



LCD MODULE
(DEPARTMENT)

SPECIFICATION

T2432C13VR01 – REV. B
(3.5” DIGITAL TFT with LED BACKLIGHT)
1-Chip Solution

CUSTOMER APPROVAL
.....STAMP AND SIGNATURE.....
DATE: _____

IMPORTANT NOTE: This document must be approved by customer and send back to CCT by mail, email or fax.

If the approved document is not returned, CCT will assume it has been approved if any Mass Production Order is issued subsequently.

	Designation	Name	Signature/Date
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LCD Module Specification

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2.0 Record of revision

Rev	Date	Item	Page	Comment
A	11/10/07			Initial Release – 1 Chip Solution
B	05/03/08			Update on FPC design



3.0 General specification

Display format : 320 (W) x RGB x 240 (H) dots

Screen size : 3.5 inch

Surface treatment : Anti-glare

Active area : 70.08mm x 52.56mm

General dimensions : 76.90mm x 63.90mm x 3.25mm

Pixel pitch : 0.219mm x 0.219mm

LCD type : CSTN TFT

Polarizer mode : Reflective Transflective

Transmissive

View angle : 6 O'clock 12 O'clock

9 O'clock 3 O'clock

Backlight : EL LED CCFL

Backlight color : Yellow Green Amber White

Blue Green Others

Temperature range : Normal temperature Wide temperature

Operating -10 to 60 C

Operating -20 to 70 C

Storage -20 to 70 C

Storage -30 to 80 C

**4.0 Absolute maximum rating – IC only**

Parameter	Symbol	Min.	Max.	Unit	Remark
Input voltage	V _{CI}	VSS-0.3	+5.0	V	Note 1
Supply voltage	V _{CC}	-0.3	+5.0	V	Note 1
	V _{CCIO}	-0.3	+5.0	V	Note 1

Note 1 – The modules may be destroyed if they are used beyond the absolute maximum ratings.

5.0 Electrical characteristics

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Supply voltage	V _{CC}	-	+2.8	-	V	
Input voltage	H Level	V _{IH}	+0.8V _{CC}	-	V _{CC}	V
	L Level	V _{IL}	0.0	-	+0.2V _{CC}	V
Supply current	I _{CC}	-	20	-	mA	
Vcom	VcomH	2.5	-	4.5	V	
	VcomL	-3.0	-	0	V	
TFT Gate ON voltage	VGH	-	15	-	V	
TFT Gate OFF voltage	VGL	-	-10	-	V	

Backlight

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Backlight voltage	V _{LED}	18.0	19.2	20.8	V	I _{LED} = 20mA
Backlight current	I _{LED}	-	20	-	mA	LED = 6
Luminance		3200	3600	-	cd/m ²	

6.0 Environmental requirements

No	Item	Conditions
1.	Operating Temperature	Refer page 3
2.	Storage Temperature	Refer page 3
3.	Operating Humidity	5% to 95%RH
4.	Cycle Test	0 C @ 30 min to 50 C @ 30min for 1 cycle run for 10 cycles

Note: The background on LCD has the possibility to be changed in different temperature range.



7.0 LCD specification

7.1 Electro-optical characteristic

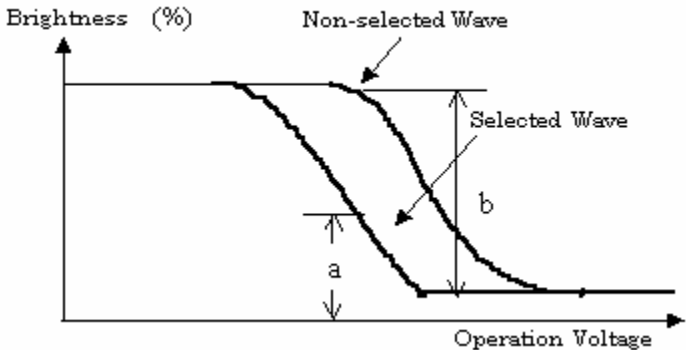
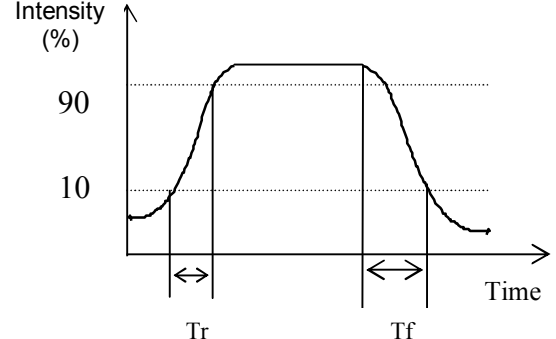
Temp = 25°C

No	Item	Symbol	Conditions	Commercial			Unit	Ref.
				Min.	Typ.	Max.		
1	Brightness			300	350	-	cd/m ²	
2	Viewing Angle	θ_{x1}	CR ≥ 10	55	70	-	Deg	7.1.1
		θ_{x2}		55	70	-		
		θ_{y1}		45	60	-		
		θ_{y2}		55	70	-		
3	Contrast Ratio	Cr	$\theta = 0^{\circ}$	300	450	-		7.1.2
4	Response Time	Tr	$\theta = 0^{\circ}$	-	10	-	ms	7.1.3
		Tf		-	15	-		
5	Chromacity White	X	$\theta = 0^{\circ}$	0.29	0.31	0.33		
		Y		0.31	0.33	0.35		
6	Uniformity	U	9 points	75	80		%	

* Measurement readings are subjected to method of measuring and varies between different measuring methods.

No.	Characteristics	Definition
7.1.1	Viewing Angle	



<p>7.1.2</p>	<p>Contrast Ratio <i>Conditions</i> (a) Temperature: 25°C (b) Viewing Angle, $\theta = 0^\circ$</p>	 <p>Contrast Ratio = $\frac{\text{Brightness of non-selected state (b)}}{\text{Brightness of selected state (a)}}$</p>
<p>7.1.3</p>	<p>Response Time</p>	 <p>T_r : Measured between 10% and 90% of LCD segment maximum response with V_{ON}.</p> <p>T_f : With voltage switches to zero and the instant LCD segment reaches 10% of its maximum response.</p>



8.0 Interface

8.1		Pin-out Assignments		
CONNECTOR				
Pin No	Symbol	Function	Remark	
1	VBL-	Cathode of LED backlight		
2	VBL-			
3	VBL+	Anode of LED backlight		
4	VBL+			
5	NC	Not connected		
6	NC			
7	POL	Polarity signal to monitor VCOM signal		
8	/RESET (RESB)	System reset signal pin		
9	/CS (CSB)	Chip select signal pin for serial interface		
10	SCL	Clock signal input pin for serial interface		
11	SDI	Data input pin for serial interface		
12	D0	Data input pins		
13	D1			
14	D2			
15	D3			
16	D4			
17	D5			
18	D6			
19	D7			
20	D8			
21	D9			
22	D10			
23	D11			
24	D12			
25	D13			
26	D14			
27	D15			
28	D16			
29	D17			
30	D18			
31	D19			
32	D20			
33	D21			
34	D22			
35	D23			
36	HSYNC			
37	VSYNC			
38	DOTCLK			
39	NC		Not connected	



40	NC	Not connected	
41	VCC	Power supply for logic system	
42	VCC		
43	NC	Not connected	
44	NC		
45	NC		
46	UD	Up / Down scan setting High – Normal scan (G0 ~ G239) Low – Reverse scan (G239 ~ G0)	
47	NC	Not connected	
48	LR	Left / Right scan setting High – Normal scan (First data S0~S2) Low – Reverse scan (First data S959~S957)	
49	NC	Not connected	
50	NC		
51	NC		
52	DEN	Display enable signal pin	
53	GND	Ground terminal	
54	GND		

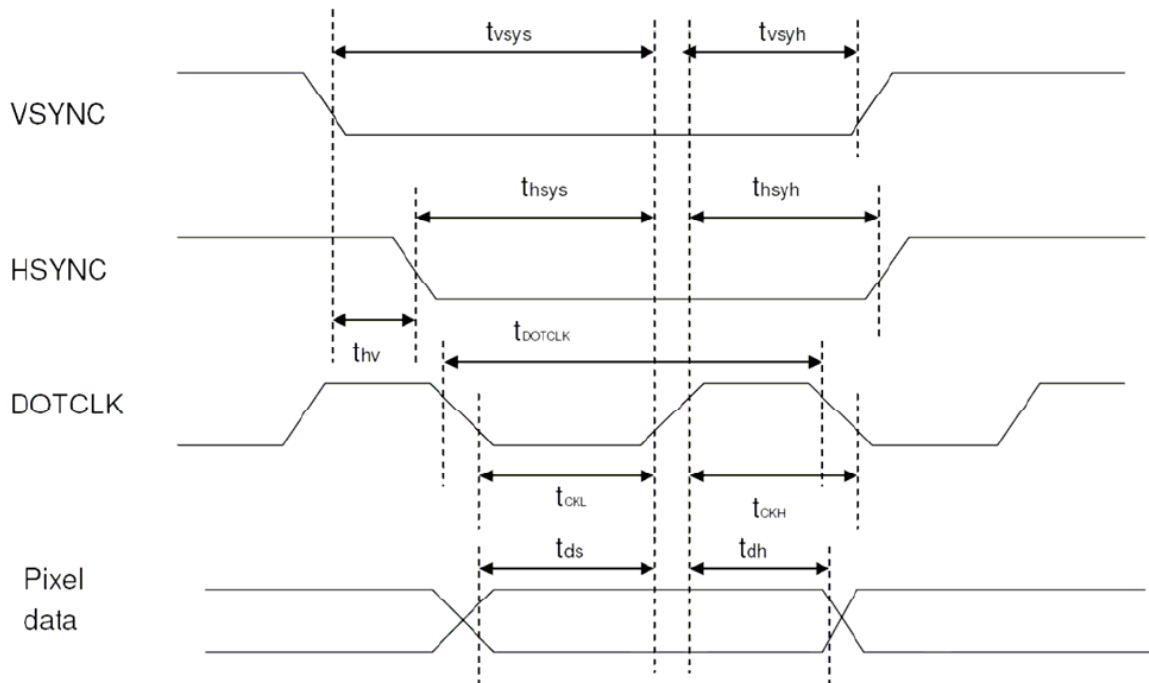
Connector type – Pin no 54pins, pitch = 0.5mm



9.0 Timing Characteristics / Timing Diagram

9.1 Pixel timing

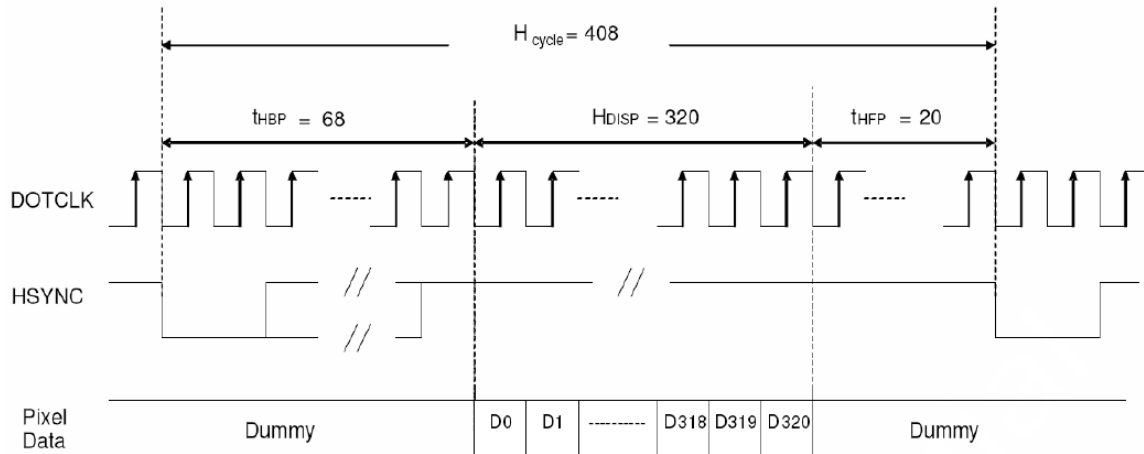
Characteristics	Symbol	Min.	Typ.	Max.	Unit
		18 bit	18 bit	18 bit	
DOTCLK Frequency	fDOTCLK	-	6.5	10	MHz
DOTCLK Period	tDOTCLK	100	154	-	ns
Vertical Sync Setup Time	tvsys	20	-	-	ns
Vertical Sync Hold Time	tvsyh	20	-	-	ns
Horizontal Sync Setup Time	thsys	20	-	-	ns
Horizontal Sync Hold Time	thsyh	20	-	-	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



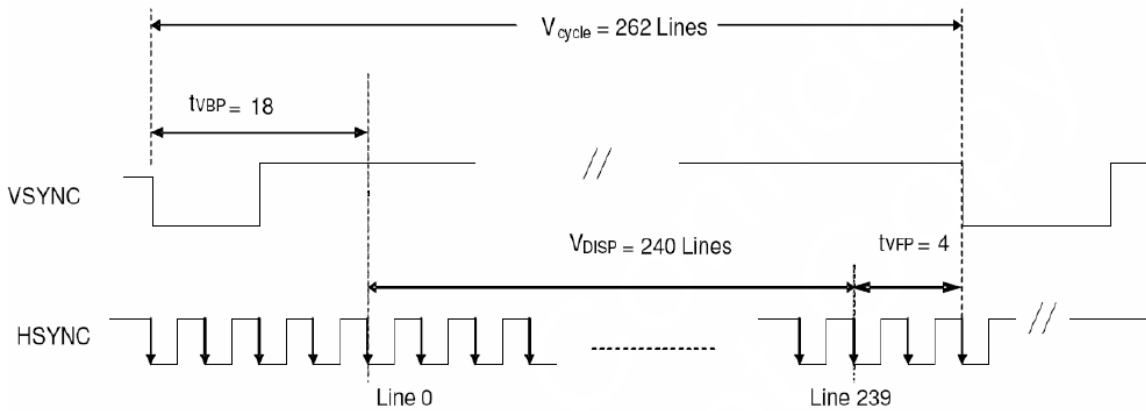


9.2 Timing characteristics of data transmission

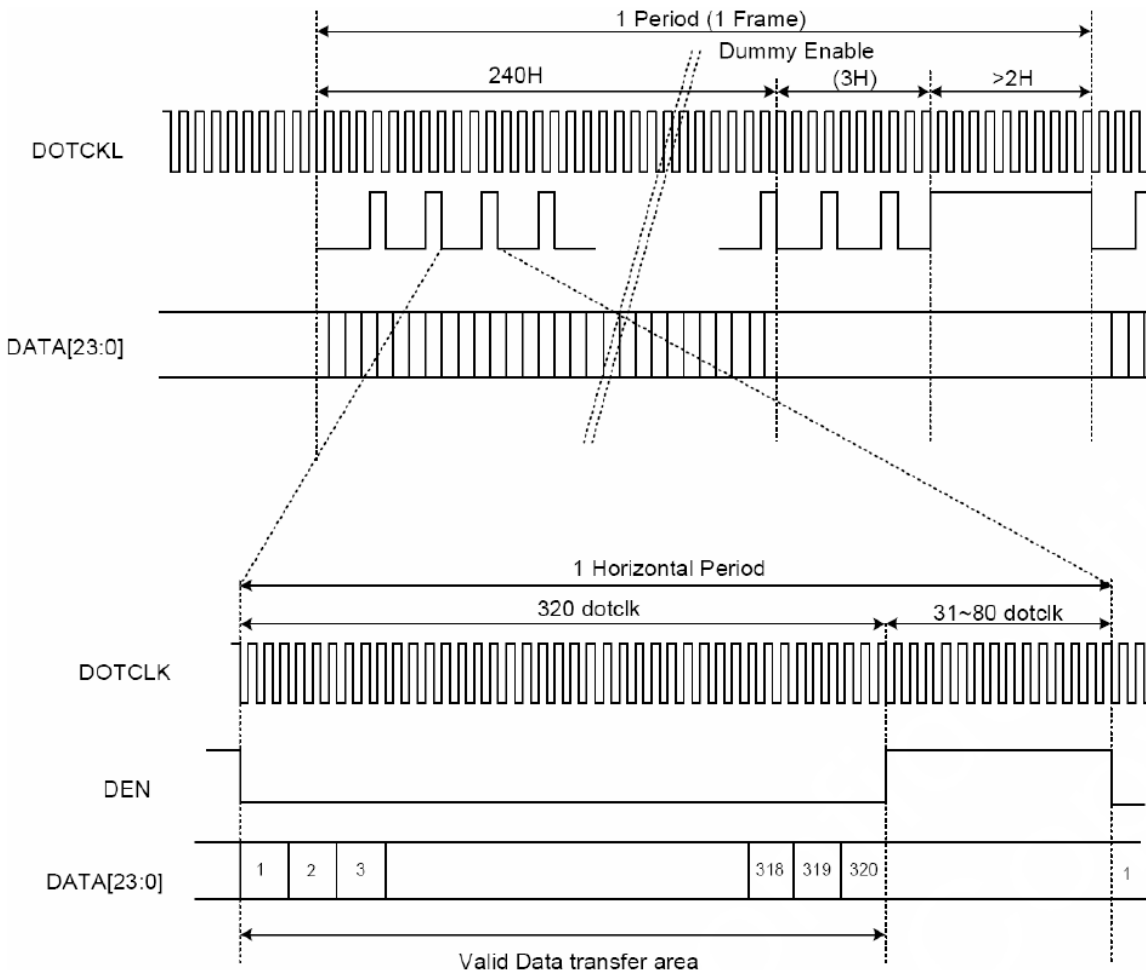
Characteristics	Symbol	Min.	Typ.	Max.	Unit
		18 bit	18 bit	18 bit	
DOTCLK Frequency	fDOTCLK	-	6.5	10	MHz
DOTCLK Period	tDOTCLK	100	154	-	ns
Horizontal Frequency (Line)	fH	-	14.9	22.35	KHz
Vertical Frequency (Refresh)	fV	-	60	90	Hz
Horizontal Back Porch	tHBP	-	68	-	tDOTCLK
Horizontal Front Porch	tHFP	-	20	-	tDOTCLK
Horizontal Data Start Point	tHBP	-	68	-	tDOTCLK
Horizontal Blanking Period	tHBP+tHFP	-	88	-	tDOTCLK
Horizontal Display Area	H _{DISP}	-	320	-	tDOTCLK
Horizontal Cycle	H _{cycle}	-	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	V _{DISP}	-	240	-	Lines
Vertical Cycle	V _{cycle}	-	262	350	Lines



Horizontal data transmission timing (SYNC mode – Parallel RGB interface)



Vertical timing transmission timing (SYNC mode – Parallel RGB interface)



Timing characteristics of DE mode

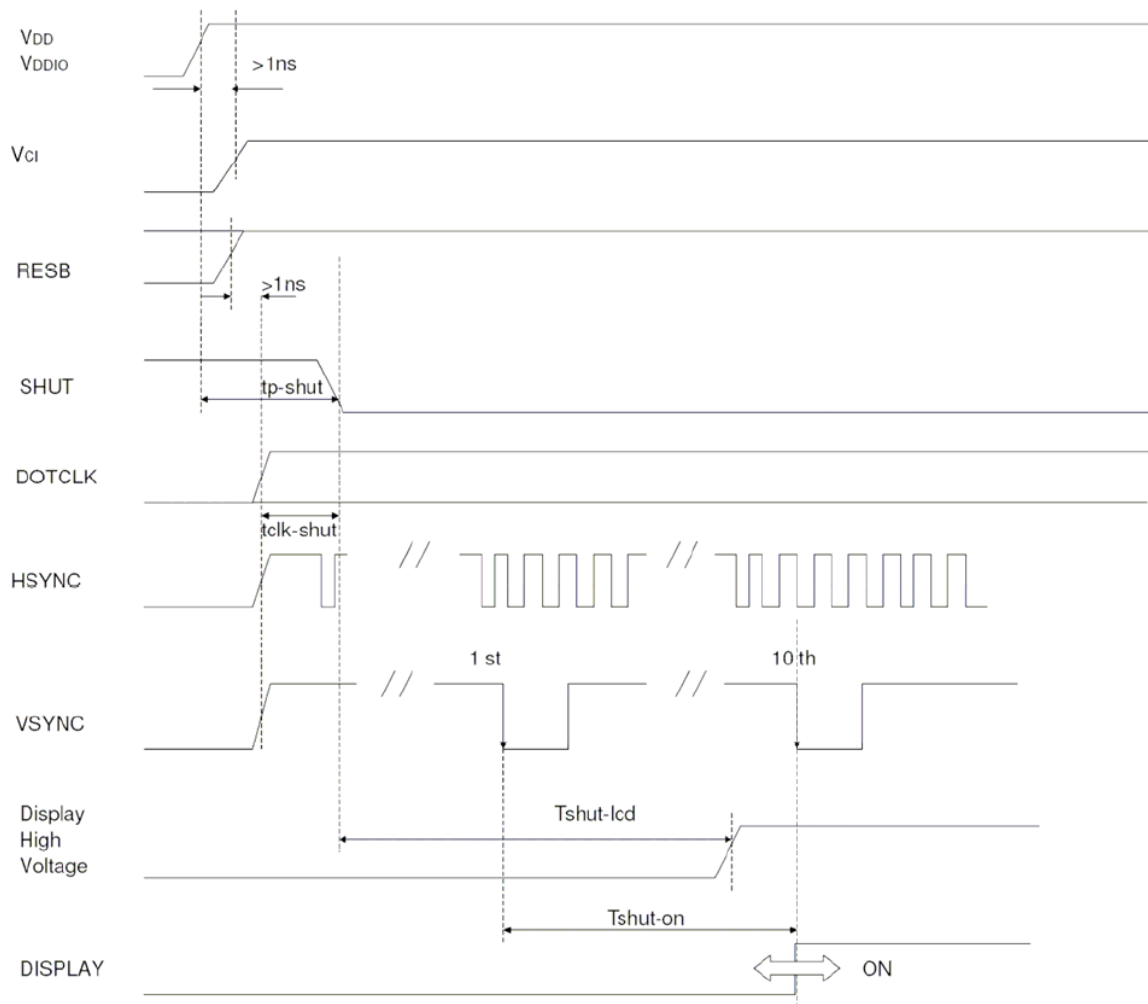


9.3 Power up sequence

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	tshut-on	-	-	10	frame
- 1 line: 408 clk - 1 frame: 262 line - DOTCLK = 6.5MHz		-	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.

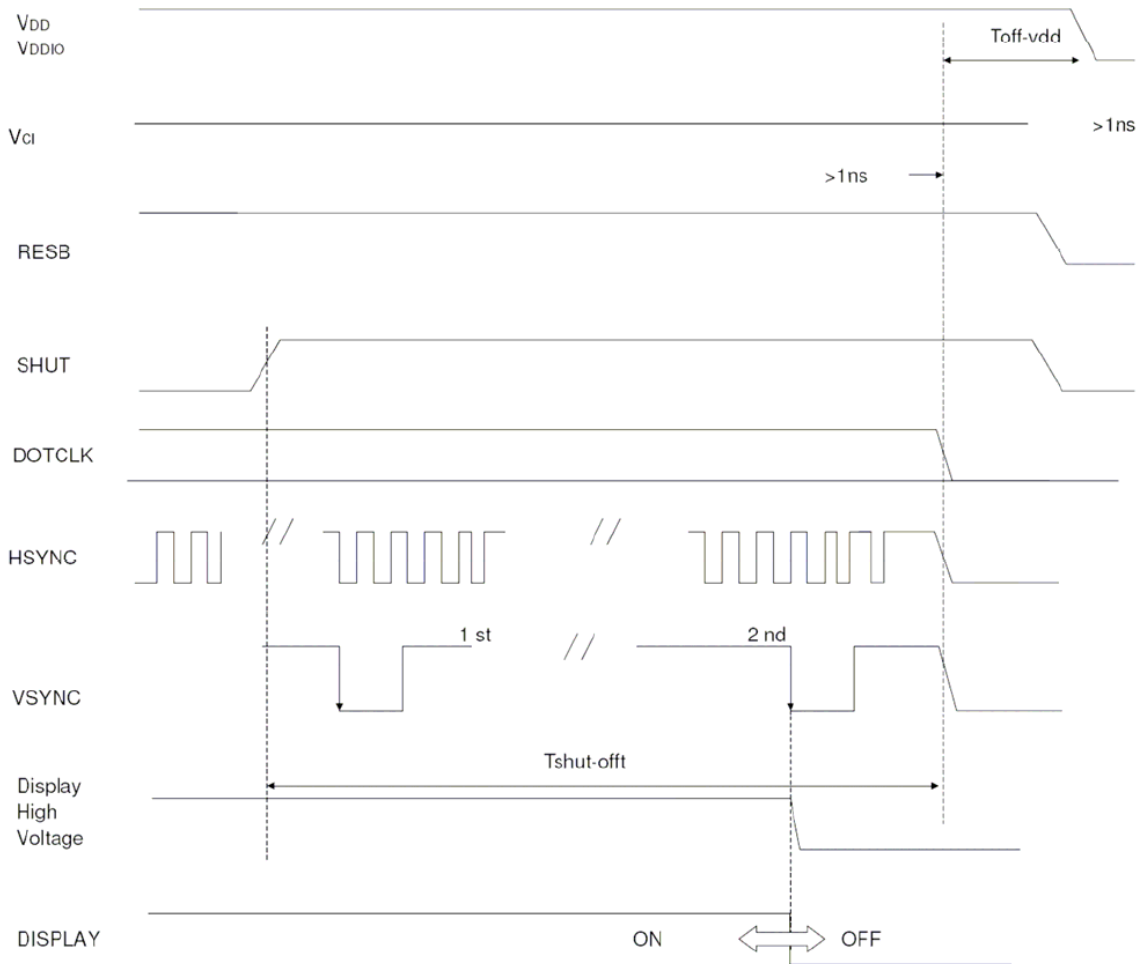




9.4 Power down sequence

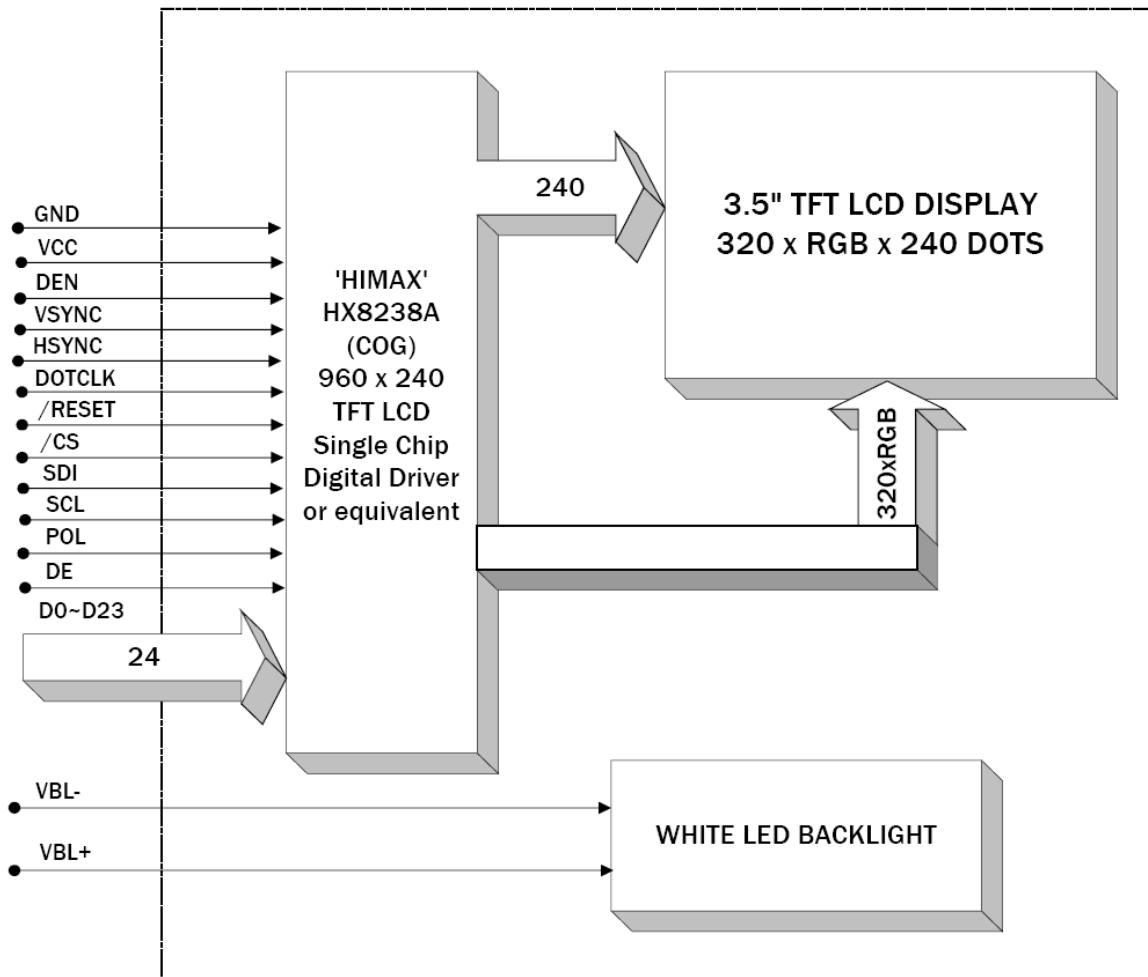
Characteristics	Symbol	Min	Typ	Max	Uni
Rising edge of SHUT to display off	tshut-off	2	-	-	frame
- 1 line: 408 clk		33.4	-	-	ms
- 1 frame: 262 line					
- DOTCLK = 6.5MHz					
Input-signal-off to VDDD / VDDIO off	toff-vdd	1	-	-	us

Note: DOTCLK must be maintained at least 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.





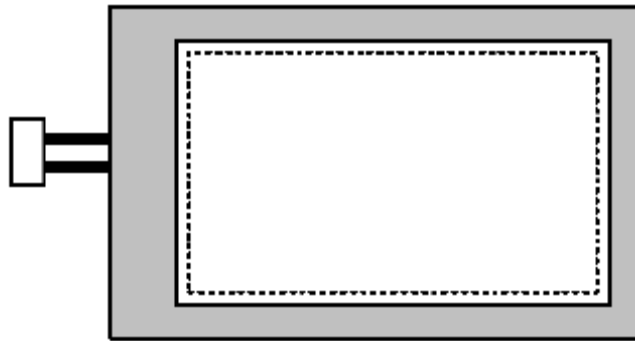
10.0. Block diagram







11.0 Panel inspection

Item		Specification/Description			
Display	Function	No Display			
		Malfunction			
Operating	Contrast ratio	Out of Spec			
	Line defect	No obvious Vertical and Horizontal line defect in bright , dark and colored.			
	Point Defect (red,green,blue,dark)	Item	Acceptable number		
			A	B	Total
		BRIGHT DOT	$N \leq 0$	$N \leq 2$	$N \leq 6$
		DARK DOT	$N \leq 2$	$N \leq 4$	
		TOTAL DOT	$N \leq 2$	$N \leq 4$	
TWO ADJACENT DOT		NOT ALLOWED			
THREE OR MORE ADJACENT DOT	NOT ALLOWED				
External Inspection (non-operating)	Scratch on the polarizer	L(mm)	W(mm)	Acceptable number	
		$L \leq 2.5$	$W \leq 0.1$	3	
		$L > 2.5$	$W > 0.1$	0	
	Dent or bubble on the polarizer	Dimension(mm)		Acceptable number	
		$D \leq 0.3$		3	
		$D \leq 0.1$		Disregard	
	Foreign material on the polarizer	Dimension(mm)		Acceptable number	
		$D \leq 0.5$		2	
		$D \leq 0.1$		Disregard	



 Zone A (Active Area)

 Zone B (Viewing Area)



12.0 Mechanical specification

