

Product Specification



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Thin-Film-Transistor LCD Module

Model: GAIQ28WNJH1E0


Acceptance

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1. General Description and Features

GAIQ28WNJH1E0 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 and a back light system. This TFT LCD has a 2.8(4:3) inch diagonally measured active display area with QVGA(240 horizontal by 320 vertical pixel) resolution.

1.1. Features

- 2.8 inch configuration
- LED Backlight
- RoHS Compliance


1.2. LCD Module

Item	Specification	Unit
Screen Size	2.8 inches	Diagonal
Display Resolution	240(H) x RGB x 320(V)	Dot
Active Area	43.2(H) x 57.6(V)	mm
Outline Dimension	50.4(H) x 69.2(V) x 2.3(T)	mm
Display mode	Normally Black	--
Pixel pitch	0.18(H) x 0.18(V)	mm
Pixel arrangement	RGB-Vertical Stripe	--
Display Color	262K	--
Viewing Direction	ALL	
BL unit	White LED	--
Driver IC	ST7789V	--
Input Interface	Digital, Parallel 16bit	--

2. Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	50.3	50.4	50.5	mm	--
	Vertical (V)	69.1	69.2	69.3	mm	--
	Thickness (T)	2.2	2.3	2.4	mm	--
Weight		--	TBD	--	g	--

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3. Absolute Maximum Ratings

3.1 Environment Absolute Ratings

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)

3.2 Electrical Absolute Rating

3.2.1 TFT LCD Module

(V_{SS}=GND=0)


Parameter	Symbol	Min.	Max.	Unit	Remark
Power supply voltage	VCC	-0.3	4.5	V	
Interface supply voltage	VDDIO	-0.3	VCC	V	
Input signal voltage	VIN	0.5	VDDIO+0.5	V	

Note (1) Permanent damage may occur to the LCD module if beyond this specification. Functional operation should be restricted to the conditions described under Normal Operating Conditions.

Note (2) Permanent damage to the device may occur if exceed maximum values

Note (3) Within Ta=25±2°C

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4 Electrical Characteristics

4.1 TFT LCD Module

Parameter	Symbol	Condition	Specification			Unit	Related Pins
			MIN.	TYP.	MAX.		
Power & Operation Voltage							
System Voltage	VDD	Operating voltage	2.4	2.75	3.3	V	
Interface Operation Voltage	VDDI	I/O Supply Voltage	1.65	1.8	3.3	V	
Gate Driver High Voltage	VGH		12.2		14.97	V	Note 4
Gate Driver Low Voltage	VGL		-12.5		-7.16	V	
Gate Driver Supply Voltage		VGH-VGL	19.36		27.47	V	Note 5
Input / Output							
Logic-High Input Voltage	VIH		0.7VDDI		VDDI	V	Note 1
Logic-Low Input Voltage	VIL		VSS		0.3VDDI	V	Note 1
Logic-High Output Voltage	VOH	I _{OH} = -1.0mA	0.8VDDI		VDDI	V	Note 1
Logic-Low Output Voltage	VOL	I _{OL} = +1.0mA	VSS		0.2VDDI	V	Note 1
Logic-High Input Current	I _{IH}	V _{IN} = VDDI			1	uA	Note 1
Logic-Low Input Current	I _{IL}	V _{IN} = VSS	-1			uA	Note 1
Input Leakage Current	I _{IL}	I _{OH} = -1.0mA	-0.1		+0.1	uA	Note 1
VCOM Voltage							
VCOM amplitude	VCOM			VSS		V	
Source Driver							
Source Output Range	V _{sout}		V _{AN}		V _{AP}	V	
Gamma Reference Voltage(Positive)	V _{AP}		4.45		6.4	V	Note 6
Gamma Reference Voltage(Negative)	V _{AN}		-4.6		-2.65	V	
Source Output Settling Time	T _r	Below with 99% precision			20	us	Note 2
Output Offset Voltage	V _{OFFSET}				35	mV	Note 3

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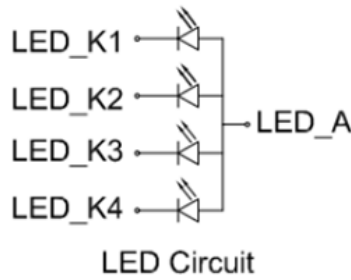
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4.2 Backlight Unit


Parameter	Symbol	Min	Typ	Max	Units	Condition
LED Voltage	V_L	2.8	3.2	3.5	V	
LED current	I_f	-	80	-	mA	(2)
Power Consumption	P_{LED}	-	256	-	mW	
LED Life-Time	Hr	(30,000)	--	--	Hour	(1)(2)

Note (1) LED life time (Hr) can be defined as the time in which it continues to operate under the condition: $T_a=25 \pm 3 \text{ }^\circ\text{C}$, typical IL value indicated in the above table until the brightness becomes less than 50%.

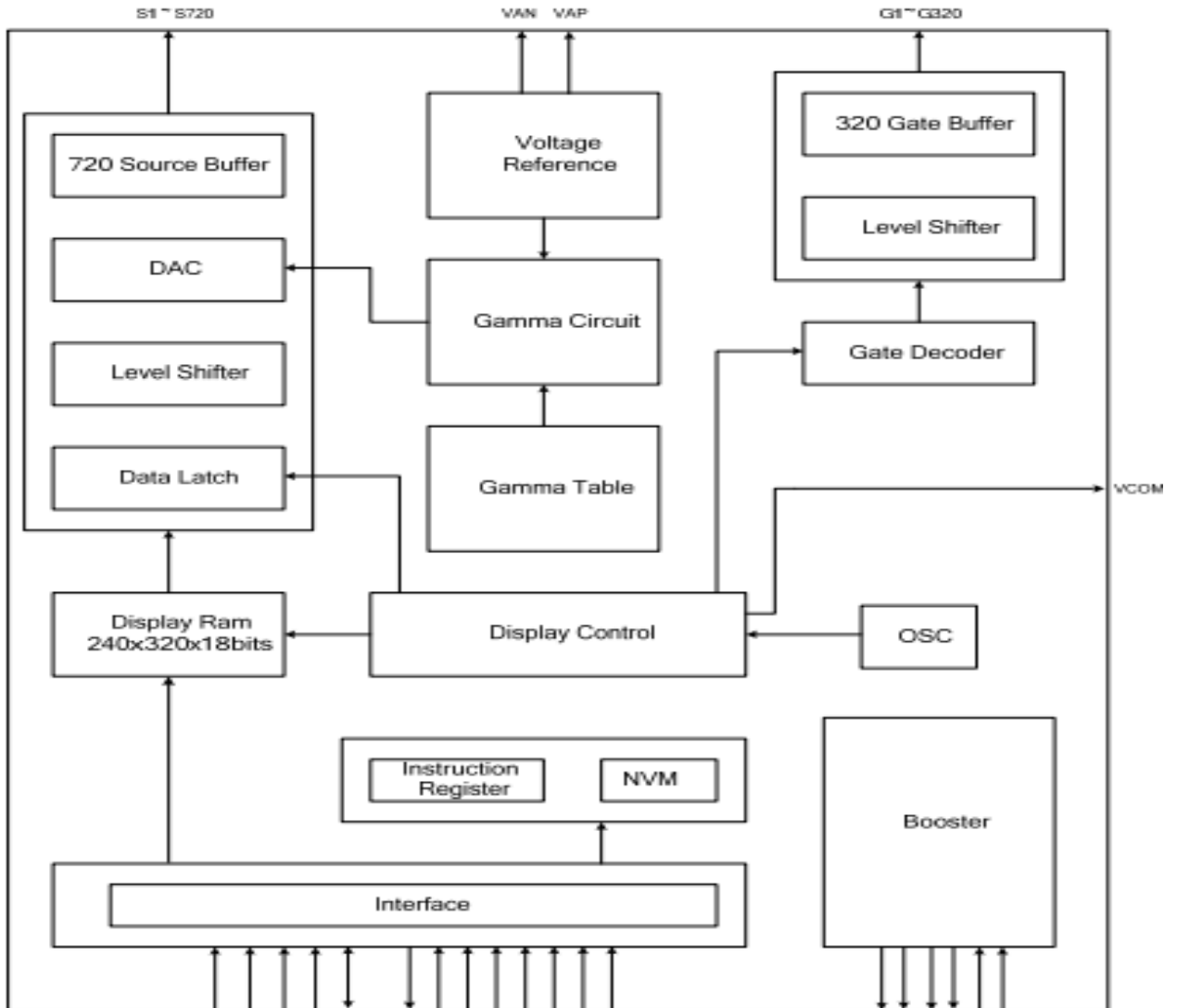
Note (2) The “LED life time” is defined as the module brightness decrease to 50% original brightness at $T_a=25 \text{ }^\circ\text{C}$ and $I_L=80\text{mA}$. The LED lifetime could be decreased if operating I_L is larger than 80mA. The constant current driving method is suggested.




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5 BLOCK DIAGRAM



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6 Interface Connection

Pin No.	Symbol	I/O	Function	Remark
1	DB1	I/O	Data bus.	
2	DB2	I/O	Data bus.	
3	DB3	I/O	Data bus.	
4	DB4	I/O	Data bus.	
5	GND	P	Ground	
6	VDD	P	Power supply for logic voltage.3.3V	
7	/CS	I	Chip selection pin Low enable High disable	
8	RS	I	A register select signal. Low: select an index or status register, High: select a control register.	
9	/WR	I	A write strobe signal and enables an operation to write data when the signal is low.	
10	/RD	I	A read strobe signal and enables an operation to read out data when the signal is low.	
11	NC	-	No connection	
12	NC	-	No connection	
13	NC	-	No connection	
14	NC	-	No connection	
15	NC	-	No connection	
16	LEDA	P	Anode of LED backlight.	
17	LEDK4	P	Cathode of LED backlight.	
18	LEDK3	P	Cathode of LED backlight.	
19	LEDK2	P	Cathode of LED backlight.	
20	LEDK1	P	Cathode of LED backlight.	
21	NC	-	No connection	
22	DB5	I/O	Data bus.	
23	DB10	I/O	Data bus.	
24	DB11	I/O	Data bus.	
25	DB12	I/O	Data bus.	
26	DB13	I/O	Data bus.	
27	DB14	I/O	Data bus.	
28	DB15	I/O	Data bus.	
29	DB16	I/O	Data bus.	

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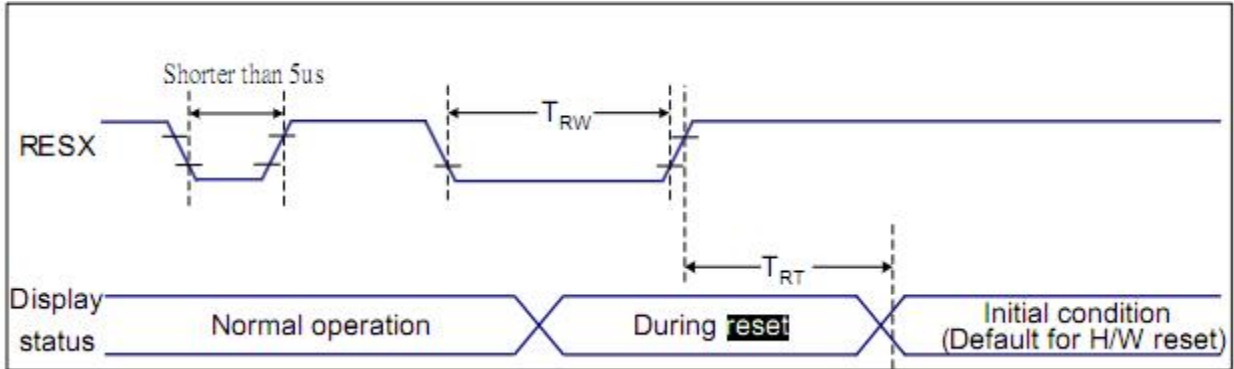
30	DB17	I/O	Data bus.	
31	/RESET	I	A reset pin.	
32	VDD	P	Power supply voltage.3.3v	
33	VDD	P	Power supply voltage.3.3v	
34	GND	P	Ground	
35	DB6	I/O	Data bus.	
36	DB7	I/O	Data bus.	
37	DB8	I/O	Data bus.	

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7 Timing Characteristics

7.1 Reset Operation



Related Pins	Symbol	Parameter	MIN	MAX	Unit
RESX	TRW	Reset pulse duration	10	-	us
	TRT	Reset cancel	-	5 (Note 1, 5)	ms
-			120 (Note 1, 6, 7)	ms	

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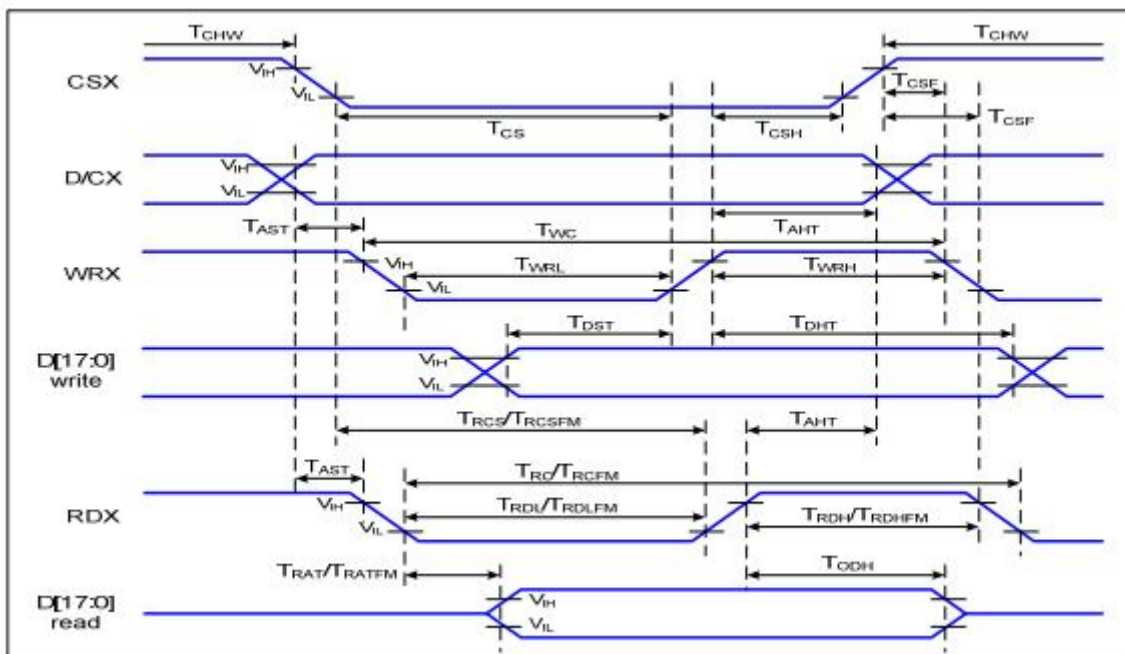
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7.2 80-System Bus Interface Timing Characteristics

Signal	Symbol	Parameter	Min	Max	Unit	Description
D/CX	T_{AST}	Address setup time	0		ns	-
	T_{AHT}	Address hold time (Write/Read)	10		ns	
CSX	T_{CHW}	Chip select "H" pulse width	0		ns	-
	T_{CS}	Chip select setup time (Write)	15		ns	
	T_{RCS}	Chip select setup time (Read ID)	45		ns	
	T_{RCSFM}	Chip select setup time (Read FM)	355		ns	
	T_{CSF}	Chip select wait time (Write/Read)	10		ns	
	T_{CSH}	Chip select hold time	10		ns	
WRX	T_{WC}	Write cycle	66		ns	-
	T_{WRH}	Control pulse "H" duration	15		ns	
	T_{WRL}	Control pulse "L" duration	15		ns	
RDX (ID)	T_{RC}	Read cycle (ID)	160		ns	When read ID data
	T_{RDH}	Control pulse "H" duration (ID)	90		ns	
	T_{RDL}	Control pulse "L" duration (ID)	45		ns	
RDX (FM)	T_{RCFM}	Read cycle (FM)	450		ns	When read from frame memory
	T_{RDHFM}	Control pulse "H" duration (FM)	90		ns	
	T_{RDLFM}	Control pulse "L" duration (FM)	355		ns	
D[17:0]	T_{DST}	Data setup time	10		ns	For CL=30pF




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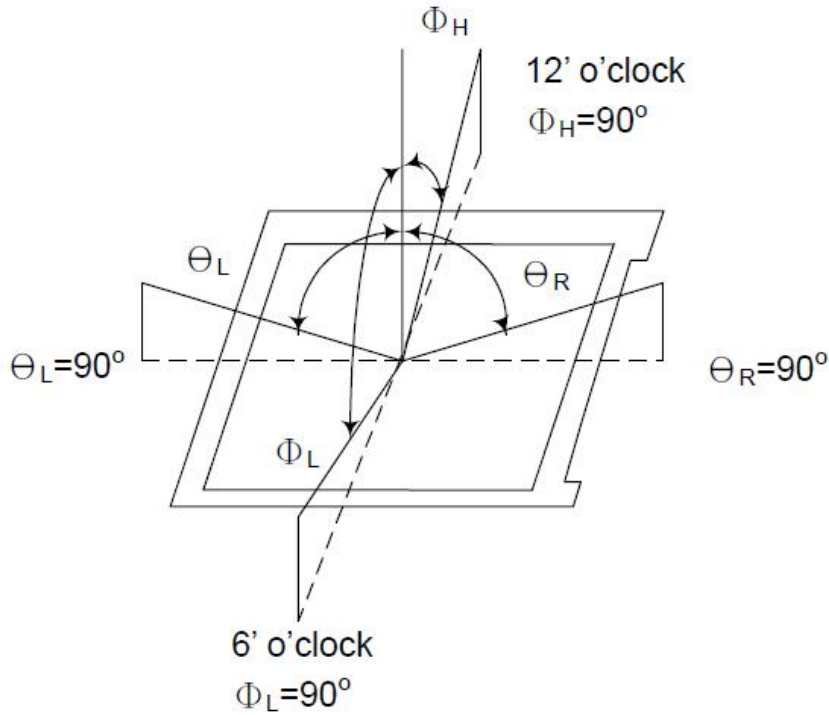
8 Optical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit	Note	
Luminance of White (center)	L_w	--	300	380	--	cd/m ²	(4)(5)	
Response time	T_{r+T_f}	$\theta=0^\circ$	--	30	40	ms	(3)	
Contrast ratio	CR	At optimized viewing angle	600	800	--	--	(2)	
Luminance Uniformity	ΔL	--	75	80	--	%	(4)(6)	
Color Chromaticity (CIE 1931)	White	W_x	$\theta=0^\circ$ Normal Viewing Angle	0.256	0.306	0.356	--	(1)(4)
		W_y		0.277	0.327	0.377		
	Red	R_x		0.634	0.654	0.674		
		R_y		0.296	0.316	0.336		
	Green	G_x		0.244	0.264	0.284		
		G_y		0.553	0.573	0.593		
	Blue	B_x		0.121	0.141	0.161		
		B_y		0.066	0.086	0.106		
Viewing Angle	Hor.	θ_R	$CR \geq 10$	--	(80)	--	Degree	(1)
		θ_L		--	(80)	--		
	Ver.	θ_U		--	(80)	--		
		θ_D		--	(80)	--		
Color Gamut	--	--	--	(70)	--	%		

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Note (1) Definition of Viewing Angle:




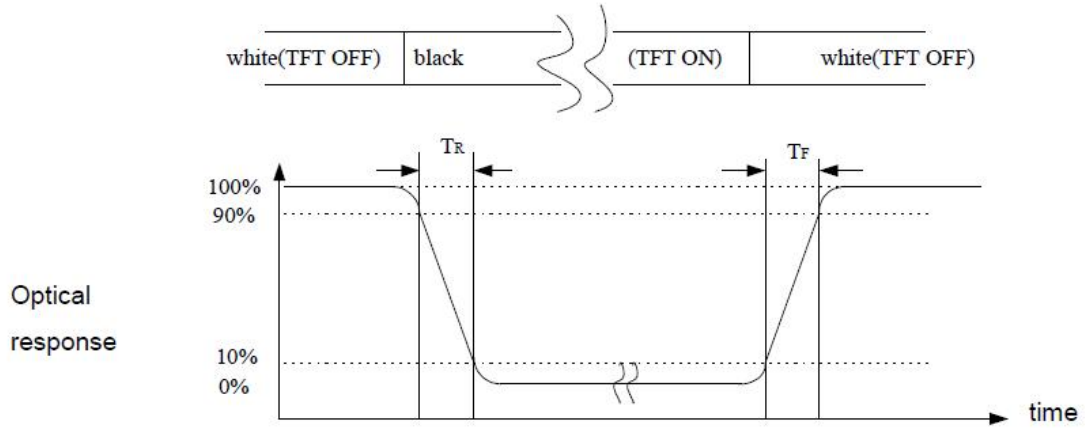
Note (2) Definition of Contrast Ratio (CR) :
measured at the center point of panel

$$CR = \frac{\text{Luminance with all pixels white (L}_{255}\text{)}}{\text{Luminance with all pixels black (L}_0\text{)}}$$

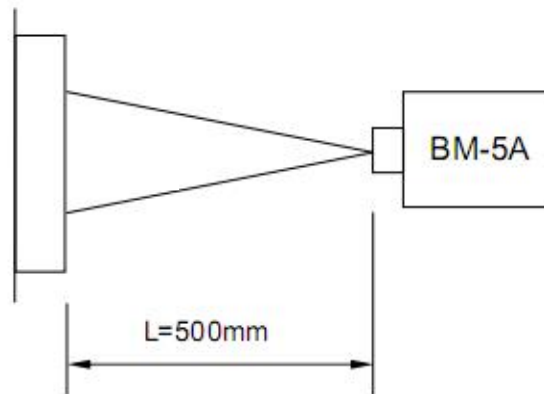
Note (3) Definition of Response Time: Sum of T_R and T_F

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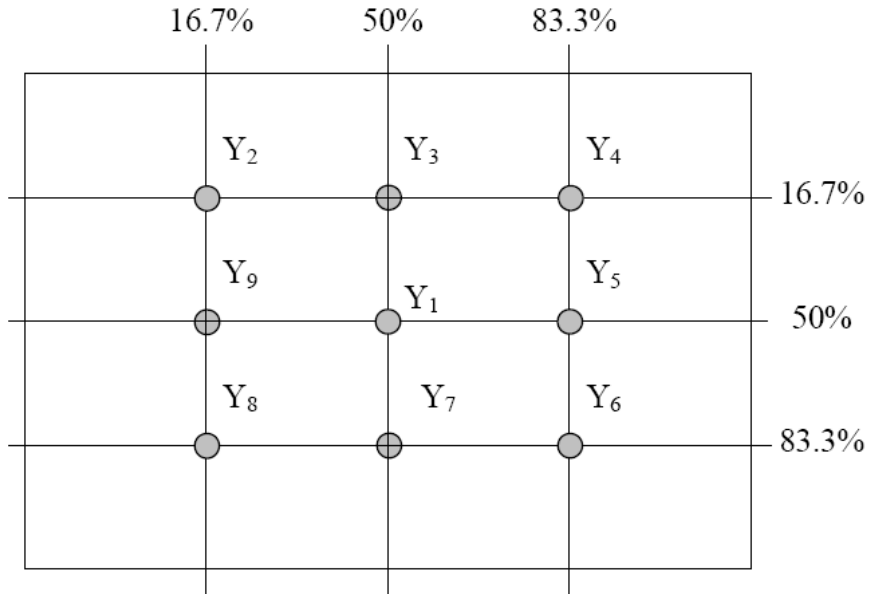
Note (4) Optical characteristic measurement setup



Note (5) Definition of Center Luminance of White (center) Center Luminance= Y1

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Note (6) Definition of brightness uniformity

$$\text{Luminance uniformity} = \frac{(\text{Min Luminance of 9 points})}{(\text{Max Luminance of 9 points})} \times 100\%$$

Note (7) Rubbing Direction (The different Rubbing Direction will cause the different optimal view direction).

Note (8) Measured at the brightness of the panel when all terminals of LCD panel are electrically open.

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9 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	Thermal Shock	-30°C (0.5Hr)~70°C (0.5Hr) 20cycles	2
7	Electrostatic Discharge Test Operating	C=150pF,R=330Ω, 5 points/panel, Air : ±8KV, 5 times Contact : ±4KV, 5 times (Environment : 30%~60%, 86Kpa~106Kpa)	

Note (1)No dew condensation to be observed.

Note (2)The function test shall be conducted after 4 hours storage at the normal temperature and humidity after removed from the test chamber.

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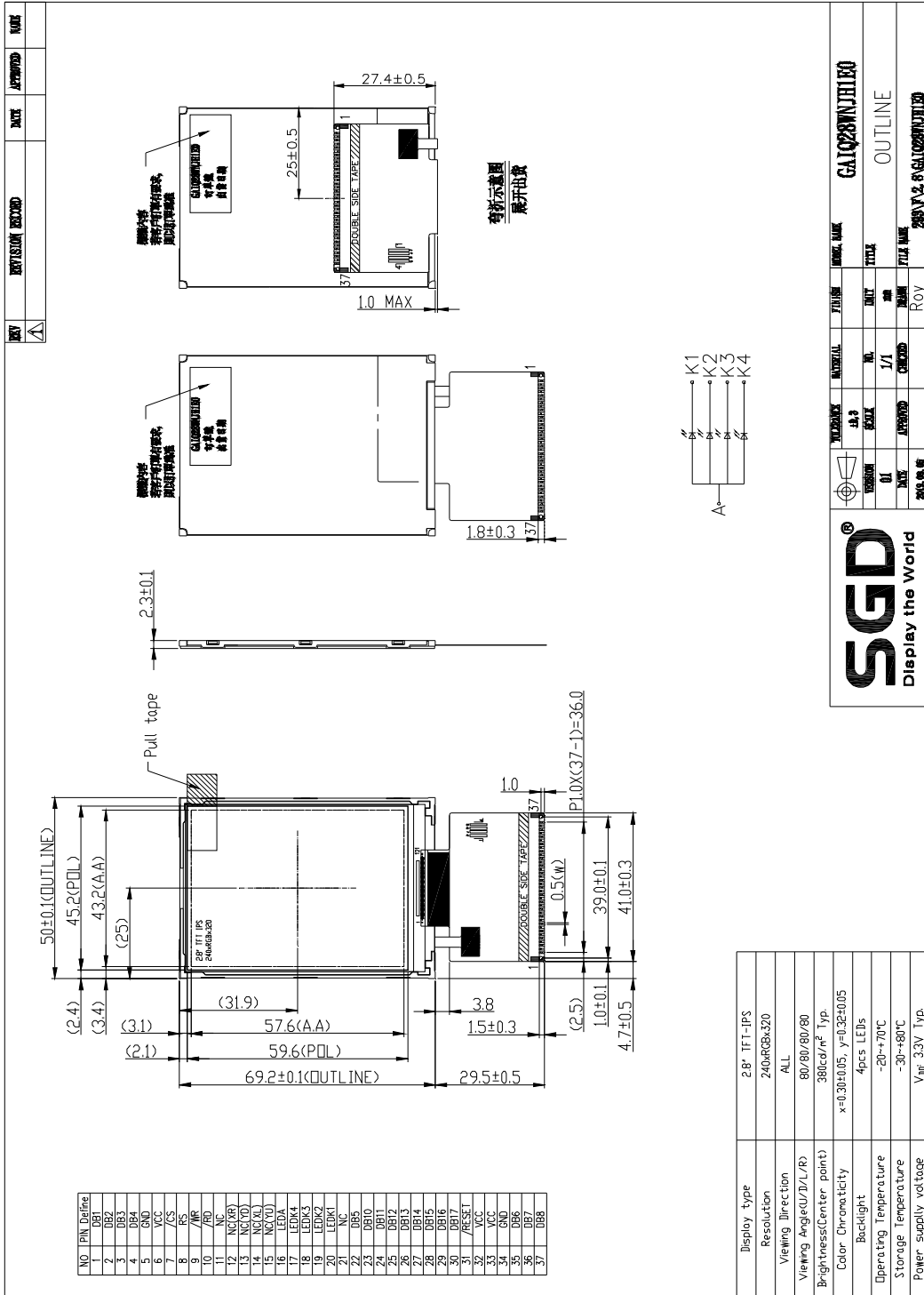
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10 DIMANSIONAL OUTLINE



Display type	28" TFT-IPS
Resolution	240xRGBx320
Viewing direction	ALL
Viewing Angle(U/L/R)	80/80/80/80
Brightness(Center point)	380cd/m ² Typ.
Color Chromaticity	x=0.30±0.05, y=0.32±0.05
Backlight	4pcs LEDs
Operating Temperature	-20~+70°C
Storage Temperature	-30~+80°C
Power supply voltage	V _{BE} 3.3V Typ.

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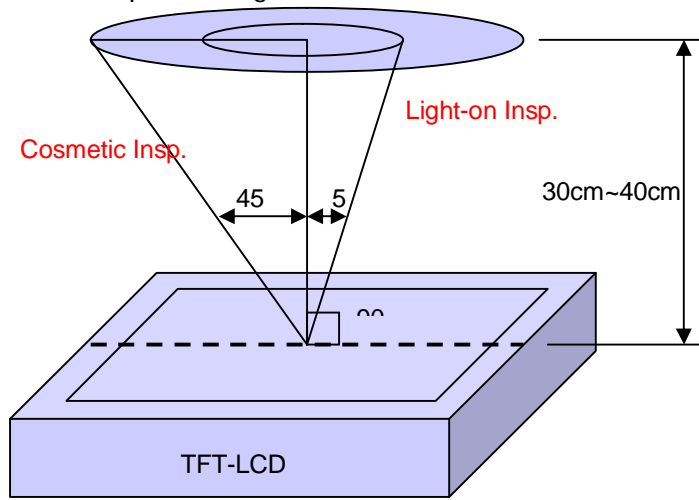
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11 . Incoming Inspection Standards

11.1 Inspection and Environment Conditions

11.1.1 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)

11.2 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


11.3 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%

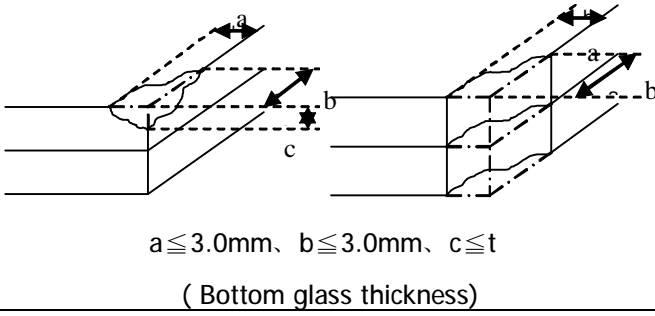
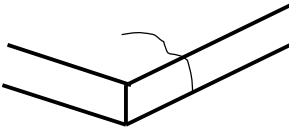
(3) The classification of Major(MA) and Minor(MI) defects is shown as 3. Inspection Criteria.

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11.4 Inspection Criteria

11.4.1.1 Cosmetic Inspection(Panel):

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

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Outline Dimension	Must in Spec, refer to related product spec.	MI
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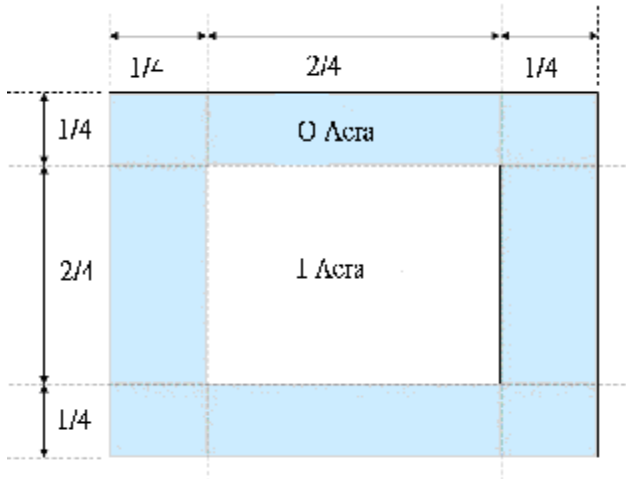
11.4.1.2 Functional Inspection:

Item	Judgment Criteria			Classification
	Area(Note1)	I	O	
Point Defect	Bright dot	Random	2	
		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 $0.2\text{mm} < D \leq 0.5\text{mm}$: $N \leq 8$ $D > 0.3\text{mm}$: 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 $1.0\text{mm} < L \leq 5\text{mm}$: $N \leq 8$ $W > 0.2\text{mm}$ or $L > 5\text{mm}$: Not allowed			MI
Display Function Abnormal	No Malfunction can be allowed			MA

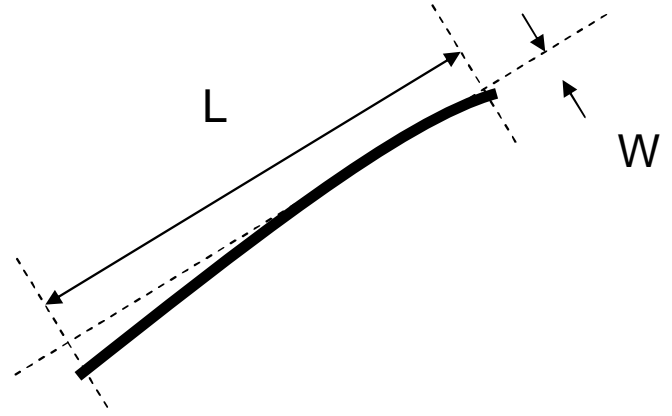
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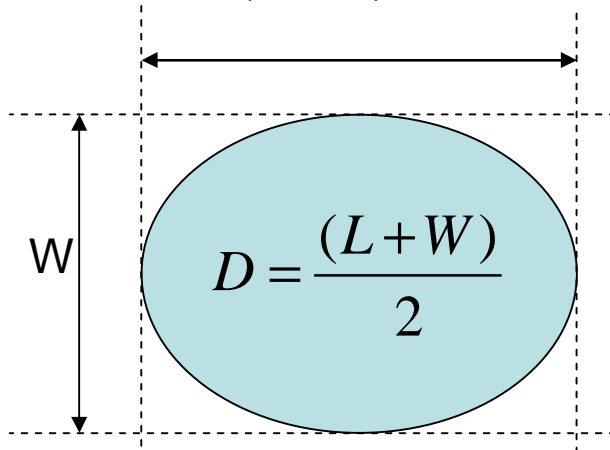
Note-1 : I/O Area Definition



Note-2 : Polarizer Scratch



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



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

