

Display Elektronik GmbH

DATA SHEET

LCD MODULE

**DEM 320240U VMH-PW-N
(A-TOUCH)**

**3,5" TFT
(IPS)**

Product Specification

Ver.: 0

05.02.2020

Revise Records

Rev.	Date	Contents	Written	Approved
0	05.02.2020	Preliminary Specification	C	MHI

Special Notes

Note1.	
Note2.	
Note3.	
Note4.	
Note5.	

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1. General Description and Features

DEM 320240U VMH-PW-N(A-TOUCH) is a 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. Graphics and texts can be displayed on a 320 (W) x RGB x 240 (H) dots with 16.7M colors by supplying 24 bits data signal. The following table described the features of DEM 320240U VMH-PW-N(A-TOUCH).

1.1 Features

- Transmissive and back-light
- IPS mode.
- RoHS Compliance

1.2 LCD Module

Item	Specification	Unit
Screen Size	3.5 Inches	Diagonal
Display Resolution	320 x 240	Pixel
Active Area	70.08 x 52.56	mm
Outline Dimension	76.90 x 63.90 x 4.40	mm
Display Mode	Normally Black / Transmissive	--
Pixel Arrangement	R,G,B Vertical Stripe	--
Pixel Size	0.219 x 0.219	mm
Surface Treatment	Anti-Glare	
Driver IC	ST7272	
Display Color	16.7 Million	--
Viewing Direction	Full View	--
Input Interface	RGB Digital 24-bits color RGB	--

2. Mechanical Information

Item	Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal	--	(76.90)	--	mm
	Vertical	--	(63.90)	--	mm
	Thickness	--	(4.40)	--	mm
Weight	--	(40)	--	g	--

Note (1) Not Include Component. Refer to the Outline Dimension Drawing as attached.

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.

($T_a=25\pm 2^\circ\text{C}$, $V_{SS}=\text{GND}=0$)

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

Note (1) 90 % RH Max. ($40^\circ\text{C} \geq T_a$). Maximum wet-bulb temperature at 39°C or less. ($T_a > 40^\circ\text{C}$) 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 $+25^\circ\text{C}$.

3.1.2 Electrical Absolute Maximum Ratings

3.1.2.1 TFT-LCD Module

($V_{SS}=\text{GND}=0$)

Parameter	Symbol	Min.	Max.	Unit	Remark
Power Supply Voltage	VDD	-0.3	3.6	V	

3.1.2.2 Backlight Unit

($V_{SS}=\text{GND}=0$)

Parameter	Symbol	Min.	Max.	Unit	Remark
Current of Backlight Unit	IB	--	(40)	mA	
Voltage of Backlight Unit	VB	--	(19.2)	V	

3.1.3 DC Electrical Characteristics of the TFT LCD

(Ta=25±2°C, V_{SS}=GND=0)

Item	Symbol	Min.	Typ.	Max.	Unit	Remark	
Power Supply Voltage	VDD	-	(3.3)	(3.6)	V		
Input Voltage for Logic	H Level	V _{IH}	0.7xVCC	-	VCC	V	VCC=3.3V
	L Level	V _{IL}	0	-	0.3xVCC	V	VCC=3.3V
Power Supply Current for LCM	ICC		(18)	(23)	mA		

Note1: fv =60Hz , Ta=25°C , Display pattern : White pattern



3.1.4 Back-Light Unit

The Back-light system is an edge-lighting type with 6 white LED (Light Emitting Diode)s. The characteristics of 6 white LEDs are shown in the following tables.

(Ta= Room Temp)

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Note
Forward Voltage	V _B	-	(18.6)	-	V	
Forward Current	I _B		(35)	(40)	mA	(1)
Power Consumption	P _{BL}	-	(651)	-	mW	(2)
LED Lifetime	-	(35000)	(50000)	-	hr	(3)

Note (1) LEDs in 3 series x 2 parallel type.

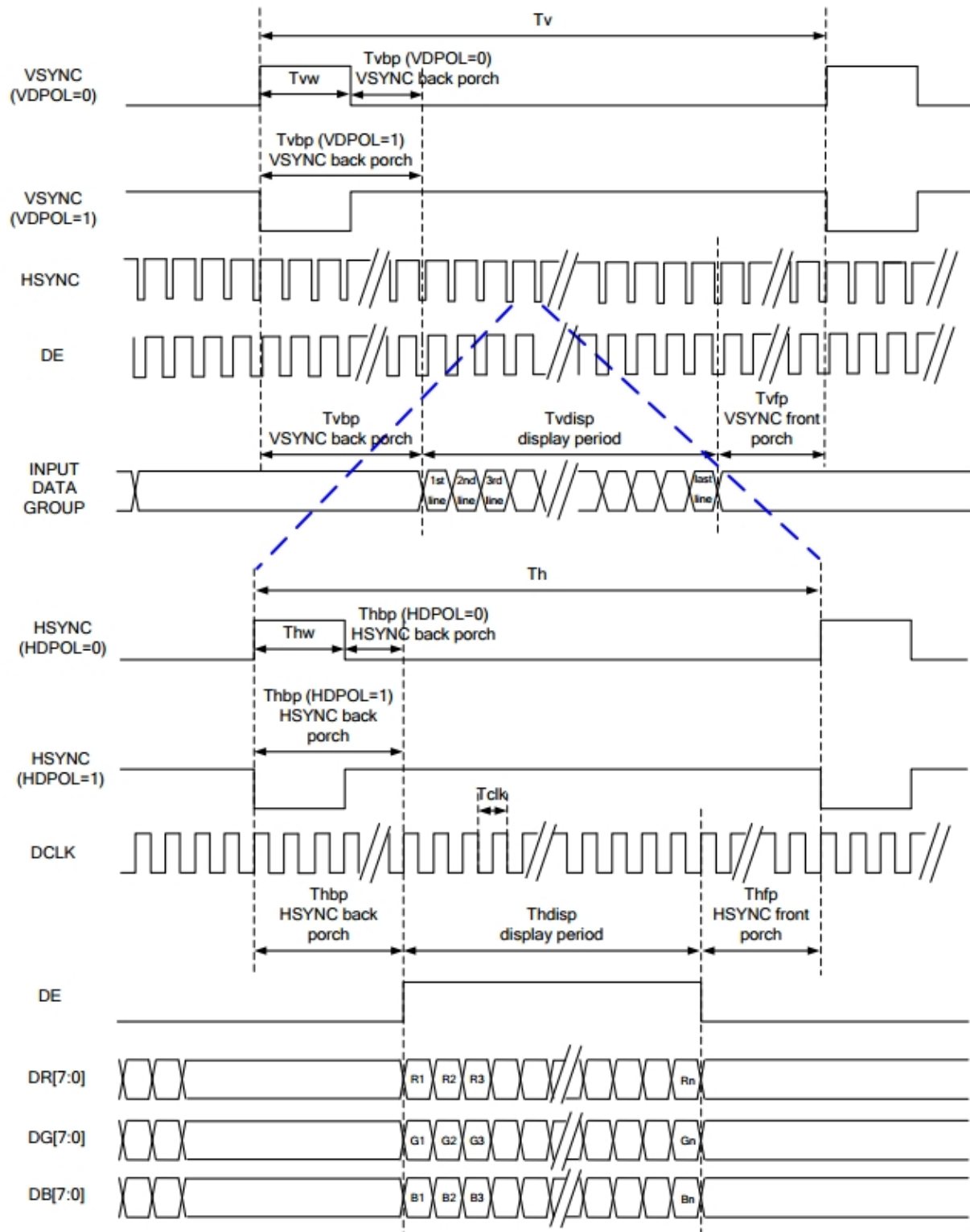
(2) Where I_B = 35mA, V_B = 18.6V, P_{BL} = V_B × I_B

(3) This type of LED is a Twin crystal lamp , which means that there are 2 LEDs connected in series in 1 LED.

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

3.2 AC Timing Characteristic of The LCD

3.2.1 Timing Condition



Parallel 24-bit RGB Input Timing Table							
Item	Symbol	Min.	Typ.	Max.	Unit	Remark	
DCLK Frequency	Fclk	5	6	8	MHz		
DCLK Period	Tclk	125	167	200	ns		
HSYNC	Period Time	Th	325	371	438	DCLK	
	Display Period	Thdisp		320		DCLK	
	Back Porch	Thbp	3	43	43	DCLK	
	Front Porch	Thfp	2	8	75	DCLK	
	Pulse Width	Thw	2	4	43	DCLK	By H_BLANKING setting
VSYNC	Period Time	Th	244	260	289	HSYNC	
	Display Period	Thdisp		240		HSYNC	
	Back Porch	Thbp	2	12	12	HSYNC	By V_BLANKING setting
	Front Porch	Thfp	2	8	37	HSYNC	
	Pulse Width	Thw	2	4	12	HSYNC	

4. Optical Characteristics

4.1 Optical characteristic of the LCD

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods.

Measuring equipment: BM-7A

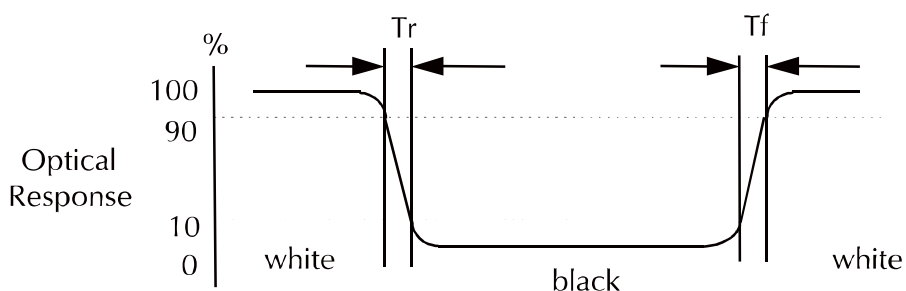
Item	Symbol	Condition	Min	Type	Max	Unit	Note	
Brightness	B		(650)	(800)	--	cd/m ²		
Response Time	T _r + T _f	θ=0°	-	25	35	ms	.	
Contrast Ratio	CR	At optimized viewing angle	(600)	(700)	-	--		
Luminance Uniformity	ΔL		70	75	--	%		
NTSC	S		--	50	--	%		
Color Chromaticity (CIE 1931)	White	W _x	θ=0° Normal Viewing Angle		(0.317)		--	BM-7A
		W _y			(0.352)			
	Red	R _x			(0.636)		--	
		R _y			(0.343)			
	Green	G _x			(0.339)		--	
		G _y			(0.581)			
	Blue	B _x			(0.111)		--	
		B _y			(0.052)			
Viewing Angle	Hor.	θ _R	CR≥10	70	80	--	Degree	
		θ _L		70	80	--		
	Ver.	θ _U		70	80	--		
		θ _D		70	80	--		

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".

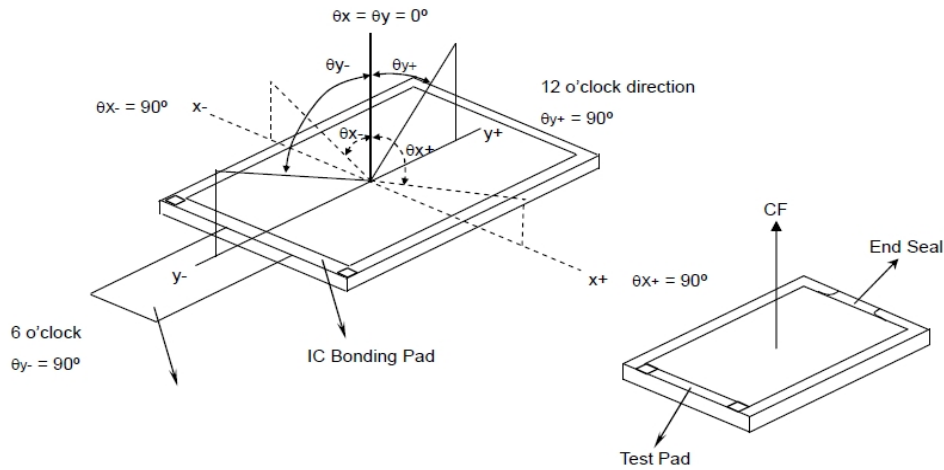


c. Definition of contrast ratio:

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

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
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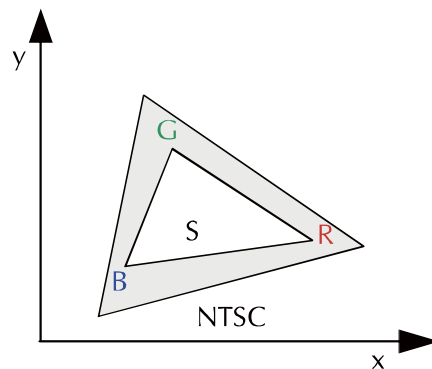
g. Definition of White Uniformity

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

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



5. Touch Screen Panel Specifications

5.1 Touch Screen Panel Specifications

Electrical Characteristics

Item	Min.	Typ.	Max.	Unit	Note
Linearity	-	-	1.5	%	Analog X and Y directions
Terminal Resistance	(200)	-	(900)	Ω	X (Glass side)
	(200)	-	(900)	Ω	Y (Film side)
Insulation Resistance	20	-	-	M Ω	DC 25V
Chattering	-	-	10	ms	100k Ω pull-up
Transparency	78	-	-	%	Non-glare

5.2 Mechanical & Reliability Characteristics

Item	Min.	Typ.	Max.	Unit	Note
Activation Force	(60)	-	(100)	g	
Durability-Surface Scratching	Write 100,000	-	-	characters	(1)
Durability-Surface Pitting	1,000,000	-	-	touches	(2)
Surface Hardness	3	-	-	H	SCA188-BNN10(AR AG)

Note (1) Measurement for Surface area - Scratch 100,000 times straight line on the Film.

- Force : 250gf
- Speed : 60mm/sec(same position (from10mm to 100mm))
- Stylus : Φ 2.0 polyacetal pen

Note (2) Pit 1,000,000 times on the Film with a Φ 2.6 silicon rubber.

- Force : Force : 250gf
- Speed : 2times/sec

6. I/O Terminal

6.1 Pin Assignment

Pin No.	Symbol	I/O	Function	Remark
1	LED K	P	Backlight (Cathode)	
2	LED K	P	Backlight (Cathode)	
3	LED A	P	Backlight (Anode)	
4	LED A	P	Backlight (Anode)	
5	N/C	---	Not Connection	
6	N/C	-	Not Connection	
7	RESET	I	Reset Pin	
8	N/C	-	Not Connection	
9	N/C	-	Not Connection	
10	N/C	-	Not Connection	
11	N/C	-	Not Connection	
12	B0	I	Blue Data Bit 0	
13	B1	I	Blue Data Bit 1	
14	B2	I	Blue Data Bit 2	
15	B3	I	Blue Data Bit 3	
16	B4	I	Blue Data Bit 4	
17	B5	I	Blue Data Bit 5	
18	B6	I	Blue Data Bit 6	
19	B7	I	Blue Data Bit 7	
20	G0	I	Blue Data Bit 0	
21	G1	I	Blue Data Bit 1	
22	G2	I	Blue Data Bit 2	
23	G3	I	Blue Data Bit 3	
24	G4	I	Blue Data Bit 4	
25	G5	I	Blue Data Bit 5	
26	G6	I	Blue Data Bit 6	
27	G7	I	Blue Data Bit 7	
28	R0	I	Blue Data Bit 0	
29	R1	I	Blue Data Bit 1	
30	R2	I	Blue Data Bit 2	
31	R3	I	Blue Data Bit 3	
32	R4	I	Blue Data Bit 4	
33	R5	I	Blue Data Bit 5	

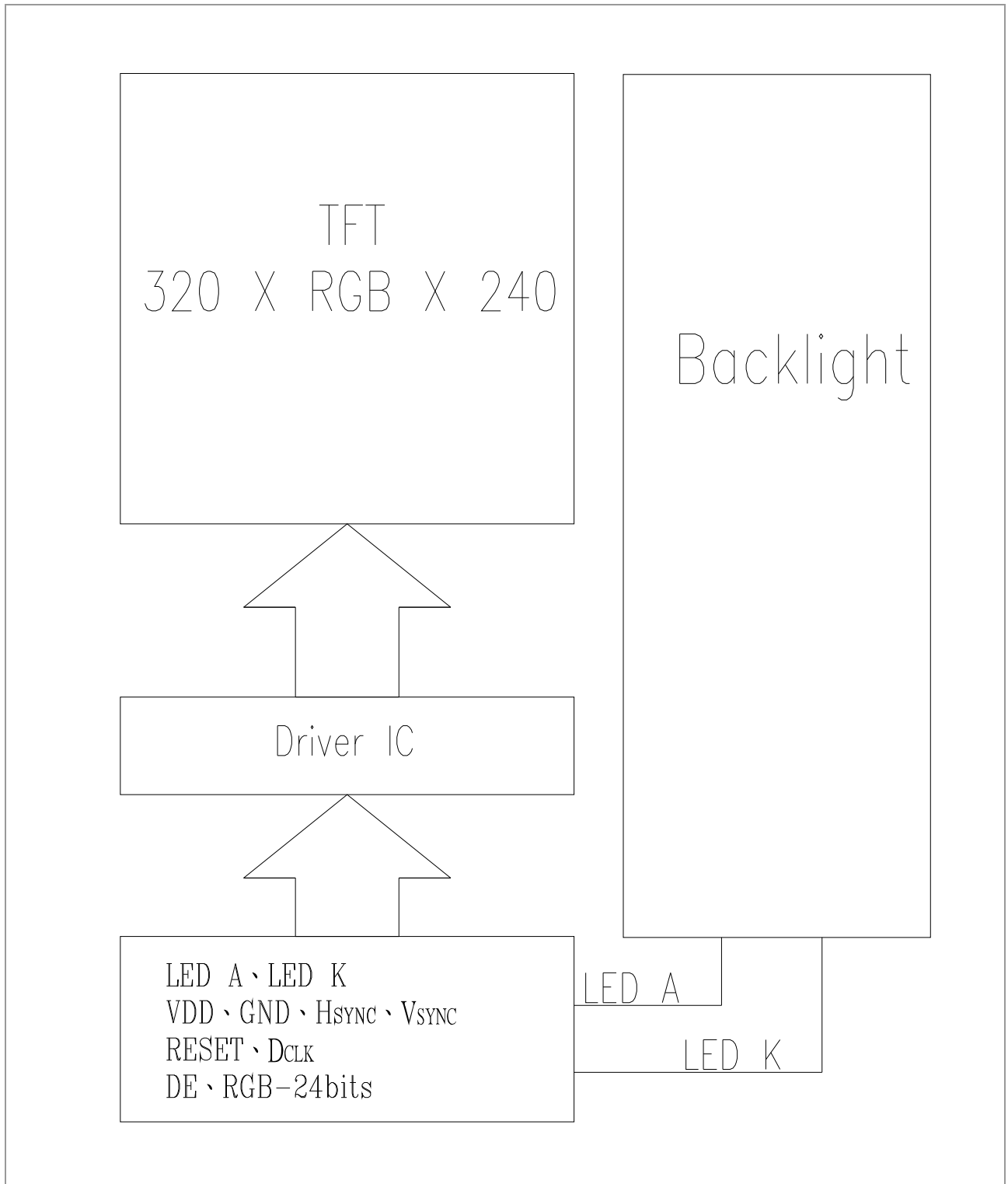
34	R6	I	Blue Data Bit 6	
35	R7	I	Blue Data Bit 7	
36	H _{SYNC}	I	Horizontal Sync Input	
37	V _{SYNC}	I	Vertical Sync Input	
38	D _{CLK}	I	Dot Clock signal and oscillator source	
39	VDD	P	Power Supply for LCM	
40	VDD	P	Power Supply for LCM	
41	VDD	P	Power Supply for LCM	
42	VDD	P	Power Supply for LCM	
43	VDD	P	Power Supply for LCM	
44	N/C	-	Not Connection	
45	N/C	-	Not Connection	
46	N/C	-	Not Connection	
47	N/C	-	Not Connection	
48	N/C	-	Not Connection	
49	N/C	-	Not Connection	
50	N/C	-	Not Connection	
51	N/C	-	Not Connection	
52	DE	I	Data Enable Input	
53	GND	P	Ground	
54	GND	P	Ground	

I: Input, P: Power

Notes:

- 1) NC Pin must be retained; this pin can't contact GND or other signal.
- 2) GND Pin must ground contact, can not be floating.

6.2 Block Diagram



7. Displayed Color and Input Data

	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	
	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	
	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	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	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	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	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	
	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	
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	
	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	
	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	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	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	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	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	
	Green(255)	0	0	0	0	0	0	0	0	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	
	Blue(1)	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	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	Blue(127)	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	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	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.

8. Reliability Condition

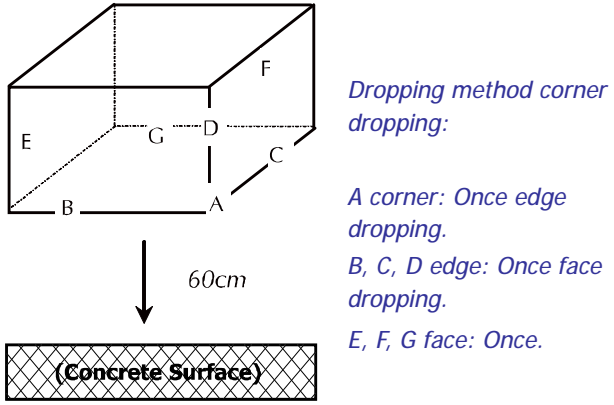
No change on display and in operation under the following test condition.

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.  <p><i>Dropping method corner dropping:</i> <i>A corner: Once edge dropping.</i> <i>B, C, D edge: Once face dropping.</i> <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.

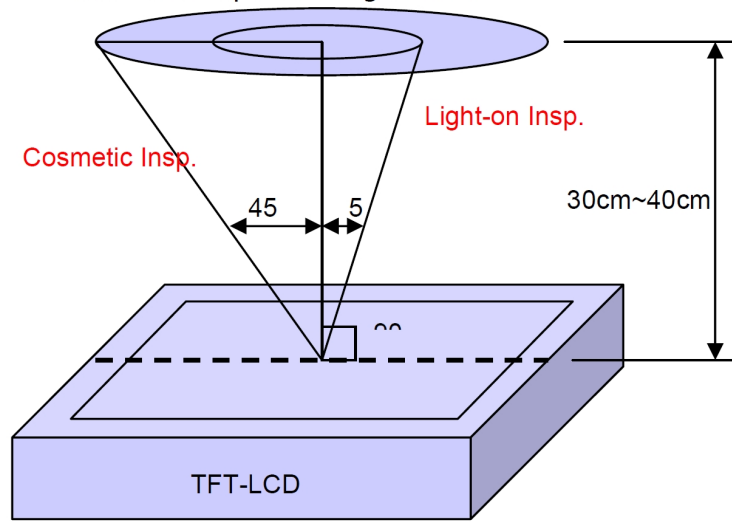
9. Incoming Inspection Standards

9.1. Inspection and Environment Conditions

9.1.1. 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)

9.1.2. 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

9.1.3. Sampling Conditions:

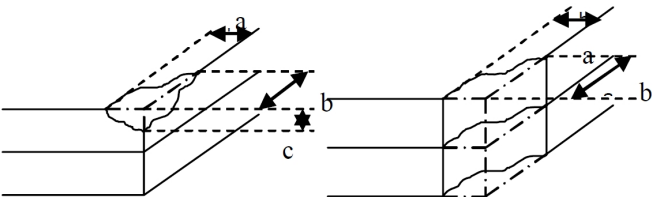
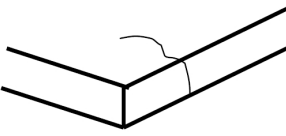
- (1) Lot Size: Quantity of shipment lot per model
- (2) Sampling Method:

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.

9.1.4. Inspection Criteria

9.1.4.1. Cosmetic Inspection(Panel):

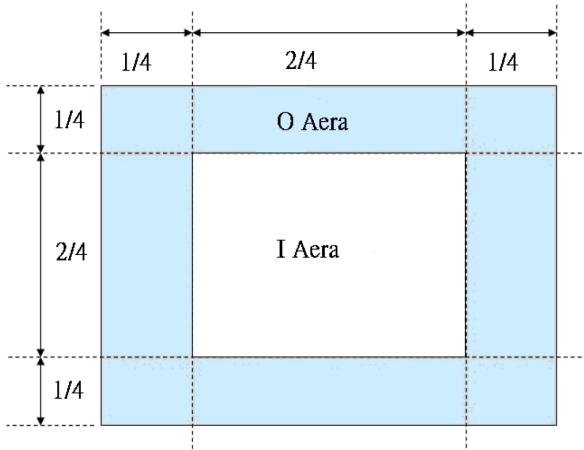
Item	Judgment Criteria	Classification
Chipping on Panel	 <p>$a \leq 3.0\text{mm}$, $b \leq 3.0\text{mm}$, $c \leq t$ (Bottom glass thickness)</p>	MA
Scratch on Panel *Note-2	<p>$W \leq 0.05\text{mm}$ or $L < 5\text{mm}$: Ignored</p> <p>$0.05\text{mm} < W \leq 0.1\text{mm}$ and $L \leq 5\text{mm}$: $N \leq 5$</p> <p>$W > 0.1\text{mm}$ or $L > 5\text{mm}$: Not allowed</p>	MI
Bubble or Dent on Panel *Note-3	<p>$D \leq 0.2\text{mm}$: Ignored</p> <p>$0.2\text{mm} < D \leq 0.3\text{mm}$: $N \leq 5$</p> <p>$D > 0.3\text{mm}$: 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
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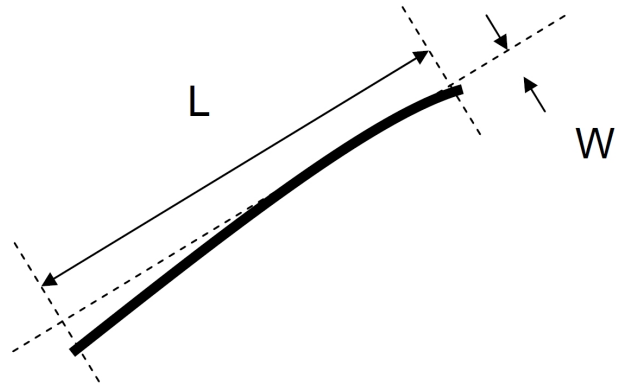
9.1.4.2. Functional Inspection:

Item	Judgment Criteria			Classification
	Area(Note1)	I	O	
Point Defect	Bright dot	Random	1	
		2 dots adjacent	0	0
		3 dots adjacent or more	0	0
	Dark dot	Random	2	
		2 dots adjacent	0	
		3 dots adjacent or more	0	0
	Total Dot Defect		3	
	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 $0.2\text{mm} < D \leq 0.3\text{mm}$: $N \leq 3$ $D > 0.3\text{mm}$: Not allowed			MI
Foreign Material in line or spiral shape *Note-4	$W \leq 0.05\text{mm}$ or $L \leq 3\text{mm}$: Ignored $0.05\text{mm} < W \leq 0.1\text{mm}$ and $1.0\text{mm} < L \leq 2\text{mm}$: $N \leq 4$ $W > 0.1\text{mm}$ or $L > 5\text{mm}$: Not allowed			MI
Display Function Abnormal	No Malfunction can be allowed			MA

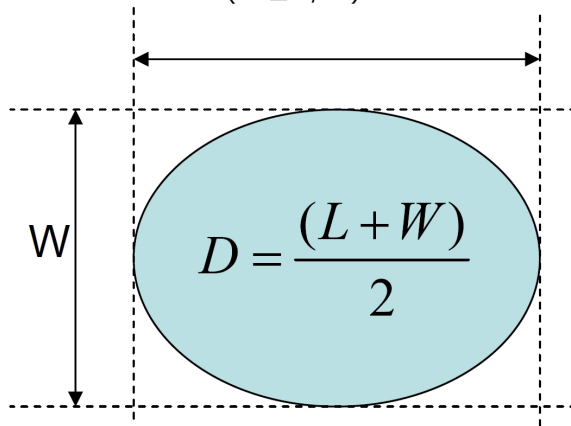
Note-1 : I/O Area Definition



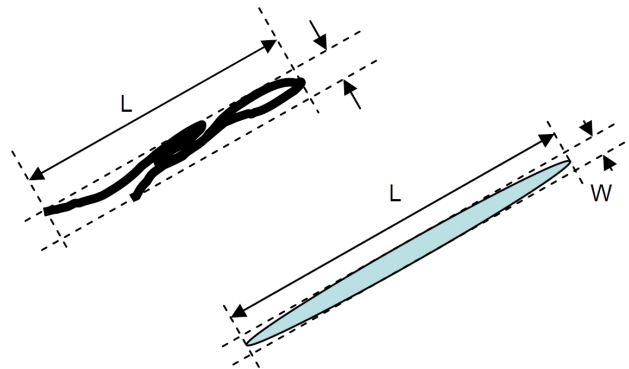
Note-2 : Polarizer Scratch



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



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



10. Dimensional Outlines

