

Display Elektronik GmbH

DATA SHEET

TFT MODULE

DEM 320240A TMH-PW-N

3,5" TFT

Product Specification

Ver.: 3

18.08.2017

Revise Records

Rev.	Date	Contents	Written	Approved
0	16.07.2010	Preliminary Specification	KS	MHO
1	18.07.2017	1.Modify Mechanical Information · Backlight Unit Dimensional Outlines 2. Add Incoming Inspection Standards	RY	MHO
2	04.08.2017	Modify AC CHARACTERISTICS · Dimensional Outlines	RY	MHO
3	18.08.2017	Modify General Description and Features · Optical Characteristics	RY	MHO

Special Notes

Note1.	
Note2.	
Note3.	
Note4.	
Note5.	

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1 General Description and Features

DEM 320240A TMH-PW-N 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 and a back-light unit. The resolution of a 3.5" contains 320RGBx240 dots and can display up to 65K/262K colors. The following table described the features of DEM 320240A TMH-PW-N.

1.1 Features

- Transmissive and Backlight with 6 LEDs are available.
- TN (Twisted Nematic) Mode.
- 8 Bits i80 System Interface
- RoHS Compliance

1.2 LCD Module

Item	Specification	Unit
Screen Size	3.5 Inches	Diagonal
Display Resolution	320 x RGB x 240	Dot
Pixel Pitch	0.073 x 0.219	mm
Active Area	70.08 x 52.56	mm
Outline Dimension	76.9 x 63.9 x 3.4	mm
Display Mode	Normally white / Transmissive	--
Pixel Arrangement	RGB Side-Stripe	--
Surface Treatment	Anti-Glare (AG)	--
Display Color	65K/262K	--
Viewing Direction	6 o'clock (Gray Inversion)	--
TFT Driver	SSD2119Z7 or equivalent	--
Input Interface	8 Bits i80 System Interface.	--

2 Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	76.6	76.9	77.2	mm	--
	Vertical (V)	63.6	63.9	64.2	mm	(1)
	Thickness (T)	3.25	3.4	3.55	mm	(1)
Weight		--	32	--	g	--

Note (1) Not include FPC.

Refer to the Dimensional Outlines for further information.

3 Electrical Specifications

3.1 Absolute Max. Ratings

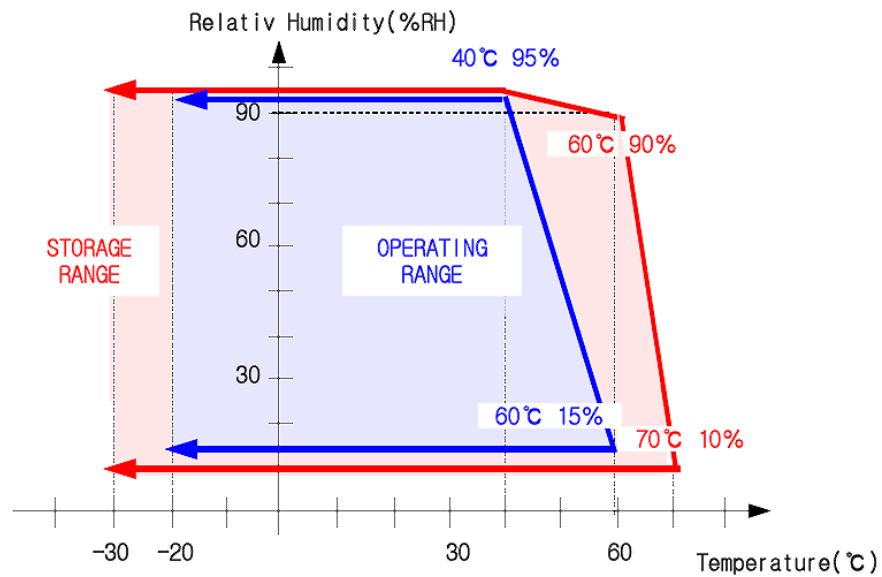
3.1.1 Absolute Ratings of Environment

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

(Ta=+25±2°C, Vss=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 guaranteed 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, Vss=GND=0)

Item	Symbol	Value		Unit	Condition
		Min.	Max.		
Logic Power Supply	V _{DDIO}	-0.3	4.0	V	--
Logic Input Voltage	V _{CI}	V _{SS} -0.3	5.0	V	--
Current Drain Per Pin Excluding VDD and VSS	I	--	25	mA	--

Note: Temp. ≤ +60°C, 90% RH MAX.

Temp. > +60°C, absolute humidity shall be less than 90% RH at +60°C

3.2.2 Backlight Unit

(Ta=+25±2°C)

Item	Symbol	Min.	Max.	Unit	Note
Current	I _f	--	30	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_{DDIO} =3.3V)

Item	Symbol	Value			Unit	Condition
		Min.	Typ.	Max.		
Power Supply of IO pins	V _{DDIO}	1.4	--	3.6	V	
Booster Reference Supply Voltage Range	V _{CI}	2.5 or V _{DDIO}	--	3.6	V	

4.2 Backlight Unit

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

(Ta=+25±2°C)

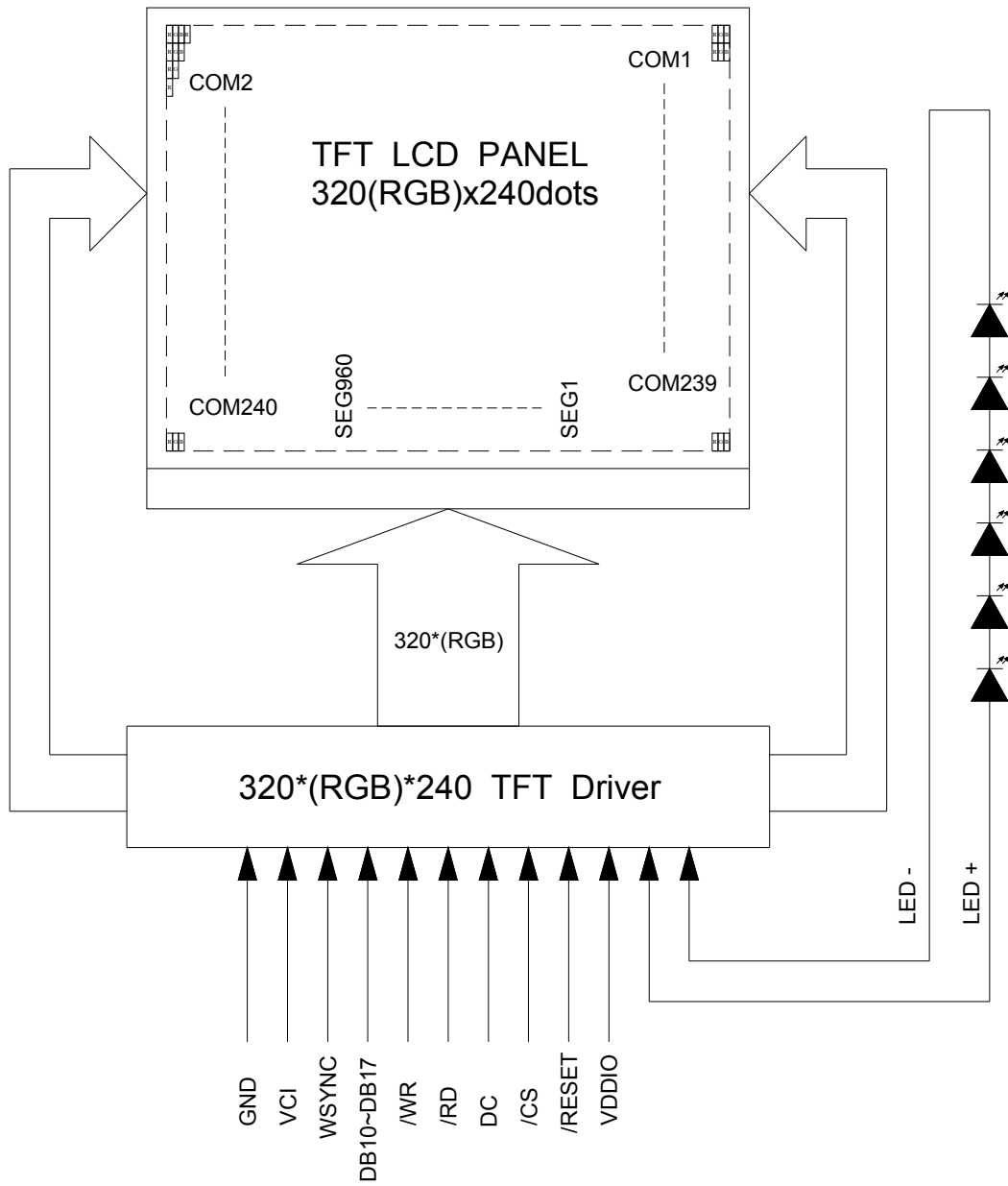
Item	Symbol	Value			Unit	Condition
		Min.	Typ.	Max.		
LED Voltage	V _L	-	(19.2)	-	V	
LED Current	I _f	-	(20)	-	mA	
Power Consumption	P _{LED}	-	(384)	-	mW	
LED Life Time (+25°C)	-	(50000)	-	-	hr	

Note (1) 6 LEDs serial type.

(2) Where I_f = 20mA, P_{LED} = V_F × I_B

5 Block Diagram

5.1 Interface System Structure with Backlight Unit



6 Input Terminal Pin Assignment**6.1 CN1 Pin Assignment (LCD)**

Pin No.	Symbol	I/O	Function
1	LED_A	P	Ground
2	LED_K	P	Ground
3	V _{DDIO}	P	Logic power supply(+3.0~3.6V)
4	NC	I/O	Not Connection
5~12	NC	I/O	Not Connection
13	NC	I/O	Not Connection
14~21	DB10~DB17	I/O	Data bus
22	WSYNC	O	Ram Write Synchronization output
23	GND	P	Ground
24	/CS	I	Chip select pin for 8080 Parallel Interface. Low: chip can be accessed; High: chip cannot be accessed.
25	/WR	I	Indicates read cycle when High, write cycle when Low)
26	/RD	I	Enable signal
27	DC	I	Parallel Interface
28	/RESET	P	Hardware Reset
29	V _{DDIO}	P	Logic power supply(+3.0~3.6V)
30	VCI	P	Booster input voltage pin. - Connect to voltage source between 2.5V to 3.6V
31	NC	I	Not Connection
32	NC	I	Not Connection
33	NC	I	Not Connection
34	NC	I	Not Connection
35	GND	P	Ground
36	GND	P	Ground

7 Optical Characteristics

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (a).
 Measuring equipment: BM-5A, BM-7

(Ta=+25±2°C)

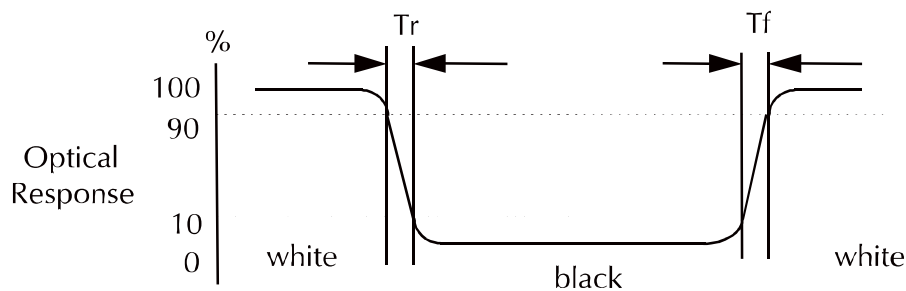
Item	Symbol	Condition	Min	Type	Max	Unit	Note
Brightness	--	--	(250)	(300)	--	cd/m ²	(a),(b)
Response Time	T _R	θ=0°	--	(8)	(12)	ms	(a),(b)
	T _F		--	(17)	(23)	ms	
Contrast Ratio	CR	At optimized viewing angle	(320)	(400)	--	--	(a)
Color Chromaticity	Red	R _X	(0.627)	(0.647)	(0.667)	--	(a)
		R _Y	(0.316)	(0.336)	(0.356)		
	Green	G _X	(0.29)	(0.31)	(0.33)	--	
		G _Y	(0.556)	(0.576)	(0.596)		
	Blue	B _X	(0.116)	(0.136)	(0.156)	--	
		B _Y	(0.109)	(0.129)	(0.149)		
	White	W _X	(0.287)	(0.307)	(0.327)	--	
		W _Y	(0.335)	(0.355)	(0.375)		
Viewing Angle (6H) Gary Inversion	Hor.	θ _R	50	(60)	--	Degree	(a)
		θ _L	50	(60)	--		
	Ver.	φ _H	40	(50)	--		
		φ _L	50	(60)	--		

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-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:

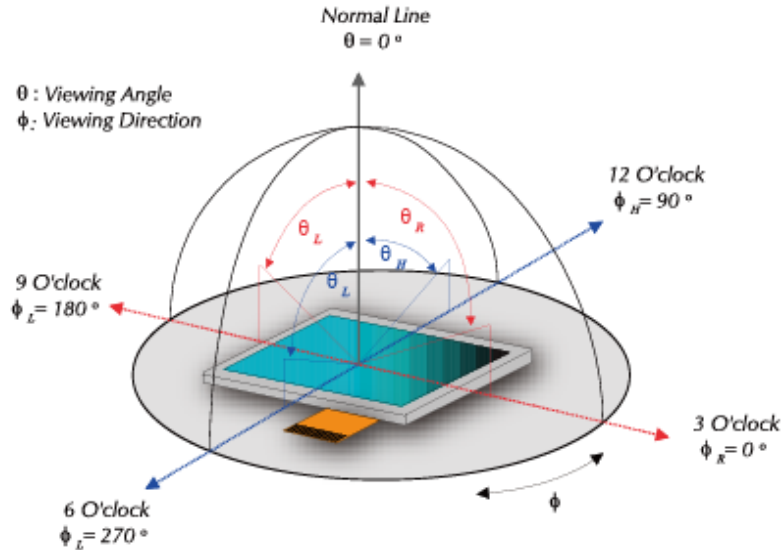
Brightness measured when LCD is at "white state"

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

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
---------------------------------	----------

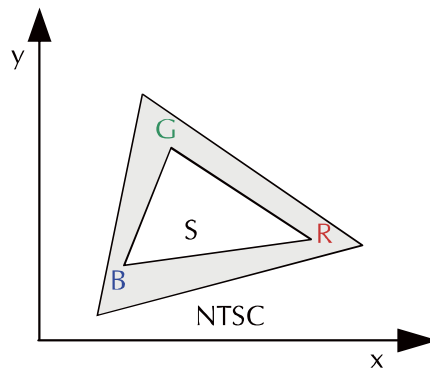
g. Definition of White Uniformity

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

h. The definition of Color Gamut -Color Chromaticity CIE 1931

Color coordinate of white & red, green, blue at center point.

$$\text{Color Gamut: NTSC (\%)} = (\text{RGB Triangle Area} / \text{NTSC Triangle Area}) \times 100$$



8 Basic Display Color and Gray Scale

8.1 Mapping for writing an Instruction

		Hardware pins																	
Interface	Cycle	D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
18 bits		IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	x	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0	x
16 bits		IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8		IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0	
9 bits	1 st	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	x									
	2 nd	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0	x									
8 bits	1 st	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8										
	2 nd	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0										

Remark : x Don't care bits
 Not connected pins

8.2 Mapping for writing an Pixel Data

			Hardware pins																	
Interface	Color mode	Cycle	D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
18 bits	262k		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
16 bits	262k	1 st	R5	R4	R3	R2	R1	R0	x	x		G5	G4	G3	G2	G1	G0	x	x	
		2 nd	B5	B4	B3	B2	B1	B0	x	x		R5	R4	R3	R2	R1	R0	x	x	
		3 rd	G5	G4	G3	G2	G1	G0	x	x		B5	B4	B3	B2	B1	B0	x	x	
		1 st	R5	R4	R3	R2	R1	R0	x	x		G5	G4	G3	G2	G1	G0	x	x	
		2 nd	x	x	x	x	x	x	x	x		B5	B4	B3	B2	B1	B0	x	x	
		2 nd	R5	R4	R3	R2	R1	R0	x	x		G5	G4	G3	G2	G1	G0	x	x	
	65k		R4	R3	R2	R1	R0	G5	G4	G3		G2	G1	G0	B4	B3	B2	B1	B0	
9 bits	262k	1 st	R5	R4	R3	R2	R1	R0	G5	G4	G3									
		2 nd	G2	G1	G0	B5	B4	B3	B2	B1	B0									
8 bits	262k	1 st	R5	R4	R3	R2	R1	R0	x	x										
		2 nd	G5	G4	G3	G2	G1	G0	x	x										
		3 rd	B5	B4	B3	B2	B1	B0	x	x										
	65k	1 st	R4	R3	R2	R1	R0	G5	G4	G3										
2 nd		G2	G1	G0	B4	B3	B2	B1	B0											

Remark : x Don't care bits
 Not connected pins

9 AC CHARACTERISTICS

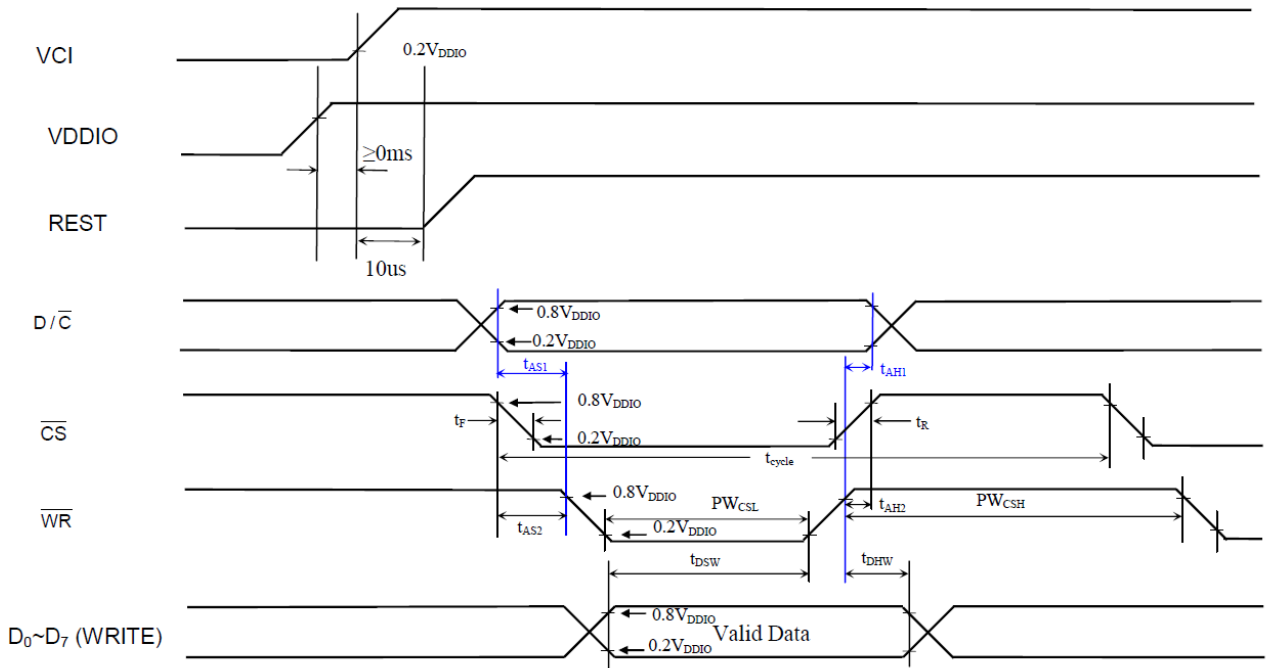
9.1 Parallel 8080 Timing Characteristics

(Ta=+25 ±2°C, V_{DDIO} =3.3V)

Symbol	Parameter	Min	Typ	Max	Unit
t _{cycle}	Clock Cycle Time (write cycle)	75	-	-	ns
t _{cycle}	Clock Cycle Time (read cycle) (Based on VOL/VOH = 0.3*V _{DDIO} /0.7*V _{DDIO})	450	-	-	ns
t _{AS1}	Address Setup Time between (R/ \overline{W}) and D/ \overline{C}	0	-	-	ns
t _{AH1}	Address Hold Time between (R/ \overline{W}) and D/ \overline{C}	0	-	-	ns
t _{AS2}	Address Setup Time between (R/ \overline{W}) and \overline{CS}	0	-	-	ns
t _{AH2}	Address Hold Time between (R/ \overline{W}) and \overline{CS}	0	-	-	ns
t _{DSW}	Data Setup Time (D0~D7, WRITE)	5	-	-	ns
t _{DHW}	Data Hold Time (D0~D7, WRITE)	5	-	-	ns
t _{ACC}	Data Access Time (D0~D7, READ)	250	-	-	ns
t _{OH}	Output Hold time (D0~D7, READ)	100	-	-	ns
PW _{CSL}	Pulse width /CS low (write cycle)	40	-	-	ns
PW _{CSH}	Pulse width /CS high (write cycle)	25	-	-	ns
PW _{CSL}	Pulse width /CS low (read cycle)	500	-	-	ns
PW _{CSH}	Pulse width /CS high (read cycle)	500	-	-	ns
t _R	Rise time	-	-	4	ns
t _F	Fall time	-	-	4	ns

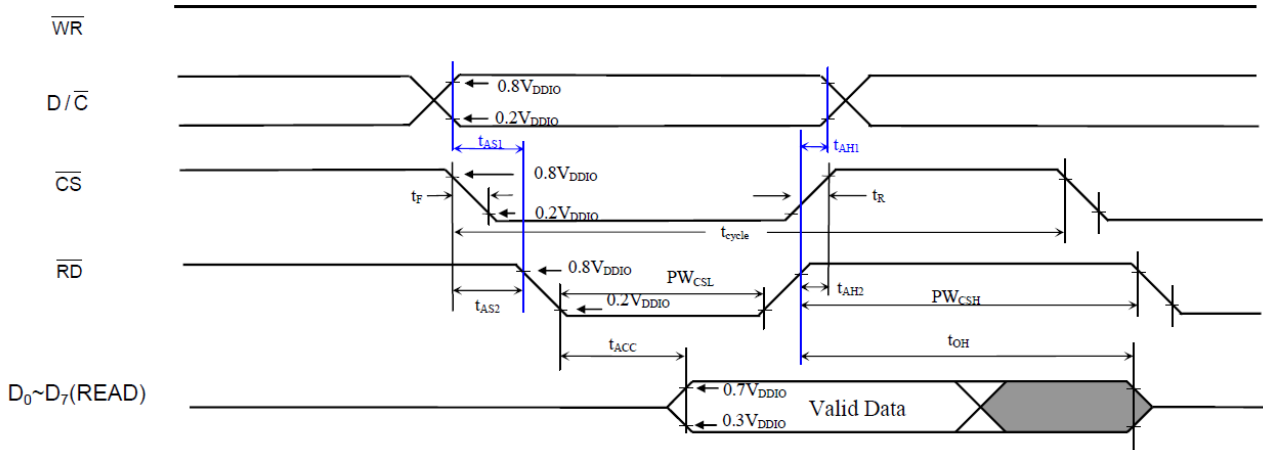
Note: CS can be pulled low during the write cycle, only /RW is needed to be toggled

Write Cycle



Remark: It's highly recommended that \overline{RD} remains high for the whole write cycle

Read Cycle



10 TEST

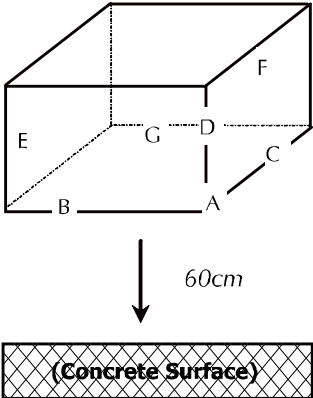
No change on display and in operation under the following test condition.

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

Temperature: +20±5°C.

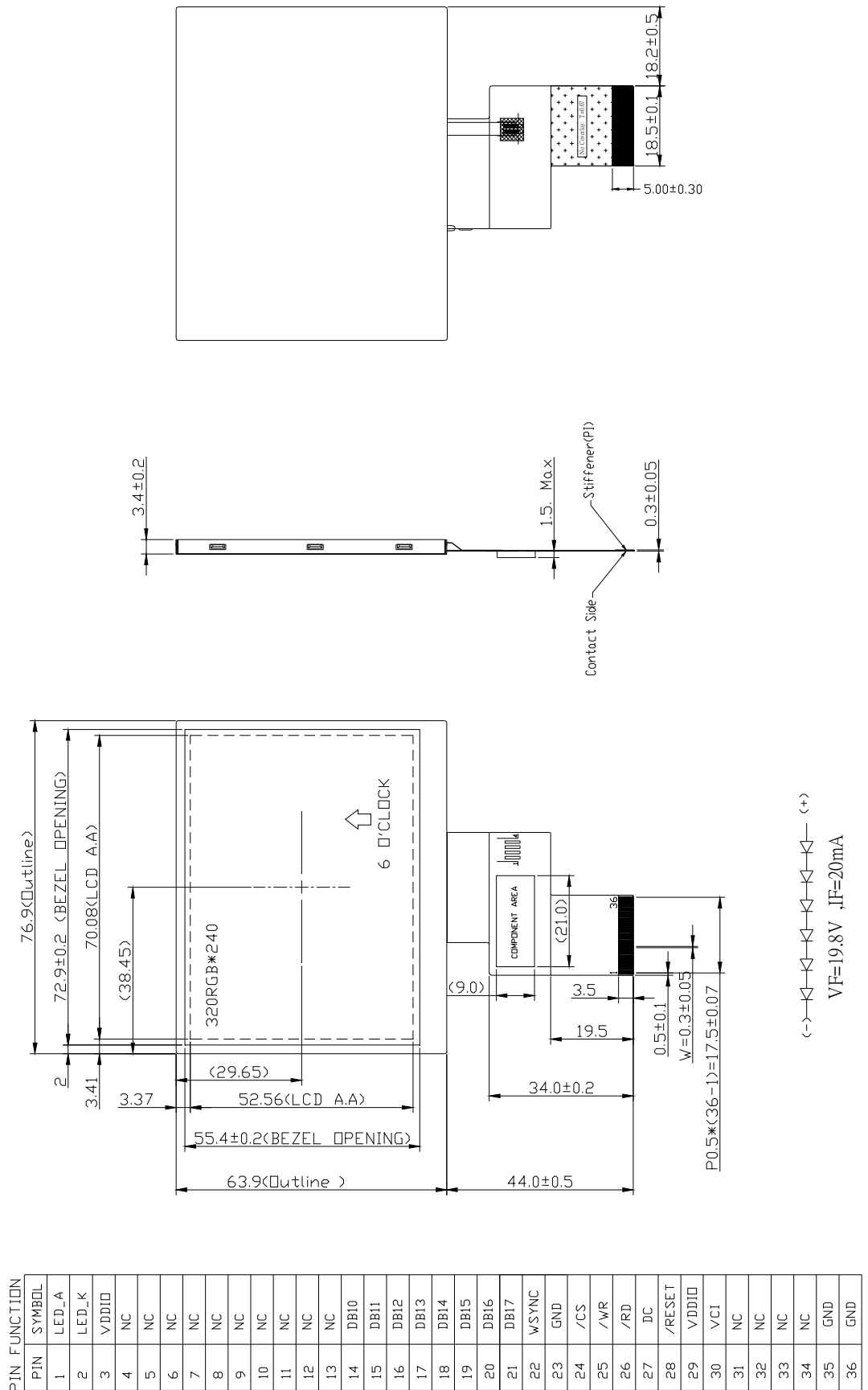
Humidity: 65±5%RH.

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	<p>To be measured after dropping from 60cm high on the concrete surface in packing state.</p>  <p><i>Dropping method corner dropping:</i></p> <p><i>A corner: Once edge dropping.</i></p> <p><i>B, C, D edge: Once face dropping.</i></p> <p><i>E, F, G face: Once.</i></p>	

- Notes:
1. No dew condensation to be observed.
 2. The function test shall be conducted after 4 hours storage at the normal temperature and humidity after removed from the test chamber.
 3. Vibration test will be conducted to the product itself without putting I in a container.

11 Dimensional Outlines

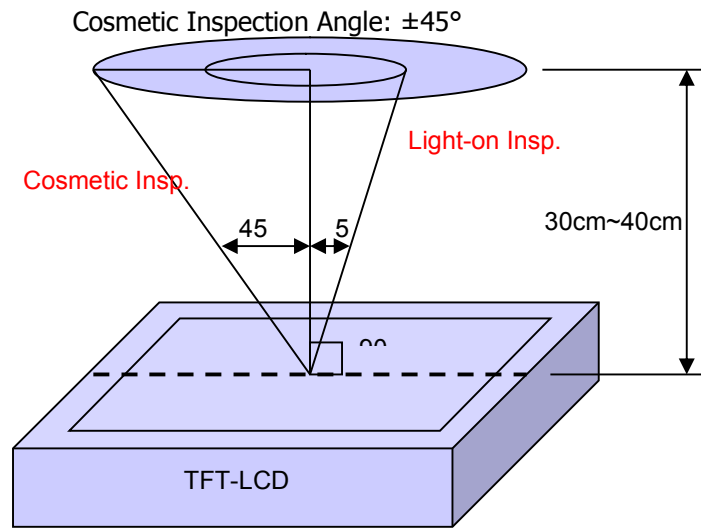


12 Incoming Inspection Standards

12.1 Inspection and Environment Conditions

12.1.1 Inspection Conditions:

- (1) Inspection Distance: 35 cm±5cm
- (2) View Angle: Light-on Inspection Angle: ±5°



(perpendicular to LCD panel surface)

12.1.2 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

12.1.3 Sampling Conditions:

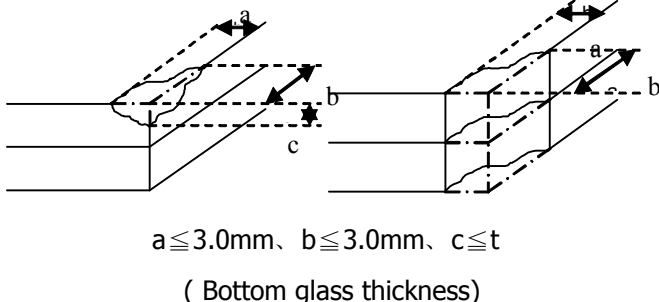
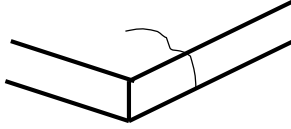
- (1) Lot Size: Quantity of shipment lot per model
- (2) Sampling Method:

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.

12.1.4 Inspection Criteria

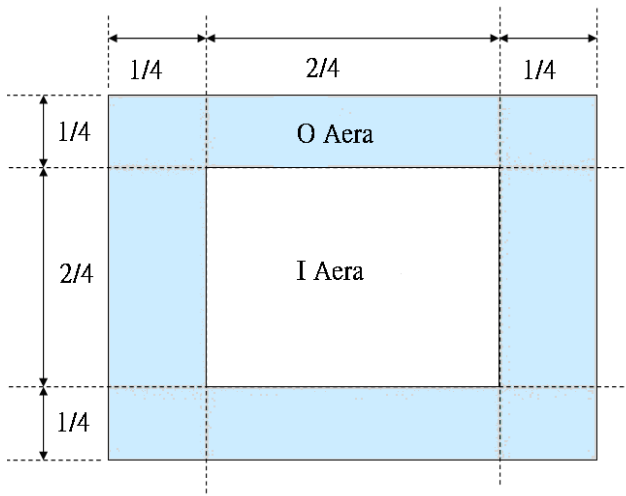
12.1.4.1 Cosmetic Inspection (Panel):

Item	Judgment Criteria	Classification
Chipping on Panel	 <p>$a \leq 3.0\text{mm}$, $b \leq 3.0\text{mm}$, $c \leq t$ (Bottom glass thickness)</p>	MA
Scratch on Panel *Note-2	<p>$W \leq 0.05\text{mm}$ or $L < 5\text{mm}$: Ignored $0.05\text{mm} < W \leq 0.1\text{mm}$ and $L \leq 5\text{mm}$: $N \leq 5$ $W > 0.1\text{mm}$ or $L > 5\text{mm}$: Not allowed</p>	MI
Bubble or Dent on Panel *Note-3	<p>$D \leq 0.2\text{mm}$: Ignored $0.2\text{mm} < D \leq 0.3\text{mm}$: $N \leq 5$ $D > 0.3\text{mm}$: Not allowed</p>	MI
Panel Crack	 <p>Not Allowed crack</p>	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	$L \leq 20\text{mm}$, $W \leq 0.2$, $N \leq 3$	MI
Metal Squash Dent /Flange(Front Side)	$D(W) \leq 1, L \leq 3, N \leq 3;$	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

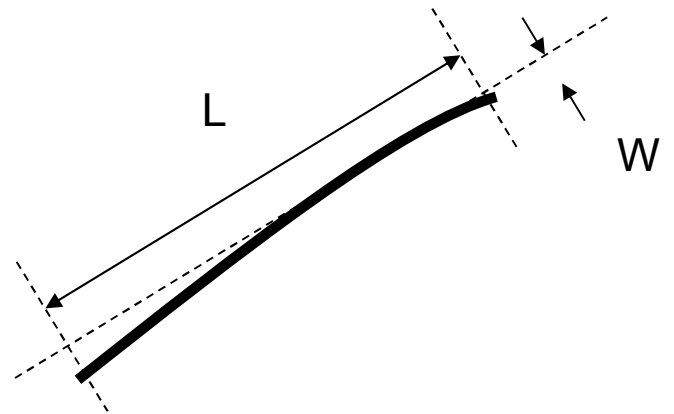
13.1.4.2 Functional Inspection:

Item	Judgment Criteria			Classification	
	Area(Note1)	I	O		
Point Defect	Bright dot	Random	2		MI
		2 dots adjacent	0	0	
		3 dots adjacent or more	0	0	
	Dark dot	Random	3		
		2 dots adjacent	0		
		3 dots adjacent or more	0	0	
	Total Dot Defect		5		
	Distance	Distance between Bright and Bright dot	$L \geq 5\text{mm}$		
		Distance between Bright and Dark dot	$L \geq 5\text{mm}$		
		Distance between Dark dot	$L \geq 5\text{mm}$		
(1) It is defined as Point Defect if defect area > 0.5dot (2) It is ignored if defect area $\leq 0.5\text{dot}$ (3)Weak point defect will be defined as Bright Dot if it can be observed through ND filter 5%(Full Screen Black Inspection)					
Line Defect	Obvious vertical or horizontal line defect is not allowed.			MA	
Mura	Not allowed if it can be observed through ND Filter 5 %			MI	
Foreign Material in spot shape *Note-3	$D \leq 0.2\text{mm}$: Ignored $0.2\text{mm} < D \leq 0.5\text{mm}$: $N \leq 8$ $D > 0.5\text{mm}$: Not allowed			MI	
Foreign Material in line or spiral shape *Note-4	$W \leq 0.05\text{mm}$ or $L \leq 5\text{mm}$: Ignored $0.05\text{mm} < W \leq 0.2\text{mm}$ and $L 1.0\text{mm} \leq 5\text{mm}$: $N \leq 8$ $W > 0.2\text{mm}$ or $L > 5\text{mm}$: Not allowed			MI	
Display Function Abnormal	No Malfunction can be allowed			MA	

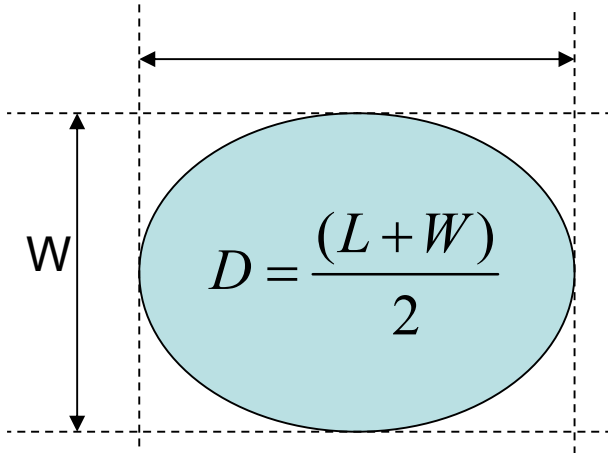
Note-1: I/O Area Definition



Note-2: Polarizer Scratch



Note-3: Spot Foreign Material
($W \geq L / 4$)



Note-4: Line or Spiral Foreign Material
($W < L / 4$)

