2.5 inch
TFT LCD Screen Series

GooDisplay®

GDT250T2080

Dalian Good Display Co., Ltd.

DOCUMENT REVISION HISTORY

DOCUMENT REVISION FROM TO	DATE	DESCRIPTION	CHANGED BY	CHECKED BY
A	2013.07.04	First Release		

CONTENTS

Preliminary Specification
of
LCD Module Type
Model No.: GDT250T2080

Note: The characteristics and performance index listed in this preliminary specification are subjected to final verification and validation. It's aimed for sample build and evaluation only, not yet for mass production.
The ultimate design performance in final specification may change.

1. General Description

- 2.5" (diagonal), 4:3 Landscape,, QVGA, normally white, TN type, transmissive, amorphous silicon TFT LCD module with single chip (COG) driver
- Display Resolution: 320 x RGB x 240
- Wide viewing angle (U/D/L/R): 50/70/75/75 @CR > 10
- Viewing Direction: 6 o'clock
- Grey scale inversion: 12 o'clock
- Display up to 262K colours
- 18-bits digital RGB (Digital interface with T-CON) + 4-wires SPI interface
- AG surface polarizer treatment
- White LED backlight
- NTC included (NTC sensor Murata NCP18XH103F03RB)
- FPC connection
- Extended operating temperature

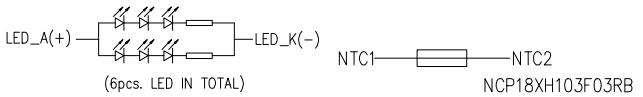
2. Mechanical Specifications

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

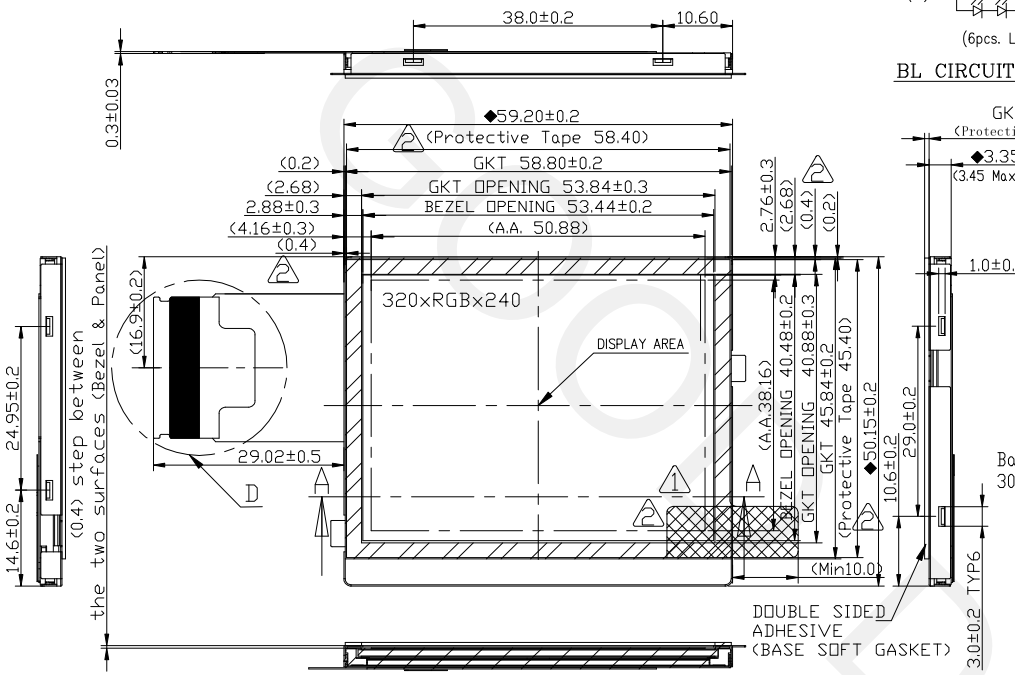
Table 1

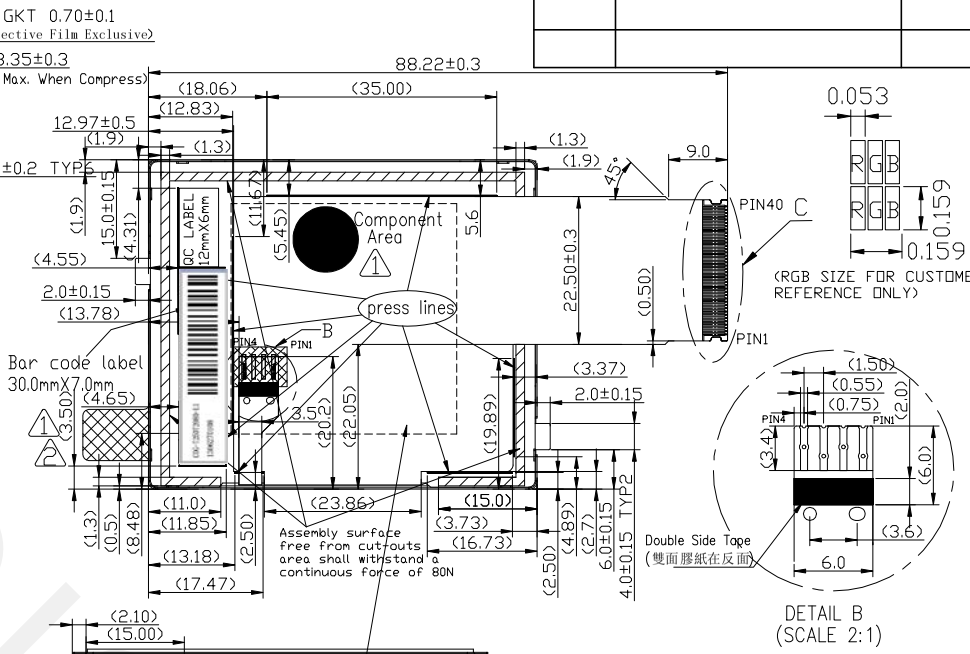
Parameters		Specifications	Unit
Outline dimensions		59.2 (W) x 50.15 (H) x 3.35 (D) (Exclude FPCs & component height)	mm
Color TFT 320x RGB x 240	Bezel opening	53.44 (W) x 40.48 (H)	mm
	Visible area	50.88 (W) x 38.16 (H)	mm
	Active area	50.88 (W) x 38.16 (H)	mm
	Display format	QVGA (320 x RGB x 240)	dots
	Color configuration	Vertical RGB stripes	-
	Dot pitch	0.053 (*3) (W) x 0.159 (H)	mm
Backlight		LED	-
Weight		20.5 (TBC)	gram

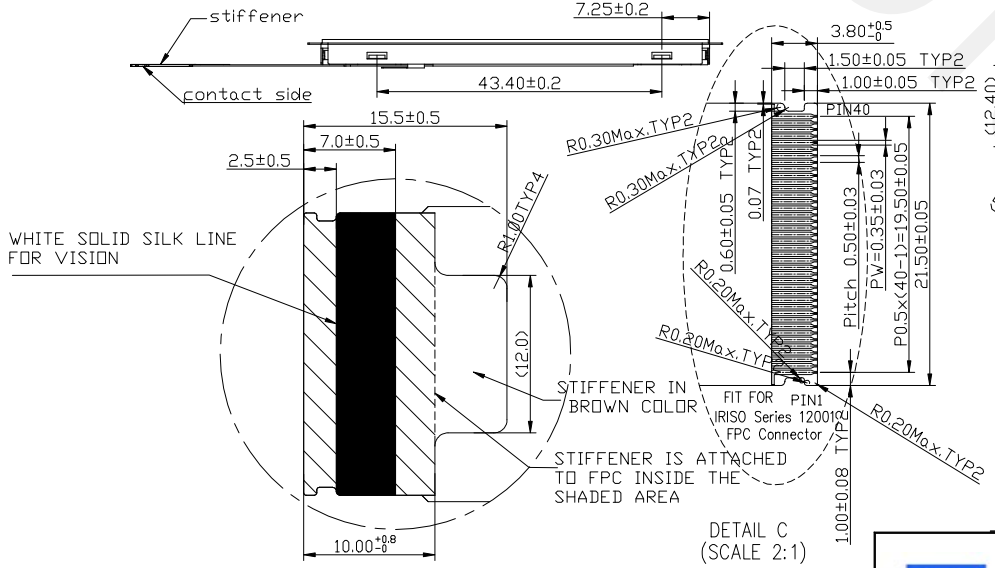
ISSUE	AMENDMENT	DATE
3	ADD LBE-DIA13-03/Pull Tape	14.02.25
6	Protective Tape Update	14.09.22

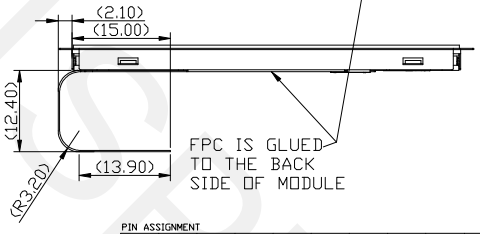


BL CIRCUIT DIAGRAM:









PIN ASSIGNMENT

1	2	3	4	5	6	7	8	9	10
LED_A	NC	LED_K	NTC1	NTC2	VCI	IOVCC	GND	B0	B1
11	12	13	14	15	16	17	18	19	20
B2	B3	B4	B5	GND	G0	G1	G2	G3	G4
21	22	23	24	25	26	27	28	29	30
G5	GND	R0	R1	R2	R3	R4	R5	GND	DCLOCK
31	32	33	34	35	36	37	38	39	40
GND	CS	SCL	NRESET	DEN	HSYNC	VSYNC	SDO	SDI	GND

DISPLAY TYPE	2.5" TRANSMISSIVE, COLOUR TFT	
VIEWING DIRECTION	6 O'CLOCK (BEST VIEWING)	
DISPLAY RESOLUTION	320 x RGB x 240	
DISPALY MODE	NORMALLY WHITE	
INPUT VOLTAGE (VCC)	3.0	
OPERATING TEMPERATURE	-30 TO +85 °C	
STORAGE TEMPERATURE	-40 TO +90 °C	
UNIFORMITY ON MODULE SURFACE	80%	
LUMINANCE ON MODULE SURFACE (Cd/m2)	400 (Min.)/500 (TYP.)	
BACKLIGHT	TYPE	WHITE LED
	FORWARD CURRENT (CURRENT DRIVEN)	20mA per String 40mA in Total
	FORWARD VOLTAGE	MIN --
		TYP 9.0V
		MAX --
REMARK:		

NOTES:
1. ◇ : SPECIAL CHARACTERISTIC
2. + : SAFETY CHARACTERISTIC
3. ▽ : CRITICAL DIMENSION
4. (...) : REFERENCE DIMENSION

DALIAN GOOD DISPLAY CO., LTD.

TITLE: SPECIFICATION OF MODULE

PROJECT NO: GDT250T2080

CUSTOMER REF:

TOLERANCE UNLESS OTHERWISE SPECIFIED:	X.X ±0.3 X.XX ±0.1 ANGULAR: ± 1°
DIMENSIONS IN MM	FINISH: N/A
MATERIAL: N/A	OVERALL THK: N/A
SCALE: DO NOT ON SCALE	

THIRD ANGLE PROJECTION

	NAME	SIGN	DATE
DRAWN:			2014.09.22
CHECKED:			
APPROVED:			

ITEM NO.: GDT250T2080

DESCRIPTION: GDT250T2080

FILE NO: REV: 2

SHEET 1 OF 1

3. Interface Signals

3.1 TFT-LCD Panel Driving

Table 2: Pin Assignment

Pin No.	Symbol	I/O	Description	Remarks
1	LED_A	P	Anode of LED-backlight	
2	NC	-		
3	LED_K	P	Cathode of LED-backlight	
4	NTC1	C	Temperature Sensor Terminal 1	
5	NTC2	C	Temperature Sensor Terminal 2	
6	VCI	I	Analog Power Supply	
7	IOVCC	I	Power Supply for Interfaces and Digital Power	
8	GND	-	Ground	
9	B0	I	Blue data (LSB)	
10	B1	I	Blue data	
11	B2	I	Blue data	
12	B3	I	Blue data	
13	B4	I	Blue data	
14	B5	I	Blue data (MSB)	
15	GND	-	Ground	
16	G0	I	Green data (LSB)	
17	G1	I	Green data	
18	G2	I	Green data	
19	G3	I	Green data	
20	G4	I	Green data	
21	G5	I	Green data (MSB)	
22	GND	-	Ground	
23	R0	I	Red data (LSB)	
24	R1	I	Red data	
25	R2	I	Red data	
26	R3	I	Red data	
27	R4	I	Red data	
28	R5	I	Red data (MSB)	
29	GND	-	Ground	
30	DCLOCK	I	Dot/Pixel Clock Signal	
31	GND	-	Ground	
32	CS	I	Chip Select (SPI I/F)	
33	SCL	I	Serial Clock Input (SPI I/F)	
34	NRESET	I	Reset Pin	
35	DEN	I	Data input enable signal (RGB I/F)	
36	HSYNC	I	Horizontal Sync Signal	
37	VSYNC	I	Vertical Sync Signal	

Pin No.	Symbol	I/O	Description	Remarks
38	SDO	O	Serial Data Output (SPI I/F)	
39	SDI	I	Serial Data Input (SPI I/F)	
40	GND	-	Ground	

Remarks: For I/O, “I” is Input, “O” is Output, “P” is Power, and “C” is passive.

3.2 LED Backlight Driving

Included in TFT-LCD FPCA, please refer to Section 3.1.

4. Absolute Maximum Ratings

The product or its functions may subject to permanent damage if it's stressed beyond those absolute maximum ratings list below. Exposure to absolute maximum rating conditions for extended periods may affect display module reliability.

Table 3: Absolute Maximum Ratings & Environmental Conditions

Item	Symbol	Min.	Max.	Unit
Digital power supply	V_{CC}	-0.3	+3.5	V
Analog power supply	V_{CI}	-0.3	+3.5	V
LED forward voltage	V_F	-	9.9	V
LED forward current	I_F	-	+60	mA
Relative Humidity (at 60°C, Note 3)	RH		90	%
Operating Temperature (Note 2)	T_{opr}	-30	+85	°C
Storage Temperature	T_{stg}	-40	+90	°C

Note 1: GND=0V.

Note 2: Panel surface temperature should not exceed 85°C.

Note 3: No condensation allowed under any condition.

[Caution]

Do not display fixed pattern for prolonged hours because it may develop image sticking on the display.

5. Electrical Specifications

5.1 Block Diagram

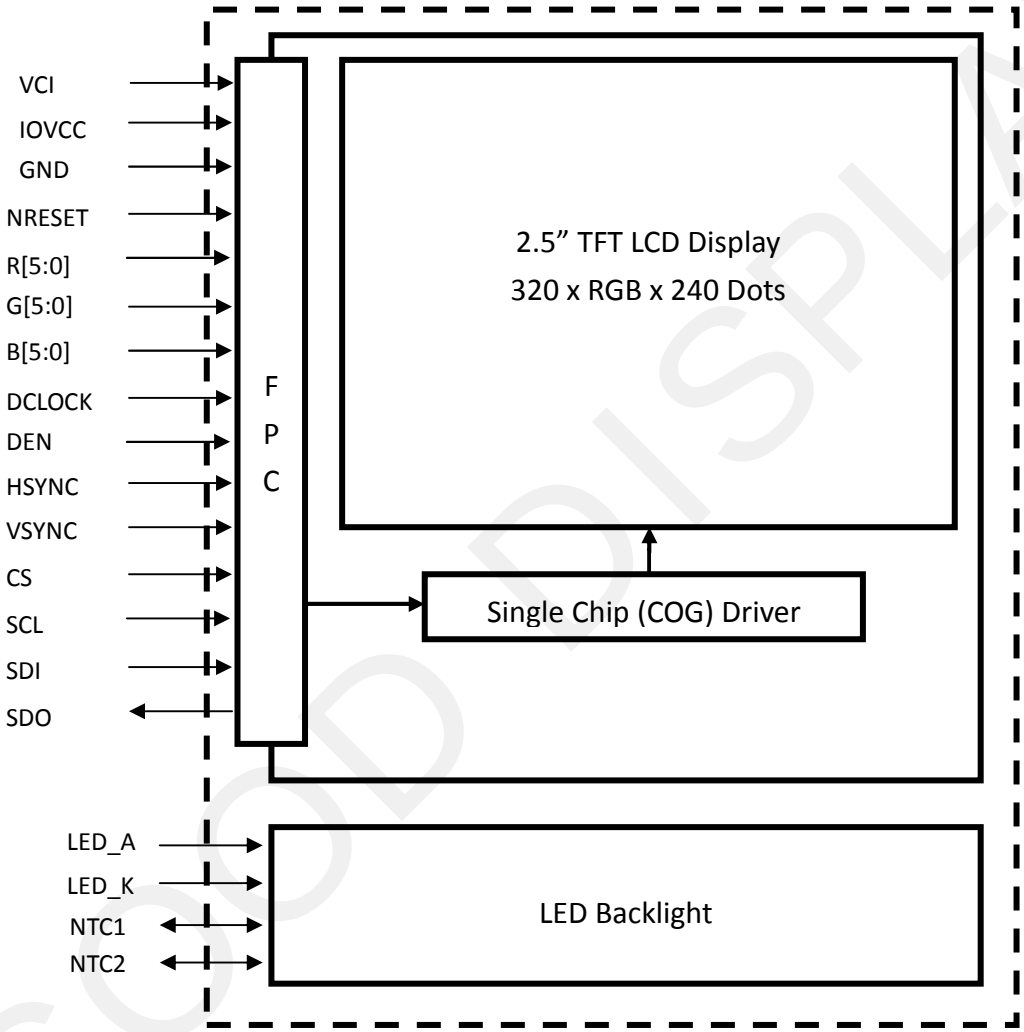


Figure 2: Block Diagram

5.2 Typical Electrical Characteristics

GND=0V, VCC= 3.0V, VCI= 3.0V

Table 4

Parameter	Symbol	Min.	Typ.	Max.	Unit
Digital power supply	IOVCC	2.4	3.0	3.3	V
Analog power supply	VCI (Note 6)	2.4	3.0	3.3	V
Digital current supply	I_{IOVCC}	-	1	3	mA
Analog current supply	I_{VCI}	-	11	22	mA
TFT gate ON voltage	V_{GH} (Note 2)	10.0	15.0	15.0	V
TFT gate OFF voltage	V_{GL} (Note 3)	-7.3	-9.9	-12.7	V
TFT common electrode voltage	V_{COM} (Note 4)	-1.60	1.36	3.83	V
Driver input high signal voltage	V_{IH}	0.8*V_{CC}	-	-	V
Driver input low signal voltage	V_{IL}	-	-	0.2*V_{CC}	
LED Life Time (50%)	(Note 5)	30000	-	-	hrs

Note 1: There is tolerance in optimum LCD driving voltage during production and it will be within the specified range.

Note 2: VGH is TFT Gate operating voltage (Black pattern).

Note 3: VGL is TFT Gate operating voltage (Black pattern).

Note 4: Vcom must be adjusted to optimize display quality.

Note 5: The “LED Life Time” is defined as the time period when the brightness decrease to 50% of the initial value under continuous lighting at 25°C (dry condition) with the recommended driving current

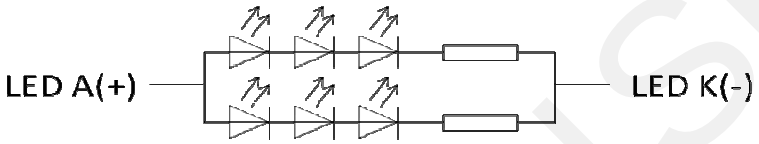
Note 6: If IOVCC and VCI are connected to different power sources, during power on, IOVCC should be applied before VCI; while during power off, VCI should be disconnected before IOVCC. Turning on/off IOVCC and VCI at the same time is also okay.

5.3 Recommended Driving Condition For LED Backlight

Table 5 (Ta = 25°C)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Supply voltage of LED backlight	V_{LED}	Backlight current=40 mA Number of LED dies= 6pcs	-	10.0	-	V	Note 1
Supply current of LED backlight	I_{LED1}, I_{LED2}	Per LED string	-	20	-	mA	Note 2, 4
Total Supply current of LED backlight	I_{LED} (Total)	$I_{LED1} + I_{LED2}$		40			Note 2, 4
Backlight Power Consumption	P_{LED}	-	-	400		mW	Note 3

Note 1: Backlight Circuit Diagram



No. of LEDs : 3 pcs x 2 strings

Note 2: The LED driving condition is defined for each LED module.
Input current = 20mA x 2 = 40mA

Note 3: Backlight power consumption is calculated by I_{LED} x V_{LED}

Note 4: Backlight driving current best at 40mA (total) or below, and should not significantly exceed 40mA at all temperature; otherwise, overheating may happen and may damage the backlight.

5.4 Timing Characteristics

5.4.1 Serial Interface Characteristics

GND=0V, IOVCC= 3.0V, VCI=3.0V

Table 6: AC Characteristic of SPI Interface

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Chip select setup time (Write) Chip select setup time (Read	tCSS tCSH	CSX	40 40	- -	- -	ns
Write cycle Control pulse “H” duration Control pulse “L” duration	tWC tWRH tWRL	SCL (Write)	130 80 40	- - -	- - -	ns
Read cycle Control pulse “H” duration Control pulse “L” duration	tRC tRDH tRDL	SCL (Read)	150 60 60	- - -	- - -	ns
Data setup time Data hold time	tDS tDH	SDI/ SDO (Input)	30 30	- -	- -	ns
Read access time Output disable time	tRACC tOD	SDI/ SDO (Output) Max CL=30pF; min CL=8pF	10 10	- -	- 50	ns

Note: The input signal rise time and fall time (tr, tf) is specified at 15 ns or less.

Logic high and low levels are specified as 30% and 70% of IOVCC for Input signals.

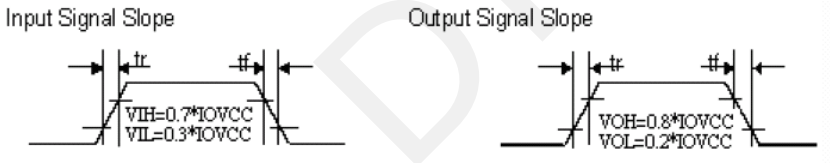


Figure 3

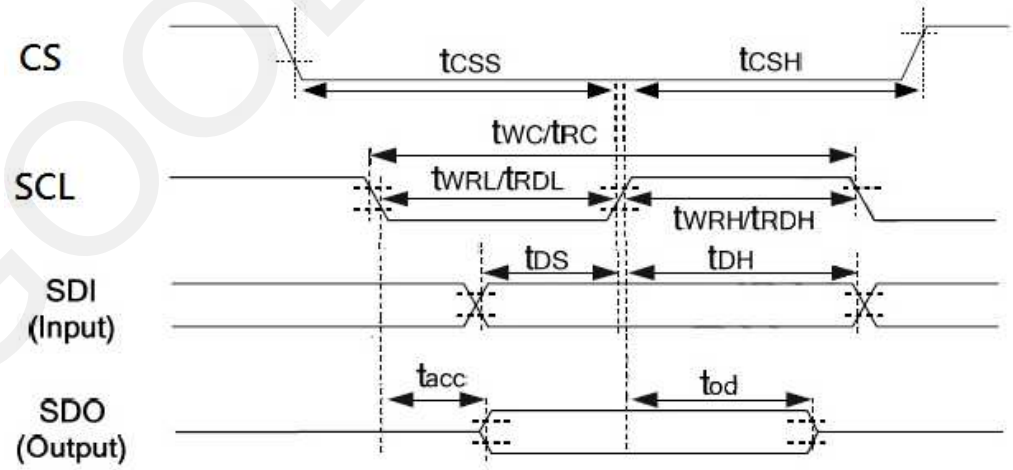


Figure 4: Serial Interface Characteristics

5.4.2 RGB Interface Characteristics

GND=0V, IOVCC= 3.0V, VCI= 3.0V

Table 7: AC Characteristic of RGB Interface

Symbol	Parameter	Conditions	Related Pins	Min.	Typ.	Max.	Unit
VS	VSYNC Low Pulse Width	-	VSYNC	1	-	16	Line
VBP	Vertical Back Porch	-	VSYNC	1	-	63	Line
VFP	Vertical Front Porch	-	VSYNC	1	-	63	Line
VBL	Vertical Blanking Period	VS+VBP+VFP	VSYNC	3	-	142	Line
VDISP	Vertical Active Area	-	VSYNC	-	240	-	Line
VP	VSYNC Cycle	-	VSYNC	243	-	382	Line
HS	HSYNC Low Pulse Width	-	HSYNC	1	-	53	DCLOCK
HBP	Horizontal Back Porch	-	HSYNC	1	-	53	DCLOCK
HFP	Horizontal Front Porch	-	HSYNC	1	-	5	DCLOCK
HBLK	Horizontal Blanking Period	HS+HBP+HFP	HSYNC	3	-	159	DCLOCK
HDISP	Horizontal Active Area	-	HSYNC	-	320	-	DCLOCK
HP	HSYNC Cycle	-	HSYCN	323	-	479	DCLOCK
F_{frame}	Frame Frequency	-	DOTCLK	55	60	65	Hz
t_{DCYC}	DCLOCK cycle time		DOTCLK	83 (Note 2)	-	250 (Note 3)	ns
t_{DLW} t_{CHW}	DCLOCK Low time DCLOCK High time	-	DOTCLK	25 30	-	-	ns
t_{DDS} t_{DDH}	RGB Data setup time RGB Data hold time	-	DOTCLK, R[5:0], G[5:0], B[5:0]	15 15	-	-	ns
t_{DCSS} t_{DCSH}	ENABLE setup time ENABLE hold time	-	DEN	15 15	-	-	ns
t_{DSYN}	SYNC setup time	-	DCLOCK, HSYNC, VSYNC	15	-	-	ns

Note 1: The input signal rise time and fall time (tr, tf) is specified at 15 ns or less.

Note 2: DOTCLK = 12MHz.

Note 3: DOTCLK= 4MHz.

Note 4: Data line can be set to “H” or “L” during blanking time – Don’t care.

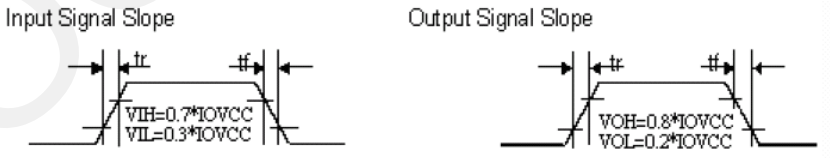


Figure 5

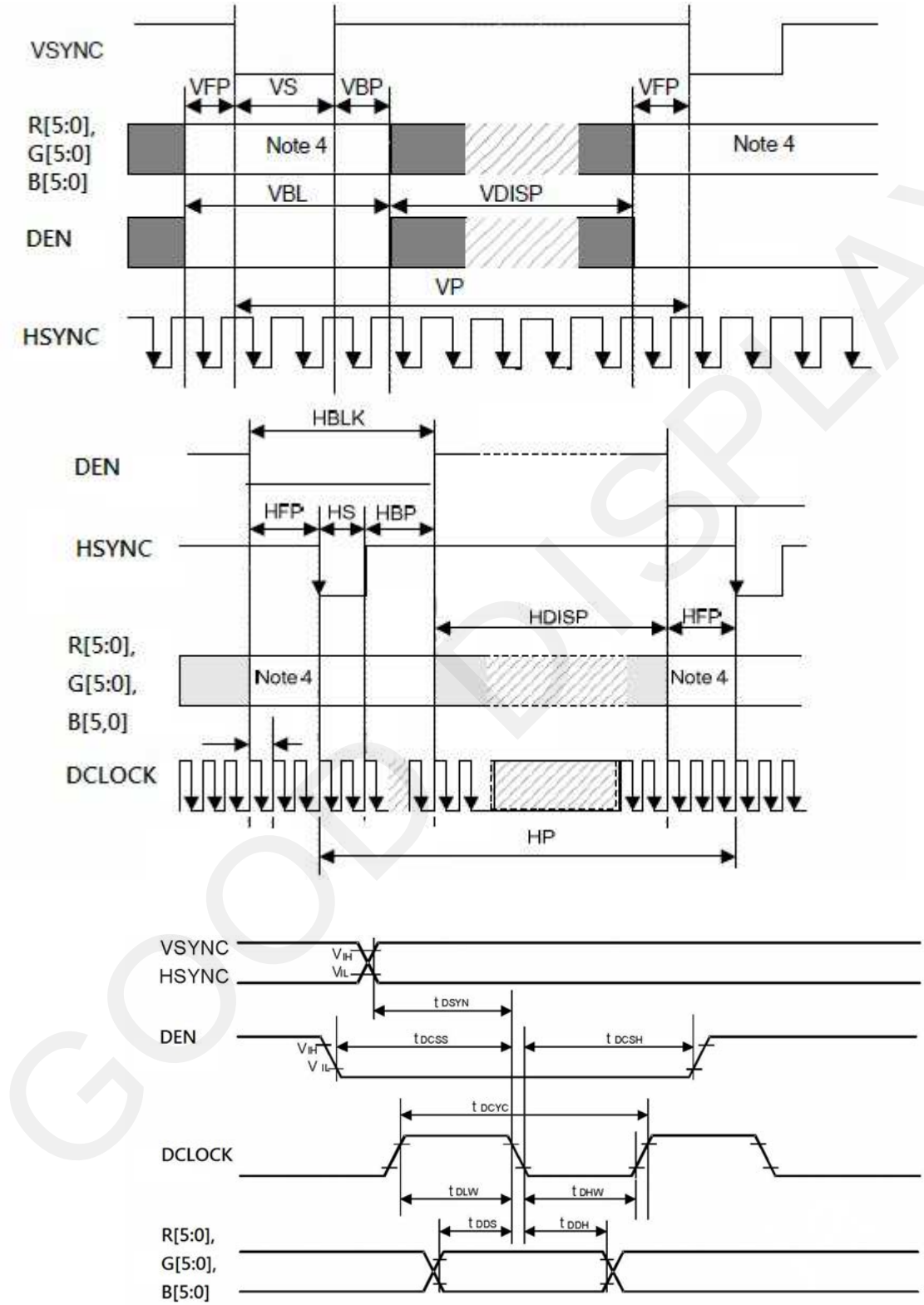


Figure 6: RGB Interface Characteristics

5.4.3 Reset Input Timing

Table 8

Symbol	Parameter	Related Pins	Min.	Typ.	Max.	Note	Unit
t_{RESW}	Reset low pulse width (1)	NRESET	10	-	-	-	μs
t_{REST}	Reset complete time (2)	-	-	-	5	When reset applied during STB mode	ms
		-	-	-	120	When reset applied during STB mode	ms

Note 1: Spike due to an electrostatic discharge on NRESET line does not cause irregular system reset according to the table below.

NRESET Pulse	Action
Shorter than 5μs	Reset Rejected
Longer than 10μs	Reset
Between 5μs and 10μs	Reset Start

Note 2: During the resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120ms, when Reset Starts in STB Out -mode. The display remains the blank state in STB –mode) and then return to Default condition for H/W reset.

Note 3: During Reset Complete Time, ID2 value in OTP will be latched to internal register during this period. This loading is done every time when there is H/W reset complete time (tREST) within 5ms after a rising edge of NRESET.

Note 4: Spike Rejection also applies during a valid reset pulse as shown below:

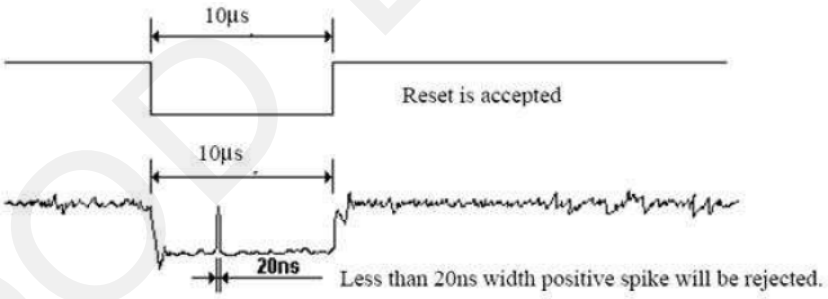


Figure 7

Note 5: It is necessary to wait 5msec after releasing tRES before sending commands. Also STB Out command cannot be sent for 120msec.

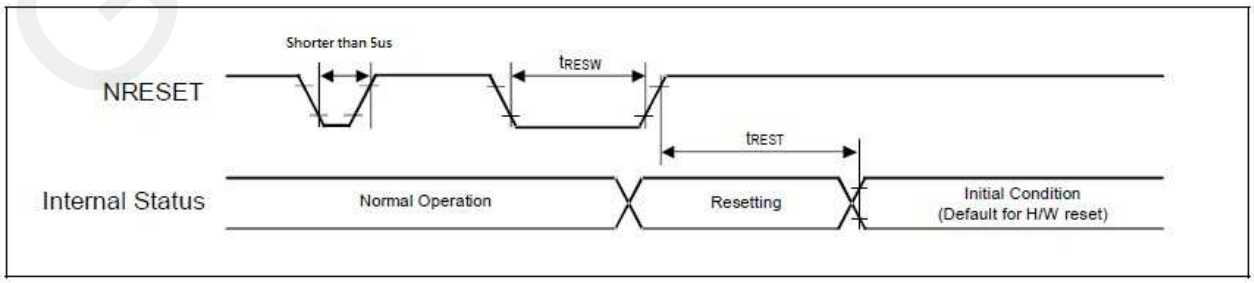


Figure 8: Reset Input Timing

5.5 Power On / Off Sequence

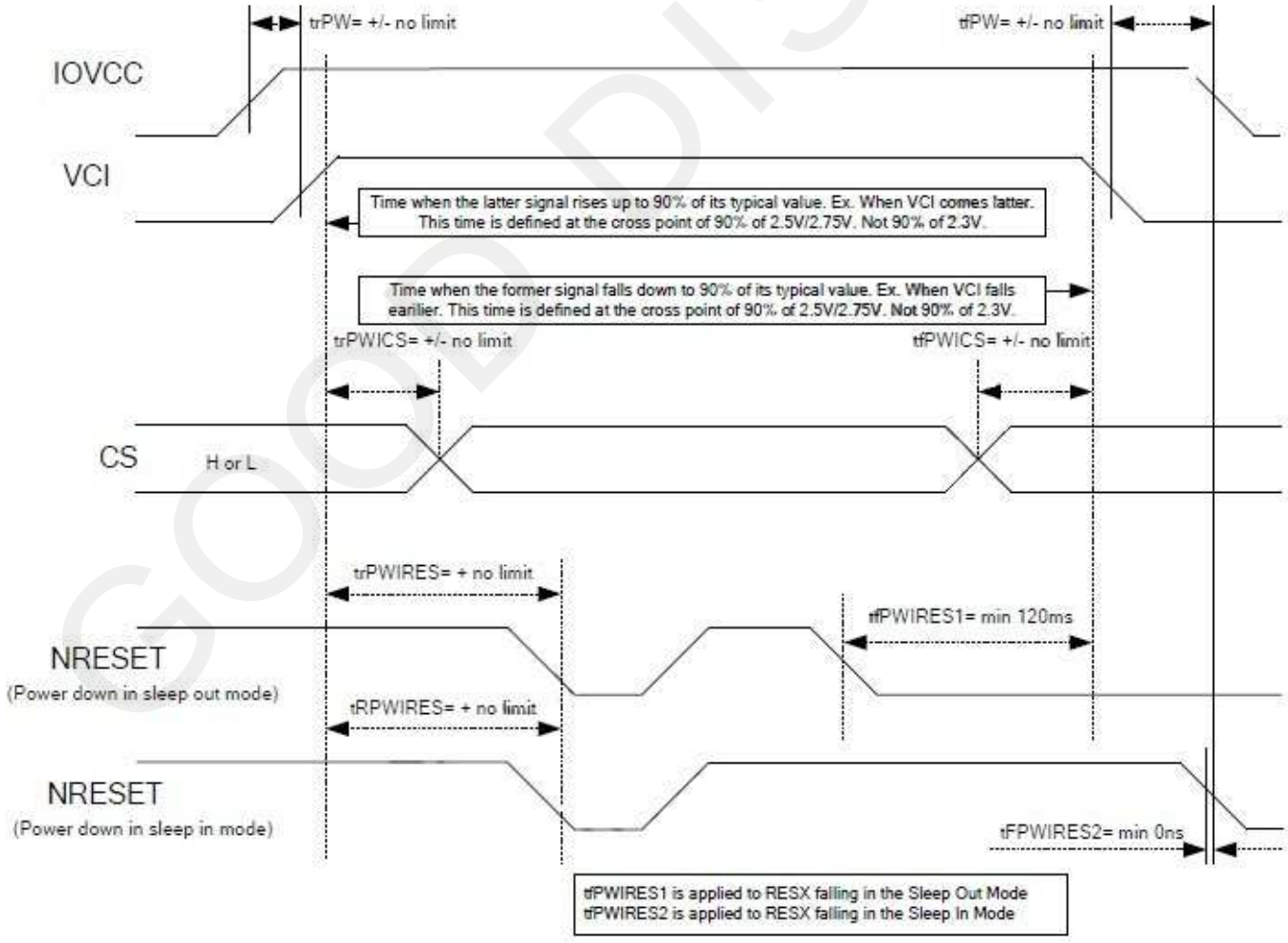
If IOVCC and VCI are connected to different power sources, during power on, IOVCC should be applied before VCI; while during power off, VCI should be disconnected before IOVCC.

Turning on/off IOVCC and VCI at the same time is also okay.

During Power off, if LCD is in STB Out mode, IOVCC and VCI must be powered down minimum 120ms after NRESET has been released; if LCD is in STB In mode, IOVCC and VCI can be powered down minimum 0ms after NRESET has been released. CS can be applied at any time or can be permanently grounded. NRESET has priority over CS.

Please refer to Appendix for Initialization code reference

If NRESET is held high or unstable by host during Power On, then a hardware reset must be applied after both IOVCC and VCI have been applied. There is no timing restriction upon this hardware reset.



If NRESET is held low and stable by host during Power On, then the NRESET must be held low for minimum 10us after both IOVCC and VCI have been applied.

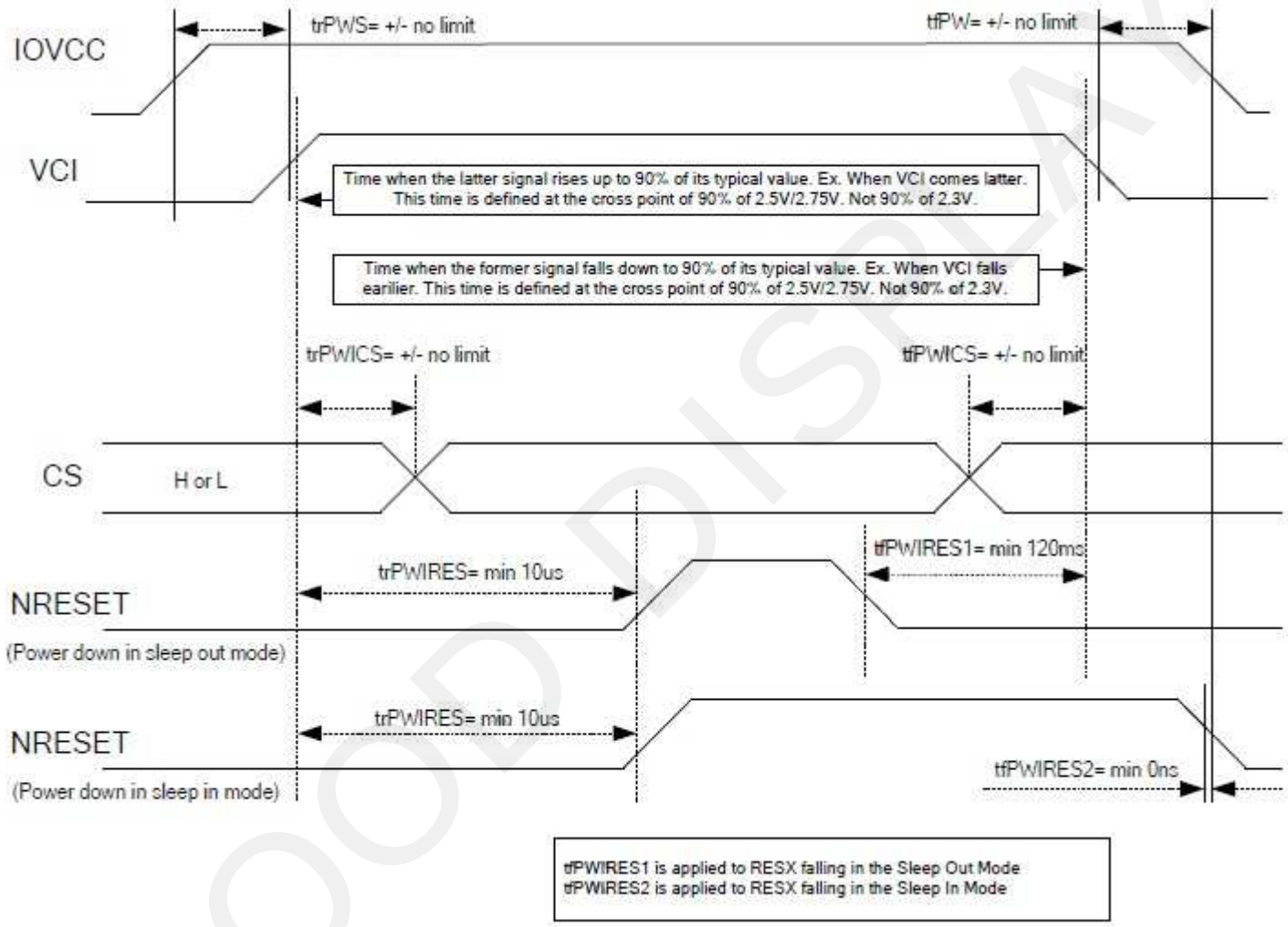


Figure 9: Power Supply Setting Flow

6. Optical Characteristics

Conditions unless specified otherwise:

- Ta = 25°C
- Supply voltage = 3.3 volts
- Elapsed time from switch on is greater than 30 minutes
- RGB, white and black test patterns only
- Factory settings
- Brightness = 100% unless specified
- Measurements are conducted at ambient temperature and perpendicular unless specified

Table 9

Items		Symbol	Condition		Min.	Typ.	Max.	Unit	Note
Response Time		T_R+T_F	Ta=25°C	Viewing normal angle θ=ϕ=0°	-	30	-	ms	(Note 1)
Viewing angle	12’	θ2	Ta=25°C	Center CR≥10	-	70	-	deg.	(Note 2)
	6’	θ1			-	50	-		
	9’	ϕ2			-	75	-		
	3’	ϕ1			-	75	-		
Contrast Ratio		CR	Ta=25°C	Viewing normal angle θ=ϕ=0°		500	-	-	(Note 3)
Brightness		Br	Ta=25°C		400	500	-	cd/m^2	
Chromaticity	White	x_W	Ta=25°C	Viewing normal angle θ=ϕ=0°	-	0.317		-	All color point values TBC (Note 4)
		y_W			-	0.337		-	
	Red	x_R			-	0.635	-	-	
		y_R			-	0.339	-	-	
	Green	x_G			-	0.350	-	-	
		y_G			-	0.614	-	-	
	Blue	x_B			-	0.143	-	-	
		y_B			-	0.078	-	-	
Luminance Uniformity		ΔY9	Ta=25°C	9 Points	70	80			(Note 5)
NTSC Ratio		-	Ta=25°C	-		65			%

Note 1: The electro-optical response time measurements shall be made as Figure 10 by switching the “data” input signal OFF and ON. The times needed for the luminance to change from 10% to 90% s T_r, and 90% to 10% is T_f.

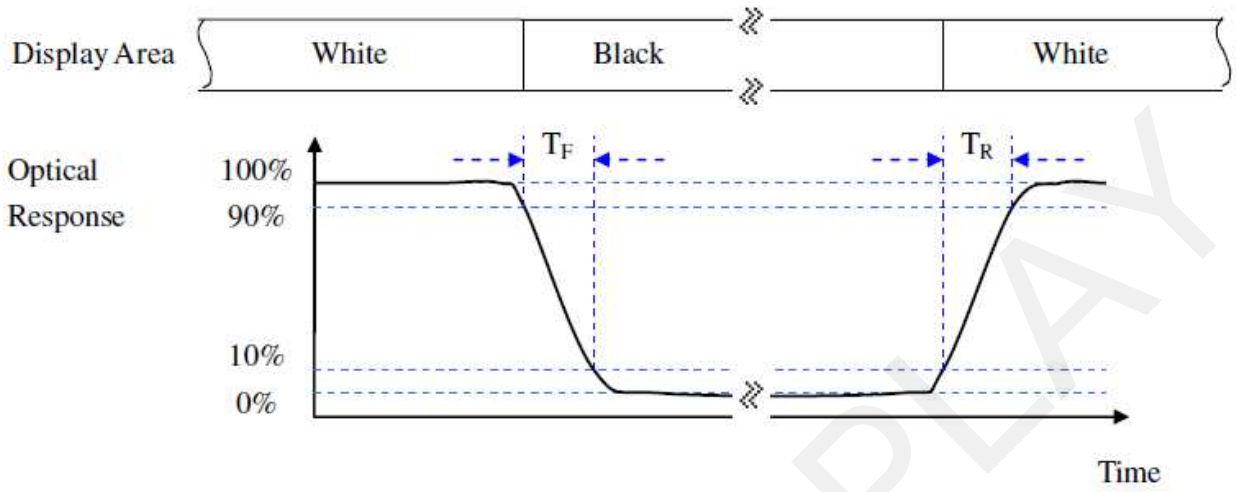


Figure 10: Response Time Testing

Note 2: The definitions of viewing angle.

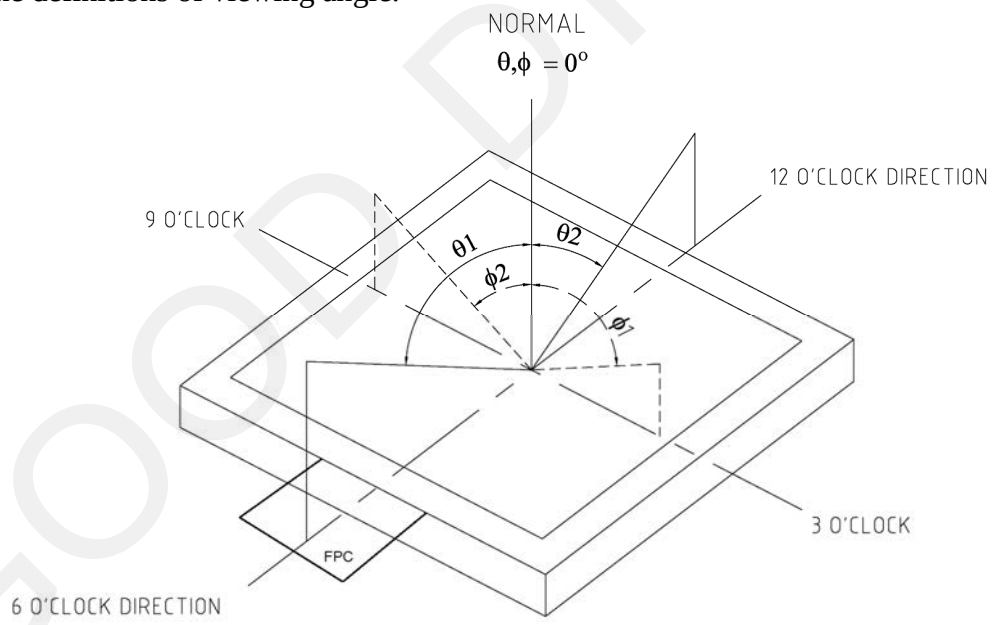


Figure 11

Note 3: Contrast measurements shall be made at viewing angle of $\theta=0^{o}$ and at the center of the LCD surface by using DMS. Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black) state. (See Figure 11)

Luminace Contrast Ratio (CR) is defined mathematically.

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

Note 4:The color chromaticity coordinates specified in Table 9 shall be updated from later actual spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the panel.

Note 5: The White luminance uniformity on LCD surface is measured per VESA standard over 9 points and is then expressed as

$$\text{Uniformity } \Delta Y = \frac{\text{Minimum Luminance of 9 points}}{\text{Maximum Luminance of 9 points}} \text{ X 100 (\%)}$$

7. Reliability Tests / Environmental

7.1 Reliability Test Conditions

Table 10: List of Reliability Tests

Test		Symbol	Condition	Reference
1	High Temperature Storage	HST	+90°C / 240 hrs	IEC 60068-2-2 Bb
2	Low Temperature Storage	LST	-40°C / 240 hrs	IEC 60068-2-1 Ab
3	High Temperature Operating (Note)	HOT	+85°C / 240 hrs	IEC 60068-2-2 Bb
4	Low Temperature Operating	LOT	-30°C / 240 hrs	IEC 60068-2-1 Ab
5	Accelerated Humidity Test Operating	AHTO	+60°C / 90% RH / 240 hrs	IEC60068-2-78 Cab
6	Temperature Shock Test	TST	-30°C <> +85°C, 30min/5min/30min,100cycles Non-Operating	IEC 60068-2-14Na
7	UV exposure resistance	UV	1KW Xenon / 100 hrs Power off.	IEC 60068-2-5 Sa
8	Mechanical Shock (Note 2)	-	3 directions: X,Y,Z axes Repeats:6 Peak acc.:100 G Pulse duration: 6 ms (half sine wave) Non-Operating	IEC 60068-2-27Ea
9	Mechanical Vibration (Note 2)	-	3 directions: X,Y,Z axes Sweep time: 10 (1Oct/ min) Frequency: 10 -> 150->10 Hz 10-58 Hz: constant amplitude 0.75mm peak. 58-150Hz: constant acceleration 10g peak Sinusoidal , Non-Operating	IEC 60068-2-6Fc

Note 1: LCD panel surface temperature should not exceed 85ºC.

Note 2: For module internal structure robustness test purpose only. Customer application cluster design should take care of overall mounting robustness with display module.

7.2 Electrostatic Discharge (ESD)

Table 11: ESD Test Conditions

Test	Condition	Method	Remark
Human body model	R = 330Ω, C = 150pF, • Air discharge: ±15 KV to display surface • Contact discharge: ±8 KV to metal frame	IEC61000-4-2	Not operating
Machine model	R = 0Ω, C = 200pF, ±200V to I/O pins	MIL-STD-883, method 3015	Not operating

Note 1: The TFT-LCD panel and IC on module are sensitive to electrostatic discharge; please make sure equipments and operators are properly ground before and during handling

Note 2: As different customer application have different interfacing designs and assembly processes, the display module has no ESD protection circuitry. Customer is required to take special care on ESD level control in the assembly and test processes.

8. Quality Requirements

The defect categories covered in this specification include defects in the active area such as dot defects, blemishes and partly / completely malfunctioning displays as well as visual appearance of the complete product and packaging of the product.

8.1 Inspection Conditions and Test Patterns

Table 12: List of inspection conditions and test pattern

Item	Condition	
Ambient lighting	Non-operating inspection 1000 ± 200 Lux. Operating inspection < 200 Lux.	
Light on test	Display surface brightness refer to Table 9 in “Section 6 Optical Characteristics”	
Temperature /Humidity	22 ± 3°C with 65 ± 20%	
Driving condition	Equipment	Product specific test tool
	Test pattern	Black, White, R, G, B
	Supply voltage	Typical voltages as given in the specification
Inspection method	Time	≤ 1 minute
	Distance	35 cm ± 5 cm from display
	Viewing angle	Standard viewing angle of inspection shall be perpendicular to the display. Inspection at other viewing angles shall not exceed the range of specified viewing angles.

8.1.1 Dot and line defect criteria

Table 13: Dot & Line defect criteria

Item		R	G	B	Total (3)	Inspection pattern
Dot defects (1) (4) (5)	Single bright	0			4	(a) (c) (d) (e)
	Joined bright (2)(3)	0				
	Single dark	4				(b) (c) (d) (e)
	Joined dark (2)(3)	2				
Line defects		0				(a) (b) (c) (d) (e)

a. Black field
b. White field
c. R field
d. G filed
e. B field

Note:
(1) A dot (sub-pixel) containing a defect area larger than 50% of its size is counted as a defective dot as per above table. A dot containing a defect area smaller than 50% of its size will be counted as a circular defect (see applicable section).
(2) 2 adjacent defective dots joined together are regarded as **1** joined dot defect.
(3) 3 or more adjacent dots joined together are not allowed.
(4) No more than 2 defective dots shall be allowed within a surface of 25 mm x 25 mm.
(5) Dot and line defects would be ignored when not detecting under 5% ND filter

8.2 Blemishes and cosmetic anomalies

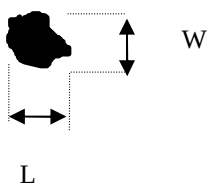
Note: The black border is the rim between the active area of the display and the metal front cover.

8.2.1 Circular defects

Table 14: Circular defects requirement – LCD

Size (mm)	Acceptance number	
	Active area	Black border
$D \leq 0.2$	No count	No count
$0.2 < D \leq 0.4$	3	
$0.4 < D$	0	

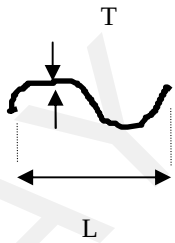
Remark: D = (Length + Width) / 2, for L and W.



8.2.2 Long defects

Table 15: Long defects

Size (mm)		Acceptance number	
		Active area	Black border
0.03 < T ≤ 0.1	L ≤ 2.0	3	No count
-	L > 2.0	0	
T > 0.1	-	0	



Remark: T = defect thickness, L = defect contour length.

8.2.3 Other cosmetic defects (operating)

Table 16: Other cosmetic defects

Item	Criteria of acceptance	Inspection pattern
Residual shadow	Less than 3 seconds	All patterns
Light leakage	Not visible in 30º viewing cone	Pure white
Mura (Non-uniformity)	Invisible through a 5% ND filter	Pure back and pure white

8.3 Malfunctioning

Not allowed are:

- Malfunctioning display: no picture, distinct block or line failure
- Malfunctioning backlight
- Excessive start up time > 3 seconds

8.4 Appearance

Not allowed are:

- Type and/or serial number (if any) wrong, missing or not legible
- Offensive surface damage
- Connectors damaged
- Stains within active area, such as fingerprints or adhesive residuals
- Dirty appearance (cannot be removed with a dry cloth)

8.5 Packing

Not allowed are:

- Box damaged wet, badly taped or stapled causing the product not arriving in good condition at the customer
- Type or model number wrong (if any), missing or not legible

9. Handling Cautions

9.1 Mounting of module

- Please power off the display module before it is disconnected or connected to the application.
- If the connection to the application is not good, following problems may result.
  1. Significant noise on signals between display module and application
  2. Unstable display performance
  3. Parts on the module will be heat up or damaged
- The polarizer is made of soft material and is susceptible to flaw. The display must be handled with care.
- Protective film (Laminator) is applied on surface for protection against scratches and dirts. Please avoid electrostatic charge build-up when peeling off the laminator.

9.2 Precautions in Mounting

- When metal part of the TFT-LCD module (shielding lid and rear case) is soiled, wipe it with soft dry cloth.
- Wipe off water drops or finger grease immediately when found. Prolonged contact with water may cause discoloration or spots.
- The TFT-LCD panel module contains glass which breaks or cracks easily if dropped or bumped on hard surface. Please handle with care.
- The TFT-LCD panel and IC on module are sensitive to electrostatic discharge; please make sure equipments and operators are properly ground before and during handling.

9.3 Adjusting module

- Adjusting volumes on the rear face of the module have been set to its optimal before shipment. Therefore, do not change any adjusted values. If adjusted values are changed, the display may not perform to specification.

9.4 Others

- Do not expose the module to direct sunlight or intensive ultraviolet rays for prolonged hours
- Store the module at room temperature condition.
- If LCD panel breaks, liquid crystal may escape from the panel. Avoid bringing it to eyes or mouth contact. When liquid crystal sticks on hands, clothes or feet, wash it out immediately with soap.
- Observe all other precautionary requirements as in handling general electronic components.
- Please adjust the voltage of common electrode as materials of attachment by 1 module.
- Do not expose the display module to harmful gases such as acid and alkali gasses, which will corrode electronic components.
- Do not disassemble the display module because it can cause permanent damage and will void the warranty agreement.

10. Definitions

Data sheet status	
Objective Specification	This data sheet contains target or goal specifications for product development.
Preliminary Specification	This data sheet contains preliminary data; supplementary data may be published later.
Product Specification	This data sheet contains final product specification.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating. Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operating of the device at these or any other conditions above those given in the Characteristics sections of the specification is not implied. Expose to limiting values for extended periods may affect device reliability. Device is functional within the limiting conditions doesn't imply the same performance over the covered conditions, customer is required to decide the best range for the final applications.	

11. Life Support Applications

These products are not designed for use in life saving appliances, devices or systems where malfunctioning of these products can reasonably be expected to result in personal injury. Customers using or selling these products for use in such applications do so at their own risk and agree full non liability of Varitronix Limited for any damages or losses resulting from such improper use or sale

12. Appendix

12.1 Initialization Code sequence for Power On (Revision 2)

Command/ Parameter	Code (Hex)	Remark
Reset		
Apply Power On Sequence and Reset as in Section 5.5		
Initialization Code		
CS	0	Set Chip Select Pin LOW
Command	0x11	
CS	1	Set Chip Select Pin HIGH
Delay 360ms		
CS	0	CS=0
Command	0xB9	EXTC
Parameter	0xFF	
Parameter	0x83	
Parameter	0x68	
CS	1	CS=1
Delay 10ms		
CS	0	CS=0
Command	0xEA	
Parameter	0x02	
CS	1	CS=1
Delay 10ms		
CS	0	CS=0
Command	0x36	
Parameter	0xC8	Address mode
CS	1	CS=1
Delay 10ms		
CS	0	CS=0
Command	0x3A	
Parameter	0x66	
CS	1	CS=1
Delay 10ms		
CS	0	CS=0
Command	0xB9	EXTC
Parameter	0xFF	
Parameter	0x83	
Parameter	0x68	
CS	1	CS=1
Delay 10ms		
CS	0	CS=0
Command	0xC0	
Parameter	0x3F	display optimization
Parameter	0x3F	display optimization
CS	1	CS=1
Delay 40ms		

Command/ Parameter	Code (Hex)	Remark
Initialization Code (Cont'd)		
CS	0	CS=0
Command	0xB9	EXTC
Parameter	0xFF	
Parameter	0x83	
Parameter	0x68	
CS	1	CS=1
Delay 10ms		
CS	0	CS=0
Command	0xE3	
Parameter	0x00	display optimization
Parameter	0x00	display optimization
Parameter	0x00	display optimization
Parameter	0x00	display optimization
CS	1	CS=1
Delay 40ms		
CS	0	CS=0
Command	0xB9	EXTC
Parameter	0xFF	
Parameter	0x83	
Parameter	0x68	
CS	1	CS=1
Delay 10ms		
CS	0	CS=0
Command	0xB1	Power Setting
Parameter	0x00	
Parameter	0x01	
Parameter	0x1E	
Parameter	0x04	
Parameter	0x22	
Parameter	0x11	
Parameter	0xD4	
CS	1	CS=1
Delay 40ms		
CS	0	CS=0
Command	0xB9	EXTC
Parameter	0xFF	
Parameter	0x83	
Parameter	0x68	
CS	1	CS=1
Delay 10ms		
CS	0	CS=0
Command	0xB3	
Parameter	0x08	falling clock data latch
CS	1	CS=1
Delay 10ms		

Command/ Parameter	Code (Hex)	Remark
Initialization Code (Cont'd)		
CS	0	CS=0
Command	0xB9	EXTC
Parameter	0xFF	
Parameter	0x83	
Parameter	0x68	
CS	1	CS=1
Delay 10ms		
CS	0	CS=0
Command	0xB4	display optimization
Parameter	0x01	display optimization
Parameter	0x00	display optimization
Parameter	0x00	display optimization
Parameter	0x12	display optimization
Parameter	0x12	display optimization
Parameter	0x1B	display optimization
Parameter	0x43	display optimization
CS	1	CS=1
Delay 40ms		
CS	0	CS=0
Command	0xB9	EXTC
Parameter	0xFF	
Parameter	0x83	
Parameter	0x68	
CS	1	CS=1
Delay 10ms		
CS	0	CS=0
Command	0xB6	
Parameter	0x6D	no need to write if OTP done
Parameter	0x75	
Parameter	0x4A	
CS	1	CS=1
Delay 40ms		
CS	0	CS=0
Command	0xB9	EXTC
Parameter	0xFF	
Parameter	0x83	
Parameter	0x68	
CS	1	CS=1
Delay 10ms		
CS	0	CS=0
Command	0xB0	
Parameter	0x0F	
CS	1	CS=1
Delay 30ms		

Command/ Parameter	Code (Hex)	Remark
Initialization Code (Cont'd)		
CS	0	CS=0
Command	0xB9	EXTC
Parameter	0xFF	
Parameter	0x83	
Parameter	0x68	
CS	1	CS=1
Delay 10ms		
CS	0	CS=0
Command	0xE0	
Parameter	0x00	
Parameter	0x21	
Parameter	0x20	
Parameter	0x1F	
Parameter	0x21	
Parameter	0x3F	
Parameter	0x0F	
Parameter	0x55	
Parameter	0x01	
Parameter	0x05	
Parameter	0x08	
Parameter	0x0D	
Parameter	0x05	
Parameter	0x00	
Parameter	0x1E	
Parameter	0x20	
Parameter	0x1F	
Parameter	0x1E	
Parameter	0x3F	
Parameter	0x2A	
Parameter	0x70	
Parameter	0x1A	
Parameter	0x12	
Parameter	0x17	
Parameter	0x1A	
Parameter	0x1E	
Parameter	0x1F	
CS	1	CS=1
Delay 40ms		
CS	0	CS=0
Command	0x29	
CS	1	CS=1
Delay 40ms		
END		

12.2 Register Code for Power Off

Command/ Parameter	Code (Hex)	Remark
Register Code		
CS	0	CS=0
Command	0x28	Display off
CS	1	CS=1
Delay 10ms		
CS	0	CS=0
Command	0x10	Enter Sleep Mode
CS	1	CS=1
End		