Thin-Film-Transistor LCD Module
Model: GATQ28WNGF1E0

Acceptance

Solomon Goldentek Display Corp.

NO. 18 Ta-Yeh St., Ta-Fa Industrial Park,Ta-Liao Hsiang, Kaohsiung Hsien 831, TAIWAN , R.O.C.

FAX: 886-7-7886800

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Product Specification				
SGD® DISPLAY THE WORLD	Model: GATQ28WNGF1E0	Rev. No.	Issued Date.	Page.
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Revise Records

Rev.	Date	Contents	Written	Approved
A	2016/09/19	Preliminary Specification	Marcus Huang	Oliver Lee

Special Notes

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Contents

1. General Description and Features

GATQ28WNGF1E0 is a color active matrix thin film transistor (TFT) liquid crystal display (LCD) tha t 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 inch diagonally measured activ e 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	50.0(H) x 69.2(V) x 2.2(T)	mm
Display mode	Normally white/ Transmissive	--
Pixel pitch	0.18(H) x 0.18(V)	mm
Pixel arrangement	RGB-Vertical Stripe	--
Display Color	262K	--
Viewing Direction	12 o'clock	
BL unit	White LED	--
Driver IC	ST7789V	--

2. Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	49.8	50.0	50.2	mm	--
	Vertical (V)	69.0	69.2	69.4	mm	--
	Thickness (T)	2.1	2.2	2.3	mm	--
Weight		--	TBD	--	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	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) With in Ta=25±2°C

4 Electrical Characteristics

4.1 TFT LCD Module

(Ta=25±2°C,GND=AV_{SS}=GND=0V)

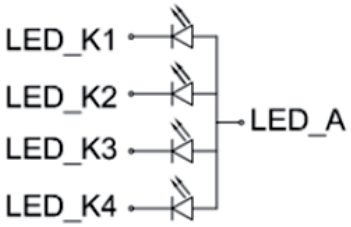
Item		Symbol	Min.	Typ.	Max.	Unit	Remark
Power supply		VCI	2.5	2.8	3.3	V	
		IOVCC	1.65	2.8	3.3	V	
		IDD	--	--	20	mA	
Input Voltage for logic	H Level	V_{IH}	0.7x IOVCC	--	IOVCC	V	
	L Level	V_{IL}	VSS	--	0.3x IOVCC	V	
Output Voltage for logic	H Level	V_{OH}	0.8x IOVCC	--	IOVCC	V	
	L Level	V_{OL}	VSS	--	0.2x IOVCC	V	
Power consumption		8 Color Mode	--	20.72	29.7	mW	
		Sleeping Mode	--	19.6	28.05	uW	

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: Ta=25±3 ℃, typical IL value indicated in the above table until the brightness becomes less than 50%.

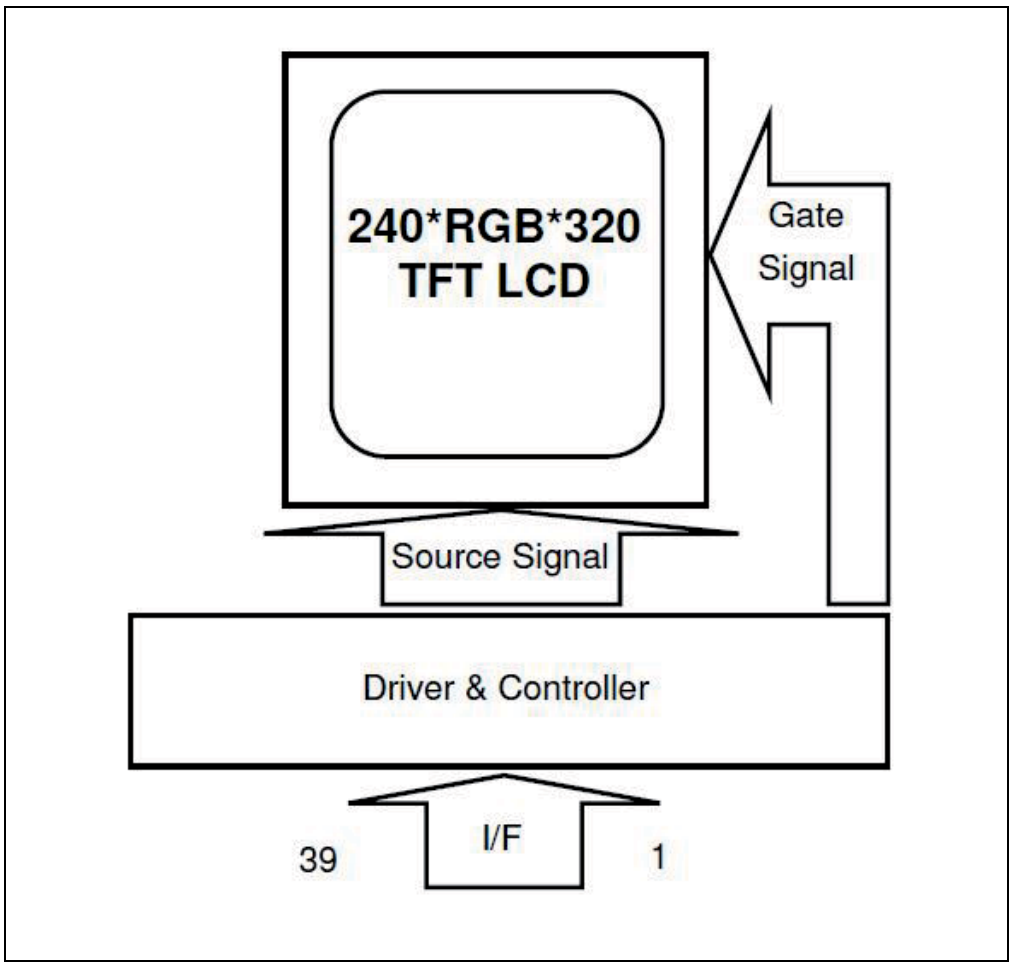
Note (2) The "LED life time" is defined as the module brightness decrease to 50% original brightness at Ta=25℃ and IL=80mA. The LED lifetime could be decreased if operating IL is larger than 80mA. The constant current driving method is suggested.



LED Circuit

5 BLOCK DIAGRAM

5.1 LCD Module Block Diagram



6 Interface Connection

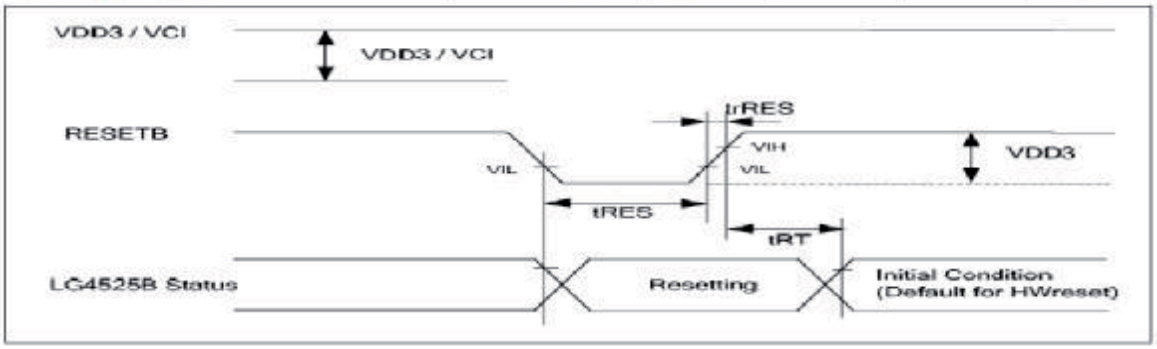
Pin No.	Symbol	I/O	Function	Remark
1	DB1	I/O	Data bus.	
2	DB2	I/O	Data bus.	
3	DB3	I/O	Data bus.	
4	DB4	I/O	Data bus.	
5	GND	P	Ground	
6	VCC	P	Power supply for logic voltage.	
7	/CS	I	A chip select signal. Low: the ILI9341 is selected and accessible. High: the ILI9341 is not selected and not accessible	
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	IM0	I	Select the MPU system interface mode	
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.	

30	DB17	I/O	Data bus.	
31	/RESET	I	A reset pin. Initializes the ILI9341 with a low input. Be sure to execute a power-on reset after supplying	
32	VCC	P	Power supply voltage.	
33	VCC	P	Power supply voltage.	
34	GND	P	Ground	
35	DB6	I/O	Data bus.	
36	DB7	I/O	Data bus.	
37	DB8	I/O	Data bus.	

7 Timing Characteristics

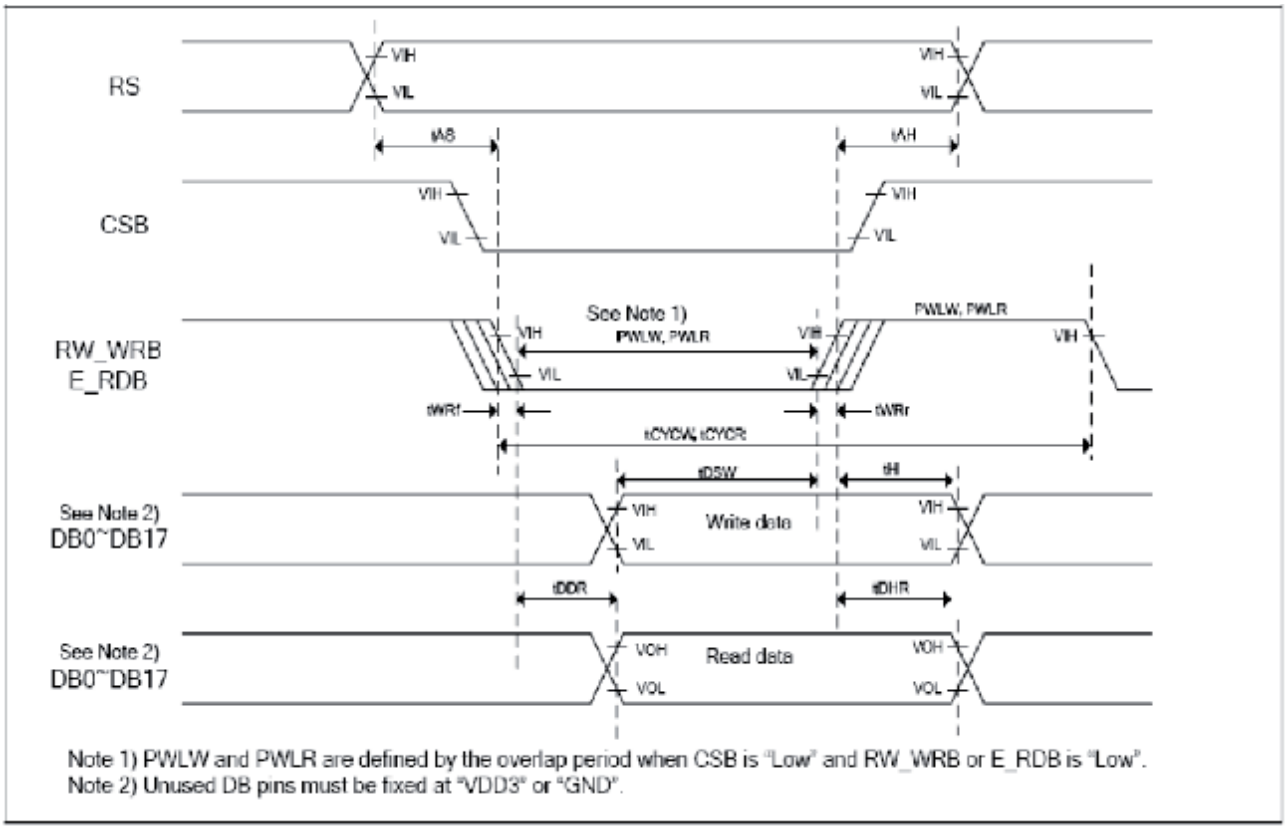
7.1 Reset Operation

Item	Symbol	Unit	Min	Typ	Mac
Reset "Low" level width	tRES	ms	1	-	-
Reset rise time	trRES	us	-	-	10



7.2 80-System Bus Interface Timing Characteristics

Item		Symbol	Unit	Min.	Typ.	Max.
Bus Cycle time	Write	tCYCW	ns	T.B.D.	-	-
	Read	tCYCR	ns	T.B.D.	-	-
Write "Low" level pulse width	Write	PWLW	ns	T.B.D.	-	-
Read "Low" level pulse width	Read	PWLR	ns	T.B.D.	-	-
Write "High" level pulse width	Write	PWHW	ns	T.B.D.	-	-
Read "High" level pulse width	Read	PWHR	ns	T.B.D.	-	-
Write/Read rise/fall time		tWRr,tWRF	ns		-	T.B.D.
Setup time	Write (RS to CSB/ WRB)	tAS	ns	T.B.D.	-	-
	Read (RS to CSB/ RDB)			T.B.D.	-	-
Address hold time		tAH	ns	T.B.D.	-	-
Write data setup time		tDSW	ns	T.B.D.	-	-
Write data hold time		tH	ns	T.B.D.	-	-
Read data delay time		tDDR	ns			T.B.D.
Read data hold time		tDHR	ns	T.B.D.	-	-



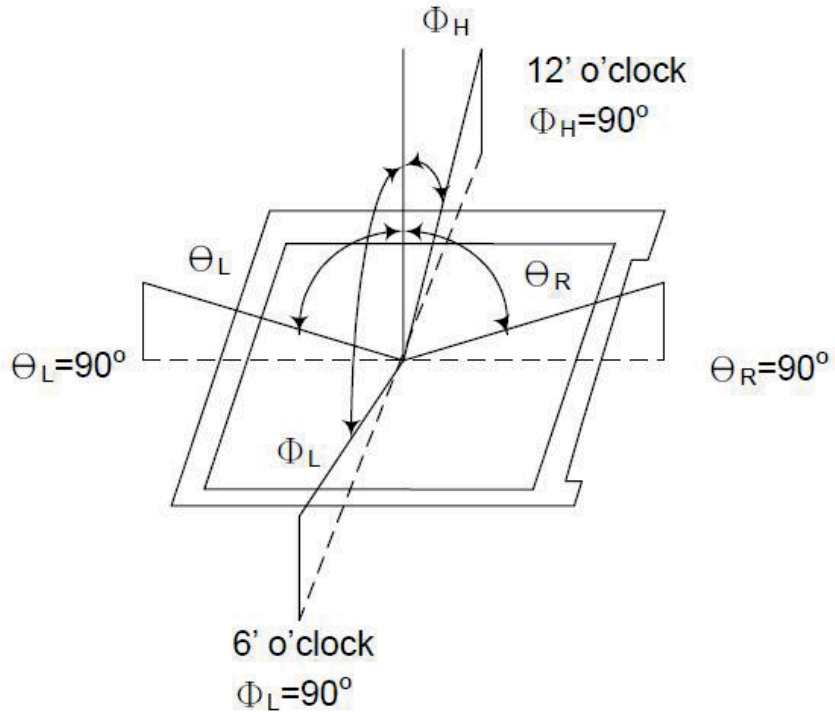
Note 1) PWLW and PWLR are defined by the overlap period when CSB is "Low" and RW_WRB or E_RDB is "Low".
Note 2) Unused DB pins must be fixed at "VDD3" or "GND".

8 Optical Characteristics

8.1 Optical specification

Item		Symbol	Condition	Min	Type	Max	Unit	Note
Luminance of White (center)		L_W	--	200	250	--	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	0.257	0.307	0.357	--	(1)(4)
		Wy		0.252	0.302	0.352		
	Red	Rx		0.581	0.631	0.681		
		Ry		0.296	0.346	0.396		
	Green	Gx		0.300	0.350	0.400		
		Gy		0.512	0.562	0.612		
	Blue	Bx		0.099	0.149	0.199		
		By		0.025	0.075	0.125		
Viewing Angle	Hor.	θ_R	CR≥10	--	(50)	--	Degree	(1)
		θ_L		--	(50)	--		
	Ver.	θ_U		--	(60)	--		
		θ_D		--	(55)	--		
NTSC		--	--	--	(61)	--	%	

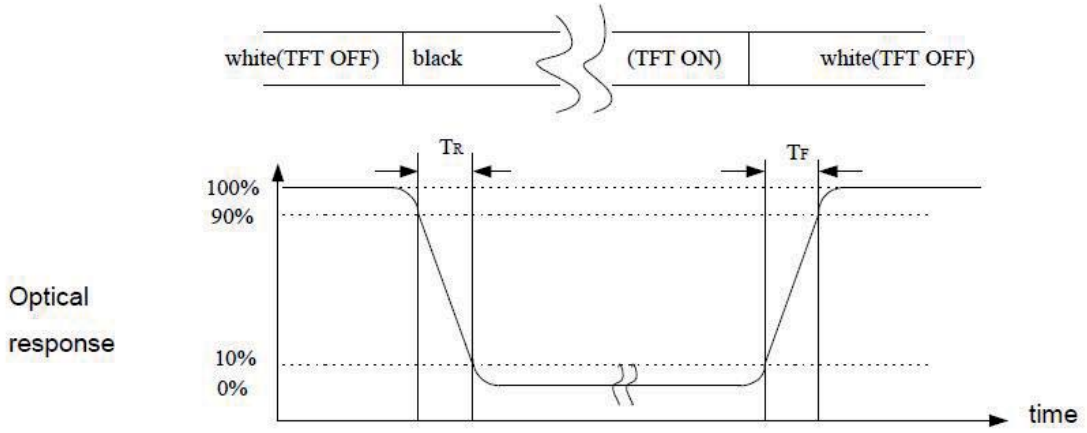
Note (1) Definition of Viewing Angle:



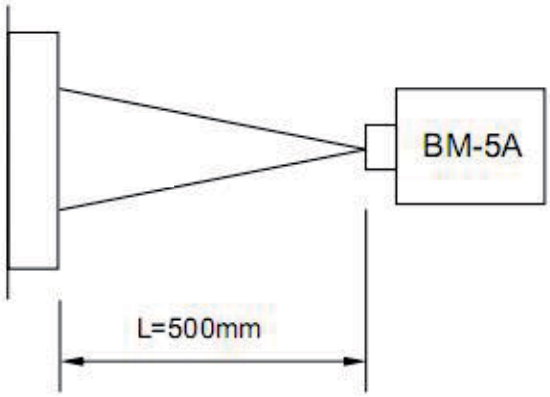
Note (2)Definition of Contrast Ratio(CR) :
measured at the center point of panel

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

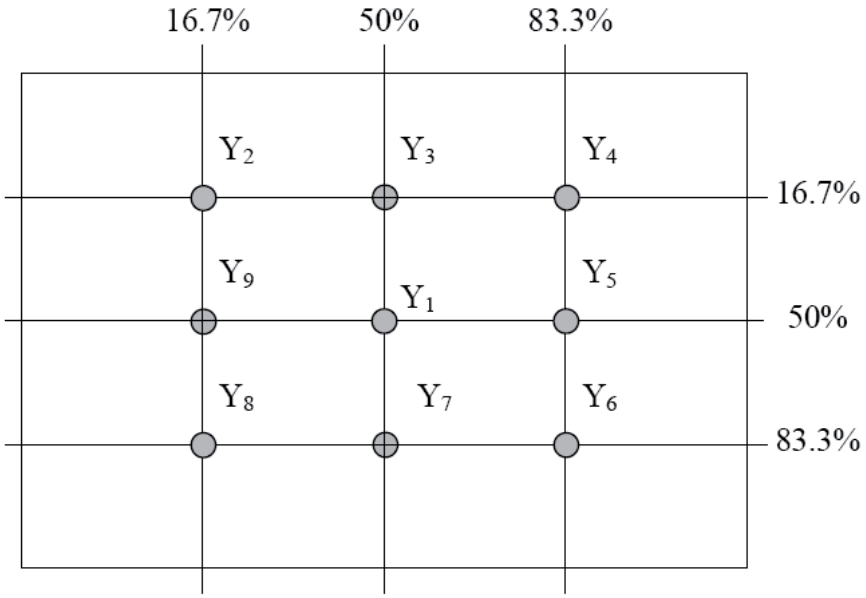
Note (3) Definition of Response Time: Sum of T_R and T_F



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.

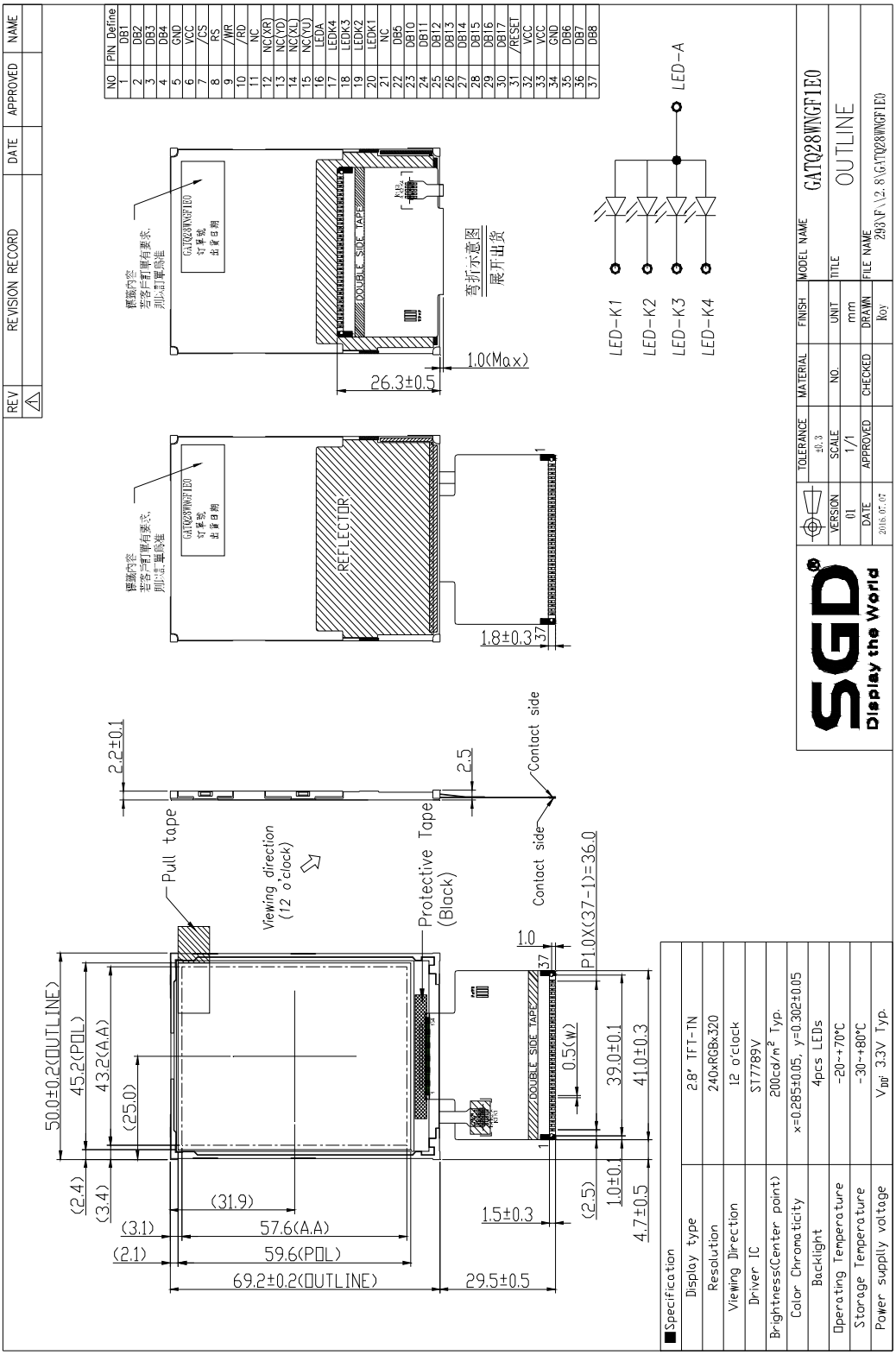
Tests will be not conducted under functioning state.

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

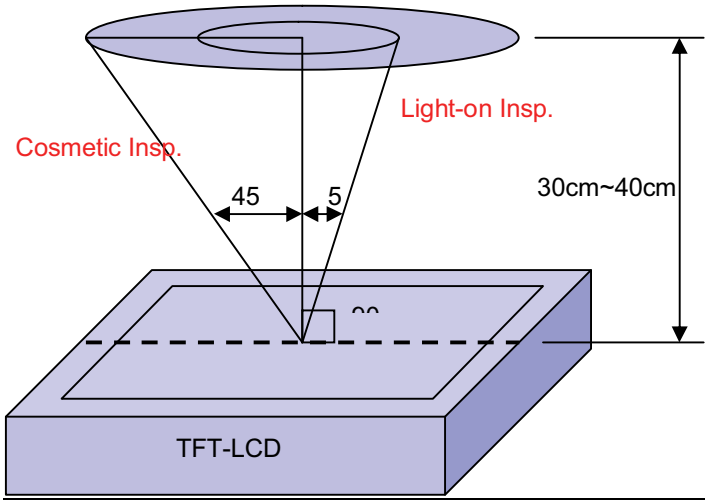
11.1 Inspection and Environment Conditions

11.1.1 Inspection Conditions:

(1)Inspection Distance: 35 cm±5cm

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

Cosmetic Inspection Angle : ±45°



(perpendicular to LCD panel surface)

11.1.2 Environment Conditions:

Ambient Temperature		23℃±5℃
Ambient Humidity		55±10%RH
Ambient Illumination	Cosmetic Inspection	more than 600 Lux
	Functional Inspection	300~500 Lux

11.1.3 Sampling Conditions:

(1) Lot Size: Quantity of shipment lot per model

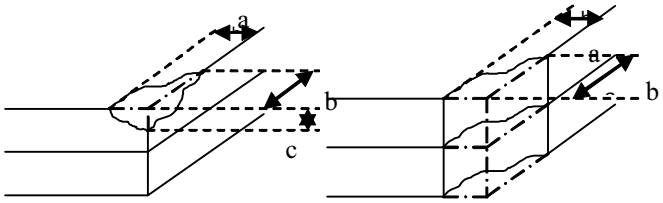
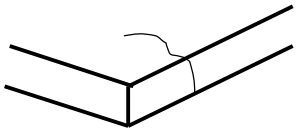
(2) Sampling Method:

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 Inspection Criteria

11.1.4.1 Cosmetic Inspection(Panel):

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

11.1.4.2 Functional Inspection:

Item	Judgment Criteria				Classification
	Area(Note1)		I	O	
Point Defect	Bright dot	Random	1		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		3		
	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≦3mm: Ignored 0.05mm<W≦0.1mm and 1.0mm<L≦2mm: N≦4 W>0.1mm or L>5mm: Not allowed				MI
Display Function Abnormal	No Malfunction can be allowed				MA

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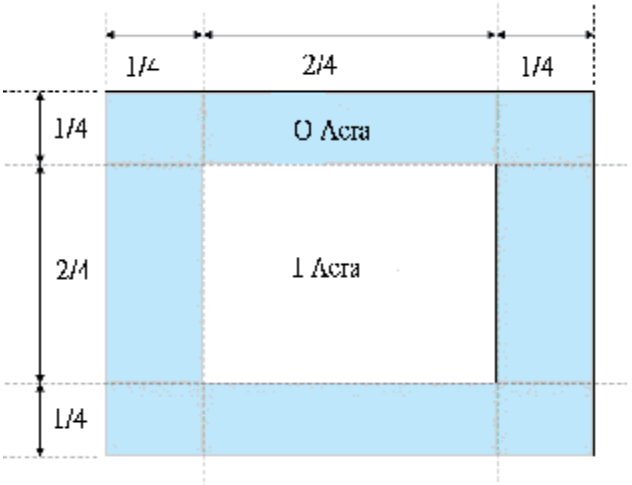
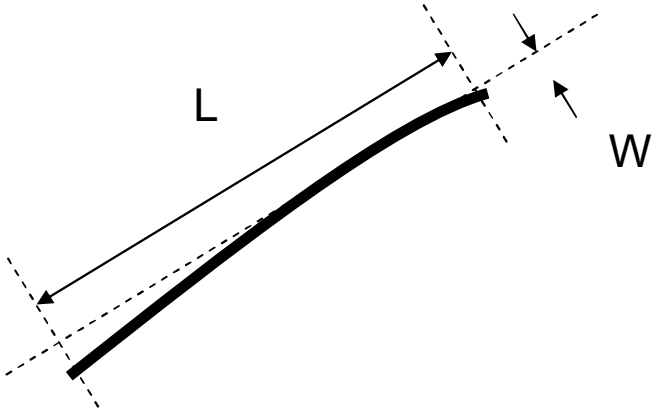
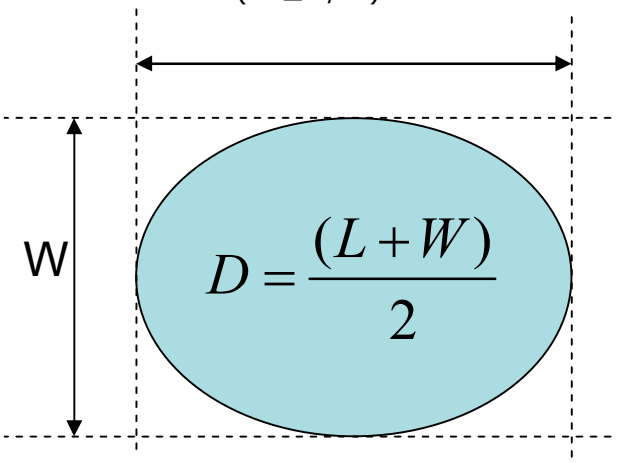
Note-1： I/O Area Definition



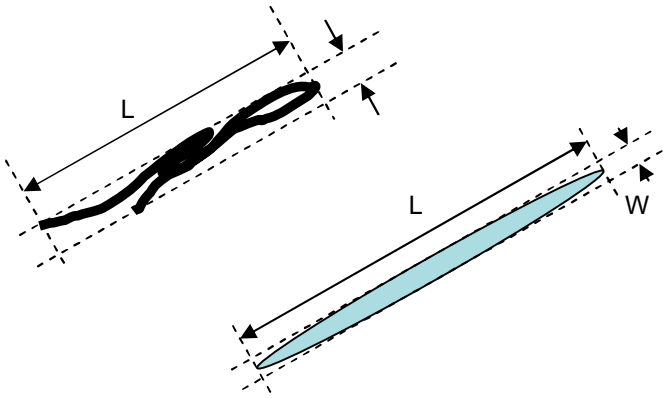
Note-2： Polarizer Scratch



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



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



11.2