DOCUMENT NUMBER AND REVISION

VL-PS-COG-T350MCQH-01 REV. A

(COG-T350MCQH-01)

DOCUMENT TITLE:

PRELIMINARY SPECIFICATION

OF

LCD MODULE TYPE

MODEL NO.: COG-T350MCQH-01

DEPARTMENT	NAME	SIGNATURE	DATE
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CONTENTS

VARITRONIX LIMITED

Preliminary Specification
of
LCD Module Type
Model No.: COG-T350MCQH-01

1. General Description

- 3.5", 320 x RGB x 240 dots 262K colors transmissive positive dot matrix TFT LCD module.
- Amorphous Silicon TFT active matrix.
- Viewing angle: 6 o'clock.
- Driving scheme: 1/240 duty.
- Driving IC:'HIMAX' HX8238A (COG) 960x240 TFT LCD Single Chip Digital driver or equivalent.
- 18-bits parallel RGB input mode.
- Logic voltage: 3.0V.
- White LED backlight.
- FPC connection.
- "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		76.9(W) x 63.9(H) x 3.25(D) (Excluded component area, FPC, terminals of backlight)	mm
Color TFT 320xRGBx240	LCD active area	70.08(W) x 52.56(H)	mm
	Display format	320 x RGB x 240	dots
	Color configuration	R.G.B. stripe	-
	Dot pitch	0.219(RGB)(W) x 0.219(H)	mm
Weight		Approx: TBD	gram

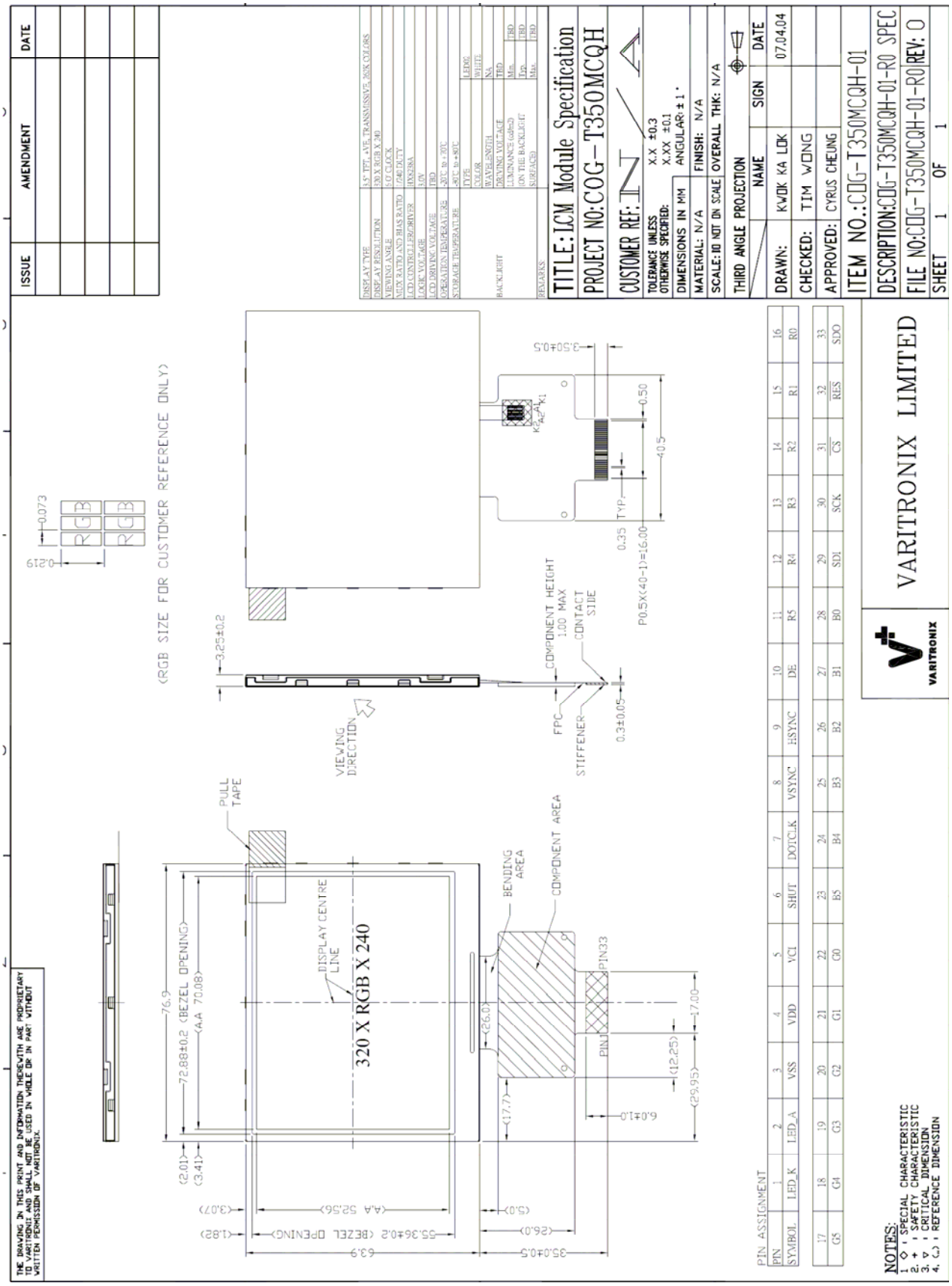


Figure 1: Module Specification

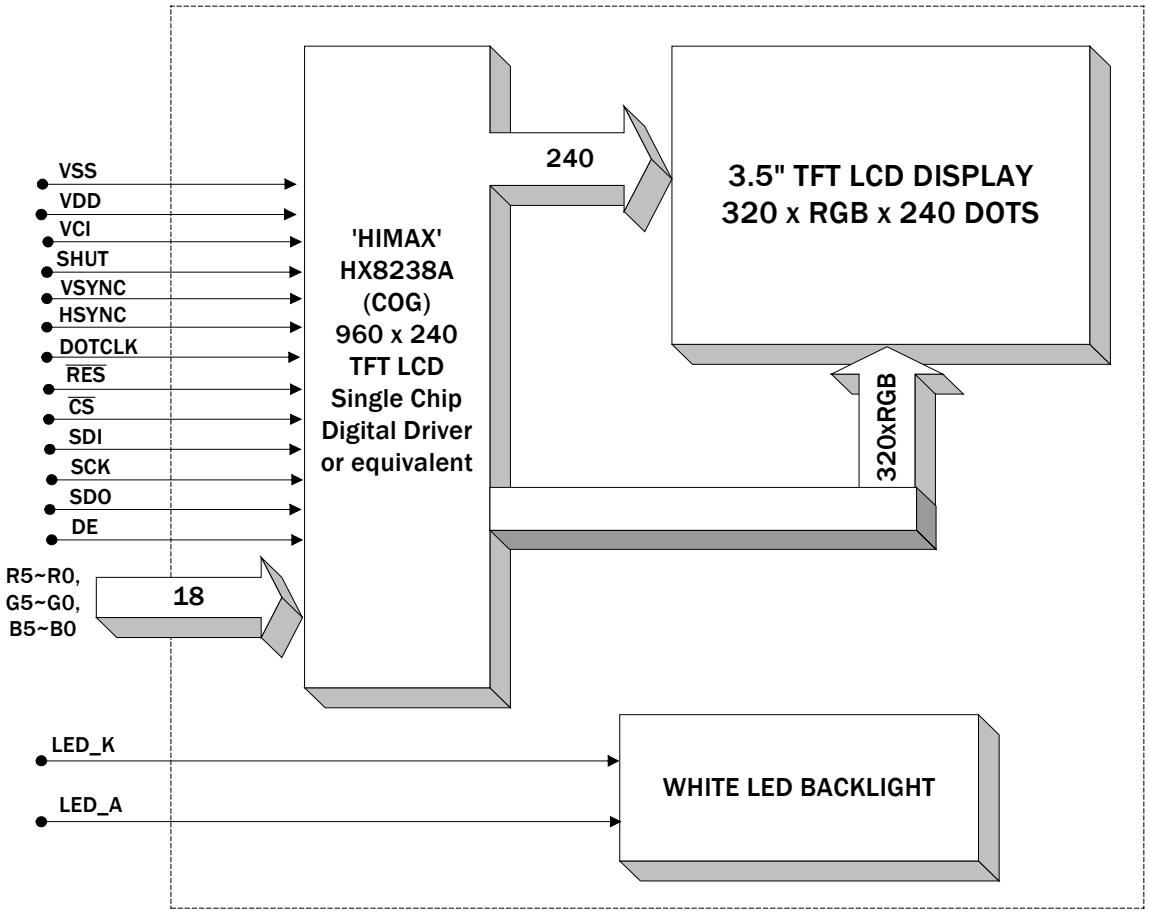


Figure 2: Block Diagram

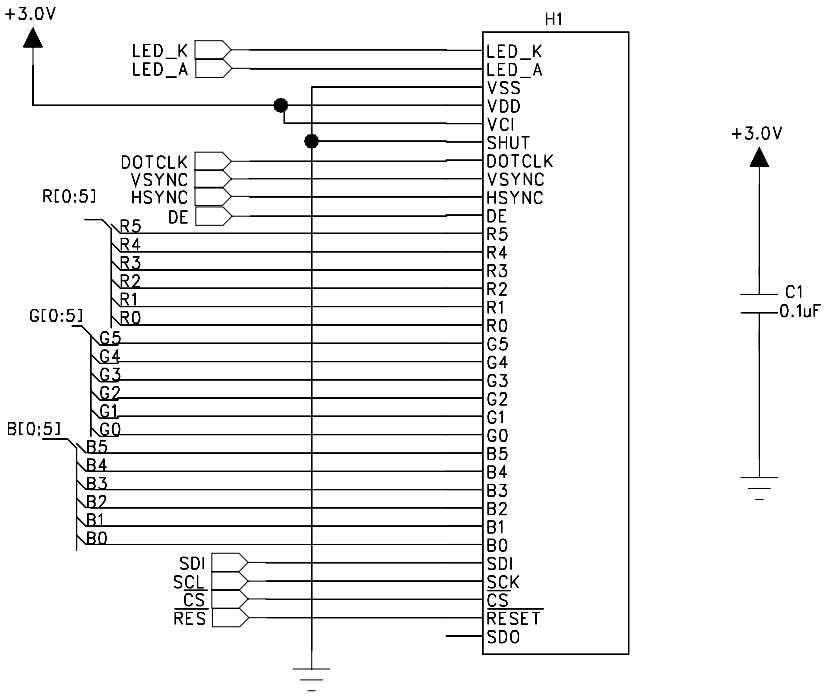


Figure 3: Reference Circuit Diagram

3. Interface signals

Table 2: Pin assignment

Pin No.	Symbol	Description
1	LED_K	Cathode of LED backlight.
2	LED_A	Anode of LED backlight.
3	VSS	Ground.
4	VDD	Power supply to logic circuit.
5	VCI	Power supply to analog circuit.
6	SHUT	Display shut down pin to put the driver into sleep mode. A sharp falling edge must be provided to such pin when IC power on. Internal pull low. - Connect to VDD for sleep mode. - Connect to VSS for normal operating mode. (Refer to Power Up Sequence)
7	DOTCLK	Dot-clock signal and oscillator source. A non-stop external clock must be provided to that pin even at front or black porch non-display period.
8	VSYNC	Frame synchronization signal pin.
9	HSYNC	Line synchronization signal pin.
10	DE	Display enable signal pin.
11	R5	Graphic data input pins.
12	R4	
13	R3	
14	R2	
15	R1	
16	R0	
17	G5	
18	G4	
19	G3	
20	G2	
21	G1	
22	G0	
23	B5	
24	B4	
25	B3	
26	B2	
27	B1	
28	B0	
29	SDI	Data input pin for serial mode.
30	SCK	Clock input pin for serial interface.
31	$\overline{CS}$	Chip select pin for serial interface.
32	$\overline{RES}$ (RESB)	System reset pin.
33	SDO	Data output pin for serial mode.

4. Absolute Maximum Ratings

4.1 Electrical Maximum Ratings – for IC Only

Table 3

Parameter	Symbol	Min.	Max.	Unit
Supply voltage	VDD	-0.3	+4.0	V
Input voltage	VCI	VSS-0.3	5.0	V

Note: 1. 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 (Ta)	-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, VDD=VCI=3.0V, VSS=0V.

Table 5

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Power supply pin of IO pins	VDD		2.9	3.0	3.1	V
Booster Reference Supply Voltage Range	VCI		2.9	3.0	3.1	V
TFT Gate ON Voltage	VGH(Note 1)	At Ta=25±5°C (Note 3)	-	15	-	V
TFT Gate OFF Voltage	VGL(Note 2)		-	-10	-	V
TFT Common Electrode Voltage	VcomH		2.5	-	4.5	V
	VcomL		-3	-	0	V
Low level input voltage	V_{IL}		0		0.1VDD	V
High level input voltage	V_{IH}		0.8VDD	-	VDD	V
Supply current (digital & analog)	IDD+I_{VCI}	VDD=3.0V	-	TBD	-	mA
Supply voltage of white LED backlight	VLED	Forward current =20mA x 2 Number of LED dice = 3 x 2 = 6 (Note 4)	9.0	9.6	10.4	V
Luminance (on the backlight surface)			3400	3800	-	cd/m^2

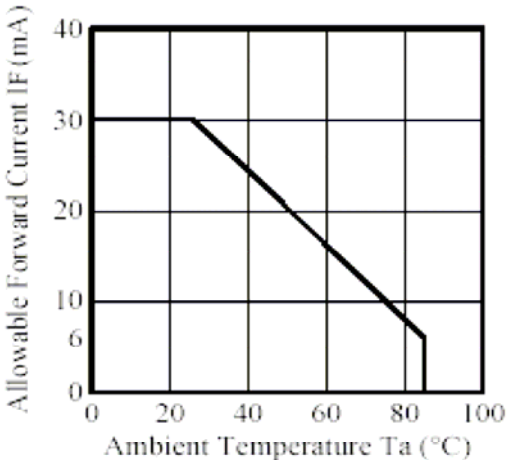
Note (1): VGH is TFT Gate operating voltage.

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

The low voltage level VGL signal must be fluctuates with same phase as Vcom, in case of Storage on Gate structure.

Note (3): Vcom must be adjusted to optimize display quality.

Note (4): Ambient Temperature vs. Allowable Forward Current



5.2 Timing Specifications

5.2.1 Pixel timing (for reference only)

Table 6

Characteristics	Symbol	Min.	Typ.	Max.	Unit
		18 bit	18 bit	18 bit	
DOTCLK Frequency	fDOTCLK	-	6.5	10	MHz
DOTCLK Period	tDOTCLK	100	154	-	ns
Vertical Sync Setup Time	tvsys	20	-	-	ns
Vertical Sync Hold Time	tvsyh	20	-	-	ns
Horizontal Sync Setup Time	thsys	20	-	-	ns
Horizontal Sync Hold Time	thsyh	20	-	-	ns
Phase difference of Sync Signal Falling Edge	thv	1	-	240	tDOTCLK
DOTCLK Low Period	tCKL	50	-	-	ns
DOTCLK High Period	tCKH	50	-	-	ns
Data Setup Time	tds	12	-	-	ns
Data hold Time	tdh	12	-	-	ns
Data pulse width	tRES	10	-	-	ns

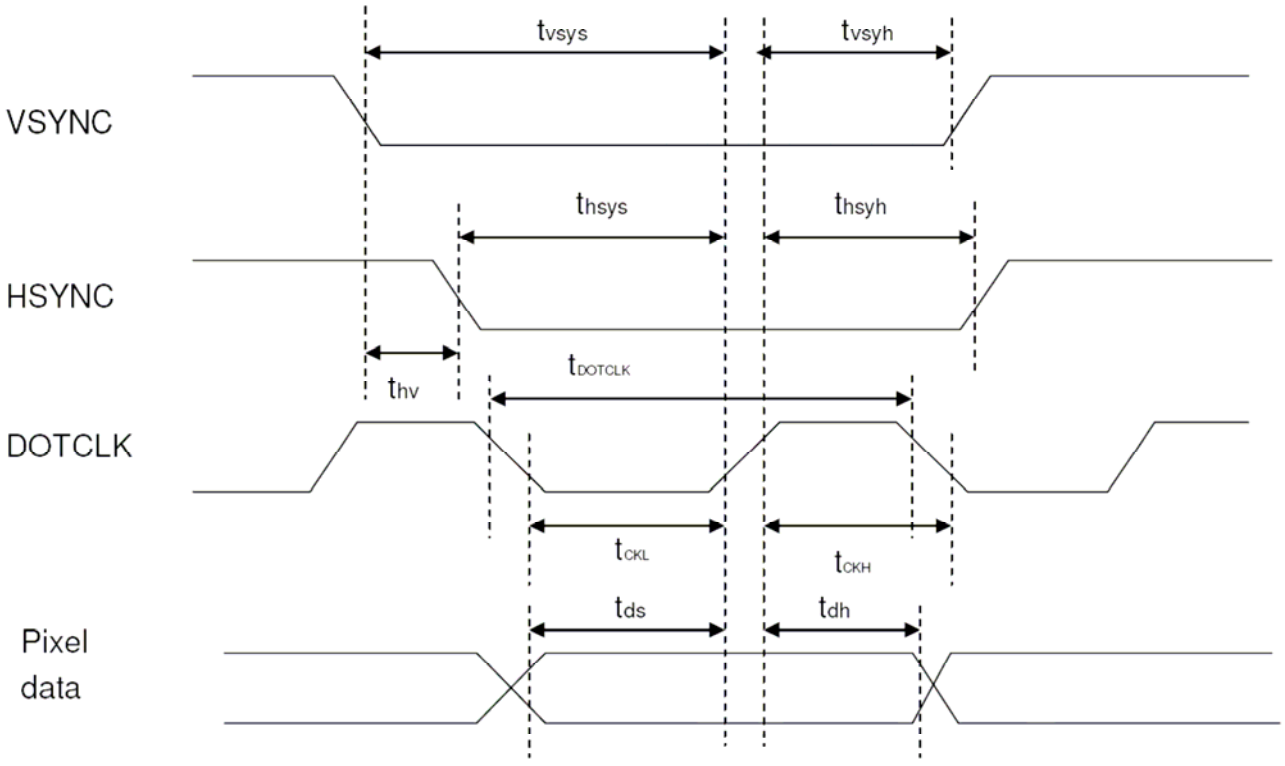
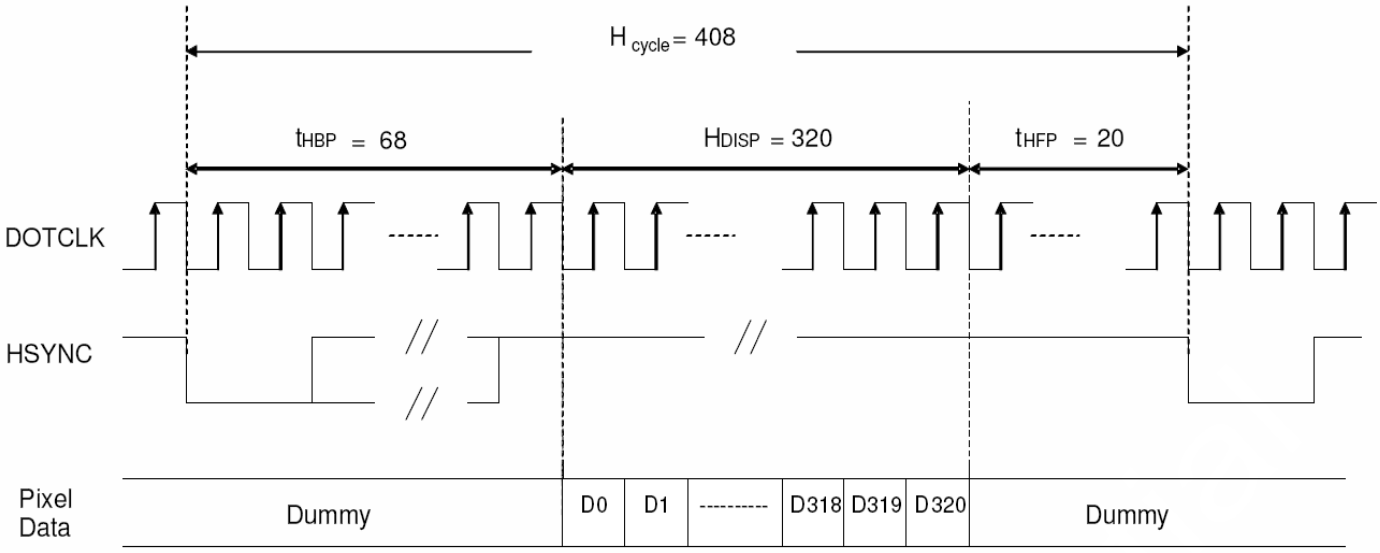


Figure 4: Pixel timing

5.2.2 Data transaction timing in normal operating mode (for reference only)

Table 7

Characteristics	Symbol	Min.	Typ.	Max.	Unit
		18 bit	18 bit	18 bit	
DOTCLK Frequency	fDOTCLK	-	6.5	10	MHz
DOTCLK Period	tDOTCLK	100	154	-	ns
Horizontal Frequency (Line)	fH	-	14.9	22.35	KHz
Vertical Frequency (Refresh)	fV	-	60	90	Hz
Horizontal Back Porch	tHBP	-	68	-	tDOTCLK
Horizontal Front Porch	tHFP	-	20	-	tDOTCLK
Horizontal Data Start Point	tHBP	-	68	-	tDOTCLK
Horizontal Blanking Period	tHBP+tHFP	-	88	-	tDOTCLK
Horizontal Display Area	HDISP	-	320	-	tDOTCLK
Horizontal Cycle	Hcycle	-	408	450	tDOTCLK
Vertical Back Porch	tVBP	-	18	-	Lines
Vertical Front Porch	tVFP	-	4	-	Lines
Vertical Data Start Point	tVBP	-	18	-	Lines
Vertical Blanking Period	tVBP+tVFP	-	22	-	Lines
Vertical Display Area	VDISP	-	240	-	Lines
Vertical Cycle	Vcycle	-	262	350	Lines



a) Horizontal Data Transaction Timing

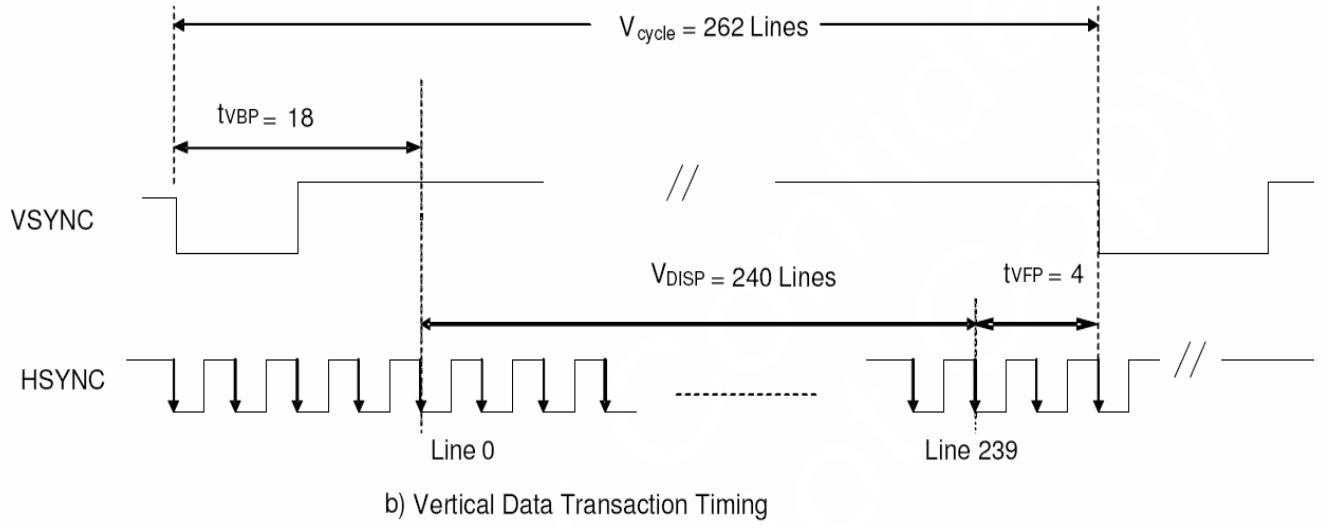


Figure 5: Data transaction timing in parallel RGB interface (SYNC mode)

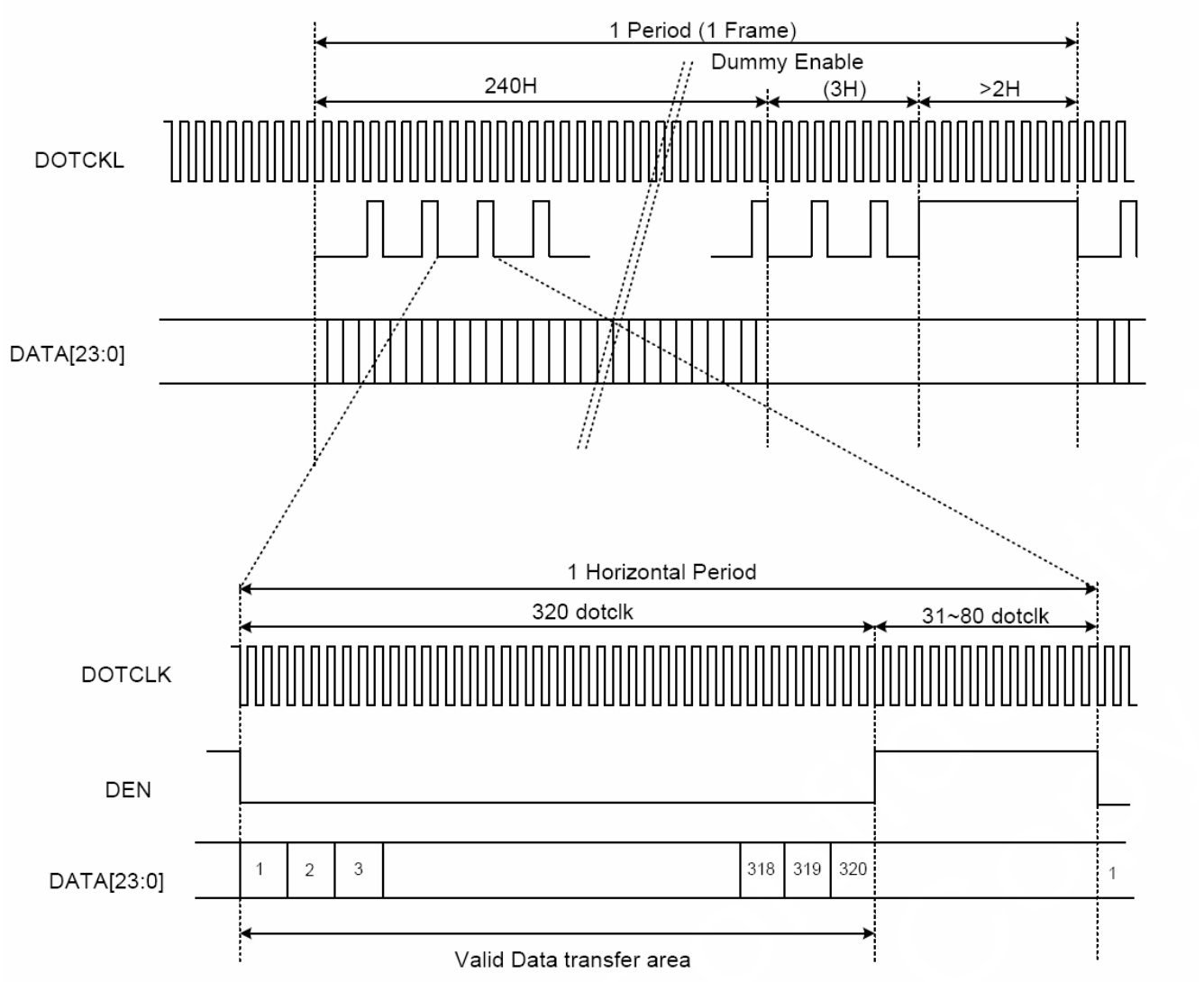


Figure 6: Signal timing in DE mode

5.3 Power up sequence

Table 8

Characteristics	Symbol	Min	Typ	Max	Units
VDDD / VDDIO on to falling edge of SHUT	tp-shut	1	-	-	us
DOTCLK	tclk-shut	1	-	-	clk
Falling edge of SHUT to LCD power on	tshut-lcd	-	-	128	ms
Falling edge of SHUT to display start - 1 line: 408 clk - 1 frame: 262 line -DOTCLK = 6.5MHz	tshut-on	-	-	10	frame
		-	166	-	ms

Note: It is necessary to input DOTCLK before the falling edge of SHUT.
Display starts at 10th falling edge of VSTNC after the falling edge of SHUT.

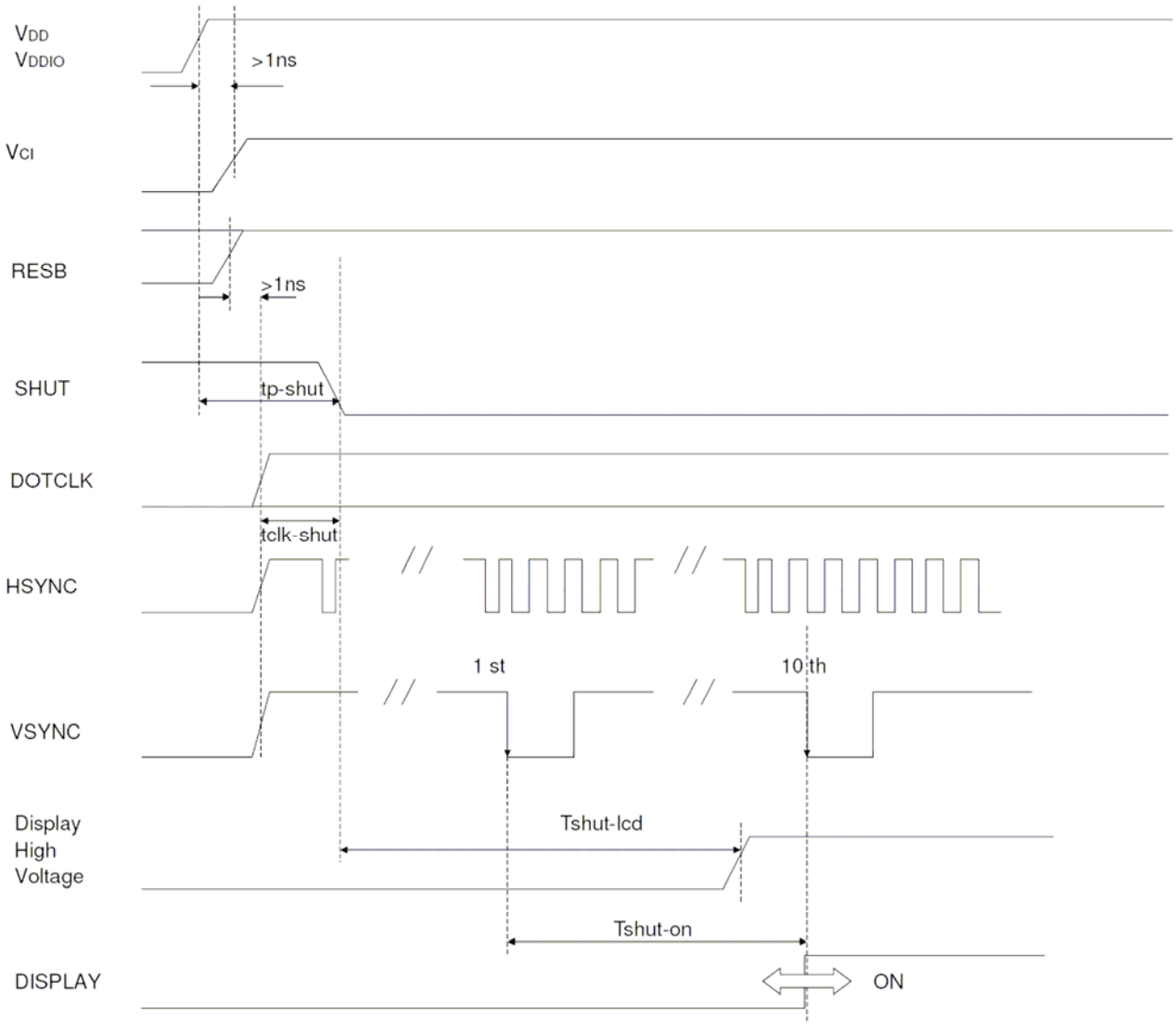


Figure 7: Power up sequence

5.4 Power down sequence

Table 9

Characteristics	Symbol	Min	Typ	Max	Uni
Rising edge of SHUT to display off - 1 line: 408 clk - 1 frame: 262 line - DOTCLK = 6.5MHz	tshut-off	2	-	-	frame
		33.4	-	-	ms
Input-signal-off to VDDD / VDDIO off	toff-vdd	1	-	-	us

Note: DOTCLK must be maintained at lease 2 frames after the rising edge of SHUT.
Display become off at the 2nd falling edge of VSTNC after the falling edge of SHUT.
If RESET signal is necessary for power down, provide it after the 2-frames-cycle of the SHUT period.

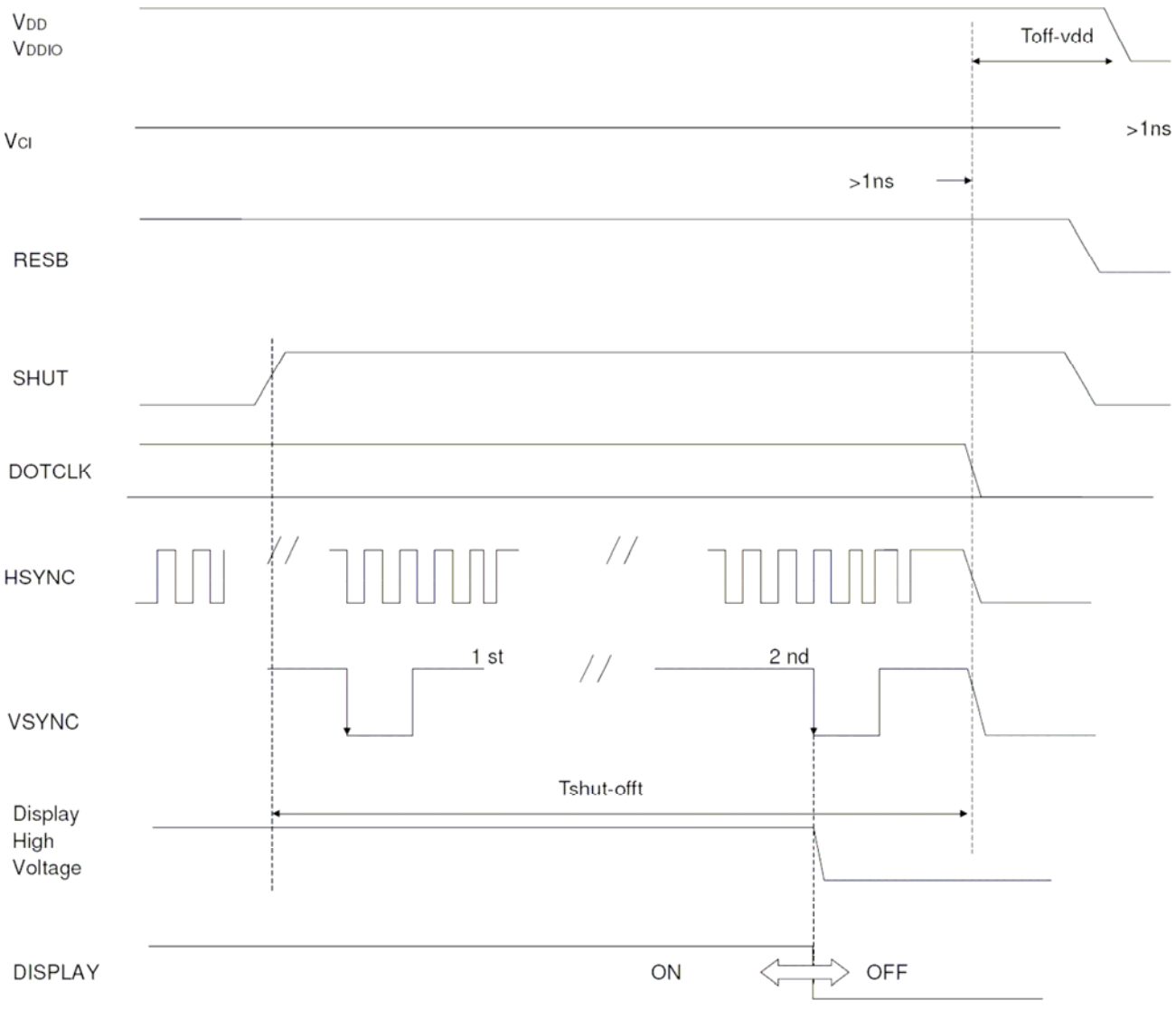


Figure 8: Power down sequence

6. Optical Characteristics (for TFT panel only)

Table 10

Item		Symbol	Conditions	Specifications Min.	Typ.	Max.	Unit	Note
Transmittance		T%	Viewing normal angle $\theta_X = \theta_Y = 0°$	-	7.5	-	%	All left side data are based on following condition-T6 NTSC:60% LC:5091 Light: C light (Machine: BM5A) Normal Polarizer without DBEF Reference only
Contrast Ratio		CR		150	200	-	--	
Response Time		T_R		-	15	30	ms	
		T_F		-	35	50	ms	
Chromaticity	Red	X_R		-	0.64	-	-	
		Y_R		-	0.34	-	-	
	Green	X_G		-	0.30	-	-	
		Y_G		-	0.58	-	-	
	Blue	X_B		-	0.13	-	-	
		Y_B		-	0.14	-	-	
	White	X_W		-	0.31	-	-	
		Y_W		-	0.35	-	-	
Viewing Angle	Hor.	θ_{X+}	Center CR≥10	-	45	-	deg.	
		θ_{X-}		-	45	-		
	Ver.	θ_{Y+}		-	15	-		
		θ_{Y-}		-	35	-		

*Note (1) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

Contrast Ratio (CR) = L63 / L0

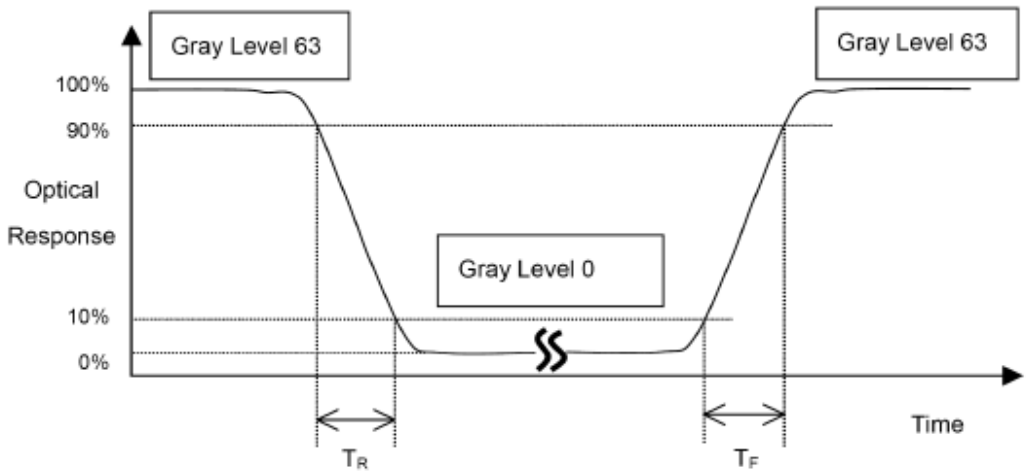
L63: Luminance of gray level 63

L0: Luminance of gray level 0

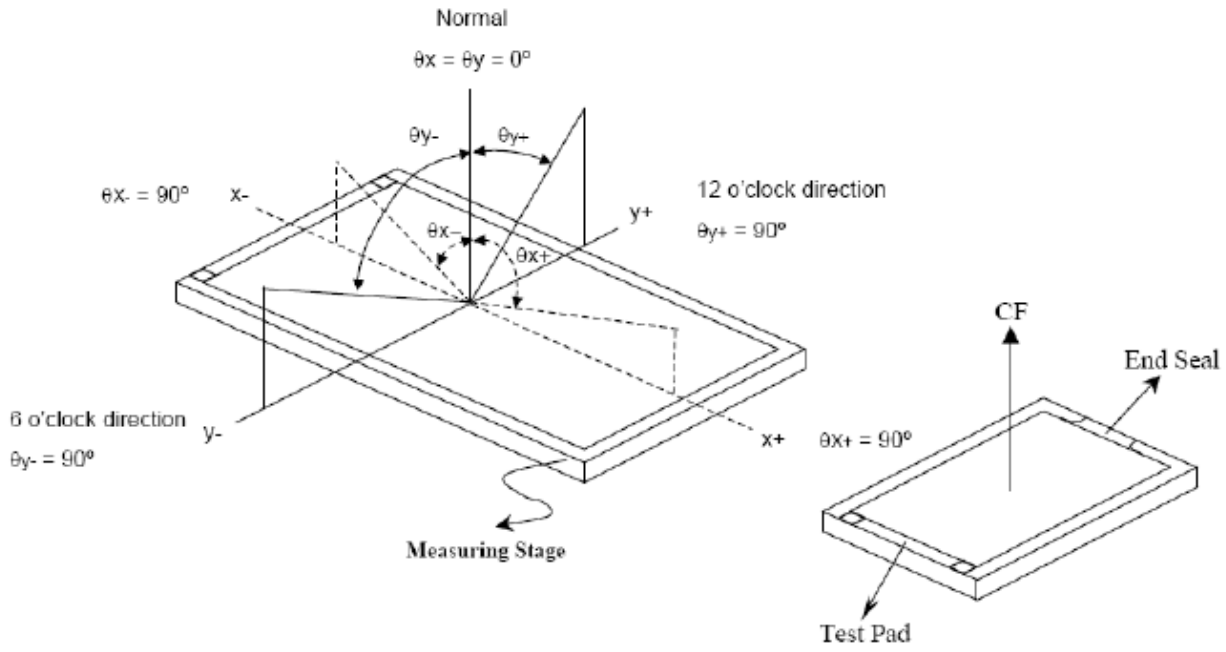
CR = CR (10)

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (5).

*Note (2) Definition of Response Time (TR, TF):



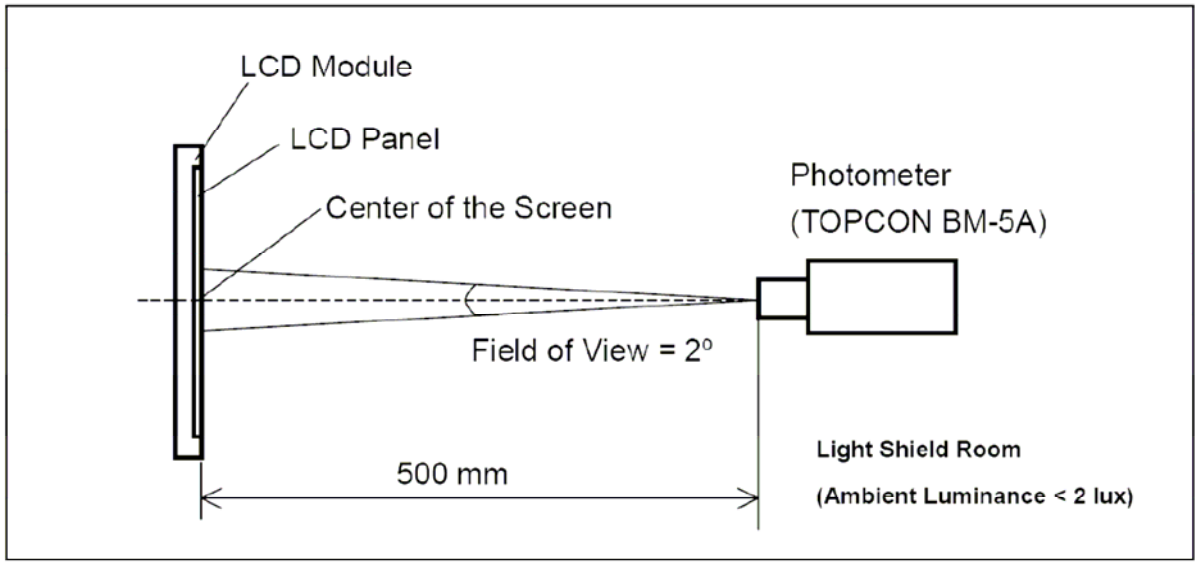
*Note(3) Definition of Viewing Angle



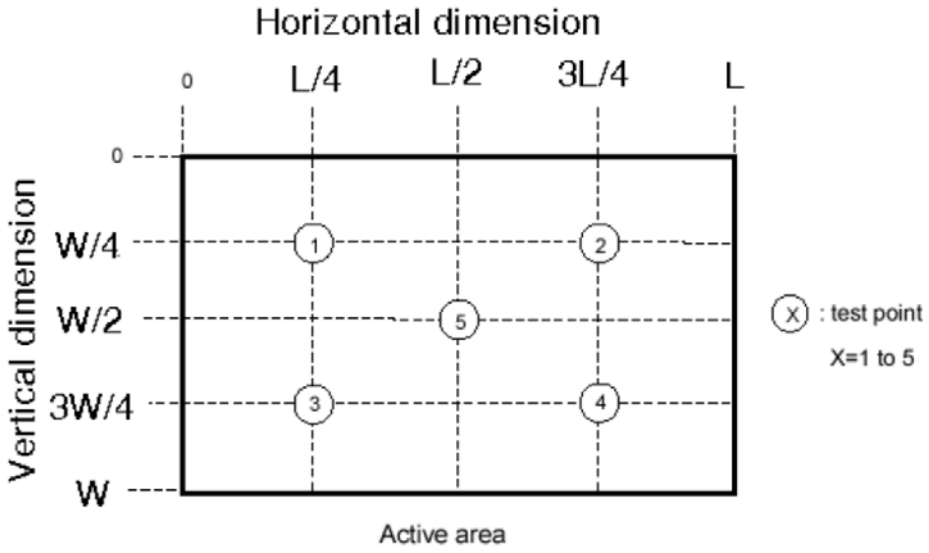
*** The above "Viewing Angle" is the measuring position with Largest Contrast Ratio; not for good image quality. View Direction for good image quality is 12 O'clock. Module maker can increase the "Viewing Angle" by applying Wide View Film.

*Note (4) Measurement Set-Up:

The LCD module should be stabilized at a given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.



*Note (5)



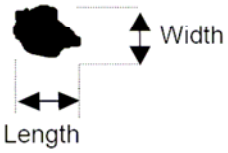
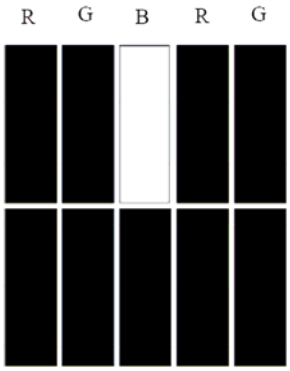
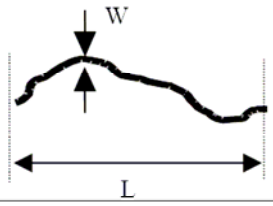
7. Reliability specification (for TFT panel only)

No.	Test Item	Test Condition	Check Time
1	High temp storage	T= 80℃	240 hrs
2	Low temp storage	T= -30℃	240 hrs
3	High temp operation	T= 70℃	240 hrs
4	Low temp operation	T= -20℃	240 hrs
5	High temp & High humidity	T=60℃ H=90%	240 hrs

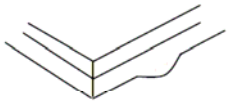
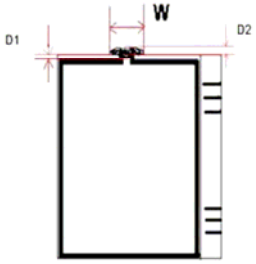
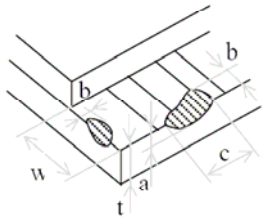
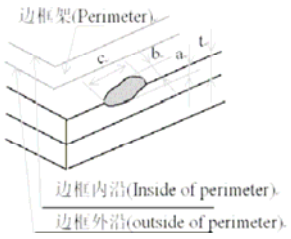
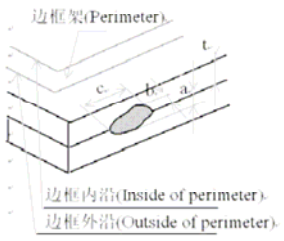
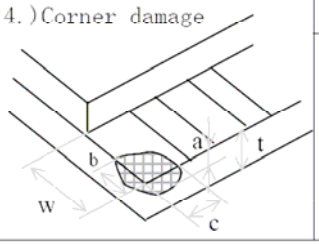
Reliability Test Criteria:

Display function should be no change under normal operating condition.

8. TFT inspection specification

Failure mode	Illustration	Category (Unit: mm)		Acceptable count	
				Viewing area	Non-Viewing area
Black spot White spot	 Φ= (Length+width)/2	A	Φ≦0.10	Not count	Not count
		B	0.10<Φ≦0.15	The gap between the two spots should be 5 mm and above.After divided the display into 9 zones with equal area, only 2 spots are acceptable in each zone.	
		C	0.15<Φ≦0.25	2	
		D	0.25<Φ	0	
Bright spot (Red spot, green spot and blue spot caused by damaged colour filter)		A	Area≦1 sub-pixel	The gap between the two spots should 5 mm and above.	N/A
Black line White line		A	W≦0.05	Not count	Not count
		B	0.05<W≦0.08, L≦8.0	2	
		C	0.08<W or L>8.0	Judged by spot spec	

Below are cosmetic inspection specifications

<table>
<tr><td rowspan="2">Excess glass</td><td>  </td><td>b≦1.0, this defect shall not affect the outline dimension or assembly process.(Remarks: For COG process, the defect size is decided by the dimension of LCD panel.)</td></tr>
<tr><td>  </td><td>This defect shall not affect the outline dimension or assembly process.</td></tr>
<tr><td>The depth of UV glue entered in LCD cell</td><td>  </td><td>a. D1≧0.2，not enter into viewing area
b. D2≦0.8,
c. W=End mouth width + (2~6 mm)</td></tr>
<tr><td rowspan="4">Glass defect (scratch, damage)</td><td>1.) LCD ledge damage
  </td><td colspan="2">Category
A: The defect shall not affect the outline dimension or assembly process at non ITO zone.
B: b≦1/4w, a & c not count (at ITO zone)
C: Alignment mark on LCD ledge shall not be damaged.</td></tr>
<tr><td>2.) Outside of perimeter damage
  </td><td colspan="2">b can’t reach inside of perimeter.</td></tr>
<tr><td>3.) Joint glass damage
  </td><td colspan="2">b can’t reach outside of perimeter or ITO layout.</td></tr>
<tr><td>4.)Corner damage
  </td><td>A</td><td>a ≦ t， b ≦ 3.0， c ≦ 3.0
B. Alignment mark on LCD ledge shall not be damaged.</td></tr>
<tr><td colspan="3">Remark: A stands for thickness of damage, b for width, c for length and t for glass thickness. (Unit: mm)</td></tr>
</table>

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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- END -

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