# CUSTOMER APPROVAL SHEET

| | |
|---|---|
| Company Name | |
| MODEL | A090XE02 V3 |
| CUSTOMER APPROVED | |

- ☐ APPROVAL FOR SPECIFICATIONS ONLY (Spec. Ver. 0.3)
- ☐ APPROVAL FOR SPECIFICATIONS AND ES SAMPLE (Spec. Ver. 0.3)
- ☐ APPROVAL FOR SPECIFICATIONS AND CS SAMPLE (Spec. Ver. 0.3)
- ☐ CUSTOMER REMARK :

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| | |
|---|---|
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| Total pages : | 38 |
| Date : | 2012/02/02 |

# Product Specification

## 9" EPD MODULE

## Model Name : A090XE02 V3

| | |
|---|---|
| **Planned Lifetime:** | From 2011/May. To 2012/Nov. |
| **Phase-out Control:** | From 2012/May. To 2012/Nov. |
| **EOL Schedule:** | 2012/Nov |

< ◆ >Preliminary Specification
< >Final Specification



Note: The content of this specification is subject to change.

Record of Revision

| Version | Revise Date | Page | Content |
|---|---|---|---|
| 0.0 | 2011/06/15 | All | First Draft. |
| 0.1 | 2011/11/15 | 25 | Modify reliability test criteria. |
| | | 4 | General Information, weight |
| | | 5,6 | Ddrawing |
| | | 21 | Panel Power Consumption |
| | | 27 | Module/Panel Label Information |
| 0.2 | 2012/1/12 | 22 | Modify contrast Ratio |
| | | 22 | Modify update Time |
| 0.3 | 2012/02/02 | 7, 8 | Modify pin assignment description |
| | | 11 | Modify Operation rating |
| | | 12 | Modify Panel Power consumption |
| | | 17 | Modify VCOM_OUT voltage definition, VCOM relationship |
| | | 20, 21 | Modify power on/off sequence |
| | | 29, 30 | Modify appilcation circuit |
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# Contents

# A. General Information

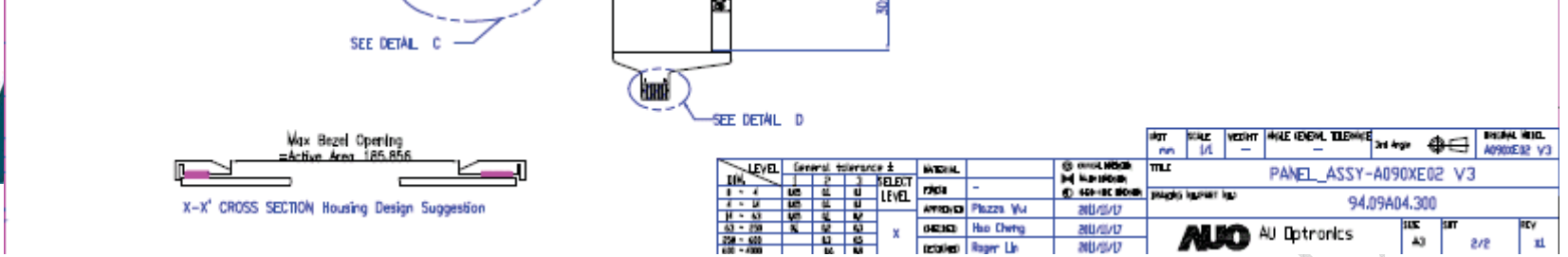
This display is a active matrix electrophoretic display (EPD), which comprises a-si TFT substrace, electrophoretic front plane, protective anti-glare top-sheet, driver ICs, and FPC. It is designed for applications such as e-book or e-reader.

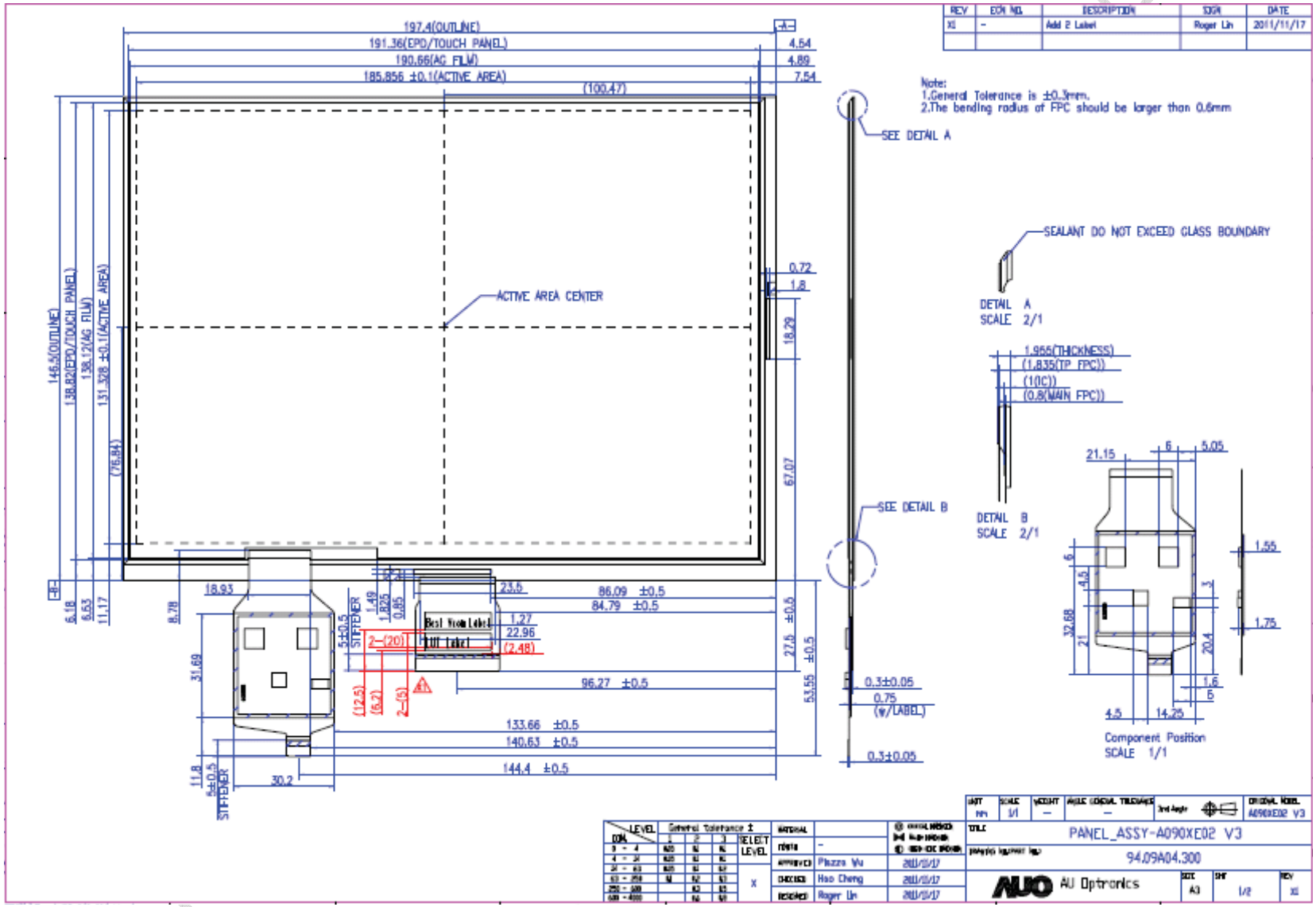
| NO. | Item | Unit | Specification | Remark |
|---|---|---|---|---|
| 1 | Screen Size | inch | 9 (Diagonal) | |
| 2 | Display Resolution | dot | 1024 (H)× 768(V) | |
| 3 | Overall Dimension | mm | 197.4(H) × 147.5(V) × 1.955(T) | Note 1 |
| 4 | Active Area | mm | 185.86(H)×131.33(V) | |
| 5 | Dot Pitch | mm | 0.1815 (H)x 0.171(V) | |
| 6 | Gray level | -- | 16 | |
| 7 | Weight | g | 121 | |
| 8 | Surface Treatment | | AG (7.5 ± 2%)<br>Hard coating(3H) | Note 2 |

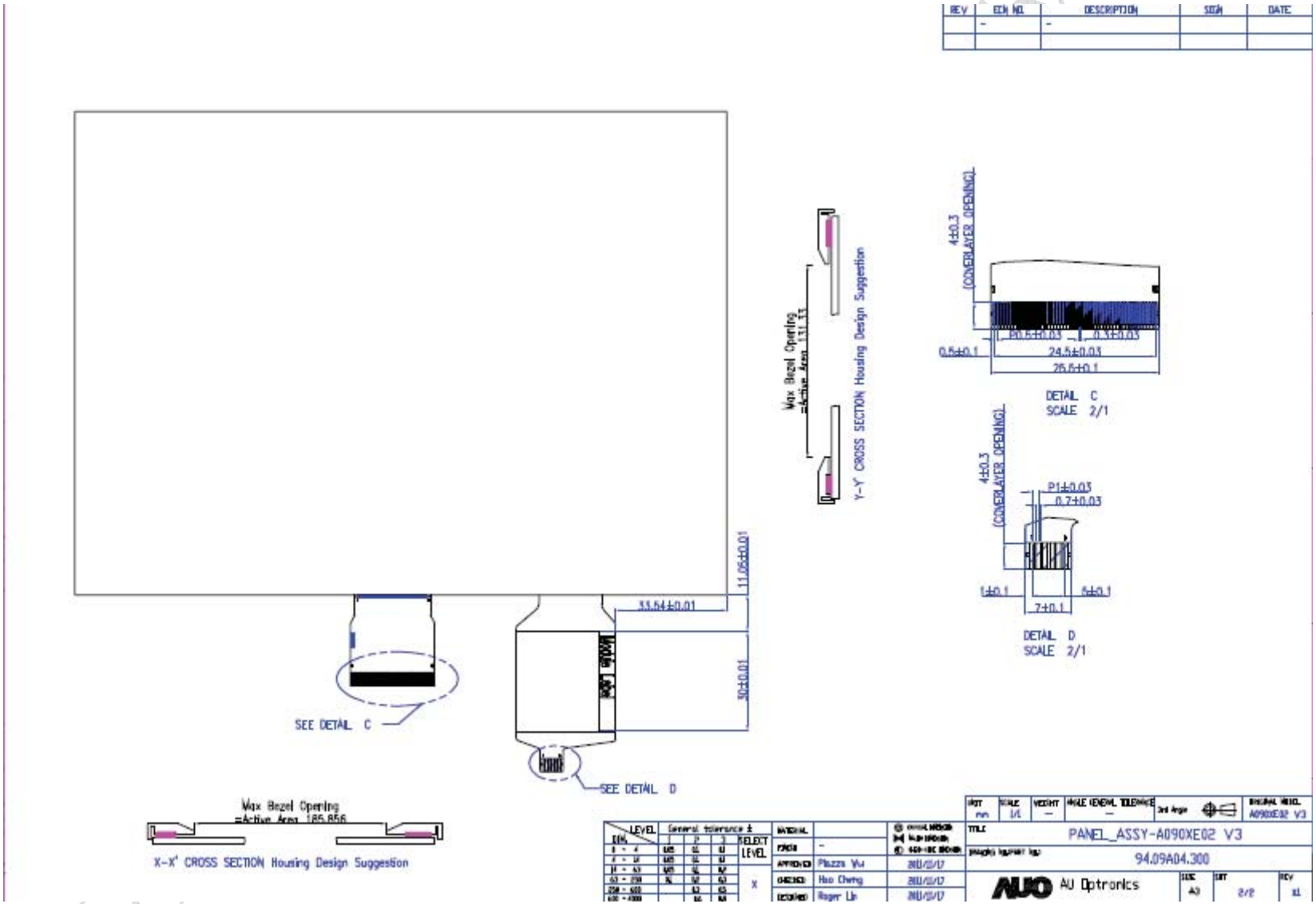
Note 1 : Not include FPC and label. Refer next page to get further information.

Note 2 : 750 g load force on UNI/JPIA 3H pencil, speed is 3.5mm/s on the AG film and scratch length is 1cm and write 5 handwriting, Scratch no. ≦2 is OK

B.





# C. Electrical Specifications

## 1. Panel Pin Assignment

Recommended connector : FH12-50S-0.5SH.

| Pin No. | Symbol | I/O | I/O Structure | Description | Remark |
|---|---|---|---|---|---|
| 1 | Dummy | -- | -- | Dummy pin | |
| 2 | DIODL | I/O | Type 2 | Vertical start pulse input/output | |
| 3 | VEE | P | -- | The most negative power supply for gate output | |
| 4 | VGG | P | -- | The most positive power supply for gate output | |
| 5 | VDD | P | -- | Digital power | |
| 6 | VSS | P | -- | Digital ground | |
| 7 | UDR | I | Type 4 | Input pin to select the shift direction of the start pulse.<br>(CMOS signal)<br>(1). UDR="H",<br>DIODL ->G1->G2->…->G767->G768->DIODR<br>(2). UDR="L" (**Default**),<br>DIODR ->G768->G767-> …->G2->G1->DIODL | Note1 |
| 8 | OEDR | I | Type 2 | Input pin for the output enable control | Note2 |
| 9 | CPVR | I | Type 2 | Input pin for the shift clock | |
| 10 | DIODR | I/O | Type 2 | Vertical start pulse input/output | |
| 11 | VCOM_IN | I | -- | To panel VCOM | |
| 12 | VCOM_OUT | O | -- | VCOM output to system(from driver IC) | |
| 13 | VCOMDC | P | Type 2 | External voltage for VCOMDC | |
| 14 | VCOMH | P | -- | External voltage for VCOM high power | |
| 15 | VCOML | P | -- | External voltage for VCOM low power | |
| 16 | VSS | P | -- | Digital circuit ground supply for source driver | |
| 17 | SHD_N | I | Type 4 | DC-DC converter shut down pin.<br>"0" : Enable.(Panel shut down; **Default**)<br>"1" : Disable. | |
| 18 | PWR_RDY | O | Type 1 | Power ready output.<br>When SHD_N from "1" to "0": PWR_RDY will become "0".<br>When SHD_N from "0" to "1": after 100ms, PWR_RDY will become "1". | |
| 19 | VCOMIN_0 | I | Type 2 | Logic Input for VCOM_OUT voltage generate. | |

<table>
<tr><td>20</td><td>VCOMIN_1</td><td>I</td><td>Type 2</td><td>Logic Input for VCOM_OUT voltage generate.</td><td></td></tr>
<tr><td>21</td><td>XDIOL</td><td>I/O</td><td>Type 5</td><td rowspan="2">Horizontal start pulse input/output.<br>These pins are used to input and output shift data. These pins are switched as input or output by setting the SHL pin as follow.<br><table><tr><th>SHL</th><th>XDIOL</th><th>XDIOR</th></tr><tr><td>L</td><td>Input</td><td>Output</td></tr><tr><td>H</td><td>Output</td><td>Input</td></tr></table></td><td rowspan="2"></td></tr>
<tr><td>22</td><td>XDIOR</td><td>I/O</td><td>Type 5</td></tr>
<tr><td>23</td><td>LD</td><td>I</td><td>Type 3</td><td>Latch data.</td><td>Note3</td></tr>
<tr><td>24</td><td>D0</td><td>I</td><td>Type 3</td><td>Data input, First pixel LSB</td><td></td></tr>
<tr><td>25</td><td>D1</td><td>I</td><td>Type 3</td><td>Data input, First pixel MSB</td><td></td></tr>
<tr><td>26</td><td>D2</td><td>I</td><td>Type 3</td><td>Data input, Second pixel LSB</td><td></td></tr>
<tr><td>27</td><td>D3</td><td>I</td><td>Type 3</td><td>Data input, Second pixel MSB</td><td></td></tr>
<tr><td>28</td><td>D4</td><td>I</td><td>Type 3</td><td>Data input, Third pixel LSB</td><td></td></tr>
<tr><td>29</td><td>D5</td><td>I</td><td>Type 3</td><td>Data input, Third pixel MSB</td><td></td></tr>
<tr><td>30</td><td>D6</td><td>I</td><td>Type 3</td><td>Data input, Forth pixel LSB</td><td></td></tr>
<tr><td>31</td><td>D7</td><td>I</td><td>Type 3</td><td>Data input, Forth pixel MSB</td><td></td></tr>
<tr><td>32</td><td>SHL</td><td>I</td><td>Type 3</td><td>Horizontal (left/right) scan direction.<br>SHL = “L”: Shift right to left.<br>SHL = “H”:Shift left to right. Default</td><td></td></tr>
<tr><td>33</td><td>XCLK</td><td>I</td><td>Type 3</td><td>Horizontal Clock input..</td><td>Note3</td></tr>
<tr><td>34</td><td>Dummy</td><td>D</td><td>--</td><td>Dummy pin</td><td></td></tr>
<tr><td>35</td><td>VREF</td><td>C</td><td>--</td><td>For power setting capactor connected pin.</td><td></td></tr>
<tr><td>36</td><td>AVDD</td><td>C</td><td>--</td><td>For power setting capactor connected pin.</td><td></td></tr>
<tr><td>37</td><td>C1P</td><td>C</td><td>--</td><td>For charge pump capactor connected pin.</td><td></td></tr>
<tr><td>38</td><td>C1N</td><td>C</td><td>--</td><td>For charge pump capactor connected pin.</td><td></td></tr>
<tr><td>39</td><td>VSS</td><td>P</td><td>--</td><td>Digital ground</td><td></td></tr>
<tr><td>40</td><td>VSSA</td><td>P</td><td>--</td><td>Analog ground.</td><td></td></tr>
<tr><td>41</td><td>VDD</td><td>P</td><td>--</td><td>Digital power</td><td></td></tr>
<tr><td>42</td><td>VREF_POS</td><td>C</td><td>--</td><td>For power setting capactor connected pin.</td><td></td></tr>
<tr><td>43</td><td>VREF_NEG</td><td>C</td><td>--</td><td>For power setting capactor connected pin.</td><td></td></tr>
<tr><td>44</td><td>VDDX8</td><td>P</td><td>--</td><td>DCDC positive voltage</td><td></td></tr>
<tr><td>45</td><td>NVDDX8</td><td>P</td><td>--</td><td>DCDC negative voltage</td><td></td></tr>
<tr><td>46</td><td>VDPS</td><td>P</td><td>--</td><td>External voltage for source postive power.</td><td></td></tr>
<tr><td>47</td><td>VDNS</td><td>P</td><td>--</td><td>External voltage for source negative power.</td><td></td></tr>
<tr><td>48</td><td>VDNG</td><td>C</td><td>--</td><td>For power setting capactor connected pin.</td><td></td></tr>
<tr><td>49</td><td>VCOM_IN</td><td>I</td><td>--</td><td>To panel VCOM</td><td></td></tr>
</table>

| | | | | | |
|---|---|---|---|---|---|
| 50 | Dummy | D | -- | Dummy pin | |

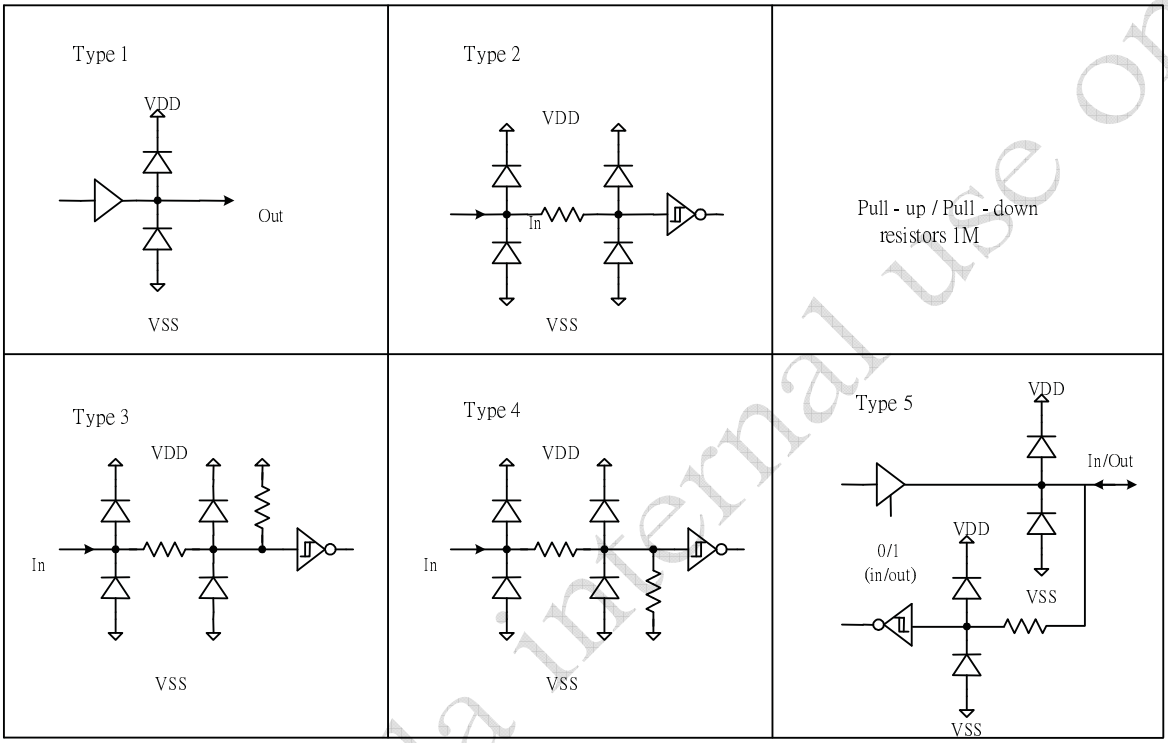
I: Input pin; O:output pin, I/O: Input / Output; P: Power pin; C: capacitor pin; D：Dummy

Note 1: Scanning up to down must to set UDR="H"

Note 2: Please reference chapter E

Note 3: Please reference chapter E

**I/O Pin Structure:**



## 2. Touch Panel Pin Assignment

Recommended connector : FH12-6S-1SH.

| Pin No. | Symbol | I/O | Description | Remark |
|---|---|---|---|---|
| 1 | GND | P | Touch panel ground. | |
| 2 | VDD_TP | P | Touch panel power. | |
| 3 | TP_INT | O | Touched Interrupt Indicator pin. | |
| 4 | IICSCL | I | Serial input clock in I2C-Bus interface operation pin. | |
| 5 | IICSDA | I/O | Serial input/output data in I2C-Bus interface operation pin. | |
| 6 | RST_TP | I | Touch panel reset pin. | |

## 3. Absolute Maximum Ratings

| Item | Symbol | Condition | Min. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|
| Power voltage | VDD | VSSA=VSS= 0 | -0.3 | +5.0 | V | |
| Digital input voltage | VI | GND =0 | -0.3 | VDD+0.3 | V | |
| Source voltage | VDPS | VSSA=VSS=0 | 0 | VDDX8-1 | V | |
| | VDNS | VSSA=VSS=0 | NVDDX8+1 | 0 | V | |
| | VDDX8 | VSSA=VSS=0 | 0 | 22 | V | |
| | NVDDX8 | VSSA=VSS=0 | -22 | 0 | V | |
| | VDNG | VSSA=VSS=0 | NVDDX8 | 0 | V | |
| Gate voltage | VGG | VSS=0 | -0.3 | VEE+55 | V | |
| | VEE | VSS=0 | VGG-55 | +0.3 | V | |
| VCOM_OUT voltage | VCOMH | VSSA=VSS=0 | 0 | VDDX8-1 | V | |
| | VCOML | VSSA=VSS=0 | NVDDX8+1 | 0 | V | |
| | VCOMDC | VSSA=VSS=0 | -5 | 0 | V | |
| Storage temperature | Tstg | - | -55 | 125 | ℃ | |
| Operating | Topa | - | -30 | 85 | ℃ | |

## 4. Operation Ratings

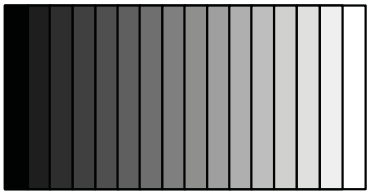
| Item | Symbol | Min. | Typical | Max. | Unit | Remark |
|---|---|---|---|---|---|---|
| Power voltage | VDD | 3.0 | 3.3 | 3.6 | V | |
| Source voltage | VDPS | 14.5 | 15 | 15.5 | V | |
| | VDNS | -15.5 | -15 | -14.5 | V | |
| | VDDX8 | 14.5 | 15 | 15.5 | V | Short with VDPS |
| | NVDDX8 | -- | -15 | -- | V | Short with VDNS |
| | VDNG | -- | -15 | -- | V | Short with VDNS |
| Gate voltage | VGG | 19 | 19.5 | 20 | V | |
| | VEE | -22 | -21.5 | -21 | V | |
| VCOM_OUT voltage | VCOMH | -- | 0 | -- | V | |
| | VCOML | -- | 0 | -- | V | |
| | VCOMDC | -- | 0 | -- | V | |
| VCOM voltage | VCOM_IN | -5 | | 0 | V | |

# D.Electrical Characteristics

## 1. Panel Power Consumption

| Item | Symbol | Condition | Min. | Typical | Max. | Unit |
|---|---|---|---|---|---|---|
| Supply Voltage | VDD | VSSA=VSS= 0V | 3 | 3.3 | 3.6 | V |
| Low Level Input Voltage | Vil | Digital input pins | GND | - | 0.3xVDD | V |
| High Level Input Voltage | Vih | Digital input pins | 0.7xVDD | - | VDD | V |
| Operating temperature | $T_{op}$ | | - | 25 | - | ℃ |
| Operation Power Dissipation | P | VDD=3.3V | | 1.61 | 3.2 | mA |
| | | VDPS=15V | | 1.71 | 2.5 | mA |
| | | VDNS=-15V | | 1.26 | 2.5 | mA |
| | | VDDX8=15V | | 0.19 | 0.4 | mA |
| | | NVDDX8=-15V | | 0.19 | 0.4 | mA |
| | | VGG=19.5V | | 1.48 | 2.5 | mA |
| | | VEE=-21.5V | | 1.48 | 2.5 | mA |
| | | VCOMH=0V | | 0 | 0 | mA |
| | | VCOML=0V | | 0 | 0 | mA |
| | | VCOMDC=0V | | 0 | 0 | mA |
| | | VCOM_IN=TBD V | | TBD | TBD | mA |
| Standby Power Dissipation | P | VDD=3.3V | | 0.03 | 0.1 | mA |
| | | VDPS=0V | | 0 | | mA |
| | | VDNS=0V | | 0 | | mA |
| | | VDDX8=0V | | 0 | | mA |
| | | NVDDX8=0V | | 0 | | mA |
| | | VGG=0V | | 0 | | mA |
| | | VEE=0V | | 0 | | mA |
| | | VCOMH=0V | | 0 | | mA |
| | | VCOML=0V | | 0 | | mA |
| | | VCOMDC=0V | | 0 | | mA |
| | | VCOM_IN=TBD V | | 0 | | mA |

Note: Typical power consumption measured by following pattern



2. Touch Panel Power Consumption

| Mode | Symbol | Condition | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|---|
| Active | Ptp_a | VDD= 5.0V | - | 18 | 20 | mA | |
| Sleep | Ptp_s | | - | 1.6 | 2 | mA | |
| Deep Sleep | Ptp_dp | | - | 0.8 | 1 | mA | |

# E. Input timing AC Characteristics

## 1. Horizontal input timing

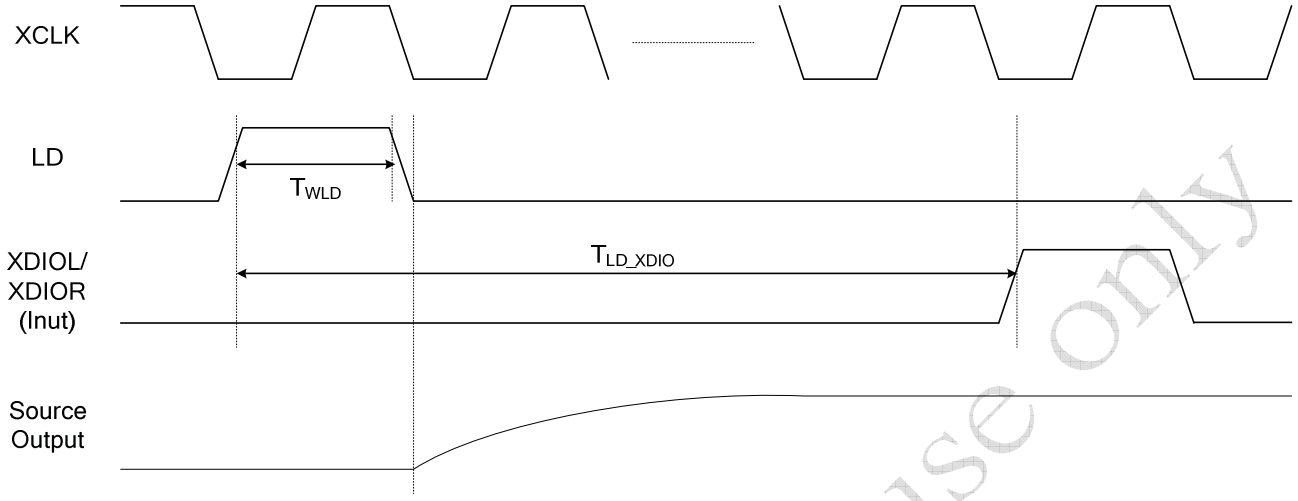
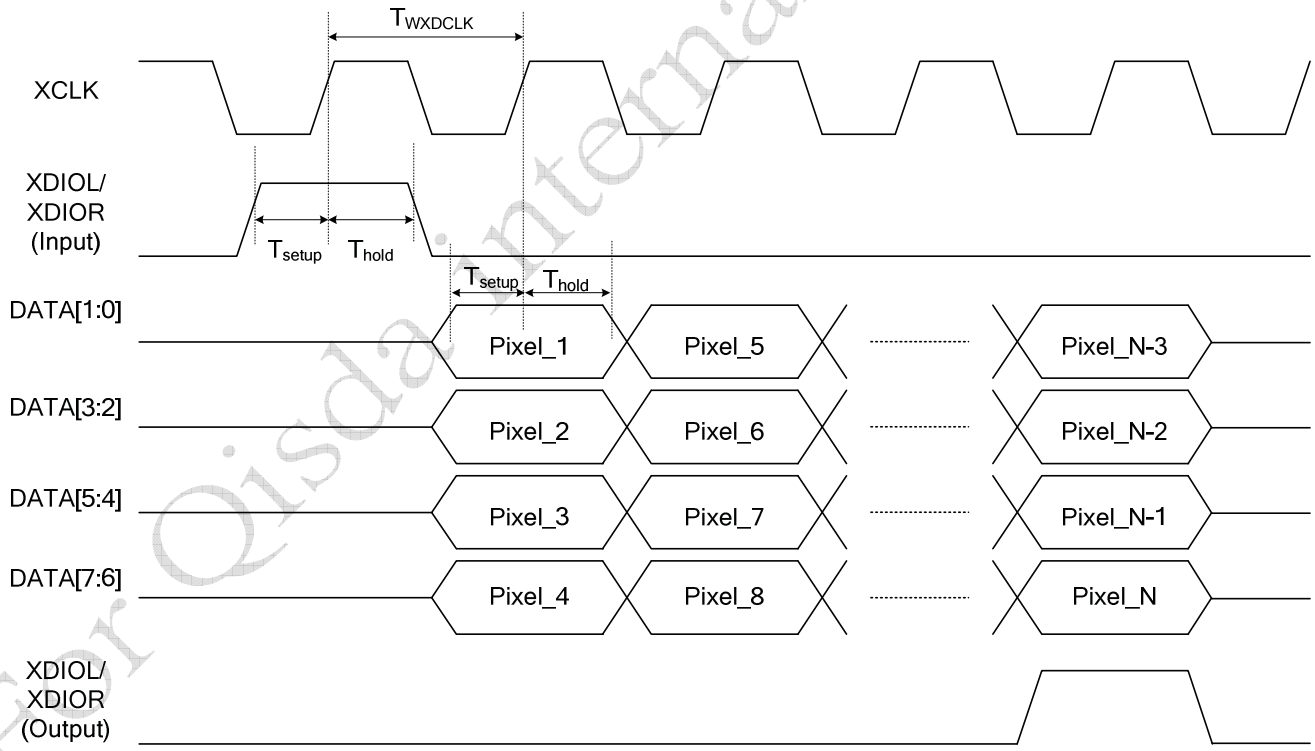



**Figure 1:** LD input timing




**N=1024**

**Figure 2:** Horizontal data Input timing

(VDD=VDD_DRV=3.3V, VSSA=VSS=VSS_DRV=0V, TA=25℃)

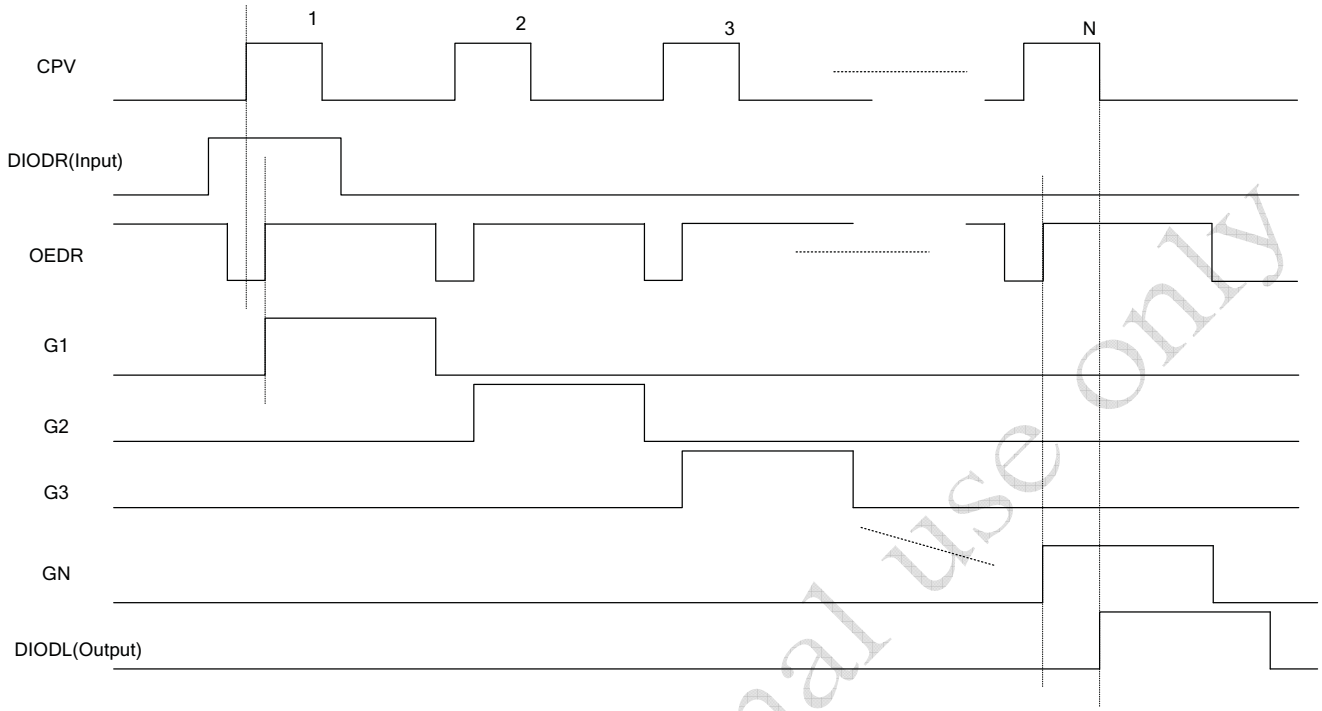
| PARAMETER | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|
| Clock pulse width | $T_{WXDCLK}$ | 13 | | | ns |
| Data setup time | $T_{setup}$ | 2 | - | - | ns |
| Data hold time | $T_{hold}$ | 2 | - | - | ns |
| LD pulse width | $T_{WLD}$ | 1 | - | - | XCLK |
| Time from LD to XDIOL/XDIOR | $T_{LD\_DIO}$ | 5 | - | - | XCLK |

### 1.1 Relation ship of input data and source output voltage

The source driver output voltage will base on input 2 bits data, and the relationship is as below:

| MSB | LSB | Function |
|---|---|---|
| 0 | 0 | Source output is 0V |
| 0 | 1 | Source output is VDPS(+15V) |
| 1 | 0 | Source output is VDNS(-15V) |
| 1 | 1 | Source output is floating |

## 2. Vertical input timing




**N=768**

**Figure 3:** Vertical input timing

## 3. VCOM_OUT voltage definition

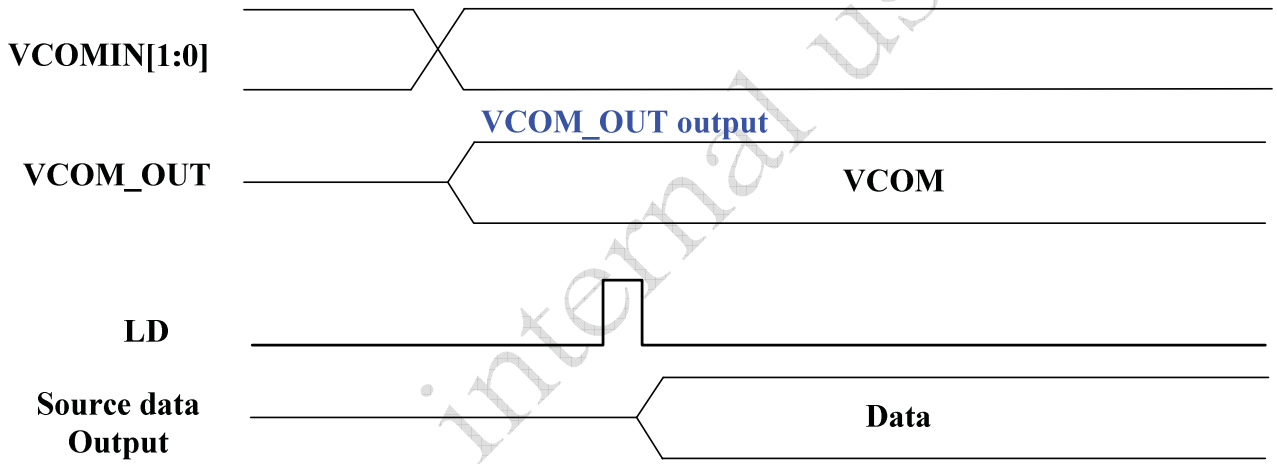
The VCOM output voltage will base on input pins VCOMIN[1:0], and the relationship is as below:

| VCOMIN[1 :0] | Function |
|---|---|
| 00 | VCOM_OUT output is VCOMDC v |
| 01 | VCOM_OUT output is VCOMH v |
| 10 | VCOM_OUT output is VCOML v |
| 11 | VCOM_OUT output is floating |

## 4. VCOM_OUT relationship

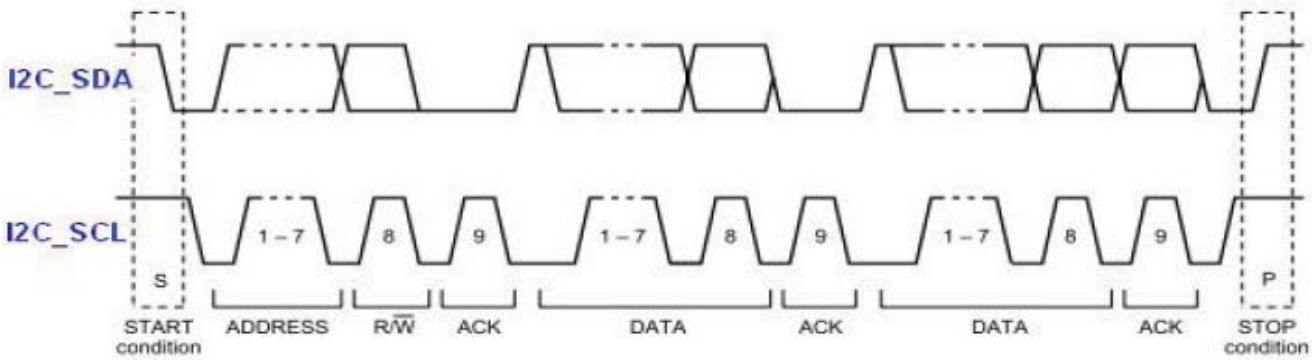
VCOM_OUT will change while VCOMIN[1:0] change

Source output will change while LD signal falling edge.



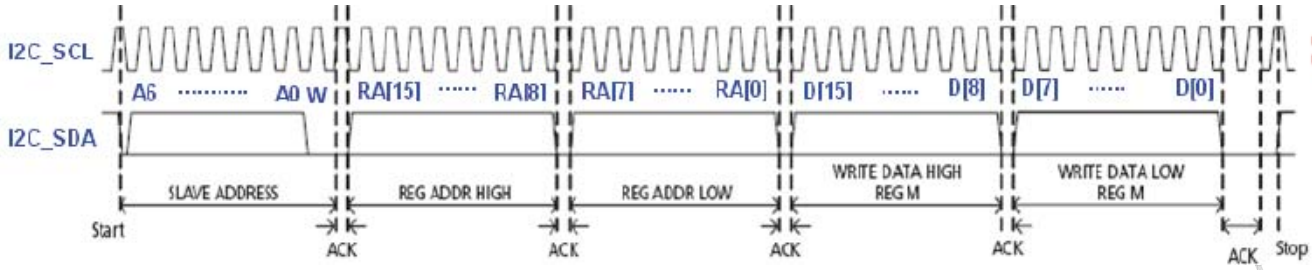

## 5. Touch panel timing

### 5.1. I2C Timing Diagram




Note : Slave address is 1001100.

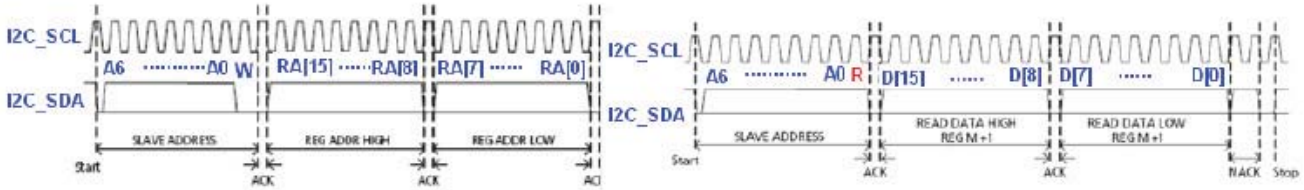
### 5.2. Register Write Sequence



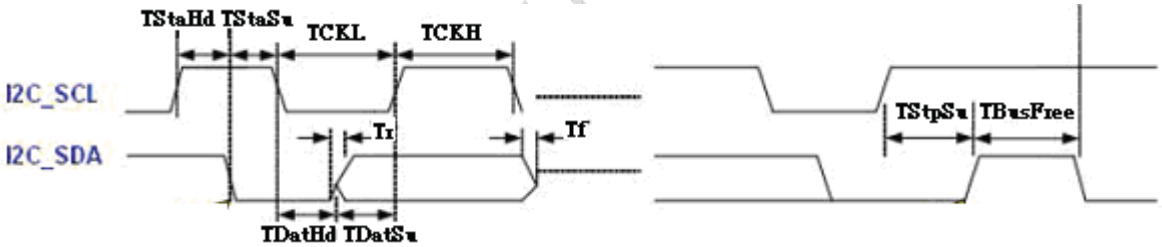

### 5.3. Register Read Sequence


S = start condition
P = stop condition
Sr = restart condition
A = acknowledge
$\overline{A}$ = no-acknowledge

slave to master
master to slave




### 5.4. I2C Timing Characteristics




**VDDI=1.65~3.3V, VCI=2.5~3.3V, TA=25℃**

| Item | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Working Frequency | Fclk | - | - | 400 | KHz |
| I2C Clock Low | TckL | 1250 | - | - | ns |
| I2C Clock High | TckH | 1250 | - | - | ns |
| I2C Data ring time | Tr | - | - | 300 | ns |
| I2C Data falling time | Tf | - | - | 300 | ns |
| I2C Data hold time | TDatHd | 0 | - | - | ns |
| I2C Data setup time | TDatSu | 100 | - | - | ns |
| I2C Start Condition hold time | TStaHd | 600 | - | - | ns |
| I2C Start Condition setup time | TStaSu | 600 | - | - | ns |

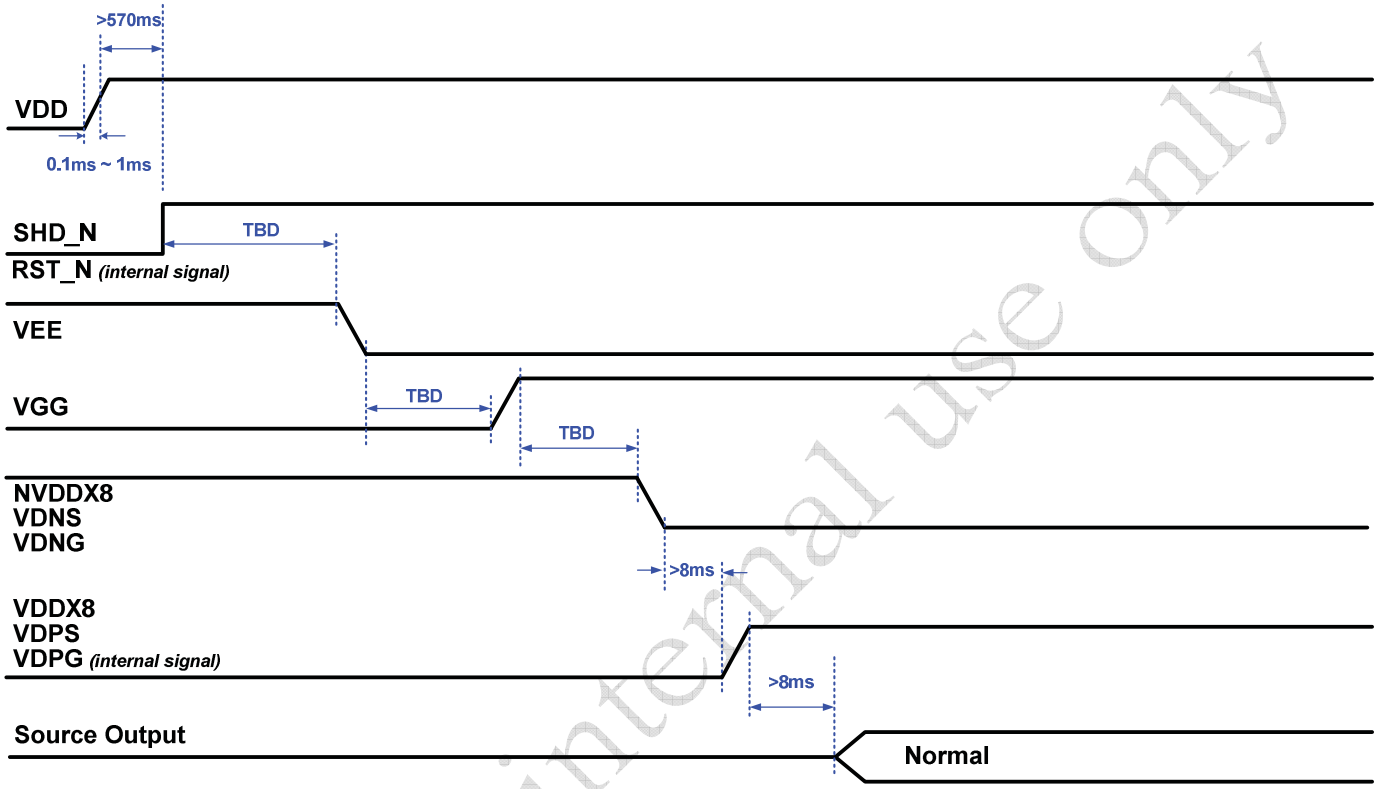
| | | | | | |
|---|---|---|---|---|---|
| I2C Stop Condition setup time | TStpSu | 600 | - | - | ns |
| I2C Bus free time | TBusFree | 1300 | - | - | ns |

# F. Power On/Off Characteristics

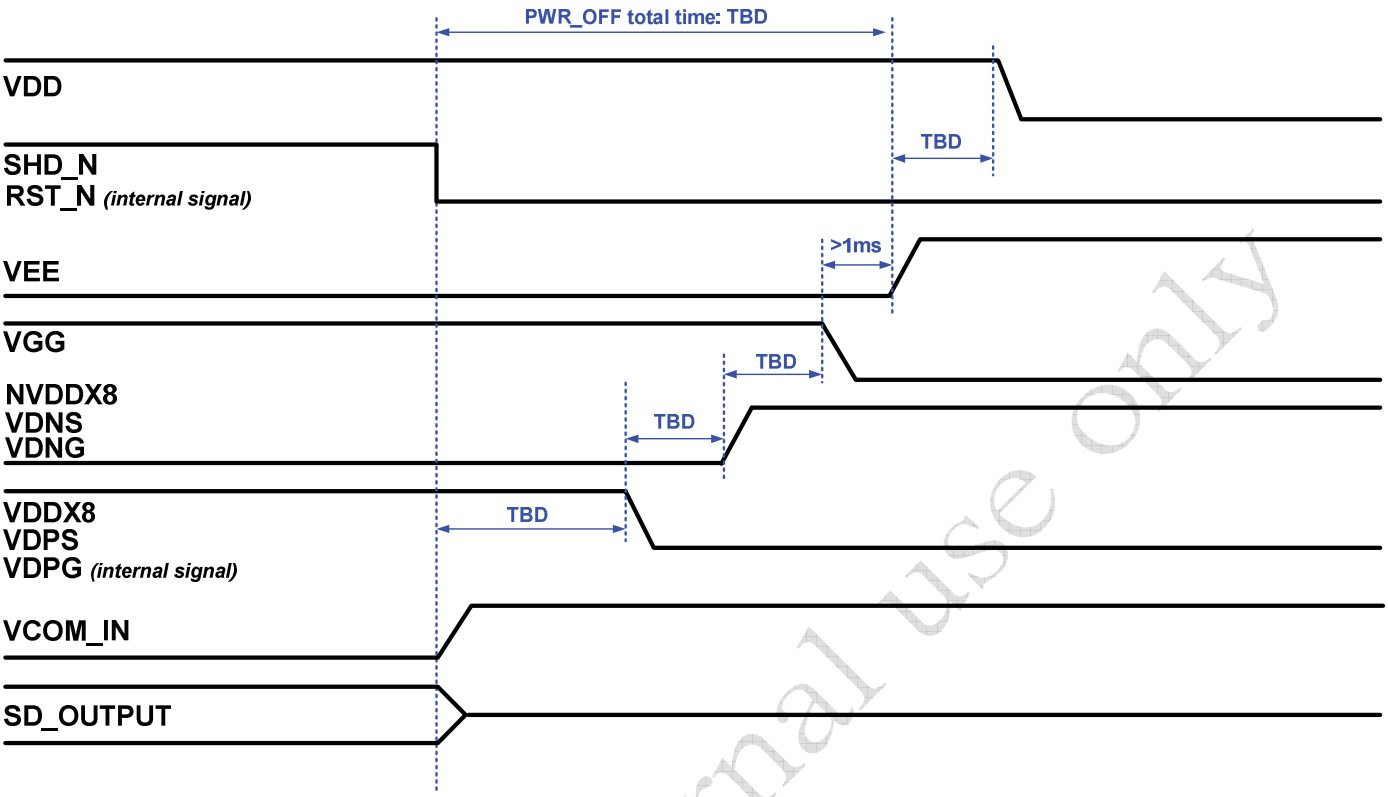
## 1. Recommended Power On/off Sequence

The suggested power on/off sequence is below:

### 1.1 Power on sequence:



### 1.2 Power off sequence:



# G. Optical Specification

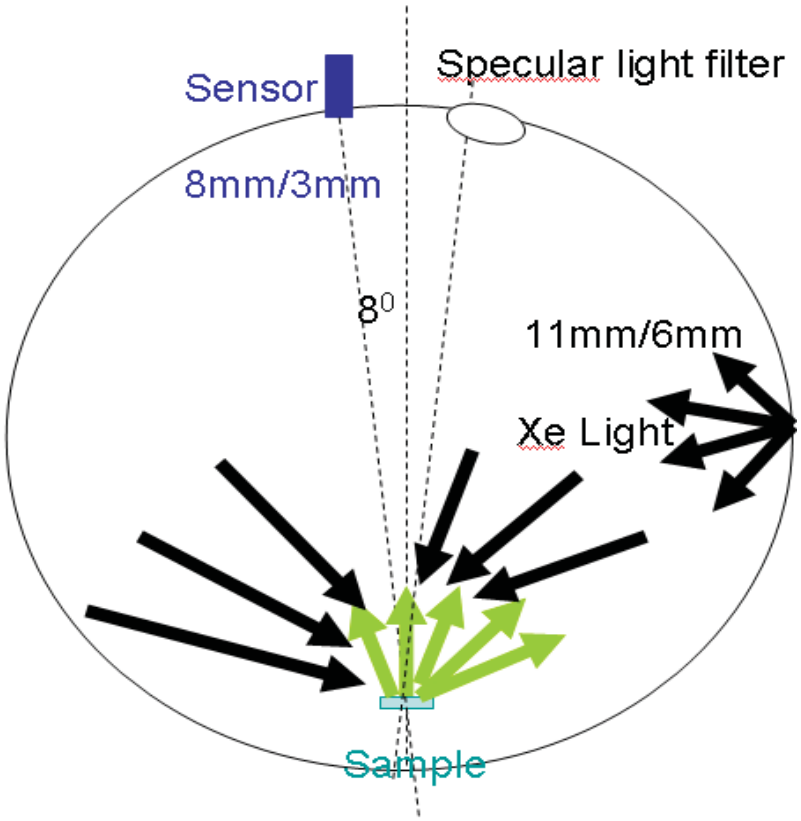
All optical specification is measured under typical condition (Note 1, 2)

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|---|
| Reflectance | R | white | 25 | 34 | -- | % | Note1,2,3,4 |
| Contrast Ratio | CR | At optimized viewing angle | 8 | 11 | -- | | Note1,2,3,5 |
| Update Time | T | T=25℃<br>T=10℃<br>T=0℃ | -- | 600<br>1100<br>1500 | 700<br>1210<br>1650 | ms | Note 3 |

Note 1. Ambient temperature =25℃

Note 2. Reflectance and constrast ratio are measured by KONICA MINOLTA spectrophotometer CM-2600d.

Note 3: The measurement shall be conducted under AUO specificed driving condition, including LUT and TCON codes.



Note 4. Definition of Reflectance:

The Reflectance is expressed as:

R = Reflectance Factor$_{\text{white board}}$ x ($L_{\text{center}}$ / $L_{\text{white board}}$)

$L_{\text{center}}$ is the luminance measured at center in a white area. $L_{\text{white board}}$ is the luminance of a standard white board.

Note 5. Definition of contrast ratio:

The contrast ratio (CR) is the ratio between the reflectance in a full white area (Rl) and reflectance in a dark area (Rd).

$$\text{Contrast ratio (CR)} = \frac{Rl}{Rd}$$

# H. Reliability Test Items

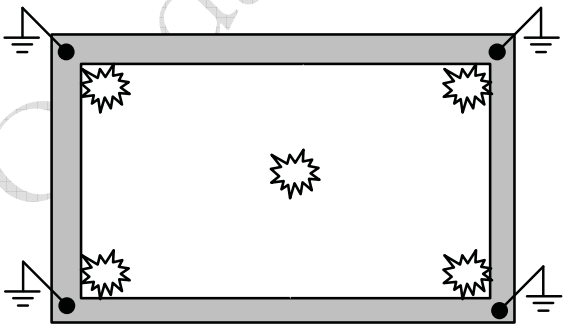
| | Test | Condition | Condition | Remark |
|---|---|---|---|---|
| 1 | High-Temperature Operation | Tamb=+50℃, RH=30% for 240hrs | IEC 60068-2-2Bp | Update pattern four times per minute. |
| 2 | Low-Temperature Operation | Tamb=0℃ for 240hrs | IEC 60068-2-2Ab | Update pattern four times per minute. |
| 3 | High-Temperature Storage | Tamb=+60℃, RH=23% for 240hrs | IEC 60068-2-2Bp | |
| 4 | Low-Temperature Storage | Tamb=-25℃ for 240hrs | IEC 60068-2-2Ab | |
| 5 | High-Temperature, High-Humidity Operation | Tamb=+40℃, RH=90% for 168hrs | IEC 60068-2-3CA | Update pattern four times per minute. |
| 6 | High-Temperature, High-Humidity Storage | Tamb=+60℃, RH=80% for 240hrs | IEC 60068-2-3CA | |
| 7 | Temperature Cycle | 1 Cycle：[-25° C 30min] → [+60° C 30min]：100 cycles | IEC 60068-2-14 | |
| 8 | UV Exposure Resistance | Condition: 765W/m2, 40℃<br>Test Duration: 7 cycles<br>(Definition of 1 cycle:<br>8 hr at exposure state and 16 Hr at non-exposure state) | IEC 60068-2-5Sa | |
| 9 | Package Vibration | 1.04G, Frequency：10 ~ 500HZ<br>Direction：X, Y, Z<br>Duration：1 hours in each direction | | |
| 10 | Package Drop Impact | Drop from height of 100 cm on concrete surface.<br>Drop sequence：1 corner, 3 edges, 6 faces one drop for each. | | |
| 11 | Electrostatic discharge | Air-mode：+/- 6kV<br>Contact-mode：+/- 2kV | IEC 61000-4-2 | |
| 12 | FPC Bonding Strength | Pull the FPC Stiffener part with a force of 500gf in the horizontal and vertical directions | | |

| | | | | |
|---|---|---|---|---|
| 13 | FPC bending Performance | Apply MIT method.<br>Bending rate radius：1.0mm<br>Weight 500gf, Bending angle：±135° Bending cycle：20 times | | |
| 14 | Stylus Tapping | POLYACETAL Pen：Top R0.8mm<br>Load：300gf<br>Speed：2 times/sec<br>Total 13,500 times | | Pass criteria - no glass breakage or damage to micro-cups. |
| 15 | Altitude test Operation | 700hPa(=3,000m) 48hrs | | |
| 16 | Altitude test Storage | 260hPa(=10,000m) 48hrs | | |

Note 1. The test modules will be kept at 25℃ environment for 4 hours after finish the environmental test and make measurement after AUO specified TCON code and waveform re-driving. there is no display function NG issue occurred. All the cosmetic specification is judged before the reliability stress.

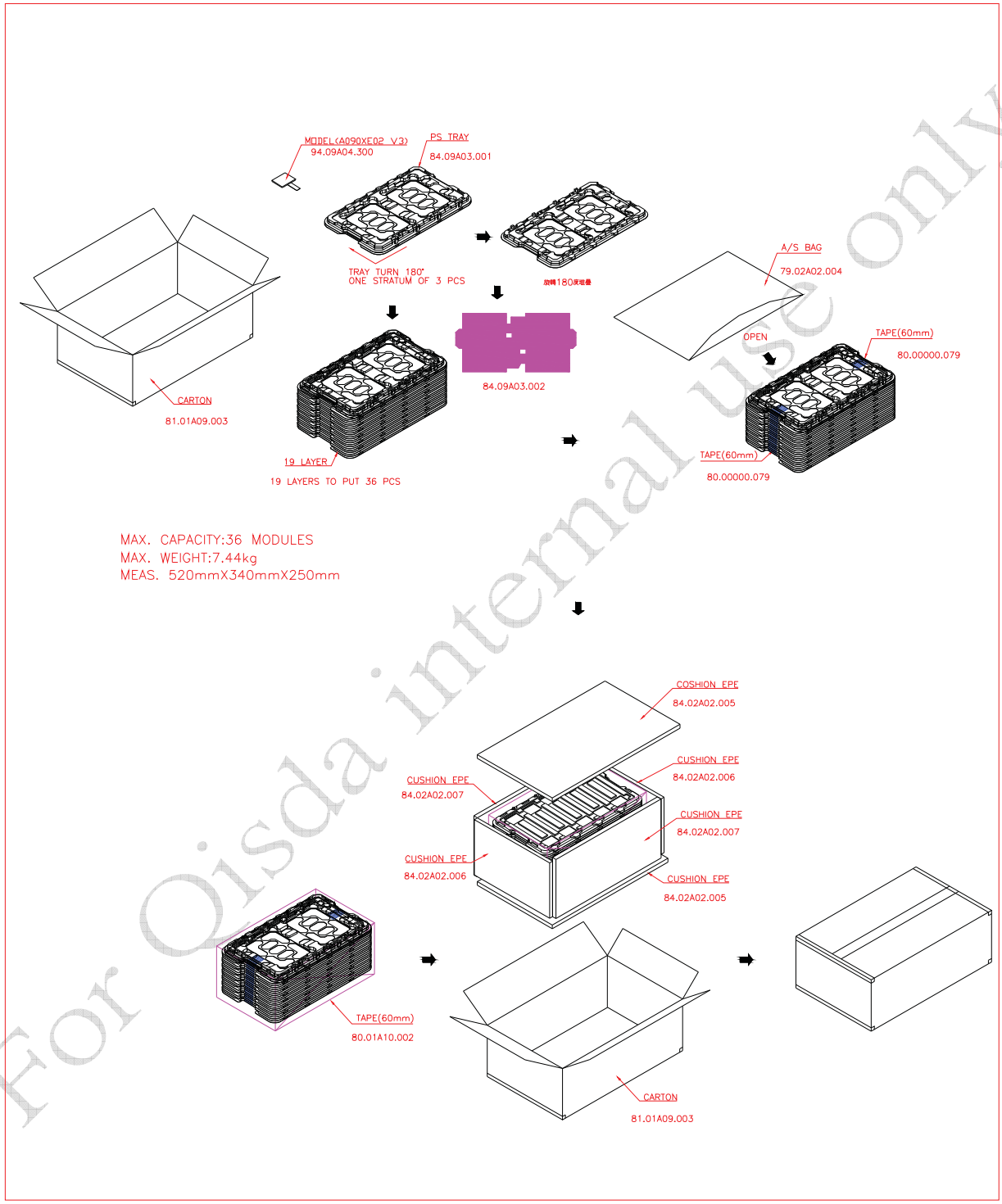
Note 2. ESD testing method.

1. Ambient: 24~26℃, 56~65%RH, atmospheric pressure : 940~960hPa
2. Instruments:NoisekenESS-2000,
3. Operation System: AUO pattern generator
4. Test Mode: Non-operating mode, test pattern: chess
5. Test Method:
   a. Contact Discharge: 150pF(330Ω) 1sec, 5 points, 10 times/point
   b. Air Discharge: 150pF(330Ω) 1sec, 5 points, 10 times/point
6. Test point:



# I. Packing and Marking

## 1. Packing Form



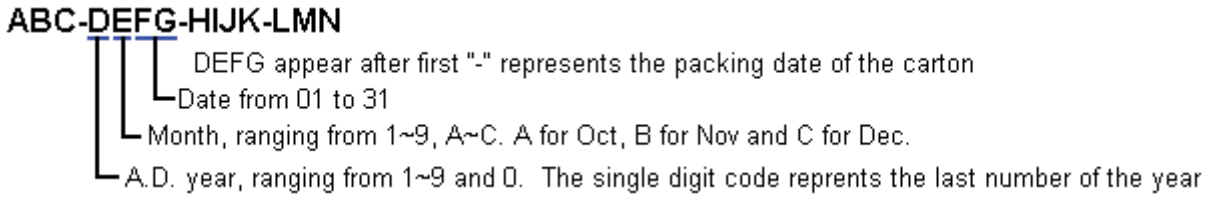
## 2. Module/Panel Label Information

The module/panel (collectively called as the “Product”) will be attached with a label of Shipping Number which represents the identification of the Product at a specific location. Refer to the Product outline drawing for detailed location and size of the label. The label is composed of a 22-digit serial number and printed with code 39/128 with the following definition:

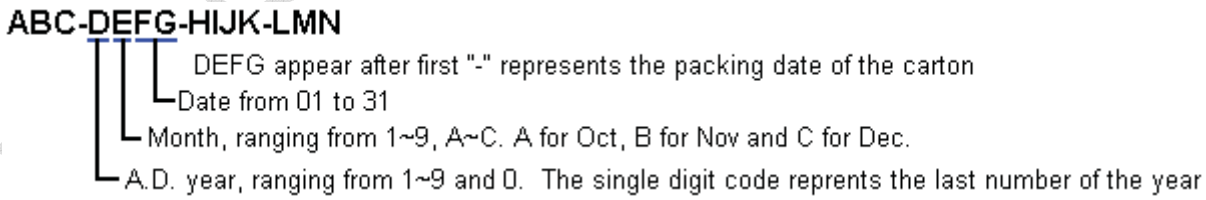
| | ABCDEFGHIJK(LMN) |
|---|---|
| AB | Weekcode |
| C | Year code |
| D | Fab code |
| E | Version code |
| FGHIJK | For internal system usage and production serial numbers |
| LMN | Version control code |

## 3. Carton Label Information

The packing carton will be attached with a carton label where packing Q’ty, AUO Model Name, AUO Part Number, Customer Part Number (Optional) and a series of Carton Number in 13 or 14 digits are printed. The Carton Number is apparing in the following format:



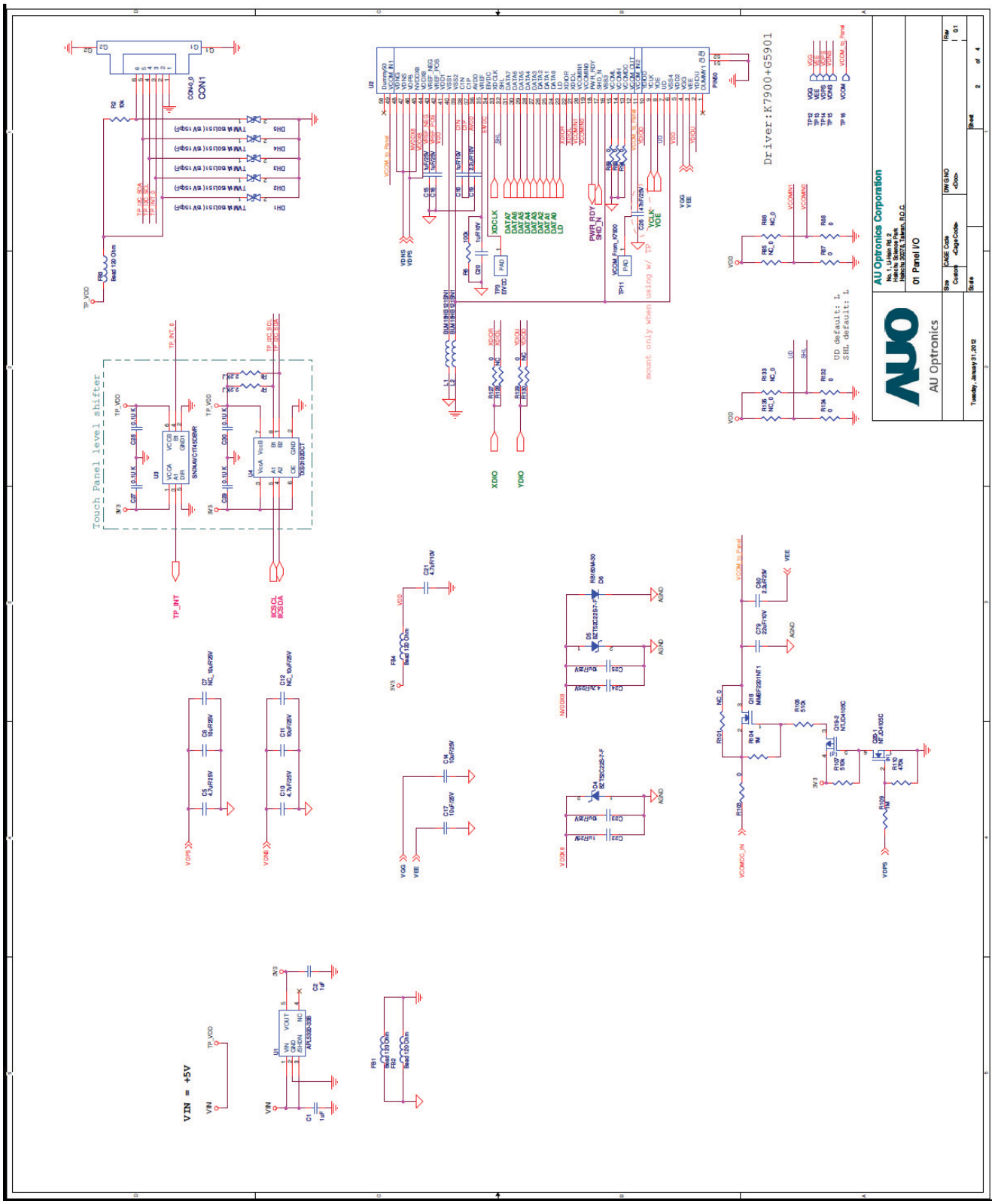

Refer to the drawing of packing format for the location and size of the carton label.



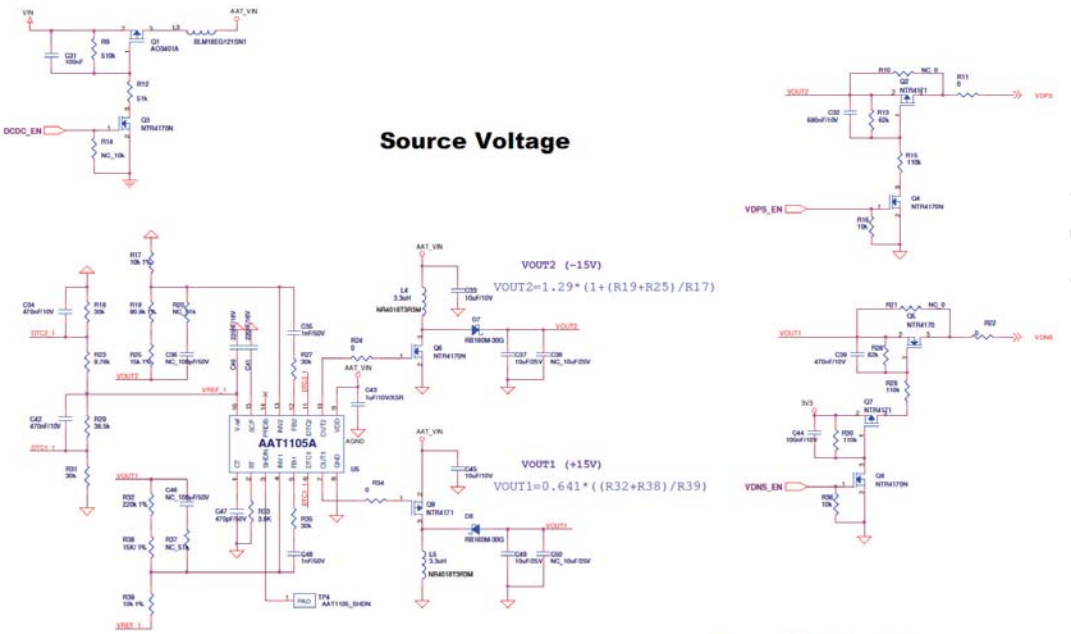

Refer to the drawing of packing format for the location and size of the carton label.

# J. Application Note

## 1. Application Circuit



## Source Voltage

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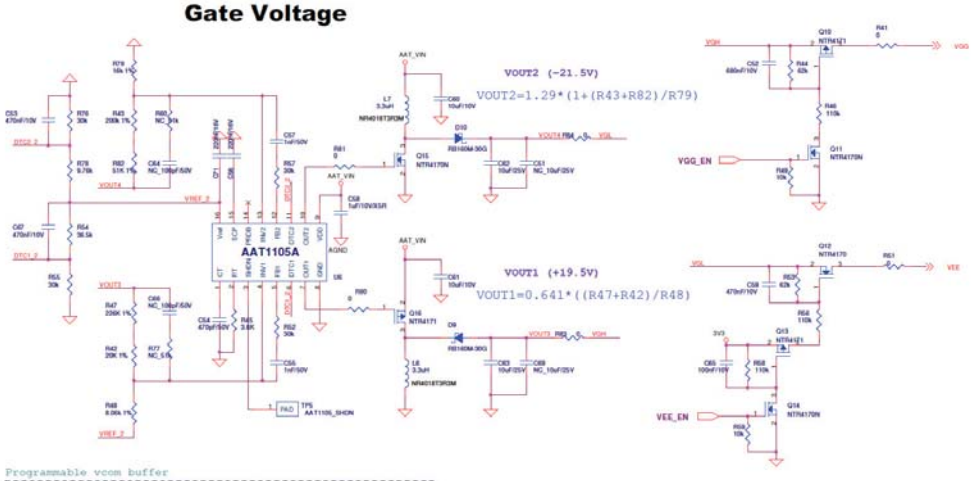
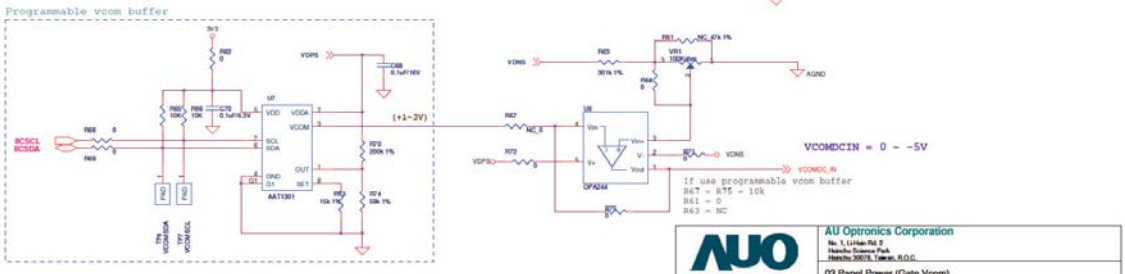
AU Optronics
02 Panel Power (DATA)

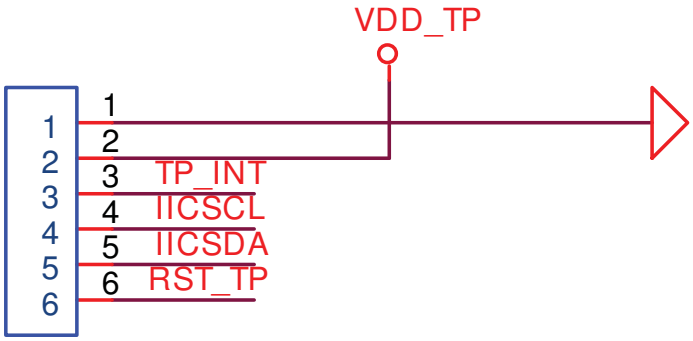
## Gate Voltage




AU Optronics Corporation
AU Optronics
03 Panel Power (Gate Vcom)

**2. Touch panel pin assign circuit**



# K. Precautions

1. Do not twist or bend the module and prevent the unsuitable external force for display module during assembly.
2. Adopt measures for good heat radiation. Be sure to use the module with in the specified temperature.
3. Avoid dust or oil mist during assembly.
4. Follow the correct power sequence while operating. Do not apply the invalid signal, otherwise, it will cause improper shut down and damage the module.
5. Less EMI: it will be more safety and less noise.
6. Please operate module in suitable temperature. The response time & brightness will drift by different temperature.
7. Be sure to turn off the power when connecting or disconnecting the circuit.
8. Display surface never likes dirt or stains.
9. A dewdrop may lead to destruction. Please wipe off any moisture before using module.
10. High temperature and humidity may degrade performance. Please do not expose the module to the direct sunlight and so on.
11. Acetic acid or chlorine compounds are not friends with display module.
12. Static electricity will damage the module, please do not touch the module without any grounded device.
13. Do not disassemble and reassemble the module by self.
14. Be careful do not touch the rear side directly.
15. No strong vibration or shock. It will cause module broken.
16. Storage the modules in suitable environment with regular packing.
17. Be careful of injury from a broken display module.
18. Please avoid the pressure adding to the surface (front or rear side) of modules, because it will cause the display non-uniformity or other function issue.
19. Application under direct sunlight is strongly not recommended as it would result in display performance degradation.
20. It is highly recommended that the display is exposed to an even lighting condition to ensure a good display uniformity.
21. Elimination of light exposure to the display by applying proper means, e.g. lighting shielding cover is suggested when the display is not being used to extend the life performance of the device.
22. Heat isolation or heat sink to control uniformity of panel temperature should smaller than 1℃
23. Any performance degradation or display distortion which can be eliminated by display refreshing should not be regarded as a defect

# L. Touch Panel Command and Register Map

## 1. I2C Protocol Definition

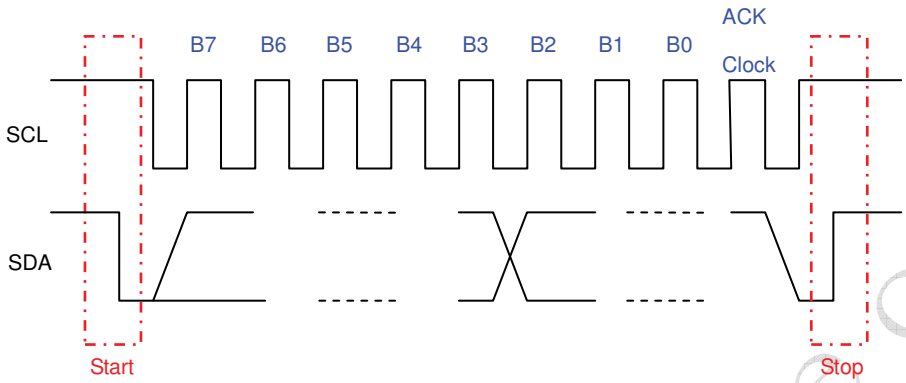



Figure 1. Standard $I^2C$ Transaction Unit

The sensor controller supports standard $I^2C$ protocol with SCL up to 400KHz. The device address is 0x5C. The chip also provides both single and sequential access. Figure 2 shows the write operation using single or sequential mode. Figure 3 also depicts the standard I2C transaction for single for sequential read mechanism.

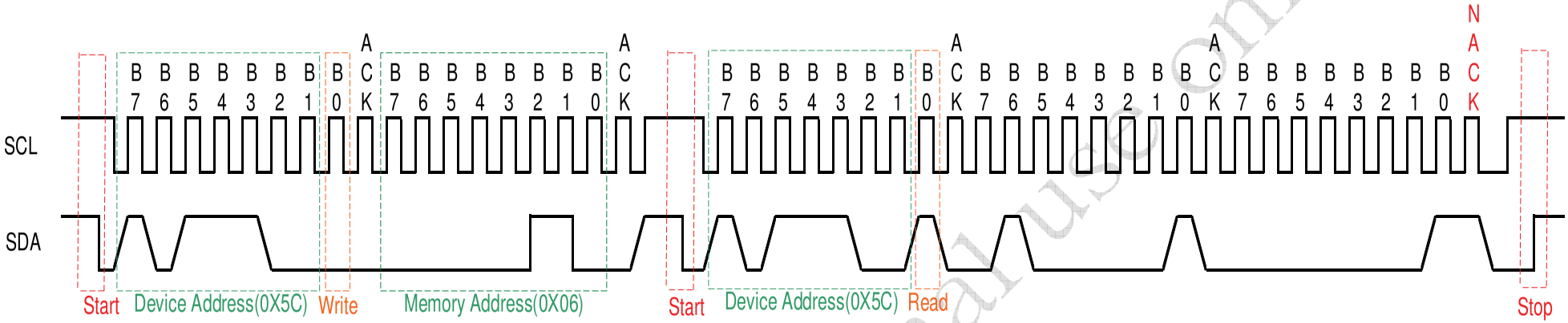
| Write Operation | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Single | Start | Device Address (W) | A | Mem Addr | A | Data[0] | A | Stop | | | | | | | | |
| Sequential | Start | Device Address (W) | A | Mem Addr | A | Data[0] | A | Data[1] | A | ..... | A | Data[n] | A | Stop | | |

Figure 2. Write Operation with Single/Multiply Access

| Read Operation | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Single | Start | Device Address (W) | A | Mem Addr | A | Start | Device Address (R) | A | Data[0] | NA | Stop | | | | | |
| Sequential | Start | Device Address (W) | A | Mem Addr | A | Start | Device Address (R) | A | Data[0] | A | ..... | A | Data[n] | NA | Stop | |

Figure 3. Read Operation with Single/Multiply Acce

Suppose the Y[3] raw data is 321. If only Y[3] is read, user should issue the waveform as following:



## 2. Coordinate Register Map

| Addr. | Addr.(HEX) | Description | R/W | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 00 | X1 (LSB) | R | X1[7] | X1[6] | X1[5] | X1[4] | X1[3] | X1[2] | X1[1] | X1[0] |
| 1 | 01 | X1 (MSB) | R | 0 | 0 | 0 | 0 | 0 | 0 | X1[9] | X1[8] |
| 2 | 02 | Y1 (LSB) | R | Y1[7] | Y1[6] | Y1[5] | Y1[4] | Y1[3] | Y1[2] | Y1[1] | Y1[0] |
| 3 | 03 | Y1 (MSB) | R | 0 | 0 | 0 | 0 | 0 | 0 | Y1[9] | Y1[8] |

**Note: (1) (X1, Y1) means the touched point**

**(2) The coordinate of X1 = X1(LSB) + X1(MSB)*256, Y1 = Y1(LSB) + Y1(MSB)*256**

**(3) If no touch, (X1, Y1)=(0,0)**

## 3. Display and Touch Resolution

If screen resolution (blue) is 1024x768 , and touch resolution (yellow) is the same (1024x768)

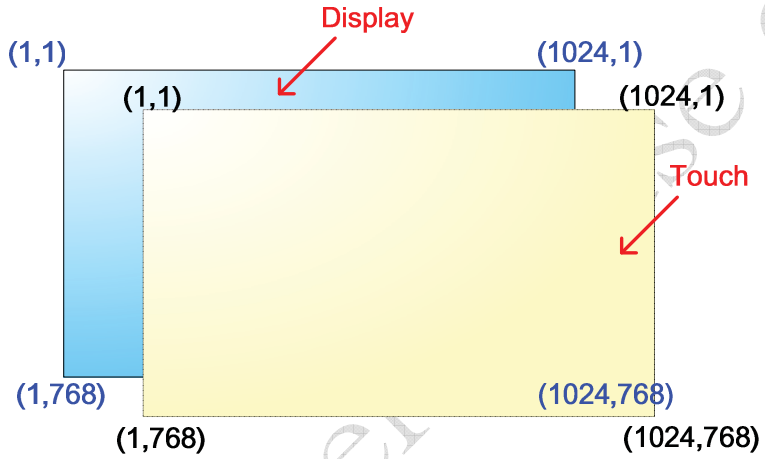
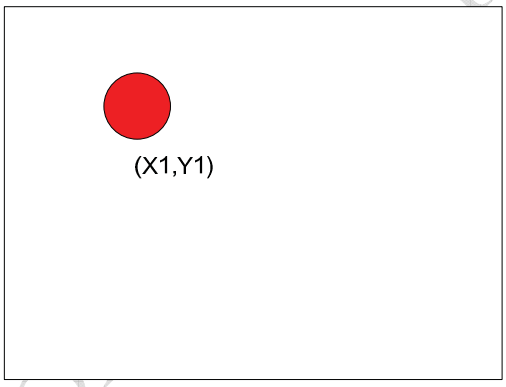
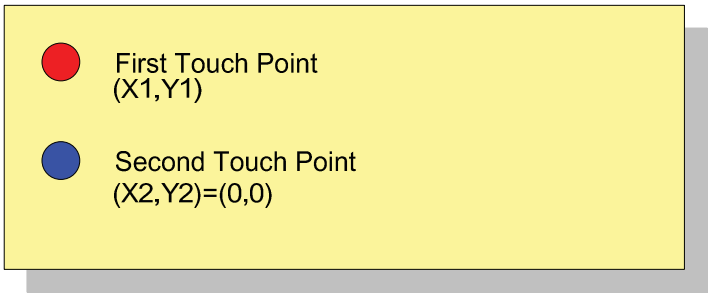



Figure 4 Reference of touched point diagram

## 4. Single Touch




Single Touching




## 5. Sensitivity

| Addr. | Addr.(HEX) | Description | R/W | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 111 | 6F | X_SENSITIVITY (THRESHOLD) | R/W | X_SENSITIVITY[7:0] | | | | | | | |
| 112 | 70 | Y_SENSITIVITY (THRESHOLD) | R/W | Y_SENSITIVITY[7:0] | | | | | | | |

**Note: (1) The default value for X/Y SENSITIVITY is 0X14**

# 6. Interrupt Operation Mode

This chip should support both polling and interrupt way to get the coordinate and raw data by I2C interface. The figure below depicts the interruption operation.

## 6.1 Interrupt Mode Setting

| Addr. | Addr.(HEX) | Description | R/W | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 113 | 71 | INT_SETTING | R/W | TP_NUM[2] | TP_NUM[1] | TP_NUM[0] | INT_RELEASE | EN_INT | INT_POL | INT_MODE[1] | INT_MODE[0] |
| 114 | 72 | INT_WIDTH | R/W | INT_WIDTH[7:0] | | | | | | | |

Note: (1) TP_NUM[2:0]

TP_NUM means how many fingers touched on the panel

000: No finger 001: One finger

010: Reserved others: Reserved

(2) INT_RELEASE

Under Touch Periodical Mode, once the behaviour of finger touched and then left was established, sensing IC will stop to scan until INT_RELEASE be modified INT_RELEASE default is 0

(3) EN_INT

0: Disable interrupt 1: Enable interrupt

(4) INT_POL

0: The interrupt is low-active (default) 1: the interrupt is high-active

(5) INT_ MODE[1:0]

00: INT assert periodically 01: INT assert only when coordinate difference

10: Touch Indicate (default) 11: INT assert only when INT_RELEASE be modified

(6) The default value for INT_SETTING is 0X0A ; INT_WIDTH is 0X64

## 6.2 Sensing Periodical Mode (INT_MODE[1:0] = [0,0]).

For sensing periodical mode, the INT_MODE[1:0] should be [0,0].

The data must be ready (including coordinate and raw data) before signal 'INT' rising.

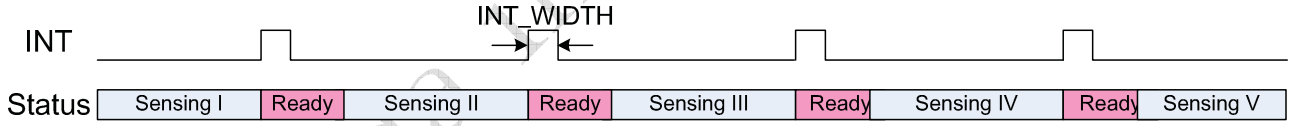



Figure 5: Interruption with INT_R auto-reset

## 6.3 Coordinate Compare Mode (INT_MODE[1:0] = [0,1]).

The INT signal will be asserted while coordinate changes under comparison mode (INT_MODE[1:0] = [0,1]).

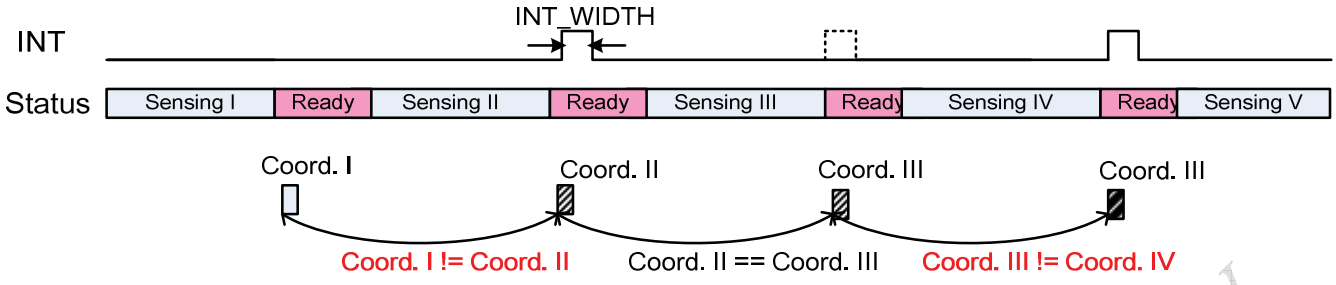


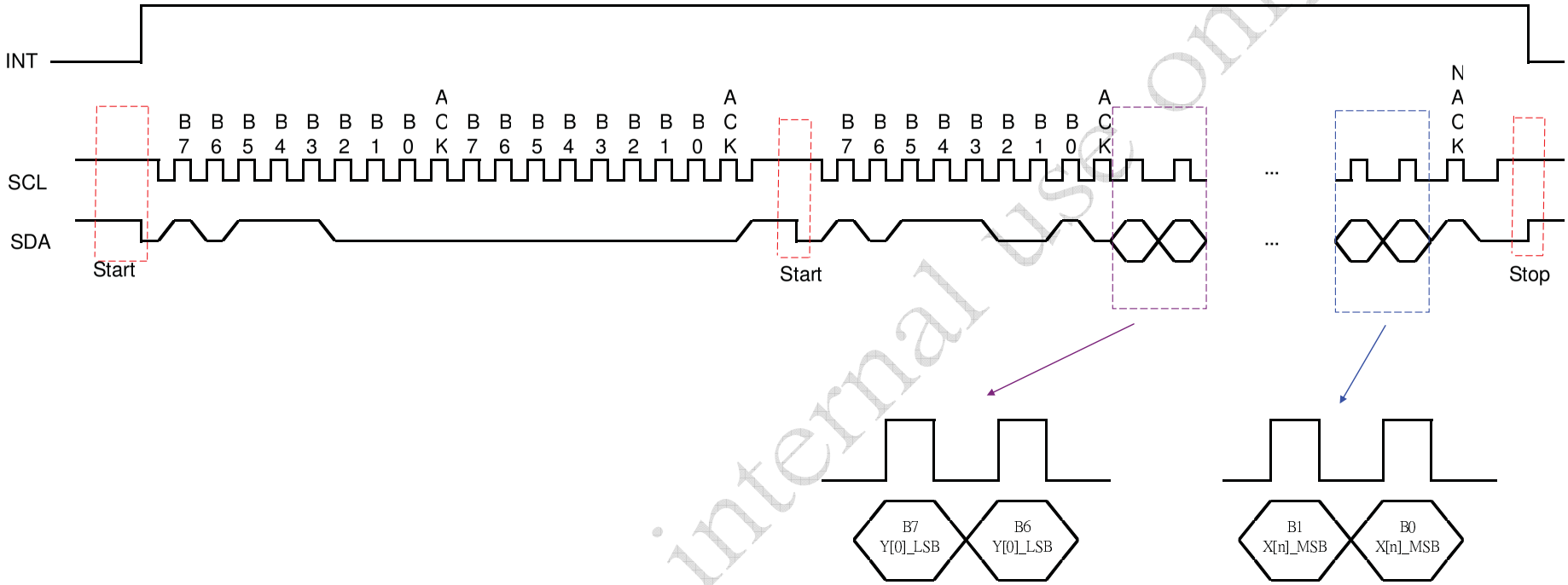

Figure 6: Interruption Flag under Coordinate Compare Mode

### 6.4 Touch Indicate Mode (INT_MODE[1:0] = [1,0]).

The interrupt will assert when the touch is valid. The interrupt should keep high until the touch is released.


Figure 7: Touch Indicate Mode

Combination interrupt with I2C sequential read raw data operation for as following (for INT_MODE[1:0] = [1,0])



## 7. Power Mode

| Addr. | Addr.(HEX) | Description | R/W | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 115 | 73 | Power Mode | R/W | IDLE_PERIOD[3] | IDLE_PERIOD[2] | IDLE_PERIOD[1] | IDLE_PERIOD[0] | 0 | ALLOW_SLEEP | POWER_MODE[1] | POWER_MODE[0] |

The capacitive sensor controller support 3 steps of power saving: Active, Sleep, Deep Sleep, the following section describe relative scan rate and power consumption:

**The default value is 0X50**

**Active Mode:**

The scan speed will reach 60Hz, this mode makes full-speed sensing and data process to provide best performance. the Power Mode is '0'.

**Sleep Mode:**

This mode will lower the scan speed down to 10Hz. Active Mode can enter sleep mode automatically or by command. When the system issues a command to change power mode to '1', the scan rate will switch to 10Hz at next scan cycle. When allow_sleep parameter is given, and user don't touch the screen longer than IDLE_PERIOD ms. the controller should also enter sleep mode directly and change the scan rate to 10 Hz immediately.

When user touches the screen in **active region**, the controller should return to Active mode. besides, when system assert a command to change the power mode to '0', the scan rate should also rise to 60Hz

**Deep Sleep Mode:**

When the chip enter deep sleep mode, the scan speed will reduce to 1Hz to achieve minimum power consumption. While deep sleep mode, all the registers are accessible during 4 ms, and it start from end of interrupt transition. The figure 13 and figure 14 shows a example to reference.

The only way to leave/enter deep sleep mode is change the power mode by specific command. The power mode is defined as '2'

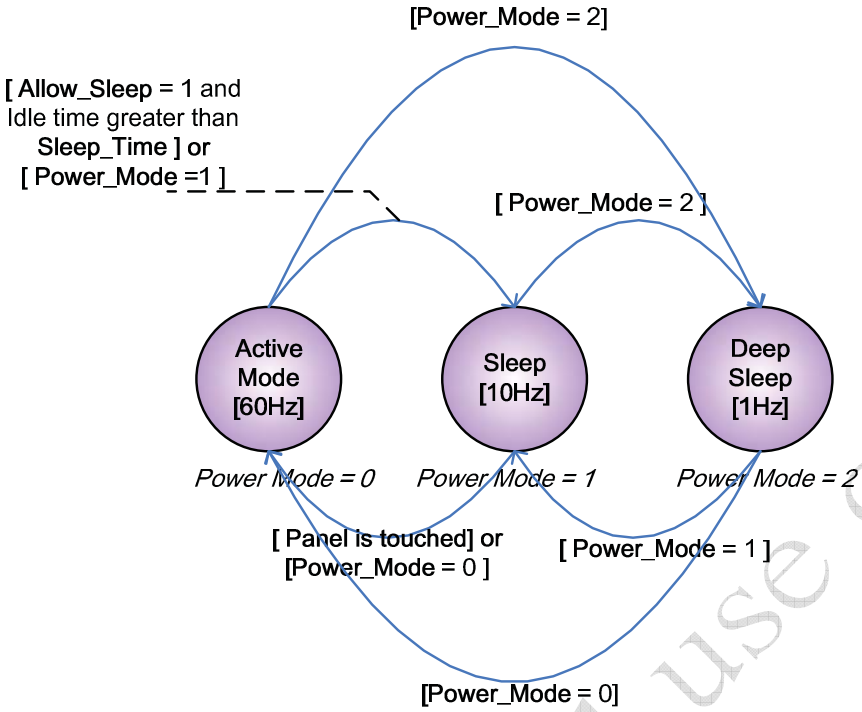



Figure 8 Power Mode Diagram

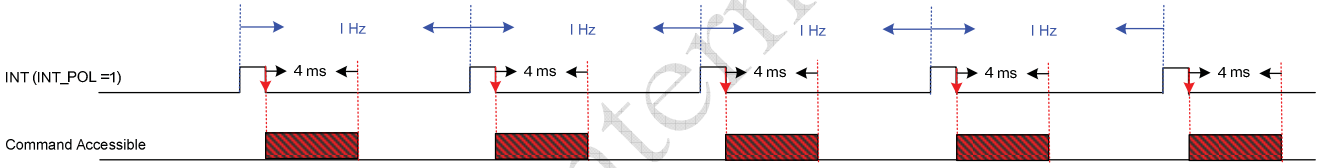



Figure 9 Command Accessible in Deep Sleep Mode (INT_POL=1)

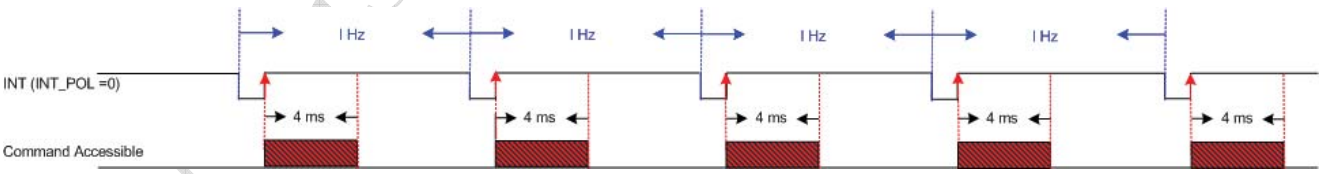



Figure 10 Command Accessible in Deep Sleep Mode (INT_POL=0)

## 8. Calibration

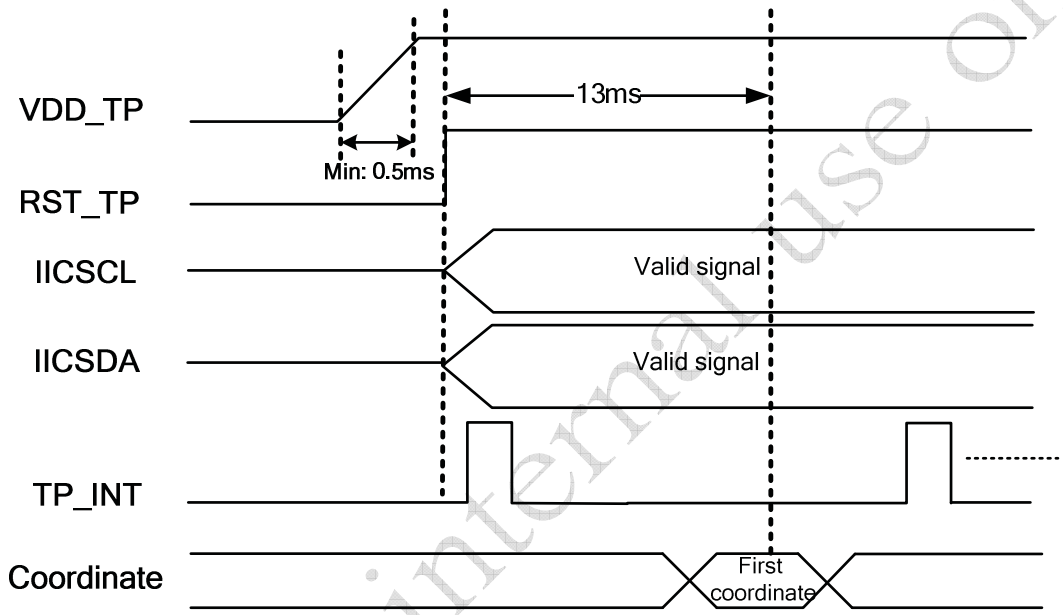
| Addr. | Addr.(HEX) | Description | R/W | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 120 | 78 | Calibration | W | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |

"Calibration" procedure has to be done once after assembly

Set address 0x78 as a 0x03 and wait 500ms, "Calibration" procedure will be done

## 9. Power On/Off Sequence

### 9.1 power on sequence




### 9.2 power off sequence