□ Tentative Specification
□ Preliminary Specification
■ Approval Specification

MODEL NO.: V400DJ1

SUFFIX: KS5

Revision : C8
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
Chao-Chun Chung	Vita Wu	Delia Lin

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REVISION HISTORY

Version	Date	Page (New)	Section	Description
Ver. 1.0	Oct.14, 2014	All	All	The Preliminary specification was firstly issued.
Ver. 2.0	Dec.03, 2014	All	All	The Approval specification was firstly issued.

1. GENERAL DESCRIPTION

1.1 OVERVIEW

V400DJ1-KS5 is a 40" TFT Liquid Crystal Display module with LED Backlight unit and 8Lanes V-by-One HS interface. This module supports 3840 x 2160 Quad Full HDTV format and can display true 1.07G colors (8-bit+FRC). The driving board module for backlight is built-in.

1.2 FEATURES

- High brightness : 350 nits
- High contrast ratio : 5000:1
- Fast response time : Gray to Gray typical : 8.5 ms
- High color saturation : NTSC 88%
- Quad Full HDTV (3840 x 2160 pixels) resolution, true HDTV format
- V-by-One HS interface
- Optimized response time for 50Hz/60Hz frame rate
- Viewing Angle : 176(H)/176(V) (CR > 10) VA Technology
- Ultra wide viewing angle: Super MVA technology
- RoHs compliance
- T-con input frame rate *: FHD 50/60Hz, FHD 100/120Hz, QFHD 24/30Hz or QFHD 50/60Hz, Output frame rate: QFHD 50/60Hz

*: The detail setting such as I2C command or timing requirement in FHD/QFHD is specified in INX application note. It's important and necessary to follow the specification either in product SPEC or application note, otherwise it may lead to abnormal or no display. INX application note would be provided by INX in the design-in stage.

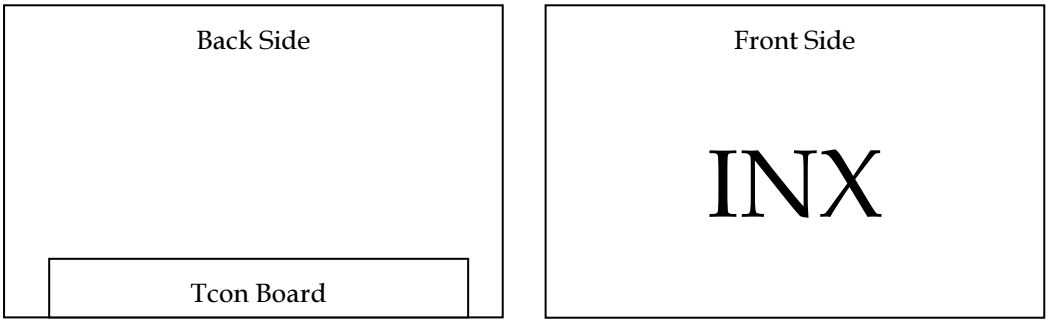
1.3 GENERAL SPECIFICATIONS

Item	Specification	Unit	Note
Active Area	878.112(H) x 485.352(V) (39.5" diagonal)	mm	(1)
Bezel Opening Area	881.112(H) x 488.352(V)	mm	
Driver Element	a-si TFT active matrix	-	-
Pixel Number	3840 x R.G.B. x 2160	pixel	-
Pixel Pitch(Sub Pixel)	0.076225 (H) x 0.2247 (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	Anti-Glare coating (Haze 1%)，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)	892.112	893.112	894.112	mm	(1),(2)
	Vertical (V)	503.352	504.352	505.352	mm	(1),(2)
	Depth (D)	12.775	13.775	14.775	mm	To Rear
		24.075	25.075	26.075	mm	To converter cover
Weight			7340		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	ºC	(1)
Operating Ambient Temperature	T_{OP}	0	50	ºC	(1), (2)
Shock (Non-Operating)	S_{NOP}	-	50	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 ºC).

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

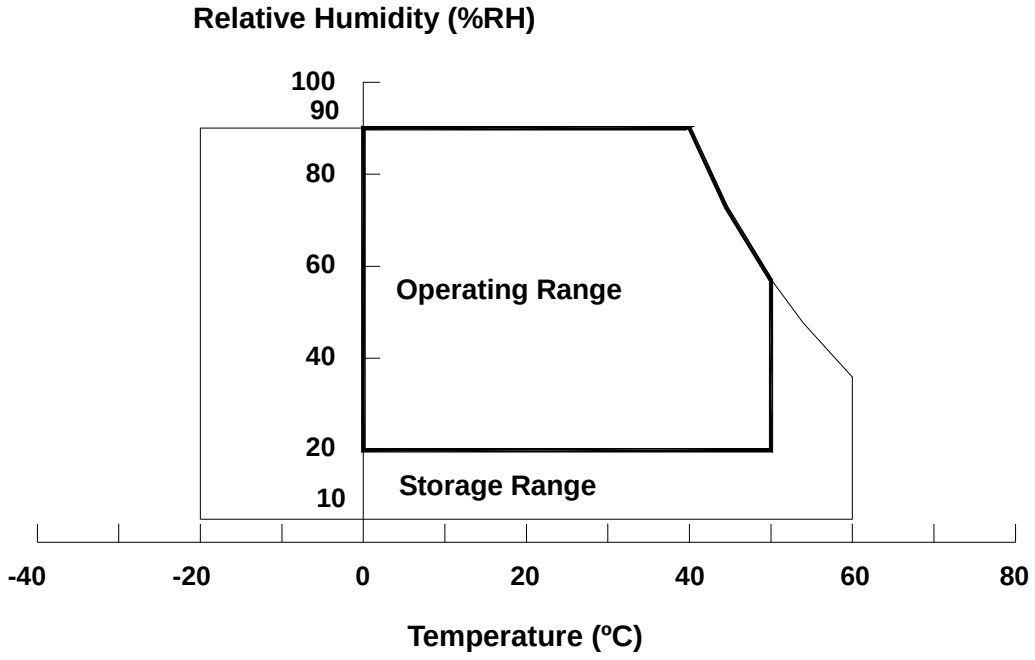
(c) No condensation.

Note (2) Thermal management should be considered in final product design to prevent the surface temperature of display area from being over 65 ºC. 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	

2.3.2 BACKLIGHT CONVERTER UNIT

Item	Symbol	Test Condition	Min.	Type	Max.	Unit	Note
Light Bar Voltage	V_W	Ta = 25 ℃	-	-	45	V_{RMS}	2D Mode
Converter Input Voltage	V_{BL}	-	0	-	30	V	
Control Signal Level	-	-	-0.3	-	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.

Note (2) No moisture condensation or freezing.

Note (3) The control signals include On/Off Control and External PWM Control.

3. ELECTRICAL CHARACTERISTICS

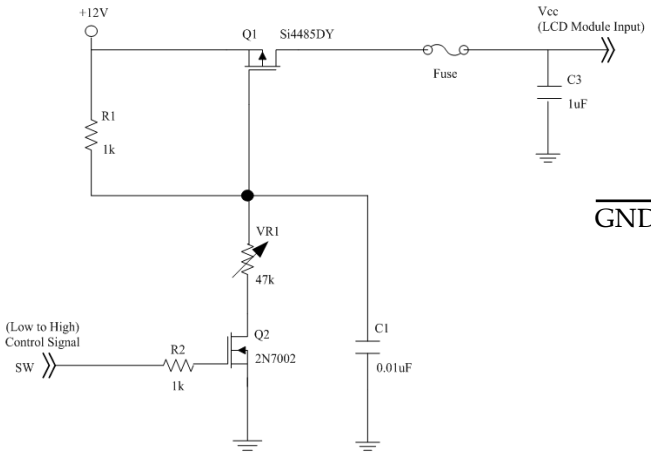
3.1 TFT LCD MODULE

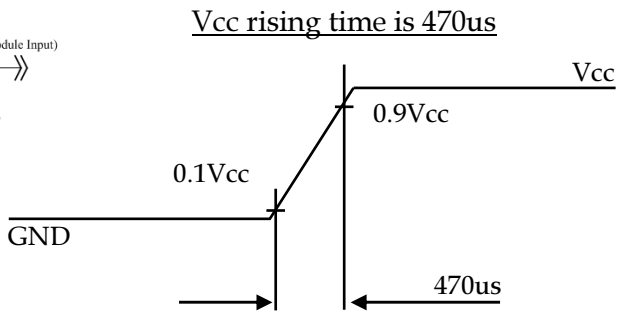
(Ta = 25 ± 2 ºC)

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		V_{CC}	10.8	12	13.2	V	(1)
Rush Current		I_{RUSH}	—	—	3.5	A	(2)
OFHD 120Hz Output Power Consumption	White Pattern	P_T	—	13.075	15.616	W	(3)
	Horizontal Stripe	P_T	—	27.720	33.556	W	
	Black Pattern	P_T	—	14.040	16.832	W	
OFHD 120Hz Output Power Supply Current	White Pattern	—	—	1.090	1.301	A	
	Horizontal Stripe	—	—	2.310	2.796	A	
	Black Pattern	—	—	1.170	1.403	A	
QFHD 60Hz Output Power Consumption	White Pattern	P_T	—	11.621	13.884	W	
	Horizontal Stripe	P_T	—	28.843	34.882	W	
	Black Pattern	P_T	—	11.765	14.102	W	
QFHD 60Hz Output Power Supply Current	White Pattern	—	—	0.968	1.157	A	
	Horizontal Stripe	—	—	2.404	2.907	A	
	Black Pattern	—	—	0.980	1.175	A	
V-by-One HS	Differential Input High Threshold Voltage	VLVTH	+50	—	—	mV	(4)
	Differential Input Low Threshold Voltage	VLVTL	—	—	-50	mV	
CMOS interface	Input High Threshold Voltage	V_{IH}	2.7	—	3.3	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.)

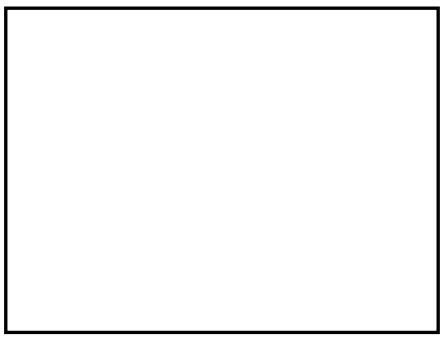
Note (2) Measurement condition :





Note (3) The specified power supply current is under the conditions at Vcc = 12 V, Ta = 25 ± 2 ºC, fv = 60/120 Hz, whereas a power dissipation check pattern below is displayed.

a. White Pattern

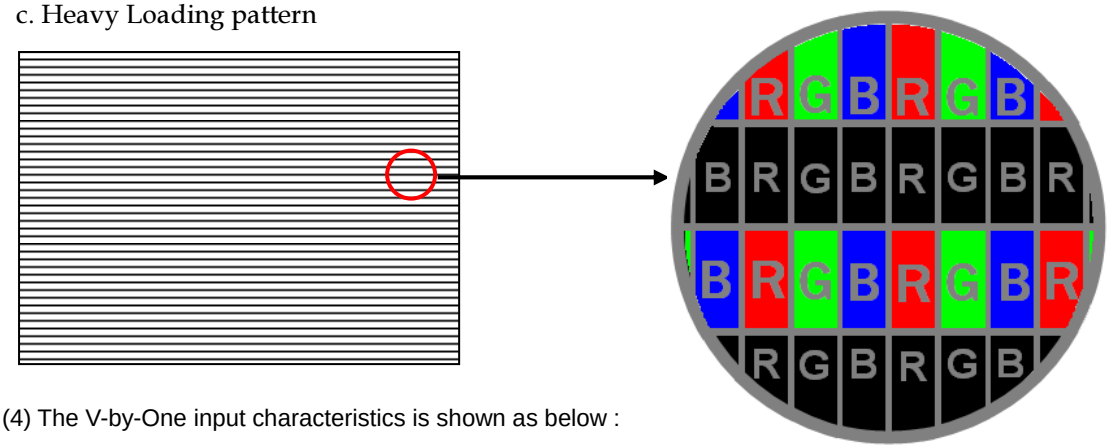


Active Area

b. Black Pattern

Active Area

c. Heavy Loading pattern



Note (4) The V-by-One input characteristics is shown as below :

3.2 BACKLIGHT UNIT

3.2.1 CONVERTER CHARACTERISTICS

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Power Consumption	$P_{BL(2D)}$	—	37.9	43.6	W	(1), (2)
Converter Input Voltage	VBL	22.8	24.0	25.2	VDC	
Converter Input Current	$I_{BL(2D)}$	—	1.6	1.9	A	Non Dimming
Input Inrush Current	$I_{R(2D)}$	—	—	3.9	Apeak	V_{BL}=22.8V (3), (6)
Dimming Frequency	FB	470	480	490	Hz	(5)
Dimming Duty Ratio	DDR	0	-	100	%	(4), (5)
Life Time	-	30,000	-	-	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 40" backlight unit under input voltage 24V, at 2D/3D Mode and lighting 1 hour later.

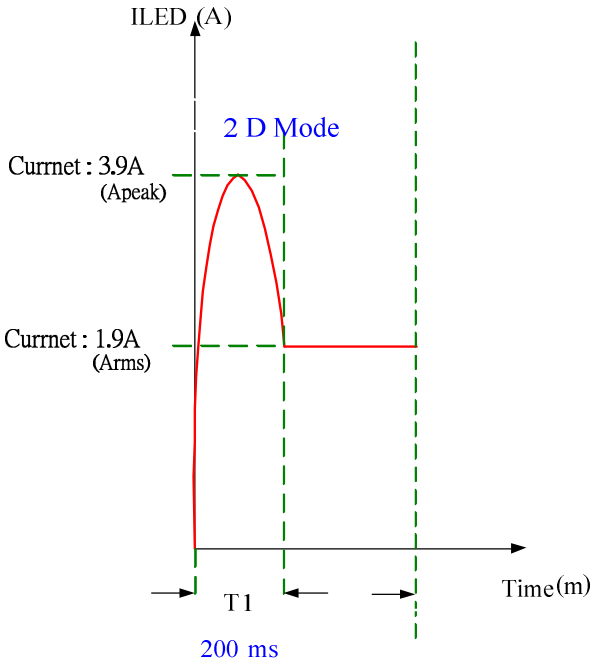
Note (3) For input inrush current measure, the VBL rising time from 10% to 90% is about 20ms.

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.

Test Condition : **VBL= 22.8V,** IL=115mA at 2D Mode



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) ,(9)
	LO		—	0	—	0.8	V	Duty off	
External PWM Frequency		F_{EPWM}	—	150	160	170	Hz	Normal mode (7) ,(9)	
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.

Note (8) [Recommend] EPWM duty ratio is set at 100%(Max. Brightness) in 3D Mode.

Note (9) Used the EPWM signal control user dimming only in 2D normal Mode. 2D scan and 2D local dimming Mode please reference 5.1 Note (11) and application Note.

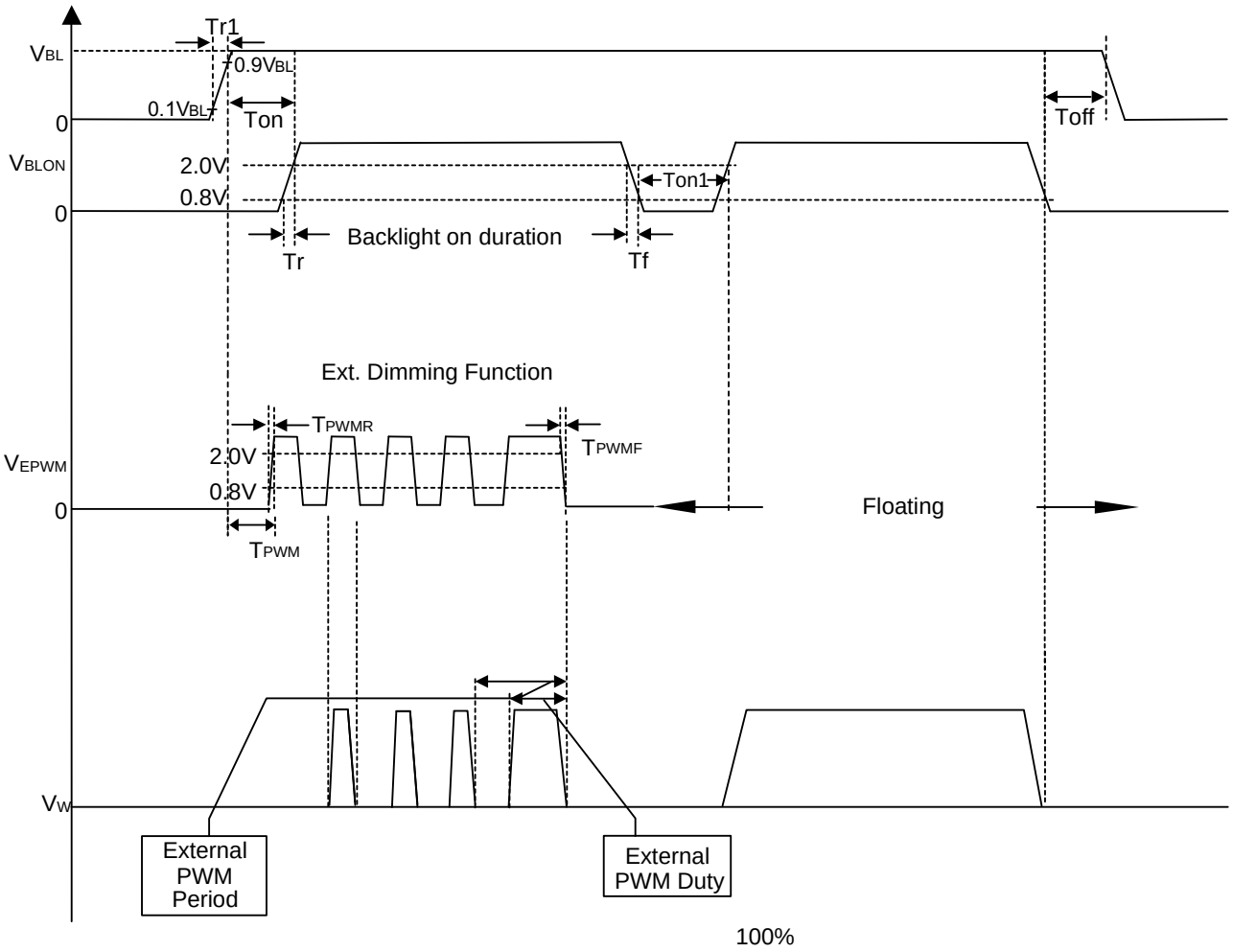


Fig. 1

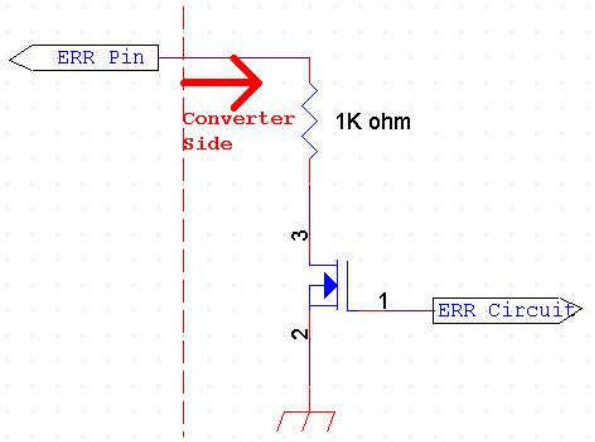


Fig. 2

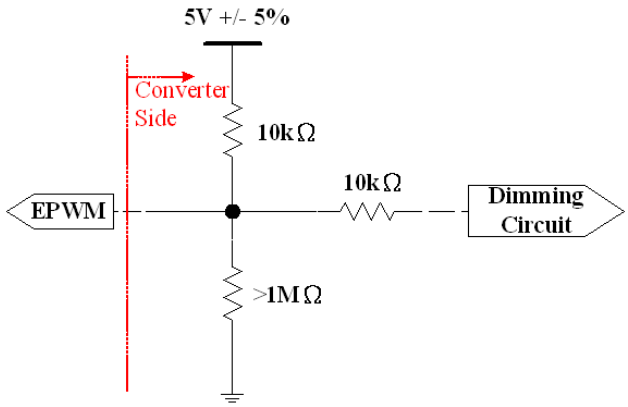
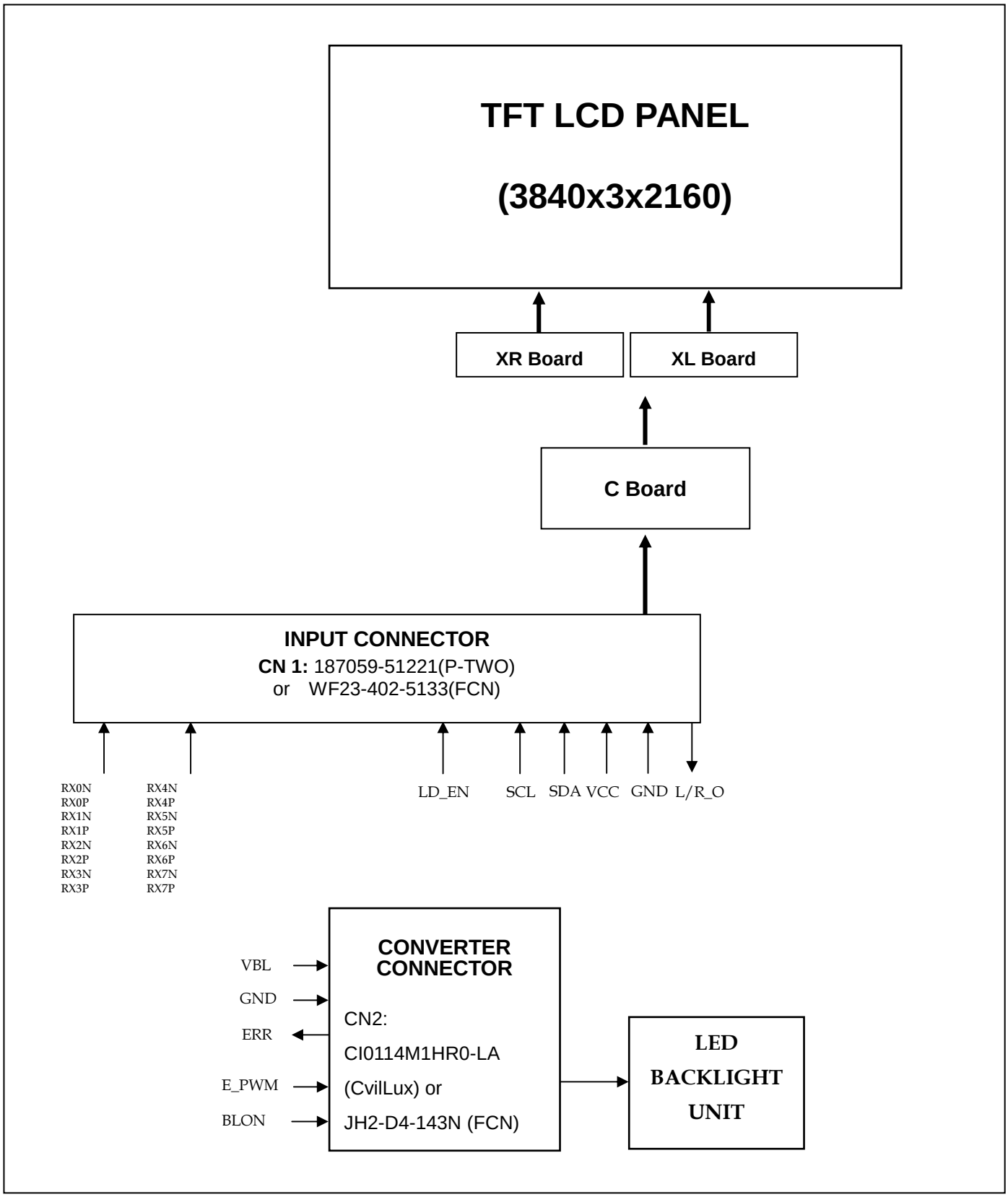


Fig. 3

4. BLOCK DIAGRAM OF INTERFACE

4.1 TFT LCD MODULE



5 .INPUT TERMINAL PIN ASSIGNMENT

5.1 TFT LCD MODULE

CNV1 Connector Pin Assignment (187059-51221(P-TWO) or WF23-402-5133(FCN))

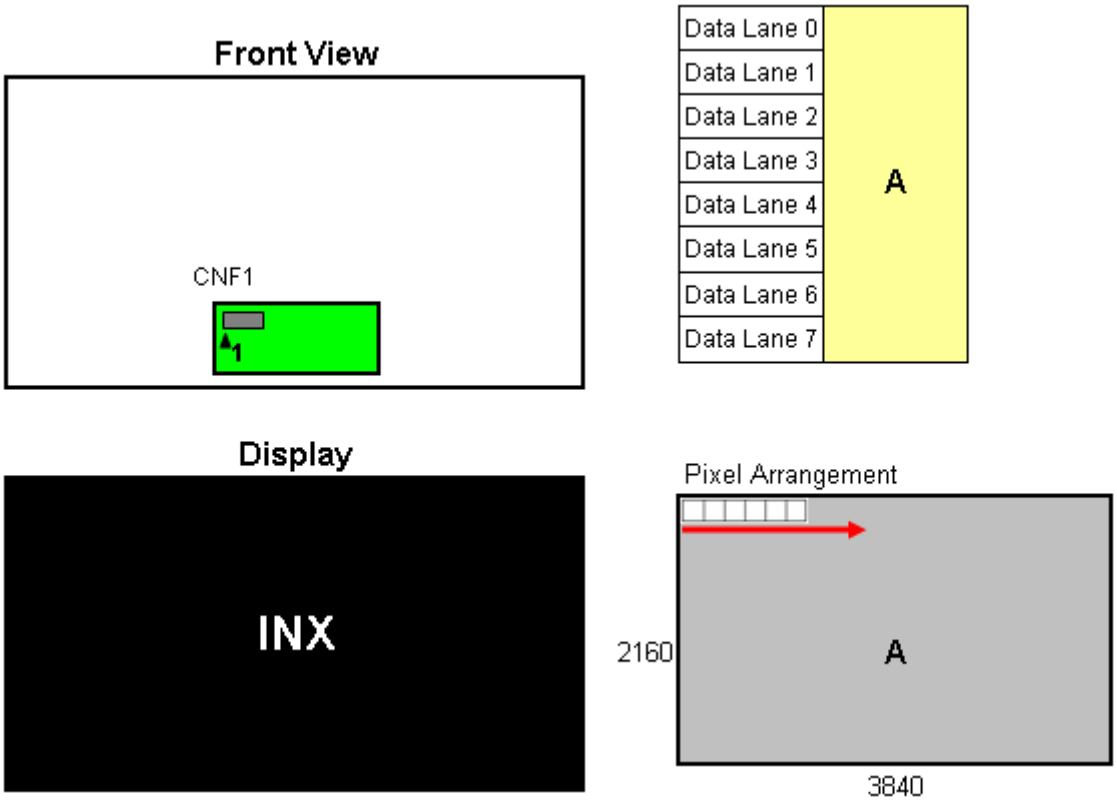
Matting connector : FI-RE51HL (JAE)

Pin	Name	Description	Note
1	Vin	Power input (+12V)	
2	Vin	Power input (+12V)	
3	Vin	Power input (+12V)	
4	Vin	Power input (+12V)	
5	Vin	Power input (+12V)	
6	Vin	Power input (+12V)	
7	Vin	Power input (+12V)	
8	Vin	Power input (+12V)	
9	N.C.	No Connection	(6)
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	N.C	No Connection	(6)
18	SDA	I2C Data signal	(7) (8)
19	SCL	I2C Clock signal	(7) (8)
20	N.C.	No Connection	(6)
21	N.C.	No Connection	(6)
22	LD_EN	Local Dimming Mode Enable.	(2)(3)
23	N.C.	No Connection	(6)
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 V-by-One differential data input in area A. Lane 0	(1)
29	RX0P	1ST Pixel Positive V-by-One differential data input in area A. Lane 0	
30	GND	Ground	
31	RX1N	2ND Pixel Negative V-by-One differential data input in area A. Lane 1	(1)
32	RX1P	2ND Pixel Positive V-by-One differential data input in area A. Lane 1	
33	GND	Ground	

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

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

Area	Lane	Data Stream
A	Lane 0	1, 9, 17, ..., 3825, 3833
	Lane 1	2, 10, 18, ..., 3826, 3834
	Lane 2	3, 11, 19, ..., 3827, 3835
	Lane 3	4, 12, 20, ..., 3828, 3836
	Lane 4	5, 13, 21, ...,3829, 3837
	Lane 5	6, 14, 22, ..., 3830, 3838
	Lane 6	7, 15, 23, ..., 3831, 3839
	Lane7	8, 16, 24, ..., 3832, 3840



Note (2) Local dimming enable selection. (Default: enable)

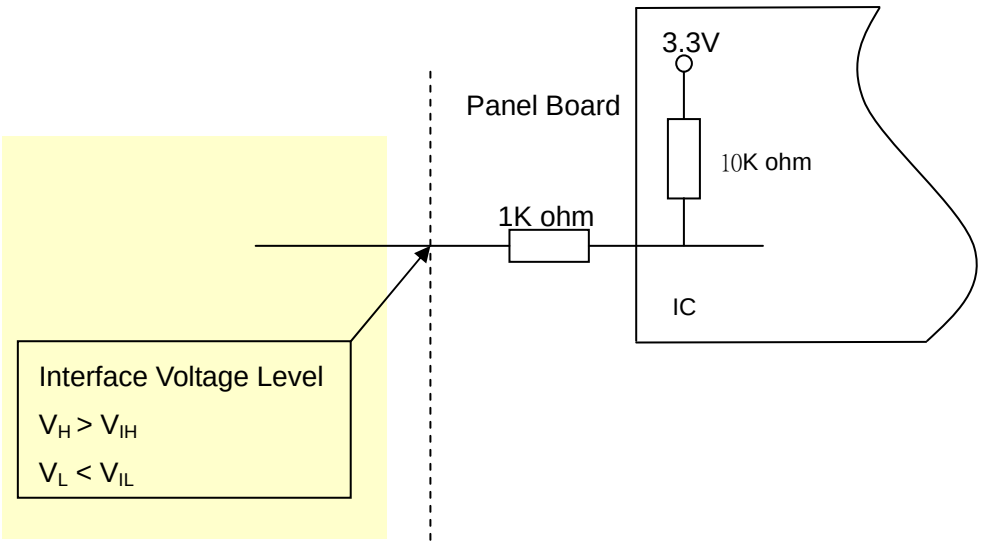
L= Connect to GND, H=Connect to +3.3V or Open

LD_EN	Note
L	Local Dimming Disable
H or Open	Local Dimming Enable

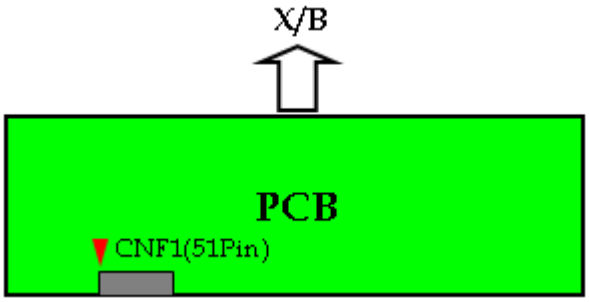
LD_EN enable pin should be set in power on stage.

Backlight should be turned off in the period of changing original setting after power on.

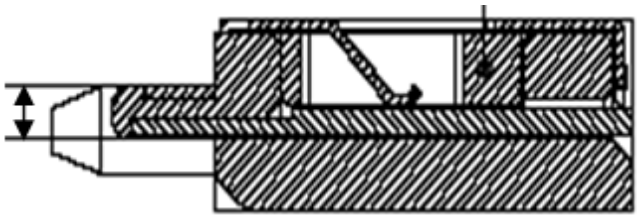
Note (3) Interface optional pin has internal scheme as following diagram. Customer should keep the interface voltage level requirement which including Panel board loading as below.



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) Local dimming table select & User dimming adjust for customer use. (User dimming is available only at 2D Mode. User dimming duty ratio is set at 100%

Note (8) The detail setting such as I2C command or timing requirement in FHD/QFHD is specified in INX application note. It's important and necessary to follow the specification either in product SPEC or application note, otherwise it may lead to abnormal or no display. INX application note would be provided by INX in the design-in stage.

5.2 BACKLIGHT UNIT

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

CN2

Connector Type : CF2012FV0R0-NH(Cvilux) or FF03-301-1231(FCN)

Pin No.	Symbol	Description
1	VLED+	Positive of LED string
2	VLED+	
3	VLED+	
4	NC	NC
5	N-	Negative of LED string
6	N-	
7	N-	
8	N-	
9	N-	
10	N-	
11	N-	
12	N-	

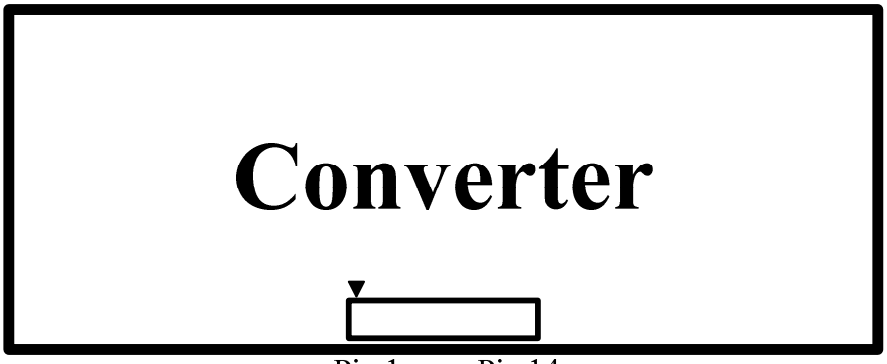
5.3 CONVERTER UNIT

CN1 (Header) : CI0114M1HR0-LA (CvilLux)

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

5.4 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	1	0	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	1	0	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	1
	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	1	0
	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	1	0	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	0	1	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	0	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	0	1

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

6. INTERFACE TIMING

6.1 INPUT SIGNAL TIMING SPECIFICATIONS

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

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
Data Clock	Frequency	1/Tc	70	74.25	78	MHz	(1)
V-by-One Receiver	Intra-Pair skew		-0.3	—	0.3	UI	(2)
	Inter-pair skew		-5	—	5	UI	(3)
	Spread spectrum modulation range	F_{clkin_mod}	1/Tc-0.5%	—	1/Tc+0.5%	MHz	(4)
	Spread spectrum modulation frequency	F_{SSM}	—	—	30	KHz	

6.1.1 Timing spec for QFHD Frame Rate = 50Hz

Signal	Item		Symbol	Min.	Typ.	Max.	Unit	Note
Data Clock	Frequency		F_{clkin} (=1/TC)	70	74.25	78	MHZ	(1)
Frame rate	2D mode		Fr5	47	50	53	Hz	(5),(6)
Vertical Active Display Term (8 Lane,3840X2160 Active Area)	2D Mode	Total	Tv	2200	2700	2790	Th	Tv=Tvd+Tvb
		Display	Tvd	2160	2160	2160	Th	
		Blank	Tvb	40	540	630	Th	
Horizontal Active Display Term (8 Lane,3840X2160 Active Area)	2D Mode	Total	Th	530	550	600	Tc	Th=Thd+Thb
		Display	Thd	480	480	480	Tc	
		Blank	Thb	50	70	120	Tc	

6.1.2 Timing spec for QFHD Frame Rate = 60Hz

Signal	Item		Symbol	Min.	Typ.	Max.	Unit	Note
Data Clock	2D Mode		F_{clkin} (=1/TC)	70	74.25	78	MHz	(1)
Frame Rate	2D Mode		F_r	57	60	63	Hz	(5),(6)
Vertical Active Display Term (8 Lane,3840X2160 Active Area)	2D Mode	Total	Tv	2208	2250	2350	Th	Tv=Tvd+Tvb
		Display	Tvd	2160			Th	
		Blank	Tvb	48	90	190	Th	

Horizontal Active Display Term (8 Lane,3840X2160 Active Area)	2D Mode	Total	Th	530	550	600	Tc	Th=Thd+Thb
		Display	Thd	480			Tc	
		Blank	Thb	50	70	120	Tc	

6.1.3 Input Timing Spec for FHD, Frame Rate = 50Hz

Signal	Item		Symbol	Min.	Typ.	Max.	Unit	Note
Data Clock	Frequency		F_{clkin} (=1/TC)	70	74.25	78	MHz	(1)
Frame Rate	2D Mode		F_r	47	50	53	Hz	(5),(6)
Vertical Active Display Term (2 Lane,1920X1080 Active Area)	2D Mode	Total	Tv	1104	1350	1395	Th	Tv=Tvd+Tvb
		Display	Tvd	1080			Th	
		Blank	Tvb	24	270	315	Th	
Horizontal Active Display Term (2 Lane,1920X1080 Active Area)		Total	Th	1060	1100	1340	Tc	Th=Thd+Thb
		Display	Thd	960			Tc	
		Blank	Thb	100	140	380	Tc	

6.1.4 Input Timing Spec for FHD, Frame Rate = 60Hz

Signal	Item		Symbol	Min.	Typ.	Max.	Unit	Note
Data Clock	Frequency		F_{clkin} (=1/TC)	70	74.25	78	MHz	(1)
Frame Rate	2D Mode		F_r	57	60	63	Hz	(5),(6)
Vertical Active Display Term (2 Lane,1920X1080 Active Area)	2D Mode	Total	Tv	1104	1125	1395	Th	Tv=Tvd+Tvb
		Display	Tvd	1080			Th	
		Blank	Tvb	24	45	315	Th	
Horizontal Active Display Term (2 Lane,1920X1080 Active Area)		Total	Th	1060	1100	1340	Tc	Th=Thd+Thb
		Display	Thd	960			Tc	
		Blank	Thb	100	140	380	Tc	

6.1.5 Input Timing Spec for FHD, Frame Rate = 100Hz

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
Data Clock	Frequency	F_{clkin} (=1/TC)	70	74.25	78	MHz	(1)

Frame Rate	2D Mode		F_r	97	100	103	Hz	(5),(6)
Vertical Active Display Term (4 Lane,1920X1080 Active Area)	2D Mode	Total	Tv	1104	1350	1395	Th	Tv=Tvd+Tvb
		Display	Tvd	1080			Th	
		Blank	Tvb	24	270	315	Th	
Horizontal Active Display Term (4 Lane,1920X1080 Active Area)		Total	Th	530	550	670	Tc	Th=Thd+Thb
		Display	Thd	480			Tc	
		Blank	Thb	50	70	190	Tc	

6.1.6 Input Timing Spec for FHD, Frame Rate = 120Hz

Signal	Item		Symbol	Min.	Typ.	Max.	Unit	Note
Data Clock	2D Mode		F_{clkin} (=1/TC)	70	74.25	78	MHz	(1)
Frame Rate	2D Mode		F_r	117	120	123	Hz	(5),(6)
Vertical Active Display Term (4 Lane,1920X1080 Active Area)	2D Mode	Total	Tv	1104	1125	1395	Th	Tv=Tvd+Tvb
		Display	Tvd	1080			Th	
		Blank	Tvb	24	45	315	Th	
		Blank	Tvb	45			Th	
Horizontal Active Display Term (4 Lane,1920X1080 Active Area)	2D Mode	Total	Th	530	550	670	Tc	Th=Thd+Thb
		Display	Thd	480			Tc	
		Blank	Thb	50	70	190	Tc	

6.1.7 Input Timing spec for QFHD, Frame Rate = 24Hz

Signal	Item		Symbol	Min.	Typ.	Max.	Unit	Note
Data Clock	Frequency		F_{clkin} (=1/TC)	70	74.25	78	MHz	(1)
Frame Rate	2D Mode		F_r	23.6	24	24.5	Hz	(5),(6)
Vertical Active Display Term (4 Lane,3840X2160 Active Area)	2D Mode	Total	Tv	2208	2250	2750	Th	Tv=Tvd+Tvb
		Display	Tvd	2160			Th	
		Blank	Tvb	48	90	590	Th	
Horizontal Active Display Term (4 Lane,3840X2160 Active Area)		Total	Th	1060	1100	1200	Tc	Th=Thd+Thb
		Display	Thd	960			Tc	
		Blank	Thb	80	140	240	Tc	

6.1.8 Input Timing spec for QFHD, Frame Rate = 30Hz

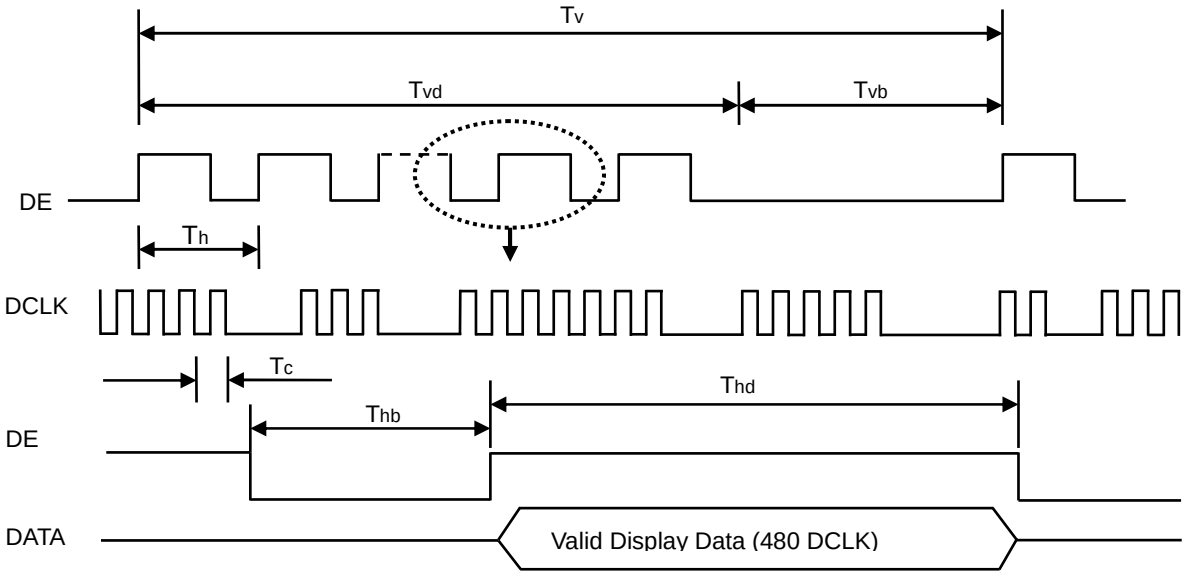
Signal	Item		Symbol	Min.	Typ.	Max.	Unit	Note
Data Clock	2D Mode		F_{clkin} (=1/TC)	70	74.25	78	MHz	(1)
Frame Rate	2D Mode		F_r	29	30	31	Hz	(5),(6)
Vertical Active Display Term (4 Lane,1920X1080 Active Area)	2D Mode	Total	Tv	2208	2250	2350	Th	Tv=Tvd+Tvb
		Display	Tvd	2160			Th	
		Blank	Tvb	48	90	190	Th	
		Blank	Tvb	90			Th	
Horizontal Active Display Term (4 Lane,1920X1080 Active Area)	2D Mode	Total	Th	1060	1100	1200	Tc	Th=Thd+Thb
		Display	Thd	960			Tc	
		Blank	Thb	80	140	240	Tc	

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

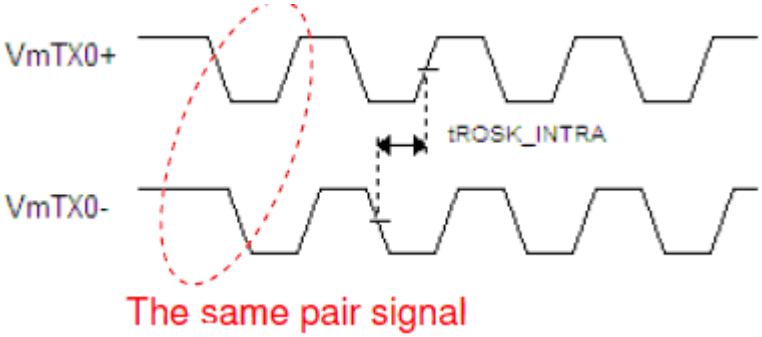
Fclkin(max) ≧ Fr × Tv × Th

Fr × Tv × Th ≧ Fclkin (min)

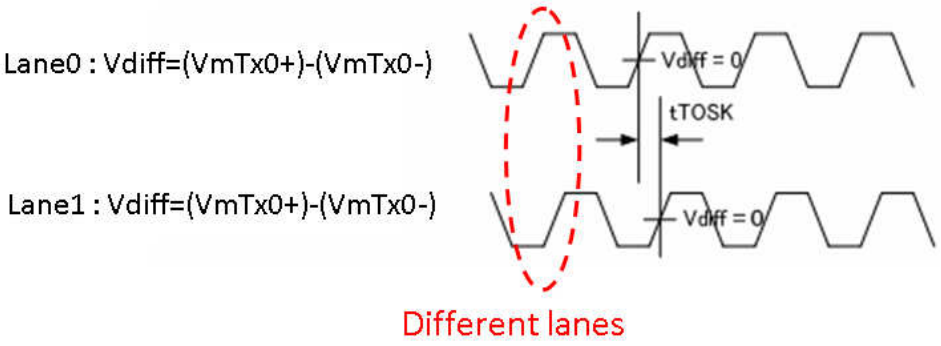
INPUT SIGNAL TIMING DIAGRAM



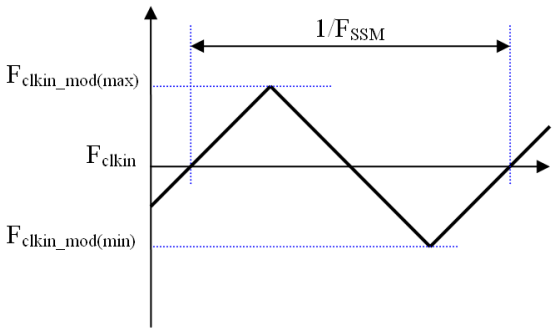
Note (2) Intra-pair Data skew



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

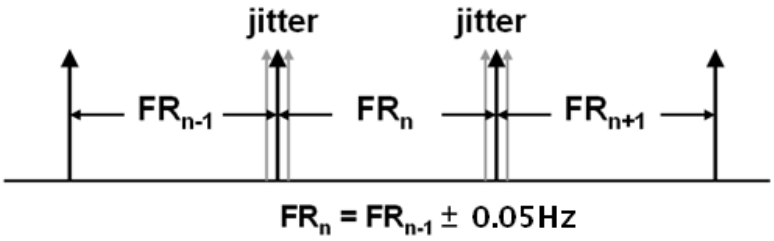


Note (4) The SSCG (Spread spectrum clock generator) is defined as below figures.



Note (5) The frame-to-frame jitter of the input frame rate is defined as the above figures. FRn = FRn-1 ± 0.05Hz.

Note (6) The setup of the frame rate jitter > 0.05Hz may result in poor picture quality or cosmetic LED backlight symptom but the electric function is not affected.



6.2 V by One Input Signal Timing Diagram

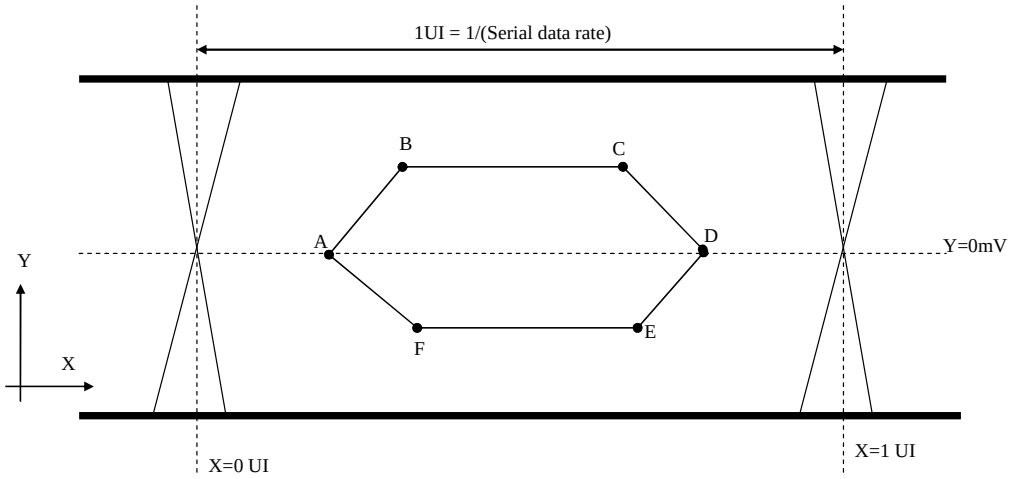


Table 1 Eye Mask Specification

	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”

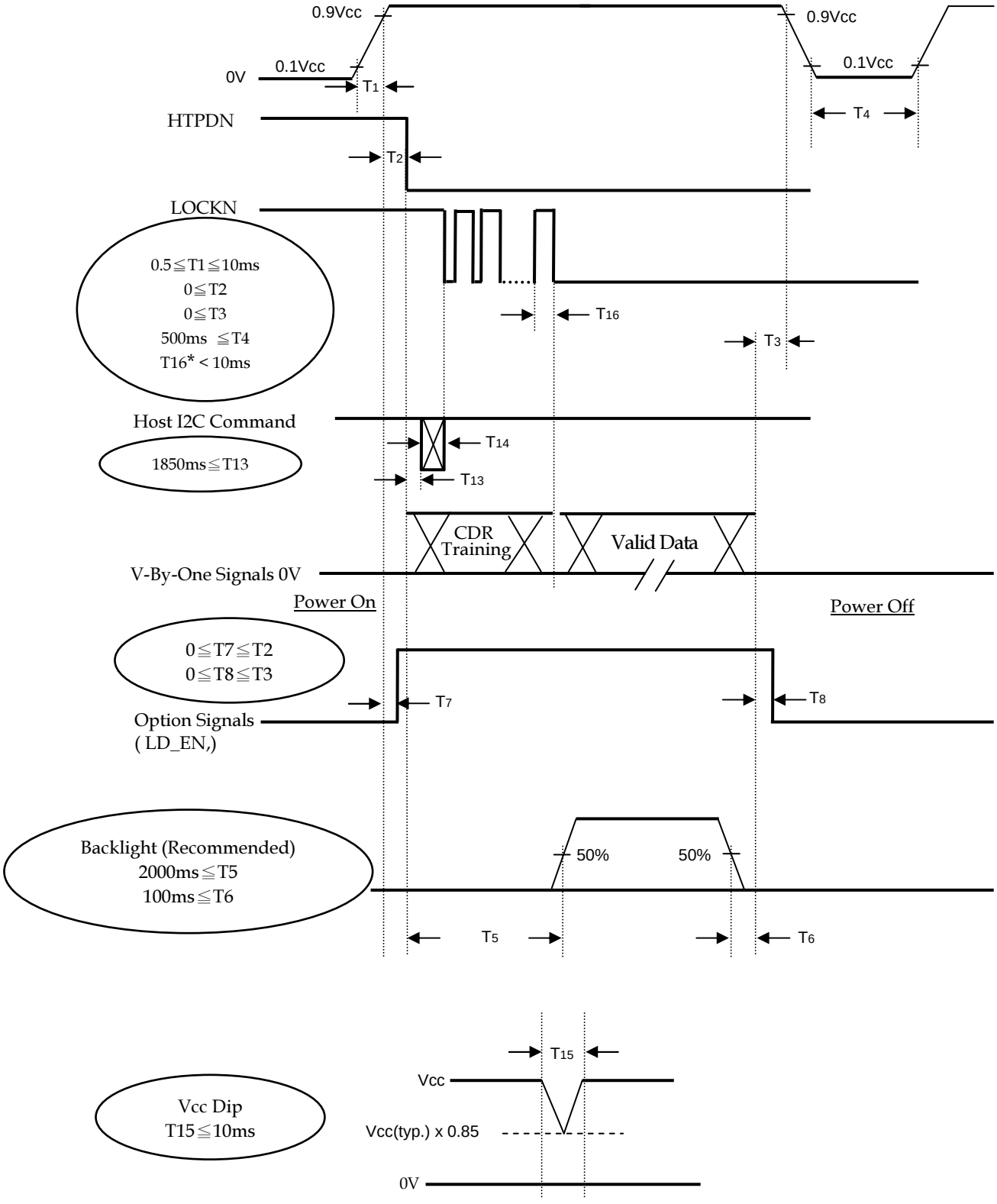
6.3 Byte Length and Color mapping of V-by-One HS

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]
	D[16]	B[2]
	D[17]	B[3]
	D[18]	B[4]
	D[19]	B[5]
Byte 2	D[20]	B[6]
	D[21]	B[7]
	D[22]	B[8]
	D[23]	B[9]
	D[24]	X
	D[25]	X
	D[26]	B[0]
	D[27]	B[1]
Byte 3	D[28]	G[0]
	D[29]	G[1]
	D[30]	R[0]
	D[31]	R[1]

6.4 POWER ON/OFF SEQUENCE

(Ta = 25 ± 2 ºC)

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) When 2D mode is changed, TCON will insert black pattern internally. During black insertion, TCON would load required optical table and TCON parameter setting. The black insertion time should be longer than 650ms because TCON must recognize 2D format and set the correct parameter.

Note (7) Vcc must decay smoothly when power-off.

Note (8) T5 ＞ (T13 + T14)

Note (9) T16, V-by-One signals shall be stabilized and follows timing specification which defined by section 6.1 & 6.2.

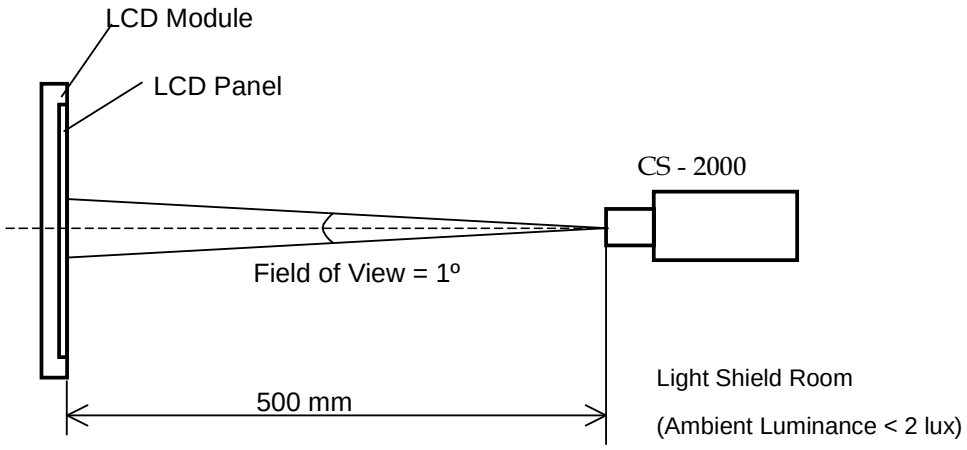
7. OPTICAL CHARACTERISTICS

7.1 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"		
Vertical Frame Rate	Fr	60	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. “42”)



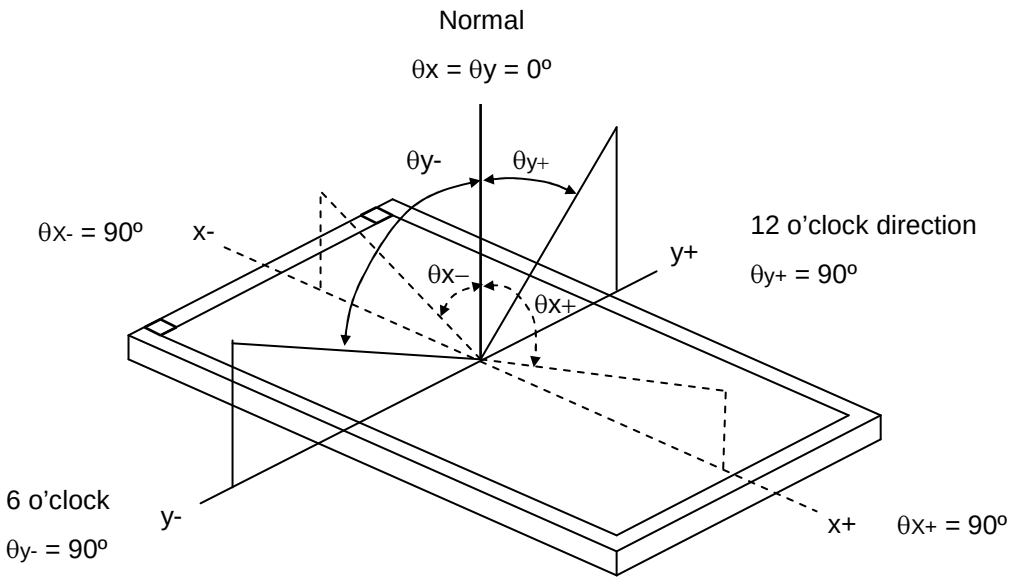
7.2 OPTICAL SPECIFICATIONS

The relative measurement methods of optical characteristics are shown in 7.2. The following items should be measured under the test conditions described in 7.1 and stable environment shown in 7.1.

Item		Symbol		Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio		CR		θ_x=0°, θ_Y =0° Viewing angle at normal direction	3500	5000	-	-	Note (2)
Response Time		Gray to gray				8.5	17	ms	Note (3)
Center Luminance of White		L_C	2D		280	350	-	cd/m^2	Note (4)
White Variation		δW					1.3	-	Note (6)
Cross Talk		CT	2D		-		4	%	Note (5)
Color Chromaticity	Red	Rx			Typ.- 0.03	0.670	Typ.+ 0.03	-	
		Ry				0.307		-	
	Green	Gx				0.259		-	
		Gy				0.648		-	
	Blue	Bx				0.151		-	
		By				0.054		-	
	White	Wx				0.280		-	
		Wy				0.290		-	
	Correlated color temperature					10000		K	
	Color Gamut	C.G.			-	88	-	%	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.

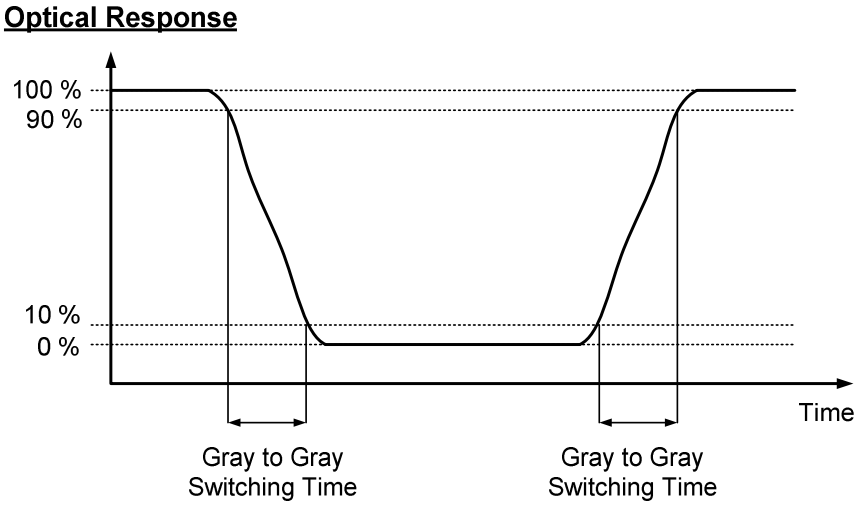
$$\text{Contrast Ratio (CR)} = \frac{\text{Surface Luminance of L1023}}{\text{Surface Luminance of L0}}$$

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).

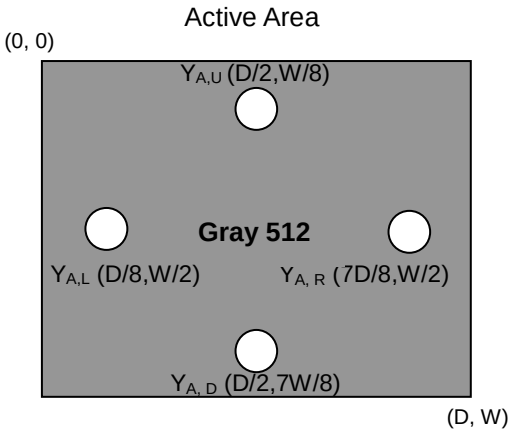
Note (5) Definition of Cross Talk (CT) :

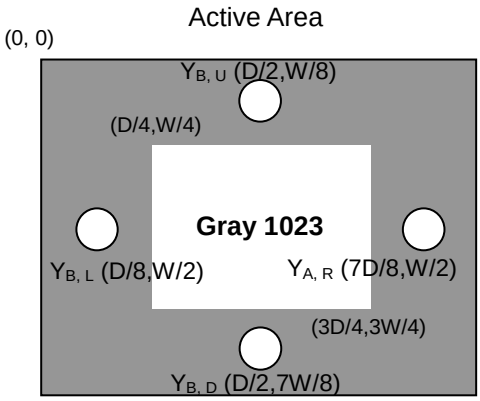
$CT = | Y_B – Y_A | / Y_A \times 100$ (%)

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)

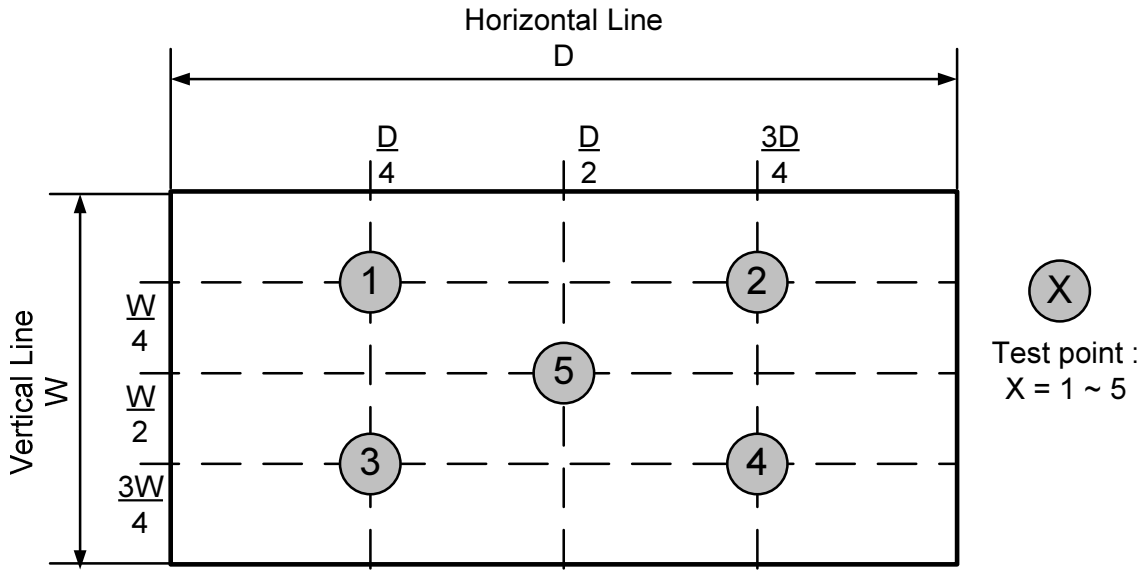




Note (6) Definition of White Variation (δW):

Measure the luminance of gray level 1023 at 5 points

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



8. PRECAUTIONS

8.1 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] Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched. Water, IPA (Isoproyl Alcohol) or Hexane are desirable cleaners. Do not use Ketone type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.

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

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

[13.1] 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.

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

[14] 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.

8.2 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 20 hrs 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.

8.3 SAFETY STANDARDS

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

Regulatory	Item	Standard
Information Technology equipment	UL	UL60950-1:2006 or Ed.2:2007
	cUL	CAN/CSA C22.2 No.60950-1-03 or 60950-1-07
	CB	IEC60950-1:2005 / EN60950-1:2006+ A11:2009
Audio/Video Apparatus	UL	UL60065 Ed.7:2007
	cUL	CAN/CSA C22.2 No.60065-03:2006 + A1:2006
	CB	IEC60065:2001+ A1:2005 / EN60065:2002 + A1:2006+ A11:2008

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

9. DEFINITION OF LABELS

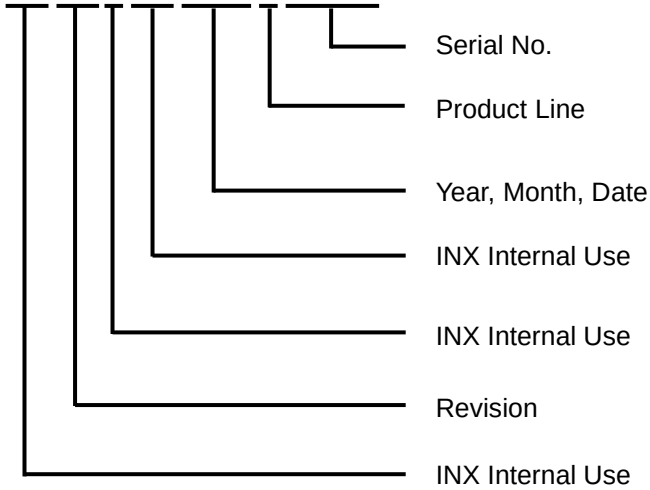
9.1 MODULE LABEL

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

Model Name : V400DJ1-KS5

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

Serial ID : X 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.

9.2 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 V400DJ1-KS5

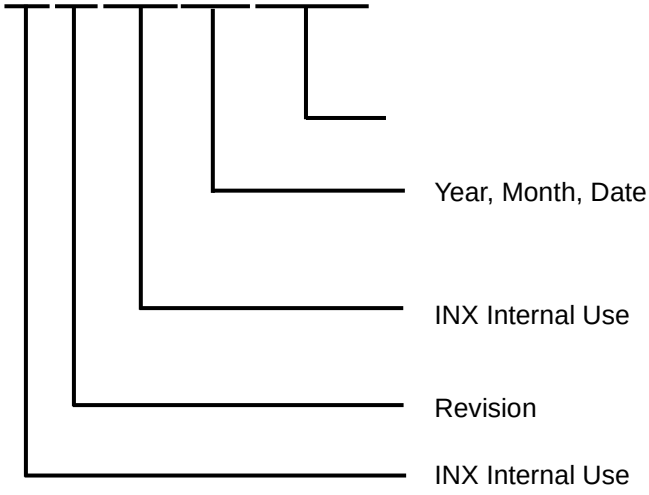
Carton ID._____ Quantities ___

XXXXXXXXXXXXX

Made In Taiwan (Made In China)

Model Name: V400DJ1– KS5

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

10. PACKAGING

10.1 PACKAGING SPECIFICATIONS

(1) 7 LCD TV modules / 1 Box

(2) Box dimensions : 954(L) X 378 (W) X 625 (H)

(3) Weight: approximately 55.6 Kg

10.2 PACKAGING METHOD

Figures 10-1 and 10-2 are the packing method

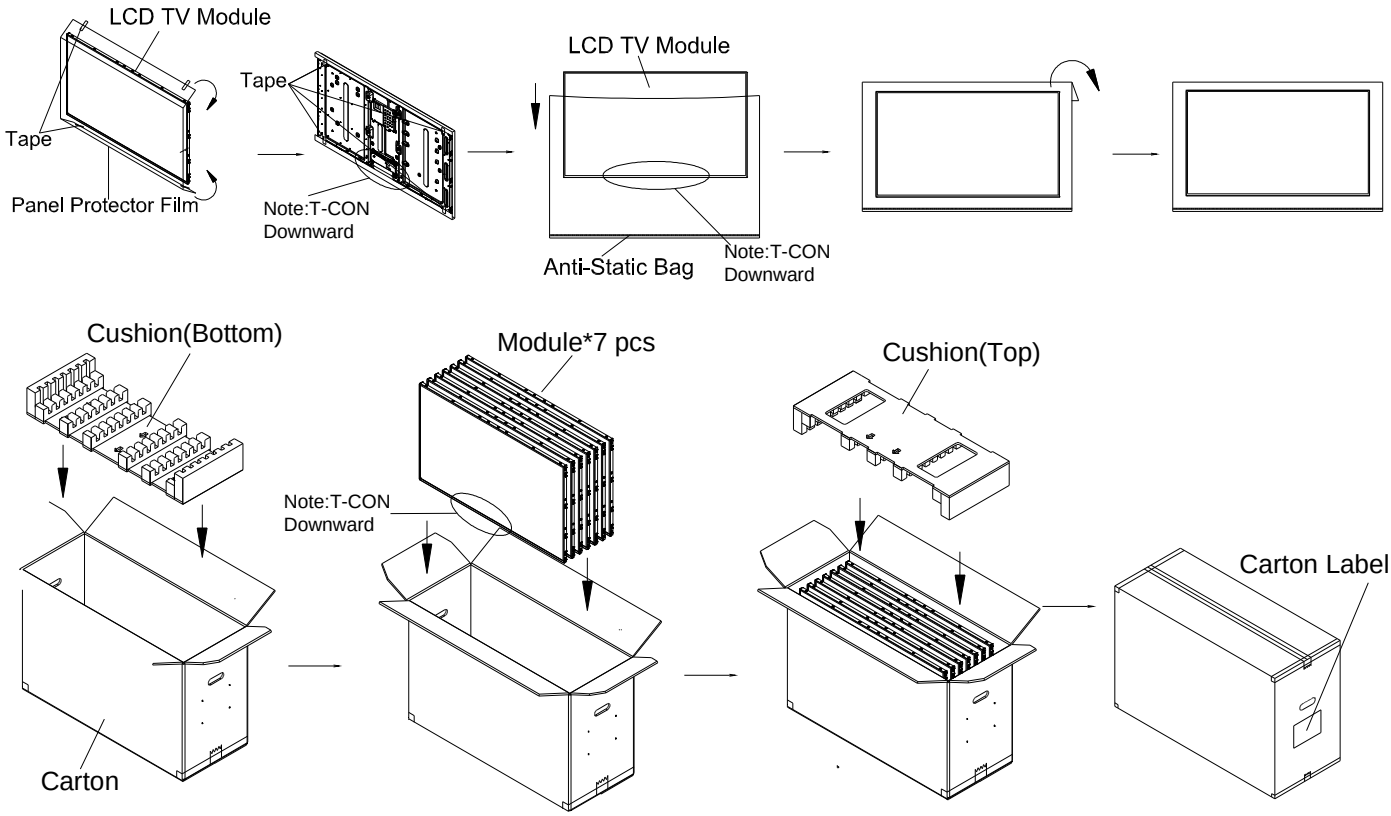
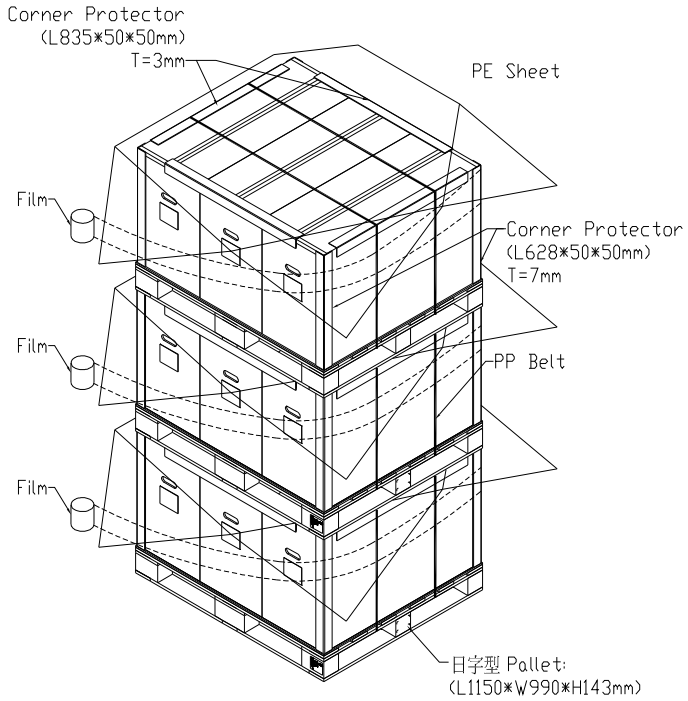
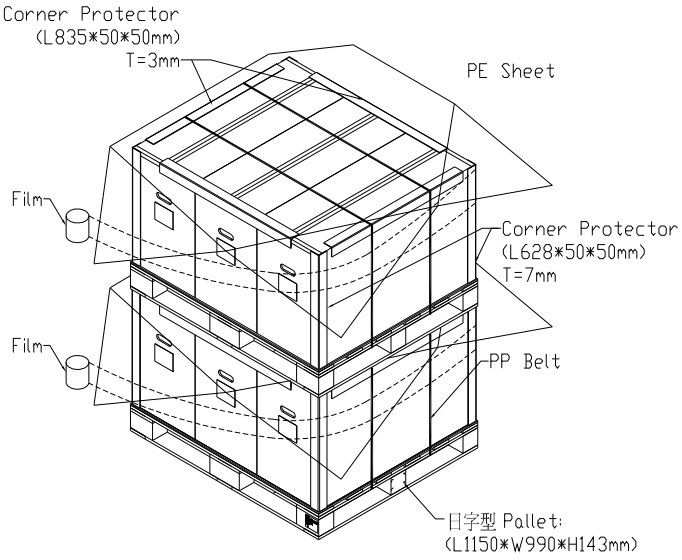


Figure 10-1 packing method

Sea / Land Transportation
(40ft HQ Container)



Sea / Land Transportation
(20ft / 40ft Container)



Air Transportation

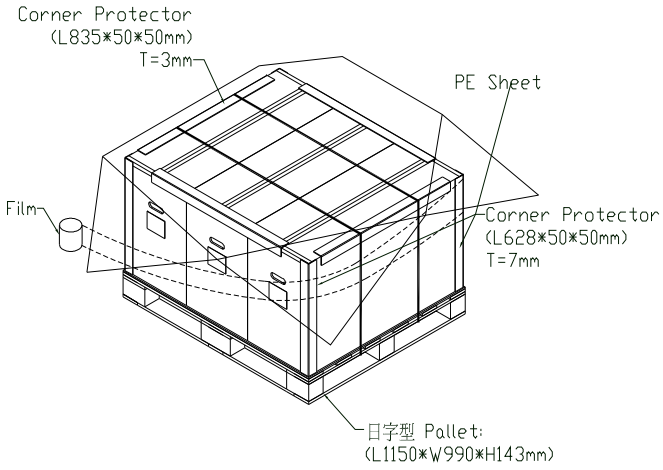


Figure 10-2 packing method

10.3 UN-PACKAGING METHOD

Figures 10-3 is the un-packing method

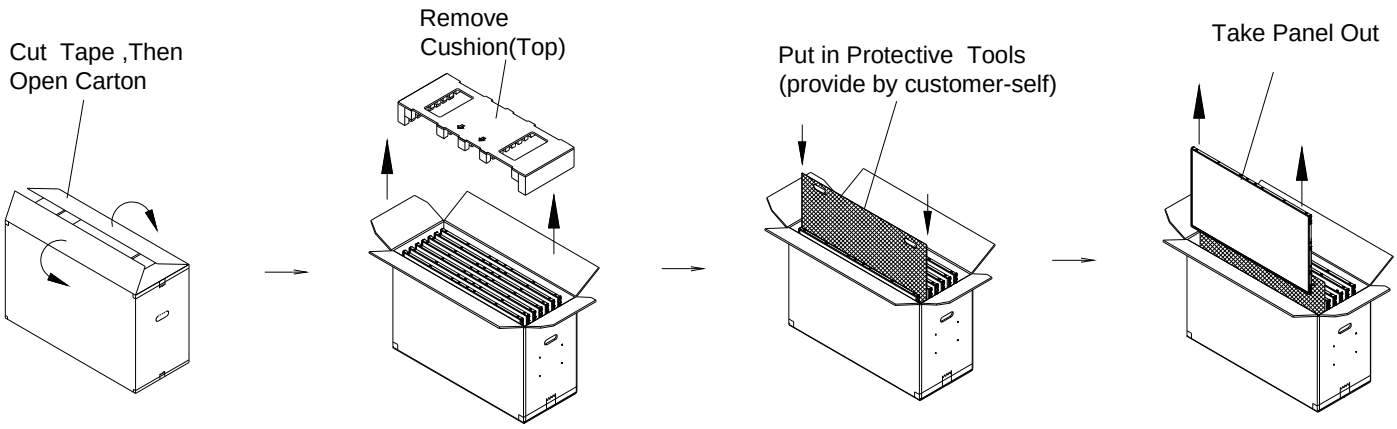


Figure 10-3 un-packing method

11. MECHANICAL CHARACTERISTIC