LIQUID CRYSTAL DISPLAY MODULE

Product Specification

CUSTOMER	**Standard**
CUSTOMER PART NUMBER	
PRODUCT NUMBER	**DET090WVNTCMI-1W**

Product Mgr	Design Eng
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Date: 07-March-13	Date: 07-March-13

☐ **Approval for Specification only**

☐ **Approval for Specification and Sample**

1. Table of Contents

2. Record of Revisions

Rev.	Comments	Page	Date
1	Preliminary Specification was first issued.	All	07/0313

3. Module Numbering System

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
D	E	T	0	9	0	W	V	N	T	C	M	I	-	1	A

1	D	DENSITRON Standard TFT
2	E	
3	T	
4~6	0	TFT Size: **043**=4.3", **057**=5.7", **070**=7", **090**=9", **101**=10.1"
	9	
	0	
7~8	W	TFT Resolution: **QQ**: 480X272 (Quarter VGA), **VG**: 640X480 (VGA) **WV**: 800X480 (WVGA), **WS**: 1024X600 (WSVGA)
	V	
9	N	TFT Brightness: **N**: Normal Brightness, **H**: High Brightness
10	T	TFT Interface System: **T**: TTL, **L**: LVDS
11~13	C	Touch Type: **NT**: Non-Touch, **CS**: Capacitive Single Touch, **CM**: Capacitive Multi Touch, **RS**: Resistive Single Touch, **RM**: Resistive Multi Touch
	M	
	I	Touch Interface: **0:** No interface, **U:** USB I/F, **I:** I2C I/F, **S:** SPI I/F
14	-	
15~16	1	Revision
	A	A: Standard, W: Wide Viewing Angle

4. Application

This specification is applied to the 9 inch WVGA supported TFT-LCD module With projected capacitive touch (PCT) and can display true 262,144 colors (8 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 9” TFT-LCD panel, a driver circuit and LED backlight unit and used as the input devices for general electric appliances via human’s finger.

5. Features

- WVGA (800×480 pixels) resolution.
- Digital 24 bit parallel RGB.
- Dot inversion mode with stripe type.
- Projected Capacitive Touch
  - I^2C Interface
  - Multi Touch (Ten points)

6. General Specifications

Item	Specifications	Unit
Screen Size	9 (Diagonal)	inch
Display Format	800RGB(H)×480(V)	dot
Active Area	198.0(H)×111.696(V)	mm
Dot Pitch	0.0825(H)×0.2327(V)	mm
Pixel Configuration	RGB Vertical Stripe	-
Display Mode	TN Type Transmissive Mode Normally White	-
Surface Treatment	Clear(7H)	-
Viewing Direction	6 O’clock (The Gray Inversion will appear at this direction)	-
Outline Dimension	211.1(W)×126.5(H)×7.45(D)	mm
Weight	343	g
RoHS Compliance	DNSITRON certifies this product to be in compliance with European Union Directive 2002/95/EC 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_{ST}	-30	+80	°C	(1)(2)
Operating Ambient Temperature	T_{OP}	-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=V_{SS}=0V)

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Digital Power Supply Voltage	DV_{DD}	-0.3	5.0	V	-
Analog Power Supply Voltage	AV_{DD}	-0.5	13.5	V	-
Gate High Voltage	V_{GH}	13.0	19.0	V	-
Gate Low Voltage	V_{GL}	-12.0	-2.0	V	-
Gate High To Gate Low Voltage	V_{GH} - V_{GL}	-	31.0	V	-

7.2.2 Backlight Unit

(Ta=25±2°C)

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Current of Backlight Unit	I_B	-	250	mA	(1)
Voltage of Backlight Unit	V_B	-	11.0	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.		
Digital Power Supply Voltage	DV_{DD}	3.0	3.3	3.6	V	-
Analog Power Supply Voltage	AV_{DD}	10.2	10.4	10.6	V	-
Gate High Voltage	V_{GH}	16.3	17.0	17.7	V	-
Gate Low Voltage	V_{GL}	-5.7	-5.0	-4.3	V	-
Input signal voltage	V_{COM}	4.0	4.2	4.4	V	-
Digital Power Supply Current	DI_{DD}	-	5.5	10	mA	(1)
Analog Power Supply Current	AI_{DD}		32	50	mA	(1)
Gate High Current	I_{GH}		0.3	1	mA	(1)
Gate Low Current	I_{GL}		0.3	1	mA	(1)
Input High Threshold Voltage	V_{IH}	0.7 DV_{DD}	-	DV_{DD}	V	-
Input Low Threshold Voltage	V_{IL}	0	-	0.3 DV_{DD}	V	-
VSYNC Frequency	F_V	-	60	-	Hz	-
DCLK Frequency	DCLK	-	33.26	-	MHz	-

Note (1) The specified power consumption is under the conditions at DV_{DD} =3.3V, AV_{DD} =10.4V, V_{GH} =17.0V, V_{GL} =-5V, V_{COM} =4.2V ,F_V=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_B	198	220	242	mA	(1)
Voltage of Backlight Unit	V_B	9.3	9.9	10.5	V	I_B =220mA
Power Consumption	P_{BL}	-	(2.18)	-	W	I_B =220mA
LED Life Time(25℃)	-	20000	-	-	hr	(2)

Note 1: The LED Supply Voltage is defined by the number of LED at Ta=25℃ and IL =220mA.

Note 2: The “LED life time” is defined as the module brightness decrease to 50% original brightness at Ta=25℃ and IL =220mA. The LED lifetime could be decreased if operating IL is lager than 220 mA.

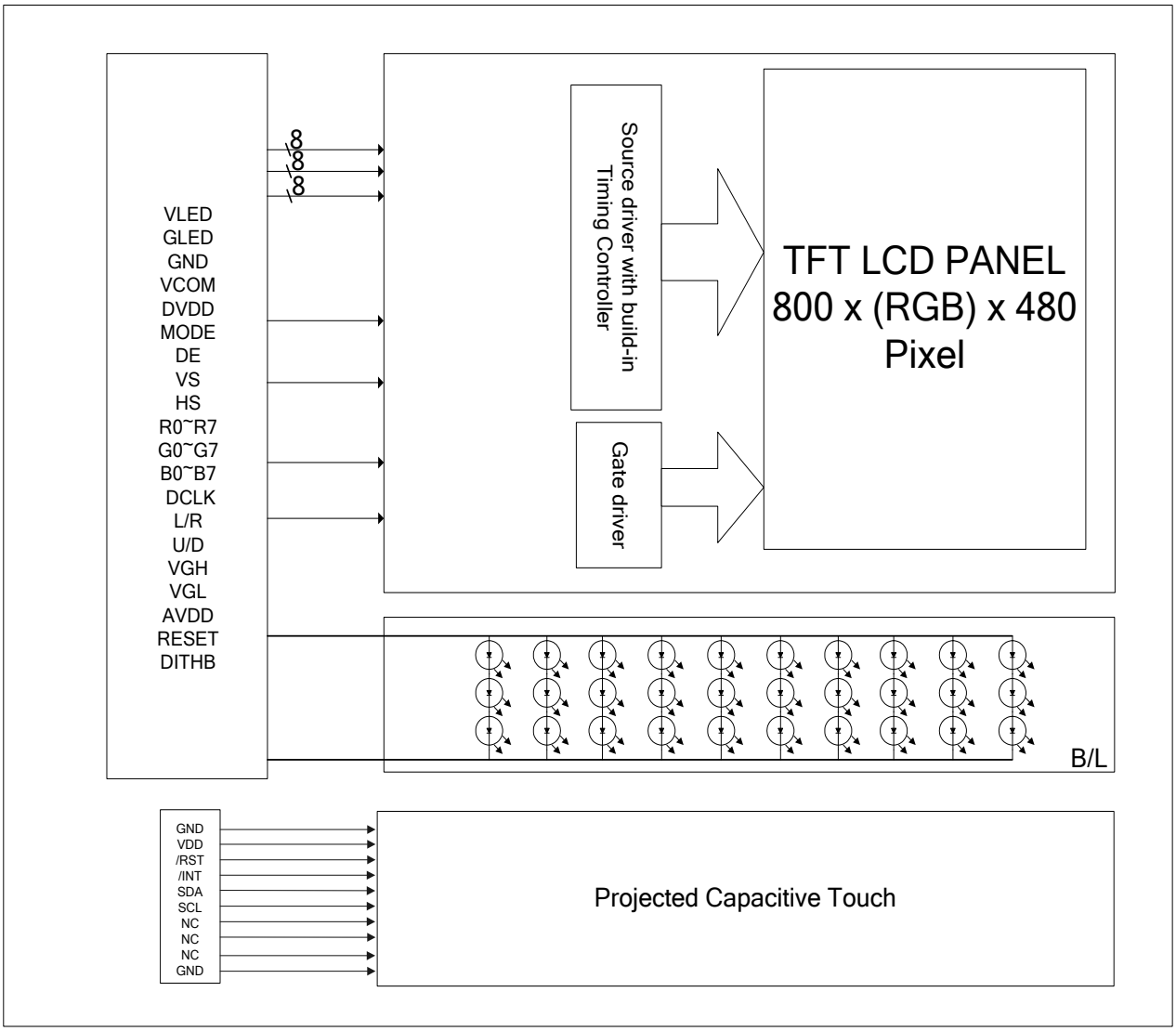
8.3 Projected Capacitive Touch

Item	Value			Unit	Note
	Min.	Typ.	Max.		
Operating Voltage	3.0	3.3	3.6	V	-
Power Supply Current	-	16.6	23.3	mA	(1)
Power Consumption	-	54.78	76.89	mW	@3.3V
Interface	I^2C				-
Function	Multi Touch				-

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

9. Block Diagram

9.1 TFT-LCD Module with Backlight Unit



10. Input / Output Terminals Pin Assignment

10.1 TFT-LCD Module

Connector: Hirose FH12A-50S-0.5SH

Pin No.	Symbol	I/O	Description	Remark
1	VLED	-	Power for LED backlight	
2	VLED	-	Power for LED backlight	
3	GLED	-	Ground for LED backlight	
4	GLED	-	Ground for LED backlight	
5	GND	P	Ground	
6	V_{COM}	I	Common voltage	
7	DV_{DD}	P	Power for Digital Circuit	
8	MODE	I	DE/SYNC mode select	Note 1
9	DE	I	Data Input Enable	
10	VS	I	Vertical Sync Input	
11	HS	I	Horizontal Sync Input	
12	B7	I	Blue data(MSB)	
13	B6	I	Blue data	
14	B5	I	Blue data	
15	B4	I	Blue data	
16	B3	I	Blue data	
17	B4	I	Blue data	
18	B1	I	Blue data	Note 2
19	B0	I	Blue data(LSB)	Note 2
20	G7	I	GREEN data(MSB)	
21	G6	I	GREEN data	
22	G5	I	GREEN data	
23	G4	I	GREEN data	
24	G3	I	GREEN data	
25	G2	I	GREEN data	
26	G1	I	GREEN data Note 2	
27	G0	I	GREEN data(LSB) Note 2	
28	R7	I	RED data(MSB)	
29	R6	I	RED data	
30	R5	I	RED data	

Pin No.	Symbol	I/O	Description	Remark
31	R4	I	RED data	
32	R3	I	RED data	
33	R2	I	RED data	
34	R1	I	RED data	Note 2
35	R0	I	RED data (LSB)	Note 2
36	GND	P	Ground	
37	DCLK	I	Sample clock Note 3	
38	GND	P	Ground	
39	L/R	I	Left / right selection	Note 4,5
40	U/D	I	Up / down selection	Note 4,5
41	V_{GH}	P	Gate ON Voltage	
42	V_{GL}	P	Gate OFF Voltage	
43	AV_{DD}	P	Power for Analog Circuit	
44	RESET	I	Global reset pin.	Note 6
45	NC	-	No connection	
46	V_{COM}	I	Common Voltage	
47	DITHB	I	Dithering function	Note 7
48	GND	P	Ground	
49	NC	-	No connection	
50	NC	-	No connection	

I: input, O: output, P: Power

Note 1: DE/SYNC mode select. Normally pull high.

When select DE mode, MODE=”1”, VS and HS must pull high.

When select SYNC mode, MODE= ”0”, DE must be grounded.

Note 2: When input 18 bits RGB data, the two low bits of R, G and B data must be grounded.

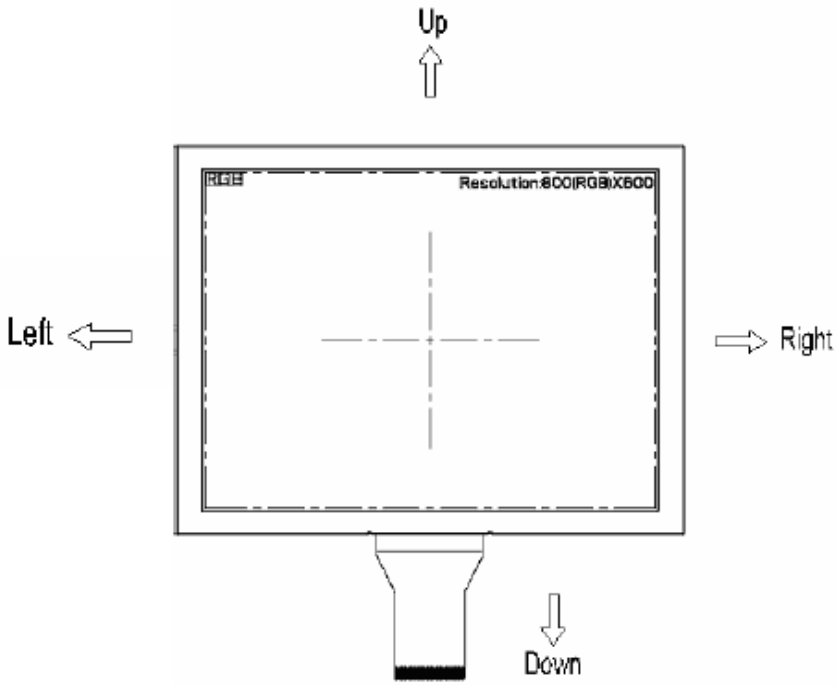
Note 3: Data shall be latched at the falling edge of DCLK.

Note 4: Selection of scanning mode

Setting of scan control input		Scanning direction
U/D	L/R	
GND	DV_{DD}	Up to down, left to right
DV_{DD}	GND	Down to up, right to left
GND	GND	Up to down, right to left
DV_{DD}	DV_{DD}	Down to up, left to right

Note 5: Definition of scanning direction.

Refer to the figure as below:



Note 6: Global reset pin. Active low to enter reset state. Suggest to connect with an RC reset circuit for stability. Normally pull high.

Note 7: Dithering function enable control, normally pull high.
When DITHB=”1”,Disable internal dithering function,
When DITHB=”0”,Enable internal dithering function,

10.2 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 transcation.
5	SDA	I/O	I^2C data signal.
6	SCL	I	I^2C clock signal.
7	NC	-	Not Connection
8	NC	-	Not Connection
9	NC	-	Not Connection
10	GND	I	System ground.

10.3 Color Data Input Assignment

The brightness of each primary color(red, green and blue) is based on the 8 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							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	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	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	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	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	0	0	0	0	0	0
	Red(1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(253)	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(255)	1	1	1	1	1	1	1	1	0	0	0	0	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	0	0	0	0	0	0
	Green(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Green(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(253)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
	Green(254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Green(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	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	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	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	0	0	0	0	0	0	1	0
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	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(253)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
	Blue(254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Blue(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

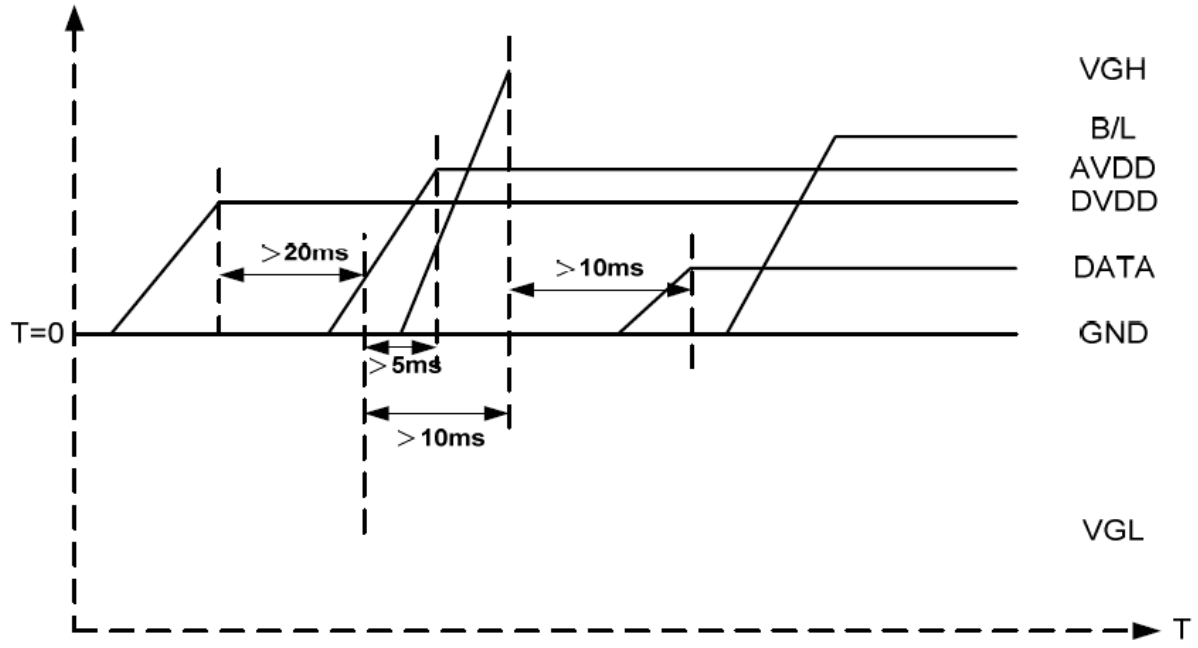
11. Interface Timing

11.1 Input Signal Characteristics

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
HS setup time	T_{hst}	8	-	-	ns	
HS hold time	T_{hhd}	8	-	-	ns	
VS setup time	T_{vst}	8	-	-	ns	
VS hold time	T_{vhd}	8	-	-	ns	
Data setup time	T_{dsu}	8	-	-	ns	
Data hole time	T_{dhd}	8	-	-	ns	
DE setup time	T_{esu}	8	-	-	ns	
DE hole time	T_{ehd}	8	-	-	ns	
DV_{DD} Power On Slew rate	T_{POR}	-	-	20	ms	From 0 to 90% DV_{DD}
RESET pulse width	T_{Rst}	1	-	-	ms	
DCLK cycle time	T_{coh}	20	-	-	ns	
DCLK pulse duty	T_{cwh}	40	50	60	%	

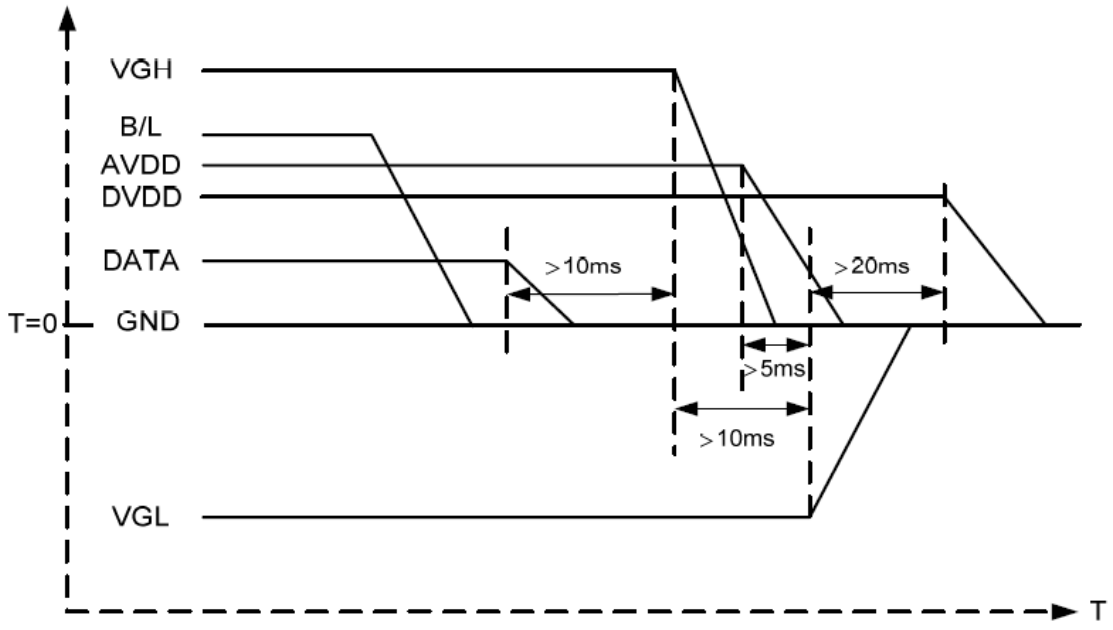
11.2 Power Sequence

Power on:



DVDD→VGL→VGH→Data→B/L

Power off:



B/L→Data→VGH→VGL→DVDD

Note: Data include R0~R7, B0~B7, GO~G7, U/D, L/R, DCLK, HS,VS,DE.

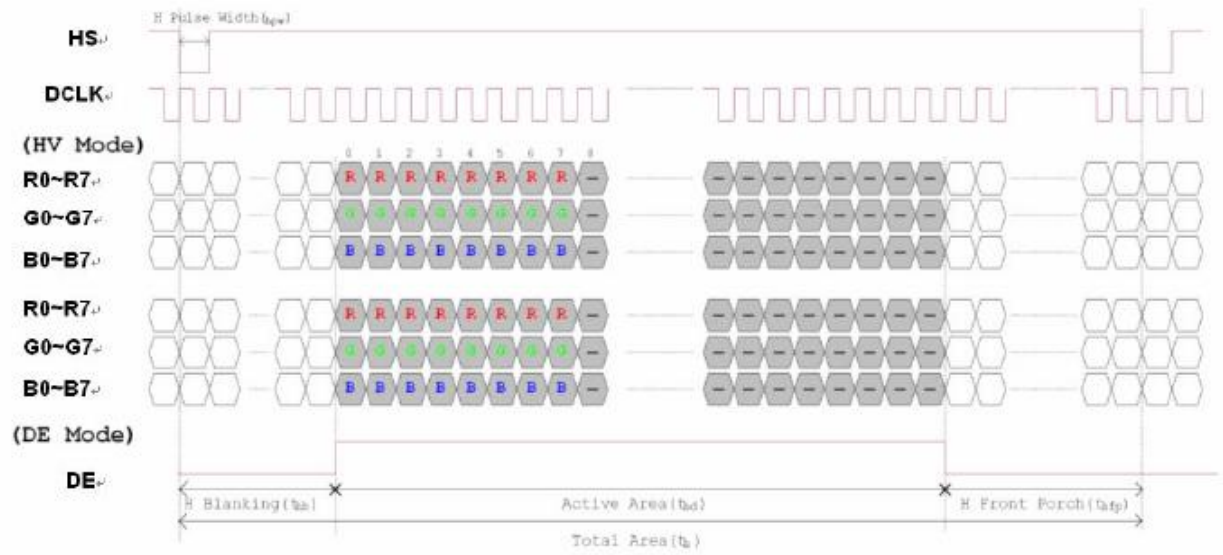
11.3 Timing

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Horizontal Display Area	thd	-	800	-	DCLK	
DCLK Frequency	fclk	26.4	33.3	46.8	MHz	
One Horizontal Line	th	862	1056	1200	DCLK	
HS pulse width	thpw	1	-	40	DCLK	
HS Blanking	thb	46	46	46	DCLK	
HS Front Porch	thfp	16	210	354	DCLK	

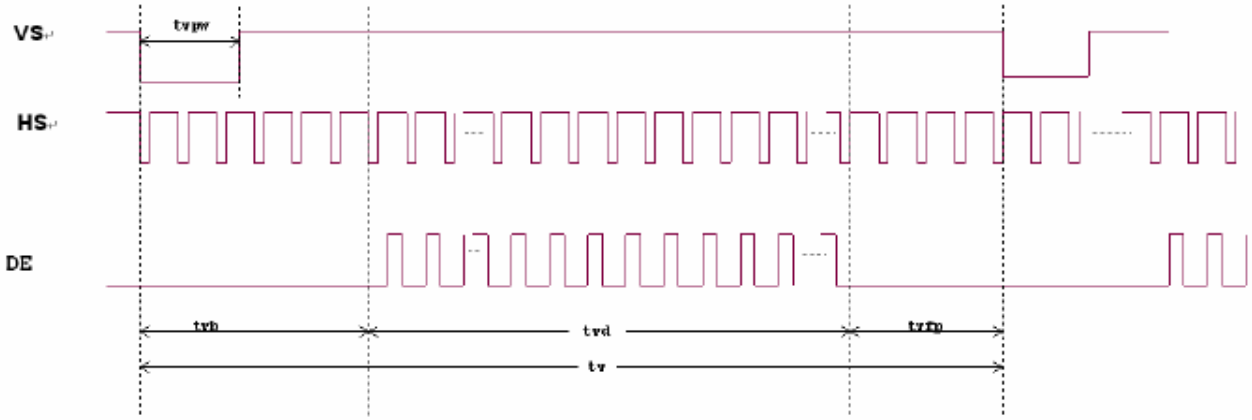
Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Vertical Display Area	tvd	-	480	-	TH	
VS period time	tv	510	525	650	TH	
VS pulse width	tvpw	1	-	20	TH	
VS Blanking	tvb	23	23	23	TH	
VS Front Porch	tvfp	7	22	147	TH	

11.4 Waveform

11.4.1 Data input format



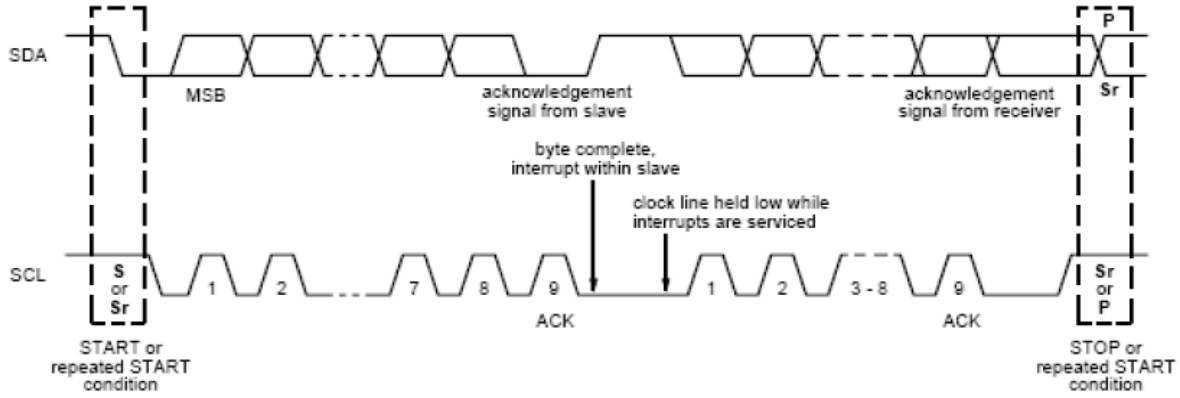
Horizontal input timing diagram.



Vertical input timing diagram.

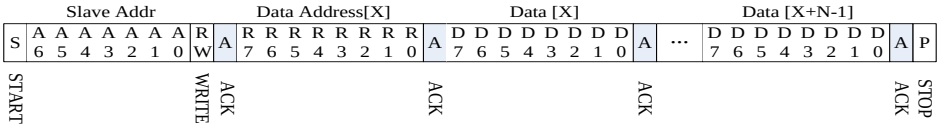
11.5 Timing Requirement of Projected Capacitive Touch

11.5.1 I2C Data Transfer Format

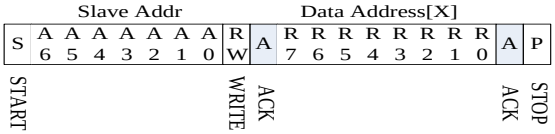


Mnemonics	Description
S	I^2C Start or I^2C Restart
A[6:0]	Slave Address = 0x70
W	1'b0: Write
R	1'b1: Read
C	ACK
P	STOP: the indicate the end of a packet (if this bit is missing, S will indicate the end of the current packet and the beginning of the next packet)

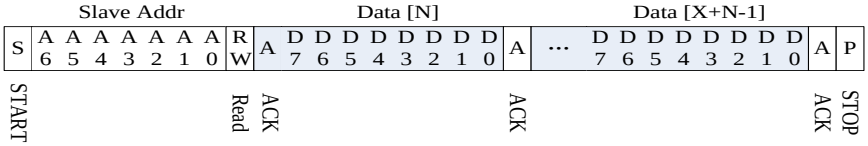
Write N bytes to I2C slave



Set Data Address



Read X bytes from I^2C Slave

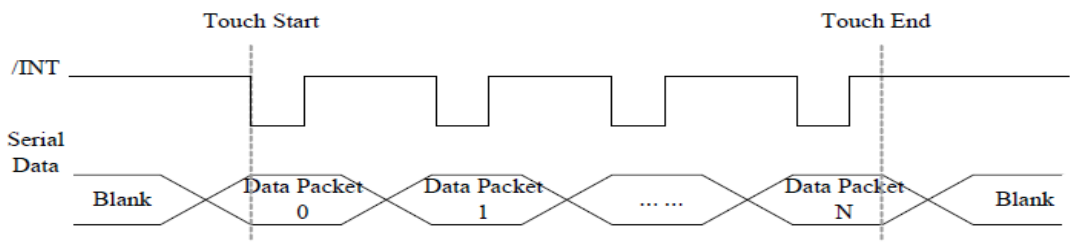


11.5.2 I2C Timing Characteristics

(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

11.5.3 Interrupt Trigger Mode



11.5.4 I2C Operating Mode Register Map

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Host Access
Op,00h	DEVICE_MODE		Device Mode[2:0]							RW
Op,01h	Reserved									R
Op,02h	TD_STATUS					Number of touch points[3:0]				R
Op,03h	TOUCH1_YH	1st Event Flag				1st Touch Y Position[11:8]				R
Op,04h	TOUCH1_YL	1st Touch Y Position[7:0]								R
Op,05h	TOUCH1_XH	1st Touch ID[3:0]				1st Touch X Position[11:8]				R
Op,06h	TOUCH1_XL	1st Touch X Position[7:0]								R
Op,07h	Reserved									R
Op,08h	Reserved									R
Op,09h	TOUCH2_YH	2nd Event Flag				2nd Touch Y Position[11:8]				R
Op,0Ah	TOUCH2_YL	2nd touch Y Position[7:0]								R

Op,0Bh	TOUCH2_XH	2nd Touch ID[3:0]		2nd Touch X Position[11:8]	R
Op,0Ch	TOUCH2_XL	2nd Touch X Position[7:0]			R
Op,0Dh	Reserved				R
Op,0Eh	Reserved				R
Op,0Fh	TOUCH3_YH	3rdEvent Flag		3rd Touch Y Position[11:8]	R
Op,10h	TOUCH3_YL	3rd Touch Y Position[7:0]			R
Op,11h	TOUCH3_XH	3rd Touch ID[3:0]		3rd Touch X Position[11:8]	R
Op,12h	TOUCH3_XL	3rd Touch X Position[7:0]			R
Op,13h	Reserved				R
Op,14h	Reserved				R
Op,15h	TOUCH4_YH	4thEvent Flag		4th Touch Y Position[11:8]	R
Op,16h	TOUCH4_YL	4th Touch Y Position[7:0]			R
Op,17h	TOUCH4_XH	4th Touch ID[3:0]		4th Touch X Position[11:8]	R
Op,18h	TOUCH4_XL	4th Touch X Position[7:0]			R
Op,19h	Reserved				R
Op,1Ah	Reserved				R
Op,1Bh	TOUCH5_YH	5thEvent Flag		5th Touch Y Position[11:8]	R
Op,1Ch	TOUCH5_YL	5thTouch Y Position[7:0]			R
Op,1Dh	TOUCH5_XH	5th Touch ID[3:0]		5th Touch X Position[11:8]	R
Op,1Eh	TOUCH5_XL	5th Touch X Position[7:0]			R
Op,1Fh	Reserved				R
Op,20h	Reserved				R
Op,21h	TOUCH6_YH	6thEvent Flag		6th Touch Y Position[11:8]	R
Op,22h	TOUCH6_YL	6thTouch Y Position[7:0]			R
Op,23h	TOUCH6_XH	6th Touch ID[3:0]		6th Touch X Position[11:8]	R
Op,24h	TOUCH6_XL	6th Touch X Position[7:0]			R
Op,25h	Reserved				R
Op,26h	Reserved				R
Op,27h	TOUCH7_YH	7thEvent		7th Touch	R

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

11.5.5 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 [2:0]	000b Normal operating Mode 001b System Information Mode (Reserved) 100b Test Mode – read raw data (Reserved)

11.5.6 TD_STATUS

This register is the Touch Data status register.

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

11.5.7 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 ~ Op,39h	7:6	Event Flag	00b: Put Down 01b: Put Up 10b: Contact 11b: No event
	5:4		Reserved
	3:0	Touch Y Position [11:8]	MSB of Touch Y Position in pixels

11.5.8 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 ~ Op,3Ah	7:0	Touch Y Position [7:0]	LSB of the Touch Y Position in pixels

11.5.9 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 ~ Op,3Bh	7:4	Touch ID[3:0]	Touch ID of Touch Point
	3:0	Touch X Position [11:8]	MSB of Touch X Position in pixels

11.5.10 TOUCHn_XL (n:1-10)

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

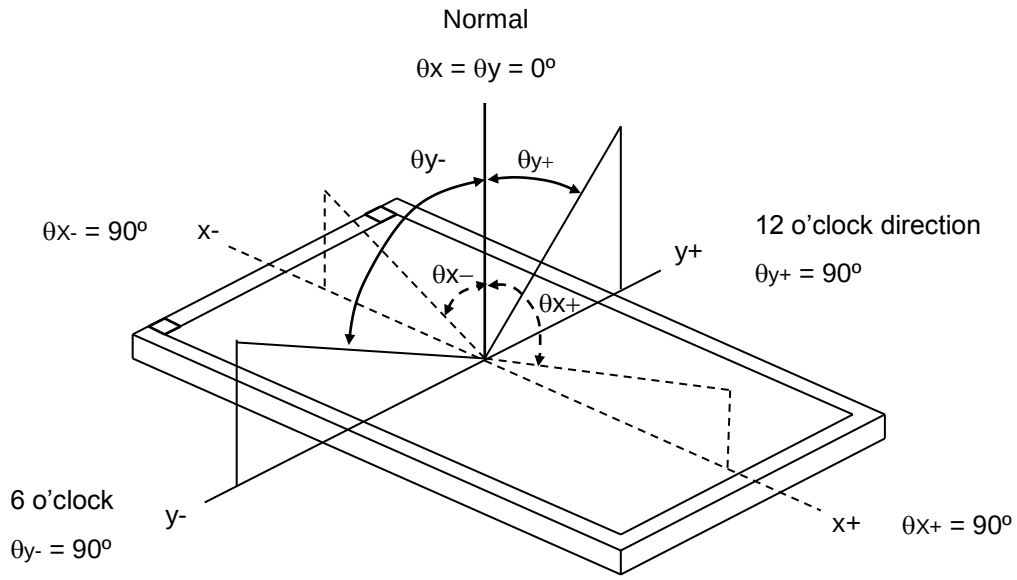
Address	Bit Address	Register Name	Description
Op,06h ~ Op,3Ch	7:0	Touch X Position [7:0]	LSB of The Touch X Position in pixels

12. Optical Characteristics

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

Item		Symbol	Conditions	Min.	Typ.	Max.	Unit	Note
Contrast Ratio		CR	θ_x=0°, θ_Y =0° Viewing Normal Angle	400	（500）	-	-	(2)
Response Time		T_R		-	10	20	ms	(3)
		T_F		-	15	30	ms	
Luminance(Center)		Y		170	（220）	-	cd/m^2	(4)
Brightness uniformity		BUNI		70	（75）	-	%	(5)
Color Chromaticity	White	Wx		0.26	0.31	0.36	-	(1),(4)
		Wy		0.28	0.33	0.38	-	
Viewing Angle	Horizontal	θ_x+	CR≥10	60	（70）	-	deg.	
		θ_x-		60	（70）	-		
	Vertical	θ_Y+		40	（50）	-		
		θ_Y-		60	（70）	-		

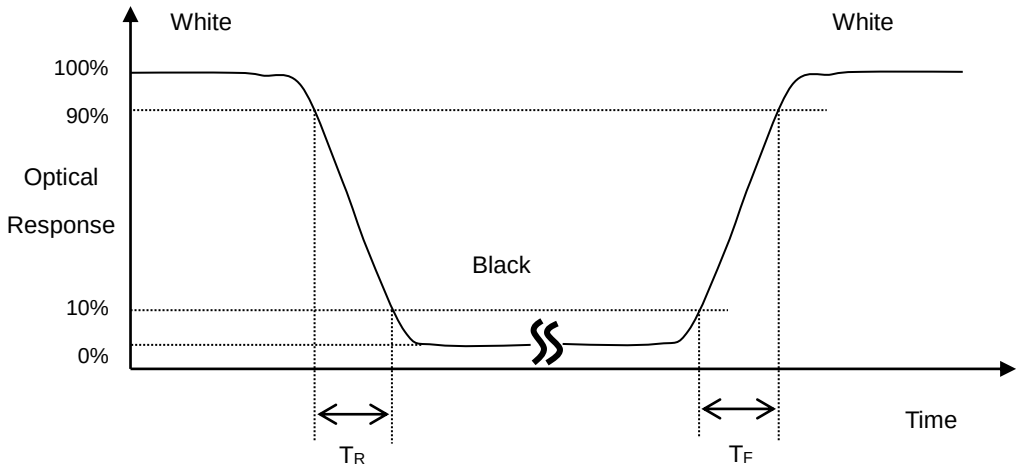
Note (1) Definition of Viewing Angle (θx, θy):



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

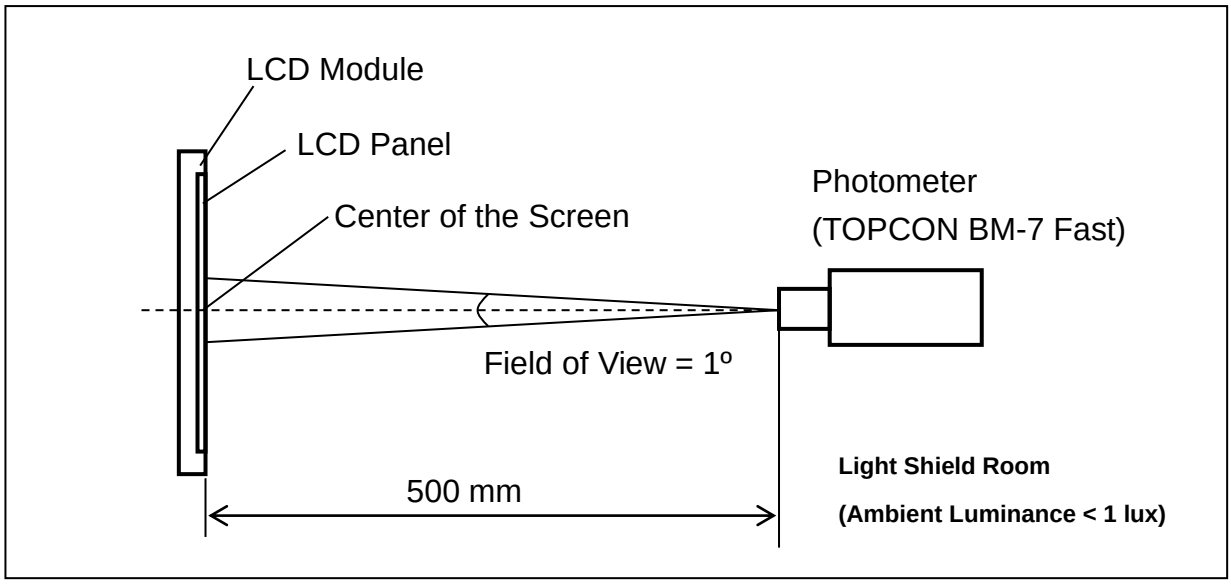
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD on the "White" state}}{\text{Luminance measured when LCD on the "Black" state}}$$

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



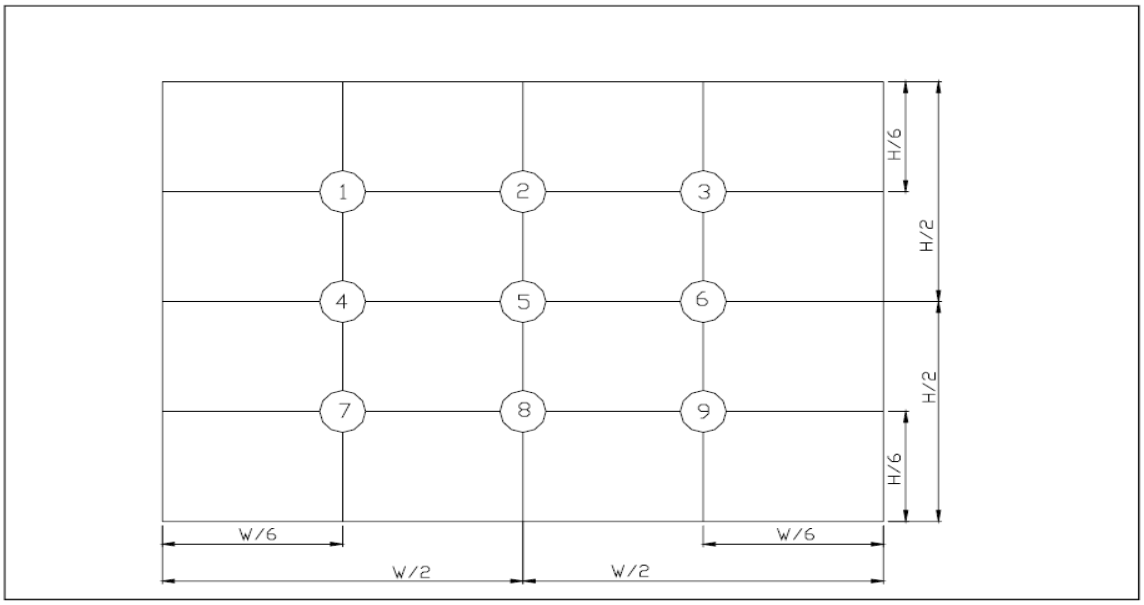
Note (4) Measurement Set-Up:

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 windless room.



Note (5) Definition of brightness uniformity

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



(單位 ：mm)

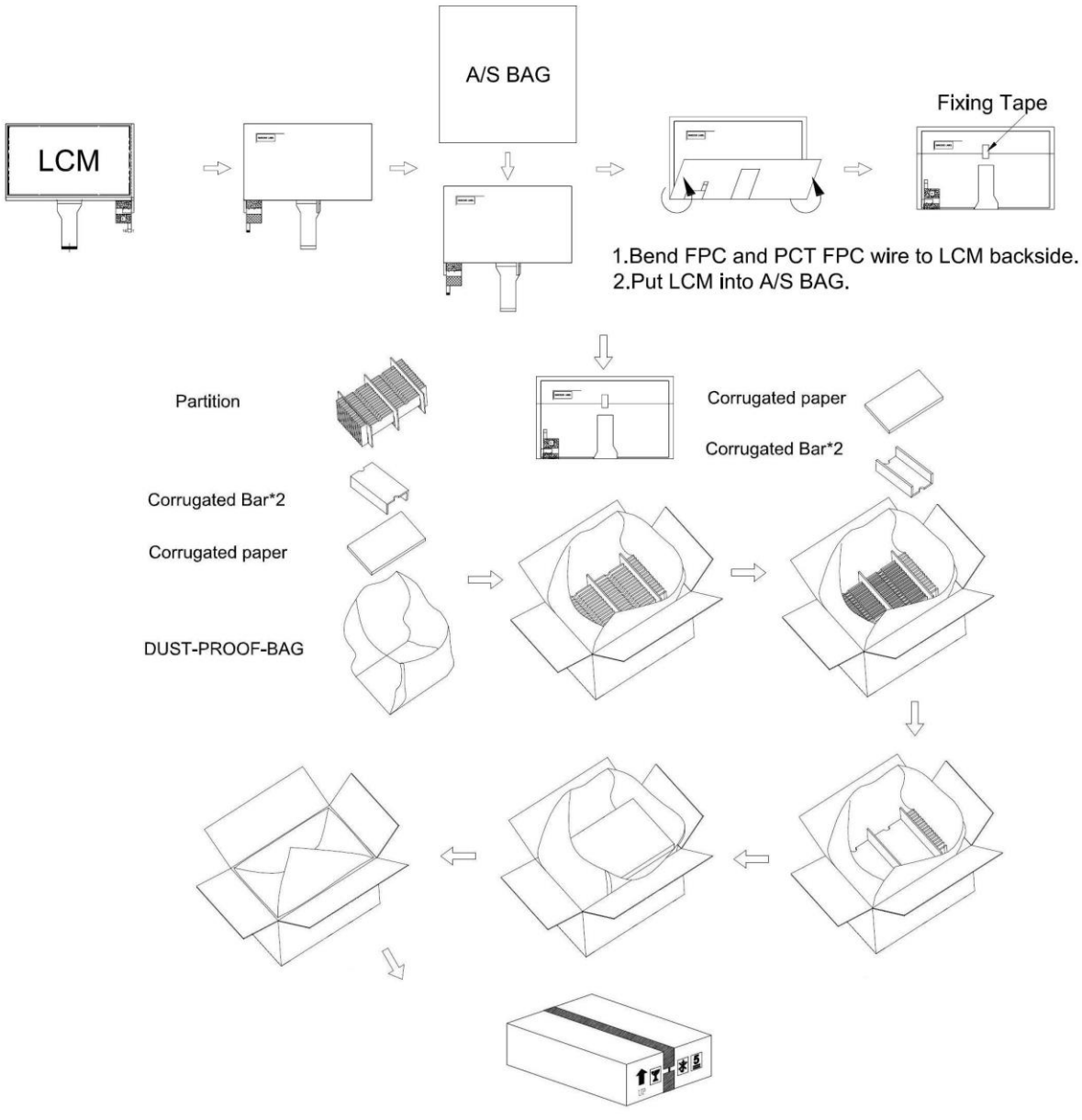
13. Reliability Test

(Note3)

Item	Test Conditions	Remark
High Temperature Storage	Ta = 80℃ 240hrs	Note 1，Note 4
Low Temperature Storage	Ta = -30℃ 240hrs	Note 1，Note 4
High Temperature Operation	Ts = 70℃ 240hrs	Note 2，Note 4
Low Temperature Operation	Ta = -20℃ 240hrs	Note 1，Note 4
Operate at High Temperature and Humidity	+60℃, 90%RH 240hrs	Note 4
Thermal Shock	-30℃/30 min ~ +80℃/30 min for a total 100 cycles, Start with cold temperature and end with high temperature.	Note 4
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)	
Mechanical Shock	100G 6ms,±X, ±Y, ±Z 3 times for each direction	
Package Vibration Test	Random Vibration : 0.015G*G/Hz from 5-200HZ, -6dB/Octave from 200-500HZ 2 hours for each direction of X. Y. Z. (6 hours for total)	
Package Drop Test	Height:60 cm 1 corner, 3 edges, 6 surfaces	
Electro Static Discharge	± 2KV, Human Body Mode, 100pF/1500Ω	

Note 1: Ta is the ambient temperature of samples.
Note 2: Ts 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				
	ITEM	SIZE(LxWxH) unit:mm	MATERIAL	Q.T.Y	NOTE
1	PARTITION	512.0x349.0x226.0	CORRUGATED PAPER	1	
2	CORRUGATED PAPER	510.0x350.0	CORRUGATED PAPER	2	
3	CORRUGATED BAR	349.0x118.0x44.0	CORRUGATED PAPER	4	
4	DUST-PROOF BAG	700.0x530.0	PE	1	
5	A/S BAG	240.0x230.0	PE	30	
6	CARTON	460.0x360.0x355.0	CORRUGATED PAPER	1	
7	PRODUCT	211.1x126.5x7.45		30	

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 10ºC, 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

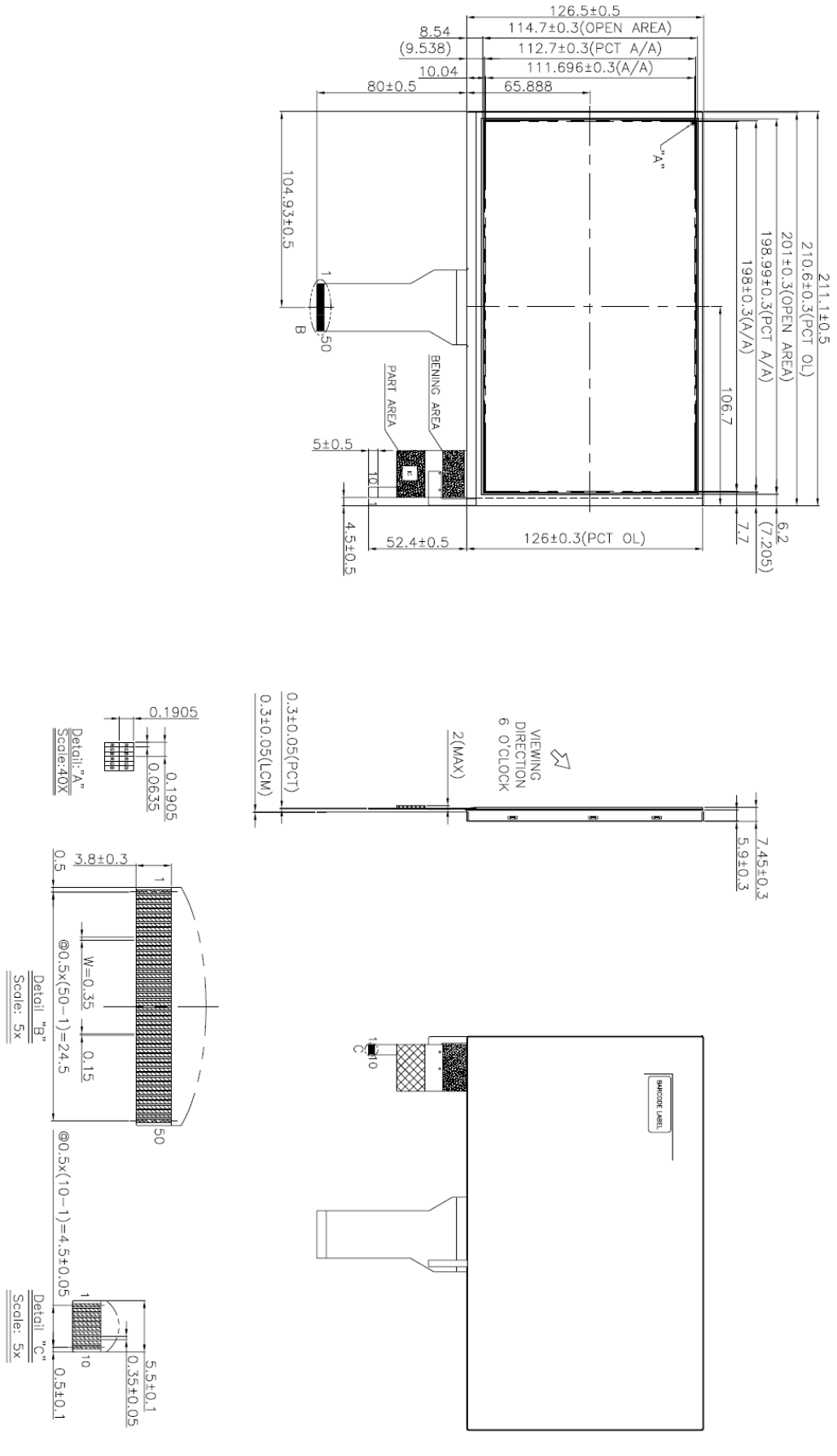
(1) Acceptance inspection period

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.

16.Outline Drawing



17. Incoming Inspection Standards

17.1 The environmental condition of inspection

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

(1) Ambient temperature 25 ± 5℃

(2) Humidity: 60 ± 5% RH

(3) Viewing distance is approximately 35 ~ 40 cm

(4)Viewing angle is normal to the LCD panel as Fig _1(10°)

(5) Ambient Illumination: 300 ~ 500 Lux for external appearance inspection

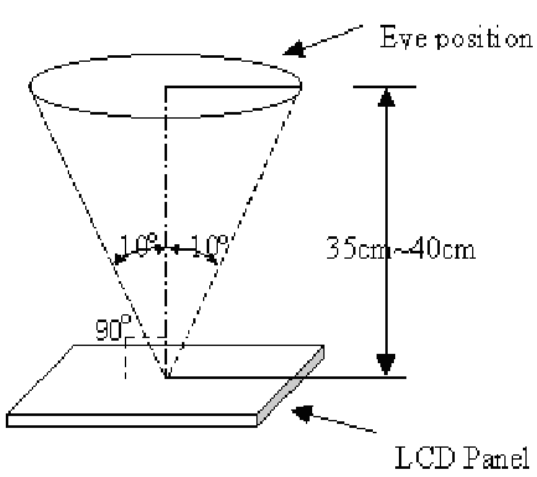


Fig _ 1

17.2 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.

17.3 Inspection Parameters

<table>
<tr><th colspan="2">Item</th><th colspan="5">Specification/Description</th><th>Note</th></tr>
<tr><td rowspan="2">Display</td><td>Function</td><td colspan="5">No Display</td><td>-</td></tr>
<tr><td colspan="5">Malfunction</td><td>-</td></tr>
<tr><td rowspan="2">Operating</td><td>Contrast ratio</td><td colspan="5">Out of Spec</td><td>-</td></tr>
<tr><td>Line defect</td><td colspan="5">No obvious Vertical and Horizontal line defect in bright , dark and colored.</td><td>-</td></tr>
<tr><td rowspan="6">Operating</td><td rowspan="6">Point Defect (red,green,blue, dark， white)</td><td rowspan="2">Item</td><td colspan="3">Acceptable number</td><td rowspan="2">Note: 1、 4、 5、6</td></tr>
<tr><td>A</td><td>B</td><td>Total</td></tr>
<tr><td>BRIGHT DOT</td><td>N≦3</td><td>N≦3</td><td rowspan="3">N≦8</td></tr>
<tr><td>DARK DOT</td><td>N≦5</td><td>N≦6</td></tr>
<tr><td>TOTAL DOT</td><td>N≦5</td><td>N≦6</td></tr>
<tr><td>TWO ADJACENT DOT</td><td colspan="3">NOT ALLOWED</td></tr>
<tr><td>THREE OR MORE ADJACENT DOT</td><td colspan="3">NOT ALLOWED</td></tr>
<tr><td rowspan="3">External Inspection (non-operating)</td><td>Scratch on the polarizer</td><td colspan="5"><table><tr><td>L(mm)</td><td>W(mm)</td><td>Acceptable number</td></tr><tr><td>L≦2.5</td><td>W≦0.1</td><td>4</td></tr><tr><td>L＞2.5</td><td>W＞0.1</td><td>0</td></tr></table></td><td>Note:2</td></tr>
<tr><td>Dent or bubble on the polarizer</td><td colspan="5"><table><tr><td>Dimension(mm)</td><td>Acceptable number</td></tr><tr><td>D≦0.5</td><td>4</td></tr><tr><td>D≦0.15</td><td>Disregard</td></tr></table></td><td>Note:3</td></tr>
<tr><td>Line Criteria or Dot Criteria on the polarizer</td><td colspan="5"><table><tr><td>Inactive dot</td><td>Acceptable number</td></tr><tr><td>D<0.2mm</td><td>Disregard</td></tr><tr><td>0.2≦D≦0.5mm
L≦1.8mm,W≦0.1mm</td><td>Line &dot number N≦7</td></tr></table></td><td>Note:2、3</td></tr>
</table>

Incoming Inspection Touch Panel

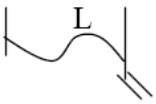
Circular Defects
Linear Defects
Scratch
Air Bubble
Crack

(1) Circular Defects

ϕ =(L+W)/2

Diameter(mm)	Spec
$\phi \leqq 0.2$	No quantity limit
$0.2 < \phi < 0.5$	Max 5 defect
$0.5 \leqq \phi$	Reject
The Min distance of defects must be above 10.0mm.	

(2) Linear Defects



Length	Width	Acceptable
12.0≧L	0.06≧W	Accept
L≧12.0	W≧0.06	Reject

(3)Scratch

Length	Width	Acceptable
12.0≧L	0.06≧W	Accept
L≧12.0	W≧0.06	Reject
The Min distance of defects must be above 15.0mm.		

(4) Air Bubble

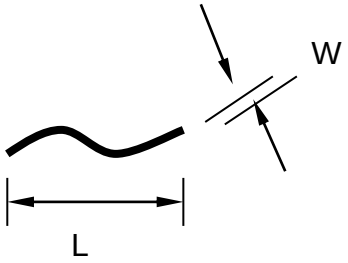
Diameter(mm)	Spec
$\phi \leqq 0.2$	No quantity limit
$0.2 < \phi \leqq 0.6$	Max 5 defect
The Min distance of defects must be above 10.0mm.	

(5)Crack Reject

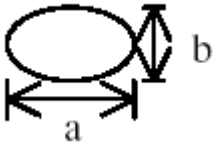
Note1. The definition of dot defect :

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.

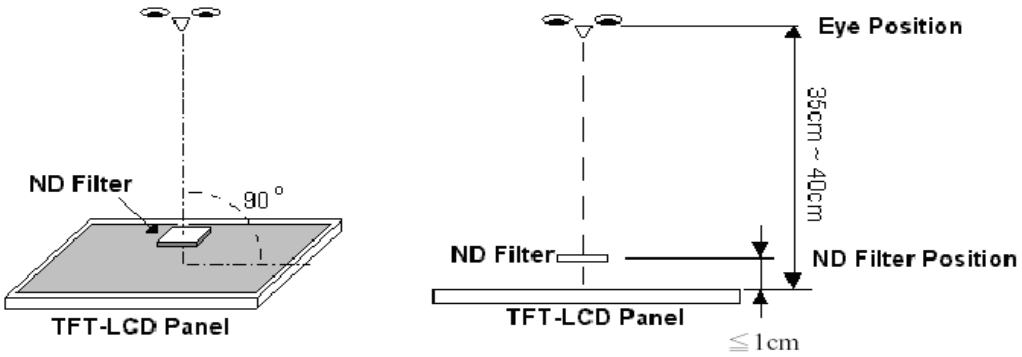
Note2.



Note3. D：Diameter D=(a+b)/2

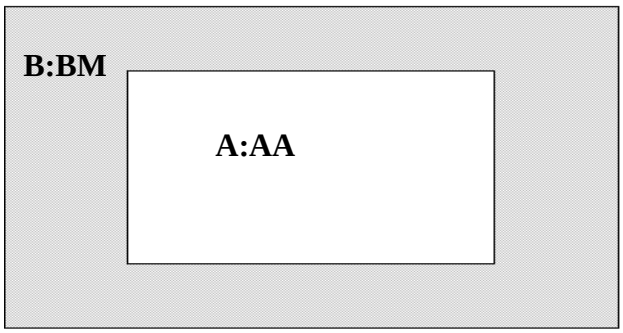


Note4. Bright dot is defined through 6% transmission ND Filter as following.



Note5. ADJACENT DOT

Note6.



17.4 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.