☐ Tentative Specification
☐ Preliminary Specification
■ Approval Specification

MODEL NO.: SA00DK1

SUFFIX: K02

Revision : R1
Customer :

APPROVED BY SIGNATURE

Name / Title _____ _____
Note

Please return 1 copy for your confirmation with your signature and comments.

Approved By	Checked By	Prepared By
Roger Huang	Chih-Fan Ting	Chia-Wen Chen

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REVISION HISTORY

Version	Date	Page (New)	Section	Description
Ver. 0.0	5/26, 2017	All	All	The tentative specification was first released.
Ver. 1.0	8/9,2017	All	All	The preliminary specification was first released.
Ver. 2.0	8/31,2017	All	All	The approval specification was first released.

1. GENERAL DESCRIPTION

1.1 OVERVIEW

SA00DK1-K02 is a 99.5" TFT Liquid Crystal Display PID module with LED Backlight unit and 16Lane V-by-one interface. This module supports 3840 x 2160 Quad Full HDTV format and can display true 1.07G colors (8-bit+FRC).

1.2 FEATURES

- High brightness 700 nits
- High contrast ratio 3000:1
- Fast response time Gray to Gray typical : 6.5 ms
- High color saturation NTSC 98%
- Quad Full HDTV (3840 x 2160 pixels) resolution, true Quad Full HDTV format
- V-by-One interface
- Optimized response time for 100Hz/120Hz frame rate
- Viewing Angle : 178(H)/178(V) (CR>10) VA Technology
- Ultra wide viewing angle : Super MVA technology
- RoHs compliance
- T-con input frame rate : QFHD 100/120Hz, Output frame rate: QFHD 100/120Hz

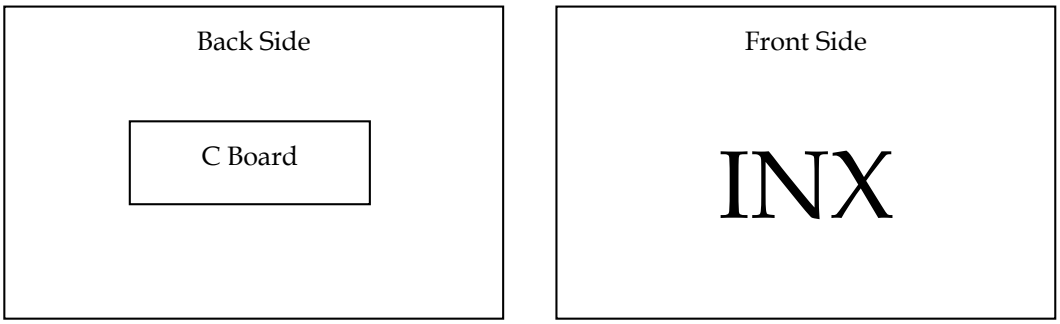
1.3 GENERAL SPECIFICATI0NS

Item	Specification	Unit	Note
Active Area	2203.2(H) x 1239.3(V) (99.5" diagonal)	mm	(1)
Bezel Opening Area	2207.2(H) x 1243.3(V)	mm	
Driver Element	a-si TFT active matrix	-	-
Pixel Number	3840 x R.G.B. x 2160	pixel	-
Pixel Pitch (Sub Pixel)	0.19125(H) x 0.5735(V)	mm	-
Pixel Arrangement	RGB vertical stripe	-	-
Display Colors	1.07G colors (8-bit+FRC)	color	-
Display Operation Mode	Transmissive mode / Normally black	-	-
Surface Treatment	AGLR / Hardness 3H	-	(2)
Rotation Function	Unachievable		(3)
Display Orientation	Signal input with "INX"		(3)

Note (1) Please refer to the attached drawings in chapter 11 for more information about the front and back outlines.

Note (2) The spec of the surface treatment is temporarily for this phase. INX reserves the rights to change this feature.

Note (3)



1.4 MECHANICAL SPECIFICATIONS

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	2249.3	2251.8	2254.3	mm	(1),(2)
	Vertical (V)	1282.6	1285.1	1287.6	mm	(1),(2)
	Depth (D)	40.5	41.5	43	mm	To Rear
		42.6	44.1	45.6	mm	To P-Cover
Weight			61000		g	

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.

Note (2) Module Depth does not include connectors.

2. ABSOLUTE MAXIMUM RATINGS

2.1 ABSOLUTE RATINGS OF ENVIRONMENT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	T_{ST}	-20	+60	°C	(1)
Operating Ambient Temperature	T_{OP}	0	50	°C	(1), (2)
Shock (Non-Operating)	S_{NOP}	-	35	G	(3), (5)
Vibration (Non-Operating)	V_{NOP}	-	1.0	G	(4), (5)

Note (1) Temperature and relative humidity range is shown in the figure below.

(a) 90 %RH Max. (Ta ≦ 40 °C).

(b) Wet-bulb temperature should be 39 °C Max.

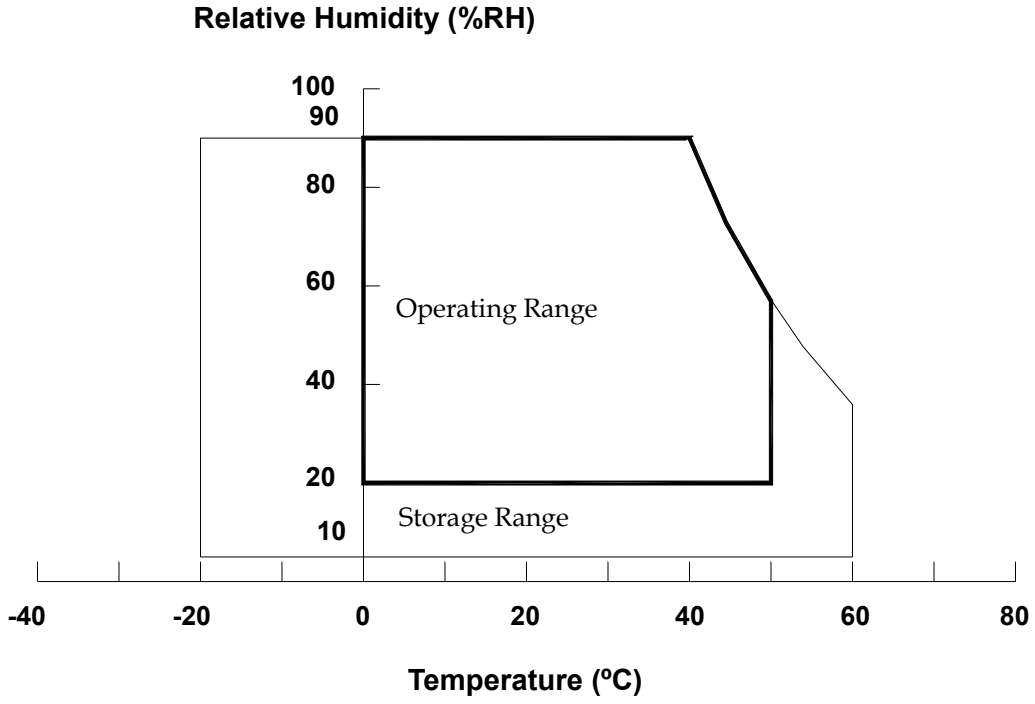
(c) No condensation.

Note (2) Thermal management should be considered in final product design to prevent the surface temperature of display area from being over 65 °C. The range of operating temperature may degrade in case of improper thermal management in final product design.

Note (3) 11 ms, half sine wave, 1 time for ± X, ± Y, ± Z.

Note (4) 10 ~ 200 Hz, 30 min, 1 time each X, Y, Z.

Note (5) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.



2.2 PACKAGE STORAGE

When storing modules as spares for a long time, the following precaution is necessary.

(a) Do not leave the module in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35 ℃ at normal humidity without condensation.

(b) The module shall be stored in dark place. Do not store the TFT-LCD module in direct sunlight or fluorescent light.

2.3 ELECTRICAL ABSOLUTE RATINGS

2.3.1 TFT LCD MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	V_{CC}	-0.3	13.5	V	(1)
Logic Input Voltage	V_{IN}	-0.3	3.6	V	

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions

2.3.2 BACKLIGHT CONVERTER UNIT

Item	Symbol	Test Condition	Min.	Type	Max.	Unit	Note
Light Bar Voltage	V_W	Ta = 25 ℃	-	-	50.64	V_{RMS}	

3. ELECTRICAL CHARACTERISTICS

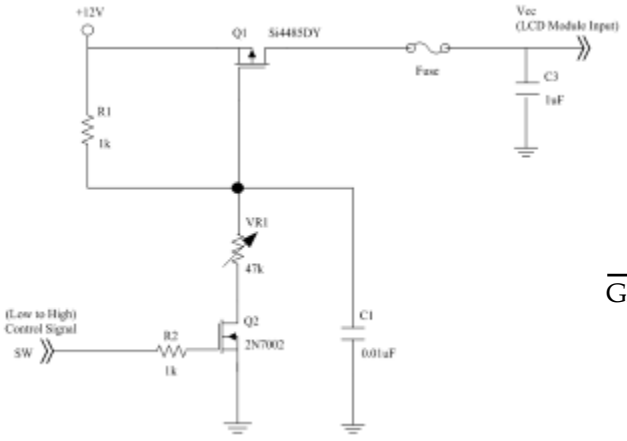
3.1 TFT LCD MODULE

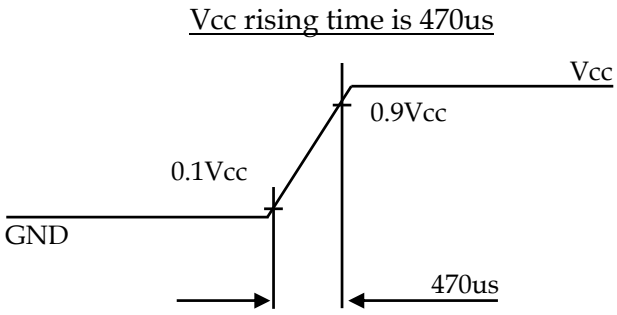
(Ta = 25 ± 2 °C)

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		V_{CC}	10.8	12	13.2	V	(1)
Rush Current		I_{RUSH}	—	—	9.88	A	(2)
Power consumption	White Pattern	P_T	—	27.78	30.56	W	(3)
	Black Pattern	P_T	—	27.08	29.79		
	Heavy Loading pattern 2W2B (by cell and platform)	P_T	—	77.65	85.41		
Power Supply Current	White Pattern	P_T	—	2.64	2.86	A	
	Black Pattern	P_T	—	2.59	2.81		
	Heavy Loading pattern 2W2B (by cell and platform)	P_T	—	7.5	8.13		
V-by-One HS	Differential Input High Threshold Voltage	V_{LVTH}	—	—	+50	mV	(4)
	Differential Input Low Threshold Voltage	V_{LVTL}	-50	—	—	mV	
	Differential Input Resistor	R_{RIN}	80	100	120	ohm	
CMOS interface	Input High Threshold Voltage	V_{IH}	2.7	—	3.6	V	
	Input Low Threshold Voltage	V_{IL}	0	—	0.7	V	

Note (1) The module should be always operated within the above ranges. The ripple voltage should be controlled under 10% of Vcc (Typ.)

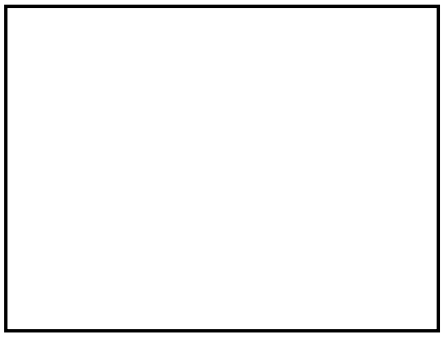
Note (2) Measurement condition :





Note (3) The specified power supply current is under the conditions at Vcc = 12 V, Ta = 25 ± 2 °C, fv = 120 Hz, whereas a power dissipation check pattern below is displayed.

a. White Pattern

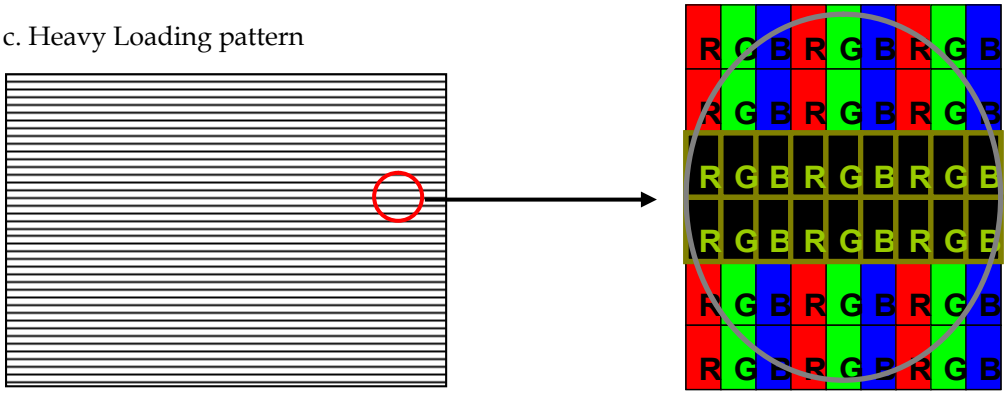


Active Area

b. Black Pattern

Active Area

c. Heavy Loading pattern



3.2 BACKLIGHT UNIT

3.2.1 LED LIGHT BAR CHARACTERISTICS

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Power Consumption	$P_{BL(2D)}$	—	377.48	428.57	W	(1), (2)
Converter Input Voltage	VBL	22.8	24.0	25.2	VDC	
Converter Input Current	$I_{BL(2D)}$	—	15.73	17.86	A	Non Dimming
Input Inrush Current	$I_{R(2D)}$	—	—	25.75	Apeak	V_{BL}=22.8V (3), (6)
Dimming Frequency	FB	150	160	170	Hz	(5)
Dimming Duty Ratio	DDR	5	-	100	%	(4), (5)
Life Time	-	50,000	-	-	Hrs	(7)

Note (1) The power supply capacity should be higher than the total converter power consumption P_{BL}. Since the pulse width modulation (PWM) mode was applied for backlight dimming, the driving current changed as PWM duty on and off. The transient response of power supply should be considered for the changing loading when converter dimming.

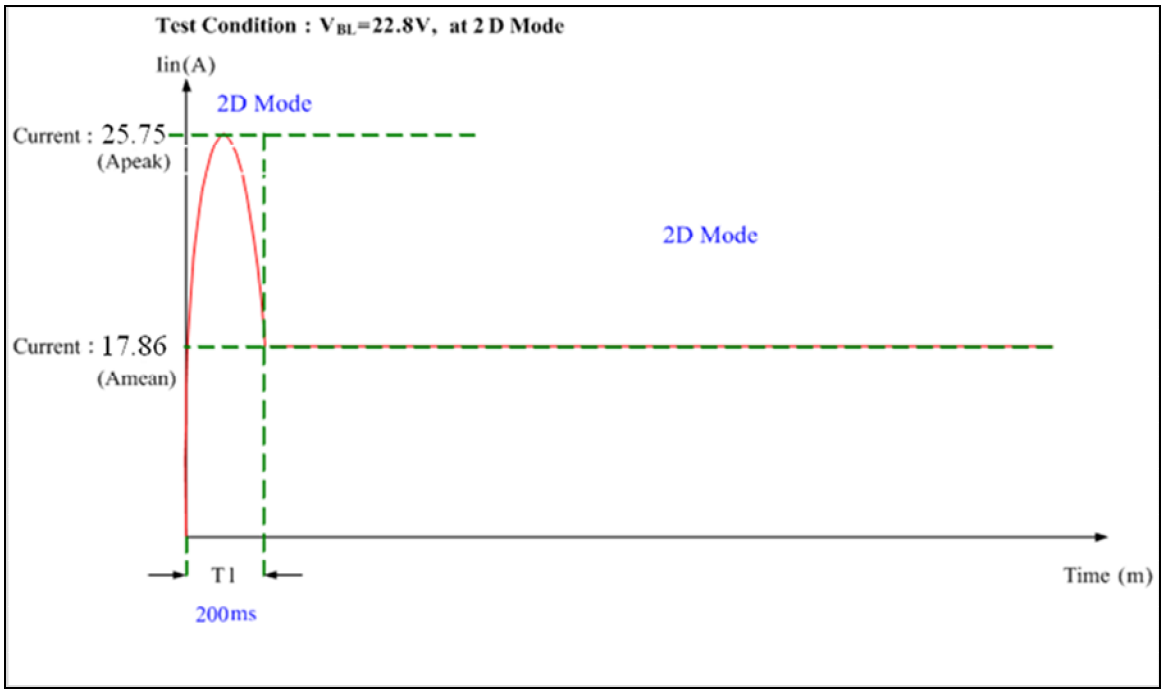
Note (2) The measurement condition of Max. value is based on 100" backlight unit under input voltage 24V, at 2D Mode and lighting 1 hour later.

Note (3) For input inrush current measure, the VBL rising time from 10% to 90% is about 20ms.

Note (4) EPWM signal have to input available duty range. Between 97% and 100% duty (DDR) have to be avoided. (97% < DDR < 100%) But 100% duty (DDR) is possible. 5% duty (DDR) is only valid for electrical operation.

Note (5) FB and DDR are available only at 2D Mode.

Note (6) Below diagram is only for power supply design reference.



Note (7) The lifetime is defined as the time which luminance of the LED decays to 50% compared to the initial value, Operating condition: Continuous operating at Ta = 25±2℃

3.2.2 CONVERTER INTERFACE CHARACTERISTICS

Parameter		Symbol	Test Condition	Value			Unit	Note	
				Min.	Typ.	Max.			
On/Off Control Voltage	ON	VBLON	—	2.0	—	5.0	V		
	OFF		—	0	—	0.8	V		
External PWM Control Voltage	HI	VEPWM	—	2.0	—	5.25	V	Duty on	(5), (6)
	LO		—	0	—	0.8	V	Duty off	
External PWM Frequency		F_{EPWM}	—	150	160	170	Hz	Normal mode (7)	
Error Signal		ERR	—	—	—	—	—	Abnormal: Open	
VBL Rising Time		Tr1	—	20	—	—	ms	10%-90%V_{BL}	
Control Signal Rising Time		Tr	—	—	—	100	ms		
Control Signal Falling Time		Tf	—	—	—	100	ms		
PWM Signal Rising Time		TPWMR	—	—	—	50	us	(6)	
PWM Signal Falling Time		TPWMF	—	—	—	50	us		
Input Impedance		Rin	—	1	—	—	MΩ	EPWM, BLON	
PWM Delay Time		TPWM	—	100	—	—	ms	(6)	
BLON Delay Time		T_{on}	—	300	—	—	ms		
		T_{on1}	—	300	—	—	ms		
BLON Off Time		Toff	—	300	—	—	ms		

Note (1) The Dimming signal should be valid before backlight turns on by BLON signal. It is inhibited to change the external PWM signal during backlight turn on period.

Note (2) The power sequence and control signal timing are shown in the Fig.1. For a certain reason, the converter has a possibility to be damaged with wrong power sequence and control signal timing.

Note (3) While system is turned ON or OFF, the power sequences must follow as below descriptions:

Turn ON sequence: VBL → PWM signal → BLON

Turn OFF sequence: BLOFF → PWM signal → VBL

Note (4) When converter protective function is triggered, ERR will output open collector status. Please refers to Fig.2.

Note (5) The EPWM interface that inserts a pull up resistor to 5V in Max Duty (100%), please refers to Fig.3.

Note (6) EPWM is available only at 2D Mode.

Note (7) EPWM signal have to input available frequency range.

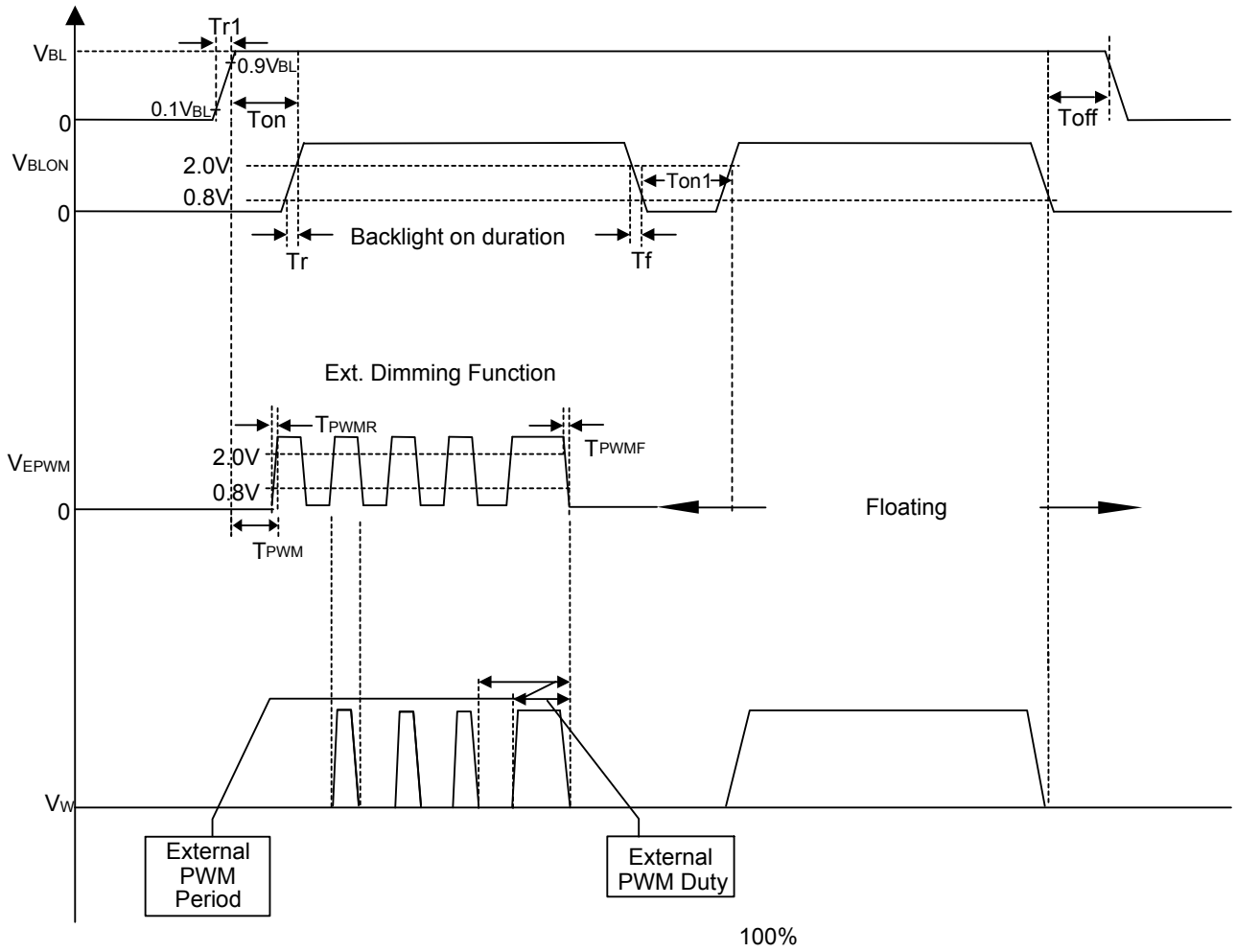


Fig. 1

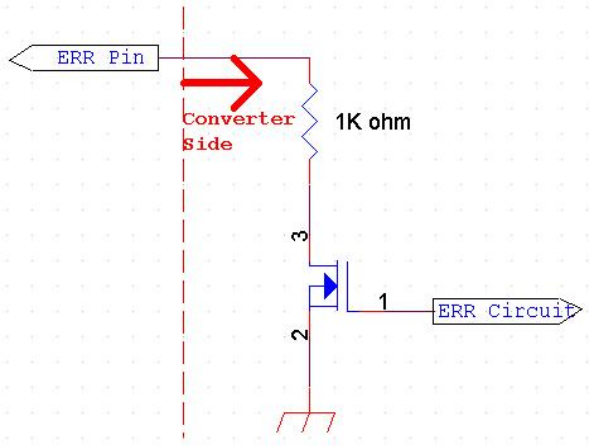


Fig. 2

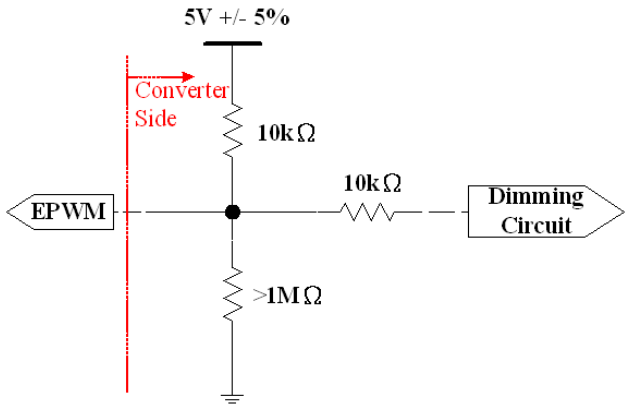


Fig. 3

4. INPUT TERMINAL PIN ASSIGNMENT

4.1 TFT LCD MODULE

CNV1 Connector Pin Assignment: [187059-51221(P-Two) , WF23-402-5133(FCN)]

Matting Connector : [FI-RE51HL (JAE)]

Pin	Name	Description	Note
1	N.C.	No Connection	(9)
2	N.C.	No Connection	
3	N.C.	No Connection	
4	N.C.	No Connection	
5	N.C.	No Connection	
6	N.C.	No Connection	
7	N.C.	No Connection	
8	N.C.	No Connection	
9	N.C.	No Connection	
10	GND	Ground	
11	GND	Ground	
12	GND	Ground	
13	GND	Ground	
14	GND	Ground	
15	N.C.	No Connection	(6)
16	N.C.	No Connection	(6)
17	2D	Please, Pull Low 1kohm to GND	
18	SDA	I2C Data signal	(2)
19	SCL	I2C Clock signal	(2)
20	WP	Write Protection (0V~0.7V/Open→Disable, 2.7V~3.3V→Enable) (for Auto-Vcom)	
21	STV	STV output for local dimming use.	(6)
22	N.C.	No Connection	(6)
23	TST_AGE	TST_AGE Enable(High level is enable aging mode)	(3)
24	N.C.	No Connection	(6)
25	HTPDN	Hot plug detect output, Open drain.	
26	LOCKN	Lock detect output, Open drain.	
27	GND	Ground	
28	RX0N	1ST Pixel Negative VbyOne differential data input in area A. Lan 0	(1)
29	RX0P	1ST Pixel Positive VbyOne differential data input in area A. Lan 0	
30	GND	Ground	
31	RX1N	2ND Pixel Negative VbyOne differential data input in area A. Lan 1	(1)
32	RX1P	2ND Pixel Positive VbyOne differential data input in area A. Lan 1	

33	GND	Ground	
34	RX2N	3RD Pixel Negative VbyOne differential data input in area A. Lan 2	(1)
35	RX2P	3RD Pixel Positive VbyOne differential data input in area A. Lan 2	
36	GND	Ground	
37	RX3N	4TH Pixel Negative VbyOne differential data input in area A. Lan 3	(1)
38	RX3P	4TH Pixel Positive VbyOne differential data input in area A. Lan 3	
39	GND	Ground	
40	RX4N	5TH Pixel Negative VbyOne differential data input in area A. Lan 4	(1)
41	RX4P	5TH Pixel Positive VbyOne differential data input in area A. Lan 4	
42	GND	Ground	
43	RX5N	6TH Pixel Negative VbyOne differential data input in area A. Lan 5	(1)
44	RX5P	6TH Pixel Positive VbyOne differential data input in area A. Lan 5	
45	GND	Ground	
46	RX6N	7TH Pixel Negative VbyOne differential data input in area A. Lan 6	(1)
47	RX6P	7TH Pixel Positive VbyOne differential data input in area A. Lan 6	
48	GND	Ground	
49	RX7N	8TH Pixel Negative VbyOne differential data input in area A. Lan 7	(1)
50	RX7P	8TH Pixel Positive VbyOne differential data input in area A. Lan 7	
51	GND	Ground	

CNV2 Connector Pin Assignment: [187060-41221(P-TWO) , WF23-400-413C(FCN)]

Matting Connector : [FI-RE41HL(JAE)]

Pin	Name	Description	Note
1	GND	Ground	
2	RX8N	1ST Pixel Negative VbyOne differential data input in area B. Lan 8	(1)
3	RX8P	1ST Pixel Positive VbyOne differential data input in area B. Lan 8	
4	GND	Ground	
5	RX9N	2ND Pixel Negative VbyOne differential data input in area B. Lan 9	(1)
6	RX9P	2ND Pixel Positive VbyOne differential data input in area B. Lan 9	
7	GND	Ground	
8	RX10N	3RD Pixel Negative VbyOne differential data input in area B. Lan 10	(1)
9	RX10P	3RD Pixel Positive VbyOne differential data input in area B. Lan 10	
10	GND	Ground	
11	RX11N	4TH Pixel Negative VbyOne differential data input in area B. Lan 11	(1)

12	RX11P	4TH Pixel Positive VbyOne differential data input in area B. Lan 11	
13	GND	Ground	
14	RX12N	5TH Pixel Negative VbyOne differential data input in area B. Lan 12	(1)
15	RX12P	5TH Pixel Positive VbyOne differential data input in area B. Lan 12	
16	GND	Ground	
17	RX13N	6TH Pixel Negative VbyOne differential data input in area B. Lan 13	(1)
18	RX13P	6TH Pixel Positive VbyOne differential data input in area B. Lan 13	
19	GND	Ground	
20	RX14N	7TH Pixel Negative VbyOne differential data input in area B. Lan 14	(1)
21	RX14P	7TH Pixel Positive VbyOne differential data input in area B. Lan 14	
22	GND	Ground	
23	RX15N	8TH Pixel Negative VbyOne differential data input in area B. Lan 15	(1)
24	RX15P	8TH Pixel Positive VbyOne differential data input in area B. Lan 15	
25	GND	Ground	
26	N.C.	No Connection	(6)
27	N.C.	No Connection	
28	N.C.	No Connection	
29	N.C.	No Connection	
30	N.C.	No Connection	
31	N.C.	No Connection	(8)
32	N.C.	No Connection	
33	N.C.	No Connection	
34	N.C.	No Connection	
35	N.C.	No Connection	(6)
36	N.C.	No Connection	
37	N.C.	No Connection	
38	N.C.	No Connection	(8)
39	N.C.	No Connection	(8)
40	N.C.	No Connection	(6)
41	N.C.	No Connection	(8)

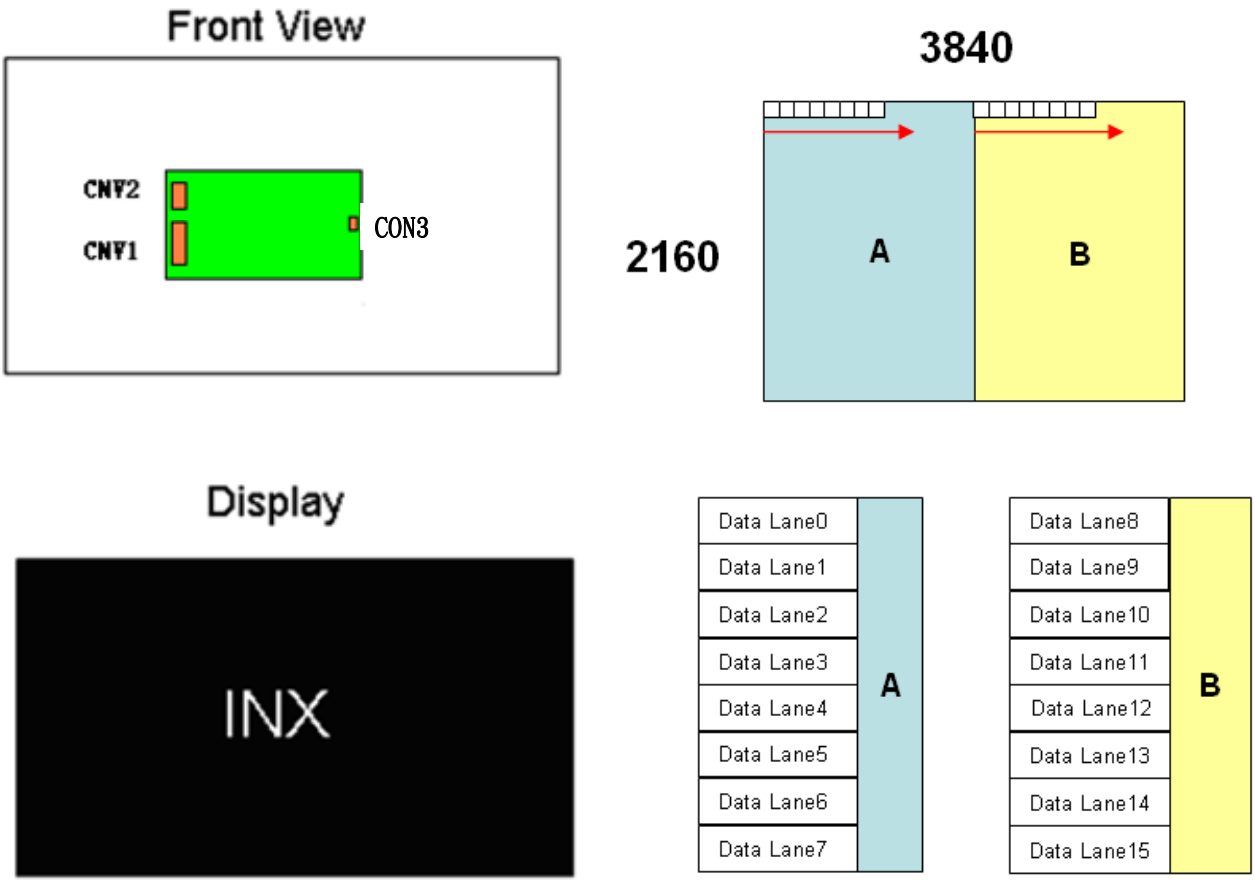
CON3 Connector Pin Assignment: [CI0105M1HR0-LA-NH(瀚荃) , JH2-D4-053N(全康-FCN)]

Matting connector : [PHR5(JST)]

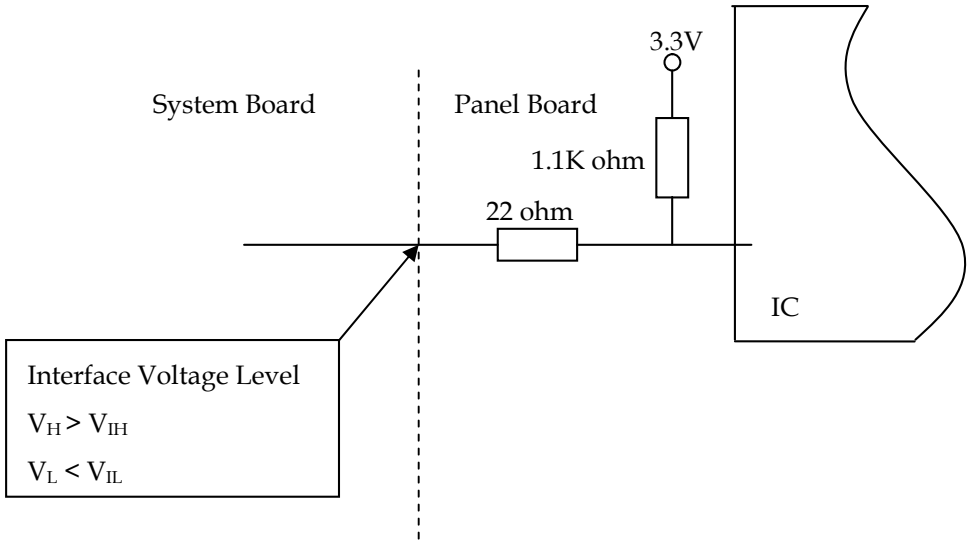
1	GND	Ground	
2	GND	Ground	
3	Vin	Power input (+12V)	(7)
4	Vin	Power input (+12V)	
5	Vin	Power input (+12V)	

Note (1) V-by-One HS Data Mapping

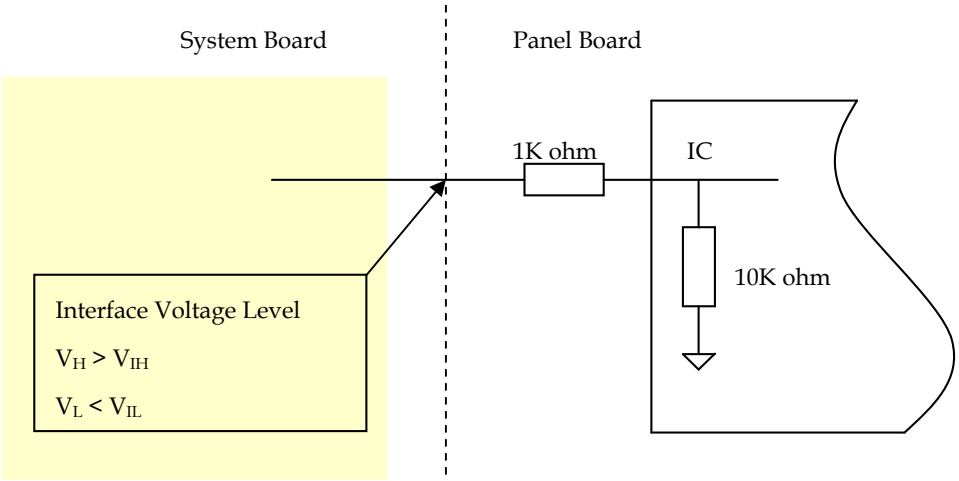
Area	Lane	Data Stream
A	Lane 0	1, 9, 17, ..., 1905, 1913
	Lane 1	2, 10, 18, ..., 1906, 1914
	Lane 2	3, 11, 19, ..., 1907, 1915
	Lane 3	4, 12, 20, ..., 1908, 1916
	Lane 4	5, 13, 21, ..., 1909, 1917
	Lane 5	6, 14, 22, ..., 1910, 1918
	Lane 6	7, 15, 23, ..., 1911, 1919
	Lane7	8, 16, 24, ..., 1912, 1920
B	Lane 8	1921, 1929, 1937, ..., 3825, 3833
	Lane 9	1922, 1930, 1938, ..., 3826, 3834
	Lane 10	1923, 1931, 1939, ..., 3827, 3835
	Lane 11	1924, 1932, 1940, ..., 3828, 3836
	Lane12	1925, 1933, 1941, ..., 3829, 3837
	Lane 13	1926, 1934, 1942, ..., 3830, 3838
	Lane 14	1927, 1935, 1943, ..., 3831, 3839
	Lane 15	1928, 1936, 1944, ..., 3832, 3840



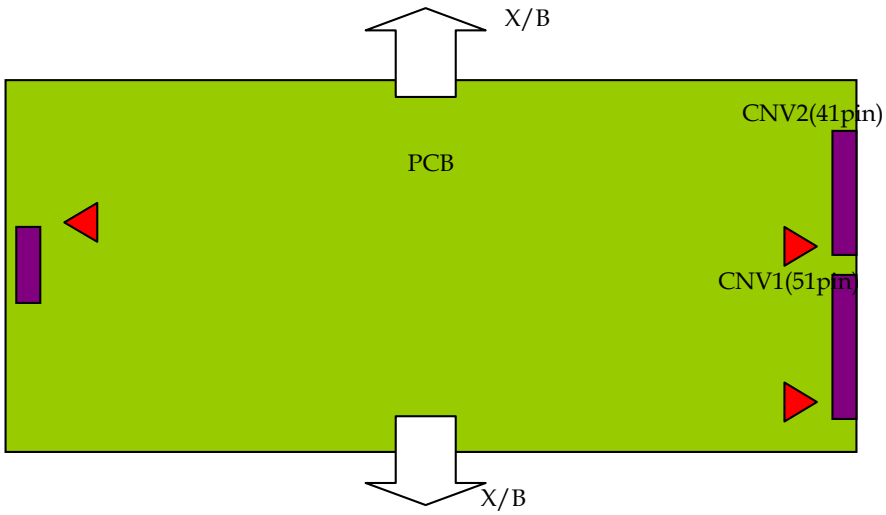
Note (2) Interface optional pin has internal scheme as following diagram. Customer should keep the interface voltage level requirement which including Panel board loading as below.



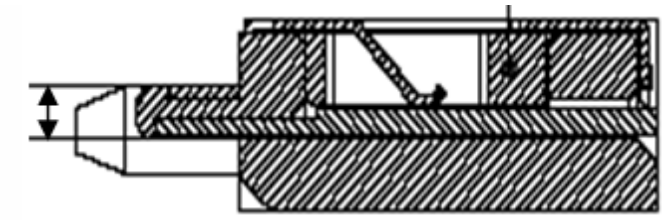
Note (3) Interface optional pin has internal scheme as following diagram. Customer should keep the interface voltage level requirement which including Panel board loading as below.



Note (4) V-by-One HS connector pin order defined as follows



Note (5) V-by-One connector mating dimension range request is 0.93mm~1.0mm as below



Note (6) Reserved for internal use. Please leave it open.

Note (7) (Optional) Power input (+12V), Please check the current rating of FFC cable to meet the power consumption requirement.

Note (8) Not connected in Tcon board

Note (9) Not connected in Tcon board. Please leave it open to avoid 12V-GND short, too.

4.2 BACKLIGHT UNIT

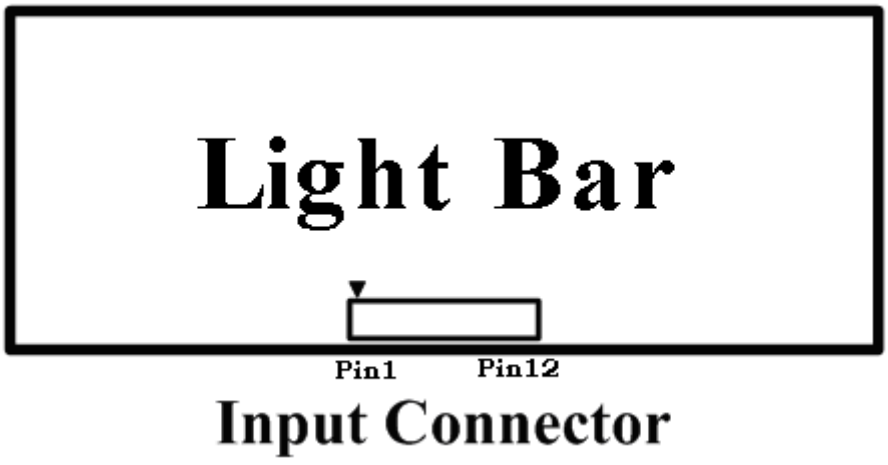
4.2.1 LIGHT BAR UNIT

The pin configuration for the housing and lead wire is shown in the table below.

CNV03~CNV18 Connector Pin Assignment: [196388-12041-3(P-TWO), FF01-430-123A(FCN)]

Pin №	Symbol	Feature
1	VLED+	Positive of LED String
2	VLED+	
3	VLED+	
4	VLED+	
5	NC	NC
6	NC	NC
7	NC	NC
8	NC	NC
9	NC	NC
10	NC	NC
11	VLED-	Negative of LED String
12	VLED-	

Note (1) Light Bar Input connector pin order defined as follows



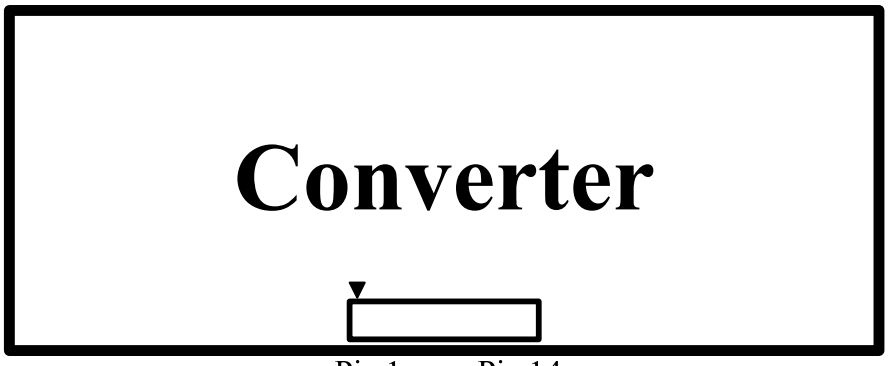
4.2.2 CONVERTER UNIT

CN1 Connector Pin Assignment: [CI0114M1HR0-LA (CvilLux) , JH2-D4-143N (FCN)]
Matting connector: [JST PHR-14]

Pin No.	Symbol	Feature
1	VBL	+24V
2		
3		
4		
5		
6	GND	GND
7		
8		
9		
10		
11	ERR	Normal (GND) ; Abnormal (Open collector)
12	BLON	BL ON/OFF
13	NC	NC
14	E_PWM	External PWM Control

Note (1) If Pin14 is open, E_PWM is 100% duty.

Note (2) Input connector pin order defined as follows

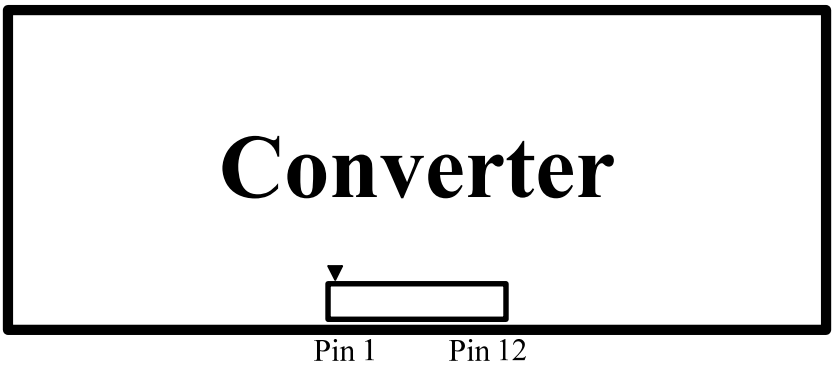


Input Connector

CN2 Connector Pin Assignment: [CI0112M1HR0-LA (CvilLux) or JH2-D4-123N (FCN)]
Matting connector: [JST PHR-12]

Pin No.	Symbol	Feature
1	VBL	+24V
2		
3		
4		
5		
6	GND	GND
7		
8		
9		
10		
11	NC	NC
12	NC	NC

Note (3) Input connector pin order defined as follows



Input Connector

4.3 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 10-bit gray scale data input for the color. The higher the binary input the brighter the color. The table below provides the assignment of color versus data input.

Color		Data Signal																													
		Red										Green										Blue									
		R9	R8	R7	R6	R5	R4	R3	R2	R1	R0	G9	G8	G7	G6	G5	G4	G3	G2	G1	G0	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
Basic Colors	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
	Red	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	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	1	1	1	1	1	1	1	1	1	1	1	1
Gray Scale Of Red	Red (0) / Dark	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
	Red (1)	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	0	0	0
	Red (2)	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	0	0	0	0
	:			:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:			:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	;	:	:	:	:	:	:	:	:	:
	Red (1021)	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (1022)	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (1023)	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale Of Green	Green (0) / Dark	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
	Green (1)	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
	Green (2)	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
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green (1021)	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0
	Green (1022)	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
	Green (1023)	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
Gray Scale Of Blue	Blue (0) / Dark	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
	Blue (1)	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
	Blue (2)	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
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue (1021)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	1
	Blue (1022)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0
	Blue (1023)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1

Note (1) 0: Low Level Voltage，1: High Level Voltage

5. INTERFACE TIMING

5.1 INPUT SIGNAL TIMING SPECIFICATIONS

The input signal timing specifications are shown as the following table and timing diagram. (Ta = 25 ± 2 °C)

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
Frequency	Data Clock	1/Tc	70	74.3	80	MHZ	(1)
VbyOne Receiver	Data skew between each area (A/B)	Tblock	-0.06	—	0.06	H	(2)
	Intra-Pair skew		-0.3	—	0.3	UI	(3)
	Inter-pair skew		-5	—	5	UI	(4)
	Spread spectrum modulation range	F_{clkin_mod}	1/Tc-0.5%	—	1/Tc+0.5%	MHz	(5)
	Spread spectrum modulation frequency	F_{SSM}	—	—	30	KHz	

5.1.1 Input Timing Spec for UHD, Frame Rate = 100Hz

Signal	Item		Symbol	Min.	Typ.	Max.	Unit	Note
Frame rate	2D mode		Fr6	94	100	106	Hz	
Vertical Active Display Term (8 Lan,1920X2160 Active Area)	2D Mode	Total	Tv	2200	2250	2790	Th	Tv=Tvd+Tvb
		Display	Tvd	2160	2160	2160	Th	—
		Blank	Tvb	40	90	630	Th	—
Horizontal Active Display Term (8 Lan,1920X2160 Active Area)	2D Mode	Total	Th	270	285	300	Tc	Th=Thd+Thb
		Display	Thd	240	240	240	Tc	—
		Blank	Thb	30	45	60	Tc	—

5.1.2 Input Timing Spec for UHD, Frame Rate = 120Hz

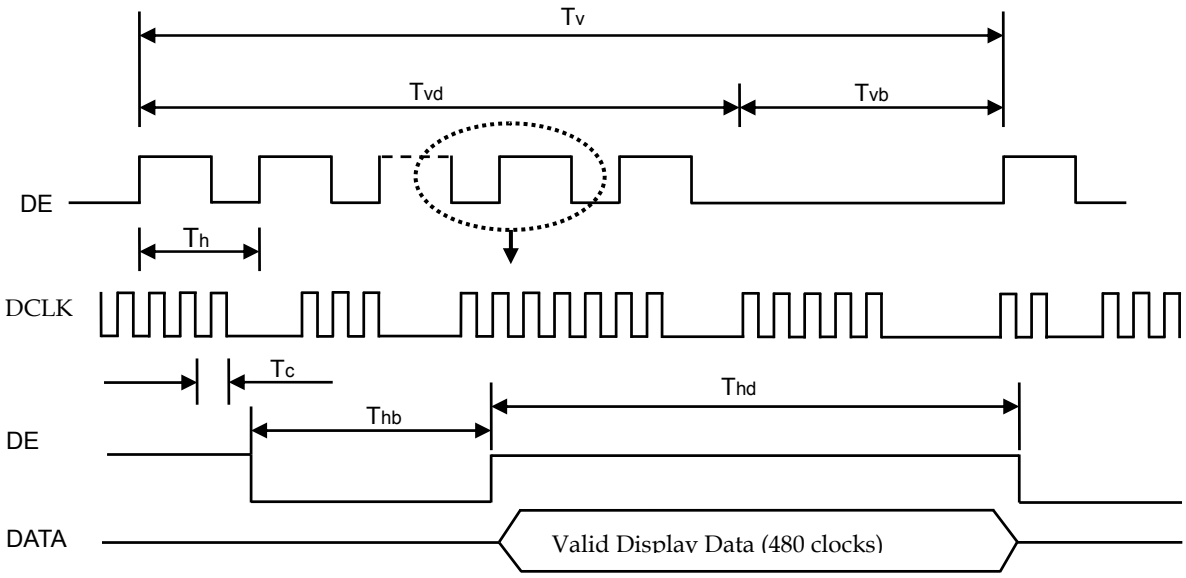
Signal	Item		Symbol	Min.	Typ.	Max.	Unit	Note
Frame rate	2D mode		Fr6	114	120	126	Hz	
Vertical Active Display Term (8 Lan,960X2160 Active Area)	2D Mode	Total	Tv	2200	2250	2790	Th	Tv=Tvd+Tvb
		Display	Tvd	2160	2160	2160	Th	—
		Blank	Tvb	40	90	630	Th	—
Horizontal Active Display Term (8 Lan,960X2160 Active Area)	2D Mode	Total	Th	270	285	300	Tc	Th=Thd+Thb
		Display	Thd	240	240	240	Tc	—
		Blank	Thb	30	45	60	Tc	—

Note (1) Please make sure the range of pixel clock has follow the below equation:

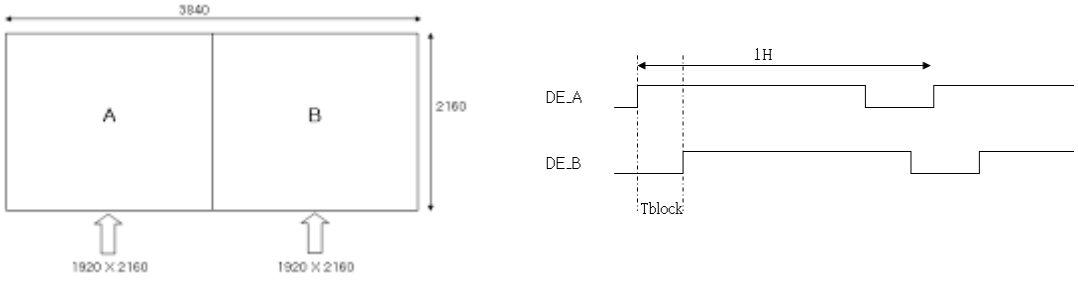
Fclkin(max) ≧ Fr6 ╳ Tv ╳ Th

Fr5 ╳ Tv ╳ Th ≧ Fclkin(min)

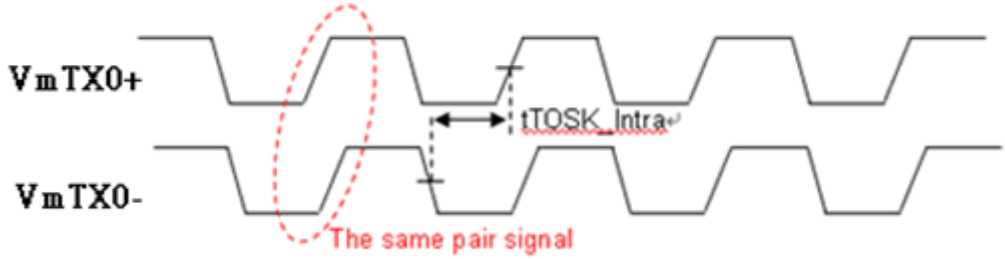
INPUT SIGNAL TIMING DIAGRAM



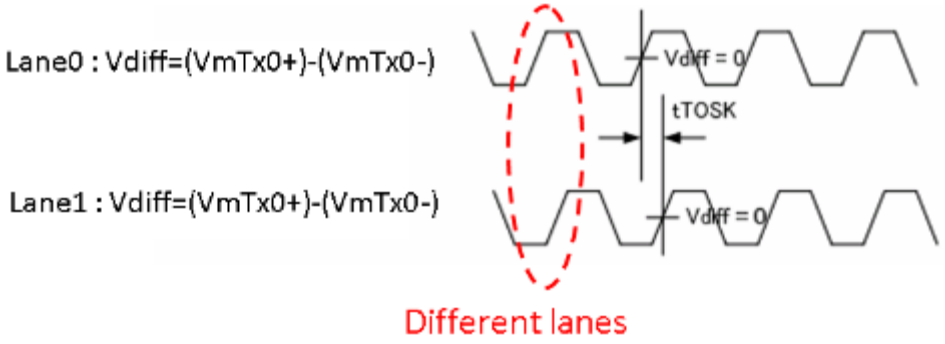
Note (2) Data skew between areas



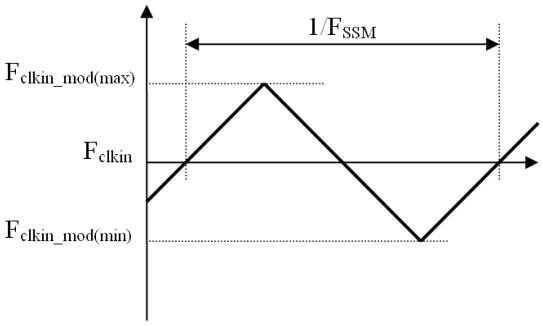
Note (3) V-by-One HS Inter-pair skew.



Note (4) V-by-One HS Inter-pair skew.

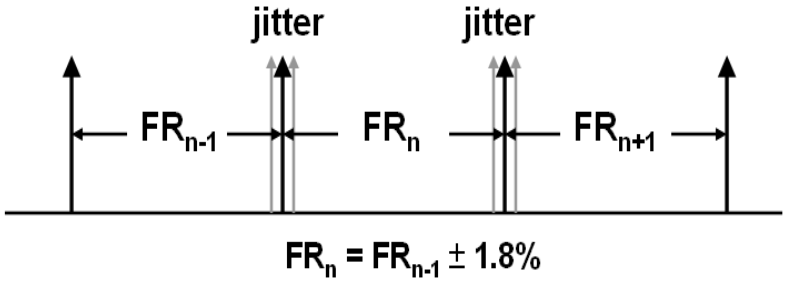


Note (5) The SSCG (Spread spectrum clock generator) is defined as below figures.



Note (6) For converter reference signals, The frame-to-frame jitter of the input frame rate is defined as the above figures. FRn = FRn-1 ± 1.8%.

Note (7) For converter reference signals, The setup of the frame rate jitter > 1.8% may result in the cosmetic LED backlight symptom.



5.2 Timing Diagram

5.2.1 V by One Signal Timing Diagram

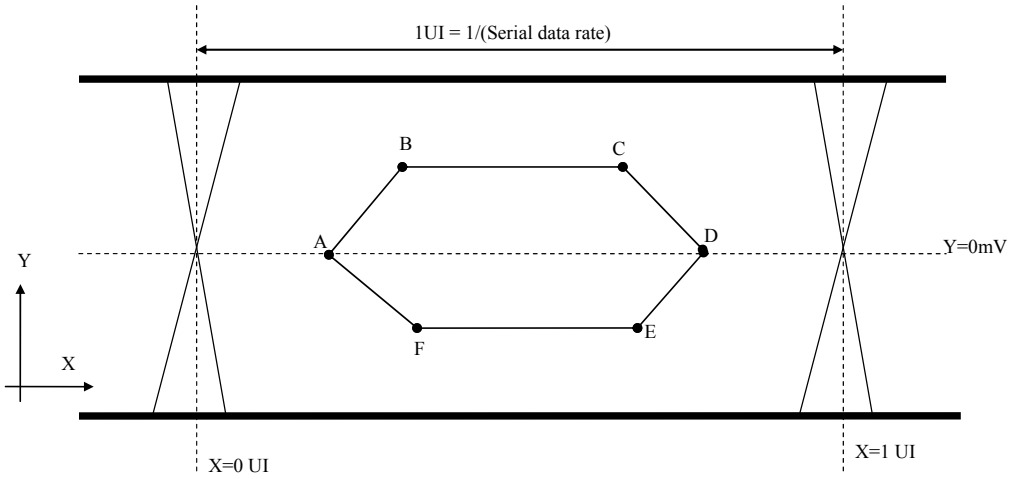


Table 1 Eye Mask Specification

	X [UI]	Y [mV]	Note
A	0.25	0	(1)
B	0.3	50	(1)
C	0.7	50	(1)
D	0.75	0	(1)
E	0.7	-50	(1)
F	0.3	-50	(1)

Note (1) Input levels of V-by-One HS signals are comes from "V-by-One HS Stander Ver.1.4"

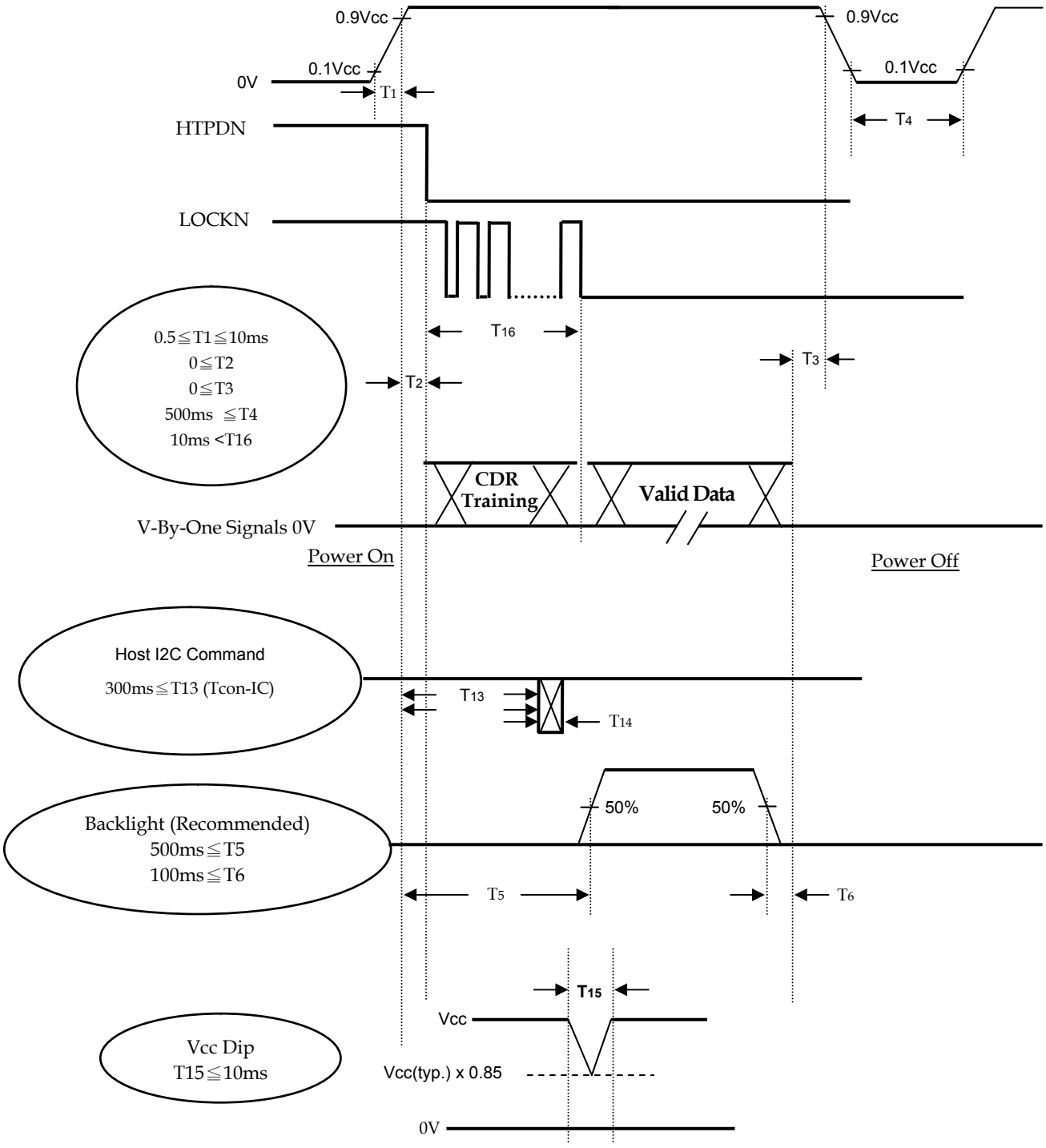
5.3 Byte Length and Color mapping of V-by-One HS

Packer input & Unpacker output		30bpp RGB (10bit)
Byte 0	D[0]	R[2]
	D[1]	R[3]
	D[2]	R[4]
	D[3]	R[5]
	D[4]	R[6]
	D[5]	R[7]
	D[6]	R[8]
	D[7]	R[9]
Byte 1	D[8]	G[2]
	D[9]	G[3]
	D[10]	G[4]
	D[11]	G[5]
	D[12]	G[6]
	D[13]	G[7]
	D[14]	G[8]
	D[15]	G[9]
Byte 2	D[16]	B[2]
	D[17]	B[3]
	D[18]	B[4]
	D[19]	B[5]
	D[20]	B[6]
	D[21]	B[7]
	D[22]	B[8]
	D[23]	B[9]
Byte 3	D[24]	X
	D[25]	X
	D[26]	B[0]
	D[27]	B[1]
	D[28]	G[0]
	D[29]	G[1]
	D[30]	R[0]
	D[31]	R[1]

5.4 POWER ON/OFF SEQUENCE

(Ta = 25 ± 2 °C)

To prevent a latch-up or DC operation of LCD module, the power on/off sequence should be as the diagram below.



Note (1) The supply voltage of the external system for the module input should follow the definition of Vcc.

Note (2) Apply the LED voltage within the LCD operation range. When the backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become abnormal screen.

Note (3) In case of Vcc is in off level, please keep the level of input signals on the low or high impedance. If T2<0,that maybe cause electrical overstress failure.

Note (4) T4 should be measured after the module has been fully discharged between power off and on period.

Note (5) Interface signal shall not be kept at high impedance when the power is on.

Note (6) Vcc must decay smoothly when power-off.

Note (7) T5 Backlight turn on time depend on T14 command length+T13

Note (8) The time between I2C commands must be greater than 10 frames at least.

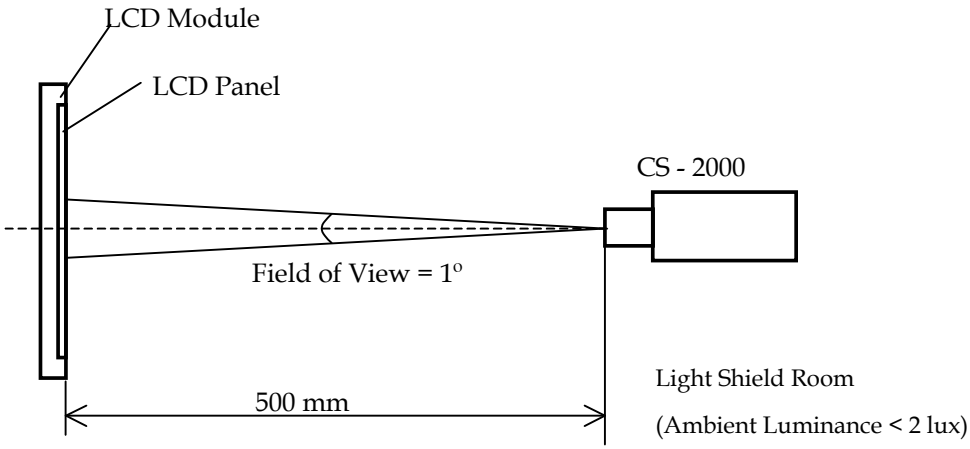
6. OPTICAL CHARACTERISTICS

6.1 TEST CONDITIONS

Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	°C
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	V_{CC}	12±1.2	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
LED Current	IL	115±3.5	mA
Vertical Frame Rate	Fr	120	Hz

The LCD module should be stabilized at given temperature for 1 hour to avoid abrupt temperature change during measuring in a windless room.

Local Dimming Function should be Disable before testing to get the steady optical characteristics (According to 5.1 CNF1 Connector Pin Assignment, Pin no. “22”)



6.2 OPTICAL SPECIFICATIONS

The relative measurement methods of optical characteristics are shown in 6.2.1 and 6.2.2.

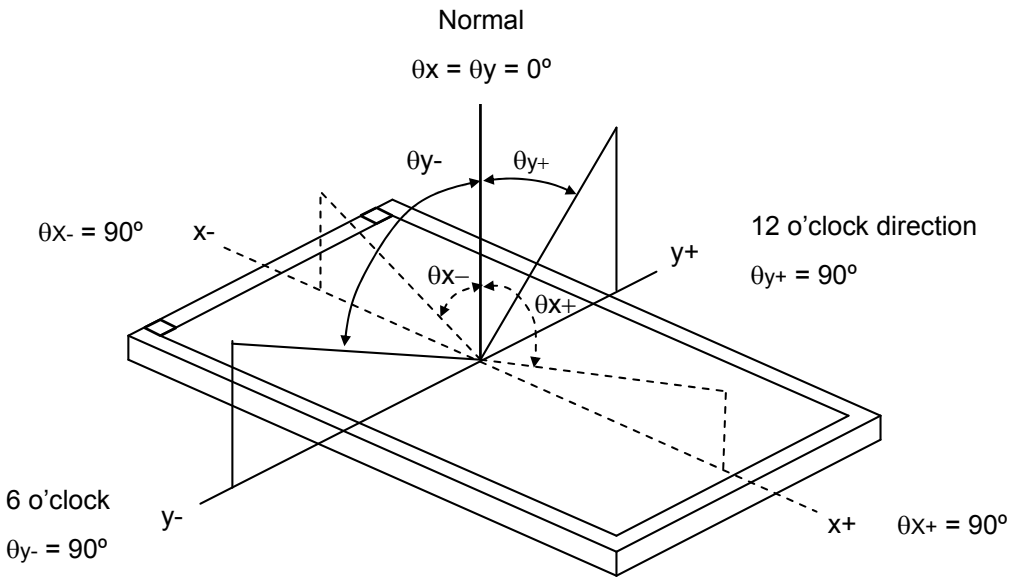
6.2.1 THE NORMAL MODE OPTICAL SPECIFICATIONS

The relative measurement methods of optical characteristics are shown in 6.2.1. The following items should be measured under the test conditions described in 6.1.1 and stable environment shown in 6.1.1.

Item		Symbol		Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio		CR		θ_x=0°, θ_Y =0° Viewing angle at normal direction	2100	3000		-	Note (2)
Response Time		Gray to gray				6.5	13	ms	Note (3)
Center Luminance of White		L_C	2D		560	700		cd/m²	Note (4)
White Variation		δW					1.3	-	Note (6)
Cross Talk		CT	2D				4	%	Note (5)
Color Chromaticity	Red	Rx			Typ.-0.03	0.685	Typ.+0.03	-	
		Ry				0.307		-	
	Green	Gx				0.259		-	
		Gy				0.682		-	
	Blue	Bx				0.152		-	
		By				0.046		-	
	White	Wx				0.280		-	
		Wy				0.290		-	
	Correlated color temperature					10000		K	
	Color Gamut	C.G.			-	98	-	%	NTSC
Viewing Angle	Horizontal	θ_x+		CR>10	80	89	-	Deg.	(1)
		θ_x-			80	89	-		
	Vertical	θ_Y+			80	89	-		
		θ_Y-			80	89	-		

Note (1) Definition of Viewing Angle (θx, θy) :

Viewing angles are measured by Autronic Conoscope Cono-80 (or Eldim EZ-Contrast 160R).



Note (2) Definition of Contrast Ratio (CR) :

The contrast ratio can be calculated by the following expression.

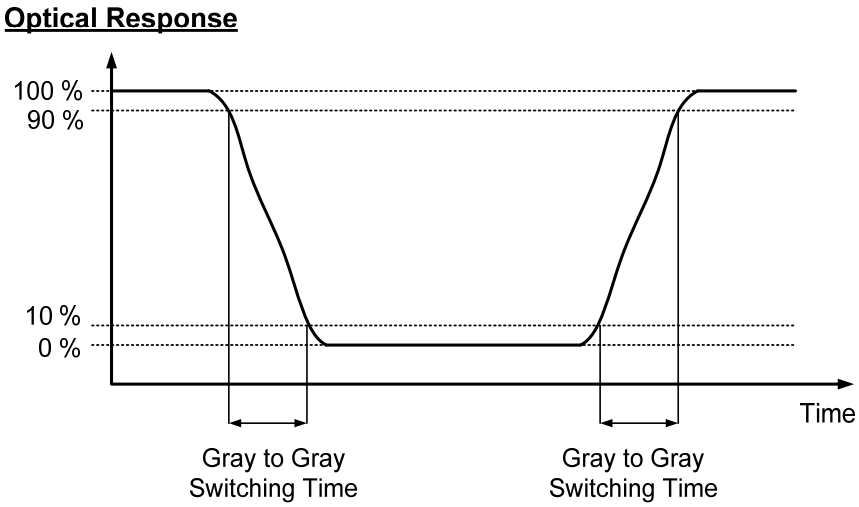
$$\text{Contrast Ratio (CR)} = \frac{\text{Surface Luminance of L1023}}{\text{Surface Luminance of L0}}$$

L1023: Luminance of gray level 1023

L 0: Luminance of gray level 0

CR = CR (5), where CR (X) is corresponding to the Contrast Ratio of the point X at the figure in Note (6).

Note (3) Definition of Gray-to-Gray Switching Time :



The driving signal means the signal of gray level 0, 124, 252, 380, 508, 636, 764, 892 and 1023.

Gray to gray average time means the average switching time of gray level 0, 124, 252, 380, 508, 636, 764, 892 and 1023 to each other.

Note (4) Definition of Luminance of White (L_C) :

Measure the luminance of gray level 1023 at center point.

L_C = L (5), where L (x) is corresponding to the luminance of the point X at the figure in Note (6).

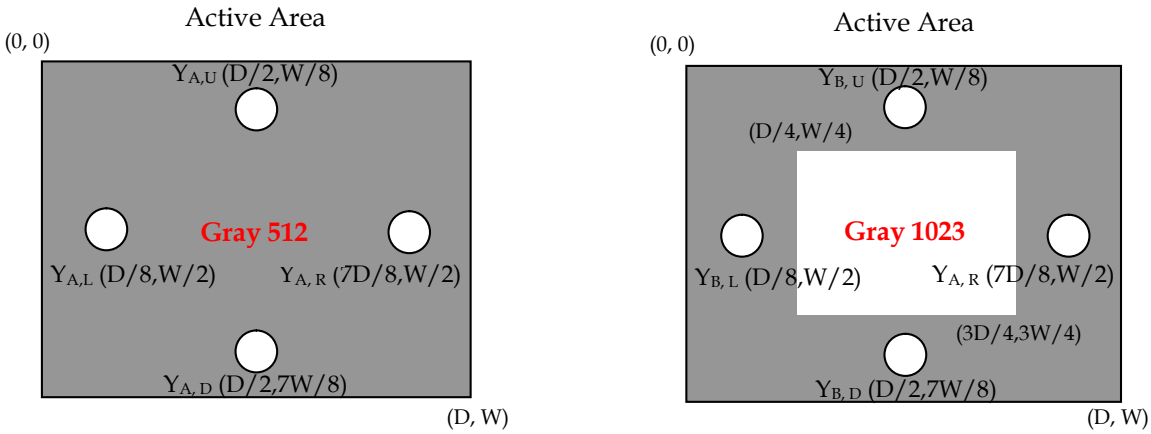
Note (5) Definition of Cross Talk (CT) :

$CT = | Y_B - Y_A | / Y_A \times 100\ (\%)$

Where :

YA = Luminance of measured location without gray level 1023 pattern (cd/m2)

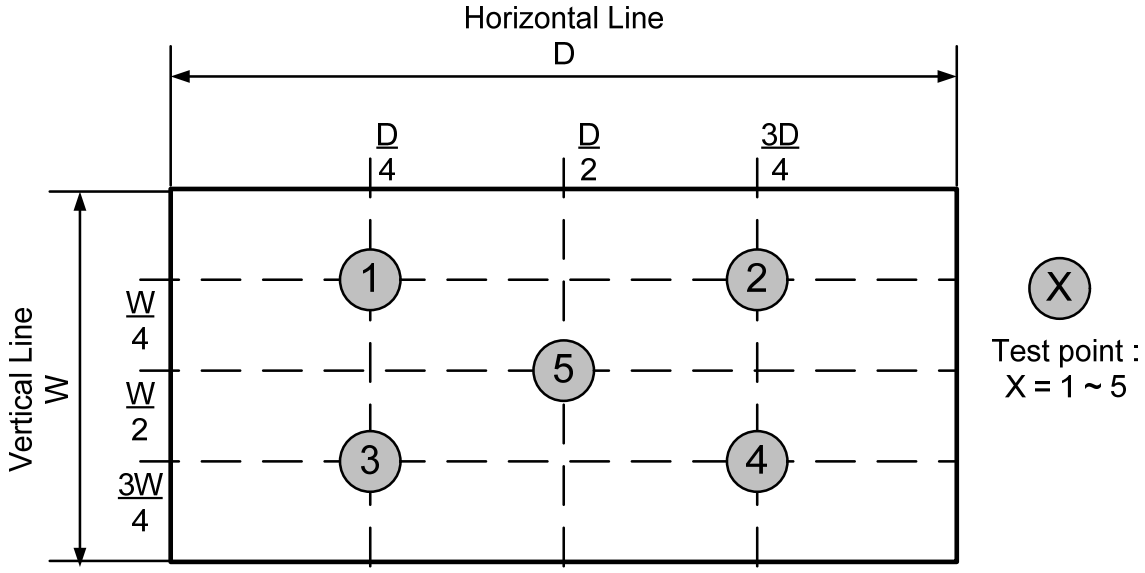
YB = Luminance of measured location with gray level 1023 pattern (cd/m2)



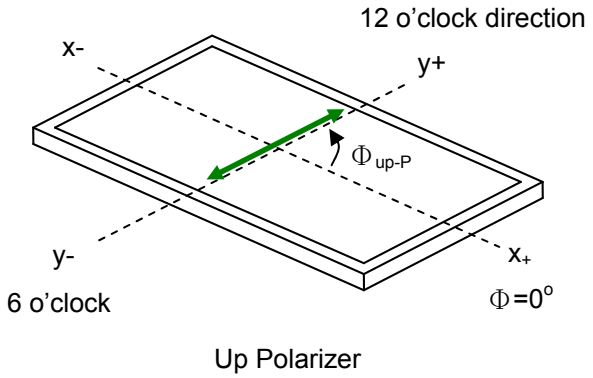
Note (6) Definition of White Variation (δW):

Measure the luminance of gray level 1023 at 5 points

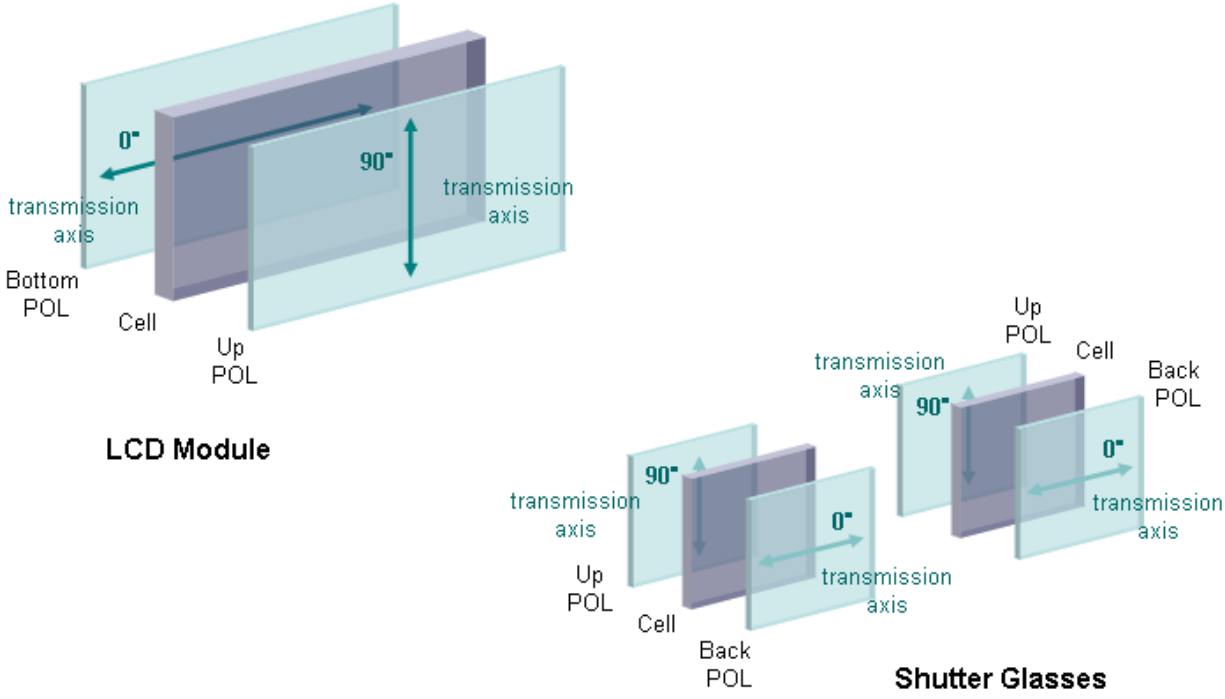
$$\delta W = \frac{\text{Maximum [L (1), L (2), L (3), L (4), L (5)]}}{\text{Minimum [L (1), L (2), L (3), L (4), L (5)]}}$$



Note (7) This is a reference for designing the shutter glasses of 3D application. Definition of the transmission direction of the up polarizer ($\Phi_{up\text{-}P}$) on LCD Module :



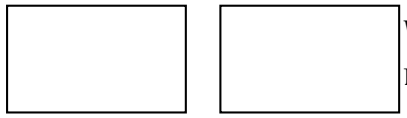
The transmission axis of the front polarizer of the shutter glasses should be parallel to this panel transmission direction to get a maximum 3D mode luminance.



Note (8) Definition of the 3D mode performance (measured under 3D mode, use INX's shutter glass) :

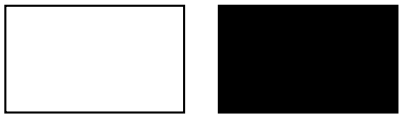
a. Test pattern

Left eye image and right eye image are displayed alternated



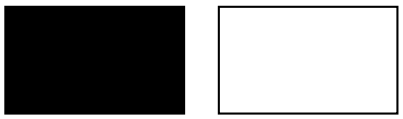
WW

Left eye image: W1023; Right eye image: W1023



WB

Left eye image: W1023; Right eye image: W0



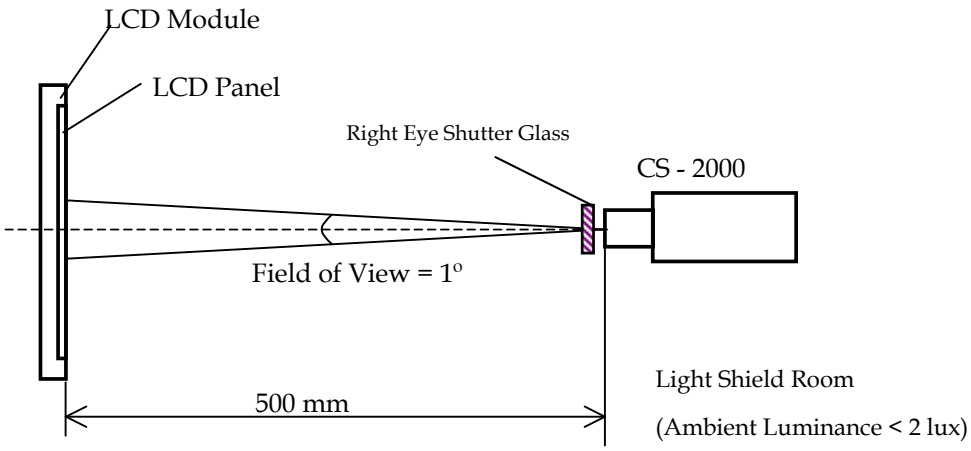
BW

Left eye image: W0; Right eye image: W1023

BB

Left eye image: W0; Right eye image: W0

b. Measurement setup



Shutter glasses are well controlled under suitable timing, and measure the luminance of the center point of the panel through the right eye glass. The transmittance of the glass should be larger than 40.0% under 3D mode operation. The luminance of the test pattern "WW", denoted L(WW); the luminance of the test pattern "WB", denoted L(WB) ; the luminance of the test pattern "BW", denoted L(BW); the luminance of the test pattern "BB", denoted "L(BB)

c. Definition of the Center Luminance of White, Lc (3D) : L(WW)

d. Definition of the 3D mode white crosstalk, CT (3D-W) : $CT(3D-W) \equiv \left| \frac{L(WB)-L(BB)}{L(WW)-L(BB)} \right|$

e. Definition of the 3D mode dark crosstalk, CT (3D-D) : $CT(3D-D) \equiv \left| \frac{L(WW)-L(BW)}{L(WW)-L(BB)} \right|$

7. PRECAUTIONS

7.1 ASSEMBLY AND HANDLING PRECAUTIONS

[1] Do not apply rough force such as bending or twisting to the module during assembly.

[2] Do not apply pressure or impulse to the module to prevent the damage of LCD panel and Backlight.

[3] Bezel of Set can not press or touch the panel surface. It will make light leakage or scrape.

[4] It should be attached to the system firmly using all mounting holes.

[5] It is recommended to assemble or to install a module into the user's system in clean working areas. The dust and oil may cause electrical short or worsen the polarizer, do not press or scratch the surface harder than a HB pencil lead.

[6] Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.

[7] Protection film for polarizer on the module should be slowly peeled off just before use so that the electrostatic charge can be minimized.

[8] Do not disassemble the module.

[9] Always follow the correct power-on sequence when the LCD module is turned on. This can prevent the damage and latch-up of the CMOS LSI chips.

[10] Do not plug in or pull out the I/F connector while the module is in operation, pins of I/F connector should not be touched directly with bare hands. Do not adjust the variable resistor located on the module.

[11] Moisture can easily penetrate into LCD module and may cause the damage during operation.

[12] When storing modules as spares for a long time, the following precaution is necessary.

[12.1] Do not leave the module in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35℃ at normal humidity (under 70%) without condensation.

[12.2] The module shall be stored in dark place. Do not store the TFT-LCD module in direct sunlight or fluorescent light.

[13] When ambient temperature is lower than 10ºC, the display quality might be reduced. For example, the response time will become slow, and the starting voltage of LED will be higher than that of room temperature.

[14] Use a soft dry cloth without chemicals and Ethyl Alcohol for cleaning, because the surface of polarizer is very soft and easily scratched. Do not use Ketone type materials (ex. Acetone), Toluene, Ethyl acid or Methyl chloride, these chemical solvent might permanently damage the polarizer due to chemical action.

7.2 SAFETY PRECAUTIONS

To optimize PID module's lifetime and functions, operating conditions should be followed as below

[1] Normal operating condition

[1.1] Temperature : 20±15℃

[1.2] Humidity : 55±20%

[1.3] Well-ventilated place is suggested to set up PID module and system.

[1.4] Display pattern : regular switched patterns or moving pictures.

[1.4.1] Periodical power-off or screen saver is needed after long-term static display.

[1.4.2] Moving picture or black pattern is strongly recommended for screen saver.

[2] Operating requirements of PID modules and systems to prevent uneven display under long-term operating.

[2.1] PID suitable operating time : under 24 hours a day or less.

(* The moving picture can be allowed for 24 hours a day)

[2.2] Periodical display contents should be changed from static image to moving picture.

[2.2.1] Different background and image colors changed respectively, and changed colors periodically.

[2.2.2] Background and image with large different luminance displayed at the same time should be avoided.

[3] The startup voltage of a Backlight may cause an electrical shock while assembling with the converter. Do not disassemble the module or insert anything into the Backlight unit.

[4] Do not connect or disconnect the module in the "Power On" condition.

[5] Do not exceed the absolute maximum rating value. (supply voltage variation, input voltage variation, variation in part contents and environmental temperature…) Otherwise the module may be damaged.

[6] If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.

[7] Module should be turned clockwise (regular front view perspective) when used in portrait mode.

[8] Ultra-violet ray filter is necessary for outdoor operation.

[9] Only when PID module is operated under right operating conditions, lifetime in this spec can be guaranteed. After the module's end of life, it is not harmful in case of normal operation and storage.

7.3 SAFETY STANDARDS

The LCD module should be certified with safety regulations as follows:

Regulatory	Item	Standard
Information Technology equipment	UL	UL 60950-1,2nd Ed, 2014
	cUL	CSA C22.2 No.60950-1-07, 2nd Ed,2014-10
	CB	IEC60950-1:2005+ A1:2009+ A2:2013 / EN60950-1:2006+ A11:2009+ A1:2010+ A12:2011+ A2:2013
Audio/Video Apparatus	UL	UL 60065, 7th Edition, 2013
	cUL	CAN/CSA-C22.2 No. 60065-03, 1st Edition + A1:2006 + A2:2012
	CB	IEC 60065:2001 (Seventh Edition)+ A1:2005+A2:2010 / EN60065:2002+ A1:2006+ A11:2008+ A2:2010+ A12:2011

If the module displays the same pattern for a long period of time, the phenomenon of image sticking may be occurred.

8. DEFINITION OF LABELS

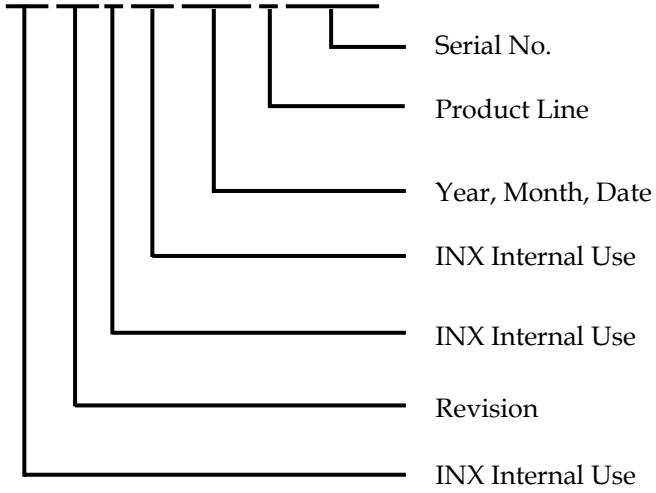
8.1 MODULE LABEL

The barcode nameplate is pasted on each module as illustration, and its definitions are as following explanation.

Model Name : SA00DK1-K02

Revision : Rev. XX, for example: A0, A1… B1, B2… or C1, C2…etc.

Serial ID : X X X X X X Y M D L N N N N



Serial ID includes the information as below :

Manufactured Date :

Year : 2001=1, 2002=2, 2003=3, 2004=4…2010=0, 2011=1, 2012=2…

Month: 1~9, A~C, for Jan. ~ Dec.

Day: 1~9, A~Y, for 1st to 31st, exclude I ,O, and U.

Revision Code : Cover all the change

Serial No. : Manufacturing sequence of product

Product Line : 1→Line1, 2→Line 2, …etc.

8.2 CARTON LABEL

The barcode nameplate is pasted on each box as illustration, and its definitions are as following explanation.

P.O. NO._____

Parts ID._____

Model Name SA00DK1-K02

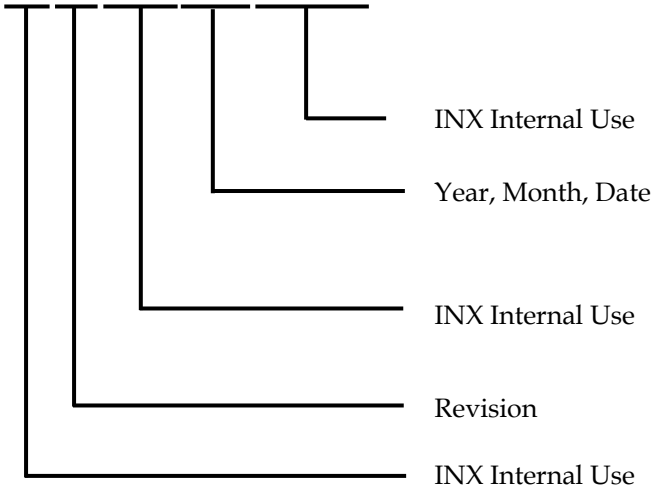
Carton ID._____ Quantities ___

XXXXXXXXXXXXX

Made In China

Model Name: SA00DK1– K02

Carton ID: X X X X X X X Y M D X X X X



Serial ID includes the information as below :

Manufactured Date:

Year: 2010=0, 2011=1, 2012=2…etc.

Month: 1~9, A~C, for Jan. ~ Dec.

Day: 1~9, A~Y, for 1st to 31st, exclude I ,O, and U.

Revision Code: Cover all the change

9. PACKAGING

9.1 PACKAGING SPECIFICATIONS

Packaging Method of multi-boxes in a pallet

(1) 5 LCD TV modules / 1 Box

(2) Box dimensions: 2490(L) X 730 (W) X 1410 (H)

(3) Weight: approximately 375Kg (5 modules per box)

9.2 PACKAGING METHOD

Packaging method is shown in following figures.

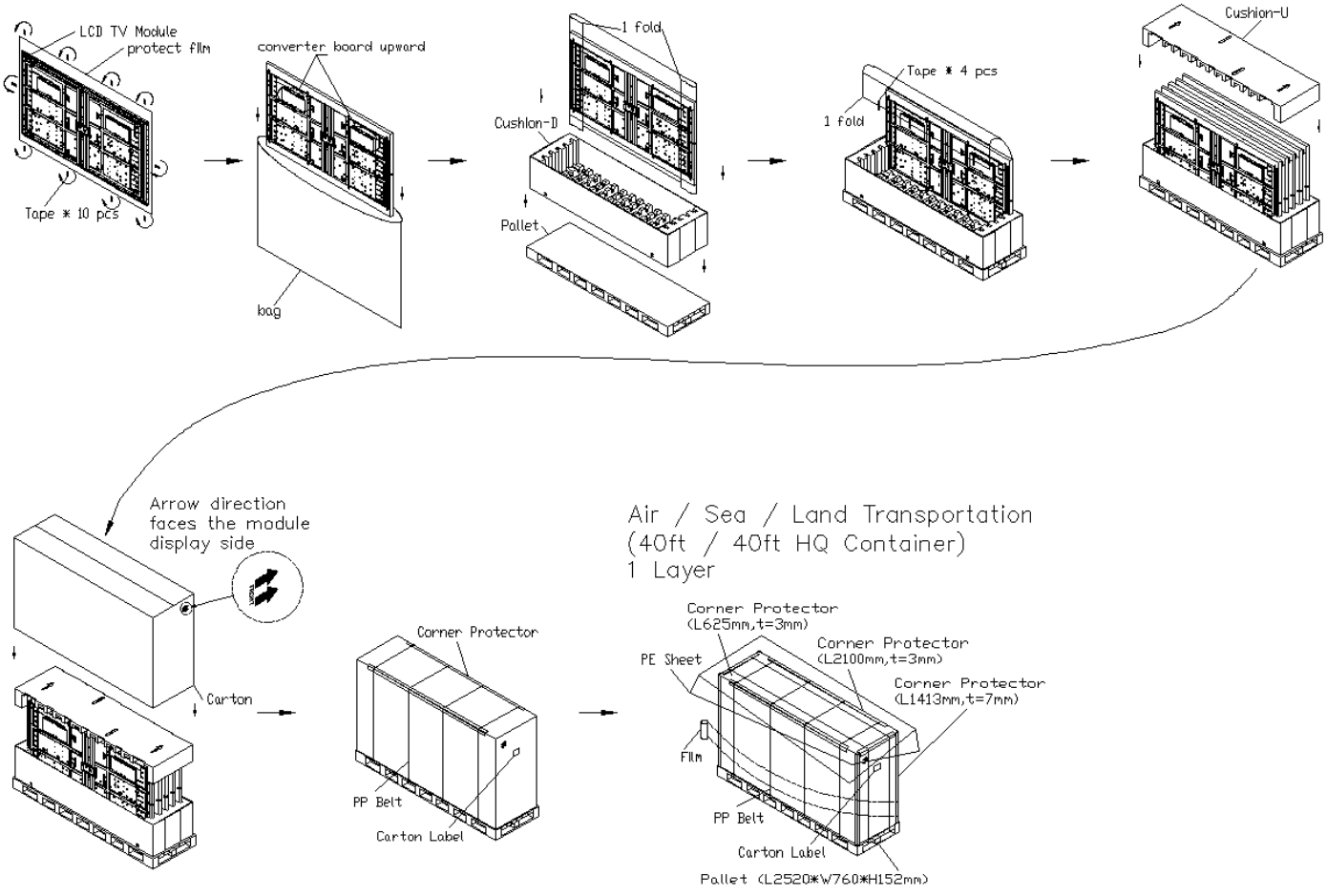


Figure 9-1 packing method

9.3 UN-PACKAGING METHOD

Un-packaging method is shown as following figures.

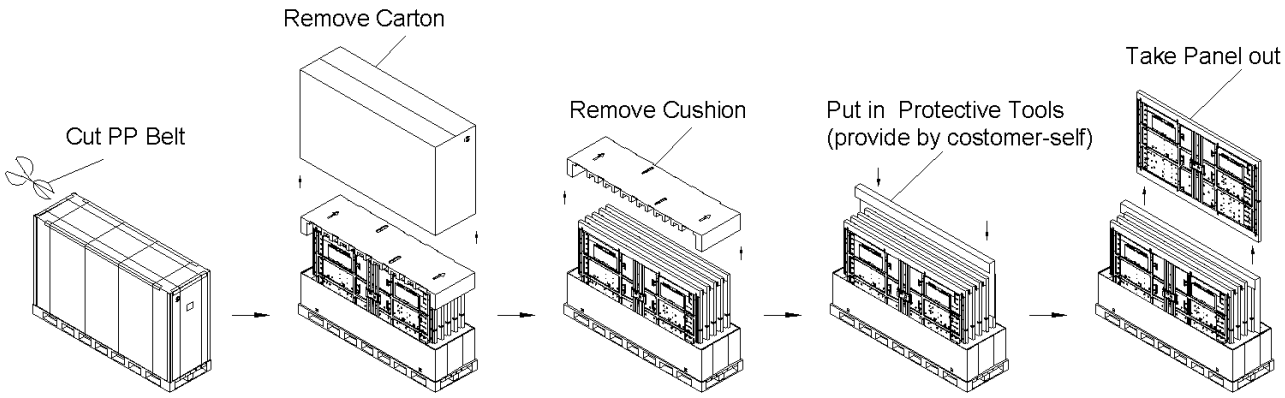
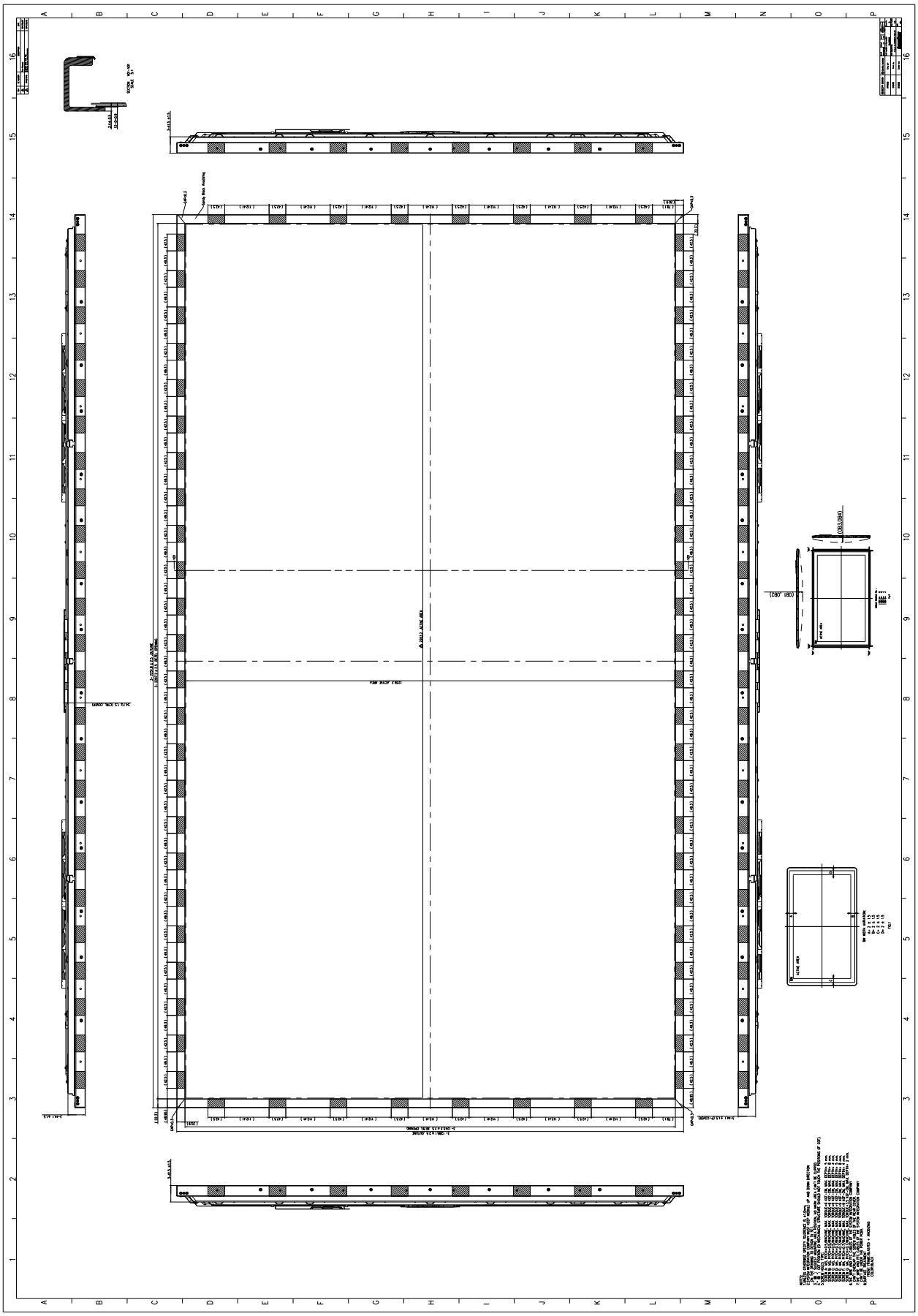
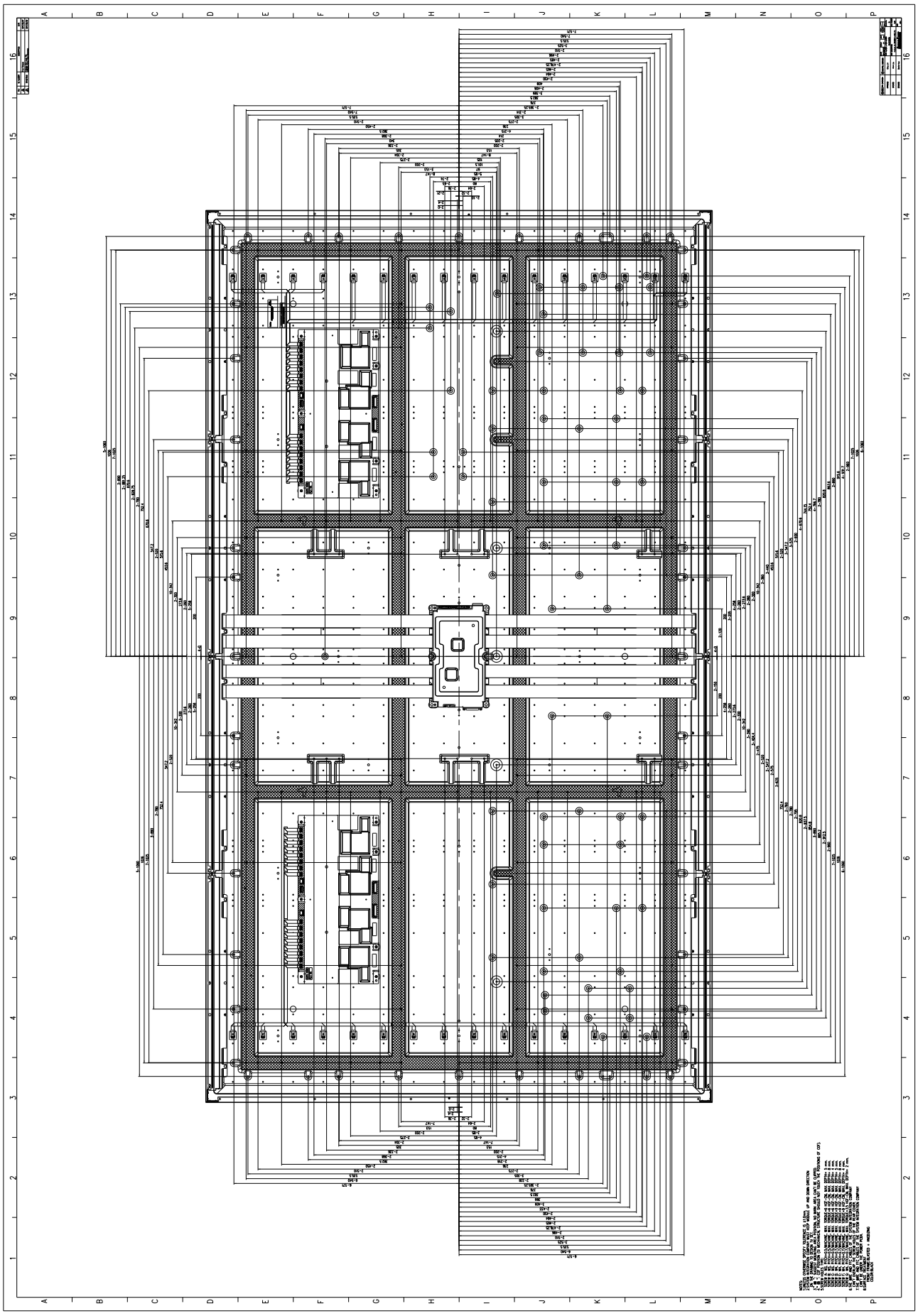
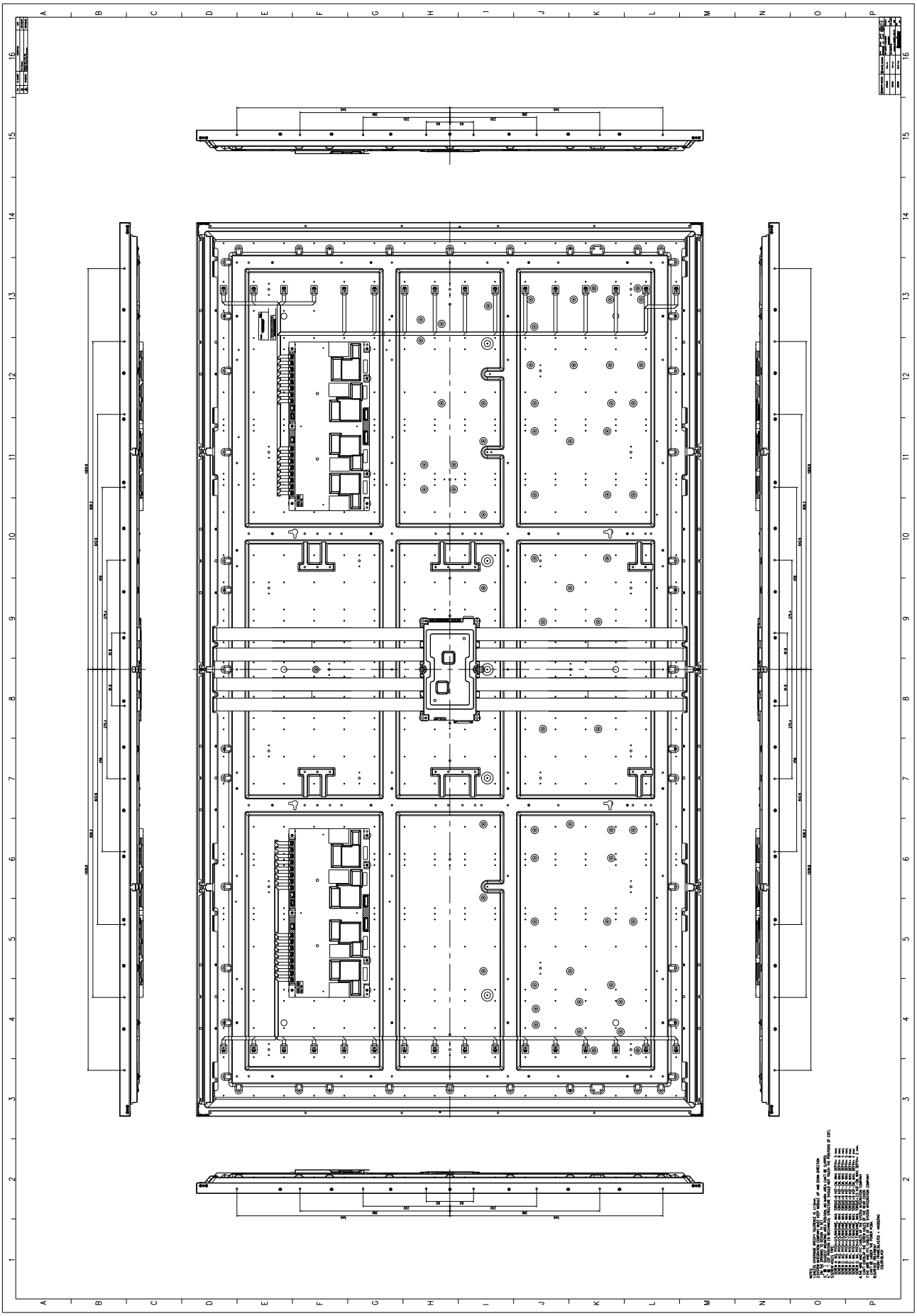


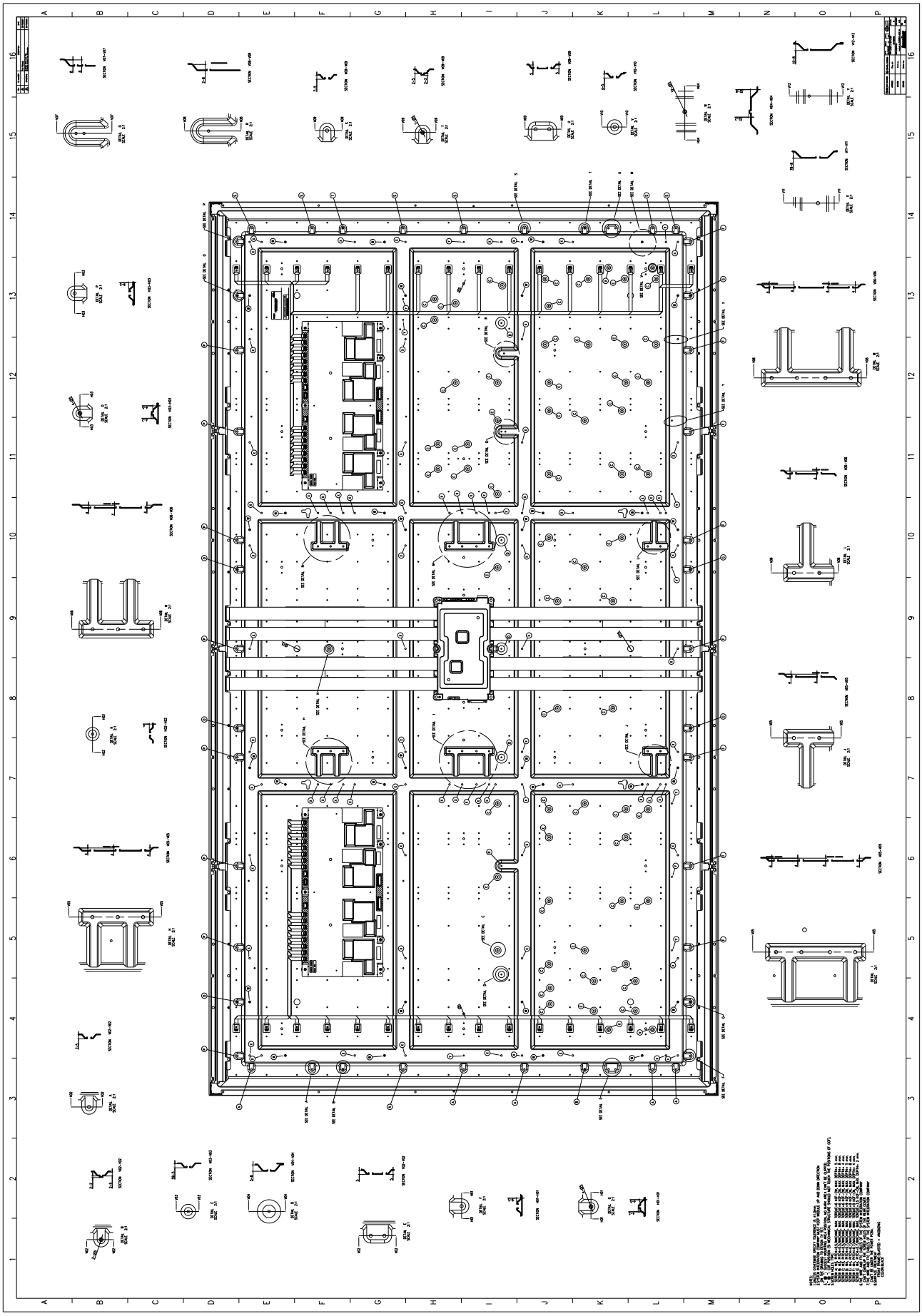
Figure 9-2 un-packing method

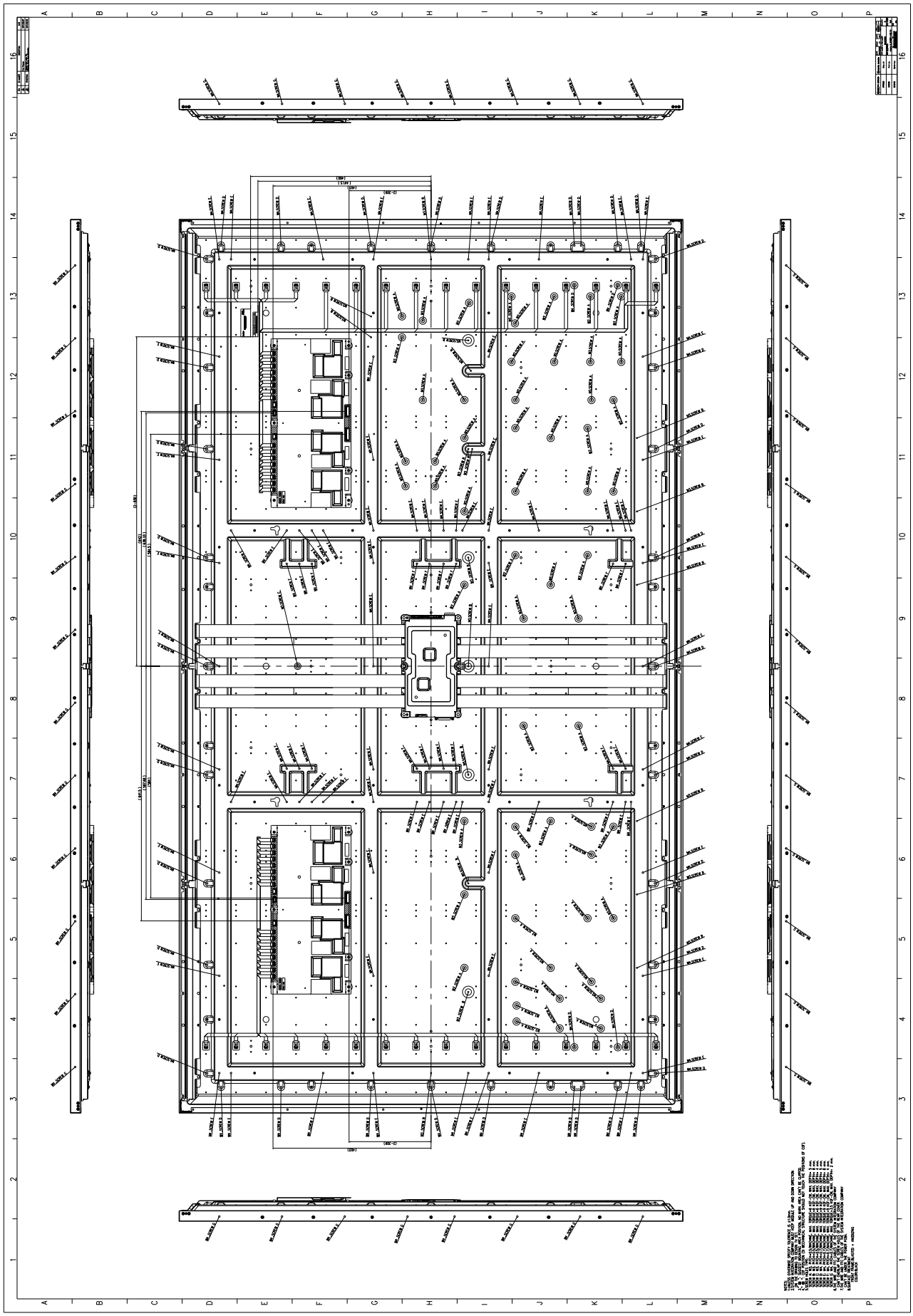
10. MECHANICAL CHARACTERISTIC

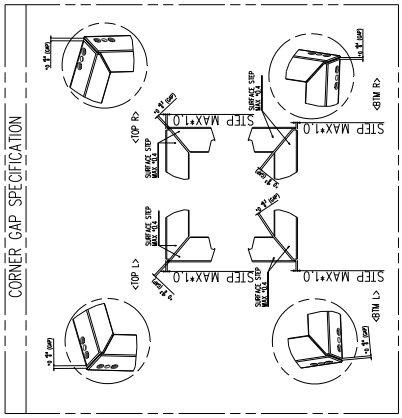


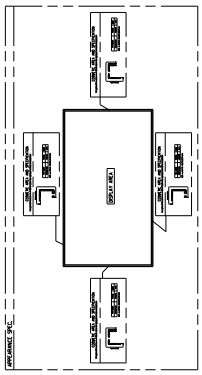












Appendix A

A.1 I2C timing

Symbol	Parameter	Min.	Max.	Unit
t_{SU-STA}	Start setup time	250	-	ns
t_{HD-STA}	Start hold time	250	-	ns
t_{SU-DAT}	Data setup time	80	-	ns
t_{HD-DAT}	Data hold time	0	-	ns
t_{SU-STO}	Stop setup time	250	-	ns
t_{BUF}	Time between Stop condition and next Start condition	500	-	ns