

Product Specification



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Thin-Film-Transistor LCD Module


Model: GAIQ24MNJH2E0

Acceptance

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1. General Description and Features

GAIQ24MNJH2E0 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 2.4 inch diagonally measured active display area with QVGA(240 horizontal by 320 vertical pixel) resolution.

1.1 Features

- 2.4inch configuration
- LED Backlight
- RoHS Compliance


1.2 LCD Module

Item	Specification	Unit
Screen Size	2.4 inches	Diagonal
Display Resolution	240(H) x RGB x 320(V)	Dot
Active Area	36.72(H) x 48.96(V)	mm
Outline Dimension	42.72(H) x 60.26(V) x 2.3(T)	mm
Display mode	Normally Black	--
Pixel pitch	0.153(H) x 0.153(V)	mm
Pixel arrangement	RGB-Vertical Stripe	--
Display Color	262K	--
Viewing Direction	ALL	
BL unit	White LED	--
Driver IC	ST7789V	--

2. Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	42.57	42.72	42.87	mm	--
	Vertical (V)	60.11	60.26	60.41	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)

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	IOH = -1.0mA	0.8VDDI		VDDI	V	Note 1
Logic-Low Output Voltage	VOL	IOL = +1.0mA	VSS		0.2VDDI	V	Note 1
Logic-High Input Current	I _{IH}	V _{IN} = VDDI			1	μA	Note 1
Logic-Low Input Current	I _{IL}	V _{IN} = VSS	-1			μA	Note 1
Input Leakage Current	I _{IL}	IOH = -1.0mA	-0.1		+0.1	μA	Note 1

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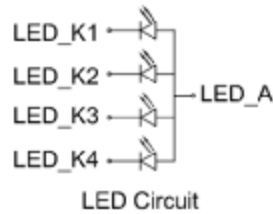
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4.2 Backlight Unit

Parameter	Symbol	Min	Typ	Max	Units	Condition
LED Voltage	V_L	2.8	3.1	3.4	V	
LED current	I_f	-	80	-	mA	(2)
LED Life-Time	Hr	(35,000)	(50,000)	--	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 I_L 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 $T_a=25^\circ\text{C}$ 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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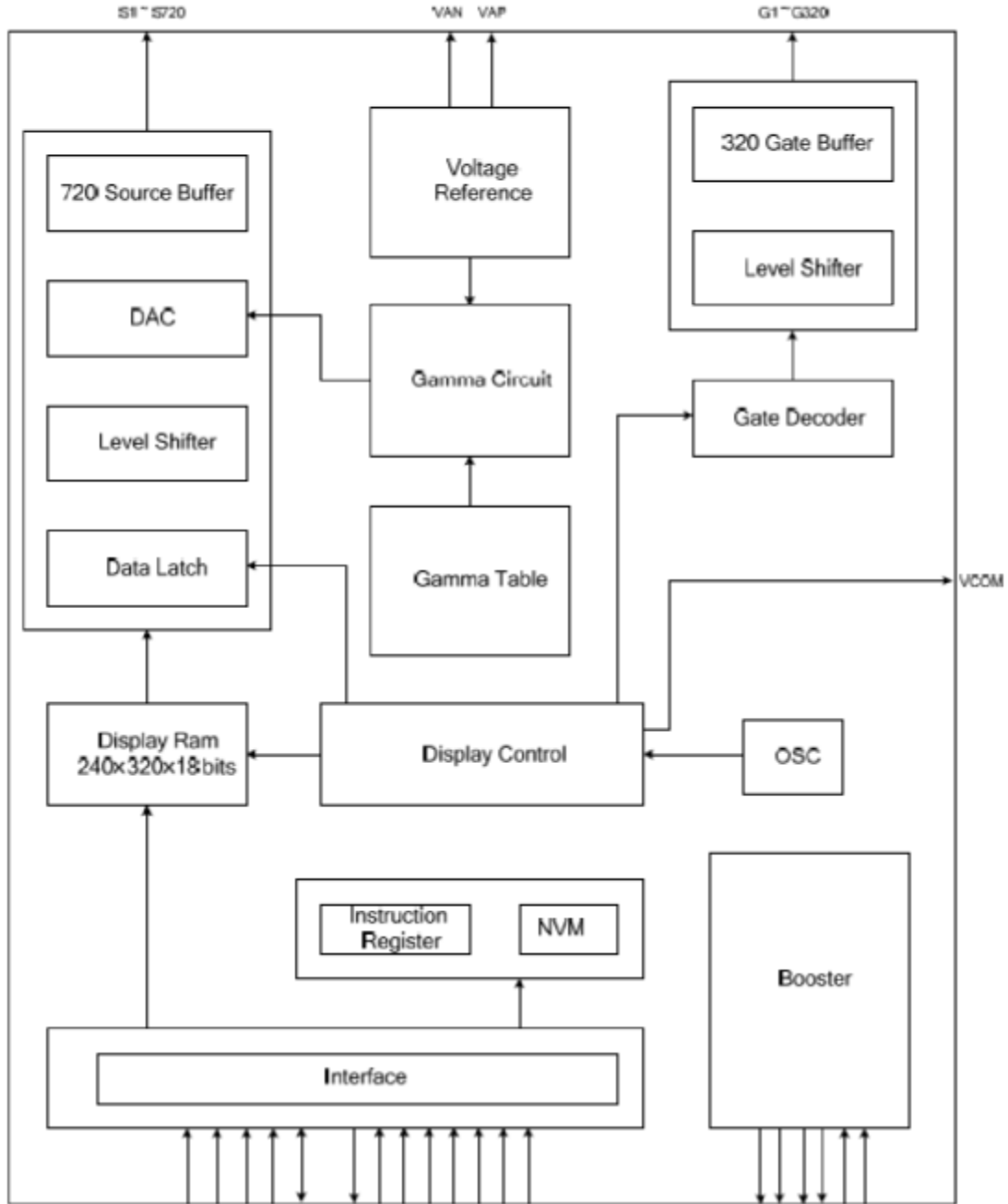
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5 BLOCK DIAGRAM




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6 Interface Connection

PIN	Symbol	IO	Functions
1	LEDA	P	Power for LED backlight anode
2	LEDK4	P	Power for LED backlight cathode
3	LEDK3	P	Power for LED backlight cathode
4	LEDK2	P	Power for LED backlight cathode
5	LEDK1	P	Power for LED backlight cathode
6	GND	P	Power ground
7	IM0	I	Select the MCU interface mode
8	IM1	I	Select the MCU interface mode
9	IM2	I	Select the MCU interface mode
10	IM3	I	Select the MCU interface mode
11	TE	O	Tearing effect output pin
12	NC	-	No connection
13	GND	P	Power ground
14	RESET	I	Reset signal
15	DB17	I/O	Data input
16	DB16	I/O	Data input
17	DB15	I/O	Data input
18	DB14	I/O	Data input
19	DB13	I/O	Data input
20	DB12	I/O	Data input
21	DB11	I/O	Data input
22	DB10	I/O	Data input
23	DB9	I/O	Data input
24	DB8	I/O	Data input
25	DB7	I/O	Data input
26	DB6	I/O	Data input
27	DB5	I/O	Data input
28	DB4	I/O	Data input
29	DB3	I/O	Data input

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30	DB2	I/O	Data input
31	DB1	I/O	Data input
32	DB0	I/O	Data input
33	RD	I	Read signal
34	WR	I	Write signal
35	RS	I	Command/date Select
36	CS	I	Chip select
37	GND	P	Power ground
38	IOVDD	P	Power supply pin 1.8V
39	VDD	P	Power supply pin 2.8V
40	VDD	P	Power supply pin 2.8V
41	NC(YU)	I	(TP YU) If not used, please fix this pin at no connect
42	NC(XR)	I	(TP XR) If not used, please fix this pin at no connect
43	NC(YD)	I	(TP YD) If not used, please fix this pin at no connect
44	NC(XL)	I	(TP XL) If not used, please fix this pin at no connect
45	NC	-	No connection

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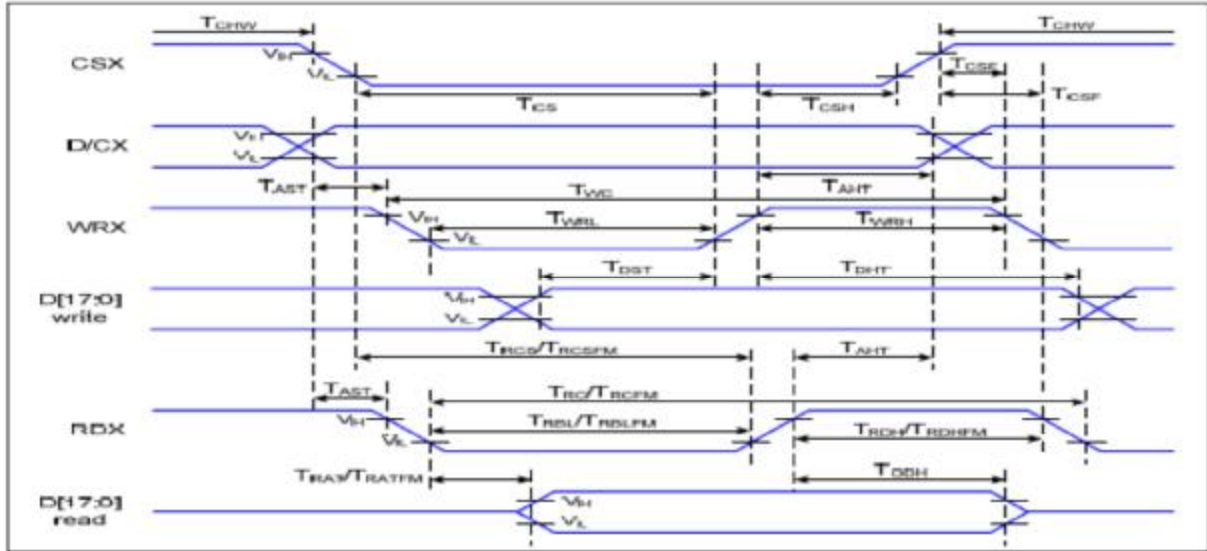
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7 Interface Timing

7.1 8080 Series MCU Parallel Interface Characteristics: 16 / 8-Bit Bus



$V_{DD1}=1.65$ to $3.3V$, $V_{DD}=2.4$ to $3.3V$, $AGND=DGND=0V$, $T_a=-30$ to 70 °C

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_{CHV}	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_{CSP}	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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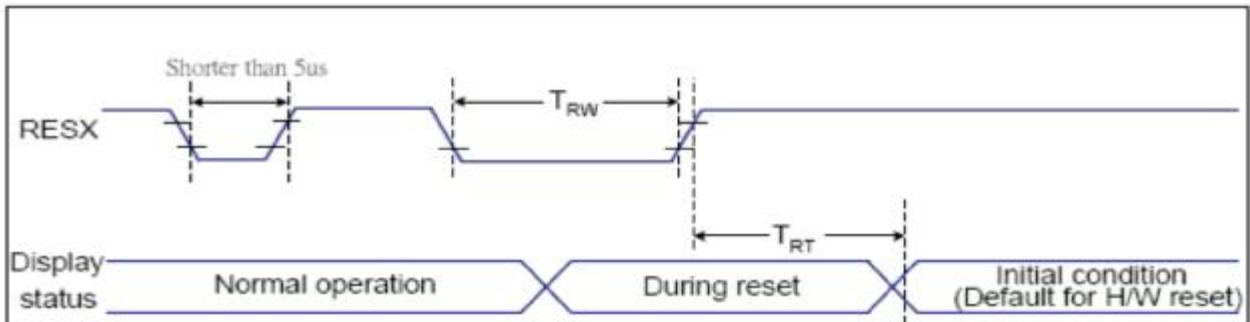
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T_{DHT}	Data hold time	10		ns
T_{RAT}	Read access time (ID)		40	ns
T_{RATFM}	Read access time (FM)		340	ns
T_{ODH}	Output disable time	20	80	ns


7.2 Reset Timing Characteristics



$V_{DDI}=1.65$ to $3.3V$, $V_{DD}=2.4$ to $3.3V$, $AGND=DGND=0V$, $T_a=-30 \sim 70 \text{ } ^\circ\text{C}$

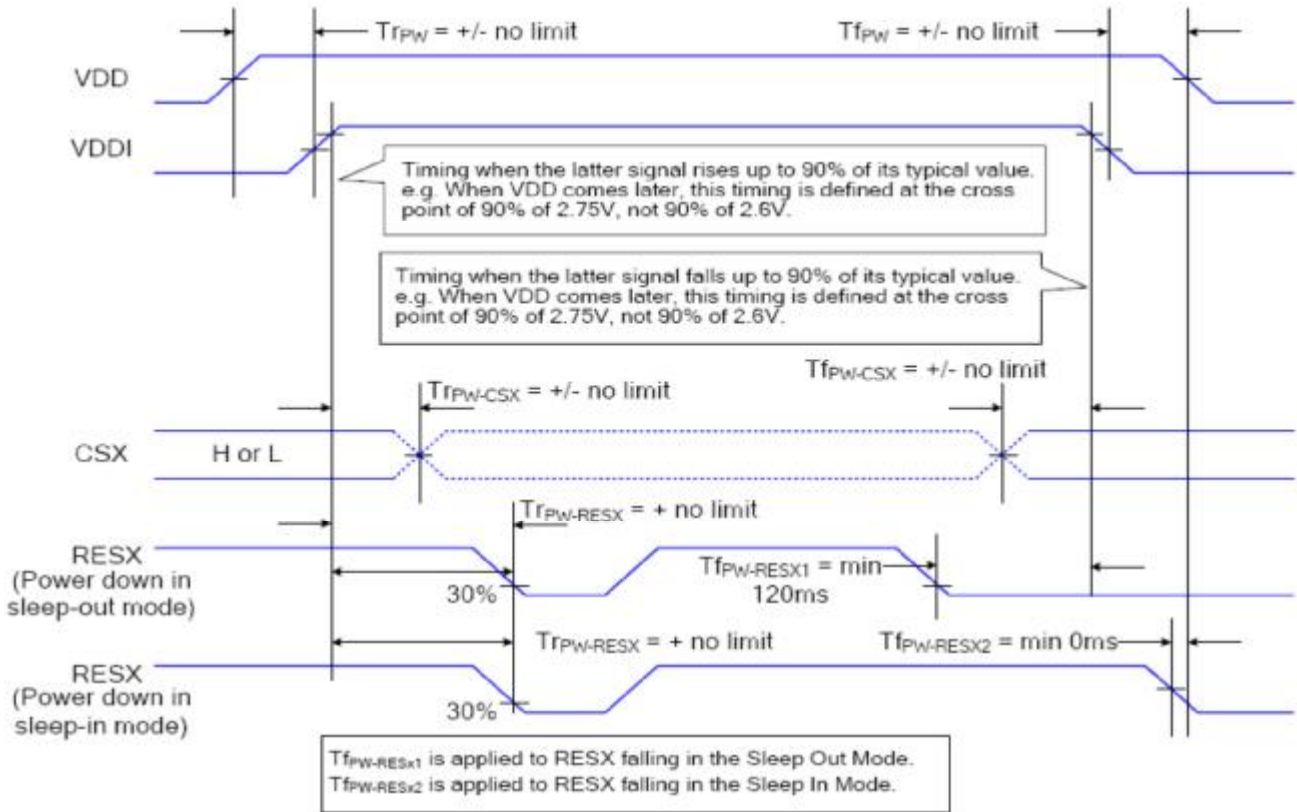
Related Pins	Symbol	Parameter	MIN	MAX	Unit
RESX	TRW	Reset pulse duration	10	-	us
	TRT	Reset cancel	-	5 (Note 1, 5) 120 (Note 1, 6, 7)	ms

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7.3 Power ON/OFF Sequence

The power on/off sequence is illustrated below




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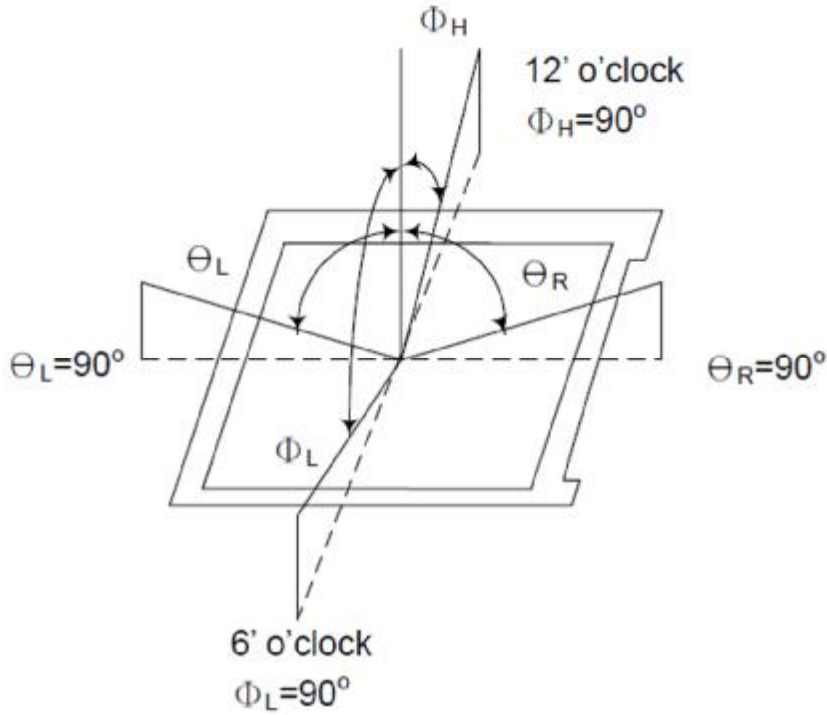
8 Optical Characteristics

Item	Symbol	Condition	Min	Type	Max	Unit	Note	
Luminance of White (center)	L_w	--	220	300	--	cd/m ²	(4)(5)	
Response time	T_{r+} T_f	$\theta=0^\circ$	--	(35)	--	ms	(3)	
Contrast ratio	CR	At optimized viewing angle	640	800	--	--	(2)	
Luminance Uniformity	ΔL	--	75	80	--	%	(4)(6)	
Color Chromaticity (CIE 1931)	White	W_x	$\theta=0^\circ$ Normal Viewing Angle	0.260	0.310	0.360	--	(1)(4)
		W_y		0.285	0.335	0.385		
	Red	R_x		0.590	0.640	0.690		
		R_y		0.291	0.341	0.391		
	Green	G_x		0.252	0.312	0.352		
		G_y		0.554	0.604	0.654		
	Blue	B_x		0.119	0.149	0.179		
		B_y		0.023	0.053	0.083		
Viewing Angle	Hor.	θ_R	CR \geq 10	--	(80)	--	Degree	(1)
		θ_L		--	(80)	--		
	Ver.	θ_U		--	(80)	--		
		θ_D		--	(85)	--		
NTSC	--	--	--	(70)	--	%		

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Note (1) Definition of Viewing Angle:




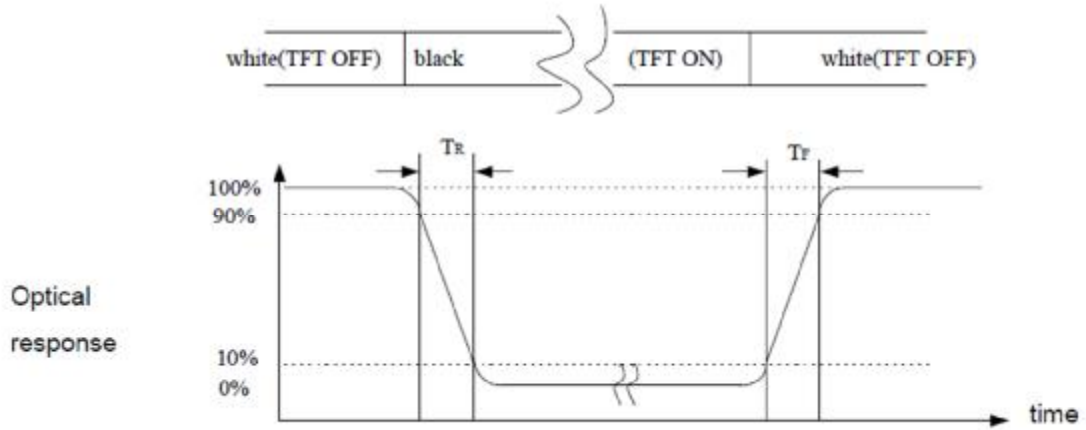
Note (2) Definition of Contrast Ratio (CR) :
 measured at the center point of panel

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

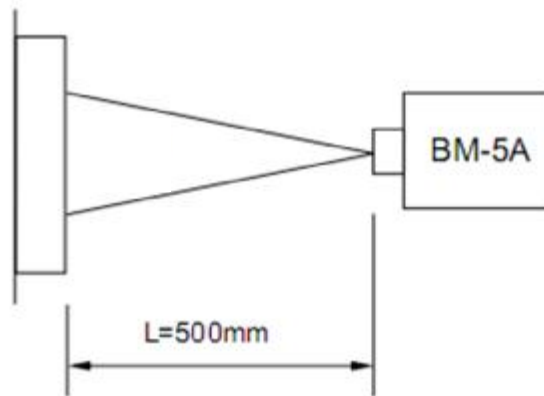
Note (3) Definition of Response Time: Sum of T_R and T_F

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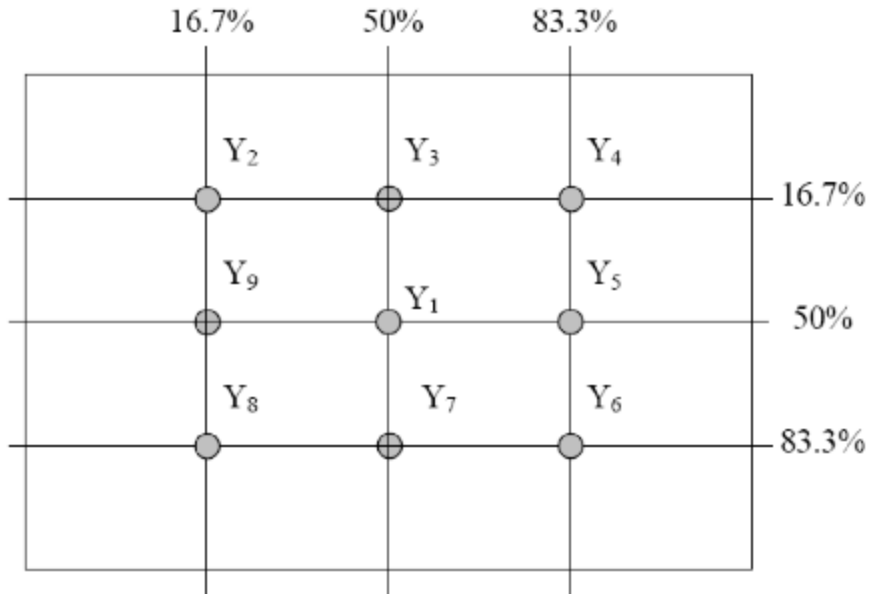
Note (4) Optical characteristic measurement setup



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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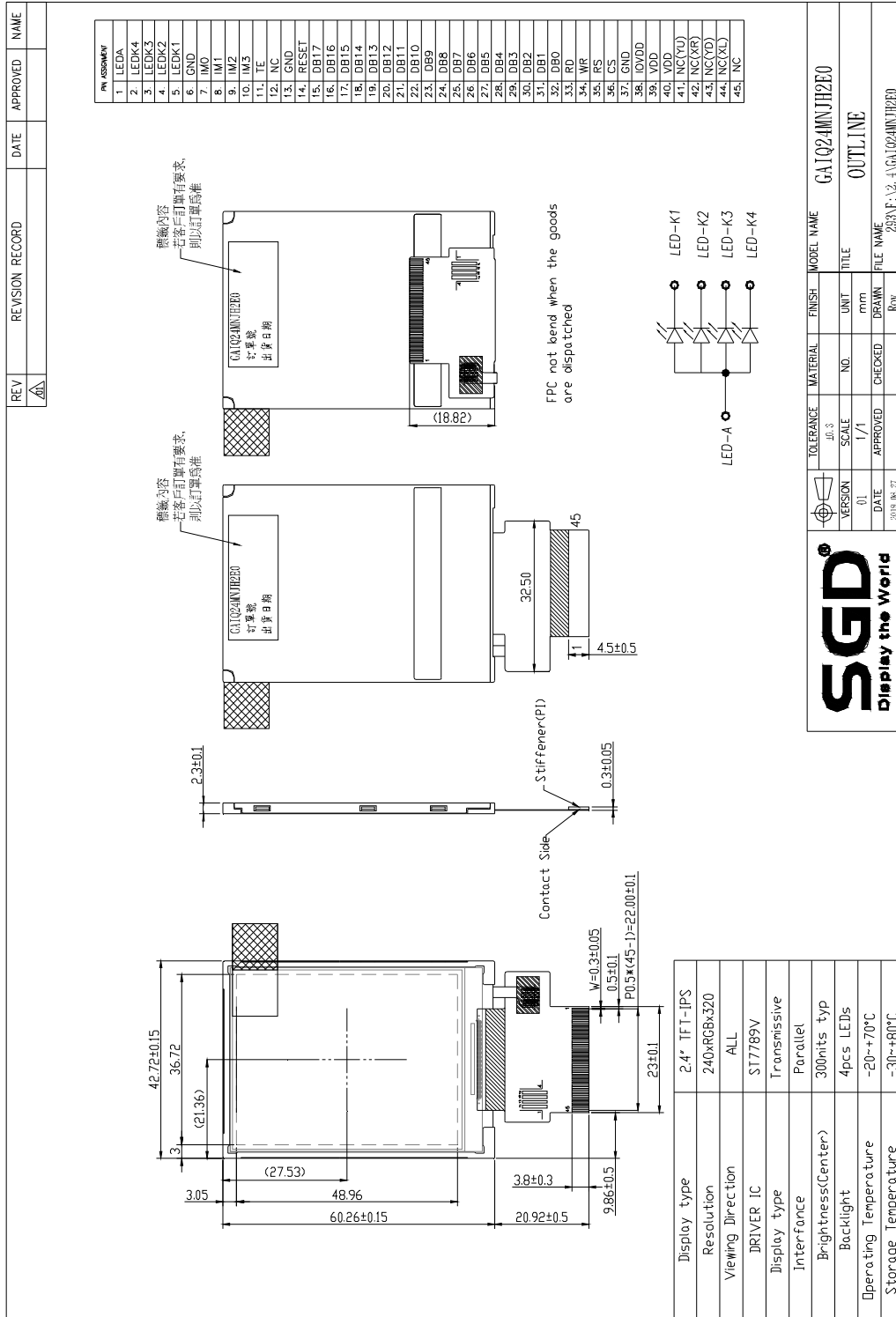
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10 DIMENSIONAL OUTLINE



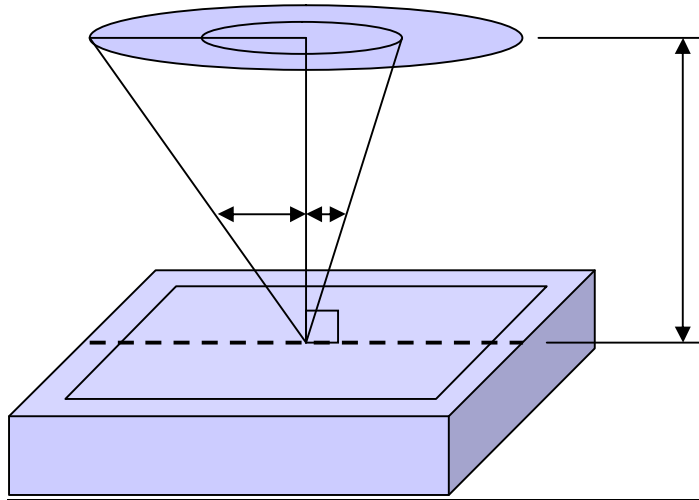
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11 Inspection and Environment Conditions

11.1.1 Inspection Conditions:

- (1) Inspection Distance: 30cm
- (2) View Angle : Light-on Inspection Angle : $\pm 5^\circ$
Cosmetic Inspection Angle : $\pm 45^\circ$



(perpendicular to LCD panel surface)

11.1.2 Environment Conditions:

Ambient Temperature		$25^\circ\text{C} \pm 2^\circ\text{C}$
Ambient Humidity		$55 \pm 10\% \text{RH}$
Ambient Illumination	Functional Inspection	300 ± 50 luminance


11.1.3 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.

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11.1.4 Functional Inspection:

Item	Judgment Criteria			Classification
	Area(Note1)	I	O	
Point Defect	Bright dot	Random	0	
		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		2	
	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 $L \leq 3.0\text{mm}$: Ignored $0.05\text{mm} < W \leq 0.1\text{mm}$ and $1.0\text{mm} < L \leq 2.0\text{mm}$: $N \leq 4$ $W > 0.1\text{mm}$ or $L > 5\text{mm}$: Not allowed			MI
Display Function Abnormal	No Malfunction can be allowed			MA

D: diameter, N: number, W: horizontal width, L: vertical high

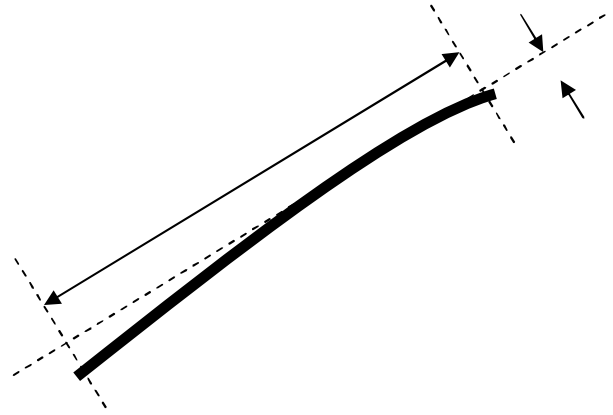
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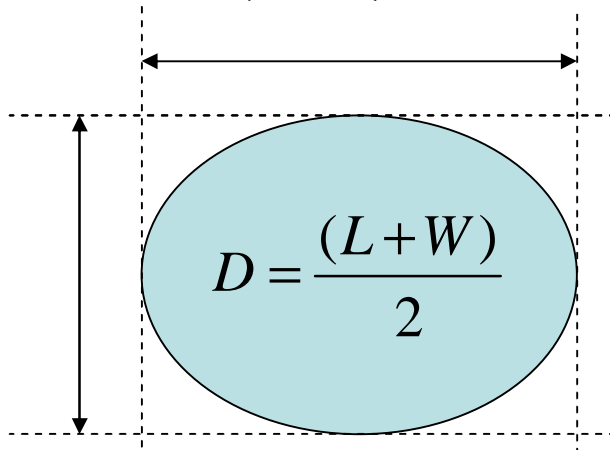
Note-1 : I/O Area Definition



Note-2 : Polarize Scratch



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



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

