



SAMSUNG DISPLAY



Product Specification

() Preliminary Specification

(√) Approval Specification

Any modification of Spec is not allowed without SDC's permission.

CUSTOMER	R/A
DATE OF	2016/4/

MODEL NO.	LT1550FN
EXTENSION	-N

Customer Approval & Feedback	

Approved by	 2016/4/14
Prepared by	 2016/4/14
New Business Team Samsung Display Co.,	

Table of Contents

REVISION HISTORY	3
GENERAL DESCRIPTION	5
1. ABSOLUTE MAXIMUM RATINGS	
1.1 ENVIRONMENTAL ABSOLUTE RATINGS	7
1.2 ELECTRICAL ABSOLUTE RATINGS	8
1.3 THE OTHERS ABSOLUTE RATINGS	8
2. APPLICATION INFORMATION FOR PID(PUBLIC INFORMATION DISPLAY)	9
3. OPTICAL CHARACTERISTICS	1
4. ELECTRICAL CHARACTERISTICS	
4.1 TFT LCD MODULE	1
4.2 BACK LIGHT UNIT	1
4.3 LED CONVERTER CHARACTERISTICS	1
5. INPUT TERMINAL PIN ASSIGNMENT	
5.1 INPUT SIGNAL & POWER	1
5.2 LED CONVERTER INPUT PIN CONFIGURATION	2
5.3 LED CONVERTER POWER SEQUENCE	2
5.4 V-by-One LVDS INTERFACE	2
5.5 INPUT SIGNALS, BASIC DISPLAY COLORS AND GRAY SCALE	2
6. INTERFACE TIMING	
6.1 TIMING PARAMETERS (DE ONLY MODE)	2
6.2 TIMING DIAGRAMS OF INTERFACE SIGNAL (DE ONLY MODE)	2
6.3 V-by-One Rx ELECTRICAL CHARACTERISTICS	2
6.4 THE SEQUENCE OF POWER ON AND OFF	3
7. OUTLINE DIMENSION	3
8. RELIABILITY TEST	3
9. PACKING	3
10. MARKINGS & OTHERS	3
11. GENERAL PRECAUTIONS	
11.1 HANDLING	3
11.2 STORAGE	3
11.3 OPERATION	3
11.4 OPERATION CONDITION GUIDE	3
11.5 OTHERS	3

REVISION HISTORY

Date	Rev.No.	Page	Revision Description
2016/04/14	000	a	Approval Specification firstly issued
			Preliminary Spec -> Approval Spec change point
		13/23	Input Interface Timing change(60 → 120Hz)
		1	41Pin Input Pin-map add(60 → 120Hz)
		2	V-by-One Lane Grouping change(60 → 120Hz)
		3	Panel Qty for the 1pallet change(22 → 20EA)

* (Reference) Preliminary Spec History

Date	Rev.No.	Page	Revision Description
2015/09/0	000	a	Preliminary Specification Firstly issued
2015/09/2	001	1	Modify the Data Scan direction and V-by-One Data Format
2015/11/1 7	002	4	(a)General Information : Weight TBD → 15,000 (b) General Information : Surface Treatment Hardness TBD →
		5	(a)Mechanical information Update (b) Measure point of Depth Update
		6	Delete the TBD on Shock / Vibration item
		9	Contrast Ratio Update
		1	Vsync/Hsync/Main Frequency Update
		1	Inrush Current : Max 5.67 → 6.95
		4	Output Current : -/120/125 → - /130/136.5 External PWM Dimming
		1	Additional appendix Update
		2	Interface Timing Update
2015/11/1	003	1	T-Con Board Current update
2015/11/1 9	004	9	Luminance Min : TBD → (400)
		1	LED Quantity : TBD → (150)
2015/12/1 4	005	1	LED Quantity and Structure update
		2	Vsync Typ update : 67.5 → 130
		29/30	Outline 2D update
2015/12/2 8	006	5	Black Matrix Shift Max : TBD → 2.0
		9	1) f_{clk} : TBD → 74.25*8 2) Response Time : -/8/16 → -/6/15 3) Color Temperature mix : TBD → 8000
		1	(a)Current of power supply - Black : -/1200/1600 → -/1180/1590 - White : -/1200/1600 → -/1170/1570 - N-Pattern : -/3400/4600 → 3350/3800
		2	(b) f_v : TBD → 120(Panel Internal operation frequency)
		1	Backlight On/Off control Max : 5.25 → 5.5
		2	T_{LOCK} Max : TBD → 10
		3	2D Back Update(Userhole depth Added)
		3	Update the Packing information
		4	Display Colors : 8bit → Dithered 10bit
2016/01/2 5	007	9	- f_v : TBD → 60Hz - Color Chromaticity - Rx : 0.640 → 0.650 - Gx : 0.300 → 0.310 - Gy : 0.600 → 0.620
		1	Rush Current : Max TBD → 10A
		2	Spread Spectrum : TBD -> 0.5% / 30kHz
		2	V-by-One Rx Specifications update

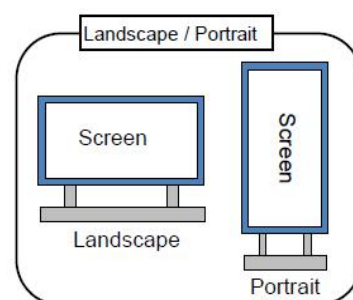
GENERAL DESCRIPTION

DESCRIPTION

LTI550FN01-N is a color active matrix liquid crystal display (LCD) that uses amorphous silicon TFT (Thin Film Transistor) as switching components. This model is composed of a TFT LCD panel, a driver circuit, and a back-light unit. This 55.0" model has a resolution of 3,840 x 2,160 pixels (16:9) can display up to 16.7 Million colors with the wide viewing angle of 89° or higher in all directions.

FEATURES

RoHS compliance(Pb-free)
 UHD(3,840 x 2,160) resolution(16:9)
 SVA(Super Vertical Align) mode
 High Tni(85°C) Liquid Crystal
 High speed response
 High contrast ratio, High aperture ratio with the wide color gamut
 Wide viewing angle($\pm 178^\circ$)
 Landscape / Portrait type compatible
 V-by-One Interface(16Lanes @ 3,840 x 2,160)
 DE(Data Enable) mode
 Edge LED Backlight
 Low power consumption
 Black Mura Improvement Technology



APPLICATIONS

Public Information Display (PID)

(If there is the intent to use this product for other purpose, please contact Samsung Display.)

GENERAL INFORMATION

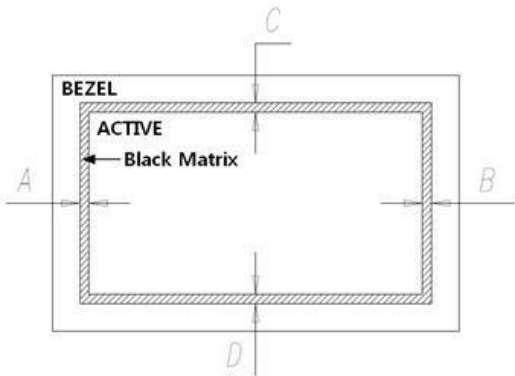
Item	Specification	Uni	Note
Module Size	1234.4(H) x 705.2(V)	m m	Typ
	22.2		Max
Weight	15,000	g	Max
Display area	1209.6(H) x 680.4(V)	mm	
Driver Element	a-Si TFT active		
Display colors	1.08B (Dithered)		
Number of pixel	3,840 x 2,160	Pixe	
Pixel	RGB Vertical stripe		
Display Mode	Normally Black		
Surface treatment	Haze 25% / 2H		Anti-
Luminance of	500(Typ)	cd/ m	

MECHANICAL INFORMATION

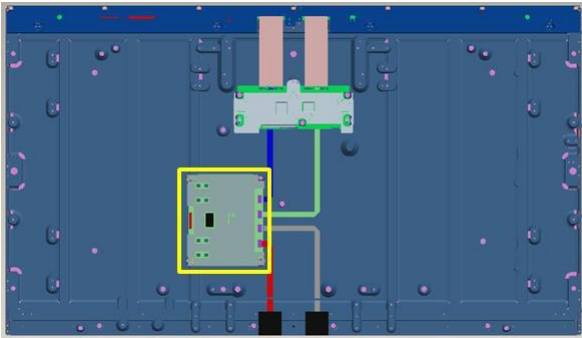
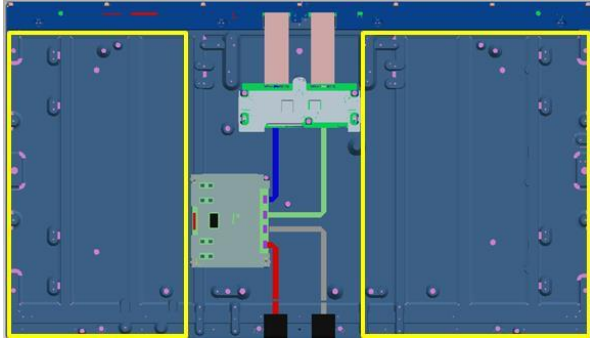
Item		Min.	Typ.	Max.	U	No
Module Size	Horizontal	1233.2	1234.4	123	m	
	Vertical (V)	704.2	705.2	706.	m	
	Depth (D)	21.2	22.2	24.2	m	(2)
		6	7	8.9	m	(2)
Bezel Op	Horizontal	1213.4	1214.6	121	m	
	Vertical (V)	657.4	658.4	659.	m	
Black Mat	Horizontal	-	-	2.0	m	(1)
	Vertical (V)	-	-	2.0	m	
Weig		-	15,000		g	

Note (1) Measure the figure for Black Matrix shift to be recorded on the spec. with referring to the drawings.

- (a) $|A - B| \leq \text{Horizontal Spec}$
- (b) $|C - D| \leq \text{Vertical Spec}$



Note (2) Measure point of Depth

	
Yellow Box	Yellow Box
a. Max Depth	b. SDC inspection Depth

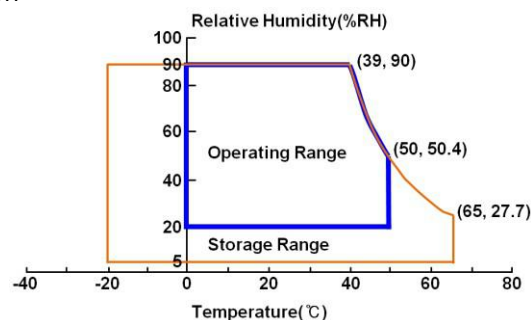
11 ABSOLUTE MAXIMUM RATINGS

1.1 ENVIRONMENTAL ABSOLUTE RATINGS

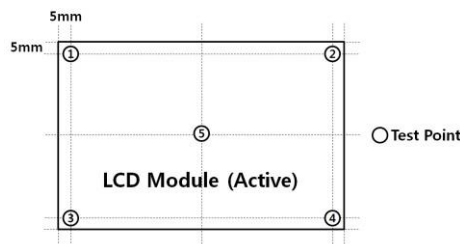
Item	Symbol	M	M	Un	Not
Storage temperature	T _{STG}	-	65	°C	(1)
Operation Temperature	T _{OPR}	0	50	°C	(1)
Glass Surface temperature (Operation)	T _{CENTER}	0	50	°C	(2)
	T.Uniformi	-	10		
Storage humidity	H _{STG}	5	90	%	(1)
Operating humidity	H _{OPR}	20	90	%	(1)
Shock (non-operating)	Snop(X,Y,	-	30	G	(4),
Vibration (non-operating)	V _{nop}	-	1.	G	(5),
Endurance on static	-	-	15	V	(3)

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

- 11.1** 90 % RH Max. (Ta ≤ 39 °C)
11.2 Relative Humidity is 90% or less. (Ta > 39 °C)
11.3 No condensation



Note(2) Definition of test point



ΔT should be less than 10°C ($\Delta T = |T_{\text{CENTER}} - T_{\text{CORNER}}|$) (Ambient Temperature 25 ± 2 °C)

T_{CENTER} : Temperature of the center of the glass surface (Test point 5)

Note(3) Keep the static electricity under 150V in Polarizer attaching process.

Note(4) 11ms, half sine wave, one time for ±X, ±Y, ±Z axis

Note(5) 10~300Hz, Swap rate for X, Y, Z axis one time.

Note(6) The Fixture for the test of the vibration and shock, which holds the module to be tested shall be hard and rigid in order for the module not to be twisted or bent by the fixture.

• ELECTRICAL ABSOLUTE RATINGS

(1) TFT LCD MODULE

Item	Symb	Max	U	No
Power Supply	VDD	13.2	V	(1)

(2) BACKLIGHT UNIT(LED Unit)

Item	Symb	M	Un	No
Input Supply	V _{CC}	26	V	(1)

Note(1) Ta= 25 ± 2 °C

The permanent damage or defect to the device may occur if the panel is operated at the figure set, which exceeds a ceiling of maximum value stated in the former spec. The functional operation should be limited to the conditions described above under normal operating conditions.

• THE OTHERS ABSOLUTE RATINGS

Static Electricity Pressure Resistance

Item	Test Conditions	Remark
Contact	150pF, 330Ω, ±10kV, 210points,	Operating
Air Discharge	150pF, 330Ω, ±20kV, 210points,	

12 APPLICATION INFORMATION FOR PID (Public Information Display)

A PID's screen may display the sudden image such as an image retention.

To extend the lifetime and optimize a function of module, the below-mentioned operating conditions are required.

- **Normal operating condition**

- * Temperature: $20 \pm 15^{\circ}\text{C}$
- * Humidity: $55 \pm 20\%$
- * Display pattern: Moving image or image, which switches regularly.
Note) The sudden image on the screen can be displayed after the static image is shown in the long-term.

- **The operating conditions when the module is operated under the abnormal condition.**

- Ambient condition
 - It is recommended to set the PID up in the well-ventilated place.
- The function of power off and screen saver
 - The function of periodical power-off or a screen saver is needed when the static image is displayed in the long-term.

- **Operating conditions to prevent the sudden display resulted from displaying the static image in the long-term.**

(6) *The proper operating time: Up to 24 hours a day.*

(But, Image Sticking is not guaranteed with 24 hours operation)

- (7) The moving image shall be inserted between the static displays periodically.
 - The refresh time for liquid crystal is needed.
- (8) The periodic changing of background color and character's color(image)
 - Use the different color for background and character (image) respectively.
 - Change colors periodically.
- (9) Avoid combining the color for background with the color for character, which has a largely different luminance.
Note (1) Abnormal condition means all operating condition except normal operating condition.
Note (2) The moving image or black pattern is strongly recommended as a screen saver.

- **Only the lifetime of PID stated in this spec is guaranteed if the PID is used under the proper operating conditions.**

- **Clean the system regularly for not accumulating the dust around the system considering user environment, otherwise, its reliability and function may not be satisfied.**

13 OPTICAL CHARACTERISTICS

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

Measuring equipment : TOPCON RD-80S, SR-3, ELDIM EZ-Contrast

$T_a = 25 \pm 2 \text{ }^{\circ}\text{C}$, $V_{DD} = 12\text{V}$, $f_v = 60\text{Hz}$, $f_{DCLK} = 74.25 \times 8\text{MHz}$, $I_F = 100\%$ duty

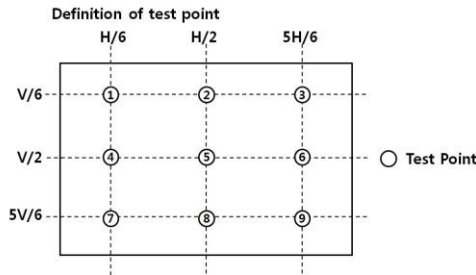
Ite		Symb	Condi	Min	Typ	Ma	Uni	Note
Contrast Ratio		C/R	-	3000	4000	-	-	(3) SR-3
Response time	G-to-G	T _g	-	-	6	15	msec	(5) RD-80S
Luminance of White (At the center of screen)		Y _L	-	400	500	-	cd/m ²	(3) SR-3
Color Chromaticity (CIE 1931)	Red	R _X	Normal ϕ = 0 θ = 0 Viewing Angle	TYP. -0.03	0.65	TYP +0.03	-	(7), (8) SR-3
		R _Y			0.33			
	Green	G _X			0.31			
		G _Y			0.62			
	Blue	B _X			0.15			
		B _Y			0.06			
	White	W _X			0.28			
		W _Y			0.29			
Color Gamut		-	-	60	72	-	%	(7) SR-3
Color Temperature		-	-	8000	10000	-	K	
Viewing Angle	Hor.	θ _L	CR ≥ 10	7	89	-	Degree	(8)) S R- 3
		θ _R		7	89	-		
	Ver.	θ _U		7	89	-		
		θ _D		7	89	-		
Brightness Uniformity		B _{uni}	-	-	-	25	%	(4) SR-3

Note(1) Test Equipment Setup

The measurement should be executed in a stable, windless and dark room between 40min and 60min after lighting the backlight at the given temperature for stabilization of the backlight. This should be measured in the center of screen.

Environment condition : $T_a = 25 \pm 2 \text{ }^{\circ}\text{C}$

Note(2) Definition of test point



Note(3) Definition of Contrast ratio(C/R)

: Ratio of max.gray(Gmax) & min.gray(Gmin) at the center point ⑤ of the panel.

$$C/R = \frac{G_{\max}}{G_{\min}}$$

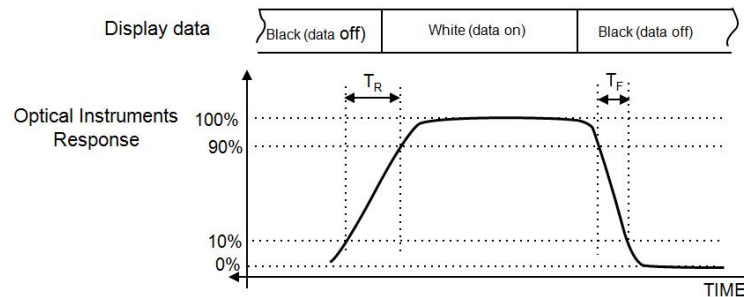
Gmax : Luminance in all white pixels
Gmin : Luminance in all black pixels.

Note(4) Definition of brightness uniformity at 9 points(Test pattern : Full white)

$$B_{\min} = 100\% \times \frac{(B_{\max} - B_{\min})}{B_{\max}}$$

Bmax : Maximum brightness
Bmin : Minimum brightness

Note(5) Definition of Response time : Average response time of all Gray to Gray except Tr, Tf



※ G-to-G : Average response time between the whole gray scale to the whole gray scale.

Gray to Gray Response										
	Gr ay	E								
		0	31	63	95	127	159	191	223	255
Sta rt	0		Tr(0-31)	Tr(0-63)	Tr(0-95)	Tr(0-127)	Tr(0-159)	Tr(0-191)	Tr(0-223)	Tr(0-255)
	3	Tr(31-0)		Tr(31-63)	Tr(31-95)	Tr(31-127)	Tr(31-159)	Tr(31-191)	Tr(31-223)	Tr(31-255)
	6	Tr(63-0)	Tr(63-31)		Tr(63-95)	Tr(63-127)	Tr(63-159)	Tr(63-191)	Tr(63-223)	Tr(63-255)
	9	Tr(95-0)	Tr(95-31)	Tr(95-63)		Tr(95-127)	Tr(95-159)	Tr(95-191)	Tr(95-223)	Tr(95-255)
	12	Tr(127-0)	Tr(127-31)	Tr(127-63)	Tr(127-95)		Tr(127-159)	Tr(127-191)	Tr(127-223)	Tr(127-255)
	15	Tr(159-0)	Tr(159-31)	Tr(159-63)	Tr(159-95)	Tr(159-127)		Tr(159-191)	Tr(159-223)	Tr(159-255)
	19	Tr(191-0)	Tr(191-31)	Tr(191-63)	Tr(191-95)	Tr(191-127)	Tr(191-159)		Tr(191-223)	Tr(191-255)
	22	Tr(223-0)	Tr(223-31)	Tr(223-63)	Tr(223-95)	Tr(223-127)	Tr(223-159)	Tr(223-191)		Tr(223-255)
	25	Tr(255-0)	Tr(255-31)	Tr(255-63)	Tr(255-95)	Tr(255-127)	Tr(255-159)	Tr(255-191)	Tr(255-223)	
T										

T*(X-Y) : Response time from level of gray at X to level of gray at Y

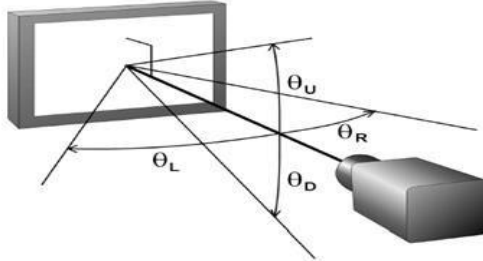
The definition of response time = $\sum [T^*(X-Y)] / 72$

Note(6) Definition of Luminance of White : Luminance of white at center point ⑤

Note(7) Definition of Color Chromaticity (CIE 1931)

Color coordinate of Red, Green, Blue & White at center point ⑤

Note(8) Definition of Viewing Angle : Viewing angle range($C/R \geq 10$)



14 ELECTRICAL CHARACTERISTICS

• TFT LCD MODULE

The connector to transmit a display data and a timing signal should be connected.

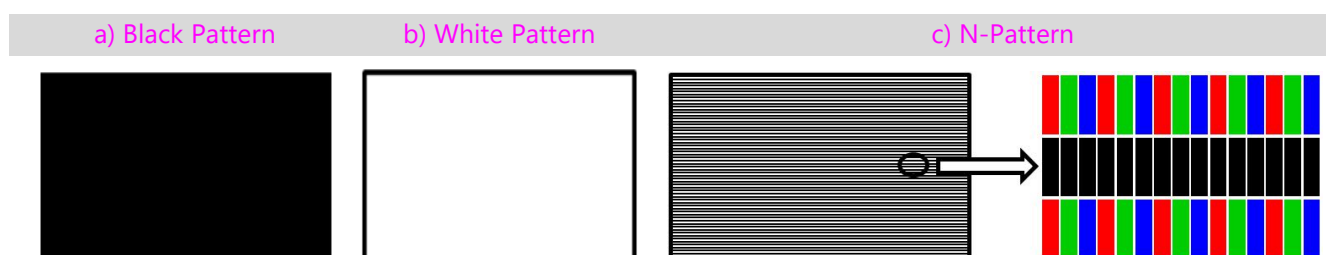
$T_a = 25 \pm 2^\circ\text{C}$

Ite	Symb	Min	Typ	Max	U	Not
Voltage of Power Supply	V_{DD}	10.8	12	13.2	V	(1)
Current of Power Supply	(a) Black	I_{DD}	-	1180	mA	(2), (3)
	(b) White		-	1170		
	(C) N-Pattern		-	3350		
Vsync Frequency	f_V	96	120	124	Hz	-
Hsync Frequency	f_H	216	270	279	kH	-
Main Frequency	F_{dclk}	60*16	74.25*	76.75*	M	-
Rush Current	I_{RUSH}	-	-	10	A	(4)

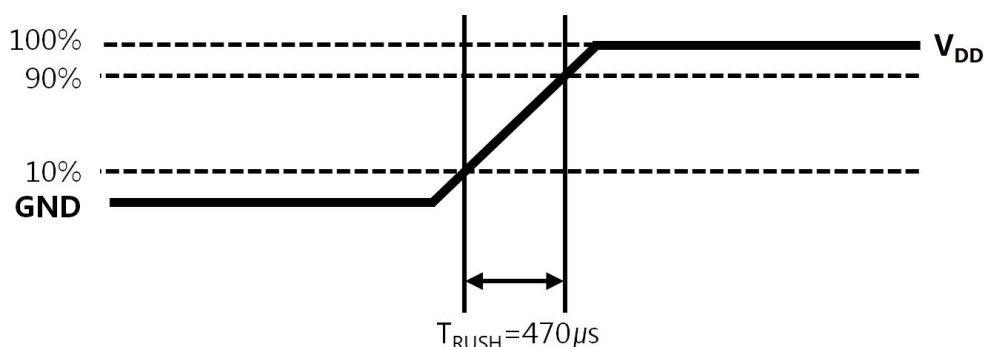
Note(1) The ripple voltage should be controlled under 10% of V_{DD} .

Note(2) $f_V = 120\text{Hz}$, $f_{DCLK} = 297\text{MHz}$, $V_{DD} = 12.0\text{V}$, DC Current.

Note(3) The pattern for checking the power dissipation (LCD module only).



Note(4) Conditions for measurement



The rush current, I_{RUSH} can be measured when T_{RUSH} is $470\mu s$.

• BACK LIGHT UNIT

The back light unit contains 300 LEDs(Light Emitting Diode).
The characteristics of BLU are shown in the following tables.

Ta = 25 ± 2 °C

Item	Symb	Min	T	M	Unit	No
Operating Life	Hr	50,0	-	-	Hour	(1)

Note(1) It is defined as the time to take until the brightness reduces to 50% of its original value.
[Operating condition : Ta = 25±2°C]



• LED CONVERTER CHARACTERISTICS

Items	Symbol	Conditions	Specifications			Uni t	Note	
			M	T	Ma			
Input Voltage	V _{in}	-	2 2	2 4	26	V	Ta=25±2°C	
Inrush Current	I _{inrush}	V _{in} = 24V Dim = Max	-	-	6.9 5	A	(2)`	
Out put	I _{LED}	V _{in} = 24V Dim = Max	-	1 2	13 6.5	mA (rms)	Per string	
Backlight On/Off Control	ENA	Enable	2.	-	5.5	V	-	
		Disable	-	-	0.4			
Analog Dimming	V _{A_Dim}	V _{in} = 24V	0	-	3.3	V	(3), (6) Converter input Pin#14 :	
	D _{A_Dim}		1	-	10	%		
Exter nal PW M Dimming	V _{EXT_Dim}	High	2.	-	5.5	V	(3), (4), (5), (6), (7) Converter input Pin#13 : N.C.	
		Low	-	-	0.4			
	D _{EXT_Dim}	Vin =	1	-	10	%		
	F _{EXT_Dim}	V _{in} = 24V Dim =	9 0	-	20 0	H z		
	T _{Rising}	Vin = 24V	-	-	20	n s		
	T _{Falling}		-	-	20			

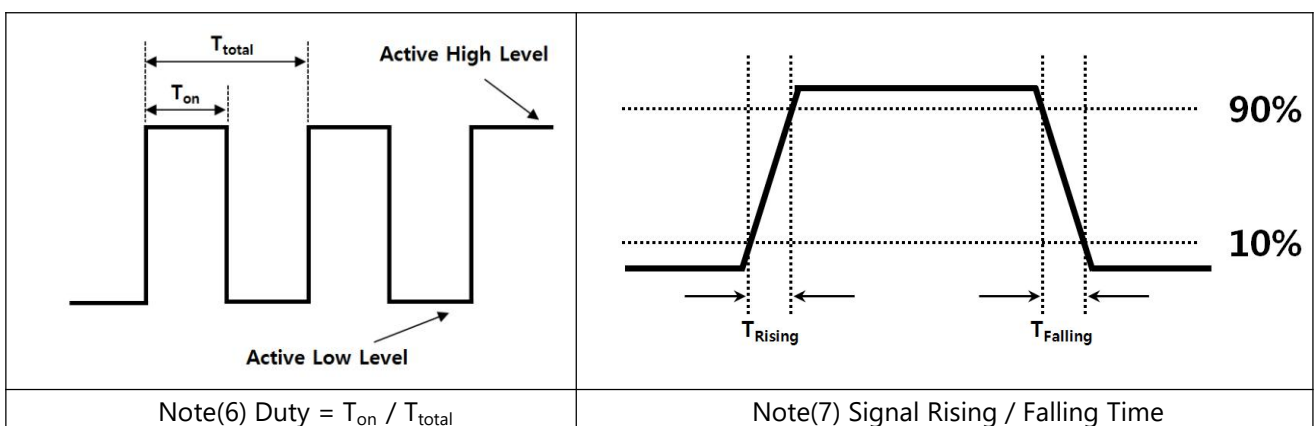
Note(1) All data was approved after running 120 minutes.

Note(2) Inrush is measured within BLU on 10ms after leaving the BLU as it is at least 1hr or more at room temperature(25°C).

Note(3) Internal PWM Dimming mode and External PWM Dimming mode are not available at the same time. If one of the dimming control signal was input(connected), the other dimming control signal must be floating(No connection).

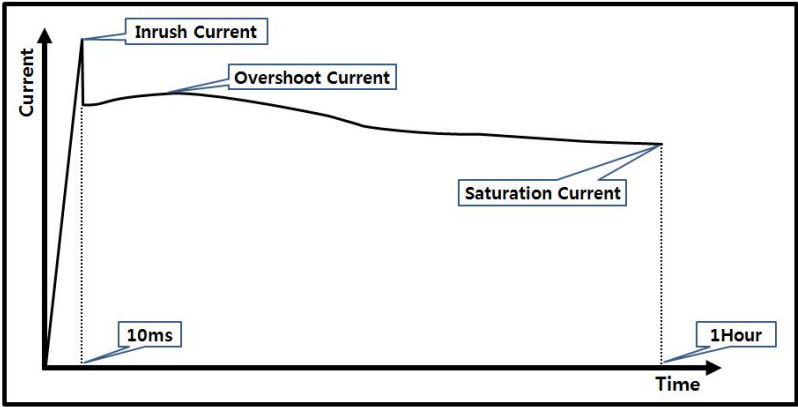
Note(4) External PWM frequency should be sync from SET frequency.

Note(5) Use the PWM Frequency which doesn't make a waterfall and a sound noise within this range. (Recommend) and Waterfall is not guaranteed with using another range of External PWM Dimming.



※ Additional appendix for supply current

Items	Symbol	Conditions	Specificati			U ni
			M	Typ	M	
Input Current	I_{in_Oversh}	$V_{in}=24V$, Dim=3.3V (Within 1hr at BLU)	-	5.76	5.	A
	$I_{in_Saturat}$	$V_{in}=24V$, Dim=3.3V (After 1hr Aging)	-	5.71	5.	



15 INPUT TERMINAL PIN ASSIGNMENT

6.1 INPUT SIGNAL & POWER

Connector : FI-RE51S-HF-J (JAE)

P I	Sym bol	Description	P I	Sym bol	Description
1	VDD	VDD 12V	2	GND	Ground
2			2	Rx0_	V-by-One Data Lane
3			2	Rx0_P	V-by-One Data Lane
4			3	GND	Ground
5			3	Rx1_	V-by-One Data Lane
6			3	Rx1_P	V-by-One Data Lane
7			3	GND	Ground
8			3	Rx2_	V-by-One Data Lane
9	NC	No Connecti	3	Rx2_P	V-by-One Data Lane
1	GND	Ground	3	GND	Ground
1			3	Rx3_	V-by-One Data Lane
1			3	Rx3_P	V-by-One Data Lane
1			3	GND	Ground
1			4	Rx4_	V-by-One Data Lane
1	NC	No Connecti on Note(1)	4	Rx4_P	V-by-One Data Lane
1			4	GND	Ground
1			4	Rx5_	V-by-One Data Lane
1			4	Rx5_P	V-by-One Data Lane
1			4	GND	Ground
2			4	Rx6_	V-by-One Data Lane
2			4	Rx6_P	V-by-One Data Lane
2			4	GND	Ground
2			4	Rx7_	V-by-One Data Lane
2	PWM	PWM_I	5	Rx7_P	V-by-One Data Lane
2	HTPD	1.8V or 3.3V Level	5	GND	Ground
2	LOCK	1.8V or 3.3V Level	-	-	-

Connector : FI-RE41S-HF-J (JAE)

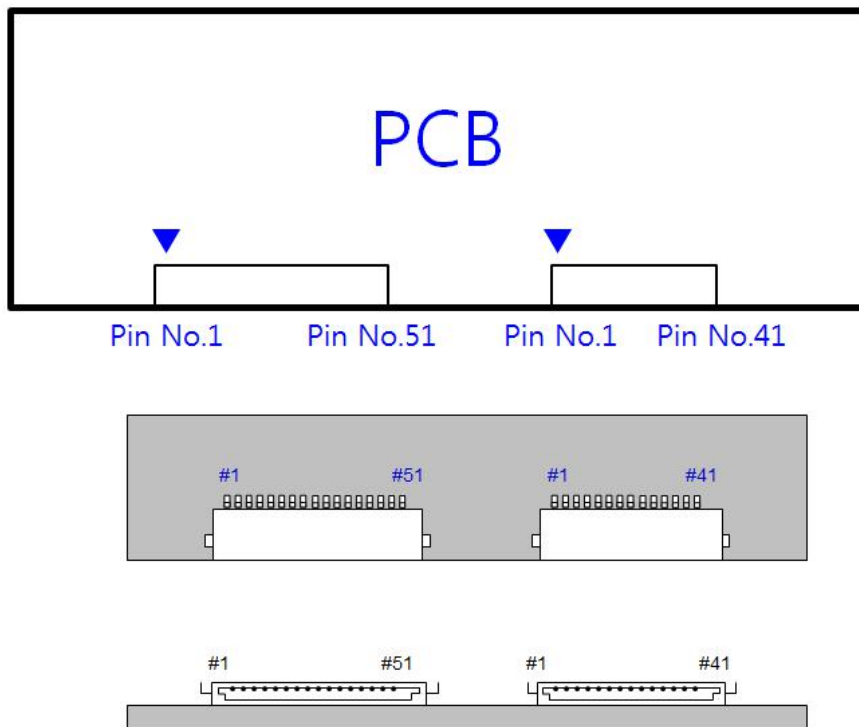
P I	Sym bol	Description	P I	Sym bol	Description
1	GND	Ground	2	GND	Ground
2	Rx8_	V-by-One Data Lane	2	Rx15_	V-by-One Data Lane
3	Rx8_P	V-by-One Data Lane	2	Rx15_	V-by-One Data Lane
4	GND	Ground	2	GND	Ground
5	Rx9_	V-by-One Data Lane	2	NC	No Connecti on Note(1)
6	Rx9_P	V-by-One Data Lane	2		
7	GND	Ground	2		
8	Rx10_	V-by-One Data Lane	2		
9	Rx10_	V-by-One Data Lane	3		
1	GND	Ground	3		
1	Rx11_	V-by-One Data Lane	3		
1	Rx11_	V-by-One Data Lane	3		
1	GND	Ground	3		
1	Rx12_	V-by-One Data Lane	3		
1	Rx12_	V-by-One Data Lane	3		
1	GND	Ground	3		
1	Rx13_	V-by-One Data Lane	3		
1	Rx13_	V-by-One Data Lane	3		
1	GND	Ground	4		
2	Rx14_	V-by-One Data Lane	4		
2	Rx14_	V-by-One Data Lane		-	-

Note(1) No Connection : These pins are only used for SAMSUNG internal purpose.

Note(2)

Characteristics		M	Typ	Max	U
Supply	1.8V	1.	1.8	1.95	V
	3.3V	3.	3.3	3.6	V

Note(3) V-by-One Connector



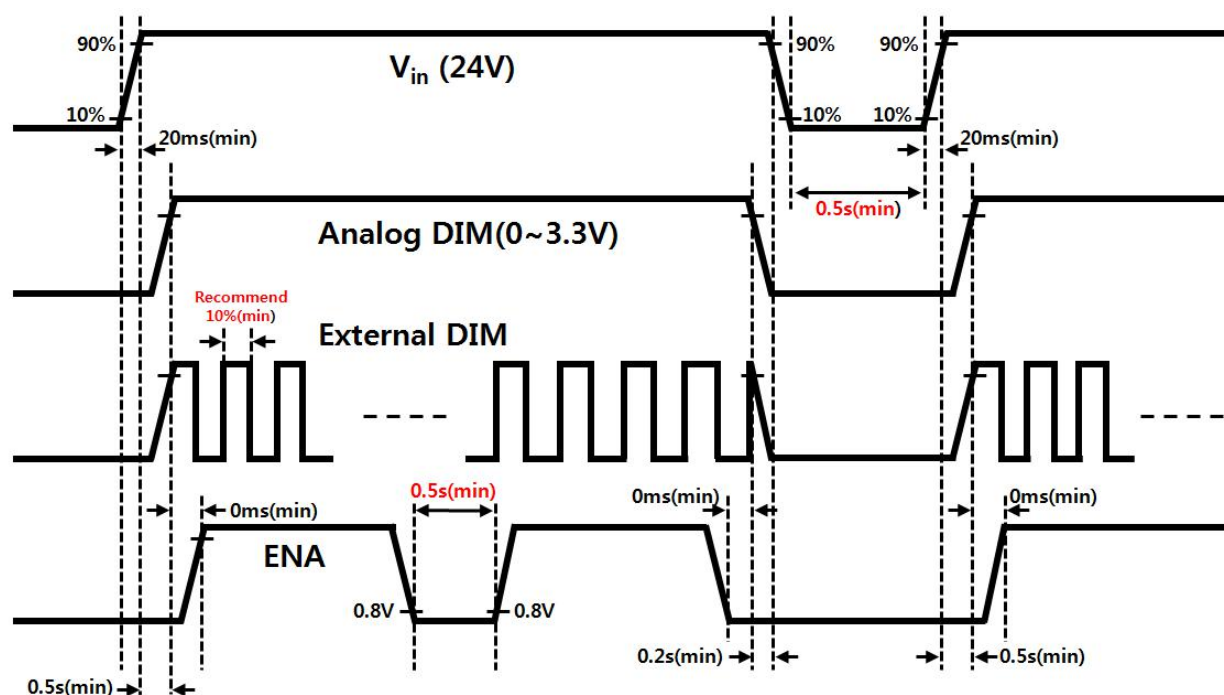
- (1) All GND pins should be connected together and also be connected to the LCD's metal chassis.
- (2) All power input pins should be connected together.
- (3) All N.C pins should be separated from other signal or power.

6.2 LED CONVERTER INPUT PIN CONFIGURATION

Connector : YEONHO, 20022WR-H14B2

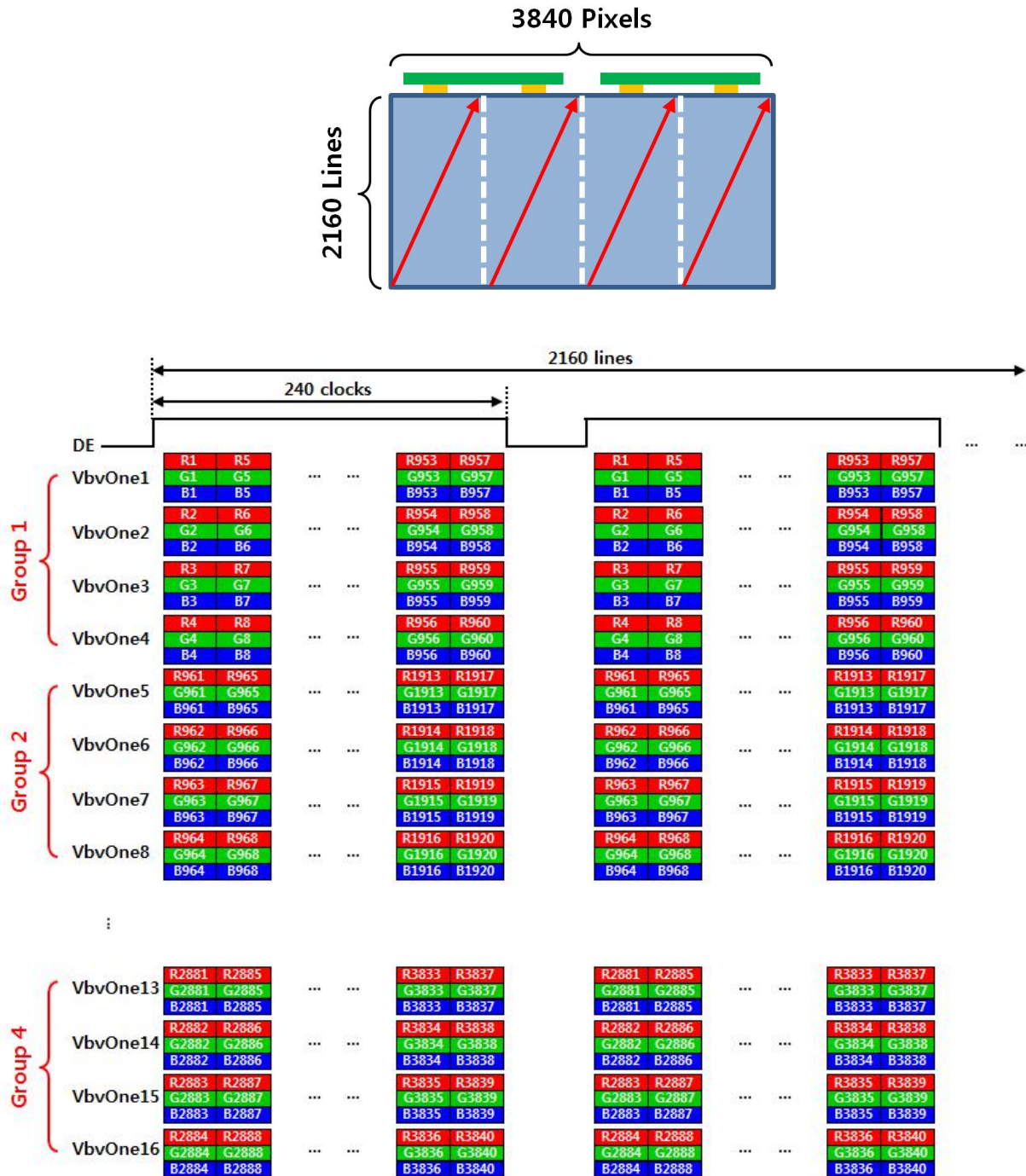
PIN	Pin Configuration(FUNCTION)
1	V _{in} (24V)
2	V _{in} (24V)
3	V _{in} (24V)
4	V _{in} (24V)
5	V _{in} (24V)
6	GND
7	GND
8	GND
9	GND
10	GND
11	Error out (Normal : GND, Abnormal : Open Collector)
12	ENA (Converter On/Off control signal) Off : -0.3~0.8V / On :
13	Analog Dimming control (0V : Min, 3.3V : Max) (No Connection in case of using External PWM Dimming)
14	External PWM Dimming control (No Connection in case of using Internal PWM Dimming)

6.3 LED CONVERTER POWER SEQUENCE



6.4 V-by-One INTERFACE

- Input Data format @ UHD 120Hz
- Input Data mapping : 4 Division input



6.5 INPUT SIGNALS, BASIC DISPLAY COLORS AND GRAY SCALE

COLO R	DISPLA Y (8bit)	DATA																								G RA Y	
		R								GRE								BL									
		R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3	B4	B5	B6	B7		
BASI C COLO R	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-		
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-	
	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	-	
	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	-	
	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	-	
	MAGEN	1	1	1	1	1	1	1	1	0	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	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	1	-
GR AY SC AL E OF RE D	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R0		
	DARK ↑	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1	
		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R3	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R3	
	↓ LIGHT	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2	
		0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2	
	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	R2	
GRAY SCALE OF GREE N	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G0		
	DARK ↑	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G1	
		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G1	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	G3	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	G3	
	↓ LIGHT	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G2	
		0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G2	
	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	G2	
GRAY SCALE OF BLUE	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B0		
	DARK ↑	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	B1	
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	B1	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3	
	↓ LIGHT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	B2	
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	B2	
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	B2	

Note) Definition of Gray

Rn : Red Gray, Gn : Green Gray, Bn : Blue Gray(n = Gray Level)

Input Signal : 0 = Low Level Voltage, 1 = High Level Voltage

16 INTERFACE TIMING

5.1 TIMING PARAMETERS (DE ONLY MODE)

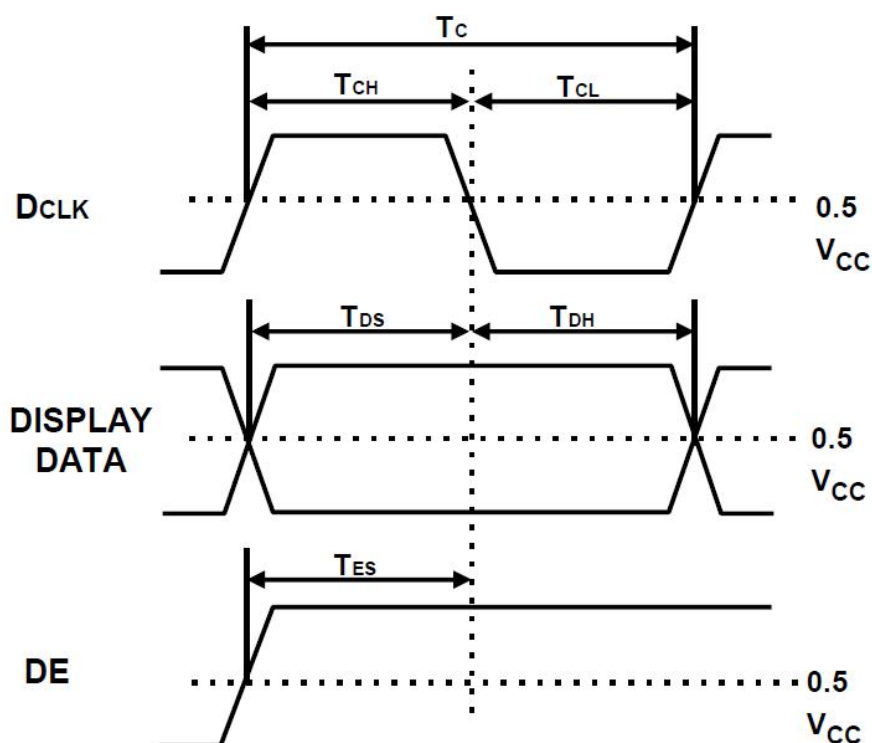
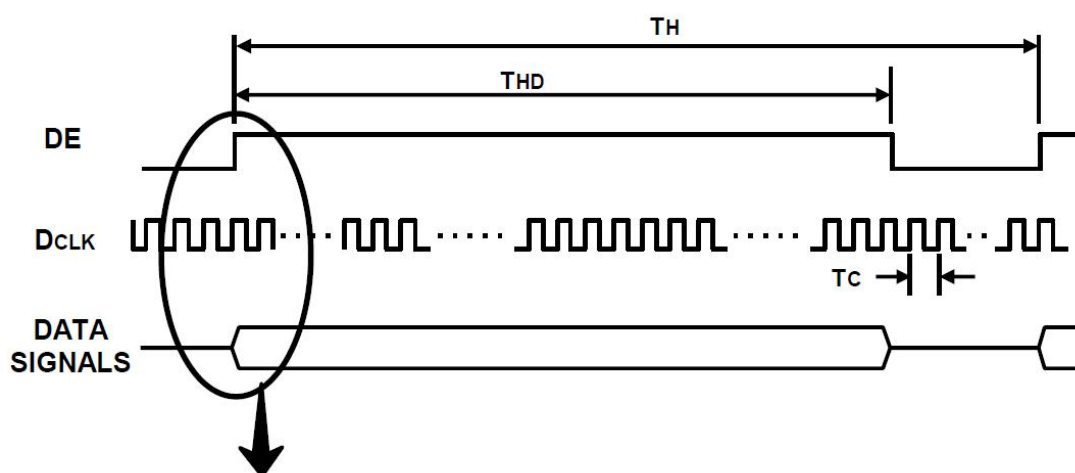
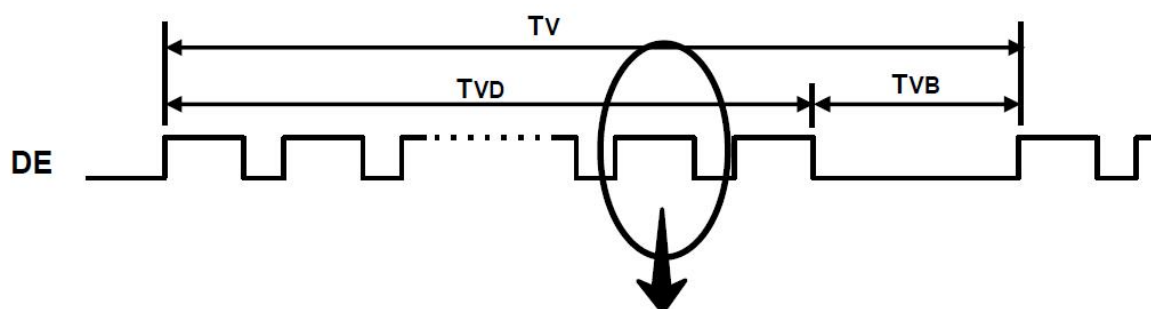
SIGNAL	ITEM	SYMB	MI	TYP	MAX	Unit	NO
Clock	Frequency	$1/T_C$	60*	74.25*	76.75*	MH	-
Hsync		F_H	216	270	279	KHz	-
Vsync		F_V	96	120	124	Hz	-
Term for the vertical	Active display period	T_{VD}	-	2160	-	Line	-
	Total vertical	T_V	220	2250	2850	Line	-
Term for the horizontal	Active display	T_{HD}	-	3840	-	Cloc	-
	Total Horizontal	T_H	433	4400	4704	cloc	Note 2)

Note1) The signals of Hsync and Vsync must be inputted even though this T-con is operated at DE mode.

- Test Point: TTL controls signal and CLK at V-by-One Tx at the input terminal of system.
- Internal VDD = 3.3V
- The spread spectrum
 - The limit of spread spectrum's range of SET in which the LCD module is assembled should be within 0.5 %
 - Frequency for modulation : Max 30 KHz

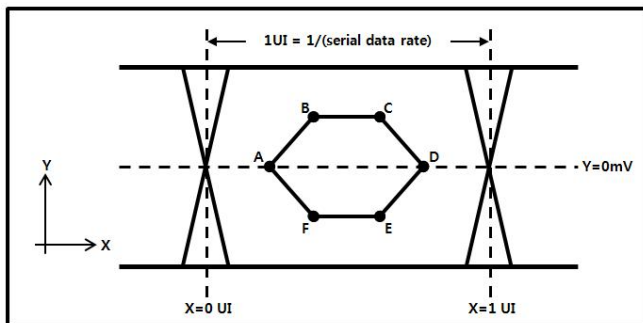
Note2) All V-by-One channel's Total Horizontal should be the same value

5.2 TIMING DIAGRAMS OF INTERFACE SIGNAL (DE ONLY MODE)



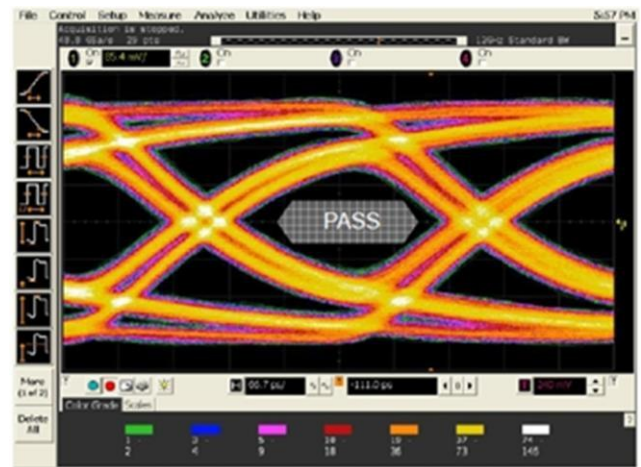
5.3 V-by-One Rx ELECTRICAL SPECIFICATIONS

4 V-by-One Rx Eye spec(Rx PLL Loop Bandwidth : 15MHz)



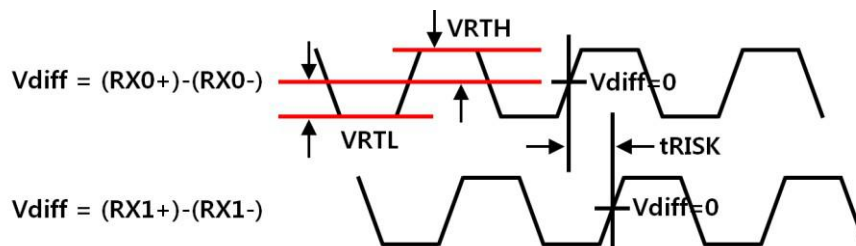
	X (UI)	Y (mV)
A	0.25	0
B	0.3	50
C	0.7	50
D	0.75	0
E	0.7	-50
F	0.3	-50

(a) Eye Mask



(b) Example of Eye Diagram

5 V-by-One Rx DC Characteristics



SIGNAL	SYMB	Condition	M	Typ	Max	Un
Unit Interval	UI	3 byte	266	tTCIP(1)/	1667	psec
		4 byte		tTCIP(1)/		
		5 byte		tTCIP(1)/		
Differential Input High	VRTH	-	5	-	-	mV
Differential Input Low	VRTL	-	-	-	-50	
Intra Pair skew	tRISK	-	-	-	0.3	UI
Inter Pair skew		-	-	-	5	
Differential Input Resistance	Rdiff	-	8	100	120	Oh

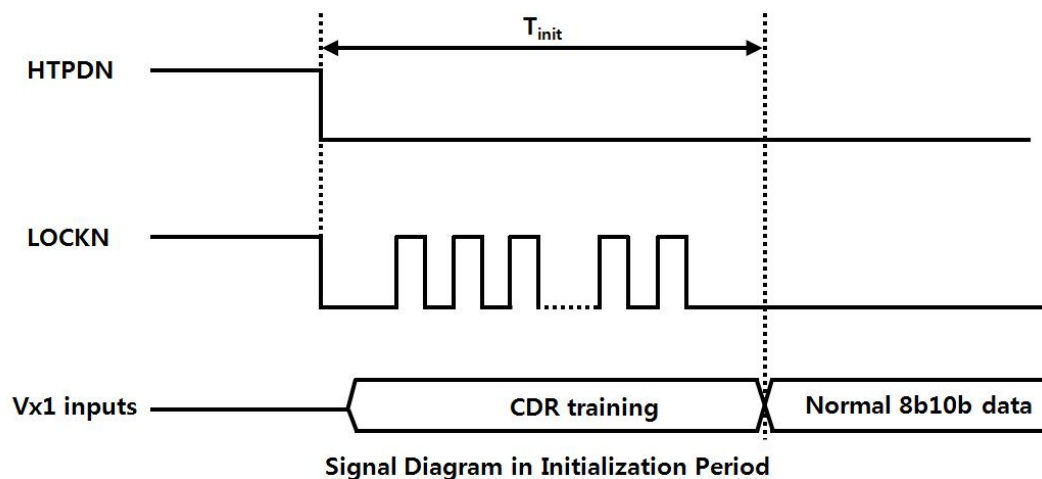
Note(1) tTCIP is the pixel data unit time per lane.

Note(2) It must meet the "V-by-One Rx Eye spec".

6 V-by-One Characteristics in Initialization Period

Characteristics	SYMB	M	Ty	M	UN
Initialization Time from HTPDN 'LOW' to normal 8b10b	V_{init}	-	-	270	ms

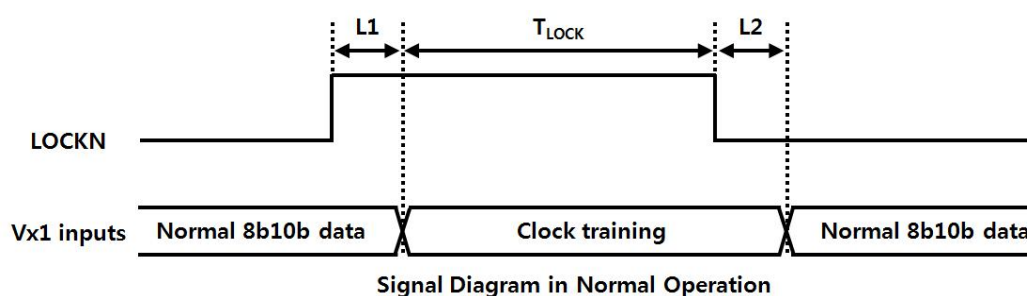
* There is the Abnormal Display Risk with out of Spec of V_{init} .



7 V-by-One Characteristics in Normal Operation

Characteristics	SYMB	M	Ty	M	UN
Lock Time from clock training pattern to LOCKN 'LOW' in normal	T_{LOCK}	-	-	10	ms
Latency from LOCKN 'HIGH' to clock training	L1	-	-	10	ms
Latency from LOCKN 'LOW' to normal 8b10b	L2	-	-	10	ms

* T_{LOCK} can be changeable by Rx.



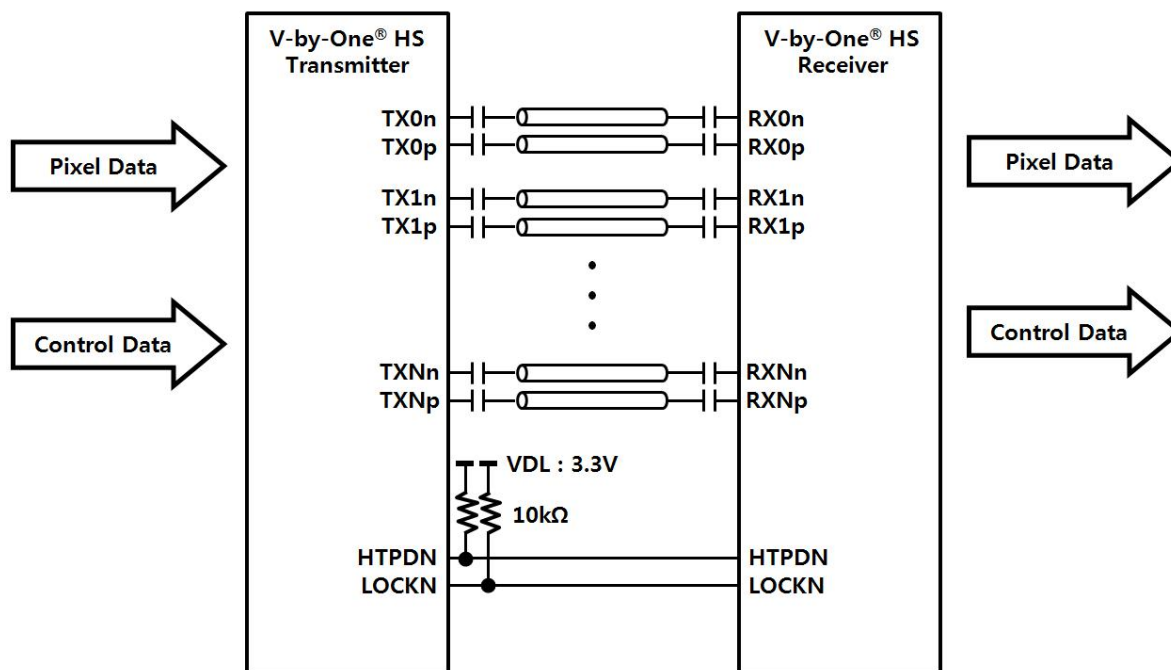
a. Byte Length and Color Mapping : 4byte mode & 30bpp RGB mode

Mode			Packer input & Unpacker output	36bpp RGB /YCbCr44	30bpp RGB /YCbCr44	24bpp RGB /YCbCr44	18bpp RGB /YCbCr44	40b pp RGB	32b pp RGB	
5byte mode	4byte mode	3byte mode	Byte 0	D[0]	R/Cr[4]	R/Cr[	R/Cr[	-	R[2]	R[0]
				D[1]	R/Cr[5]	R/Cr[	R/Cr[	-	R[3]	R[1]
				D[2]	R/Cr[6]	R/Cr[	R/Cr[	R/Cr[	R[4]	R[2]
				D[3]	R/Cr[7]	R/Cr[	R/Cr[	R/Cr[	R[5]	R[3]
				D[4]	R/Cr[8]	R/Cr[	R/Cr[	R/Cr[	R[6]	R[4]
				D[5]	R/Cr[9]	R/Cr[	R/Cr[	R/Cr[	R[7]	R[5]
				D[6]	R/Cr[10]	R/Cr[	R/Cr[	R/Cr[	R[8]	R[6]
				D[7]	R/Cr[11]	R/Cr[	R/Cr[	R/Cr[	R[9]	R[7]
		Byte 1	D[8]	G/Y[4]	G/Y[2]	G/Y[0]	-	G[2]	G[0]	
			D[9]	G/Y[5]	G/Y[3]	G/Y[1]	-	G[3]	G[1]	
			D[10]	G/Y[6]	G/Y[4]	G/Y[2]	G/Y[	G[4]	G[2]	
			D[11]	G/Y[7]	G/Y[5]	G/Y[3]	G/Y[	G[5]	G[3]	
			D[12]	G/Y[8]	G/Y[6]	G/Y[4]	G/Y[	G[6]	G[4]	
			D[13]	G/Y[9]	G/Y[7]	G/Y[5]	G/Y[	G[7]	G[5]	
			D[14]	G/Y[10]	G/Y[8]	G/Y[6]	G/Y[	G[8]	G[6]	
			D[15]	G/Y[11]	G/Y[9]	G/Y[7]	G/Y[	G[9]	G[7]	
		Byte 2	D[16]	B/Cb[4]	B/Cb[	B/Cb[	-	B[2]	B[0]	
			D[17]	B/Cb[5]	B/Cb[	B/Cb[	-	B[3]	B[1]	
			D[18]	B/Cb[6]	B/Cb[	B/Cb[	B/Cb	B[4]	B[2]	
			D[19]	B/Cb[7]	B/Cb[	B/Cb[	B/Cb	B[5]	B[3]	
			D[20]	B/Cb[8]	B/Cb[	B/Cb[	B/Cb	B[6]	B[4]	
			D[21]	B/Cb[9]	B/Cb[	B/Cb[	B/Cb	B[7]	B[5]	
			D[22]	B/Cb[10]	B/Cb[	B/Cb[	B/Cb	B[8]	B[6]	
			D[23]	B/Cb[11]	B/Cb[	B/Cb[	B/Cb	B[9]	B[7]	
	Byte 3	D[24]	-	-	-	-	R[0]	-		
		D[25]	-	-	-	-	R[1]	-		
		D[26]	B/Cb[2]	B/Cb[	-	-	G[0]	-		
		D[27]	B/Cb[3]	B/Cb[	-	-	G[1]	-		
		D[28]	G/Y[2]	G/Y[0]	-	-	B[0]	-		
		D[29]	G/Y[3]	G/Y[1]	-	-	B[1]	-		
		D[30]	R/Cr[2]	R/Cr[	-	-	W/Y	-		
		D[31]	R/Cr[2]	R/Cr[	-	-	W/Y	-		
	Byte 4	D[32]	-	-	-	-	W/Y	W/Y		
		D[33]	-	-	-	-	W/Y	W/Y		
		D[34]	B/Cb[0]	-	-	-	W/Y	W/Y		
		D[35]	B/Cb[1]	-	-	-	W/Y	W/Y		
		D[36]	G/Y[0]	-	-	-	W/Y	W/Y		
		D[37]	G/Y[1]	-	-	-	W/Y	W/Y		
		D[38]	R/Cr[0]	-	-	-	W/Y	W/Y		
		D[39]	R/Cr[1]	-	-	-	W/Y	W/Y		

b. Packer Mapping

Condit							Pack er Outp	
Mode	DE	Enable	Disa					
	Frami ng	FSACTI VF	FSBS	FSBP	FSBE/FS BE			
5byte mode	4byte mode	3byte mode	Byte0	D[0]	Vsync H → SYNH L → SYNL	Vsyn c H → 0xFF L → 0x00	Vsync H → SYNH L → SYNL	PD[0]
				D[1]				PD[1]
				D[2]				PD[2]
				D[3]				PD[3]
				D[4]				PD[4]
				D[5]				PD[5]
				D[6]				PD[6]
				D[7]				PD[7]
		Byte1	D[8]	Hsync H → SYNH L → SYNL	Hsyn c H → 0xFF L → 0x00	Hsync H → SYNH L → SYNL	PD[0]	
			D[9]				PD[1]	
			D[10]				PD[2]	
			D[11]				PD[3]	
			D[12]				PD[4]	
			D[13]				PD[5]	
			D[14]				PD[6]	
			D[15]				PD[7]	
		Byte2	D[16]	BS	CTL[0]	BE/BE_SR	PD[0]	
			D[17]		CTL[1]		PD[1]	
			D[18]		CTL[2]		PD[2]	
			D[19]		CTL[3]		PD[3]	
			D[20]		CTL[4]		PD[4]	
			D[21]		CTL[5]		PD[5]	
			D[22]		CTL[6]		PD[6]	
			D[23]		CTL[7]		PD[7]	
		Byte3	D[24]	BS	CTL[8]	BE/BE_SR	PD[0]	
			D[25]		CTL[9]		PD[1]	
			D[26]		CTL[1]		PD[2]	
			D[27]		CTL[1]		PD[3]	
	D[28]		CTL[1]		PD[4]			
	D[29]		CTL[1]		PD[5]			
	D[30]		CTL[1]		PD[6]			
	D[31]		CTL[1]		PD[7]			
	Byte4	D[32]	BS	CTL[1]	BE/BE_SR	PD[0]		
		D[33]		CTL[1]		PD[1]		
		D[34]		CTL[1]		PD[2]		
		D[35]		CTL[1]		PD[3]		
		D[36]		CTL[2]		PD[4]		
		D[37]		CTL[2]		PD[5]		
		D[38]		CTL[2]		PD[6]		
		D[39]		CTL[2]		PD[7]		
-			D	K	D	K	D/K	

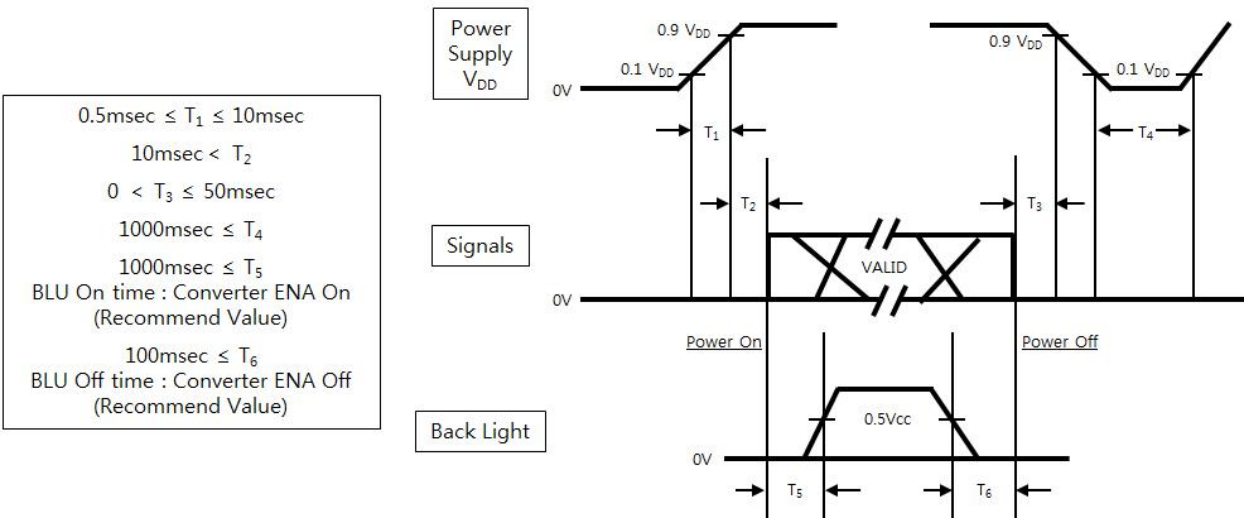
c. V-by-One HS Link System diagram : HTPDN & LOCKN Pull-up resistor is needed at the transmitterside.
 - All inputs include Vx1 inputs and TTL inputs.



—○— Indicates microstrip lines or cables with their differential characteristic impedance being 100Ω

* VDL : 3.3V

5.4 THE SEQUENCE OF POWER ON AND OFF

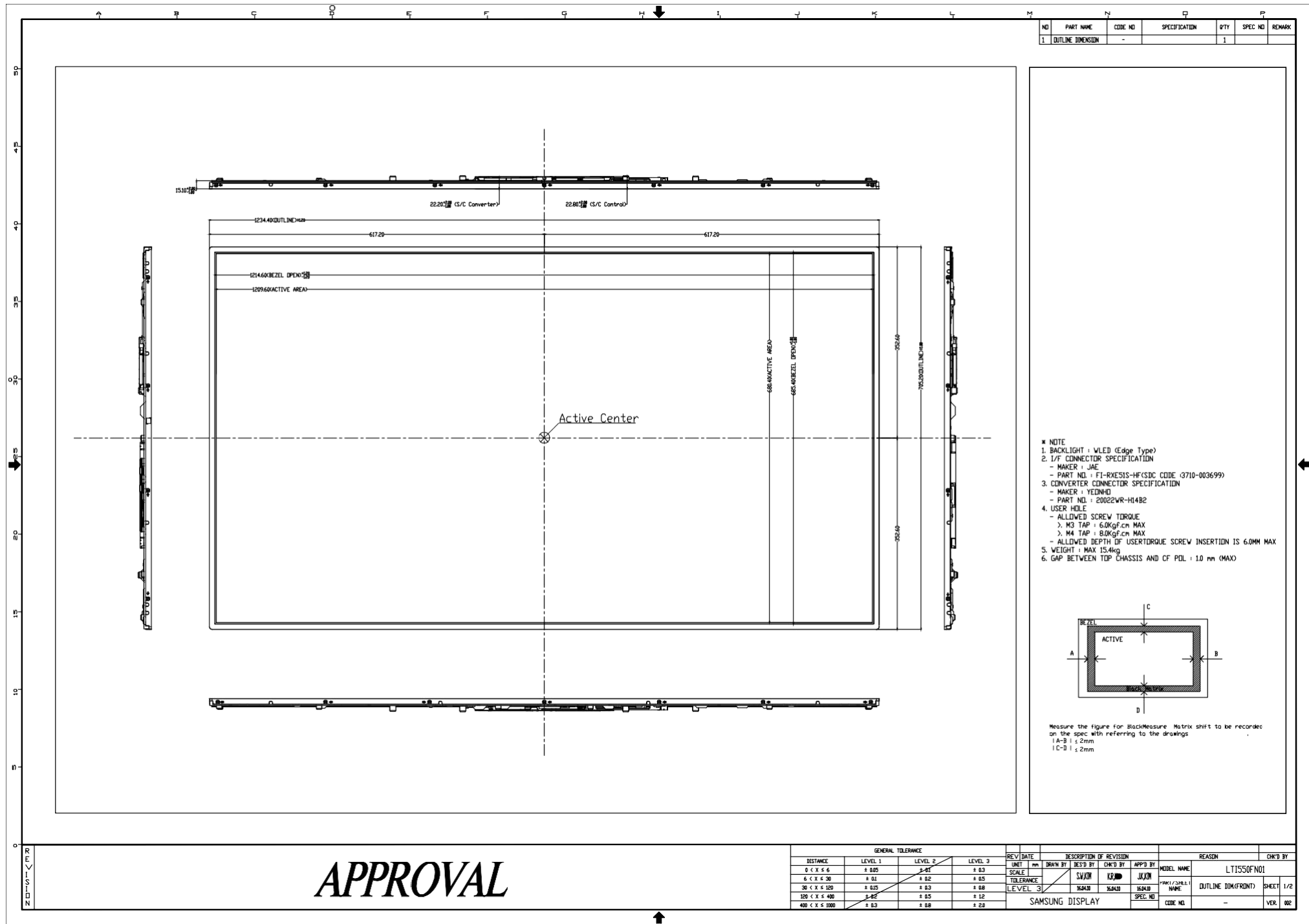


Timi	Remarks
T ₁	The time, during which the level of V _{DD} is rising from 10% to 90%.
T ₂	The changing time, during which the V _{DD} starts rising beyond 90% until the valid data of signal started coming in.
T ₃	The changing time, during which the valid data of signal starts leaving out until the V _{DD}
T ₄	The changing time, during which the V _{DD} starts falling below 10% to restart the
T ₅	The changing time, during which the signal of BLU starts rising beyond 50%.
T ₆	The changing time, during which the signal of BLU starts falling below 50%.

- The inputted V_{DD} 's value for supply voltage, BLU, and signal to the external system of the module shall be computed with referring to the former mentioned value.
- a. The method to apply the voltage to the LED within the range, which the LCD operates. When the back -light is turned on before the LCD is operated or the power of LCD is turned off before the back-light is turned off, the abnormal display on the screen may be shown momentarily.
- b. Please keep the level of input signal low or keep the level of impedance high when the value of V_{DD} is below 10%.
- c.The value shall be measured after the module has been fully discharged between the period, which the power is turned on and the period, which the power is turned off like the T4 timing. The backlight may be flashed if the interface signal remains floated when the above-mentioned signal becomes invalid.

17 OUTLINE DIMENSION

Please refer next 2pages.



18 RELIABILITY TEST

Item	Test condition	Quanti
HTOL	50°C, 500hr determination	8EA
LTOL	0°C, 500hr determination	4EA
HTS	70°C, 500hr determination	4EA
LTS	-25°C, 500hr determination	4EA
THB	50°C / 90%RH, 500hr determination	10EA
WHTS	60°C / 75%RH, 500hr determination	4EA
T/S	-20 ~ 60°C, Dwell time : 60Min, 200cycle	4EA
TSS	-20 ~ 65°C, 220cycle	4EA
Image sticking	50°C, Mosaic pattern (9X10), 168hrs	8EA
Contact ESD	±10 kV, 210Point, 1 time/Point	3EA
Air ESD	±20 kV, 210Point, 1 time/Point	3EA
Input Con. ESD	±15kV, Input Con. Pin, 3 times/Pin	3EA
Dust	5sec spray, 5min sedimentation / 10hr Power 10min on, 10min off	2EA
Pallet Vibration → Pallet Drop	Pallet vibration : 1.05Grms, 5 ~ 200Hz, 2hr/stack side Pallet Drop : 20cm, bottom side 2 angles,	2Pallet
Vibration	Frequency range 10hz~300hz for 10min at the sine wave at 1.5G Direction of X, Y and Z axis for 30min	3EA
Shock	30G for ±X and Y axis / 30G for ±Z axis	3EA
Altitude	-40~50°C, 0m(0ft) ~ 13,700m(45,000ft),	4EA

[Criteria on evaluation]

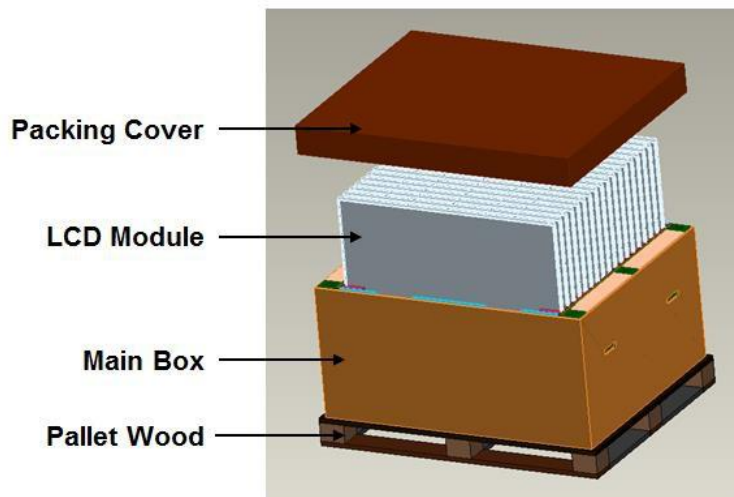
The components of product, which may affect to the function of display shall not be changed when the display quality test is executed under the normal operating condition.

- a. HTOL / LTOL : The operating at the high and low temperature*
- b. THB : The slant of temperature and humidity
- c. HTS / LTS : The storage at the high and low temperature
- d. WHTS : The storage condition at the high temperature with the high humidity

19 PACKING

2 Packing Form : Paper Box

3 Packing Method



Note(1) Total Weight : Approximately 382.7kg [With Pallet-Plastic]

Note(2) Acceptance number of piling : Move – 1Pallet, Stock – 2Pallet

Note(3) Carton size : 1440mm(H) x 1120mm(V) x 769mm(Height) [Without Pallet Plastic]
1475mm(H) x 1150mm(V) x 891mm(Height) [With Pallet Plastic]

4 Packing Material

N	Part name	Quanti
1	Packing Cover	1 EA
2	Main Box	1 EA
3	LCD	20 EA
3	Bag-	20 EA
4	Protector-Panel	20 EA
5	Pallet	1 EA

20 MARKINGS & OTHERS

A nameplate bearing followed by is affixed to a shipped product at the specified location on each product.

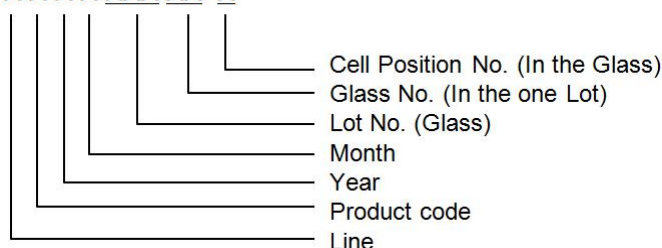
(1) Parts number : LTI550FN01

(2) Revision code : Three letters

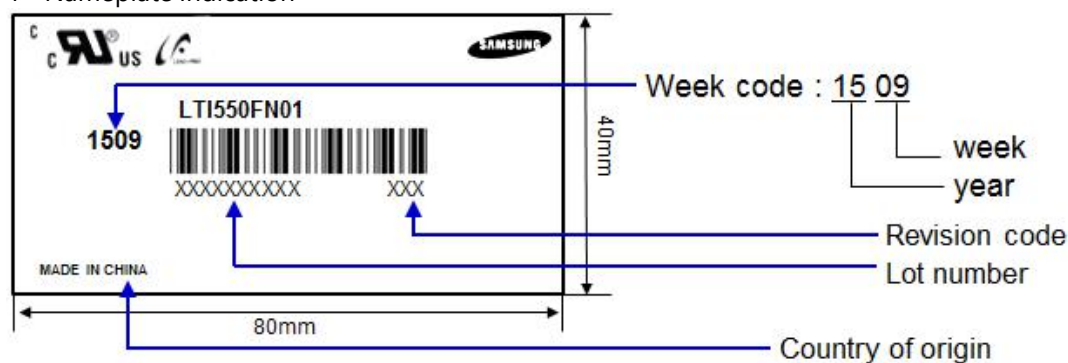
(3) Lot number

X X X X XXX XX X

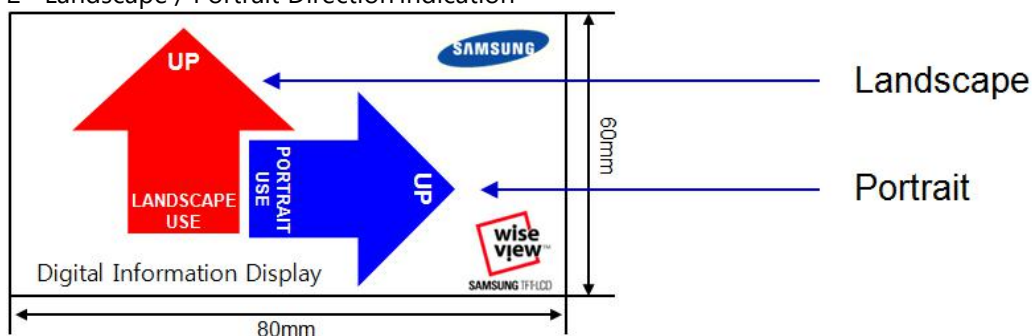
:



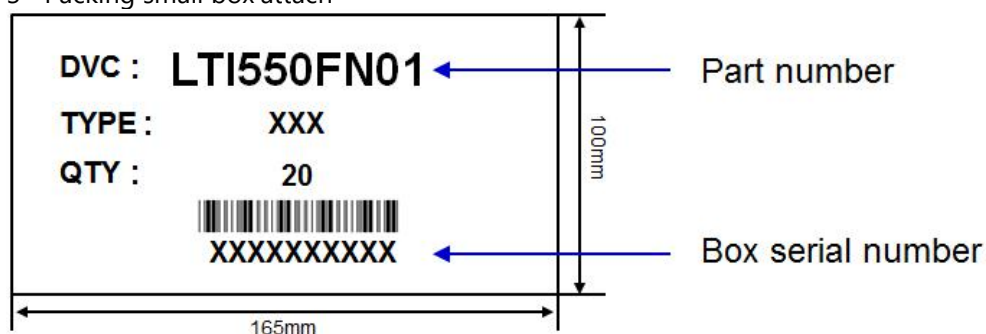
1 Nameplate Indication



2 Landscape / Portrait Direction Indication



3 Packing small box attach



21 GENERAL PRECAUTIONS

a. HANDLING

- When the module is assembled, It should be attached to the system firmly using every mounting holes. Be careful not to twist and bend the modules.
- Refrain from strong mechanical shock and / or any force to the module. In addition to damage, this may cause improper operation or damage to the module and LED back-light.
- Note that polarizers are very fragile and could be easily damaged. Do not press or scratch the surface harder than a HB pencil lead.
- Wipe off water droplets or oil immediately. If you leave the droplets for a long time, Staining and discoloration may occur.
- If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
- The desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane. 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.
- 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, legs or clothes, it must be washed away thoroughly with soap.
- Protect the module from static. it may cause damage to the C-MOS Gate Array IC.
- Use fingerstalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- Do not disassemble the module.
- Do not pull or fold the LED wire.
- Do not touch any component which is located on the back side.
- Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
- Pins of I/F connector shall not be touched directly with bare hands.

b. STORAGE

We highly recommend to comply with the criteria in the table below.

ITE	Unit	Mi	Ma
Storage Temperature	(°C)	5	40
Storage	(%rH)	35	75
Storage Life	12		
Storage Condition	1) The storage room should be equipped with a good ventilation facility, which has a temperature controlling system. 2) Products should be placed on the pallet, which is away from the wall not on the floor. 3) Prevent products from being exposed to the direct sunlight, moisture, and water. Be cautious not to pile the products up. 4) Avoid storing products in the environment, which other hazardous material is placed. 5) If products are delivered or kept in the storage facility more than 3 months, we recommend you to leave products under the condition including a 20°C temperature and a humidity of 50% for 24 hours. 6) If you store semi-manufactured products for more than 3 months, bake the products under the condition including the 50°C temp. and the 10% humidity for 24hrs		

c. OPERATION

- 1) Do not connect or disconnect the cable to/ from the module at the "Power On" condition.
- 2) The power shall be always turned on/off by the item 6.4. "Power on/off sequence"
- 3) The module has a circuit with a high frequency. The system manufacturers shall suppress the electromagnetic interference sufficiently. The methods to ground and shield are important to minimize the interference.
- 4) Design the length of cable to connect between the connector for back-light and the converter as short as possible and the shorter cable shall be connected directly.

The longer cable between that of back-light and that of converter may cause the luminance of LED to lower and need a higher startup voltage(Vs).

d. OPERATION CONDITION GUIDE

- 1) The LCD product should be operated under normal conditions.

Normal condition is defined as below;

Temperature : 20±15°C

Humidity : 55±20%

Display pattern : continually changing pattern (Not stationary)

- 2) If the product will be used in extreme conditions such as high temperature, humidity, display patterns or operation time etc., It is strongly recommended to contact SDC for Application engineering advice. Otherwise, its reliability and function may not be guaranteed. Extreme conditions are commonly found at Airports, Transit Stations, Banks, Stock market, and Controlling systems.

e. OTHERS

- 1) Ultra-violet ray filter is necessary for outdoor operation.
- 2) Module should be turned clockwise (regular front view perspective) when used in portrait mode.
- 3) Avoid condensation of water. It may result in improper operation or disconnection of electrode.
- 4) Do not exceed the absolute maximum rating value. (supply voltage variation, input voltage variation, variation in part contents and environmental temperature, and so on) Otherwise the Module may be damaged.
- 5) If the Module keeps displaying the same pattern for a long period of time, the image may be "sticked" to the screen. To avoid image sticking, it is recommended to use a screensaver.
- 6) This Module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.
- 7) Please contact SDC in advance when you display the same pattern for a long time.