Thin-Film-Transistor LCD Module
Model: GATQ24NNGL3E0

Acceptance

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Product Specification				
SGD® DISPLAY THE WORLD	Model: GATQ24NNGL3E0	Rev. No.	Issued Date.	Page.
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Revise Records

Rev.	Date	Contents	Written	Approved
A	2017/1/23	Preliminary Specification	LF	Michael

Special Notes

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Contents

1. General Description and Features

GATQ24NNGL3E0 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 dis play 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 2.55(T)	mm
Display mode	Normally white/ Transmissive	--
Pixel pitch	0.153(H) x 0.153(V)	mm
Pixel arrangement	RGB-Vertical Stripe	--
Display Color	262K	--
Viewing Direction	6 o'clock	
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)	2.45	2.55	2.65	mm	--
Weight		--	10	--	g	--

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	4.6	V	
Interface supply voltage	VDDIO	-0.3	4.6	V	
Input signal voltage	VIN	0.3	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) With in Ta=25±2°C

4 Electrical Characteristics

4.1 TFT LCD Module

(Ta=25±2°C,GND=AV_{SS}=GND=0V)

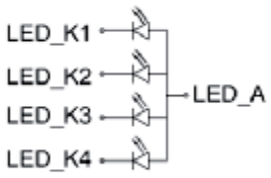
Item		Symbol	Min.	Typ.	Max.	Unit	Remark
Power supply		VCI	2.4	2.75	3.3	V	
		IOVCC	1.65	1.8	3.3	V	
		IDD	--	--	30	mA	
Input Voltage for logic	H Level	V_{IH}	0.7x IOVCC	--	IOVCC	V	
	L Level	V_{IL}	VSS	--	0.3x IOVCC	V	
Output Voltage for logic	H Level	V_{OH}	0.8x IOVCC	--	IOVCC	V	
	L Level	V_{OL}	VSS	--	0.2x IOVCC	V	
Power consumption		8 Color Mode	--	16.8	22.5	mW	
		Sleeping Mode	--	140	165	uW	

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)
Power Consumption	P_{LED}	-	248	-	mW	
LED Life-Time	Hr	(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: Ta=25±3 ℃, typical IL value indicated in the above table until the brightness becomes less than 50%.

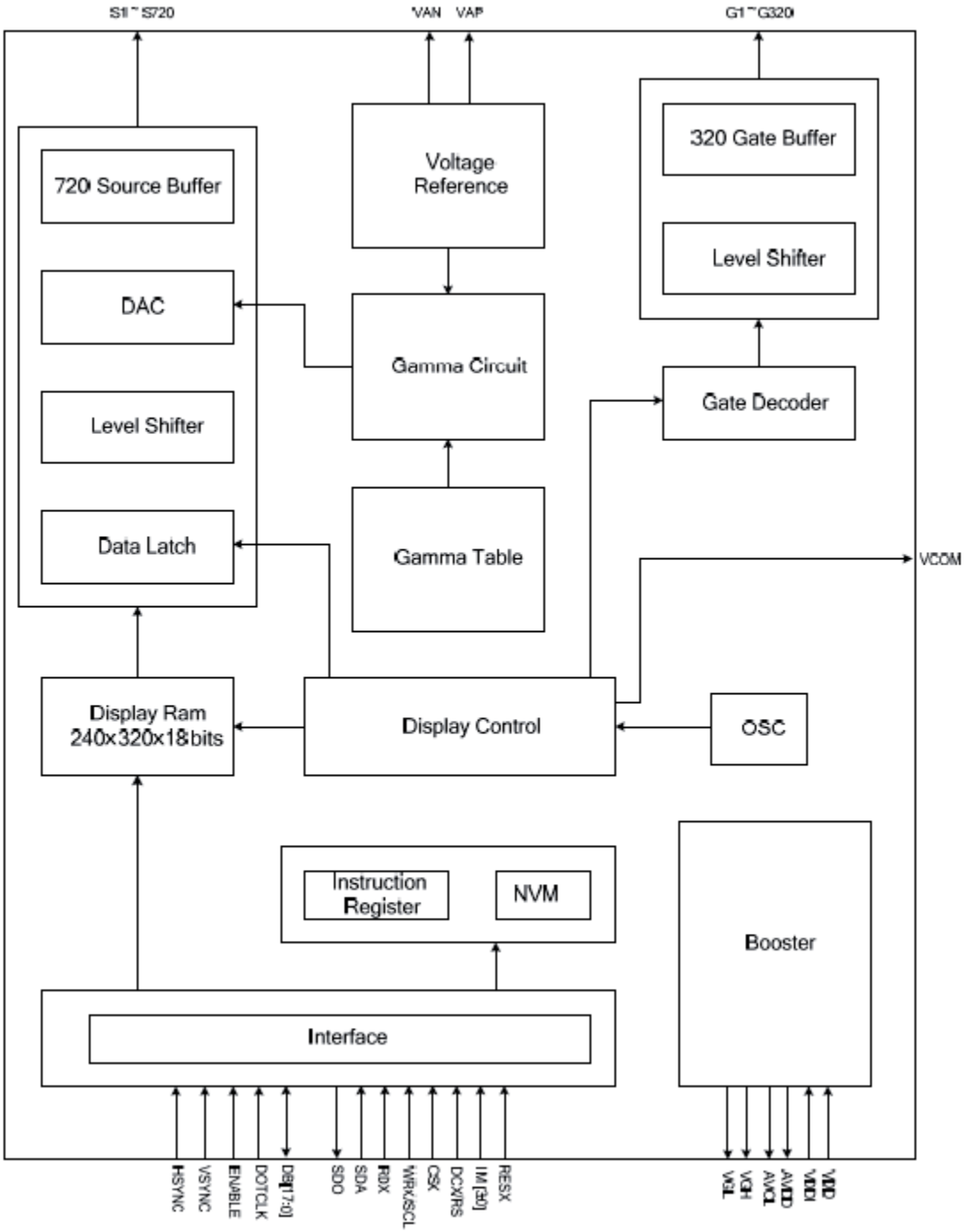
Note (2) The "LED life time" is defined as the module brightness decrease to 50% original brightness at Ta=25℃ and IL=80mA. The LED lifetime could be decreased if operating IL is larger than 80mA. The constant current driving method is suggested.



LED Circuit

5 BLOCK DIAGRAM

5.1 LCD Module Block Diagram



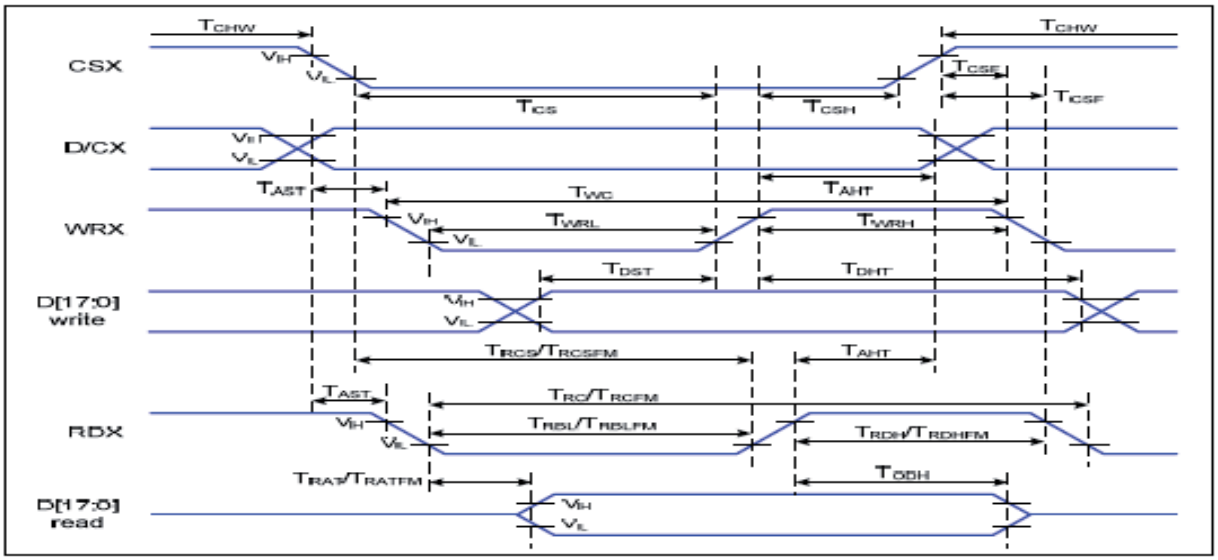
6 Interface Connection

PIN	Symbol	IO	Functions
1	GND	P	Power ground
2	LEDA	P	Power for LED backlight anode
3	LEDK4	P	Power for LED backlight cathode
4	LEDK3	P	Power for LED backlight cathode
5	LEDK2	P	Power for LED backlight cathode
6	LEDK1	P	Power for LED backlight cathode
7	GND	P	Power ground
8	NC	-	No connection
9	IM0	I	Select the MCU interface mode
10	RESET	I	Reset signal
11	D15	I/O	Data input
12	D14	I/O	Data input
13	D13	I/O	Data input
14	D12	I/O	Data input
15	D11	I/O	Data input
16	D10	I/O	Data input
17	D9	I/O	Data input
18	D8	I/O	Data input
19	D7	I/O	Data input
20	D6	I/O	Data input
21	D5	I/O	Data input
22	D4	I/O	Data input
23	D3	I/O	Data input
24	D2	I/O	Data input
25	D1	I/O	Data input
26	D0	I/O	Data input
27	RD	I	Read signal
28	WR	I	Write signal
29	RS	I	Command/date Select
30	CS	I	Chip select

31	NC	-	No connection
32	VDDI	P	Low voltage power supply for interface logic circuits
33	VCI	P	High voltage power supply for analog circuit blocks
34	NC	-	No connection
35	NC	-	No connection
36	NC	-	No connection
37	NC	-	No connection
38	NC	-	No connection
39	GND	P	Power ground

7 Interface Timing

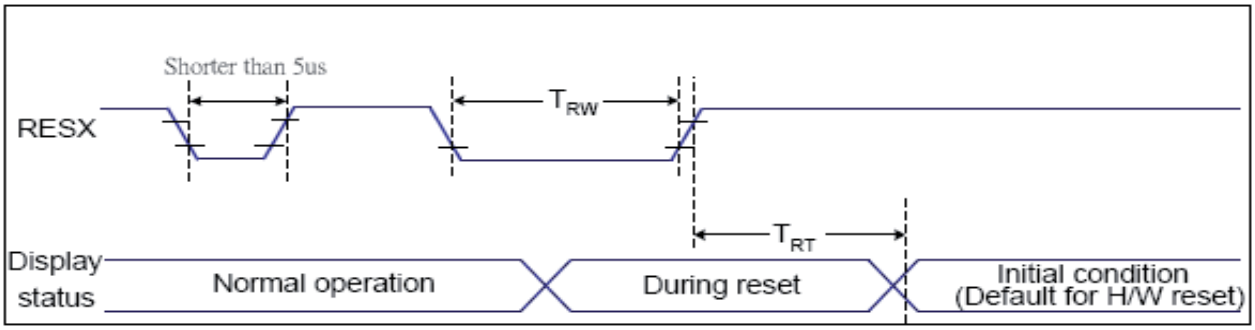
7.1 8080 Series MCU Parallel Interface Characteristics: 16 / 8-Bit Bus



VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta= -30 to 70 ℃

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
	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

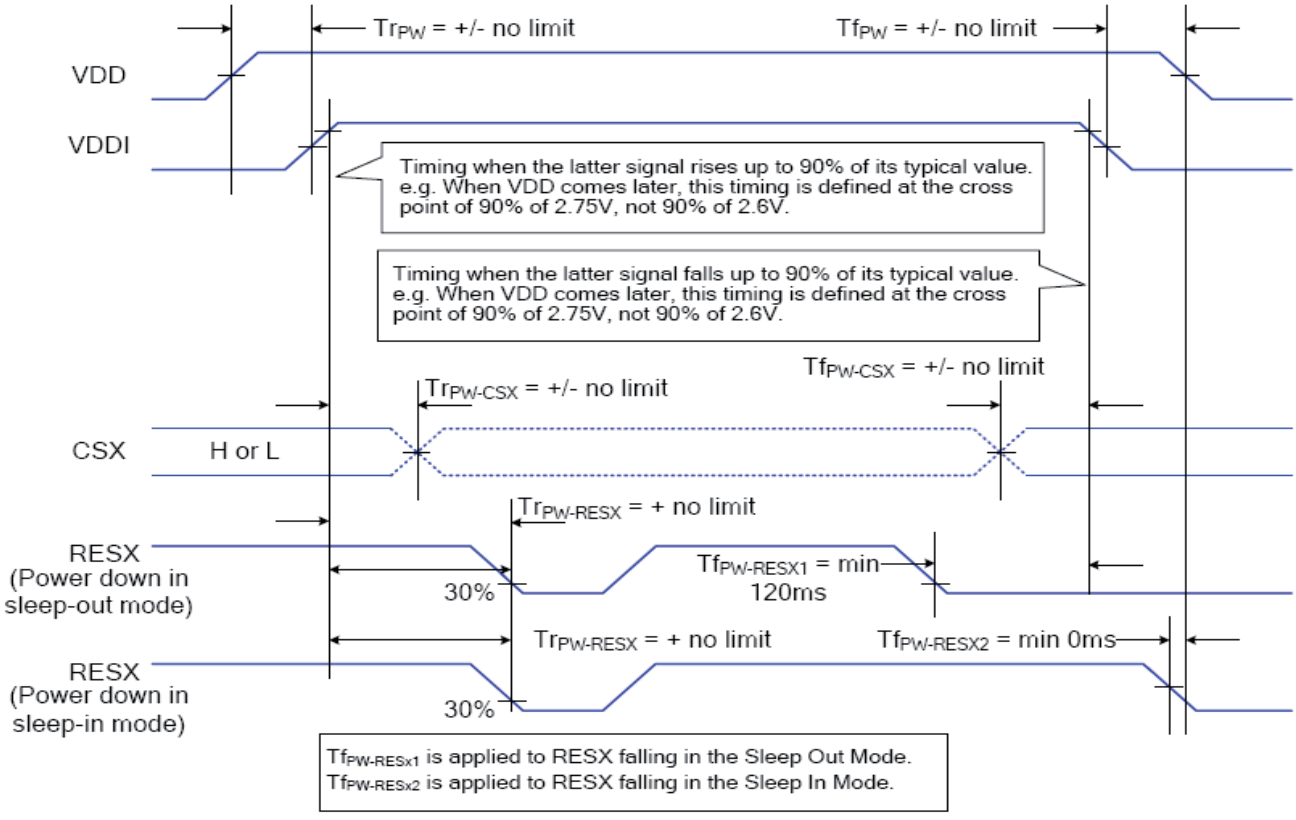


VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=-30 ~ 70 ℃

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

7.3 Power ON/OFF Sequence

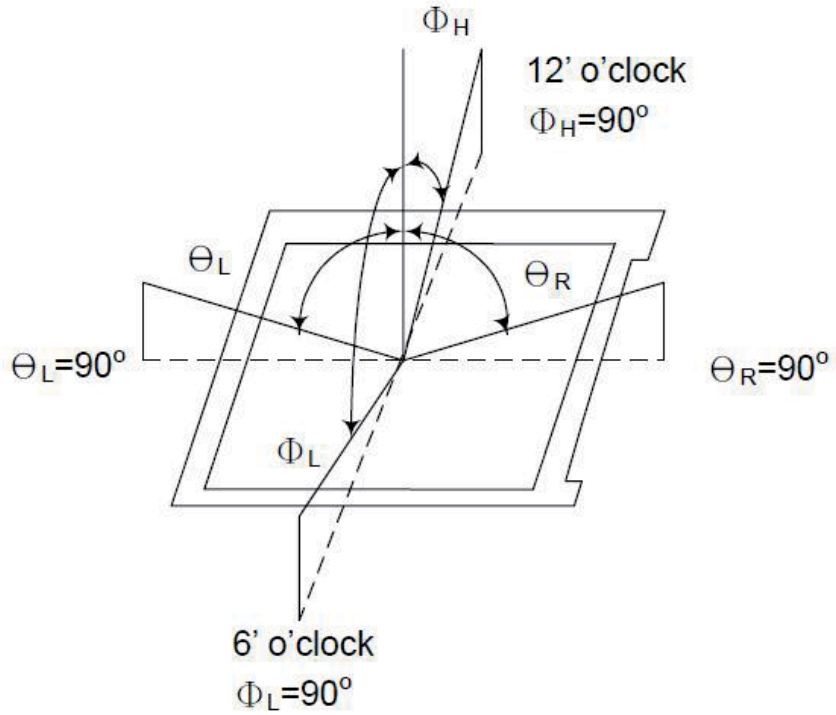
The power on/off sequence is illustrated below



8 Optical Characteristics

Item		Symbol	Condition	Min	Type	Max	Unit	Note
Luminance of White (center)		L_W	--	350	450	--	cd/m^2	(4)(5)
Response time		T_{r+} T_f	θ=0°	--	(25)	--	ms	(3)
Contrast ratio		CR	At optimized viewing angle	400	500	--	--	(2)
Luminance Uniformity		ΔL	--	75	80	--	%	(4)(6)
Color Chromaticity (CIE 1931)	White	Wx	θ=0° Normal Viewing Angle	0.235	0.285	0.315	--	(1)(4)
		Wy		0.268	0.318	0.368		
	Red	Rx		0.548	0.598	0.648		
		Ry		0.345	0.395	0.445		
	Green	Gx		0.251	0.301	0.351		
		Gy		0.537	0.587	0.637		
	Blue	Bx		0.099	0.149	0.199		
		By		0.05	0.1	0.15		
Viewing Angle	Hor.	θ_R	CR≥10	--	(50)	--	Degree	(1)
		θ_L		--	(50)	--		
	Ver.	θ_U		--	(60)	--		
		θ_D		--	(55)	--		
NTSC		--	--	--	(61)	--	%	

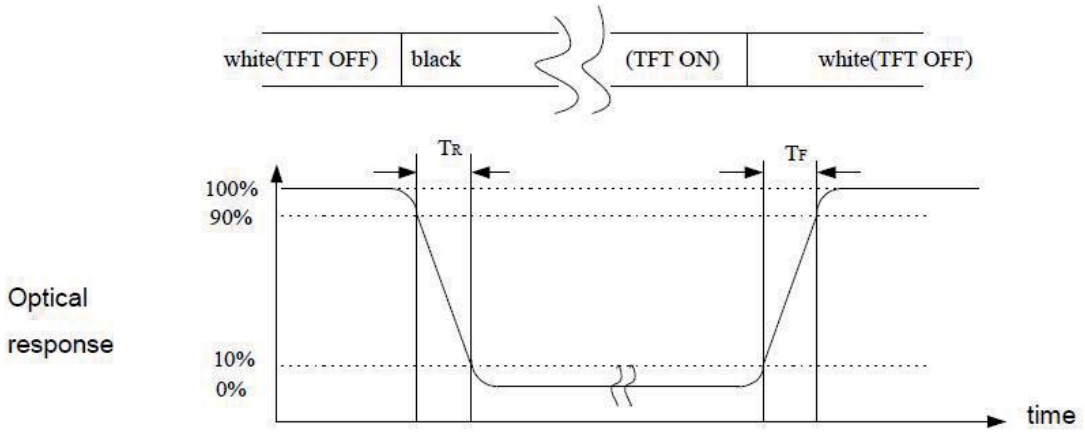
Note (1) Definition of Viewing Angle:



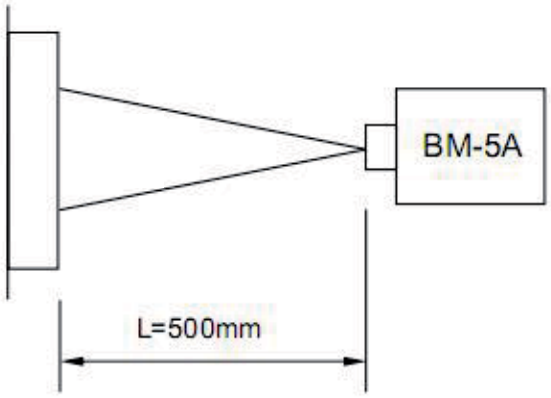
Note (2)Definition of Contrast Ratio(CR) :
measured at the center point of panel

$$CR = \frac{\text{Luminance with all pixels white (L255)}}{\text{Luminance with all pixels black (L0)}}$$

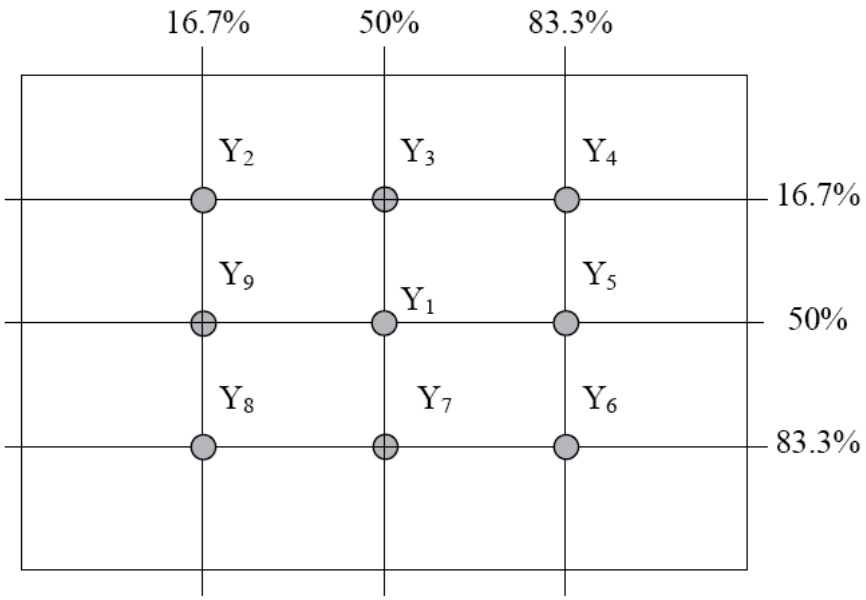
Note (3) Definition of Response Time: Sum of T_R and T_F



Note (4) Optical characteristic measurement setup



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



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.

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.

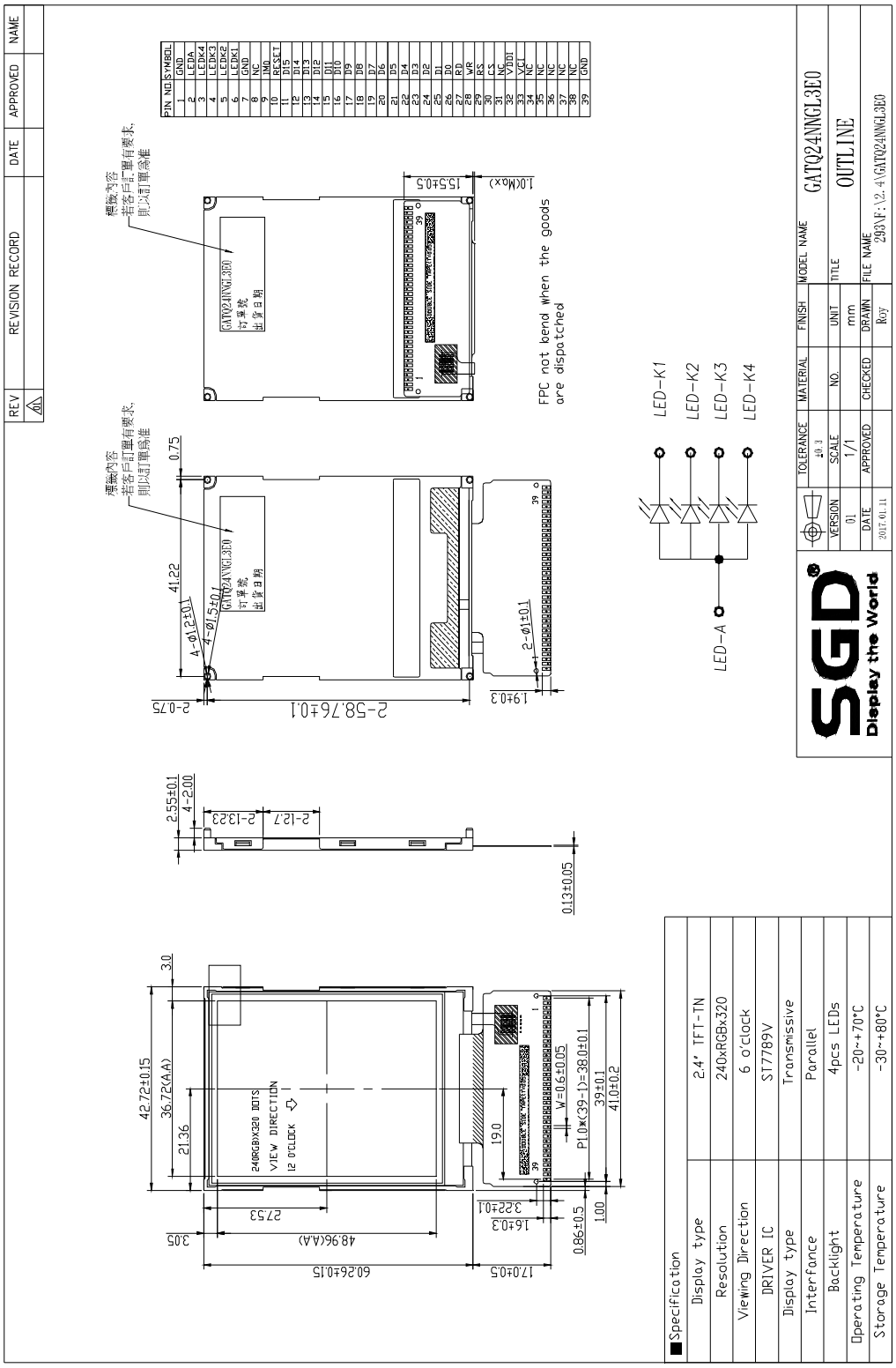
Tests will be not conducted under functioning state.

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℃ (0.5Hr)~70℃ (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.

10 DIMANSIONAL OUTLINE



11 Incoming Inspection Standards

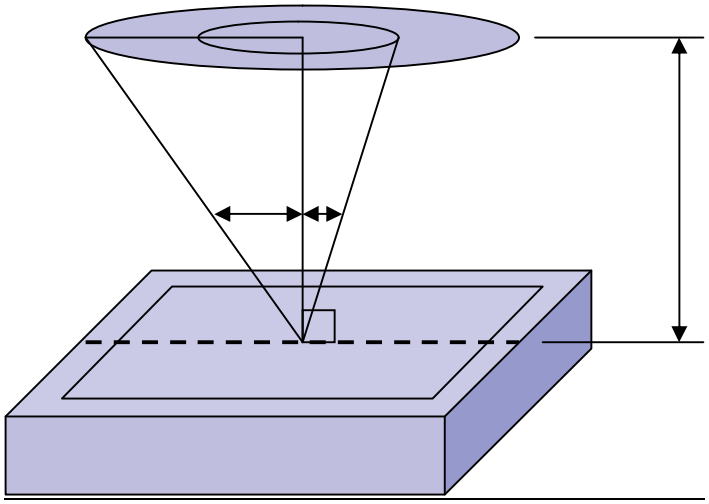
11.1 Inspection and Environment Conditions

11.1.1 Inspection Conditions:

(1)Inspection Distance: 30cm

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

Cosmetic Inspection Angle : ±45°



(perpendicular to LCD panel surface)

11.1.2 Environment Conditions:

Ambient Temperature		25℃±2℃
Ambient Humidity		55±10%RH
Ambient Illumination	Functional Inspection	300±50 Lux

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.

11.1.4 Functional Inspection:

Item	Judgment Criteria				Classification
	Area(Note1)		I	O	
Point Defect	Bright dot	Random	0		MI
		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≧5mm		
		Distance between Bright and Dark dot	L≧5mm		
		Distance between Dark dot	L≧5mm		
	(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)				
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≦0.2mm: Ignored 0.2mm<D≦0.3mm: N≦3 D>0.3mm: Not allowed				MI
Foreign Material in line or spiral shape *Note-4	W≦0.05mm or L≦3.0mm: Ignored 0.05mm<W≦0.1mm and 1.0mm<L≦2.0mm: N≦4 W>0.1mm or L>5mm: Not allowed				MI
Display Function Abnormal	No Malfunction can be allowed				MA

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

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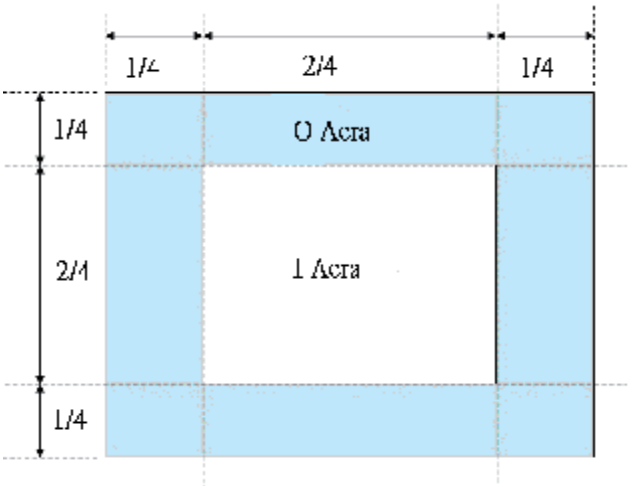
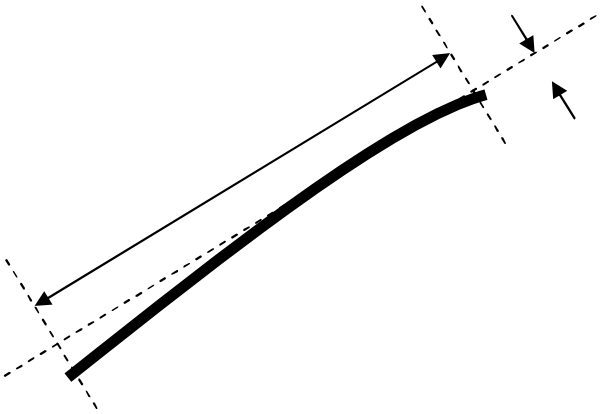
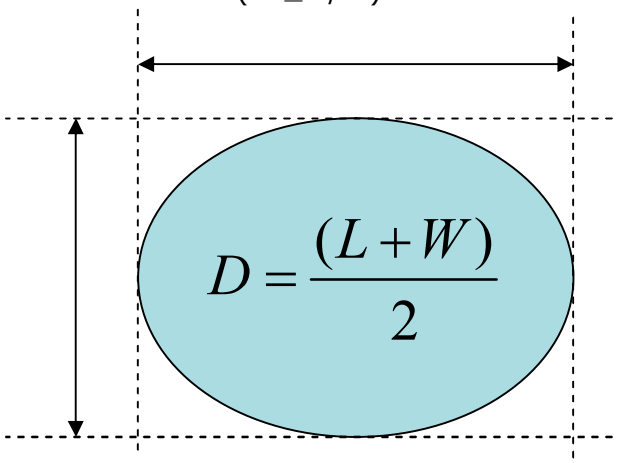
Note-1： I/O Area Definition



Note-2： Polarizer Scratch



Note-3：Spot Foreign Material
(W ≧L / 4)



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