

APPROVAL SHEET

承认书

客户名称 Customer	
产品型号 Part NO.	NV156FHM-N4Z
产品内容 Product type	Mode: TFT LCD Module
备注栏 Remarks	☐ APPROVAL FOR SEPCIFICATIONS ONLY ☒ APPROVAL FOR SEPCIFICATIONS AND SAMPLE
客户确认签章 Signature by Customer:	
备注/ Notes:	

PREPARED BY	CHECKED BY	APPROVED BY

RECORDS OF REVISION

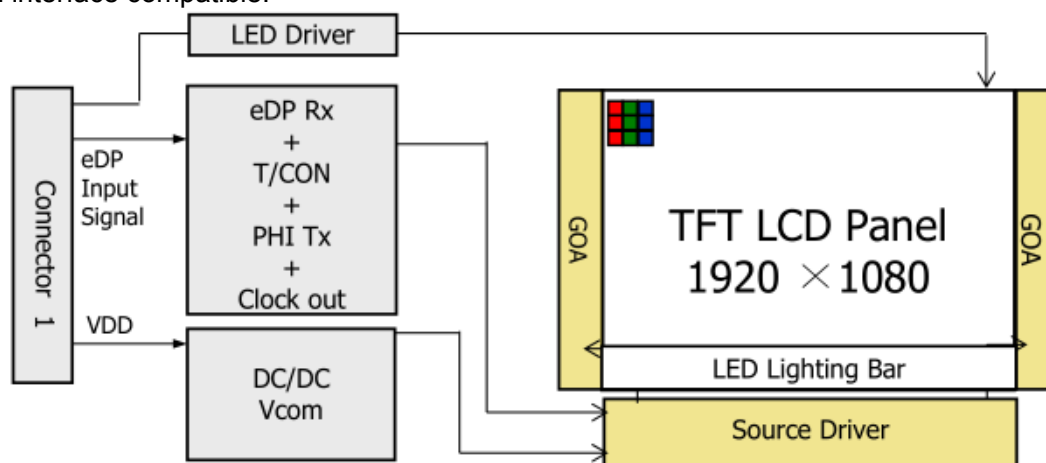
[illegible]

1. Application

This specification applies to a color TFT-LCM Module,

2. Overview

The TFT-LCM Module is a color active matrix TFT LCD module using amorphous silicon TFT's (Thin Film Transistors) as an active switching devices. This module has a 15.6 inch diagonally measured active area with FHD resolutions (1920 horizontal by 1080 vertical pixel array). Each pixel is divided into RED, GREEN, BLUE dots which are arranged in vertical Stripe and this module can display 262,144 colors. The TFT-LCD panel used for this module is a low reflection and higher color type. Therefore, this module is suitable for Notebook PC. The LED Driver for back-light driving is built in this model. All input signals are eDP1.2 interface compatible.



- 2 lane eDP Interface with 2.7Gbps Link Rates
- Thin and light weight
- 6-bit color depth, display 262K colors
- Single LED Lighting Bar. (Down side/Horizontal Direction)
- Green Product (RoHS & Halogen free product)
- On board LED Driving circuit
- Low driving voltage and low power consumption
- On board EDID chip

3. Mechanical specifications.

Parameter	Specification	Unit	Note
Display size	15.6" (Diagonal)	inch	
Active area	344.16(H) × 193.59(V)	mm	
Pixel Format	1920(H) × 1080(V) (1 pixel = R + G + B dot)	pixel	
Pixel pitch	0.17925(H) × 0.17925 (V)	mm	
Pixel configuration	R, G, B vertical stripe		
Display mode	Normally black		
Display colors	262K	colors	
Power Consumption	0.6	W	
Surface treatment of front polarizer	Anti-glare coating: (3H)		

Outline dimensions

Parameter		Min	Typ	Max	Unit	Remark
Unit outline dimensions	Width	350.46	350.76	351.06	mm	
	Height	204.66	204.96	205.26	mm	
	Depth	2.7	2.9	3.1	mm	w/o PWB.[Note3-2]
Mass		-	-	-	g	

4. Input Terminals

4-1 Driving interface of PWB

The electronics interface connector is UJU IS050-L30B-C10 or Compatible.

The connector interface pin assignments are listed in Table 6.

<Table 6. Pin Assignments for the Interface Connector>

Pin No.	Symbol	I/O	Function	Remark
1	CABC_ENABLE	-	CABC_Function Reserved	
2	H_GND	P	High Speed round	
3	Lane1_N	I	Complement Signal Link Lane 1	
4	Lane1_P	I	True Signal Link Lane 1	
5	H_GND	P	High Speed round	
6	Lane0_N	I	Complement Signal Link Lane 0	
7	Lane0_P	I	True Signal Link Lane 0	
8	H_GND	P	High Speed round	
9	AUX_CH_P	I	True Signal Auxiliary Channel	
10	AUX_CH_N	I	Complement Signal Auxiliary Channel	
11	H_GND	P	High Speed round	
12	LCD_VDD	P	LCD logic and driver power(3.3V)	
13	LCD_VDD	P	LCD logic and driver power(3.3V)	
14	LCD_Self_Test	I	Reserved for LCD manufacturer's use	
15	LCD_GND	P	LCD logic and driver ground	
16	LCD_GND	P	LCD logic and driver ground	
17	HPD	O	HPD signal pin	
18	LED-1	P	Backlight ground	
19	LED-2	P	Backlight ground	
20	LED-3	P	Backlight ground	
21	LED-4	P	Backlight ground	
22	BL_ENABLE	I	Backlight on/off	
23	BL_PWM_DIM	I	System PWM	
24	NC	-	Reserved for LCD manufacturer's use	
25	NC	-	Reserved for LCD manufacturer's use	
26	BL_PWR	P	LED Power Supply 5V-21V	
27	BL_PWR	P	LED Power Supply 5V-21V	
28	BL_PWR	P	LED Power Supply 5V-21V	
29	BL_PWR	P	LED Power Supply 5V-21V	
30	NC	-	No Connection	

*1 P: POWER I: Input O: Output

The electronics interface connector is UJU IS050-L30B-C10 or Compatible.

Mating housing/ Part Number: I-PEX 20454-030T or Compatible

The connector interface pin assignments are listed in Table 6.

CN1 pin 1 position



4-2 eDP interface

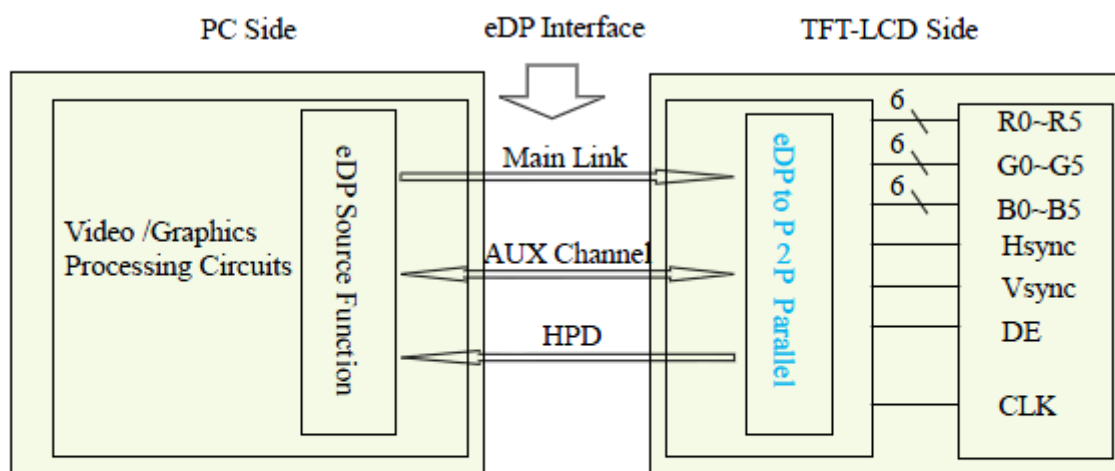


Figure 8. eDP Interface Architecture

Note:

Transmitter : Parade DP501 or equivalent.

Transmitter is not contained in module.

Fig.4-2-4 eDP 2lane 6bit input data mapping

5. Electrical Characteristics

5-1 Absolute Maximum Ratings

Parameter	Symbol	Condition	Ratings		Unit	Remark
			MIN	MAX		
+3.3V supply voltage	V _{DD}	Ta=25°C	-0.3	+4.0	V	
Backlight supply voltage	V _{BL}	Ta=25°C	-0.3	+26.5	V	
Input voltage(eDP)	V _I	Ta=25°C	-0.3	+2.0	V	[Note 5-1]
Input voltage(BL)	V _{BL_I}	Ta=25°C	-0.3	V _{DD} +0.3	V	[Note 5-2]
Storage temperature	T _{stg}		-10	+60	°C	[Note 5-3]
Operation temperature	T _{opa}		0	+50	°C	

(*) "Absolute Maximum Ratings" is regulations that do not exceed it even momentarily.

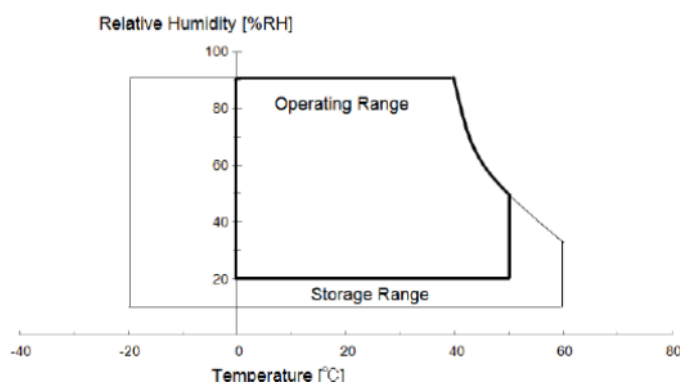
(*) Stress beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device.

[Note 5-1] eDP signals

[Note 5-2] Backlight control signals (BL_ENABLE, BL_PWM_DIM)

[Note 5-3] Humidity: 90%RH Max.at Ta ≤ +40°C.

Maximum wet-bulb temperature at +39°C or less at Ta > +40°C, No condensation.



5-2 Electrical Specifications

< Electrical specifications >

Ta=25+/-2°C

Parameter		Min.	Typ.	Max.	Unit	Remarks
Power Supply Voltage	V _{DD}	3.0	3.3	3.6	V	Note 1
Permissible Input Ripple Voltage	V _{RF}	-10% VDD	-	+10% VDD	V	@ V _{DD} = 3.3V
Power Supply Inrush Current	I _{inrush}	-	-	2	A	Note3
Power Supply Current	Mosaic	I _{DD}	-	273	mA	Note 1
	RGB		-	545	mA	
Power Consumption	Mosaic	P _M	-	0.9	W	
	RGB	P _{RGB}	-	1.8	W	
	BLU	P _{BL}	-	-	W	Note 2
	Total	P _D	-	0.9	W	@Mosaic

Notes :

1. The supply voltage is measured and specified at the interface connector of LCM.
The current draw and power consumption specified is for 3.3V at 25 °C.
a) Mosaic pattern 8*8
b) R/G/B patterns



Figure 3. Power Measure Patterns

2. Calculated value for reference ($V_{LED} \times I_{LED}$)
3. Measure condition (Figure 4)

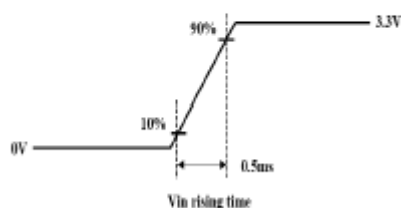


Figure 4. Inrush Measure Condition

5.3. DC Characteristics

5-3-1. TFT-LCD panel driving

The specification of the eDP Rx interface timing parameter is shown in Table 8.

<eDP Rx Interface Timing Specification>

Item	Symbol	Min	Typ	Max	Unit	Remark
Spread spectrum clock (Link clock down-spreading)	ssc	0	-	0.5	%	
Differential peak-to-peak input voltage at package pins	VRX-DIFFp-p	100	-	1320	mV	
Rx input DC common mode voltage	VRX_DC_CM	0	-	2	V	
Differential termination resistance	RRX-DIFF	80	-	120	Ω	
Single-ended termination resistance	RRX-SE	40	-	60	Ω	
Rx short circuit current limit	IRX_SHORT	-	-	50	mA	
Intra-pair skew at Rx package pins (HBR) RX intra-pair skew tolerance at HBR	LRX_SKEW_ INTRA_PAIR	-	-	60	ps	
AC Coupling Capacitor	C _{SOURCE_ME}	75		200	nF	Source side

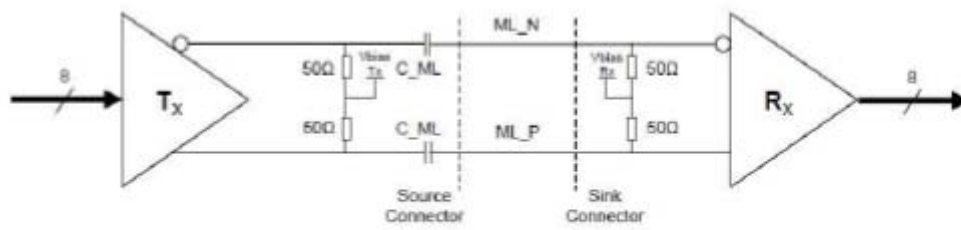


Figure 10. Main link differential pair

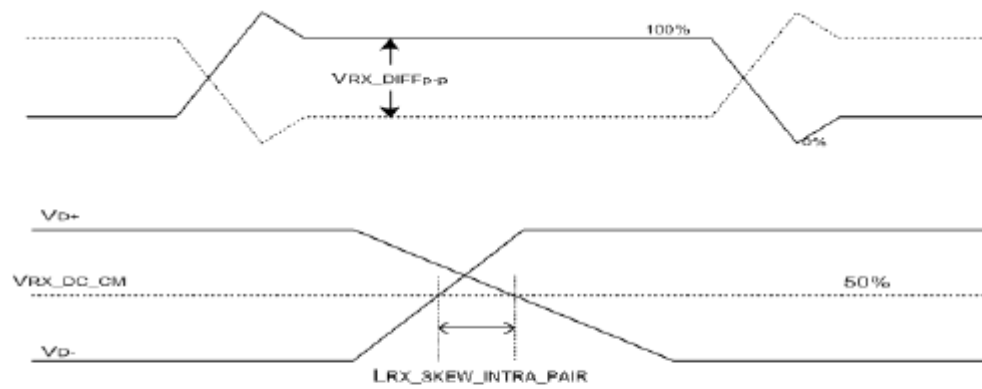
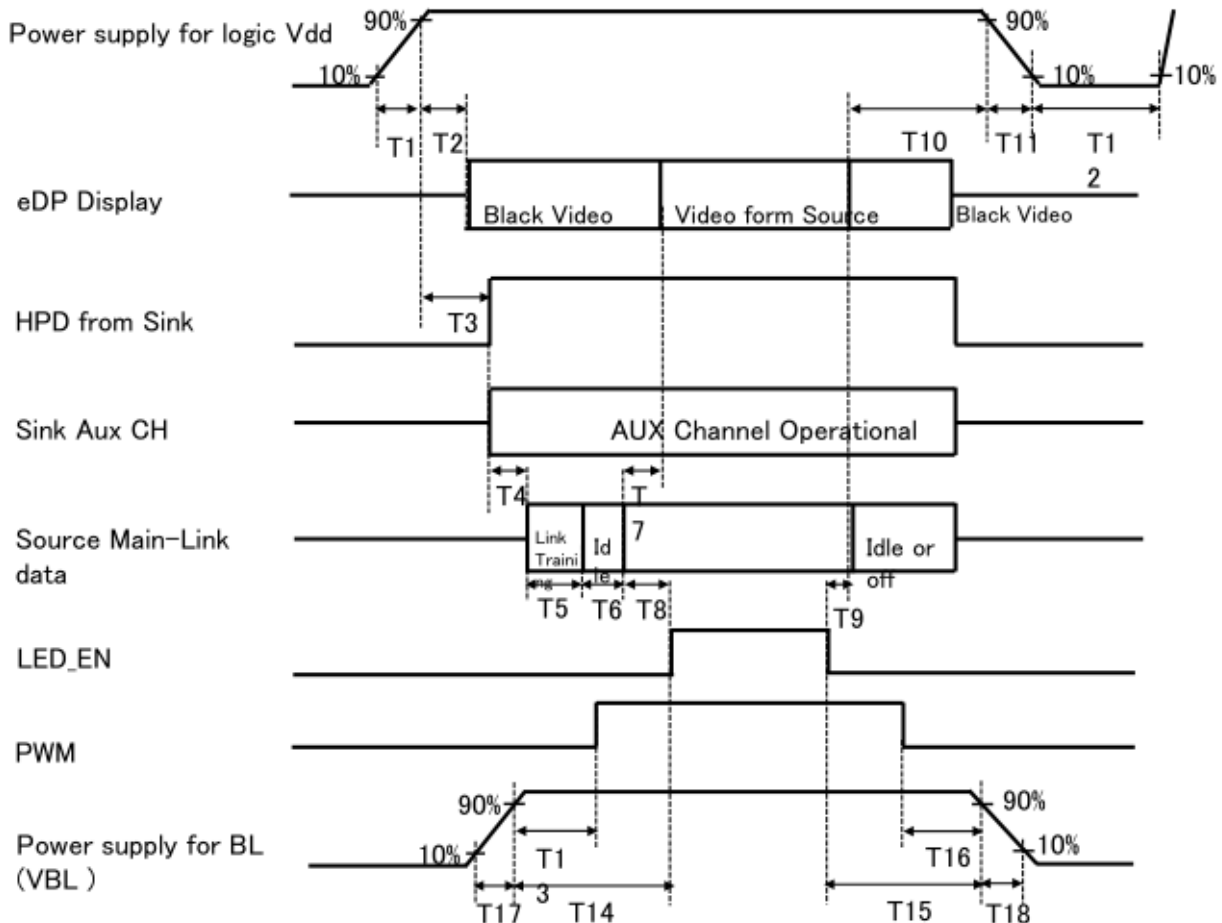


Figure 15. VRX-DIFFp-p & LRX_SKEW_INTRA_PAIR

5-3-2. POWER SEQUENCE

To prevent a latch-up or DC operation of the LCD module, the power on/off sequence shall be as shown in below



- | | |
|----------------------|----------------------|
| ● 0.5ms ≤ T1 ≤ 10 ms | ● 0ms ≤ T7 ≤ 50ms |
| ● 0ms ≤ T2 ≤ 200 ms | ● 0ms ≤ T10 ≤ 500 ms |
| ● 0ms ≤ T3 ≤ 200 ms | ● 0ms ≤ T11 ≤ 10 ms |
| ● 0ms ≤ T13 | ● 150ms ≤ T12 |
| ● 0ms ≤ T14 | ● 0ms ≤ T15 |
| ● 0ms ≤ T17 | ● 0ms ≤ T16 |
| | ● 0ms ≤ T18 |

Notes:

1. When the power supply VDD is 0V, keep the level of input signals on the low or keep high impedance.
2. Do not keep the interface signal high impedance when power is on. Back Light must be turn on after power for logic and interface signal are valid.

6 . Backlight driving

The backlight system is an edge-lighting type with white-LED.

(It is usually required to measure under the following condition: $T_a=25^{\circ}\text{C}\pm 2^{\circ}\text{C}$)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Supply voltage	V_{BL}	7.0	12.0	21.0	V	
Current dissipation	I_{BL}	-	200	-	mA	$V_{BL}=12\text{V}$ Duty Ratio=100%
Modulated light signal voltage	$V_{PWM\ H}$	2.5	-	5	V	
	$V_{PWM\ L}$	0	-	0.6	V	
Brightness Control Duty Ratio	Duty	1	-	100	%	[Note6-3-1]
Brightness Control frequency	f_{PWM}	100	-	10,000	Hz	
LED-BL ON/OFF High voltage	$V_{CNT\ H}$	2.5	-	5	V	[Note6-3-3]
LED-BL ON/OFF low voltage	$V_{CNT\ L}$	0	-	0.6	V	
LED lifetime	-	-	30,000	-	h	LED

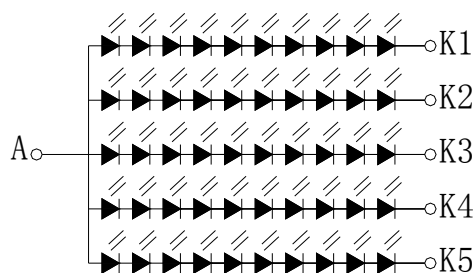
Notes : 1. Power supply voltage 12V for LED Driver

Calculator Value for reference $I \times V \times F \times 40 / \text{efficiency} = P_{LED}$

2. The LED Life-time define as the estimated time to 50% degradation of initial luminous.

3. 1% duty cycle is achievable with a dimming frequency less than 1KHz.

LED structure



Backlight LED 10串5并50颗 Circuit

7. Timing characteristics of input signals

7-1. Timing Characteristics

The TFT-LCM Module is operated by the DE only.

Item		Symbols	Min	Typ	Max	Unit
Clock	Frequency	1/Tc	139.9	149.6	162.8	MHz
Frame Period		Tv	1100	1140	1180	lines
			-	60	-	Hz
			-	16.67	-	ms
Vertical Display Period		Tvd	-	1080	-	lines
One line Scanning Period		Th	2120	2187	2300	clocks
Horizontal Display Period		Thd	-	1920	-	clocks

Note : The above is as optimized setting.

7-2. Input data signals and display position on the screen



Display position of input data(VH)

7-3 Input signal, basic display colors and gray scale of each color

	Colors & Gray scale	Data signal																	
		R0	R1	R2	R3	R4	R5	G0	G1	G2	G3	G4	G5	B0	B1	B2	B3	B4	B5
Basic colors	Black	0	0	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	0	1	1	1	1	1	1
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Light Blue	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Purple	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gray scale of Red	Black	0	0	0	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	0	0	0
	Darker	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	↑						↑						↑					
	▽	↓						↓						↓					
	Brighter	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	▽	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Gray scale of Green	Black	0	0	0	0	0	0	0	0	0	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
	Darker	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	△	↑						↑						↑					
	▽	↓						↓						↓					
	Brighter	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0	0	0
	▽	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Gray scale of Blue	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	Darker	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	△	↑						↑						↑					
	▽	↓						↓						↓					
	Brighter	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1
	▽	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Gray scale of White & Black	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0
	Darker	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
	△	↑						↑						↑					
	▽	↓						↓						↓					
	Brighter	1	0	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1
	▽	0	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

8. EDID Specifications

Address (HEX)	Function	Hex	Dec	crc	Input values.	Notes
00	Header	00	0		0	EDID Header
01		FF	255		255	
02		FF	255		255	
03		FF	255		255	
04		FF	255		255	
05		FF	255		255	
06		FF	255		255	
07		00	0		0	
08	ID Manufacturer Name	09	9		BOE	ID = BOE
09		E5	229			
0A	ID Product Code	F7	247		2807	ID = 2807
0B		0A	10			
0C	32-bit serial No.	00	0		0	
0D		00	0		0	
0E		00	0		0	
0F		00	0		0	
10	Week of manufacture	1B	27		27	
11	Year of Manufacture	20	32		2022	Manufactured in 2022
12	EDID Structure Ver.	01	1		1	EDID Ver 1.0
13	EDID revision #	04	4		4	EDID Rev. 0.4
14	Video input definition	95	149		-	Refer to right table
15	Max H image size	22	34		34	34.4 cm (Approx)
16	Max V image size	13	19		19	19.4 cm (Approx)
17	Display Gamma	78	120		2.2	Gamma curve = 2.2
18	Feature support	03	3		-	Refer to right table
19	Red/Green low bits	90	144		-	Red / Green Low Bits
1A	Blue/White low bits	15	21		-	Blue / White Low Bits
1B	Red x high bits	96	150	602	0.588	Red (x) = 10010110 (0.588)
1C	Red y high bits	5E	94	377	0.368	Red (y) = 01011110 (0.368)
1D	Green x high bits	59	89	356	0.348	Green (x) = 01011001 (0.348)
1E	Green y high bits	92	146	584	0.570	Green (y) = 10010010 (0.57)
1F	Blue x high bits	29	41	164	0.160	Blue (x) = 00101001 (0.16)
20	Blue y high bits	21	33	133	0.130	Blue (y) = 00100001 (0.13)
21	White x high bits	50	80	321	0.313	White (x) = 01010000 (0.313)
22	White y high bits	54	84	337	0.329	White (y) = 01010100 (0.329)
23	Established timing 1	00	0		-	Refer to right table
24	Established timing 2	00	0		-	
25	Established timing 3	00	0		-	

26	Standard timing #1	01	1			Not Used
27		01	1			
28	Standard timing #2	01	1			Not Used
29		01	1			
2A	Standard timing #3	01	1			Not Used
2B		01	1			
2C	Standard timing #4	01	1			Not Used
2D		01	1			
2E	Standard timing #5	01	1			Not Used
2F		01	1			
30	Standard timing #6	01	1			Not Used
31		01	1			
32	Standard timing #7	01	1			Not Used
33		01	1			
34	Standard timing #8	01	1			Not Used
35		01	1			
36	Detailed timing/monitor descriptor #1	70	112		149.6	149.5908MHz Main clock
37		3A	58			
38		80	128		1920	Hor Active = 1920
39		0B	11		267	Hor Blanking = 267
3A		71	113		-	4 bits of Hor. Active + 4 bits of Hor. Blanking
3B		38	56		1080	Ver Active = 1080
3C		3C	60		60	Ver Blanking = 60
3D		40	64		-	4 bits of Ver. Active + 4 bits of Ver. Blanking
3E		30	48		48	Hor Sync Offset = 48
3F		20	32		32	H Sync Pulse Width = 32
40		36	54		3	V sync Offset = 3 line
41		00	0		6	V Sync Pulse width : 6 line
42		58	88		344	Horizontal Image Size = 344 mm (Low 8 bits)
43		C2	194		194	Vertical Image Size = 194 mm (Low 8 bits)
44		10	16		-	4 bits of Hor Image Size + 4 bits of Ver Image Size
45		00	0		0	Hor Border (pixels)
46		00	0		0	Vertical Border (Lines)
47		1A	26		-	Refer to right table

48	Detailed timing/monitor descriptor #2	F5	245		99.7	99.7272MHz Main clock
49		26	38			
4A		80	128		1920	Hor Active = 1920
4B		0B	11		267	Hor Blanking = 267
4C		71	113		-	4 bits of Hor. Active + 4 bits of Hor. Blanking
4D		38	56		1080	Ver Active = 1080
4E		3C	60		60	Ver Blanking = 60
4F		40	64		-	4 bits of Ver. Active + 4 bits of Ver. Blanking
50		30	48		48	Hor Sync Offset = 48
51		20	32		32	H Sync Pulse Width = 32
52		36	54		3	V sync Offset = 3 line
53		00	0		6	V Sync Pulse width : 6 line
54		58	88		344	Horizontal Image Size = 344 mm (Low 8 bits)
55		C2	194		194	Vertical Image Size = 194 mm (Low 8 bits)
56		10	16		-	4 bits of Hor Image Size + 4 bits of Ver Image Size
57		00	0		0	Hor Border (pixels)
58		00	0		0	Vertical Border (Lines)
59		1A	26		-	Refer to right above table
5A	Detailed timing/monitor descriptor #3	00	0			Nvidia nvDPS (Refer the tab of nvDPS) Lowest refresh rate that does not cause any visual/optical side effect
5B		00	0			
5C		00	0			
5D		00	0			
5E		00	0			
5F		00	0			
60		00	0			
61		00	0			
62		00	0			
63		00	0			
64		00	0			
65		00	0			
66		00	0			
67		00	0			
68		00	0			
69		00	0			
6A		00	0			
6B		00	0			

6C	Detailed timing/monitor descriptor #4	00	0			Detailed Timing Description #4
6D		00	0			Flag
6E		00	0			Reserved
6F		02	2			For Brightness Table and Power consumption
70		00	0			Flag
71		0B	11		-	PWM % [7:0] @ Step 0
72		40	64		-	PWM % [7:0] @ Step 5
73		FF	255		-	PWM % [7:0] @ step 10
74		0A	10		-	Nits [7:0] @ Step 0
75		3C	60		-	Nits [7:0] @ Step 5
76		7D	125		-	Nits [7:0] @ Step 10
77		16	22		-	Panel Electronics Power @32x32 Chess Pattern = 900mW
78		14	20		-	Backlight Power @60 nits = 838.588235294118mW
79		29	41		-	Backlight Power @Step 10 = 3300mW
7A		7D	125		-	Nits @ 100% PWM Duty = 250nit
7B		00	0			Format:
7C		00	0			terminate with ASCII code 0Ah
7D		00	0			and pad field with ASCII code 20h
7E	Extension flag	00	0		1	0 : 1個EDID; N-1: N个EDID
7F	Checksum	78	120	120	-	

9. OPTICAL SPECIFICATION

9.1 Overview

The test of Optical specifications shall be measured in a dark room (ambient luminance ≤ 1 lux and temperature = $25 \pm 2^\circ\text{C}$) with the equipment of Luminance meter system (Goniometer system and PR730) and test unit shall be located at an approximate distance

50cm from the LCD surface at a viewing angle of θ and Φ equal to 0° , We refer to $\theta\Phi=0(=\theta_3)$ as the 3 o'clock direction (the "right"), $\theta\Phi=90(=\theta_{12})$ as the 12 o'clock direction("upward"), $\theta\Phi=180(=\theta_9)$ as the 9 o'clock direction ("left") and $\theta\Phi=270(=\theta_6)$ as the 6 o'clock direction ("bottom"). While scanning θ and /or Φ , the center of the measuring spot on the Display surface shall stay fixed. The backlight should be operating for 30 minutes prior to measurement. VDD shall be $3.3 \pm 0.3\text{V}$ at 25°C . Optimum viewing angle direction is 6 'clock.

9.2 ptical characteristics

Paramete	Conditions	Min.	Typ.	Max.	Unit	Note
Viewing Angle (CR>10)	Horizontal	θ_L	-	85	-	degree
		θ_R	-	85	-	
	Vertical	θ_T	-	85	-	
		θ_B	-	85	-	
Contrast Ratio	Center		800	1000	-	
Response Time	Tr+Td	-	20	25	ms	
CF Color Chromaticity (CIE1931)	Red x	Typ. -0.03	0.578	Typ. +0.03	-	[Note 9-2,9-6] Normal operation (PWM Duty=100%)
	Red y		0.365		-	
	Green x		0.355		-	
	Green y		0.590		-	
	Blue x		0.155		-	
	Blue y		0.127		-	
	White x		0.313		-	
	White y		0.329		-	
NTSC ratio	%		(45)		-	
Center Luminance of white	Y_{LI}	230	270		cd/m2	
White uniformity	δ_w	75	80			[Note 9-2,9-7]

Notes :

※The measurement shall be taken 30 minutes after lighting the module at the following rating.

※Condition: PWM Duty = 100%

※The optical characteristics shall be measured in a dark room or equivalent.

[Note 9-1] Measurement of viewing angle range [Note 9-2] Measurement of luminance and Response time.
Chromaticity and Contrast.

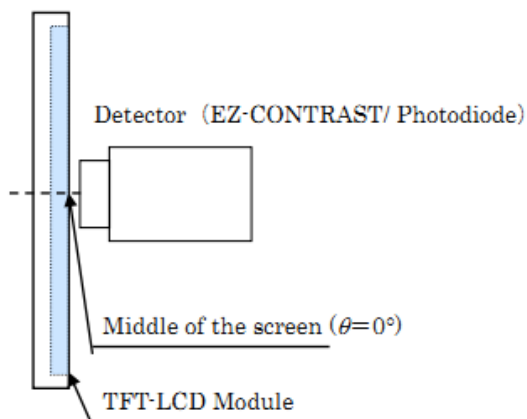


Fig.9-1 Measurement of Viewing angle range and Response time.
(Viewing angle range: EZ-CONTRAST, Response time: Photodiode)

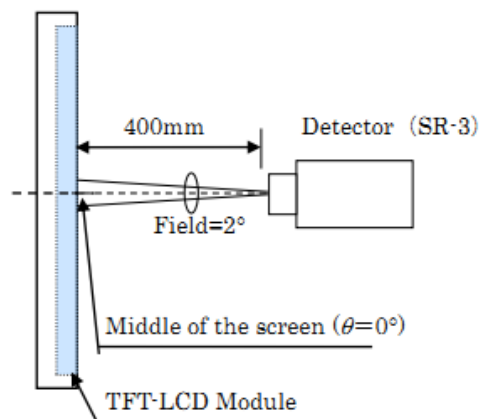


Fig.9-2 Measurement of Contrast, Luminance, Chromaticity, White variation, Crosstalk and Color temperature variation.

[Note 9-3] Definitions of viewing angle range

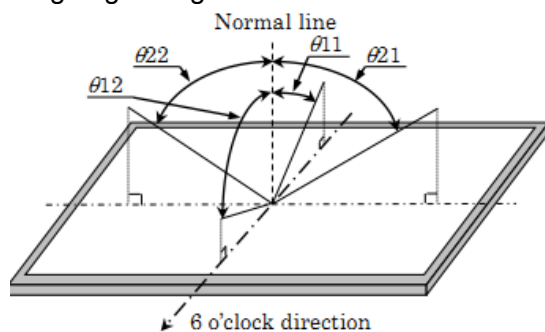


Fig.9-3 Viewing angle

[Note 9-4] Definition of contrast ratio:

The contrast ratio is defined as the following.

$$\text{Contrast Ratio} = \frac{\text{Luminance(Brightness) with all pixels white}}{\text{Luminance(Brightness) with all pixels Black}}$$

[Note 9-5] Definition of response time:

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".

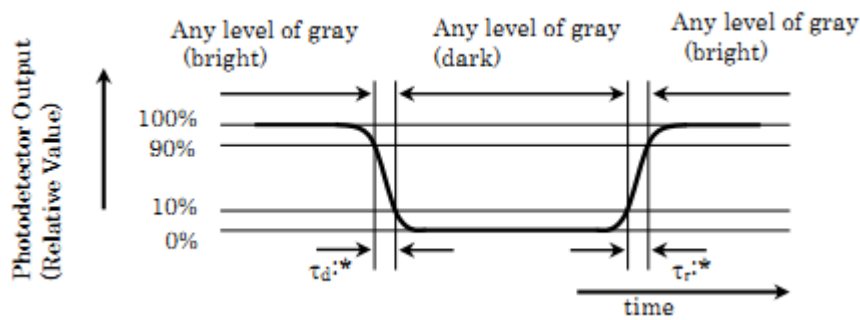


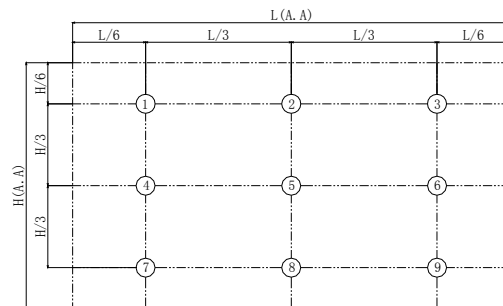
Fig.9-4 Response time

[Note 9-6] This shall be measured at center of the screen.

[Note 9-7] Definition of white uniformity:

White uniformity is defined as the following with 9 measurements

$$\bar{\delta}_w = \frac{\text{Minimum Luminance of 9 Points(Brightness)}}{\text{Maximum Luminance of 9 Points(Brightness)}}$$



10. Display Quality

The display quality of the color TFT-LCD module shall be in compliance with the Incoming Inspection Standard.

11. Handling Precautions

- Be sure to turn off the power supply when inserting or disconnecting the cable.
Please insert for too much stress not to join a connector in the case of insertion of a connector.
- Be sure to design the cabinet so that the module can be installed without any extra stress such as warp or twist.
- Since the front polarizer is easily damaged, pay attention not to scratch it.
- Wipe off water drop immediately. Long contact with water may cause discoloration or spots.
- When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.
- Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface. Handle with care.
- Since CMOS LSI is used in this module, take care of static electricity and injure the human earth when handling. Observe all other precautionary requirements in handling components.
- This module has its circuitry PCBs on the side and should be handled carefully in order not to be stressed.
- Laminate film is attached to the module surface to prevent it from being scratched. Peel the laminate film off slowly just before the use with strict attention to electrostatic charges. Ionized air shall be blown over during the action. Blow off the 'dust' on the polarizer by using an ionized nitrogen gun, etc. Working under the following environments is desirable.
 - All workers wear conductive shoes, conductive clothes, conductive fingerstalls and grounding belts without ail.
 - Use Ionized blower for electrostatic removal, and peel of the laminate film with a constant speed. (Peeling of it at over 2 seconds)
- The polarizer surface on the panel is treated with Anti-Glare. In case of attaching protective board over the LCD, be careful about the optical interface fringe etc. which degrades display quality.
- Do not expose the LCD module to a direct sunlight, for a long period of time to protect the module from the ultra violet ray.
- When handling LCD modules and assembling them into cabinets, please be noted that long-term storage in the environment of oxidization or deoxidization gas and the use of such materials as reagent, solvent, adhesive, resin, etc. which generate these gasses, may cause corrosion and discoloration of the LCD modules.
- Liquid crystal contained in the panel may leak if the LCD is broken. Rinse it as soon as possible if it gets inside your eye or mouth by mistake.
- Disassembling the module can cause permanent damage and should be strictly avoided.

Please don't remove the fixed tape, insulating tape etc that was pasted on the original module.
(Except for protection film of the panel.)

- o) Be careful when using it for long time with fixed pattern display as it may cause afterimage.
(Please use a screen saver etc., in order to avoid an afterimage.)
- p) If a minute particle enters in the module and adheres to an optical material, it may cause display non-uniformity issue, etc. Therefore, fine-pitch filters have to be installed to cooling and inhalation hole if you intend to install a fan.
- q) Epoxy resin (amine series curing agent), silicone adhesive material (dealcoholization series and oxime series), tray forming agent (azo compound) etc, in the cabinet or the packing materials may induce abnormal display with polarizer film deterioration regardless of contact or noncontact to polarizer film.
Be sure to confirm the component of them.
- r) Do not use polychloroprene. If you use it, there is some possibility of generating Cl₂ gas that influences the reliability of the connection between LCD panel and driver IC.
- s) Do not put a laminate film on LCD module, after peeling of the original one. If you put on it, it may cause discoloration or spots because of the occurrence of air gaps between the polarizer and the film.
- t) Ground module bezel to stabilize against EMI and external noise.

12. Packaging Condition(TBD)

Piling number of cartons	
Package quantity in one carton	
Carton size	
Total mass of one carton filled with full modules	
Packing form	

13. Label (TBD)

- 1) Module Bar code label:
TBD
- 2) Packing bar code label
TBD

14. RoHS Directive

This LCD open-cell is compliant with RoHS Directive.

15. Reliability Test Items

No.	Test Item	Conditions
1	High temperature storage test	Ta=60℃ 72h
2	Low temperature storage test	Ta=-10℃ 72h
3	High temperature & high humidity operation test	Ta=40℃80%RH 72h (No condensation)
4	High temperature operation test	Ta=50℃ 72h
5	Low temperature operation test	Ta=0℃ 72h

[Result Evaluation Criteria] Under the display quality test condition with normal operation state.

Do not change these condition as such changes may affect practical display function.

[Normal operation state] temperature : + 15~ + 35℃ , Humidity : 45~75% , Atmospheric pressure : 86~106kPa

