DOCUMENT NUMBER AND REVISION

VL-PS-COG-T240MBQI-04 REV. A

(2.4" TFT CGA+FPA+LBL)

DOCUMENT TITLE:

PRELIMINARY SPECIFICATION

OF

LCD MODULE TYPE

MODEL NO.: COG-T240MBQI-04

DEPARTMENT	NAME	SIGNATURE	DATE
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VARITRONIX LIMITED

Preliminary Specification
of
LCD Module Type
Model No.: COG-T240MBQI-04

1. General Description

- 2.4"(diagonal), 240 x RGB x 320 dots, 262k colors, QVGA, TFT, transmissive, dot matrix LCD module.
- Amorphous Silicon TFT active matrix.
- Viewing angle: 12 o'clock.
- Driving scheme: 1/320 duty.
- Driving IC: 'ILITEK' ILI9320 (COG) TFT controller / driver or equivalent.
- Data interface: 8080 system 16-bit Parallel bus interface
- Logic voltage: 2.8V(typ.).
- Touch panel.
- "RoHS" compliance.

2. Mechanical Specifications

The mechanical detail is shown in Fig. 1 and summarized in Table 1 below.

Table 1

Parameter		Specifications	Unit
Outline dimensions		42.72(W) x 61.46(H) x 4.0(D) (Exclude DST, bending area, component area, cable of backlight and FPC)	mm
Color TFT 240xRGBx320	Viewing area (T/P)	38.72(W) x 53.96(H)	mm
	Active area (T/P)	37.72(W) x 53.16(H)	mm
	Active area (LCD)	36.72(W) x 48.96(H)	mm
	Display format	240 x RGB x 320	dots
	Color configuration	RGB stripe	-
	Dot pitch	0.153(RGB)(W) x 0.153(H) (or 0.051(W) x 0.153(H))	mm
Weight		TBD	grams

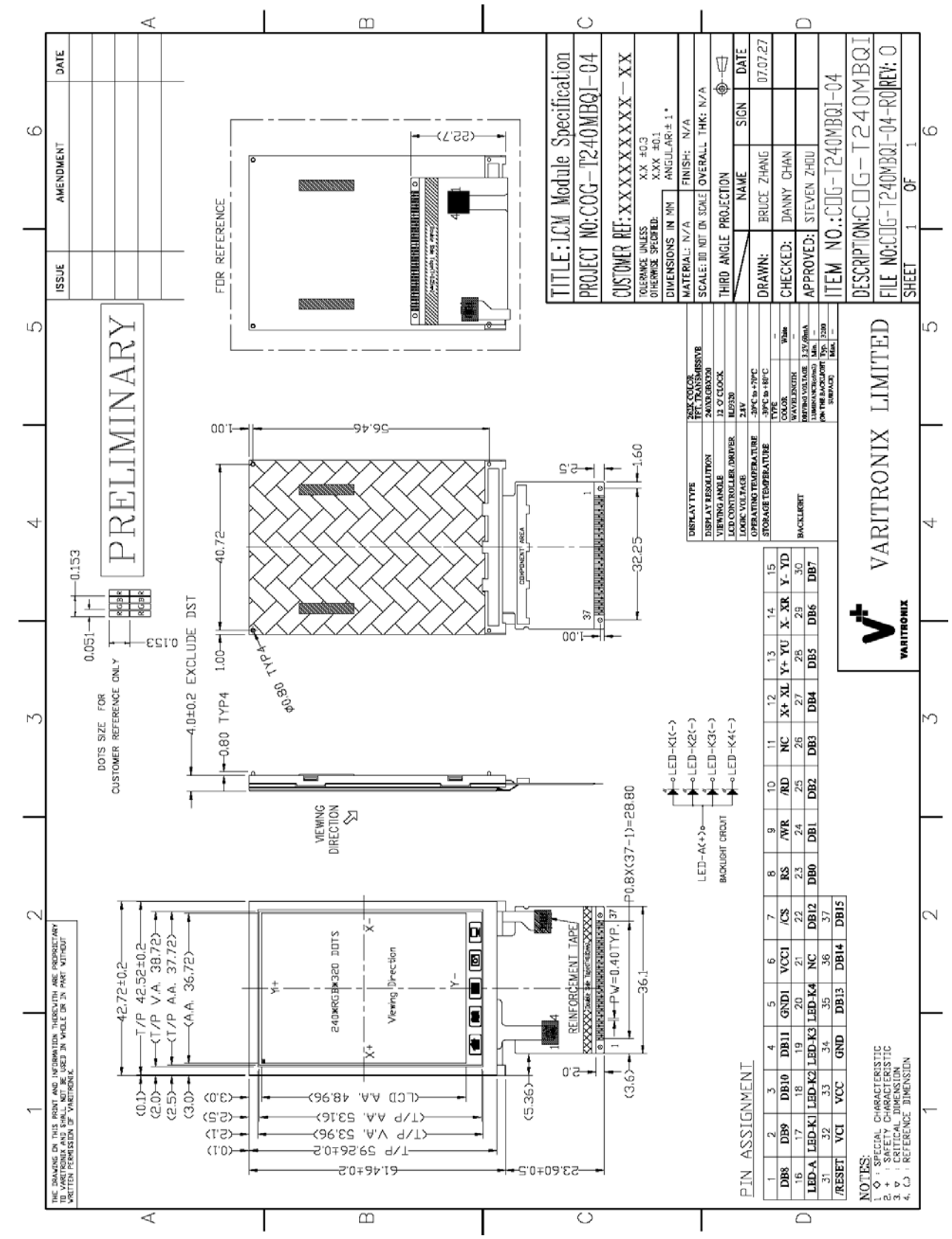


Figure 1: Module Specification

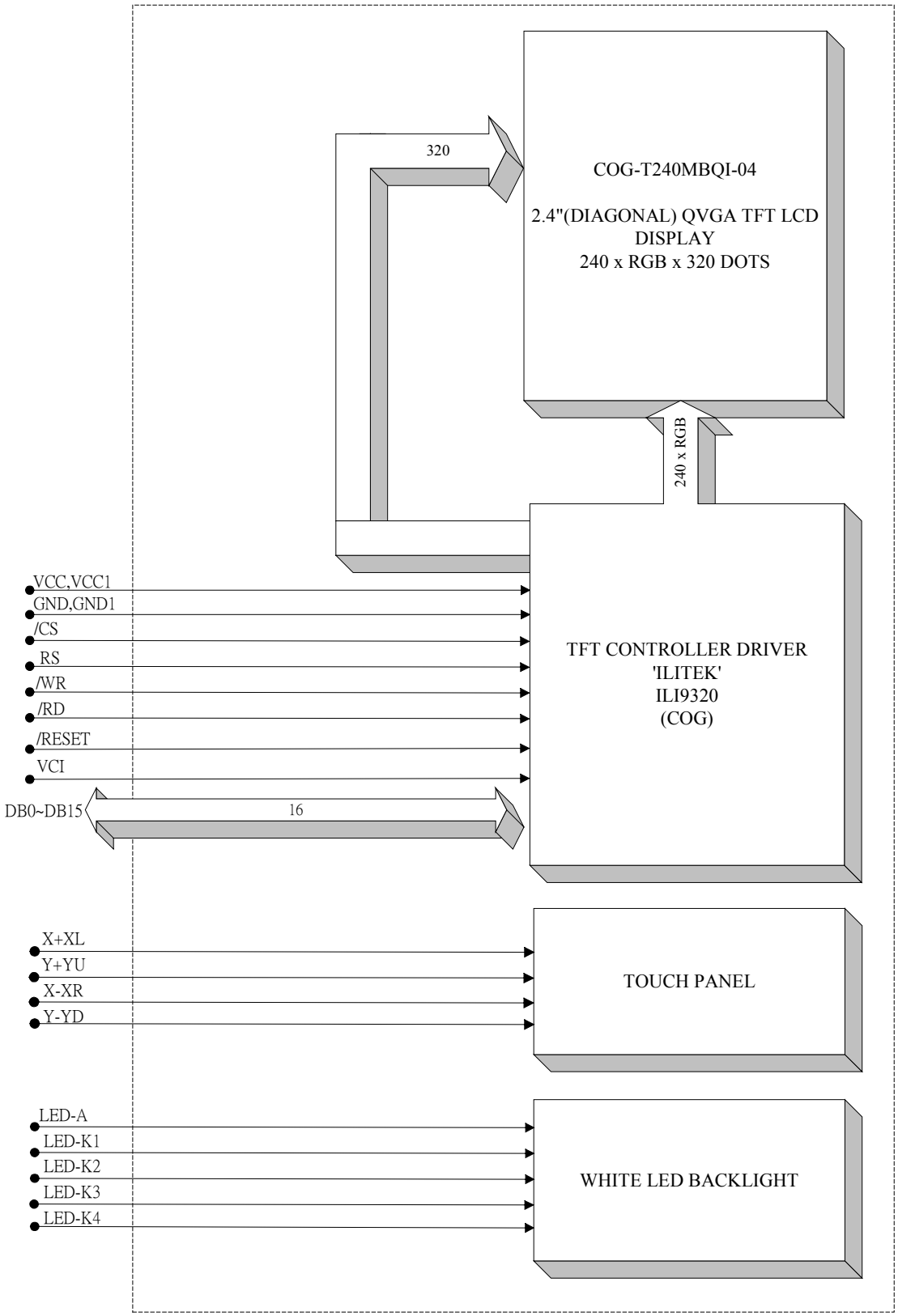


Figure 2: Block Diagram

3. Interface signals

Table 2: Pin assignment

Pin No.	Symbol	Description
5	GND1	Ground.
6	VCC1	Power supply.
7	/CS (NCS)	A chip select signal. Low: the ILI9320 is selected and accessible High: the ILI9320 is not selected and not accessible
8	RS	A register select signal. Low: select an index or status register; High: select a control register
9	/WR (NWR)	A write strobe signal and enables an operation to write data when the signal is low.
10	/RD (NRD)	A read strobe signal and enables an operation to read out data when the signal is low.
11,21	NC	No connection.
12	X+XL	X+XL input position of touch panel.
13	Y+YU	Y+YU input position of touch panel.
14	X-XR	X-XR input position of touch panel.
15	Y-YD	Y-YD input position of touch panel.
16	LED-A	Anode of LED backlight.
17~20	LED-K1~K4	Cathode of LED backlight.
1	DB8	Data bus in 80-system interface mode.
2	DB9	
3	DB10	
4	DB11	
22	DB12	
23	DB0	
24	DB1	
25	DB2	
26	DB3	
27	DB4	
28	DB5	
29	DB6	
30	DB7	
35	DB13	
36	DB14	
37	DB15	
31	/RESET (NRESET)	A reset pin. Initializes the ILI9320 with a low input. Be sure to execute a power-on reset after supplying power.
32	VCI	A supply voltage to the analog circuit.
33	VCC	Power supply.
34	GND	Ground.

4. Absolute Maximum Ratings

4.1 Electrical Maximum Ratings – for IC Only

Table 3

Parameter	Symbol	Min.	Max.	Unit	Note
Power supply voltage (1)	VCC, IOVCC	-0.3	+4.6	V	1,2
Power supply voltage (1)	VCI - AGND	-0.3	+4.6	V	1,4
Power supply voltage (1)	DDVDH - AGND	-0.3	+6.0	V	1,4
Power supply voltage (1)	AGND - VCL	-0.3	+4.6	V	1
Power supply voltage (1)	DDVDH - VCL	-0.3	+9.0	V	1,5
Power supply voltage (1)	VGH - AGND	-0.3	+18.5	V	1,5
Power supply voltage (1)	AGND - VGL	-0.3	+18.5	V	1,6
Input voltage	Vt	-0.3	VCC+0.3	V	7

Notes:

1. VCC, DGND must be maintained
2. (High) (VCC = VCC) ≥ DGND (Low), (High) IOVCC ≥ DGND (Low).
3. Make sure (High) VCI ≥ DGND (Low).
4. Make sure (High) DDVDH ≥ ASSD (Low).
5. Make sure (High) DDVDH ≥ VCL (Low).
6. Make sure (High) VGH ≥ ASSD (Low).
7. Make sure (High) ASSD ≥ VGL (Low).
8. The modules may be destroyed if they are used beyond the absolute maximum ratings.

4.2 Environmental Condition

Table 4

Item	Operating temperature (Topr)		Storage temperature (Tstg) (Note 1)		Remark
	Min.	Max.	Min.	Max.	
Ambient temperature	-20°C	+70°C	-30°C	+80°C	Dry
Humidity (note 1)	90% max. RH for Ta ≤ 40°C < 50% RH for 40°C < Ta ≤ Maximum operating temperature				No condensation
Vibration (IEC 68-2-6) cells must be mounted on a suitable connector	Frequency: 10 ~ 55 Hz Amplitude: 0.75 mm Duration: 20 cycles in each direction.				3 directions
Shock (IEC 68-2-27) Half-sine pulse shape	Pulse duration: 11 ms Peak acceleration: 981 m/s^2 = 100g Number of shocks: 3 shocks in 3 mutually perpendicular axes.				3 directions

Note 1: Product cannot sustain at extreme storage conditions for long time.

5. Electrical Specifications

5.1 Typical Electrical Characteristics

At Ta = 25 °C, VCC=VCC=IOVCC=2.8V, GND=0V.

Table 5

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
IO operating voltage	IOVCC		-	2.8	-	V
Logic operating voltage	VCC		-	2.8	-	V
Analog operating voltage	VCI		-	TBD	-	V
TFT gate ON voltage	VGH(Note 1)		12	-	18	V
TFT gate OFF voltage	VGL(Note 2)		-12	-	-7	V
TFT common electrode voltage	Vcom(Note 3)		-2	-	5	V
TFT kick-back voltage Max.	△Vp Max		0.2	-	1.5	V
TFT kick-back voltage Min.	△Vp Min		0.2	-	1.5	V
Input signal voltage	V_{IH}	"H" level	0.8VCC	-	VCC	V
	V_{IL}	" L" level	-0.3	-	0.2VCC	V
Supply current (Logic & LCD)	ICC	VCC=2.8V	-	TBD	-	mA
Supply voltage of white LED backlight	VLED	Forward current =60 mA Number of LED dies = 4	-	3.2	-	V
Luminance (on the backlight surface)			-	3200	-	cd/m^2

Note (1): VGH is TFT Gate operating voltage.

Note (2): VGL is TFT Gate operating voltage.

The low voltage level VGL signal must be fluctuates with same phase as Vcom.

Note (3): Vcom must be adjusted to optimize display quality, as Crosstalk and Contrast Ratio etc..

5.2 Touch Panel Electrical Specification

Table 6

Item	Specification	Conditions
Resistance	TBD	
	TBD	
Linearity	TBD	
Hardness of surface	TBD	
Surface texture	TBD	
Transparency	TBD	

5.3 Timing Specification

5.3.1 Reset Timing Characteristics

Table 7

Item	Symbol	Unit	Min.	Typ.	Max.
Reset low-level width	t_{RES}	ms	1	-	-
Reset rise time	t_{rRES}	µs	-	-	10

Figure 3: Reset Timing

5.3.2 i80-system Interface Timing Characteristics

Normal Write Mode

Table 8

Item		Symbol	Unit	Min.	Typ.	Max.	Test Condition
Bus cycle time	Write	t_{CYCW}	ns	100	-	-	-
	Read	t_{CYCR}	ns	300	-	-	-
Write low-level pulse width		PW_{LW}	ns	50	-	500	-
Write high-level pulse width		PW_{HW}	ns	50	-	-	-
Read low-level pulse width		PW_{LR}	ns	150	-	-	-
Read high-level pulse width		PW_{HR}	ns	150	-	-	
Write / Read rise / fall time		t_{WRr}/t_{WRf}	ns	-	-	25	
Setup time	Write (RS to nCS, E/nWR)	t_{AS}	ns	10	-	-	
	Read (RS to nCS, RW/nRD)			5	-	-	
Address hold time		t_{AH}	ns	5	-	-	
Write data set up time		t_{DSW}	ns	10	-	-	
Write data hold time		t_H	ns	15	-	-	
Read data delay time		t_{DDR}	ns	-	-	100	
Read data hold time		t_{DHR}	ns	5	-	-	

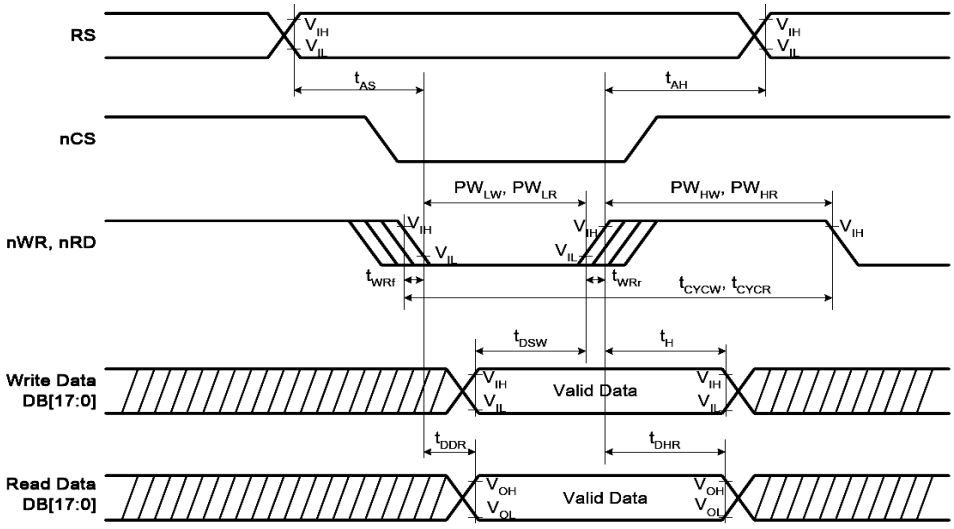


Figure 4: i80-system Interface Timing

5.4 Display ON/OFF Sequence

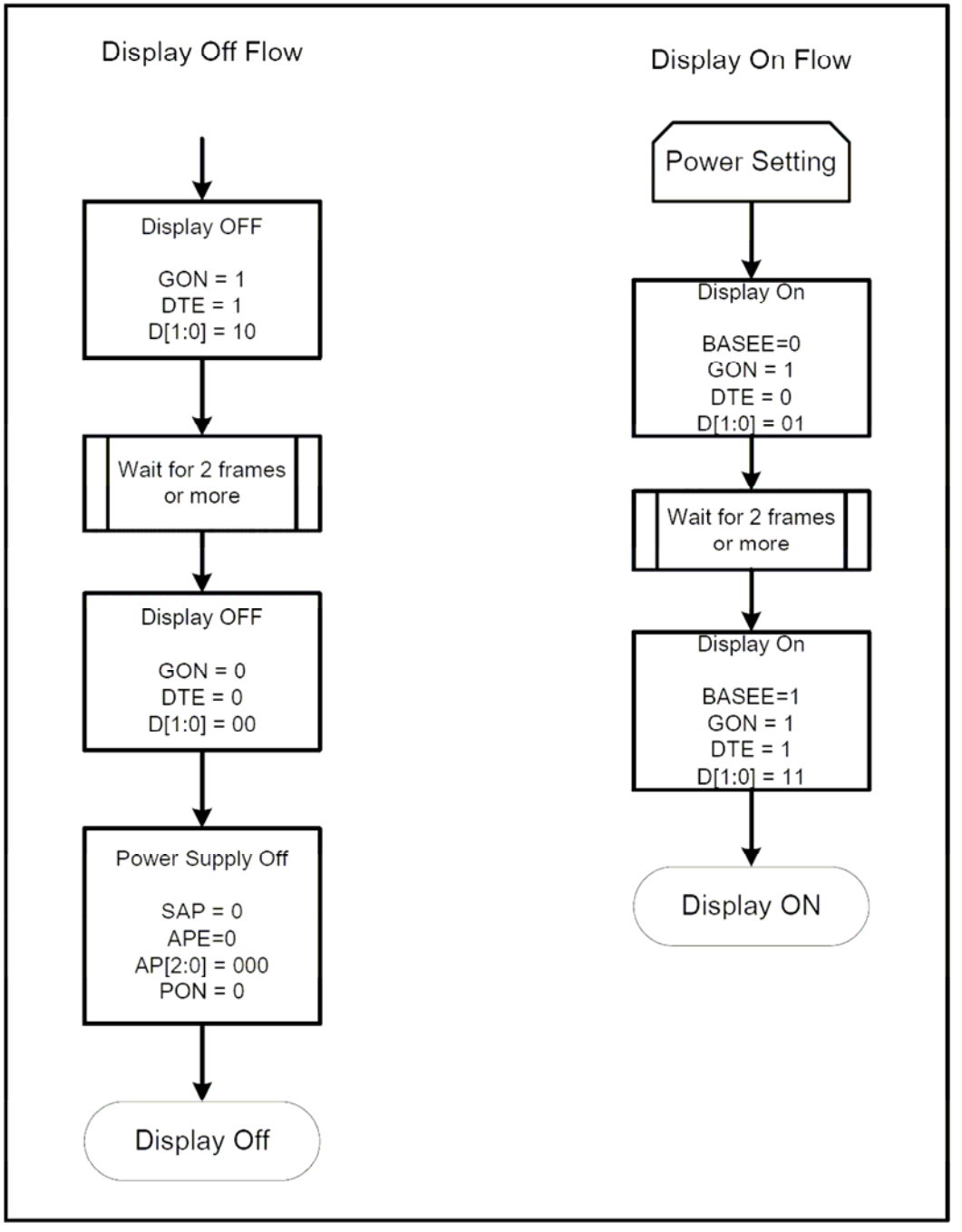


Figure 5: Display On/Off Register Setting Sequence

5.5 Deep Standby and Sleep Mode

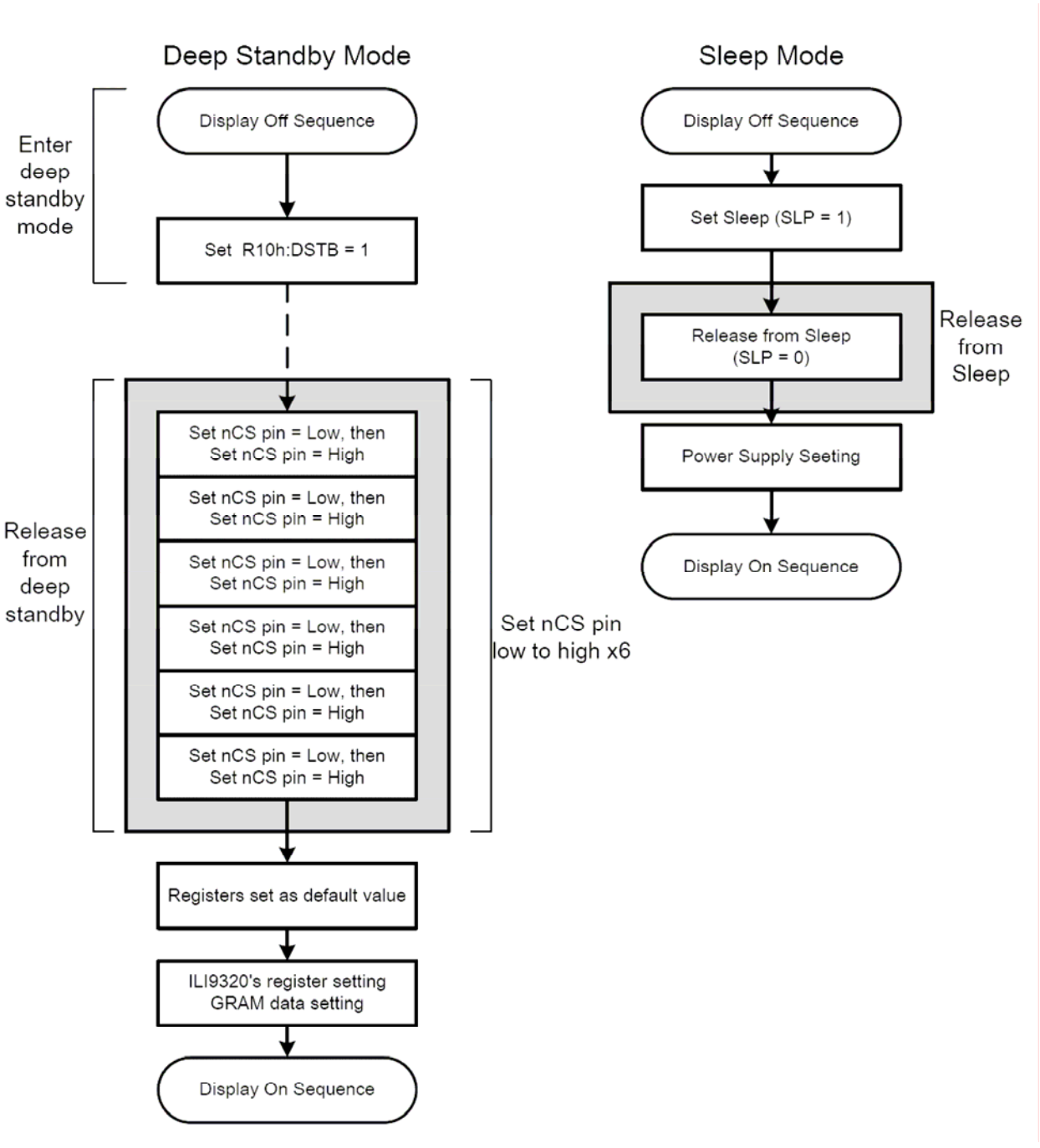


Figure 6: Deep Standby/Sleep Mode Register Setting Sequence

5.6 Power Supply Configuration

When supplying and cutting off power, follow the sequence below. The setting time for oscillators, step-up circuits and operational amplifiers depends on external resistance and capacitance.

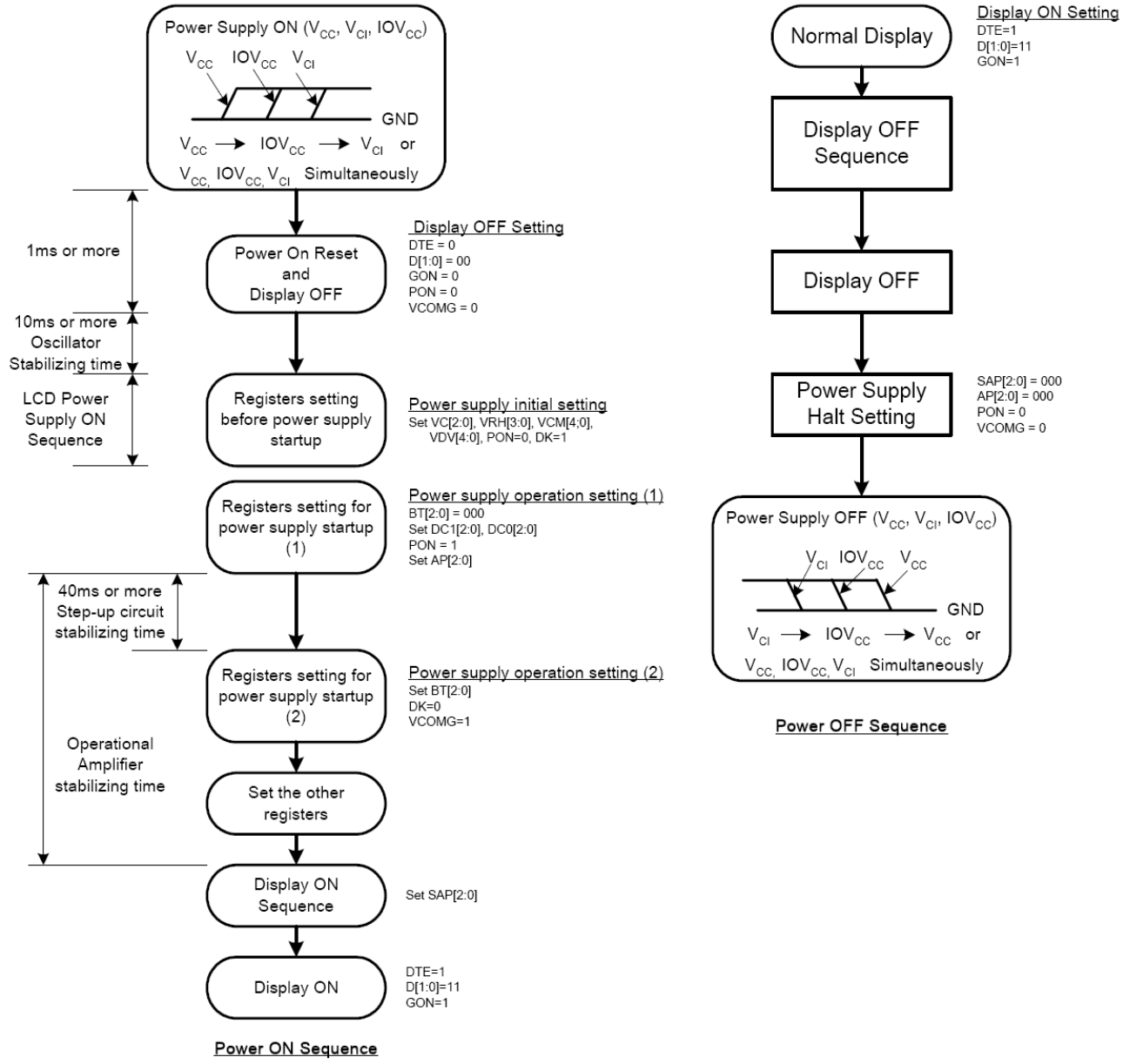


Figure 7: Power Supply ON/OFF Sequence

6. Optical Characteristics

Table 9: Optical specifications (light source: C light, for panel only)

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Threshold voltage		Vsat		2.2	2.3	2.4	V	Figure8
		Vth		1.3	1.4	1.5	V	
Viewing Angle range	Horizontal	Θ_3	CR > 10	40	45		Deg.	Note 1
		Θ_9		40	45		Deg.	
	Vertical	Θ_{12}		45	50		Deg.	
		Θ_6		15	20		Deg.	
Contrast ratio		CR	$\Theta = 0°$		300			Note 2
Transmittance		T(%)	$\Theta = 0°$		5.8			Note 3
White Chromaticity		x_w	$\Theta = 0°$	0.280	0.300	0.320		*Color Filter Glass
		y_w		0.314	0.334	0.354		
Reproduction Of color	Red	x_R	$\Theta = 0°$	0.610	0.630	0.650		
		y_R		0.311	0.331	0.351		
	Green	x_G		0.265	0.285	0.305		
		y_G		0.541	0.561	0.581		
	Blue	x_B		0.115	0.135	0.155		
		y_B		0.106	0.126	0.146		
Response Time		Tr+Tf	$\Theta = 0°$		25		msec	Note 4

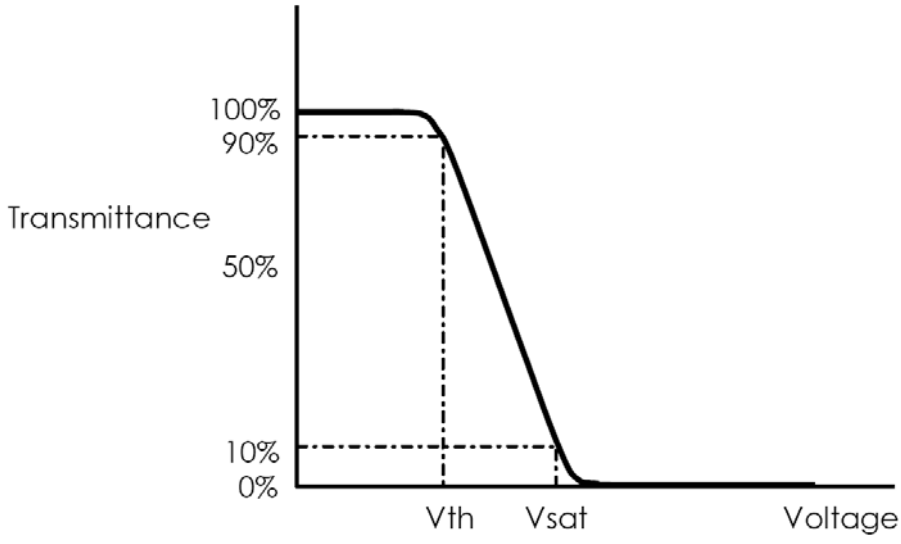


Figure 8: The definition of Vth & Vsat

Note (1). Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing are determined for the horizontal or 3, 9 o'clock direction and the vertical or 6, 12 o'clock direction with respect to the optical axis which is normal to the LCD surface.

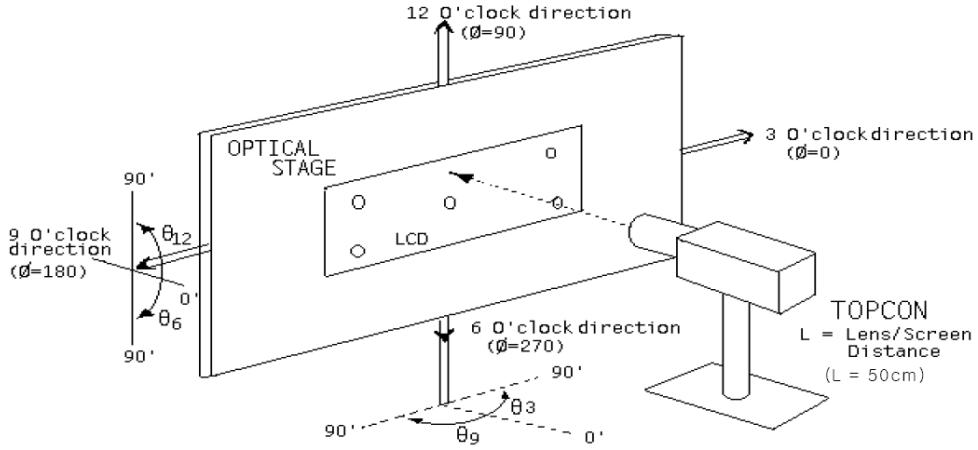


Figure 9

Note (2). Contrast measurements shall be made at viewing angle of $\theta = 0°$ and at the center of the LCD surface. Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black) state. (See Figure 9) Luminance
Contrast Ratio (CR) is defined mathematically.

$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$

Note (3). Transmittance is the value with Polarizer The color chromaticity coordinates specified in Table 9 shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the C/F. Measurement condition is C - light source & Halogen Lamp.

Note (4). The electro-optical response time measurements shall be made as Figure 10 by switching the "data" input signal ON and OFF. The times needed for the luminance to change from 10% to 90% is Tr, and 90% to 10% is Td.

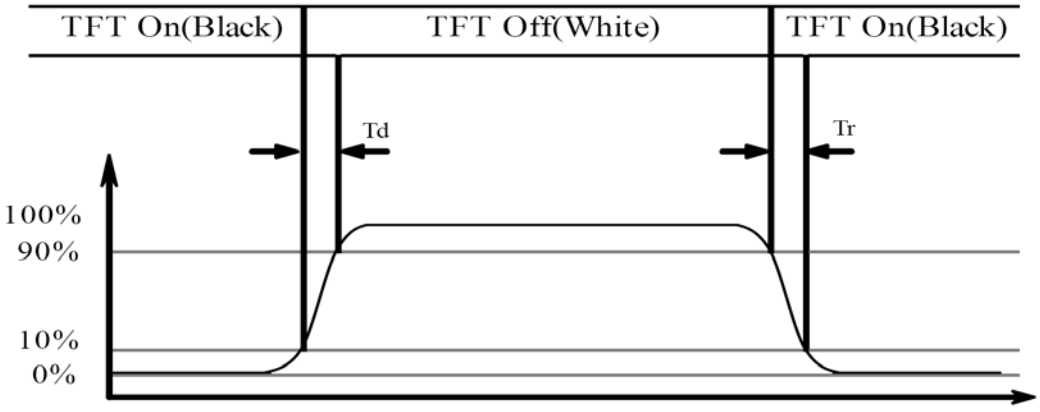


Figure 10

7. Reliability Test

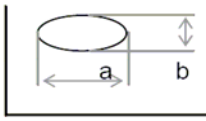
Table 10

No	Test Items	Conditions	
1	High temperature storage test	Ta = 80 °C, 240 hrs	
2	Low temperature storage test	Ta = -30 °C, 240 hrs	
3	High temperature operation Test	Ta = 70 °C, 240 hrs	
4	Low temperature operation test	Ta = -20 °C, 240 hrs	
5	High Temp. and High Humidity Storage	T = 60℃ /90% for 240hr (But no condensation dew)	
6	High temperature & high humidity operation test	Ta = 60 °C, 90 %RH, 240 hrs	
7	Thermal shock	Ta = -40 °C ↔ 80 °C , 100 cycle	
8	Packing Vibration test (non-operating)	Frequency range : 10Hz ~ 55Hz Stroke : 1.5mm , Sweep : 10Hz~55Hz XYZ 2 hours for each direction	
9	Packing Shock test (non-operating)	980m/s2, 6ms, ±X,Y,Z 3times for direction	
10	Press Cooking Test	2atm, 120℃, 100%, 24h	
11	Altitude Test (non – operating)	25°C, 24h, 40000ft	
12	Electrostatic discharge test	Air Contact	: 150 pF, 330Ω, 8KV 5times/4Corner : 150 pF, 330Ω, 6KV 5times/4Corner

8. TFT Panel Inspection Specifications

Note: Customer must 100% examine received TFT panels according to this inspection specifications.

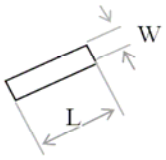
1. Dot Defects (including particles and TFT dot defects)



Φ=(a+b)/2

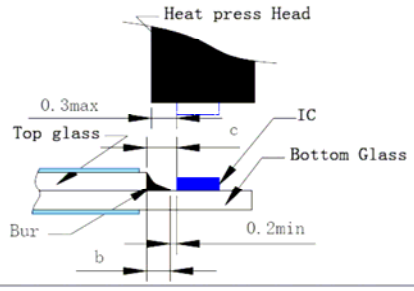
Classifications		Acceptable counts	
		Visible area	Non-visible area
A grade	Φ≦0.10	Don't care	Don't care
	0.10<Φ≦0.20	1	
	0.20<Φ	0	
B grade (for reference)	0.1<Φ≦0.15	5	
	0.15<Φ≦0.2	3	

2. Line Defects

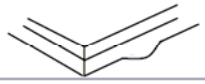


Classifications		Acceptable counts	
		Visible area	Non-visible area
A grade	W≦0.03,L≦3.0	Don't care	Don't care
	0.03<W≦0.05,L≦2.0	1	
	0.05<W	According to dot defects.	
B grade (for reference)	0.03<W≦0.05,L≦3.0	3	

3.Glass bur

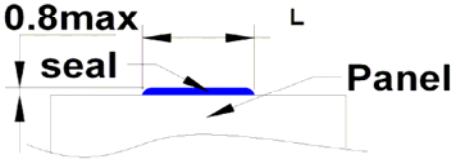


1). b ≦ 1.0, and not affect outline dimension and assemble
2). Around bonding area, b must fulfill b ≦ (c-0.2) max,
Any burs should not affect the assemble as a rule.



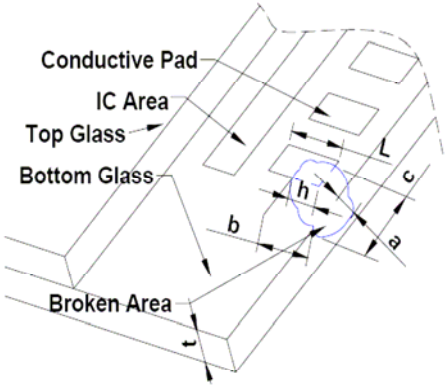
Not affect outline dimension and assemble

4. End seal dimension



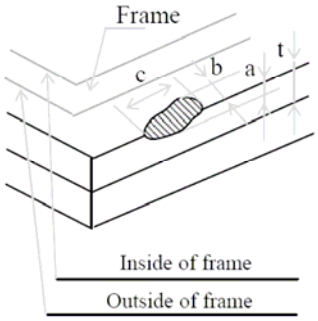
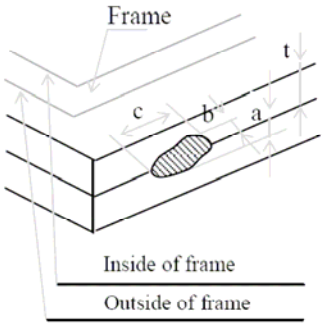
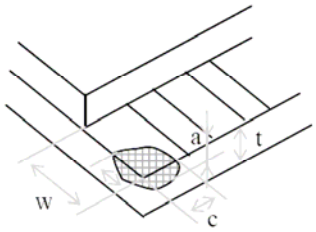
1).Depth =< 0.2 mm, and not enter to the visible area.
2). Height =< 0.8 mm.
3). L=The cell chip width+(2~6)mm.

5. Glass edges breakage



Breakage on step glass

Categories	
A	If a ≦ t and b ≦3, c has no limit.
B	a ≦ t, b≦3, c≦3
C	If damage FPC contacts and /or alignment mark, then b ≦ 0.5, and the FPC contacts h ≦ L x 25% max
D	Side breakage should not damage alignment mark.

	Edge breakage 	b should not arrive inside of frame
	Breakage between upper and lower glass 	b should not arrive outside of frame
	Corner breakage 	a ≦ t, b ≦ 3.0, c ≦ 3.0 Corner breakage should not damage track and /or alignment mark.

Items	Position	Inspection Criteria
6.Crack	Whole area	Not allowed
7.Surface cleanness	Step surface	The impurity which is easy to clean is allowed, glass particle is not allowed.

Remark: a: breakage thickness; b: breakage depth; c: breakage length; t: glass thickness; h: damaged FPC contact length; L: total length of FPC contacts (Unit: mm)

9. Remark

HANDLING LCD AND LCD MODULES

1. Liquid Crystal Display (LCD)

LCD is made up of glass, organic sealant, organic fluid and polymer based polarizers. The following precautions should be taken when handling:

(1) Keep the temperature within range for use and storage. Excessive temperature and humidity could cause polarization degredation, polarizer peel-off or bubble generation. When storage for a long period over 40° C is required, the relative humidity should be kept below 60%.
(2) Do not contact the exposed polarizers with anything harder than an HB pencil lead. To clean dust off the display surface, wipe gently with cotton, chamois or other soft material soaked in petroleum benzin. Never scrub hard.
(3) Varitronix does not responsible for any polarizer defect after the protective film has been removed from the display
(4) Wipe off saliva or water drops immediately. Contact with water over a long period of time may cause polarizer deformation or color fading, while an active LCD with water condensation on its surface will cause corrosion of ITO electrodes.
(5) PETROLEUM BENZIN is recommended to remove adhesives used to attach front/rear polarizers and reflectors, while chemicals like acetone, toluene, ethanol and isopropyl alcohol will cause damage to the polarizer. Avoid oil and fats. Avoid lacquer and epoxies which might contain solvents and hardeners to cause electrode errosion. Some solvents will also soften the epoxy covering the DIL pins and thereby weakening the adhesion of the epoxy on glass. This will cause the exposed electrodes to erode electrochemically when operating in high humidity and condensing environment.
(6) Glass can be easily chipped or cracked from rough handling, especially at corners and edges.
(7) Do not drive LCD with DC voltage.
(8) When soldering DIL pins, avoid excessive heat and keep soldering temperature between 260°C to 300°C for no more than 5 seconds. Never use wave or reflow soldering.

2. Liquid Crystal Display Modules (MDL)

2.1 Mechanical Considerations

MDL's are assembled and adjusted with a high degree of precision. Avoid excessive shocks and do not make any alterations or modifications. The following should be noted.
(1) Do not tamper in any way with the tabs on the metal frame.
(2) Do not modify the PCB by drilling extra holes, changing its outline, moving its components or modifying its pattern.
(3) Do not touch the elastomer connector (conductive rubber), especially when inserting an EL panel.
(4) When mounting a MDL make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
(5) Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels.
(6) If FPCA need to be bent, please refer the suggested bending area on the specification. The stiffener and component area on FPC/FFC/COF must not be bent during or after assembly (Note: for those models with FPC/FFC/COF +stiffener).
(7) Sharp bending should be avoided on FPC to prevent track cracking.

2.2 Static Electricity

MDL contains CMOS LSI's and the same precaution for such devices should apply, namely:

(1) The operator should be grounded whenever he comes into contact with the module. Never touch any of the conductive parts such as the LSI pads, the copper leads on the PCB and the interface terminals with any part of the human body.
(2) The modules should be kept in antistatic bags or other containers resistant to static for storage.
(3) Only properly grounded soldering irons should be used.
(4) If an electric screwdriver is used it should be well grounded and shielded from commutator sparks.
(5) The normal static prevention measures should be observed for work clothes and working benches; for the latter conductive (rubber) mat is recommended.
(6) Since dry air is inducive to statics, a relative humidity of 50 - 60% is recommended.

2.3 Soldering

(1) Solder only to the I/O terminals.
(2) Use only soldering irons with proper grounding and no leakage.
(3) Soldering temperature is 280°C ± 10°C .
(4) Soldering time: 3 to 4 seconds.
(5) Use eutectic solder with resin flux fill.
(6) If flux is used. the LCD surface should be covered to avoid flux spatters. Flux residue should be removed afterwards.
(7) Use proper de-soldering methods (e.g. suction type desoldering irons) to remove lead wires from the I/O terminals when necessary. Do not repeat the soldering/ desoldering process more than three times as the pads and plated through holes may be damaged.

2.4 Label

Identification labels will be stuck on the module without obstructing the viewing area of display.

3. Operation

(1) The viewing angle can be adjusted by varying the LCD driving voltage Vo.
(2) Driving voltage should be kept within specified range, excess voltage shortens display life.
(3) Response time increases with decrease in temperature.
(4) Display may turn black or dark Blue at temperatures above its operational range; this is however not destructive and the display will return to normal once the temperature falls back to range.
(5) Mechanical disturbance during operation (such as pressing on the viewing area) may cause the segments to appear "fractured". They will recover once the display is turned off.
(6) Condensation at terminals will cause malfunction and possible electrochemical reaction. Relative humidity of the environment should therefore be kept below 60%.
(7) Display performance may vary out of viewing area. If there is any special requirement on performance out of viewing area, please consult Varitronix.

4. Storage and Reliability

(1) LCD's should be kept in sealed polyethylene bags while MDL's should use antistatic ones. If properly sealed, there is no need for desiccant.
(2) Store in dark places and do not expose to sunlight or fluorescent light. Keep the temperature between 0°C and 35°C and the relative humidity low. Please consult VARITRONIX for other storage requirements.
(3) Water condensation will affect reliability performance of the display and is not allowed.
(4) Semi-conductor device on the display is sensitive to light and should be protected properly.
(5) Power up/down sequence.
   a) Power Up: in general, LCD supply voltage, Vo must be supplied after logic voltage, VDD becomes steady. Please refer to related IC data sheet for details.
   b) Power Down: in general, LCD supply voltage, Vo must be removed before logic voltage, VDD turns off. Please refer to related IC data sheet for details.

5. Safety

If any fluid leaks out of a damaged glass cell, wash off any human part that comes into contact with soap and water. Never swallow the fluid. The toxicity is extremely low but caution should be exercised at all times.

LIMITED WARRANTY

VARITRONIX LCDs and modules are not consumer products, but may be incorporated by VARITRONIX's customers into consumer products or components thereof. VARITRONIX does not warrant that its LCDs and components are fit for any such particular purpose.

1. The liability of VARITRONIX is limited to repair or replacement on the terms set forth below. VARITRONIX will not be responsible for any subsequent or consequential events or injury or damage to any personnel or user including third party personnel and/or user.

   Unless otherwise agreed in writing between VARITRONIX and the customer, VARITRONIX will only replace or repair any of its LCD which is found defective electrically or visually when inspected in accordance with VARITRONIX LCD Acceptance Standards (copies available on request), for a period of one year from the date of shipment. Confirmation of such date shall be based on freight documents.

2. No warranty can be granted if any of the precautions stated in HANDLING LCD and LCD Modules above have been disregarded. Broken glass, scratches on polarizers, mechanical damages as well as defects that are caused by accelerated environmental tests are excluded from warranty.
3. In returning the LCD and Modules, they must be properly packaged and there should be detailed description of the failures or defects.

IMPORTANT NOTICE

The information presented in this document has been carefully checked and is believed to be accurate, however, no responsibility is assumed for inaccuracies. VARITRONIX reserves the right to make changes to any specifications without further notice for performance, reliability, production technique and other considerations, VARITRONIX does not assume any liability arising out of the application or use of products herein. Please see Limited Warranty in the previous section.

"Varitronix Limited reserves the right to change this specification."

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