

**MODEL NO:** SEL028HDHG06-00

**ISSUED DATE:** 2013/09/13

**VERSION :** V1.0

- Preliminary Specification
- Final Product Specification

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

Approved by	Notes

Prepared by	Checked by	Approved by

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## 1 General Specifications

	Feature	Spec
<b>Display Spec.</b>	Size	2.8 inch
	Resolution	240(RGB) *320
	Technology Type	a-Si TM
	Pixel Configuration	RGB Vertical Stripe
	Pixel pitch(mm)	0.180x0.180
	Display Mode	Normal White ,TN
	Surface Treatment	HC
	Viewing Direction	12 o'clock
	Gray Scale Inversion Direction	6 o'clock
<b>Mechanical Characteristics</b>	LCM (W x H x D) (mm)	50.0±0.2*69.2±0.2*2.95±0.2
	Active Area(mm)	43.2*57.6
	With /Without TSP	Without TSP
	Connection Type	ZIP
	LED Numbers	4 LEDs
	Weight (g)	TBD
<b>Electrical Characteristics</b>	Interface	18 bit CPU
	Color Depth	262K
	Driver IC	ST7789S

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: ± 5%

## 2 Input/Output Terminals

No.	Symbol	I/O	Description
1	nRESET	I	Reset signal; Must be reset after power is supplied;
2	GND	P	Ground
3	GND	P	Ground
4	GND	P	Ground
5	IOVCC	P	power supply
6	IOVCC	P	power supply
7	GND	P	Ground
8	VCI	P	power supply
9	VCI	P	power supply
10	NC	— —	No connection
11	GND	P	Ground
12	GND	P	Ground
13	D15	I	Data input, Fix to the GND level if unused;
14	D14	I	Data input, Fix to the GND level if unused;
15	D13	I	Data input, Fix to the GND level if unused;
16	D12	I	Data input, Fix to the GND level if unused;
17	D11	I	Data input, Fix to the GND level if unused;
18	D10	I	Data input, Fix to the GND level if unused;
19	D9	I	Data input, Fix to the GND level if unused;
20	D8	I	Data input, Fix to the GND level if unused;
21	D7	I	Data input, Fix to the GND level if unused;
22	D6	I	Data input, Fix to the GND level if unused;
23	D5	I	Data input, Fix to the GND level if unused;
24	D4	I	Data input, Fix to the GND level if unused;
25	D3	I	Data input, Fix to the GND level if unused;
26	D2	I	Data input, Fix to the GND level if unused;
27	D1	I	Data input, Fix to the GND level if unused;
28	D0	I	Data input, Fix to the GND level if unused;
29	GND	P	Ground
30	nCS	I	Chip select signal. Low: the ILI9335 is selected and accessible; High: the ILI9335 is not selected and not accessible; Fix to the GND level when not in use;
31	DNC_SCL	I	Register select signal. Low: select an index or status register; High: select a control register; Fix to either IOVCC or GND level when not in use;
32	GND	P	Ground

33	LED+	P	Back light anode
34	LED+	P	Back light anode
35	LED-	P	Back light cathode
36	LED-	P	Back light cathode
37	nWR_RNW	I	Write signal; Fix to IOVCC or GND level when not in use;
38	NRD_E	I	Read signal; Fix to IOVCC or GND level when not in use;
39	GND	P	Ground
40	GND	P	Ground

I/O definition: I --- Input ; O --- Output ; P --- Power ; N --- No Connection ;

**Table 2.1 Input terminal pin assignment**

### 3 Absolute Maximum Ratings

Item	Symbol	MIN	MAX	Unit	Remark
Power Supply Voltage 1	VCC	-0.30	4.60	V	Base on IC Spec
Power Supply Voltage 2	Vin	-0.50	VCC+0.5	V	Base on IC Spec
Power Supply Voltage 3	VGH-VGL	-0.30	30.00	V	Base on IC Spec
Power Supply Voltage 4	VCOM	TBD	TBD	V	Base on Test
Back Light Forward Current	I <sub>LED</sub>	-	20	mA	For each LED
Operating Temperature	T <sub>OPR</sub>	-20	60	°C	Base on RA
Storage Temperature	T <sub>STG</sub>	-30	80	°C	Base on RA

**Table 3.1 absolute maximum rating**

## 4 Electrical Characteristics

### 4.1 LCD Module

(GND=AGND= 0V, TA= 25°C)

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Logic Supply Voltage 1	VCC	2.4	3.0	3.3	V	
Logic Supply Voltage 2	VCOM	-2.0	-	0	V	
Input Signal Voltage	Low Level	VIL	0	-	0.3*VCC	V
	High Level	VIH	0.7*VCC	-	VCC	V
Output Signal Voltage	Low Level	VO <sub>L</sub>	-	-	0.2*VCC	V
	High Level	VO <sub>H</sub>	0.8*VCC	-	-	V
Power Consumption	Black Mode (60Hz)	-	TBD	-	mW	
	Back Light	-	TBD	-	mW	

**Table 4.1 LCD Module Electrical Characteristics(TTL Mode)**

### 4.2 Backlight Unit

Ta=25°C

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Forward Current	I <sub>F</sub>	--	20	25	mA	4 LEDs
Forward Voltage	V <sub>F</sub>	--		--	V	
Backlight Power Consumption	W <sub>BL</sub>	--			mW	

**Table 4.2 Backlight Unit Electrical Characteristics**

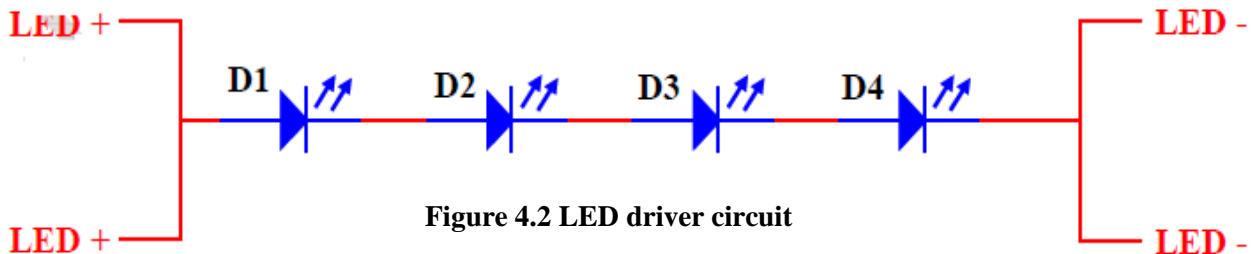
Note1: The LED driving condition is defined for each LED module (6 LED Serial6) .

For each LED : I<sub>F</sub> =20mA, V<sub>F</sub> =3.2V.

current should be inputted. And forward voltage is for reference only.

Note 2 : Under LCM operating, the stable forward

Note 3 : The LED driving condition is defined for each LED module

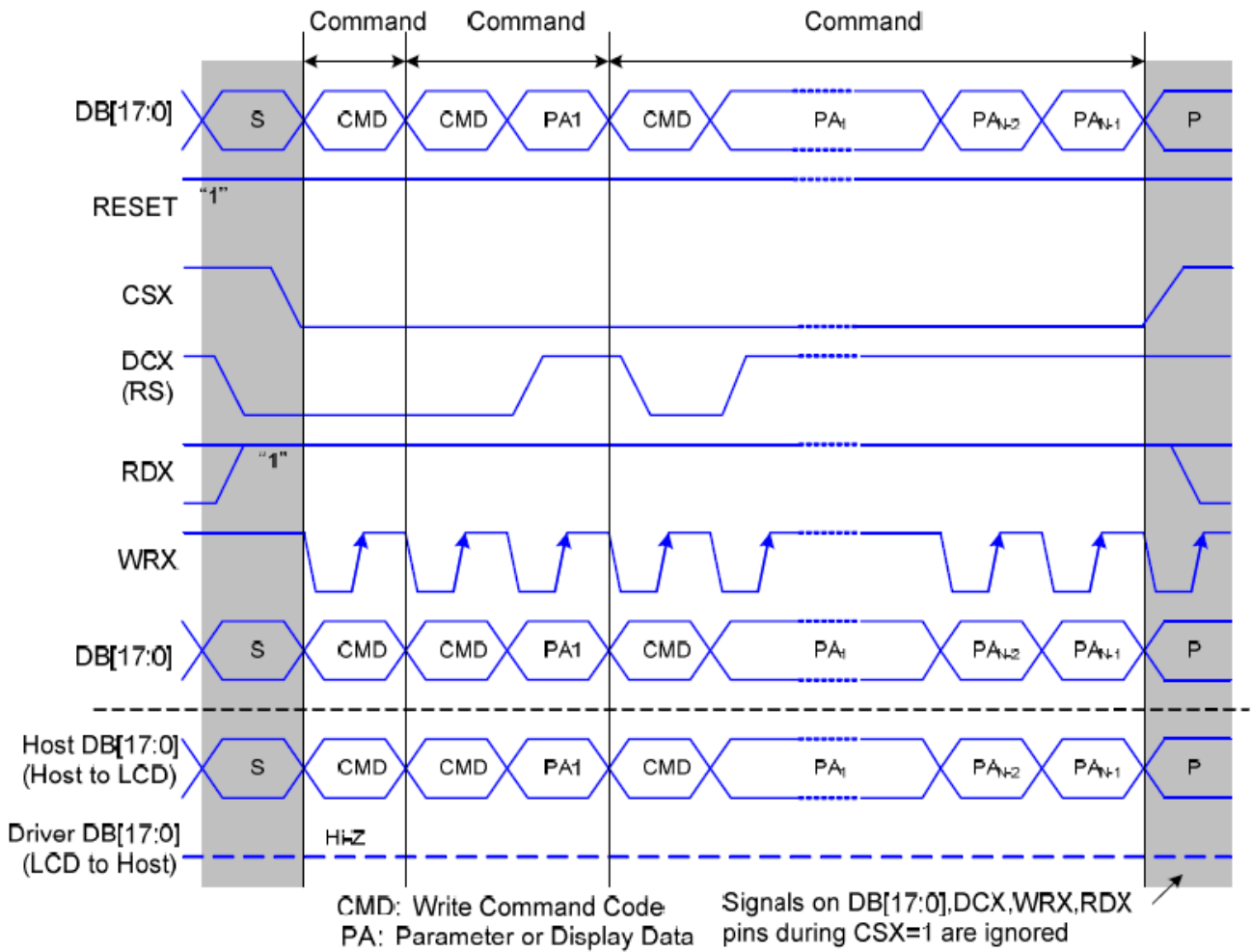


**Figure 4.2 LED driver circuit**

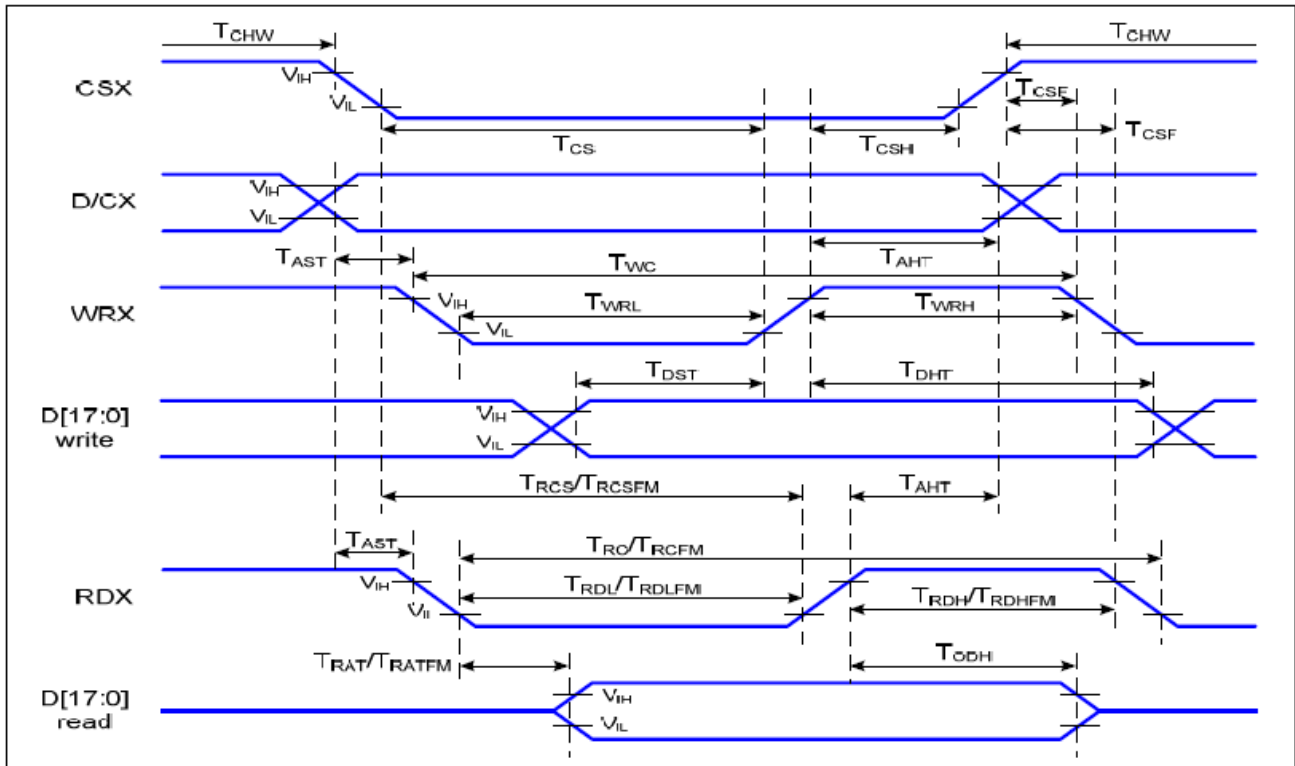


## 5 Timing Chart

### 5.1 Input Clock And Data Timing



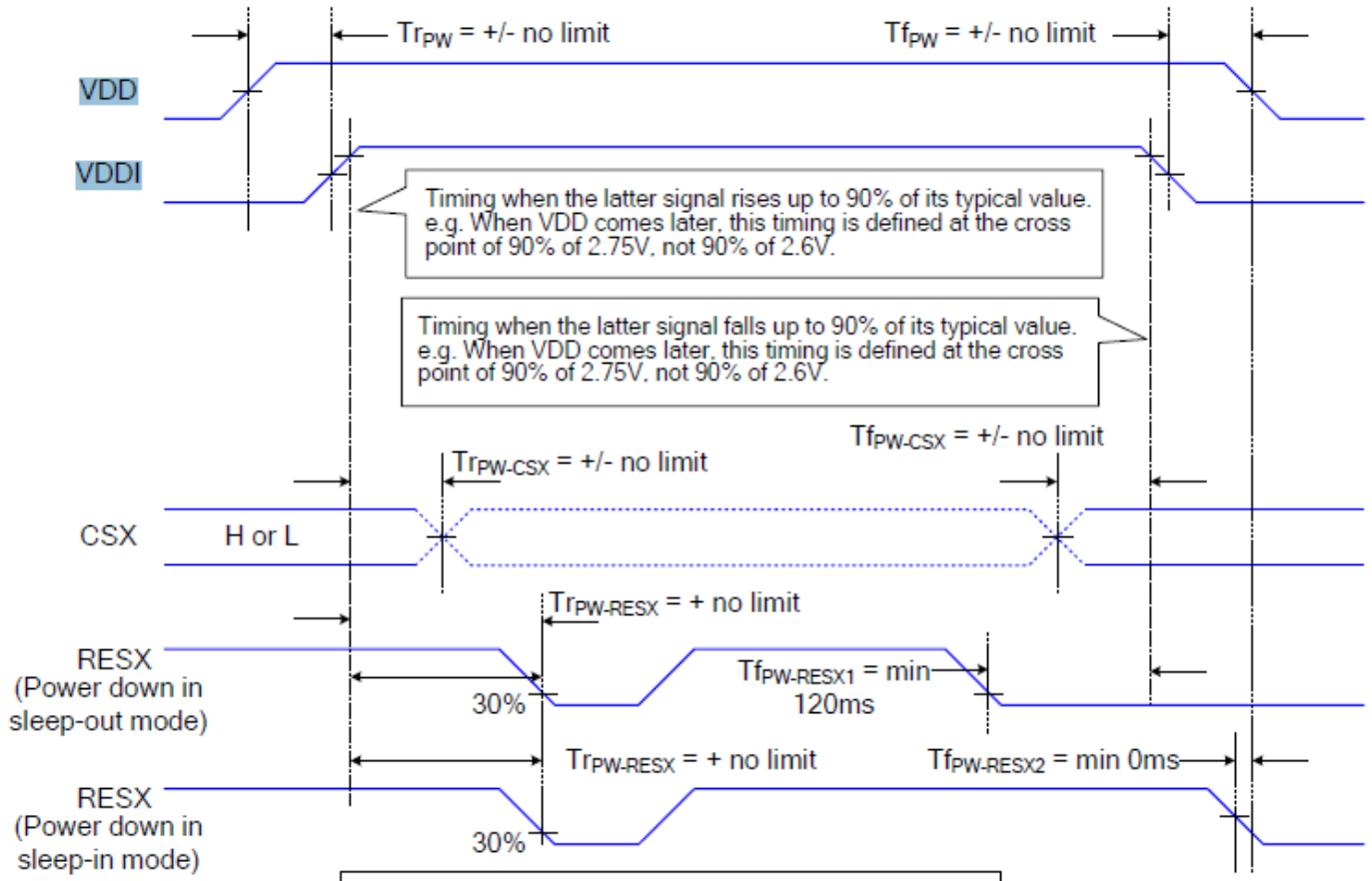
## 5.2 Interface Timing Characteristics



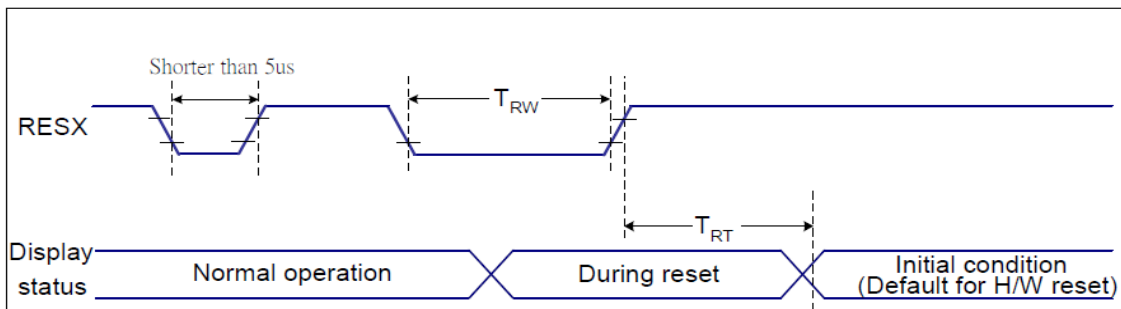
Signal	Symbol	Parameter	Min	Max	Unit	Description
D/CX	$T_{AST}$	Address setup time	0		ns	-
	$T_{AHT}$	Address hold time (Write/Read)	10		ns	
CSX	$T_{CHW}$	Chip select "H" pulse width	0		ns	-
	$T_{CS}$	Chip select setup time (Write)	15		ns	
	$T_{RCS}$	Chip select setup time (Read ID)	45		ns	
	$T_{RCSFM}$	Chip select setup time (Read FM)	355		ns	
	$T_{CSF}$	Chip select wait time (Write/Read)	10		ns	
	$T_{CSH}$	Chip select hold time	10		ns	
WRX	$T_{WC}$	Write cycle	66		ns	-
	$T_{WRH}$	Control pulse "H" duration	15		ns	
	$T_{WRL}$	Control pulse "L" duration	15		ns	
RDX (ID)	$T_{RC}$	Read cycle (ID)	160		ns	When read ID data
	$T_{RDH}$	Control pulse "H" duration (ID)	90		ns	
	$T_{RDL}$	Control pulse "L" duration (ID)	45		ns	
RDX (FM)	$T_{RCFM}$	Read cycle (FM)	450		ns	When read from frame memory
	$T_{RDHFM}$	Control pulse "H" duration (FM)	90		ns	
	$T_{RDLFM}$	Control pulse "L" duration (FM)	355		ns	
D[17:0]	$T_{DST}$	Data setup time	10		ns	For CL=30pF

## 5.3 POWER ON/OFF SEQUENCE

### 5.3.1 Power On/Off



### 5.3.2 Reset Timing



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

Related Pins	Symbol	Parameter	MIN	MAX	Unit
RESX	TRW	Reset pulse duration	10	-	us
	TRT	Reset cancel	-	5 (Note 1, 5)	ms
-			120 (Note 1, 6, 7)	ms	

## 6 Optical Characteristics

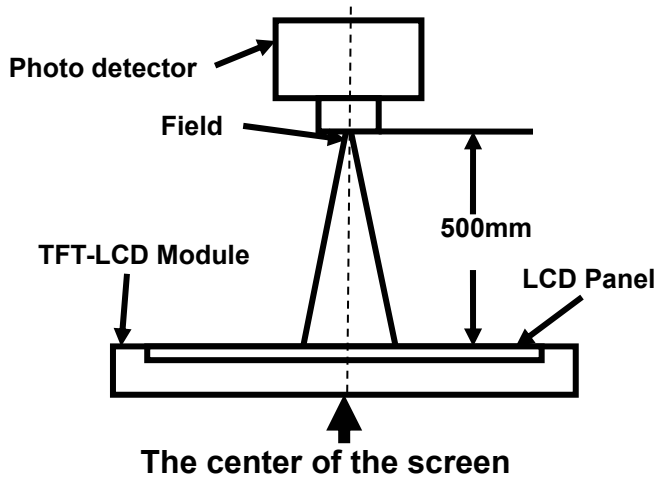
Item	Symbol	Condition	Min	Typ	Max	Unit	Remark	
<b>View Angles</b>	$\theta T$	$CR \geq 10$	50	60	-	Degree	Note2,3	
	$\theta B$		60	70	-			
	$\theta L$		60	70	-			
	$\theta R$		60	70	-			
<b>Contrast Ratio</b>	CR	$\theta=0^\circ$	300	350	-	-	Note 3	
<b>Response Time</b>	$T_{ON}$	25°C	-	20	30	ms	Note 4	
	$T_{OFF}$							
<b>Chromaticity</b>	<b>White</b>	Backlight is on	x	0.246	0.296	0.346	-	Note 1,5
			y	0.275	0.325	0.375		
	<b>Red</b>		x	0.578	0.628	0.678	-	Note 1,5
			y	0.285	0.335	0.385		
	<b>Green</b>		x	0.288	0.338	0.388	-	Note 1,5
			y	0.561	0.611	0.661		
	<b>Blue</b>		x	0.100	0.150	0.200	-	Note 1,5
			y	0.028	0.078	0.128		
<b>Uniformity</b>	U	-	75	80	-	%	Note 6	
<b>NTSC</b>	-	-	-	65	-	%	Note 5	
<b>Luminance</b>	L	-	250	300	-	cd/m		

Test Conditions:

1.  $I_F = 20$  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.

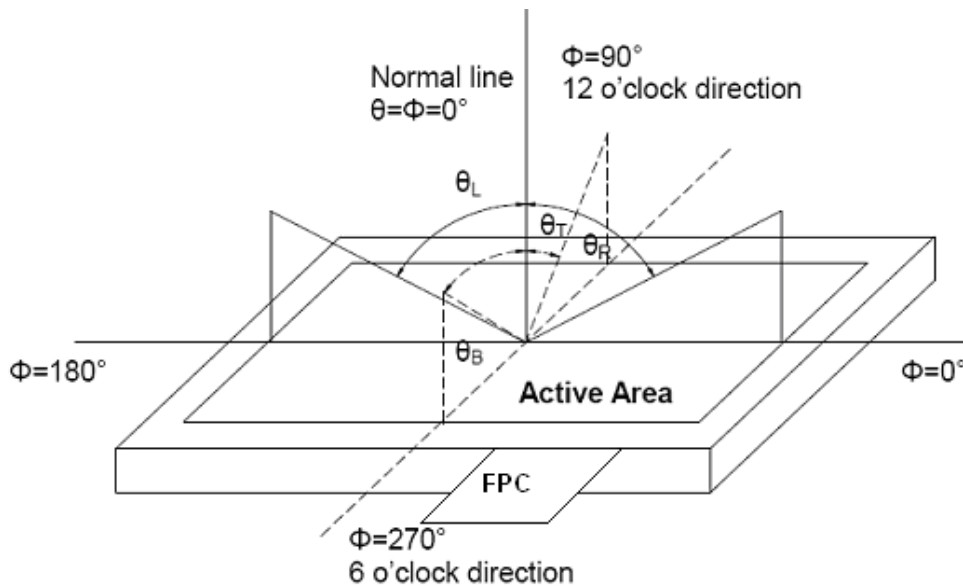
The optical characteristics should be measured in dark room. After 5 Minutes operation, the optical properties are measured at the center point of the LCD screen. All input terminals LCD panel must be ground when measuring the center area of the panel.



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

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

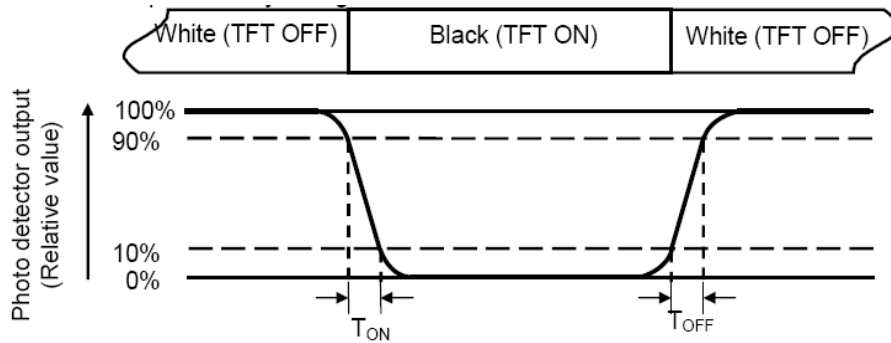
“White state “: The state is that the LCD should drive by Vwhite.

“Black state“: The state is that the LCD should drive by Vblack.

V<sub>white</sub>: To be determined    V<sub>black</sub>: To be determined.

**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<sub>ON</sub>) is the time between photo detector output intensity changed from 90% to 10%. And fall time (T<sub>OFF</sub>) is the time between photo detector output intensity changed from 10% to 90%.



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

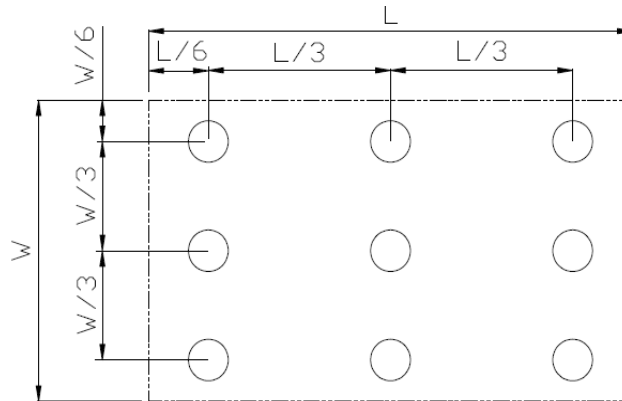
Color coordinates measured at center point of LCD.

**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.

$$\text{Luminance Uniformity (U)} = \text{Lmin} / \text{Lmax}$$

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



L<sub>max</sub>: The measured Maximum luminance of all measurement position.

L<sub>min</sub>: 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 Test

No	Test Item	Condition	Remarks
1	High Temperature Operation	Ts=+60°C,240hrs	IEC60068-2-1:2007 GB2423.2-2008
2	Low Temperature Operation	Ta=-20°C,240hrs	IEC60068-2-1:2007 GB2423.1-2008
3	High Temperature Storage	Ta=+80°C, 240hrs	IEC60068-2-1:2007 GB2423.2-2008
4	Low Temperature Storage	Ta=-30°C,240hrs	IEC60068-2-1:2007 GB2423.1-2008
5	Storage at High Temperature and Humidity	Ta=+60°C, 90%RH 240 hours	IEC60068-2-78 :2001 GB/T2423.3—2006
6	Thermal Shock (non-operation)	-30°C 30min~+70°C 30min, Change time:5min, 20Cycles	Start with cold temperature, End with high temperature, IEC60068-2-14:1984,G B2423.22-2002
7	ESD	C=150pF, R=330Ω, 5point/panel Air: ±8KV, 5times; Contact: ±4KV, 5 times; (Environment: 15°C~35°C,30%~60%,86Kpa~106Kpa)	IEC61000-4-2:2001 GB/T17626.2-2006
8	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)	IEC60068-2-6:1982 GB/T2423.10—1995
9	Mechanical Shock (Non OP)	60G 6ms, ±X, ±Y, ±Z 3times, for each direction	IEC60068-2-27:1987 GB/T2423.5—1995
10	Package Drop Test	Height: 80 cm, 1 corner, 3edges, 6 surfaces	IEC60068-2-32:1990 GB/T2423.8—1995
11	Package Vibration Test	Random Vibration: 0.015GxG/Hz for 5-200Hz, -6dB/Octave from 200-500Hz 2 hours for each direction of X, Y, Z (6 hours for total)	IEC60068-2-34 GB/T2423.11

Note1: Ts is the temperature of panel's surface.

Note2: Ta is the ambient temperature of sample.

Note3: Before cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.

Note 4: 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.



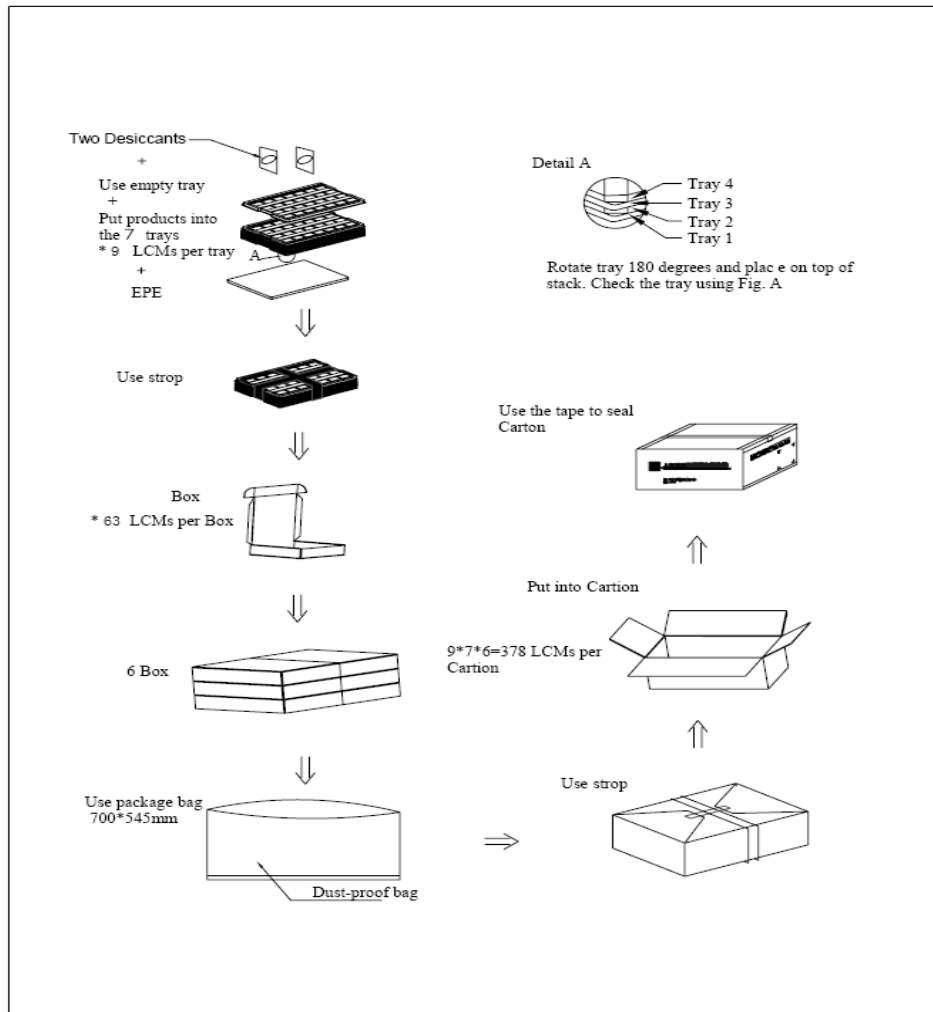


## 9 Packing Drawing

Per Carton

No	Item	Model (Material)	Dimensions(mm)	Unit Weight(Kg)	Quantity	Remark	
1	LCM module	SEL028HDHG06	50×69.2×2.95	TBD	378		
2	Tray	PET (Transmit)	315×247×10.8	TBD	48	Anti-static	
3	EPE	EPE	315×247×5	0.009	6		
4	DUST-PROOF BAG	PE	700×545	0.046	1		
5	BOX	CORRUGATED PAPER	345×260×70	0.227	6		
6	Desiccant	Desiccant	45×50	0.0035	12		
7	Carton	CORRUGATED PAPER	544×365×250	1.01	1		
8	Total weight	TBD Kg					

### Packaging flow



## 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:

- Water
- 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°C ~ 40°C 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.