

SPECIFICATION FOR APPROVAL

() Preliminary Specification

(●) Final Specification

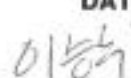
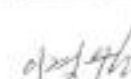
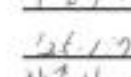
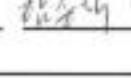
Title	65" UHD(QWUXGA) OLED
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BUYER	Global
MODEL	

SUPPLIER	LG Display Co., Ltd.
*MODEL	LE650PQW
SUFFIX	HTL2

APPROVED BY	SIGNATURE DATE
/	
/	
/	

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

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**OLED TV Development Dept.
LG Display Co., Ltd.**

Product Specification

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RECORD OF REVISIONS

Revision No.	Revision Date	Page	Description
0.1	July. 01 2024	-	
0.2	July.15.2024	16	Update power sequence as standard
0.2	July.31.2024	7	Update 17 pin Description
		10	Update Timing Table(DE)
		11	Update Timing Table(VRR)
		15	Update 10bit Table
		47~49	Update APPENDIX-VII
0.3	Sep.10.2024	6	Update Electrical Characteristics
	Sep.30.2024	7	Update 22, 23 and note 6
	Sep.30.2024	11	5940 -> 5964
	Sep.30.2024	12	CDR characteristic DC Gain., Zero[GHz], Pole1[GHz], Pole2[GHz]
	Sep.30.2024	18	415.6ms → 150ms
	Sep.30.2024	19	Update QSM Table and Note
	Sep.30.2024	22	Update note
	Sep.30.2024	40	THCV216→ THCV215
	Sep.30.2024	34	Page Delete
	Sep.30.2024	41	Update I2C Register
	Sep.30.2024	49	Update P-ID Read page ADD
	Sep.30.2024	50	Update GTG Result
	Sep.30.2024	51	Update MPRT Result
0.4	Nov.06.2024	52	Update FFC Drawing
	Nov.06.2024	41	Delete Serial 30R
	Nov.08.2024	11	Add 74.25MHz VRR Mode table
0.5	Dec.10.2024	6	Update Electrical Characteristics
		11	Update Timing Table(Only Gaming mode : VRR Mode)
		19	Update QSM operation
		26~28	Update drawing
		32	Update Operating Precautions
		46	Update Register Map
1.0	Dec. 27. 2024	-	Release Final CAS
1.1	Jan. 21. 2025	21, 22, 57	Flash peak appendix add

Product Specification

1. General Description

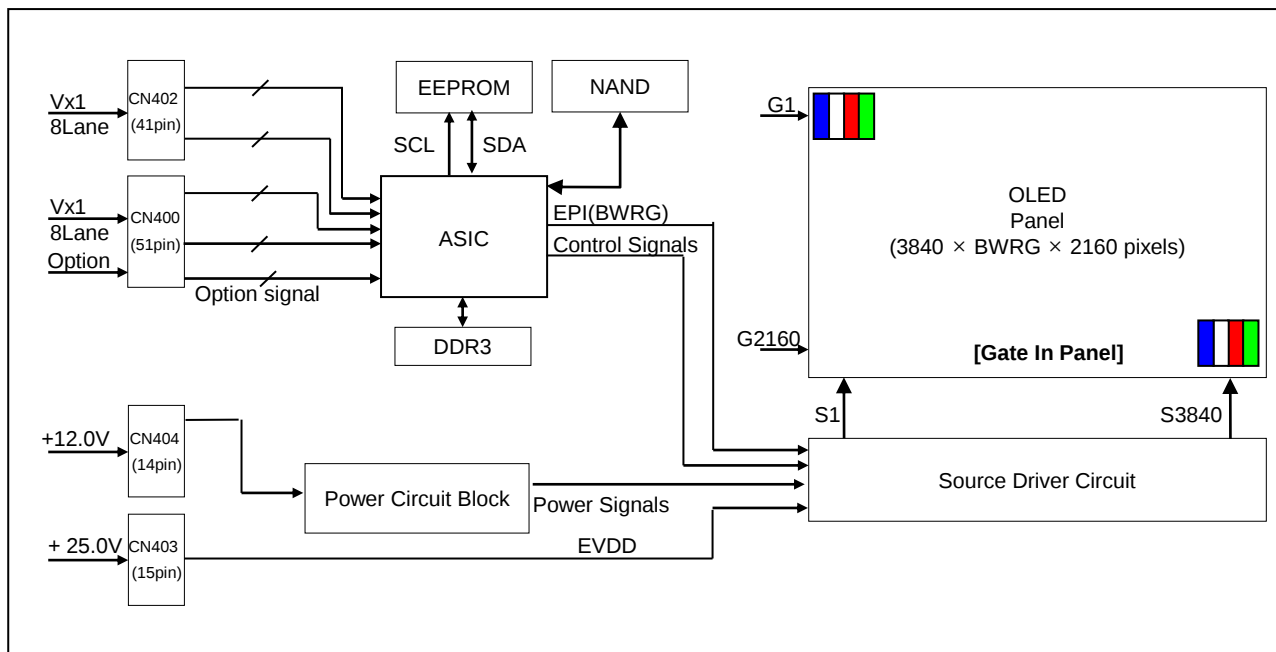
The LE650PQW is a Color Active Matrix Organic Light Emitting Diode Display (OLED).

The matrix employs Oxide Thin Film Transistor as the active element. It is a Bottom emission display type. It has a 65 inch diagonally measured active display area with QWUXGA resolution (2160 vertical by 3840 horizontal pixel array).

Each pixel is divided into Red, Green, Blue and White sub-pixels or dots which are arrayed in vertical stripes. Gray scale or the luminance of the sub-pixel color is determined with a 10-bit gray scale signal for each dot. Therefore, it can present a palette of more than 1.07B(true) colors.

It has been designed to apply the 10-bit/11-bit 16-lane V by One interface.

It is intended to support TV where high brightness, super wide viewing angle, high color gamut, high color depth and fast response time are important.



General Features

Active Screen Size	64.53 inch (1638.963mm) diagonal
Outline Dimension (Typ.)	1437.88(H) x 817.82(V) x 0.79(B) mm
Pixel Pitch	0.372 mm x 0.372 mm
Pixel Format	3840 horiz. by 2160 vert. Pixels, BWRG stripe arrangement
Color Depth	10bit(R), 1.07Billion colors
Luminance, White	1000 / 350 cd/m(Center 1point ,Typ.)
Color Viewing Angle	R/L 120 (min.), U/D 120 (min.) ($\Delta u'v' \leq 0.025$)
Power Consumption	147.5W (Typ.) [Logic: 16.8W, EVDD = 130.7W] @ IEC62087]
Weight	2.8kg (Typ.)
Display Mode	Normally black
Surface Treatment	Hard coating(2H), Anti-reflection treatment of the front polarizer (Reflectance Typ. 0.6%)

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2. Absolute Maximum Ratings

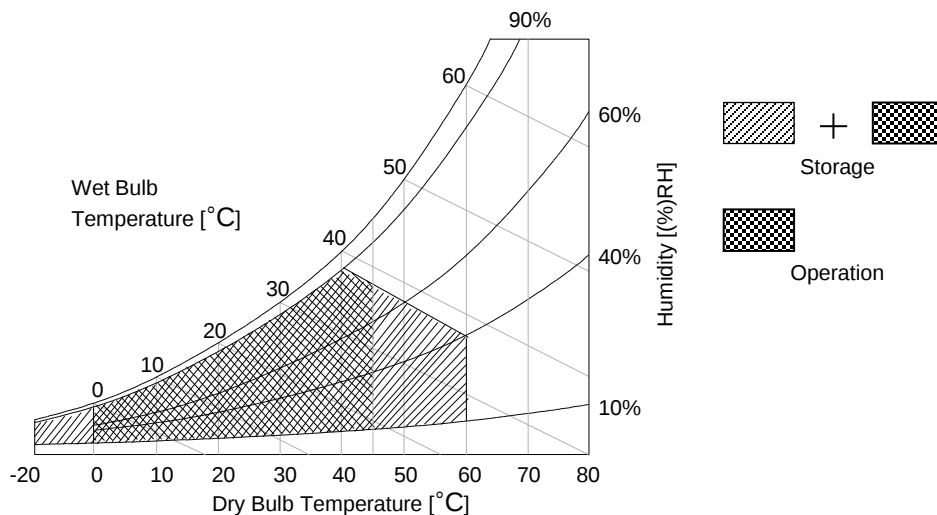
The following items are maximum values which, if exceeded, may cause faulty operation or damage to the OLED module.

Table 1. Absolute Maximum Ratings

Parameter		Symbol	Value		Unit	Note
			Min	Max		
Power Input Voltage	Logic	VDD	-0.3	+14.0	V _{DC}	1
	EVDD	EVDD	-0.3	+ 28.0	V _{DC}	
T-Con Option Selection Voltage		V _{LOGIC}	-0.3	+3.7	V _{DC}	
Operating Temperature		T _{OP}	0	+45	°C	2
Storage Temperature		T _{ST}	-20	+60	°C	
Operating Ambient Humidity		H _{OP}	10	90	%RH	2
Storage Humidity		H _{ST}	10	90	%RH	

Note:

1. Ambient temperature condition ($T_a = 25 \pm 2 \text{ }^{\circ}\text{C}$)
2. Temperature and relative humidity range are shown in the figure below.
Wet bulb temperature should be Max 39°C, and no condensation of water.



Product Specification

3. Electrical Specifications

3-1. Electrical Characteristics

It requires two power inputs. One is employed to power for the circuit. The other is used for the EVDD.

Table 2. Electrical Characteristics

Parameter	Symbol	Values			Unit	Notes
		Min	Typ	Max		
Power Input Voltage	VDD	10.8	12.0	13.2	V	
	EVDD	23.8	25.0	26.3		
Power Input Current	I_{VDD}	-	1.4	1.54	A	1-1 / 1-2
		-	2.3	2.53		1,2
	I_{EVDD}	-	5.2	5.8		1-1
			5.1	5.6		1-2
		-	13.7	14.4		1,3
T-CON Option Voltage	V_{IL}	0	-	0.8	V	
	V_{IH}	2.7	-	3.6	V	
Power Consumption	P_{VDD}	-	16.8	18.48	Watt	1-1 / 1-2
		-	27.6	30.4		2
	P_{EVDD}	-	130.7	143.8		1-1
			126.8	139.5		1-2
		-	342.5	359.6		3
Rush current	I_{RUSH}	I_{RUSH_VDD}	-	7.0	A	
		I_{RUSH_EVDD}	-	21.0		
		T_{RUSH_VDD}	-	100	us	
		T_{RUSH_EVDD}	-	2	ms	

Note

- 1-1. The specified current and power consumption are under the VDD=12.0V, EVDD=25.0V Ta=25 ± 2°C, f_v=120Hz condition whereas standard moving picture(IEC62087) is displayed and f_v is the frame frequency.
 ※ Before measuring the power consumption based on the standard moving picture(IEC62087), the power supplier's input voltage is needed to set the integrated power meter to be the EVDD Typ. value based on 25% APL Pattern.
- 1-2 The specified current and power consumption are under the VDD=12.0V, EVDD=25.0V Ta=25 ± 2°C, f_v=120Hz condition whereas standard moving picture(CLASP) is displayed and f_v is the frame frequency.
2. The current (I_{VDD}) is specified at the maximum current pattern (1by1 Horizontal Pattern) and under the VDD=12.0V, EVDD=24.5V Ta=25 ± 2°C condition.
3. The current (I_{EVDD}) is specified at the maximum current pattern (Secondary Color Pattern) and under the VDD=12.0V, EVDD=24.5V Ta=25 ± 2°C condition.

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3-2. Interface Connections

This OLED module employs two kinds of interface connection, 51-pin connector and 41-pin connector are used for the module signals and 14-pin & 15-pin connectors are used for the module powers.

3-2-1. OLED Module (Signals)

- Module Connector(CN400) : 05030WR-H51B (YEONHO)
- Mating Connector : 05030WR-H51B (Yeonho) or compatible

Table 3. Module Connector(CN400) Pin Configuration

Pin No.	Symbol	Description	Pin No.	Symbol	Description
1	NC (Reserved)	No Connection (Reserved)	27	GND	Ground
2	NC (Reserved)	No Connection (Reserved)	28	Rx0n	V-by-One HS Data Lane 0
3	NC (Reserved)	No Connection (Reserved)	29	Rx0p	V-by-One HS Data Lane 0
4	NC (Reserved)	No Connection (Reserved)	30	GND	Ground
5	NC (Reserved)	No Connection (Reserved)	31	Rx1n	V-by-One HS Data Lane 1
6	NC (Reserved)	No Connection (Reserved)	32	Rx1p	V-by-One HS Data Lane 1
7	NC (Reserved)	No Connection (Reserved)	33	GND	Ground
8	NC (Reserved)	No Connection (Reserved)	34	Rx2n	V-by-One HS Data Lane 2
9	NC (Reserved)	No Connection (Reserved)	35	Rx2p	V-by-One HS Data Lane 2
10	JB&Off-RS Power_off done	JB&Off-RS&Power_off done (H), Set ← Module	36	GND	Ground
11	AC_DET	AC_DET (H= On), Set → Module	37	Rx3n	V-by-One HS Data Lane 3
12	Error Detection	H=Error, L=Normal (note 4)	38	Rx3p	V-by-One HS Data Lane 3
13	I2C-SDA1	I2C for Customer	39	GND	Ground
14	I2C-SCL1		40	Rx4n	V-by-One HS Data Lane 4
15	Data Format 0	Data Format[1:0] (note5, Default: 00) 00:1-div, 01:2-div, 10:4-div, 11:8-div	41	Rx4p	V-by-One HS Data Lane 4
16	Data Format 1		42	GND	Ground
17	NC	No use	43	Rx5n	V-by-One HS Data Lane 5
18	I2C-SDA	I2C for Customer	44	Rx5p	V-by-One HS Data Lane 5
19	I2C-SCL		45	GND	Ground
20	EVDD Det	EVDD reset, Set ← Module	46	Rx6n	V-by-One HS Data Lane 6
21	NC	No Connection (Reserved)	47	Rx6p	V-by-One HS Data Lane 6
22	GND	AGP0 (note 6, Default GND)	48	GND	Ground
23	GND	AGP1 (note 6, Default GND)	49	Rx7n	V-by-One HS Data Lane 7
24	GND	Ground	50	Rx7p	V-by-One HS Data Lane 7
25	HTPDN	Hot plug detect	51	GND	Ground
26	LOCKN	Lock detect	-	-	-

Notes : 1. All GND (ground) pins should be connected together.

2. All Input levels of V-by-One signals are based on the V-by-One HS Standard.

3. Specific pin No. #10 is used for compensation when power turn off.

4. Specific pin No. #12 is used for "Power Error detection" of the OLED module.

5. Specific pins No. #15 and #16 are Vx1 Input Format. This module can support 1~8 division mode (Please see the Appendix VI for more information.)

6. Specific pins No. #22 and #23 are used for "No signal detection" of system signal interface.

It should be GND for NSB (No Signal Black) while the system interface signal is not.

If this #22 pin is "H", #23 pin is "GND", OLED module displays AGP (Auto Generation Pattern).

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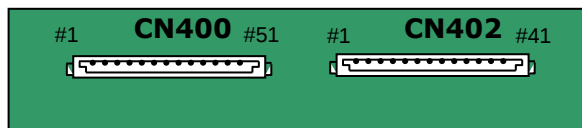
- Module Connector (CN402) : 05030WR-H41B5(Yeonho)
- Mating Connector : 05030WR-H41B5(Yeonho) compatible

Table 4. Module Connector(CN402) Pin Configuration

No	Symbol	Description	No	Symbol	Description
1	GND	Ground	22	GND	Ground
2	Rx8n	V-by-One HS Data Lane 8	23	Rx15n	V-by-One HS Data Lane 15
3	Rx8p	V-by-One HS Data Lane 8	24	Rx15p	V-by-One HS Data Lane 15
4	GND	Ground	25	GND	Ground
5	Rx9n	V-by-One HS Data Lane 9	26	NC	No Connection
6	Rx9p	V-by-One HS Data Lane 9	27	NC	No Connection
7	GND	Ground	28	NC	No Connection
8	Rx10n	V-by-One HS Data Lane 10	29	NC	No Connection
9	Rx10p	V-by-One HS Data Lane 10	30	NC	No Connection
10	GND	Ground	31	NC	No Connection
11	Rx11n	V-by-One HS Data Lane 11	32	NC	No Connection
12	Rx11p	V-by-One HS Data Lane 11	33	NC	No Connection
13	GND	Ground	34	NC	No Connection
14	Rx12n	V-by-One HS Data Lane 12	35	NC	No Connection
15	Rx12p	V-by-One HS Data Lane 12	36	NC	No Connection
16	GND	Ground	37	NC	No Connection
17	Rx13n	V-by-One HS Data Lane 13	38	NC	No Connection
18	Rx13p	V-by-One HS Data Lane 13	39	QSMEN	QSMEN (Set→Module)
19	GND	Ground	40	ON_RF	ON_RF_DONE (Set ← Module)
20	Rx14n	V-by-One HS Data Lane 14	41	NC	No Connection
21	Rx14p	V-by-One HS Data Lane 14	-		

- Notes :
1. All GND (ground) pins should be connected together.
 2. #26~#36 NC (No Connection) : These pins are used only for LGD (Do not connect)

◆ Rear view of OLED Module



< Top view of PCB >

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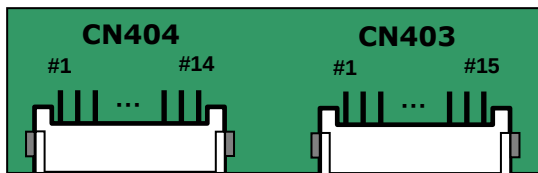
3-2-2. OLED Module (Powers)

- EVDD Connector(CN403) : 20022WR-H15B2(manufactured by Yeon Ho)
- Mating Connector : 20022HS-15B2(BK)(manufactured by Yeon Ho)
- VDD Connector(CN404) : 20022WR-H14B2(manufactured by Yeon Ho)
- Mating Connector : 20022HS-14B2(BK)(manufactured by Yeon Ho)

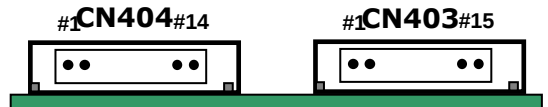
Table 5. EVDD / VDD Connector(CN403, CN404) Pin Configuration

No	Symbol	Description	No	Symbol	Description
1	EVSS	OLED Panel Ground	1	GND	Ground
2	EVSS	OLED Panel Ground	2	GND	Ground
3	EVSS	OLED Panel Ground	3	GND	Ground
4	EVSS	OLED Panel Ground	4	GND	Ground
5	EVSS	OLED Panel Ground	5	GND	Ground
6	EVSS	OLED Panel Ground	6	GND	Ground
7	EVSS	OLED Panel Ground	7	VDD	Power Supply +12V
8	EVDD	OLED Panel Power Supply +25.0V	8	VDD	Power Supply +12V
9	EVDD	OLED Panel Power Supply +25.0V	9	VDD	Power Supply +12V
10	EVDD	OLED Panel Power Supply +25.0V	10	VDD	Power Supply +12V
11	EVDD	OLED Panel Power Supply +25.0V	11	VDD	Power Supply +12V
12	EVDD	OLED Panel Power Supply +25.0V	12	VDD	Power Supply +12V
13	EVDD	OLED Panel Power Supply +25.0V	13	NC	No connection
14	EVDD	OLED Panel Power Supply +25.0V	14	NC	No connection
15	EVDD	OLED Panel Power Supply +25.0V			

◆ Rear view of OLED Module



< Top view of PCB >



< Side view of PCB >

Product Specification

3-3. Signal Timing Specifications

Table 6 shows the signal timing required at the input of the V-by-One transmitter. All of the interface signal timings should be satisfied with the following specification for normal operation.

Table 6. Timing Table(DE Only Mode)

ITEM		Symbol	Min	Typ	Max	Unit	Note
Horizontal	Display Period	t _{HV}	240	240	240	tCLK	3840 / 16
	Blank	t _{HB}	33	35	36	tCLK	1
			0.44	0.47	0.48	us	3
	Total	t _{HP}	273	275	276	tCLK	
Vertical	Display Period	t _{VV}	2160	2160	2160	Lines	
	Blank	t _{VB}	86 (492)	90 (540)	128 (700)	Lines	1
			311 (1820)	333 (1998)	476 (2601)	us	3
	Total	t _{VP}	2246 (2652)	2250 (2700)	2288 (2860)	Lines	
ITEM		Symbol	Min	Typ	Max	Unit	Note
Frequency	DCLK	f _{CLK}	74.00	74.25	74.50	MHz	1188 / 16
	Horizontal	f _H	268	270	272	KHz	1
	Vertical	f _V	118 (95)	120 (100)	121 (102)	Hz	2 NTSC (PAL)

- Note: 1. The input of HSYNC & VSYNC signal does not have an effect on normal operation (DE Only Mode).
 If you use spread spectrum of EMI, add some additional clock to minimum value for clock margin.
 2. The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rate and the horizontal frequency.
 3. If you change the DCLK, must satisfy the minimum horizontal & vertical blank time.

※ This OLED module supports Spread Spectrum Clocking tolerance with up to 30kHz/ ±0.5%
 ※ Timing should be set based on clock frequency.

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Table 6-2. Timing Table(Only Gaming mode : VRR Mode)

ITEM		Symbol	Min	Typ	Max	Unit	Note
Horizontal	Display Period	t _{HV}	240	240	240	tCLK	3840 / 16
	Blank	t _{HB}	33	35	36	tCLK	
	Total	t _{HP}	273	275	276	tCLK	
Vertical	Display Period	t _{VV}	2160	2160	2160	Lines	
	Blank	t _{VB}	86	90	4590	Lines	
	Total	t _{VP}	2246	2250	6750	Lines	
ITEM		Symbol	Min	Typ	Max	Unit	Note
Frequency	DCLK	f _{CLK}	74.00	74.25	74.50	MHz	1188 / 16
	Horizontal	f _H	268	270	272	KHz	
	Vertical	f _V	40	120	121	Hz	

Table 6-3. Timing Table(Only Gaming mode : VRR Mode)

ITEM		Symbol	Min	Typ	Max	Unit	Note
Horizontal	Display Period	t _{HV}	240	240	240	tCLK	3840 / 16
	Blank	t _{HB}	19	20	20	tCLK	
	Total	t _{HP}	259	260	260	tCLK	
Vertical	Display Period	t _{VV}	2160	2160	2160	Lines	
	Blank	t _{VB}	87	90	5964	Lines	
	Total	t _{VP}	2247	2250	8124	Lines	
ITEM		Symbol	Min	Typ	Max	Unit	Note
Frequency	DCLK	f _{CLK}	83.99	84.24	84.49	MHz	1347.84 / 16
	Horizontal	f _H	324	324	325.25	KHz	
	Vertical	f _V	40	144	144.7	Hz	

Note:

1. Only applicable to Gaming mode with VRR operation
2. The device could not work properly in case it is operated by VRR mode.
 - 1) This OLED module supports adaptive sync timing only under moving picture in room temperature(25 ± 5°C)
 - 2) It would not work usually under still image & reliability test.
 - 3) Under those condition, the phenomenon such as image sticking, flickering, flashing and dither noise in low gray could be found on the screen.

Product Specification

3-4. V by One Signal Specifications

3-4-1. V by One Eye Mask Specification

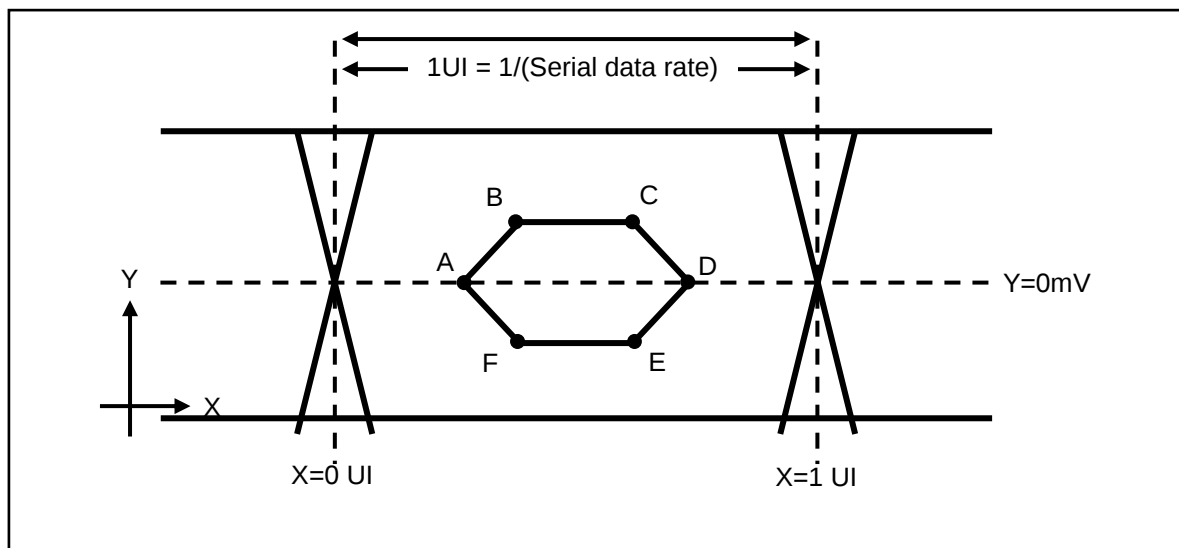


Table 7. Eye Mask Specification

	X [UI]	Note	Y [mV]	Note
A	0.25 (max)	2	0	-
B	0.30 (max)	2	50	3
C	0.70 (min)	3	50	3
D	0.75 (min)	3	0	-
E	0.70 (min)	3	-50	3
F	0.30 (max)	2	-50	3

Notes : 1.1 All Input levels of V-by-One signals are based on the V by One HS Standard.

1.2 When using the Tx's Pre-Emphasis function to be set to a minimum value that meets the EYE mask spec.

2. This is allowable maximum value.

3. This is allowable minimum value.

4. The eye diagram is measured by the oscilloscope and receiver CDR characteristic must be emulated.

- PLL type : 2nd Order

- DC Gain : 1.5056

- Zero[GHz] : 0.63

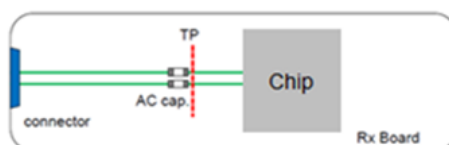
- Pole1[GHz] : 2.55

- Pole2[GHz] : 3.35

- Loop Band Width : 10

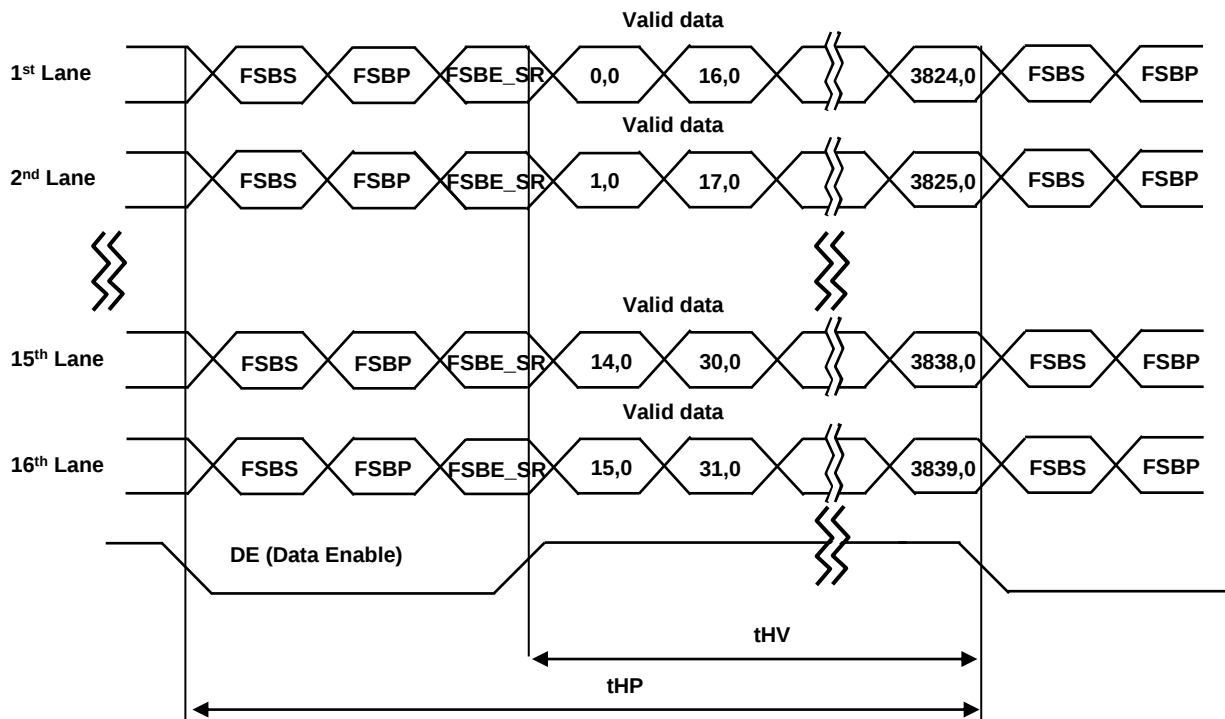
- Damping Factor : 2

5. EYE mask measuring point



Product Specification

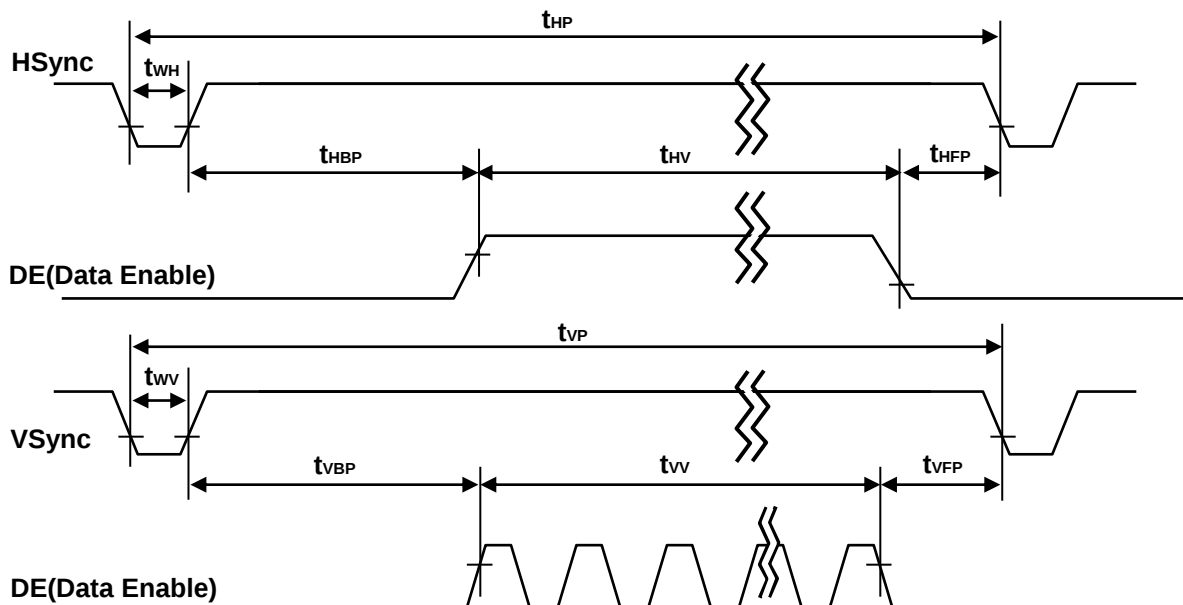
3-4-2. V by One Input Signal Timing Diagram



* Reference: Sync. Relation

$$* t_{HB} = t_{HFP} + t_{WH} + t_{HBP}$$

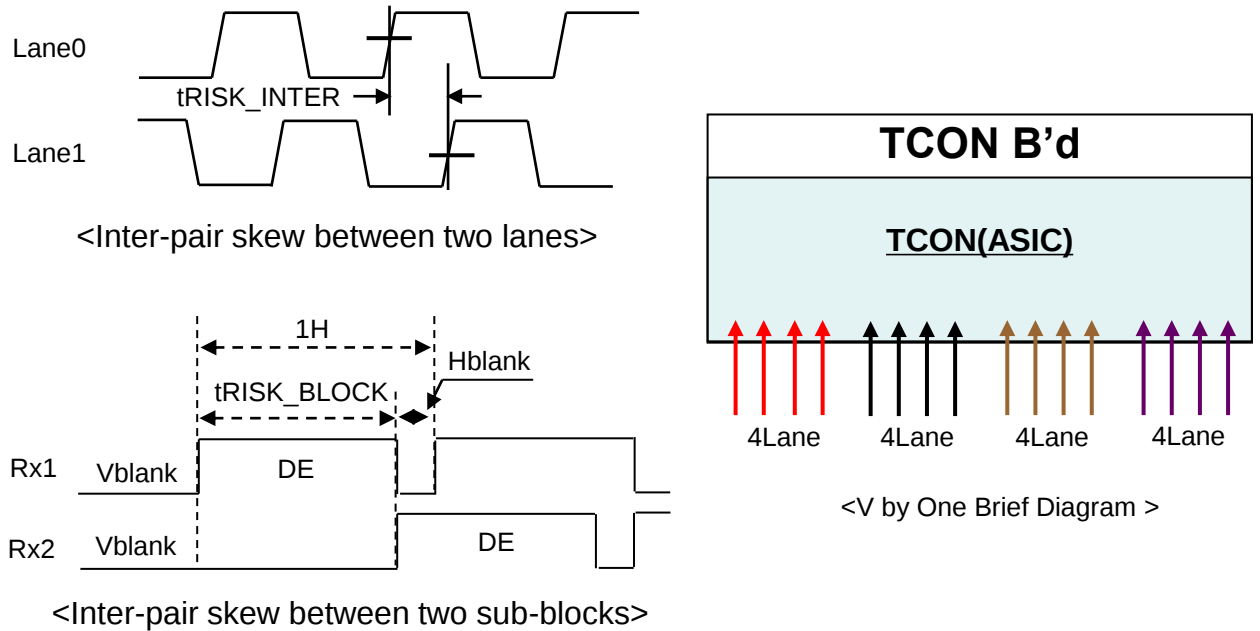
$$* t_{VB} = t_{VFP} + t_{WV} + t_{VBP}$$



Product Specification

3-4-3. V by One Input Signal Characteristics

1) AC Specification



Description	Symbol	Min	Max	Unit	Note
Allowable inter-pair skew between lanes	tRISK_INTER	-	5	UI	1, 3
Allowable inter-pair skew between sub-blocks	tRISK_BLOCK	-	1	DE	1, 4

Notes: 1. $1UI = 1/\text{serial data rate}$

2. it is the time difference between the true and complementary single-ended signals.

3. it is the time difference of the differential voltage between any two lanes in one sub block.

4. it is the time difference of the differential voltage between any two blocks in one IP.

5. APL packet of Vx1 Input

5-1) APL data transmission should be completed between after 5H from frame last DE falling and 10H before next frame DE rising.

5-2) APL data transmission should be inputted only one time during V blank period.

Product Specification

3-5. Color Data Reference

The brightness of each primary color (red, green, blue) is based on the 10bit gray scale data input for the color. The higher binary input, the brighter the color. Table 8. provides a reference for color versus data Input.

Table 8. Color Data Reference

Packer input & Unpacker output		30bpp RGB (10bit)
Byte0	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]
Byte1	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]
Byte2	D[16]	B[2]
	D[17]	B[3]
	D[18]	B[4]
	D[19]	B[5]
	D[20]	B[6]
	D[21]	B[7]
	D[22]	B[8]
	D[23]	B[9]
Byte3	D[24]	Don't care
	D[25]	Don't care
	D[26]	B[0]
	D[27]	B[1]
	D[28]	G[0]
	D[29]	G[1]
	D[30]	R[0]
	D[31]	R[1]

Notes 1. 30bpp RGB (10bit) is 4 byte mode.

Product Specification

3-6. Power Sequence

3-6-1. OLED Driving Circuit

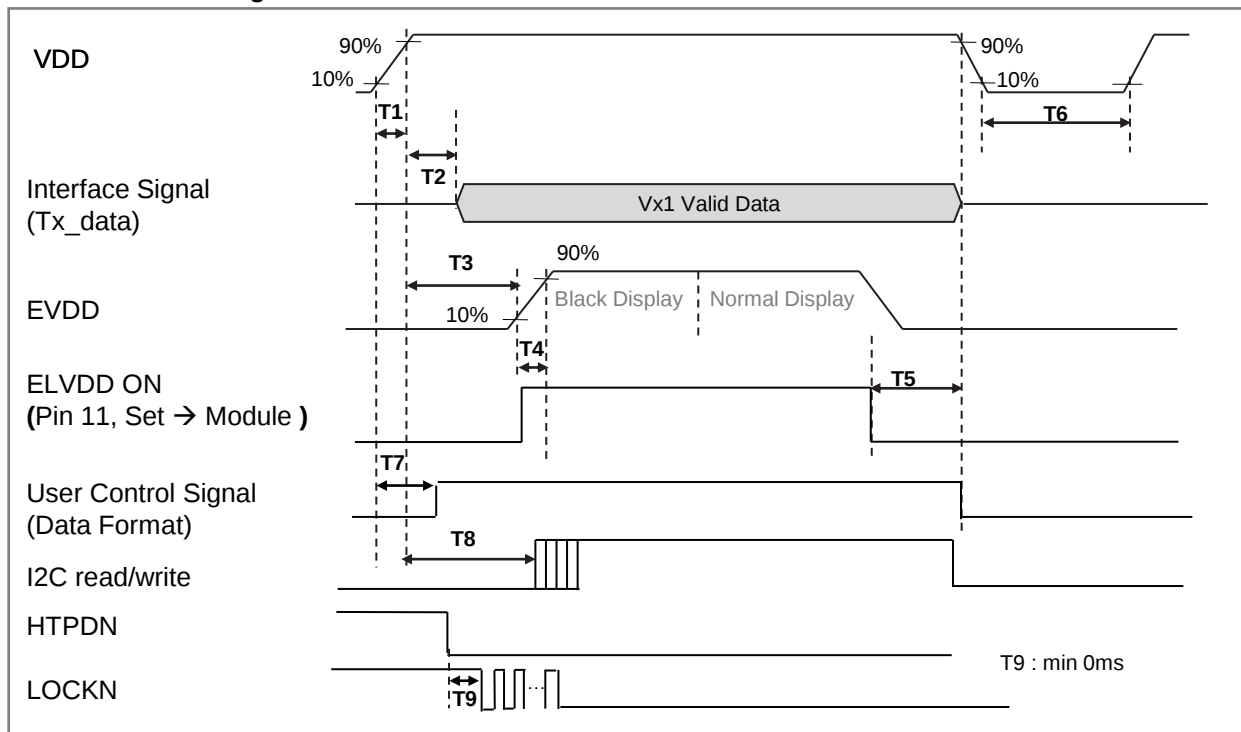


Table 9. Power Sequence

Parameter	Value			Unit	Notes
	Min	Typ	Max		
T1	1	-	20	ms	
T2	58	-	-	ms	
T3	0.54	-	-	sec	1
T4	5	-	50	ms	
T5	30	-	-	ms	
T6	1.5	-	-	sec	2
T7	0	-	T1+T2	ms	3
T8	600	-	-	ms	4

- Note :
- The T3 is recommended value, the case when failed to meet a minimum specification, abnormal display would be shown. There is no reliability problem. T3 should be larger than T2.
 - T6 should be measured after the module has been fully discharge between power off and on period.
 - If the on time of signals (Interface signal and user control signals) precedes the on time of Power(VDD) it will be happened abnormal display. When T7 is NC status, T7 doesn't need to be measured
 - I2C is able to be accessed from 600ms after VDD 90% rising
 - Before the power for logic (VDD) turns on, JB&Off-RS Done , Error Detection, I2C, Data Format, AC_DET, EVDD DET signals should be less than 0.8V.
- ※ Black pattern is displayed during black display period before normal display. (ON RF Time 2.7s)
- ※ When the power for logic (VDD) turns off , EVDD should be less than 5V.
- But, it does not matter if there is no garbage image.

Product Specification

3-6-2. OFF RS Compensation Operation

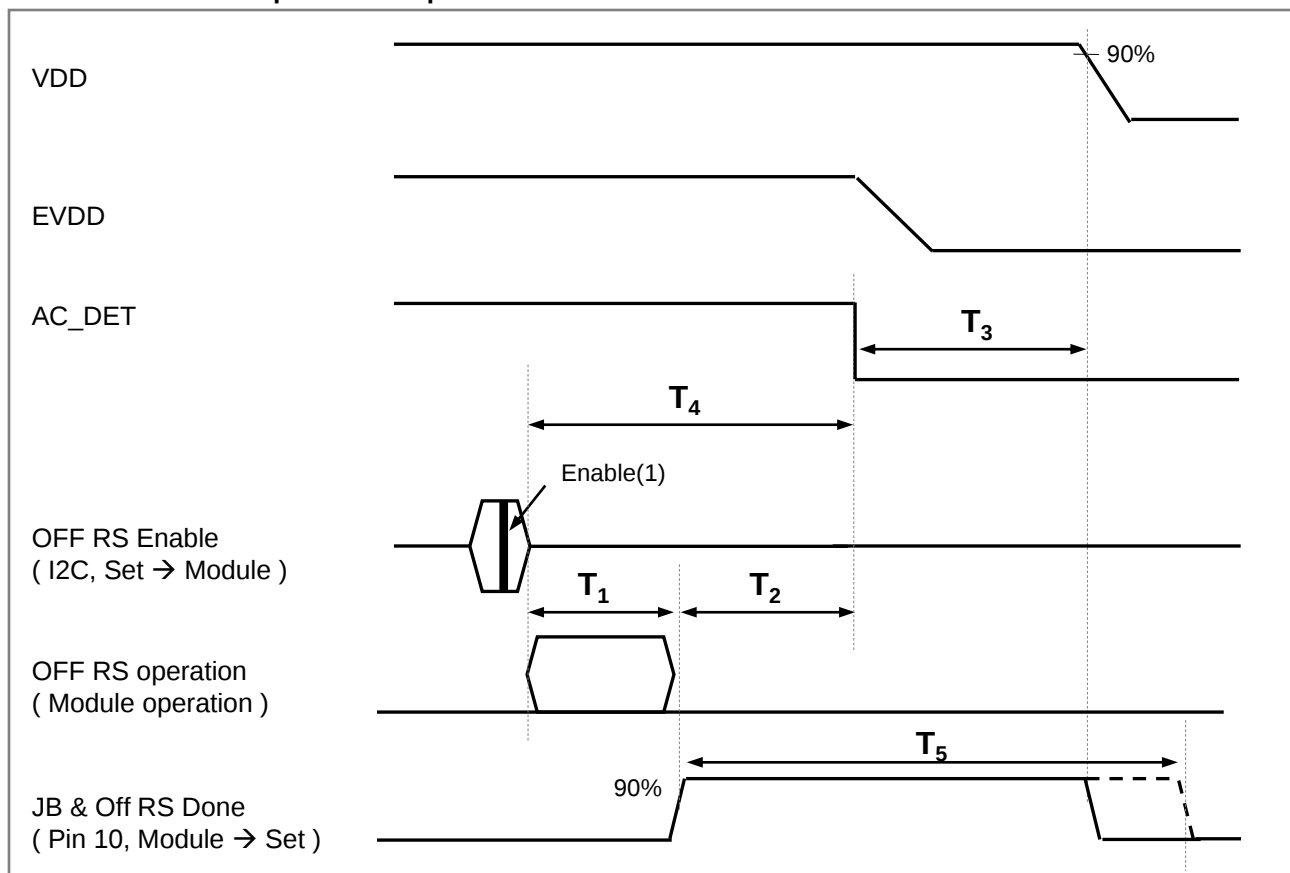


Table 10. Off-RS Power Sequence

Parameter	Value			Unit	Notes
	Min	Typ	Max		
T1	310	-	370	sec	1
T2	0	-	10	sec	
T3	30	-	-	ms	
T4	310	-	380	sec	2-1
	380	-	500	sec	2-2
T5	0.5	7	10	sec	

Note : 1. It is the actual RS sensing time. This timing is determined according to the characteristics of the panel.
(LGD Internal timing)

2-1. When Off-RS Done Signal is transferred normally.

2-2. When Off-RS Done Signal is not transferred.

※ When there is power on action before completing OFF RS operation, don't change OFF RS enable signal (1→0). Just do power off and power on.

※ Off RS Enable is only available during Normal Display period.

※ In order to prevent mura defects, it is recommended that customer do Off-RS in their lines.

※ When the power for logic (VDD) turns off, EVDD should be less than 5V.

But, it does not matter if there is no garbage image.

Product Specification

3-6-3. JB compensation operation

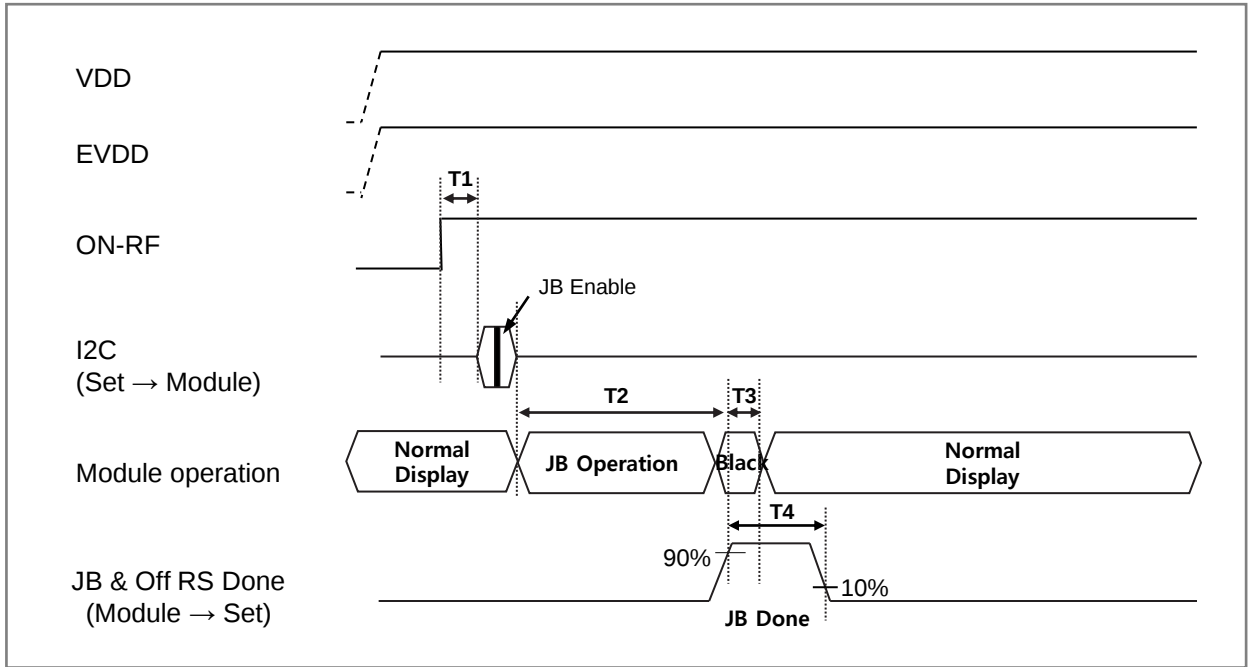


Table 11. JB Power Sequence

Parameter	Value			Unit	Notes
	Min	Typ	Max		
T1	200	-	-	ms	
T2	-	-	21	sec	
T3	150	-	508.0	ms	Black PTN
T4	0.5	7	10	sec	

Note : ※ At VRR mode, T3 can change by adaptive sync timing(T3 need 19 frame) (VRR Only)

※ T3 can change by adaptive sync timing(T3 need 19 frame) (VRR only)

※ T2 is the actual JB sensing time. This timing is determined according to the characteristics of the panel.
(LGD Internal timing)

Product Specification

3-6-4. QSM Operation

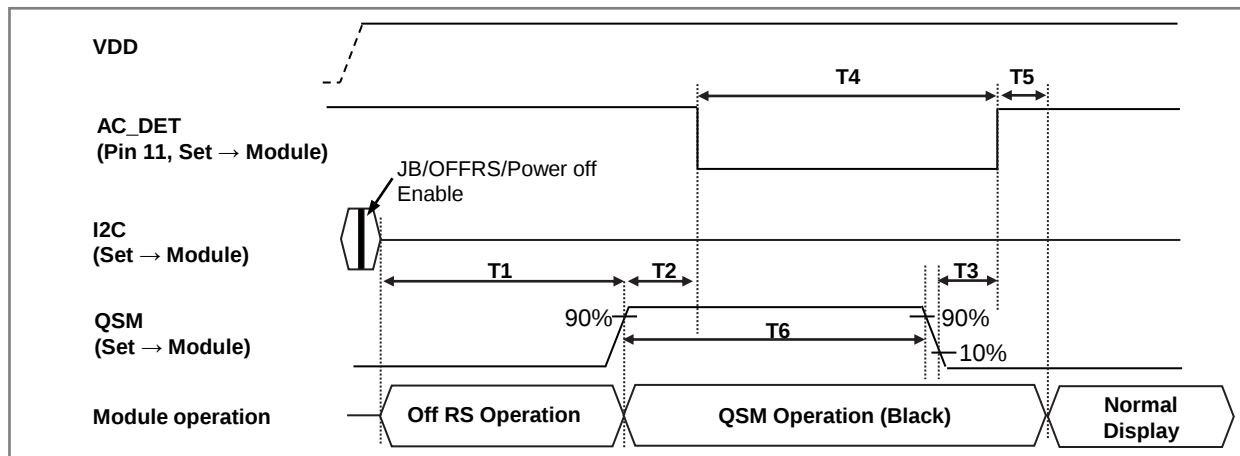


Table 12. QSM Sequence

Parameter	Value			Unit	Notes
	Min	Typ	Max		
T1	1	-	-	Sec	
T2	75	-	-	ms	Note
T3	10	-	-	ms	Note
T4	1	-	-	sec	
T5	-	-	500	ms	
T6	3	-	-	sec	

Note : ※ QSM EN pulse width should be more than 1s.

※ QSM EN & AC_DET sequence should meet following order.

(QSM Rising → AC SET Falling → QSM Falling → AC DET Rising)

Product Specification

3-6-5. Power off sequence

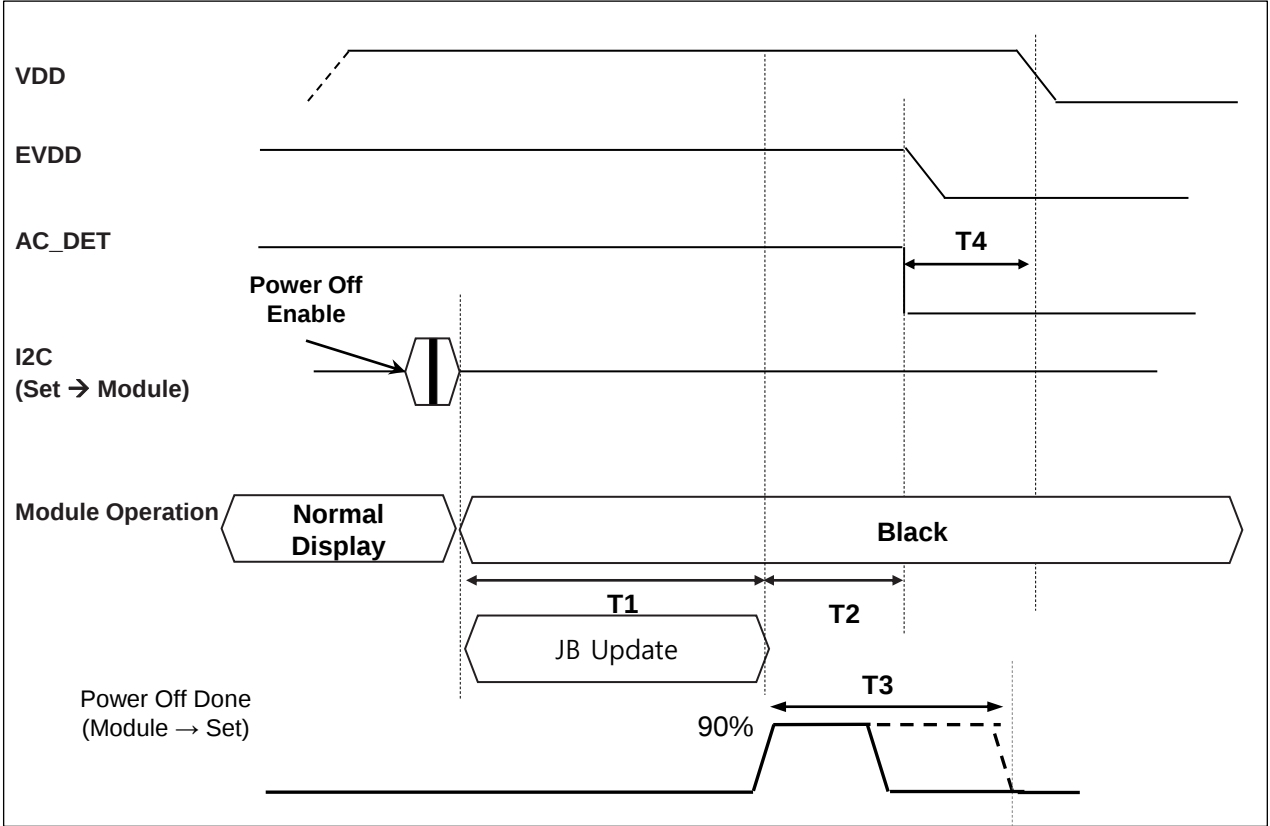


Table 8. POWER SEQUENCE

Parameter	Value			Unit	Notes
	Min	Typ	Max		
T1	-	-	16.5	sec	
T2	30	-	-	ms	
T3	5	7	10	sec	
T4	30	-	-	ms	

Product Specification

4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable in a dark environment at $25\pm 2^{\circ}\text{C}$. The values are specified at distance 50cm from the OLED surface at a viewing angle of Φ and θ equal to 0° . FIG. 1 shows additional information concerning the measurement equipment and method.

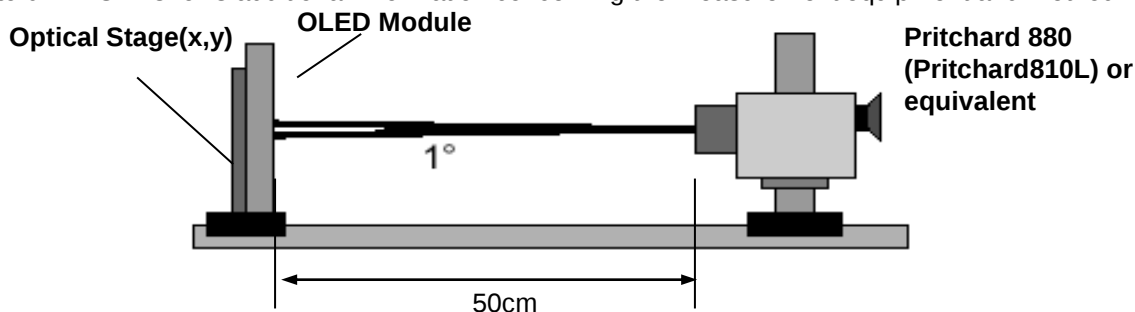


FIG. 1 Optical Characteristic Measurement Equipment and Method

Table 14. Optical Characteristics

$T_a = 25\pm 2^{\circ}\text{C}$, $V_{DD}=12\text{V}$, $EV_{DD}=25.0\text{V}$, $f_v=120\text{Hz}$, $D_{clk}=74.25\text{MHz}$

Parameter		Symbol		Value			Unit	Note	
				Min	Typ	Max			
Contrast Ratio		CR @ Pritchard 880		280,000	350,000	-		1	
		CR @ Pritchard 810L (25% APL)		2,640,000	3,300,000	-			
Surface Luminance, white		L _{WH}	2D	Normal	280	350	-	cd/m²	2
				Peak	800	1000	-		
				HDR 10%	1760	2200	-		
				HDR 3%	2320	2900	-		
Luminance Uniformity		δ _{WHITE}	9P	75	85		%	3	
Response Time	Gray-to-Gray	G to G		-	0.1	0.5	ms	4	
	MPRT	MPRT		-	6	12	ms	5	
Color Coordinates [CIE1931]	RED	Rx		Typ -0.02	0.691	Typ +0.02			
		Ry			0.308				
	GREEN	Gx			0.248				
		Gy			0.704				
	BLUE	Bx			0.150				
		By			0.046				
	WHITE	Wx		Typ -0.015	0.281	Typ +0.015			
		Wy			0.288				
Color Temperature					10,000		K		
Color Gamut (DCI)				94.0	99.5		%		
Color Viewing Angle	θ=60° φ=0°,90°,180°,270°	Δu'v			0.015	0.025	Degree	6	
Life Time (B ₍₁₀₎)		Hrs		30,000				7	
Gray Scale				-	2.2	-		8	

Product Specification

Note : 1. Contrast Ratio(CR) is defined mathematically as :

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

It is measured at center 1-point.

2. Normal full white luminance is determined with 100% APL after 30 minutes 'ON' with APL 100%(Full white) pattern in a dark environment at $25 \pm 2^{\circ}\text{C}$. It is the luminance value at center 1-point across the OLED surface 50cm from the surface with all pixels displaying white. For additional measurement, OLED module need to power-off for 2 minutes(min). Peak luminance is determined with 25% APL after 1.5 minutes at least 'ON' with 25% white window box. HDR luminance is determined with 10% APL after 60 seconds at least 'ON' with 10% white window box. For more information, see FIG 2.

※ Normal : APL 100% (Full white) / Peak : APL 25% / HDR : APL 10% / HDR : APL 3%

Flash peak : refer to the guide within Appendix XIV.

HDR Luminance should only be applied when entering HDR Contents

3. The variation in surface luminance , δ WHITE is defined as :

$$\delta \text{ WHITE}(9\text{P}) = \text{Minimum}(L_{\text{on}1}, \dots, L_{\text{on}9}) / \text{Maximum}(L_{\text{on}1}, \dots, L_{\text{on}9})$$

Where $L_{\text{on}1}$ to $L_{\text{on}9}$ are the luminance with all pixels displaying white at 9 locations .

For more information, see the FIG. 2.

4. Response time is the time required for the display to transit from G(N) to G(M) (Rise Time, Tr_R) and from G(M) to G(N) (Decay Time, Tr_D). For additional information, see the FIG. 3. ($N < M$)

※ G to G Spec stands for average value of all measured points.

※ Test equipment : PR-810, Test Distance : Display Height * 0.35

Measuring Field : 1° , Test Pattern : APL10% Window Box

5. MPRT is defined as the 10% to 90% blur-edge width B_{ij} (pixels) and scroll speed U (pixels/frame)at the moving picture. For more information, see FIG 4.

6. Viewing Angle Color Shift (VACS) is defined as follows after measuring color coordinates at each angle.; $\text{VACS} = \sqrt{du^2 + dv^2}$ (@ CIE (u' , v') color space) For more information, see the FIG. 5.

7. Test Condition : IEC62087 standard video with OFF-RS every 4 hours at room temperature 25°C (If the cumulative time of usage is over 4 hours, OFF-RS compensation should be performed.)

8. Gray scale specification.

Gamma Value is approximately 2.2. For more information, see the Table 15.

Table 15. Gray Scale Specification

Gray Level	Luminance [%] (Typ)
L0	0.001
L63	0.20
L127	0.97
L191	2.42
L255	4.61
L319	7.59
L383	11.4
L447	16.0
L511	21.6
L575	28.0
L639	35.4
L703	43.7
L767	53.0
L831	63.2
L895	74.5
L959	86.7
L1023	100

Product Specification

Measuring point for surface luminance & measuring point for luminance variation.

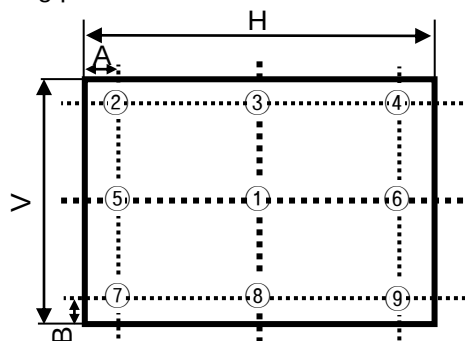


FIG. 2-1 9 Points for Luminance Measure with 100% APL

A: $H/9$ B: $V/9$ @ H,V: Active Area

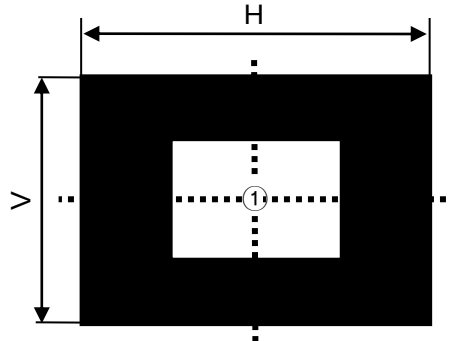


FIG. 2-2. 1 Point for peak luminance measure with 25% APL

@ H,V: Active Area

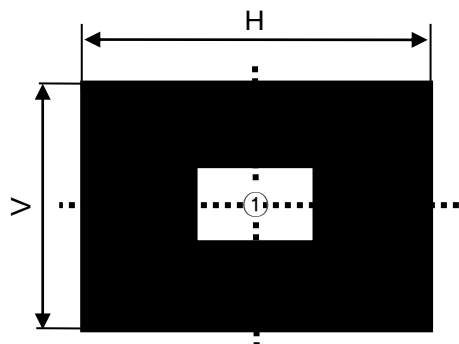


FIG. 2-3. 1 Point for peak luminance measure with 10% APL

@ H,V: Active Area

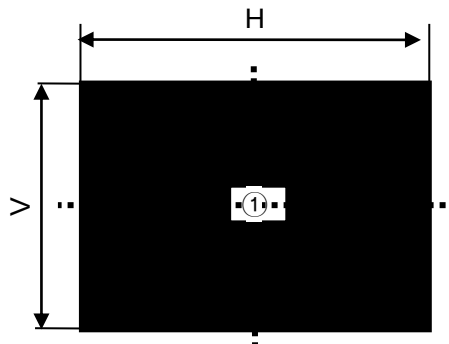


FIG. 2-4. 1 Point for peak luminance measure with 3% APL

@ H,V: Active Area

Response time is defined as the following figure and shall be measured by switching the input signal for "Gray(N)" and "Gray(M)".

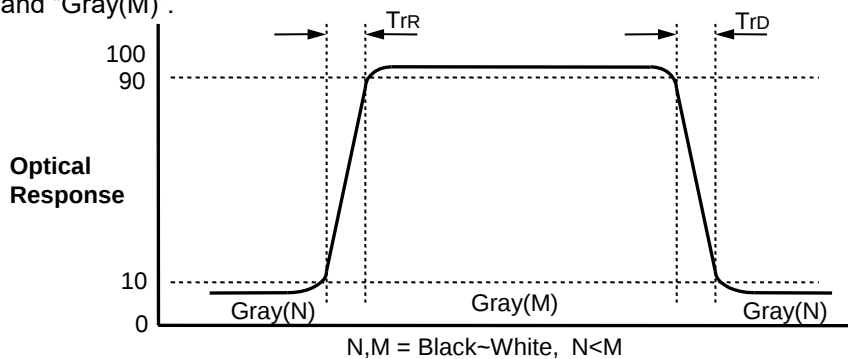


FIG. 3 Response Time

Product Specification

MPRT is defined as the 10% to 90% blur-edge with B_{ij} (pixels) and scroll speed U (pixels/frame)at the moving picture.

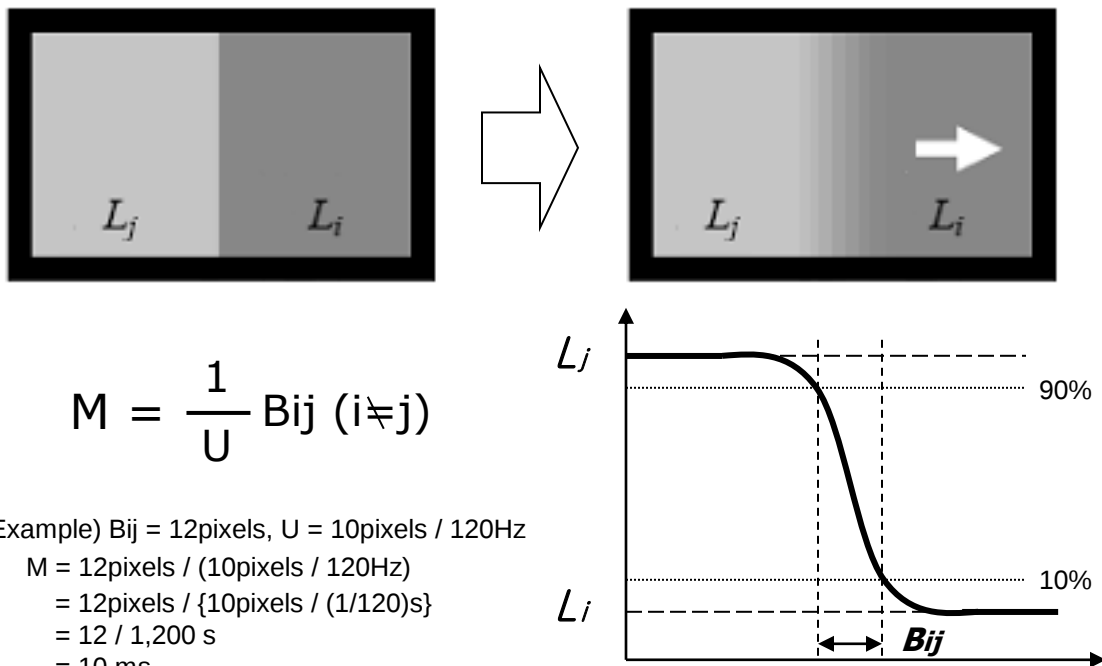


FIG. 4 MPRT

Dimension of viewing angle range

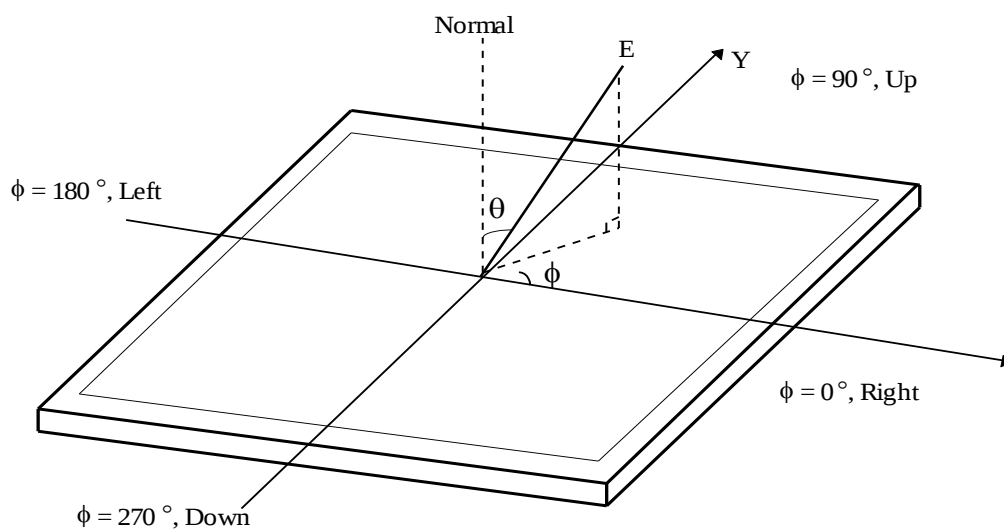


FIG. 5 Viewing Angle

Product Specification

5. Mechanical Characteristics

Table 16 provides general mechanical characteristics.

Table 16. Mechanical Characteristics

Item	Value	
Outline Dimension (Sealing Board Ass'y)	Horizontal	1437.88 mm
	Vertical	817.82 mm
	Thickness (at slimmest part)	0.79 mm
Active Display Area	Horizontal	1428.48 mm
	Vertical	803.52 mm
Weight	2.8 kg (Typ., Board Ass'y only)	

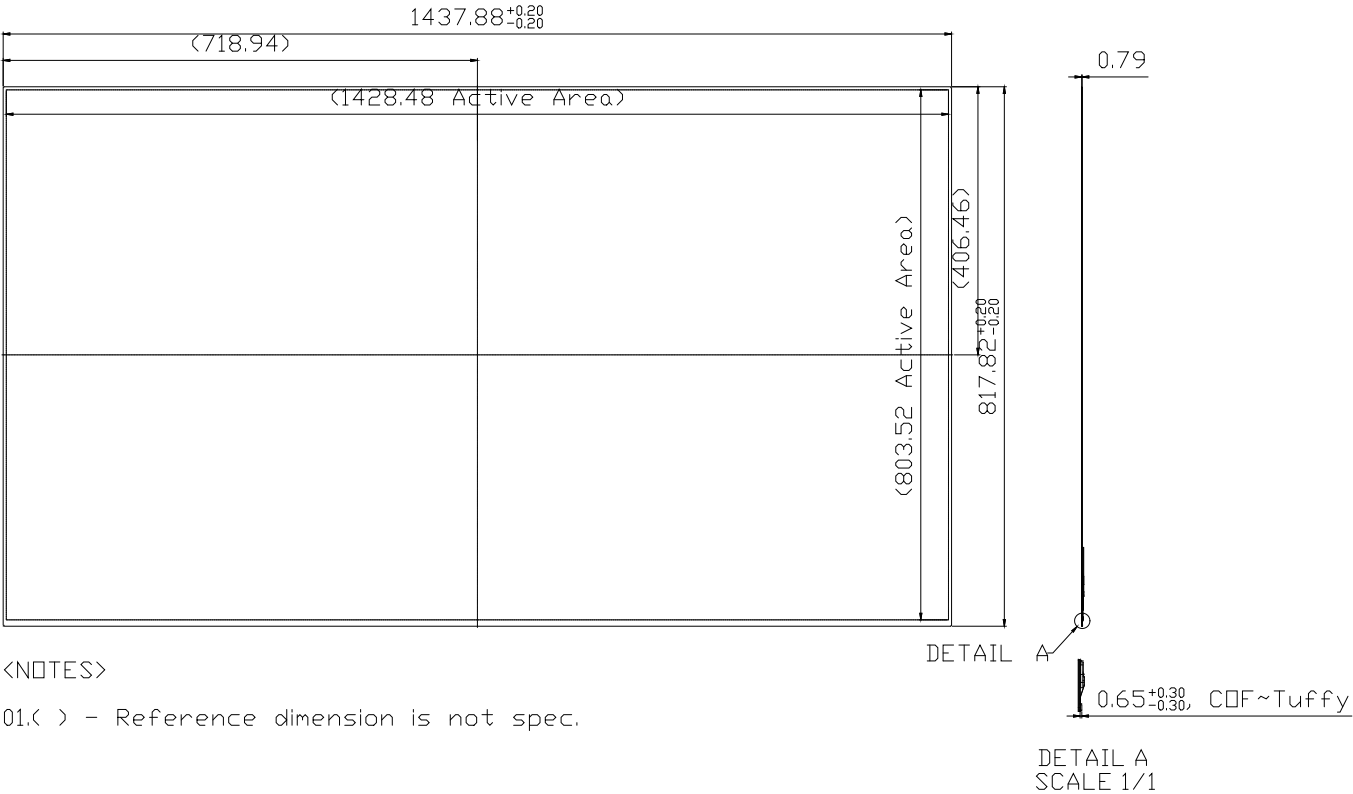
Note : Please refer to a mechanical drawing in terms of tolerance at the next page.

Table 17. Mechanical Characteristics

Item	Value	
On Bezel (Active Area ~ Edge of Sealing Board Ass'y)	Horizontal	4.70mm (Left) / 4.70mm (Right)
	Vertical	4.70mm (Top) / 9.60mm (Bottom)

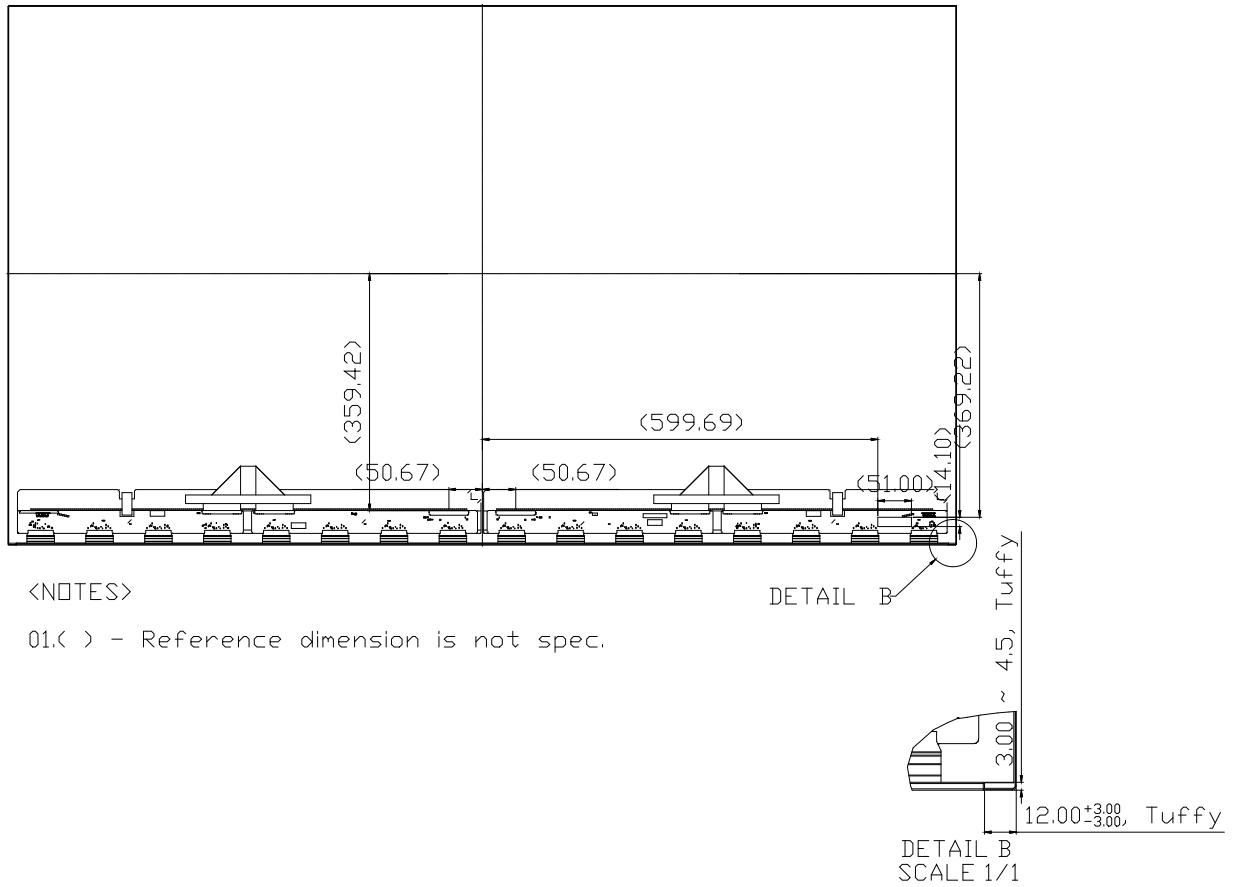
Product Specification

[FRONT VIEW]



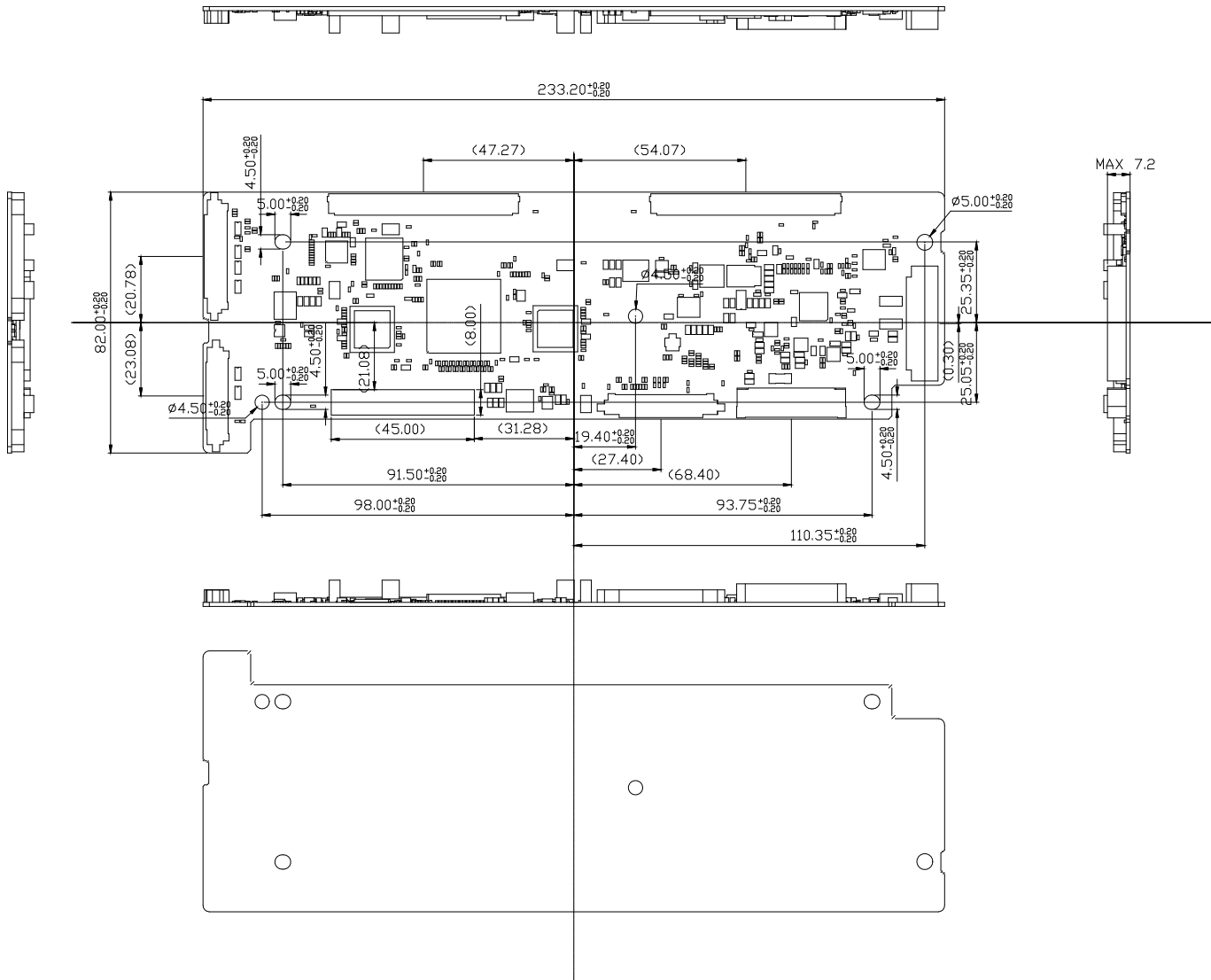
Product Specification

[REAR VIEW]



Product Specification

[C-PCB VIEW]



<NOTES>

01. () - Reference dimension is not spec.

Product Specification

6. Reliability

Table 18. Environment Test Condition

No.	Test Item	Condition
1	High temperature storage test	Ta= 60°C 240h
2	Low temperature storage test	Ta= -20°C 240h
3	High temperature operation test	Ta= 50°C 50%RH 240h
4	Low temperature operation test	Ta= 0°C 240h
5	Pallet packing vibration test (non-operating)	Wave form : random Vibration level : 2.0Grms Bandwidth : 3-300Hz Duration : Z, 60min
6	Humidity condition Operation	Ta= 40 °C, 90%RH
7	Altitude operating storage / shipment	0 - 15,000 ft 0 - 40,000 ft

Note : 1. Before and after Reliability test, OLED Module should be operated with normal function.

7. International Standards

7-1. Safety

(1) IEC 62368-1, The International Electro-technical Commission (IEC).

Audio/video, Information and Communication Technology Equipment - Safety - Safety Requirements.

(2) EN 62368-1, European Committee for Electro-technical Standardization (CENELEC)

Audio/video, Information and Communication Technology Equipment - Safety Requirements

(3) UL 62368-1, UL LLC.

Audio/video, Information and Communication Technology Equipment - Safety Requirements.

(4) CAN/CSA C22.2 No.62368-1, Canadian Standards Association (CSA).

Audio/video, Information and Communication Technology Equipment - Safety Requirements

(5) IEC 60065, The International Electro-technical Commission (IEC).

Audio, Video and Similar Electronic Apparatus - Safety Requirements

7-2. Environment

(1) RoHS, Commission Delegated Directive (EU) 2015/863 of 31 March 2015 amending Annex II to Directive 2011/65/EU of the European Parliament and of the Council

Product Specification

8. Packing**8-1. Information of OLED Board Ass'y Label**

(1) Lot Mark

A	B	C	D	E	F	G	H	I	J	K	L	M
---	---	---	---	---	---	---	---	---	---	---	---	---

A,B,C : SIZE(INCH)

E : MONTH

D : YEAR

F ~ M : SERIAL NO.

Note

1. YEAR

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Mark	K	L	M	N	P	Q	R	S	T	U	V

2. MONTH

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Spe	Oct	Nov	Dec
Mark	1	2	3	4	5	6	7	8	9	A	B	C

(2) Location of Lot Mark

Serial NO. is printed on the label. The label is attached to the backside of the OLED module.
This is subject to change without prior notice.

8-2. Packing Form

(1) Package quantity in one Pallet : 90 pcs

(2) Pallet Size : 1700 mm(W) X 1140 mm(D) X 1179 mm(H)

Product Specification

9. Precautions

Please pay attention to the followings when you use this OLED Board Assembly.

9-1. Operating Precautions

- (1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage :
 $V = \pm 200\text{mV}$ (Over and under shoot voltage)
- (2) Response time depends on the temperature. (In lower temperature, it becomes longer.)
- (3) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- (4) When fixed patterns are displayed for a long time, Image Retention is likely to occur.
 - If the fixed image remains stationary, it is recommended to apply luminance reduction or screen protection function to the set to prevent from image sticking
 - Please contact us in advance if you plan to use the display with the same pattern for an extended period of time
- (5) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimized the interference.
- (6) Please do not give any mechanical and/or acoustical impact to Module. Otherwise, Module can't be operated its full characteristics perfectly.
- (7) A screw which is fastened up the steels should be a machine screw.
 (if not, it can causes conductive particles and deal Module a fatal blow)
- (8) Please do not set OLED on its edge.
- (9) If system antenna (Wifi) is overlapped with source PCB and FFC, It might be cause the noise.

9-2. Electrostatic Discharge Control

Since a Board Assembly is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

9-3. Precautions for Strong Light Exposure

Strong light exposure causes degradation of polarizer and color filter.

9-4. Storage Precautions

When storing modules as spares for a long time, the following precautions are necessary.

Storage conditions for packing

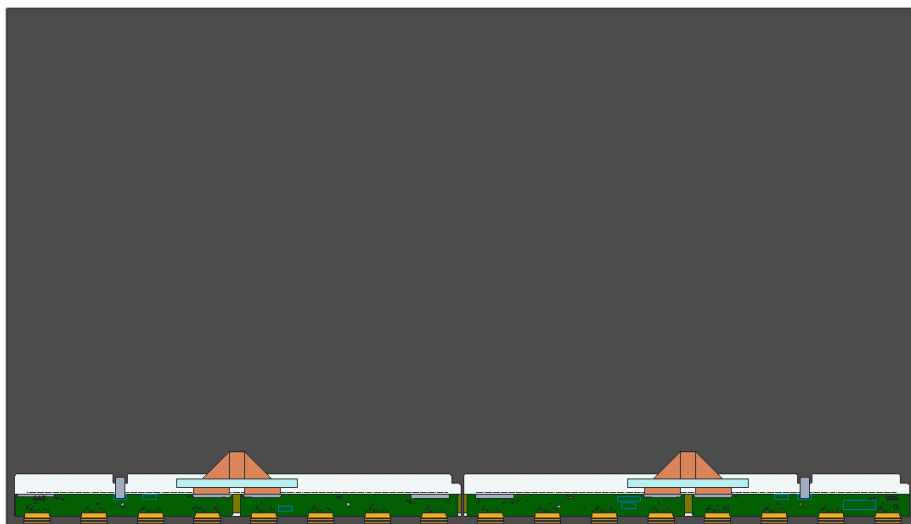
	Temperature	Humidity	Period
Storage conditions	5~35°C	35~75%	12 months

- (1) It is recommended to store in an environment equipped with a dark and air conditioning / ventilation system and a room in controlling specific condition.
- (2) It must be stored in a space composed of general air atmosphere.
- (3) Do not expose the module to sunlight or fluorescent light.
- (4) The contact with humid spaces, rainy environments, high humid atmosphere, moisture and condensation within package is not recommended.
- (5) Storing products in outside environment and out door is not recommended.
- (6) If products are stored in specified conditions over more than 3 months, it is recommended to check the product packaging condition.

Product Specification

9-5. Handling Precautions

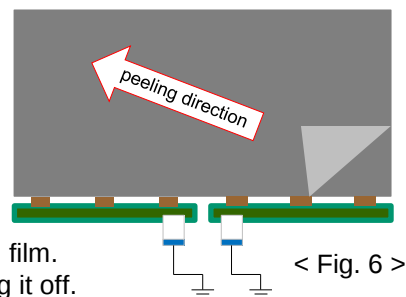
- (1) The protection film is attached to the bezel with a small masking tape.
When the protection film is peeled off, static electricity is generated between the film and polarizer.
This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
- (2) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the bezel after the protection film is peeled off.
- (3) The Encap Metal surfaces(Rear of Board Assembly) should not be any residual moisture & Salinity.
 - Always handle the Board Assembly with gloves.
 - Chlorine or water from human sweat can accelerate the corrosion of metal encapsulation
 - Encap Metal surface should be protected by the moisture, salinity
- (4) You can remove the glue easily. When the glue remains on the bezel surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.
Using a dry towel or fabric, remove water or solution like a cleaner from Board Assembly after finishing the install
 - Do not use the cleaner containing acid or chlorine ingredient
- (5) Be careful that the washing droplet is not flooded into the border gap on the panel edge, when cleaning the surface of OLED Module. It may cause abnormal operating or a malfunction in the OLED Module.
- (6) When the OLED Module is assembled, mechanical stress may not be put on the panel.
- (7) Be careful not to place any extra mechanical stress to the OLED module when designing the set.
- (8) Be cautious not to any extra strong force (mechanical shock, strong tapping, shooting etc.) to the OLED module. It may cause abnormal operating or a malfunction in the OLED Module.
- (9) If the panel is broken, glass should be kept away from the eyes and mouth. When it comes to contact to hands, legs, skin, or clothes, wash thoroughly with soap, and seek medical attention if necessary.
- (10) Surface temperature of the Component on PCB should be controlled under 100°C with TV Set status.
If not, problems such as IC damage or decrease of lifetime could occur.



[Rear of Board Assembly]

9-6. Protection Film

- (1) Please don't remove the protection film before assembly.
- (2) Please peel off the protection film slowly.
- (3) Please peel off the protection film just like shown in the Fig.6
- (4) Ionized air should be blown over during the peeling.
- (5) Source PCB should be connected to the ground when peel off the protection film.
- (6) The protection film should not be contacted to the source D-IC during peeling it off.
- (7) When handling the polarizer, in particular, please be aware of the following precautions.
 - Please do not damage on the edge of the polarizer in any form.
 - Peeling off the protection film must be done only with the adhesive tape, not with other means by fingers, tweezers and so on.
 - It is recommended to peel off the protection film as slowly as possible at an initial step.
 - Refer to Appendix – XI for more details



< Fig. 6 >

9-7. B/A Box Pretreatment Precautions

In winter season , in particular, please be aware of the following precautions.

- (1) Before putting B/A boxes on the line, aging process is required to make the temperature of products similar to the temperature of workplace.
- (2) Place the lid open on the B/A box and allowed to stand for 24 hours in the similar environment of work place. It was shown in Fig.7



< Fig. 7 >

9-8. Packing Precautions

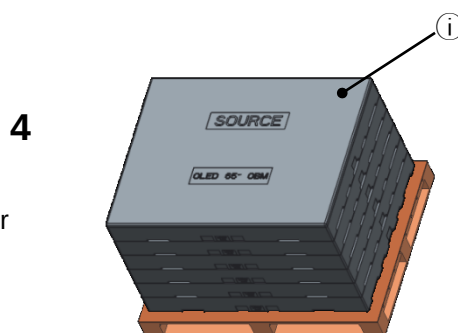
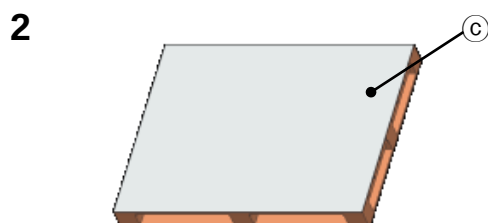
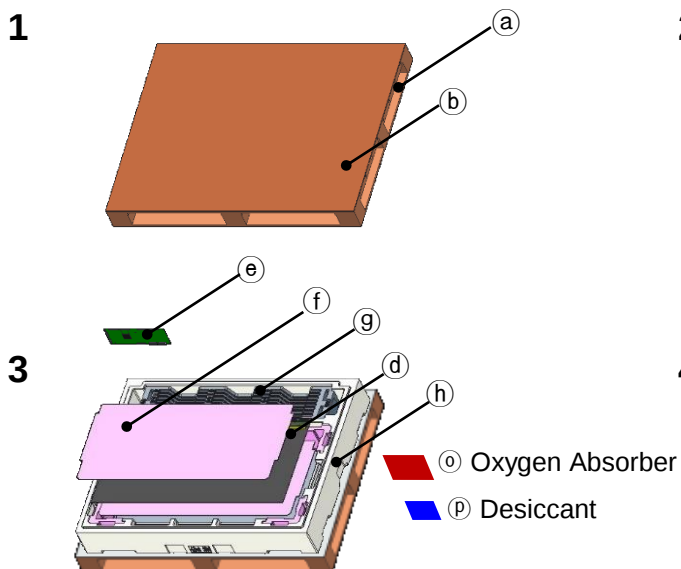
Product assembled into module should be stored in the Al-bag(cover case).

Product Specification

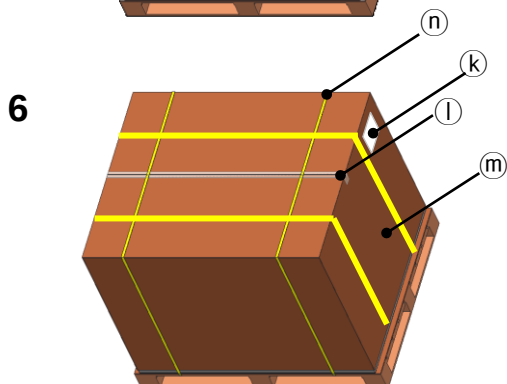
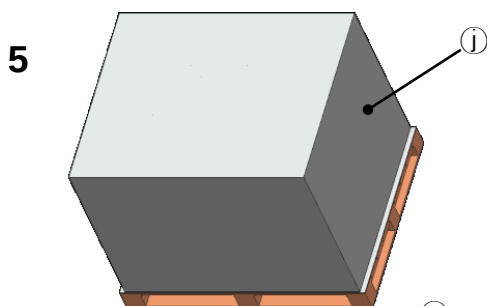
APPENDIX - I

■ Pallet Ass'y

- a) B/Ass'y Qty + PE Sheet / Box : 15pcs + 16pcs
- b) B/Ass'y Qty / Pallet : 90pcs
- c) Oxygen Absorber + Desiccant / Box : 5ea + 10ea
- d) Oxygen Absorber + Desiccant / Pallet : 30ea + 60ea
- e) Box Qty / Pallet : 6Box



*The position and quantity of Oxygen Absorber& desiccant can be changed



No.	Description	Material
(a)	Pallet	Plywood
(b)	Carton Plate	Paper(SW)
(c)	AL Sheet	AL
(d)	Board Ass'y	-
(e)	Include TCON 1ea	-
(f)	PE Sheet	LDPE
(g)	C-PCB Packing	PP
(h)	Bottom Packing	EPS
	AL-Sheet	LDPE+AL
(i)	Top Packing	EPS
(j)	AL Bag	AL
(k)	Label	PTE
(l)	Tape	OPP
(m)	Angle Packing	Paper(SW)
(n)	Band	PP
(o)	Oxygen Absorber	
(p)	Desiccant	

Product Specification

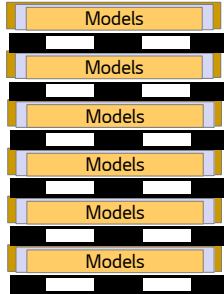
APPENDIX – I-2

■ Non Full Pallet Packing

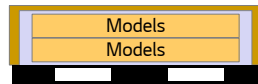
① 1Box Per Pallet



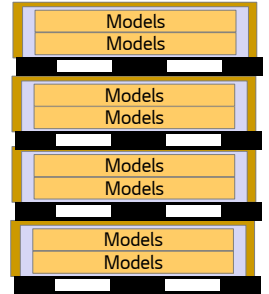
Load up to 6 Stacks



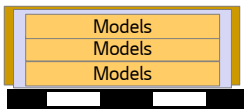
② 2Box Per Pallet



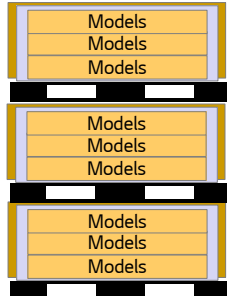
Load up to 4 Stacks



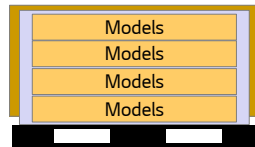
③ 3Box Per Pallet



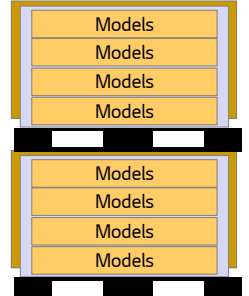
Load up to 3 Stacks



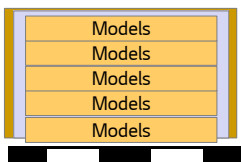
④ 4Box Per Pallet



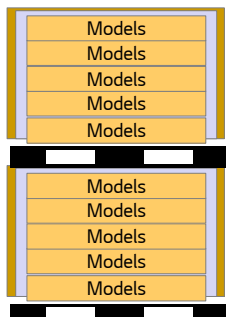
Load up to 2 Stacks



⑤ 5Box Per Pallet



Load up to 2 Stacks



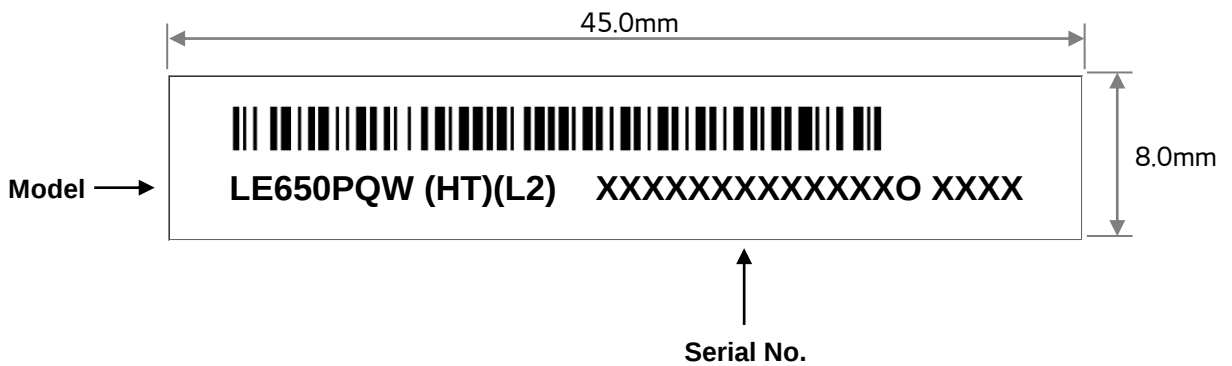
Product Specification

APPENDIX - II

■ Board Ass'y Label



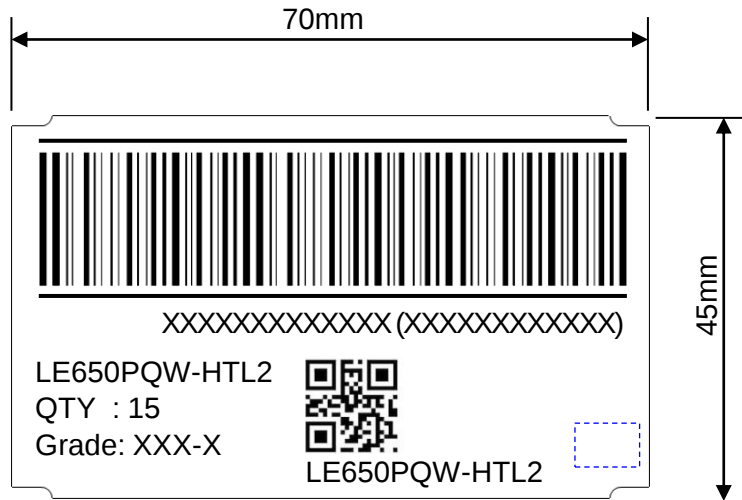
■ Control PCB Label



Product Specification

APPENDIX - III

■ Box Label



Pane FAB site information

If KR(Korea PAJU FAB), “(Blank)”

If CO(China Ghangzhou OLED FAB), “(CO)”

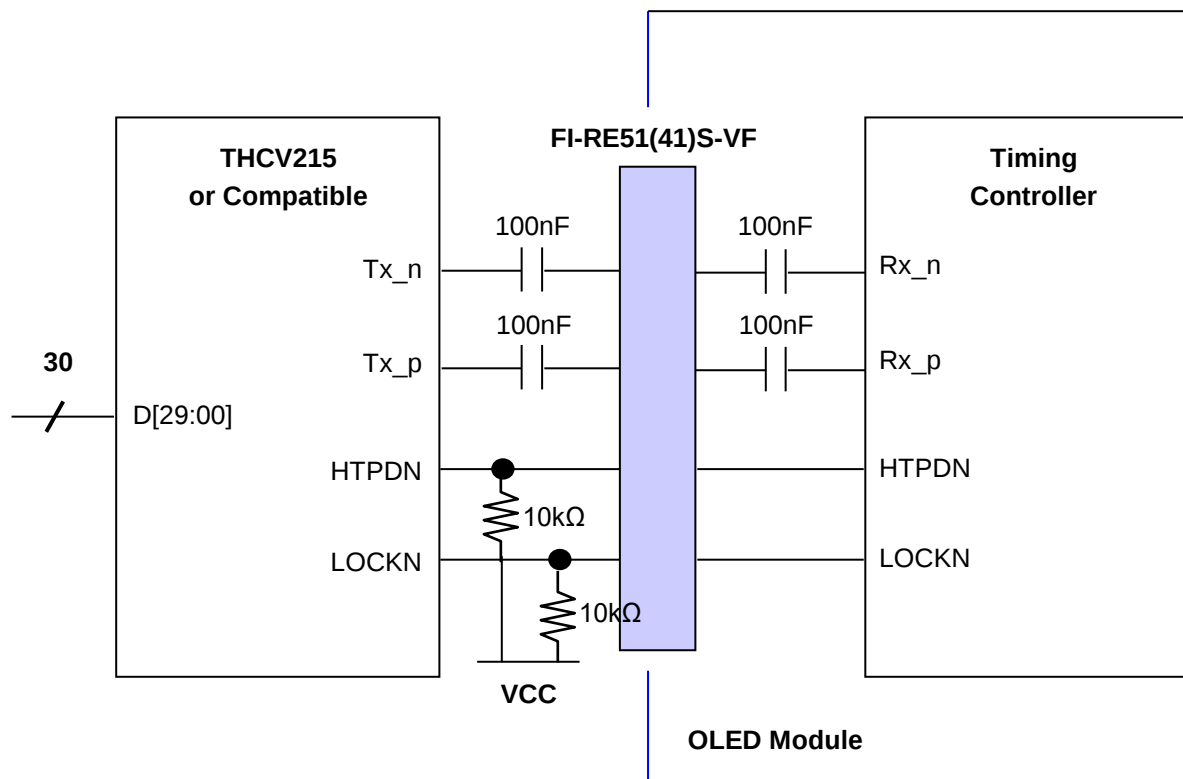
■ Pallet Label



LGD Haiphong : MADE IN VIETNAM

APPENDIX - IV

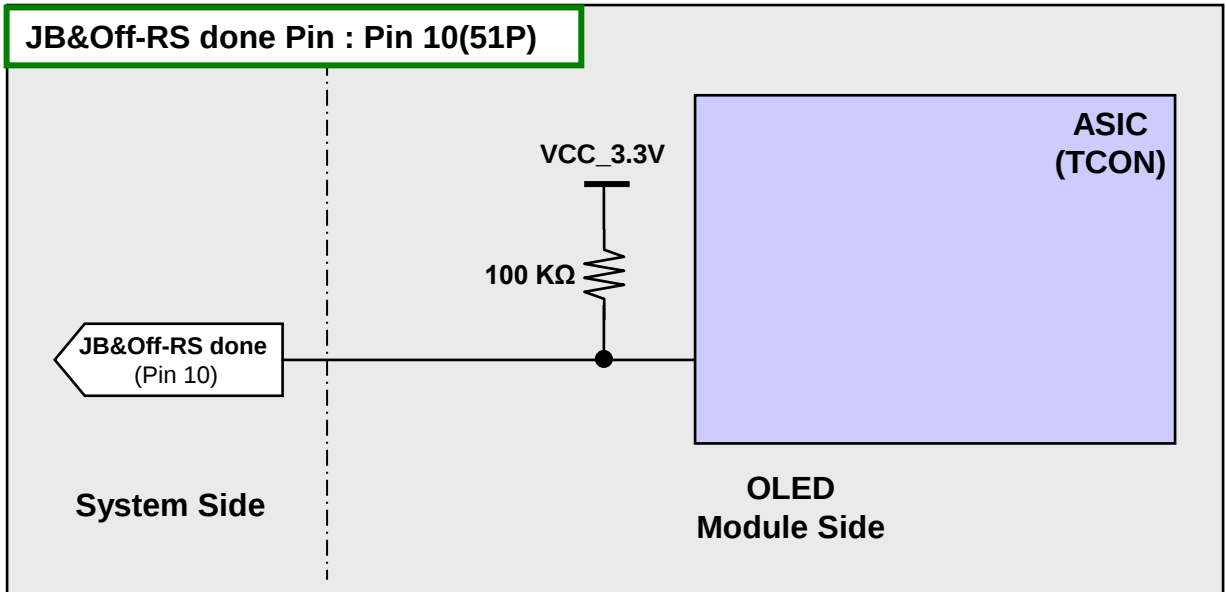
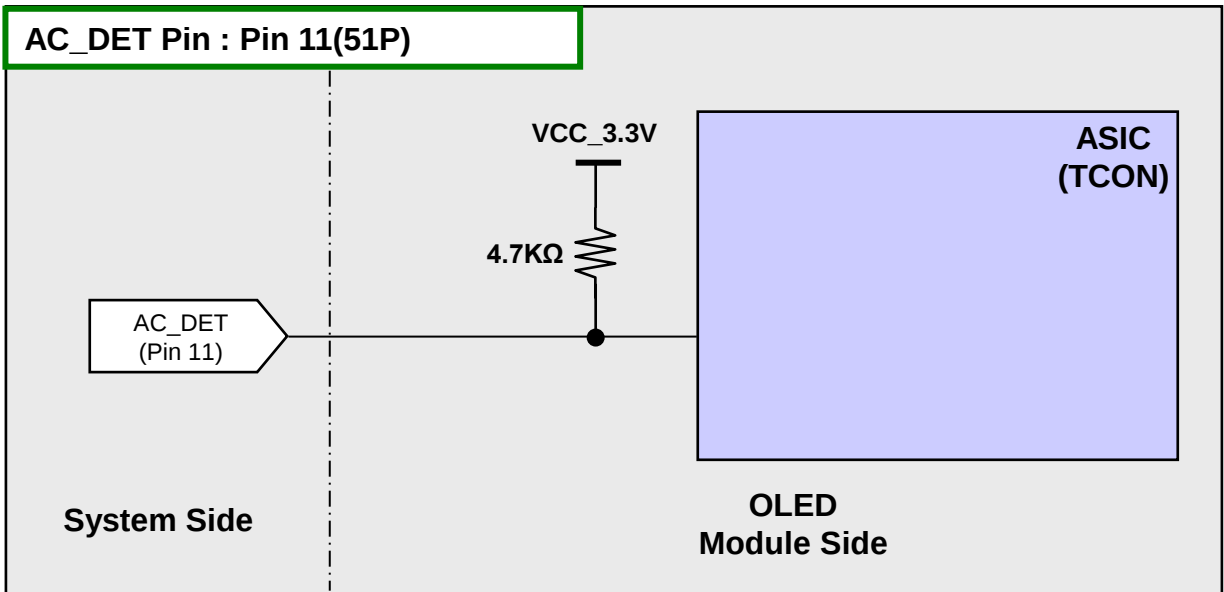
■ Required Signal Assignment for Flat Link (Thine : THCV215) Transmitter



- Note: 1. The OLED module uses a 100 nF capacitor on positive and negative lines of each receiver input.
 2. Refer to VbyOne Transmitter Data Sheet for detail descriptions. (THCV215 or Compatible)
 3. About Module connector pin configuration, Please refer to the Page 7~8.

APPENDIX - V - 1

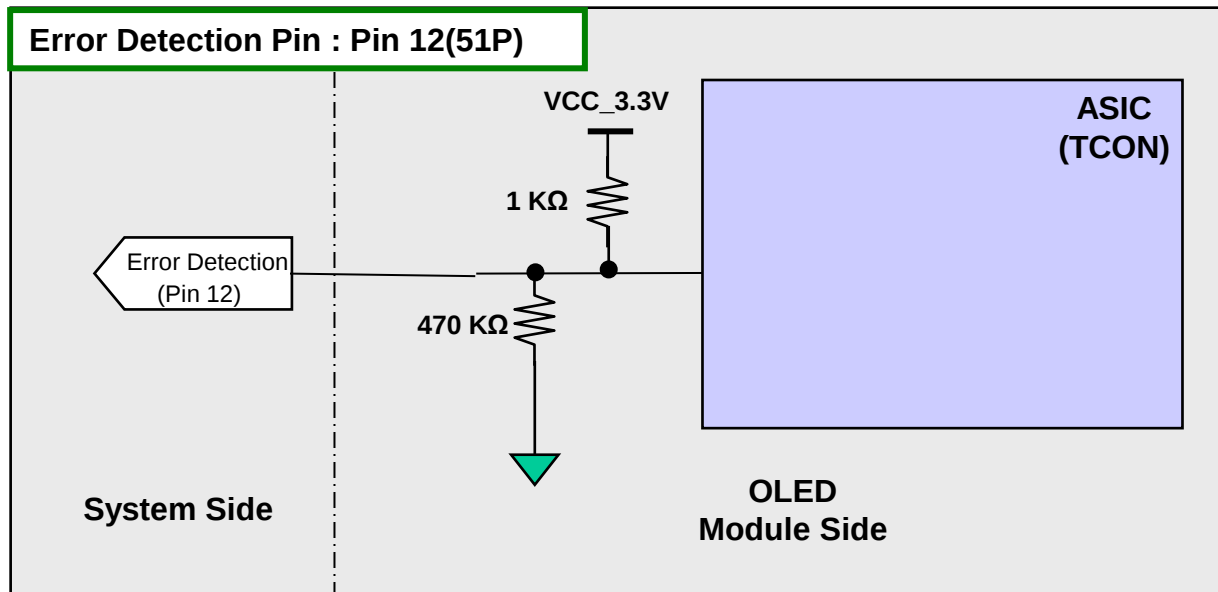
■ Circuit Block Diagram for Option Pin

(1) Circuit Block Diagram of **JB&Off-RS done** pin(2) Circuit Block Diagram of **AC_DET** pin

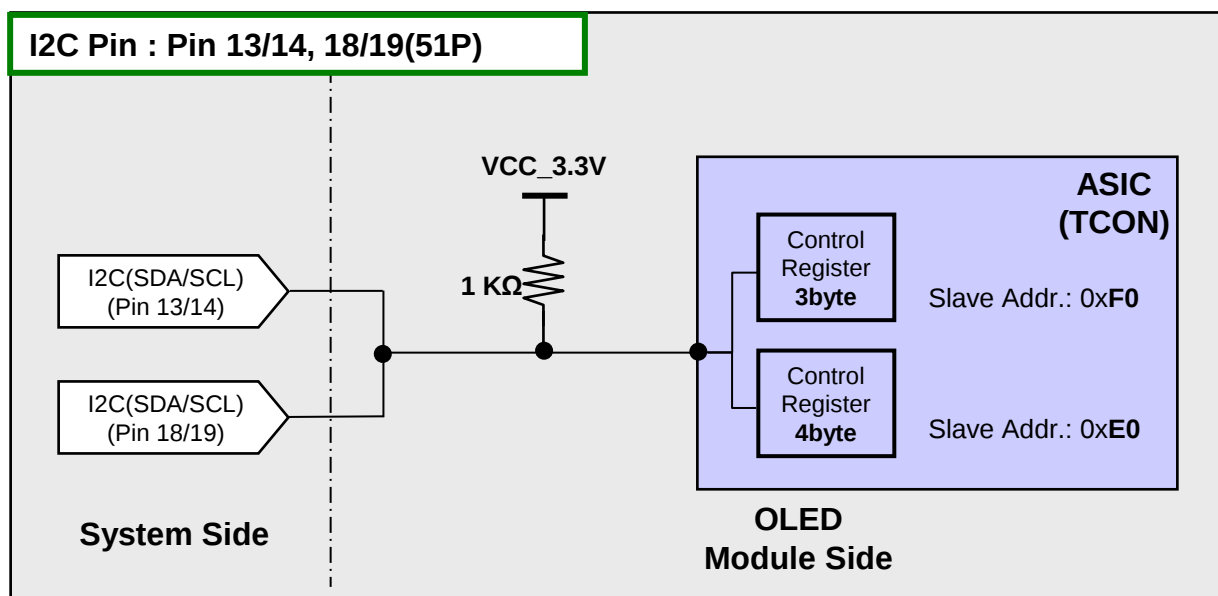
APPENDIX - V - 2

■ Circuit Block Diagram for Option Pin

(3) Circuit Block Diagram of Error Detection pin



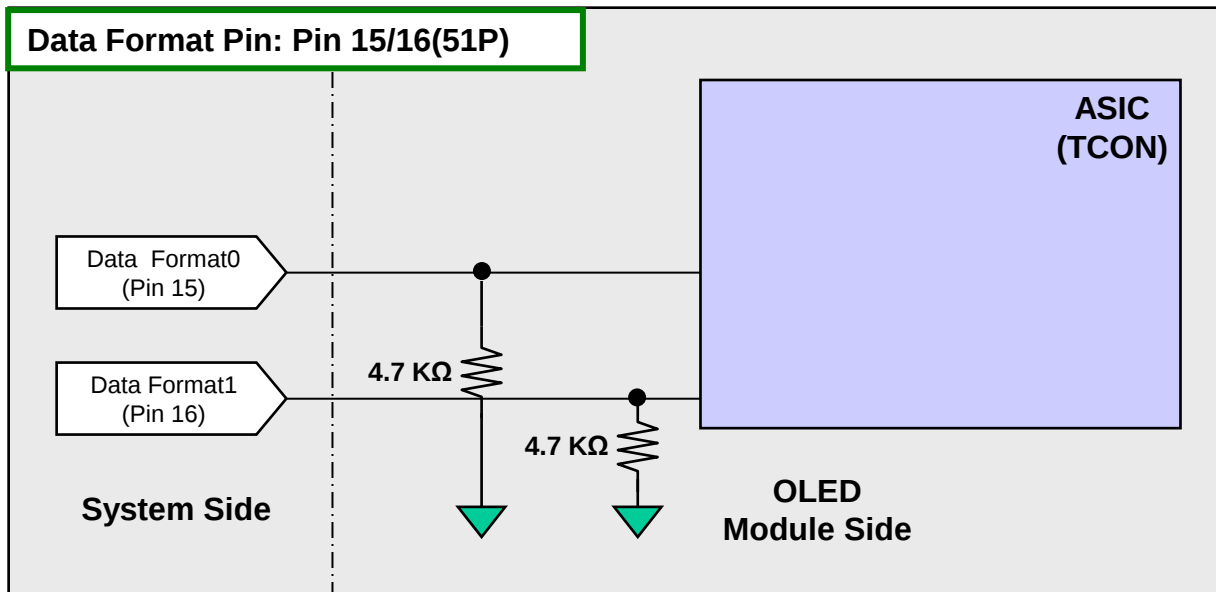
(4) Circuit Block Diagram of I2C(SDA/SCL) pin



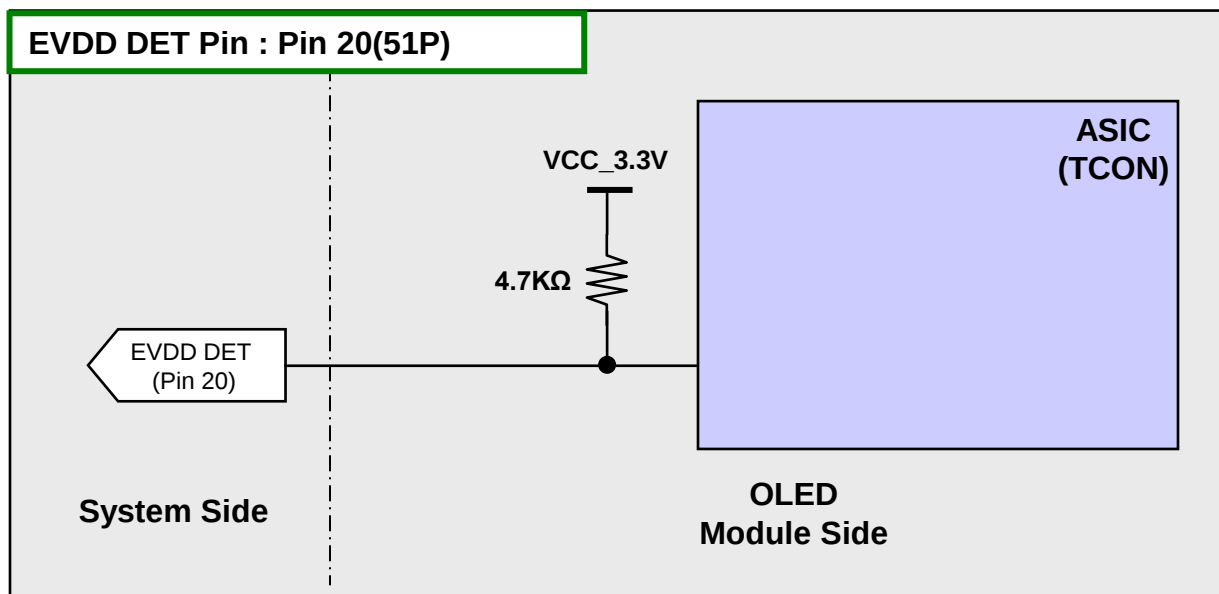
APPENDIX - V - 3

■ Circuit Block Diagram for Option Pin

(5) Circuit Block Diagram of Data Format pin



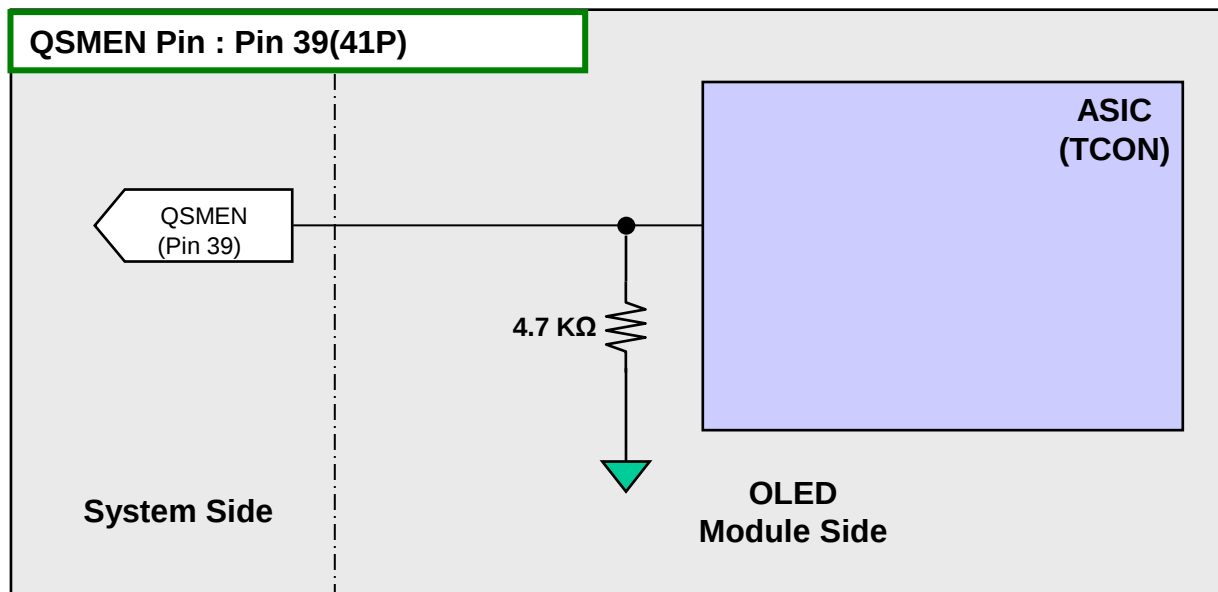
6) Circuit Block Diagram of EVDD DET pin



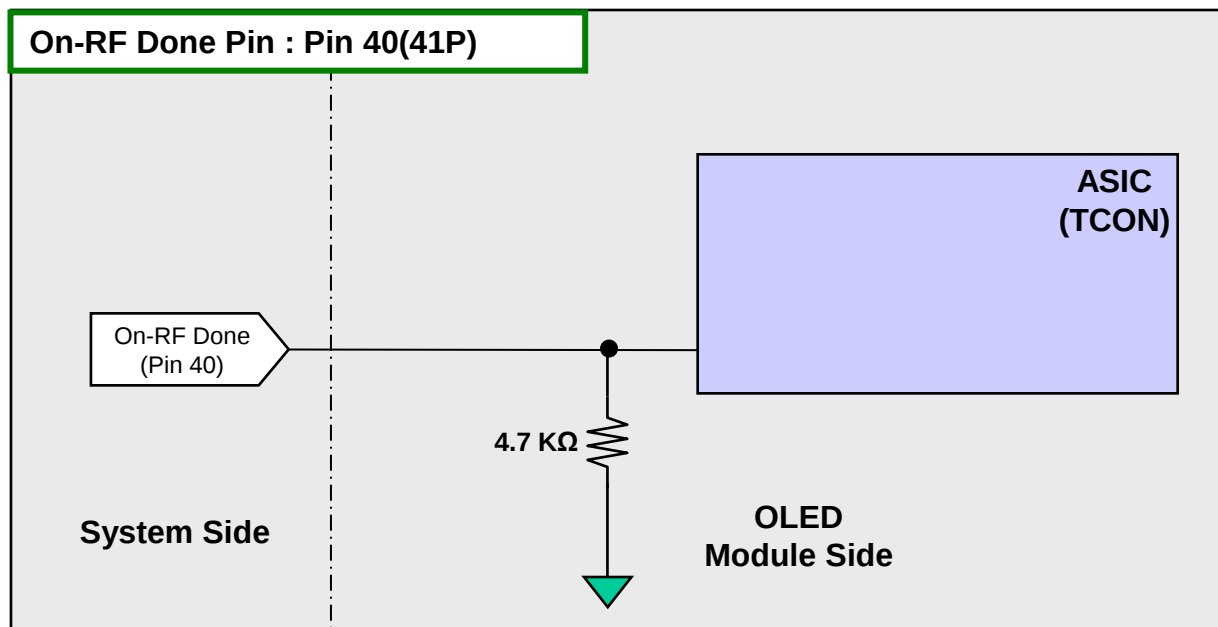
APPENDIX - V - 4

■ Circuit Block Diagram for Option Pin

(7) Circuit Block Diagram of QSMEN pin



(8) Circuit Block Diagram of On-RF Done pin

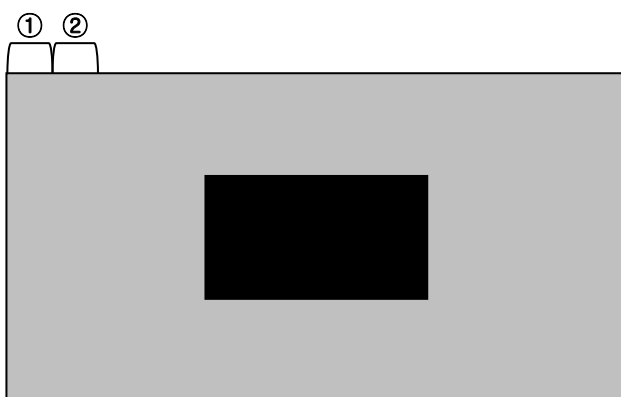


Product Specification

APPENDIX - VI - 1

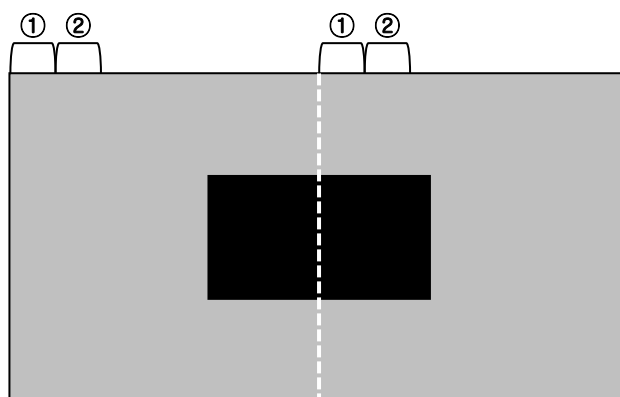
■ Input Mode of Pixel Data

Mode 1 : Non Division Mode



	1'st Data	2'nd Data	...	Data #
Lane00	1	17	...	3825
Lane01	2	18	...	3826
Lane02	3	19	...	3827
Lane03	4	20	...	3828
Lane04	5	21	...	3829
Lane05	6	22	...	3830
Lane06	7	23	...	3831
Lane07	8	24	...	3832
Lane08	9	25	...	3833
Lane09	10	26	...	3834
Lane10	11	27	...	3835
Lane11	12	28	...	3836
Lane12	13	29	...	3837
Lane13	14	30	...	3838
Lane14	15	31	...	3839
Lane15	16	32	...	3840

Mode 2 : 2 Division Mode



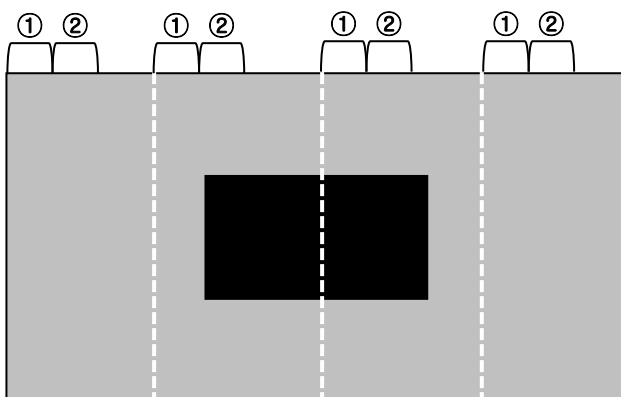
	1'st Data	2'nd Data	...	Data #
Lane00	1	9	...	1913
Lane01	2	10	...	1914
Lane02	3	11	...	1915
Lane03	4	12	...	1916
Lane04	5	13	...	1917
Lane05	6	14	...	1918
Lane06	7	15	...	1919
Lane07	8	16	...	1920
Lane08	1921	1929	...	3833
Lane09	1922	1930	...	3834
Lane10	1923	1931	...	3835
Lane11	1924	1932	...	3836
Lane12	1925	1933	...	3837
Lane13	1926	1934	...	3838
Lane14	1927	1935	...	3839
Lane15	1928	1936	...	3840

Product Specification

APPENDIX - VI - 2

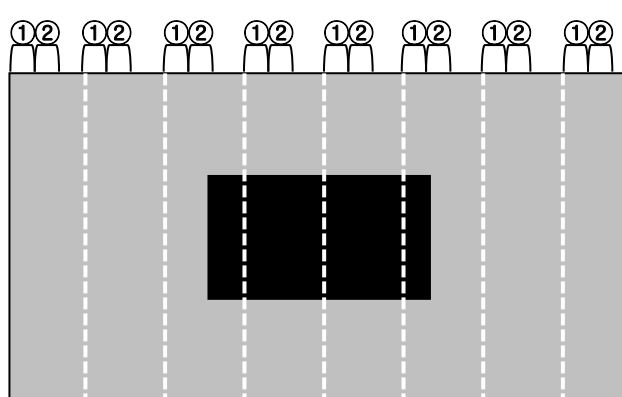
■ Input Mode of Pixel Data

Mode 3 : 4 Division Mode



	1'st Data	2'nd Data	...	Data #
Lane00	1	5	...	957
Lane01	2	6	...	958
Lane02	3	7	...	959
Lane03	4	8	...	960
Lane04	961	965	...	1917
Lane05	962	966	...	1918
Lane06	963	967	...	1919
Lane07	964	968	...	1920
Lane08	1921	1925	...	2877
Lane09	1922	1926	...	2878
Lane10	1923	1927	...	2879
Lane11	1924	1928	...	2880
Lane12	2881	2885	...	3837
Lane13	2882	2886	...	3838
Lane14	2883	2887	...	3839
Lane15	2884	2888	...	3840

Mode 4 : 8 Division Mode



	1'st Data	2'nd Data	...	Data #
Lane00	1	3	...	479
Lane01	2	4	...	480
Lane02	481	483	...	959
Lane03	482	484	...	960
Lane04	961	963	...	1439
Lane05	962	964	...	1440
Lane06	1441	1443	...	1919
Lane07	1442	1444	...	1920
Lane08	1921	1923	...	2399
Lane09	1922	1924	...	2400
Lane10	2401	2403	...	2879
Lane11	2402	2404	...	2880
Lane12	2881	2883	...	3359
Lane13	2882	2884	...	3360
Lane14	3361	3363	...	3839
Lane15	3362	3364	...	3840

Product Specification

APPENDIX - VII

■ Register Map

The following register is controlled by I2C Interface.

	Bit[7]: MSB	Bit[6]	Bit[5]	Bit[4]	Bit[3]	Bit[2]	Bit[1]	Bit[0]: LSB
Addr : 0x001	CPC EN	TPC EN	Not Use	OFF RS EN	Not Use	Not Use	Opt_ Dimmin_ start[9]	Opt_ Dimming start[8]

Device Address: 0xE0(Control Register 4byte) or 0xF0(Control Register 3byte)

Address [HEX]	Register Name	Description	Remark
0x000	Valid	Read only register (LGD use)	
0x001	[7] : CPC enable	1: enable (default), 0: disable	
	[6] : TPC enable	1: enable (default), 0: disable	
	[5] : Not use	Must Be :1	
	[4] : Off RS enable	1: enable, 0: disable	
	[3] : Not use	Must Be : 0	
	[2] : Not use	Must Be : 0	
	[1:0] Opt_Dimming_start[9:8]	APL value of P0 point	
	0x002		
0x003	Opt_p0	APL P0 point corresponds to the 255 normalized luminance	
0x004	Opt_p1	APL P1 point corresponds to the 255 normalized luminance	
0x005	Opt_p2	APL P2 point corresponds to the 255 normalized luminance	
0x006	Opt_p3	APL P3 point corresponds to the 255 normalized luminance	
0x007	Opt_p4	APL P4 point corresponds to the 255 normalized luminance	
0x008	Opt_p5	APL P5 point corresponds to the 255 normalized luminance	
0x009	Opt_p6	APL P6 point corresponds to the 255 normalized luminance	
0x00A	Opt_p7	APL P7 point corresponds to the 255 normalized luminance	

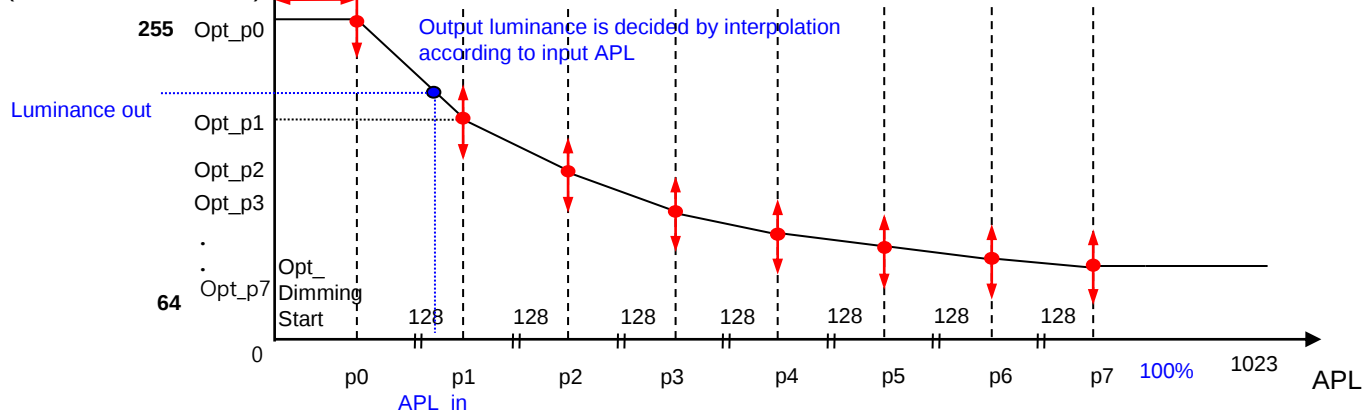
Product Specification

Address [Hex]	Register Name	Description	Remark
0x00B	[7] : Not used	LGD reserved	
	[6:5] : Not used	LGD reserved	
	[4] : LEA refresh mode en	1: LEA disable, 0: LEA enable (default)	
	[3] : HDR_en	1: Enable, 0: Disable (default)	
	[2] : Not used	LGD reserved	
	[1:0]:Not used	LGD reserved	

□ PLC curve parameter

Luminance

(255 normalized lum.)



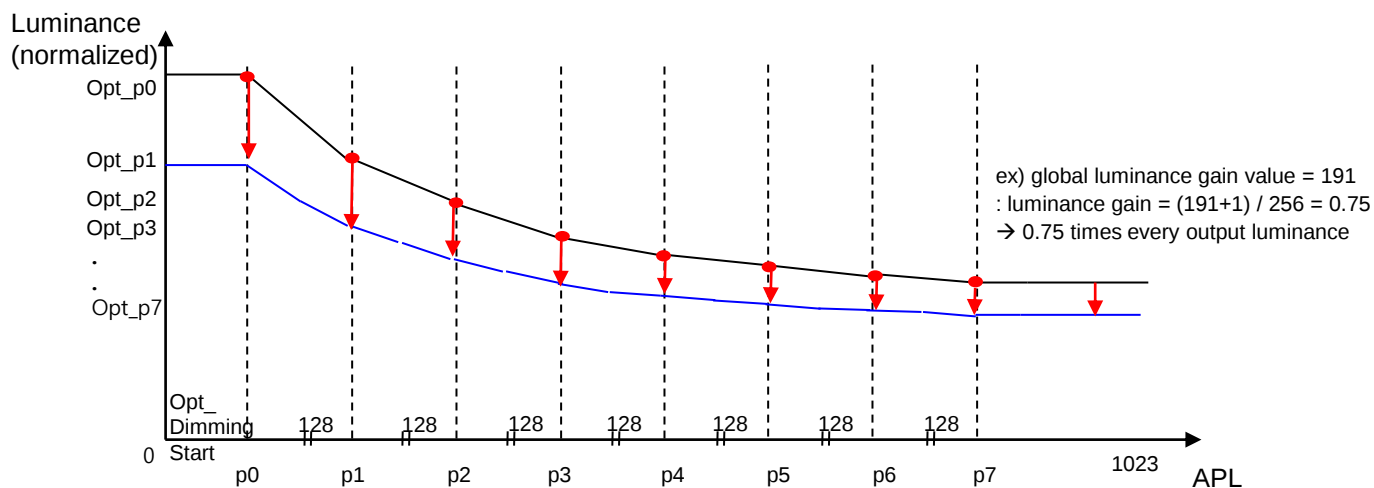
Every interval between each points except P0 is fixed to 128

- Luminance of p7~1023 interval are Opt_p7
- The point over 1023 is discarded

Product Specification

Address [Hex]	Register Name	Description	Remark
0x016	Opt_global_luminance_gain	Adjust global luminance gain 0~1 luminance gain according to 0~255 value (Same luminance gain is applied to every P0~P7 points)	Value Range: 0~255
0x05D	[7] vsJB_en	1: Enable, 0: Disable	
	[6:0] Not used	LGD reserved	
0x05E	Test_temp1[15:8]	1 st temperature sensor	Read only
0x05F	Test_temp1[7:0]		

□ Global luminance gain



Product Specification

Address [Hex]	Register Name	Description	Remark
0X1FF4 ~ 0X1FFF	[7:0] : P-ID	P-ID	Read Only

Product Specification

APPENDIX - VIII - 1

■ Gray to Gray Response Time Uniformity

This is only the reference data of G to G and uniformity for LE650PQW-HTL2 model.

(1) G to G Response Time :

Response time is defined as FIG. 3 and shall be measured by switching the input signal for "Gray (N) " and "Gray(M)". (32Gray Step at 8bit)

(2) G to G Uniformity

The variation of G to G Uniformity , $\delta_{G \text{ to } G}$ is defined as :

$$G \text{ to } G \text{ Uniformity} = \frac{\text{Maximum}(G \text{ to } G) - \text{Typical}(G \text{ to } G)}{\text{Typical}(G \text{ to } G)} \leq 1$$

*Maximum (GtoG) means maximum value of measured time (N, M = 0 (Black) ~ 1023(White), 128 gray step).

	0Gray	127ray	255Gray	...	895Gray	1023Gray
0Gray		TrR:0G→127G	TrR:0G→255G	...	TrR:0G→895G	TrR:0G→1023G
127Gray	TrD:127G→0G		TrR:127G→255G	...	TrR:127G→895G	TrR:127G→1023G
255Gray	TrD:255G→0G	TrD:255G→127G		...	TrR:255G→895G	TrR:255G→1023G
...	...	...	...		...	...
895Gray	TrD:895G→0G	TrD:895G→127G	TrD:895G→255G	...		TrR:895G→1023G
1023Gray	TrD:1023G→0G	TrD:1023G→127G	TrD:1023G→255G	...	TrD:1023G→895G	

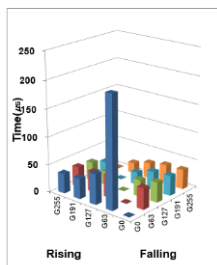
(3) Sampling Size : 1 pcs

(4) Measurement Method : Follow the same rule as optical characteristics measurement.

(5) Current Status

Below table is actual data of production on . 23. 09. 2024 (LGD PRV Event Sample)

	G to G Response Time [ms]		Average
	Min.	Max.	
# 1	0.019	0.201	0.038



Product Specification

APPENDIX - VIII - 2

■ MPRT Response Time Uniformity(δ_{MPRT})

This is only the reference data of MPRT and uniformity for LE650PQW-HTL2 model.

(1) MPRT Response Time :

Response time is defined as FIG. 4.

(2) MPRT Uniformity

The variation of MPRT Uniformity , δ_{MPRT} is defined as :

$$\text{MPRT Uniformity} = \frac{\text{Maximum (MPRT)} - \text{Typical (MPRT)}}{\text{Typical (MPRT)}} \leq 1$$

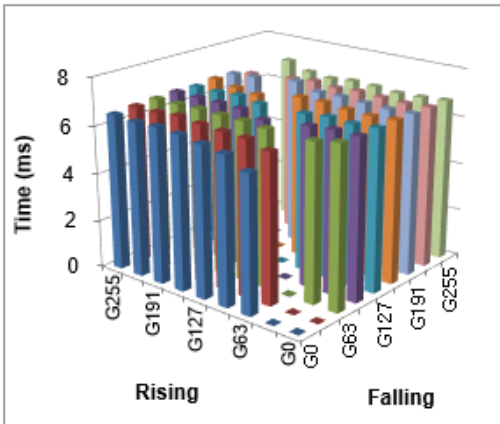
(3) Sampling Size : 2 pcs

(4) Measurement Method : Follow the same rule as optical characteristics measurement.

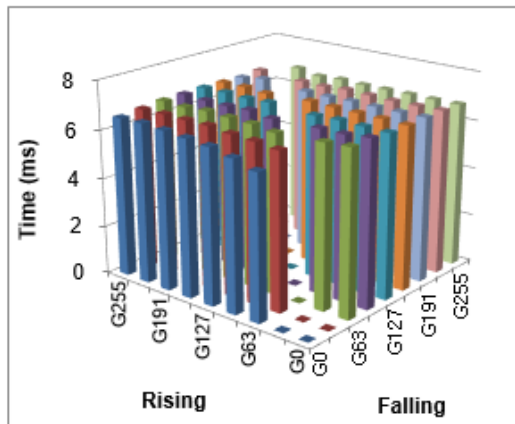
(5) Current Status

Below table is actual data of production on 23. 09. 2024 (LGD PRV Event Sample)

Sample	MPRT Response Time [ms]		Average
	Min.	Max.	
# 1	5.7	7.1	6.6
# 2	5.9	6.9	6.7



Sample #1		Final Value										Temperature
Initial Value	Gray	G255	G223	G191	G159	G127	G95	G63	G31	G0	상온	
	G255	-	7.1	6.8	6.7	6.8	6.7	6.7	6.7	6.8		
	G223	6.5	-	6.7	6.8	6.7	6.8	6.7	6.7	6.7	Average	
	G191	6.8	6.8	-	7.0	6.8	6.8	6.7	6.7	6.7	6.6	
	G159	6.8	6.6	6.5	-	6.8	6.8	6.7	6.7	6.8	Standard Dev.	
	G127	6.7	6.7	6.7	6.6	-	6.6	6.7	6.7	6.7	0.2	
	G95	6.7	6.7	6.7	6.6	6.4	-	6.6	6.7	6.7	Maximum	
	G63	6.7	6.7	6.7	6.6	6.6	6.6	-	6.6	6.7	7.1	
	G31	6.6	6.6	6.6	6.5	6.5	6.5	6.2	-	-	Minimum	
	G0	6.5	6.4	6.5	6.4	6.3	6.1	5.7	-	-	5.7	



Sample #2		Final Value										Temperature
Initial Value	Gray	G255	G223	G191	G159	G127	G95	G63	G31	G0	상온	
	G255	-	6.9	6.7	6.8	6.7	6.7	6.7	6.7	6.7		
	G223	6.8	-	6.7	6.7	6.8	6.8	6.7	6.7	6.8	Average	
	G191	6.7	6.9	-	6.7	6.7	6.7	6.7	6.7	6.8	6.7	
	G159	6.8	6.8	6.7	-	6.8	6.8	6.8	6.7	6.7	Standard Dev.	
	G127	6.8	6.8	6.7	6.8	-	6.7	6.7	6.7	6.7	0.1	
	G95	6.7	6.7	6.7	6.7	6.6	-	6.7	6.7	6.8	Maximum	
	G63	6.7	6.7	6.7	6.7	6.7	6.6	-	6.7	6.7	6.9	
	G31	6.6	6.7	6.6	6.7	6.5	6.5	6.4	-	-	Minimum	
	G0	6.5	6.6	6.5	6.4	6.4	6.2	5.9	-	-	5.9	

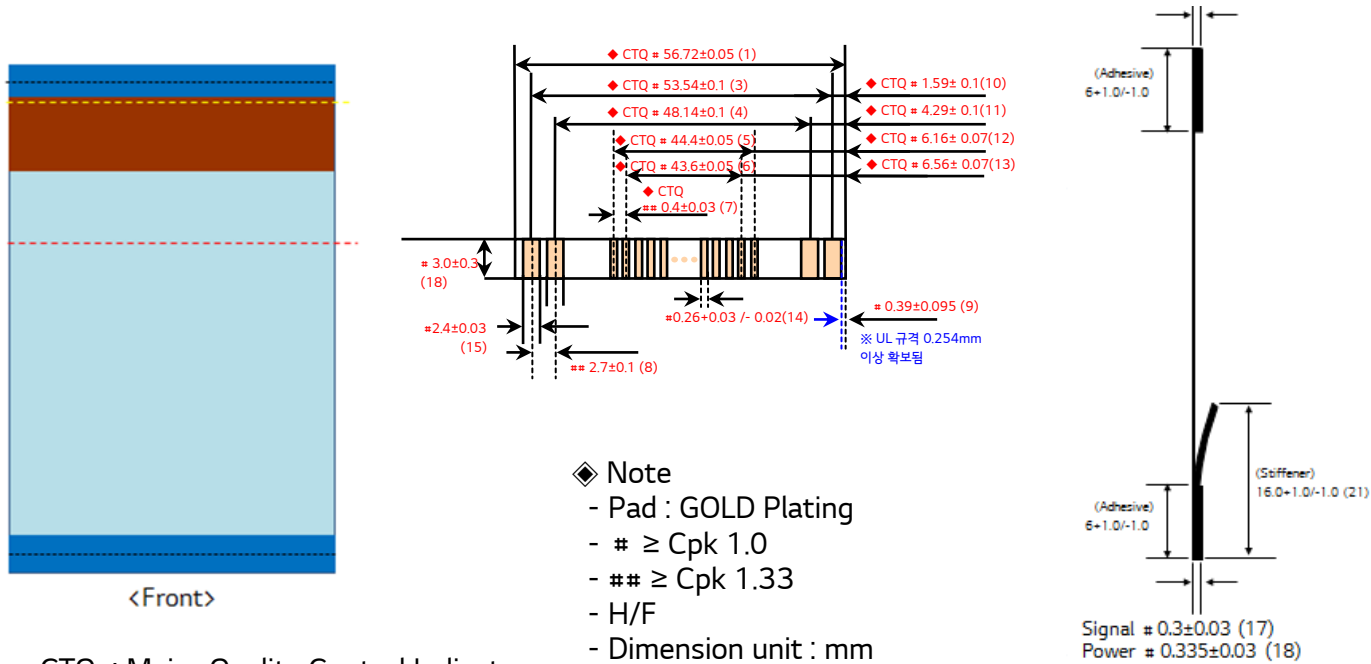
Product Specification

APPENDIX - VIII

■ FFC INFORMATION (OLED Connector)

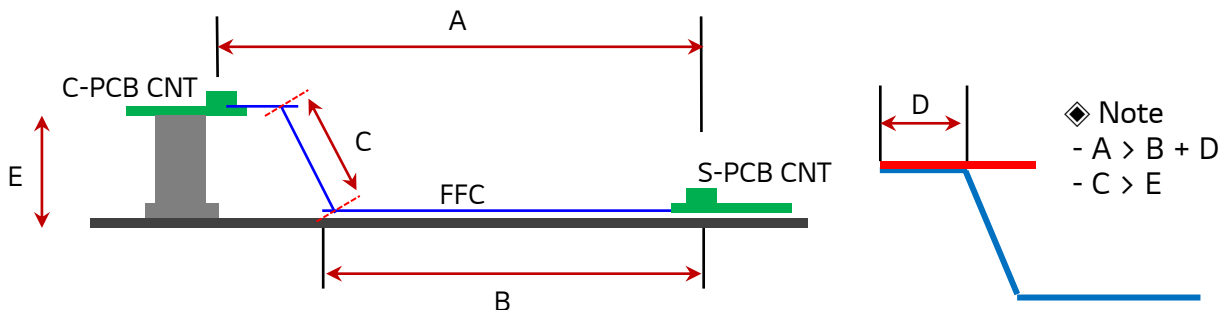
- S-PCB : TF43WEP-110S2_4-0.4SH (manufactured by HIROSE)
- C-PCB : TF43WEP-110S2_4-0.4SH (manufactured by HIROSE)

■ Drawing



- * CTQ : Major Quality Control Indicators
- * Power Line : 2oz
- * Signal Line : 1~2oz
- * Impedance : 100 ohm (IMS Shield is Recommended)

■ Z-Bending guide



- * The FFC must be folded in a Z-shape to prevent the FFC connector FLIP from being pressed or opened.
- * In particular, it is necessary to use a gently folded Z-shape FFC for the slim set concept.

APPENDIX - X

■ PLC Curve

(1) It is recommended to set the TV Set Peak Luminance to 50% of the Module Peak Luminance at P0 point in Default display mode for considering power savings and prevention of Image retention.

(Fig. 1. Set PLC Curve)

- If End users watch videos with fixed images such as broadcast logos for a long time at the level of Module Peak luminance, there is a risk of image retention defects.
Therefore, the shipping mode luminance control can proactively prevent the risk of image retention defects.
 - If customer need to promote the Picture Quality, It is recommended to use store mode.
 - It is recommended that the HDR function be applied to the module shipment condition, 'HDR Off'.
- (2) It is recommended to automatically operate the light sensor 'On' in Set shipping mode.
- It is recommended to prevent the risk of eye fatigue and image retention defects through the user of appropriate illumination depending on the user's environment.

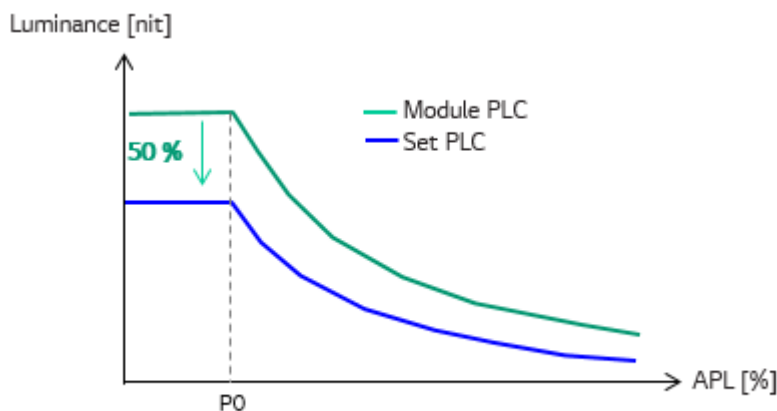


Fig. 1. Set PLC Curve

※ Default Display mode(End-user) : Set Peak Luminance $\leq$ 50% of Module Peak Luminance

※ Shipment mode : Picture mode first used by end-users after factory shipments

ex) Standard mode

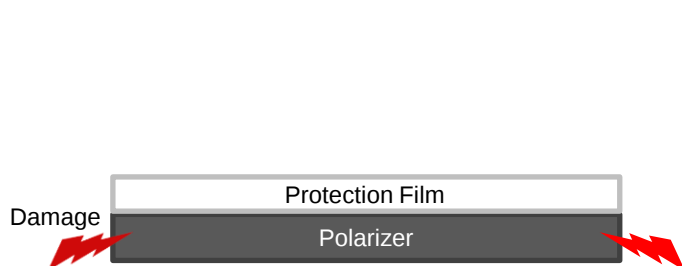
Product Specification

APPENDIX- XI

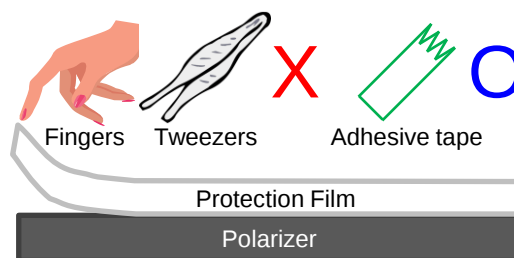
■ Things to avoid to prevent the polarizer from breakage

Any kind of damage on the edge of the polarizer is not allowed. <Fig.1>

Use an adhesive tape to peel off the protection film from the polarizer. <Fig.2>



<Fig.1>



<Fig.2>

■ Recommended values for peeling velocity and angle

The values for peeling velocity and angle should be under 2m/min and 15 degrees each. <Fig.3>



- Peeling velocity $\leq 2\text{m/min}$
- Peeling angle $\leq 15^\circ$



<Fig.3>

APPENDIX- XII

■ Guide for the FFC Connector fastening

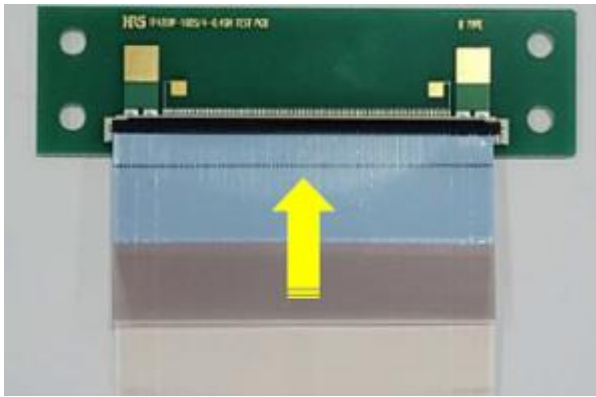
1. Preparation for insert



Place the FFC conductor face down and parallel to the connector.

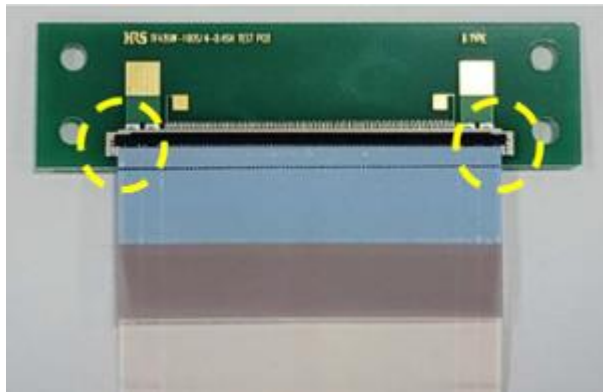


2. Insertion



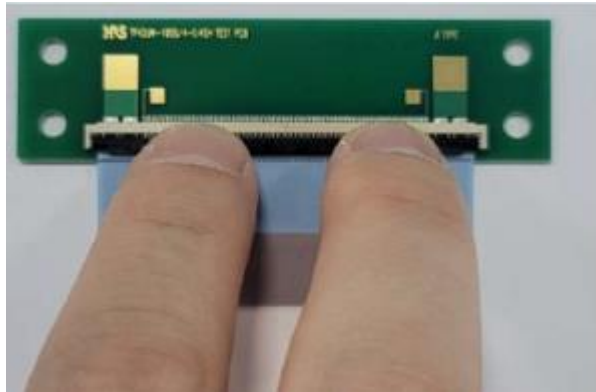
Insert the FFC horizontally and correctly without twisting.
When inserting from the corner as if swinging, it can be deformed by giving damage to the connector.

3. Completion of insertion



After the insertion, check the left and right sides
Whether there is any abnormality.
(Non-inserted, twisted, inserted position)

4. Fastening



Fasten the actuator by closing the central part as if rotating.
(Because the connector is long, please close it using two fingers.)

APPENDIX- XIII

■ Integrated Power Measurement

FIG.x shows additional information concerning the Integrated power measurement equipment and method.

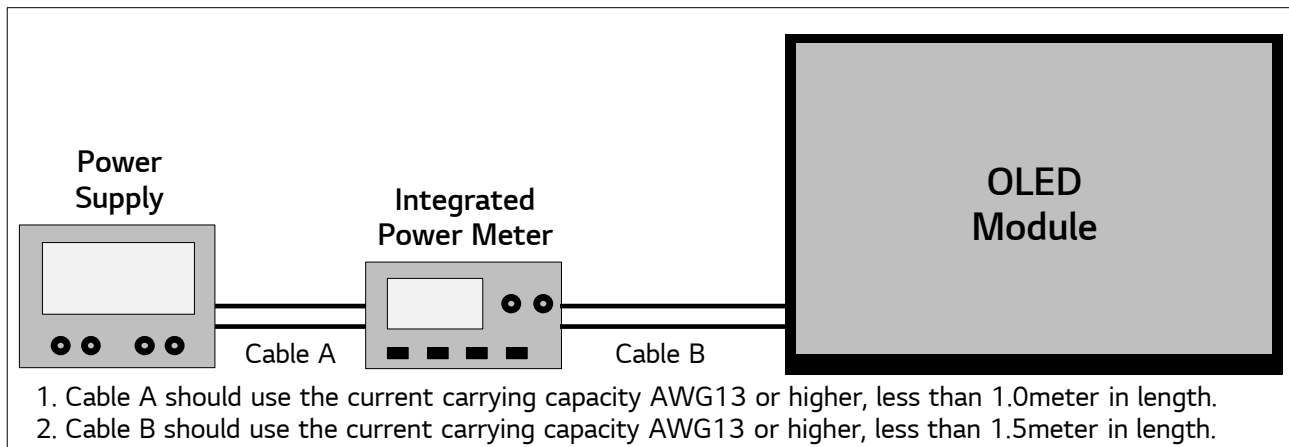


FIG.1 Integrated Power Measurement Equipment and Method

■ Measurement Procedure

FIG.xx shows additional information concerning the Integrated power measurement procedure.

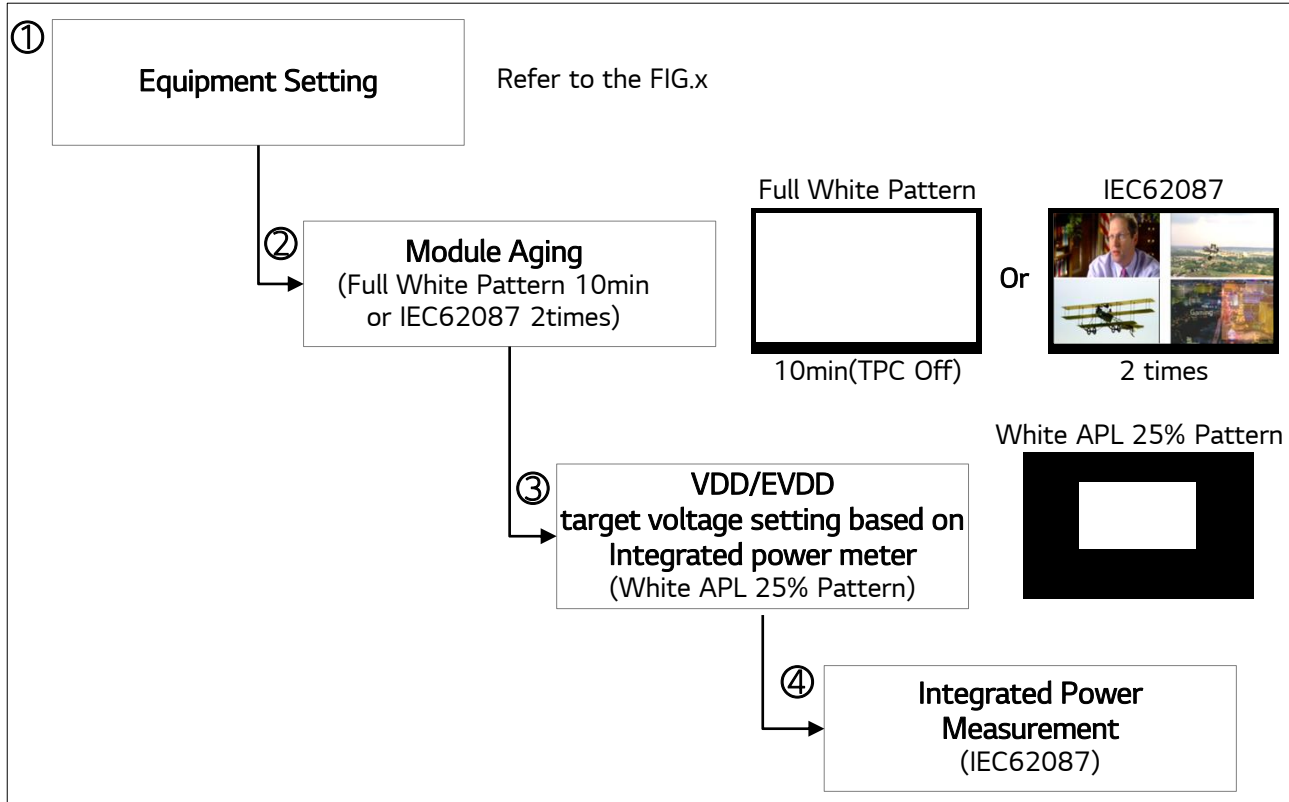
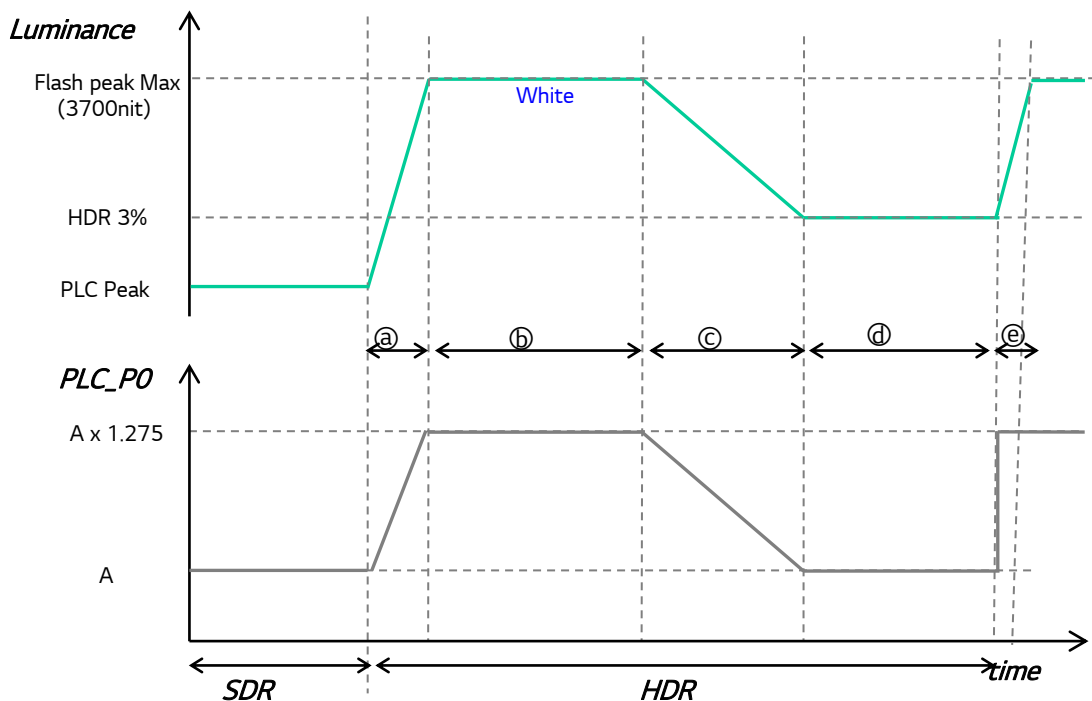


FIG.2 Integrated Power Measurement Procedure

Product Specification

APPENDIX- XIV

■ Flash peak Guide



Item		Flash Peak Design Guide
Operating Guide	Rising Stage ㉑	- Operating Condition : When HDR Contents is input (Below APL 3%, Vivid Mode (Shop Mode)) - Required Time : Within 1Frame - Controlling Method : HDR "on". Increase P0 offset gain through I2C
	Maintaining Stage ㉒	- Operating Condition : Under APL 3% - Required Time : 3~5sec. (Required, Time settings can be changed)
	Falling Stage ㉓	- Operating Condition : After satisfying the "Maintaining time (㉒)" - Required Time : (㉒ x 2) seconds - Controlling Method : Decrease P0 offset gain through I2C
	Holding Stage ㉔	- Required Operating Condition: Grey screen needs to hold for 3 seconds ※ Grey screen: Grey range 0 to 64, 90% of all pixels
	Reset ㉕	Controlling Method : Increase P0 offset gain through I2C

1) Data dependent on each panel

		P0	Remark
I2C address (0xE0)		0x03	Hex
SDR	Shipment Condition Value	A ¹⁾	decimal value
HDR	Flashing	A x 1.275	
	Normal	A	

*Flash peak brightness, reliability and performance verification require final inspection under customer actual usage conditions. Excessive Flash peak usage may cause unstable display on the screen