Specification for Approval

Customer:_____

Model Name:_____

Supplier Approval			Customer approval
R&D Designed	R&D Approved	QC Approved	
Peter	*Peng Jun*		

Revision Record

REV NO.	REV DATE	CONTENTS	Note
A	2023/03/23	NEW ISSUE	

Table of Contents

1. Overview

This Open-cell is a color active matrix LCD open-cell incorporating Oxide TFT (Thin Film Transistor).It is composed of a color TFT-LCD panel, driver ICs, a control circuit and power supply circuit. Graphics and texts can be displayed on a 1920×3×1080 dots panel with 16,777,216 colors by using eDP (Embedded Display Port) Ver1.3 interface and supplying +3.3V DC supply voltage for TFT-LCD panel driving.
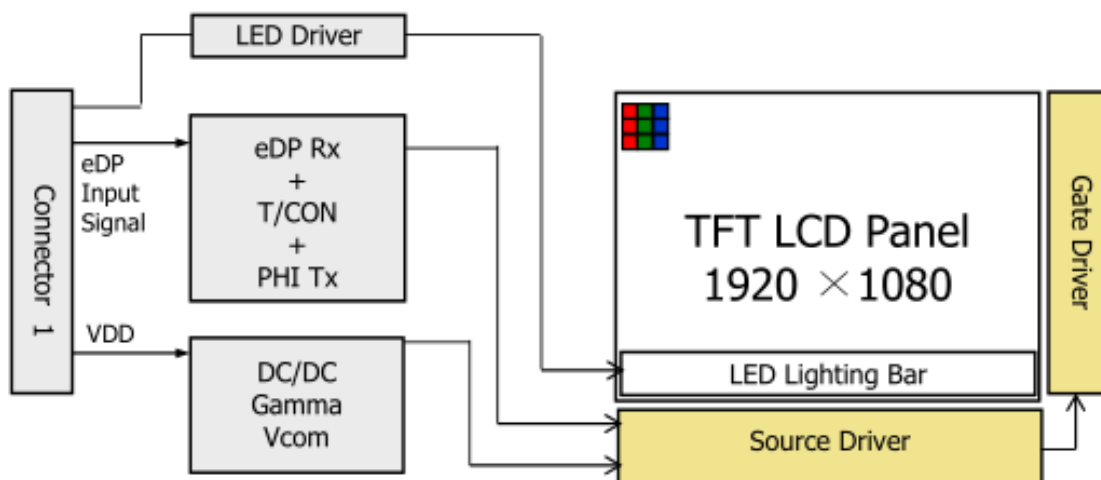
In this TFT-LCD panel, color filters for excellent color performance is incorporated to realize brighter and clearer
pictures, making this open-cell optimum for use in multi-media applications.

Optimum viewings are in all directions.

Without Backlight-driving LED controller.

eDP transfer rate specification: 2.7Gbps/2 lane.

Block drawing

2. General Information

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) （1pixel = R + G + B dot）	pixel	
Pixel pitch	0.17925(H) x 0.17925 (V)	mm	
Pixel configuration	R, G, B vertical stripe		
Display mode	Normally black		
Display scheme	FFS		
Power Consumption	0.56	W	
Surface treatment of front polarizer	Anti-glare coating: (3H)		

Outline dimensions

Parameter		Min	Typ	Max	Unit	Remark
Unit outline dimensions	Width	359.7	360	360.3	mm	
	Height	221.73	222.23	222.73	mm	
	Depth	6.2	6.4	6.6	mm	w/o PWB.[Note3-2]
Mass		-	-	-	g	

[Note 3-1] Outline dimensions is shown in page 20
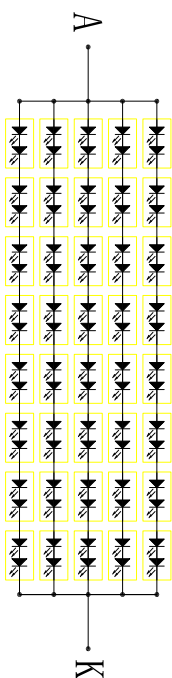[Note 3-2] Without war page and deflection.

3. External Dimensions
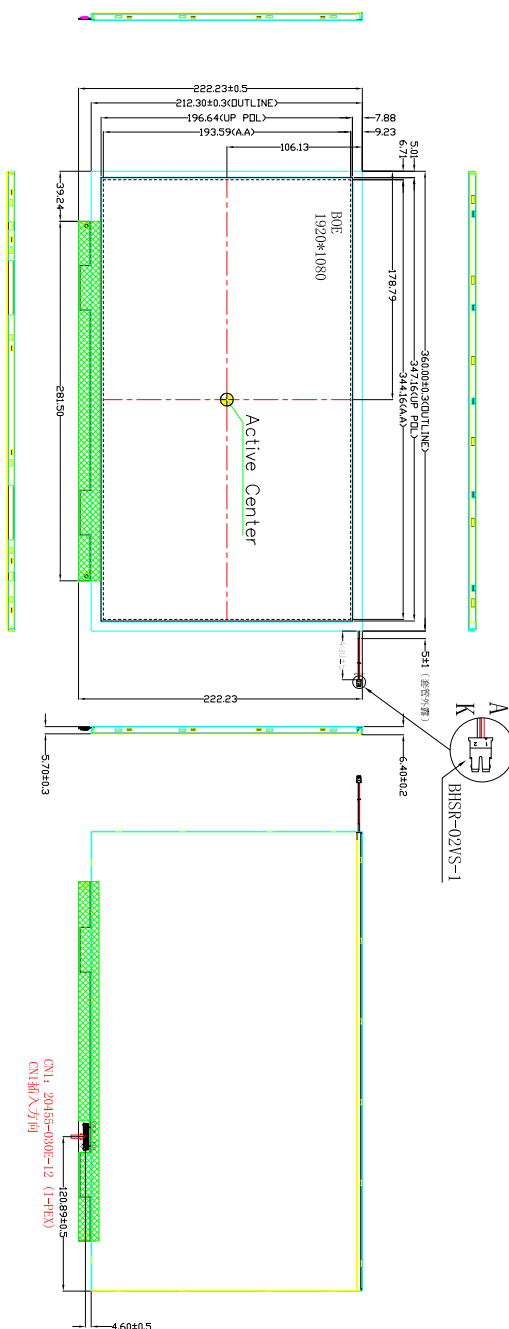
Notes:
1. Unit:mm.
2. Do not scale drawing.
3. All radii without dimension R0.2.
4. △Modification Mark.
5. draft angle: 1°
6. LCM luminance :1000cd/m^2(TYP)
7. Luminance uniformity: 75%(min)(min/max*100%)
8. UnSpecified Tolerance is ±0.2
9. Operation conditions :If= 420mA, Vf=39.2-47.6V(MAX)
   Color coordinate:X=0.27-0.35,Y=0.28-0.36
10. All materials comply with RoHS
11. The measured value of luminace and color coordinate bases FX's BM-7
12. Check item:1~9

LED*线路8串5并(双芯片)

BOE 1920*1080

Active Center

BHSR-02VS-1

CN1：20455-030E-12（1-PIN）
CN1插入方向

EDP Interface connector		
Pin NO.	Symbol	Description
1	NC	No Connection
2	NC	No Connection
3	IL_GND	Ground
4	LANE1_P	eDP RX channel 1 positive
5	LANE1_N	eDP RX channel 1 negative
6	Lane0_N	eDP RX channel 0 negative
7	Lane0_P	eDP RX channel 0 positive
8	IL_GND	Ground
9	AUX_CH_P	eDP AUX CH positive
10	AUX_CH_N	eDP AUX CH negative
11	IL_GND	Ground
12	LCD_VCC	Power Supply, 3.3V (typ.)
13	LCD_VCC	Power Supply, 3.3V (typ.)
14	NC	No Connection
15	IL_GND	Ground
16	IL_GND	Ground
17	HPD	Hot plug detect output
18	IL_GND	Ground
19	IL_GND	Ground
20	IL_GND	LED Ground
21	IL_GND	LED Ground
22	BL_ENABLE	LED enable pin(>2.3V Input;1.F not uses,NC
23	BL_PWM	System PWM Signal Input;1.F not uses,NC
24	NC	No Connection
25	NC	No Connection
26	BL_POWER	LED Power Supply 5V~21V;1.F not uses,NC
27	BL_POWER	LED Power Supply 5V~21V;1.F not uses,NC
28	BL_POWER	LED Power Supply 5V~21V;1.F not uses,NC
29	BL_POWER	LED Power Supply 5V~21V;1.F not uses,NC
30	NC	No Connection

SM:	DESCRIPTION OF REVISION	REASON	REVISED BY	DATE
△	first issue	A	XG.SU	2023/03/23

TITLE: OUTLINE DIMENSION
DRAWN BY:
CHECKED BY:
APPROVED BY:
Rev:A
D/N:AM19201080-156C-A
SCALE 1:1
SHEET NO 1 OF 1
UNIT: mm

于都上晴电子有限公司
YU DU AMSON ELECTRONICS Co.,Ltd.

4. Interface Description
4-1 Driving interface of PWB

CN1 (eDP signals，+3.3V DC power supply and B/L power supply)

Pin No.	Symbol	I/O	Function	Remark
1	NC	-	Reserved for CD	[Note4-1-1]
2	H_GND	P	High Speed round	[Note4-1-2]
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	[Note4-1-2]
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	[Note4-1-2]
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	[Note4-1-2]
12	LCD_VDD	P	LCD logic and driver power(3.3V)	
13	LCD_VDD	P	LCD logic and driver power(3.3V)	
14	NC	I	Reserved for LCD manufacturer's use	[Note4-1-1]
15	LCD_GND	P	LCD logic and driver ground	
16	LCD_GND	P	LCD logic and driver ground	
17	HPD	O	HPD signal pin	[Note4-1-3]
18	LED-1	P	NC	
19	LED-2	P	NC	
20	LED-3	P	NC	
21	LED-4	P	NC	
22	BL_ENABLE	I	NC	
23	BL_PWM_DIM	I	NC	
24	NC	-	NC	
25	NC	-	NC	
26	BL_PWR	P	NC	
27	BL_PWR	P	NC	
28	BL_PWR	P	NC	
29	BL_PWR	P	NC	
30	NC	-	Reserved for LCD manufacturer's use	[Note4-1-1]

*1P: POWER / I: INPUT / O: OUTPUT

[Note 4-1-1] Don't input any signals or any powers into a NC pin. Keep the NC pin open.
[Note 4-1-2] The shielding case is connected with signal GND.
　・Connector used :20455-030E-76(I-PEX)
　・Corresponding connector : 20453-030T (I-PEX)

(Panda is not responsible to its product quality, if the user applies a connector not corresponding to the above model.)

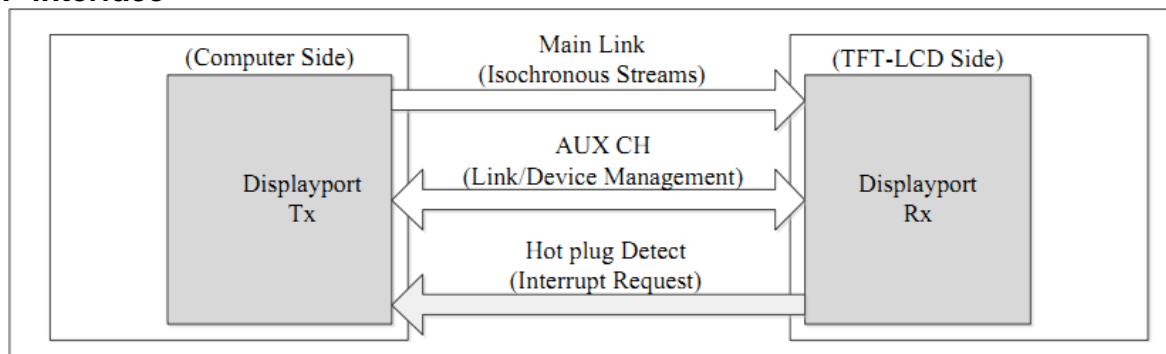**CN1 pin 1 position**

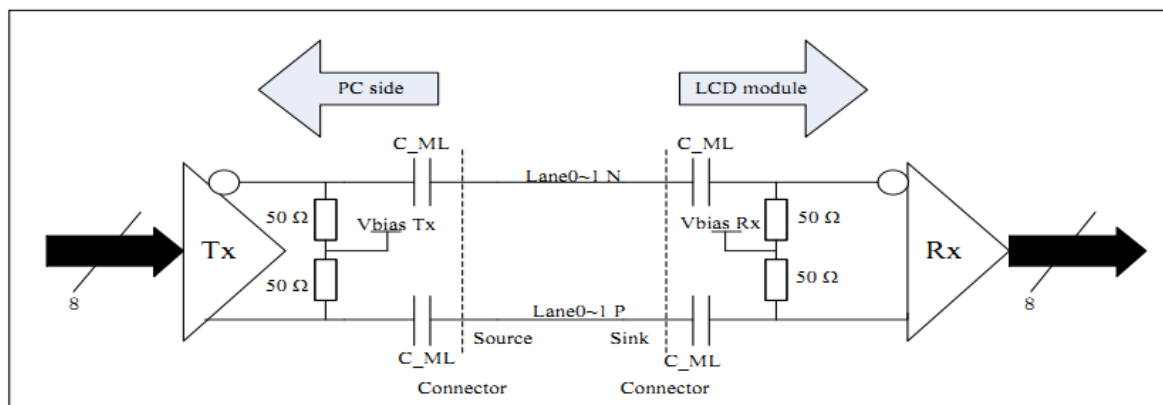**4-2 eDP interface**

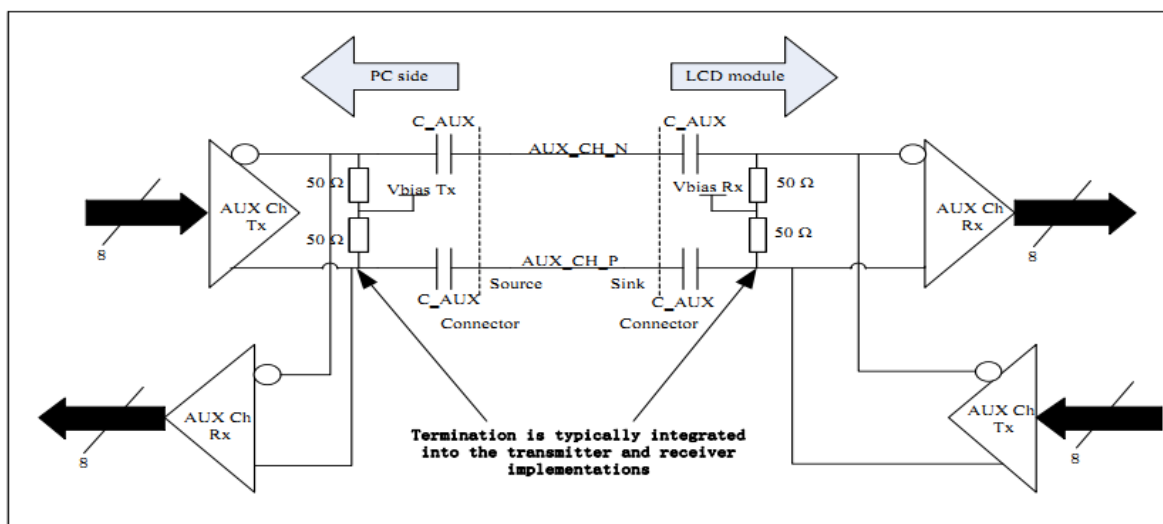Fig.4-2-1 DP architecture

Fig.4-2-2 Main Link differential pair

Fig.4-2-3 AUX Link differential pair

Lane 0	
R0-5:0	G0-5:4
G0-3.0	B0-5:2
B0-1:0	R1-5:0
G1-5:0	B1-5:4
B1-3:0	R2-5:2
R2-1:0	G2-5:0
B2-5:0	R3-5:4
R3-3:0	G3-5:2
G3-1:0	B3-5:0

5. Absolute Maximum Ratings

Parameter	Symbol	Condition	Ratings		Unit	Remark
			MIN	MAX		
+3.3V supply voltage	VDD	Ta=25℃	-0.3	+4.0	V	
Input voltage(eDP)	VI	Ta=25℃	-0.3	+1.5	V	[Note 5-1]
Input voltage(BL)	VBL_I	Ta=25℃	-0.3	VDD+0.3	V	[Note 5-2]
Storage temperature	Tstg		-0	+50	℃	[Note 5-3]
Operation temperature	Topa		-20	+60	℃	

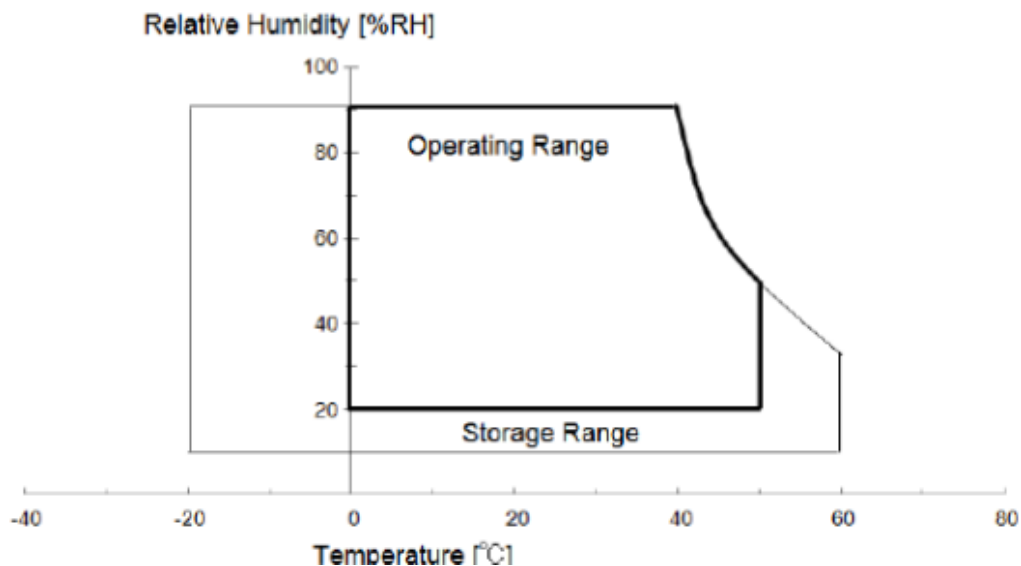(*) "Absolute Maximum Ratings" is regulations that do not exceed it even momentarily.

(*) 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℃.

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

6. DC Characteristics

DC Electrical Characteristics						
Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
+3.3V supply voltage	VDD	+3.0	+3.3	+3.6	V	[Note 6-1]
Current dissipation	IDD	-	(180)	(290)	mA	[Note 6-2]
Permissible input ripple voltage	VRP	-	-	100	mVp-p	VDD=+3.3V
eDP AUX Channel Characteristics						
Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Unit Interval for AUX channel	UI_{AUX}	0.4	0.5	0.6	µS	
Peak-to-peak voltage at TP1	$V_{AUX-DIFF-pp}$	0.32	-	1.36	V	
AUX DC Common mode Voltage	$V_{AUX-DC-CM}$	0	-	2.0	V	
AUX Short current limit	I_{AUX_SHORT}	-	-	90	mA	
AUX CH termination DC resistor	R_{AUX_TERM}	-	100	-	Ω	Differential input
AUX AC coupling capacitor	C_{AUX}	75	-	200	nF	
Number of pre-charge pulses	Pre-charge pulses	10	-	16	-	
eDP AUX Channel Characteristics						
Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Link clock down spreading	Down_Spread_Am plitude	0		0.5	%	
Differential Peak-to-peak Input Voltage at Rx package pins	$V_{RX-DIFFp-p}$	90		1200	mV	
Differential Return Loss at 1.35GHz at Rx package pins	$RL_{RX-DIFF}$	9	-	-	dB	
Differential termination resistance	$R_{RX-TERM}$	-	100	-	Ω	
RX short circuit Current Limit	$I_{RX-SHORT}$		-	50	mA	
Lane Intra-pair Skew at RX package pins	$T_{RX-SKEW-NTRA-PAIR-High-Bit-Rate}$	-	-	50	ps	

[Note 6-1] ON-OFF conditions for supply voltage.
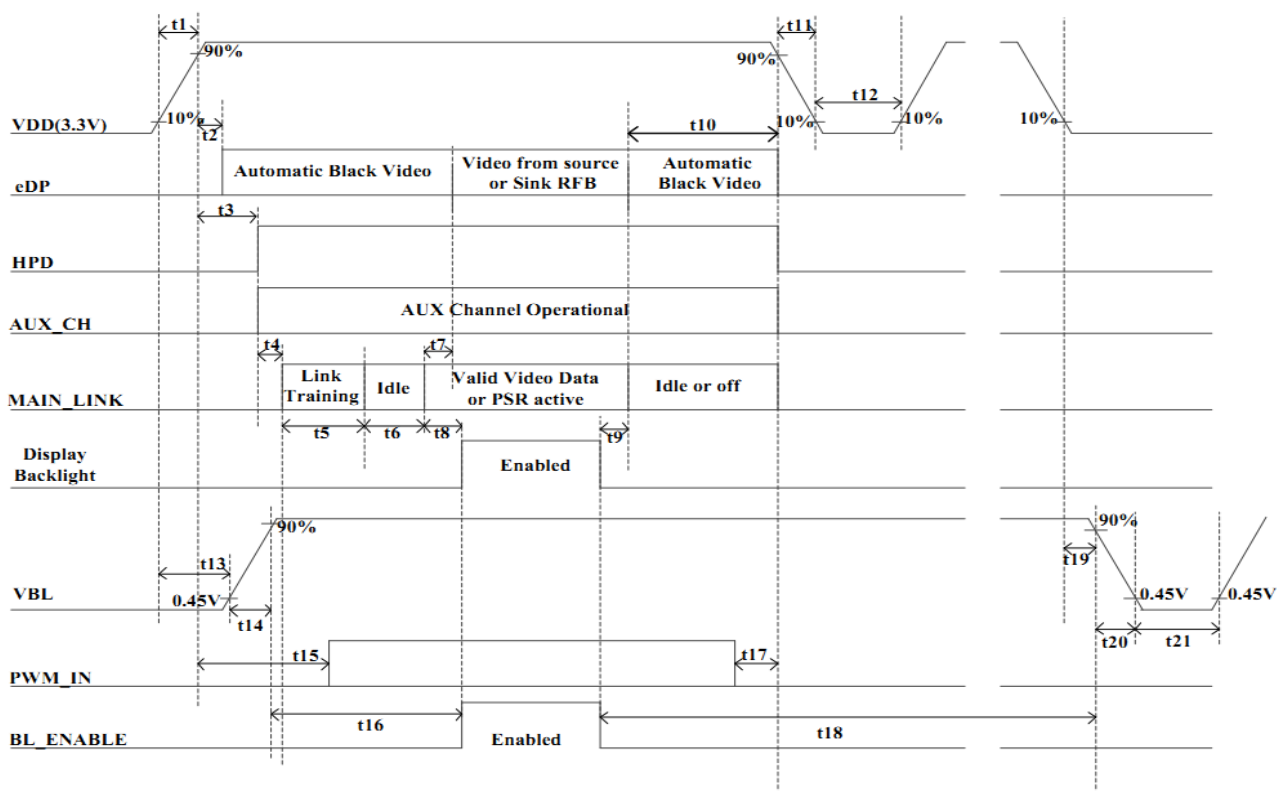
[Note6-2] Do not keep the interface signal high-impedance or unusual signal when power is on.

Symbol	Min	Max	Unit	Note
t1	0.5	10	ms	
t2	0	200	ms	
t3	0	100	ms	
t4	-	-	ms	
t5	-	-	ms	
t6	-	-	ms	
t7	(0)	(50)	ms	
t8	-	-	ms	
t9	-	-	ms	
t10	0	500	ms	
t11	1	50	ms	
t12	500	-	ms	[Note 6-3]
t13	-	-	ms	
t14	0.5	10	ms	
t15	100	-	ms	
t16	-	-	ms	
t17	0	-	ms	
t18	-	-	ms	
t19	-	-	ms	
t20	(0.1)	-	ms	
t21	(100)	-	ms	

[Note 6-3]As for the power off sequence for VDD (t11), be sure to keep above mentioned timing. If the VDD power off sequence timing is other than shown above, LCD may cause permanent damage.

*1 : As for the power sequence for backlight, it is recommended to apply above mentioned input timing.

If the backlight is light on and off at a timing other than shown above, displaying image maybe get disturbed.

VDD-dip-conditions
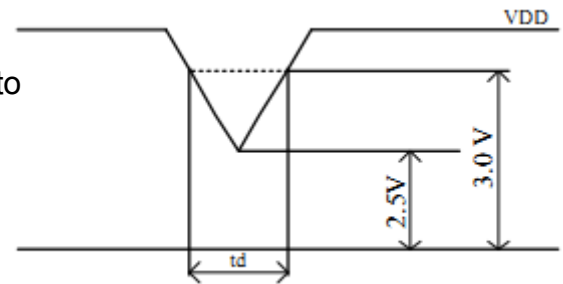1) $2.5\ V \leqq VDD < 3.0\ V$
  $td \leqq 10\ ms$

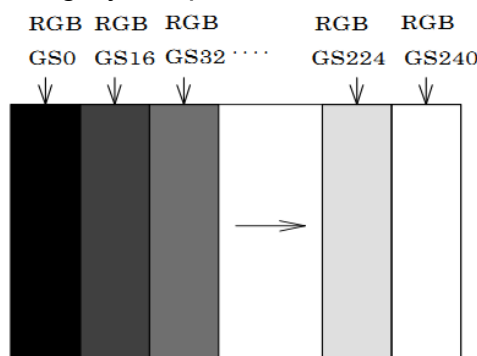Under above condition, the display image should return to an appropriate figure after VDD voltage recovers.
2) $VDD < 2.5\ V$
  VDD-dip conditions should also follow the ON-OFF conditions for supply voltage.

[Note 6-2]
Typical current condition: 16-gray-bar pattern. VDD＝+3.3V

Maximum current condition: Vertical stripe pattern. VDD＝+3.3V

7. Timing characteristics of input signals
7.1 Timing characteristics

Item		Symbols	Min	Typ	Max	Unit
Clock	Frequency	1/Tc	101	152.6	158	MHz
	High Time	Tch	-	4/7	-	Tc
	Low Time	Tcl	-	3/7	-	Tc
Frame Period		Tv	1100	1140	1200	lines
			-	60	-	Hz
			-	16.7	-	ms
Vertical Display Period		Tvd	-	1080	-	lines
One line Scanning Period		Th	2080	2230	2400	clocks
Horizontal Display Period		Thd	-	1920	-	clocks

[Note 7-1-1] In case of using the long vertical period, the deterioration of display quality, flicker, etc, may occur.

7.2. Input data signals and display position on the screen

Display position of input data(VH)

7.3 Input sigal,basic display colors and gray scale of each color

	Colors & Gray scale	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

Each basic color can be displayed in 256 gray scales from 8 bit data signals.
According to the combination of 24 bit data signals, the 16.7M color display can be achieved on the screen.
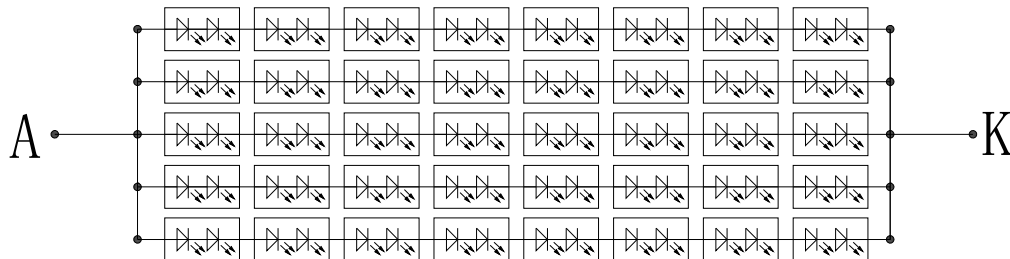
7.4 EDID Specifications (TBD)

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	F1	241		1777	ID = 1777
0B		06	6			
0C	32-bit serial No.	00	0			
0D		00	0			
0E		00	0			
0F		00	0			
10	Week of manufacture	01	1		1	
11	Year of Manufacture	1A	26		2016	Manufactured in 2016
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		-	digital signal/DP input
15	Max H image size	22	34		34	34 cm (Approx)
16	Max V image size	13	19		19	19 cm (Approx)
17	Display Gamma	78	120		2.2	Gamma curve = 2.2
18	Feature support	0A	10			RGB display, Preferred Timming mode
19	Red/Green low bits	00	0		-	Red / Green Low Bits
1A	Blue/White low bits	10	16		-	Blue / White Low Bits
1B	Red x high bits	A7	167	668	0.653	Red (x) = 10100111 (0.653)
1C	Red y high bits	57	87	348	0.340	Red (y) = 01010111 (0.34)
1D	Green x high bits	51	81	324	0.317	Green (x) = 01010001 (0.317)
1E	Green y high bits	A1	161	644	0.629	Green (y) = 10100001 (0.629)
1F	Blue x high bits	27	39	156	0.153	Blue (x) = 00100111 (0.153)
20	BLue y high bits	10	16	65	0.064	Blue (y) = 00010000 (0.064)
21	White x high bits	50	80	320	0.313	White (x) = 01010000 (0.313)
22	White y high bits	54	84	336	0.329	White (y) = 01010100 (0.329)
23	Established timing 1	00	0		-	
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	9C	156		152.6	152.6MHz Main clock
37		3B	59			
38		80	128		1920	Hor Active = 1920
39		36	54		310	Hor Blanking = 310
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 table31

48	Detailed timing/monitor descriptor #2	FD	253		117.7	117.73MHz Main clock
49		2D	45		
4A		80	128		1920	Hor Active = 1920
4B		0E	14		270	Hor Blanking = 270
4C		71	113		-	4 bits of Hor. Active + 4 bits of Hor. Blanking
4D		38	56		1080	Ver Active = 1080
4E		28	40		40	Ver Blanking = 40
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			
5A	Detailed timing/monitor descriptor #3	00	0			ASCII Data Sting Tag
5B		00	0			
5C		00	0			
5D		FE	254			
5E		00	0			
5F		4D	77		M	D/PN:MH98N
60		48	72		H	
61		39	57		9	
62		38	56		8	
63		4E	78		N	
64		**0B**	**11**	00001011		**EDID:X11**
65		4E	78		N	BOE PN:NV15 N43
66		56	86		V	
67		31	49		1	
68		35	53		5	
69		4E	78		N	
6A		34	52		4	
6B		33	51		3	

6C		00	0		
6D		00	0		
6E		00	0		Product Name Tag (ASCII)
6F		00	0		
70		00	0		
71		00	0	00000000	6-bit Color Depth & no FRC
72		41	65	01000001	WLED & singal light bar & one light bar
73		22	34	00100010	Frame rate 48Hz~65Hz
74	Detailed timing/monitor descriptor #4	9E	158	10011110	Light Controller:PWM & Max. Luminance 300
75		00	0	00000000	Front Surface: AG & RGB v-stripe
76		10	16	00010000	NTSC & DBC
77		00	0	00000000	no Motion Blur & no Active Gamma
78		00	0	00000000	no Wireless Enhancement & no In-Cell Scanner
79		0A	10	00001010	2 lane edp1.3
7A		01	1	00000001	Built-In Self Test
7B		0A	10		
7C		20	32		
7D		20	32		
7E	Extension flag	00	0		
7F	Checksum	39	57	57	-

8. Backlight Characteristic

LED*线路8串5并（双芯片）

Item	Symbol	MIN	TYP	MAX	UNIT	Test Condition
Supply Voltage	Vf	39.2	46	47.6	V	
Supply Current	If	-	420		mA	
Luminous Intensity for LCM	-	850	1000	-	cd/m²	
Uniformity for LCM	-	75	-	-	%	
Life Time	-	-	30000	-	Hr	

9. Optical Characteristics

Paramete	Conditions		Min.	Typ.	Max.	Unit	Note
Viewing Angle (CR>10)	Horizontal	θL	-	80	-	degree	[Note9-1,9-3,9-4,9-6]
		θR	-	80	-		
	Vertical	θT	-	80	-		
		θB	-	80	-		
Contrast Ratio	Center		700	1000	-	-	[Note9-2,9-4,10-6]
Response Time	Tr+Td		-	25	35	ms	[Note9-1,9-5,9-6]
CF Color Chromaticity (CIE1931)	Red x		Typ. -0.05	TBD	Typ. +0.05	-	[Note 9-2,9-6] Normal operation (PWM Duty=100%)
	Red y			TBD		-	
	Green x			TBD		-	
	Green y			TBD		-	
	Blue x			TBD		-	
	Blue y			TBD		-	
	White x			TBD		-	
	White y			TBD		-	
NTSC ratio	%			(72)		-	

※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.

Detector (EZ-CONTRAST/ Photodiode)

Middle of the screen (θ=0°)

TFT-LCD Module

400mm

Detector (SR-3)

Field=2°
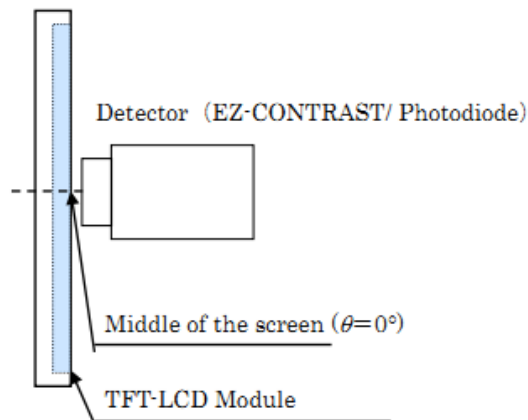
Middle of the screen (θ=0°)

TFT-LCD Module

Fig.9-1 Measurement of Viewing angle range and Response time. (Viewing angle range: EZ-CONTRAST, Response time: Photodiode)
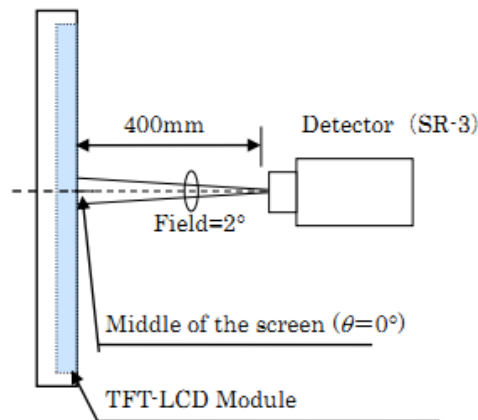
Fig.9-2 Measurement of Contrast, Luminance, Chromaticity, White variation, Crosstalk andColor temperature variation.

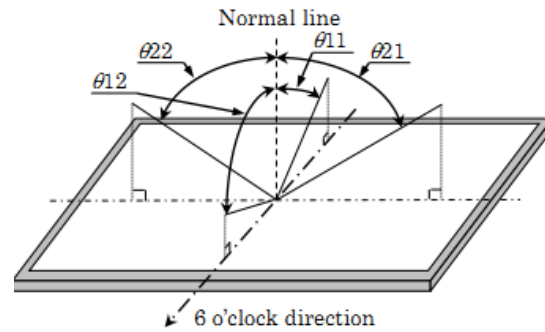[Note 9-3]Definitions of viewing angle range

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".
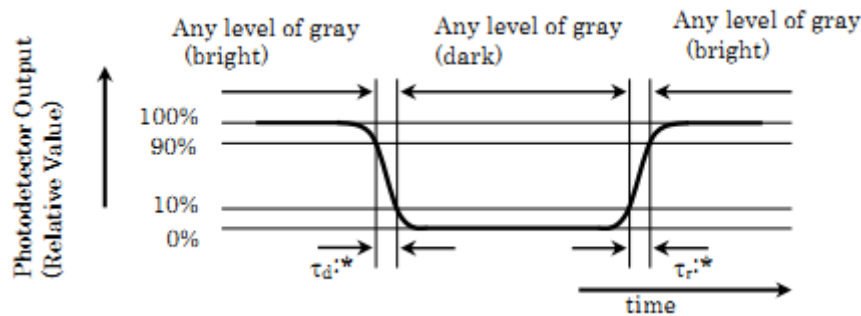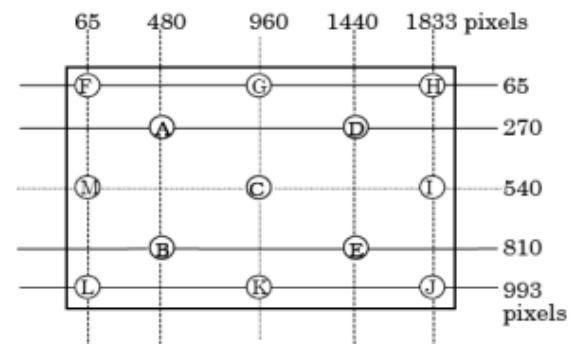

Fig.9-4 Response **time**

[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 5 measurements(A~M)

$$\delta W = \frac{\text{Maximum Luminance of 5 Points(Brightness)}}{\text{Minimum Luminance of 5 Points(Brightness)}}$$

10. Reliability Test Items

No.	Test Item	Conditions
1	High temperature storage test	Ta=60℃ 240h
2	Low temperature storage test	Ta=-20℃ 240h
3	High temperature & high humidity operation test	Ta=40℃90%RH 240h (No condensation)
4	High temperature operation test	Ta=50℃ 240h
5	Low temperature operation test	Ta=0℃ 240h

[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

11. Display Quality

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

12. Handling Precautions

a)   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.

b)   Be sure to design the cabinet so that the module can be installed without any extra stress such as warp or   twist.

c)   Since the front polarizer is easily damaged, pay attention not to scratch it.

d)   Wipe off water drop immediately. Long contact with water may cause discoloration or spots.

e)   When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.

f)   Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface. Handle with care.

g)   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.

h)   This module has its circuitry PCBs on the side and should be handled carefully in order not to be stressed.

i)   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)

j)   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.

k)   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.

l)   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.

m)   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.

n)   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.

13. Precaution for Use

13.1

A limit sample should be provided by the both parties on an occasion when the both parties agreed its necessity. Judgment by a limit sample shall take effect after the limit sample has been established and confirmed by the both parties.

13.2

On the following occasions, the handing of problem should be decided through discussion and agreement between responsible of the both parties.

● When a question is arisen in this specification
● When a new problem is arisen which is not specified in this specifications
● When an inspection specifications change or operating condition change in customer is reported to AMSON TFT , and some problem is arisen in this specification due to the change
● When a new problem is arisen at the customer's operating set for sample evaluation in the customer site.

14. Packing Method

TBD