■ **Tentative Specification**
☐ Preliminary Specification
☐ Approval Specification

MODEL NO.: G154JCE
SUFFIX: L01

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

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REVISION HISTORY

Version	Date	Section	Description
0.0	2017.09.01	All	Tentative Specification was first issued.

1. GENERAL DESCRIPTION

1.1 OVERVIEW

G154JCE-L01 is a 15.4” IAV (Industrial/Amusement/Vehicle) TFT Liquid Crystal Display module with LED backlight unit and FPD-Link III interface. This product supports 1920 x 1200 WUXGA format and can display true 16.7M colors. The converter for LED backlight is built-in.

1.2 FEATURES

- Excellent brightness (800 nits)
- High color saturation sRGB
- WUXGA (1920 x 1200 pixels) resolution
-Wide operation and storage temperature range

1.3 APPLICATION

- TFT LCD monitor for Industrial application

1.4 GENERAL SPECIFICATI0NS

Item	Specification	Unit	Note
Active Area	330.624 (H) x 206.64 (V)	mm	(1)
Driver Element	a-si TFT active matrix	-	-
Pixel Number	1920 x R.G.B. x 1200	pixel	-
Pixel Pitch	0.1905 (H) x 0.1905 (V)	mm	-
Pixel Arrangement	RGB vertical stripe	-	-
Display Colors	16.7 M	color	-
Display Operation Mode	Transmissive mode / Normally black	-	-
Surface Treatment	Anti-Glare, 3H	-	-
Total power consumption(typ)	(22)	W	typ

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

1.5 MECHANICAL SPECIFICATIONS -

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	340.82	341.12	341.42	mm	(1)
	Vertical (V)	218.84	219.14	219.44	mm	
	Depth (D)	(6.65)	(6.95)	(7.25)	mm	-
Weight		(972)	(1012)	(1052)	g	-

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

2. ABSOLUTE MAXIMUM RATINGS

2.1 ABSOLUTE RATINGS OF ENVIRONMENT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Operating Ambient Temperature	T_{OP}	-40	+85	ºC	
Storage Temperature	T_{ST}	-40	+95	ºC	

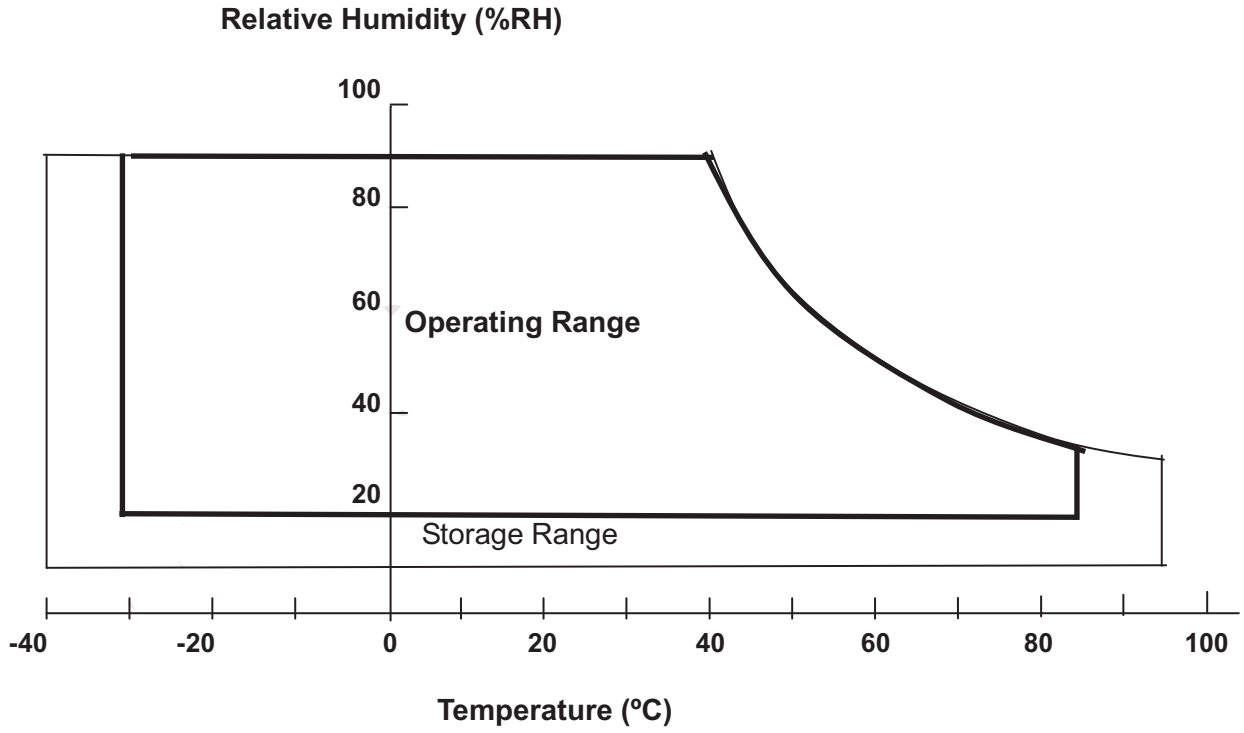
Note (1) Temperature and relative humidity range is shown in the figure below.

(a) 90 %RH Max. (Ta ≦ 40 ºC).

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

(c) No condensation

(d)The absolute maximum rating values of this product are not allowed to be exceeded at any times. The module should not be used over the absolute maximum rating value. It will cause permanently unrecoverable function fail in such a condition.



2.2 ELECTRICAL ABSOLUTE RATINGS

2.2.1 TFT LCD MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	VCC	-0.3	24	V	(1), (2)
Enable Voltage	EN(GPIO[5])	-	5.5	V	
Backlight Adjust	PWMGPIO[2])	-	5.5	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) Specified values are for LED light bar (Refer to 3.1 for further information).

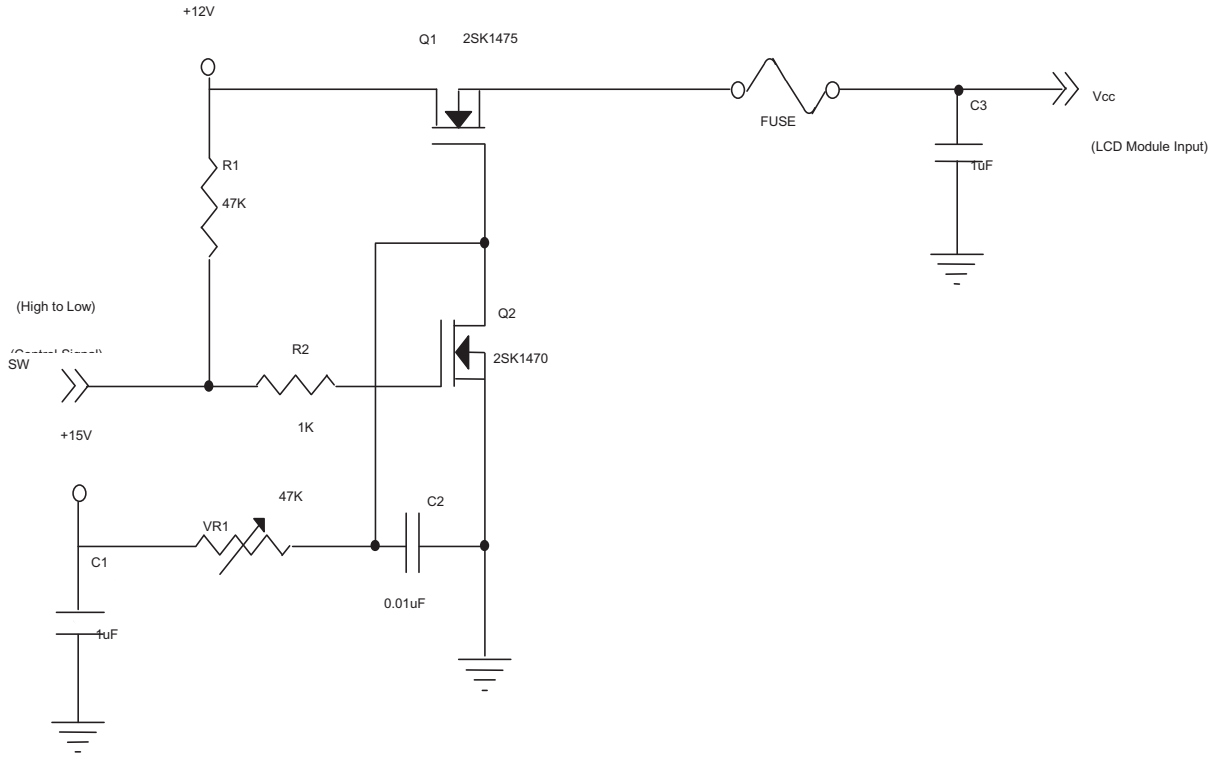
3. ELECTRICAL CHARACTERISTICS

3.1 TFT LCD MODULE

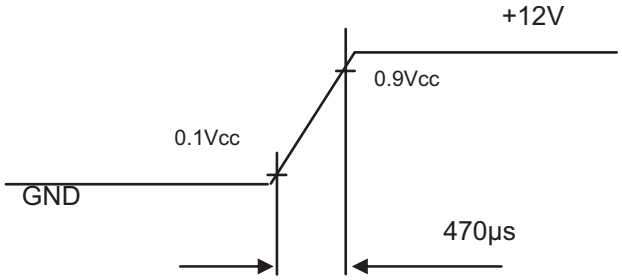
Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		V_{CC}	10.8	12	13.2	V	(1)
Ripple Voltage		V_{RP}	-	-	150	mV	-
Rush Current		I_{RUSH}	-	-	4.0	A	(2)
Power Supply Current	White	-	-	1.80	2.0	A	(3)
	Black		-	1.62	1.82	A	
Power Consumption		P_L	-	21.6	24.0	W	
EN(GPIO[5]) Control Level	Backlight on		2.0	-	5.0	V	(4)
	Backlight off		0	-	0.8	V	
PWM(GPIO[2]) Control Level	PWM High Level		2.0	-	5.0	V	(4)
	PWM Low Level		0	-	0.15	V	
PWM(GPIO[2]) Control Duty Ratio			1		100	%	
PWM(GPIO[2]) Control Frequency		f_{PWM}	190	200	210	Hz	
LED Life Time		L_L	(40,000)	-	-	Hrs	(5)

Note (1) The assembly should be always operated within above ranges.

Note (2) Measurement Conditions:



VCC rising time is 470us



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

a. White Pattern

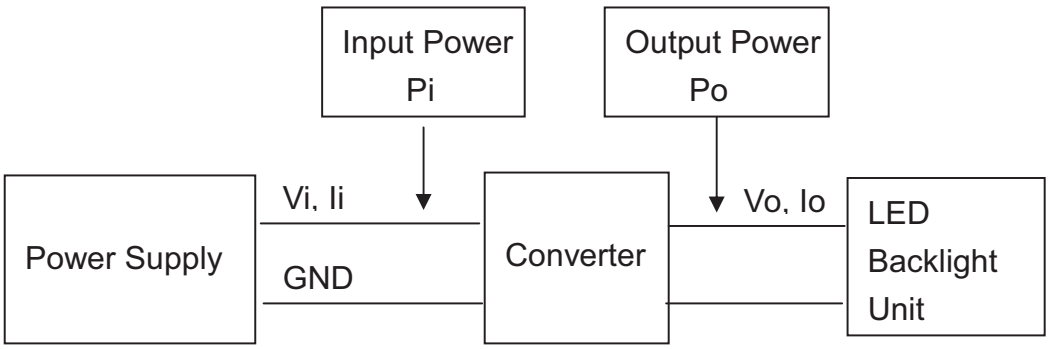
Active Area

b. Black Pattern

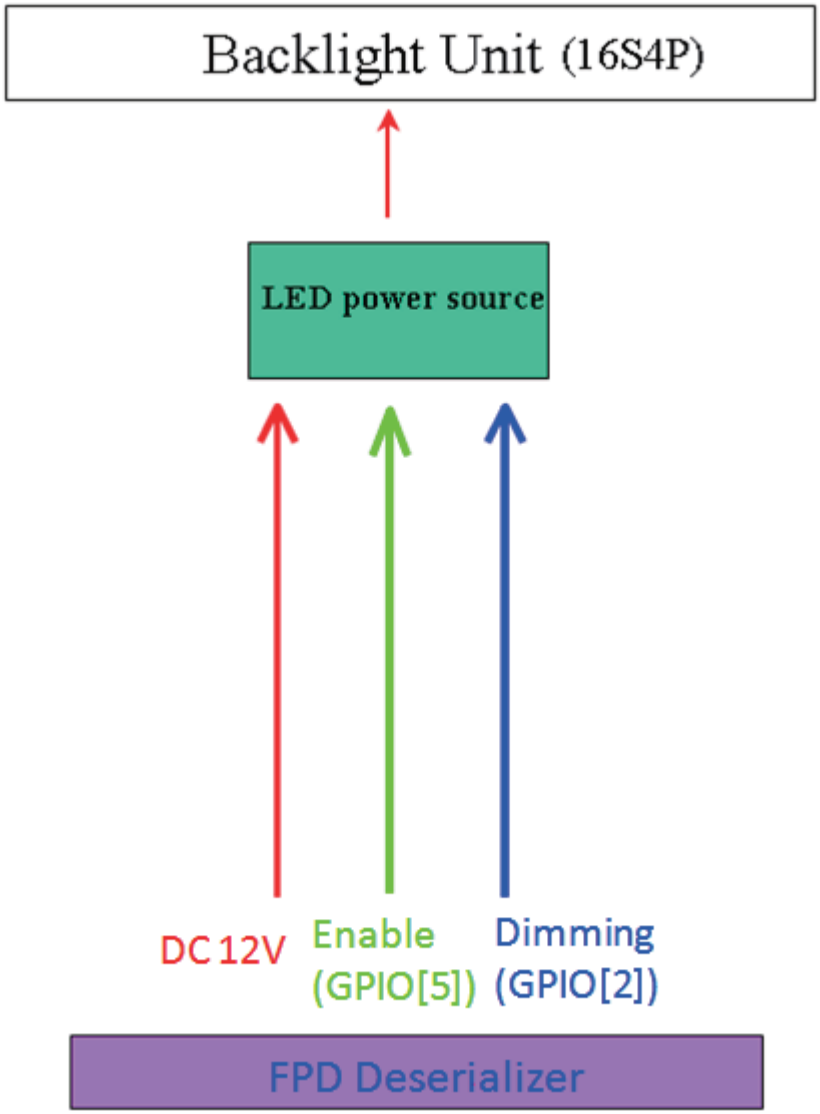
Active Area

Note (4) GPIO[2] & GPIO[5] signal diagnosis to control Backlight. The module shall use the GPIO[2] & GPIO[5] signal to control Backlight. GPIO[2] is control Backlight brightness, GPIO[5] is high to enable Backlight.

Note (5) The life time of LED is defined as the time when it continues to operate under the conditions at Ta = 25 ±2 ℃ and I_{LED} = 68mA_{DC}(LED forward current) until the brightness becomes ≦ 50% of its original value.

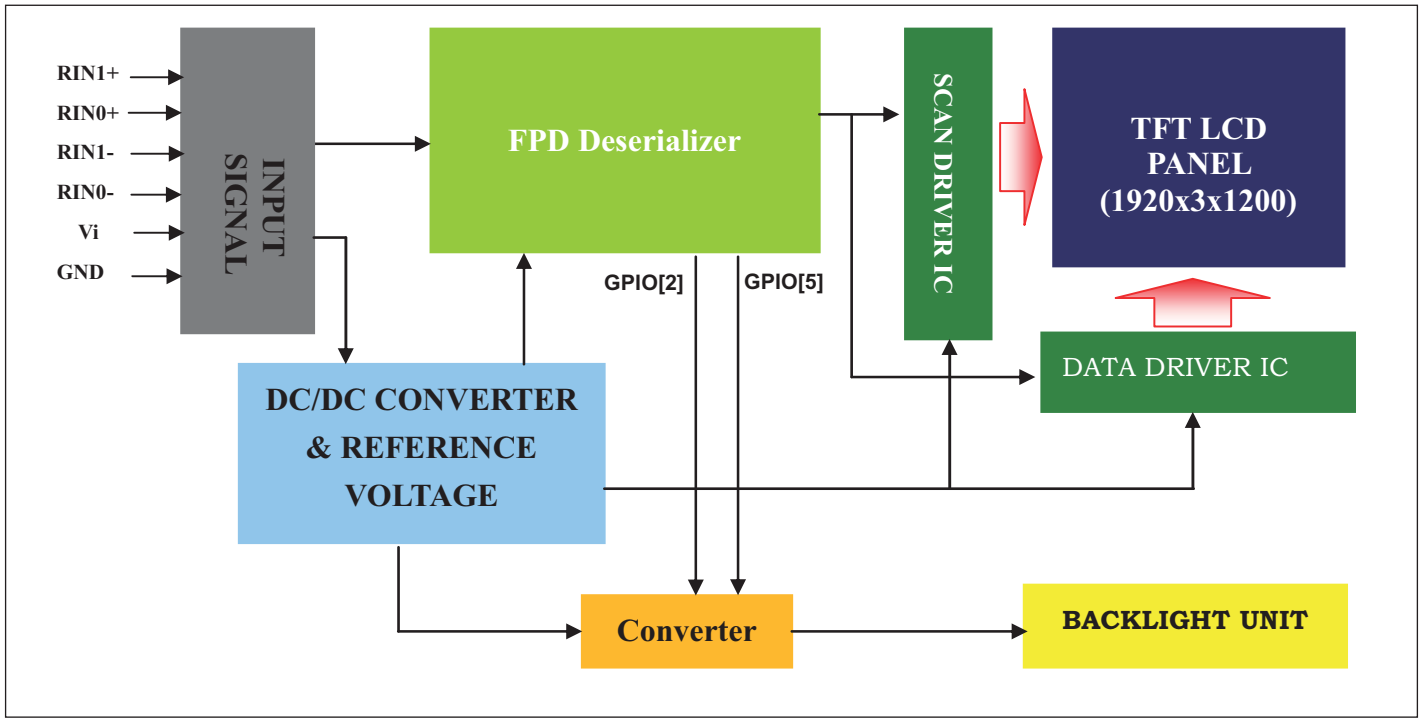


LED BL Block Diagram



4. BLOCK DIAGRAM

4.1 TFT LCD MODULE



5. INTERFACE PIN ASIGNMENT

5.1 TFT LCD MODULE

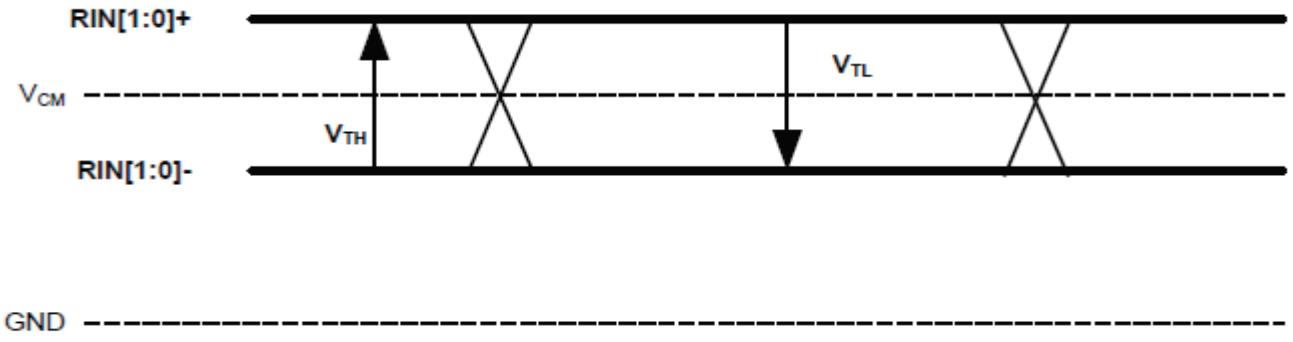
Pin No.	Name	Description
1	RIN1+	FPD-Link III True Input.
2	RIN0+	FPD-Link III True Input.
3	RIN1-	FPD-Link III Inverting Input.
4	RIN0-	FPD-Link III Inverting Input.
5	V_i	+12V power supply
6	GND	Ground

Note (1) Connector Part No.: Rosenberger(99S11D-40MA5-D)

5.2 FPD III -link DC electrical characteristics

Symbol	Parameter	Conditions	Pin/Freq.	Min.	Typ.	Max.	Unit
V_{TH}	Differential Threshold High Voltage	VCM = 2.1V	RIN0+, RIN0- RIN1+, RIN1-			+50	mV
V_{TL}	Differential Threshold Low Voltage			-50			mV
V_{ID}	Input Differential Threshold			100			mV
V_{CM}	Differential Common-mode Voltage				2.1		V
RT	Internal Termination Resistor(Differential)			80	100	120	Ω

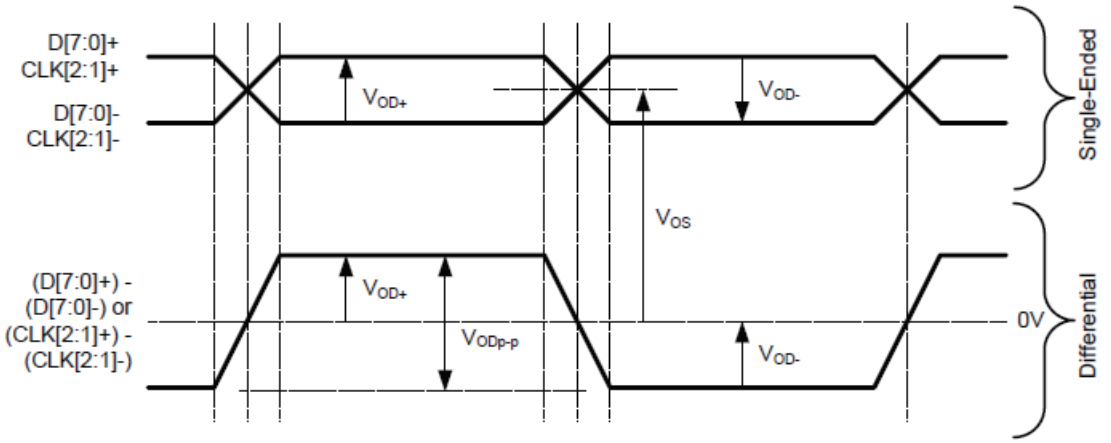
FPD-Link III Receiver DC VTH/VTL Definition:



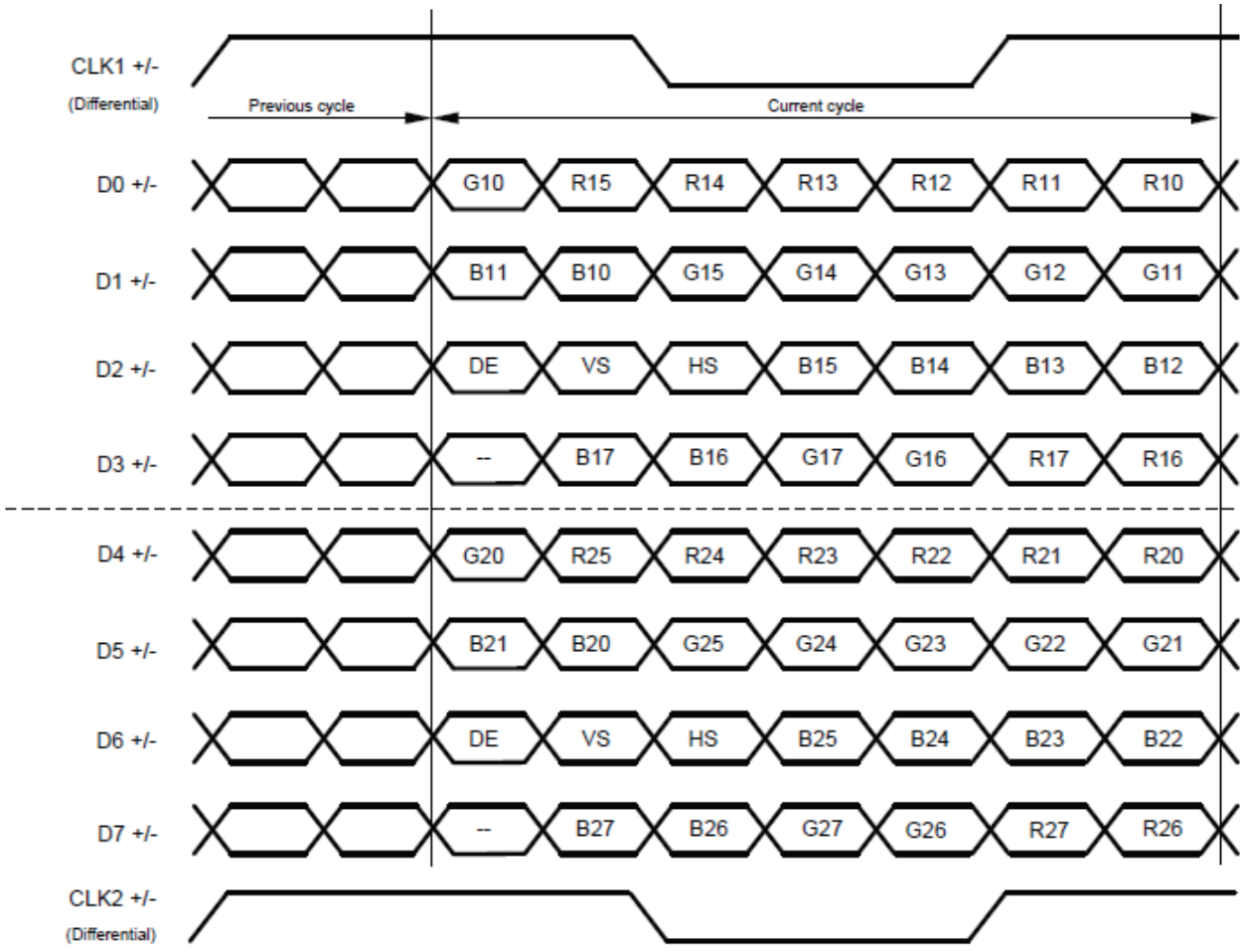
5.3 FPD-link LVDS output electrical characteristics

Symbol	Parameter	Conditions	Pin/Freq.	Min.	Typ.	Max.	Unit
V_{OD}	Output voltage swing (differential)	R_L = 100Ω	D0±, D1±, D2±, D3±, D4±, D5±, D6±, D7±, CLK1±, CLK2±	200	-	700	mV
ΔV_{OD}	Change in V_{OD} between complimentary output states			-	1	50	mV
V_{OS}	Offset Voltage			1.0	1.2	1.5	V
ΔV_{OS}	Change in V_{OS} between complimentary output states			-	1	50	mV
I_{OS}	Output Short Circuit Current				-5		mA
I_{OZ}	Output Tri-state Current			-500	-	500	μA

FPD-Link Single-Ended and Differential Waveforms:



24-bit Color Dual FPD-Link Mapping: MSBs on D3/D7:



5.4 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 8-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							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	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
	Red	1	1	1	1	1	1	1	1	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	1	1	1	1	1	1	1	1	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	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	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	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
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
	Red(1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	Red(253)	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(255)	1	1	1	1	1	1	1	1	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
	Green(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Green(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
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	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(253)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
	Green(254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Green(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	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
	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	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	1	0
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	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(253)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
	Blue(254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Blue(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

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

6. INTERFACE TIMING

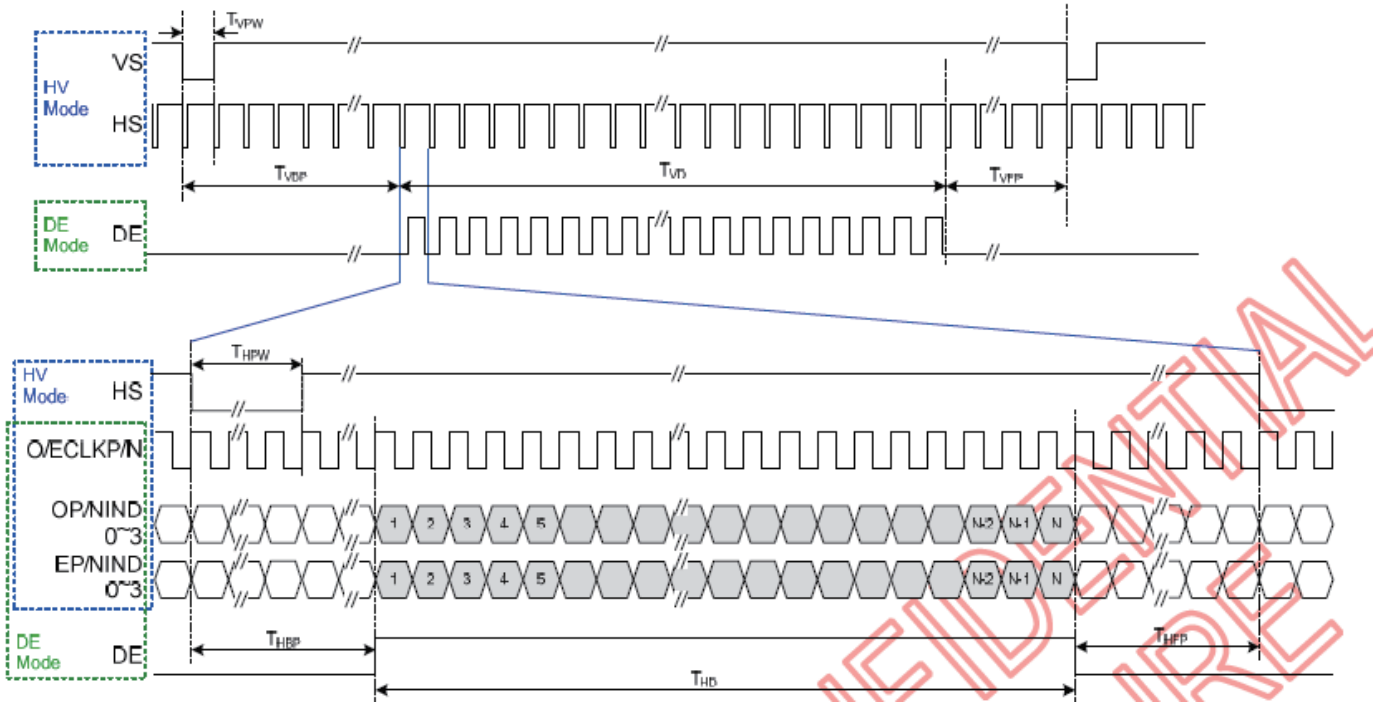
6.1 INPUT SIGNAL TIMING SPECIFICATIONS

The input signal timing specifications are shown as the following table and timing diagram.

Parameter	Symbol	Min.	Typ.	Max.	Unit
CLK frequency	F_{CLK}	73.9	74.2	83.4	MHz
Horizontal display area	T_{HD}		960		CLK
HS period time	T_H	1020	1024	1150	CLK
HS blanking	$T_{HFP} + T_{HBP}$	60	64	190	CLK
Vertical display area	T_{VD}		1200		H
Vs period time	T_V	1206	1208	1329	H
VS blanking	$T_{VBP} + T_{VFP}$	6	8	129	H

Note (1) Since this assembly is operated in DE only mode, Hsync and Vsync input signals should be set to low logic level. Otherwise, this assembly would operate abnormally.

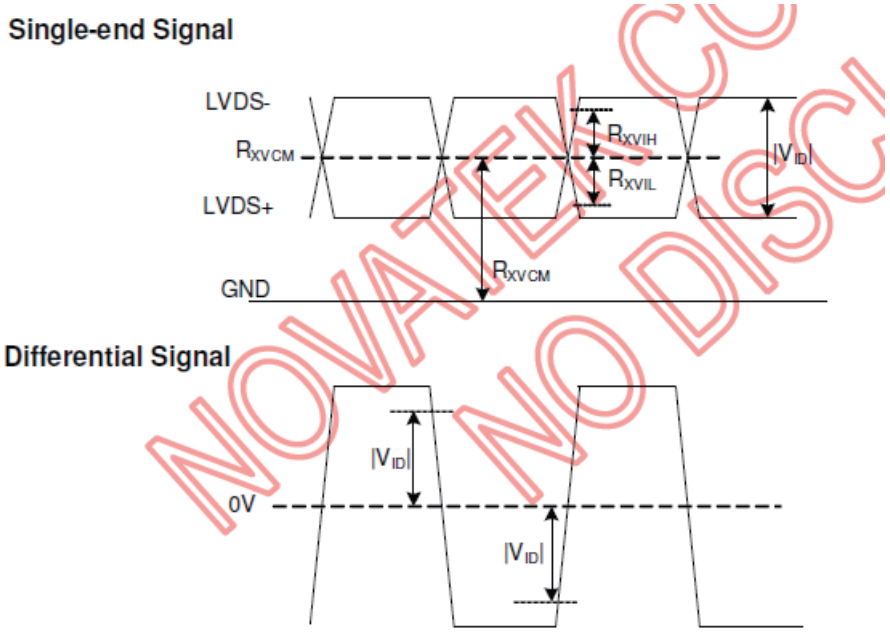
INPUT SIGNAL TIMING DIAGRAM



6.2 LVDS Interface DC characteristic

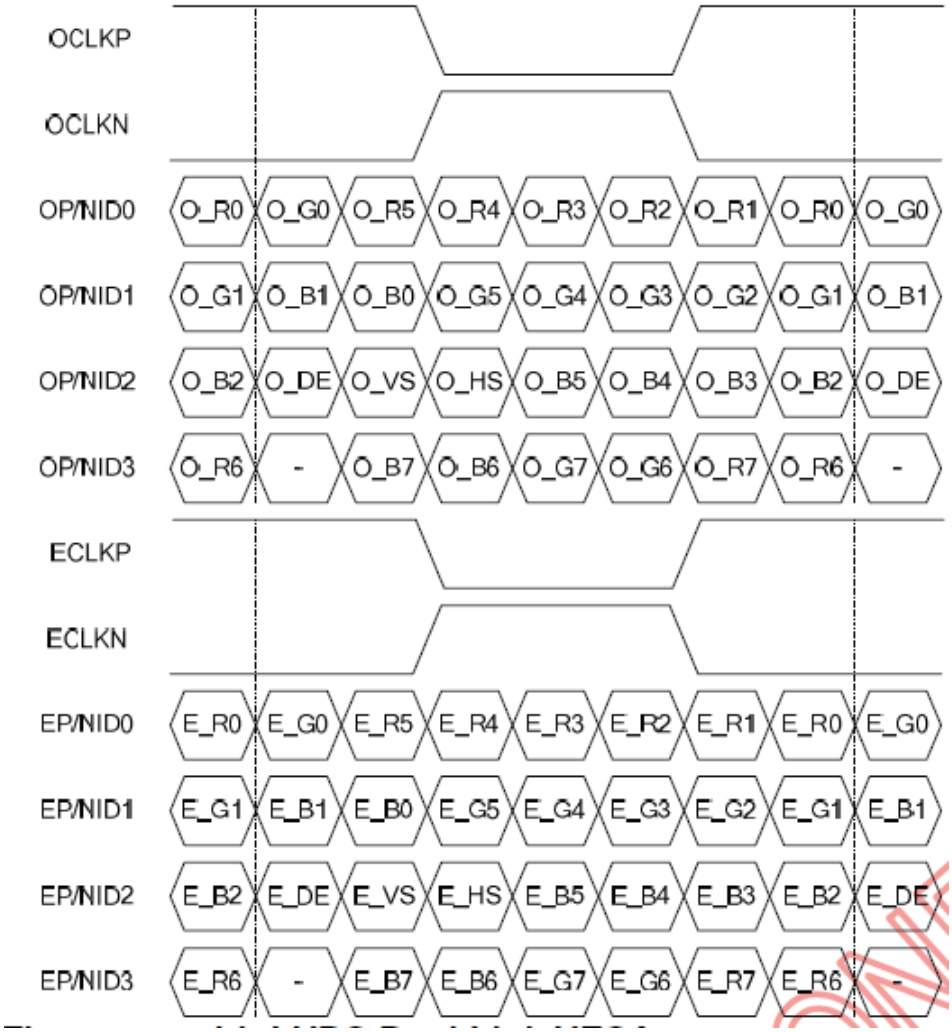
Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Differential input high threshold voltage	R_{XVTH}	+0.1		+0.3	V	
Differential input Low threshold voltage	R_{XVTL}	-0.3		-0.1	V	
Differential input common mode voltage	R_{XVCM}	1.0	1.2	$1.7-IV_{ID}I/2$	V	
Differential input voltage	$IV_{ID}I$	0.2		0.6	V	

LVDS DC Diagram:



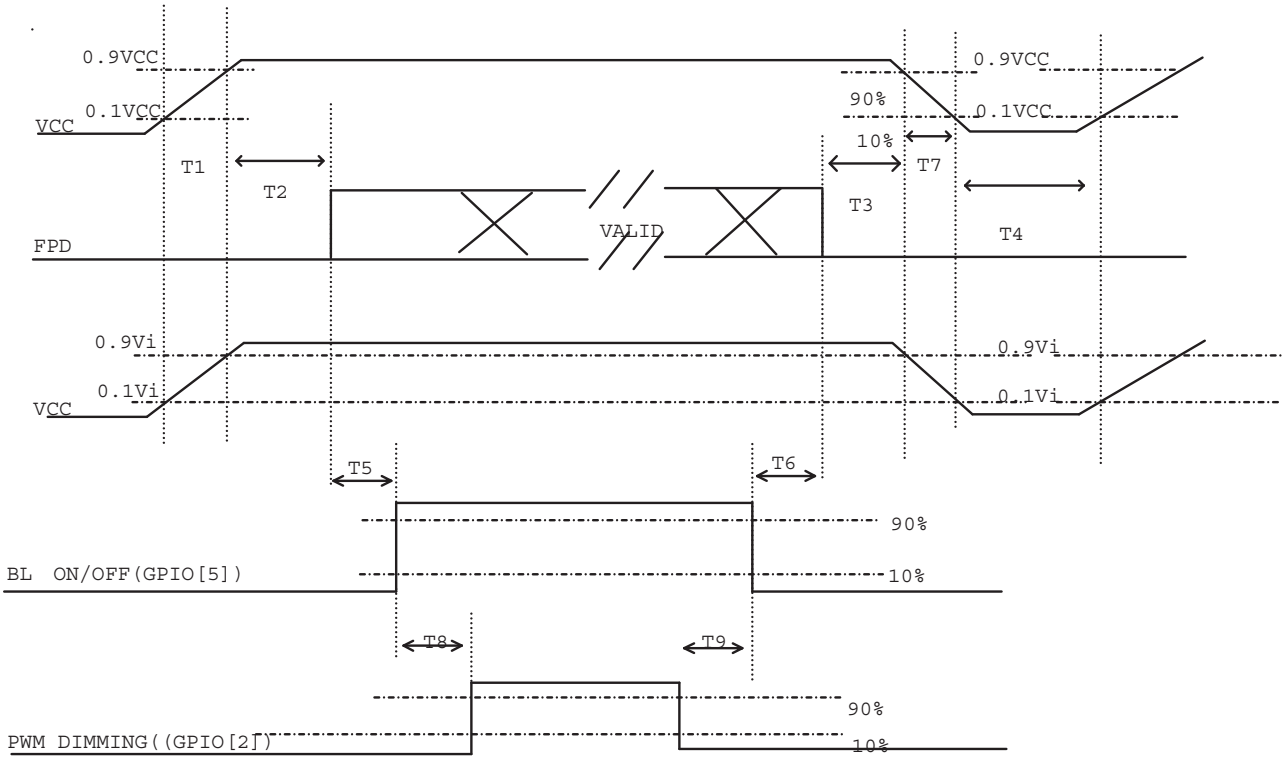
6.3 Dual-Link LVDS input Data Format

8-bit LVDS Dual Link VESA:



6.4 POWER ON/OFF SEQUENCE

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



Power ON/OFF sequence

Note (1) Please avoid floating state of interface signal at invalid period.

Note (2) When the interface signal is invalid, be sure to pull down the power supply of LCD VCC to 0 V.

Note (3) The Backlight converter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight converter power must be turned off before the power supply for the logic and the interface signal is invalid.

Parameter	Value			Units
	Min	Typ	Max	
T1	0.5	-	10	ms
T2	0	-	50	ms
T3	0	-	50	ms
T4	500	-	-	ms
T5	200	-	-	ms
T6	200	-	-	ms
T7	5	-	100	ms
T8	10	-	-	ms
T9	10	-	-	Ms

7. OPTICAL CHARACTERISTICS

7.1 TEST CONDITIONS

Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	oC
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	VCC	12	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
Converter Voltage			
Converter Duty			

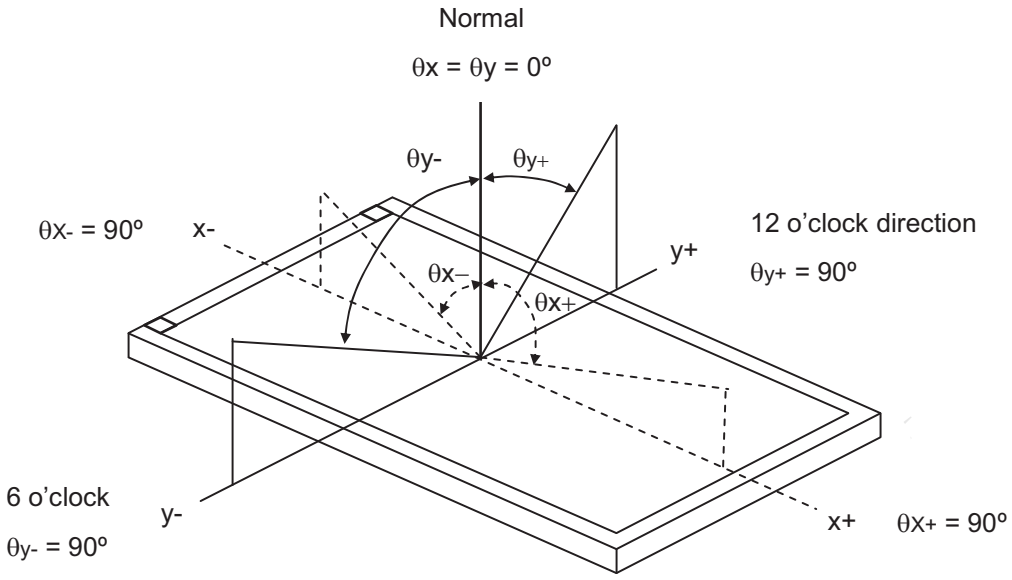
7.2 OPTICAL SPECIFICATIONS

The relative measurement methods of optical characteristics are shown in 7.2. and all items are measured at the center point of screen except white variation.The following items should be measured under the test conditions described in 7.1 and stable environment shown in Note (6).

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio		CR	θx=0°, θY =0°		(1400)		-	(2)
Response Time		TR		-	(13)		ms	(3)
		TF		-	(12)		ms	
Center Luminance of White		LC		-	(800)	-	cd/m	(4)
White Variation		δW		-		(1.25)	-	(6)
Chromaticity	Red	Rx		(0.640)			-	(5)
		Ry		(0.330)			-	
	Green	Gx		(0.300)			-	
		Gy		(0.600)			-	
	Blue	Bx		(0.150)			-	
		By		(0.060)			-	
	White	Wx		Typ. -0.035	(0.313)	Typ. +0.035	-	
		Wy			(0.329)		-	
	(sRGB)			(99%)				(5)
Viewing Angle	Horizontal	θ_x+	CR≥10		(88)	-	Deg.	(1)
		θ_x-			(88)	-		
	Vertical	θ_Y+			(88)	-		
		θ_Y-			(88)	-		
Gamma		γ	9 Steps Log-Log gamma		(2.2)	-		Gamma

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

Viewing angles are measured by BM5A



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

The contrast ratio can be calculated by the following expression.

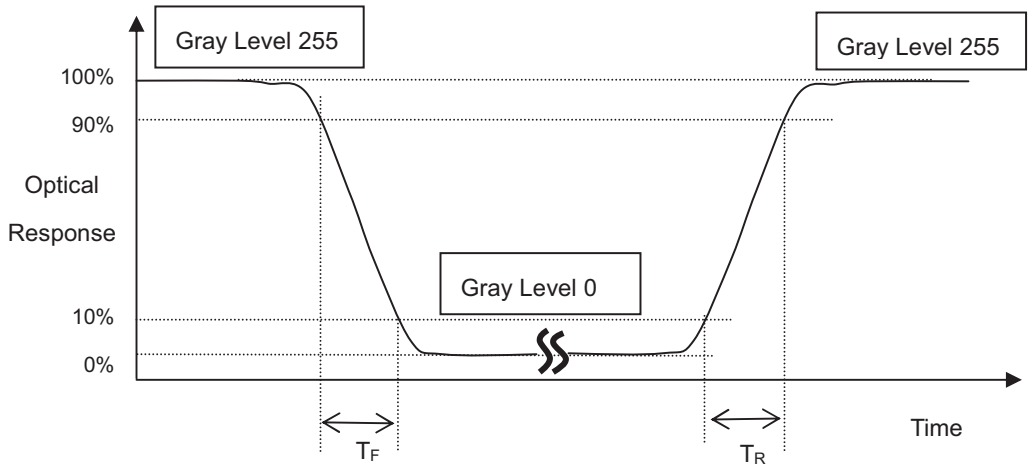
Contrast Ratio (CR) = L255 / L0

L255: Luminance of gray level 255

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 (7).

Note (3) Definition of Response Time (T_R, T_F):



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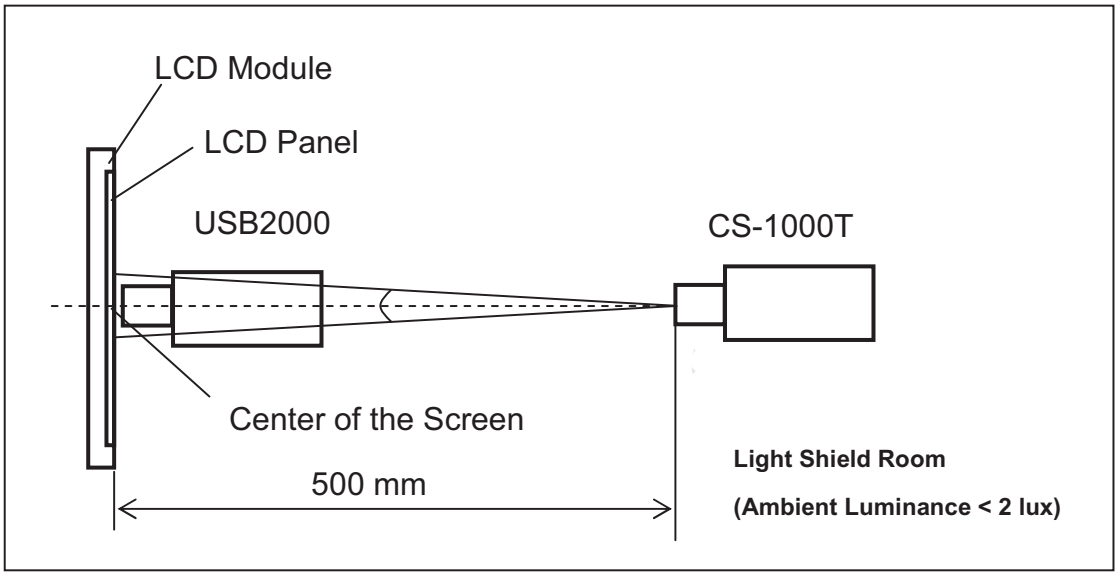
Note (4) Definition of Luminance of White (L_C):

Measure the luminance of gray level 255 at center point and 9 points

L_C = L (5), where L (X) is corresponding to the luminance of the point X at the figure in Note (7).

Note (5) Measurement Setup:

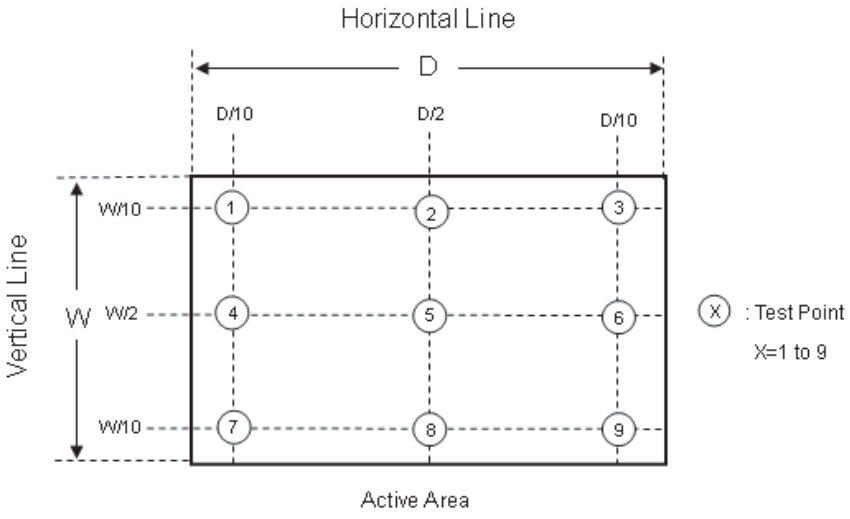
The LCD assembly should be stabilized at given temperature for 30 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 30 minutes in a windless room.



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

Measure the luminance of gray level 255 at 9 points

δW = Maximum [L (1), L (2), L (3), L (4), L (5), L (6), L (7) , L (8) , L (9)] / Minimum [L (1), L (2), L (3), L (4), L (5) , L (6), L (7) , L (8) , L(9)]



8. RELIABIITY TEST CRITERIA

Test Item	Test Condition	Note
High Temperature Storage Test	95ºC, 500 hours	(1) (2) (4)
Low Temperature Storage Test	-40ºC, 500 hours	
Thermal Shock Storage Test (Non-Operating)	[(-40℃,30min)→(85℃,30min)]/cycle, 100hrs	
High Temperature Operation Test	85ºC, 500 hours	(1) (2) (4)
Low Temperature Operation Test	-40ºC, 500 hours	
High Temperature & High Humidity Operation Test	60ºC, 90%RH, 500 hours	
Shock (Non-Operating)	10G, 6ms, half sine wave, 3 times for each direction ± X, ± Y, ± Z.	(1) (3)
Vibration (Non-Operating)	Frequency: 10 ~55~10Hz;Sweep Mode: Log SweepSweep time: 1Oct/min;Acceleration: 1.5G;Test time:2 hr for each direction of X, Y, Z.	
ESD-Contact Mode Discharge	150pf, 330Ω, ±8KV	
ESD-Air Mode Discharge	150pf, 330Ω, ±15KV	

Note (1) Criteria : Normal display image with no obvious non-uniformity and no line defect.

Note (2) Evaluation should be tested after storage at room temperature for more than two hour

Note (3) 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.

Note (4) A certain level of Mura (non-uniformity) of dark / black image will happen several days after high temperature testing (H.T.T.). There is a slowly part recovery over a long time (several months).Such a long exposure time like in H.T.T. will normally not happen in a real application. Therefore the test H.T.T. was introduced to simulate cycles with normal conditions in-between but with the same total exposure time what show a significant reduced Mura. The root cause is related to tension generated due to different amount of shrinking in the stack of layers in the polarizer sheet. The effect is more significant on larger displays like this size. An investigation into alternative polarizer material showed that there is no better alternative currently available.

9. PACKAGING

9.1 PACKING SPECIFICATIONS

(1) 7pcs LCD modules / 1 Box

(2) Box dimensions: 415 (L) X 283 (W) X 385 (H) mm

(3) Weight: approximately 9.1 Kg (7modules per box)

9.2 PACKING METHOD

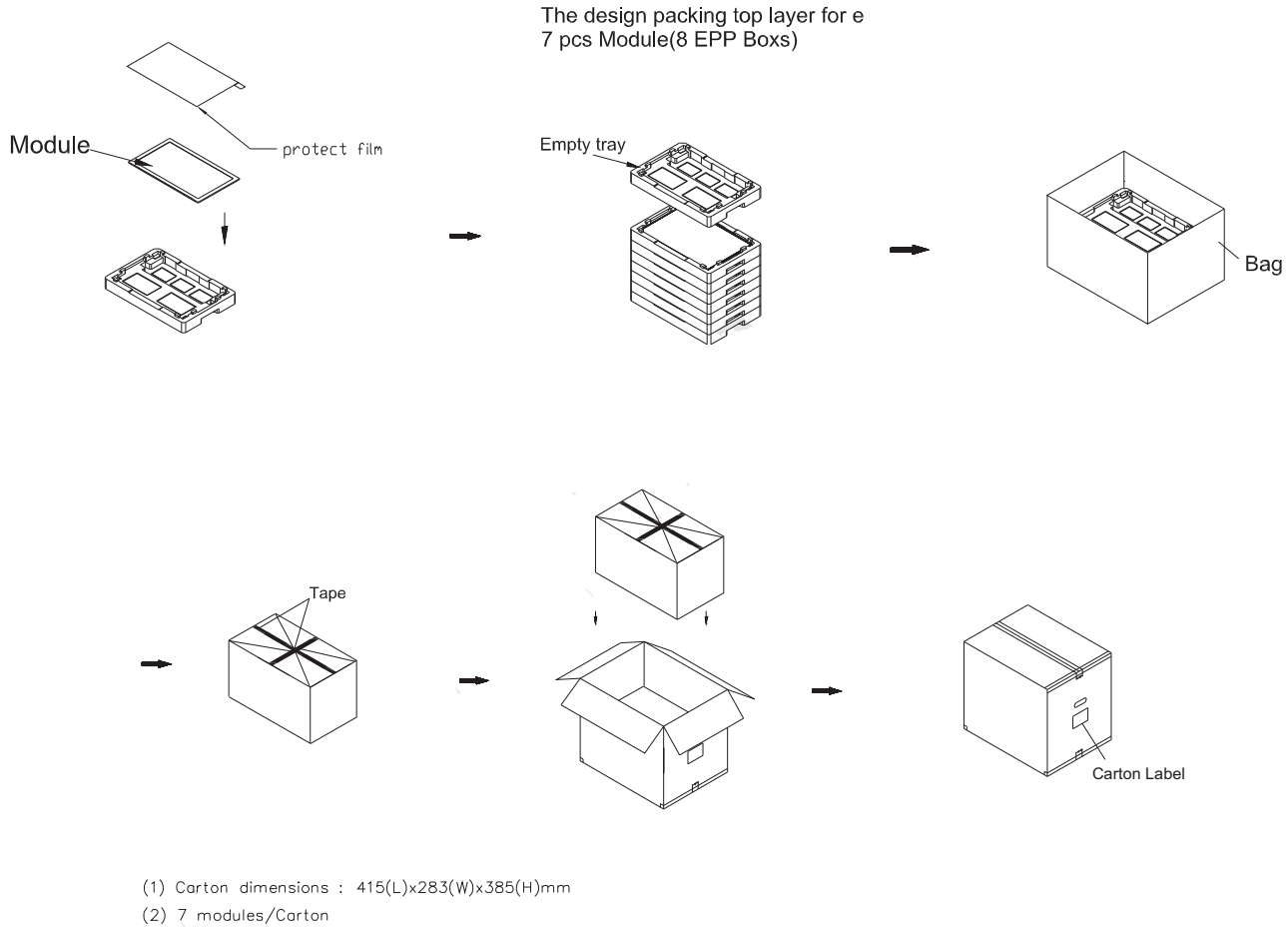


Figure. 9-1 Packing method

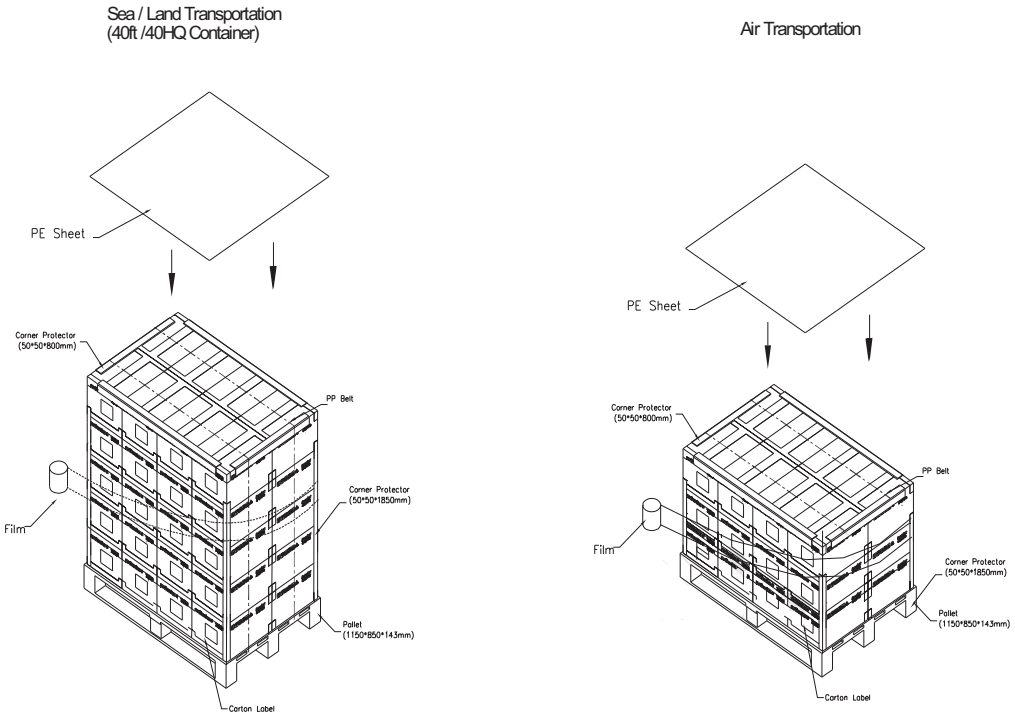


Figure. 9-2 Packing method

9.3 UN-PACKING METHOD

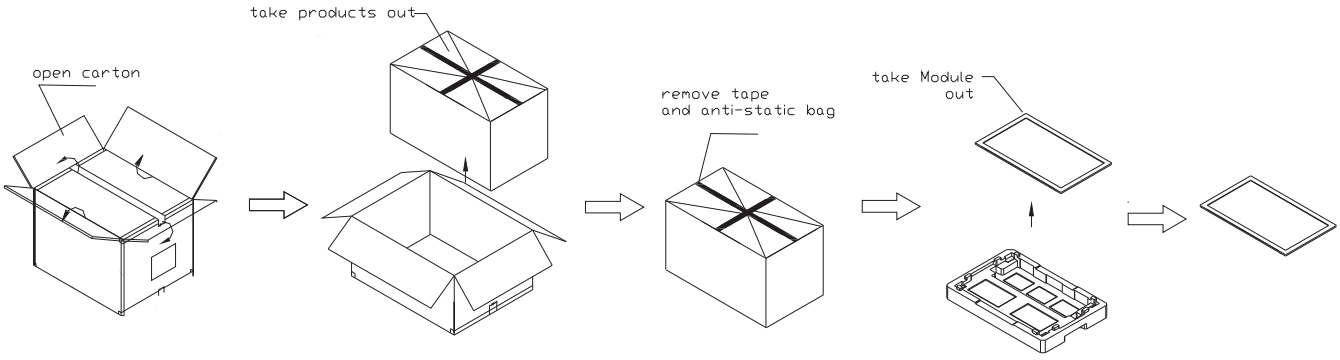


Figure. 9-3 UN-Packing method

10. DEFINITION OF LABELS

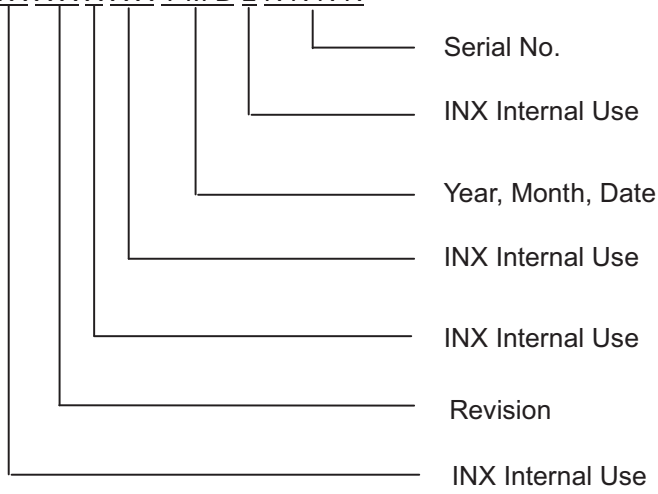
10.1 MODULE LABEL

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

(a) Model Name: G154JCE-L01

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

(c) Serial ID: X X X X X X X Y M D L N N N N



Serial ID includes the information as below:

(a) Manufactured Date: Year: 0~9, for 2010~2019

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

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

(b) Revision Code: Cover all the change

(c) Serial No.: Manufacturing sequence of product

11. PRECAUTIONS

11.1 ASSEMBLY AND HANDLING PRECAUTIONS

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

(2) 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.

(3) Do not apply pressure or impulse to the module to prevent the damage of LCD panel and Backlight.

(4) 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.

(5) Do not plug in or pull out the I/F connector while the module is in operation.

(6) Do not disassemble the module.

(7) Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.

(8) Moisture can easily penetrate into LCD module and may cause the damage during operation.

(9) High temperature or humidity may deteriorate the performance of LCD module. Please store LCD modules in the specified storage conditions.

(10) 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 backlight will be higher than that of room temperature.

(11) Do not keep same pattern in a long period of time. It may cause image sticking on LCD.

11.2 SAFETY PRECAUTIONS

(1) 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.

(2) After the module's end of life, it is not harmful in case of normal operation and storage.

12. MECHANICAL CHARACTERIS