



## PRODUCT SPECIFICATION

*Part Number*

PT322457A-TLMWU-EMC37

|                      |                                  |
|----------------------|----------------------------------|
| CUSTOMER             |                                  |
| CUSTOMER PART NUMBER |                                  |
| DESCRIPTION          | 5.7" TFT LCD, Medium Bright, CTP |
| APPROVED BY          |                                  |
| DATE                 |                                  |

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### 3. Module Numbering System

PT \_\_\_\_\_ - \_\_\_\_\_ - \_\_\_\_\_

1.      2.      3.      4.      5.      6.      7.      8.      9      10.   11.   12.   13.   14.

#### 1. P-TEC TFT

#### 2. LENGTH x WIDTH PIXELS

If third character is a zero, it is removed to shorten part number. Example: 240 x 320 = PT3224

#### 3. DIAGONAL DIMENSIONS

Example: 3.5" display = 35 in part number

#### 4. PRODUCT VERSION

Series assigned by P-tec

#### 5. LCD MODE

T: TN

I: IPS

V: VA

#### 6. POLARIZER

LM: Transmissive

LF: Transflective

#### 7. BACKLIGHT COLOR

No Backlight: Left Blank

W: White

B: Blue/Green

S: Yellow/Green

#### 8. VIEWING DIRECTION

D: 6 o'clock

U: 12 o'clock

F: Full Viewing Angle

#### 9. A ~ Z CODE

Assigned by P-tec

#### 11. TEMPERATURE RANGE

Normal: Left Blank

Wide: X

#### 12. LUMINANCE

Blank: Normal (<300 nit)

M: Middle (>= 300 nit)

H: High (> 600 nit)

#### 13. TOUCH PANEL OPTION

No TP: Left Blank

C: Capacitive TP

R: Resistive TP

#### 14. SPECIAL CHARACTERS

Customer special requirements



#### 4. Application

This specification is applied to the 5.7 inch QVGA supported TFT-LCD module With projected capacitive touch (PCT) and can display true 262,144 colors(6 bit/ color). The module is designed for OA, Car TV application and other electronic products which require flat panel display of digital signal interface. This module is composed of a 5.7" TFT-LCD panel, a driver circuit and LED backlight unit and used as the input devices for general electric appliances via both finger and Capacitive stylus pen.

#### 5. Features

- QVGA (320×240 pixels) resolution.
- Digital 18 bit parallel RGB.
- Line inversion mode with stripe type.
- Both DE mode and SYNC mode are supported for digital RGB input data format.
- Projected Capacitive Touch
  - I<sup>2</sup>C Interface
  - Multi Touch (Ten points)

#### 6. General Specifications

| Item                | Specifications                                                                                                                                                                      | Unit |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| Screen Size         | 5.7 (Diagonal)                                                                                                                                                                      | inch |
| Display Format      | 320RGB(H)×240(V)                                                                                                                                                                    | dot  |
| Active Area         | 115.2(H)×86.4(V)                                                                                                                                                                    | mm   |
| Dot Size            | 0.120(H)×0.360(V)                                                                                                                                                                   | mm   |
| Pixel Configuration | RGB Vertical Stripe                                                                                                                                                                 | -    |
| Display Mode        | TN Type<br>Transmissive Mode<br>Normally White                                                                                                                                      | -    |
| Surface Treatment   | Clear(7H)                                                                                                                                                                           | -    |
| Viewing Direction   | 12 O'clock<br>(The Gray Inversion will appear at this direction)                                                                                                                    | -    |
| Outline Dimension   | 144.0(H)×104.6(W)×14.55(D)                                                                                                                                                          | mm   |
| Weight              | 258                                                                                                                                                                                 | g    |
| RoHS Compliance     | P-tec certifies this product to be in compliance with European Union Directive 2011/65/EU on the restriction of certain hazardous substances in electrical and electronic equipment | -    |



## 7. Absolute Maximum Ratings

### 7.1 Absolute Ratings of Environment

| Item                          | Symbol          | Value |      | Unit | Note   |
|-------------------------------|-----------------|-------|------|------|--------|
|                               |                 | Min.  | Max. |      |        |
| Storage Temperature           | T <sub>ST</sub> | -30   | +80  | °C   | (1)(2) |
| Operating Ambient Temperature | T <sub>OP</sub> | -20   | +70  | °C   | (1)(2) |

Note1: Background color changes slightly depending on ambient temperature.

This phenomenon is reversible.

Note2: Please refer to item of RELIABILITY.

### 7.2 Electrical Absolute Ratings

#### 7.2.1 TFT-LCD Module

(Ta=25±2°C, GND=VSS=0V)

| Item                         | Symbol | Value |      | Unit | Note |
|------------------------------|--------|-------|------|------|------|
|                              |        | Min.  | Max. |      |      |
| Digital Power Supply Voltage | VCC    | -0.3  | 4.3  | V    | -    |

#### 7.2.2 Backlight Unit

(Ta=25±2°C)

| Item                      | Symbol         | Value |      | Unit | Note |
|---------------------------|----------------|-------|------|------|------|
|                           |                | Min.  | Max. |      |      |
| Current of Backlight Unit | I <sub>B</sub> | -     | 75   | mA   | (1)  |
| Voltage of Backlight Unit | V <sub>B</sub> | -     | 30   | V    | (1)  |

Note (1) Permanent damage to the device may occur if maximum values are exceeded or reverse voltage is loaded.

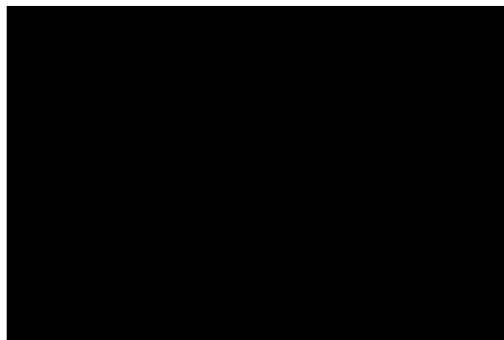
**8. Electrical Characteristics****8.1 TFT-LCD Module**

(Ta=25±2°C)

| Item                         | Symbol         | Value  |        |        | Unit | Note |
|------------------------------|----------------|--------|--------|--------|------|------|
|                              |                | Min.   | Typ.   | Max.   |      |      |
| Power Supply Voltage         | VCC            | 3.0    | 3.3    | 3.6    | V    | -    |
| Input High Threshold Voltage | VIH            | 0.7VCC | -      | VCC    | V    | -    |
| Input Low Threshold Voltage  | VIL            | 0      | -      | 0.3VCC | V    | -    |
| Power Consumption            | P <sub>L</sub> |        | (0.24) |        | W    | (1)  |
| Frame Frequency              | F <sub>V</sub> | -      | 60     | -      | Hz   | -    |
| Dot Clock                    | DCLK           | -      | 6.4    | 7      | MHz  | -    |

Note (1) The specified power consumption is under the conditions at VCC=3.3V,  
F<sub>V</sub>=60Hz, whereas a power dissipation check pattern below is displayed.

Black Pattern / 0 Gray



Active Area

**8.2 Backlight Unit**

(Ta=25±2°C)

| Item                      | Symbol          | Value |       |      | Unit | Note                 |
|---------------------------|-----------------|-------|-------|------|------|----------------------|
|                           |                 | Min.  | Typ.  | Max. |      |                      |
| Current of Backlight Unit | I <sub>B</sub>  | -     | 60    | -    | mA   | -                    |
| Voltage of Backlight Unit | V <sub>B</sub>  | -     | 23.1  | -    | V    | I <sub>B</sub> =60mA |
| Power Consumption         | P <sub>BL</sub> | -     | (1.4) | -    | W    | I <sub>B</sub> =60mA |
| LED Life Time(25°C)       |                 | 40000 | --    | --   | hr   | (1)                  |

Note (1) : Lamp life time is defined as under 25±2°C , when the average brightness  
decrease to 50% of original brightness



### 8.3 Projected Capacitive Touch

| Item                          | Symbol          | Value            |       |        | Unit | Note  |
|-------------------------------|-----------------|------------------|-------|--------|------|-------|
|                               |                 | Min.             | Typ.  | Max.   |      |       |
| Operating Voltage             | VDD             | 3.0              | 3.3   | 3.6    | V    | -     |
| Power Supply Current          | IDD             | -                | (TBD) | (TBD)  | mA   | (1)   |
| Input High Threshold Voltage  | V <sub>IH</sub> | 0.7VDD           | -     | VDD    | V    | -     |
| Input Low Threshold Voltage   | V <sub>IL</sub> | -0.3             | -     | 0.3VDD | V    | -     |
| Output High Threshold Voltage | V <sub>OH</sub> | 0.7VDD           | -     | -      | V    | -     |
| Output Low Threshold Voltage  | V <sub>OL</sub> | -                | -     | 0.3VDD | V    | -     |
| Power Consumption             | P <sub>L</sub>  | -                | (TBD) | (TBD)  | mW   | @3.3V |
| Interface                     |                 | I <sup>2</sup> C |       |        |      | -     |
| Function                      |                 | Multi Touch      |       |        |      | -     |

Note (1) This test condition is touched with 10 points.





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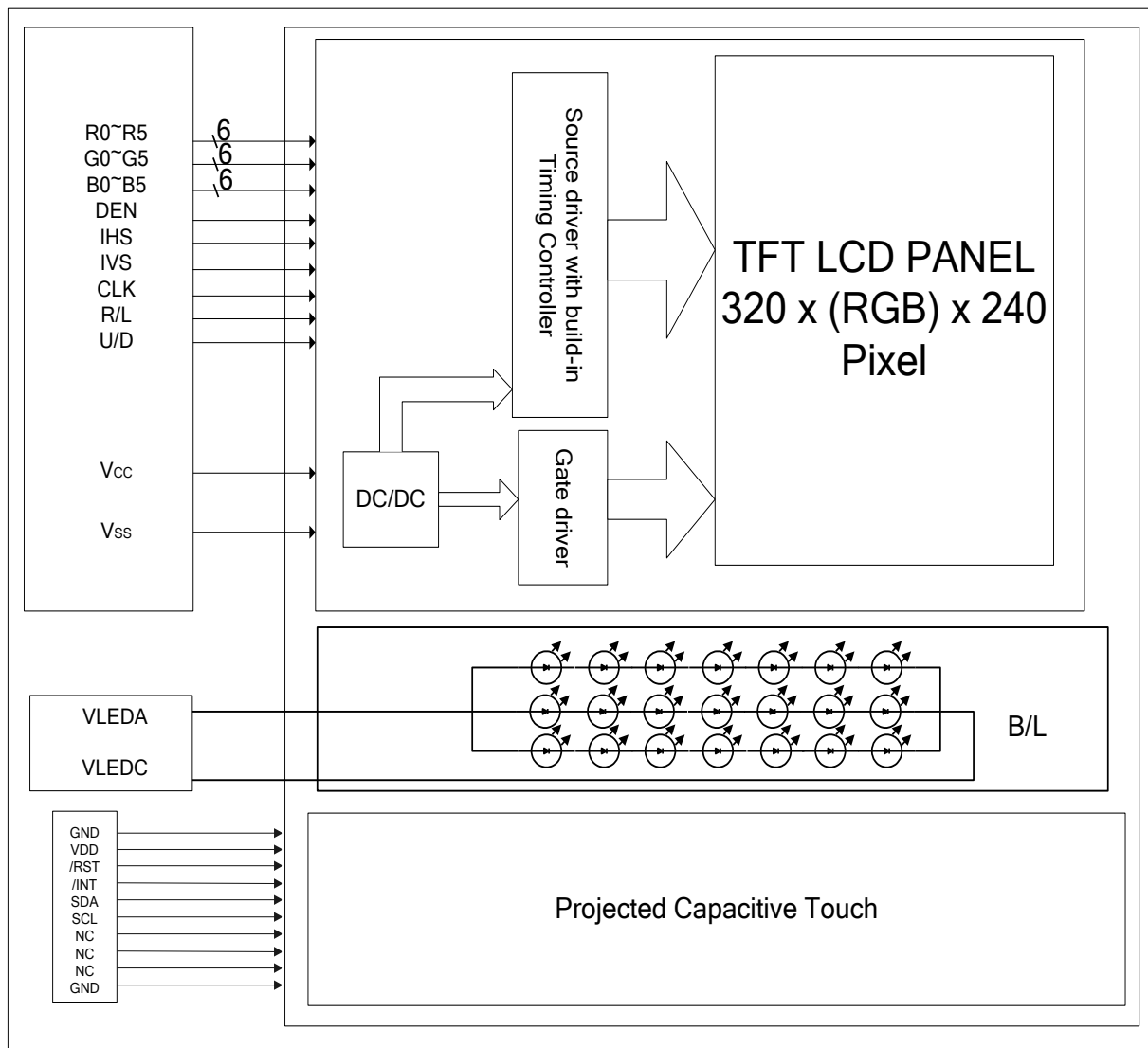
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## 9. Block Diagram





## 10. Input / Output Terminals Pin Assignment

### 10.1 TFT-LCD Module

Connector: CVILUX CF25331D0R0-05

| Pin No. | Symbol | I/O | Description                                                                      |
|---------|--------|-----|----------------------------------------------------------------------------------|
| 1       | VSS    | I   | Ground                                                                           |
| 2       | CLK    | I   | Clock signal                                                                     |
| 3       | IHS    | I   | Horizontal synchronous signal                                                    |
| 4       | IVS    | I   | Vertical synchronous signal                                                      |
| 5       | VSS    | I   | Ground                                                                           |
| 6       | R0     | I   | RED data (LSB)                                                                   |
| 7       | R1     | I   | RED data                                                                         |
| 8       | R2     | I   | RED data                                                                         |
| 9       | R3     | I   | RED data                                                                         |
| 10      | R4     | I   | RED data                                                                         |
| 11      | R5     | I   | RED data(MSB)                                                                    |
| 12      | VSS    | I   | Ground                                                                           |
| 13      | G0     | I   | GREEN data(LSB)                                                                  |
| 14      | G1     | I   | GREEN data                                                                       |
| 15      | G2     | I   | GREEN data                                                                       |
| 16      | G3     | I   | GREEN data                                                                       |
| 17      | G4     | I   | GREEN data                                                                       |
| 18      | G5     | I   | GREEN data(MSB)                                                                  |
| 19      | VSS    | I   | Ground                                                                           |
| 20      | B0     | I   | Blue data(LSB)                                                                   |
| 21      | B1     | I   | Blue data                                                                        |
| 22      | B2     | I   | Blue data                                                                        |
| 23      | B3     | I   | Blue data                                                                        |
| 24      | B4     | I   | Blue data                                                                        |
| 25      | B5     | I   | Blue data(MSB)                                                                   |
| 26      | VSS    | I   | Ground                                                                           |
| 27      | DEN    | I   | Input data enable control                                                        |
| 28      | VCC    | I   | +3.3V power supply                                                               |
| 29      | VCC    | I   | +3.3V power supply                                                               |
| 30      | R/L    | I   | Right-and-Left scan setting.<br>("L" : Normally , "H" : Right-and-Left reversal) |



| Pin No. | Symbol | I/O | Description                                                             |
|---------|--------|-----|-------------------------------------------------------------------------|
| 31      | U/D    | I   | Up/down scan setting.<br>("H": normal scan. "L": Up-and-Down reversal.) |
| 32      | NC     | I   | No connection                                                           |
| 33      | VSS    | I   | Ground                                                                  |

## 10.2 Backlight Unit

Connector: JST BHSR-02VS-1(N)

| Pin No. | Symbol | I/O | Description            | Wire Color |
|---------|--------|-----|------------------------|------------|
| 1       | VLEDA  | I   | Backlight LED Anode.   | Red        |
| 2       | VLEDC  | I   | Backlight LED Cathode. | Black      |

## 10.3 Projected Capacitive Touch

Connector: CVILUX CF25101D0R0-05

| Pin No. | Symbol | I/O | Description                                                                     |
|---------|--------|-----|---------------------------------------------------------------------------------|
| 1       | GND    | I   | System ground.                                                                  |
| 2       | VDD    | I   | +3.3V power supply.                                                             |
| 3       | /RST   | I   | External reset signal, active low.                                              |
| 4       | /INT   | O   | Interrupt signal, active low, asserted to request Host start a new transaction. |
| 5       | SDA    | I/O | I <sup>2</sup> C data signal.                                                   |
| 6       | SCL    | I   | I <sup>2</sup> C clock signal.                                                  |
| 7       | NC     | -   | Not Connection                                                                  |
| 8       | NC     | -   | Not Connection                                                                  |
| 9       | NC     | -   | Not Connection                                                                  |
| 10      | GND    | I   | System ground.                                                                  |



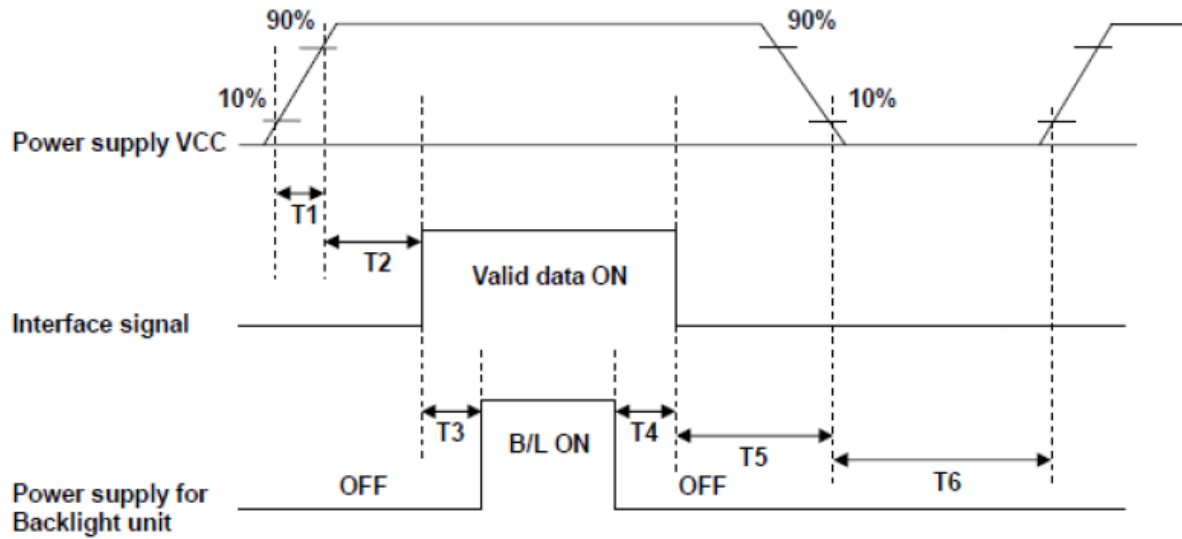
## 10.4 Color Data Input Assignment

The brightness of each primary color(red, green and blue) is based on the 6 bit gray scale data input for the color. The higher the binary input, the brighter the color. The table provides the assignment of color versus data input.

| Color               |                 | Data Signal |     |     |     |     |     |       |     |     |     |     |     |      |     |     |     |     |     |
|---------------------|-----------------|-------------|-----|-----|-----|-----|-----|-------|-----|-----|-----|-----|-----|------|-----|-----|-----|-----|-----|
|                     |                 | Red         |     |     |     |     |     | Green |     |     |     |     |     | Blue |     |     |     |     |     |
|                     |                 | D05         | D04 | D03 | D02 | D01 | D00 | D15   | D14 | D13 | D12 | D11 | D10 | D25  | D24 | D23 | D22 | D21 | D20 |
| Basic Colors        | Black           | 0           | 0   | 0   | 0   | 0   | 0   | 0     | 0   | 0   | 0   | 0   | 0   | 0    | 0   | 0   | 0   | 0   | 0   |
|                     | Red             | 1           | 1   | 1   | 1   | 1   | 1   | 0     | 0   | 0   | 0   | 0   | 0   | 0    | 0   | 0   | 0   | 0   | 0   |
|                     | Green           | 0           | 0   | 0   | 0   | 0   | 0   | 1     | 1   | 1   | 1   | 1   | 1   | 0    | 0   | 0   | 0   | 0   | 0   |
|                     | Blue            | 0           | 0   | 0   | 0   | 0   | 0   | 0     | 0   | 0   | 0   | 0   | 0   | 1    | 1   | 1   | 1   | 1   | 1   |
|                     | Cyan            | 0           | 0   | 0   | 0   | 0   | 0   | 1     | 1   | 1   | 1   | 1   | 1   | 1    | 1   | 1   | 1   | 1   | 1   |
|                     | Magenta         | 1           | 1   | 1   | 1   | 1   | 1   | 0     | 0   | 0   | 0   | 0   | 0   | 1    | 1   | 1   | 1   | 1   | 1   |
|                     | Yellow          | 1           | 1   | 1   | 1   | 1   | 1   | 1     | 1   | 1   | 1   | 1   | 1   | 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   |
| Gray Scale Of RED   | Red(0) / Dark   | 0           | 0   | 0   | 0   | 0   | 0   | 0     | 0   | 0   | 0   | 0   | 0   | 0    | 0   | 0   | 0   | 0   | 0   |
|                     | Red(1)          | 0           | 0   | 0   | 0   | 0   | 1   | 0     | 0   | 0   | 0   | 0   | 0   | 0    | 0   | 0   | 0   | 0   | 0   |
|                     | Red(2)          | 0           | 0   | 0   | 0   | 1   | 0   | 0     | 0   | 0   | 0   | 0   | 0   | 0    | 0   | 0   | 0   | 0   | 0   |
|                     | :               | :           | :   | :   | :   | :   | :   | :     | :   | :   | :   | :   | :   | :    | :   | :   | :   | :   | :   |
|                     | :               | :           | :   | :   | :   | :   | :   | :     | :   | :   | :   | :   | :   | :    | :   | :   | :   | :   | :   |
|                     | Red(61)         | 1           | 1   | 1   | 1   | 0   | 1   | 0     | 0   | 0   | 0   | 0   | 0   | 0    | 0   | 0   | 0   | 0   | 0   |
|                     | Red(62)         | 1           | 1   | 1   | 1   | 1   | 0   | 0     | 0   | 0   | 0   | 0   | 0   | 0    | 0   | 0   | 0   | 0   | 0   |
|                     | Red(63)         | 1           | 1   | 1   | 1   | 1   | 1   | 0     | 0   | 0   | 0   | 0   | 0   | 0    | 0   | 0   | 0   | 0   | 0   |
| Gray Scale Of Green | Green(0) / Dark | 0           | 0   | 0   | 0   | 0   | 0   | 0     | 0   | 0   | 0   | 0   | 0   | 0    | 0   | 0   | 0   | 0   | 0   |
|                     | Green(1)        | 0           | 0   | 0   | 0   | 0   | 0   | 0     | 0   | 0   | 0   | 0   | 1   | 0    | 0   | 0   | 0   | 0   | 0   |
|                     | Green(2)        | 0           | 0   | 0   | 0   | 0   | 0   | 0     | 0   | 0   | 0   | 1   | 0   | 0    | 0   | 0   | 0   | 0   | 0   |
|                     | :               | :           | :   | :   | :   | :   | :   | :     | :   | :   | :   | :   | :   | :    | :   | :   | :   | :   | :   |
|                     | :               | :           | :   | :   | :   | :   | :   | :     | :   | :   | :   | :   | :   | :    | :   | :   | :   | :   | :   |
|                     | Green(61)       | 0           | 0   | 0   | 0   | 0   | 0   | 1     | 1   | 1   | 1   | 0   | 1   | 0    | 0   | 0   | 0   | 0   | 0   |
|                     | Green(62)       | 0           | 0   | 0   | 0   | 0   | 0   | 1     | 1   | 1   | 1   | 1   | 0   | 0    | 0   | 0   | 0   | 0   | 0   |
|                     | Green(63)       | 0           | 0   | 0   | 0   | 0   | 0   | 1     | 1   | 1   | 1   | 1   | 1   | 0    | 0   | 0   | 0   | 0   | 0   |
| Gray Scale Of Blue  | Blue(0) / Dark  | 0           | 0   | 0   | 0   | 0   | 0   | 0     | 0   | 0   | 0   | 0   | 0   | 0    | 0   | 0   | 0   | 0   | 0   |
|                     | Blue(1)         | 0           | 0   | 0   | 0   | 0   | 0   | 0     | 0   | 0   | 0   | 0   | 0   | 0    | 0   | 0   | 0   | 0   | 1   |
|                     | Blue(2)         | 0           | 0   | 0   | 0   | 0   | 0   | 0     | 0   | 0   | 0   | 0   | 0   | 0    | 0   | 0   | 0   | 1   | 0   |
|                     | :               | :           | :   | :   | :   | :   | :   | :     | :   | :   | :   | :   | :   | :    | :   | :   | :   | :   | :   |
|                     | :               | :           | :   | :   | :   | :   | :   | :     | :   | :   | :   | :   | :   | :    | :   | :   | :   | :   | :   |
|                     | Blue(61)        | 0           | 0   | 0   | 0   | 0   | 0   | 0     | 0   | 0   | 0   | 0   | 0   | 1    | 1   | 1   | 1   | 0   | 1   |
|                     | Blue(62)        | 0           | 0   | 0   | 0   | 0   | 0   | 0     | 0   | 0   | 0   | 0   | 0   | 1    | 1   | 1   | 1   | 1   | 0   |
|                     | Blue(63)        | 0           | 0   | 0   | 0   | 0   | 0   | 0     | 0   | 0   | 0   | 0   | 0   | 1    | 1   | 1   | 1   | 1   | 1   |



## 10.5 Power ON/OFF Sequence

**POWER SEQUENCE TABLE**

| Parameter | Value |     |      | Units |
|-----------|-------|-----|------|-------|
|           | Min.  | Typ | Max. |       |
| T1        | 0.5   | -   | 20   | ms    |
| T2        | 0     | -   | 40   | ms    |
| T3        | 350   | -   | -    | ms    |
| T4        | 350   | -   | -    | ms    |
| T5        | 0     | -   | 40   | ms    |
| T6        | 1000  | -   | -    | ms    |

**11. Interface Timing****11.1 Input Signal Characteristics**

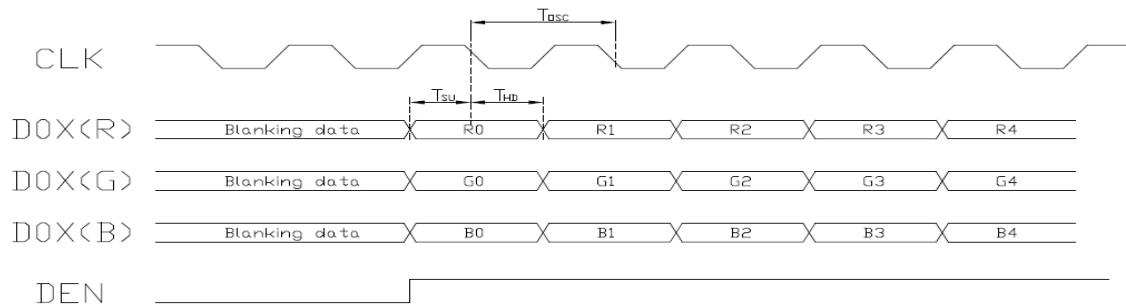
| PARAMETER       |      | Symbol    | Min. | Typ.  | Max. | Unit      |
|-----------------|------|-----------|------|-------|------|-----------|
| CLK period      |      | $T_{OSC}$ | -    | 156   | -    | ns        |
| Data setup time |      | $T_{SU}$  | 12   | -     | -    | ns        |
| Data hold time  |      | $T_{HD}$  | 12   | -     | -    | ns        |
| IHS period      |      | $T_H$     | -    | 408   | -    | $T_{OSC}$ |
| IHS pulse width |      | $T_{HS}$  | 5    | 30    | -    | $T_{OSC}$ |
| IHS setup time  |      | $T_{Cr}$  | 12   | -     | -    | ns        |
| IHS hold time   |      | $T_{Cf}$  | 12   | -     | -    | ns        |
| IVS pulse width |      | $T_{VS}$  | 1    | 3     | 5    | $T_H$     |
| IVS setup time  |      | $T_{Vr}$  | 12   | -     | -    | ns        |
| IVS hold time   |      | $T_{Vf}$  | 12   | -     | -    | $\mu s$   |
| IVS-DEN time    | NTSC | $T_{VSE}$ | -    | 18    | -    | $T_H$     |
|                 | PAL  | $T_{VSE}$ | -    | 26    | -    | $T_H$     |
| IHS-DEN time    |      | $T_{HE}$  | 36   | 68    | 88   | $T_{OSC}$ |
| DEN pulse width |      | $T_{EP}$  | -    | 320   | -    | $T_{OSC}$ |
| DEN-STH time    |      | $T_{DES}$ | -    | 1     | -    | $T_{OSC}$ |
| IVS period      | NTSC | -         | -    | 262.5 | -    | $T_H$     |
|                 | PAL  | -         | -    | 312.5 | -    | $T_H$     |

**Note:** When SYNC mode is used, 1st data start from 68th CLK after IHS falling.

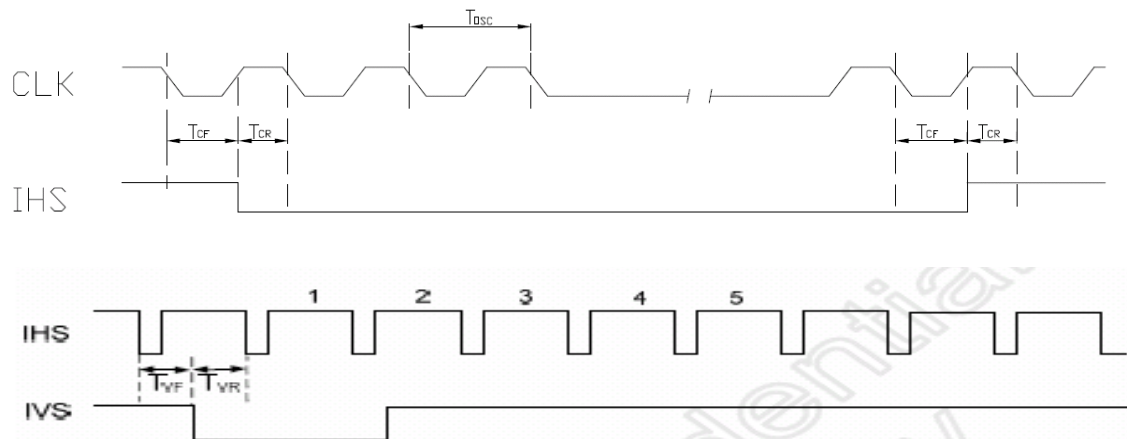


## 11.2 Waveform

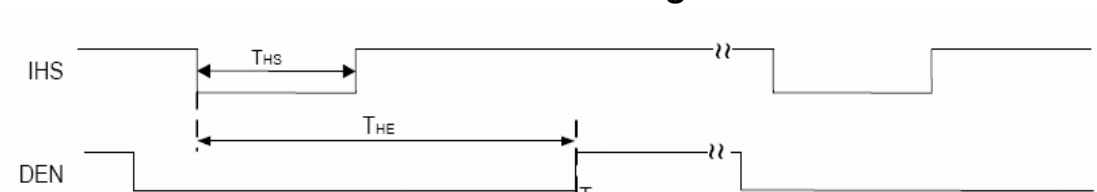
### 11.2.1 Clock and Data Waveform



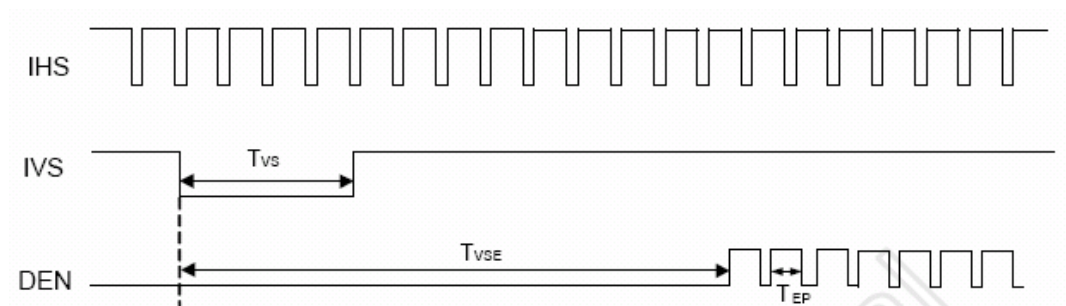
### 11.2.2 Clock and Sync waveforms



### 11.2.3 IHS and horizontal control timing waveforms



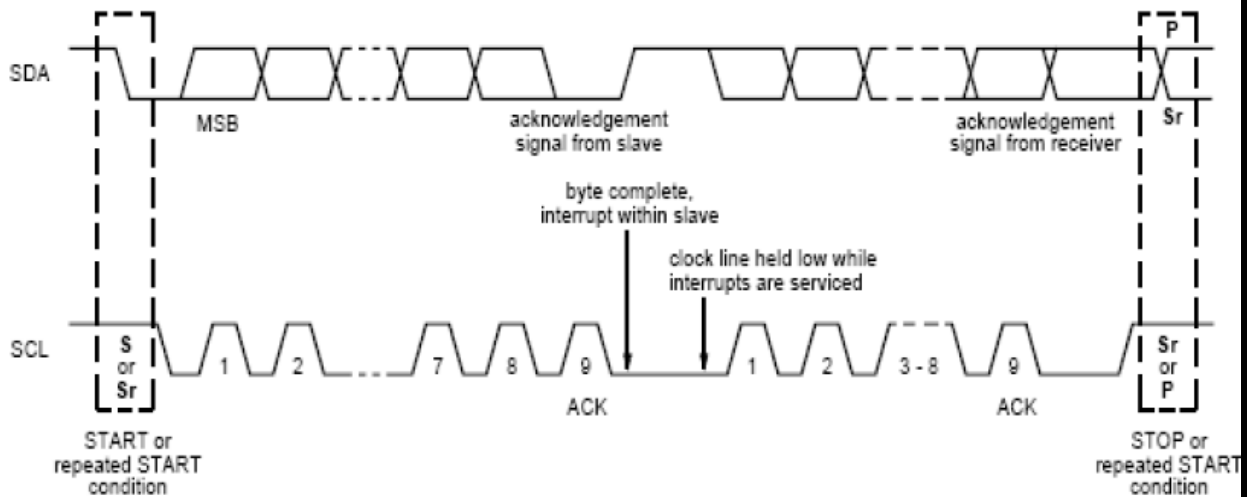
### 11.2.4 IHS and vertical control timing waveforms





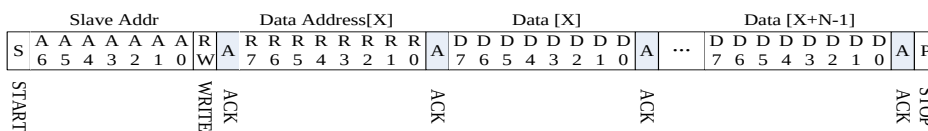
## 11.3 Timing Requirement of Projected Capacitive Touch

### 11.3.1 I2C Data Transfer Format

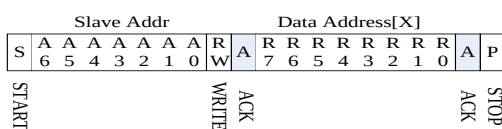


| Mnemonics | Description                                                                                                                                         |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| S         | I <sup>2</sup> C Start or I <sup>2</sup> C Restart                                                                                                  |
| A[6:0]    | Slave Address = 7'b0111000                                                                                                                          |
| W         | 1'b0: Write                                                                                                                                         |
| R         | 1'b1: Read                                                                                                                                          |
| C         | ACK                                                                                                                                                 |
| P         | STOP: the indicate the end of a packet (if this bit is missing, S will indicate the end of the current packet and the beginning of the next packet) |

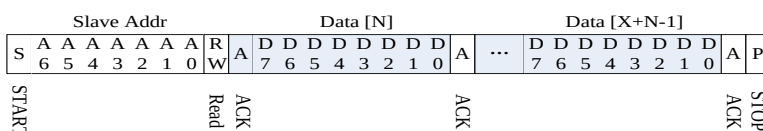
#### Write N bytes to I2C slave



#### Set Data Address



#### Read X bytes from I<sup>2</sup>C Slave

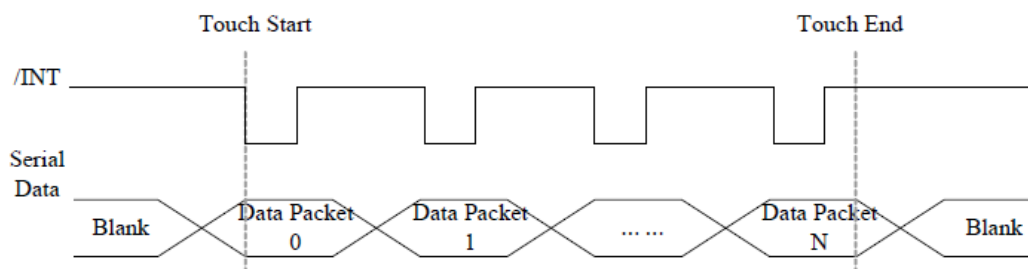




**11.3.2 I2C Timing Characteristics**

(Ta=25±2°C)

| Parameter                                        | Min | Max | Unit |
|--------------------------------------------------|-----|-----|------|
| SCL frequency                                    | -   | 400 | kHz  |
| Bus free time between a STOP and START condition | 4.7 | -   | μs   |
| Hold time (repeated) START condition             | 4.0 | -   | μs   |
| Data setup time                                  | 250 | -   | ns   |
| Setup time for a repeated START condition        | 4.7 | -   | μs   |
| Setup time for STOP condition                    | 4.0 | -   | μs   |

**11.3.3 Interrupt Trigger Mode****11.3.4 I2C Operating Mode Register Map**

| Address | Name        | Bit<br>7                              | Bit<br>6            | Bit<br>5 | Bit<br>4 | Bit<br>3                                  | Bit<br>2 | Bit<br>1 | Bit<br>0 | Host<br>Access |
|---------|-------------|---------------------------------------|---------------------|----------|----------|-------------------------------------------|----------|----------|----------|----------------|
| Op,00h  | DEVICE_MODE |                                       | Device<br>Mode[2:0] |          |          |                                           |          |          |          | RW             |
| Op,01h  | Reserved    |                                       |                     |          |          |                                           |          |          |          | R              |
| Op,02h  | TD_STATUS   |                                       |                     |          |          | Number of<br>touch points[3:0]            |          |          |          | R              |
| Op,03h  | TOUCH1_YH   | 1 <sup>st</sup> Event<br>Flag         |                     |          |          | 1 <sup>st</sup> Touch<br>Y Position[11:8] |          |          |          | R              |
| Op,04h  | TOUCH1_YL   | 1 <sup>st</sup> Touch Y Position[7:0] |                     |          |          |                                           |          |          |          | R              |
| Op,05h  | TOUCH1_XH   | 1 <sup>st</sup> Touch ID[3:0]         |                     |          |          | 1 <sup>st</sup> Touch<br>X Position[11:8] |          |          |          | R              |
| Op,06h  | TOUCH1_XL   | 1 <sup>st</sup> Touch X Position[7:0] |                     |          |          |                                           |          |          |          | R              |
| Op,07h  | Reserved    |                                       |                     |          |          |                                           |          |          |          | R              |
| Op,08h  | Reserved    |                                       |                     |          |          |                                           |          |          |          | R              |
| Op,09h  | TOUCH2_YH   | 2 <sup>nd</sup> Event<br>Flag         |                     |          |          | 2 <sup>nd</sup> Touch<br>Y Position[11:8] |          |          |          | R              |

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|        |           |                                       |                                           |   |
|--------|-----------|---------------------------------------|-------------------------------------------|---|
| Op,0Ah | TOUCH2_YL | 2 <sup>nd</sup> touch Y Position[7:0] |                                           | R |
| Op,0Bh | TOUCH2_XH | 2 <sup>nd</sup> Touch ID[3:0]         | 2 <sup>nd</sup> Touch<br>X Position[11:8] | R |
| Op,0Ch | TOUCH2_XL | 2 <sup>nd</sup> Touch X Position[7:0] |                                           | R |
| Op,0Dh | Reserved  |                                       |                                           | R |
| Op,0Eh | Reserved  |                                       |                                           | R |
| Op,0Fh | TOUCH3_YH | 3 <sup>rd</sup> Event<br>Flag         | 3 <sup>rd</sup> Touch<br>Y Position[11:8] | R |
| Op,10h | TOUCH3_YL | 3 <sup>rd</sup> Touch Y Position[7:0] |                                           | R |
| Op,11h | TOUCH3_XH | 3 <sup>rd</sup> Touch ID[3:0]         | 3 <sup>rd</sup> Touch<br>X Position[11:8] | R |
| Op,12h | TOUCH3_XL | 3 <sup>rd</sup> Touch X Position[7:0] |                                           | R |
| Op,13h | Reserved  |                                       |                                           | R |
| Op,14h | Reserved  |                                       |                                           | R |
| Op,15h | TOUCH4_YH | 4 <sup>th</sup> Event<br>Flag         | 4 <sup>th</sup> Touch<br>Y Position[11:8] | R |
| Op,16h | TOUCH4_YL | 4 <sup>th</sup> Touch Y Position[7:0] |                                           | R |
| Op,17h | TOUCH4_XH | 4 <sup>th</sup> Touch ID[3:0]         | 4 <sup>th</sup> Touch<br>X Position[11:8] | R |
| Op,18h | TOUCH4_XL | 4 <sup>th</sup> Touch X Position[7:0] |                                           | R |
| Op,19h | Reserved  |                                       |                                           | R |
| Op,1Ah | Reserved  |                                       |                                           | R |
| Op,1Bh | TOUCH5_YH | 5 <sup>th</sup> Event<br>Flag         | 5 <sup>th</sup> Touch<br>Y Position[11:8] | R |
| Op,1Ch | TOUCH5_YL | 5 <sup>th</sup> Touch Y Position[7:0] |                                           | R |
| Op,1Dh | TOUCH5_XH | 5 <sup>th</sup> Touch ID[3:0]         | 5 <sup>th</sup> Touch<br>X Position[11:8] | R |
| Op,1Eh | TOUCH5_XL | 5 <sup>th</sup> Touch X Position[7:0] |                                           | R |
| Op,1Fh | Reserved  |                                       |                                           | R |
| Op,20h | Reserved  |                                       |                                           | R |
| Op,21h | TOUCH6_YH | 6 <sup>th</sup> Event<br>Flag         | 6 <sup>th</sup> Touch<br>Y Position[11:8] | R |
| Op,22h | TOUCH6_YL | 6 <sup>th</sup> Touch Y Position[7:0] |                                           | R |
| Op,23h | TOUCH6_XH | 6 <sup>th</sup> Touch ID[3:0]         | 6 <sup>th</sup> Touch<br>X Position[11:8] | R |
| Op,24h | TOUCH6_XL | 6 <sup>th</sup> Touch X Position[7:0] |                                           | R |
| Op,25h | Reserved  |                                       |                                           | R |
| Op,26h | Reserved  |                                       |                                           | R |

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|        |            |                                        |  |                                            |   |
|--------|------------|----------------------------------------|--|--------------------------------------------|---|
| Op,27h | TOUCH7_YH  | 7 <sup>th</sup> Event<br>Flag          |  | 7 <sup>th</sup> Touch<br>Y Position[11:8]  | R |
| Op,28h | TOUCH7_YL  | 7 <sup>th</sup> Touch Y Position[7:0]  |  |                                            | R |
| Op,29h | TOUCH7_XH  | 7 <sup>th</sup> Touch ID[3:0]          |  | 7 <sup>th</sup> Touch<br>X Position[11:8]  | R |
| Op,2Ah | TOUCH7_XL  | 7 <sup>th</sup> Touch X Position[7:0]  |  |                                            | R |
| Op,2Bh | Reserved   |                                        |  |                                            | R |
| Op,2Ch | Reserved   |                                        |  |                                            | R |
| Op,2Dh | TOUCH8_YH  | 8 <sup>th</sup> Event<br>Flag          |  | 8 <sup>th</sup> Touch<br>Y Position[11:8]  | R |
| Op,2Eh | TOUCH8_YL  | 8 <sup>th</sup> Touch Y Position[7:0]  |  |                                            | R |
| Op,2Fh | TOUCH8_XH  | 8 <sup>th</sup> Touch ID[3:0]          |  | 8 <sup>th</sup> Touch<br>X Position[11:8]  | R |
| Op,30h | TOUCH8_XL  | 8 <sup>th</sup> Touch X Position[7:0]  |  |                                            | R |
| Op,31h | Reserved   |                                        |  |                                            | R |
| Op,32h | Reserved   |                                        |  |                                            | R |
| Op,33h | TOUCH9_YH  | 9 <sup>th</sup> Event<br>Flag          |  | 9 <sup>th</sup> Touch<br>Y Position[11:8]  | R |
| Op,34h | TOUCH9_YL  | 9 <sup>th</sup> Touch Y Position[7:0]  |  |                                            | R |
| Op,35h | TOUCH9_XH  | 9 <sup>th</sup> Touch ID[3:0]          |  | 9 <sup>th</sup> Touch<br>X Position[11:8]  | R |
| Op,36h | TOUCH9_XL  | 9 <sup>th</sup> Touch X Position[7:0]  |  |                                            | R |
| Op,37h | Reserved   |                                        |  |                                            | R |
| Op,38h | Reserved   |                                        |  |                                            | R |
| Op,39h | TOUCH10_YH | 10 <sup>th</sup> Event<br>Flag         |  | 10 <sup>th</sup> Touch<br>Y Position[11:8] | R |
| Op,3Ah | TOUCH10_YL | 10 <sup>th</sup> Touch Y Position[7:0] |  |                                            | R |
| Op,3Bh | TOUCH10_XH | 10 <sup>th</sup> Touch ID[3:0]         |  | 10 <sup>th</sup> Touch<br>X Position[11:8] | R |
| Op,3Ch | TOUCH10_XL | 10 <sup>th</sup> Touch X Position[7:0] |  |                                            | R |
| Op,3Dh | Reserved   |                                        |  |                                            | R |
| Op,3Eh | Reserved   |                                        |  |                                            | R |



### 11.3.5 DEVICE\_MODE

This register is the device mode register, configure it to determine the current mode of the chip.

| Address | Bit Address | Register Name        | Description                                                                                                              |
|---------|-------------|----------------------|--------------------------------------------------------------------------------------------------------------------------|
| Op,00h  | 6:4         | Device Mode<br>[2:0] | 000b Normal operating Mode<br>001b System Information Mode<br>(Reserved)<br>100b Test Mode – read raw data<br>(Reserved) |

### 11.3.6 TD\_STATUS

This register is the Touch Data status register.

| Address | Bit Address | Register Name                  | Description                                 |
|---------|-------------|--------------------------------|---------------------------------------------|
| Op,02h  | 3:0         | Number of touch<br>points[3:0] | How many points detected.<br>1-10 is valid. |

### 11.3.7 TOUCHn\_YH (n:1-10)

This register describes MSB of the Y coordinate of the nth touch point and the corresponding event flag.

| Address               | Bit Address | Register Name                 | Description                                                   |
|-----------------------|-------------|-------------------------------|---------------------------------------------------------------|
| Op,03h<br>~<br>Op,39h | 7:6         | Event Flag                    | 00b: Put Down<br>01b: Put Up<br>10b: Contact<br>11b: No event |
|                       | 5:4         |                               | Reserved                                                      |
|                       | 3:0         | Touch Y<br>Position<br>[11:8] | MSB of Touch Y Position in pixels                             |

**11.3.8 TOUCHn\_YL (n:1-10)**

This register describes LSB of the Y coordinate of the nth touch point.

| Address               | Bit Address | Register Name                | Description                           |
|-----------------------|-------------|------------------------------|---------------------------------------|
| Op,04h<br>~<br>Op,3Ah | 7:0         | Touch Y<br>Position<br>[7:0] | LSB of the Touch Y Position in pixels |

**11.3.9 TOUCHn\_XH (n:1-10)**

This register describes MSB of the X coordinate of the nth touch point and corresponding touch ID.

| Address               | Bit Address    | Register Name                                   | Description                                                      |
|-----------------------|----------------|-------------------------------------------------|------------------------------------------------------------------|
| Op,05h<br>~<br>Op,3Bh | 7:4<br><br>3:0 | Touch ID[3:0]<br><br>Touch X Position<br>[11:8] | Touch ID of Touch Point<br><br>MSB of Touch X Position in pixels |

**11.3.10 TOUCHn\_XL (n:1-10)**

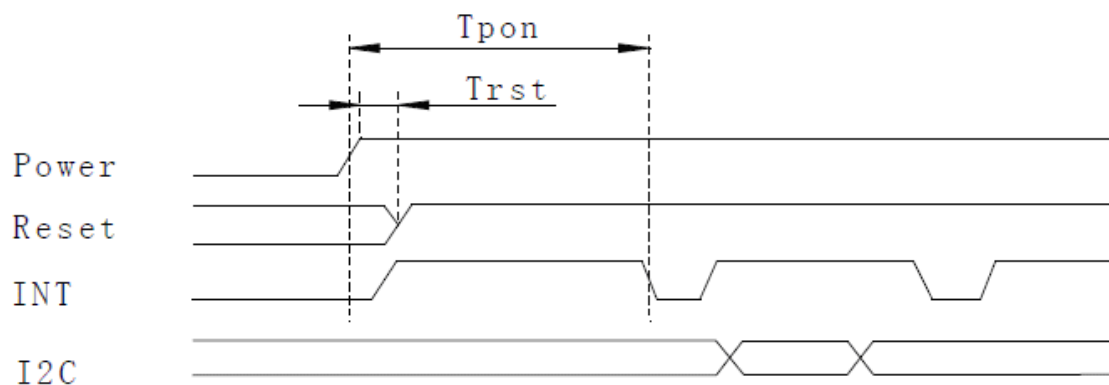
This register describes LSB of the X coordinate of the nth touch point.

| Address               | Bit Address | Register Name                | Description                           |
|-----------------------|-------------|------------------------------|---------------------------------------|
| Op,06h<br>~<br>Op,3Ch | 7:0         | Touch X<br>Position<br>[7:0] | LSB of The Touch X Position in pixels |



## 11.4 POWER ON/Reset Sequence

Reset and GPIO such as /INT and I2C are advised to be low before powering on. The signal of waking up should be set to be high after powering on. /INT signal will be sent to the host after initializing all parameters and then start to report points to the host.



*Power on Sequence*

Reset time must be enough to guarantee reliable reset, the time of starting to report point after resetting approach to the time of starting to report point after powering on.

| Parameter | Description                                        | Min | Max | Units |
|-----------|----------------------------------------------------|-----|-----|-------|
| Tris      | Rise time from 0.1VDD to 0.9VDD                    | --  | 10  | ms    |
| Tpon      | Time of starting to report point after powering on | 300 | --  | ms    |
| Trsi      | Time of starting to report point after resetting   | 300 | --  | ms    |
| Trst      | Reset time                                         | 5   | --  | ms    |
| Twai      | Time of starting to report point after waking      | 300 | --  | ms    |

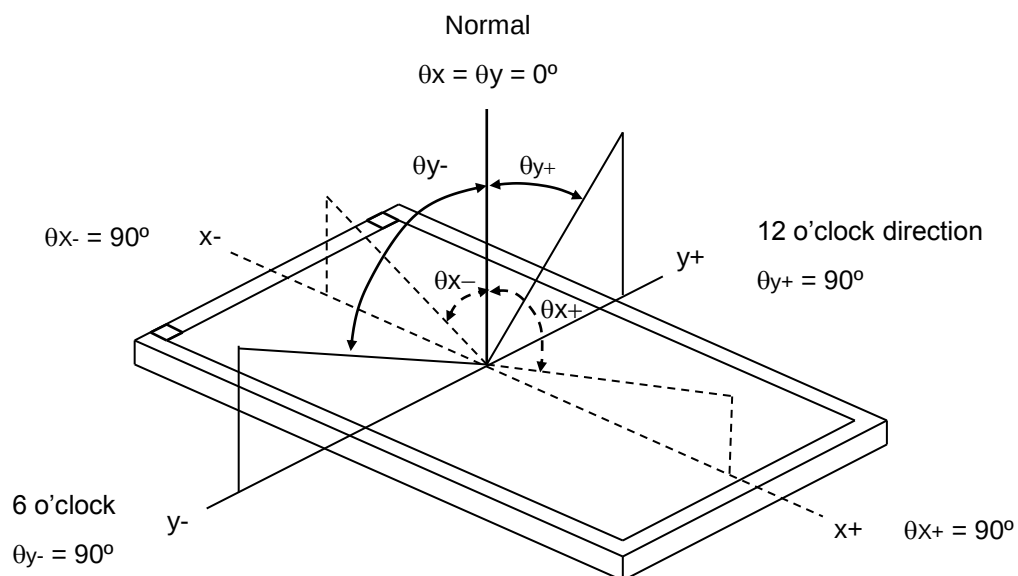
**12. Optical Characteristics**

The optical characteristics should be measured in a dark environment ( $\leq 1$  lux) or equivalent state with the methods shown in Note (4).

| Item                  |            | Symbol         | Conditions                                                   | Min.  | Typ.    | Max.  | Unit              | Note    |
|-----------------------|------------|----------------|--------------------------------------------------------------|-------|---------|-------|-------------------|---------|
| Contrast Ratio        |            | CR             | $\theta_x=0^\circ, \theta_y=0^\circ$<br>Viewing Normal Angle | 300   | ( 450 ) | -     | -                 | (2)     |
| Response Time         |            | $T_R$          |                                                              | -     | 15      | -     | ms                | (3)     |
|                       |            | $T_F$          |                                                              | -     | 35      | -     | ms                |         |
| Luminance(Center)     |            | Y              |                                                              | 295   | ( 325 ) | -     | cd/m <sup>2</sup> | (4)     |
| Brightness uniformity |            | BUNI           |                                                              | 80    | ( 85 )  | -     | %                 | (5)     |
| Color Chromaticity    | Red        | R <sub>x</sub> |                                                              | 0.585 | 0.635   | 0.685 | -                 | (1),(4) |
|                       |            | R <sub>y</sub> |                                                              | 0.300 | 0.350   | 0.400 | -                 |         |
|                       | Green      | G <sub>x</sub> |                                                              | 0.290 | 0.340   | 0.390 | -                 |         |
|                       |            | G <sub>y</sub> |                                                              | 0.540 | 0.590   | 0.640 | -                 |         |
|                       | Blue       | B <sub>x</sub> |                                                              | 0.095 | 0.145   | 0.195 | -                 |         |
|                       |            | B <sub>y</sub> |                                                              | 0.045 | 0.095   | 0.145 | -                 |         |
|                       | White      | W <sub>x</sub> |                                                              | 0.270 | 0.32    | 0.370 | -                 |         |
|                       |            | W <sub>y</sub> |                                                              | 0.295 | 0.345   | 0.395 | -                 |         |
| Viewing Angle         | Horizontal | $\theta_{x+}$  | CR $\geq$ 10                                                 | 55    | ( 60 )  | -     | deg.              |         |
|                       |            | $\theta_{x-}$  |                                                              | 55    | ( 60 )  | -     |                   |         |
|                       | Vertical   | $\theta_{y+}$  |                                                              | 45    | ( 55 )  | -     |                   |         |
|                       |            | $\theta_{y-}$  |                                                              | 35    | ( 50 )  | -     |                   |         |



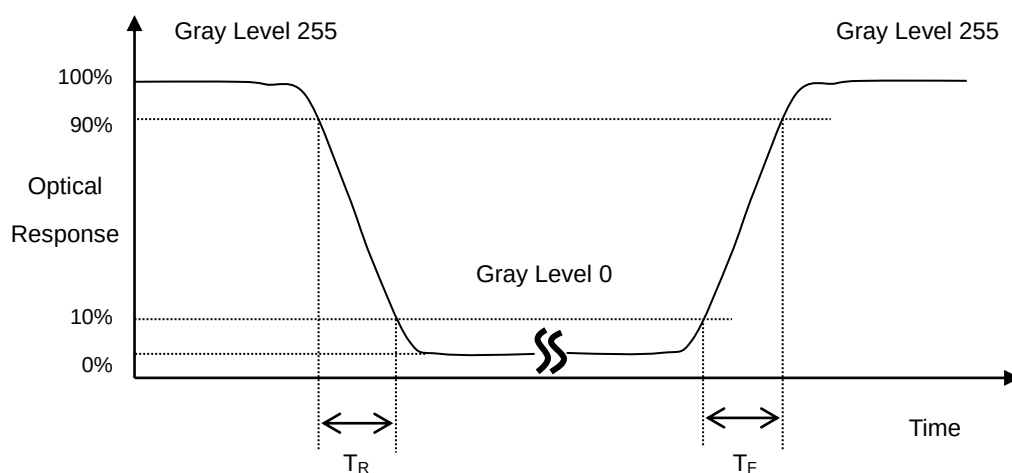
Note (1) Definition of Viewing Angle ( $\theta_x$ ,  $\theta_y$ ):



Note (2) Definition of Contrast Ratio (CR):

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD on the "White" state}}{\text{Luminance measured when LCD on the "Black" state}}$$

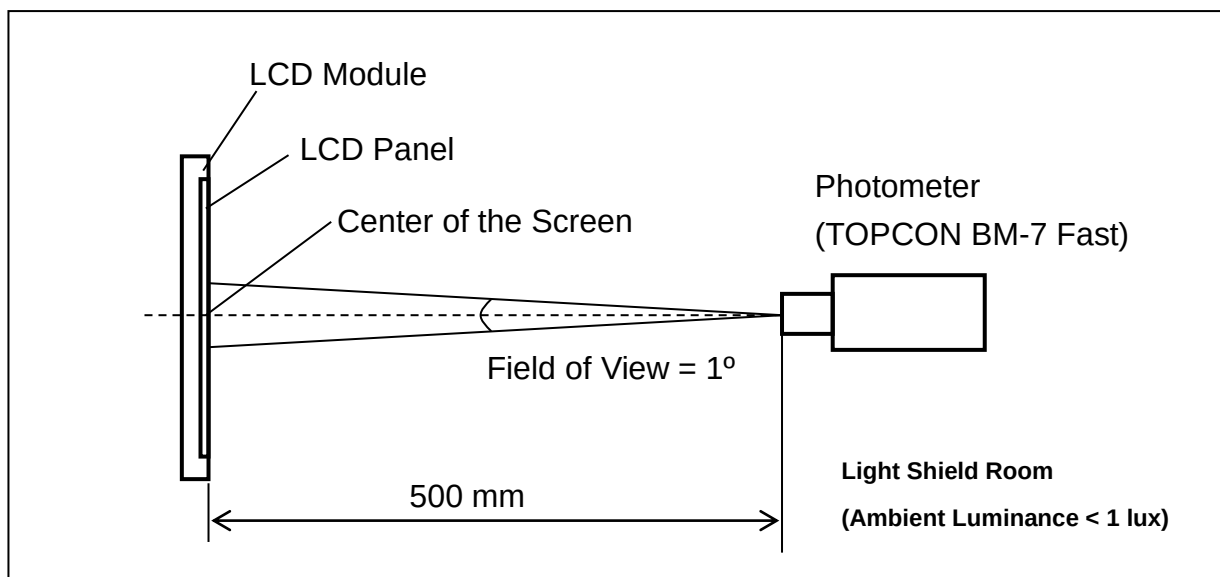
Note (3) Definition of Response Time ( $T_R$ ,  $T_F$ ):



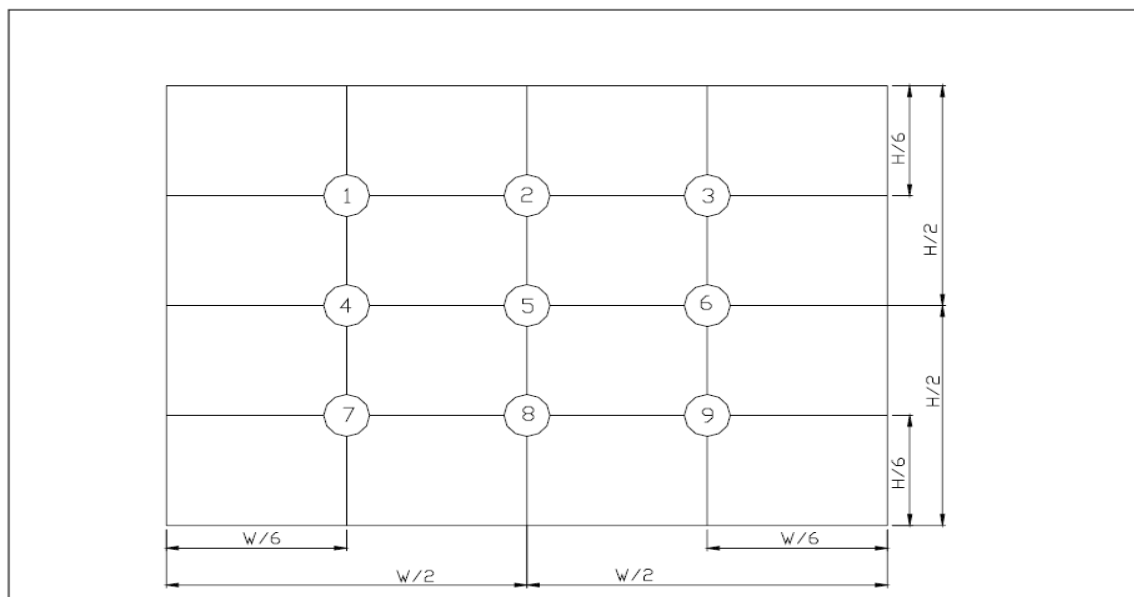


**Note (4) Measurement Set-Up:**

The LCD module should be stabilized at a given temperature for 30 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 30 minutes in a dark room or equivalent condition.

**Note (5) Definition of brightness uniformity**

Brightness uniformity=(Min Luminance of 9 points)/(Max Luminance of 9 points)×100%



( 單位 : mm )



### 13. Reliability Test

| No. | Test Items                                         | Test Condition                                                         | Remark        |
|-----|----------------------------------------------------|------------------------------------------------------------------------|---------------|
| 1   | High Temperature Storage Test                      | T <sub>a</sub> = 80℃ 240 hours                                         | (1),(3),(4)   |
| 2   | Low Temperature Storage Test                       | T <sub>a</sub> = -30℃ 240 hours                                        | (1),(3),(4)   |
| 3   | High Temperature Operation Test                    | T <sub>s</sub> = 70℃ 240 hours                                         | (2),(3),(4)   |
| 4   | Low Temperature Operation Test                     | T <sub>a</sub> = -20℃ 240 hours                                        | (1),(3),(4)   |
| 5   | High Temperature and High Humidity Operation Test  | T <sub>a</sub> =60℃ 90%RH 240 hours                                    | (3), (4)      |
| 6   | Electro Static Discharge Test<br>( non-operating ) | -Panel Surface/Top Case<br>: 150pF, 330Ω<br>Air : ±15kV, Contact: ±8kV | ( 3 )         |
| 7   | Mechanical Shock Test<br>( non-operating )         | Half sine wave,<br>100G, 6ms<br>3 times shock of each six surfaces     | ( 3 )         |
| 8   | Vibration Test<br>( non-operating )                | Sine wave, 10 ~ 55 ~ 10Hz,<br>amplitude:1.5mm<br>3 axis, 2 hours/axis  | ( 3 )         |
| 9   | Thermal Shock Test<br>( non-operating )            | -20℃ ( 30min ) ~ 70℃ ( 30min ) ,10<br>cycles                           | ( 3 ) , ( 4 ) |
| 10  | Drop Test(with Carton)                             | Height : 80 <sub>cm</sub><br>1 corner, 3 edges, 6 surfaces             | ( 3 )         |

Note 1 : T<sub>a</sub> is the ambient temperature of samples.

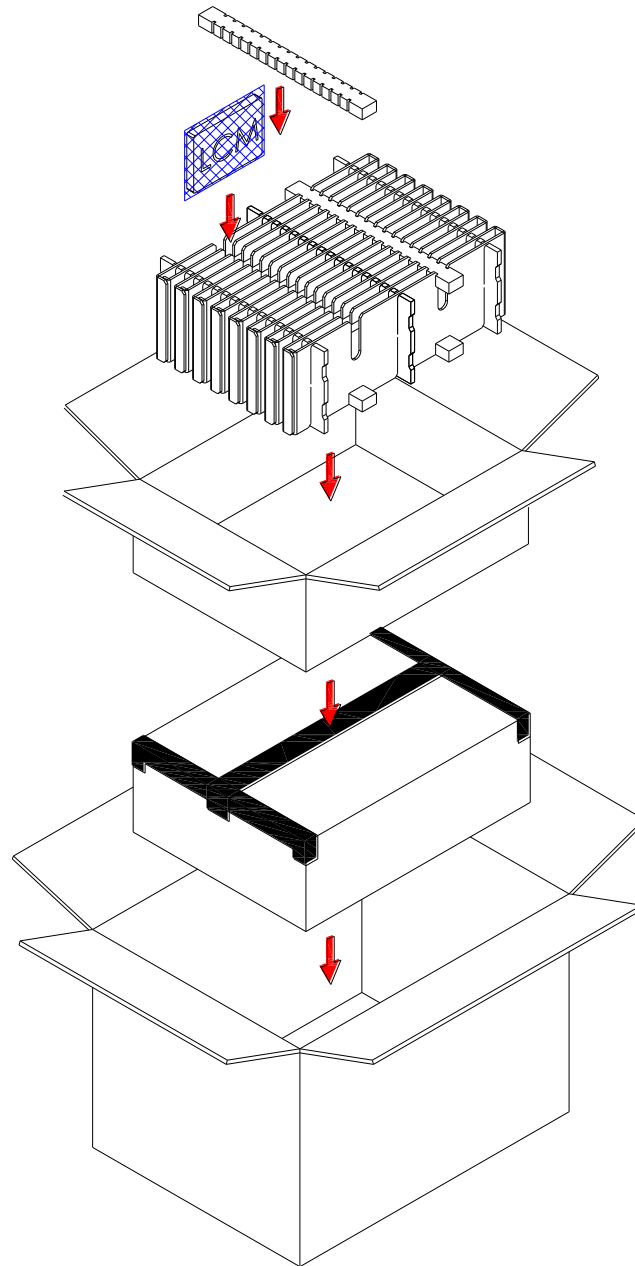
Note 2 : T<sub>s</sub> is the temperature of panel' s surface.

Note 3 : In the standard condition, there shall be no practical problem that may affect the display function.  
After the reliability test, the product only guarantees operation, but don' t guarantee all of the cosmetic specification.

Note 4 : Before cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.



## 14. Packaging



### PARTS LIST

|   | PARTS LIST            |                     |          |       |      |
|---|-----------------------|---------------------|----------|-------|------|
|   | ITEM                  | SIZE(LxWxH) unit:mm | MATERIAL | Q.T.Y | NOTE |
| 1 | STATIC SHIELDING BAGS | 300.0x145.0x0.09    |          | 60    |      |
| 2 | EPE PAD               | 345.0x30.0x20.0     | EPE      | 8     |      |
| 3 | CARD BOARD            | 345.0x150.0x3.5     | CARTON   | 6     |      |
| 4 | CARD BOARD            | 450.0x23.0x150.0    | CARTON   | 16    |      |
| 5 | INTERNAL BOX          | 455.0x350.0x164.0   | CARTON   | 2     |      |
| 6 | EXTERNAL BOX          | 475.0x370.0x375.0   | CARTON   | 1     |      |
| 7 | PRODUCT               | 144.0x104.6x14.55   |          | 60    |      |



## **15. Precautions**

### **15.1 Assembly and Handling Precautions**

- (1) Do not apply rough force such as bending or twisting to the module during assembly.
- (2) It's recommended to assemble or to install a module into the user's system in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
- (3) Don't apply pressure or impulse to the module to prevent the damage of LCD panel and Backlight.
- (4) Always follow the correct power-on sequence when the LCD module is turned on. This can prevent the damage and latch-up of the CMOS LSI chips.
- (5) Do not plug in or pull out the I/F connector while the module is in operation.
- (6) Do not disassemble the module.
- (7) Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.
- (8) Moisture can easily penetrate into LCD module and may cause the damage during operation.
- (9) High temperature or humidity may deteriorate the performance of LCD module. Please store LCD module in the specified storage conditions.
- (10) When ambient temperature is lower than 10°C, the display quality might be reduced. For example, the response time will become slow.

### **15.2 Safety Precautions**

- (1) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.
- (2) After the module's end of life, it is not harmful in case of normal operation and storage.

### **15.3 Terms of Warrant**

- (1) Acceptance inspection period  
The period is within one month after the arrival of contracted commodity at the buyer's factory site.
- (2) Applicable warrant period  
The period is within twelve months since the date of shipping out under normal using and storage conditions.

|                                                                                                |                       |           |             |
|------------------------------------------------------------------------------------------------|-----------------------|-----------|-------------|
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|                                                                                                | PT322457A-TLMWU-EMC37 | SPEC ONLY | 29          |

#### 15.4 Caution

This P-TEC LCD module has been specifically designed for use only in electronic devices in the areas of audio control, office automation, industrial control, home appliances, etc. The modules should not be used in applications where module failure could result in physical harm or loss of life, and P-TEC expressly disclaims any and all liability relating in any way to the use of the module in such applications.

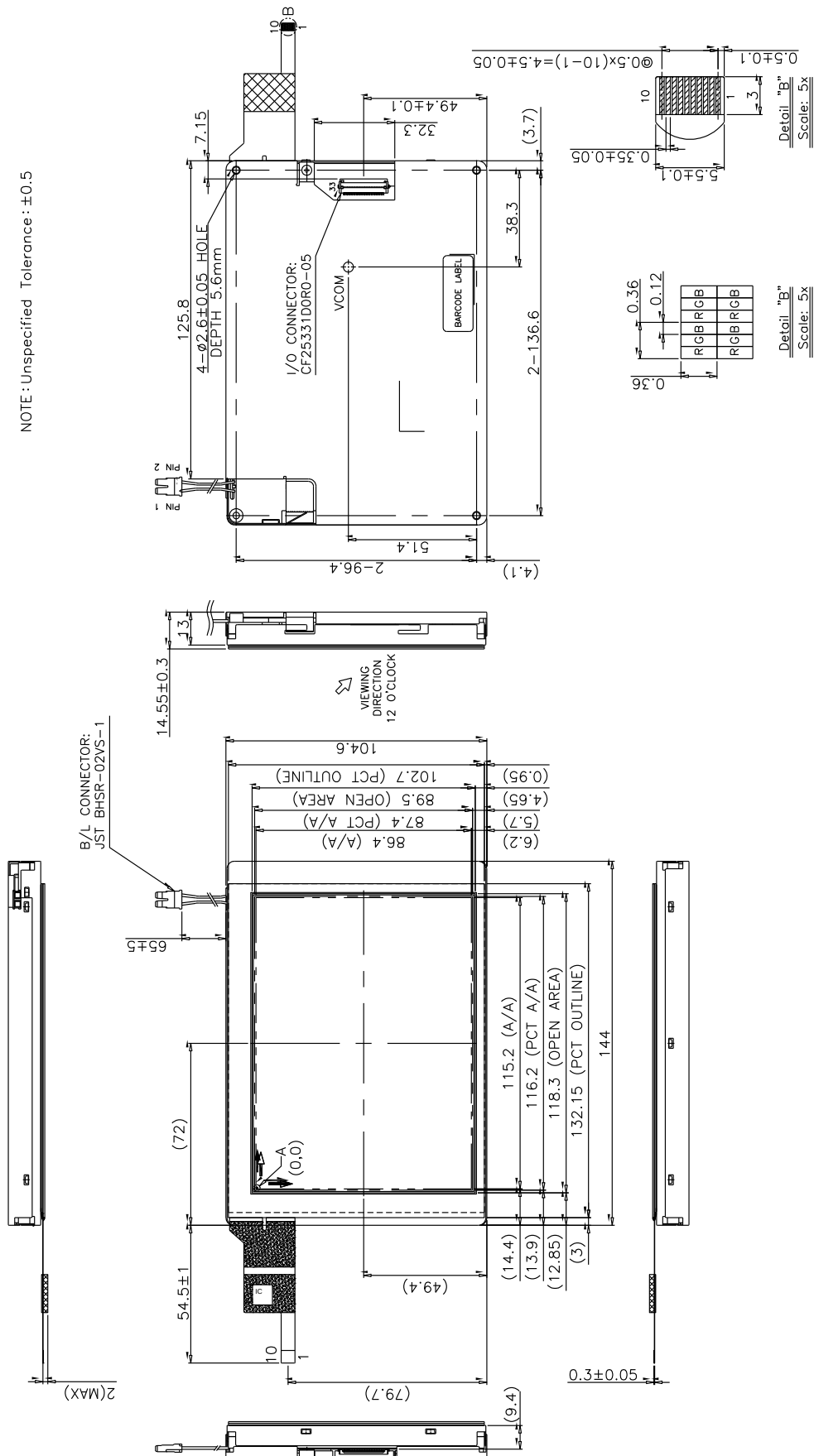


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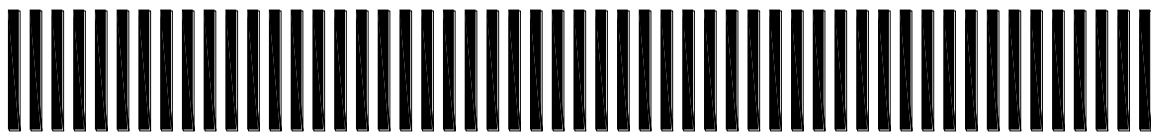
30

NOTE: Unspecified Tolerance:  $\pm 0.5$

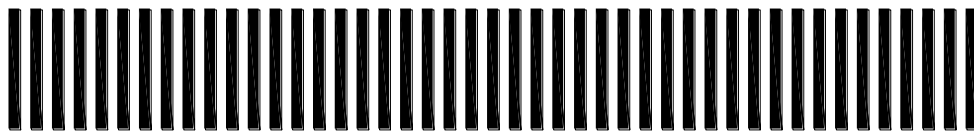


**17. Definition of Labels**

The bar code nameplate is pasted on each module as illustration, and its definitions are as following explanation.



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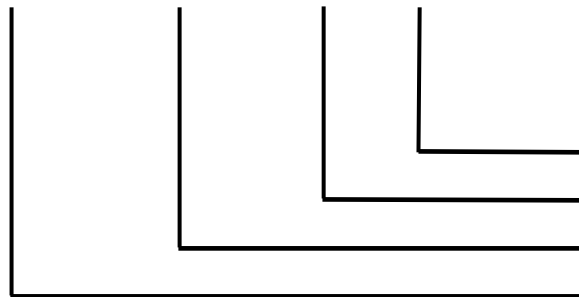


A B C D E F G H I J K L

(a) Module Name : PT322457A-TLMWU-EMC37

(b) Serial ID :

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



Serial No.

Factory Code

Manufactured Date

Screen Size

Serial ID includes the information as below :

(a) Screen size (Diagonal) : Inch Code (ABCD)

3.5" → 0350

10.4" → 1040

(b) Manufactured Date : Year, Month, Day (EFG)

Year (E)

|      |      |      |      |      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|------|------|------|------|
| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
| Mark | 0    | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    |
| Year | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
| Mark | A    | B    | C    | D    | E    | F    | G    | H    | I    | J    |

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Month (F)

| 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    |

Day (G)

| Day  | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Mark | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | A  | B  | C  | D  | E  | F  | G  |
| Day  | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |    |
| Mark | H  | I  | J  | K  | L  | M  | N  | O  | P  | Q  | R  | S  | T  | U  | V  |    |

(c) Factory Code (H):

For P-TEC internal use.

(d) Serial No. (IJKL):

Manufacturing sequence of product, for example : 0001~9999.



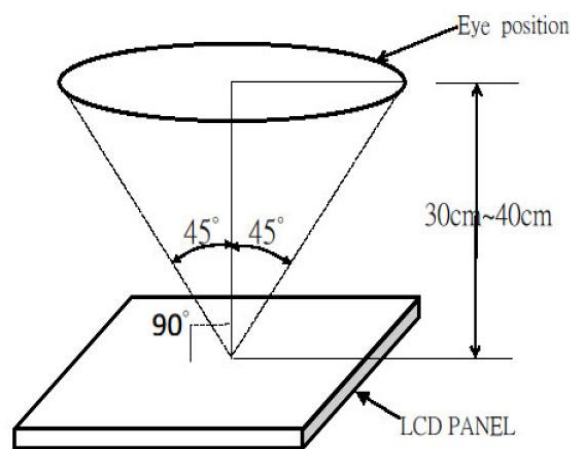


## 18. Incoming Inspection Standards

### 18.1 The environmental condition of inspection

The environmental condition and visual inspection shall be conducted as below.

- (1) Ambient temperature  $25 \pm 5^{\circ}\text{C}$
- (2) Humidity: 45 ~ 65 % RH
- (3) Viewing distance is approximately 30 ~ 40 cm
- (4) Viewing angle is normal to the LCD panel as Fig \_1 (  $\pm 45^{\circ}$  )
- (5) Ambient Illumination: 300 ~ 500 Lux for external appearance inspection



Fig\_1

### 18.2 The defects classify of AQL as following:

- (1) Test method :According to [ANSI/ASQC Z 1.4](#) .General Inspection Level II take a single time
- (2) The defects classify of AQL as following:

| Class of defects | AQL   | Definition                                                                                                       |
|------------------|-------|------------------------------------------------------------------------------------------------------------------|
| Major            | 0.65% | It is defect that is likely to result in failure or to reduce materially the usability of the intended function. |
| Minor            | 1.5%  | It is a defect that will not result in functioning problem with deviation classified.                            |

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**18.3 Inspection Parameters**

| Item                                                      |                                                          | Specification/Description                                                    |                   |                   |       | Note                    |
|-----------------------------------------------------------|----------------------------------------------------------|------------------------------------------------------------------------------|-------------------|-------------------|-------|-------------------------|
| Display                                                   | Function                                                 | No Display                                                                   |                   |                   |       | -                       |
|                                                           |                                                          | Malfunction                                                                  |                   |                   |       | -                       |
| Operating                                                 | Contrast ratio                                           | Out of Spec                                                                  |                   |                   |       | -                       |
|                                                           | Line defect                                              | No obvious Vertical and Horizontal line defect in bright , dark and colored. |                   |                   |       | -                       |
|                                                           | Point Defect<br>(red ,green ,blue<br>,dark ,white)       | Item                                                                         | Acceptable number |                   |       | Note:<br>1 、 4<br>5 、 6 |
|                                                           |                                                          |                                                                              | A                 | B                 | Total |                         |
|                                                           |                                                          | BRIGHT DOT                                                                   | N≤2               | N≤2               | N≤7   |                         |
|                                                           |                                                          | DARK DOT                                                                     | N≤3               | N≤4               |       |                         |
|                                                           |                                                          | TOTAL DOT                                                                    | N≤4               | N≤5               |       |                         |
|                                                           |                                                          | TWO ADJACENT DOT                                                             | NOT ALLOWED       |                   |       |                         |
|                                                           | THREE OR MORE<br>ADJACENT DOT                            | NOT ALLOWED                                                                  |                   |                   |       |                         |
| External<br>Inspection<br>(non-operating<br>or operating) | Scratch<br>(in display area)                             | L(mm)                                                                        | W(mm)             | Acceptable number |       | Note:2                  |
|                                                           |                                                          | L≤2.5                                                                        | W≤0.1             | 4                 |       |                         |
|                                                           |                                                          | L>2.5                                                                        | W>0.1             | 0                 |       |                         |
|                                                           | Polarizer dent or<br>bubble<br>(in display area)         | Dimension(mm)                                                                |                   | Acceptable number |       | Note:3                  |
|                                                           |                                                          | D≤0.25                                                                       |                   | Disregard         |       |                         |
|                                                           |                                                          | D≤0.5                                                                        |                   | 4                 |       |                         |
|                                                           | Line Shape<br>(Particles and<br>Lint in display<br>area) | L(mm)                                                                        | W(mm)             | Acceptable number |       | Note:2                  |
|                                                           |                                                          | -                                                                            | W≤0.07            | Disregard         |       |                         |
|                                                           |                                                          | L≤5                                                                          | W≤0.1             | 4                 |       |                         |
|                                                           |                                                          | L≥5                                                                          | W≥0.1             | 0                 |       |                         |
|                                                           | Dot Shape<br>(Particle in<br>Display area)               | Dimension(mm)                                                                |                   | Acceptable number |       | Note:3                  |
|                                                           |                                                          | D≤0.25                                                                       |                   | Disregard         |       |                         |
|                                                           |                                                          | D≤0.5                                                                        |                   | 4                 |       |                         |



| Item                                                |      | Specification/Description                                                                                                                                              | Note |
|-----------------------------------------------------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| External Inspection<br>(non-operating or operating) | mura | Has the non-uniform phenomenon<br>                                                   |      |
|                                                     |      | Weak defect will be defined as mura if it can be observed through ND filter 6%<br> |      |



### Incoming Inspection Touch Panel

Circular Defects

Linear Defects

Scratch

Air Bubble

Crack

Y:

Long breakage

Z:

Wide breakage

D:

thickness  
breakage

T:

single piece of  
glass thickness  
(Touch sensor  
single thickness)

VA:

Touch control  
panel viewing  
area.

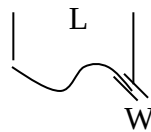
Sensor wide:  
the size of the  
long side of the  
touch panel.

(1) Circular Defects

$$\phi = (L+W)/2$$

| Diameter(mm)          | Spec              |
|-----------------------|-------------------|
| $\phi \leq 0.2$       | No quantity limit |
| $0.2 < \phi \leq 0.4$ | Max 5 defect      |
| $0.5 \leq \phi$       | Reject            |

(2) Linear Defects



| Length                                            | Width         | Acceptable   |
|---------------------------------------------------|---------------|--------------|
| $8.0 \geq L$                                      | $0.06 \geq W$ | Accept       |
| $8.0 \geq L$                                      | $0.08 \geq W$ | Max 5 defect |
| $L > 8.0$                                         | $W > 0.08$    | Reject       |
| The Min distance of defects must be above 15.0mm. |               |              |

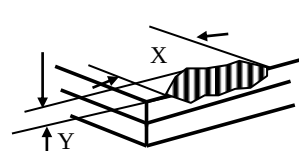
(3) Scratch

| Length                                            | Width         | Acceptable   |
|---------------------------------------------------|---------------|--------------|
| $8.0 \geq L$                                      | $0.06 \geq W$ | Accept       |
| $8.0 \geq L$                                      | $0.08 \geq W$ | Max 5 defect |
| $L > 12.0$                                        | $W > 0.08$    | Reject       |
| The Min distance of defects must be above 15.0mm. |               |              |

(4) Air Bubble

| Diameter(mm)                                      | Spec              |
|---------------------------------------------------|-------------------|
| $\phi \leq 0.2$                                   | No quantity limit |
| $0.2 < \phi \leq 0.6$                             | Max 3 defect      |
| The Min distance of defects must be above 10.0mm. |                   |

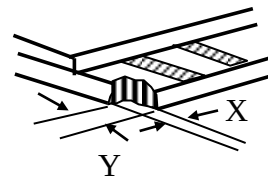
(5) Crack



$$Z \leq T, X \leq 1/8 \text{ Sensor wide}$$

Y: Did not enter the VA

(Accept)



$$X \leq 3\text{mm and } Y \leq 1/3D$$

(Accept)



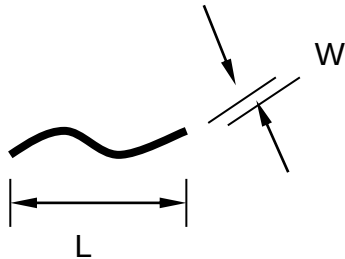
(Reject)



Note1. The definition of dot defect :

The dot defect was judged after repair and the size of a defective dot over 1/2 of whole dot is regarded as one defective dot.

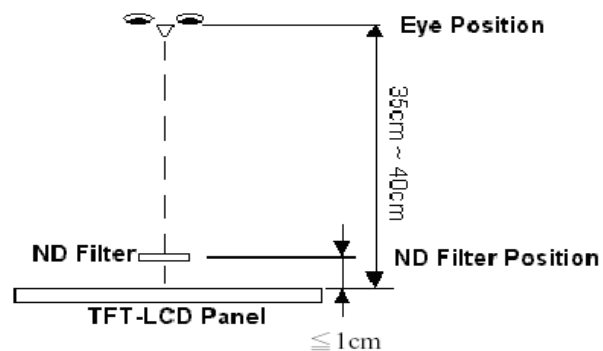
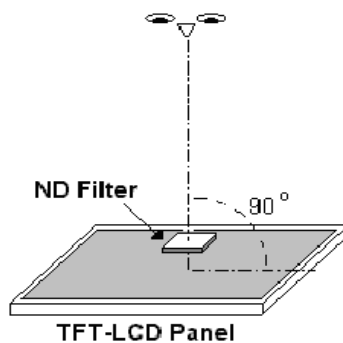
Note2.



Note3. D : Diameter  $D=(a+b)/2$



Note4. Bright dot is defined through 6% transmission ND Filter as following.

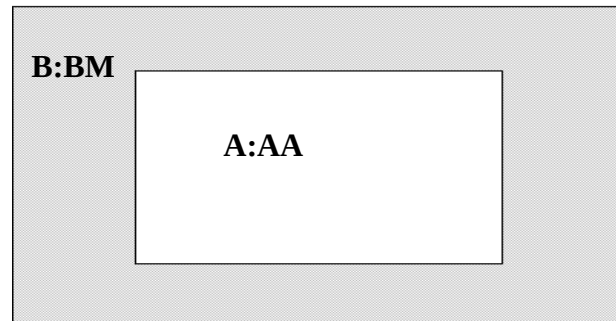


Note5. ADJACENT DOT



|                                                                                                |                       |           |             |
|------------------------------------------------------------------------------------------------|-----------------------|-----------|-------------|
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Note6.



#### 18.4 Handling of LCM

- (1)Don't give external shock.
- (2)Don't apply excessive force on the surface.
- (3)Liquid in LCD is hazardous substance. Must not lick and swallow. when the liquid is attach to your hand, skin, cloth etc. Wash it out thoroughly and immediately.
- (4)Don't operate it above the absolute maximum rating.
- (5)Don't disassemble the LCM.