



SPECIFICATION FOR LCD MODULE

MODULE NO: AFD480272A1T-4.3N6WTM-C
VERSION NO.: V1.0

Customer's Approval:

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	SIGNATURE	DATE
PREPARED BY		
CHECKED BY		
APPROVED BY		

RECORD OF REVISION

Version	Revised Date	Page	Content
V1.0	2013/12/05	--	First Issued

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1. GENERAL DESCRIPTION

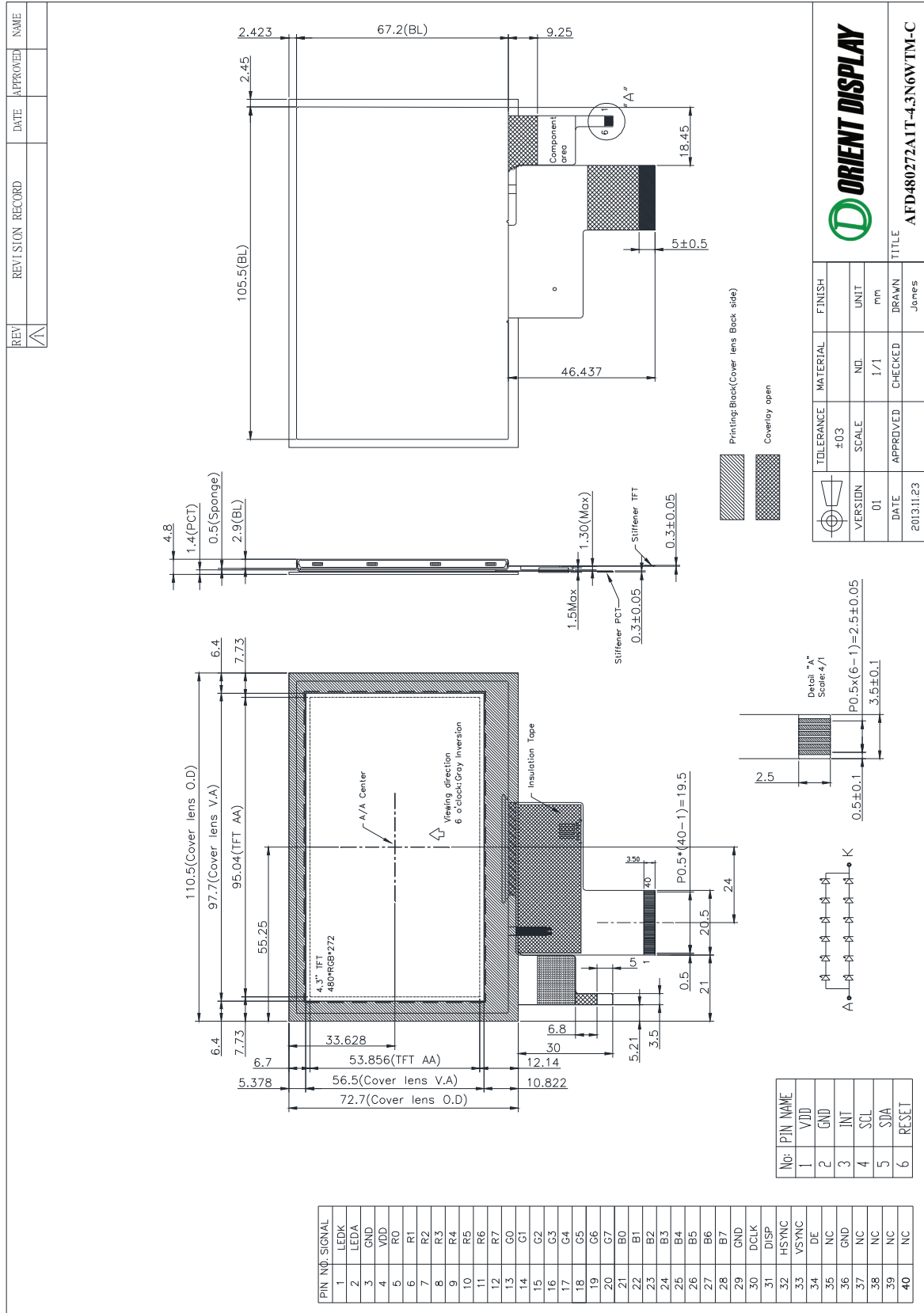
1.1 Description

The specifications is model AFD480272A1T-4.3N6WTM-C is a color active matrix thin film transistor (TFT) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching device. This model is composed of a TFT LCD panel, a driving circuit, a back light system and projected capacitive touch panel. This TFT LCD has a 4.3 (16:9) inch diagonally measured active display area with WQVGA (480 horizontal by 272 vertical pixels) resolution.

1.2 Features:

No.	Item	Specification	Unit
1	Panel Size	4.3"	Inch
2	Number of Pixels	480 (W) x RGB x 272 (H)	Pixels
3	Active Area	95.04 (W) × 53.856 (H)	mm
4	Pixel Pitch	0.198 (W) × 0.198(H)	mm
5	Outline Dimension	110.5 (W) × 72.7 (H) × 4.8 (T)	mm
6	Number of Colors	16.7M	- -
7	Display Mode	TN / Normally White / Transmissive	- -
8	View Direction	6 o'clock(Gray Inversion)	
9	Display Format	RGB vertical stripe	- -
10	Surface Treatment	Clear (7H)	- -
11	Contrast Ratio	600 (Typ.)	- -
12	Luminance (cd/m ²)	400 (Typ.)	cd/m2
13	Interface	RGB 24bit Interface	- -
14	Backlight	White LED	- -
15	Driver IC	--	- -
16	Operation Temperature	-20 ~ 70	°C
17	Storage Temperature	-30 ~ 80	°C
18	Weight	(60)	g

2. MECHANICAL SPECIFICATION



3. PIN DESCRIPTION

Pin No.	Symbol	I/O	Function	Remark
1	VLED-	P	Power for LED backlight cathode	
2	VLED+	P	Power for LED backlight anode	
3	GND	P	Power Ground	
4	VDD	P	Power Supply	
5	R0	I	Red data signal (LSB)	
6	R1	I	Red data signal	
7	R2	I	Red data signal	
8	R3	I	Red data signal	
9	R4	I	Red data signal	
10	R5	I	Red data signal	
11	R6	I	Red data signal	
12	R7	I	Red data signal (MSB)	
13	G0	I	Green data signal (LSB)	
14	G1	I	Green data signal	
15	G2	I	Green data signal	
16	G3	I	Green data signal	
17	G4	I	Green data signal	
18	G5	I	Green data signal	
19	G6	I	Green data signal	
20	G7	I	Green data signal (MSB)	
21	B0	I	Blue data signal (LSB)	
22	B1	I	Blue data signal	
23	B2	I	Blue data signal	
24	B3	I	Blue data signal	
25	B4	I	Blue data signal	
26	B5	I	Blue data signal	
27	B6	I	Blue data signal	
28	B7	I	Blue data signal (MSB)	
29	DGND	P	Digital ground	
30	DCLK	I	Pixel clock	
31	DISP	I	Display on/ off	
32	HSYNC	I	Horizontal sync signal	
33	VSNC	I	Vertical sync signal	
34	DE	I	Data Enable signal	
35	NC	-	No Connect	
36	GND	P	Power Ground	

37	NC	-	No Connect	
38	NC	-	No Connect	
39	NC	-	No Connect	
40	NC	-	No Connect	

4. ABSOLUTE MAXIMUM RATINGS

4.1 Electrical Absolute Rating

4.1.1 TFT LCD Module

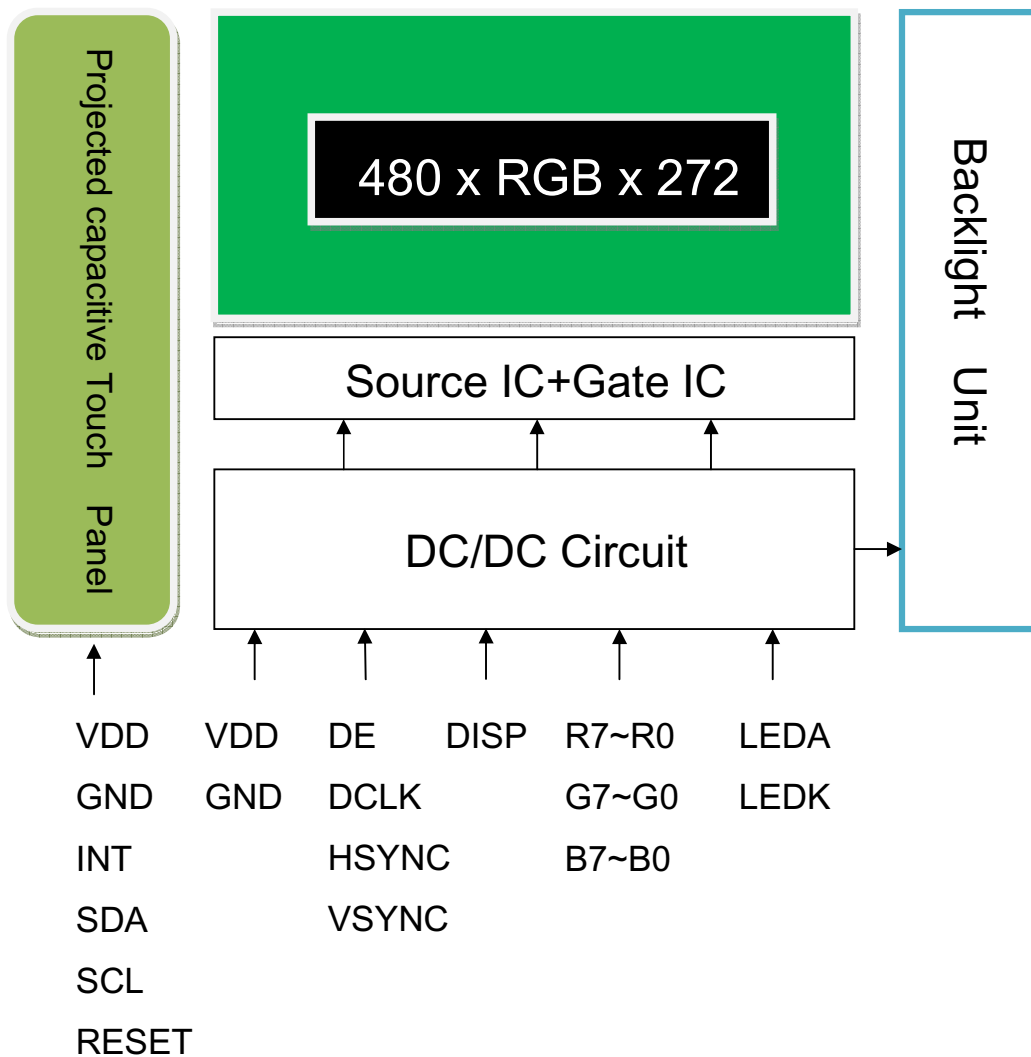
Item	Symbol	Values		Unit	Note
		Min.	Max.		
TFT Power supply voltage	VDD	-0.3	5.0	V	
PCT Power supply voltage	VDD	-0.3	7.0	V	

4.1.2 Environment Absolute Rating

Item	Symbol	Values			Unit	Note
		Min.	Typ.	Max.		
Operating Temperature	Topa	-20		70	°C	Ambient temperature
Storage Temperature	Tstg	-30		80	°C	

5. BLOCK DIAGRAM

5.1 TFT LCD Module



6. Relationship Between Displayed Color and Input

6.1 8 bit

	Color & Gray Scale	Data Signal																							
		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 Color	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
Red	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)	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(127)	0	1	1	1	1	1	1	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
Green	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
	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(127)	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	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
Blue	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
	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
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(127)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	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

0 : Low level voltage, 1 :High level voltage

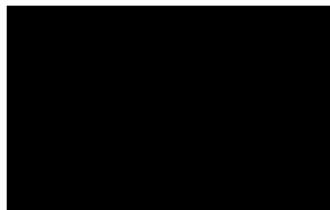
Each basic color can be displayed in 256 gray scales from 8 bit data signals. With the combination of total 24 bit data signals, the 16,777,216-color display can be achieved on the screen.

7. ELECTRICAL CHARACTERISTICS

7.1 TFT LCD Module

Item		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power supply voltage		VDD	3.0	3.3	3.6	V	
Input Voltage for logic	H Level	VIH	0.7xVDD	-	VDD	V	
	L Level	VIL	0	-	0.3xVDD	V	
Digital Current		IDD	-	(4.2)	-	mA	Note1

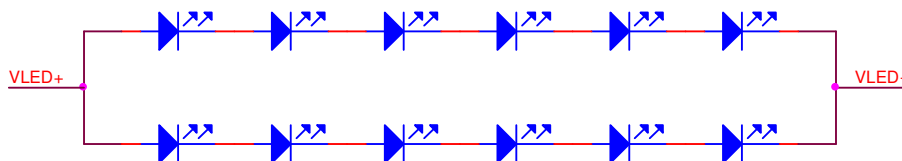
Note 1: frame =60Hz , Ta=25°C , Display pattern : Black pattern



7.2 Backlight Unit

Item	Symbol	Value			Unit	Condition
		Min.	Typ.	Max.		
LED Voltage	VL	(18)	(19.2)	(20.4)	V	
LED Current	If	-	(40)	-	mA	6S2P
Power Consumption	PBL	-	768	-	mW	
LED Life Time (25°C)	-	(20000)	-	-	hr	(1)

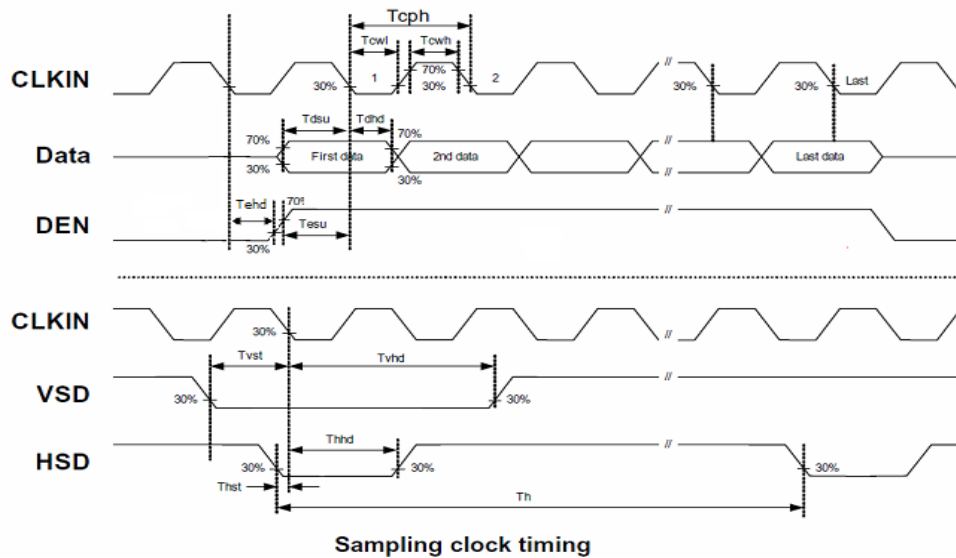
Note (1): The “LED life time” is defined as the module brightness decrease to 50% original brightness that the ambient temperature is 25°C 60% RH.



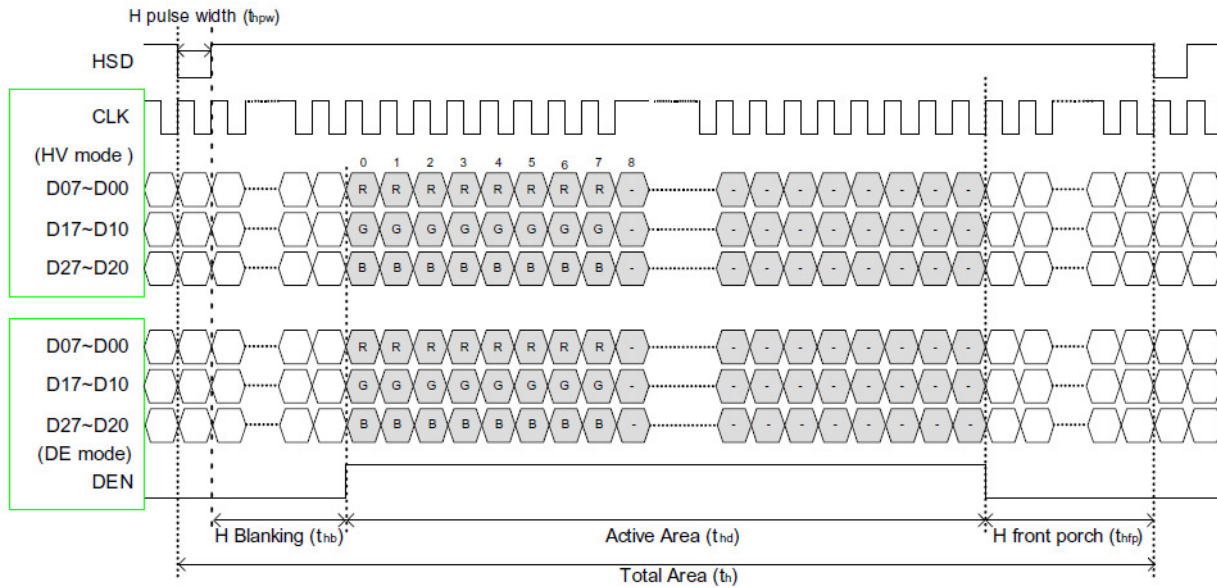
7.3 INTERFACE SPECIFICATIONS

7.3.1 Timing characteristics

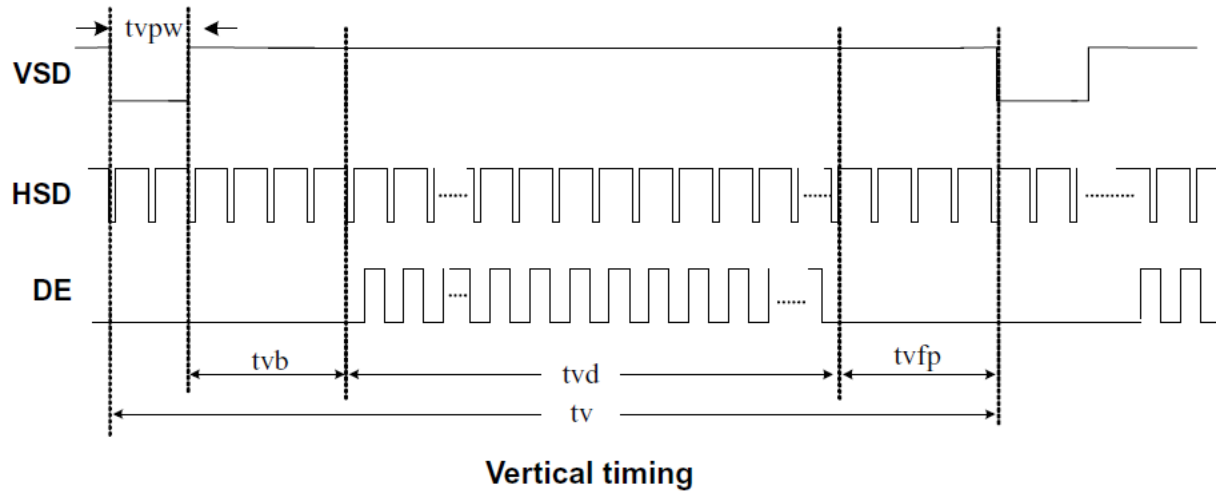
Signal	Parameter	Symbol	Min.	Typ.	Max.	Unit.	Note
DCLK	DCLK cycle time	Tcph	83.3	111.1	200	ns	
	DCLK Frequency	fclk	5	9	12	MHz	
	DCLK High plus width	Tcwh	40	50	60	%	
Horizontal	HSD setup time	Thst	12	-	-	ns	
	HSD hold time	Thhd	12	-	-	ns	
	Horizontal display area	thd	-	480	-	Tcph	
	HSD period time	th	520	525	800	Tcph	
	HSD pulse width	thpw	1	-	-	Tcph	
	HSD back porch	thb	36	40	255	Tcph	
	HSD front porch	thfp	4	5	65	Tcph	
Vertical	VSD setup time	Tvst	12	-	-	ns	
	VSD hold time	Tvhd	12	-	-	ns	
	Vertical display area	tv	-	272	-	th	
	VSD period time	tv	-	288	-	th	
	VSD pulse width	tvpw	1	-	-	th	
	VSD back porch	tvb	3	8	31	th	
	VSD front porch	tvfp	2	8	93	th	
DE	DE setup time	Tesu	12	-	-	ns	
	DE hold time	Tehd	12	-	-	ns	
DATA	Data setup time	Tdsu	12	-	-	ns	
	Data hold time	Tdhd	12	-	-	ns	



7.3.2 Input Timing Table

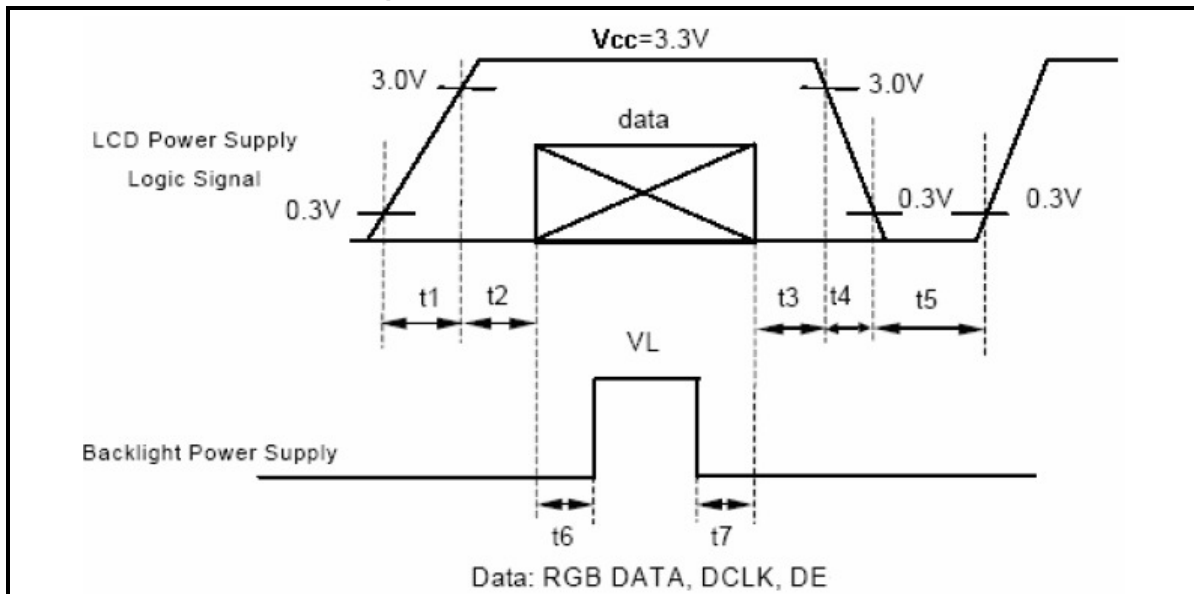


Horizontal display timing range



Vertical timing

7.4 Power On / Off Sequence



$t_1 \leq 10ms : 1 sec \leq t_5$

$50ms \leq t_2 : 200ms \leq t_6$

$0 < t_3 \leq 50ms : 200ms \leq t_7$

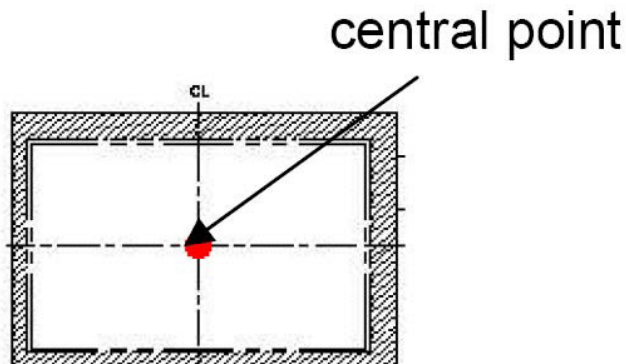
$0 < t_4 \leq 10ms$

8. PROJECTED CAPACITIVE TOUCH PANEL

8.1 Main Feature

Item	Specification	Unit
Screen Size	4.3 inches	Diagonal
Type	Projected Capacitive Touch Panel	--
Input Mode	Human's Finger	--
Sensor Active Area	98.7 (H)(typ.) X 63.7 (V)(typ.)	mm
Module Outline	110.5 (H)(typ.) X 72.7 (V)(typ.)	mm
Interface	I2C	--
Finger	5	--
Point hitting life time	1,000,000 times (min.)	Note1
Power Supply voltage	2.5V (min.) 3.3V (typ.) 3.5V DC (max.)	V
Power Supply current	14mA (typ.)	mA

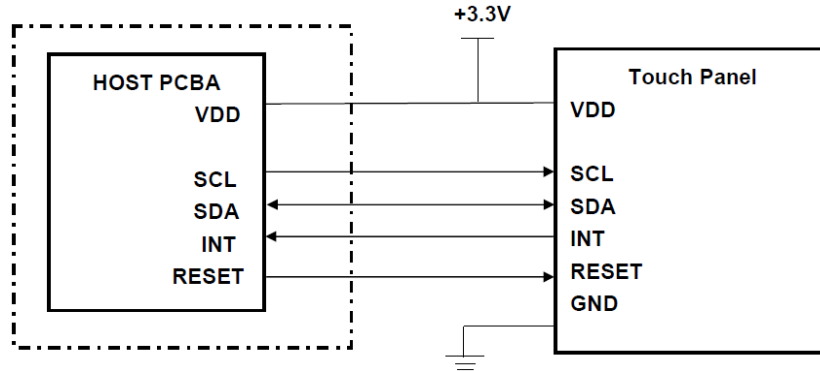
Note1: Use 8 mm diameter silicon rubber/force 3N to knock on the same point twice per second (no-operating), after test function check pass.



8.2 Pin Assignments and Definitions

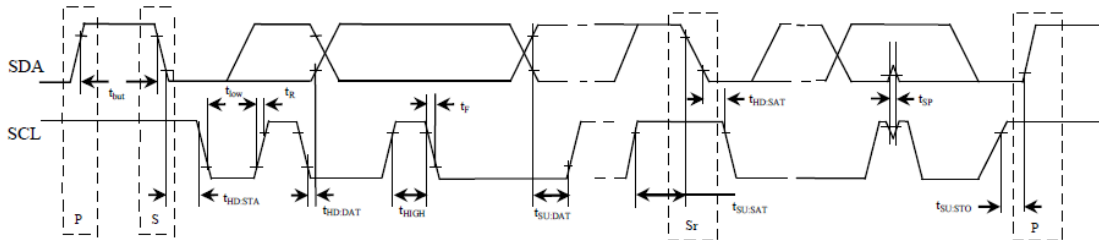
Item	Name	I/O	Unit
1	VDD	P	Power; VDD =3.3V(typ.)
2	GND	P	Power ground
3	INT	O	Interrupt, Active low
4	SCL	I	Serial Clock
5	SDA	I/O	Serial data
6	RESET	O	Reset, Active low

8.3 BLOCK DIAGRAM



Note : To reduce the noise from the power, we suggest you use the independent power for the touch panel (VDD).

8.4 Interface and Data Format (Slave address is 0x94H)



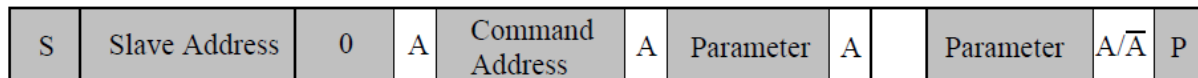
Parameter	Symbol	Standard-Mode I ² C-BUS		Fast-Mode I ² C-BUS		Unit
		Min.	Max.	Min.	Max.	
SCL clock frequency	f_{SCL}	0	100	0	400	KHz
Bus free time between STOP and START condition	t_{BUF}	4.7	-	1.3	-	μ s
Hold time (repeated) START condition. After this period, the first clock pulse is generated	$t_{HD:STA}$	4.0	-	0.6	-	μ s
LOW period of the SCL clock	t_{LOW}	4.7	-	1.3	-	μ s
HIGH period of the SCL clock	t_{HIGH}	4.0	-	0.6	-	μ s
Set-up time for a repeated START condition	$t_{SU:STA}$	4.7	-	0.6	-	μ s
Data hold time	$t_{HD:DAT}$	0	-	0	0.9	μ s
Data set-up time	$t_{SU:DAT}$	250	-	100	-	μ s
Rise time of both SDA and SCL signals	t_R	-	1000	$20+0.1C_b$	300	μ s
Fall time of both SDA and SCL signals	t_F	-	300	$20+0.1C_b$	300	μ s
Set-up time for STOP condition	$t_{SU:STO}$	4.0	-	0.6	-	μ s
Capacitive load for each bus line.	C_b	-	400	-	400	pF

Note:

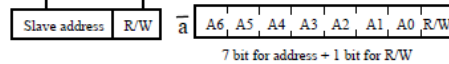
- (1) All values are referred to VIH (0.7xVDD) and VIL (0.3xVDD) level.
- (2) A device must internally provide a hold time of at least 300ns for the SDA signal (referred to the VIH of the SCL signal) in order to bridge the undefined region of the falling edge of SCL.
- (3) The maximum $t_{HD:DAT}$ has only to be met if the device does not stretch the LOW period (t_{LOW}) of the SCL signal.
- (4) A fast-mode I²C-bus device can be used in a standard-mode I²C-bus system, but the requirement $t_{SU:DAT} \geq 250$ ns must then be met. This will automatically be the case if the device does not stretch the LOW period of the SCL signal. If such a device does stretch the LOW period of the SCL signal, it must output the next data bit to the SDA line $t_{R,max} \ t_{SU:DAT} = 1000+250=1250$ ns (according to the standard-mode I²C-bus specification) before the SCL line is released.
- (5) C_b = total capacitance of one bus line in pF.

8.5 Format of Data Frame

Write mode



Slave Address Write



From master to slave

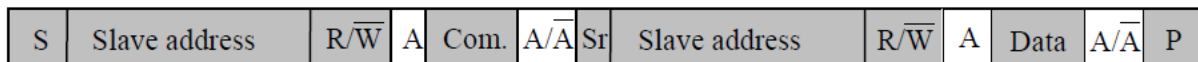


From slave to master

$\bar{A}$ = acknowledge (SDA LOW)
A= not acknowledge (SDA HIGH)
S= START condition
P= STOP condition

Data Format of writing

Read mode

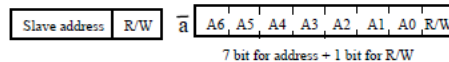


Write

Sr=repeated START condition

read

n bytes+ack.
↓
n Parameters



From master to slave



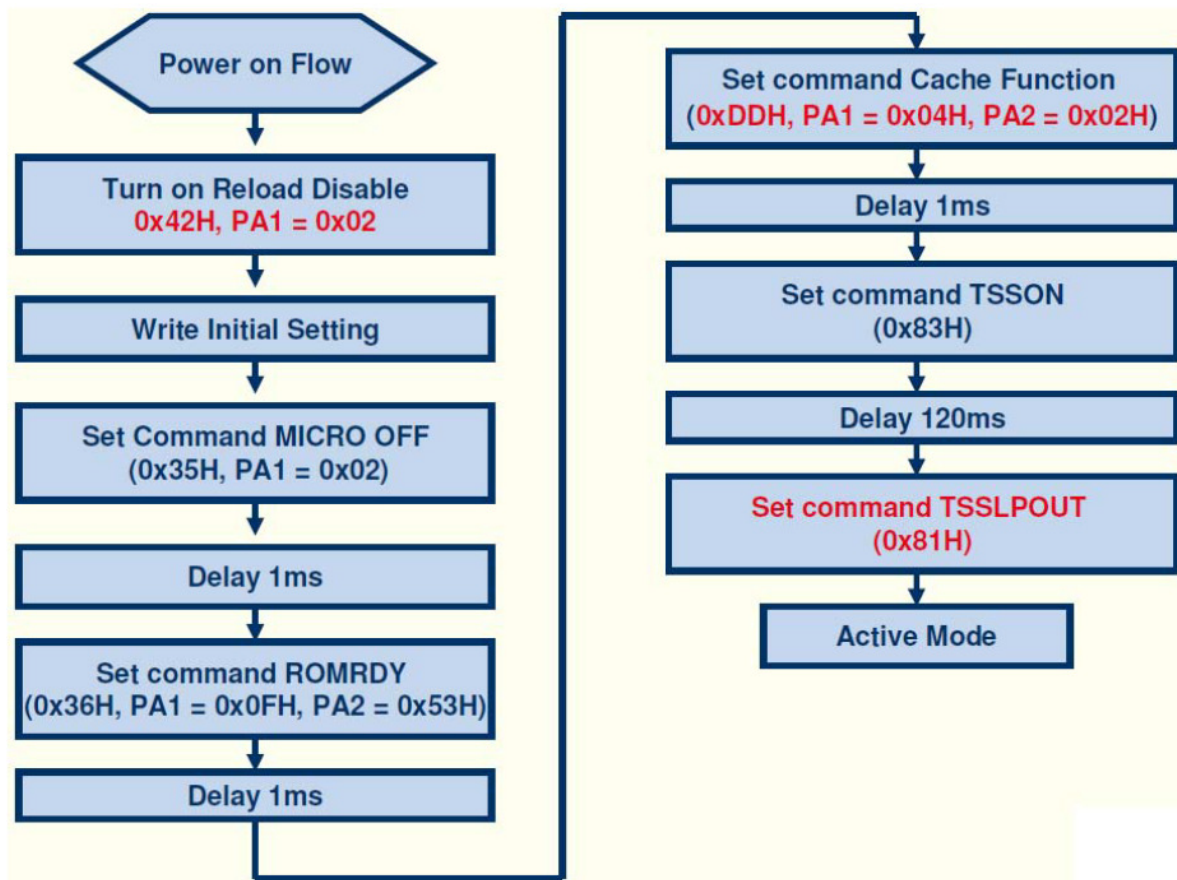
From slave to master

$\bar{A}$ = acknowledge (SDA LOW)
A= not acknowledge (SDA HIGH)
S= START condition
P= STOP condition

Data Format of reading mode

8.6 Initialize the CTP controller

Set Command Reload Disable = 1 (0x42H, PA1 = 0x02)
Write Initial Stetting (This step will only be executed in the first time power on sequence)
Set Command MICRO OFF (0x35H, PA1 = 0x02) to turn on internal MCU
Delay 1ms
Set command ROMRDY (0x36H, PA1 = 0x0FH, PA2 = 0x53H) to turn on internal flash.
Delay 1ms
Set command Cache Function (0xDDH, PA1 = 0x04H, PA2 = 0x02H) (*Note : PA1 is changeable)
Delay 1ms
Set command TSSON (0x83H) to starting touch sensing.
Delay 120ms
Set command TSSLPOUT (0x81H) to turn on internal power.



8.7 Data format

When finger touch, enter event will occurred and coordinate data will be calculated, and than interrupt signal appear (TSIX pull low).

Baseband should receive data when interrupt occur.

ID Inf * 1							
ID 8	ID 7	ID 6	ID 5	ID 4	ID 3	ID 2	ID 1
ID Inf * 2							
Virtual Key				X	X	ID10	ID 9

Figure 9.5.4.1

Note : ID5,ID6,ID7,ID8,ID9,ID10 Don't Care.

	Max Ponit	5 Finger			
	Total Bytes	32 Bytes			
Byte1	write_event4	Coordinate 1st	Byte23	write_event2	Finger Size 3rd
Byte2	write_event3		Byte24	write_event1	Finger Size 4th
Byte3	write_event2		Byte25	write_event4	Finger Size 5th
Byte4	write_event1		Byte26	write_event3	Dummy
Byte5	write_event4	Coordinate 2nd	Byte27	write_event2	Dummy
Byte6	write_event3		Byte28	write_event1	Dummy
Byte7	write_event2		Byte29	write_event4	Point Number
Byte8	write_event1		Byte30	write_event3	ID Inf *1
Byte9	write_event4	Coordinate 3rd	Byte31	write_event2	ID Inf *2
Byte10	write_event3		Byte32	write_event1	Checksum(LSB)
Byte11	write_event2				
Byte12	write_event1				
Byte13	write_event4	Coordinate 4th			
Byte14	write_event3				
Byte15	write_event2				
Byte16	write_event1				
Byte17	write_event4	Coordinate 5th			
Byte18	write_event3				
Byte19	write_event2				
Byte20	write_event1				
Byte21	write_event4	Finger Size 1st			
Byte22	write_event3	Finger Size 2nd			

8.8 Command list

Hex	Operation Code	D7	D6	D5	D4	D3	D2	D1	D0	Function
0	No operation	0	0	0	0	0	0	0	0	-
80	Sleep IN	1	0	0	0	0	0	0	0	-
81	Sleep Out	1	0	0	0	0	0	0	1	-
82	Sense Off	1	0	0	0	0	0	1	0	-
83	Sense On	1	0	0	0	0	0	1	1	-
85	Read Event	1	0	0	0	0	1	0	1	-
	1st parameter	B31	B30	B29	B28	B27	B26	B25	B24	-
	2nd parameter	B23	B22	B21	B20	B19	B18	B17	B16	-
	3rd parameter	B15	B14	B13	B12	B11	B10	B9	B8	-
	4th parameter	B7	B6	B5	B4	B3	B2	B1	B0	-
86	Read All Events	1	0	0	0	0	1	1	0	-
	1st parameter	B31	B30	B29	B28	B27	B26	B25	B24	-
	2nd parameter	B23	B22	B21	B20	B19	B18	B17	B16	-
	3rd parameter	B15	B14	B13	B12	B11	B10	B9	B8	-
	4th parameter	B7	B6	B5	B4	B3	B2	B1	B0	-
	5th parameter	E3	E2	E1	E0	F1	P2	P1	P0	-
	6th parameter	B23	B22	B21	B20	B19	B18	B17	B16	-
	...	:	:	:	:	:	:	:	:	-
	(n+1)th parameter	B7	B6	B5	B4	B3	B2	B1	B0	-
87	Read Latest Event	1	0	0	0	0	1	1	1	-
	1st parameter	B31	B30	B29	B28	B27	B26	B25	B24	-
	2nd parameter	B23	B22	B21	B20	B19	B18	B17	B16	-
	3rd parameter	B15	B14	B13	B12	B11	B10	B9	B8	-
	4th parameter	B7	B6	B5	B4	B3	B2	B1	B0	-
88	Clear Stack	1	0	0	0	1	0	0	0	-

8.9 User define command list table

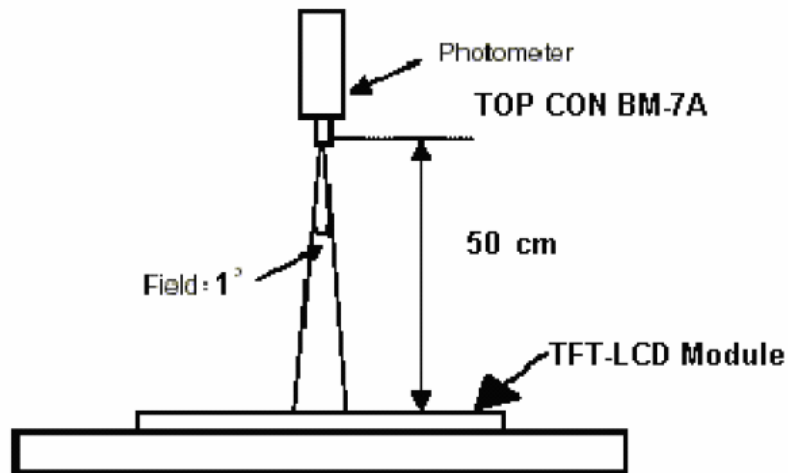
Hex	Operation Code	D7	D6	D5	D4	D3	D2	D1	D0	Function
31h	Device ID	0	0	1	1	0	0	0	1	Response Device ID Code
	1st parameter	85								-
	2nd parameter	20								-
	3rd parameter	00								-
32h	Version ID	0	0	1	1	0	0	0	1	Read Firmware version

9. OPTICAL CHARACTERISTICS

Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Brightness		--	Note1, Note 3, ($\theta = 0^{\circ}$; Normal Viewing Angle)	320	400	--	cd/m2
Uniformity		B-uni		70	75	-	%
Contrast Ratio		CR		480	600	--	--
Response Time		Tr		--	6	--	ms
		Tf		--	14	--	ms
Color Chromaticity	White	Wx		0.260	0.310	0.360	--
		Wy		0.280	0.330	0.380	--
View angle	Horizontal	θ x+	Center CR≥10	65	75	--	
		θ x-		65	75	--	
	Vertical	θ Y+		50	60	--	
		θ Y-		60	70	--	
Image sticking		tis	2 hours	--	--	2	Sec

Note : The following optical specifications shall be measured in a darkroom or equivalent state (ambient luminance ≤ 1 lux, and at room temperature). The operation temperature is $25^\circ\text{C} \pm 2^\circ\text{C}$. The measurement method is shown in Note1.

Note1: The method of optical measurement:

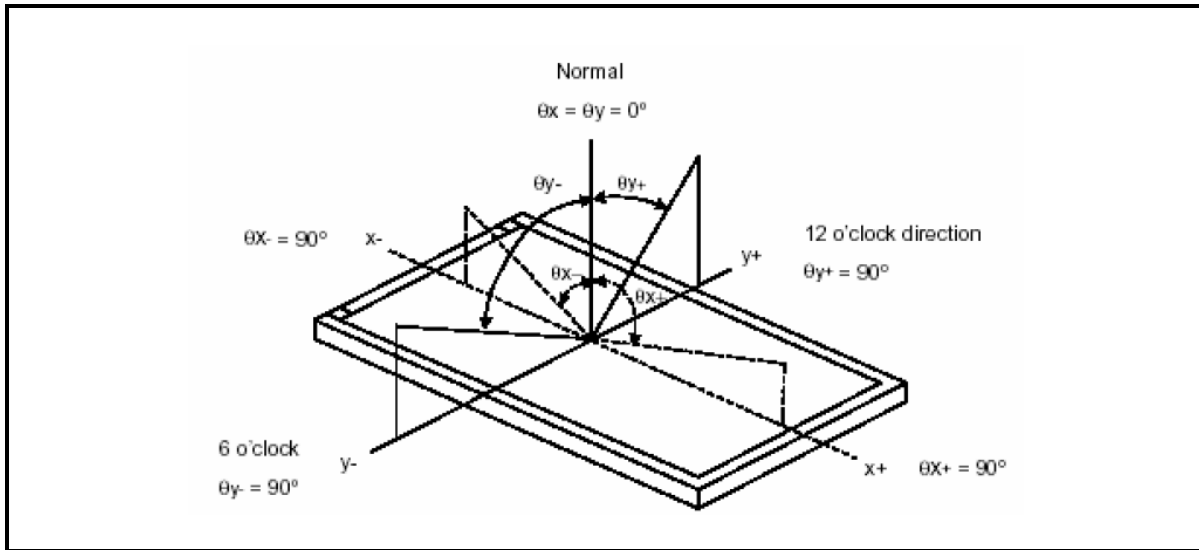


Note2: Measured at the center area of the panel and at the viewing angle of the $\theta x = \theta y = 0^\circ$

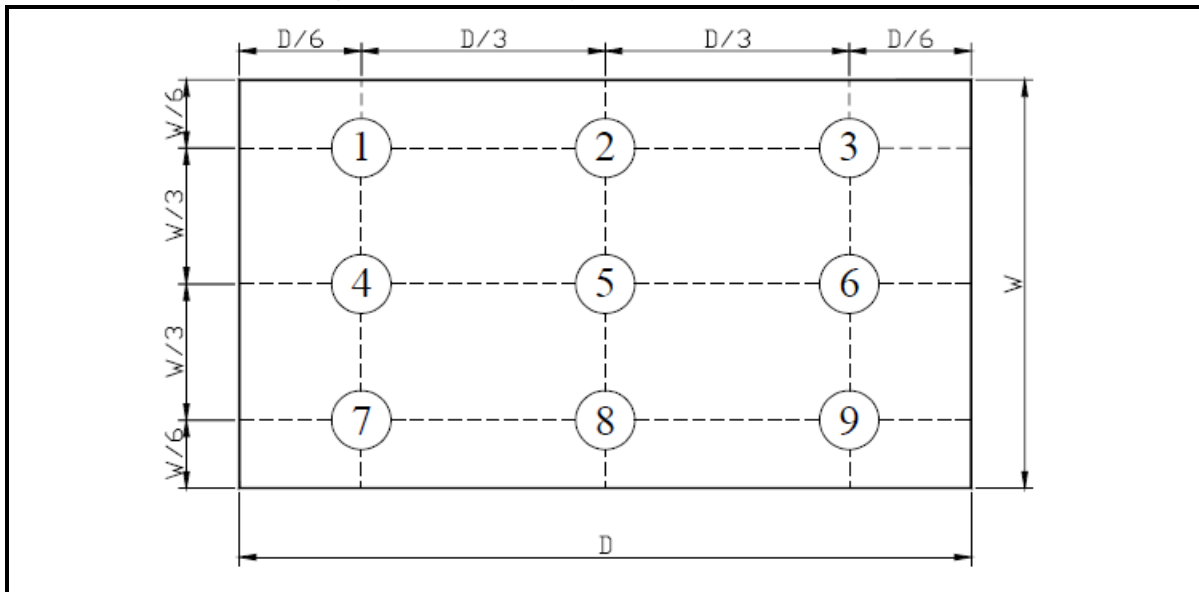
Note3: Definition of Contrast Ratio (CR):

CR = Luminance with all pixels in white state $\div$ Luminance with all pixels in Black state

Note4: Definition of Viewing Angle:



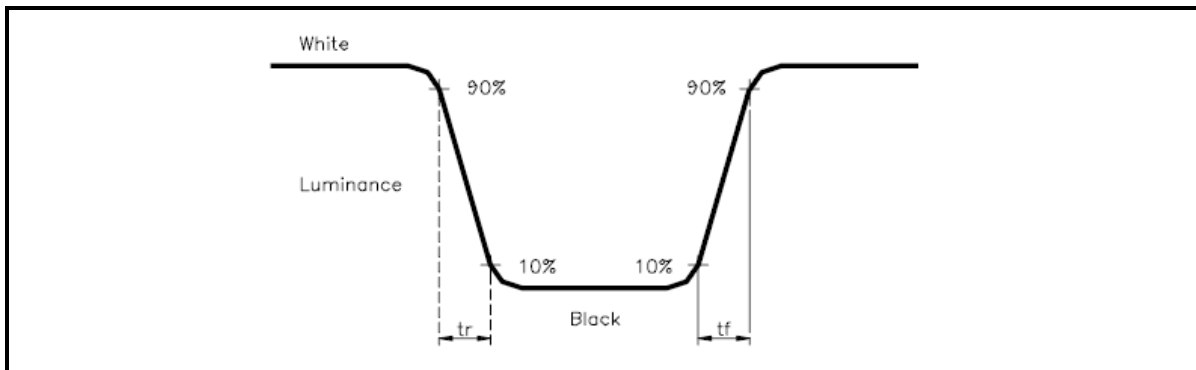
Note 5: Definition of Brightness Uniformity (B-uni):



$$B\text{-uni} = (\text{Minimum luminance of 9 points} \div \text{Maximum luminance of 9 points}) \times 100\%$$

Note 6: Definition of Response Time:

The Response Time is set initially by defining the “Rising Time (T_r)” and the “Falling Time (T_f)” respectively. T_r and T_f are defined as following figure



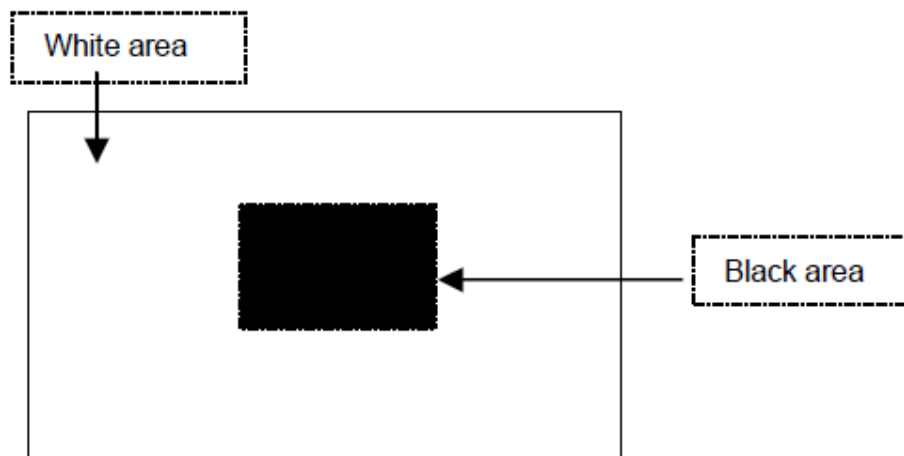
Note 7: Definition of Chromaticity:

The color coordinates (W_x, W_y), (R_x, R_y), (G_x, G_y), and (B_x, B_y) are obtained with all pixels in the viewing field at white, red, green, and blue states, respectively.

Note 8: Definition of Image sticking (t_{is}):

Continuously display the test pattern shown in the figure below for 2 hours. Then display a completely white screen. The previous image shall not persist more than 2 sec at 25 °C

Image sticking pattern



10. RELIABILITY

10.1 Test Condition

10.1.1 Temperature and Humidity(Ambient Temperature)

Temperature : $25 \pm 5^{\circ}\text{C}$

Humidity : $65 \pm 5\%$

10.1.2 Operation

Unless specified otherwise, test will be conducted under function state.

10.1.3 Container

Unless specified otherwise, vibration test will be conducted to the product itself without putting it in a container.

10.1.4 Test Frequency

In case of related to deterioration such as shock test. It will be conducted only once.

10.2 TESTS

No.	ITEM	CONDITION CRITERION
1	High Temperature Storage	80°C, 120 hrs
2	Low Temperature Storage	-30°C, 120 hrs
3	High Temperature Operating	70°C, 120 hrs
4	Low Temperature Operating	-20°C, 120 hrs
5	High Temperature/Humidity Non-Operating	60°C, 90%RH, 120 hrs
6	Temperature Shock Non-Operating	-30°C $\longleftrightarrow$ 80°C (0.5hr each), 25 cycles
7	Vibration Test Non-Operating	Frequency:0 ~ 55 Hz Amplitude:1.5 mm Sweep Time:11min Test Period:6 Cycles for each Direction of X,Y,Z
8	Electro-static Discharge Non-Operating	150pF,330Ω Air:± 8KV;Contact: ±4KV 10 times/point;4 points/panel face

Note1: The test sample have recovery time for 24 hours at room temperature before the function check. In the standard conditions, there is no any touch panel function NG issue occurred.

10.3 JUDGMENT STANDARD

The judgment of the above test should be made as follow:

Pass: Normal display image with no obvious non-uniformity and no line defect. Partial transformation of the module parts should be ignored.

Fail: No display image, obvious non-uniformity, or line defects.

10.4 INCOMING INSPECTION STANDARDS

No.	Parameter	Criteria																
1	Operating	Display function: No Display malfunction (Major)																
		Contrast ratio (Black, White): Does not meet specified range in the spec. (Major) (Note:3)																
		Line Defect: No obvious Vertical and Horizontal line defect in bright, dark and colored. (Major) (Note:1)																
		Point Defect (Red, green, blue, dark): Active area ≤ 5 dots (Minor) (Note:1)																
		<table><tr><th rowspan="2">Item</th><th colspan="2">Acceptable number</th><th rowspan="2">Total</th></tr><tr><th>A</th><th>B</th></tr><tr><td>Bright</td><td>0</td><td>2</td><td rowspan="3">5</td></tr><tr><td>Dark</td><td>2</td><td>4</td></tr><tr><td>Total</td><td>2</td><td>4</td></tr></table>	Item	Acceptable number		Total	A	B	Bright	0	2	5	Dark	2	4	Total	2	4
		Item		Acceptable number			Total											
			A	B														
		Bright	0	2	5													
		Dark	2	4														
		Total	2	4														
Non-uniformity: Visible through 6%ND filter. (Minor)																		
Foreign material in Black or White spots shape (W>1/4L)																		
<table><tr><th>Zone Dimension</th><th>Acceptable number</th><th>Class Of Defects</th><th>AQL Level</th></tr><tr><td>D> 0.5</td><td>0</td><td rowspan="3">Minor</td><td rowspan="3">1.5</td></tr><tr><td>0.1 ≤ D ≤ 0.5</td><td>4</td></tr><tr><td>D ≤ 0.1</td><td>*</td></tr></table> D = (Long + Short) / 2 * : Disregard	Zone Dimension	Acceptable number	Class Of Defects	AQL Level	D> 0.5	0	Minor	1.5	0.1 ≤ D ≤ 0.5	4	D ≤ 0.1	*						
Zone Dimension	Acceptable number	Class Of Defects	AQL Level															
D> 0.5	0	Minor	1.5															
0.1 ≤ D ≤ 0.5	4																	
D ≤ 0.1	*																	
Foreign Material in Line or spiral shape (W≤1/4L) (Note: 4)																		
<table><tr><th>L (mm)</th><th>Zone W(mm)</th><th>Acceptable number</th><th>Class Of Defects</th><th>AQL Level</th></tr><tr><td>L >2</td><td>W>0.1</td><td>0</td><td rowspan="3">Minor</td><td rowspan="3">1.5</td></tr><tr><td>0.5 < L ≤ 2</td><td>0.03 < W≤0.1</td><td>1</td></tr><tr><td>L ≤0.5</td><td>W≤0.03</td><td>*</td></tr></table> L : Length W : Width * : Disregard	L (mm)	Zone W(mm)	Acceptable number	Class Of Defects	AQL Level	L >2	W>0.1	0	Minor	1.5	0.5 < L ≤ 2	0.03 < W≤0.1	1	L ≤0.5	W≤0.03	*		
L (mm)	Zone W(mm)	Acceptable number	Class Of Defects	AQL Level														
L >2	W>0.1	0	Minor	1.5														
0.5 < L ≤ 2	0.03 < W≤0.1	1																
L ≤0.5	W≤0.03	*																
2	External Inspection (non-operating)	Dimension: Outline (Major)																
		Bezel appearance: uneven (Minor)																
		Scratch on the polarize: (Note:2)																
		<table><tr><th>L (mm)</th><th>Zone W(mm)</th><th>Acceptable number</th><th>Class Of Defects</th><th>AQL Level</th></tr><tr><td>--</td><td>W>0.1</td><td>0</td><td rowspan="2">Minor</td><td rowspan="2">1.5</td></tr><tr><td>L ≤ 2</td><td>W≤0.1</td><td>3</td></tr></table> L : Length W : Width * : Disregard	L (mm)	Zone W(mm)	Acceptable number	Class Of Defects	AQL Level	--	W>0.1	0	Minor	1.5	L ≤ 2	W≤0.1	3			
		L (mm)	Zone W(mm)	Acceptable number	Class Of Defects	AQL Level												
		--	W>0.1	0	Minor	1.5												
		L ≤ 2	W≤0.1	3														
		Dent or bubble on the polarize (Note:2)																
		<table><tr><th>Zone Dimension</th><th>Acceptable number</th><th>Class Of Defects</th><th>AQL Level</th></tr><tr><td>D≤0.05</td><td>*</td><td rowspan="2">Minor</td><td rowspan="2">1.5</td></tr><tr><td>D≤0.3</td><td>3</td></tr></table> D = (Long + Short) / 2 * : Disregard	Zone Dimension	Acceptable number	Class Of Defects	AQL Level	D≤0.05	*	Minor	1.5	D≤0.3	3						
		Zone Dimension	Acceptable number	Class Of Defects	AQL Level													
D≤0.05	*	Minor	1.5															
D≤0.3	3																	

Class of defects	Major	AQL 0.65%	Definition
	Minor	AQL 1.5%	It is a defect that will not result in functioning problem with deviation classified.

Note1:

(a) Bright point defect is defined as point defect of R,G,B with area $>1/2$ pixel respectively

(b) Dark point defect is defined as visible in full white pattern.

(c) Definition of distribution of point defect is as follows:

- minimum separation between dark point defects should be larger than 5mm.
- minimum separation between bright point defects should be larger than 5mm.

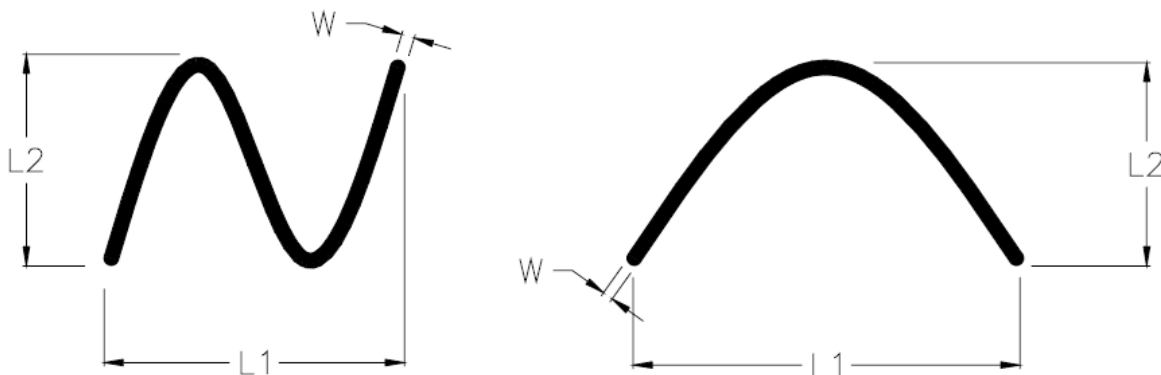
(d) Definition of joined bright point defect and joined dark point defect are as follows:

- Two or more joined bright point defects must be nil.
- Three joined dark point defects must be nil.
- Coupling of one dark and one bright point in junction is counted as one dark and bright spot with 1 pair maximum.
- Two Joined dark point is counted as two dark points with 2 pair maximum.

Note2: The external inspection should be conducted at the distance 30 ± 5 cm between the eyes of inspector and the panel.

Note3: Luminance measurement for contrast ratio is at the distance 50 ± 5 cm between the detective head and the panel with ambient luminance less than 1 lux. Contrast ratio is obtained at optimum view angle.

Note4: W-Width in mm , L-length of Max.(L1,L2) in mm.



10.5 Sampling Condition

Unless otherwise agree in written, the sampling inspection shall be applied to the incoming inspection of customer.

Lot size: Quantity of shipment lot per model.

Sampling type: normal inspection, single sampling

Sampling table: MIL-STD-105E

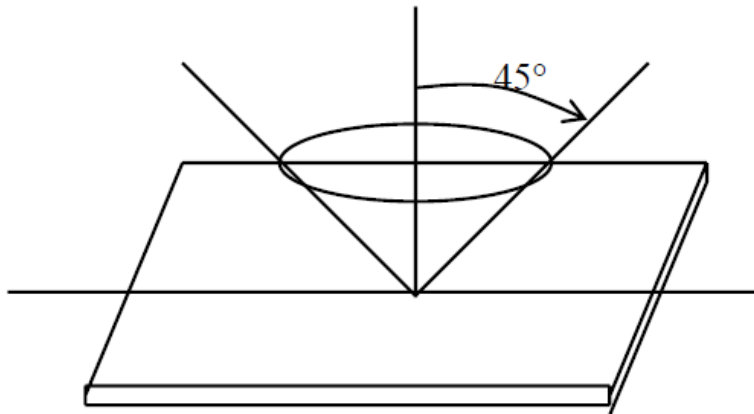
Inspection level: Level II

10.6 Inspection conditions

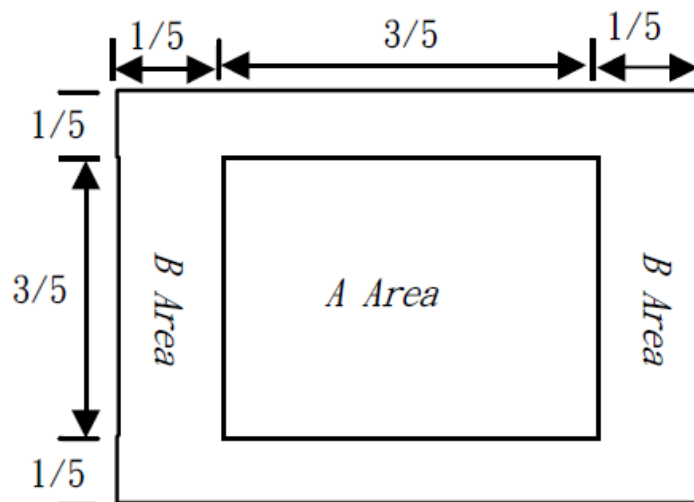
The LCD shall be inspected under 40W white fluorescent light.

$\theta \leq 45^\circ$ inspection under non-operating condition.

$\theta \leq 5^\circ$ inspection under operating condition



Definition of applicable Zones



11. PRECAUTION RELATING PRODUCT HANDLING

11.1 SAFETY

- 11.1.1** If the LCD panel breaks , be careful not to get the liquid crystal to touch your skin.
- 11.1.2** If the liquid crystal touches your skin or clothes , please wash it off immediately by using soap and water.

11.2 HANDLING

- 11.2.1** Avoid any strong mechanical shock which can break the glass.
- 11.2.2** Avoid static electricity which can damage the CMOS LSI—When working with the module, be sure to ground your body and any electrical equipment you may be using.
- 11.2.3** Do not remove the panel or frame from the module.
- 11.2.4** The polarizing plate of the display is very fragile. So , please handle it very carefully, Do not touch, push or rub the exposed polarizing with anything harder than an HB pencil lead (glass , tweezers , etc.)
- 11.2.5** Do not wipe the polarizing plate with a dry cloth, as it may easily scratch the surface of plate.
- 11.2.6** Do not touch the display area with bare hands , this will stain the display area.
- 11.2.7** Do not use ketonics solvent & aromatic solvent. Use with a soft cloth soaked with a cleaning naphtha solvent.
- 11.2.8** To control temperature and time of soldering is $280 \pm 10^{\circ}\text{C}$ and 3-5 sec.
- 11.2.9** To avoid liquid (include organic solvent) stained on LCM.

11.3 STORAGE

- 11.3.1** Store the panel or module in a dark place where the temperature is $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ and the humidity is below 65% RH.
- 11.3.2** Do not place the module near organics solvents or corrosive gases.
- 11.3.3** Do not crush, shake, or jolt the module.