Max. | | |
| LED string current | Is | - | 110 | 115 | mA | 1, 2 |
| LED string voltage | Vs | 30.0 | 32.2 | 34.4 | V | 1, 3 |
| Power consumption | PBar | - | 28.4 | 30.3 | Watt | 1, 2, 5 |
| LED life time | LED_LT | 30,000 | - | - | Hour | 4 |

Notes : The LED bar consists of 88 LED packages, 8 strings (parallel) x 11 packages (serial)

1. The specified values are for single LED bar.
2. The specified current is defined as the input current for single LED string with 100% duty cycle.
3. The specified voltage is the input LED string voltage at typical current 100% duty cycle.
4. The LED life time is defined as the time when the brightness of LED itself reach to the 50% of initial value under the conditions at $T_a = 25 \pm 2^\circ\text{C}$ and typical LED string current.
5. The power consumption shown above does not include the loss of external LED driver.
 The typical power consumption is calculated as $P_{\text{Bar}} = V_s(\text{Typ.}) \times I_s(\text{Typ.}) \times \text{No. of strings}$.
 The maximum power consumption is calculated as $P_{\text{Bar}} = V_s(\text{Max.}) \times I_s(\text{Typ.}) \times \text{No. of strings}$.

Product specification

3-2. Interface connections
3-2-1. LCD Module

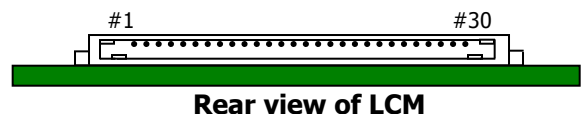
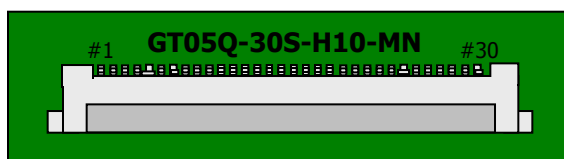
- LCD Connector(CN1) : GT05Q-30S-H10-MN (LSMtron), HD2S030HA1 (JAE), KN38B-30S-0.5H(HIROSE) or Equivalent
- Mating Connector : 20453-030T-## (Manufactured by I-PEX) or Equivalent

Table 3. Module connector (CN1) pin configuration

| No | Symbol | Description | No | Symbol | Description |
|----|------------------|---|----|--------|--|
| 1 | V _{LCD} | Power Supply +10.0V | 16 | Lane0P | True Signal for Main Link 0 |
| 2 | V _{LCD} | Power Supply +10.0V | 17 | Lane0N | Component Signal for Main Link 0 |
| 3 | V _{LCD} | Power Supply +10.0V | 18 | GND | Ground |
| 4 | V _{LCD} | Power Supply +10.0V | 19 | Lane1P | True Signal for Main Link 1 |
| 5 | V _{LCD} | Power Supply +10.0V | 20 | Lane1N | Component Signal for Main Link 1 |
| 6 | NC | No connection | 21 | GND | Ground |
| 7 | GND | Ground | 22 | Lane2P | True Signal for Main Link 2 |
| 8 | NC | No Connection(I2C serial interface for LCM) | 23 | Lane2N | Component Signal for Main Link 2 |
| 9 | NC | No Connection(I2C serial interface for LCM) | 24 | GND | Ground |
| 10 | GND | Ground | 25 | Lane3P | True Signal for Main Link 3 |
| 11 | HPD | Hot Plug Detect Signal | 26 | Lane3N | Component Signal for Main Link 3 |
| 12 | GND | Ground | 27 | GND | Ground |
| 13 | AUX_CHN | Component Signal for Auxiliary Channel | 28 | BIST | L(GND): Black, H(3.3V): Rotational Pattern |
| 14 | AUX_CHP | True Signal for Auxiliary Channel | 29 | NC | No Connection |
| 15 | GND | Ground | 30 | GND | Ground |

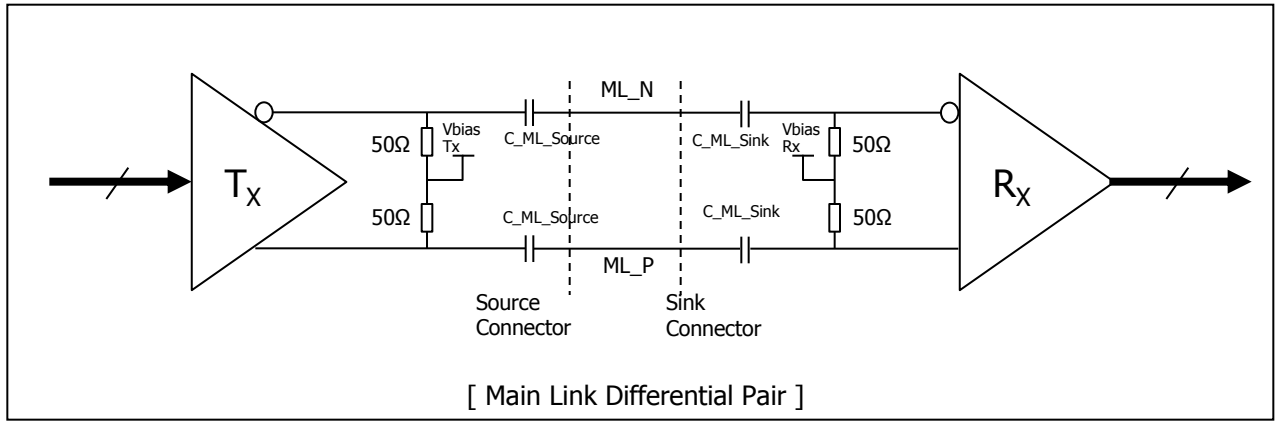
Notes :

1. All GND(ground) pins should be connected together to the LCD module's metal frame.
2. All V_{LCD} (input power) pins should be connected together.
3. BIST (Build In Self Test) : If Pin No.28 is tied to "High(3.3V)", T-con generates Rotational Pattern.
Time to stay at every pattern is about 2sec.


[FIG. 4] Connector diagram

Product specification
3-2-2. eDP Signal specifications

1. eDP Main link signal



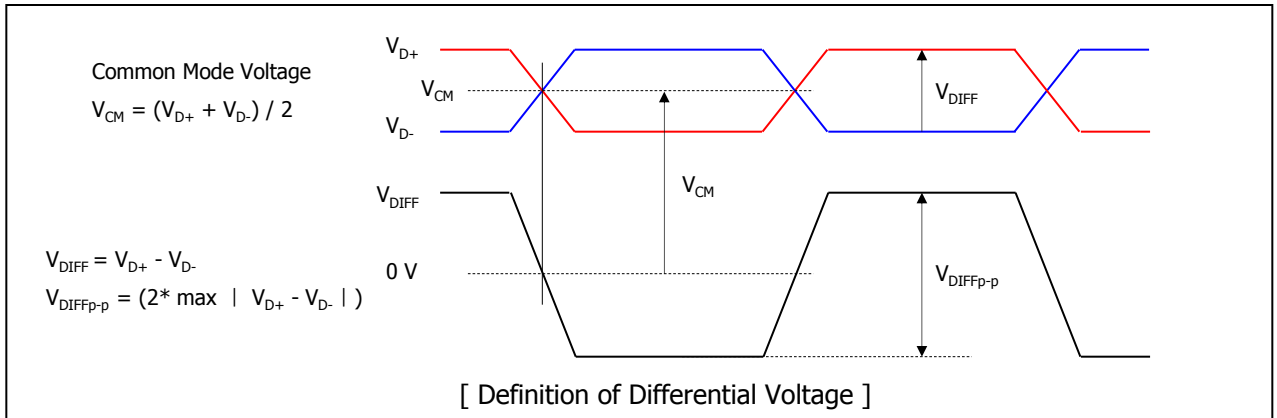
| Parameter | Symbol | Min | Typ | Max | Unit | Notes |
|--|---------------------------|------|-----|------|------|-------------|
| Unit Interval for high bit rate (5.4Gbps / lane) | UI_HBR2 | - | 185 | - | ps | |
| Link Clock Down Spreading | Amplitude | 0 | - | 0.5 | % | |
| | Frequency | 30 | - | 33 | kHz | |
| Maximum output voltage level at Source side connector | $V_{TX-DIFFp-p-Max}$ | - | - | 1.38 | V | Note 6) |
| Differential peak-to-peak voltage at Sink side connector | $V_{RX-DIFFp-p}$ | 0.09 | - | - | V | Note 7) |
| EYE width at Sink side connector | $T_{RX-EYE-CONN}$ | 0.38 | - | - | UI | Note 6,7) |
| Lane intra-pair skew | $L_{RX-SKEW-INTRA_PAIR}$ | - | - | 50 | ps | |
| AC Coupling Capacitor | $C_{SOURCE-ML}$ | 75 | - | 200 | nF | Source side |

Note)

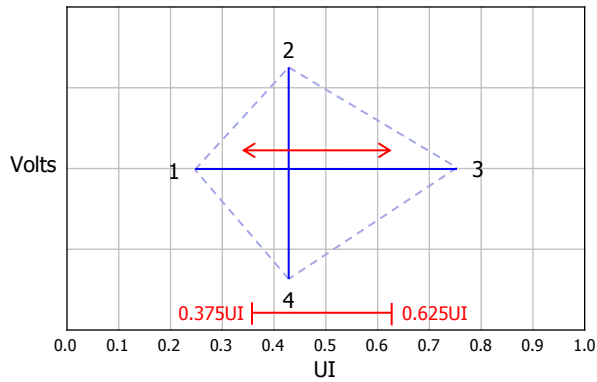
1. Termination resistor is typically integrated into the transmitter and receiver implementations.
2. In cabled embedded system, it is recommended the system designer ensure that EYE width and voltage are met at the sink side connector pins.
3. Mismatched common mode voltage will occur abnormal display.
4. All eDP electrical spec is measured at sink connector side.
5. eDP cable Impedance should be $100\text{ohm} \pm 5\%$.

Product specification

Note6) Definition of Differential Voltage



Note7) Main Link EYE Diagram

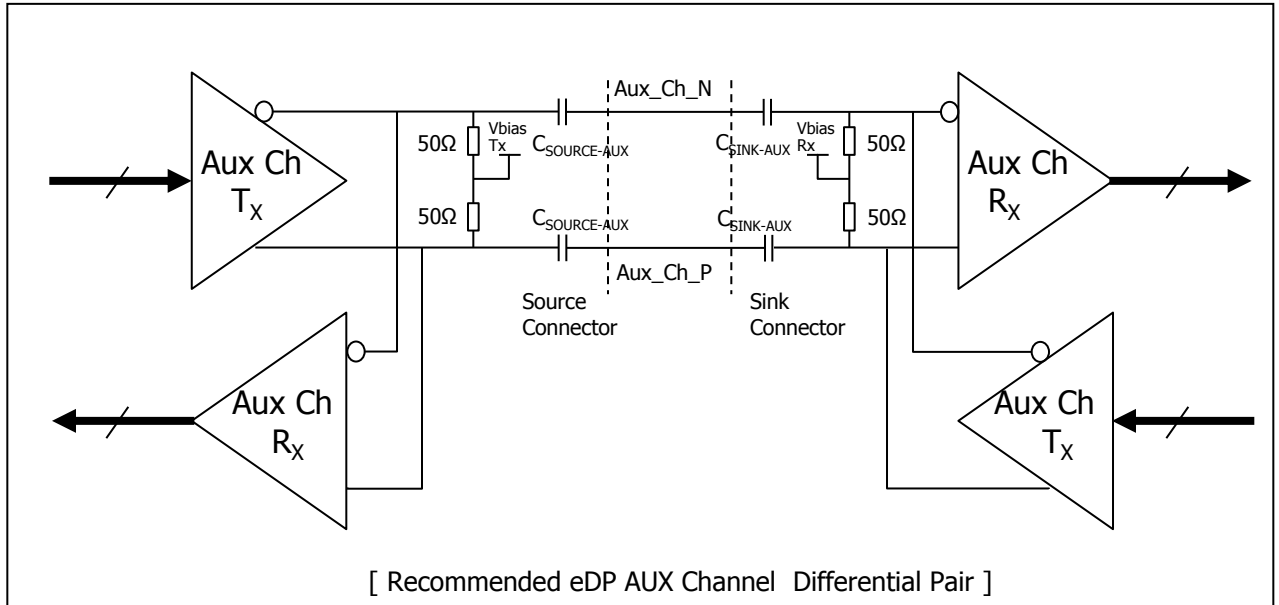


| Point | High Bit Rate 2 @ TP3 EQ | |
|-------|--|------------|
| | Time(UI) | Voltage(V) |
| 1 | Any UI location (x) where the eye width is open from x to x+0.38UI | 0.000 |
| 2 | Any passing UI location between 0.375UI-0.625UI | 0.045 |
| 3 | Point 1 + 0.38UI | 0.000 |
| 4 | Same as Point 2 | -0.045 |

[EYE Mask Vertices at embedded DP Sink Connector Pins]

Product specification

2. eDP AUX Channel signal



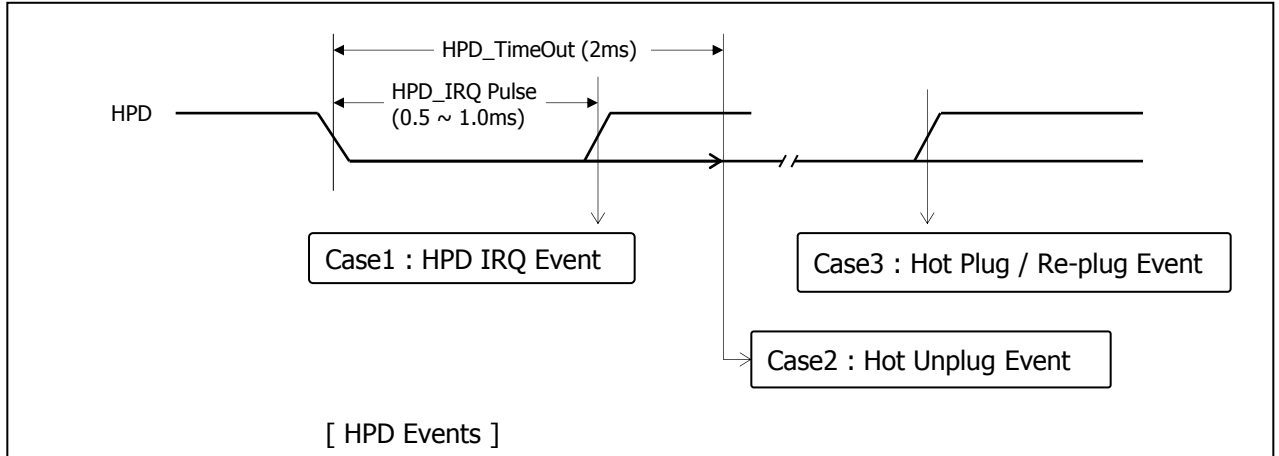
| Parameter | Symbol | Min | Typ | Max | Unit | Notes |
|--|-------------------|------|-----|------|------|---------------|
| AUX Unit Interval | UI | 0.4 | - | 0.6 | us | |
| AUX Jitter at Tx IC Package Pins | T_{jitter} | - | - | 0.04 | UI | Equal to 24ns |
| AUX Jitter at Rx IC Package Pins | | - | - | 0.05 | UI | Equal to 30ns |
| AUX Peak-to-peak voltage at Connector Pins of Receiving | $V_{AUX-DIFFP-p}$ | 0.32 | - | 1.36 | V | |
| AUX Peak-to-peak voltage at Connector Pins of Transmitting | | 0.39 | - | 1.38 | V | |
| AUX EYE width at Connector Pins of Tx and Rx | | 0.98 | - | - | UI | |
| AUX AC Coupling Capacitor | $C_{SOURCE-AUX}$ | 75 | | 200 | nF | Source side |

Note)

1. Termination resistor is typically integrated into the transmitter and receiver implementations.
2. $V_{AUX-DIFFP-p} = 2 * |V_{AUXP} - V_{AUXN}|$
3. Termination resistor should be $\pm 50\Omega$ at source side to AUX level.
4. Mismatched common mode voltage will occur abnormal display.

Product specification

3. eDP HDP Signal



| Parameter | Symbol | Min | Typ | Max | Unit | Notes |
|--------------------------------|---------|------|-----|-----|------|-----------------------|
| HPD Voltage | HPD | 2.25 | - | 3.6 | V | Sink side Driving |
| Hot Plug Detection Threshold | | 2.0 | - | - | V | Source side Detecting |
| Hot Unplug Detection Threshold | | - | - | 0.8 | V | |
| HPD_IRQ Pulse Width | HPD_IRQ | 0.5 | - | 1.0 | ms | |
| HPD_TimeOut | | 2.0 | - | - | ms | HPD Unplug Event |

Note)

1. HPD IRQ : Sink device wants to notify the Source device that Sink's status has changed so it toggles HPD line, forcing the Source device to read its Link / Sink Receiver DPCD field via the AUX-CH
2. HPD Unplug : The Sink device is no longer attached to the Source device and the Source device may then disable its Main Link as a power saving mode
3. Plug / Re-plug : The Sink device is now attached to the Source device, forcing the Source device to read its Receiver capabilities and Link / Sink status Receiver DPCD fields via the AUX-CH

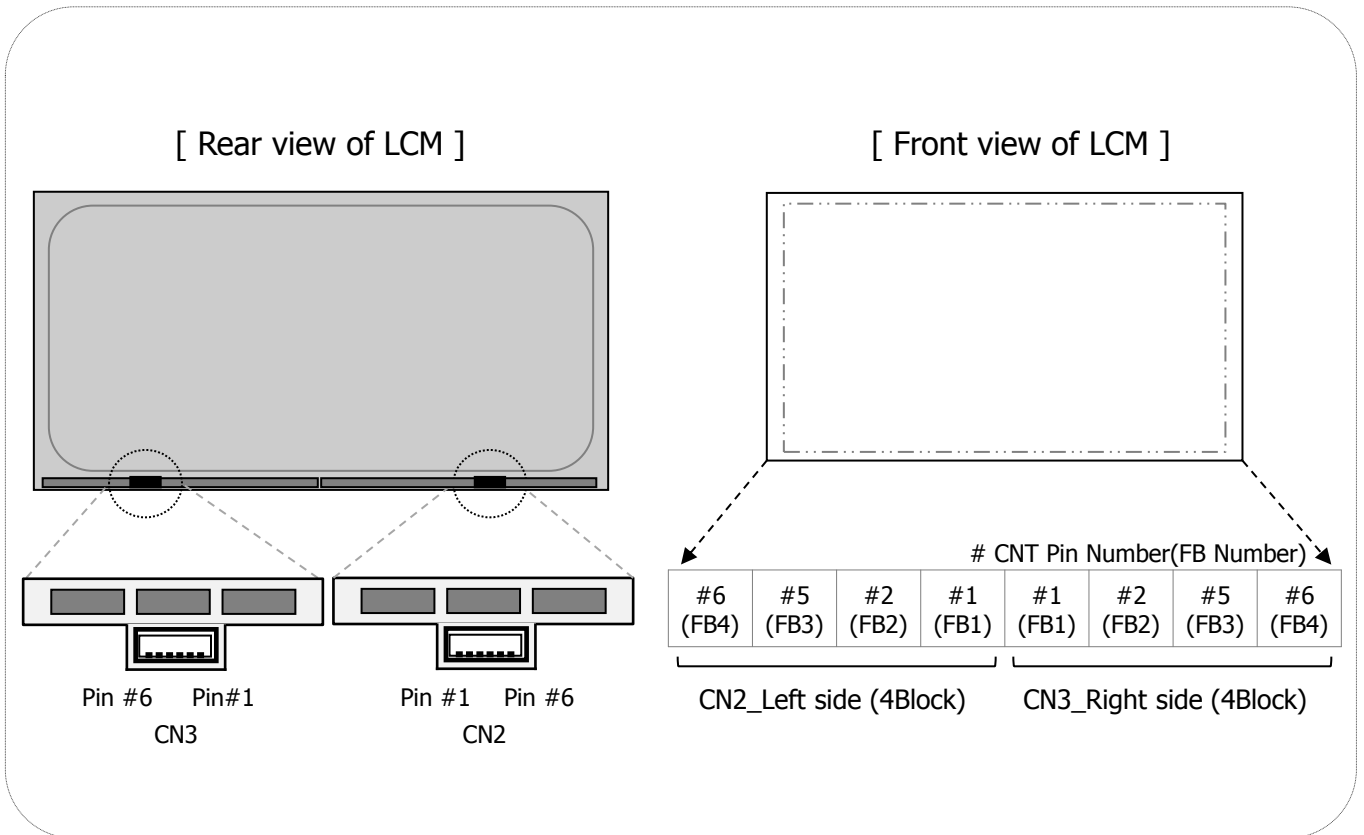
Product specification

3-2-3. Backlight connector pin configuration

Table 4. Backlight connector pin configuration(CN2, CN3)

The LED interface connector is a model BM06B-SHJS(HF)_Manufactured by JST or equivalent.
The mating connector is a SHJP-06V-S(HF), 10035HS-H06C(HF) or equivalent.
The pin configuration for the connector is shown in the table below.

| Pin | Symbol | Pin-description (CN2) | Remark | Pin | Symbol | Pin-description (CN3) | Remark |
|-----|--------|---------------------------------|-------------------------|-----|--------|---------------------------------|--------------------------|
| #1 | FB1 | Channel 1 current feedback | Left side in front view | #1 | FB1 | Channel 1 current feedback | Right side in front view |
| #2 | FB2 | Channel 2 current feedback | | #2 | FB2 | Channel 2 current feedback | |
| #3 | V LED | LED power supply (common anode) | | #3 | V LED | LED power supply (common anode) | |
| #4 | V LED | LED power supply (common anode) | | #4 | V LED | LED power supply (common anode) | |
| #5 | FB3 | Channel 3 current feedback | | #5 | FB3 | Channel 3 current feedback | |
| #6 | FB4 | Channel 4 current feedback | | #6 | FB4 | Channel 4 current feedback | |



[FIG. 5] Backlight connector view

Product specification
3-3. Signal timing specifications

This is signal timing requirement from the signal transmitter. All of the interface signal timing should satisfy the following specifications for its proper operation.

Table 5. Timing table

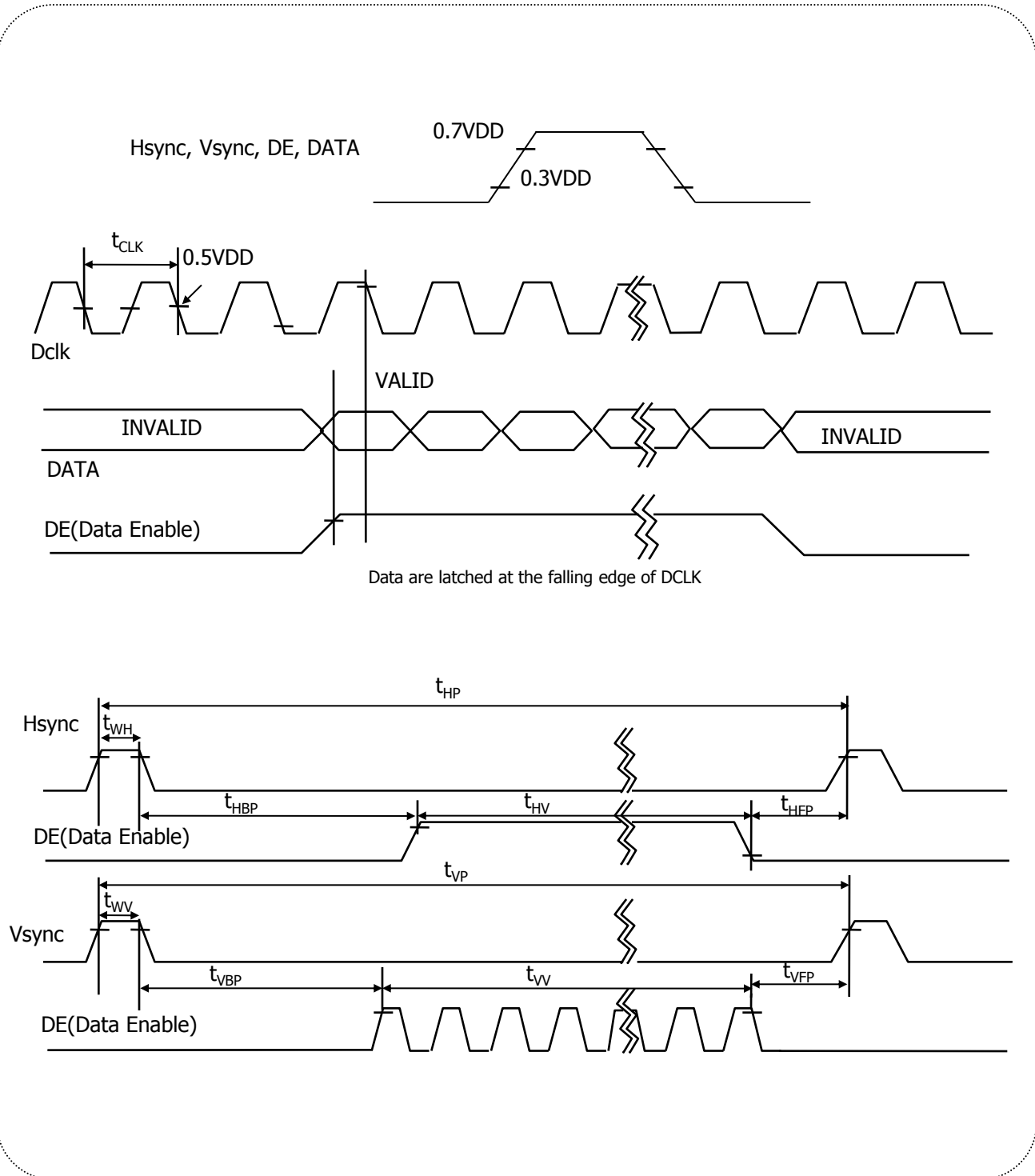
| ITEM | Symbol | | Min. | Typ. | Max. | Unit | Note |
|-------|------------------------|------|--------|--------|--------|------|-------|
| DCLK | Period | tCLK | 1.82 | 1.875 | 1.93 | ns | |
| | Frequency | - | 518.25 | 533.25 | 548.25 | MHz | |
| Hsync | Period | tHP | 3968 | 4000 | 4040 | tCLK | 1,3,4 |
| | Horizontal Valid | tHV | 3840 | 3840 | 3840 | tCLK | |
| | Horizontal Blank | tHB | 128 | 160 | 192 | | |
| | Width | tWH | 28 | 32 | 36 | tCLK | |
| | Horizontal Back Porch | tHBP | 52 | 80 | 108 | | |
| | Horizontal Front Porch | tHFP | 48 | 48 | 48 | | |
| Vsync | Period | tVP | 2220 | 2222 | 2268 | tHP | 2,4 |
| | Vertical Valid | tVV | 2160 | 2160 | 2160 | tHP | |
| | Vertical Blank | tVB | 60 | 62 | 108 | tHP | |
| | Frequency | fV | 58.2 | 59.997 | 61.68 | Hz | |
| | Width | tWV | 5 | 5 | 5 | tHP | |
| | Vertical Back Porch | tVBP | 52 | 54 | 100 | | |
| | Vertical Front Porch | tVFP | 3 | 3 | 3 | | |

Notes :

- 1.The value of Hsync period, Hsync width and Hsync valid should be even number times of tCLK.
If the value is odd number times of tCLK, it can make asynchronous signal timing and cause abnormal display.
- 2.The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rates.
- 3.The value of Hsync Period, Hsync Width, and Horizontal Back Porch should be divided by 4 without a remainder.
4. The polarity of Hsync, Vsync is not restricted.

Product specification

3-4. Signal timing waveforms



Product specification

3-5. Color input data reference

The brightness of each primary color(red,green,blue) is based on the 10-bit gray scale data input for the color; the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

Table 6. Color data reference

| Color | | Input Color Data | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------|--------------|------------------|----|----|----|----|-----|----|----|----|----|-------|----|----|----|----|-----|----|----|----|----|------|----|----|----|----|-----|----|----|----|----|
| | | RED | | | | | | | | | | GREEN | | | | | | | | | | BLUE | | | | | | | | | |
| | | MSB | | | | | LSB | | | | | MSB | | | | | LSB | | | | | MSB | | | | | LSB | | | | |
| | | R9 | R8 | R7 | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G9 | G8 | G7 | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B9 | B8 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Color | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red (1023) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green (1023) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue (1023) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| RED | RED (000) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | RED (001) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | ... | ... | | | | | | | | | | ... | | | | | | | | | | ... | | | | | | | | | |
| | RED (1022) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | RED (1023) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| GREEN | GREEN (000) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | GREEN (001) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | ... | ... | | | | | | | | | | ... | | | | | | | | | | ... | | | | | | | | | |
| | GREEN (1022) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | GREEN (1023) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BLUE | BLUE (000) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | BLUE (001) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | |
| | ... | ... | | | | | | | | | | ... | | | | | | | | | | ... | | | | | | | | | |
| | BLUE (1022) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| | BLUE (1023) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Product specification

3-6. Power sequence

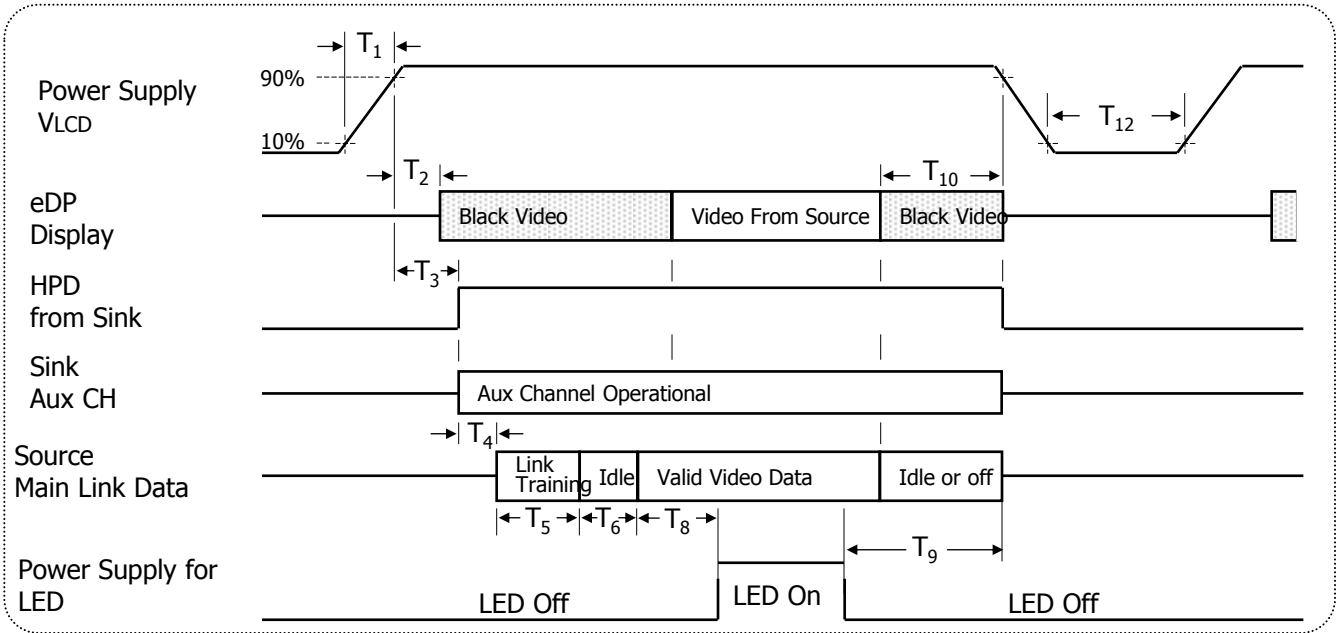


Table 7. Power sequence table

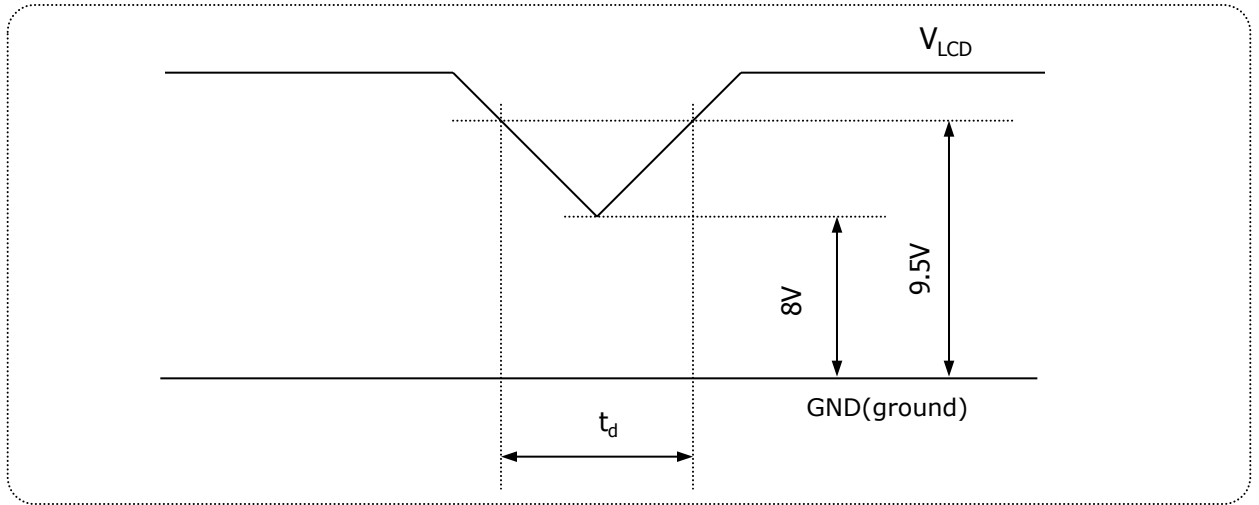
| Timing | Required By | Limits | | Units | Notes |
|----------------|-------------|--------|-----|-------|---------|
| | | Min | Max | | |
| T ₁ | Source | 0.5 | 10 | ms | - |
| T ₂ | Sink | 10 | 200 | ms | - |
| T ₃ | Sink | 15 | 200 | ms | - |
| T ₄ | Source | - | - | ms | Note 5) |
| T ₅ | Source | - | - | ms | Note 5) |
| T ₆ | Source | - | 100 | ms | Note 6) |
| T ₈ | Source | 200 | - | ms | - |
| T ₉ | Source | 200 | - | ms | Note 4) |

| Timing | Required By | Limits | | Units | Notes |
|-----------------|-------------|--------|-----|-------|-------|
| | | Min | Max | | |
| T ₁₀ | Source | 0 | 500 | ms | - |
| T ₁₂ | Source | 1000 | - | ms | - |

Note:

- Power sequence should be kept all the time including below cases for normal operation.
 - AC/DC Power On/Off
 - Mode change (resolution, frequency, timing, sleep mode, color depth change, etc.)
 The violation of power sequence can cause a significant trouble in display and reliability.
- Please avoid floating state of interface signal during signal invalid period.
- When the interface signal is invalid, be sure to pull down the VLCD.(0V)
- Please turn off the power supply for LED when the level of VLCD changes to prevent noise issue.
- Link training duration is dependent on the customer's system.
- It includes Source Frame Synchronization time.
 - Source Frame Synchronization: Time to prepare before Tx(Source) sends valid data(Invalid period)
- When the LED power and the LCD VLCD are turned off simultaneously, the display may momentarily show abnormal screen

3-7. V_{LCD} Power dip condition



[FIG. 6] Power dip condition

For proper operation, stable power supply of V_{LCD} is necessary and power dip is allowed only in below condition. Except this condition, power on/off should follow power sequence specification in previous page exactly.

1) Dip condition

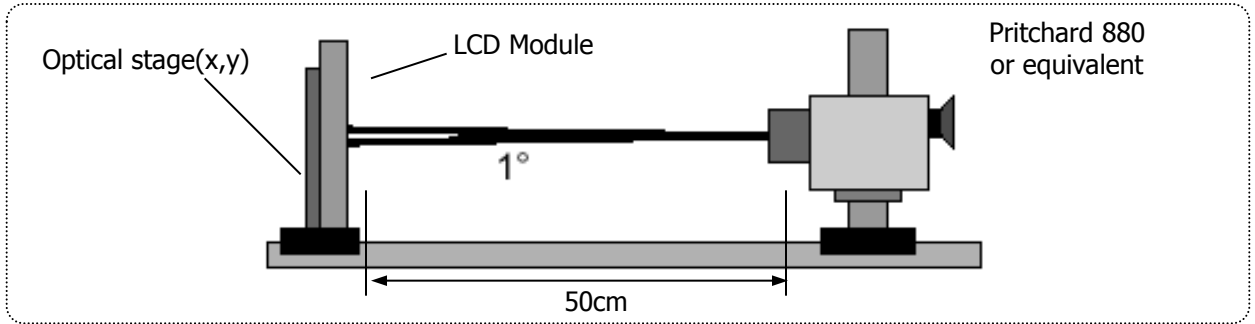
$$8V \leq V_{LCD} < 9.5V, t_d \leq 20ms$$

Product specification

4. Optical specifications

Optical characteristics are determined after the unit has been 'ON' for approximately 30 minutes in a dark environment at $25 \pm 2^\circ\text{C}$. The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of Φ and θ equal to 0° and aperture 1 degree.

FIG. 7 presents additional information concerning the measurement equipment and method.



[FIG. 7] Optical characteristic measurement equipment and method

Table 8. Optical characteristics (Ta=25 °C, VLCD=10.0V, fV=60Hz Dclk=533.25MHz, IS=110mA)

| Parameter | Symbol | Values | | | Units | Notes | |
|--|--------------------|----------------------|------------|-------|-------------------|--------|---|
| | | Min. | Typ. | Max. | | | |
| Contrast Ratio | CR | 910 | 1300 | - | | 1 | |
| Surface luminance, white | L _{WH} | 320 | 400 | - | cd/m ² | 2 | |
| Luminance variation | δ _{WHITE} | 75 | - | - | % | 3 | |
| Response time | Gray To Gray | T _{GTG_AVR} | 14 | 25 | ms | 4 | |
| Color gamut (CIE1931) | sRGB | 95 | 99 | - | % | | |
| Color coordinates [CIE1931] (By PR650) | Red | Rx | Typ. -0.03 | 0.674 | Typ. +0.03 | | |
| | | Ry | | 0.314 | | | |
| | Green | Gx | | 0.277 | | | |
| | | Gy | | 0.678 | | | |
| | Blue | Bx | | 0.154 | | | |
| | | By | | 0.053 | | | |
| | White | Wx | | 0.313 | | | |
| | | Wy | | 0.329 | | | |
| Viewing angle (CR>10, General) | Horizontal | θ _H | 170 | 178 | - | Degree | 5 |
| | Vertical | θ _V | 170 | 178 | - | | |
| Gray Scale | - | - | 2.2 | - | - | 6 | |

Product specification

4-1. Characteristics of Peak luminance

Table 9-1. Absolute maximum value of LED bar and peak luminance

| Parameter | Symbol | Values | Unit | Notes |
|--------------------|--------|--------|------|-------|
| LED string current | Is | 160 | mA | a,b,c |
| Peak luminance | Lp | 550 | nit | |

- Notes) a. LED string voltage at maximum current with 100% duty cycle is 33.4 ± 2.2 V at $T_a = 25 \pm 2^\circ\text{C}$.
 b. Table 9-1 is reference data only for HDR Function usage, refer to the appendix of LCM temperature at peak current.
 c. Peak Luminance 550nit is achieved at 160mA, while the specifications for guarantee remains under the normal operating condition specified in Table 2-2. Specifications and condition for evaluation test and mass production shall be applied with conditions specified in Table 2-2.

Product specification

Notes :

1. Contrast Ratio(CR) is defined mathematically as : **(By PR880)**

$$\text{Contrast Ratio} = \frac{\text{Surface luminance with all white pixels}}{\text{Surface luminance with all black pixels}}$$

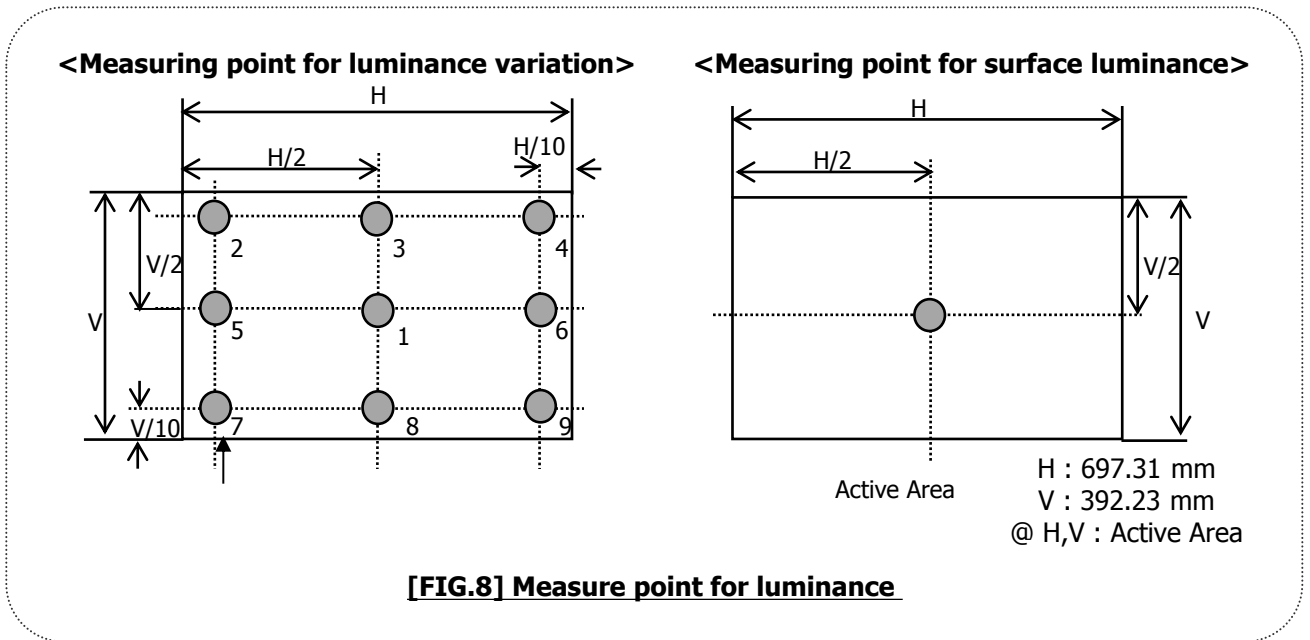
It is measured at center point(Location P1)

2. Surface luminance(L_{WH}) is luminance value at Center 1 point(P1) across the LCD surface 50cm from the surface with all pixels displaying white. For more information see FIG.7 **(By PR880)**

3. The variation in surface luminance , δ WHITE is defined as : **(By PR880)**

$$\delta_{WHITE} = \frac{\text{Minimum}(L_{P1}, L_{P2}, \dots, L_{P9})}{\text{Maximum}(L_{P1}, L_{P2}, \dots, L_{P9})} \times 100$$

Where L1 to L9 are the luminance with all pixels displaying white at 9 locations.
For more information see FIG.8



Product specification

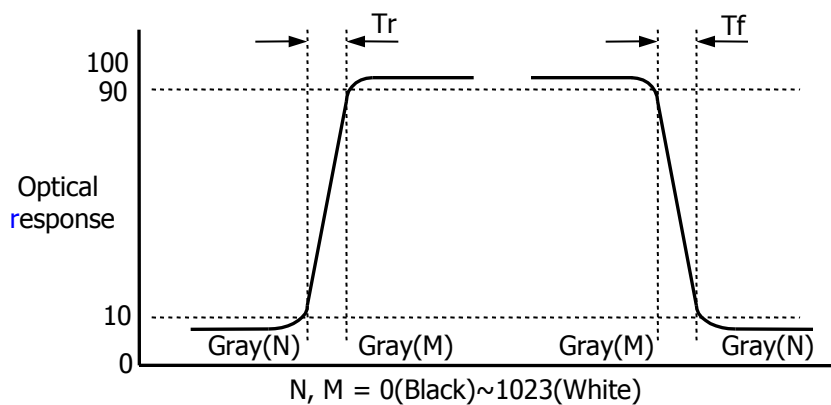
4. The Gray To Gray response time is defined as the following figure and shall be measured by switching the input signal for "Gray To Gray".

- Gray step : 5 Step
- TGTG_AVR is the total average time at rising time and falling time for "Gray To Gray".
- By RD80S

Table 9. GTG Gray table

| Gray To Gray | | Rising time | | | | |
|--------------|-------|-------------|------|------|------|----|
| | | G1023 | G767 | G511 | G255 | G0 |
| Falling time | G1023 | | | | | |
| | G767 | | | | | |
| | G511 | | | | | |
| | G255 | | | | | |
| | G0 | | | | | |

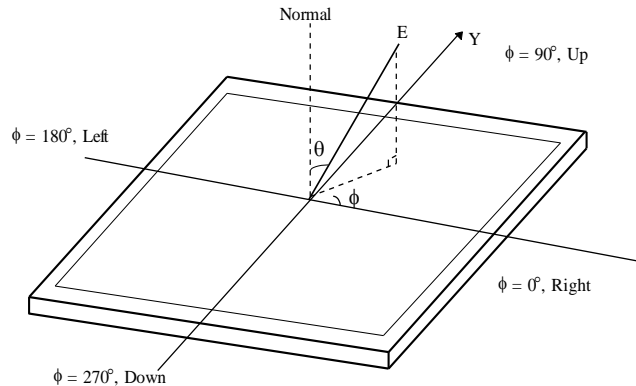
Response time is defined as the following figure and shall be measured by switching the input signal for "Gray(N)" and "Gray(M)".



[FIG. 9] Response Time

Product specification

5. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG.10 (**By PR880**)



[FIG. 10] Viewing angle

6. Gamma Value is approximately 2.2. For more information see Table 11.

Table 10. Gray Scale Specification

| Gray Level | Relative Luminance [%] (Typ.) |
|------------|-------------------------------|
| 0 | 0.11 |
| 127 | 1.08 |
| 255 | 4.72 |
| 383 | 11.49 |
| 511 | 21.66 |
| 639 | 35.45 |
| 767 | 53.00 |
| 895 | 74.48 |
| 1023 | 100 |

Product specification

5. Mechanical characteristics

The contents provide general mechanical characteristics. In addition the figures in the next page are detailed mechanical drawing of the LCD.

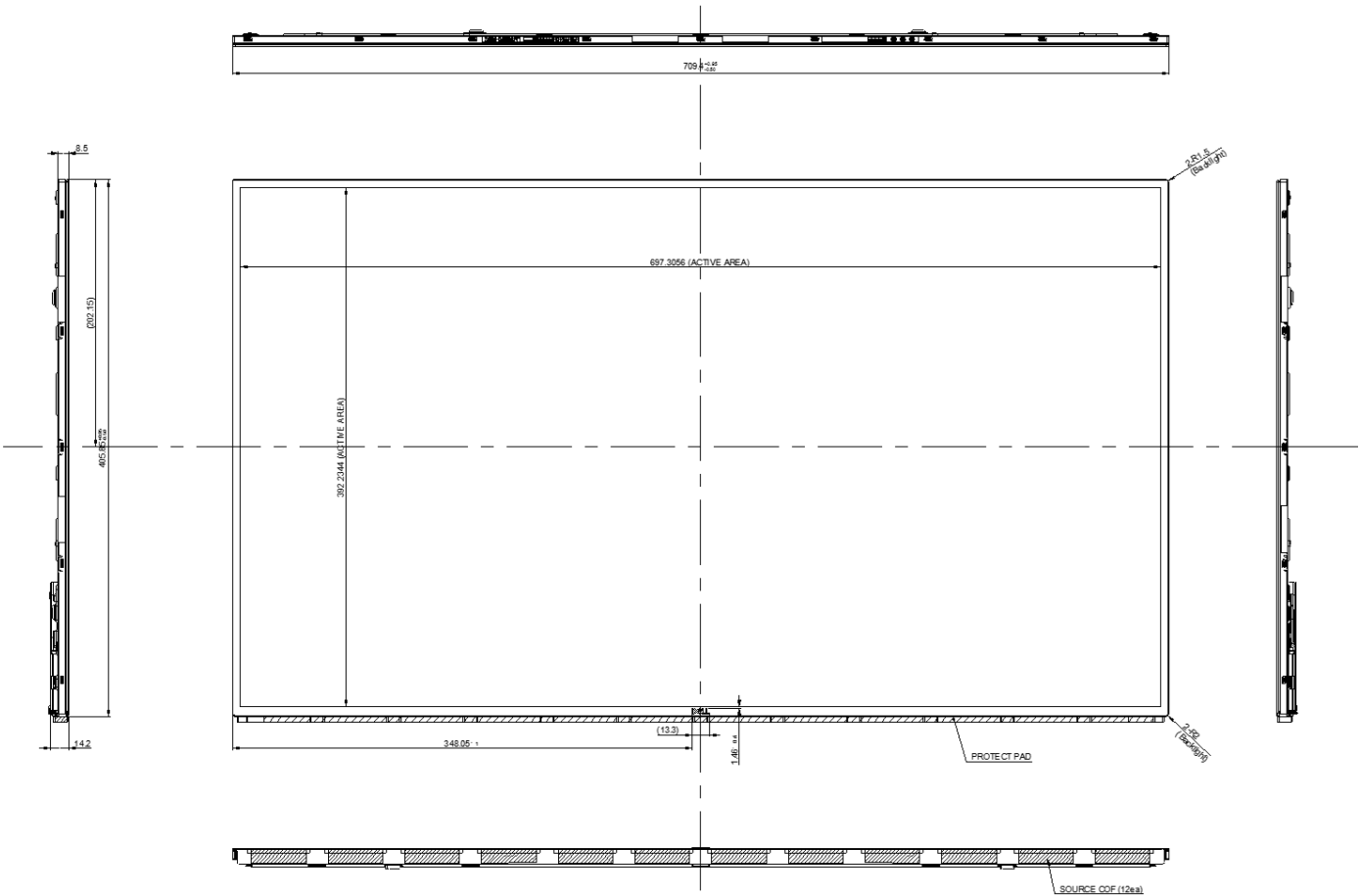
| | | |
|---------------------|---|-----------|
| Outline dimension | Horizontal | 709.40 mm |
| | Vertical | 405.85 mm |
| | Depth | 14.20 mm |
| Bezel area | Horizontal | - |
| | Vertical | - |
| Active display area | Horizontal | 697.31 mm |
| | Vertical | 392.23 mm |
| Weight | Typ. : 3,190g, Max. : 3,350g | |
| Surface Treatment | Advanced Anti-glare treatment of the front polarizer (3H) | |

Notes : Please refer to a mechanic drawing in terms of tolerance at the next page.

Outline dimensions (horizontal, vertical and outside depth) are measured by using vernier calipers.
The inside depth dimensions are measured by using height gauge, when LCM is put face down onto a flat surface.

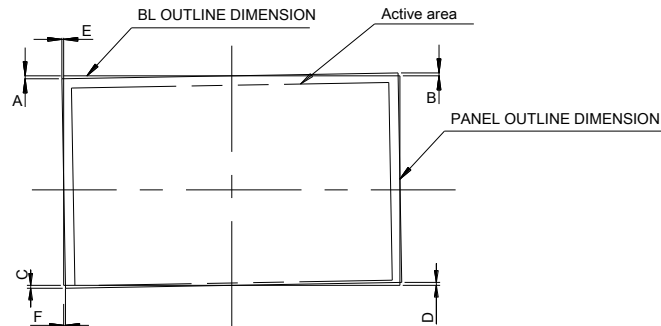
Product specification

<FRONT VIEW>



Notes

1. I/F Connector specification : LSMtron, GT05Q-30S-H10-MN or Equivalent
2. LED connector specification : SM06B-SHJH (HF) (Manufactured by JST) or Equivalent
3. Torque of user hole : 3.0~4.0kgf.cm
4. Tilt and partial disposition tolerance of display area as following
 - (1) Y-direction
 - a. Upper side : $-0.45 \leq A \leq 0.45$, $-0.45 \leq B \leq 0.45$
 - b. Lower side : $-0.45 \leq C \leq 0.6$, $-0.45 \leq D \leq 0.6$
 - (2) X-direction : $-0.45 \leq E \leq 0.45$, $-0.45 \leq F \leq 0.45$

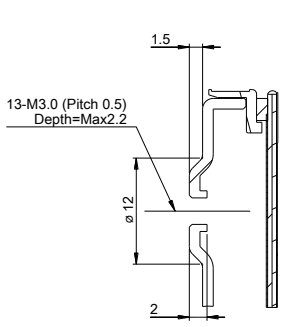
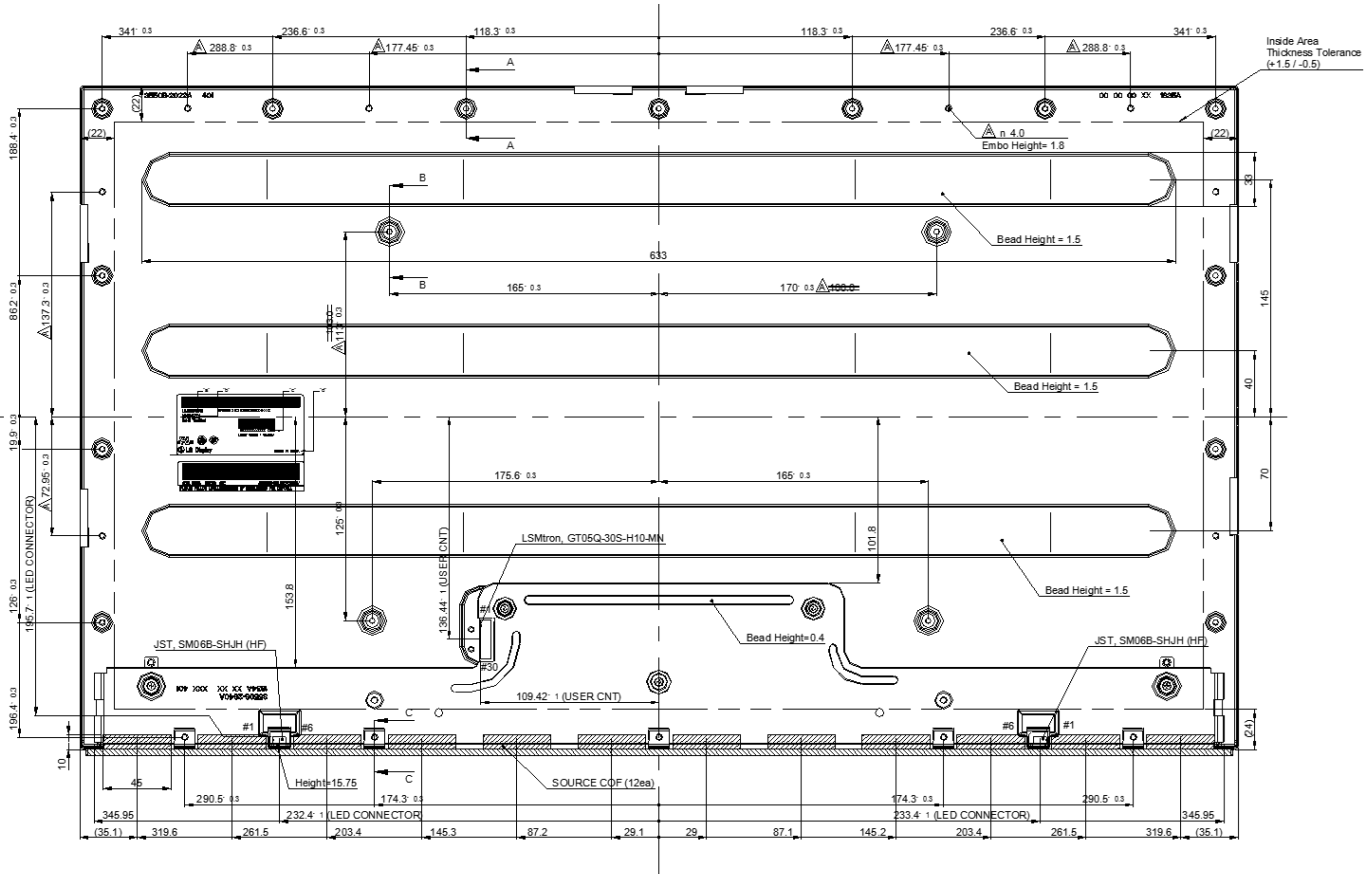


5. Unspecified tolerance is ± 0.5
6. The LCM warp(warpage) is less than 1.0 on the surface plate
7. The COF area is weak & sensitive, so please don't press the COF area
8. Undefined height should follow the 3D Modeling data
9. Protect Pad should not be removed unless system assembling

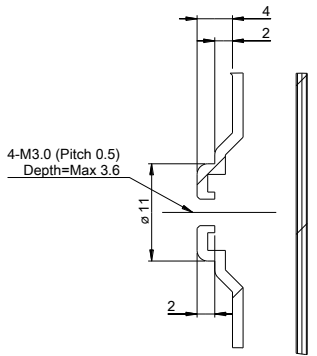
Product specification

<REAR VIEW>

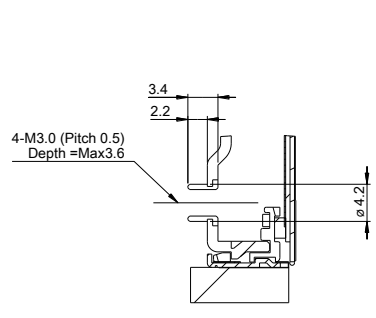
*** Reverse Panel**



SECTION A-A
SCALE 2/1



SECTION B-B
SCALE 2/1



SECTION C-C
SCALE 2/1

LGD Highly recommendation :

As The IPS panel is sensitive & slim, please recommend the metal frame of the system supports the panel by the double side-mount.

Product specification
6. Reliability

Environment test condition

| No | Test Item | Condition |
|----|--|---|
| 1 | High temperature storage test | Ta= 60°C 240h |
| 2 | Low temperature storage test | Ta= -20°C 240h |
| 3 | High temperature operation test | Ta= 50°C 50%RH 240h |
| 4 | Low temperature operation test | Ta= 0°C 240h |
| 5 | Humidity condition Operation | Ta= 40 °C ,90%RH |
| 6 | Altitude operating storage / shipment | 0 – 16,400 feet (5,000m) 0 - 40,000 feet (12,192m) |
| 7 | Maximum Storage Humidity for 4 corner light leakage Mura. | Max 70%RH , Ta=40°C |

Note 1. Result Evaluation Criteria:

TFT-LCD panels test should take place after cooling enough at room temperature.

In the standard condition, there should be no particular problems that may affect the display function.

 ※. T_a= Ambient Temperature

7. International standards

7-1. Safety

- a) UL 60950-1, Underwriters Laboratories Inc.
Information Technology Equipment - Safety - Part 1 : General Requirements.
- b) CAN/CSA-C22.2 No. 60950-1-07, Canadian Standards Association.
Information Technology Equipment - Safety - Part 1 : General Requirements.
- c) EN 60950-1, European Committee for Electrotechnical Standardization (CENELEC).
Information Technology Equipment - Safety - Part 1 : General Requirements.
- d) IEC 60950-1, The International Electrotechnical Commission (IEC).
Information Technology Equipment - Safety - Part 1 : General Requirements

7-2. Environment

- a) RoHS, Directive 2011/65/EU of the European Parliament and of the council of 8 June 2011

Product specification

8. Packing

8-1. Designation of lot mark

a) Lot mark

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

A,B,C : SIZE(INCH)
E : MONTH

D : YEAR
F ~ M : SERIAL NO.

Note

1. YEAR

| | | | | | | | | | | |
|------|------|------|------|------|------|------|------|------|------|------|
| Year | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
| Mark | A | B | C | D | E | F | G | H | J | K |

2. MONTH

| | | | | | | | | | | | | |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Mark | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C |

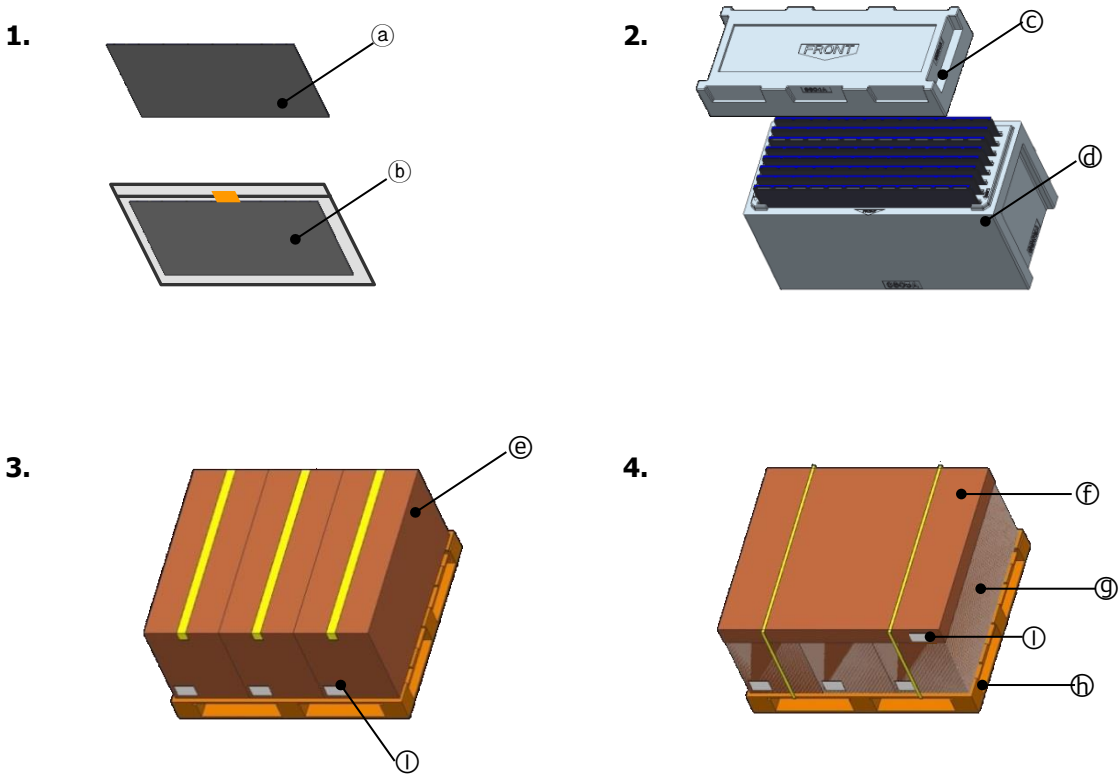
b) Location of lot mark

Serial No. is printed on the label. The label is attached to the backside of the LCD module.
This is subject to change without prior notice.

Product specification

8-2. Packing form

- a) Package quantity in one packing : 8 ea
Package quantity in one Pallet : 24 ea
- b) Packing Size : 814mm X 358 mm X 509 mm
- c) Pallet Ass'y Size: 1140 mm X 870 mm X 652 mm



| No. | Description | Material |
|-----|-----------------|-----------|
| (a) | LCM | - |
| (b) | AL-Bag | AL |
| (c) | Packing, Top | EPS |
| (d) | Packing, Bottom | EPS |
| (e) | Box | Paper(SW) |
| (f) | Angle Cover | Paper(SW) |
| (g) | Wrap | LDPE |
| (h) | Pallet | Plywood |
| (l) | Label | YUPO |

Product specification

9. Precautions

Please pay attention to the followings when you use this TFT LCD module.

9-1. Mounting precautions

- (1) You must mount a module using holes arranged in rear side.
- (2) You should consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- (3) Please attach the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to resist external force.
- (4) You should adopt radiation structure to satisfy the temperature specification.
- (5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- (6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment. Do not touch the surface of polarizer for bare hand or greasy cloth. (Some cosmetics are detrimental to the polarizer.)
- (7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- (8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
- (9) Do not open the case because inside circuits do not have sufficient strength.

9-2. Operating precautions

- (1) Response time depends on the temperature. (In lower temperature, it becomes longer.)
- (2) Brightness depends on the temperature. (In higher temperature, it becomes lower.)
And in lower temperature, response time (required time that brightness is stable after turned on) becomes longer.
- (3) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- (4) When fixed patterns are displayed for a long time, remnant image is likely to occur.
- (5) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.
- (6) Please do not give any mechanical and/or acoustical impact to LCM. Otherwise, LCM can't be operated its full characteristics perfectly.
- (7) A screw which is fastened up the steels should be a machine screw.
(If not, it causes metallic foreign material and deal LCM a fatal blow)
- (8) Please do not set LCD on its edge.
- (9) When LCMs are used for public display, defects such as Yogore & image sticking can not be guaranteed.
- (10) LCM cannot support "Interlaced scan method"
- (11) When this reverse model is used as a forward-type model (PCB on top side), LGD can not guarantee any defects of LCM.
- (12) Please conduct image sticking test after 2-hour aging with Rolling pattern and normal temperature. (25~40°C)

Product specification

9-3. Electrostatic discharge control

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

9-4. Precautions for strong light and hazardous materials exposure

Strong light exposure causes degradation of polarizer and color filter.

The LCM should be avoided direct contact with Hazardous materials such as sulfur, acetic acid, chlorine, etc. These materials may cause chemical reaction such as sulfurization, corrosion, discoloration, etc.

9-5. Storage

When storing modules as spares for a long time, the following precautions are necessary.

- (1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
- (2) The polarizer surface should not come in contact with any other object.
It is recommended that they be stored in the container in which they were shipped.

9-6. Handling precautions for protection film

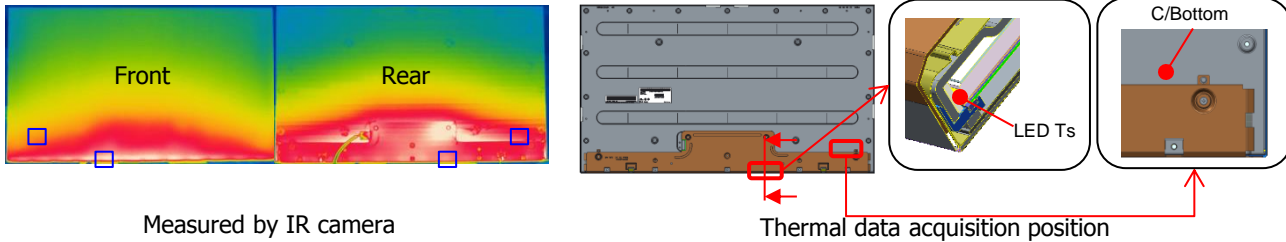
- (1) The protection film is attached to the bezel with a small masking tape.
When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
- (2) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the bezel after the protection film is peeled off.
- (3) You can remove the glue easily. When the glue remains on the bezel surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

Product specification

APPENDIX

■ LCM test result for operating HDR function

- 1) It is recommended that thermal sensor in system should be placed on the surface of C/Bottom near the LED with high temperature when measured by IR camera.



- 2) Measurement of temperature by time.
When the temperature is over 63.9°C on C/Bottom, defects are founded due to thermal effect.

Table 1 : Temperature data at typical luminance(110mA), ambient temperature(50°C)

| 110mA (Typ.) | Measure Point Temp. (Ambi. 50°C) | | |
|--------------|----------------------------------|------------|-----------------------|
| Time(min.) | C/Bottom(°C) | LED Ts(°C) | LED Ts - C/Bottom(°C) |
| 30 | 62.1 | 76.3 | 12.2 |
| 60 | 63.4 | 78.0 | 12.6 |
| 90 | 63.5 | 78.3 | 12.8 |
| 120 | 63.9 | 78.4 | 12.5 |

Table 2 : Temperature data at 500nit luminance(145mA), ambient temperature(25°C)

| 145mA | Measure Point Temp. (Ambi. 25°C) | | | Remark | |
|-----------|----------------------------------|------------|-----------------------|----------|-------------|
| Time(sec) | C/Bottom(°C) | LED Ts(°C) | LED Ts - C/Bottom(°C) | Interval | Current |
| Base | 41.1 | 56.3 | 15.2 | 120min | 110mA(Typ.) |
| 30 | 41.7 | 59.4 | 17.7 | 0.5min | 145mA |
| 60 | 41.9 | 60.0 | 18.1 | | |
| 90 | 42.2 | 60.5 | 18.3 | | |
| 120 | 42.4 | 60.7 | 18.3 | | |
| 150 | 42.6 | 61.0 | 18.4 | | |
| 180 | 42.7 | 61.2 | 18.5 | | |
| 240 | 42.9 | 61.5 | 18.6 | | |
| 300 | 43.2 | 61.9 | 18.7 | 1min | |
| 360 | 43.5 | 62.1 | 18.6 | | |
| 420 | 43.7 | 62.4 | 18.7 | | |
| 480 | 43.9 | 62.6 | 18.7 | | |
| 540 | 44.0 | 62.8 | 18.8 | | |
| 600 | 44.2 | 63.0 | 18.8 | 5min | |
| 900 | 44.7 | 63.5 | 18.8 | | |
| 1200 | 45.1 | 63.8 | 18.7 | | |
| 1500 | 45.4 | 64.2 | 18.8 | | |
| 1800 | 45.5 | 64.4 | 18.9 | | |

Product specification

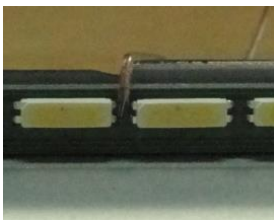
APPENDIX

■ LCM test result for operating HDR function

Table 3 : Temperature data at peak luminance(160mA), ambient temperature(25 °C)

| 160mA (Peak) Time(sec) | Measure Point Temp. (Ambi. 25°C) | | | Remark | |
|---------------------------|----------------------------------|------------|-----------------------|----------|--------------|
| | C/Bottom(°C) | LED Ts(°C) | LED Ts - C/Bottom(°C) | Interval | Current |
| Base | 41.1 | 56.3 | 15.2 | 120min | 110mA(Typ.) |
| 30 | 41.9 | 61.4 | 19.5 | 0.5min | 160mA(Peak.) |
| 60 | 42.0 | 62.3 | 20.3 | | |
| 90 | 42.3 | 62.9 | 20.6 | | |
| 120 | 42.7 | 63.3 | 20.6 | | |
| 150 | 43.0 | 63.6 | 20.6 | | |
| 180 | 43.1 | 64.0 | 20.9 | | |
| 240 | 43.6 | 64.5 | 20.9 | | |
| 300 | 44.0 | 64.9 | 20.9 | 1min | |
| 360 | 44.2 | 65.2 | 21.0 | | |
| 420 | 44.6 | 65.6 | 21.0 | | |
| 480 | 44.8 | 65.8 | 21.0 | | |
| 540 | 45.0 | 66.1 | 21.1 | | |
| 600 | 45.2 | 66.3 | 21.1 | 5min | |
| 900 | 46.3 | 67.6 | 21.3 | | |
| 1200 | 46.5 | 67.9 | 21.4 | | |
| 1500 | 46.5 | 68.0 | 21.5 | | |
| 1800 | 46.6 | 68.2 | 21.6 | | |

3) The temperature data of the LCM was measured by using a contact thermocouple (see attached Fig).



LED Ts



C/Bottom



Temperature Meter (Lutron TM-947SD / 4ch)

| GENERAL SPECIFICATIONS | | | |
|------------------------|--|---|--|
| Circuit | Custom one-chip of microprocessor LSI circuit. | | |
| Channels | T1, T2, T3, T4, T1-T2. | | |
| Sensor type | Type K thermocouple probe. Type J/T/E/R/S thermocouple probe. PT 100 ohm probe * Cooperate with an 0.00385 alpha coefficient, meet DIN IEC 751. | | |
| Resolution | 0.1°C / 1°C, 0.1°F / 1°F. | | |
| Type K | Sensor | Resolution | Accuracy |
| Type K | 0.1 °C | -50.1 to -100.0 °C -50.0 to 999.9 °C | ± (0.4 % + 1 °C) ± (0.4 % + 0.5 °C) |
| | 1 °C | 1000 to 1300 °C | ± (0.4 % + 1 °C) |
| | 0.1 °F | -58.1 to -148.0 °F -58.0 to 999.9 °F | ± (0.4 % + 1.8 °F) ± (0.4 % + 1 °F) |
| | 1 °F | 1000 to 2372 °F | ± (0.4 % + 2 °F) |

| Luminance(nit) | LED String Current(mA) | LED String Voltage(V) (Tolerance : ± 2.2V) |
|----------------|------------------------|---|
| 400 | 110 | 32.2 |
| 450 | 130 | 32.7 |
| 500 | 145 | 33.0 |
| 550 | 160 | 33.4 |

Our company network supports you worldwide with offices in Germany, Austria, Switzerland, the UK and the USA. For more information please contact:

Headquarters

Germany



FORTEC Elektronik AG

Augsburger Str. 2b
82110 Germering

Phone: +49 89 894450-0
E-Mail: info@forteca.de
Internet: www.forteca.de

Fortec Group Members

Austria



Distec GmbH Office Vienna

Nuschinggasse 12
1230 Wien

Phone: +43 1 8673492-0
E-Mail: info@distec.de
Internet: www.distec.de

Germany



Distec GmbH

Augsburger Str. 2b
82110 Germering

Phone: +49 89 894363-0
E-Mail: info@distec.de
Internet: www.distec.de

Switzerland



ALTRAC AG

Bahnhofstraße 3
5436 Würenlos

Phone: +41 44 7446111
E-Mail: info@altrac.ch
Internet: www.altrac.ch

United Kingdom



Display Technology Ltd.

Osprey House, 1 Osprey Court
Hichingbrooke Business Park
Huntingdon, Cambridgeshire, PE29 6FN

Phone: +44 1480 411600
E-Mail: info@displaytechnology.co.uk
Internet: www.displaytechnology.co.uk

USA



Apollo Display Technologies, Corp.

87 Raynor Avenue,
Unit 1 Ronkonkoma,
NY 11779

Phone: +1 631 5804360
E-Mail: info@apolloDisplays.com
Internet: www.apolloDisplays.com