

APPROVAL

| PART NO. | DESCRIPTION | REMARKS |
|----------------|---|-------------------------------|
| HT2201L | LCD MODULE (176 x RGB x 220 Dots) | This is ROHS compliant |

| | |
|--------------------------|--|
| CUSTOMER APPLICATION P/N | |
| APPROVED BY | |
| DATE | |

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HEREIN AND RETURN ONE COPY HERE OF WITH YOUR SIGNATURE OF APPROVAL.

| PERPARED BY | CHECKED BY | CONFIRMED BY |
|-------------|------------|--------------|
| | | |



HYES Optoelectronics, Inc.

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1. Basic Specifications

1.1 Display Specifications

| Item | Description | Note |
|-------------------|-----------------------------------|------------|
| Resolution | 176 × RGB × 220 | |
| Display mode | TFT, Normally White, Transmissive | 262K Color |
| Viewing direction | 6 O'clock | |
| Driving method | 528Ch-Source, 220Ch-Gate | |
| Backlighting | LED, White (4 chips in Serial) | |
| Diver IC | R61503U, COG | |
| Others | - | |

1.2 Mechanical Specifications

| Item | Specification | Unit |
|-------------------------|--------------------|------|
| Module Size (W × H × T) | 40.4 × 56.0 × 2.55 | mm |
| Viewing Area (W × H) | - | mm |
| Active Area (W × H) | 34.848 × 43.56 | mm |
| Dot Size (W × H) | 0.056 × 0.188 | mm |
| Dot Pitch (W × H) | 0.066 × 0.198 | mm |
| Weight | - | g |

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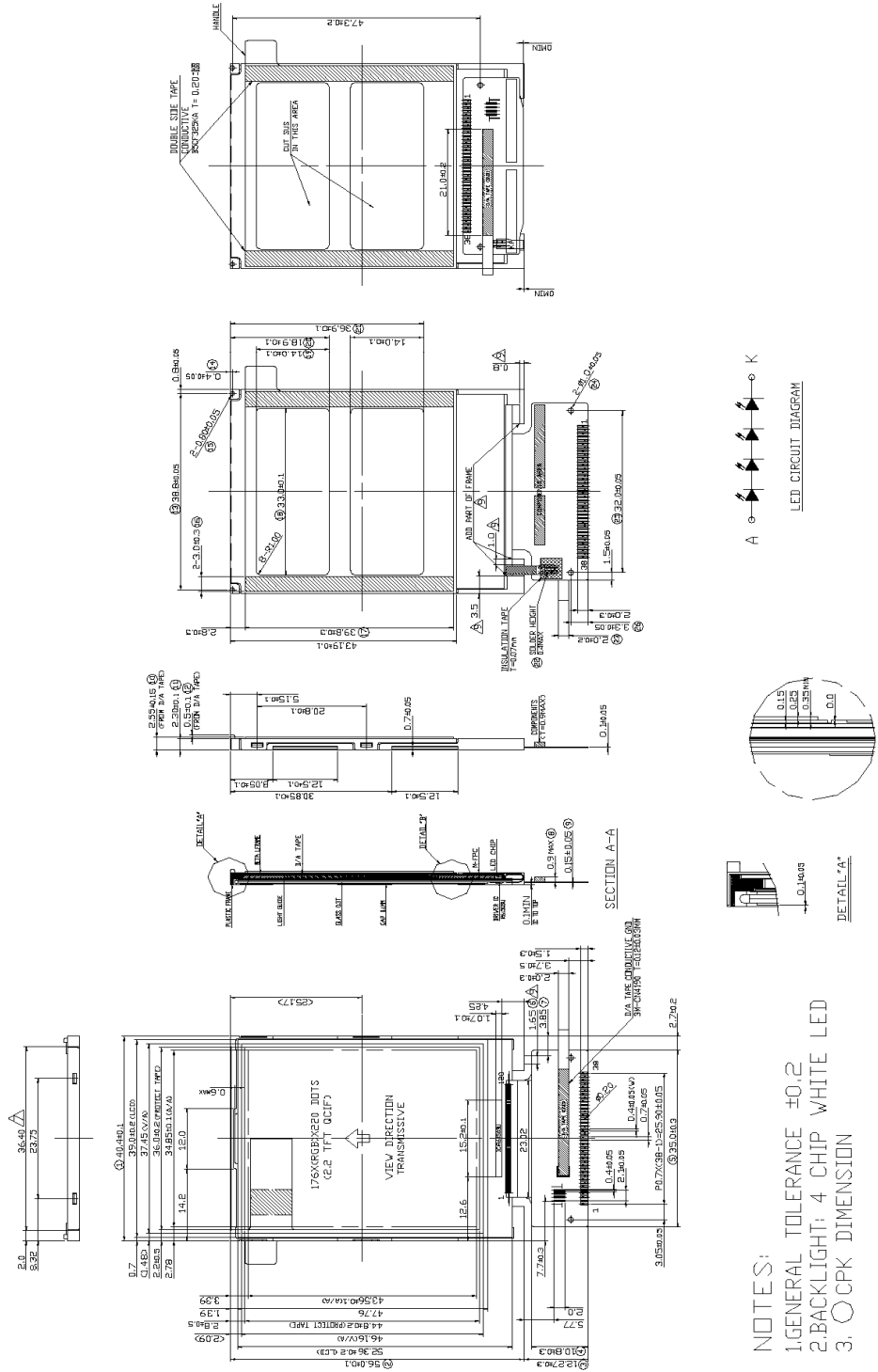
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1.3 Outline Dimension

FPC CONNECTION

| | |
|----|---------|
| 1 | GND |
| 2 | XL |
| 3 | YD |
| 4 | XR |
| 5 | YU |
| 6 | GND |
| 7 | LCM_ID |
| 8 | VCC&VCL |
| 9 | IDVCC |
| 10 | NC |
| 11 | /CS |
| 12 | RS |
| 13 | /WR |
| 14 | /RD |
| 15 | DB00 |
| 16 | DB01 |
| 17 | DB02 |
| 18 | DB03 |
| 19 | DB04 |
| 20 | DB05 |
| 21 | DB06 |
| 22 | DB07 |
| 23 | DB08 |
| 24 | DB09 |
| 25 | DB10 |
| 26 | DB11 |
| 27 | DB12 |
| 28 | DB13 |
| 29 | DB14 |
| 30 | DB15 |
| 31 | DB16 |
| 32 | DB17 |
| 33 | /RESET |
| 34 | IM3 |
| 35 | IMO |
| 36 | LEDA |
| 37 | LEDK |
| 38 | GND |



NOTES:
 1. GENERAL TOLERANCE ± 0.2
 2. BACKLIGHT: 4 CHIP WHITE LED
 3. \varnothing CPK DIMENSION

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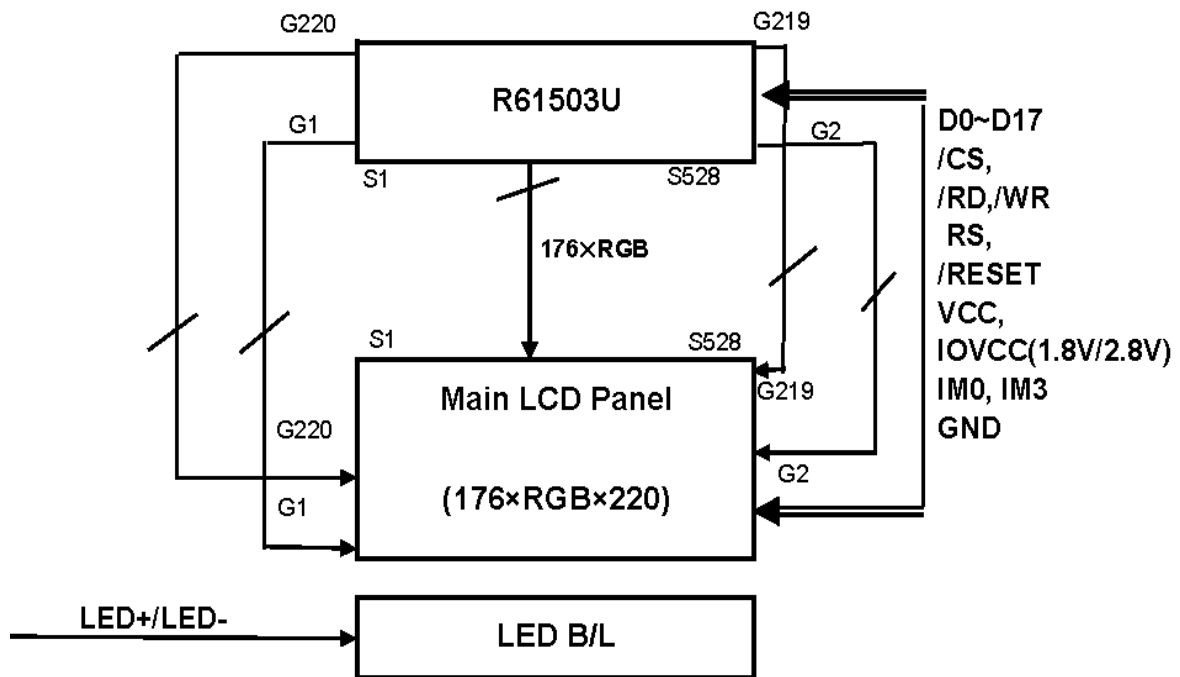


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1.4 Block Diagram



| IM3 | IM0 | Interface | Datebus |
|-----|-----|------------------|-------------------|
| 0 | 0 | 16-bit interface | DB17-DB10,DB8-DB1 |
| 0 | 1 | 8-bit interface | DB17-DB10 |
| 1 | 0 | 18-bit interface | DB17-DB0 |
| 1 | 1 | 9-bit interface | DB17-DB9 |

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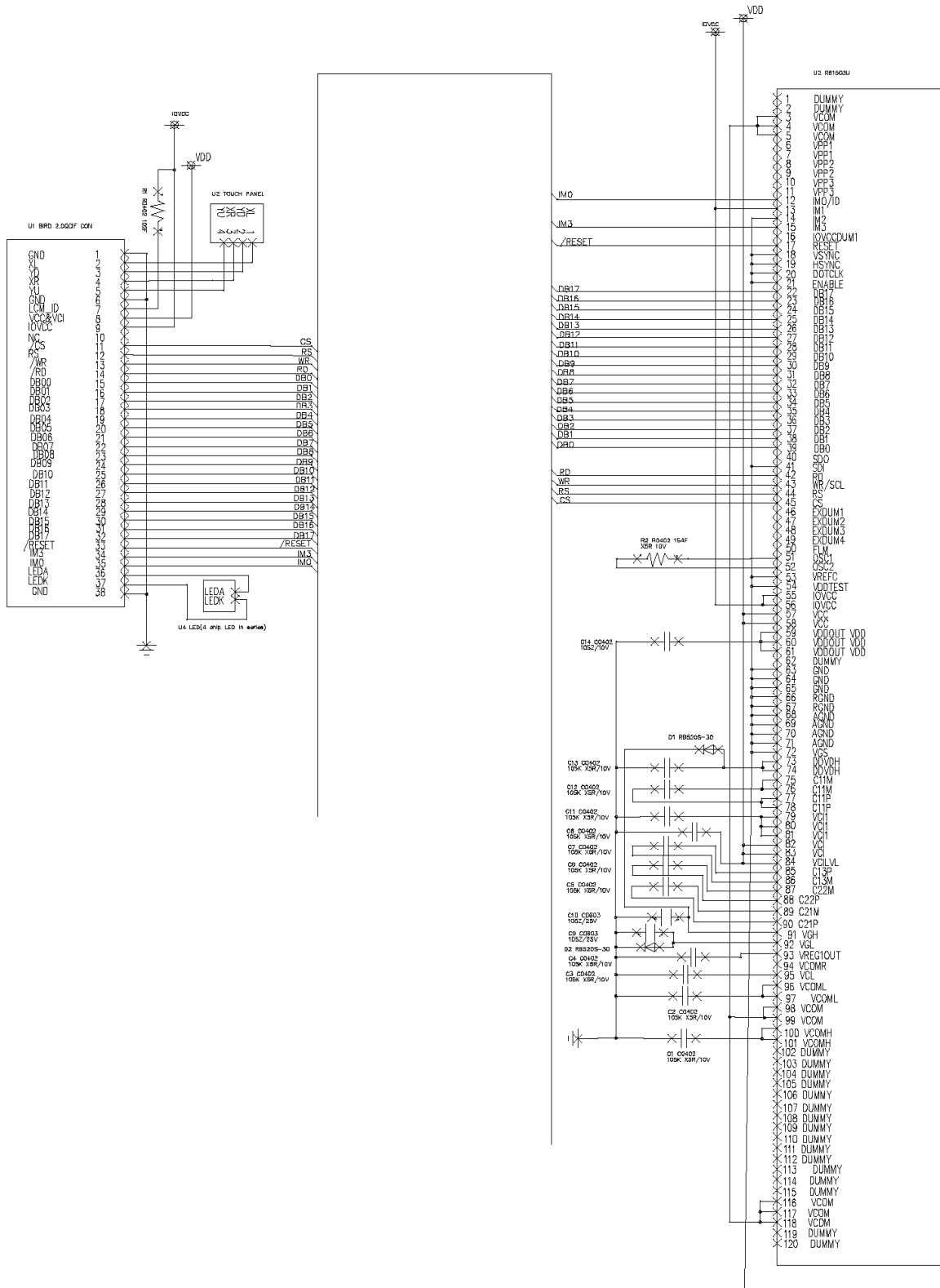
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1.5 Schematic



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2. Electrical Characteristics

2.1 Absolute Maximum Ratings

| Item | Symbol | Value | | | Unit | Condition | Remark |
|----------------|-----------------|-----------------|------|-----------|------|-----------|---------|
| | | Min. | Typ. | Max | | | |
| Supply Voltage | Logic | V _{CC} | -0.3 | - | 4.6 | V | Ta =25℃ |
| | LCD | VGH-VGL | -0.3 | - | 30 | V | Ta =25℃ |
| Input Voltage | V _{IN} | -0.3 | - | VCC + 0.3 | V | Ta =25℃ | |

2-2 Environmental Conditions

| Item | Symbol | Min. | Max. | Unit |
|--------------------------------------|----------|------|-------------|------|
| Operating temperature | Topr | -30 | 70 | ℃ |
| Storage temperature | Tstg | -40 | 80 | ℃ |
| Humidity (Ambient temperature=Ta) | Ta ≤ 50℃ | | 95% RH max. | |

2-3 DC Characteristics

| Items | Sysbol | Spec. Value | | | Unit | Condition | |
|-------------------|------------|-----------------|-------------------------|------|-----------------------|-----------|---------|
| | | Min. | Typ. | Max. | | | |
| Operating voltage | Logic | VCC | 2.72 | 2.8 | 2.88 | V | |
| | | | 1.72 | 1.8 | 1.88 | V | |
| | Vgate | VGH - VGL | - | 22.0 | - | V | Note 1) |
| Supply current | ICC | | - | 2.0 | 4.0 | mA | Note 2) |
| | | | - | 2.0 | 4.2 | mA | Note 3) |
| Input voltage | High level | V _{IH} | 0.8 × IOV _{CC} | - | IOV _{CC} | V | - |
| | Low level | V _{IL} | -0.3 | - | 0.2 × V _{CC} | V | - |

Note 1) The value can adjusted by software to optimize display quality

Note 2) Display White

Note 3) Display Black

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3. Optical Characteristics

Transmissive mode

(Ta = 25°C)

| Item | Symbol | | Min. | Typ. | Max. | Unit | Condition | Note |
|-------------------------|---------|--------------|------------|------------|------------|-------------------|----------------|------|
| Viewing | θ2-θ1 | ∅=0 (Y1-Y2) | 50 | 60 | - | Deg | Cr > 10 | |
| | | ∅=90 (X1-X2) | 80 | 90 | - | | | |
| Contrast ratio | Cr | | 200 | 300 | - | - | θ = 0 ∅ = 0 | |
| Response Time | Tr + Tf | | - | 25 | 40 | ms | θ = 0 ∅ = 0 | |
| CIE Coordi- -nate | R | (x,y) | 0.52, 0.28 | 0.57, 0.33 | 0.62, 0.38 | | θ = 0 ∅ = 0 | |
| | G | (x,y) | 0.29, 0.56 | 0.34, 0.61 | 0.39, 0.66 | | | |
| | B | (x,y) | 0.10, 0.05 | 0.15, 0.10 | 0.20, 0.15 | | | |
| | W | (x,y) | 0.24, 0.26 | 0.28, 0.31 | 0.34, 0.36 | | | |
| Brightness | L | | 200 | 240 | - | cd/m ² | ILED=18mA | |
| Uniformity | | | 70 | - | - | | | |

* ∅ = 0°, ∅ = 90° means viewing direction.

* B/L is turned on.

* Remark : as for contrast ratio, it is measured in panel only.

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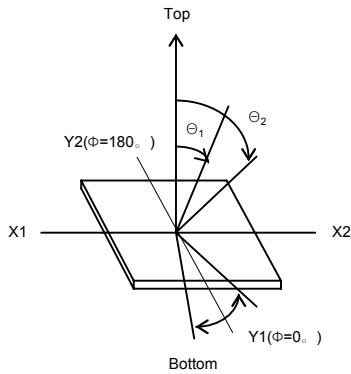
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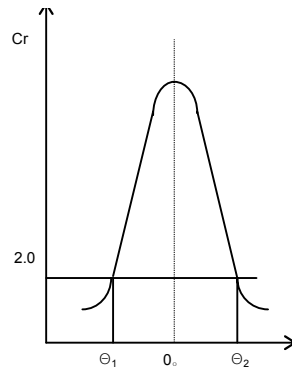
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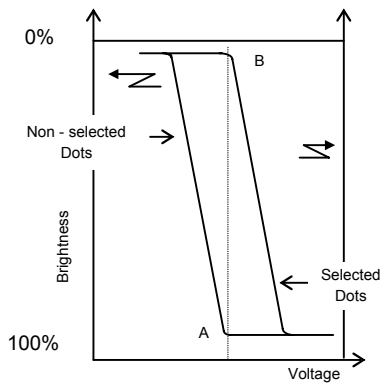
Note 1 . Definition of angle Θ and Φ



Note 2. Definition of viewing angle Θ_1 and Θ_2



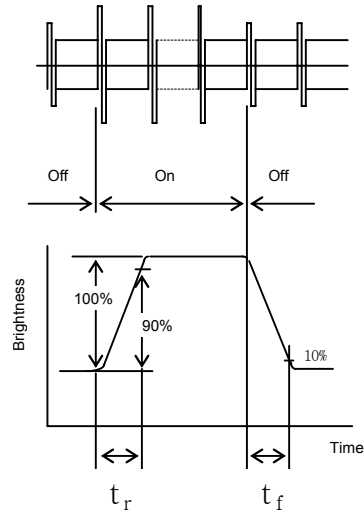
Note 3. Definition of contrast Cr



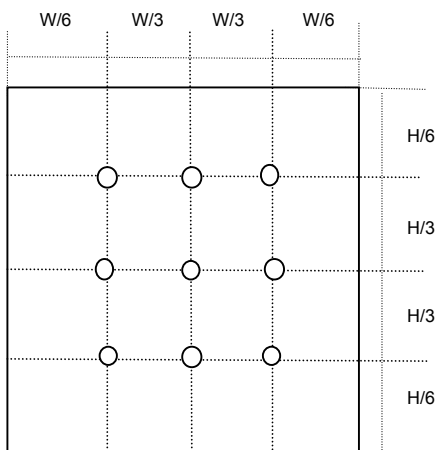
$Cr = (A/B)^P$ Negative : P = -1 Set Point
Positive : P = +1

Lens $\varnothing = 3\text{mm}$

Note 4. Definition of Optical response



Note 5. Measuring Point(9 POINTS) (WxH)



Rating is defined as the average brightness inside the viewing area

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4. Interface Pins

| no | symbol | Description |
|----|---------|---|
| 1 | GND | GND |
| 2 | XL | NC |
| 3 | YD | NC |
| 4 | XR | NC |
| 5 | YU | NC |
| 6 | GND | GND |
| 7 | LCM_ID | Connect 1k resistor with IOVCC(1.8V/2.8V) |
| 8 | VCC&VCI | VCC(2.8V) |
| 9 | IOVCC | IOVCC(1.8V/2.8V) |
| 10 | NC | NC |
| 11 | /CS | Chip select signal(low active) |
| 12 | RS | RS Signal (RS=0 : Contro,RS=1 : data) |
| 13 | /WR | Write Signal (low active) |
| 14 | /RD | Read Signal(low active) |
| 15 | DB0 | Data Bit0 |
| 16 | DB1 | Data Bit1 |
| 17 | DB2 | Data Bit2 |
| 18 | DB3 | Data Bit3 |
| 19 | DB4 | Data Bit4 |
| 20 | DB5 | Data Bit5 |
| 21 | DB6 | Data Bit6 |
| 22 | DB7 | Data Bit7 |
| 23 | DB8 | Data Bit8 |
| 24 | DB9 | Data Bit9 |
| 25 | DB10 | Data Bit10 |
| 26 | DB11 | Data Bit11 |
| 27 | DB12 | Data Bit12 |
| 28 | DB13 | Data Bit13 |
| 29 | DB14 | Data Bit14 |
| 30 | DB15 | Data Bit15 |
| 31 | DB16 | Data Bit16 |
| 32 | DB17 | Data Bit17 |
| 33 | /RESET | RESET signal(low active) |
| 34 | IM3 | system interface control |
| 35 | IM0 | system interface control |
| 36 | LEDA | LED Anode |
| 37 | LEDK | LED Cathode |
| 38 | GND | GND |

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5. Backlight Specification (LED Unit)

| Item | Symbol | Spec. Value | | | Unit | Condition |
|-------------------|-----------|-------------|------|------|------|-----------|
| | | Min. | Typ. | Max. | | |
| Real Current | I_{LED} | - | 18 | 20 | mA | note 1. |
| Power dissipation | P_D | - | - | 350 | mW | note 2. |
| Operation temp. | Topr | - 30 ~ 70 | | | °C | - |
| Storage temp. | Tstr | - 40 ~ 80 | | | °C | - |

Note 1. B/L: 4EA LED in Serial, the typical current is 18mA(full brightness)

Note2. Total power consumption(max) depends on LED current/ LED driver efficiency, etc.

6. Recommended Software Setting Values (Initial code)

LDI : R61503U

| Initial code | |
|--------------------------|-------------------|
| 0000 | 0000 |
| 0000 | 0000 |
| 0000 | 0000 |
| 0000 | 0000 |
| 0000 | 0001 |
| Power supply on sequence | |
| 0007 | 0001 (DALAY 20)ms |
| 0018 | 0001 (DALAY 20)ms |
| 0010 | 17B0 |
| 0011 | 0000 |
| 0012 | 0117 |
| 0013 | 84B6 |
| 0012 | 0137 (DALAY 20)ms |
| Gamma setting | |
| 0030 | 0003 |
| 0031 | 0204 |
| 0032 | 0002 |
| 0033 | 0207 |
| 0034 | 0507 |
| 0035 | 0303 |
| 0036 | 0407 |
| 0037 | 0702 |
| 0038 | 1702 |
| 0039 | 010f |
| 003A | 0001 |
| other mode setting | |
| 0001 | 0100 |
| 0002 | 0400 |
| 0003 | 1030 |
| 0004 | 0000 |
| 0008 | 0202 |
| 0009 | 0111 |
| 000C | 0000 |
| 000E | 0000 |
| 000F | 0000 |
| 0014 | 0000 |
| 0020 | 0000 |
| 0021 | 0000 |
| 0070 | 1B00 |
| 0071 | 0001 |
| 007A | 0000 |
| 0090 | 0000 |
| 0091 | 0100 |
| 0092 | 0007 |
| 0098 | 0001 |
| 0099 | 030C |
| 009A | 030C |
| 009C | 0000 |
| 009D | 0000 |
| Display on sequence | |
| 0007 | 0001 (DALAY 20)ms |
| 0007 | 0021 (DALAY 20)ms |
| 0012 | 1137 |
| 0007 | 0233 |
| 0022 | |

Set standby mode

| Display off sequence | |
|---------------------------|------------------|
| 0007 | 0202 |
| 0012 | 0137(DALAY 50ms) |
| 0007 | 0200 |
| Power supply off sequence | |
| 0010 | 0780 |
| 0011 | 0060 |
| 0012 | 0127 |
| 0013 | 04B6(DALAY 50ms) |
| 0010 | 0700 |
| Standby set | |
| 0010 | 0701 |

Exit standby mode

| 0000 | 0001(DALAY 50ms) |
|--------------------------|------------------|
| 0010 | 17B0 |
| Power supply on sequence | |
| Display on sequence | |

Partial display

| 0080 | 0020(1st display area) |
|---------------------|------------------------|
| 0081 | 0020(1st display area) |
| 0082 | 0030(1st display area) |
| 0083 | 0060(2st display area) |
| 0084 | 0060(2st display area) |
| 0085 | 0090(2st display area) |
| Partial display on | |
| 0007 | 3033 |
| Partial display off | |
| 0007 | 0233 |

NOTE: HYES requires the customer to follow the above instructions strictly. If customer would like to change the above instructions, the customer should inform HYES and get re-check from HYES, or the customer will be responsible for any unexpected result because of the change.

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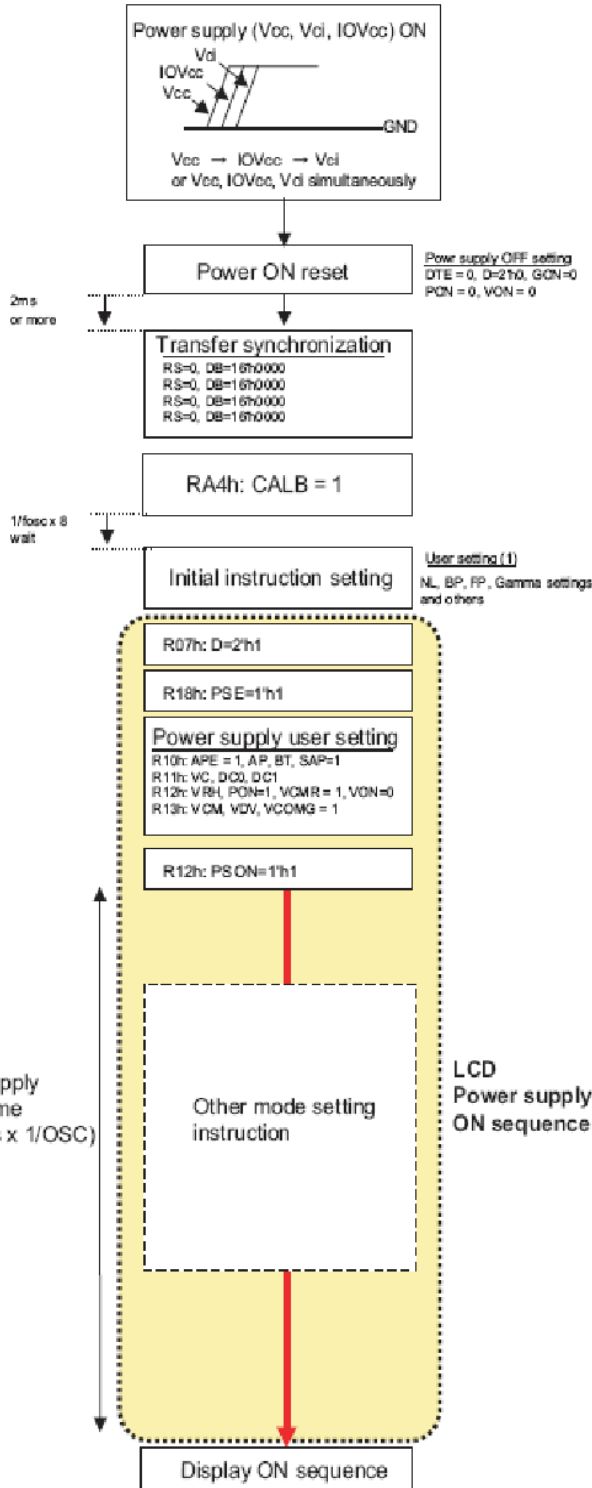
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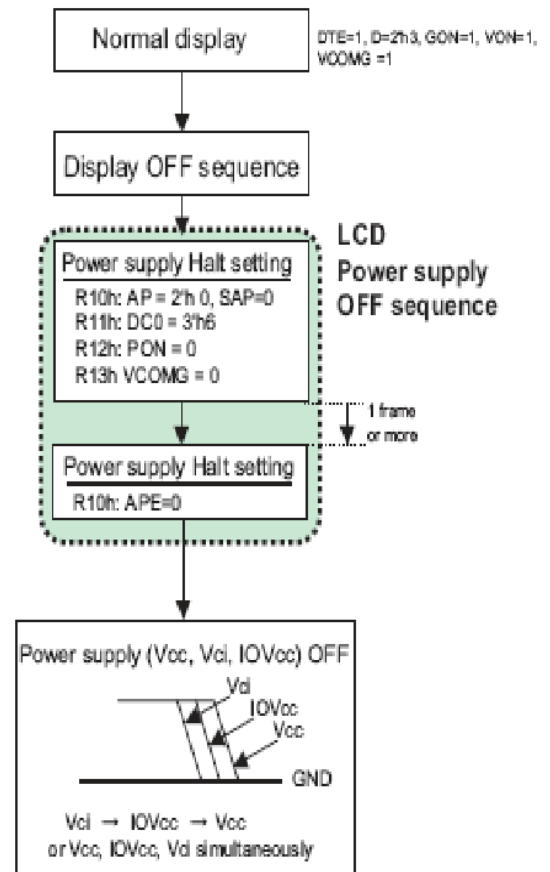
7. Power Supply Sequence & Instruction setting

7.1 Power Supply Sequence

Power ON sequence



Power supply OFF sequence



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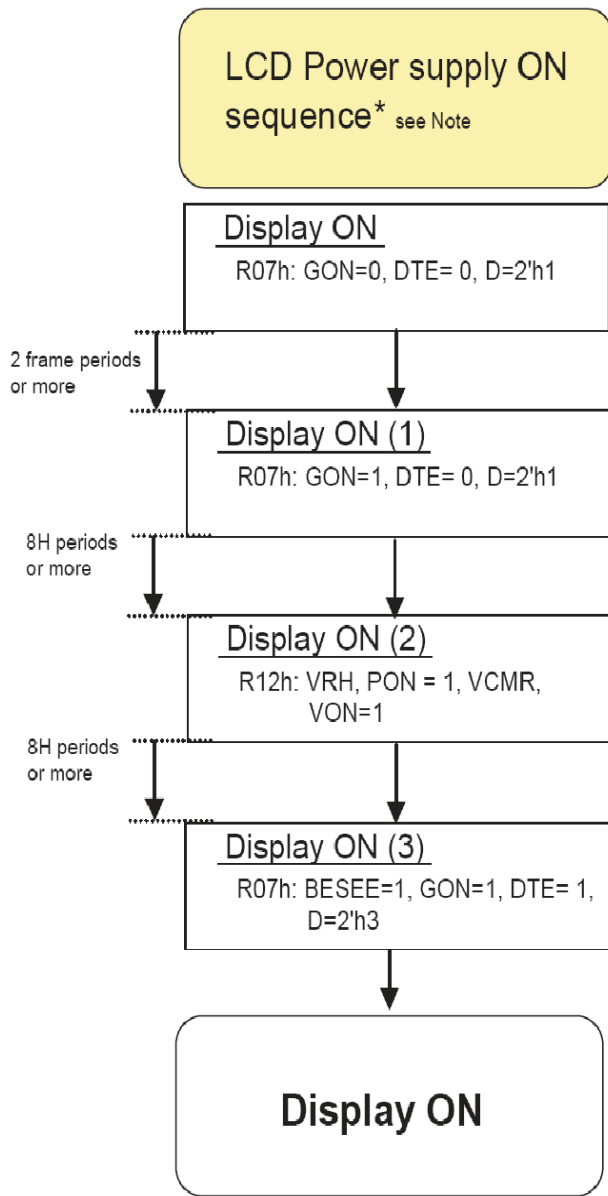
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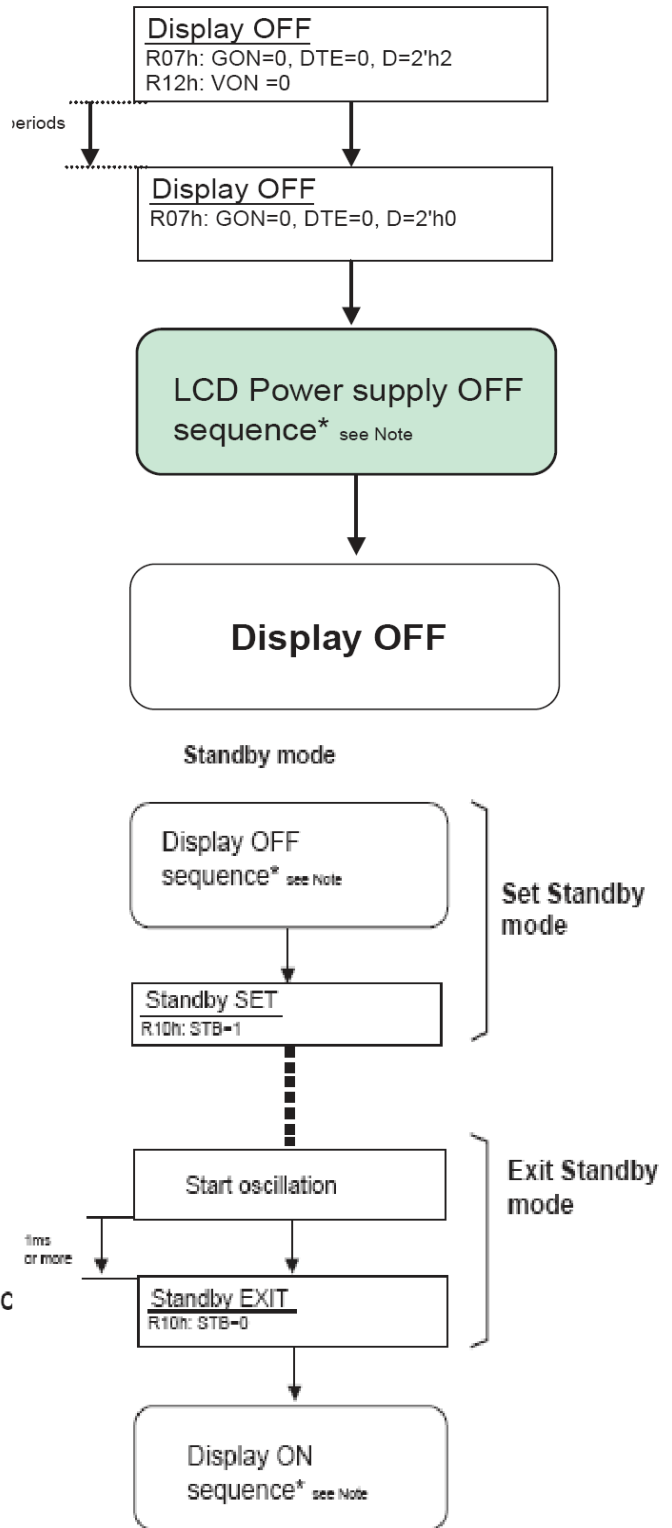
7.2 Instruction setting Sequence

Display ON sequence



Note: See power supply setting sequenc

Display OFF sequence



8. Read/Write Timing characteristics (80 series MPU)

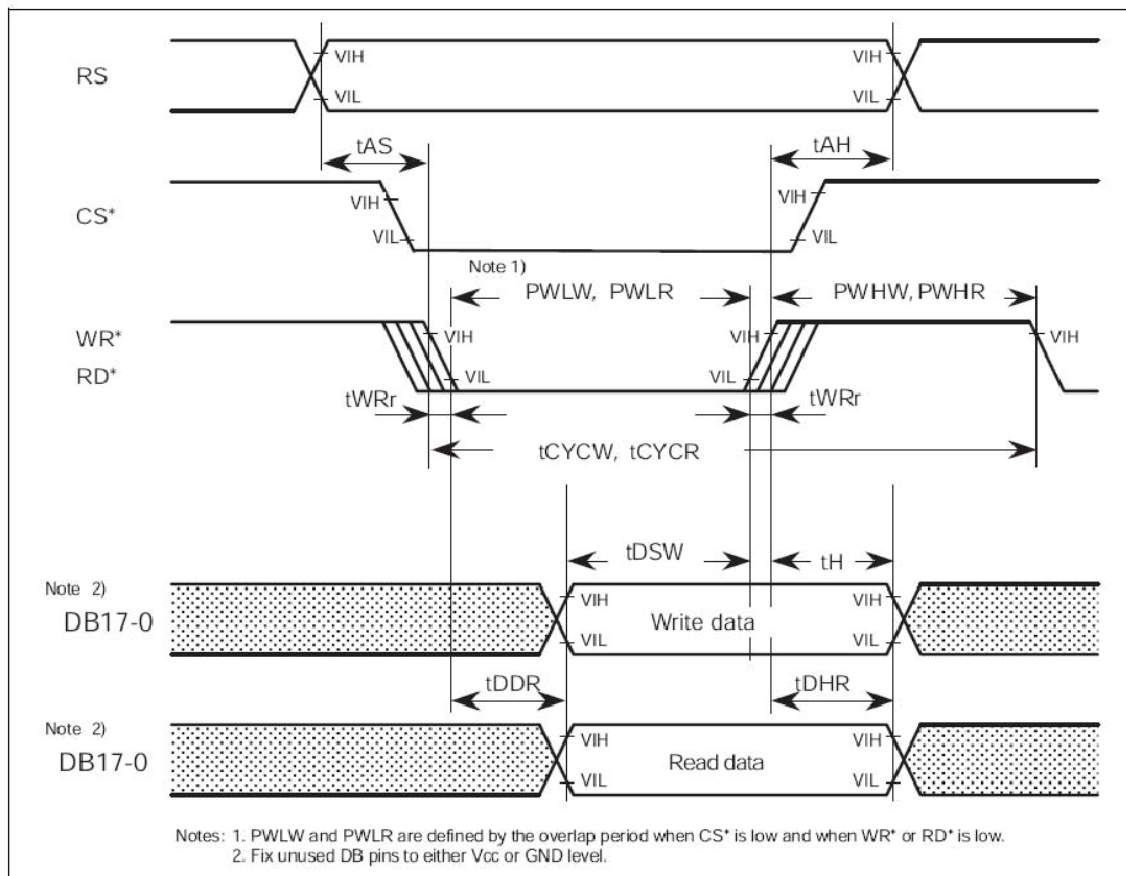


Table 86 Normal write operation (HWM= "0"), IOV_{cc} = 1.65V ~ 3.6V, V_{cc} = 2.5V ~ 3.6V

| Item | | Symbol | Unit | Timing diagram | Min | Typ | Max |
|------------------------------|---------------------|--------------------|------|----------------|-----|-----|-----|
| Bus cycle time | Write | t_{CYCW} | ns | Figure 89 | 120 | — | — |
| | Read | t_{CYCR} | ns | Figure 89 | 400 | — | — |
| Write low-level pulse width | | PW_{LW} | ns | Figure 89 | 40 | — | — |
| Read low-level pulse width | | PW_{LR} | ns | Figure 89 | 200 | — | — |
| Write high-level pulse width | | PW_{HW} | ns | Figure 89 | 50 | — | — |
| Read high-level pulse width | | PW_{HR} | ns | Figure 89 | 200 | — | — |
| Write/Read rise/fall time | | t_{WRr}, t_{DRr} | ns | Figure 89 | — | — | 25 |
| Setup time | Write (RS~CS*, WR*) | t_{AS} | ns | Figure 89 | 0 | — | — |
| | Read (RS~CS*, RD*) | | | | 10 | — | — |
| Address hold time | | t_{AH} | ns | Figure 89 | 2 | — | — |
| Write data setup time | | t_{DSW} | ns | Figure 89 | 25 | — | — |
| Write data hold time | | t_H | ns | Figure 89 | 5 | — | — |
| Read data delay time | | t_{DDR} | ns | Figure 89 | — | — | 100 |
| Read data hold time | | t_{DHR} | ns | Figure 89 | 5 | — | — |

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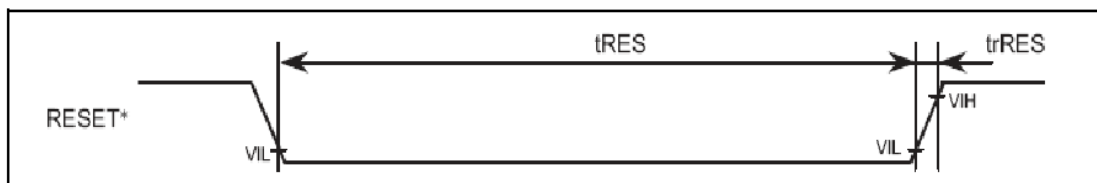
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Reset Timing characteristics

Reset Operation



| Item | Symbol | Unit | Timing diagram | Min | Typ | Max |
|-----------------------|------------|---------|----------------|-----|-----|-----|
| Reset low-level width | t_{RES} | ms | Figure 91 | 1 | — | — |
| Reset rise time | t_{rRES} | μ s | Figure 91 | — | — | 10 |

9. LCD Module Out-Going Quality Level

(1.0) Purpose

The LCD specification provides outgoing provision and its expected quality level based on our outgoing inspection of LCD.

(2.0) Applicable Scope

The LCD specification is applicable to the arrangement in regard to outgoing inspection and quality assurance after it.

(3.0) Quality Specification

(3.1) Quality Level

The quality level of HYES are based on MIL-STD-105D, Apply Level II, normal inspection by single sampling.

| Rank | Item | AQL | Note |
|------------|--|-----|------|
| Major(MA) | Segment Short, Missing | 0.4 | |
| | Solder Bridging, Cold Solder | | |
| | Outside Dimension | | |
| Minor (MI) | Black Spots, White Spots, Foreign Substance, Pinhole, Segment Deformation, Scratches(Glass & Pol.) Air Bubbles between Glass & Polarizer, Color Variation, Solder Ball, Misalignment | 1.0 | |

Note) AQL- Acceptable Quality Level

(3.2) Appearance Standards

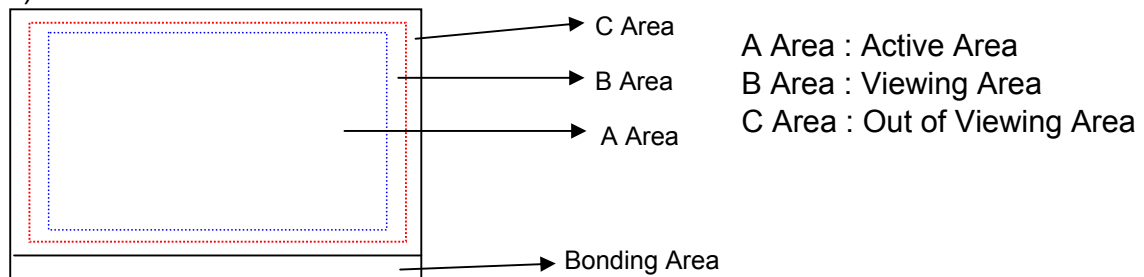
1) Inspection Conditions

The LCD shall be inspected under 20W white fluorescent lamp light.

The distance between the eyes and the sample shall be 30cm.

All directions for inspecting the sample should be within 30° to perpendicular line.

2) Definition of the Area



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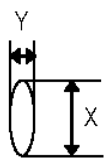
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(3.3) Apperance Spec

| No | Item | Criteria | Rank | Remark | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---------------------|--|--|---------------------|-----------------|--|--------|--------|--------|--------------|--------|--|--|---------------------|---|--|--|---------------------|---|--|--|-----------|---|--|--|-------|-------|-----------------|--|--------|--------|--------|---|---------------|--------|--|--|------------|---------------------|---|--|--|---------|---------------------|---|--|--|--|------------|------|--|--|----|---|
| 1 | Segment Short Segment Missing | Not allowed | MA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | Solder Bridging | Any bridging between components, except common circiut, is not allowed. | MA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | Outside Dimension | Drawing & specification must be within permitable tolerance. | MA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | Cold Solder | Cold solder is not allowed. | MA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | Black(White) Spots, Foreign Substances (distance between allowable defects should more than 5mm) | <p>1) Round Type</p> <table border="1"> <thead> <tr> <th rowspan="2">Area Dimension**</th> <th colspan="2">Acceptable Q'ty</th> <th rowspan="2">Remark</th> </tr> <tr> <th>A Area</th> <th>B Area</th> </tr> </thead> <tbody> <tr> <td>$d \leq 0.1$</td> <td colspan="2">Ignore</td> <td></td> </tr> <tr> <td>$0.1 < d \leq 0.15$</td> <td colspan="2">2</td> <td></td> </tr> <tr> <td>$0.15 < d \leq 0.2$</td> <td colspan="2">1</td> <td></td> </tr> <tr> <td>$d > 0.2$</td> <td colspan="2">0</td> <td></td> </tr> </tbody> </table> <p>2) Liner Type</p> <table border="1"> <thead> <tr> <th rowspan="2">Lengt</th> <th rowspan="2">Width</th> <th colspan="2">Acceptable Q'ty</th> <th rowspan="2">Remark</th> </tr> <tr> <th>A Area</th> <th>B Area</th> </tr> </thead> <tbody> <tr> <td>-</td> <td>$W \leq 0.02$</td> <td colspan="2">Ignore</td> <td></td> </tr> <tr> <td>$L \leq 2$</td> <td>$0.2 < W \leq 0.03$</td> <td colspan="2">2</td> <td></td> </tr> <tr> <td>$L > 1$</td> <td>$0.3 < W \leq 0.05$</td> <td colspan="2">0</td> <td></td> </tr> <tr> <td></td> <td>$0.05 < W$</td> <td colspan="2">spot</td> <td></td> </tr> </tbody> </table> <p>At (1) & (2) total defect q'ty is must not exceed 5 pieces.</p> | Area Dimension** | Acceptable Q'ty | | Remark | A Area | B Area | $d \leq 0.1$ | Ignore | | | $0.1 < d \leq 0.15$ | 2 | | | $0.15 < d \leq 0.2$ | 1 | | | $d > 0.2$ | 0 | | | Lengt | Width | Acceptable Q'ty | | Remark | A Area | B Area | - | $W \leq 0.02$ | Ignore | | | $L \leq 2$ | $0.2 < W \leq 0.03$ | 2 | | | $L > 1$ | $0.3 < W \leq 0.05$ | 0 | | | | $0.05 < W$ | spot | | | MI |  <p>** : Mean Diameter (X + Y)/2</p> |
| Area Dimension** | Acceptable Q'ty | | | Remark | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | A Area | B Area | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $d \leq 0.1$ | Ignore | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.1 < d \leq 0.15$ | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.15 < d \leq 0.2$ | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $d > 0.2$ | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lengt | Width | Acceptable Q'ty | | Remark | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | A Area | B Area | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| - | $W \leq 0.02$ | Ignore | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $L \leq 2$ | $0.2 < W \leq 0.03$ | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $L > 1$ | $0.3 < W \leq 0.05$ | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | $0.05 < W$ | spot | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | <table border="1"> <thead> <tr> <th rowspan="2">Area Dimension**</th> <th colspan="2">Acceptable Q'ty</th> <th rowspan="2">Remark</th> </tr> <tr> <th>A Area</th> <th>B Area</th> </tr> </thead> <tbody> <tr> <td>$d \leq 0.1$</td> <td colspan="2">Ignore</td> <td></td> </tr> <tr> <td>$0.1 < d \leq 0.15$</td> <td colspan="2">2</td> <td></td> </tr> <tr> <td>$0.15 < d \leq 0.2$</td> <td colspan="2">1</td> <td></td> </tr> <tr> <td>$d > 0.2$</td> <td colspan="2">0</td> <td></td> </tr> </tbody> </table> | Area Dimension** | Acceptable Q'ty | | Remark | A Area | B Area | $d \leq 0.1$ | Ignore | | | $0.1 < d \leq 0.15$ | 2 | | | $0.15 < d \leq 0.2$ | 1 | | | $d > 0.2$ | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Area Dimension** | Acceptable Q'ty | | | Remark | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | A Area | B Area | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $d \leq 0.1$ | Ignore | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.1 < d \leq 0.15$ | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.15 < d \leq 0.2$ | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $d > 0.2$ | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | Air Bubles Between Glass & Polarizer (Polarizer Defects) | <table border="1"> <thead> <tr> <th rowspan="2">Area Dimension**</th> <th colspan="2">Acceptable Q'ty</th> <th rowspan="2">Remark</th> </tr> <tr> <th>A Area</th> <th>B Area</th> </tr> </thead> <tbody> <tr> <td>$d \leq 0.3$</td> <td colspan="2">Ignore</td> <td></td> </tr> <tr> <td>$0.3 < d \leq 1.0$</td> <td colspan="2">1</td> <td></td> </tr> <tr> <td>$d > 1.0$</td> <td colspan="2">0</td> <td></td> </tr> </tbody> </table> | Area Dimension** | Acceptable Q'ty | | Remark | A Area | B Area | $d \leq 0.3$ | Ignore | | | $0.3 < d \leq 1.0$ | 1 | | | $d > 1.0$ | 0 | | | MI | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Area Dimension** | Acceptable Q'ty | | | Remark | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | A Area | B Area | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $d \leq 0.3$ | Ignore | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.3 < d \leq 1.0$ | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $d > 1.0$ | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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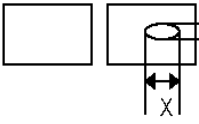
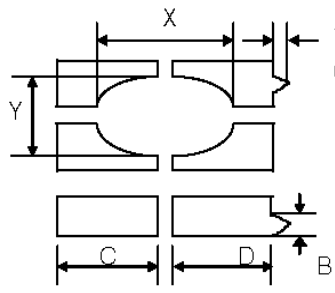
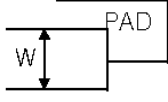
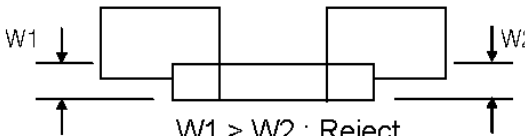
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(3.3) Appearance Spec

| No | Item | Criteria | Rank | Remark | | | | | | | | |
|--------------|---------------------------|---|------|-----------------|--------------|---|-----|---|------------|-------------------|----|-------------------------------|
| 8 | Pinhole (On Segment) |  <p> $(X+Y)/2 \leq 0.2\text{mm}$ Within 1 per one segment (Less than 0.1mm is not counted) Total defects q'ty is must not exceed 5 pieces. </p> | MI | | | | | | | | | |
| 9 | Segment Deformation |  <p> $(X+Y)/2 \leq 0.2\text{mm}$ $A \leq 0.2\text{mm}$ $B \leq 0.2\text{mm}$ $(C-D) \leq 0.2\text{mm}$ </p> <table border="1" data-bbox="534 862 1141 1008"> <thead> <tr> <th></th> <th>Acceptable Q'ty</th> </tr> </thead> <tbody> <tr> <td>Dot, Segment</td> <td>1</td> </tr> <tr> <td>LCD</td> <td>5</td> </tr> <tr> <td>≤ 0.1</td> <td>Ignore all defect</td> </tr> </tbody> </table> <p>Each visible dot must be more than half effective dot area</p> | | Acceptable Q'ty | Dot, Segment | 1 | LCD | 5 | ≤ 0.1 | Ignore all defect | MI | $(X + Y)/2 \leq 0.2\text{mm}$ |
| | Acceptable Q'ty | | | | | | | | | | | |
| Dot, Segment | 1 | | | | | | | | | | | |
| LCD | 5 | | | | | | | | | | | |
| ≤ 0.1 | Ignore all defect | | | | | | | | | | | |
| 10 | Color Variation | Within the three colors, except LCD Standard color is acceptable. | MI | | | | | | | | | |
| 11 | Glass & Polarizer Scratch | Follow NO.5(2) condition | MI | | | | | | | | | |
| 12 | Solder Ball | 1)Acceptable if the size of void is less 2)Acceptable if a solder ball is not movable 3)Rejectable if the solder ball exceed 5EA in 2.54 × 2.54mm area. | MI | | | | | | | | | |
| 13 | Miss Alignment | 1)Acceptable if it dose not exceed 50% of the lead width IC.  <p> $X \leq W/2$: Accept $X > W/2$: Reject </p> <p>IC LEAD</p> 2)Rejectable, provided that it does exceed 50% of the component termination width.  <p> $W1 > W2$: Reject </p> | | | | | | | | | | |

Note : A limitation sample is given top priority

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(4.0) Reliability Condition

| Item | Content |
|----------------------------|------------|
| Room Temperature Operation | 50,000 hrs |

Not to be conspicuous fall of LCD panel Functions, Ability and Appearance after after following test.

(4.1) Reliability Test - Module Middle Reliability

| No. | Item | Condition | Test Time | Sample Numbers | Creteria (Acc/Rej) | Note |
|-----|------------------------|---|---------------------|----------------|--------------------|------|
| 1 | High Temp Operation | 70 ± 2 °C | 240 hrs | 3 | 0/1 | |
| 2 | High Temp Storage | 80 ± 2 °C | 240 hrs | 3 | 0/1 | |
| 3 | Low Temp Operation | -30 ± 2 °C | 240 hrs | 3 | 0/1 | |
| 4 | Low Temp Storage | -40 ± 2 °C | 240 hrs | 3 | 0/1 | |
| 5 | High Humidity Storage | 50 °C 95%rh | 504 hrs | 3 | 0/1 | |
| 6 | Thermal Shock | 30mn stage -20 °C ↔70 °C | 144cycles /6days | 3 | 0/1 | |
| 7 | Vibration Test | To be measured after subjecting to total fixed amplitude of 1.5mm vibrating frequency 10 to 55Hz, one cycle 60 seconds to direction of X,Y,Z for each 15 minutes,(Total 45minutes) and after removing vibration(Non-operation state) | | | | |
| 8 | Shock Test (Drop Test) | To be measured after dropping from 150cm high onto steel board of 15mm thick and from 3 direction X,Y,Z each one time | | | | |
| 9 | ESD | <ul style="list-style-type: none"> - Condition:150pf, 330Ω, ±8KV, 5 times Air Discharge (ESD which is made by above condition should be shot on LCD glass panel, not other's area(such as on IC and so on) - After testing, cosmetic and electrical defects should not happen. - Total current consumption should be below double of initial value. - In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be juded as a good part(Operation with LCM). | | | | |
| 10 | Solar radiation(UV) | 20hours : I = 0.68 W/m ² /nm at 340 nm, T=+55 °C 4 hours : I = 0 W/m ² /nm at 340 nm, T =+35 °C | | | | |

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(4.2) In case of outgoing products 1 lot/model/week of them should applied to the following condition.

| No. | Item | Condition | Test Time | Sample Numbers | Acc/Rej | Note |
|-----|-----------------------|---------------|-----------|----------------|---------|------------|
| 1 | High Humidity Storage | 80°C 90%RH | 72 hrs | 3 | 0/1 | High Rel. |
| 2 | High Humidity Storage | 80°C 90%RH | 48 hrs | 3 | 0/1 | (Normal) |
| 3 | High Humidity Storage | 80°C 90%RH | 24 hrs | 3 | 0/1 | (Consumer) |

Pressure under high temperature and high humidity as stipulated above should be conducted with the cell(LCD Panel) no polarizers attached on.

(4.3) Criteria

- a. No. 1 ~ 8 : No changes for indication and appearance.
- b. No. 1 ~ 3, 5 ~ 8 : Leave the all samples under room temperature 4 hours after reliability test ends.
- c. No. 4 : Leave the all sample under room temperature 12 hours after reliability test ends.

(5.0) Service

(5.1) We offer a satisfactory After-Service to customer.

Customer Service at HYES LCD should service the customer complaint that to HYES except that the defect is related to the reliability of product

(5.2) For these defects not listed in this specification, the customer's complaint shall be processed by the way of mutual agreement.

17. The Caution on Handling

17.1 Assembling and Mounting Method

The LCD product of HYES consists of two thin glass and polarizer which easily get damaged. So this LCD products needs special careful handling when assembling the customer's set and LCD.

17.2 The Caution on LCD handling and cleaning

When cleaning the display surface, it should be used the soft, not rough cloth by use of following materials such as Isopropyl alcohol or ethyl alcohol.

But the material which can give the damage to display surface should not be used such as water, ketone, aromatics.

ITO Pad area needs special careful caution in related with ITO corrosion. Do not wipe ITO pad area with such the materials as is able to give the damage to ITO pads. Also the material can make the ITO corrosion should not be contacted with ITO area, such as HCFC, Soldering flux, chlorine, sulfur, spittle and fingerprint.

If panel product, HYES suggest that the customer coat the UV or silicon on ITO pad area

17.3 The Caution on Electro-characteristic of LCD

The IC which is used in HYES's LCD is C-MOS LSI drivers. So to avoid from the IC damage, HYES recommend the as following contents to our customers.

Don't connect the unused input terminal to Vdd or Vss, and don't input any signal in case of not grounding the your body, working area, machine in order to protect the ESD. So to speck, this LCD product needs the ESD-free environments.

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HYES Recommend that customer don't give the DC to LCD and limit high voltage, because DC and limit high voltage cause the undesirable deterioration of LCD and the shorter life-time.

If operating the LCD in low or high temp. chamber, the LCD could show the abnormal display such as low response time or dark display. But this phenomenon don't means the mal-function. The change of operating area to room temperature can give the recovery fo function to above LCD.

If pressing the LCD active area, LCD may show the abnormal display. But this kind's of phenomenon is not malfunction. If you reset the LCD, you can find that this phenomenon is disappeared.

7.4 Storage

The dew by water component in the ITO pad cause an open defect. Because this kinds of dew can cause the ITO corrosion. When storing the LCD in warehouse, the maximum controlled-humidity is recommended as the 55%RH or less.

If any stock for repair or other purpose, is recommended as following storage method.

- a. Store in the polyethylene bag with sealing state not to enter fresh air outside in it.
- b. Store in the dark place where neither exposure to direct sunlight nor other kind's of light.
- c. Store with no touch on polarizer surface by the anything else. If possible, store with the same packing state as HYES did.

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