

**MODEL NO. : TM028HDHG20-00****ISSUED DATE: 2015-01-15****VERSION : Ver 0.1**

☒ **Preliminary Specification**  
☐ **Final Product Specification**

**Customer : \_\_\_\_\_**

Approved by	Notes

**SHANGHAI TIANMA Confirmed :**

Prepared by	Checked by	Approved by

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This technical specification is subjected to change without notice

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## Record of Revision

[illegible]

## 1 General Specifications

Feature		Spec
<b>Display Spec.</b>	Size	2.8 inch
	Resolution	240(RGB)x320
	Interface	16 bits MCU
	Color Depth	262K
	Technology Type	a-Si
	Pixel pitch(mm)	0.18x0.18
	Pixel Configuration	R.G.B Vertical Stripe
	Display Mode	TN,NW
	Surface Treatment	Clear(3H)
	Viewing Direction	6 o'clock
	Gray Scale Inversion Direction	12 o'clock
<b>Mechanical Characteristics</b>	LCM (W x H x D) (mm)	50x69.20x4.25
	Active Area(mm)	43.2x57.6
	Driver IC	ST7362
	With /Without TSP	Without TSP
	Weight (g)	TBD
	LED Numbers	4 LEDs

Note 1: Viewing direction for best image quality is different from TFT definition. There is a 180 degree shift.

Note 2: Requirements on Environmental Protection: Q/S0002

Note 3: LCM weight tolerance:  $\pm 5\%$

## 2 Input/Output Terminals

### 2.1 TFT LCD Panel

No	Symbol	I/O	Description	Comment
1	LED1-4	P	Back light cathode	
2	LEDA	P	Back light anode	
3	GND	P	Ground	
4	RESET	P	Reset pin	
5	DB17	I	Data input	
6	DB16	I	Data input	
7	DB15	I	Data input	
8	DB14	I	Data input	
9	DB13	I	Data input	
10	DB12	I	Data input	
11	DB11	I	Data input	
12	DB10	I	Data input	
13	DB8	I	Data input	
14	DB7	I	Data input	
15	DB6	I	Data input	
16	DB5	I	Data input	
17	DB4	I	Data input	
18	DB3	I	Data input	
19	DB2	I	Data input	
20	DB1	I	Data input	
21	/RD	O	Read execution control pin	
22	WR/SCL	I	Write execution control pin	
23	RS	I	Register select signal	
24	CS	I	Chip Select Signal	
25	XR/X+	I	Resistor touch panel pin	
26	YD/Y-	I	Resistor touch panel pin	
27	XL/X-	I	Resistor touch panel pin	
28	YU/Y+	I	Resistor touch panel pin	
29	GND	P	Ground	
30	3.3/VCC	I	Power supply	

Note 1: I——Input, O——Output, P——Power/Ground,VCC=VDD

**Table 2.1 Terminal pin assignments**

### **3 Absolute Maximum Ratings**

#### **3.1 Driving TFT LCD Panel**

Ta =25℃

Item	Symbol	MIN	MAX	Unit	Remark
Supply Voltage	VCC	-0.3	4.6	V	
Back Light Forward Current	ILED		25	mA	For each LED
Operating Temperature	TOPR	-20	70	℃	
Storage Temperature	TSTG	-30	80	℃	

**Table 3.1 absolute maximum rating**

## 4 Electrical Characteristics

### 4.1 Driving TFT LCD Panel

GND=0V, Ta=25°C

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Supply Voltage	VCC	2.4	3.3	3.6	V	
IO Supply Voltage	VDDI	1.65	-	VCC	V	
Input Signal Voltage	Low Level	VIL	DGND	—	0.3* VDDI	V
	High Level	VIH	0.7* VDDI	—	VDDI	V
Output Signal Voltage	Low Level (VOL)	IOL=+1.0mA	DGND	—	0.2VDDI	V
	High Level (VOH)	IOH=-1.0mA	0.8VDDI	—	VDDI	V
(Panel+LSI) Power Consumption	Black Mode (60Hz)		TBD		mW	
	Standby Mode		TBD		mW	

**Table 4.1 LCD module electrical characteristics**

### 4.2 Backlight Unit

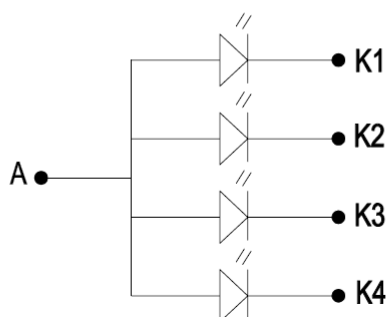
Ta=25°C

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Forward Current	IF	—	20	25	mA	For each LED
Forward Current Voltage	VF	—	3.2	—	V	For each LED
Backlight Power Consumption	WBL	—	256	—	mW	For total LEDs

**Table 4.2 Backlight Unit electrical characteristics**

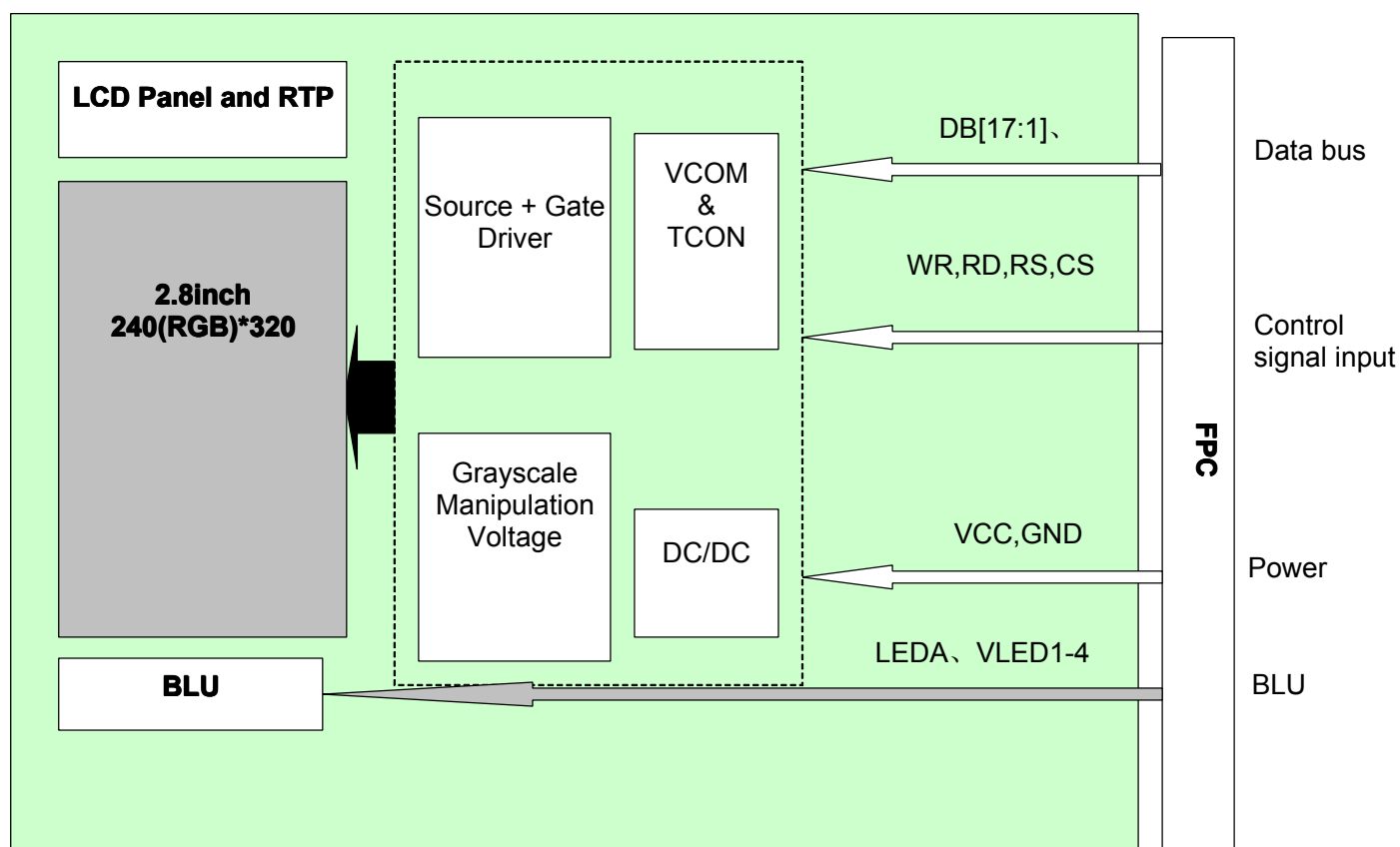
CONSTANT CURRENT:  $I=4*20=80\text{mA}$   $V_f=3.2\text{V(TYP.)}$

#### CIRCUIT DIAGRAM



### 4.3 Block Diagram

#### LCD module diagram



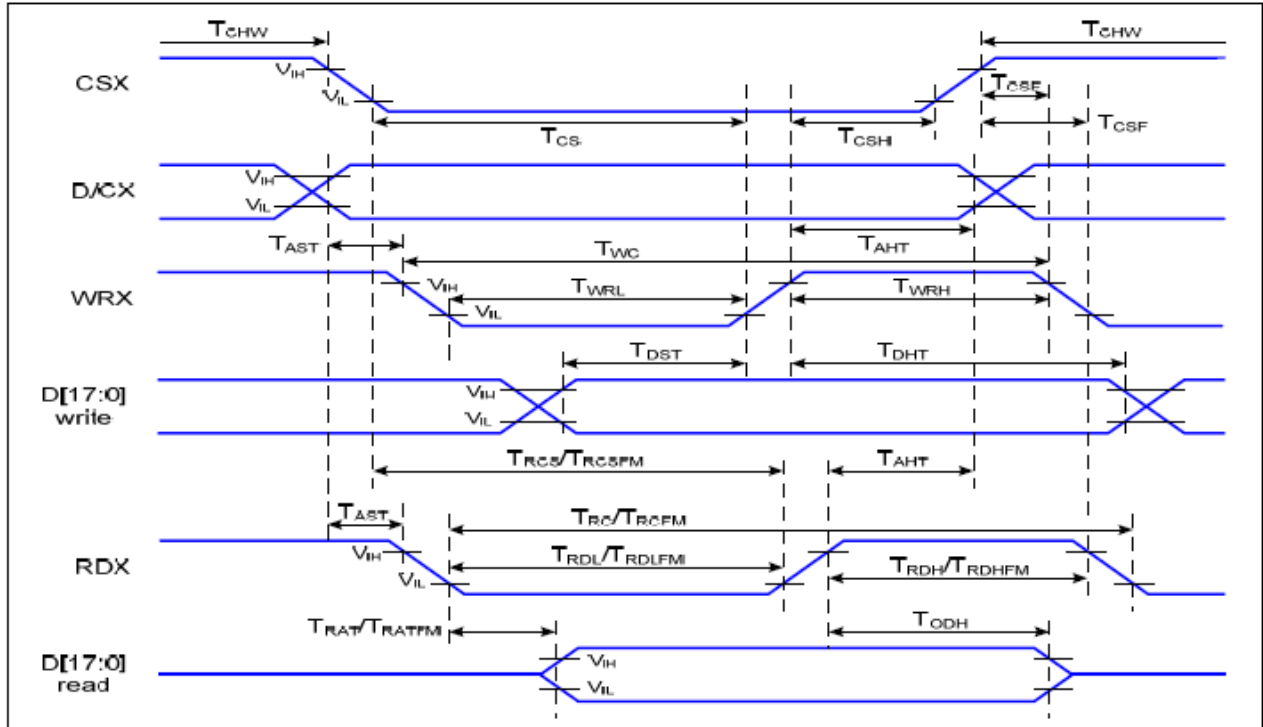


## 5 Timing Chart

### 5.1 INTERFACE TIMING

Note: Please refer to ST7362 data sheet for more details. ST7362 INTERFACE PROTOCOL  
16BIT-Parallel MCU interface, VDD=VCC.

#### 5.1.1 8080 Series MCU Parallel Interface Characteristics: 18/16/9/8-bit Bus



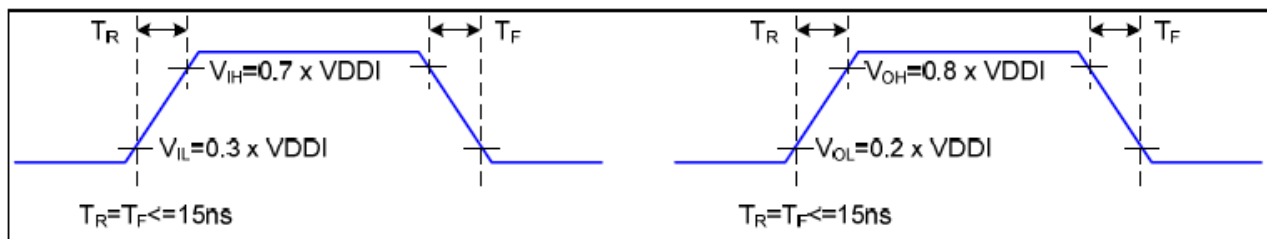
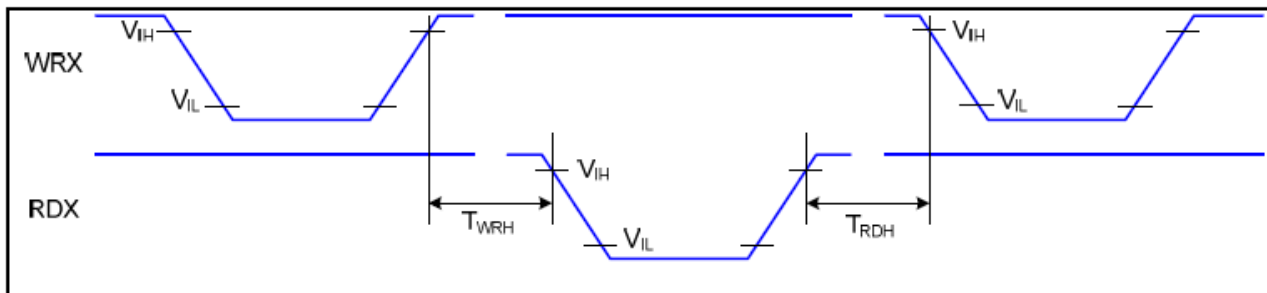
**Figure 1 Parallel Interface Timing Characteristics (8080-Series MCU Interface)**

VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta= -30 to 70 °C

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

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

**Table 4 8080 Parallel Interface Characteristics**

**Figure 2 Rising and Falling Timing for I/O Signal**

**Figure 3 Write-to-Read and Read-to-Write Timing**

*Note: The rising time and falling time ( $T_r$ ,  $T_f$ ) of input signal and fall time are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.*

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## 5.2 INITIAL CODE(TBD)

## 6 Optical Characteristics

Ta=25°C

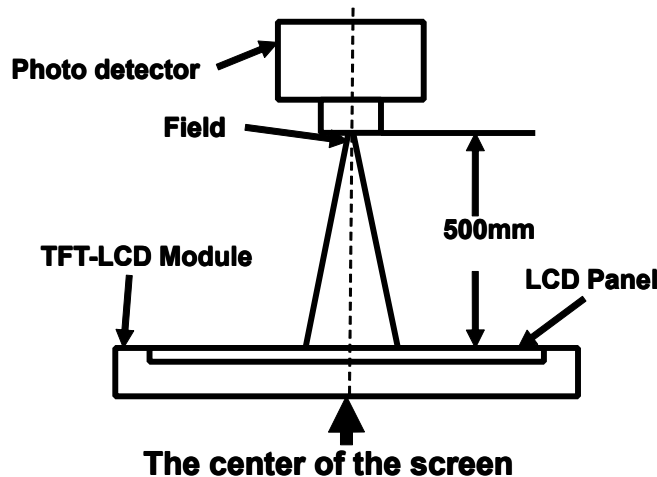
Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
View Angles		θT	CR≥10	60	70	-	Degree	Note2,3
		θB		50	60	-		
		θL		65	75	-		
		θR		65	75	-		
Contrast Ratio		CR	θ=0°	400	500	-		Note 3
Response Time		T <sub>ON</sub>	25℃	-	20	30	ms	Note 4
		T <sub>OFF</sub>						
Chromaticity	White	x	Backlight is on	0.225	0.275	0.325		Note 1,5
		y		0.236	0.286	0.336		
	Red	x		0.574	0.624	0.674		Note 1,5
		y		0.283	0.333	0.383		
	Green	x		0.284	0.334	0.384		Note 1,5
		y		0.549	0.599	0.649		
	Blue	x		0.097	0.147	0.197		Note 1,5
		y		0.018	0.068	0.118		
Uniformity		U		-	80	-	%	Note 6
NTSC				60	65	-	%	Note 5
Luminance(without lens)		L		220	290	-	cd/m <sup>2</sup>	Note 7

Test Conditions:

1.  $I_F = 22$  mA, and the ambient temperature is 25°C.
2. The test systems refer to Note 1 and Note 2.

Note 1: Definition of optical measurement system.

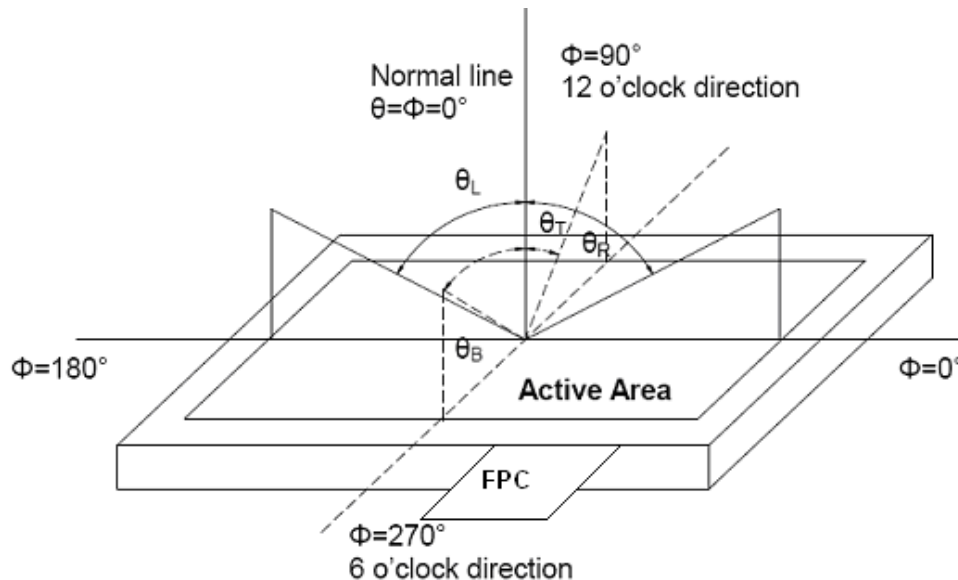
The optical characteristics should be measured in dark room. After 5 Minutes operation, the optical properties are measured at the center point of the LCD screen. All input terminals LCD panel must be ground when measuring the center area of the panel.



Item	Photo detector	Field
Contrast Ratio	SR-3A	1°
Luminance		
Chromaticity		
Lum Uniformity		
Response Time	BM-7A	2°

Note 2: Definition of viewing angle range and measurement system.

viewing angle is measured at the center point of the LCD by CONOSCOPE(ergo-80).



Note 3: Definition of contrast ratio

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

"White state ": The state is that the LCD should drive by V<sub>white</sub>.

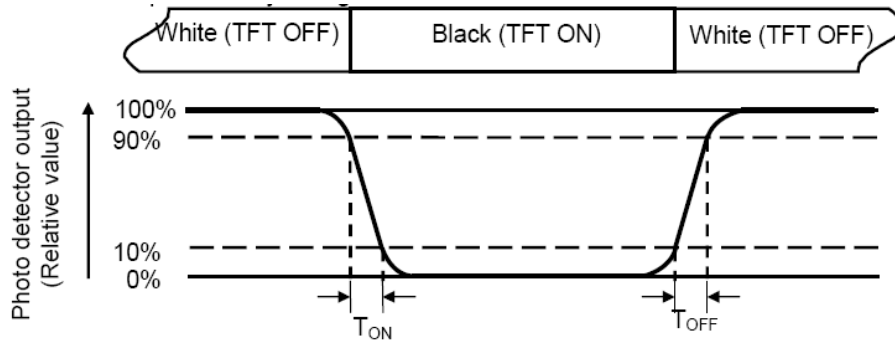
"Black state": The state is that the LCD should drive by V<sub>black</sub>.

V<sub>white</sub>: TBD V    V<sub>black</sub>: TBD V.

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**Note 4: Definition of Response time**

The response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time ( $T_{ON}$ ) is the time between photo detector output intensity changed from 90% to 10%. And fall time ( $T_{OFF}$ ) is the time between photo detector output intensity changed from 10% to 90%.


**Note 5: Definition of color chromaticity (CIE1931)**

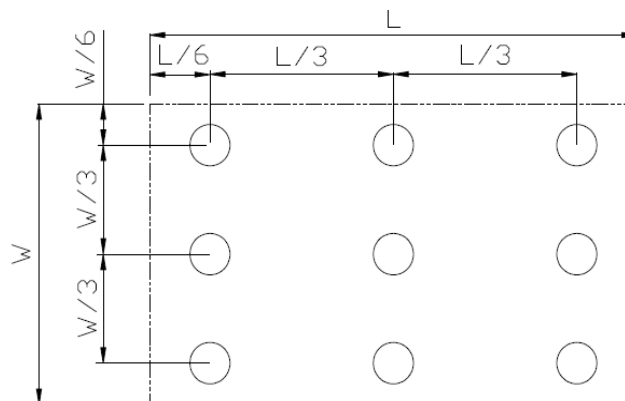
Color coordinates measured at center point of LCD.

**Note 6: Definition of Luminance Uniformity**

Active area is divided into 9 measuring areas (Refer Fig. 2). Every measuring point is placed at the center of each measuring area.

$$\text{Luminance Uniformity (U)} = L_{\min} / L_{\max}$$

L-----Active area length W----- Active area width



$L_{\max}$ : The measured Maximum luminance of all measurement position.

$L_{\min}$ : The measured Minimum luminance of all measurement position.

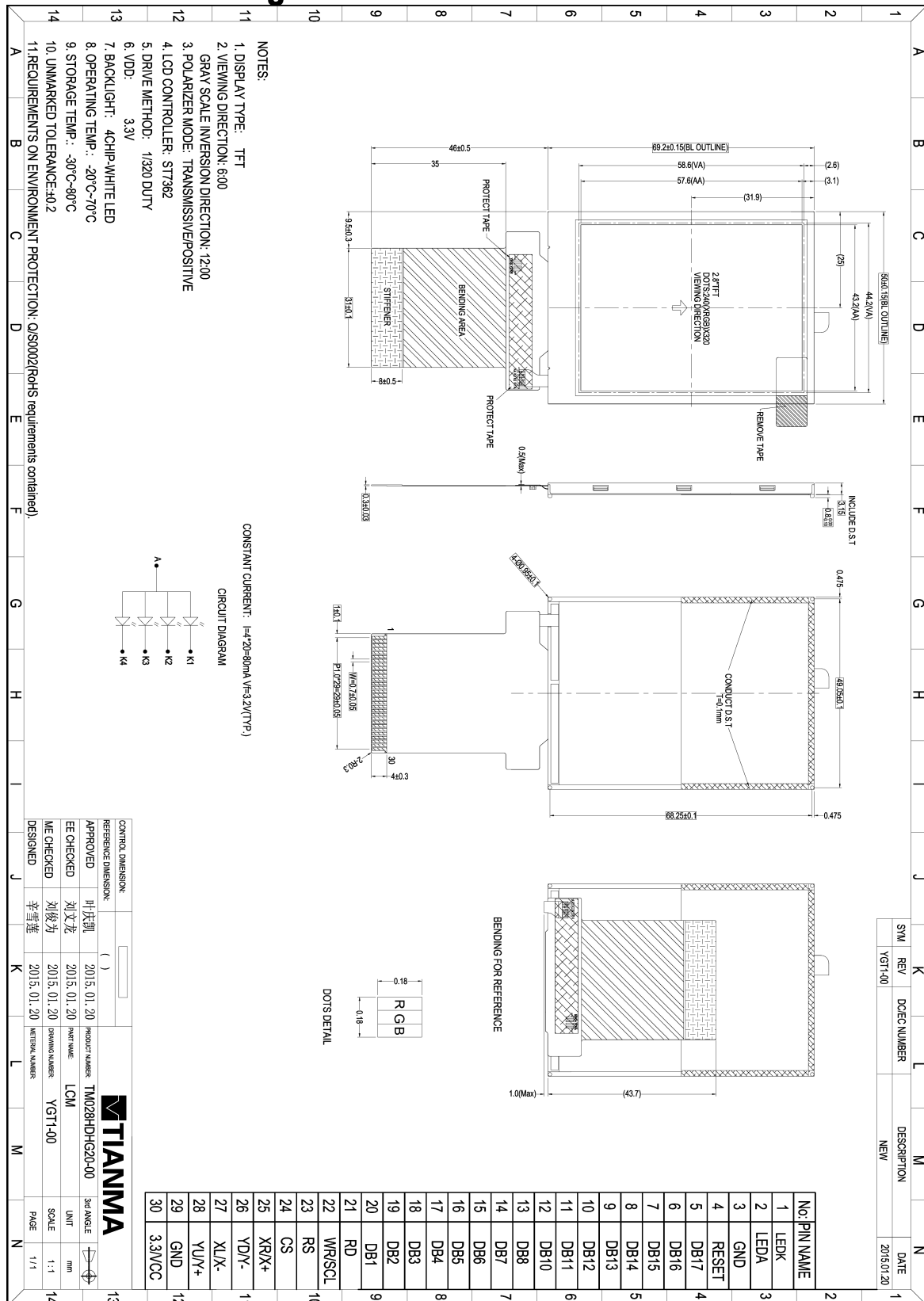
**Note 7: Definition of Luminance:**

Measure the luminance of white state at center point.

## 7 Environmental / Reliability Tests

No	Test Item	Condition	Remarks
1	High Temperature Operation	Ta=+70℃, 240hrs	Note1 IEC60068-2-1,GB2423.2
2	Low Temperature Operation	Ta=-20℃, 240hrs	IEC60068-2-1 GB2423.1
3	High Temperature Storage	Ta=+80℃, 240hrs	IEC60068-2-1 GB2423.2
4	Low Temperature Storage	Ta=-30℃, 240hrs	IEC60068-2-1 GB2423.1
5	High Temperature & High Humidity Storage	Ta=+60℃, 90% RH 240 hours	Note2 IEC60068-2-78 GB/T2423.3
6	Thermal Shock (Non-operation)	-30℃ 30 min~+80℃ 30 min, Change time:5min, 100 Cycles	Start with cold temperature, End with high temperature, IEC60068-2-14,GB2423.22
7	Electro Static Discharge (Operation)	C=150pF, R=330Ω, 5points/panel Air:±8KV, 5times; Contact:±4KV, 5 times; ( Environment: 15℃~35℃, 30%~60%, 86Kpa~106Kpa )	IEC61000-4-2 GB/T17626.2
8	Package Vibration Test	Frequency range:10~55Hz, Stroke:1.5mm Sweep:10Hz~55Hz~10Hz 2 hours for each direction of X.Y.Z. (6 hours for total)(Package condition)	IEC60068-2-6 GB/T2423.10
9	Shock (Non-operation)	60G 6ms, ±X,±Y,±Z 3times, for each direction	IEC60068-2-27 GB/T2423.5
10	Package Drop Test	Height:60 cm, 1 corner, 3 edges, 6 surfaces	IEC60068-2-32 GB/T2423.8

# 8 Mechanical Drawing

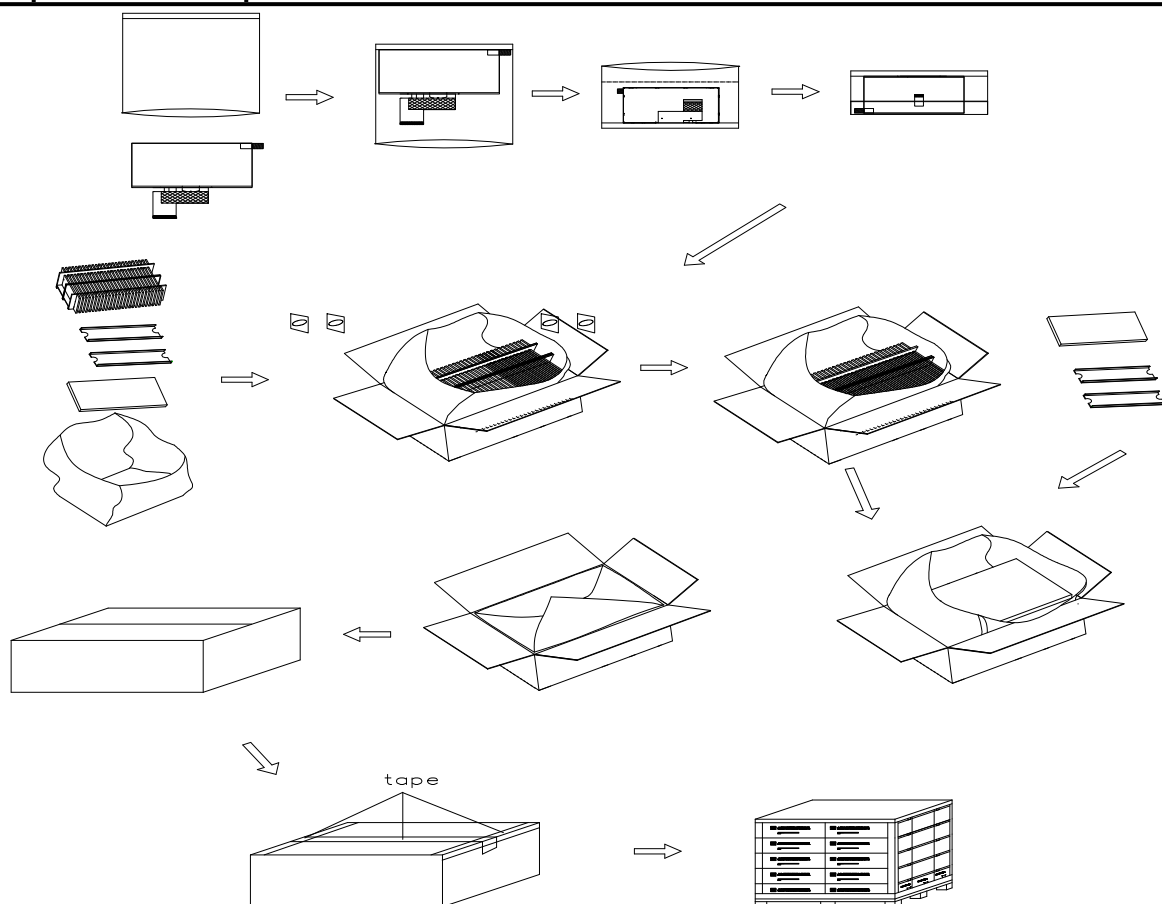


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## 9 Packing Drawing

No	Item	Model (Material)	Dimensions(mm)	Unit Weight(Kg)	Quantity	Remark
1	LCM module	TM028HDHG20-00	50×69.2×4.25	TBD	252	
2	Tray	PET	485X330X13.8	TBD	21	
3	EPE	EPE	485×330×5	0.0183	3	
4	Dust-Proof Bag	PE	700×545	0.021	1	
5	BOX	CORRUGATED PAPER	520×345×74	0.3879	3	
6	Desiccant	Desiccant	45×35	0.002	6	
7	Carton	CORRUGATED PAPER	544×365×250	1.01	1	
8	Total weight	TBD±5% Kg				



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## **10 Precautions for Use of LCD Modules**

### **10.1 Handling Precautions**

10.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

10.1.2 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.

10.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

10.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

10.1.5 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:

- Isopropyl alcohol
- Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

- Ketone
- Aromatic solvents

10.1.6 Do not attempt to disassemble the LCD Module.

10.1.7 If the logic circuit power is off, do not apply the input signals.

10.1.8 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

10.1.8.1 Be sure to ground the body when handling the LCD Modules.

10.1.8.2 Tools required for assembly, such as soldering irons, must be properly ground.

10.1.8.3 To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

10.1.8.4 The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

### **10.2 Storage precautions**

10.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

10.2.2 The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

Temperature : 0℃ ~ 40℃ Relatively humidity: ≤80%

10.2.3 The LCD modules should be stored in the room without acid, alkali and harmful gas.

### **10.3 Transportation Precautions**

10.3.1 The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.