POWERTIP TECH. CORP.

# SPECIFICATIONS

| | | |
|---|---|---|
| CUSTOMER | : | HCN070 |
| SAMPLE CODE | : | SH320480T009-LAA01 |
| MASS PRODUCTION CODE | : | PH320480T009-LAA01 |
| SAMPLE VERSION | : | 01 |
| SPECIFICATIONS EDITION | : | 002 |
| DRAWING NO. (Ver.) | : | LMD-PH320480T009-LAA01 (Ver.001) |
| PACKAGING NO. (Ver.) | : | PKG-PH320480T009-LAA01 (Ver.001) |

## Customer Approved

Date:

| Approved | Checked | Designer |
|---|---|---|
| 林裘中<br>Daniel Lin | 廖志豪<br>Rex Liao | 張慶源<br>Yuan Chang |

□ Preliminary specification for design input

■ Specification for sample approval

POWERTIP
2015.11.11
TW RD APR


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## History of Version

| Date (mm / dd / yyyy) | Ver. | Edi. | Description | Page | Design by |
|---|---|---|---|---|---|
| 07/10/2015 | 01 | 001 | New Drawing. | - | Yuan |
| 11/09/2015 | 01 | 002 | First Sample | - | Yuan |
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## Contents



Note : For detailed information please refer to IC data sheet : ST7796S-G5

# 1. SPECIFICATIONS

## 1.1 Features

**Main LCD panel**

| Item | Standard Value |
|---|---|
| Display Type | 320 * 3 (RGB) * 480 Dots |
| LCD Type | a-Si TFT , Normally white, Transmissive type |
| Screen size(inch) | 3.5 inch |
| Viewing Direction | 12 O'clock |
| Color configuration | RGB-Strip |
| Backlight | LED Backlight |
| Interface | Parallel 8080-series MCU Interface (8-bit, 9-bit, 16-bit, and 18-bit)<br>16/18 RGB Interface<br>Serial Peripheral Interface (SPI Interface)<br>MIPI Interface |
| Other(controller/driver IC) | ST7796S-G5 |
| ROHS | THIS PRODUCT CONFORMS THE ROHS OF PTC<br>Detail information please refer website :<br>http://www.powertip.com.tw/news.php?area_id_view=1085560481/ |

## 1.2 Mechanical Specifications

| Item | Standard Value | Unit |
|---|---|---|
| Outline Dimension | 55.26(W) x 84.69 (L) x 2.7(H) | mm |
| Viewing Area | 49.96(W) x 74.44(L) | mm |
| Active Area | 48.96 (W) * 73.44 (L) | mm |

Note : For detailed information please refer to LCM drawing

## 1.3 Absolute Maximum Ratings

**Module**

| Item | Symbol | Condition | Min. | Max. | Unit |
|---|---|---|---|---|---|
| Supply Voltage | VDD | - | -0.3 | +4.6 | V |
| Supply Voltage(I/O) | VDDI | - | -0.3 | +4.6 | V |
| Operating Temperature | $T_{OP}$ | - | -20 | +70 | °C |
| Storage Temperature | $T_{ST}$ | - | -30 | +80 | °C |

## 1.4 DC Electrical Characteristics

**Module** GND = 0V, Ta = 25°C

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Supply Voltage | VDD | - | 2.5 | 2.8 | 3.3 | V |
| Supply Voltage(I/O) | VDDI | | 1.65 | 1.8 | 3.3 | V |
| Input High Voltage | $V_{IH}$ | - | 0.7 VDDI | - | VDDI | V |
| Input Low Voltage | $V_{IL}$ | - | GND | - | 0.3 VDDI | V |
| Output High Voltage | $V_{OH}$ | $I_{OH}$=-0.1mA | 0.8*VDDI | - | VDDI | V |
| Output Low Voltage | $V_{OL}$ | $I_{OL}$=+0.1mA | GND | - | 0.2*VDDI | V |
| Supply Current | IDD | Pattern= Full display | - | 15 | 20 | mA |

Note1:Maximum current display

## 1.5 Optical Characteristics

**TFT LCD Module** VDD=VDDI = 3.3V, Ta=25°C

| Item | | Symbol | Condition | Min. | Typ. | Max. | unit | - |
|---|---|---|---|---|---|---|---|---|
| Response time | | Tr+ Tf | Ta = 25°C<br>θX, θY = 0° | - | 25 | 38 | ms | Note2 |
| Viewing angle | Top | θY+ | - | - | 60 | - | Deg. | Note4 |
| | Bottom | θY- | | - | 60 | - | | |
| | Left | θX- | | - | 60 | - | | |
| | Right | θX+ | | - | 60 | - | | |
| Contrast ratio | | CR | Ta = 25°C<br>θX , θY = 0° | 500 | 600 | - | - | Note3 |
| Color of CIE Coordinate ( With B/L & T/P ) | White | X | - | 0.24 | 0.29 | 0.34 | - | Note1 |
| | | Y | | 0.27 | 0.32 | 0.37 | | |
| | Red | X | | 0.55 | 0.60 | 0.65 | | |
| | | Y | | 0.30 | 0.35 | 0.40 | | |
| | Green | X | | 0.28 | 0.33 | 0.38 | | |
| | | Y | | 0.57 | 0.62 | 0.67 | | |
| | Blue | X | | 0.09 | 0.14 | 0.19 | | |
| | | Y | | 0.02 | 0.07 | 0.12 | | |
| Average Brightness Pattern=white (With LCD ) *1 | | IV | IF=120 mA | 350 | 430 | - | cd/m$^2$ | |
| Uniformity (With LCD) *2 | | △B | IF=120 mA | 70 | - | - | % | |

Note 1:

*1：△B=B(min) / B(max) * 100%

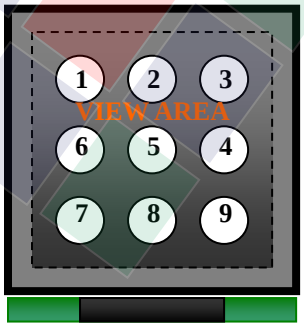
*2：Measurement Condition for Optical Characteristics:

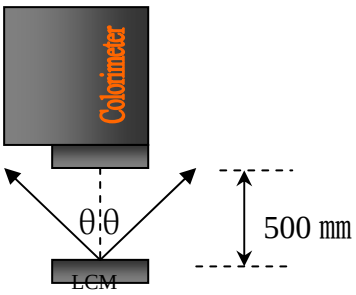
a：Environment: 25℃±5℃ / 60±20%R.H， no wind， dark room below 10 Lux at typical lamp current and typical operating frequency.

b：Measurement Distance: 500 ± 50 ㎜ ， (θ= 0°)

c：Equipment: TOPCON BM-7 fast， (field 1°)， after 10 minutes operation.

d：The uncertainty of the C.I.E coordinate measurement ±0.01， Average Brightness ± 4%



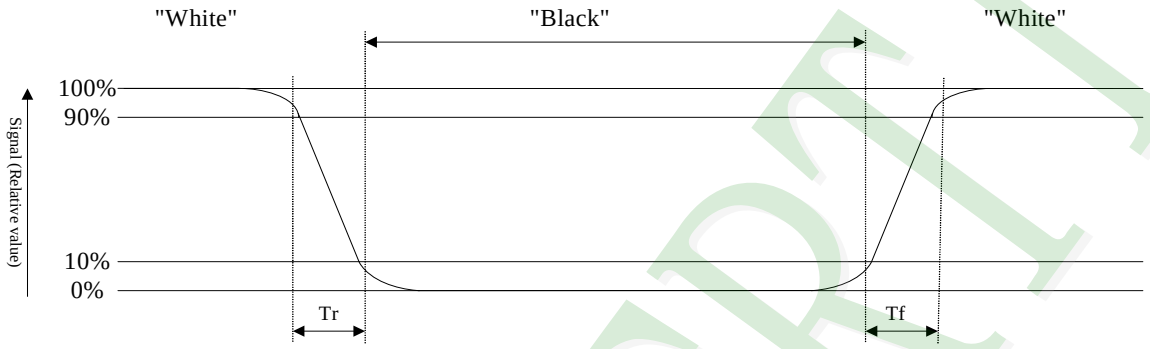

Colorimeter=BM-7 fast

To be measured at the center area of panel with a viewing cone of 1° by Topcon luminance meter BM-7, after 10 minutes operation (module)

Note2: Definition of response time:

The output signals of photo detector are measured when the input signals are changed from “black” to “white”(falling time) and from “white” to “black”(rising time), respectively. The response time is defined as the time interval between the 10% and 90% of Amplitudes.

Refer to figure as below:



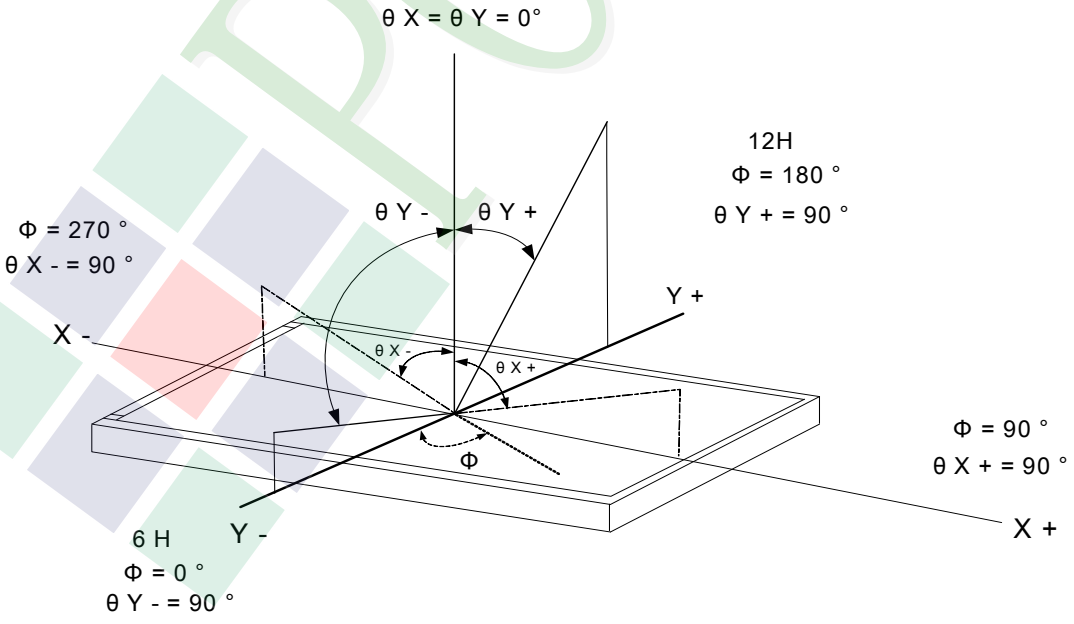

Note3: Definition of contrast ratio:

Contrast ratio is calculated with the following formula

$$\text{Contrast ratio (CR)} = \frac{\text{Photo detector output when LCD is at “White” state}}{\text{Photo detector output when LCD is at “Black” state}}$$

Note4: Definition of viewing angle:

Refer to figure as below:



## 1.6 Backlight Characteristics

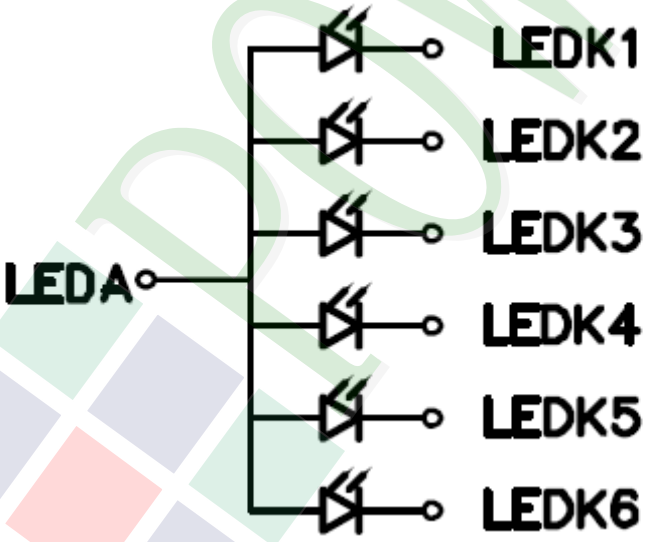
Maximum Ratings

| Item | Symbol | Conditions | Min. | Max. | Unit |
|---|---|---|---|---|---|
| Forward Current | IF | Ta =25℃ | - | 150 | mA |
| Reverse Voltage | VR | Ta =25℃ | - | 4 | V |
| Power Dissipation | PD | Ta =25℃ | - | 540 | mW |

Electrical / Optical Characteristics

| Item | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Forward Voltage | VF | IF= 120 mA | 2.8 | 3.2 | 3.6 | V |
| Average Brightness (Without LCD) | IV | | 6000 | 7200 | - | cd/m$^2$ |
| CIE Color Coordinate (Without LCD) | X | | 0.26 | 0.28 | 0.32 | - |
| | Y | | 0.26 | 0.28 | 0.32 | |
| Color | White | | | | | |

Circuit diagram：



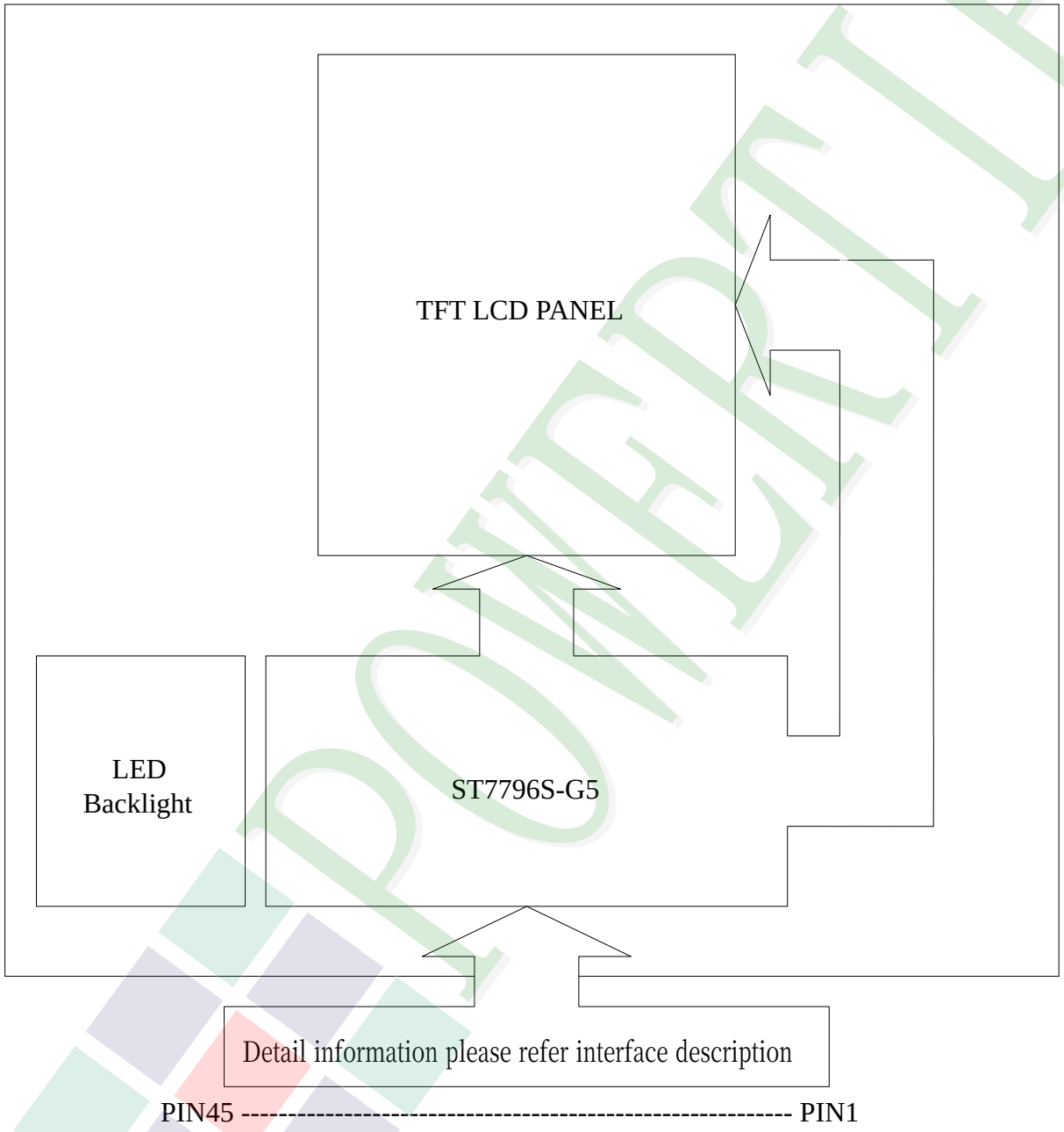

| Item | Conditions | Description |
|---|---|---|
| Life Time | Ta =25℃ IF= 120 mA | 20000 hrs |
| | | |

## 2.1 Counter Drawing

### 2.1.1 LCM Mechanical Diagram

* See Appendix

### 2.1.2 Block Diagram



## 2.2 Interface Pin Description

| Pin No. | Symbol | Function |
|---|---|---|
| 1 | LEDK6- | Power supply for LED Backlight cathode input |
| 2 | LEDK5- | |
| 3 | LEDK4- | |
| 4 | LEDK3- | |
| 5 | LEDK2- | |
| 6 | LEDK1- | |
| 7 | LEDA | Power supply for LED Backlight anode input |
| 8 | GND | Ground |
| 9 | VDD | Power supply for analog and booster circuits |
| 10 | VDDI | Power supply for I/O system.<br>VDDI must be lower than or equal to VDD. |
| 11 | TE | Tearing Effect output signal. Leave the pin open when not in use. |
| 12 | CSX | Chip selection pin. Low-active.<br>If not used, please fix this pin at VDDI or DGND level. |
| 13 | DCX | Display data/command selection (RS) pin in MCU interface.<br>DCX=’1’: display data or parameter.<br>DCX=’0’: register index / command.<br>If not used, please fix this pin at VDDI or DGND level. |
| 14 | WRX/SCL | Write enable in MCU parallel interface.<br>In SPI mode, this pin is used as SCL.<br>If not used, please fix this pin at VDDI or DGND level. |
| 15 | RDX | Read enable in 8080 MCU parallel interface. Low-active.<br>If not used, please fix this pin at VDDI or DGND level. |
| 16 | SDA | SPI interface input/output pin. The data is latched on the rising edge of the SCL signal.<br>If not used, please fix this pin at VDDI or DGND level. |
| 17 | SDO | SPI interface output pin.<br>The data is outputted on the falling edge of the SCL signal.<br>If not used, please fix this pin at floating. |
| 18 | DB0 | Data bus<br>Fix to GND level when not in use. |
| 19 | DB1 | |
| 20 | DB2 | |
| 21 | DB3 | |

<table>
<tr><td>22</td><td>DB4</td><td rowspan="14">Data bus<br>Fix to GND level when not in use.<br><table><tr><th>IM2</th><th>IM1</th><th>IM0</th><th>MPU Interface Mode</th><th>Data pin</th></tr><tr><td>0</td><td>0</td><td>0</td><td>8080 18-bit Interface</td><td>DB[17:0]</td></tr><tr><td>0</td><td>0</td><td>1</td><td>8080 9-bit Interface</td><td>DB[8:0]</td></tr><tr><td>0</td><td>1</td><td>0</td><td>8080 16-bit Interface</td><td>DB[15:0]</td></tr><tr><td>0</td><td>1</td><td>1</td><td>8080 8-bit Interface</td><td>DB[7:0],</td></tr><tr><td>1</td><td>0</td><td>0</td><td>Reserve</td><td>--</td></tr><tr><td>1</td><td>0</td><td>1</td><td>3SPI</td><td>SDA, SDO</td></tr><tr><td>1</td><td>1</td><td>0</td><td>MIPI</td><td>MIPI_DATA<br>MIPI_CLOCK</td></tr><tr><td>1</td><td>1</td><td>1</td><td>4Line SPI</td><td>SDA, SDO</td></tr></table></td></tr>
<tr><td>23</td><td>DB5</td></tr>
<tr><td>24</td><td>DB6</td></tr>
<tr><td>25</td><td>DB7</td></tr>
<tr><td>26</td><td>DB8</td></tr>
<tr><td>27</td><td>DB9</td></tr>
<tr><td>28</td><td>DB10</td></tr>
<tr><td>29</td><td>DB11</td></tr>
<tr><td>30</td><td>DB12</td></tr>
<tr><td>31</td><td>DB13</td></tr>
<tr><td>32</td><td>DB14</td></tr>
<tr><td>33</td><td>DB15</td></tr>
<tr><td>34</td><td>DB16</td></tr>
<tr><td>35</td><td>DB17</td></tr>
<tr><td>36</td><td>ENABLE</td><td>Data enable signal for RGB interface operation.<br>If not used, please fix this pin at VDDI or DGND.</td></tr>
<tr><td>37</td><td>DOTLCK</td><td>Dot clock signal for RGB interface operation.<br>If not used, please fix this pin at VDDI or DGND.</td></tr>
<tr><td>38</td><td>HSYNC</td><td>Horizontal synchronizing input signal for RGB interface operation.<br>If not used, please fix to VDDI or DGND.</td></tr>
<tr><td>39</td><td>GND</td><td>Ground</td></tr>
<tr><td>40</td><td>VSYNC</td><td>Vertical synchronizing input signal for RGB interface operation.<br>If not used, please fix to the VDDI or DGND.</td></tr>
<tr><td>41</td><td>RESET</td><td>This signal will reset the device and it must be applied to<br>properly initialize the chip.<br>Signal is active low.</td></tr>
<tr><td>42</td><td>IM2</td><td rowspan="3">The MCU interface mode select.</td></tr>
<tr><td>43</td><td>IM1</td></tr>
<tr><td>44</td><td>IM0</td></tr>
<tr><td>45</td><td>GND</td><td>Ground</td></tr>
</table>

### 2.2.1 Refer Initial Code : (RGB interface)

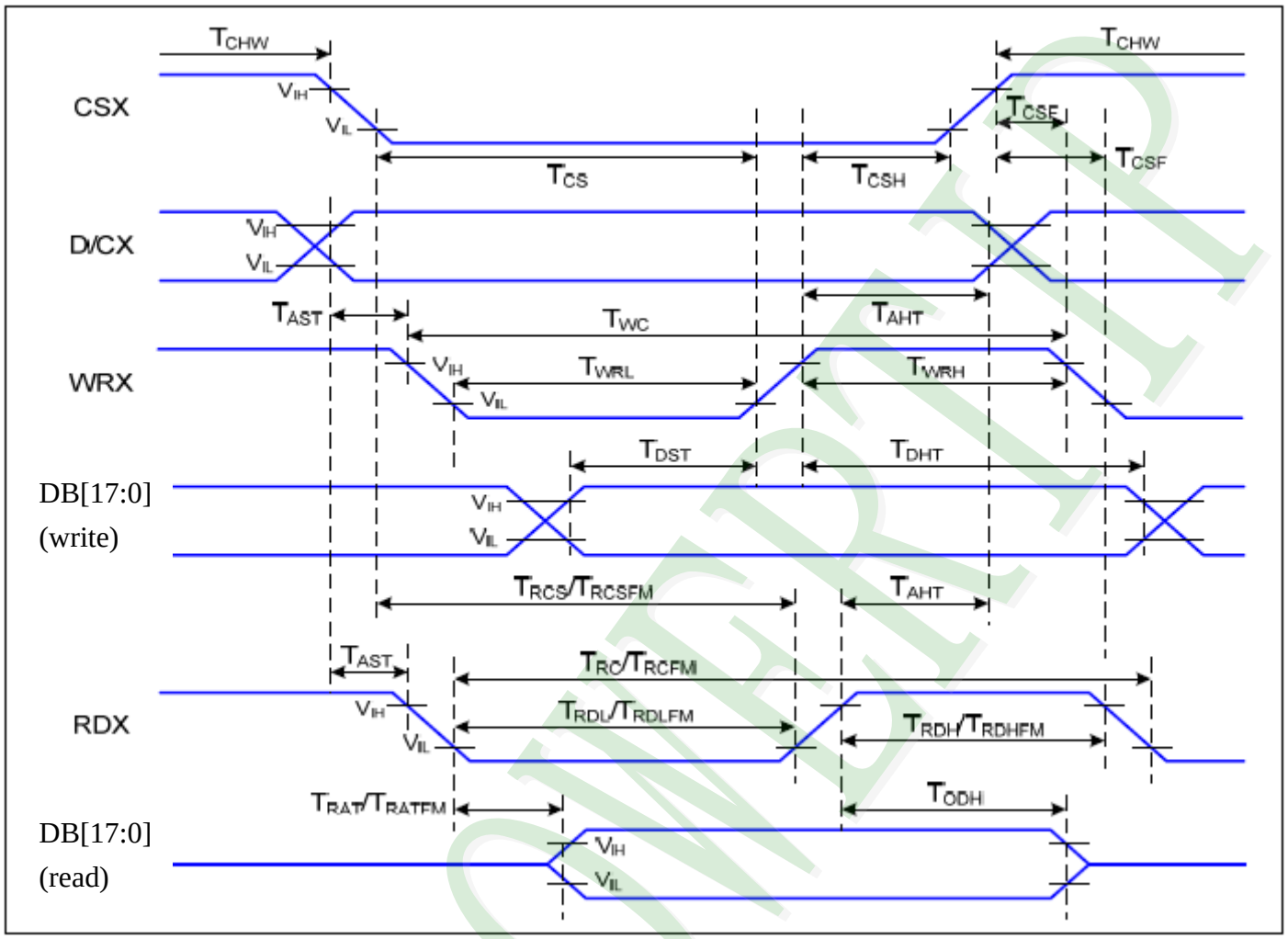
```
CALL    DELAY
CALL    DELAY
MOV     DPL,#11H
CALL    SPI_COM

CALL    DELAY
CALL    DELAY
CALL    DELAY
CALL    DELAY

MOV     DPL,#F0H
CALL    SPI_COM
MOV     DPL,#C3H
CALL    SPI_DAT

MOV     DPL,#F0H
CALL    SPI_COM
MOV     DPL,#96H
CALL    SPI_DAT

MOV     DPL,#36H
CALL    SPI_COM
MOV     DPL,#48H
CALL    SPI_DAT

MOV     DPL,#B4H
CALL    SPI_COM
MOV     DPL,#01H
CALL    SPI_DAT

MOV     DPL,#B6H
CALL    SPI_COM
MOV     DPL,#20H
CALL    SPI_DAT
MOV     DPL,#02H
CALL    SPI_DAT
MOV     DPL,#3BH
CALL    SPI_DAT

MOV     DPL,#E8H
CALL    SPI_COM
MOV     DPL,#40H
CALL    SPI_DAT
MOV     DPL,#8AH
CALL    SPI_DAT
MOV     DPL,#00H
CALL    SPI_DAT
MOV     DPL,#00H
CALL    SPI_DAT
MOV     DPL,#29H
CALL    SPI_DAT
MOV     DPL,#19H
CALL    SPI_DAT
```

```
MOV     DPL,#A5H
CALL    SPI_DAT
MOV     DPL,#33H
CALL    SPI_DAT

MOV     DPL,#C1H
CALL    SPI_COM
MOV     DPL,#06H
CALL    SPI_DAT

MOV     DPL,#C2H
CALL    SPI_COM
MOV     DPL,#A7H
CALL    SPI_DAT

MOV     DPL,#C5H
CALL    SPI_COM
MOV     DPL,#18H
CALL    SPI_DAT

MOV     DPL,#E0H
CALL    SPI_COM
MOV     DPL,#F0H
CALL    SPI_DAT
MOV     DPL,#09H
CALL    SPI_DAT
MOV     DPL,#0BH
CALL    SPI_DAT
MOV     DPL,#06H
CALL    SPI_DAT
MOV     DPL,#04H
CALL    SPI_DAT
MOV     DPL,#15H
CALL    SPI_DAT
MOV     DPL,#2FH
CALL    SPI_DAT
MOV     DPL,#54H
CALL    SPI_DAT
MOV     DPL,#42H
CALL    SPI_DAT
MOV     DPL,#3CH
CALL    SPI_DAT
MOV     DPL,#17H
CALL    SPI_DAT
MOV     DPL,#14H
CALL    SPI_DAT
MOV     DPL,#18H
CALL    SPI_DAT
MOV     DPL,#1BH
CALL    SPI_DAT


MOV     DPL,#E1H
CALL    SPI_COM
MOV     DPL,#F0H
CALL    SPI_DAT
```

```
MOV     DPL,#09H
CALL    SPI_DAT
MOV     DPL,#0BH
CALL    SPI_DAT
MOV     DPL,#06H
CALL    SPI_DAT
MOV     DPL,#04H
CALL    SPI_DAT
MOV     DPL,#03H
CALL    SPI_DAT
MOV     DPL,#2DH
CALL    SPI_DAT
MOV     DPL,#43H
CALL    SPI_DAT
MOV     DPL,#42H
CALL    SPI_DAT
MOV     DPL,#3BH
CALL    SPI_DAT
MOV     DPL,#16H
CALL    SPI_DAT
MOV     DPL,#14H
CALL    SPI_DAT
MOV     DPL,#17H
CALL    SPI_DAT
MOV     DPL,#1BH
CALL    SPI_DAT

MOV     DPL,#F0H
CALL    SPI_COM
MOV     DPL,#3CH
CALL    SPI_DAT

MOV     DPL,#F0H
CALL    SPI_COM
MOV     DPL,#69H
CALL    SPI_DAT

CALL    DELAY
CALL    DELAY
CALL    DELAY
CALL    DELAY

MOV     DPL,#29H
CALL    SPI_COM
```

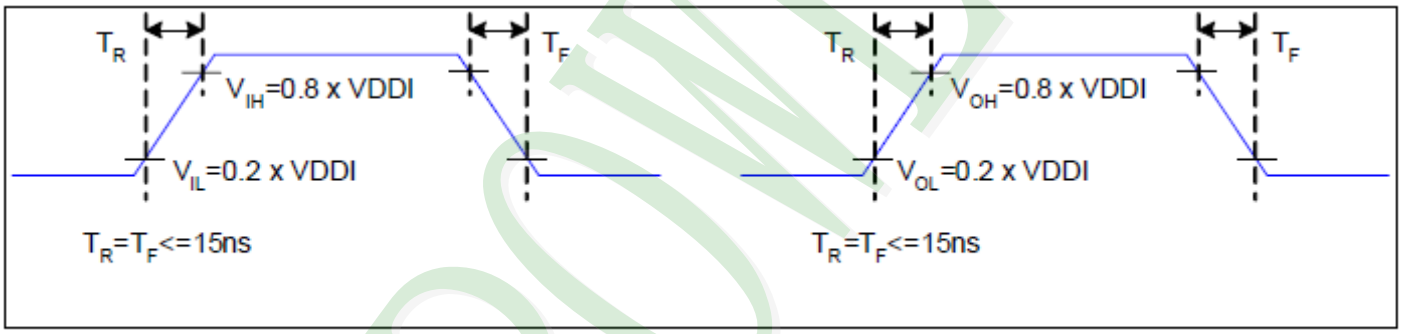
## 2.3 Timing Characteristics

8080 Series MCU Parallel Interface Characteristics: 18/16/9/8-bit Bus




| Signal | Symbol | Parameter | Min | Max | Unit | Description |
|---|---|---|---|---|---|---|
| D/CX | $T_{AST}$ | Address setup time | 0 | | ns | - |
| | $T_{AHT}$ | Address hold time (Write/Read) | 10 | | ns | |
| CSX | $T_{CHW}$ | Chip select "H" pulse width | 0 | | ns | - |
| | $T_{CS}$ | Chip select setup time (Write) | 15 | | ns | |
| | $T_{RCS}$ | Chip select setup time (Read ID) | 45 | | ns | |
| | $T_{RCSFM}$ | Chip select setup time (Read FM) | 355 | | ns | |
| | $T_{CSF}$ | Chip select wait time (Write/Read) | 10 | | ns | |
| | $T_{CSH}$ | Chip select hold time | 10 | | ns | |
| WRX | $T_{WC}$ | Write cycle | 66 | | ns | |
| | $T_{WRH}$ | Control pulse "H" duration | 15 | | ns | |

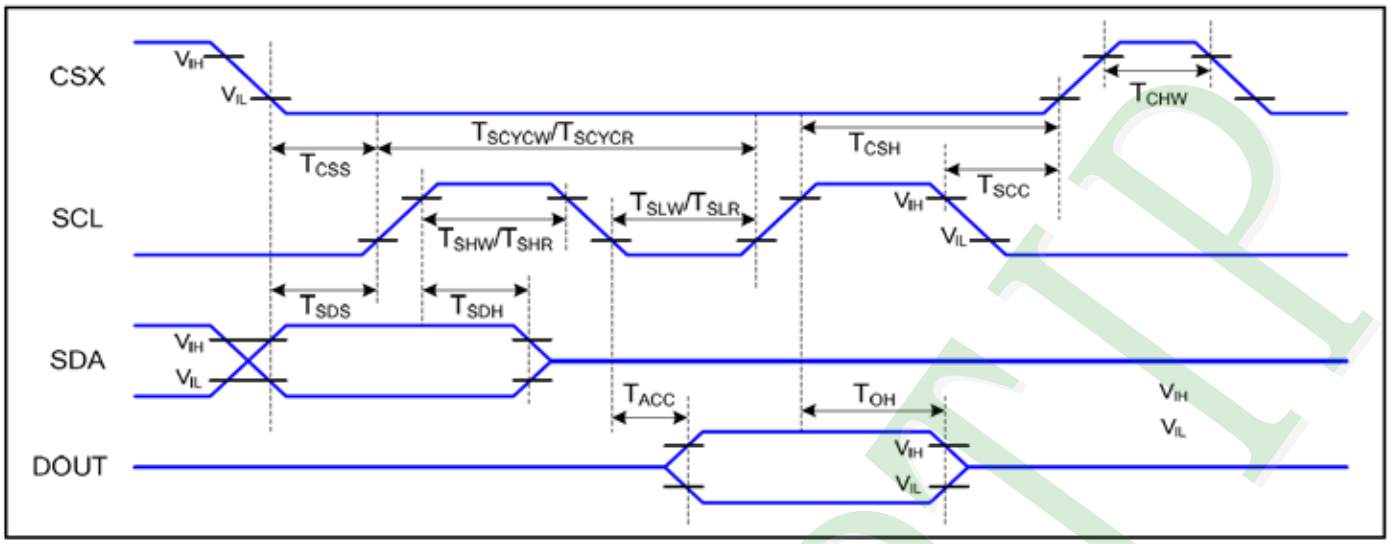
| | | | | | | |
|---|---|---|---|---|---|---|
| | $T_{WRL}$ | Control pulse "L" duration | 15 | | ns | |
| RDX (ID) | $T_{RC}$ | Read cycle (ID) | 160 | | ns | When read ID data |
| | $T_{RDH}$ | Control pulse "H" duration (ID) | 90 | | ns | |
| | $T_{RDL}$ | Control pulse "L" duration (ID) | 45 | | ns | |
| RDX (FM) | $T_{RCFM}$ | Read cycle (FM) | 450 | | ns | When read from frame memory |
| | $T_{RDHFM}$ | Control pulse "H" duration (FM) | 90 | | ns | |
| | $T_{RDLFM}$ | Control pulse "L" duration (FM) | 355 | | ns | |
| DB[17:0] | $T_{DST}$ | Data setup time | 10 | | ns | For CL=30pF |
| | $T_{DHT}$ | Data hold time | 10 | | ns | |
| | $T_{RAT}$ | Read access time (ID) | - | 40 | ns | |
| | $T_{RATFM}$ | Read access time (FM) | - | 340 | ns | |
| | $T_{ODH}$ | Output disable time | 20 | 80 | ns | |




Rising and Falling Timing for I/O Signal

Note: The rising time and falling time (Tr, Tf) of input signal and fall time are specified at 15 ns or less. Logic high and low levels are specified as 20% and 80% of VDDI for Input signals.

3-SPI Serial Data Transfer Interface Characteristics:



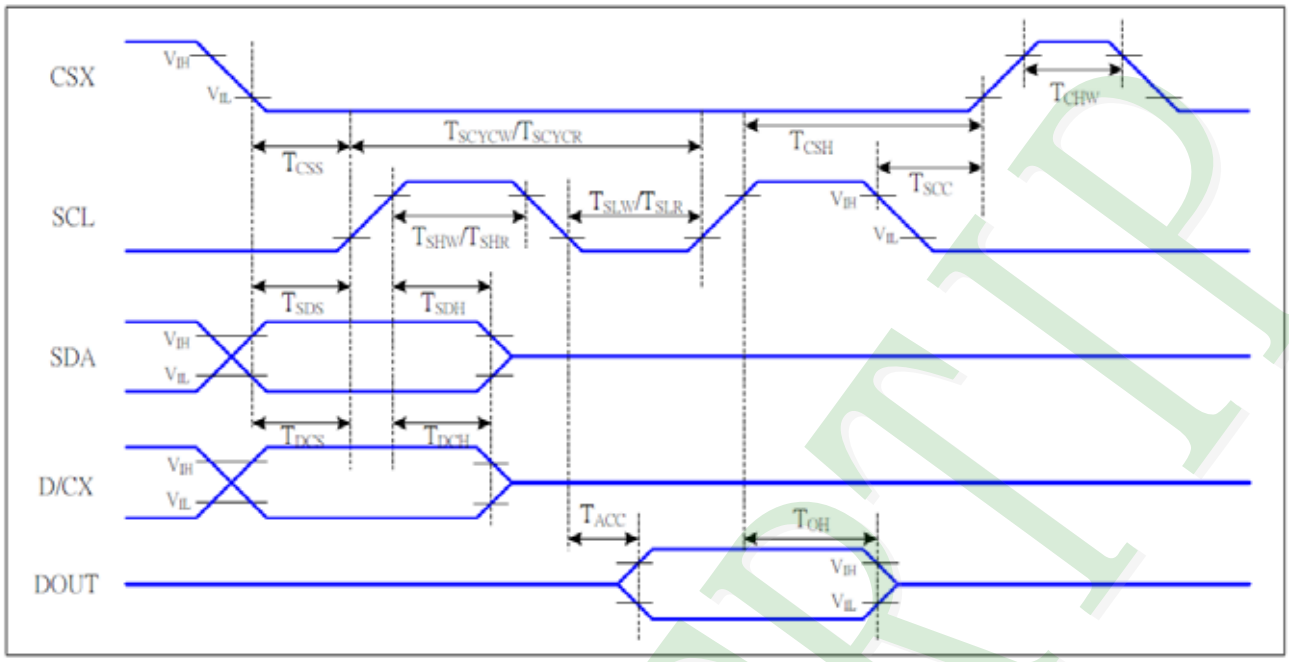

3-SPI Interface Timing Characteristics

*VDDI=1.8V,VDDA=2.8V, AGND=DGND=0V, Ta=25 ℃*

| Signal | Symbol | Parameter | Min | Max | Unit | Description |
|---|---|---|---|---|---|---|
| CSX | $T_{CSS}$ | Chip select setup time (write) | 15 | | ns | |
| | $T_{CSH}$ | Chip select hold time (write) | 15 | | ns | |
| | $T_{CSS}$ | Chip select setup time (read) | 60 | | ns | |
| | $T_{SCC}$ | Chip select hold time (read) | 65 | | ns | |
| | $T_{CHW}$ | Chip select “H” pulse width | 40 | | ns | |
| SCL | $T_{SCYCW}$ | Serial clock cycle (Write) | 66 | | ns | |
| | $T_{SHW}$ | SCL “H” pulse width (Write) | 15 | | ns | |
| | $T_{SLW}$ | SCL “L” pulse width (Write) | 15 | | ns | |
| | $T_{SCYCR}$ | Serial clock cycle (Read) | 150 | | ns | |
| | $T_{SHR}$ | SCL “H” pulse width (Read) | 60 | | ns | |
| | $T_{SLR}$ | SCL “L” pulse width (Read) | 60 | | ns | |
| SDA (DIN) | $T_{SDS}$ | Data setup time | 10 | | ns | |
| | $T_{SDH}$ | Data hold time | 10 | | ns | |
| DOUT | $T_{ACC}$ | Access time | 10 | 50 | ns | For maximum CL=30pF |
| | $T_{OH}$ | Output disable time | 15 | 50 | ns | For minimum CL=8pF |

3-SPI Interface Characteristics

4-SPI Serial Data Transfer Interface Characteristics:

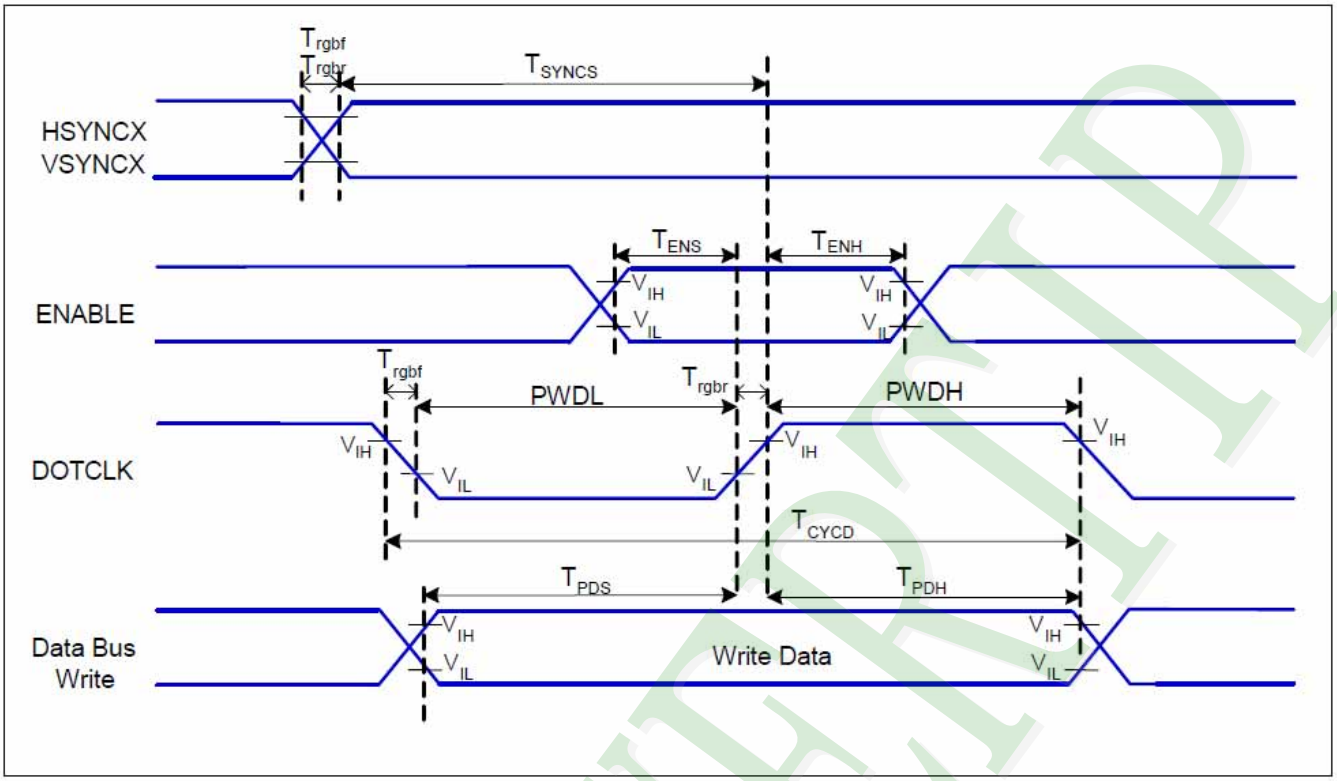



4-SPI Interface Timing Characteristics

*VDDI=1.8V,VDDA=2.8V, AGND=DGND=0V, Ta=25 ℃*

| Signal | Symbol | Parameter | MIN | MAX | Unit | Description |
|---|---|---|---|---|---|---|
| CSX | $T_{CSS}$ | Chip select setup time (write) | 15 | | ns | |
| | $T_{CSH}$ | Chip select hold time (write) | 15 | | ns | |
| | $T_{CSS}$ | Chip select setup time (read) | 60 | | ns | |
| | $T_{SCC}$ | Chip select hold time (read) | 65 | | ns | |
| | $T_{CHW}$ | Chip select "H" pulse width | 40 | | ns | |
| SCL | $T_{SCYCW}$ | Serial clock cycle (Write) | 66 | | ns | -write command & data ram |
| | $T_{SHW}$ | SCL "H" pulse width (Write) | 15 | | ns | |
| | $T_{SLW}$ | SCL "L" pulse width (Write) | 15 | | ns | |
| | $T_{SCYCR}$ | Serial clock cycle (Read) | 150 | | ns | -read command & data ram |
| | $T_{SHR}$ | SCL "H" pulse width (Read) | 60 | | ns | |
| | $T_{SLR}$ | SCL "L" pulse width (Read) | 60 | | ns | |
| D/CX | $T_{DCS}$ | D/CX setup time | 10 | | ns | |
| | $T_{DCH}$ | D/CX hold time | 10 | | ns | |
| SDA (DIN) | $T_{SDS}$ | Data setup time | 10 | | ns | |
| | $T_{SDH}$ | Data hold time | 10 | | ns | |
| DOUT | $T_{ACC}$ | Access time | 10 | 50 | ns | For maximum CL=30pF |
| | $T_{OH}$ | Output disable time | 15 | 50 | ns | For minimum CL=8pF |

RGB Interface Characteristics:



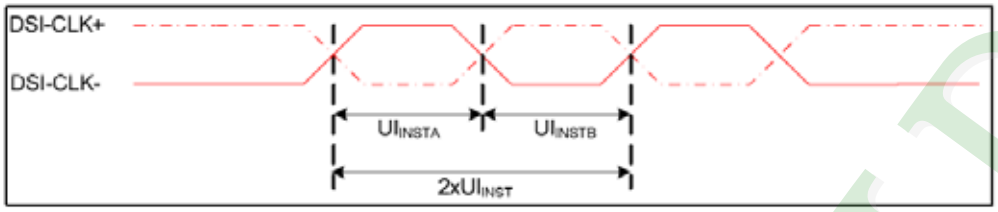

*VDDI=1.8V,VDDA=2.8V, AGND=DGND=0V, Ta=25℃*

| Signal | Symbol | Parameter | MIN | MAX | Unit | Description |
|---|---|---|---|---|---|---|
| HSYNC, VSYNC | $T_{SYNCS}$ | VSYNC, HSYNC Setup Time | 15 | - | ns | |
| ENABLE | $T_{ENS}$ | Enable Setup Time | 15 | - | ns | |
| | $T_{ENH}$ | Enable Hold Time | 15 | - | ns | |
| DOTCLK | PWDH | DOTCLK High-level Pulse Width | 30 | - | ns | |
| | PWDL | DOTCLK Low-level Pulse Width | 30 | - | ns | |
| | $T_{CYCD}$ | DOTCLK Cycle Time | 66 | - | ns | |
| | Trghr, Trghf | DOTCLK Rise/Fall time | - | 15 | ns | |
| DB | $T_{PDS}$ | PD Data Setup Time | 15 | - | ns | |
| | $T_{PDH}$ | PD Data Hold Time | 15 | - | ns | |

RGB Interface Timing Characteristics

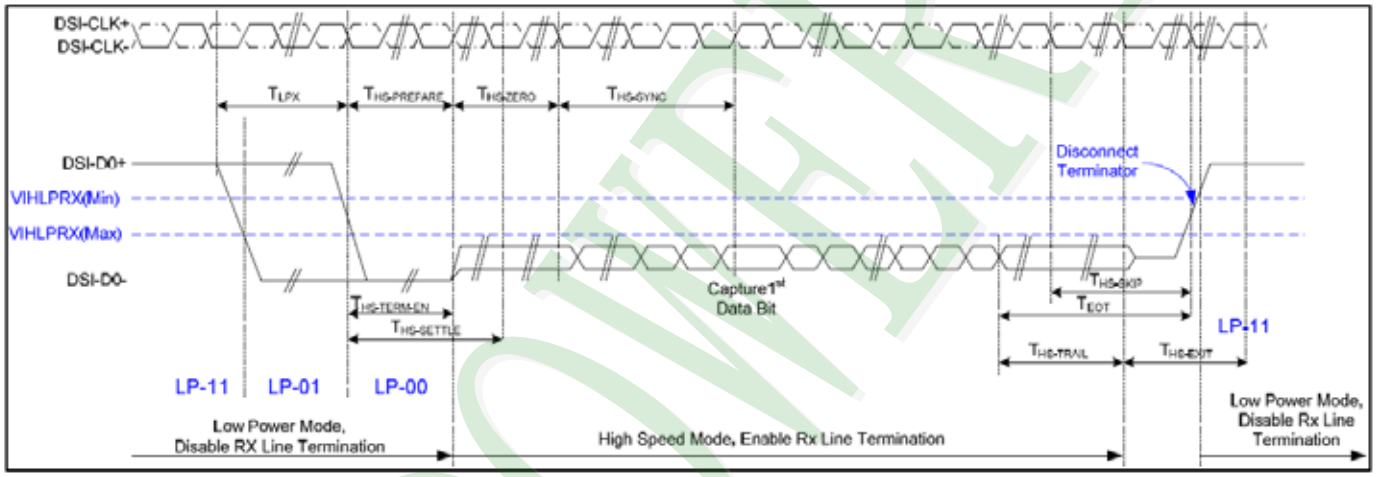
## MIPI Interface Characteristics

### High Speed Mode – Clock Channel Timing



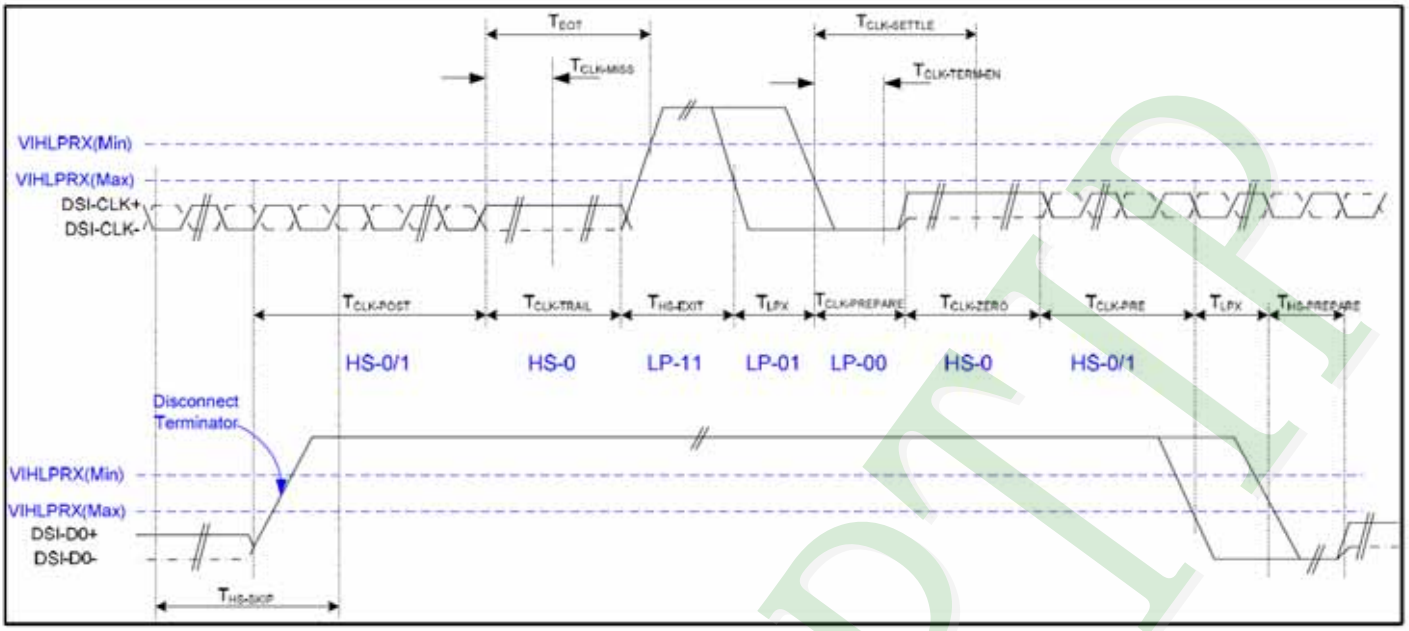

| Signal | Symbol | Parameter | MIN | MAX | Unit | Description |
|---|---|---|---|---|---|---|
| DSI-DATA_P/N | 2xUI INST | Double UI Instantaneous | 4 | 25 | ns | |
| DSI-DATA_P/N | UI INSTA ,UI INSTB | UI instantaneous Half | 2 | 12.5 | ns | |

### High-Speed Data Transmission



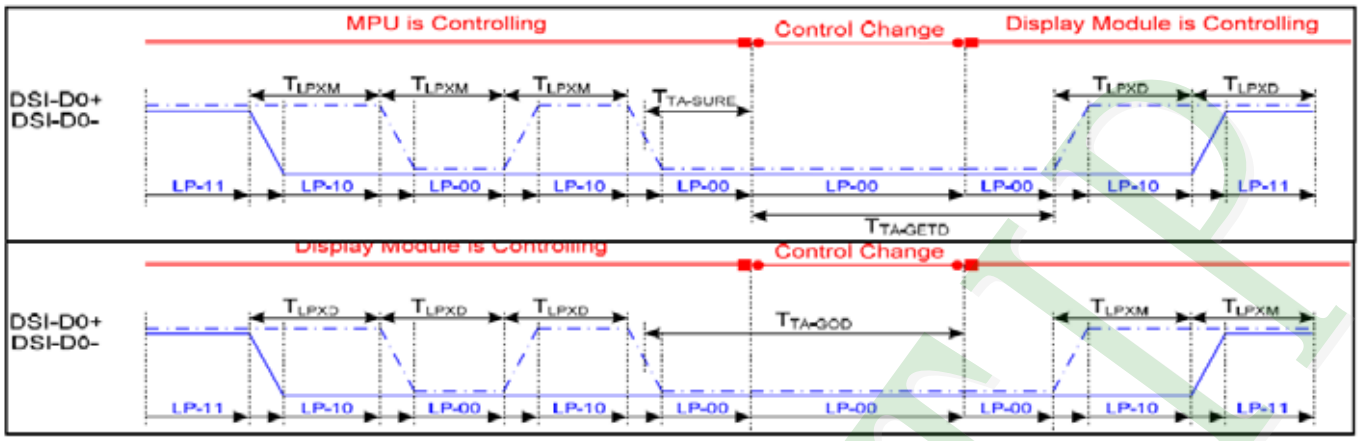

| Parameter | Symbol | MIN | TYP | MAX | Unit |
|---|---|---|---|---|---|
| Time to drive LP-00 to prepare for HS transmission | $T_{HS-PREPARE}$ | 40+4UI | | 85+6UI | ns |
| Time from start of t HS-TRAIL or t CLK-TRAIL period to start of LP-11 state | $T_{EOT}$ | | | 105+12UI | ns |
| Time to enable data receiver line termination measured from when Dn crosses VILMAX | $T_{HS-TERM-EN}$ | | | 35+4UI | ns |
| Time to drive flipped differential state after last payload data bit of a HS transmission | $T_{HS-TRAIL}$ | 60+4UI | | | ns |
| Time-out at RX to ignore transition period of EoT | $T_{HS-SKIP}$ | 40 | | 55+4UI | ns |
| Time to drive LP-11 after HS burst | $T_{HS-EXIT}$ | 100 | | | ns |
| Length of any Low-Power state period | $T_{LPX}$ | 50 | | | ns |
| Sync sequence period | $T_{HS-SYNC}$ | | 8UI | | ns |
| Minimum lead HS-0 drive period before the Sync sequence | $T_{HS-ZERO}$ | 105+6UI | | | ns |

Switching the Clock Lane between Clock Transmission and Low-Power Mode




| Parameter | Symbol | MIN | TYP | MAX | Unit |
|---|---|---|---|---|---|
| Time that the transmitter shall continue sending HS clock after the last associated Data Lane has transitioned to LP mode | $T_{CLK-POST}$ | 60+52UI | | | ns |
| Detection time that the clock has stopped toggling | $T_{CLK-MISS}$ | | | 60 | ns |
| Time to drive LP-00 to prepare for HS clock transmission | $T_{CLK-PREPARE}$ | 38 | | 95 | ns |
| Minimum lead HS-0 drive period before starting Clock | $T_{CLK-PREPARE}$ +$T_{CLK-ZERO}$ | 300 | | | ns |
| Time to enable Clock Lane receiver line termination measured from when Dn cross VIL,MAX | $T_{HS-TERM-EN}$ | | | 38 | ns |
| Minimum time that the HS clock must be set prior to any associated date lane beginning the transmission from LP to HS mode | $T_{CLK-PRE}$ | 8 | | | UI |
| Time to drive HS differential state after last payload clock bit of a HS transmission burst | $T_{CLK-TRAIL}$ | 60 | | | ns |

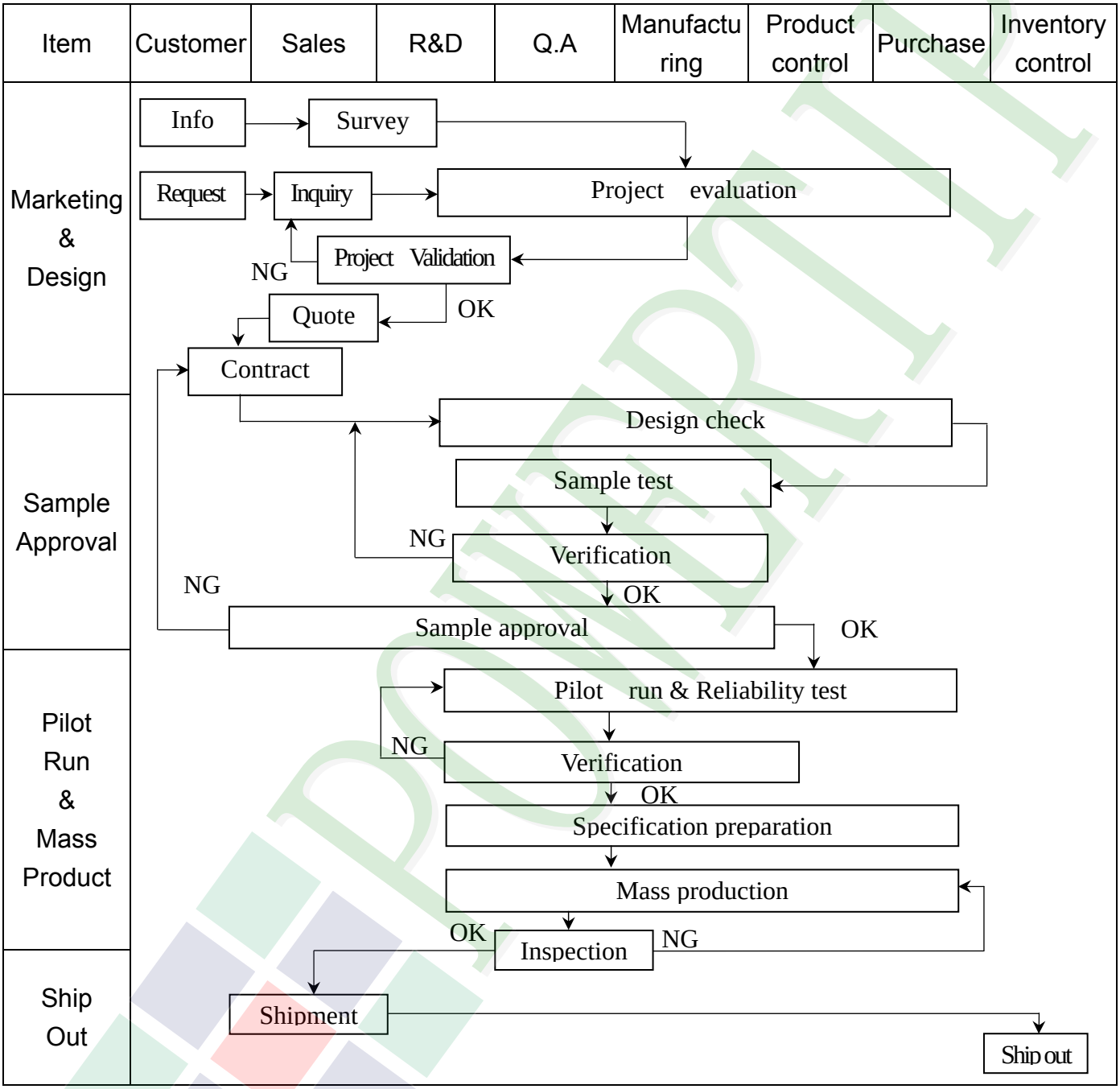
Bus Turnaround Procedure

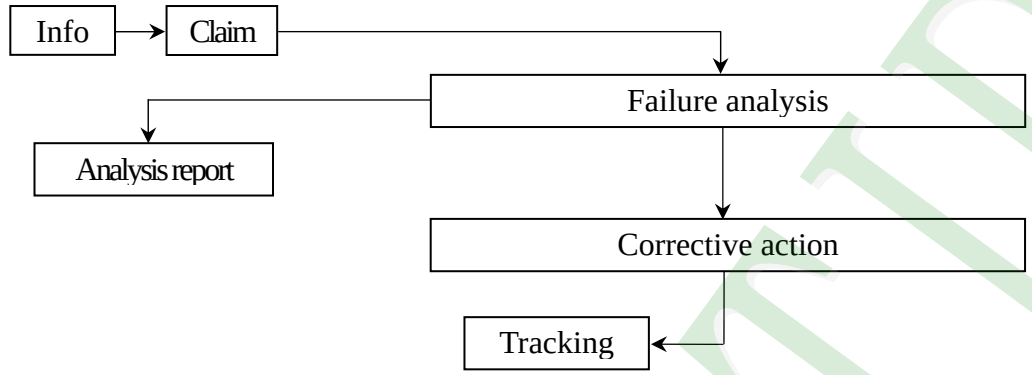



| Parameter | Symbol | MIN | TYP | MAX | Unit |
|---|---|---|---|---|---|
| Length of any Low-Power state period : Master side | $T_{LPX}$ | 50 | | 75 | ns |
| Length of any Low-Power state period : Slave side | $T_{LPX}$ | 47.5 | 50 | 52.5 | ns |
| Ratio of $T_{LPX}$ (MASTER)/ $T_{LPX}$ (SLAVE) between Master and Slave side | Ratio $T_{LPX}$ | 2/3 | | 3/2 | |
| Time-out before new TX side start driving | $T_{TA-SURE}$ | $T_{LPX}$ | | 2 $T_{LPX}$ | ns |
| Time to drive LP-00 by new TX | $T_{TA-GET}$ | | 5 $T_{LPX}$ | | ns |
| Time to drive LP-00 after Turnaround Request | $T_{TA-GO}$ | | 4 $T_{LPX}$ | | ns |

# 3. QUALITY ASSURANCE SYSTEM

## 3.1 Quality Assurance Flow Chart



| Item | Customer | Sales | R&D | Q.A | Manufacturing | Product control | Purchase | Inventory control |
|---|---|---|---|---|---|---|---|---|
| Sales Service |  | | | | | | | |
| Q.A Activity | 1. ISO 9001 Maintenance Activities<br>2. Process improvement proposal<br>3. Equipment calibration<br>4. Education And Training Activities<br>5. Standardization Management | | | | | | | |

## 3.2 Inspection Specification

◆Scope ：The document shall be applied to TFT-LCD Module for less than 3.5″ (Ver.B01).

◆Inspection Standard：MIL-STD-105E Table Normal Inspection Single Sampling Level Ⅱ.

◆Equipment：Gauge、MIL-STD、Powertip Tester、Sample

◆Defect Level：Major Defect AQL： 0.4 ； Minor Defect AQL： 1.5

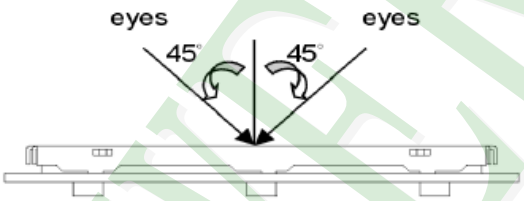
◆OUT Going Defect Level：Sampling.

◆Standard of the product appearance test：

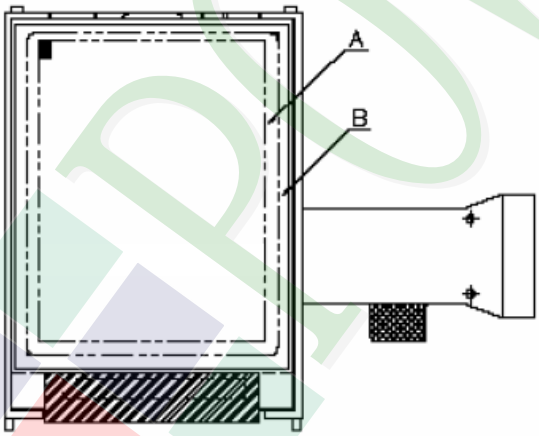
a. Manner of appearance test：

(1). The test best be under 20W×2 fluorescent light，and distance of view must be at 30 cm.

(2). The test direction is base on about around 45° of vertical line.




(3). Definition of area.




*A* area：viewing area

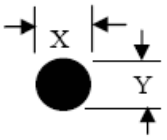
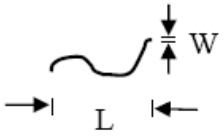
*B* area：Outside of viewing area

(4). Standard of inspection： (Unit：mm)

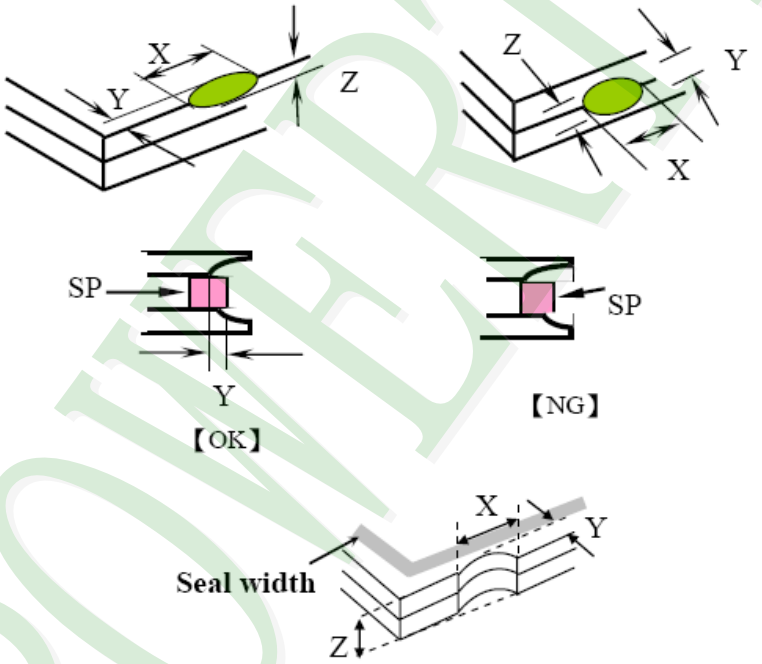
◆Specification For TFT-LCD Module Less Than 3.5″ : (Ver.B01)

<table>
<tr><th>NO</th><th>Item</th><th>Criterion</th><th>Level</th></tr>
<tr><td rowspan="3">01</td><td rowspan="3">Product condition</td><td>1.1 The part number is inconsistent with work order of production.</td><td>Major</td></tr>
<tr><td>1.2 Mixed product types.</td><td>Major</td></tr>
<tr><td>1.3 Assembled in inverse direction.</td><td>Major</td></tr>
<tr><td>02</td><td>Quantity</td><td>2.1 The quantity is inconsistent with work order of production.</td><td>Major</td></tr>
<tr><td>03</td><td>Outline dimension</td><td>3.1 Product dimension and structure must conform to structure diagram.</td><td>Major</td></tr>
<tr><td rowspan="5">04</td><td rowspan="5">Electrical Testing</td><td>4.1 Missing line character and icon.</td><td>Major</td></tr>
<tr><td>4.2 No function or no display.</td><td>Major</td></tr>
<tr><td>4.3 Display malfunction.</td><td>Major</td></tr>
<tr><td>4.4 LCD viewing angle defect.</td><td>Major</td></tr>
<tr><td>4.5 Current consumption exceeds product specifications.</td><td>Major</td></tr>
<tr><td>05</td><td>Dot defect<br><br>(Bright dot、Dark dot)<br><br>On -display</td><td>
<table>
<tr><th colspan="2">Item</th><th>Acceptance (Q'ty)</th></tr>
<tr><td rowspan="4">Dot Defect</td><td>Bright Dot</td><td>≦ 2</td></tr>
<tr><td>Dark Dot</td><td>≦ 3</td></tr>
<tr><td>Joint Dot</td><td>≦ 2</td></tr>
<tr><td>Total</td><td>≦ 3</td></tr>
</table>
5.1 Inspection pattern：full white , full black , Red , Green and blue screens.<br>
5.2 It is defined as dot defect if defect area ＞1/2 dot.<br>
5.3 The distance between two dot defect ≧5 mm.
</td><td>Minor</td></tr>
</table>

◆Specification For TFT-LCD Module Less Than 3.5″ : (Ver.B01)

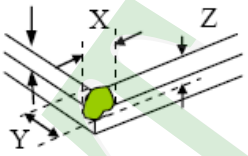
<table>
<tr><th>NO</th><th>Item</th><th>Criterion</th><th>Level</th></tr>
<tr><td>06</td><td>Black or white dot、scratch、contamination<br>Round type<br>  <br><br>Φ=(x+y) / 2<br>Line type<br>  <br></td><td>6.1 Round type ( Non-display or display) :<br><table><tr><th rowspan="2">Dimension<br>(diameter : Φ)</th><th colspan="2">Acceptance (Q'ty)</th></tr><tr><th>A area</th><th>B area</th></tr><tr><td>Φ ≦ 0.15</td><td>Ignore</td><td rowspan="4">Ignore</td></tr><tr><td>0.15 < Φ ≦ 0.20</td><td>2</td></tr><tr><td>0.20 < Φ ≦ 0.30</td><td>2</td></tr><tr><td>Φ > 0.30</td><td>0</td></tr><tr><td>Total</td><td>3</td><td></td></tr></table>6.2 Line type( Non-display or display) :<br><table><tr><th colspan="2">Dimension</th><th colspan="2">Acceptance (Q'ty)</th></tr><tr><th>Length (L)</th><th>Width (W)</th><th>A area</th><th>B area</th></tr><tr><td>---</td><td>W ≦ 0.03</td><td>Ignore</td><td rowspan="4">Ignore</td></tr><tr><td>L ≦5.0</td><td>0.03 <W ≦ 0.05</td><td>3</td></tr><tr><td>---</td><td>W >0.05</td><td>As round type</td></tr><tr><td colspan="2">Total</td><td>3</td></tr></table></td><td>Minor</td></tr>
<tr><td>07</td><td>Polarizer Bubble</td><td><table><tr><th rowspan="2">Dimension<br>(diameter : Φ)</th><th colspan="2">Acceptance (Q'ty)</th></tr><tr><th>A area</th><th>B area</th></tr><tr><td>Φ ≦ 0.20</td><td>Ignore</td><td rowspan="4">Ignore</td></tr><tr><td>0.20 < Φ ≦ 0.50</td><td>3</td></tr><tr><td>Φ > 0.50</td><td>0</td></tr><tr><td>Total</td><td>3</td></tr></table></td><td>Minor</td></tr>
</table>

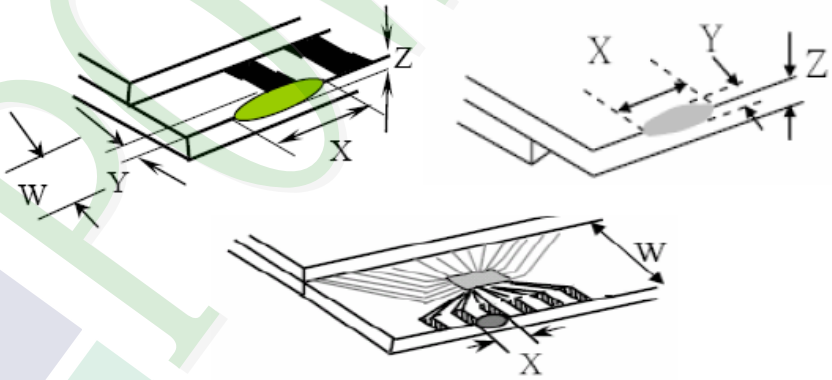
◆Specification For TFT-LCD Module Less Than 3.5″ : (Ver.B01)

| NO | Item | Criterion | Level |
|---|---|---|---|
| 08 | The crack of glass | Symbols :<br>X : The length of crack<br>Y : The width of crack.<br>Z : The thickness of crack<br>W : terminal length<br>t : The thickness of glass<br>a : LCD side length<br>8.1 General glass chip :<br>8.1.1 Chip on panel surface and crack between panels:<br>  | Minor |

| X | Y | Z |
|---|---|---|
| ≦ a | Crack can't enter viewing area | ≦1/2 t |
| ≦ a | Crack can't exceed the half of SP width. | 1/2 t < Z ≦2 t |

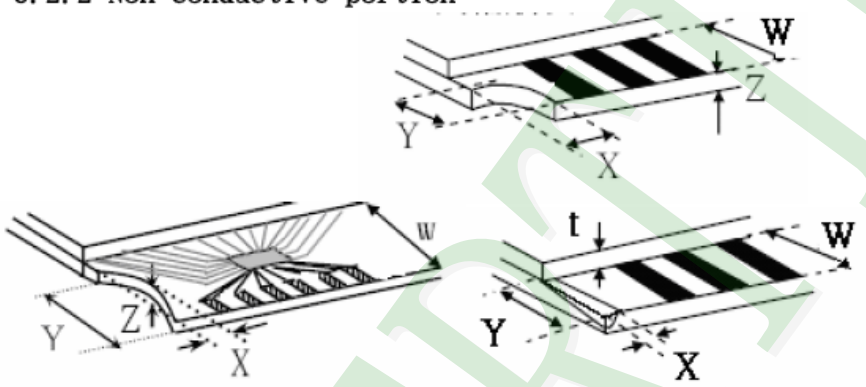
◆Specification For TFT-LCD Module Less Than 3.5″ : (Ver.B01)

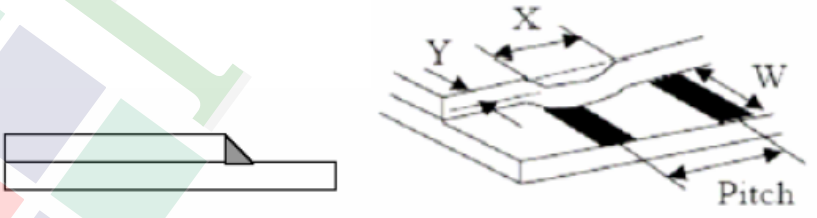
<table>
<tr><th>NO</th><th>Item</th><th>Criterion</th><th>Level</th></tr>
<tr><td rowspan="3">08</td><td rowspan="3">The crack of glass</td><td>Symbols :<br><br>X : The length of crack<br>Z : The thickness of crack<br>t : The thickness of glass<br>Y : The width of crack.<br>W : terminal length<br>a : LCD side length</td><td rowspan="3">Minor</td></tr>
<tr><td>8.1.2 Corner crack :<br> 

<table>
<tr><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>≦1/5 a</td><td>Crack can’t enter viewing area</td><td>Z ≦ 1/2 t</td></tr>
<tr><td>≦1/5 a</td><td>Crack can’t exceed the half of SP width.</td><td>1/2 t < Z ≦ 2 t</td></tr>
</table></td></tr>
<tr><td>8.2 Protrusion over terminal :<br>8.2.1 Chip on electrode pad :<br> 

<table>
<tr><th></th><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>Front</td><td>≦ a</td><td>≦ 1/2 W</td><td>≦ t</td></tr>
<tr><td>Back</td><td>≦ a</td><td>≦ W</td><td>≦ 1/2 t</td></tr>
</table></td></tr>
</table>

◆Specification For TFT-LCD Module Less Than 3.5″ : (Ver.B01)

<table>
<tr><th>NO</th><th>Item</th><th>Criterion</th><th>Level</th></tr>
<tr><td>08</td><td>The crack of glass</td><td>
Symbols :<br><br>
X : The length of crack Y : The width of crack.<br>
Z : The thickness of crack W : terminal length<br>
t : The thickness of glass a : LCD side length<br><br>
8.2.2 Non-conductive portion :<br>


<table>
<tr><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>≦ 1/3 a</td><td>≦W</td><td>≦t</td></tr>
</table>
⊙ If the chipped area touches the ITO terminal, over 2/3 of the ITO must remain and be inspected according to electrode terminal specifications.<br><br>
8.2.3 Glass remain :<br>


<table>
<tr><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>≦ a</td><td>≦ 1/3 W</td><td>≦t</td></tr>
</table>
</td><td>Minor</td></tr>
</table>

◆Specification For TFT-LCD Module Less Than 3.5″ : (Ver.B01)

| NO | Item | Criterion | Level |
|---|---|---|---|
| 09 | Backlight elements | 9.1 Backlight can't work normally. | Major |
| | | 9.2 Backlight doesn't light or color is wrong. | Major |
| | | 9.3 Illumination source flickers when lit. | Major |
| 10 | General appearance | 10.1 Pin type、quantity、dimension must match type in structure diagram. | Major |
| | | 10.2 No short circuits in components on PCB or FPC . | Major |
| | | 10.3 Parts on PCB or FPC must be the same as on the production characteristic chart .There should be no wrong parts , missing parts or excess parts. | Major |
| | | 10.4 Product packaging must the same as specified on packaging specification sheet. | Minor |
| | | 10.5 The folding and peeled off in polarizer are not acceptable. | Minor |
| | | 10.6 The PCB or FPC between B/L assembled distance(PCB or FPC ) is ≦1.5 mm. | Minor |

# 4. RELIABILITY TEST

## 4.1 Reliability Test Condition (Ver.B01)

<table>
<tr><th>NO.</th><th>TEST ITEM</th><th>TEST CONDITION</th></tr>
<tr><td>1</td><td>High Temperature Storage Test</td><td>Keep in +80 ±2℃ 96 hrs<br>Surrounding temperature, then storage at normal condition 4hrs.</td></tr>
<tr><td>2</td><td>Low Temperature Storage Test</td><td>Keep in -30 ±2℃ 96 hrs<br>Surrounding temperature, then storage at normal condition 4hrs.</td></tr>
<tr><td>3</td><td>High Temperature / High Humidity Storage Test</td><td>Keep in +60 ℃ / 90% R.H duration for 96 hrs<br>Surrounding temperature, then storage at normal condition 4hrs.<br>(Excluding the polarizer)</td></tr>
<tr><td>4</td><td>Temperature Cycling Storage Test</td><td>-30℃ → +25℃ → +80℃ → +25℃<br>(30mins) (5mins) (30mins) (5mins)<br>10 Cycle<br>Surrounding temperature, then storage at normal condition 4hrs.</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">ESD Test</td><td>Air Discharge:<br>Apply 2 KV with 5 times<br>Discharge for each polarity +/-</td><td>Contact Discharge:<br>Apply 250 V with 5 times<br>discharge for each polarity +/-</td></tr>
<tr><td colspan="2">1. Temperature ambiance : 15℃ 35℃<br>2. Humidity relative : 30% 60%<br>3. Energy Storage Capacitance(Cs+Cd) : 150pF±10%<br>4. Discharge Resistance(Rd) : 330Ω±10%<br>5. Discharge, mode of operation :<br>Single Discharge (time between successive discharges at least 1 sec)<br>(Tolerance if the output voltage indication : ±5%)</td></tr>
<tr><td>6</td><td>Vibration Test (Packaged)</td><td colspan="2">1. Sine wave 10 55 Hz frequency (1 min/sweep)<br>2. The amplitude of vibration :1.5 mm<br>3. Each direction (X、Y、Z) duration for 2 Hrs</td></tr>
<tr><td>7</td><td>Drop Test (Packaged)</td><td colspan="2"><table><tr><th>Packing Weight (Kg)</th><th>Drop Height (cm)</th></tr><tr><td>0 ~ 45.4</td><td>122</td></tr><tr><td>45.4 ~ 90.8</td><td>76</td></tr><tr><td>90.8 ~ 454</td><td>61</td></tr><tr><td>0ver 454</td><td>46</td></tr></table>Drop Direction :※1 corner / 3 edges / 6 sides each 1time</td></tr>
</table>

# 5. PRECAUTION RELATING PRODUCT HANDLING

## 5.1 SAFETY

5.1.1 If the LCD panel breaks , be careful not to get the liquid crystal to touch your skin.

5.1.2 If the liquid crystal touches your skin or clothes , please wash it off immediately by using soap and water.

## 5.2 HANDLING

5.2.1 Avoid any strong mechanical shock which can break the glass.

5.2.2 Avoid static electricity which can damage the CMOS LSI—When working with the module , be sure to ground your body and any electrical equipment you may be using.

5.2.3 Do not remove the panel or frame from the module.

5.2.4 The polarizing plate of the display is very fragile. So , please handle it very carefully ,do not touch , push or rub the exposed polarizing with anything harder than an HB pencil lead (glass , tweezers , etc.)

5.2.5 Do not wipe the polarizing plate with a dry cloth , as it may easily scratch the surface of plate.

5.2.6 Do not touch the display area with bare hands , this will stain the display area.

5.2.7 Do not use ketonics solvent & aromatic solvent. Use with a soft cloth soaked with a cleaning naphtha solvent.

5.2.8 To control temperature and time of soldering is 320±10℃and 3-5 sec.

5.2.9 To avoid liquid (include organic solvent) stained on LCM .

## 5.3 STORAGE

5.3.1 Store the panel or module in a dark place where the temperature is 25℃ ±5℃ and the humidity is below 65% RH.

5.3.2 Do not place the module near organics solvents or corrosive gases.

5.3.3 Do not crush , shake , or jolt the module.

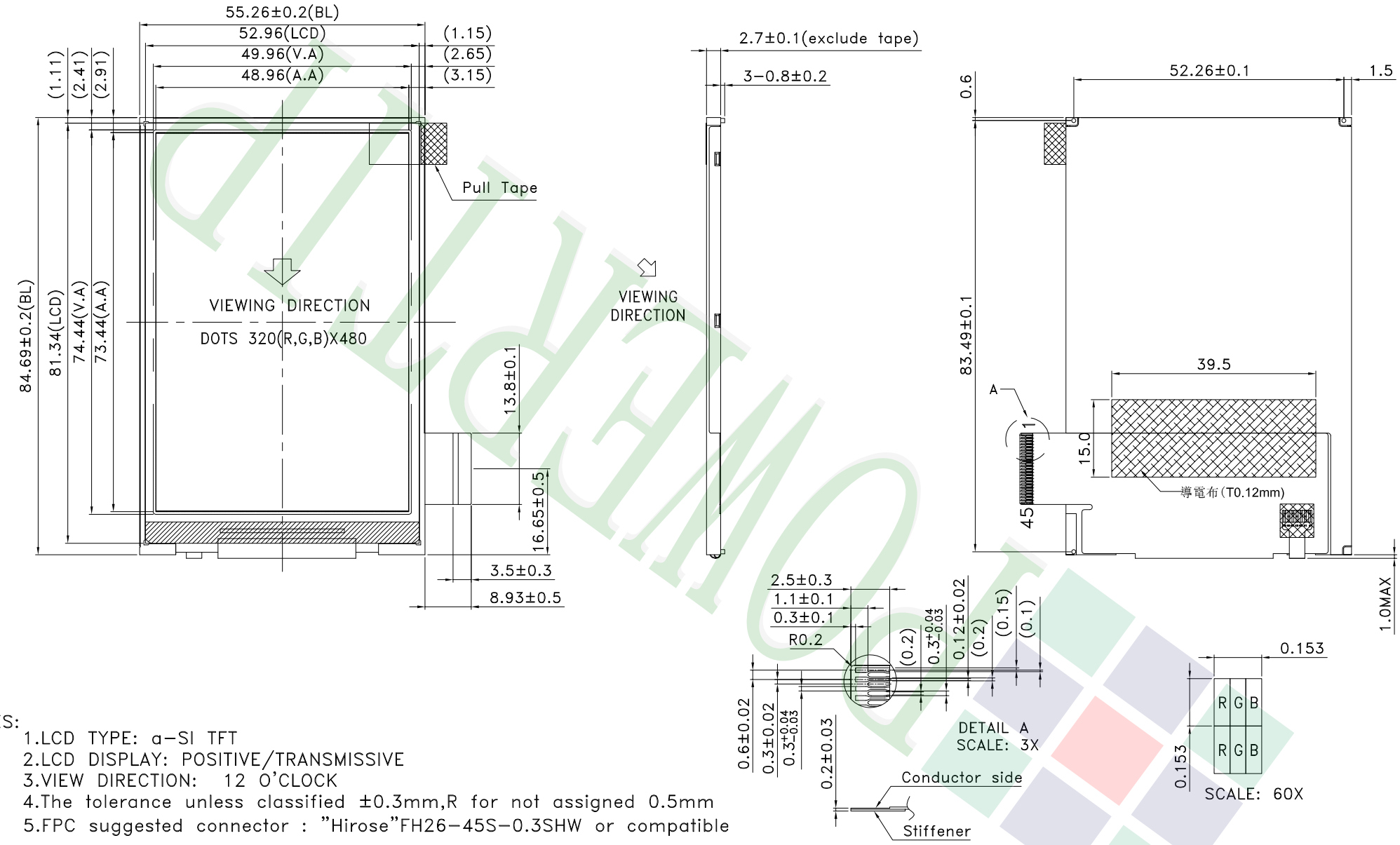
## 5.4 TERMS OF WARRANTY

5.4.1 Applicable warrant period

The period is within thirteen months since the date of shipping out under normal using and storage conditions.

5.4.2 Unaccepted responsibility

This product has been manufactured to your company's specification as a part for use in your company's general electronic products. It is guaranteed to perform according to delivery specifications. For any other use apart from general electronic equipment , we cannot take responsibility if the product is used in nuclear power control equipment , aerospace equipment , fire and security systems or any other applications in which there is a direct risk to human life and where extremely high levels of reliability are required.




NOTES:

1.LCD TYPE: a-SI TFT
2.LCD DISPLAY: POSITIVE/TRANSMISSIVE
3.VIEW DIRECTION: 12 O'CLOCK
4.The tolerance unless classified ±0.3mm,R for not assigned 0.5mm
5.FPC suggested connector : "Hirose"FH26-45S-0.3SHW or compatible

| REV | REV BY | REVISER | DATE |
|---|---|---|---|
| 007 | | | |
| 006 | | | |
| 005 | | | |
| 004 | | | |
| 003 | | | |
| 002 | | | |
| 001 | NEW DRAWING | Eva | 2015/07/08 |

PART NO: PH320480T009-LAA01

DRAWING NAME : LMD-PH320480T009-LAA01

TITLE: LCD MODULE DRAWING

久正光電股份有限公司
POWERTIP TECHNOLOGY CORPORATION

| | | | | | |
|---|---|---|---|---|---|
| Design | Eva Liao | (3) | Surface | | |
| Check | Tina Chen | Unit | MM | Material | |
| Approve | Linda Lee | Scale | FIT | Thickness | |
| | | Page | 1/1 | Quantity | |

| Length(Min) (mm) \ Tolerance \ Precision | Precision Level |
|---|---|
| 1 ~ 4 | - |
| 4 ~ 16 | - |
| 16 ~ 63 | - |
| 63 ~ 250 | - |
| 250 ~ 1000 | - |

Ver.001

| Documents NO. | PKG-PH320480T009-LAA01 |
|---|---|

# LCM包裝規格書
## LCM Packaging Specifications

| Approve | Check | Contact |
|---|---|---|
| Linda | Tina | Eva |

1.包裝材料規格表 (Packaging Material) : (per carton)

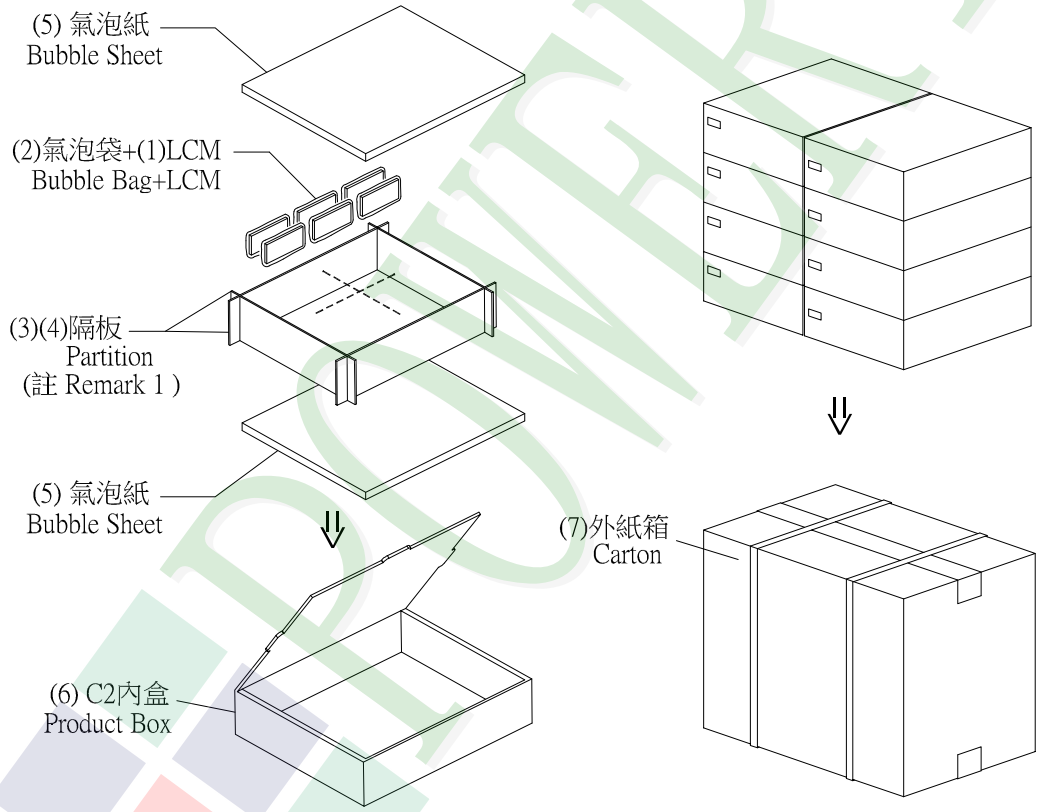
| No. | Item | Model | Dimensions (mm) | 1Pcs Weight | Quantity | Total Weight |
|---|---|---|---|---|---|---|
| 1 | 成品 (1)LCM | PH320480T009-LAA01 | 55.26 X 84.69 | 0.0203 | 288 | 5.8464 |
| 2 | 氣泡袋(2)Bubble Bag | BAG100080BWABA | 100 X 80 | 0.0012 | 288 | 0.3456 |
| 3 | A2-1隔板(3)A2-1 Partition | BX29500072BZBA | 295 X 72 X 3.0 | 0.0109 | 104 | 1.1336 |
| 4 | B2-1隔板(4)B2-1 Partition | BX24500072BZBA | 245 X 72 X 3.0 | 0.0094 | 32 | 0.3008 |
| 5 | 氣泡紙(5)Bubble Sheet | BAG280240BWABA | 280 X 240 | 0.006 | 16 | 0.096 |
| 6 | C2內盒(6)Product Box | BX31025580AABA | 310 X 255 X 86 | 0.16 | 8 | 1.28 |
| 7 | 外紙箱(7)Carton | BX52732536CCBA | 527 X 325 X 360 | 0.83 | 1 | 0.83 |
| 8 | | | | | | |
| 9 | | | | | | |

2.一 整箱總重量 (Total LCD Weight in carton ) : 9.83 Kg±10%

3.單箱數量規格表 (Packaging Specifications and Quantity) :

(1)Quantity Of Spacer : A2-1隔板 X 13 , B2-1隔板 X 4

(2)Total LCM quantity in carton : quantity per box 36 x no of boxes 8 = 288

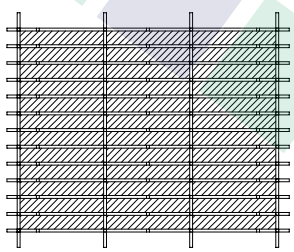



## 特 記 事 項 (REMARK)

1. LCM排放示意圖(前後間隔不放置):

1. LCM placed as figure showing:

( First and last slot should be empty)



模組(LCM) X 1pcs.