Display Elektronik GmbH

DATA SHEET

TFT MODULE

DEM 480272B1 TMH-PW-N

(C-TOUCH)

4,3“ TFT

Product Specification **Ver.: 0**

18.11.2019

Revise Records

Rev.	Date	Contents	Written	Approved
0	18.11.2019	Preliminary Specification	R	MHI

Special Notes

Note1.	

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1 General Description and Features

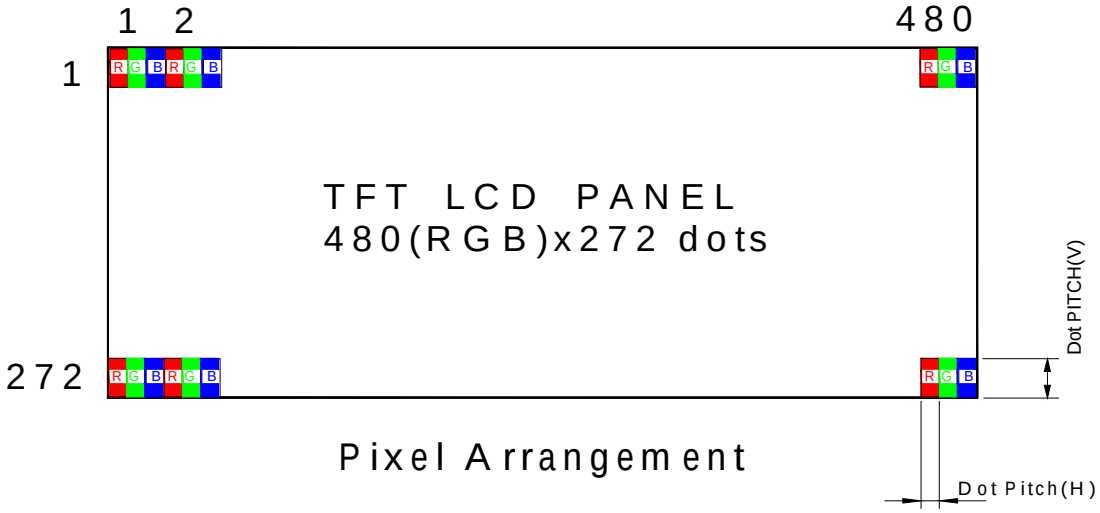
DEM 480272B1 TMH-PW-N(C-TOUCH) is a TM (Transmissive) type color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching device. This model is composed of a TFT-LCD module, a driver circuit, a touch panel and a back-light unit. The resolution of a 4.3" contains 480(RGB)x272 dots. The following table described the features of DEM 480272B1 TMH-PW-N(C-TOUCH.

1.1 Features

- Transmissive and back-light with 14 LEDs are available.
- TN mode.
- 24bit RGB Interface
- ROHS Compliance

1.2 LCD Module

Item	Specification	Unit
Screen Size	4.3 Inches	Diagonal
Display Resolution	480 x RGB x 272	Dot
Pixel Size	0.198 x 0.198	mm
Active Area	95.040 x 53.856	mm
Outline Dimension	123.5 x 85.2 x 5.32	mm
Display Mode	Normally White / Transmissive	--
Pixel Arrangement	RGB Vertical-Stripe	--
Surface Treatment	Anti-Glare (AG)	--
Display Color	16.7 Million	--
Viewing Direction	6 o'clock (Gray Inversion)	--
Input Interface	Digital 24-bits Parallel RGB	--
Color Gamut (NTSC%)	NTSC 50%	--



2 Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	123.30	123.50	123.70	mm	--
	Vertical (V)	85.00	85.20	85.40	mm	(1)
	Thickness (T)	5.02	5.32	5.62	mm	(1)
Weight		--	TBD	--	g	--

Note (1) Not include FPC.
Refer to the Dimensional Outlines for further information.

3 Electrical Specifications

3.1 Absolute Max. Ratings

3.1.1 Absolute Ratings of Environment

If the operating condition exceeds the following absolute maximum ratings, the TFT LCD module may be damaged permanently.

(Ta=25±2°C, V_{SS}=GND=0)

Item	Symbol	Min.	Max.	Unit	Note
Storage Temperature	T_{STG}	-30	80	°C	(1)
Operating Temperature	T_{OPR}	-20	70	°C	(1,2,3)

Note (1) 95 % RH Max. (40 °C ≥ Ta). Maximum wet-bulb temperature at 39 °C or less. (Ta > 40 °C)
No condensation.

Note (2) In case of below 0°, the response time of liquid crystal (LC) becomes slower and the color of panel becomes darker than normal one. Level of retardation depends on temperature, because of LC's character

Note (3) Only operation is guarantied at operating temperature. Contrast, response time, another display quality are evaluated at +25°C.

3.2 Electrical Absolute Rating

3.2.1 TFT-LCD Module

(Ta=25±2°C, V_{SS}=GND=0)

Item	Symbol	Value		Unit	Condition
		Min.	Max.		
Power Supply Voltage	DV_{DD}	-0.3	4.5	V	

3.2.2 Back-Light Unit

(Ta=25±2°C)

Item	Symbol	Min.	Max.	Unit	Note
Current of One LED	I_B	--	(25)	mA	(1)

Note (1) Permanent damage to the device may occur if maximum values are exceeded or reverse voltage is loaded. Functional operation should be restricted to the conditions described under normal operating conditions.

4 Electrical Characteristics

4.1 TFT-LCD Module

(Ta=25±2°C, V_{DD} =3.3V)

Item	Symbol	Value			Unit	Condition
		Min.	Typ.	Max.		
Power Supply Voltage	V_{DD}	3.0	3.3	3.6	V	
Digital Current	I_{DD}	-	(13)	(15)	mA	

Note (1) The specified power consumption is under the conditions at V_{CC}=3.3V , F_V=60Hz, whereas a Power dissipation check pattern below is displayed.

Black Pattern / 0 Gray

Active Area

4.2 Backlight Unit

The back-light system is an edge-lighting type with white LED (Light Emitting Diode)s.

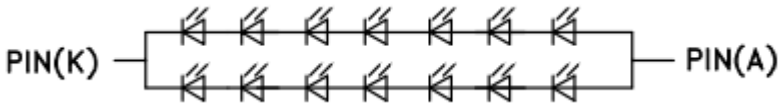
(Ta=25±2°C)

Item	Symbol	Value			Unit	Condition
		Min.	Typ.	Max.		
LED Voltage	VL	-	22.4		V	
LED Current	If	-	40		mA	
Power Consumption	P_{LED}	-	896		mW	
LED Lifetime (25℃)	-	35000	50000	-	hr	

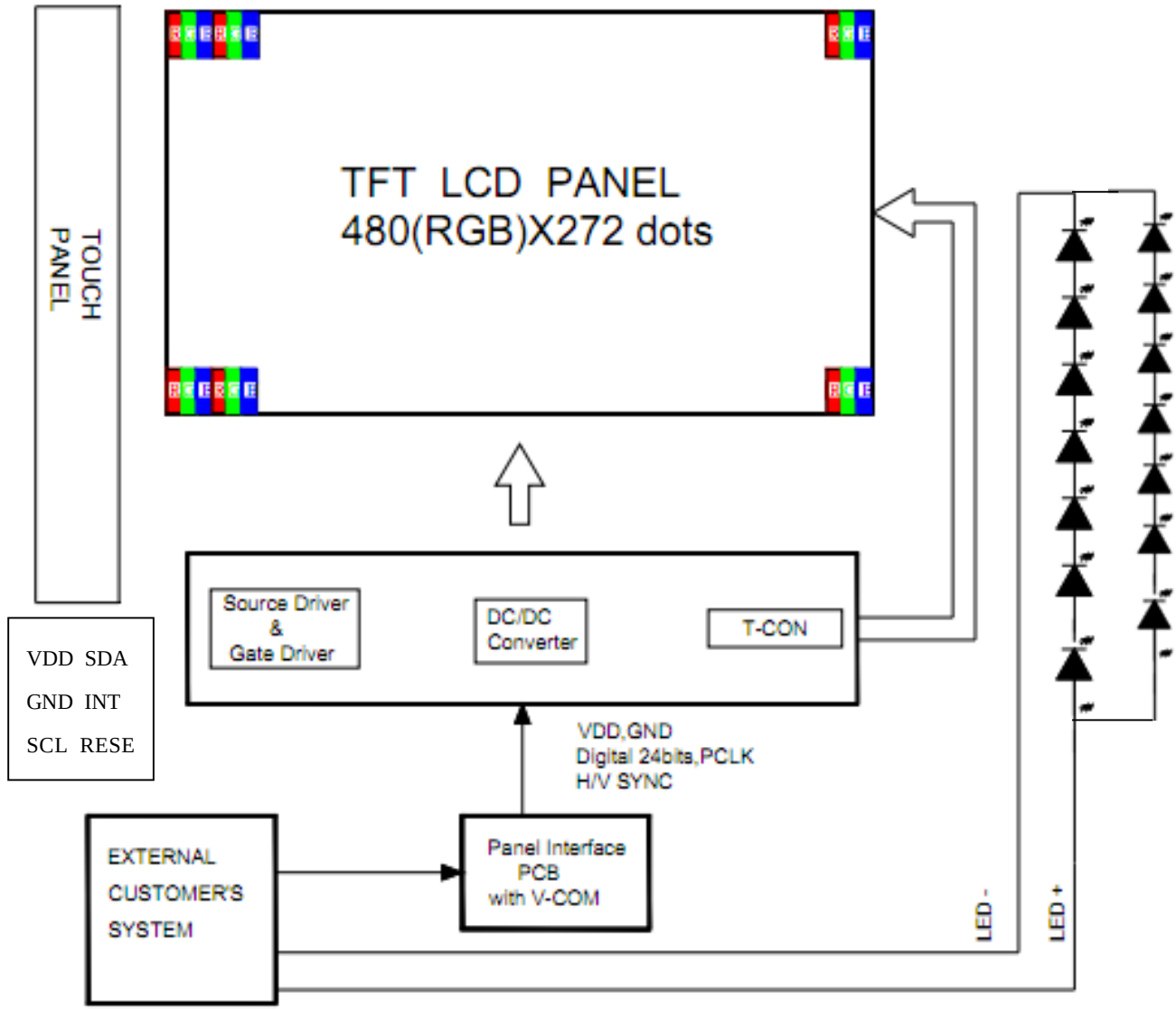
Note (1) 14 LEDs serial type.

(2) Where I_f = 40mA, V_L = 22.4V, P_{LED} = V_L × I_f

(3)The environmental conducted under ambient air flow ,at Ta=25±2°C,60%RH±5%



5 Block Diagram



6 Input Terminal Pin Assignment

6.1 CN1 Pin Assignment

(Reference Connector: Hirose:FH12A-40S-0.5SH(55) Top contact type)

Pin No	Symbol	Description	Input/Output	Note
1	VLED-	Power for LED Backlight Cathode	P	
2	VLED+	Power for LED Backlight Anode	P	
3	GND	Power Ground	P	
4	VDD	Power Supply For digital circuit	P	
5	R0	Red Data (LSB)	I	
6	R1	Red Data	I	
7	R2	Red Data	I	
8	R3	Red Data	I	
9	R4	Red Data	I	
10	R5	Red Data	I	
11	R6	Red Data	I	
12	R7	Red Data (MSB)	I	
13	G0	Green Data(LSB)	I	
14	G1	Green Data	I	
15	G2	Green Data	I	
16	G3	Green Data	I	
17	G4	Green Data	I	
18	G5	Green Data	I	
19	G6	Green Data	I	
20	G7	Green Data(MSB)	I	
21	B0	Blue Data (LSB)	I	
22	B1	Blue Data	I	
23	B2	Blue Data	I	
24	B3	Blue Data	I	
25	B4	Blue Data	I	
26	B5	Blue Data	I	
27	B6	Blue Data	I	
28	B7	Blue Data(MSB)	I	
29	GND	Power Ground	P	
30	DCLK	Dot Clock Signal	I	
31	DISP	Display On/off Mode Control H: Display On L: Display OFF	I	
32	HSYNC	Horizontal Synchronization Signal	I	(1)
33	VSYNC	Vertical Synchronization Signal	I	(1)
34	DE	Input Data Enable Control	I	

35	NC	No Connection	--	
36	GND	Power Ground	P	
37	XR	Touch Panel Right Side	I/O	
38	YD	Touch Panel Bottom Side	I/O	
39	XL	Touch Panel Left Side	I/O	
40	YU	Touch Panel Top Side	I/O	

Note:

(1). Default Use SYNC MODE.

7 Optical Characteristics

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room
Measuring equipment: BM-7A

(Ta=25±2°C , VDD =3.3V, $I_{f=}$40mA)

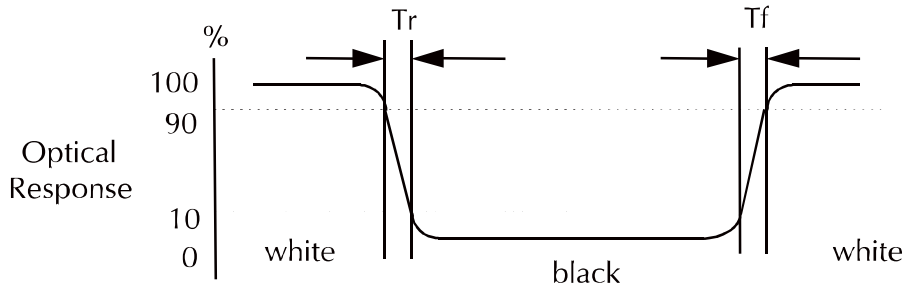
Item		Symbol	Condition	Min	Type	Max	Unit	Note
Brightness		--	--	700	900	--	cd/m^2	--
Response time		T_{on+} T_{off}	θ=0°	--	25	50	ms	--
Contrast ratio		CR	At optimized viewing angle	300	500	--	--	--
Color Chromaticity	Red	R_X	θ=0° Normal Viewing Angle	(0.57)	(0.62)	(0.67)	--	--
		R_Y		(0.29)	(0.34)	(0.39)		
	Green	G_X		(0.29)	(0.34)	(0.39)	--	
		G_Y		(0.52)	(0.57)	(0.62)		
	Blue	B_X		(0.09)	(0.14)	(0.19)	--	
		B_Y		(0.05)	(0.10)	(0.15)		
	White	Wx		(0.27)	(0.32)	(0.37)	--	
		Wy		(0.29)	(0.34)	(0.39)		
Viewing Angle (6H)	Hor.	θ_R	CR≥10	-	(70)		Degree	--
		θ_L		-	(70)			
	Ver.	θ_U		-	(50)			
		θ_D		-	(70)			

a. Test equipment setup

After stabilizing and leaving the panel alone shall be warmed up for the stable operation of LCM, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. Optical specifications are measured by Topcon BM-5A/BM-7(fast) with a viewing angle of 2° at a distance of 50cm and normal direction.

b. Definition of response time: Tr and Tf

The response time is defined as the following figure and shall be measured by switching the input signal for “black” and “white”.

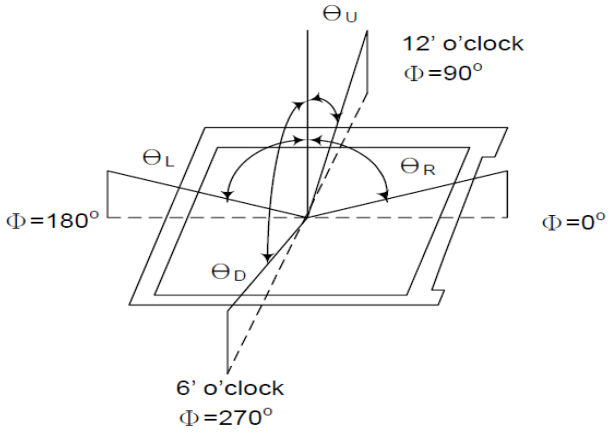


c. Definition of contrast ratio:

$$\text{Contrast Ratio (CR)} = \frac{\text{Brightness measured when LCD is at “white state”}}{\text{Brightness measured when LCD is at “black state”}}$$

d. Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

e. View Angle



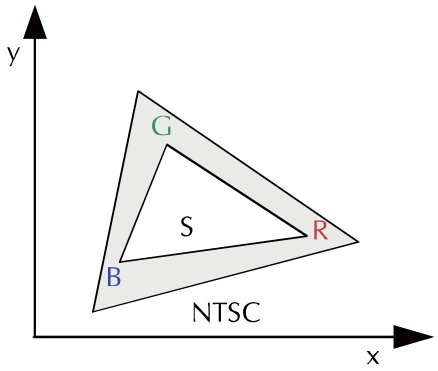
f. Definition of Luminance of White: Luminance of white at the center points

Light Source of Back-Light Unit	LED Type

g. Definition of White Uniformity

$$\text{White Uniformity} = \frac{\text{Min. luminance of white among 9-points}}{\text{Max. luminance of white among 9-points}} \times 100\%$$

h. The definition of Color Gamut -Color Chromaticity CIE 1931
Color coordinate of white & red, green, blue at center point.
Color Gamut : NTSC(%) = (RGB Triangle Area / NTSC Triangle Area) x 100



8 Touch Screen Panel Specifications

8.1 Touch Panel

Item	Specification	Unit
Screen Size	4.3 inches	Diagonal
Type	Transparent Type Projected Capacitive Touch Panel	--
Input Mode	Human's Finger/ Gloves	--
Point	5	--
Interface	I2C	--
Cover glass pencil-handness	6H(min) by JIS K5400	--
IC solution	IC : GT911	--

8.2 Electrical Characteristics

8.2.1 Absolute Maximum Ratings

Parameter	Min.	Max.	Unit
Analog power AVDD28 (please refer to AGND)	2.66	3.47	V
VDDIO (please refer to DGND)	1.7	3.47	V
Voltage on digital I/O	-0.3	3.47	V
Voltage on analog I/O	-0.3	3.47	V
Range of operating temperature	-40	85	℃
Range of storage temperature	-60	125	℃
ESD susceptibility (HB Model)	—	±2	KV

8.2.2 Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Unit
AVDD28	2.8	-	3.3	V
VDDIO	1.8	-	AVDD28	V
Operating temperature	-20	-	85	℃

8.2.3 AC Electrical Characteristics

(Ambient temperature:25℃, AVDD28=2.8V, VDDIO=1.8V)

Parameter	Min.	Typ.	Max.	Unit
OSC oscillation frequency	59	60	61	MHz
I/O output rise time, low to high	-	14	-	ns
I/O output fall time, high to low	-	14	-	ns

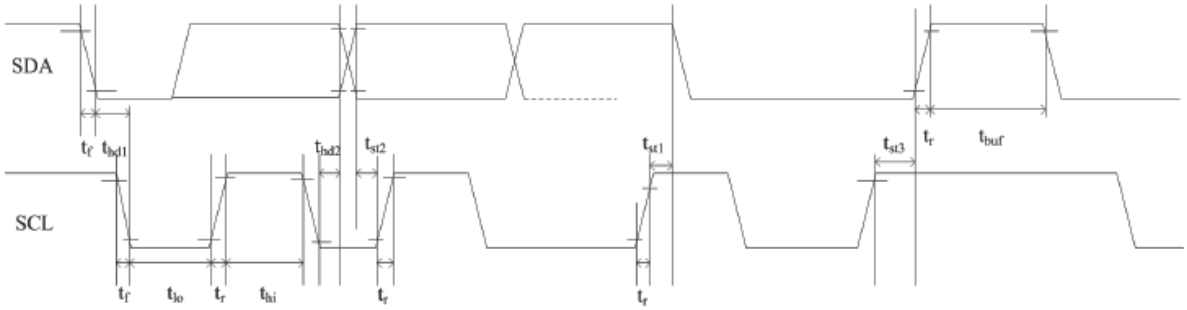
8.2.4 DC Electrical Characteristics

(Ambient temperature:25℃, AVDD28=2.8V)

Parameter	Min.	Typ.	Max.	Unit
Normal mode operating current	-	13	-	mA
Green mode operating current	-	4.5	-	mA
Sleep mode operating current	70	-	120	uA
Doze mode operating current	-	1.3	-	mA
Digital input low voltage/VIL	-0.3	-	0.25*VDDIO	V
Digital input high voltage/VIH	0.75*VDDIO	-	VDDIO+0.3	V
Digital output low voltage/VOL	-	-	0.15*VDDIO	V
Digital output high voltage/VOH	0.85*VDDIO	-	-	V

8.3 I2C Timing

GT9110 provides a standard I²C interface for SCL and SDA to communicate with the host. GT9110 always serves as slave device in the system with all communication being initialized by the host. It is strongly recommended that transmission rate be kept at or below 400Kbps. The I²C timing is shown below:



Test condition 1: 1.8V host interface voltage, 400Kbps transmission rate, 2K pull-up resistor

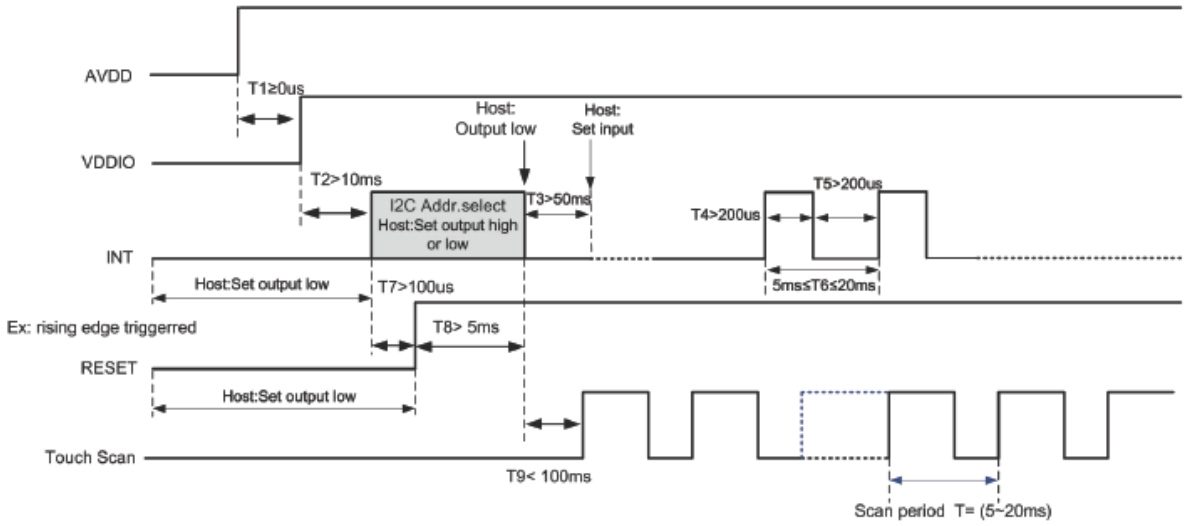
Parameter	Symbol	Min.	Max.	Unit
SCL low period	t_{lo}	1.3	-	us
SCL high period	t_{hi}	0.6	-	us
SCL setup time for Start condition	t_{st1}	0.6	-	us
SCL setup time for Stop condition	t_{st3}	0.6	-	us
SCL hold time for Start condition	t_{hd1}	0.6	-	us
SDA setup time	t_{st2}	0.1	-	us
SDA hold time	t_{hd2}	0	-	us

Test condition 2: 3.3V host interface voltage, 400Kbps transmission rate, 2K pull-up resistor

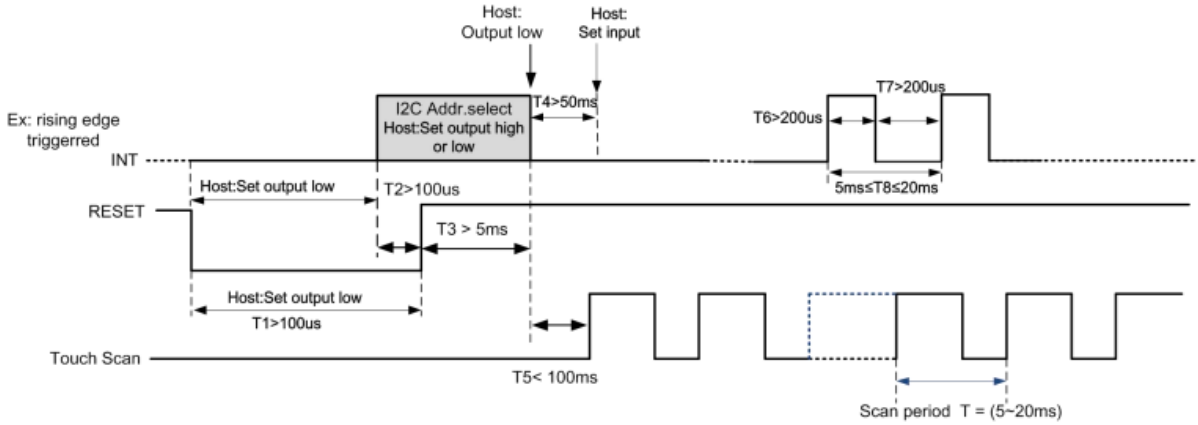
Parameter	Symbol	Min.	Max.	Unit
SCL low period	t_{lo}	1.3	-	us
SCL high period	t_{hi}	0.6	-	us
SCL setup time for Start condition	t_{st1}	0.6	-	us
SCL setup time for Stop condition	t_{st3}	0.6	-	us
SCL hold time for Start condition	t_{hd1}	0.6	-	us
SDA setup time	t_{st2}	0.1	-	us
SDA hold time	t_{hd2}	0	-	us

GT9110 supports two I2C slave addresses: 0xBA/0xBB and 0x28/0x29. The host can select the addr ess by changing the status of Reset and INT pins during the power-on initialization phase. See the diagram below for configuration methods and timings:

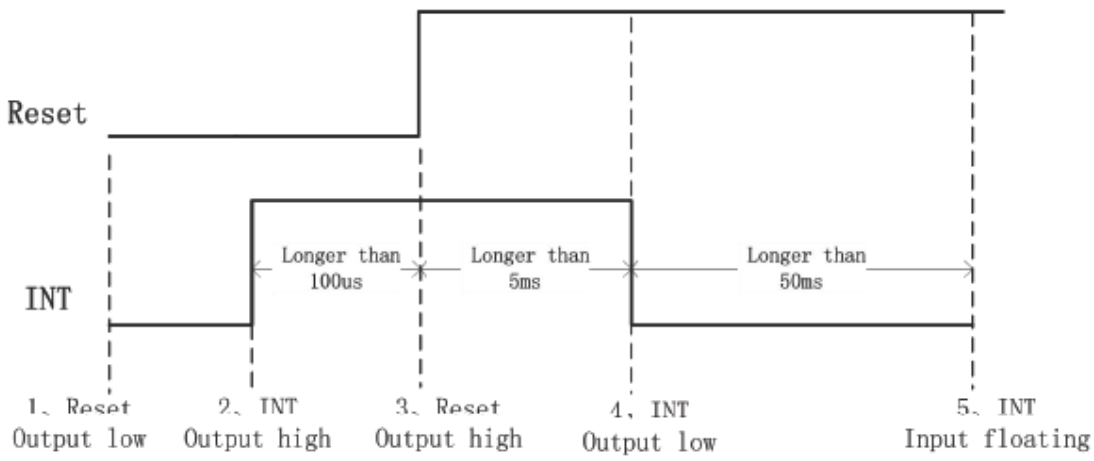
Power-on Timing:



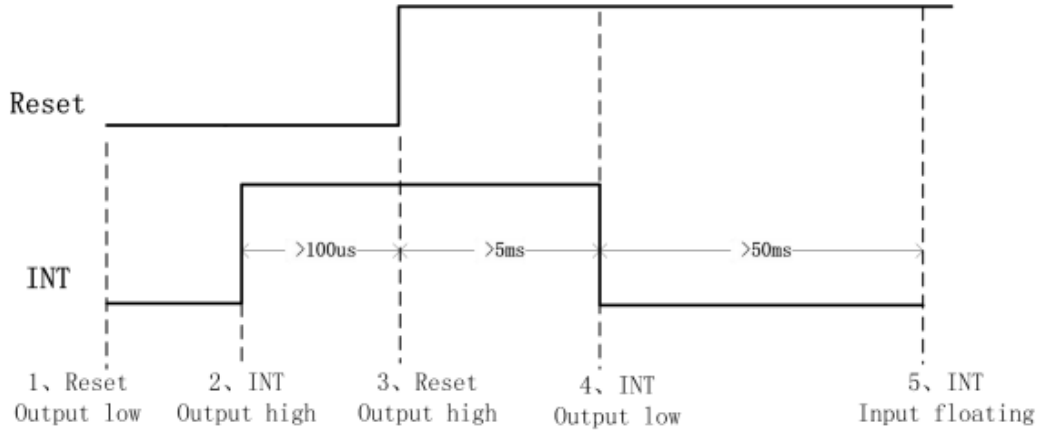
Timing for host resetting GT911:



Timing for setting slave address to 0x28/0x29:



Timing for setting slave address to 0x28/0x29:



8.4 Pin Assignments and Definitions.

Item	Name	Function
1	VDD(3.3V)	Power supply 3.3V
2	GND	Ground
3	SCL	I2C Clock
4	SDA	I2C Data
5	INT	Interrupt request to the host
6	RST	External Reset, active low

9 Basic Display Color and Gray Scale

	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(0)	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	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	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

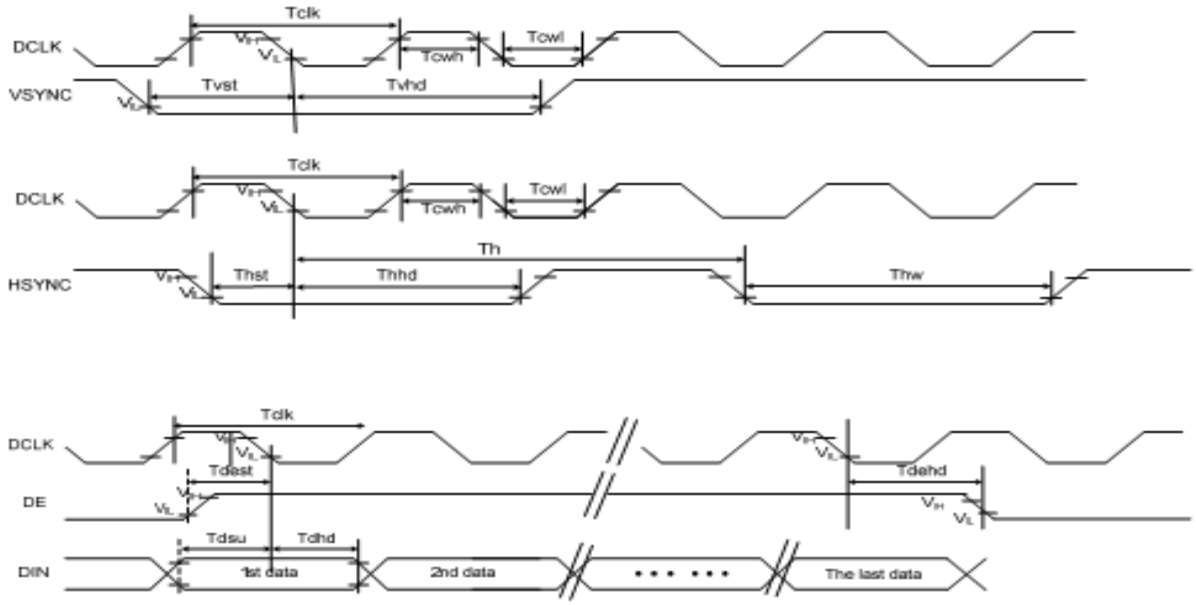
0 : Low level voltage, 1 :High level voltage

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.

10 AC Timing

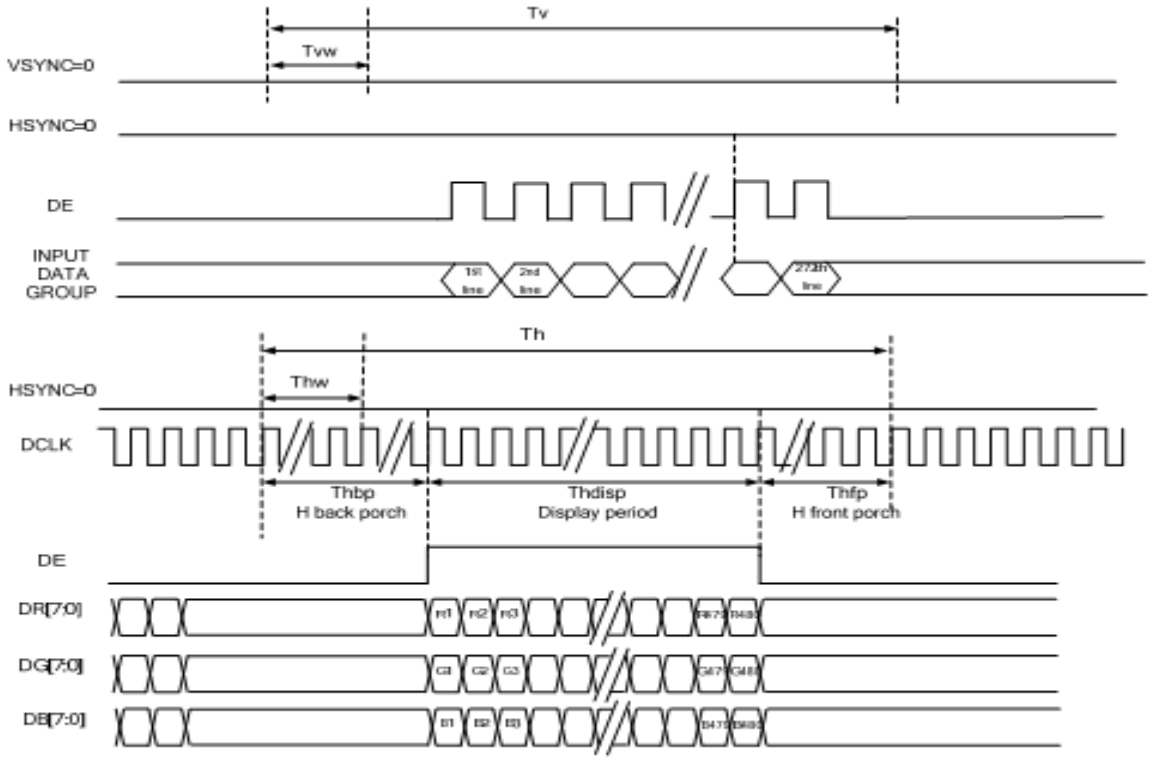
10.1 AC Characteristics

Item	Symbol	Min.	Typ.	Max.	Unit	Conditions
System operation timing						
VDD power source slew time	TPOR	-	-	20	ms	From 0V to 99% VDD
GRB pulse width	tRSTW	10	50	-	us	R=10Kohm, C=1uF
Input/ Output timing						
CLK pulse duty	Tcw	40	50	60	%	
Hsync width	Thw	2	-	-	DCLK	
Hsync period	Th	55	60	65	us	
Vsync setup time	Tvst	12	-	-	ns	
Vsync hold time	Tvhd	12	-	-	ns	
Hsync setup time	Thst	12	-	-	ns	
Hsync hold time	Thhd	12	-	-	ns	
Data setup time	Tdsu	12	-	-	ns	
Data hold time	Tdhd	12	-	-	ns	
DE setup time	Tdest	10	-	-	ns	
DE setup time	Tdehd	10	-	-	ns	



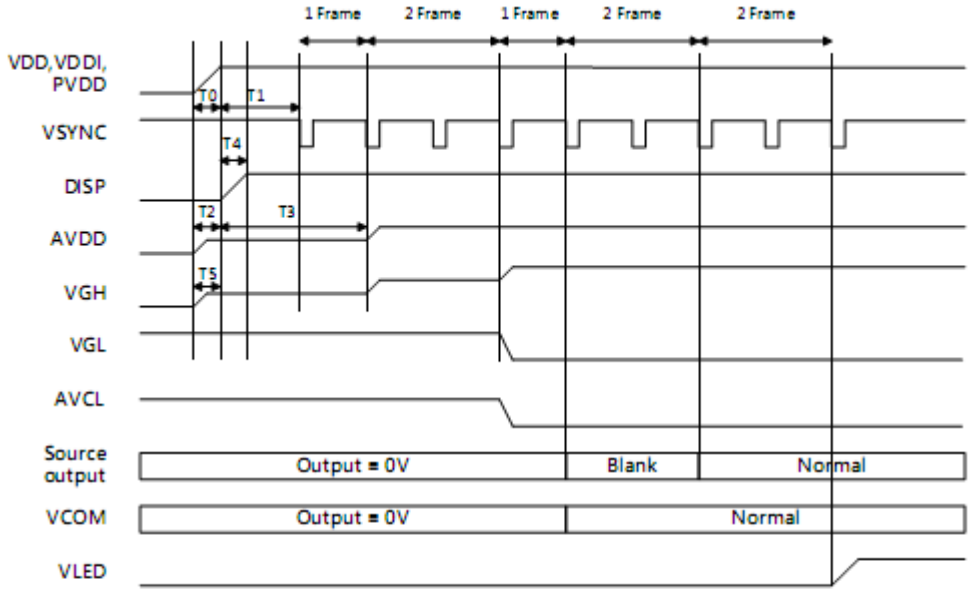
10.2 Parallel RGB Input Timing Table (SYNC MODE)

Item		Symbol	Min.	Typ.	Max.	Unit	Remark
DCLK Frequency		Fclk	8	9	12	MHz	
DCLK Period		Tclk	83	111	125	ns	
HSYNC	Period Time	Th	485	531	598	DCLK	
	Display Period	Thdisp		480		DCLK	
	Back Porch	Thbp	3	43	43	DCLK	By H_Blanking setting
	Front Porch	Thfp	2	8	75	DCLK	
	Pulse Width	Thw	2	4	75	DCLK	
VSYNC	Period Time	Tv	276	292	321	H	
	Display Period	Tvdisp		272		H	
	Back Porch	Tvbp	2	12	12	H	By V_Blanking setting
	Front Porch	Tvfp	2	8	37	H	
	Pulse Width	Tvw	2	4	37	H	



10.3 POWER ON/OFF SEQUENCE

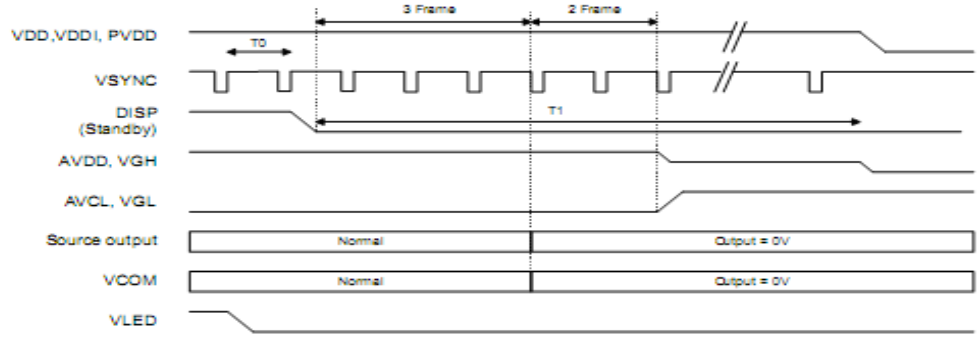
10.3.1 Power ON Sequence



Item	Description	Min. Time
T0	Determined by the external power	
T1	Time from stable VDD, VDDI, PVDD set-up to the first VSYNC	T1=0
T2	Time from AVDD=0V to AVDD=3.3V	T2=T0
T3	Time from AVDD=3.3V to AVDD=6.0V	T3=T1+ (1*Frame)
T4	Time from stable VDD, VDDI, PVDD set-up to DISP asserted	T4=0
T5	Time from VGH=0V to VGH=3.3V	T5=T0

Note: Recommend the LCM power on rise time T0= 0~ 1ms.

10.3.2 Power OFF Sequence



Item	Description	Min. Time
T0	Time from backlight power off to DISP="L"	1*Frame
T1	Time from DISP="L" to LCM Power off	5*Frame

11 Test

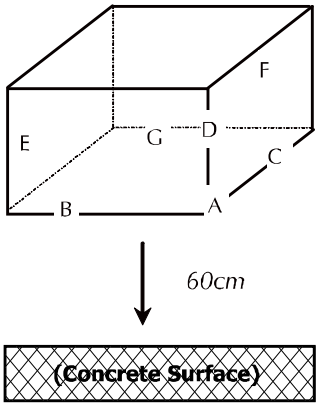
No change on display and in operation under the following test condition.

Condition: Unless otherwise specified, tests will be conducted under the following condition.

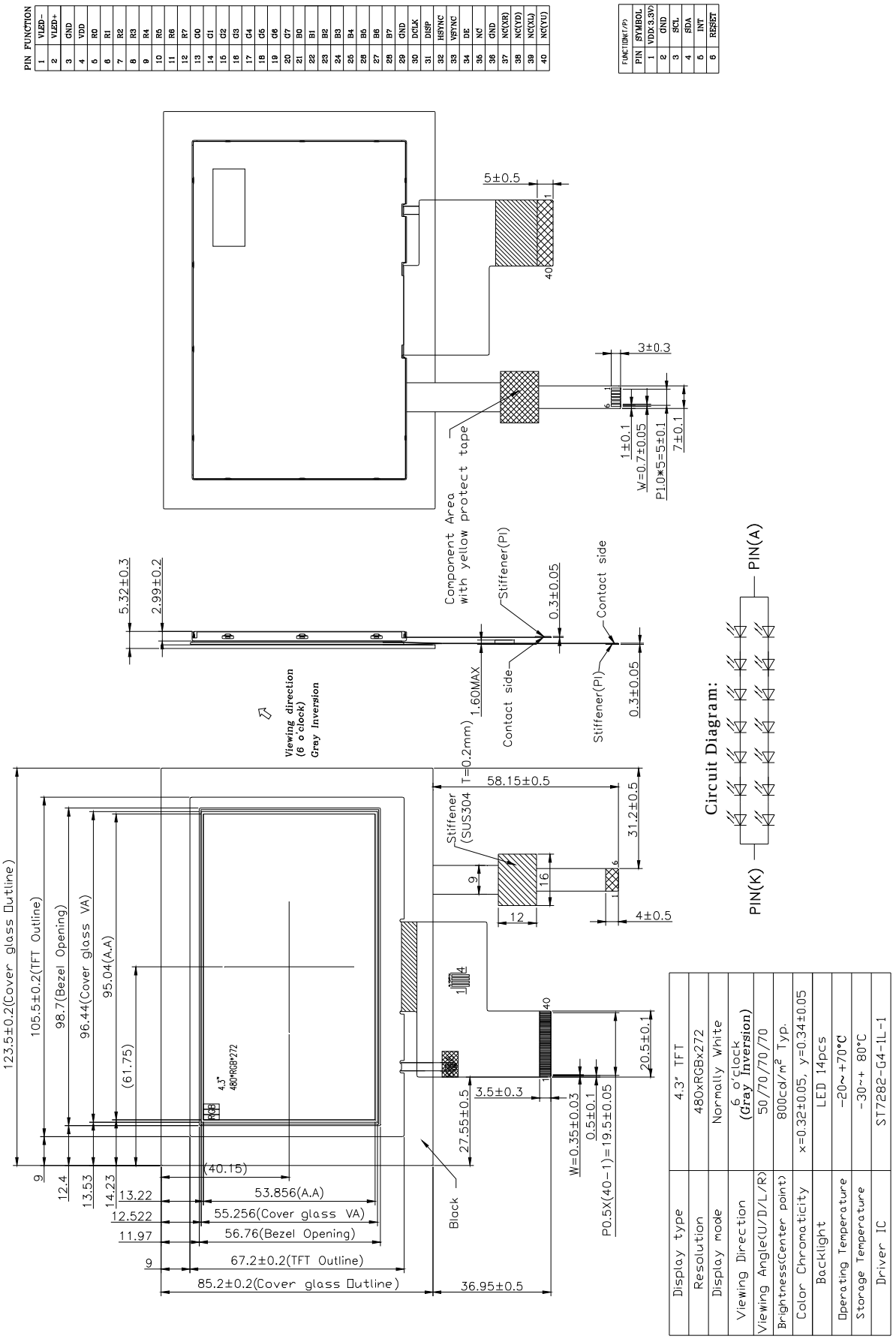
Temperature: 20±5°C.

Humidity: 65±5%RH.

Tests will be not conducted under functioning state.

No.	Parameter	Condition	Notes
1	High Temperature Operating	70°C±2°C, 240hrs (Operation state).	
2	Low Temperature Operating	-20°C±2°C, 240hrs (Operation state).	1
3	High Temperature Storage	80°C±2°C, 240hrs.	2
4	Low Temperature Storage	-30°C±2°C, 240hrs.	1,2
5	High Temperature and High Humidity Operation Test	60°C±2°C, 90%, 240hrs	1,2
6	Vibration Test	Total fixed amplitude: 1.5mm. Vibration Frequency: 10~55Hz. One cycle 60 seconds to 3 direction of X, Y, Z each 15 minutes.	3
7.	Drop Test	To be measured after dropping from 60cm high on the concrete surface in packing state.  *Dropping method corner dropping:* *A corner: Once edge dropping.* *B, C, D edge: Once face dropping.* *E, F, G face: Once.*	

12 Dimensional outlines



13 Incoming Inspection Standards

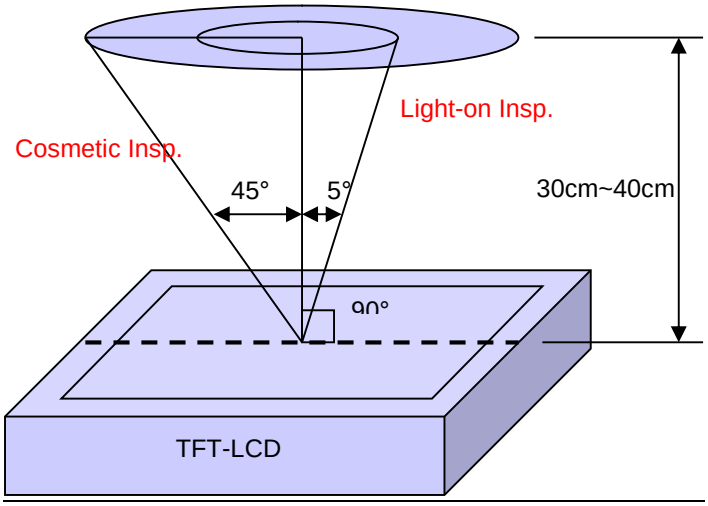
13.1 Inspection and Environment Conditions

13.1.1 Inspection Conditions:

(1)Inspection Distance: 35 cm±5cm

(2)View Angle : Light-on Inspection Angle：±5°

Cosmetic Inspection Angle：±45°



(perpendicular to LCD panel surface)

13.1.2 Environment Conditions:

Ambient Temperature		23°C±5°C
Ambient Humidity		55±10%RH
Ambient Illumination	Cosmetic Inspection	more than 600 Lux
	Functional Inspection	300~500 Lux

13.1.3 Sampling Conditions:

(1) Lot Size: Quantity of shipment lot per model

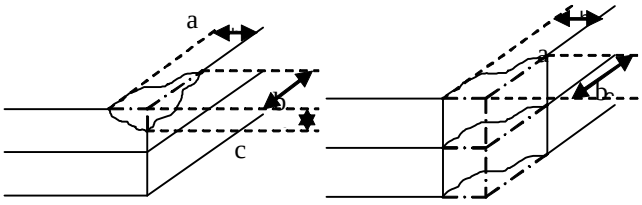
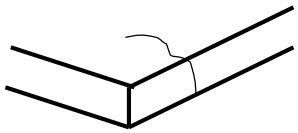
(2) Sampling Method:

Sampling Plan		MIL-STD-105E
		Normal Inspection, Single Sampling
		Level II
AQL	Major Defect	1.0%
	Minor Defect	1.5%

(3) The classification of Major(MA) and Minor(MI) defects is shown as 3. Inspection Criteria.

13.1.4 Inspection Criteria

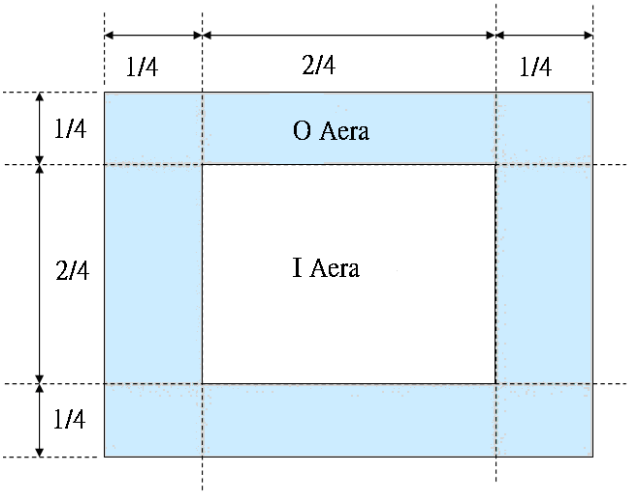
13.1.4.1 Cosmetic Inspection(Panel):

Item	Judgment Criteria	Classification
Chipping on Panel	 a≦3.0mm、b≦3.0mm、c≦t (Bottom glass thickness)	MA
Scratch on Panel *Note-2	W≦0.05mm or L< 5mm: Ignored 0.05mm<W≦0.1mm and L≦5mm: N≦5 W>0.1mm or L>5mm: Not allowed	MI
Bubble or Dent on Panel *Note-3	D≦0.2mm: Ignored 0.2mm<D≦0.3mm: N≦5 D>0.3mm: Not allowed	MI
Panel Crack	 Not Allowed crack	MA
Bezel Deformation	Obvious deformation is not allowed.	MI
Bezel Oxidation	Not allowed if it rusts continuously over 1 cm (It is out of warranty with rusted tin plate)	MI
Bezel Scratch	L□20mm , W□0.2 , N□3	MI
Metal Squash Dent /Flange(Front Side)	D(W)□1,L□3,N□3;	MI
B/L High Voltage Wire Denudation	Not allowed	MA
Polarizer flaw or leak out resin	Defect is defined as the active area.	MI
Outline Dimension	Must in Spec, refer to related product spec.	MI

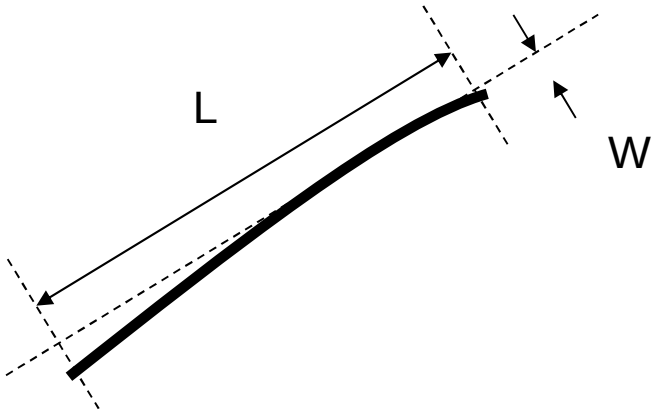
13.1.4.2 Functional Inspection:

<table>
<tr><th rowspan="2">Item</th><th colspan="4">Judgment Criteria</th><th rowspan="2">Classification</th></tr>
<tr><th colspan="2">Area(Note1)</th><th>I</th><th>O</th></tr>
<tr><td rowspan="11">Point Defect</td><td rowspan="3">Bright dot</td><td>Random</td><td colspan="2">2</td><td rowspan="11">MI</td></tr>
<tr><td>2 dots adjacent</td><td>0</td><td>0</td></tr>
<tr><td>3 dots adjacent or more</td><td>0</td><td>0</td></tr>
<tr><td rowspan="3">Dark dot</td><td>Random</td><td colspan="2">3</td></tr>
<tr><td>2 dots adjacent</td><td colspan="2">0</td></tr>
<tr><td>3 dots adjacent or more</td><td>0</td><td>0</td></tr>
<tr><td colspan="2">Total Dot Defect</td><td colspan="2">5</td></tr>
<tr><td rowspan="3">Distance</td><td>Distance between Bright and Bright dot</td><td colspan="2">L□5mm</td></tr>
<tr><td>Distance between Bright and Dark dot</td><td colspan="2">L□5mm</td></tr>
<tr><td>Distance between Dark dot</td><td colspan="2">L□5mm</td></tr>
<tr><td colspan="4">(1) It is defined as Point Defect if defect area > 0.5dot
(2) It is ignored if defect area≦0.5dot
(3)Weak point defect will be defined as Bright Dot if it can be observed through ND filter 5%(Full Screen Black Inspection)</td></tr>
<tr><td>Line Defect</td><td colspan="4">Obvious vertical or horizontal line defect is not allowed.</td><td>MA</td></tr>
<tr><td>Mura</td><td colspan="4">Not allowed if it can be observed through ND Filter 5 %</td><td>MI</td></tr>
<tr><td>Foreign Material
in spot shape
*Note-3</td><td colspan="4">D≦0.2mm: Ignored
0.2mm<D≦0.5mm: N≦8
D>0.5mm: Not allowed</td><td>MI</td></tr>
<tr><td>Foreign Material
in line
or spiral shape
*Note-4</td><td colspan="4">W≦0.05mm or L≦5mm: Ignored
0.05mm<W≦0.2mm and L1.0mm≦5mm: N≦8
W>0.2mm or L>5mm: Not allowed</td><td>MI</td></tr>
<tr><td>Display
Function Abnormal</td><td colspan="4">No Malfunction can be allowed</td><td>MA</td></tr>
</table>

Note-1： I/O Area Definition

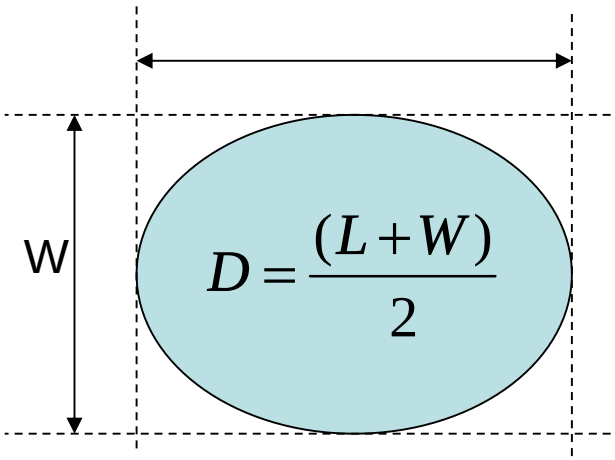


Note-2： Polarizer Scratch



Note-3：Spot Foreign Material

(W ≧L / 4)



Note-4：Line or Spiral Foreign Material

(W<L / 4)