**toppoly**

TD022THEC1

*Tentative*

Ver.: 0.01

# TFT LCD Specification

# Model Name: TD022THEC1

| Customer Signature |
| :---: |
|  |
| Date |
| **Feb 2, 2005** |

This technical specification is subjected to change without notice

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## Table of Contents

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## Record of Revision

| Rev | Issued Date | Description |
|---|---|---|
| 0.00 | Dec 10, 2004 | New released |
| 0.01 | Feb. 2, 2005 | Modify AC Character (p10), |
| | | 7.10 Optical Spec(p12) |
| | | 10. ME Drawing |
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## 1. FEATURES

The 2.2"(5.6 cm) LCD module is an trans-missive active matrix color TFT LCD module. LTPS (Low Temperature Poly Silicon) TFT technology is used. Vertical and horizontal drivers are built on the panel.

## 2. GENERAL SPECIFICATIONS

| Item | Description | Unit |
|---|---|---|
| Display Size (Diagonal) | 2.2 (5.6) | Inch(cm) |
| Display Type | Trans-missive | |
| Active Area (HxV) | 33.84 x 45.12 | mm |
| Number of Dots (HxV) | 240 x RGB x 320 | dot |
| Dot Pitch (HxV) | 0.047 x 0.141 | mm |
| Color Arrangement | RGB Stripe | |
| Color Numbers | 65536 (bit: R=5, G=6, B=5) | |
| Outline Dimension (HxVxT) | 40.6 x 56.6 x 2.91 | mm |
| Weight | TBD (Approx.) | G |
| Operating temperature | –20 to +60 | Deg C |
| Storage temperature | –30 to +70 | Deg C |

* Exclude FPCa and protrusions.

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### 3. INPUT/OUTPUT TERMINALS

| No. | Pin Name | I/O | Description | Note |
|-----|----------|-----|-------------|------|
| 1 | /RESETB | I | When /RESETB is L,an internal reset is performed | |
| 2 | TB | I | Data shift direction select | |
| 3 | RL | I | Source shift direction select | |
| 4 | NC | - | NC | |
| 5 | GND | - | Ground | |
| 6 | MCLK | I | The pixel clock signal of the RGB interface | |
| 7 | GND | - | Ground | |
| 8 | GND | - | Ground | |
| 9 | GND | - | Ground | |
| 10 | B1 | I | RGB data Bit B1 | |
| 11 | B2 | I | RGB data Bit B2 | |
| 12 | B3 | I | RGB data Bit B3 | |
| 13 | B4 | I | RGB data Bit B4 | |
| 14 | B5 | I | RGB data Bit R5(MSB) | |
| 15 | GND | - | Ground | |
| 16 | G0 | I | RGB data Bit G0 | |
| 17 | G1 | I | RGB data Bit G1 | |
| 18 | G2 | I | RGB data Bit G2 | |
| 19 | G3 | I | RGB data Bit G3 | |
| 20 | G4 | I | RGB data Bit G4 | |
| 21 | G5 | I | RGB data Bit G5(MSB) | |
| 22 | GND | - | Ground | |
| 23 | R1 | I | RGB data Bit R1 | |
| 24 | R2 | I | RGB data Bit R2 | |
| 25 | R3 | I | RGB data Bit R3 | |
| 26 | R4 | I | RGB data Bit R4 | |
| 27 | R5 | I | RGB data Bit B5(MSB) | |
| 28 | GND | I | Ground | |
| 29 | HSYNC | I | The horizontal sync signal of the RGB interface | |
| 30 | VSYNC | I | The vertical sync signal of the RGB interface | |
| 31 | GND | - | Ground | |
| 32 | GND | - | Ground | |
| 33 | DVDD | - | Power supply(2.7~3.0V) | |

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| No. | Pin Name | I/O | Description | Note |
|-----|----------|-----|-------------|------|
| 34 | DVDD | - | Power supply(2.7~3.0V) | |
| 35 | LED+ | - | LED+ | |
| 36 | LED+ | - | LED+ | |
| 37 | LED- | - | LED- | |
| 38 | LED- | - | LED- | |
| 39 | GND | - | Ground | |

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### 4. ABSOLUTE MAXIMUM RATINGS

| Parameter | Symbol | Ratings | Unit |
|---|---|---|---|
| Maximum supply voltage | DVDD | -0.3 ~ +3.6 | V |
| DC/DC Input voltage | DVDD | -0.3 to DVDD +0.3 | V |
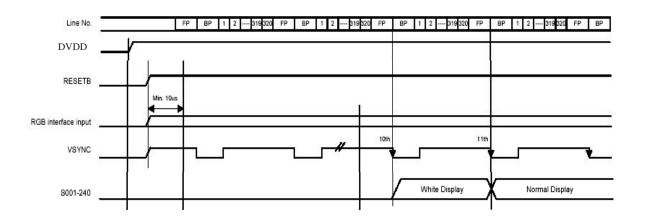
(Ta=+25℃,VSS=0V)

### 5. ELECTRICAL CHARACTERISTICS

Allowable Operation condition (Ta=-20 ~ +60℃ , VSS=0)

| Parameter | | Symbol | Conditions | Ratings | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | |
| Supply Voltage (DC/DC) | | DVDD | | 2.5 | 2.775 | 3.0 | V |
| Logic high-level input | | Vih | | 0.7 DVDD | ― | DVDD | V |
| Logic low-level input | | Vil | | 0 | ― | 0.3 DVDD | V |
| Input Signal Voltage | $H_{SYNC}$ $V_{SYNC}$ signals | HS VS | | 1.6 | 1.875 | 3.0 | V |
| | Data Signals | R,G, B | | 1.6 | 1.875 | 3.0 | V |
| | Clock signal | CLK | | 1.6 | 1.875 | 3.0 | V |
| Power consumption | Normal mode | Pwr | With loading | ― | TBD | ― | mW |

Power On sequence

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Power Off sequence
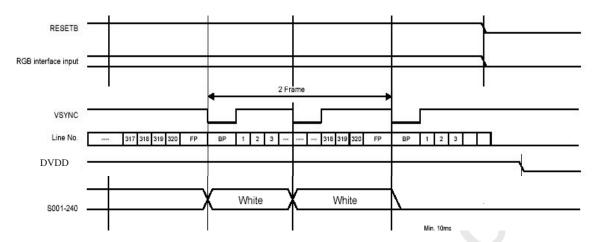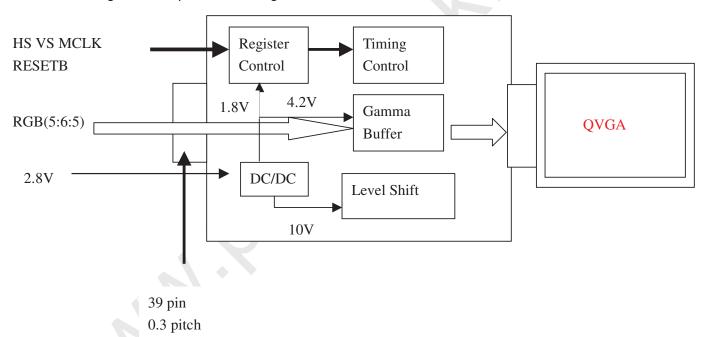


5.1 Driving TFT LCD panel block diagram



HS VS MCLK
RESETB

RGB(5:6:5)

2.8V

1.8V        4.2V

Register Control → Timing Control

Gamma Buffer

DC/DC        Level Shift

10V

QVGA

39 pin
0.3 pitch

5.2 Driving Backlight

Ta=25℃

| Item | Symbol | MIN | TYP | MAX | Unit | Remark |
|------|--------|-----|-----|-----|------|--------|
| Forward Current | $I_F$ | -- | 15 | TBD | mA | |
| Forward Current Voltage | $V_F$ | -- | 14.4 | -- | V | Note 5-2 |
| Backlight Power Consumption | $W_{BL}$ | -- | 216 | -- | mW | |

Note 5-2: LEDx4

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## 6. TIMING CHART
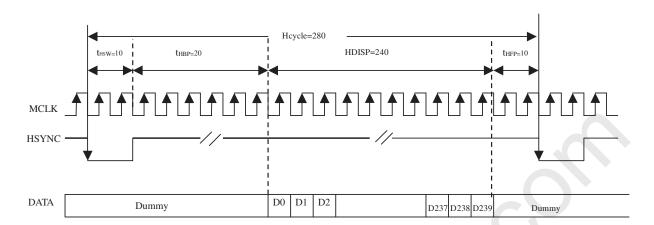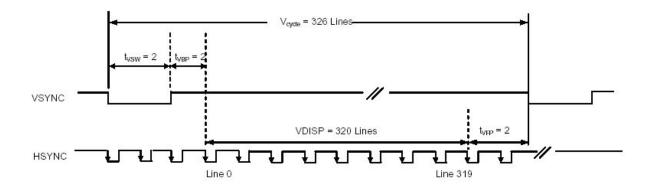
### 6.1 Horizontal Read/ Write Timing
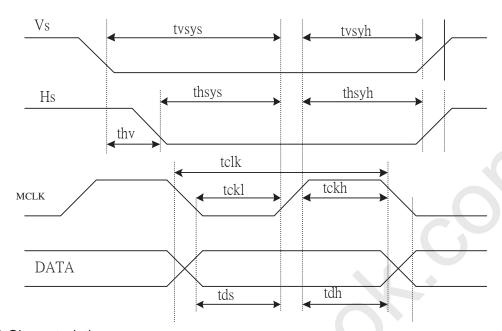


### 6.2 Vertical Read/ Write Timing

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## 6.3 Pixel clock Timing



## 6.4 AC Characteristics

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|-----------|--------|------------|-----|-----|-----|------|
| **Logic input** | | | | | | |
| Vertical Frequency | fV | | 55 | 60 | 65 | Hz |
| Horizontal Frequency | fH | | 17.9 | 19.6 | 21.2 | KHz |
| DCK Frequency | fDCK | | 5.02 | 5.48 | 5.93 | MHz |
| DCK Period | tDCK | | 199 | 183 | 169 | ns |
| DCK Low Period | tCKL | | 75 | - | - | ns |
| DCK High Period | tCKH | | 75 | - | - | ns |
| HSYNC Pulse Low Width | tHSW | | 2 | 10 | - | DCK |
| Horizontal Back Porch | tHBP | | - | 20 | - | DCK |
| Horizontal Front Porch | tHFP | | - | 10 | - | DCK |
| Horizontal Blanking Period | THBP+ tHFP | | - | 30 | - | DCK |
| Horizontal Display Area | Hdisp | | - | 240 | - | DCK |
| Horizontal Cycle | Hcycle | | 260 | 280 | 300 | DCK |
| HSYNC Set-up Time | thsys | | 20 | - | - | ns |
| HSYNC Hold Time | thsyh | | 20 | - | - | ns |
| VSYNC Pulse Low Width | tVSW | | 2 | 2 | - | HSYNC |
| Vertical Back Porch | tVBP | | - | 2 | - | HSYNC |
| Vertical Front Porch | tVFP | | 1 | 2 | - | HSYNC |
| Vertical Blanking Period | tVBP+tVFP | | - | 4 | - | HSYNC |
| Vertical Display Area | Vdisp | | - | 320 | - | HSYNC |

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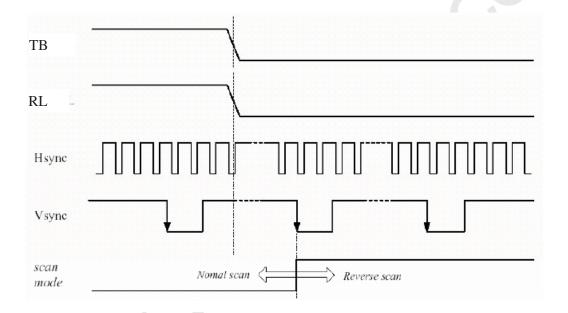
| Vertical Cycle | Vcycle | | 323 | 326 | 340 | HSYNC |
|---|---|---|---|---|---|---|
| VSYNC Set-up Time | thsys | | 20 | - | - | ns |
| VSYNC Hold Time | thsyh | | 20 | - | - | ns |
| Phase Difference of Sync Signal Falling Edge(note1) | thv | | -(tVSW-1) | - | 1Hcycle-1 | DCK |
| Data Set-up Time | tds | | 20 | - | - | ns |
| Data Hold Time | tdh | | 20 | - | - | ns |

Note1: The range if it can't met our spec , just give up first Hsync.It can't impact any side effect.

### 6.5 Display Scan Direction

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## 7. OPTICAL CHARACTERISTICS

7.1. Optical Specification (T = 25 deg C)

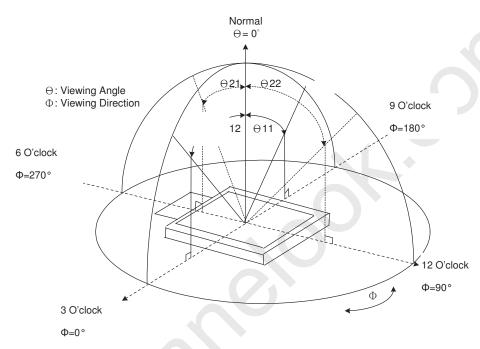| Item | | Symbol | Condition | MIN | TYP | MAX | Unit | Remarks |
|---|---|---|---|---|---|---|---|---|
| Viewing angles | | Θ11 | CR ≥ 10 | TBD | 55 | -- | Degree | Note 7-1 |
| | | Θ12 | | TBD | 55 | -- | | |
| | | Θ21 | | TBD | 55 | -- | | |
| | | Θ22 | | TBD | 45 | -- | | |
| Contrast ratio | | CR | | TBD | 300:1 | -- | | Note 7-2 |
| Luminance | | L | | | 250 | | Cd/m$^2$ | Note 7-3 |
| Uniformity | | % | | | 75 | | % | Note 7-4 |
| Response Time | | Tr + Tf | | -- | 35 | - | ms | Note 7-5 |
| Chromaticity | White | x | Θ=0° | 0.297 | 0.332 | 0.367 | | Note 7-6 |
| | | y | | 0.301 | 0.336 | 0.371 | | |
| | Red | x | | 0.566 | 0.601 | 0.636 | | |
| | | y | | 0.308 | 0.343 | 0.378 | | |
| | Green | x | | 0.277 | 0.312 | 0.347 | | |
| | | y | | 0.545 | 0.580 | 0.615 | | |
| | Blue | x | | 0.101 | 0.136 | 0.171 | | |
| | | y | | 0.058 | 0.093 | 0.128 | | |
| | NTSC | | | | 55% | | | |

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7.2 Basic measure condition

7.2.1　Ambient Temperature: Ta=25℃

7.2.2　Testing Point: Measure in the display center point and the test angle $\Theta$=0°

Measuring System A (Autronic-Melchers DMS-series)

Note 7-1: Viewing angle diagrams:

Normal
$\Theta$ = 0°

$\Theta$: Viewing Angle
$\Phi$: Viewing Direction

$\Theta$21 　 $\Theta$22

9 O'clock
$\Phi$=180°

12 　 $\Theta$11

6 O'clock
$\Phi$=270°

12 O'clock
$\Phi$=90°

$\Phi$

3 O'clock
$\Phi$=0°

Note 7-2: Contrast ratio in back light on (Measure System A)

Contrast ratio is measured in optimum common electrode voltage.

$$CR = \frac{\text{Luminance with all white pixels}}{\text{Luminance with all black pixels}}$$

Note 7-3: Luminance: (Measure System A)

Test Point: Display Center

LED Current $I_F$ = 15 mA

Notes 7-4: Definition of uniformity: Light on backlight 5 minutes before test.

$$\text{Uniformity (Lu)} = \frac{\text{Minimum Luminance of 9 test points}}{\text{Center Luminance of 9 test points}} \times 100\%$$
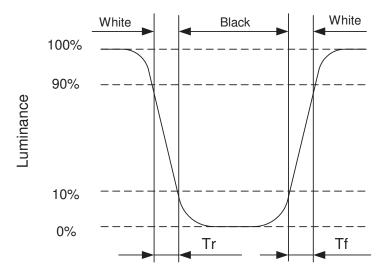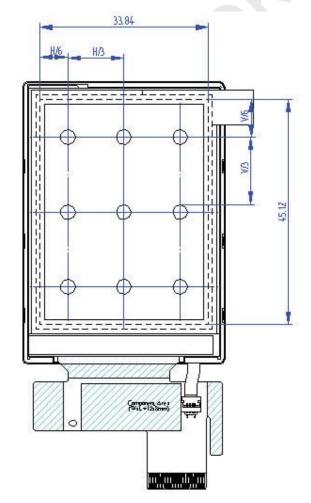
The definition of 9 test points:

Note 7-5:Definition of response time: (Measure System A)



Note 7-6: White chromaticity as back light on: (Measure System A)

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## 8. RELIABILITY

| No | Test Item | Condition |
|---|---|---|
| 1 | High Temperature Operation | Ta= 70℃, 240hrs |
| 2 | High Temperature & High Humidity Operation | Ta= 40℃, 95% RH, 240hrs |
| 3 | Low Temperature Operation | Ta=-20℃, 240hrs |
| 4 | High Temperature Storage | Ta=+80℃, 240hrs |
| 5 | Low Temperature Storage | Ta=-30℃, 240hrs |
| 6 | Thermal Shock (non-operation) | -40℃(45min)←→85℃(45min) , 30 cycles |
| 7 | Surface Discharge (non-operation) | C=150pF, R=330Ω<br>Discharge: Air:> ±15kV;<br>Contact:> ±8kV<br>5 times / Point ; 5 Points / Panel<br>Shield case connect to GND in testing |
| 8 | Vibration (non-operation) | Frequency: 10~55Hz; Amplitude: 1.5mm<br>Sweep Time: 11min<br>Test Time: 2 hrs for each direction of X, Y, Z |
| 9 | Shock (non-operation) | Acceleration: 100G; Period: 6ms<br>Directions: ±X, ±Y, ±Z; Cycles: Twice |

Ta: Ambient Temperature

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## 9. HANDLING CAUTIONS

9.1 ESD (Electrical Static Discharge) Strategy

ESD will cause serious damage of the panel, ESD strategy is very important in handling. Following items are the recommended ESD strategy

(1) In handling LCD panel, please wear non-charged material gloves. Connector the wrist conduction ring to the earth and the conducting shoes to the earth is necessary.

(2) The machine and working table for the panel should have ESD protection strategy.

(3) In handling the panel, using ionized air to decrease the charge in the environment is necessary.

(4) In the process of assembly the module, shield case should connect to the ground.

9.2 Environment

(1) Working environment of the panel should be in the clean room.

(2) The front polarizer is easy damaged. Handle it carefully and do not scratch it by sharp material.

(3) Panel has polarizer protective film in the surface. Please remove the protection film of polarizer slowly with ionized air to prevent the electrostatic discharge.

9.3 Others

(1) Turn off the power supply before connecting and disconnecting signal input cable.

(2) The connection area of FPC and panel is very weak, do not handle panel only by FPC or bend FPC.

(3) Water drop on the surface or condensation as panel power on will corrode panel electrode.

(4) As the packing bag open, watch out the environment of the panel storage. High temperature and high humidity environment is prohibited.

(5) When the TFT LCD module is broken, please watch out whether liquid crystal leaks out or not. If your hand touches liquid crystal, wash your hand cleanly by water and soap as soon as possible.

# TD022THEC1
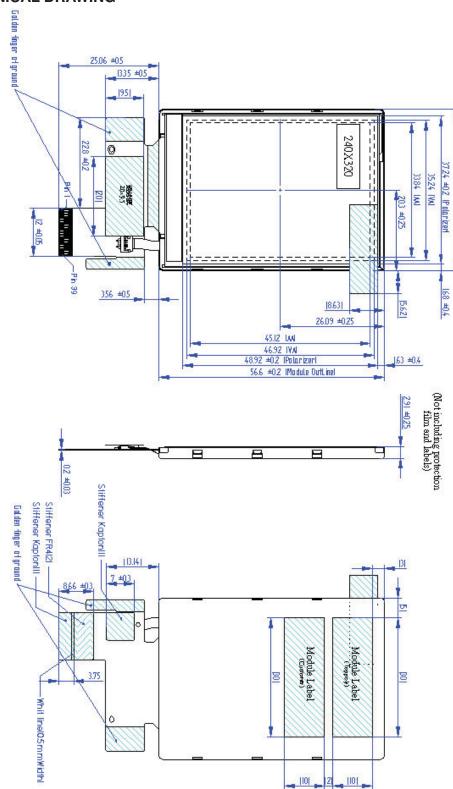
## 10.MECHANICAL DRAWING
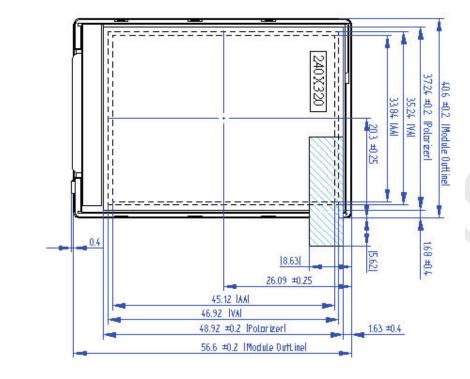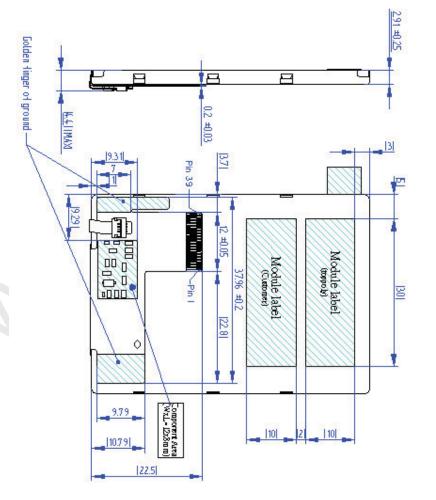
# TD022THEC1

240X320
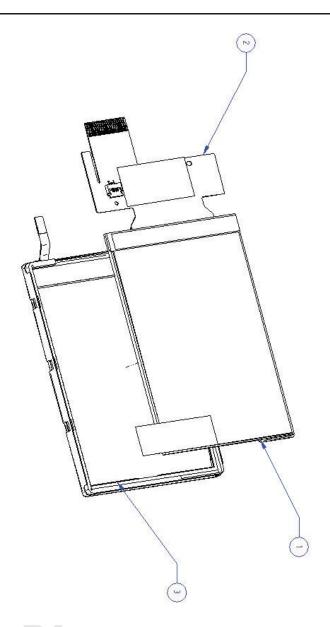
| TD022THEC1 LCM Material List | | | |
|---|---|---|---|
| NO. | Part Name | Quantity | Note |
| 1 | LCD Panel | 1 | |
| 2 | FPC | 1 | |
| 3 | Backlight Unit | 1 | |
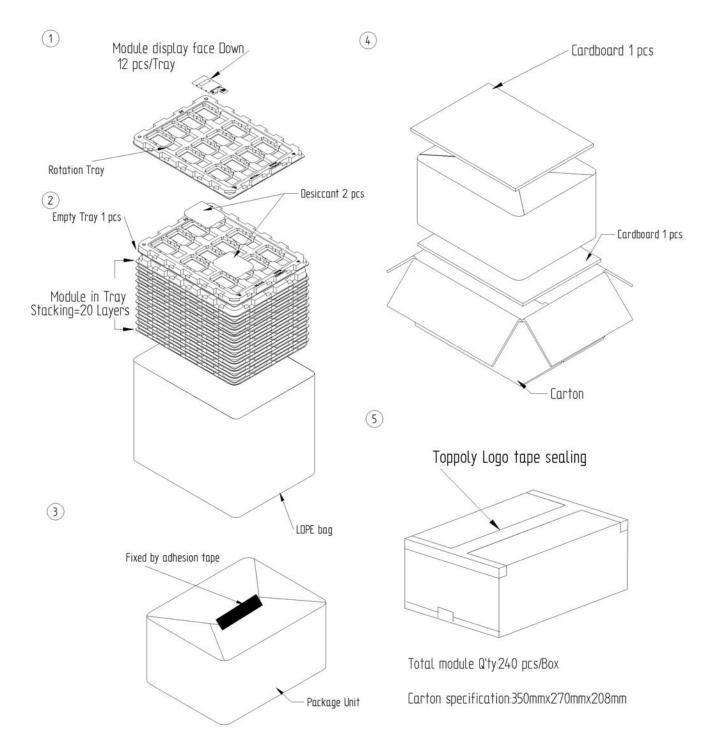
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## 11. PACKING DRAWING



① Module display face Down
12 pcs/Tray

Rotation Tray

② Empty Tray 1 pcs

Desiccant 2 pcs

Module in Tray
Stacking=20 Layers

③ 

LDPE bag

Fixed by adhesion tape

Package Unit

④ Cardboard 1 pcs

Cardboard 1 pcs

Carton

⑤ Toppoly Logo tape sealing

Total module Q'ty:240 pcs/Box

Carton specification:350mmx270mmx208mm

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### TD022THEC1 Module delivery packing method

(1). Module packed into tray cavity (with Module display face down), and stacking tray of reverse 180 degree in order.

(2). Stacking the **production on** tray with 20 layers and with 1 empty tray above the stacking tray unit, and put 2 Desiccant on the empty tray.

(3). Stacking tray unit put into the LDPE bag and fix by adhesive tape.

(4). Put 1 pcs cardboard inside the carton bottom, then pack the package unit into the carton, finally put 1 pcs cardboard above the package unit

(5) Sealing the Carton with Toppoly Logo adhesive tape.