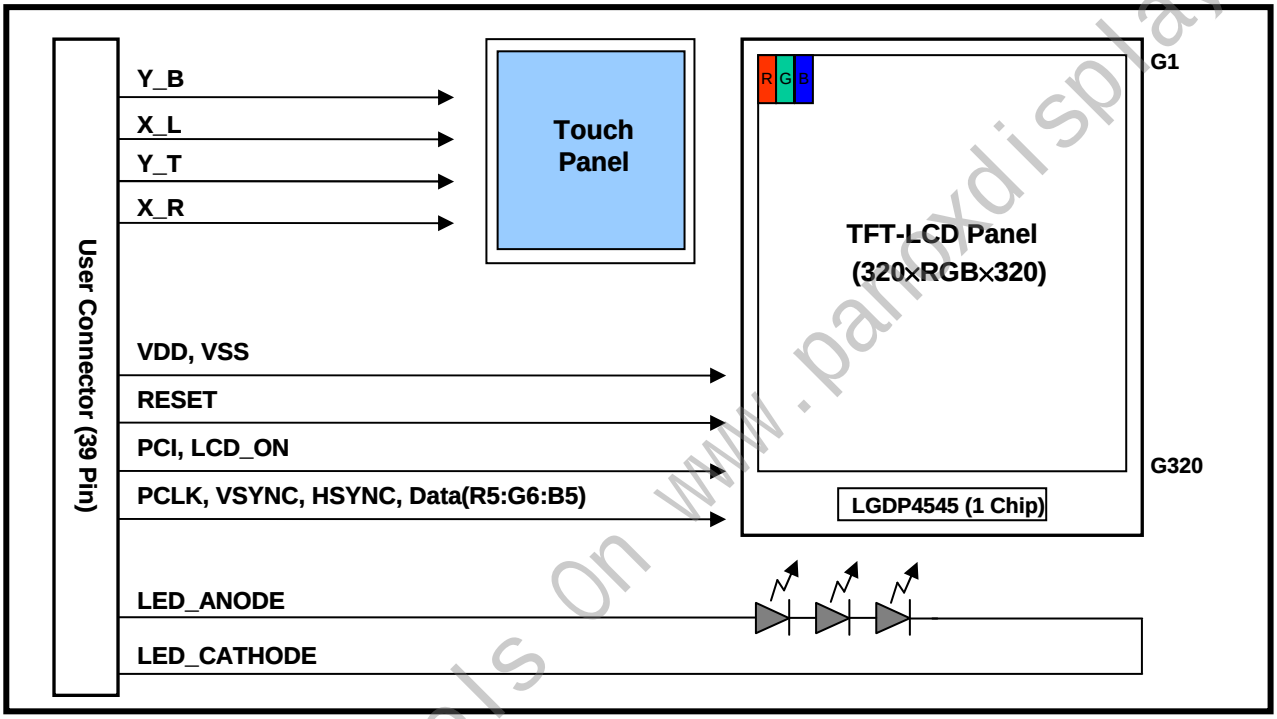
Product Specification

1. GENERAL DESCRIPTION

The LH220Q32 is a Color Active Matrix Liquid Crystal Display with Light Emission Diode(LED) backlight system. The matrix employs a-Si Thin Film Transistor as the active element.
It is transflective type display operating in the normally white mode. This TFT-LCD has 2.2 inch diagonally measured active display area with (320*RGB*320) resolution. Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes.

Block Diagram



Mating User Connector: Hirose FH23-39S-0.3SHW(05)

Fig 1.1 Block Diagram of TFT-LCD Module with LED Backlight Unit

General Features

Active screen size	2.2" diagonal
Outline Dimension	47.4 (H) X 51.85 (V) X 3.5 (T) MM (TYP.)
Pixel Pitch	0.123 (H) X 0.123 (V) mm
Pixel format	320(H) X 320 (V) (RGB Stripe)
Color depth	16-bits (R5, G6, B5)
Interface	16-bit RGB I/F
Power Consumption	161mW (typ. BL on), 36mW (typ. BL off)
Luminance	160nit(typ.) @13mA
Viewing Direction	6~7 0'clock
Weight	18 g(typ.)
Surface hardness	3H
LCD Driver	COG 1Chip

2. ABSOLUTE MAXIMUM RATINGS

The following are maximum values which, if exceeded, may cause faulty operation or damage to the unit.

Table 2.1 Absolute Maximum Ratings

Parameter	Symbol	Values		Units	Notes
		Min.	Max		
Power Supply Input	V_{DD}	-0.3	4.2	V	1
LED Power Consumption	P_{LED}	-	120	mW	2
LED Current	I_{LED}	-	30	mA	2, 3

Notes:
1. Applies to VDD, RESET, PCLK, HSYNC, VSYNC, LCD_ON, PCI, Data.
2. Applies to each LED individually.
3. Allowable forward current is refer to Fig 2.1

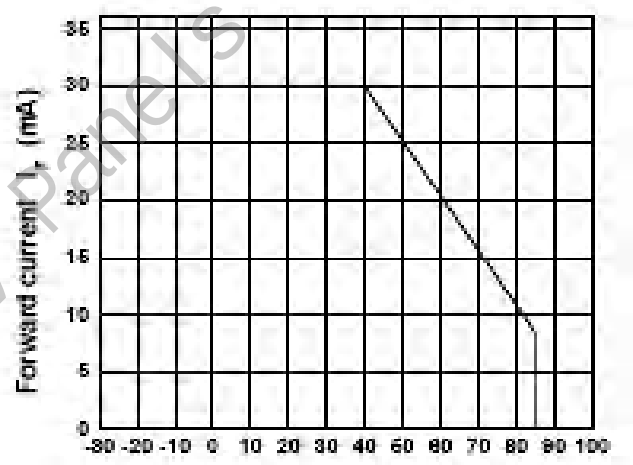


Fig 2.1 Ambient Temperature vs. Allowable Forward Current

3. ELECTRICAL SPECIFICATIONS

3-1. ELECTRICAL CHARACTERISTICS

Table 3.1 Electrical Characteristics Of TFT-LCD Module

Parameter	Symbol	Values			Units	Notes
		Min	Typ.	Max		
LCD Power Supply Voltage	V_{DD}	2.9	3.0	3.1	V	
"H"Level Input Voltage	V_{IH}	0.8 V_{DD}	-	V_{DD}	V	2
"L"Level Input Voltage	V_{IL}	0	-	0.2V_{DD}	V	2
Current Consumption, Panel	Ivdd		12	19.5	mA	1

Notes:
1. The specified current consumption are under the conditions at V_{DD} = 3.0V, Ta=25°C, and fv=54 Hz, 16 gray steps is displayed and fv is the frame frequency.
2. Input mode of Data, PCLK,HSYNC,VSYNC,LCD_ON,PCI,RESET.

3-2. BACK LIGHT UNIT

The edge-lighting type of back light unit consists of 3 LEDs which is connected in serial.

Table 3.2 Electrical Characteristics Of Back Light Unit

Parameter	Symbol	Values			Units	Notes
		Min	Typ.	Max		
LED Current	I_{LED}	-	13	30	mA	
LED Forward Voltage	V_{LED}	-	9.6	10.5	V	
LED Power Consumption	P_{LED}	-	125	137	mW	

3-3. TOUCH PANEL

Table 3.3 Touch Panel Electrical and Optical Specifications (GND=0V, Ta=25 ℃)

Parameter	Min.	Typ.	Max.	Unit	Remarks
Linearity	-1.5	-	1.5	%	
Terminal Resistance	100	-	1100	Ω	X-axis
	100	-	1100	Ω	Y-axis
Insulation Resistance	20	-	-	MΩ	DC 25V
Voltage	-	5	7	V	DC
Chattering	-	-	20	ms	DC 5V, 100kΩ
Transparency	78	80	-	%	

3-4. INTERFACE CONNECTIONS

The pin connections are provided in Table 3.3 The mating connector for the flex tail is Hirose FH23-39S-0.3SHW(05) Or equivalent.

Table 3.4 Module Connector Pin Configuration

Pin	SYMBOL	I/O, Power, Analog	Comment
1	Y_Bottom	Analog	Touch Panel Y-Bottom
2	X_Left	Analog	Touch Panel X-Left
3	Y_Top	Analog	Touch Panel Y-Top
4	X_Right	Analog	Touch Panel X-Right
5	RESET	I	LCD Reset
6	PCI	I	Power Control In
7	Vss	Power	Ground reference (0V)
8	PCLK	I	Pixel Clock
9	Vss	Power	Ground reference (0V)
10	HSYNC	I	Horizontal Sync Signal
11	VSYNC	I	Vertical Sync Signal
12	Vss	Power	Ground reference (0V)
13	R5	I	Red Data
14	R4	I	Red Data
15	R3	I	Red Data
16	R2	I	Red Data
17	R1/ID1	I/O	Red Data / ID Bit 1
18	Vss	Power	Ground reference (0V)
19	G5	I	Green Data
20	G4	I	Green Data
21	G3	I	Green Data
22	G2	I	Green Data
23	G1	I	Green Data
24	G0	I	Green Data
25	Vss	Power	Ground reference (0V)
26	B5	I	Blue Data
27	B4	I	Blue Data
28	B3	I	Blue Data
29	B2	I	Blue Data
30	B1/ID2	I/O	Blue Data / ID Bit 2
31	LCD_ON	I	Switches LCD on (active low)
32	LED_Anode	I	LED Anode
33	LED_Cathode	I	LED Cathode
34	Vss	Power	Ground reference (0V)
35	V_{DD}	Power	Digital Power Supply (3.0V)
36	Vss	Power	Ground reference (0V)
37	Vss	Power	Ground reference (0V)
38	Vss	Power	Ground reference (0V)
39	Vss	Power	Ground reference (0V)

3-5. SIGNAL TIMING SPECIFICATIONS

Table 3.5 Timing Parameters

Item	Symbol	Minimum	Typical	Maximum	Unit	Note
Input clock voltage	V_{IL}	-0.3	0	0.2*VDD	V	
	V_{IH}	0.8*VDD	-	VDD	V	
Vertical frequency	fv	50.5	54.1	57.8	Hz	
Horizontal frequency	fh	17.0	18.1	19.2	KHz	
PCLK frequency	ftch	6.25	6.5	6.75	MHz	
PCLK pulse width	tclk	148	154	160	ns	
PCLK Low/High pulse width	PW_{DL}, PW_{DH}	32	0.5tclk	-	ns	
PCLK cycle time	tCYCD	80	-	-	ns	
Hsync low pulse width	thsw	4	5	8	dots	
Vsync low pulse width	thsw	1	1	4	line	
Hsync setup time	tSYNCS	20	-	-	ns	
Hsync hold time	tSYNCH	20	-	-	ns	
Data setup time	tPDS	20	-	-	ns	
Data hold time	tPDH	20	-	-	ns	
Number of Horizontal		352	360	368	dots	
Horizontal blanking period	thblk	32	40	48	clk	
Hsync falling edge 1st data start	thbp	-	24.5	-	dots	
Hsync front porch	thfp	7.5	15.5	23.5	dots	
Number of vertical		332	334	336	line	
Vertical blanking period	tvblk	12	14	16	line	
Vsync falling edge 1st data start	tvbp	-	8	-	line	
Vsync front porch	tvfp	4	6	8	line	
Vsync falling edge Hsync falling edge	tvhde	-5	-4	100	clk	
Fast clock rise time	trgbr	-	-	25	ns	1
Fast clock fall time	trgbf	-	-	25	ns	1
Slow clock rise time	trsclk	-	-	100	ns	2
Slow clock fall time	tfsclk	-	-	100	ns	2

Notes: 1. PCLK, VSYNC, HSYNC
2. LCD_ON, PCI

3-6. SIGNAL TIMING WAVEFORMS

Fig 3.1 Horizontal Timing chart

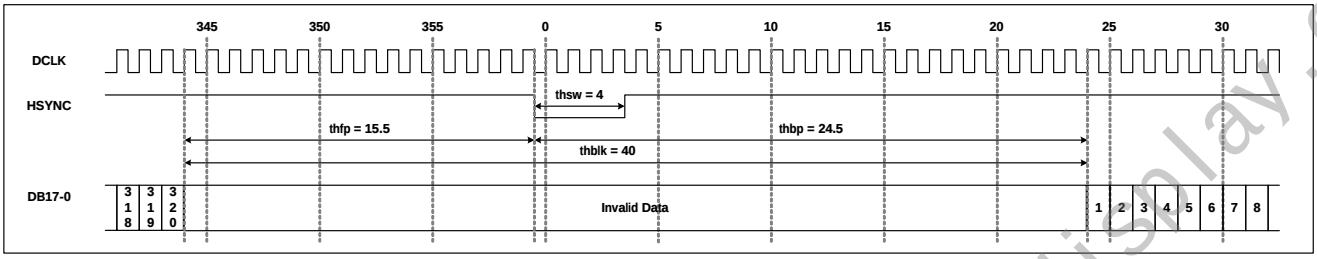


Fig 3.2 Vertical Timing chart

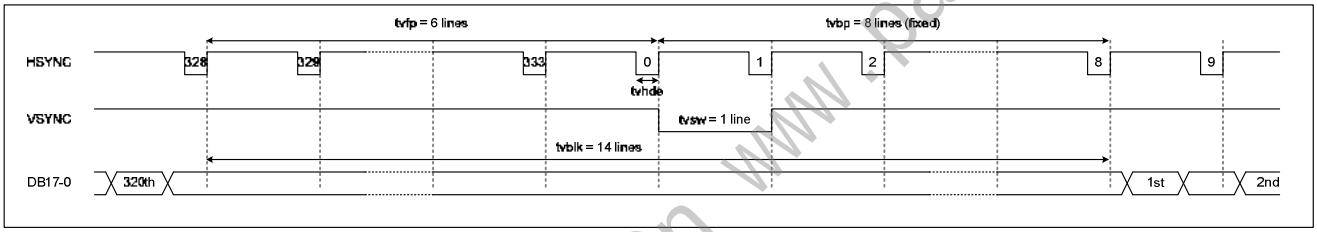
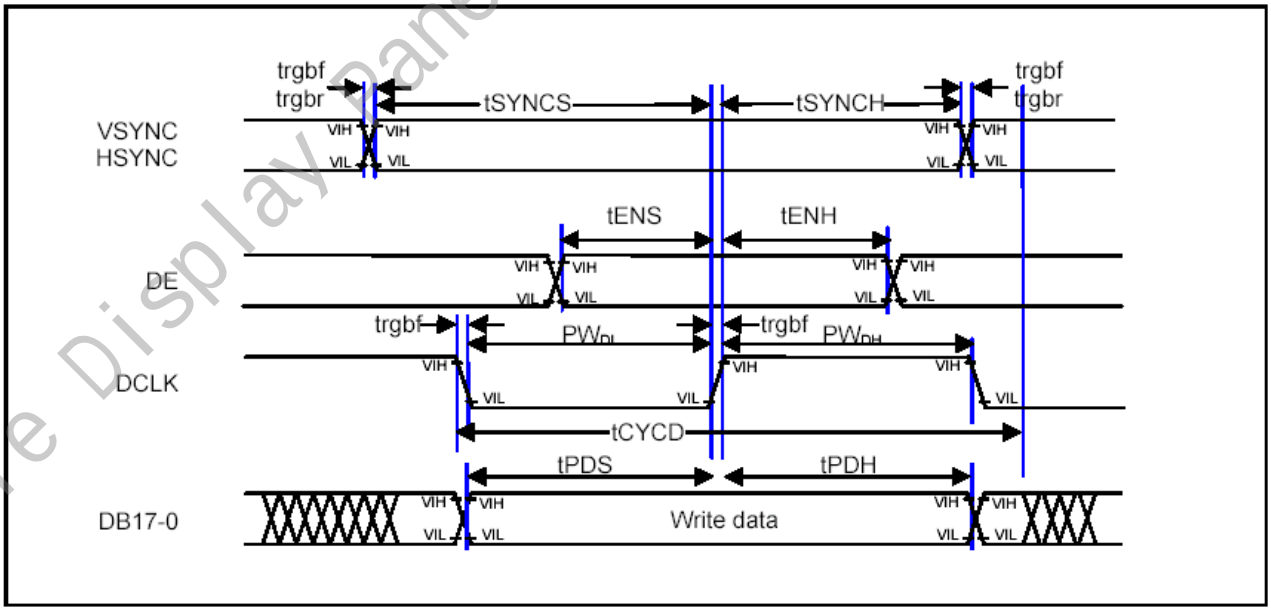


Fig 3.3 Timing Characteristics



3-7. COLOR INPUT DATA REFERENCE

Display Colors		Data Signal																
		R5	R4	R3	R2	R1	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
	Green	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0
	Cyan	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
	Red	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
	Magenta	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Red Gray Scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	↑	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	↕	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	↓	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
	Brighter	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
Green Gray Scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	↑	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	↕	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	↓	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0
	Brighter	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0
	Green	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0
Blue Gray Scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	↑	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	↕	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	↓	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1
	Brighter	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1

4. OPTICAL CHARACTERISTICS

4-1. Optical Characteristics – Backlight Off

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Viewing angle range	⊖UP	CR ≥2	60	75	-	°(degree)	Note 3
	⊖DOWN					°(degree)	Note 3
	⊖LEFT		50	65	-	°(degree)	Note 3
	⊖RIGHT					°(degree)	Note 3
Contrast ratio	CR	Optimal	3	5	-		Note 2 (Spot light)
Reflectivity	R	Optimal	2.5	3.5	-	%	Note 1 (Diffuse light)
Response time	$\tau_f + \tau_r$	⊖ =0 ° Ta =25 °C	-	40	60	ms	Note 4
White Chromaticity	Wx		0.290	0.325	0.360	CIE	Note 1 (Diffuse light)
	Wy		0.318	0.353	0.388	CIE	

1. Optical Test Equipment & method refer to Note1,2,3,4.

4-2. Optical Characteristics – Backlight On

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Viewing angle range	ΘUP	CR ≥5	25	40		°(degree)	Note 3
	ΘDOWN		35	50		°(degree)	Note 3
	ΘLEFT		60	90		°(degree)	Note 3
	ΘRIGHT					°(degree)	Note 3
Contrast ratio	CR	Optimal	100	120		--	Note 2
Brightness	Y	I_{LED}=13mA	110	160		cd/㎡	Note 1 [PR880]
Brightness Uniformity	Y	I_{LED}=13mA	80			%	Note 5 [PR880]
Backlight Power Consumption	P_{LED}	I_{LED}=13mA		125		mW	
Response time	$\tau_f + \tau_r$	Θ =0 ° Ta =25 °C		35	50	ms	Note 4
White Chromaticity	Wx	Θ =0 ° Ta =25 °C	0.240	0.290	0.340		Note 1 [PR650]
	Wy		0.263	0.313	0.363		
Red Chromaticity	Rx		0.528	0.578	0.628		
	Ry		0.289	0.339	0.389		
Green Chromaticity	Gx		0.254	0.304	0.354		
	Gy		0.494	0.544	0.594		
Blue Chromaticity	Bx		0.099	0.149	0.199		
	By		0.068	0.118	0.168		
Color Gamut	NTSC			45		%	

1. Optical Test Equipment & method refer to Note1,2,3,4.

[Note 1] Optical Test Equipment Setup

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 30 minutes in a dark environment at 25°C. The values specified are at an approximate distance 50cm from the LCD surface. In case of backlight on, measured on the center area of the panel by PHOTO RESEARCH photometer PR-880&PR650 or Equivalent.
In case of backlight off, measured on the center area of the panel by DMS-803

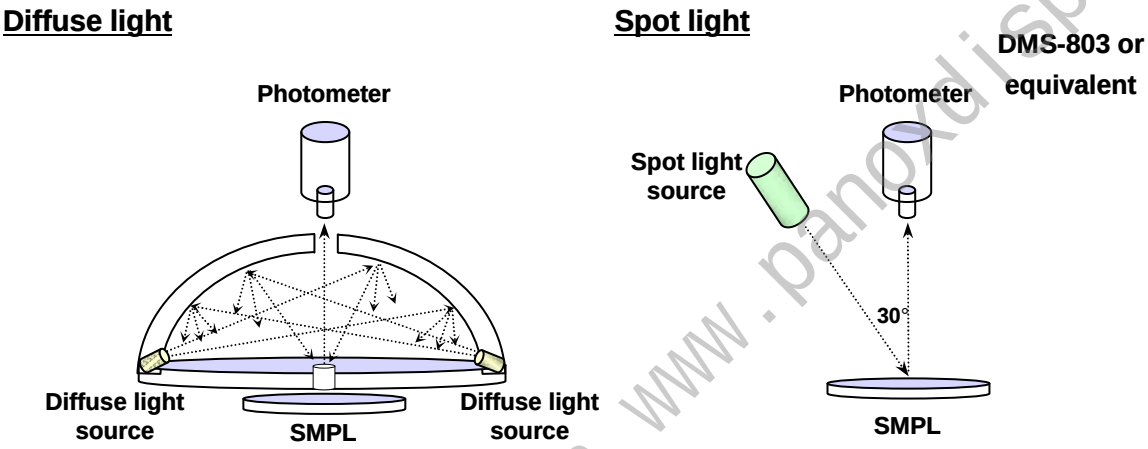


Fig 4.1 Backlight Off (Optical Characteristic Measurement Equipment and Method)

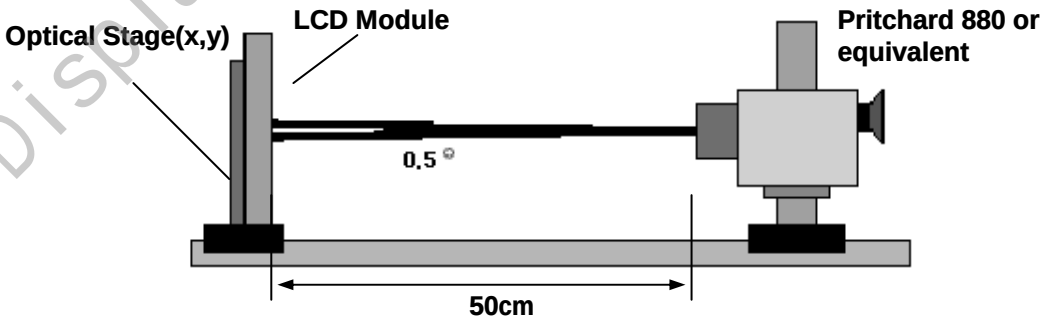


Fig 4.2 Backlight On (Optical Characteristic Measurement Equipment and Method)

[Note 2]

Contrast ratio is defined as follows ;

$$\text{Contrast Ratio(CR)} = \frac{\text{Photo detector output with LCD being “white”}}{\text{Photo detector output with LCD being “black”}}$$

[Note 3]

Viewing angle range is defined as follows;

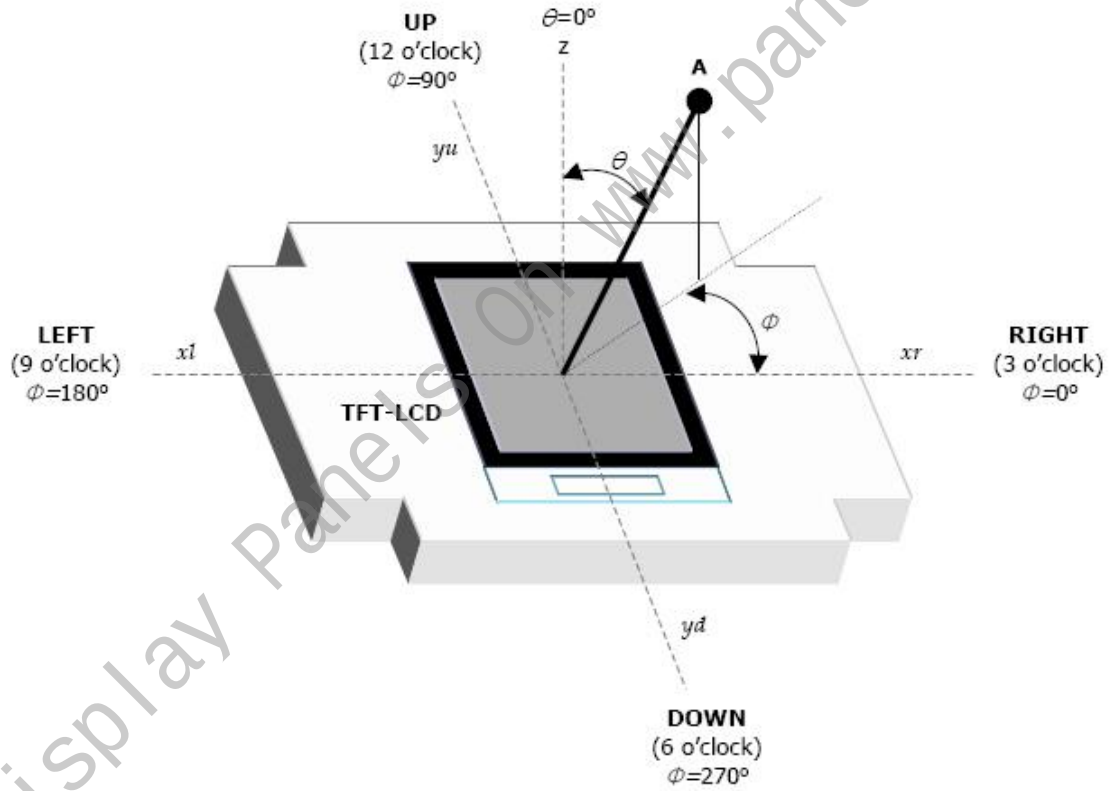


Fig 4.3 Viewing Angle Definitions

[Note 4]

Response time is obtained by measuring the transition time of photo detector output, when input signals are applied so as to make the area "black" to and from "white".

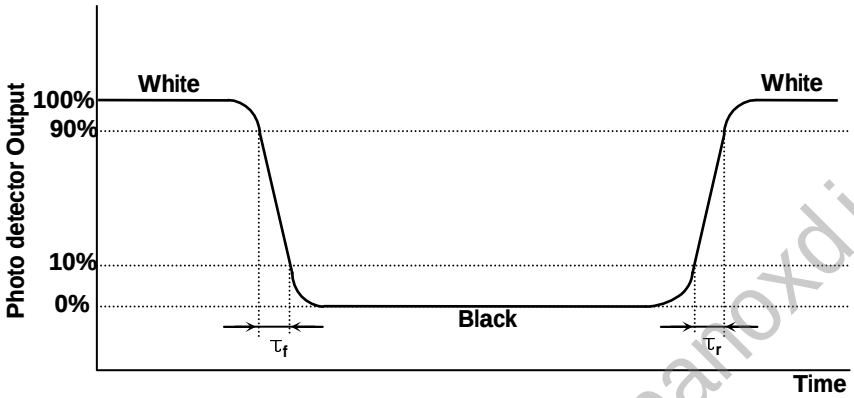


Fig 4.4 Response Time Definition

[Note 5]

The brightness measurement is taken at point B5.

$$\text{Brightness Uniformity} = \left(\frac{\text{Minimum Photo detector output for B1-B9 with all pixels white}}{\text{Maximum Photo detector output for B1-B9 with all pixels white}}\right) \times 100$$

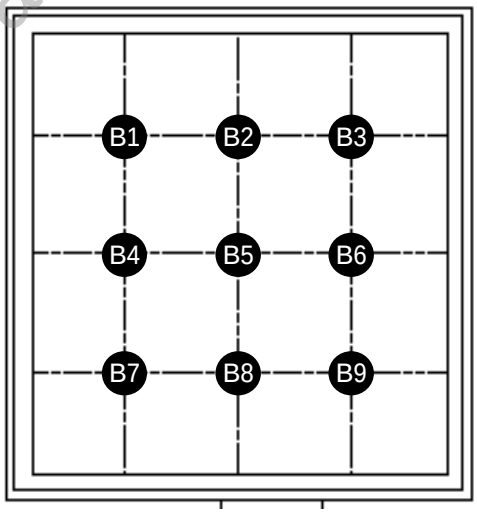


Fig 4.5 Brightness measurement points

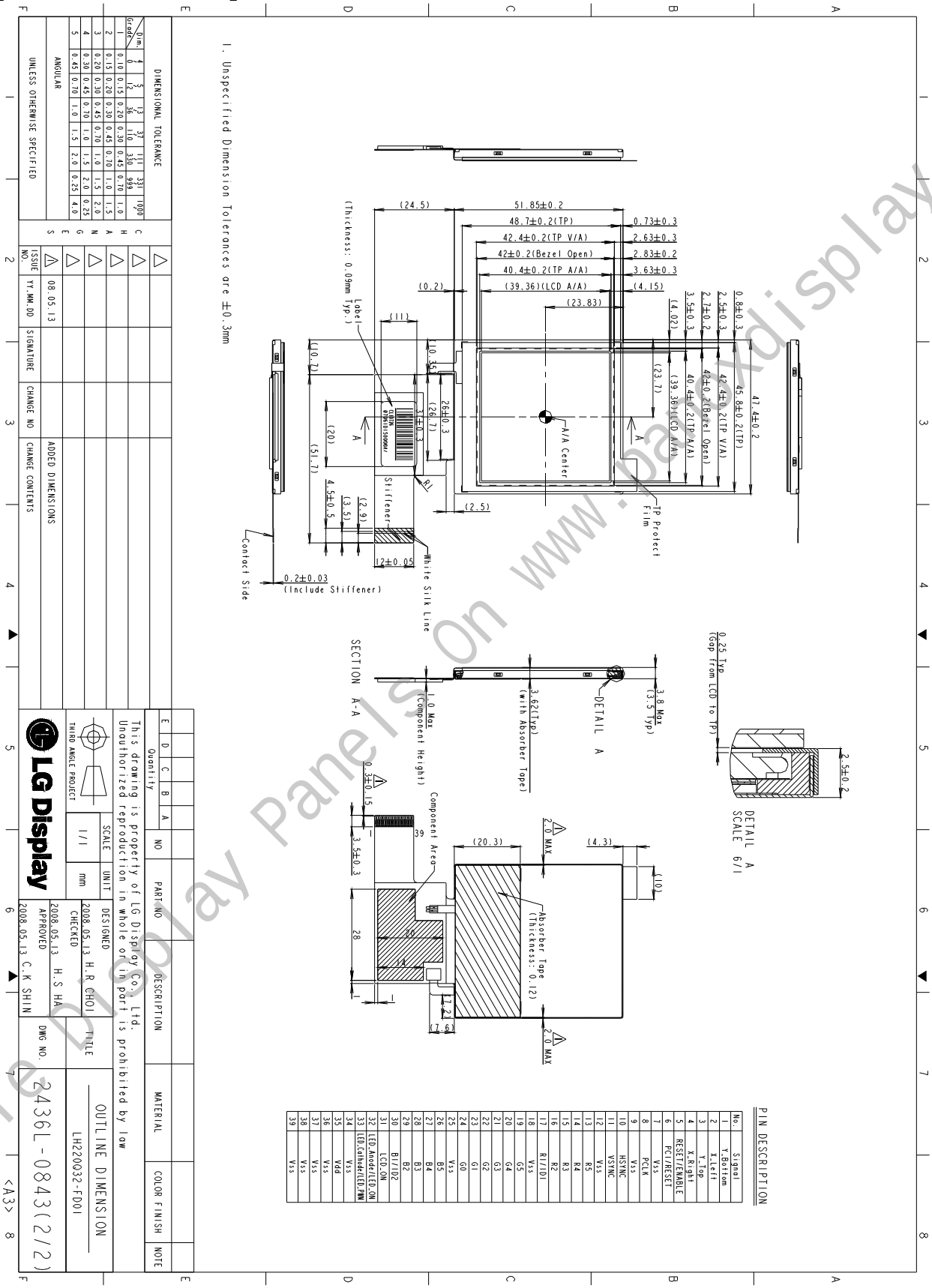
5. MECHANICAL CHRACTERISTICS

The contents provide general mechanical characteristics for the model LH220Q32.
In addition the figures in the next page are detailed mechanical drawing of the LCD.

DIMENSION	MIN	TYP	MAX	UNIT
HORIZONTAL (H)	47.2	47.4	47.6	MM
VERTICAL (V)	51.65	51.85	52.05	MM
THICKNESS (T)	-	3.5	3.8	MM

Product Specification

[Outline Dimension]



PIN DESCRIPTION					
No.	Signal	No.	Signal	No.	Signal
1	Y_Bottom	14	R4	27	B4
2	Y_Bottom	15	R3	28	B3
3	X_Left	16	R2	29	B2
4	X_Right	17	R1/1D1	30	B1/1D2
5	RESET/ENABLE	18	Vss	31	LCD_ON
6	PCI/RESET	19	G5	32	LED_Anode/LED_ON
7	Vss	20	G4	33	LED_Cathode/LED_PWM
8	PCLK	21	G3	34	Vss
9	Vss	22	G2	35	Vdd
10	HSYNC	23	G1	36	Vss
11	VSYNC	24	G0	37	Vss
12	Vss	25	Vss	38	Vss
13	R5	26	B5	39	Vss

DIMENSIONAL TOLERANCE

Dim / Grade	4	5	13	37	111	331	1000
	6	12	36	110	330	999	
1	0.10	0.15	0.20	0.30	0.45	0.70	1.0
2	0.15	0.20	0.30	0.45	0.70	1.0	1.5
3	0.20	0.30	0.45	0.70	1.0	1.5	2.0
4	0.30	0.45	0.70	1.0	1.5	2.0	0.25
5	0.45	0.70	1.0	1.5	2.0	0.25	4.0

ANGULAR

UNLESS OTHERWISE SPECIFIED

ISSUE NO.	YY.MM.DD	SIGNATURE	CHANGE NO	CHANGE CONTENTS
△	08.05.13			ADDED DIMENSIONS
△				
△				
△				

Quantity					NO	PART NO	DESCRIPTION	MATERIAL	COLOR FINISH	NOTE
A	B	C	D	E						

LG Display

THIRD ANGLE PROJECT

SCALE 1/1 | UNIT mm

DESIGNED 2008.05.13 H.R CHOI

CHECKED 2008.05.13 H.S HA

APPROVED 2008.05.13 C.K SHIN

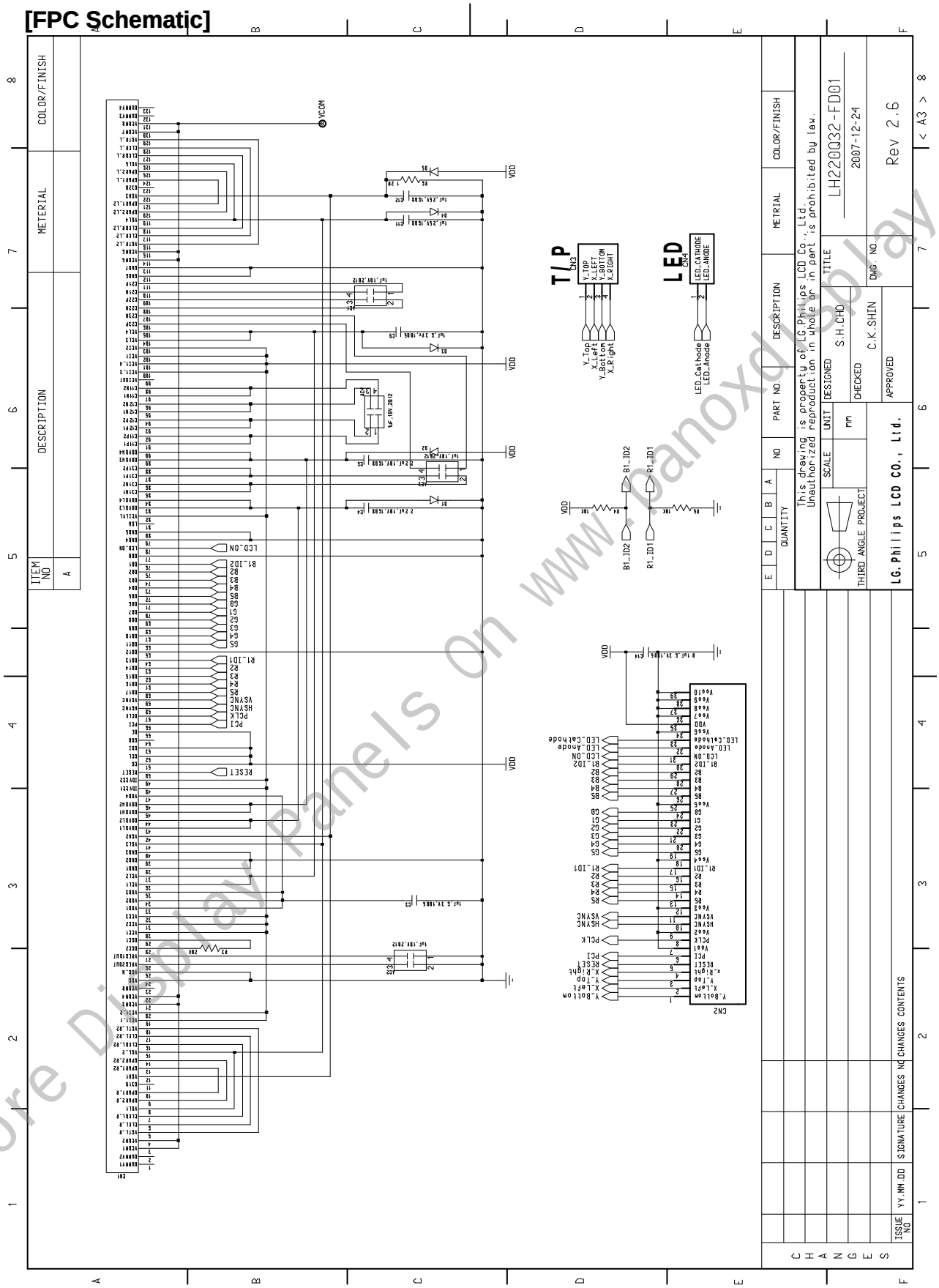
TITLE OUTLINE DIMENSION

LH220Q32-FD01

DWG NO. 2436L-0843(2/2)

Product Specification

[FPC Schematic]



6. POWER SUPPLY & Display SEQUENCE

[Power-up Sequence]

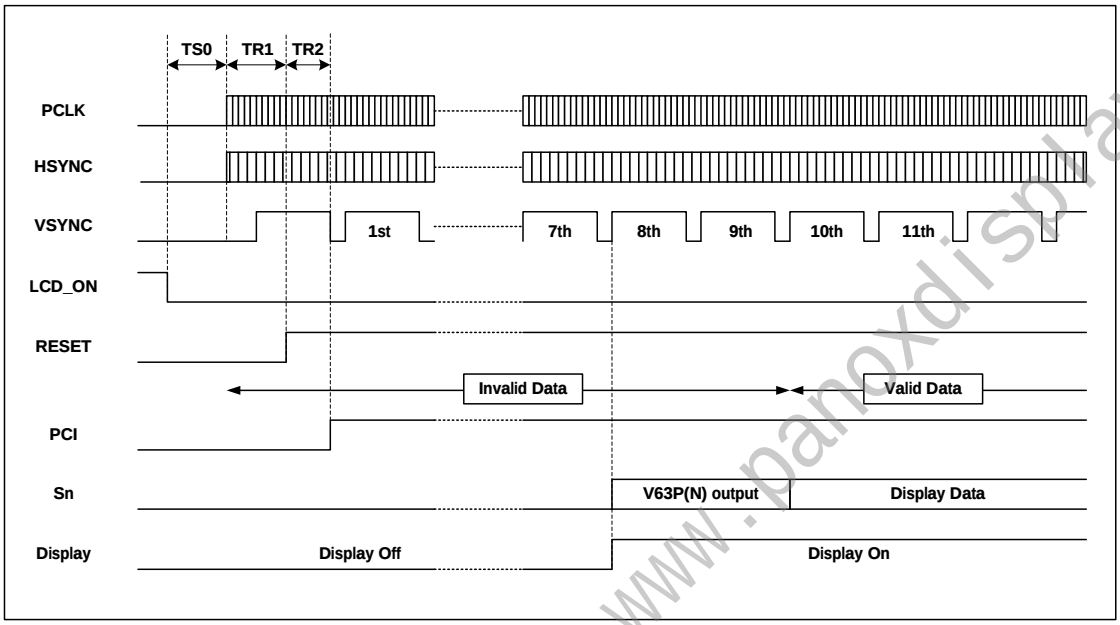


Fig 6.1 Power-up Sequence

[Power-down Sequence]

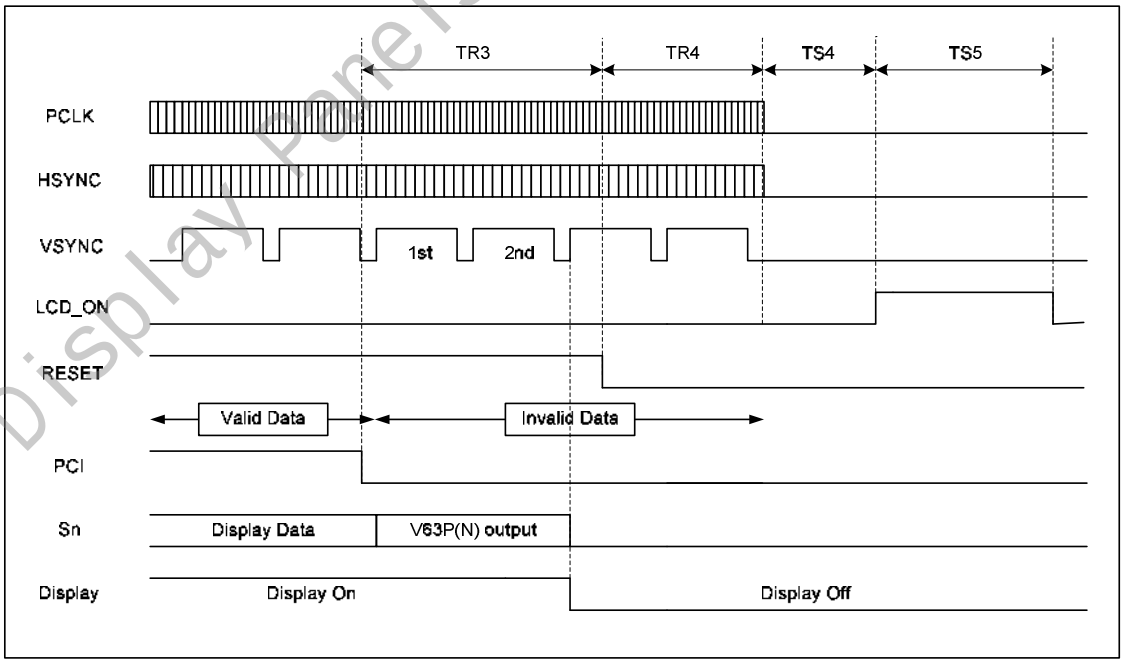


Fig 6.2 Power-down Sequence

[Power-up/down Sequence Timing Condition]

Symbol	Minimum	Typical	Maximum	Unit	Remarks
TS0	4	-	200	ms	
TR1	2	-	5	frame	2-5 frames
TR2	2	-	5	frame	2-5 frames
TR3	2.5	-	5	frame	2.5-5 frames
TR4	2	-	5	frame	2-5 frames
TS4	17.2	-	59.4	ms	
TS5	100	-	-	ms	

Table 6.1 Power-up/down Sequence Timing Conditions