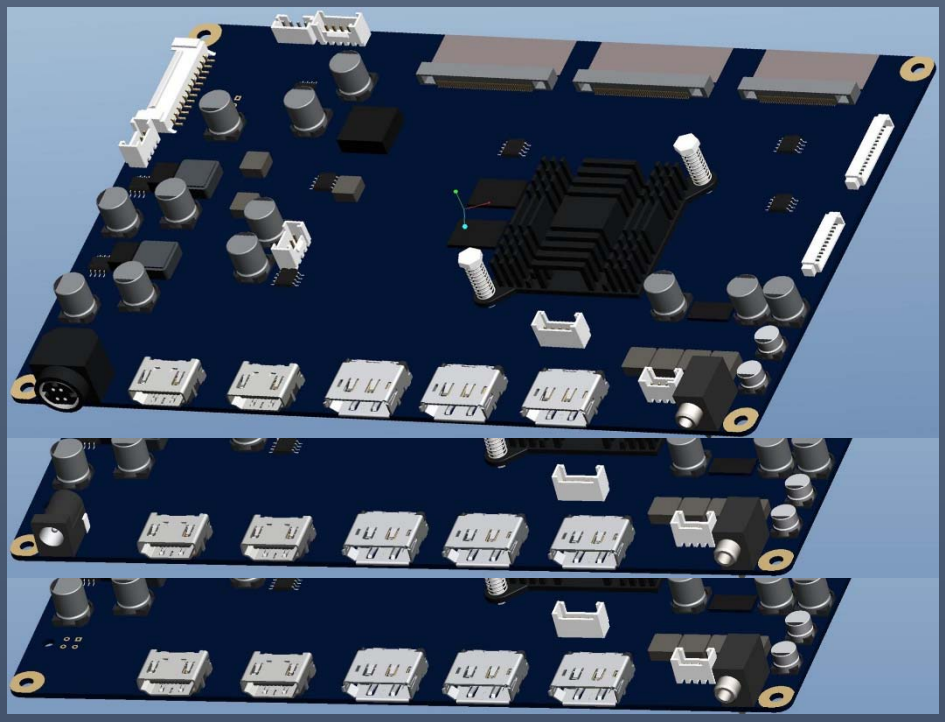
2019

Data Sheet



Saturn2

Part No.: ***STN2 - xxx….xxx***

(xxx...xxxx : target LCD part No)

Contents

Revision History

PCB Version	Rev. date	Revision Details
1.0	Nov. 2016	Engineering Sample
2.0	Feb. 2017	Mass Production version
2.1	Jun . 2017	Changing the OSD Silk print Addition of relevant electrical circuit for every pin map table respectively
	Jul 2017	Added DP MST/CLONE,FastSwap Information
2.2	Dec 2017	Addition of eDP pin map (CNF1) detail with relevant drawing Addition of VGA (CN3) drawing
2.2	Jan 2018	Correction of eDP & Vx1 output connector name from “CNF1” to “J455”. refer to the page 10 ~ 14
2.2	Feb 2018	Adoption of Transparency and Swap commends on RS232 Protocol and Command, rer to the page 43 Addition of Switching the Input Channels through RS232, refer to the page 39 & page 40
2.2	Mar 2018	Correction of eDP Pin Map Table on the page 14 Correction of relevant Circuit Diagram on the page 15
3.0	Mar 2018	Reinforce each power circuit pattern (Vcc pattern support up to 4A)
4.0	Jul 2018	Addition of “Rotation” function on the OSD Menu Addition of “Power Save” function on the OSD Meu
5.0	Sep 2019	Addition of ALCW (**A**dvanced **L**ow **C**olor **W**ashout) on the OSD Menu for below AUO models in order to make a precise video image in case of still image (static video image) AUO 43”, P430QVN02.0 AUO 55”, P550QVF06.3 AUO 75”, P750QVN02.1 AUO 85”, P850QVN02.1 Addition of S/PDIF (Optical Audio) Connector Addition of HDR (High Dynamic Range) function Addition of Video Wall function

1. General Description

- **UHD(3840x2160, 4096x2160) resolution display format.**
- Up scaling can do VGA, SVGA, XGA, SXGA,SXGA, UXGA to UHD VESA Standard Mode.
- Provides upto 30-bit color and 4Ch LVDS, Vx1 interface, e-DP 8-lane(HBR) / 4-lane(HBR2) Interface
- HDMI connector/**HDMI 2.0 /4K2K@60Hz 2Port**
- DP connector/**DP1.2/4K2K@60Hz 2Port**
- **HDCP 2.2 support**
- **PIP/ PBP(L/R, Top/Bottom)/4P(4Windows) Function**
- VGA input support by an optional cable connection (CN3 at right vertical connection port)
- OSD/Display Rotation Function
- Over driver / Over scan Function
- 6Color control
- PCM(Precise color management)
- Sharpness/Hue/Color Support
- Gamma Control
- Color Effect Function
- Response time Control
- Remote Control
- UART for RS232 Control
- **DP MST (Multi Stream, up to FHD 4 EA) or Daisy chain Output.**
- Speaker 20Wx 2ch
- Video Wall (up to 5 x 5 screens) - Option
- Speaker 20Wx 2ch
- PIP Sound Choice
- **HDR (High Dynamic Rendering) / Optional Support**
- Operating Temperature : - 10°C ~ +70°C

In case of Vx1 type, 16 lanes (120Hz vertical frequency) type TFT-LCD modules, this driving board can be integrated with an FRC board separately (“NT-13F” / Novatek NT72334TBG model or “20A08” / MStar MST6M60FV model) - Option

Special Feature

DP MST

Saturn2 supports DisplayPort Multi Stream Transport feature up to 2 video stream.
When DP MST is enabled from OSD menu, daisy chained Saturn2 will display two different image on each other screen. Windows operating system will detect DP Topology and will display two screens available. This feature requires DP Version 1.2 and supported graphic card.

DP Clone

When CLONE is enabled from OSD menu, selected input will be cloned(copied) to DP output port. It also converts HDMI and DP into DP Output.

Fast Swap

Saturn2 delivers zero-delay input swap for normal mode and 2P PIP mode. If two input sources have identical video format such as 1920x1080x60Hz on both input, Saturn2 swaps between two input sources without any delay or noise. This feature is useful for real-time monitoring environment.

2. Spec Tables

2.1 General Spec

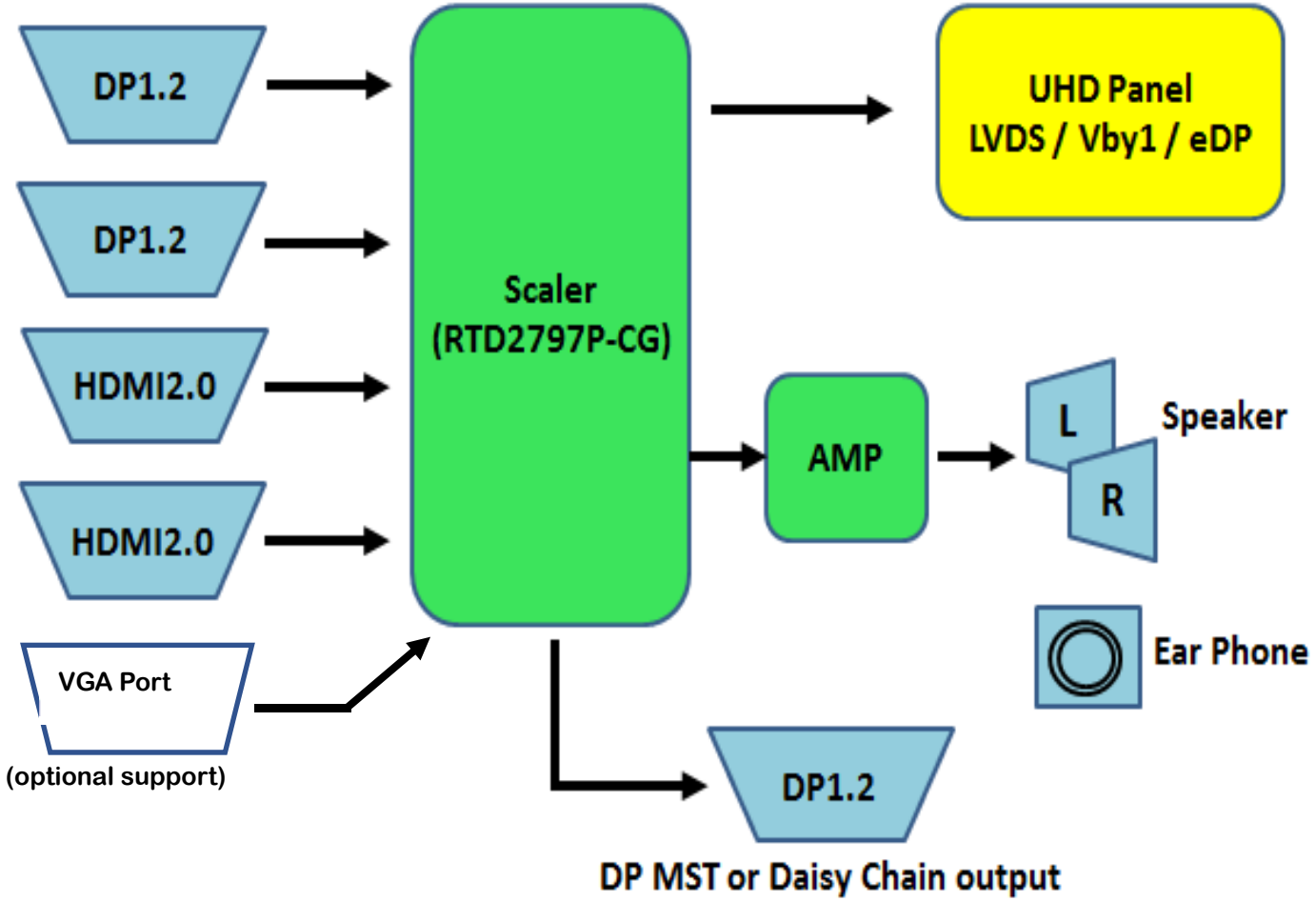
Item			Description		Remarks
Target LCD Modules		Maker	Samsung, LG, Sharp, AUO, Innolux, etc		
		Type	23.8”/27”/28”/31”/31.5”/32”/34”/40”/42”/55’/65”/84”/98”,etc (UHD) Panel, 4k2k@120Hz Panel with FRC Board		with FRC Board for 120Hz 4k2k panels
Input Frequency			H : 31 ~ 130KHz		
			V : 56 ~ 75Hz		
Control	OSD		**-PIP MODEL** : Power, Menu/Enter, Source/Exit, Up/MEMC, Down/Mute, Left/volume-, Right/Volume+, IR 2Color_LED **-NON PIP MODEL** : Power, Menu/Enter, -, +/Source Exit/Mute, Volume+, Volume-, 2Color_LED		7 keys, 2 LEDs
	P&P		DDC2B		
	Remote Controller		Infrared-Rays NEC Format.		
	RS232		PC Application		
Sync Type					
DC Jack		Type:	24V-DC, SMPS (or LIPS) , 12V-DC JACK(Option)		
Signal Input		Digital	19Pin HDMI Connector	4K2K@60 2ea	
			20Pin Display Port Connector	4K2K@60Hz 2 ea	
Audio		Input	HDMI, DP & VGA (by an Optional Port)	HDMI Jack, Display Port Jack	
		Output	Head Phone	3.5ø Stereo Jack	
			Speaker	4Pin Wafer	

2.2 Engineering Spec

Item			Description			Remarks
Power Supply	Stand-By +5VS		Min	Typical	Max	Option(Adaptor, SMPS)
			4.8	5.0	5.2	
	5V		5.3	5.5	5.7	
	12V		11.4	12.0	12.6	
	24V		22.8	24.0	25.2	
Power	Power Off	+5VS	-		≤ 1W	LED : off
	Stand By, Sleep & Suspend Mode	+5VS	-	TBD	≤ 1W	LED : red Blinking
	Normal	+5VS	-	TBD	-	LED : green without Panel Interface
		1.2V	-	0.44	0.49	
		3.3V	-	0.48	0.59	
Audio AMP	Power	Typical	-12V : 8Wrms+8Wrms (± 10%), 8Ω -24V : 20Wrms+20Wrms (± 10%), 8Ω			Volume :Adjust
	Response Frequency		100Hz ~ 20KHz			
	T.H.D		10% Under			
	Input		0.400Vrms			
Speaker	Type		External			
	Impedance		8Ω			20W x 2CH

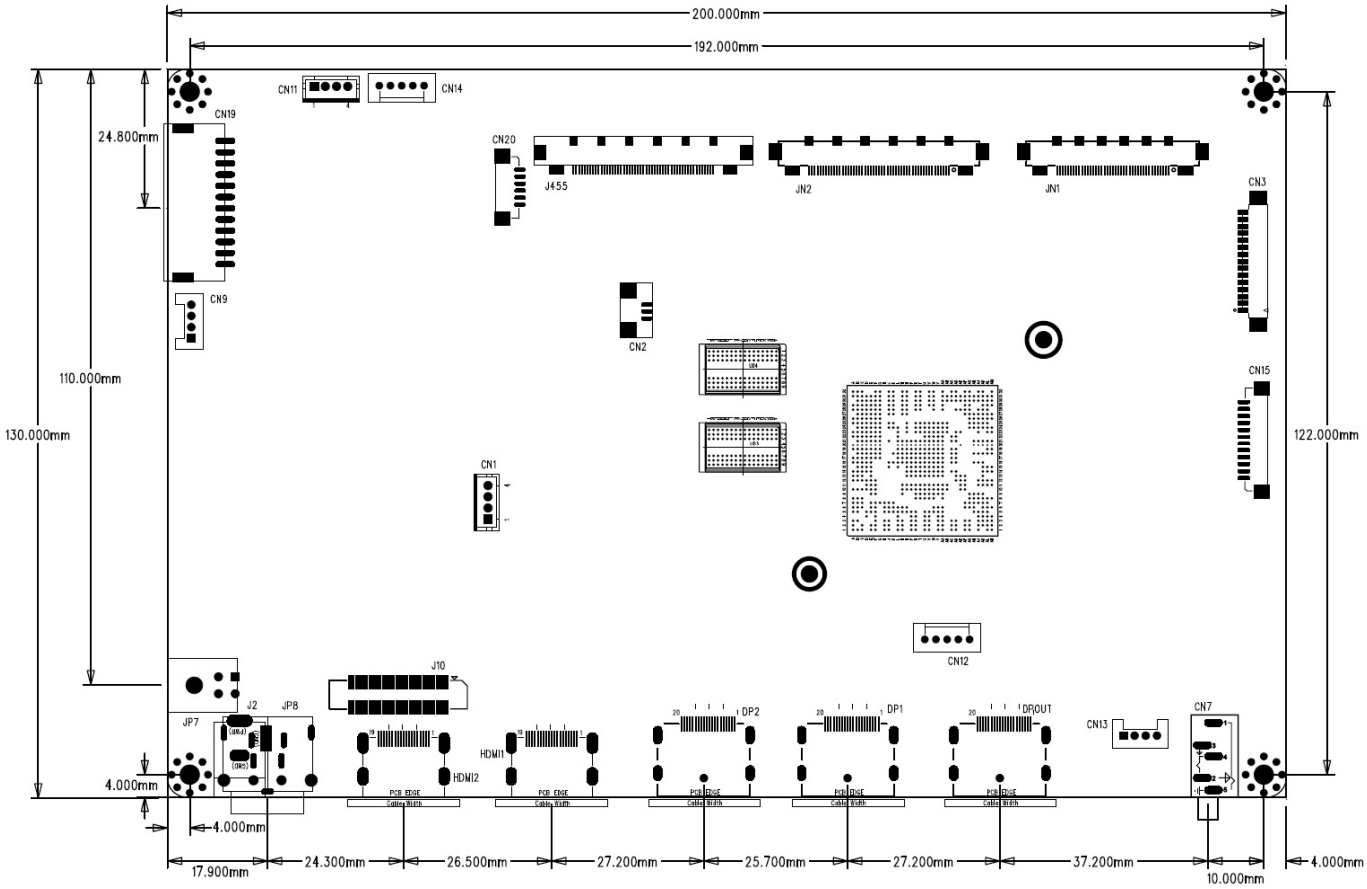
3. Block Diagram

3.1 Standard version

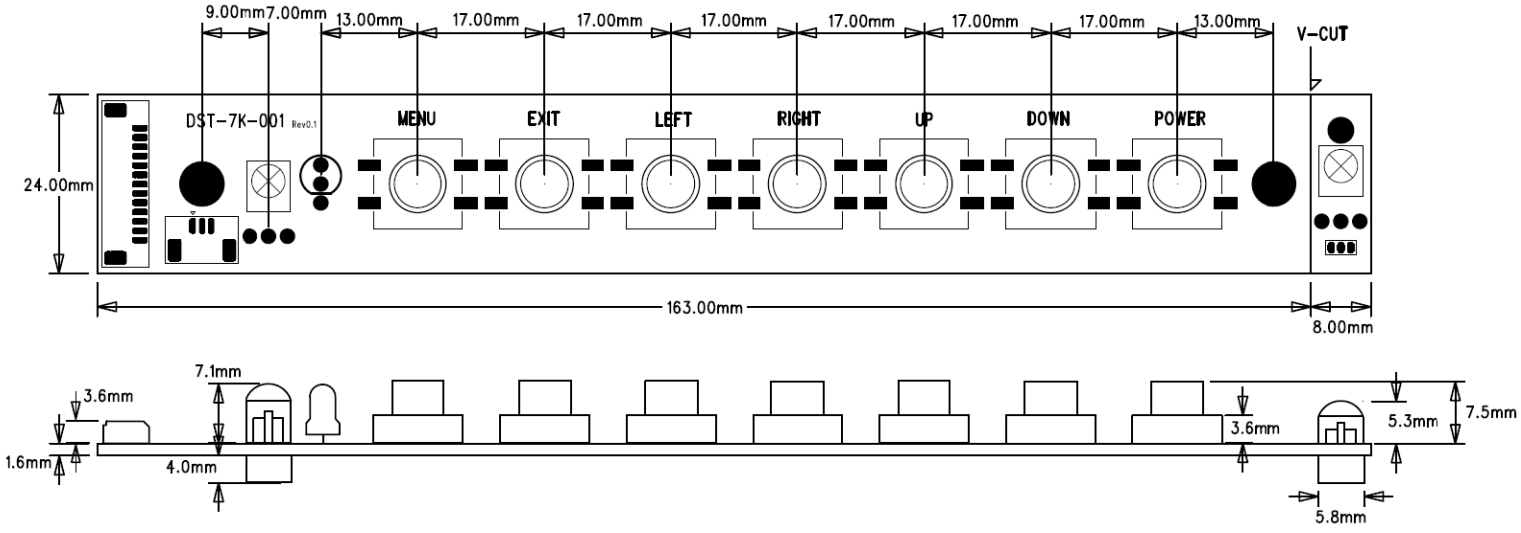


4. Board Dimensional Drawing

4.1. Main Board Drawing (unit : mm, 200 x 130 x 1.6) : Standard version

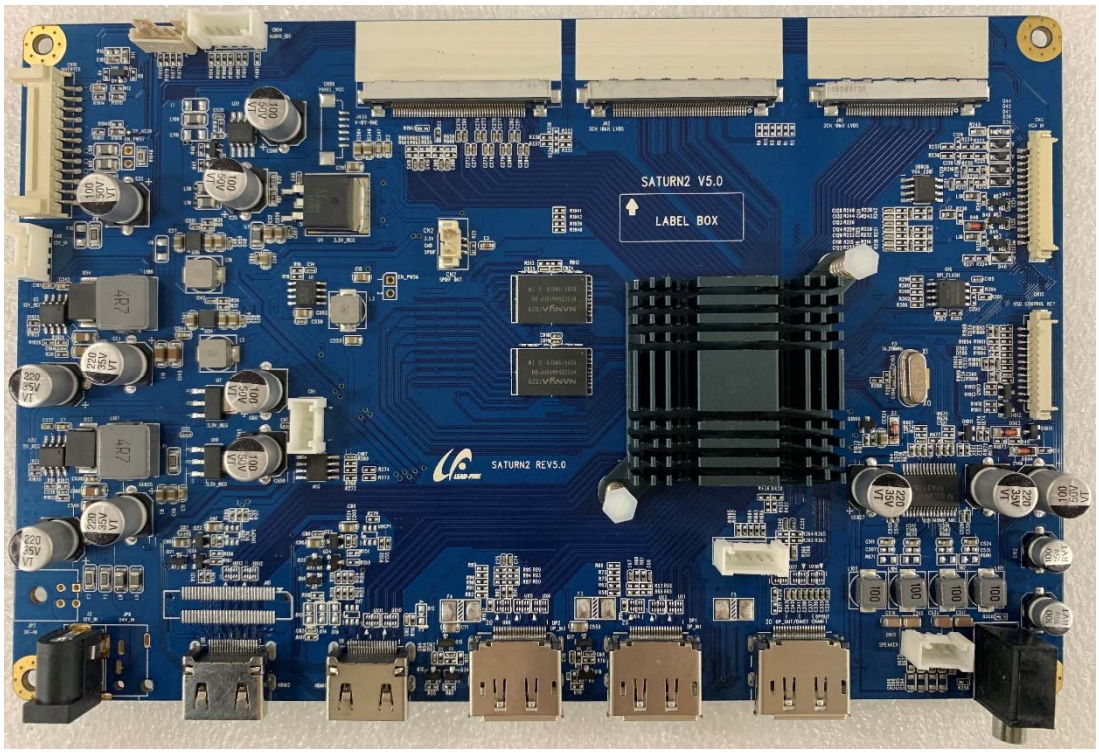


4.2. OSD Board Dimensional Drawing (unit : mm, 150 x 16 x 1.6)

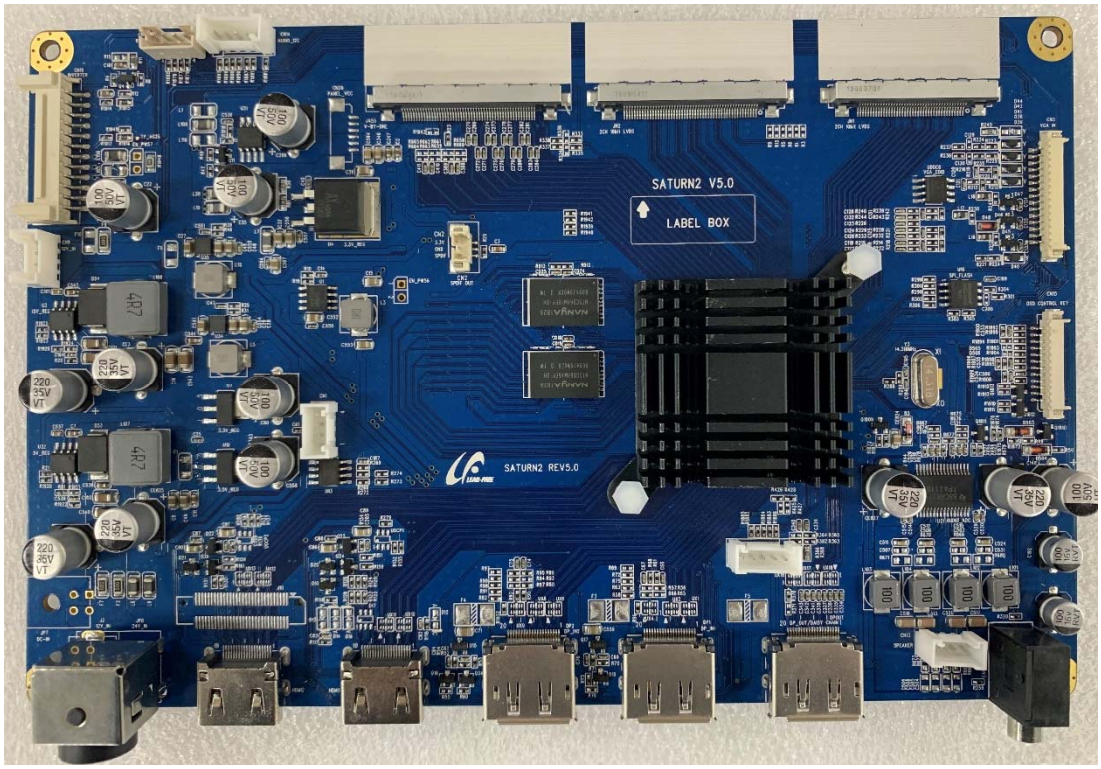


4.3 Picture

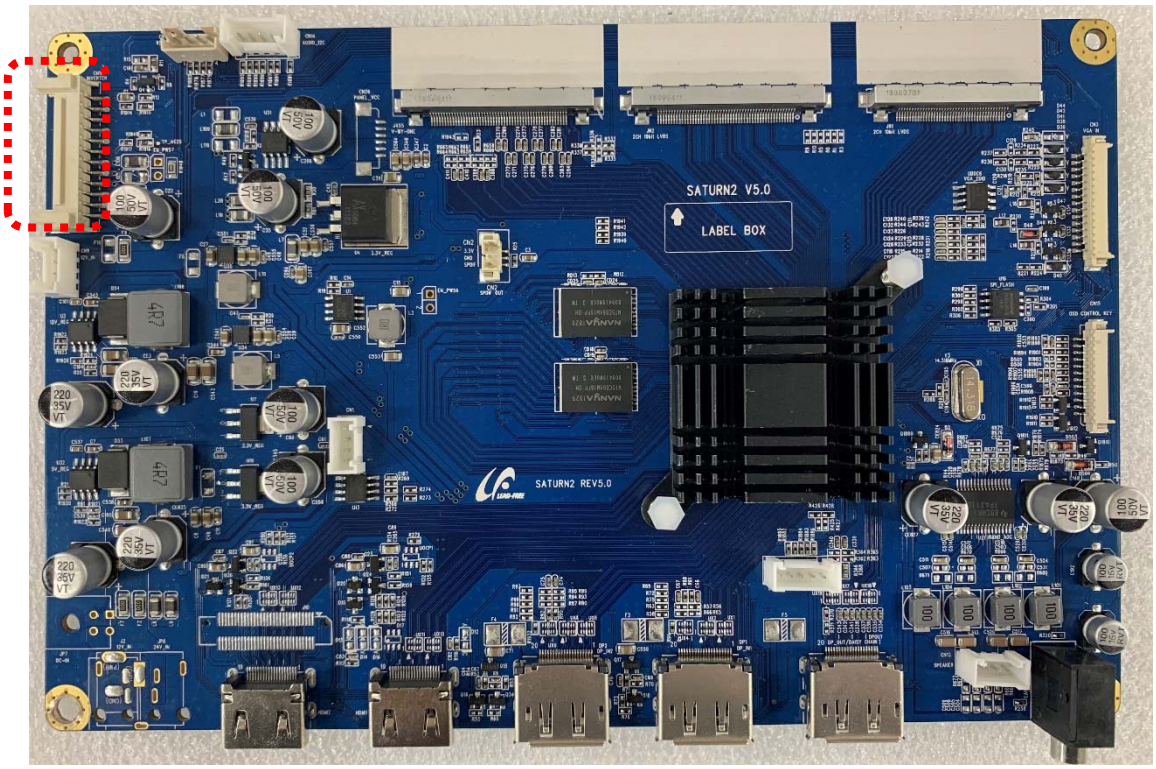
Front view : 12V Adaptor type (Barrel Jack)



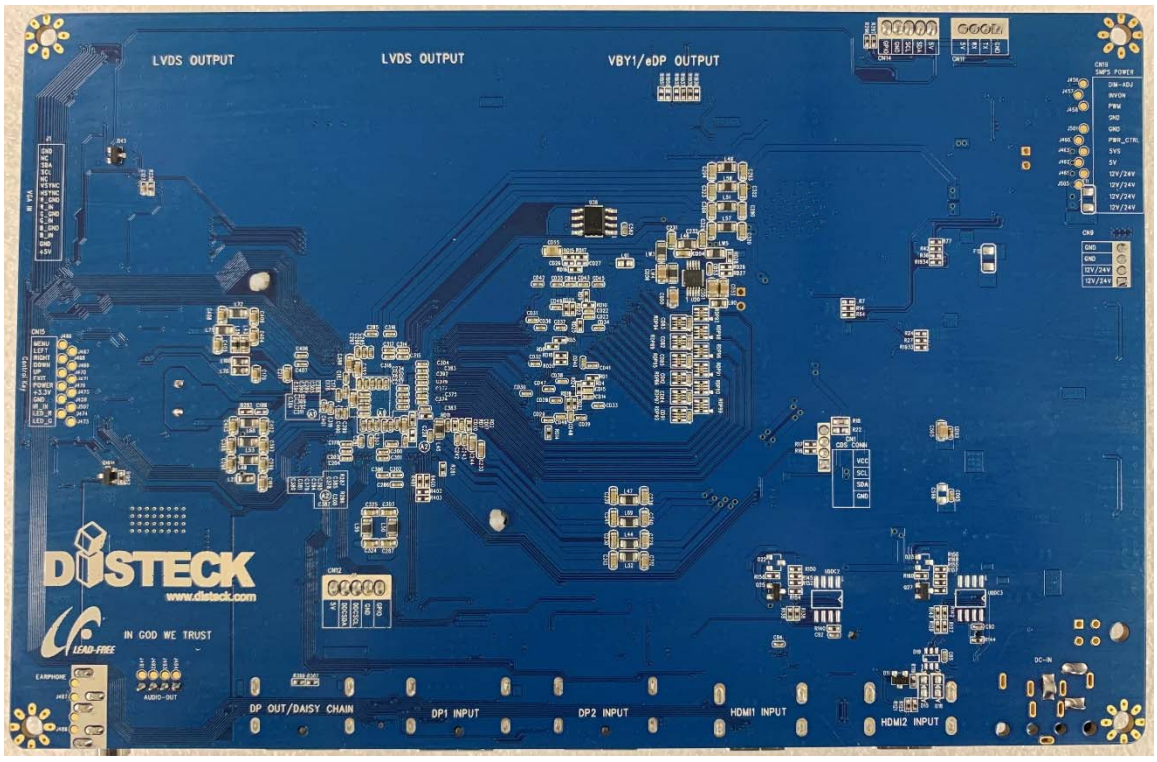
Front view : 24V Adaptor type (4 holes DIN Jack)



Front view : SMPS adoption type (ordinary wire connection, the dotted box in red / see the CN19 pin assignment table)



Rear view :



5 Connectors and Pin Information

5.1 Connector Summary

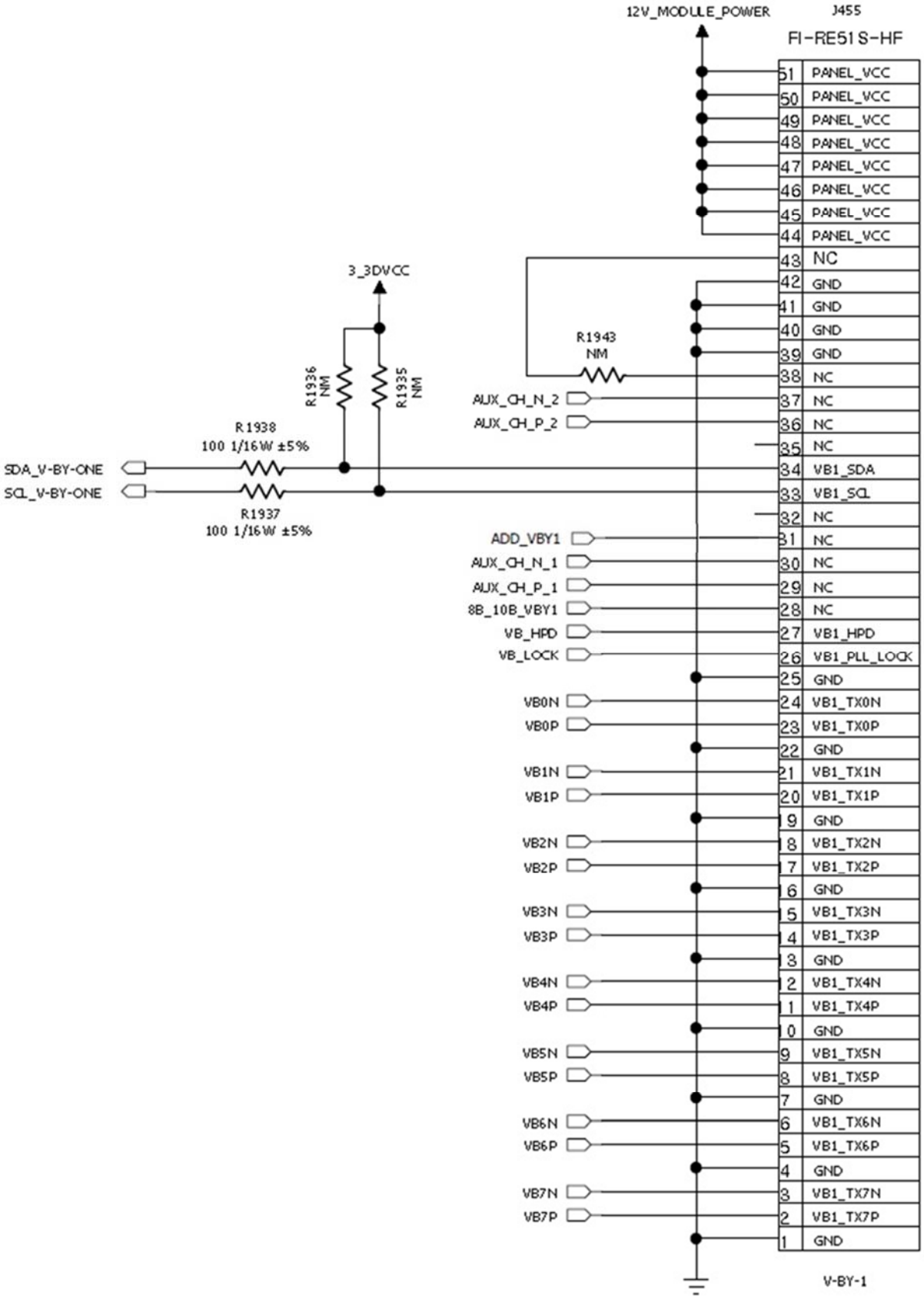
Reference	Item	Description	Type	Manufacture
J455	Signal output Wafer	For V-by-1 or e-DP Output	FI-RE51S-HF	JAE or equivalent
JN1	LVDS-2 Wafer	For LVDS C/D Output	FI-RE41S-HF	JAE or equivalent
JN2	LVDS-1 Wafer	For LVDS A/B Output	FI-RE51S-HF	JAE or equivalent
CN1	Wafer	For CDS	20010WS-04	Yeon-Ho or equivalent
CN2	Wafer	For SPDIF Output	12505WR-3P	Yeon-Ho or equivalent
CN3	Wafer	For VGA Signal Input	12505WR-15	Yeon-Ho or equivalent
CN7	Phone Jack	For Headphone Output	SJ3501-5 H7	Chang-Chun or equivalent
CN9	Wafer	For 120HZ FRC POWER	SMW200-06	Yeon-Ho or equivalent
CN11	Wafer	For RS232 Control	20010WS-04	Yeon-Ho or equivalent
CN12	Wafer	For I_2C Control(Slave)	20010WS-05	Yeon-Ho or equivalent
CN13	Wafer	For Speaker	SMW200-04	Yeon-Ho or equivalent
CN14	Wafer	For I_2C Control(Master)	20010WS-05	Yeon-Ho or equivalent
CN15	Wafer	For OSD Control key	12505WR-12	Yeon-Ho or equivalent
CN19	Wafer	For Inverter or SMPS	20037WR-12	Yeon-Ho or equivalent
CN20	Wafer	For PANEL POWER	12505WS-6P	Yeon-Ho or equivalent
J2	DC Power Jack	For 12V DC Power	DJ05H-250	Chang-Chun or equivalent
JP7	Wafer	For 12V/24V DC Power(Option)	430451400	Molex or equivalent
JP8	DC Power Jack	For 24V DC Power	KPJ-4S-S_4P	Chang-Chun or equivalent
DP1	DP Jack	For DP1.2 Input	DPCON_SINK	Molex or equivalent
DP2	DP Jack	For DP Output, Daisy Chain	DPCON_SINK	Molex or equivalent
DP3	DP Jack	For DP1.2 Input	DPCON_SINK	Molex or equivalent
HDMI2	HDMI Jack	For HDMI 2.0 Input	51L019S-36DN-A	Freeport or equivalent
HDMI3	HDMI Jack	For HDMI 2.0 Input	51L019S-36DN-A	Freeport or equivalent
J10	Wafer	For HDMI Wafer Input(Option)	FX8C-60P-SV2	Hirose or equivalent

5.2 Pin Map Details (pin assignment)

5.2.1 J455 : for V-by-1 Output, Wafer / when user adopts this connector for the Vx1 interface only

Pin No	Symbol	Description
1	GND	Ground
2	VB1_TX7P	V by One Positive data input Lane 7
3	VB1_TX7N	V by One Negative data input Lane 7
4	GND	Ground
5	VB1_TX6P	V by One Positive data input Lane 6
6	VB1_TX6N	V by One Negative data input Lane 6
7	GND	Ground
8	VB1_TX5P	V by One Positive data input Lane 5
9	VB1_TX5N	V by One Negative data input Lane 5
10	GND	Ground
11	VB1_TX4P	V by One Positive data input Lane 4
12	VB1_TX4N	V by One Negative data input Lane 4
13	GND	Ground
14	VB1_TX3P	V by One Positive data input Lane 3
15	VB1_TX3N	V by One Negative data input Lane 3
16	GND	Ground
17	VB1_TX2P	V by One Positive data input Lane 2
18	VB1_TX2N	V by One Negative data input Lane 2
19	GND	Ground
20	VB1_TX1P	V by One Positive data input Lane 1
21	VB1_TX1N	V by One Negative data input Lane 1
22	GND	Ground
23	VB1_TX0P	V by One Positive data input Lane 0
24	VB1_TX0N	V by One Negative data input Lane 0
25	GND	Ground
26	VB1_PLL_LOCK	Lock Detection
27	VB1_HPD	Hot Plug Detection
28~30	N.C	No Connection
31	Option_VBY1	Option For AUO Panel
32	N.C	No Connection
33	VB1_SCL	I2C Clock Line
34	VB1_SDA	I2C Data Line
35~38	N.C	No Connection
39~42	GND	Ground
43	N.C	No Connection
44~51	LCD_VDD	12V, VDD For LCD Module

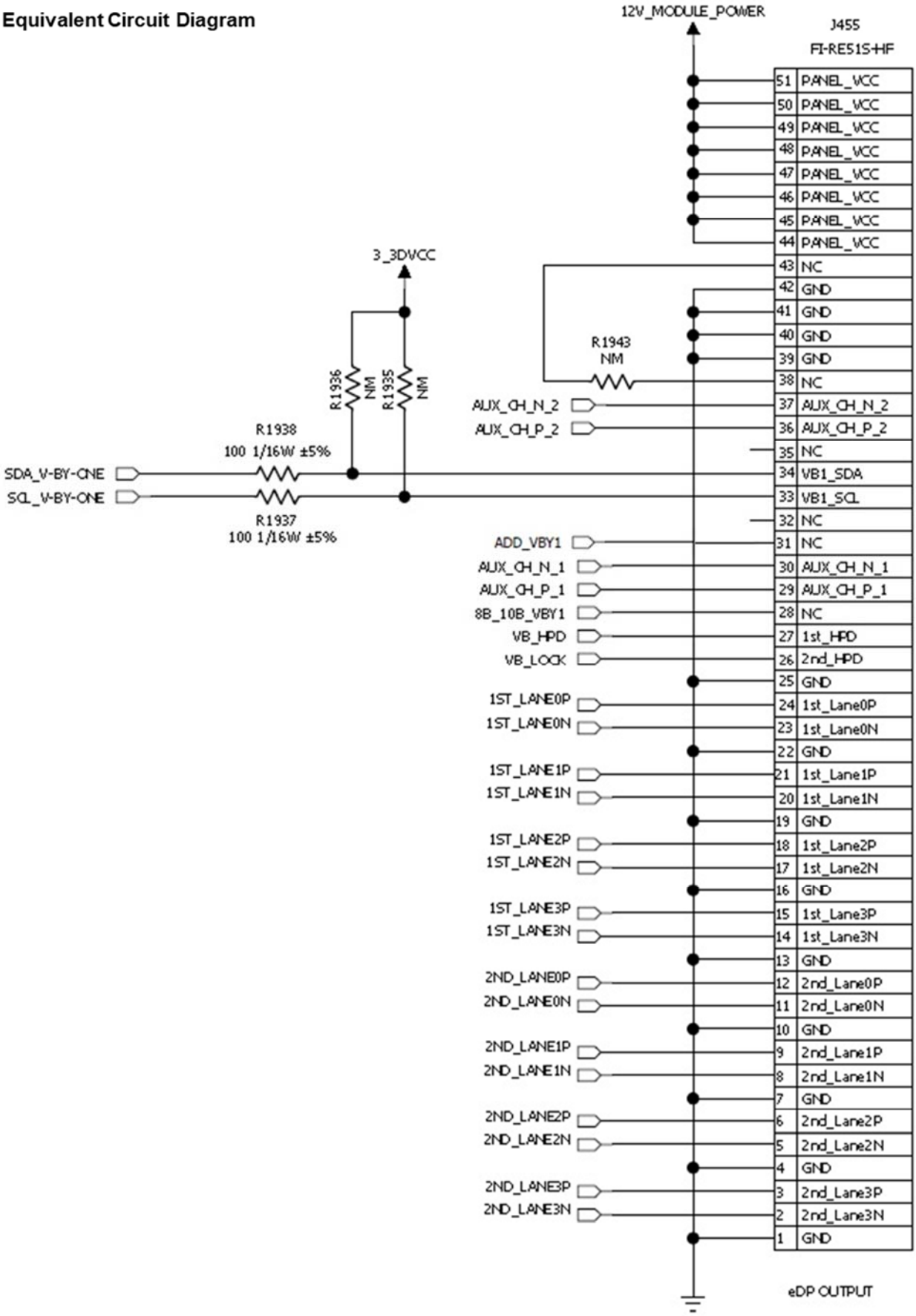
Equivalent Circuit Diagram



5.2.2 J455 : for e-DP(1.1) Output, Wafer / when user adopts this connector for the eDP interface only

Pin No	Symbol	Description
1	GND	Ground
2	2nd LANE3N	eDP 2nd t Negative data input Lane 3
3	2nd LANE3P	eDP 2nd Positive data input Lane 3
4	GND	Ground
5	2nd LANE2N	eDP 2nd Negative data input Lane 2
6	2nd LANE2P	eDP 2nd Positive data input Lane 2
7	GND	Ground
8	2nd LANE1N	eDP 2nd Negative data input Lane 1
9	2nd LANE1P	eDP 2nd Positive data input Lane 1
10	GND	Ground
11	2nd LANE0N	eDP 2nd Negative data input Lane 0
12	2nd LANE0P	eDP 2nd Positive data input Lane 0
13	GND	Ground
14	1st LANE3N	eDP 1st Negative data input Lane 3
15	1st LANE3P	eDP 1st Positive data input Lane 3
16	GND	Ground
17	1st LANE2N	eDP 1st Negative data input Lane 2
18	1st LANE2P	eDP 1st Positive data input Lane 2
19	GND	Ground
20	1st LANE1N	eDP 1st Negative data input Lane 1
21	1st LANE1P	eDP 1st Positive data input Lane 1
22	GND	Ground
23	1st LANE0N	eDP 1st Negative data input Lane 0
24	1st LANE0P	eDP 1st Positive data input Lane 0
25	GND	Ground
26	2nd HPD	2nd Hot Plug Detection
27	1st HPD	1st Hot Plug Detection
28	NC	No Connection
29	1st AUX_P	eDP 1st Positive AUX Channel
30	1st AUX_N	eDP 1st Negative AUX Channel
31~35	NC	No Connection
36	2nd AUX_P	eDP 2nd Negative AUX Channel
37	2nd AUX_N	eDP 2nd Positive AUX Channel
38	N.C	No Connection
39~42	GND	Ground
43	N.C	No Connection
44~51	LCD_VDD	12V, VDD For LCD Module

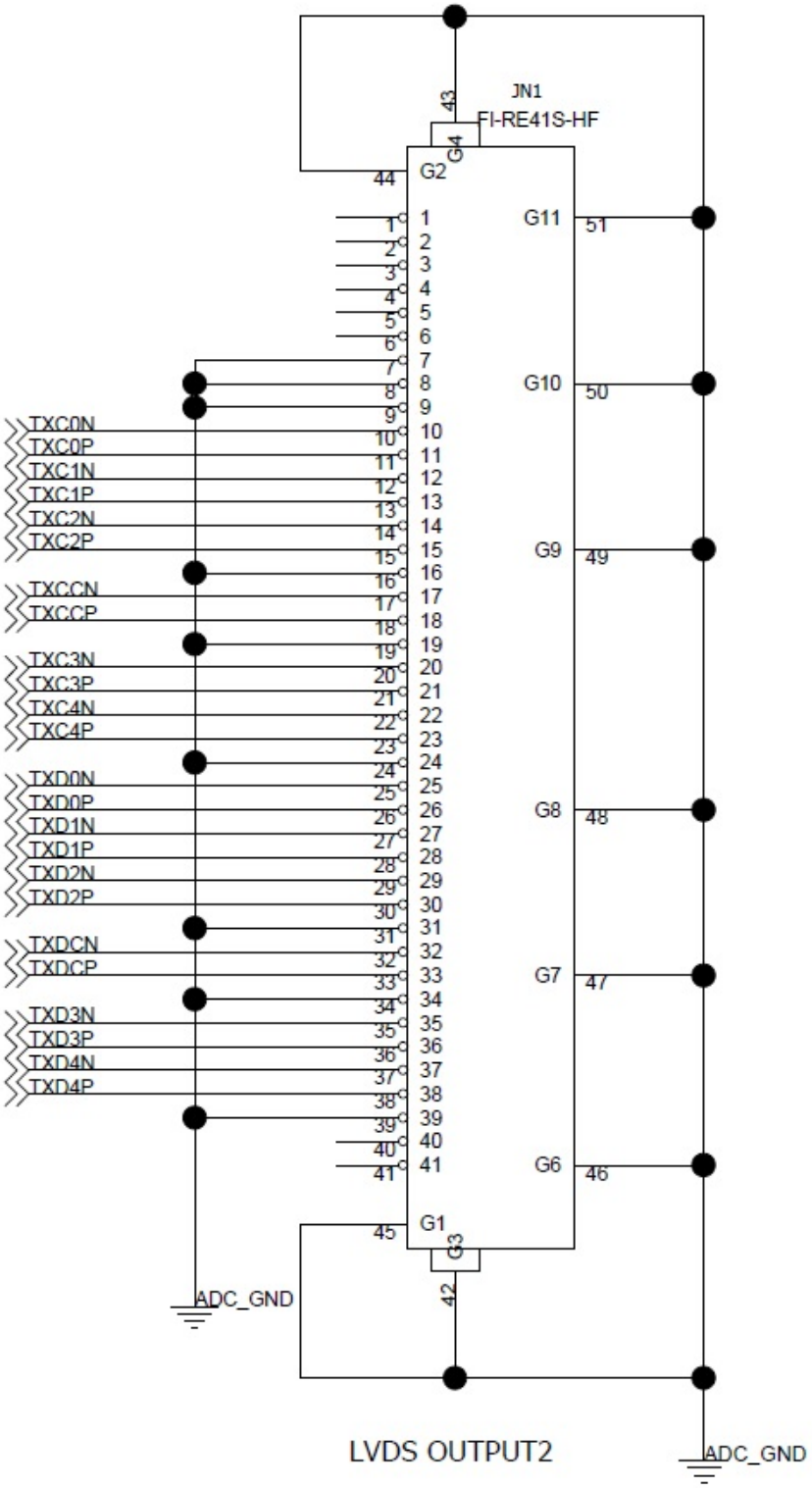
Equivalent Circuit Diagram



5.2.3 JN1 : for 2nd LVDS Output, Wafer

Pin No	Symbol	Description	Pin No.	Symbol	Description
			21	TXC 3+	3rd Channel 3+
41	NC	NC	20	TXC 3-	3rd Channel 3-
40	NC	NC	19	GND	Ground
39	GND	Ground	18	TXC C+	3th Channel C+
38	TXD 4+	4th Channel 4+	17	TXC C-	3th Channel C-
37	TXD 4-	4th Channel 4-	16	GND	Ground
36	TXD 3+	4th Channel 3+	15	TXC 2+	3th Channel 2+
35	TXD 3-	4th Channel 3-	14	TXC 2-	3th Channel 2-
34	GND	Ground	13	TXC 1+	3th Channel 1+
33	TXD C+	4th Channel C+	12	TXC 1-	3th Channel 1-
32	TXD C-	4th Channel C-	11	TXC 0+	3th Channel 0+
31	GND	GND	10	TXC 0-	3th Channel 0-
30	TXD 2+	4th Channel 2+	9	GND	Ground
29	TXD 2-	4th Channel 2-	8	GND	Ground
28	TXD 1+	4th Channel 1+	7	GND	Ground
27	TXD 1-	4th Channel 1-	6	NC	NC
26	TXD 0+	4th Channel 0+	5	NC	NC
25	TXD 0-	4th Channel 0-	4	NC	NC
24	GND	Ground	3	NC	NC
23	TXC 4+	3rd Channel 4+	2	NC	NC
22	TXC 4-	3rd Channel 4-	1	NC	NC

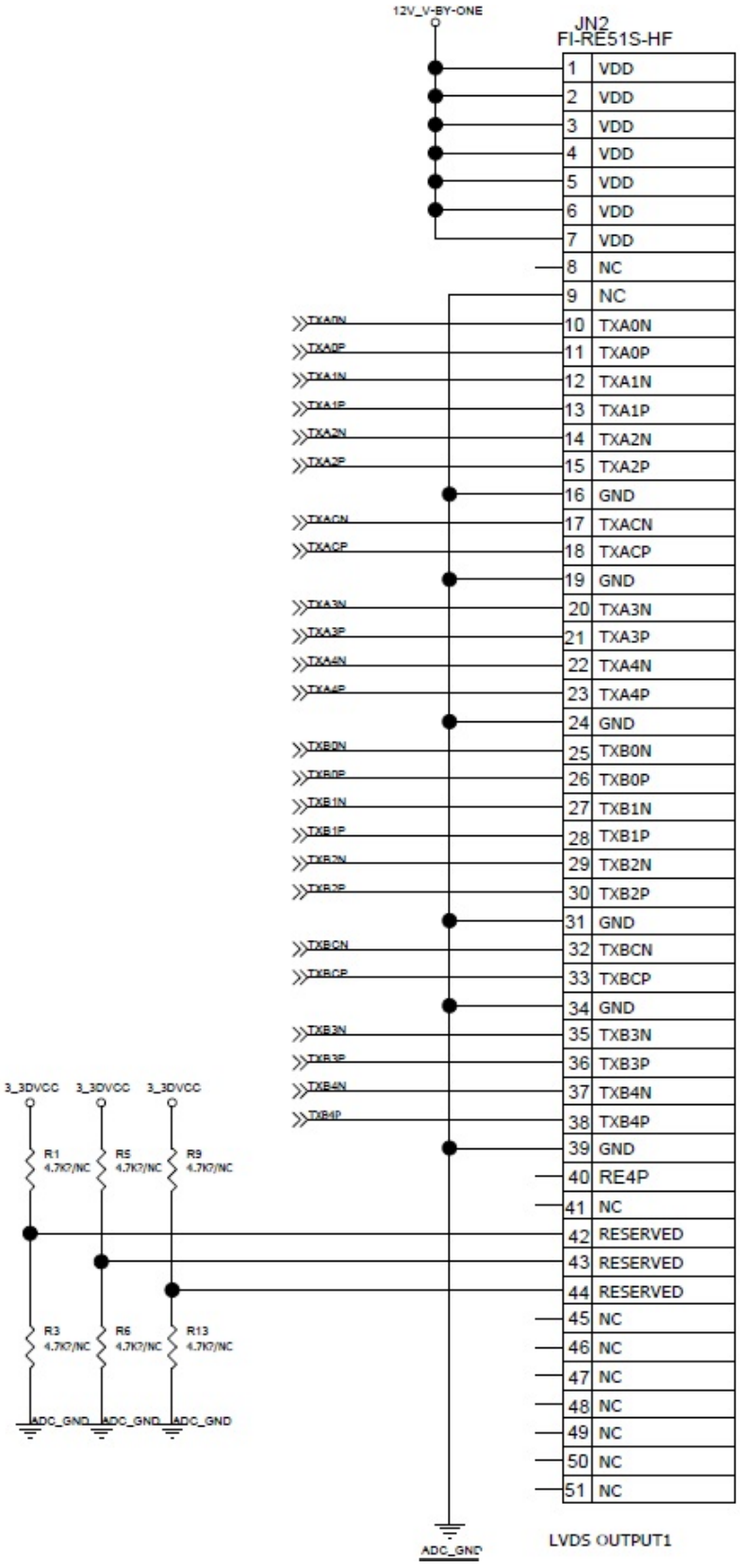
Equivalent Circuit Diagram



5.2.4 JN2 : for 1st LVDS Output, Wafer

Pin No	Symbol	Description	Pin No.	Symbol	Description
			26	TXB 0+	2st Channel 0+
51	NC	NC	25	TXB 0-	2st Channel 0-
50	NC	NC	24	GND	Ground
49	NC	NC	23	TXA 4+	1st Channel 4+
48	NC	NC	22	TXA 4-	1st Channel 4-
47	NC	NC	21	TXA 3+	1st Channel 3+
46	NC	NC	20	TXA 3-	1st Channel 3-
45	NC	NC	19	GND	Ground
44	RESERVED	RESERVED3	18	TXA C+	1st Channel C+
43	RESERVED	RESERVED2	17	TXA C-	1st Channel C-
42	RESERVED	RESERVED1	16	GND	Ground
41	NC	NC	15	TXA 2+	1st Channel 2+
40	NC	NC	14	TXA 2-	1st Channel 2-
39	GND	Ground	13	TXA 1+	1st Channel 1+
38	TXB 4+	2st Channel 4+	12	TXA 1-	1st Channel 1-
37	TXB 4-	2st Channel 4-	11	TXA 0+	1st Channel 0+
36	TXB 3+	2st Channel 3+	10	TXA 0-	1st Channel 0-
35	TXB 3-	2st Channel 3-	9	GND	Ground
34	GND	Ground	8	NC	NC
33	TXB C+	2st Channel C+	7	LCD_VDD	VDD For LCD
32	TXB C-	2st Channel C-	6	LCD_VDD	VDD For LCD
31	GND	Ground	5	LCD_VDD	VDD For LCD
30	TXB 2+	2st Channel 2+	4	LCD_VDD	VDD For LCD
29	TXB 2-	2st Channel 2-	3	LCD_VDD	VDD For LCD
28	TXB 1+	2st Channel 1+	2	LCD_VDD	VDD For LCD
27	TXB 1-	2st Channel 1-	1	LCD_VDD	VDD For LCD

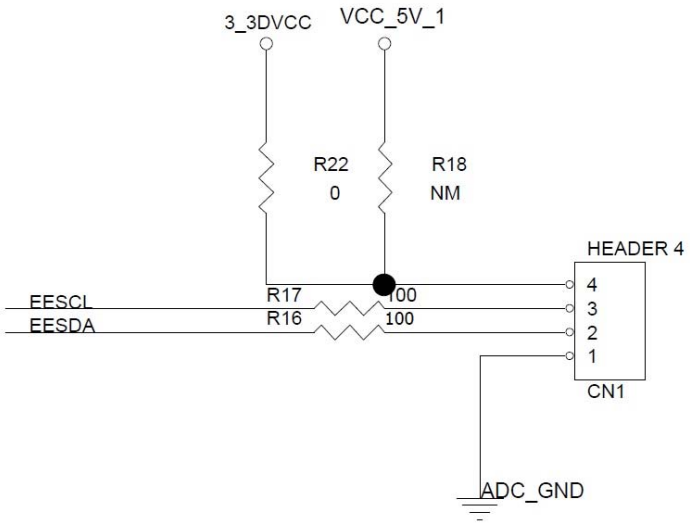
Equivalent Circuit Diagram



5.2.5 CN1 : for CDS

Pin No	Symbol	Description	Remarks
1	VCC	3.3V or 5.0V	
2	SCL	Signal for SCL	
3	SDA	Signal for SDA	
4	GND	Ground	

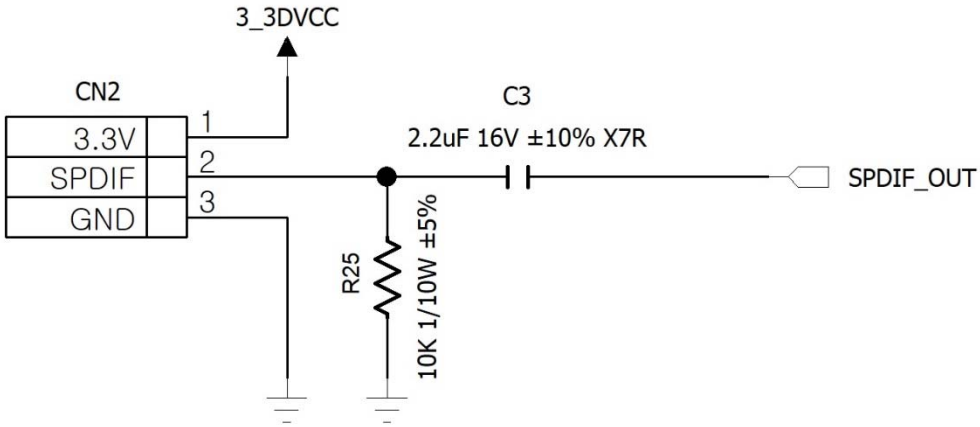
Equivalent Circuit Diagram



5.2.6 CN2 : for SPDIF

Pin No	Symbol	Description	Remarks
1	VCC	3.3V	
2	SPDIF	Signal for SPDIF	
3	GND	Ground	

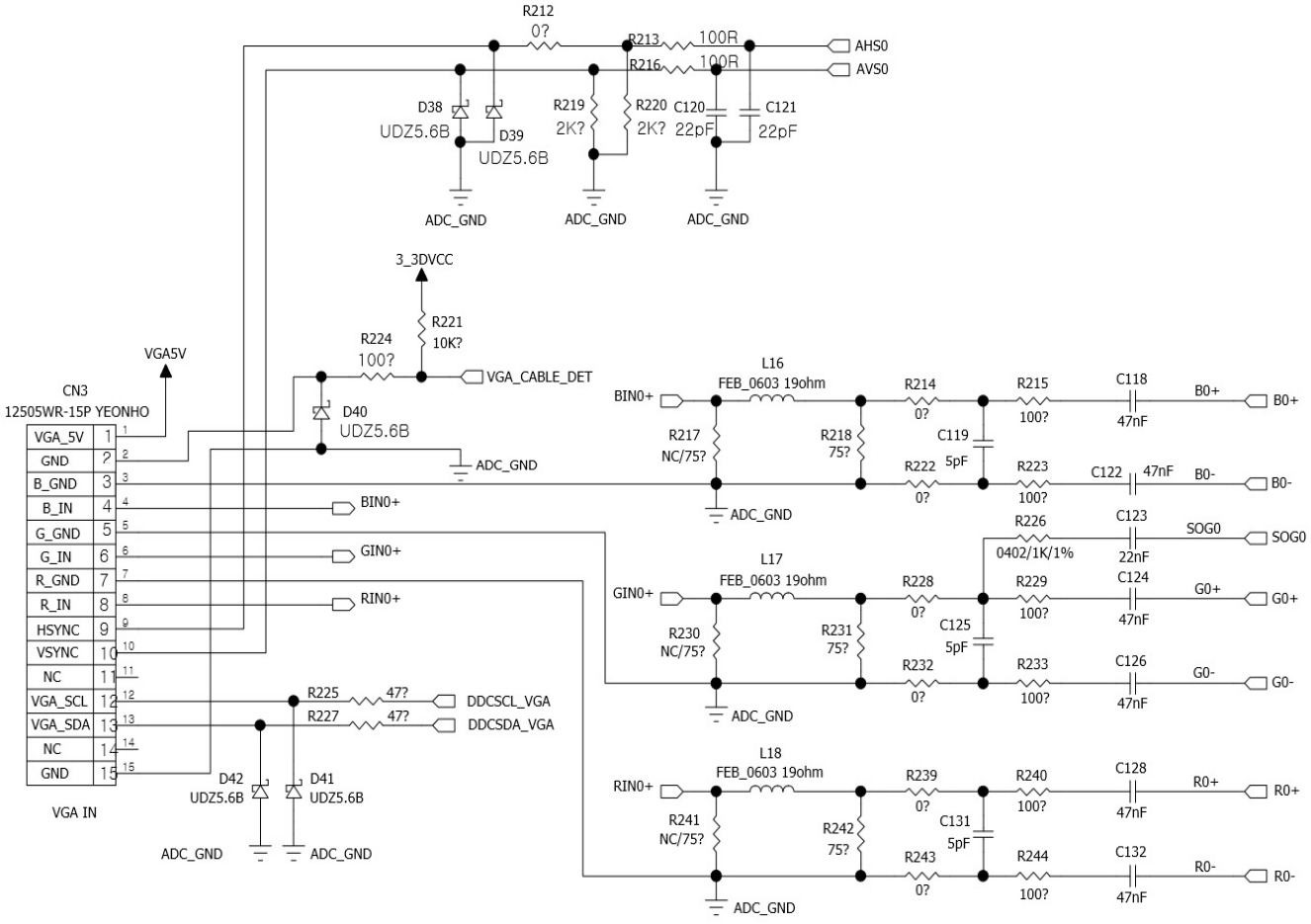
Equivalent Circuit Diagram



5.2.7 CN3 for VGA Input, D-SUB 15P

Pin No	Symbol	Description	Remarks
1	+5V	VGA +5V Power	
2	GND	Common Ground	
3	B_GND	Blue Ground	
4	B_IN	Blue Video Signal IN	
5	G_GND	Green Ground	
6	G_IN	Green Video Signal IN	
7	R_GND	Red Ground	
8	R_IN	Red Video Signal IN	
9	HSYNC	Horizontal Sync IN	
10	VSYNC	Vertical Sync IN	
11	NC	NC	
12	SCL	I2C_Clock	
13	SDA	I2C_Data	
14	NC	NC	
15	GND	Common Ground	

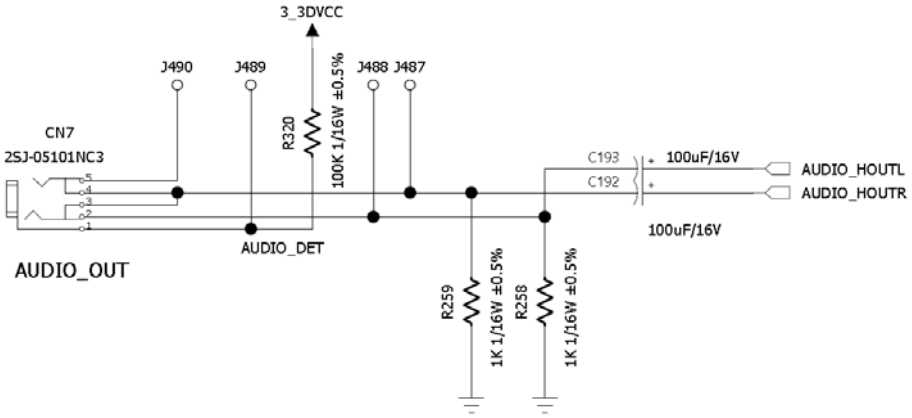
Equivalent Circuit Diagram



5.2.8 CN7 : for Audio Output, Head Phone Jack

Pin No	Symbol	Description	Remarks
1	DET	Detection	
2	L	Audio Left Input Signal	
3, 4	R	Audio Right Input Signal	
5	GND	Ground	

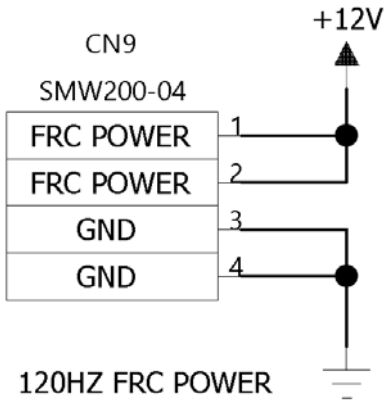
Equivalent Circuit Diagram



5.2.9 CN9 : for 120Hz FRC Board Power, wafer

9	Symbol	Description	Remarks
1,2	FRC Power	12V or 24V For FRC Power	
3,4	GND	Ground	

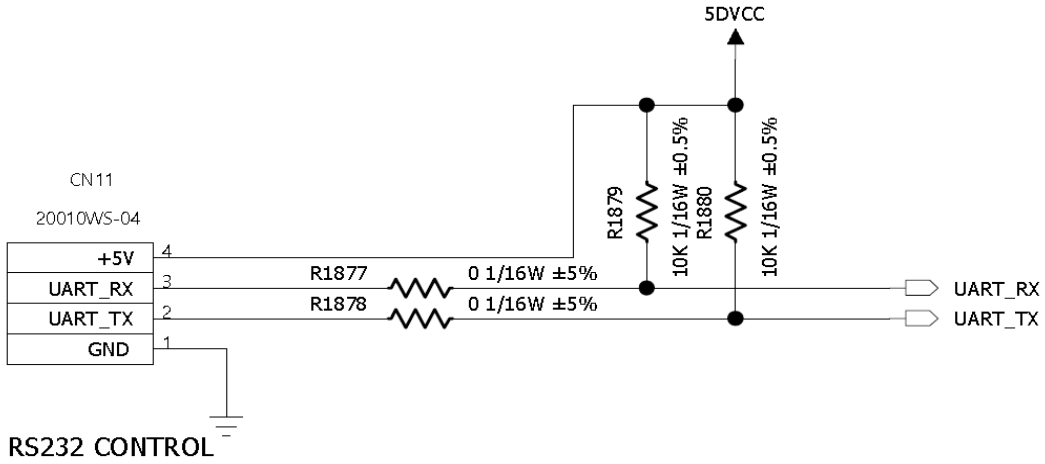
Equivalent Circuit Diagram



5.2.10 CN11 : for RS232 Control, wafer

Pin No	Symbol	Description	Remarks
1	GND	Ground	
2	TXD	Signal for TX	
3	RXD	Signal For RX	
4	5V	5V Power	

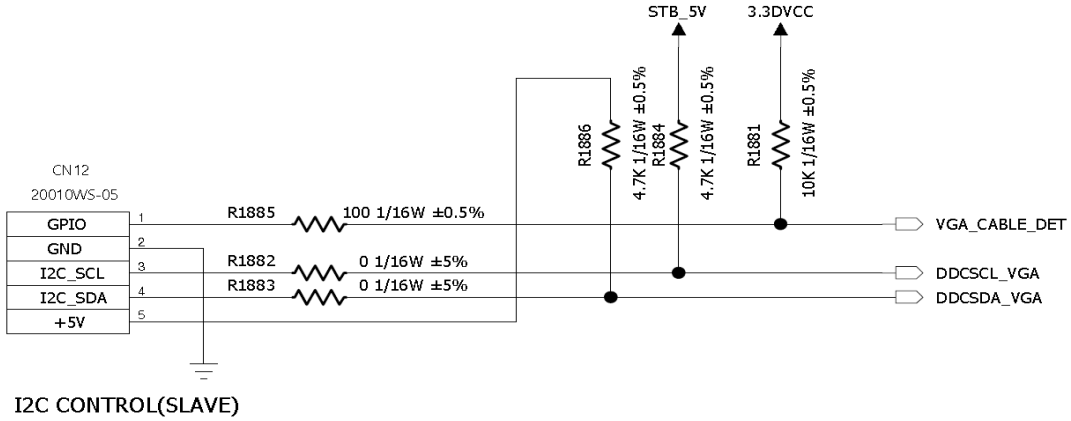
Equivalent Circuit Diagram



5.2.11 CN12 : for I_2C Control(Slave), wafer

Pin No	Symbol	Description	Remarks
1	GPIO	GPIO Option	
2	GND	Ground	
3	SDA	Signal for SDA	
4	SCL	Signal for SCL	
5	5V	5V Power	

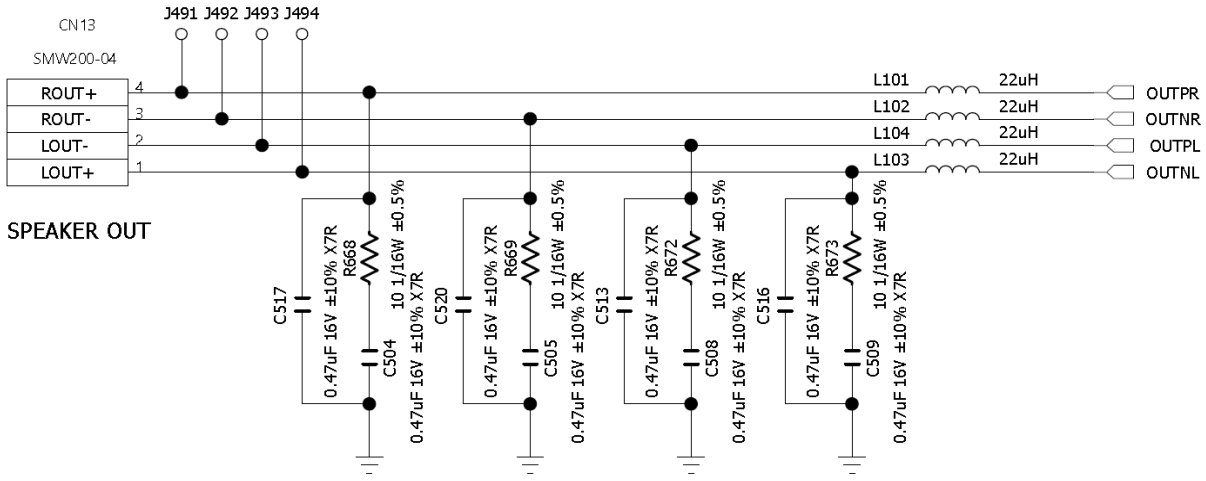
Equivalent Circuit Diagram



5.2.12 CN13 : for Speaker, wafer

Pin No	Symbol	Description	Remarks
1	SP_L+	Audio Left Speaker Output Positive	
2	SP_L-	Audio Left Speaker Output Negative	
3	SP_R-	Audio Right Speaker Output Negative	
4	SP_R+	Audio Right Speaker Output Positive	

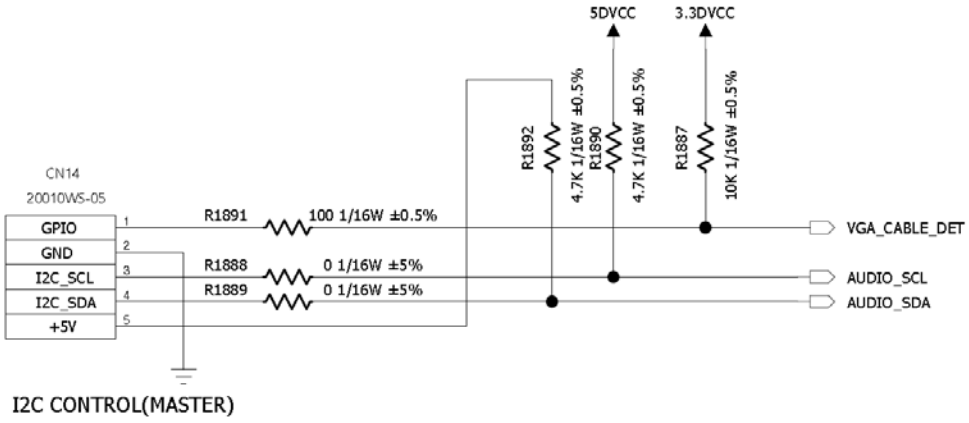
Equivalent Circuit Diagram



5.2.13 CN14 : for I_2C Control(Master), wafer

Pin No	Symbol	Description	Remarks
1	GPIO	GPIO Option	
2	GND	Ground	
3	SDA	Signal for SDA	
4	SCL	Signal for SCL	
5	5V	5V Power	

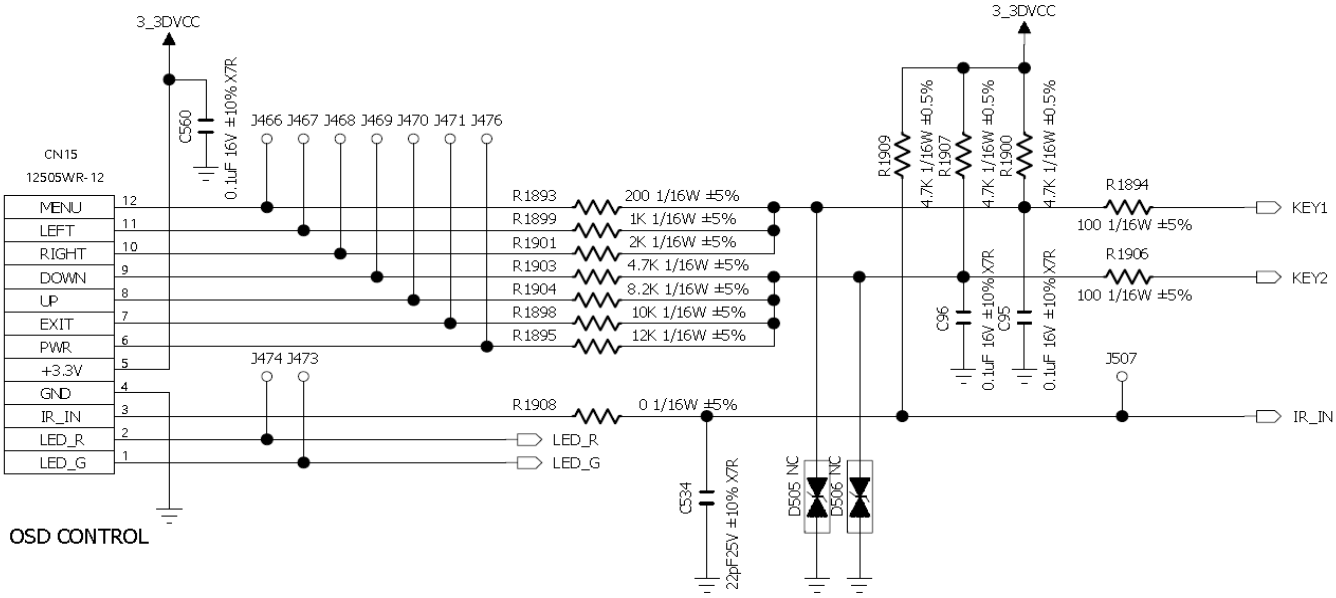
Equivalent Circuit Diagram



5.2.14 CN15 : for OSD Control Key, Wafer

Pin No	Symbol	Description	Remarks
1	LED Green Key	LED drive for Green Color	
2	LED Red_Key	LED drive for RED Color	
3	IR_Key	IR Receiver	
4	GND	Ground	
5	3.3V_Key	3.3V	
6	PWR_Key	POWER key	
7	Select Key	Select key	
8	UP_Key	UP key	
9	Down_Key	Down key	
10	Right_Key	Right key	
11	Left_Key	Left key	
12	Menu_Key	Menu / Exit key	

Equivalent Circuit Diagram

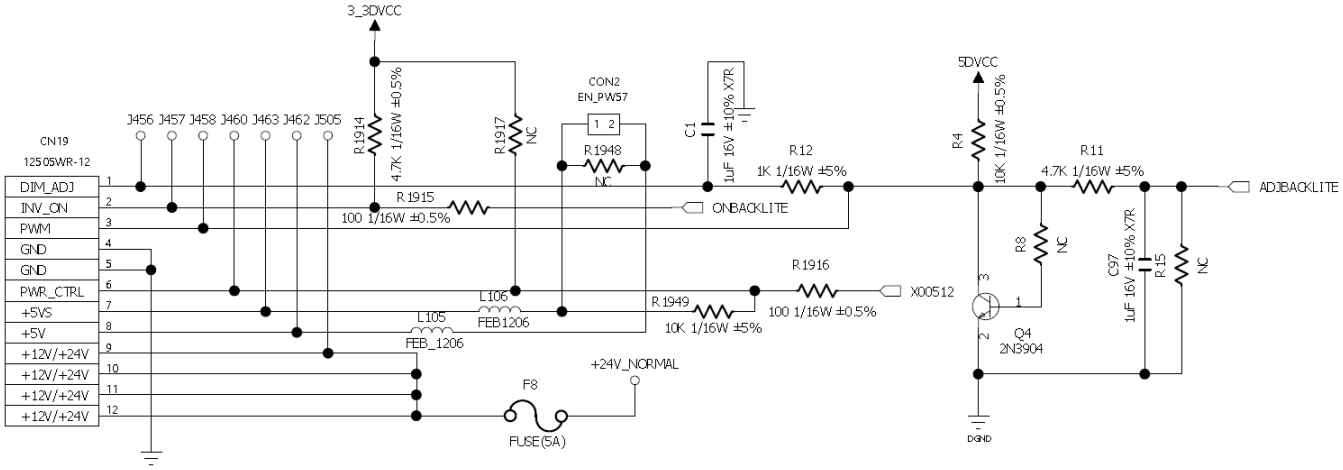


5.2.15 CN19 : for Inverter/LED Driver or SMPS, wafer

Pin No	Symbol	Description	Remarks
1	DIM-ADJ	Dimming Adjustment	
2	INVON	Inverter Power On, Off	0V (Off), 3.3V(On)
3	PWM	PWM Dimming Control	
4,5	GND	Ground	
6	PWR_CTRL	Power Control Out (SMPS), NC(Inverter)	0V (Off), 3.3V(On)
7	5VS	5VS In (SMPS), NC(Inverter)	5V ± 1%
8	5V	5V In (SMPS), NC(Inverter)	5V ± 1%

9,10,11,12	24V	24V In or 12V In(SMPS), 24V Out(Inverter)	24V ± 5% 12V ± 3%

Equivalent Circuit Diagram

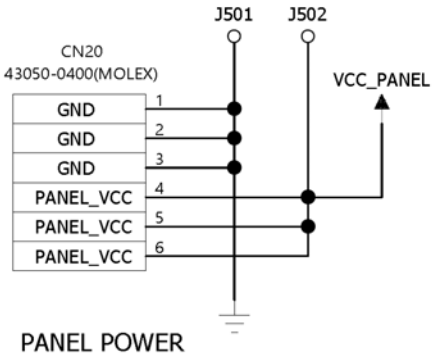


Inverter/LED Driver or SMPS

5.2.16 CN20 : for Panel Power

Pin No	Symbol	Description	Remarks
1,2,3	GND	Ground	
4,5,6	Panel Power	Power of Panel	

Equivalent Circuit Diagram



5.2.17 J2 : for 12V DC Power, Jack

	Symbol	Description	Remarks
1	12V	12V Power Input	12V ± 5%
2,3	GND	Ground	

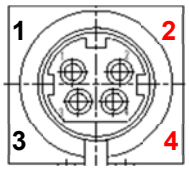
5.2.18 JP7 : for 12V/24V DC Power, Jack

Pin No	Symbol	Description	Remarks

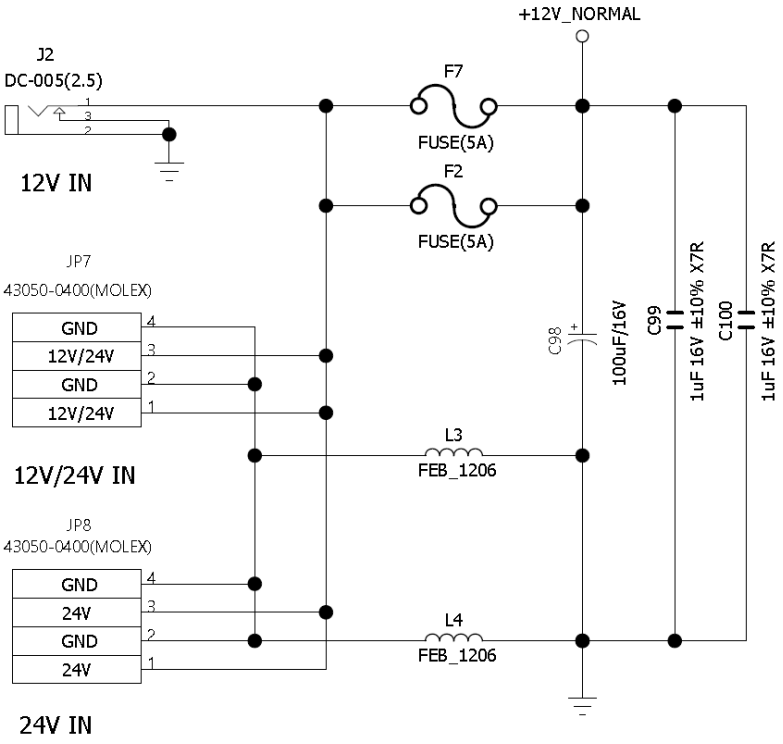
1,3	12V/24V	12V/24V Power Input	12V ± 5%
2,4	GND	Ground	

5.2.19 JP8 : for 24V DC Power, Jack

Pin No	Symbol	Description	Remarks
1,3	GND	Ground	
2,4	24V	24V Power Input	24V ± 5%



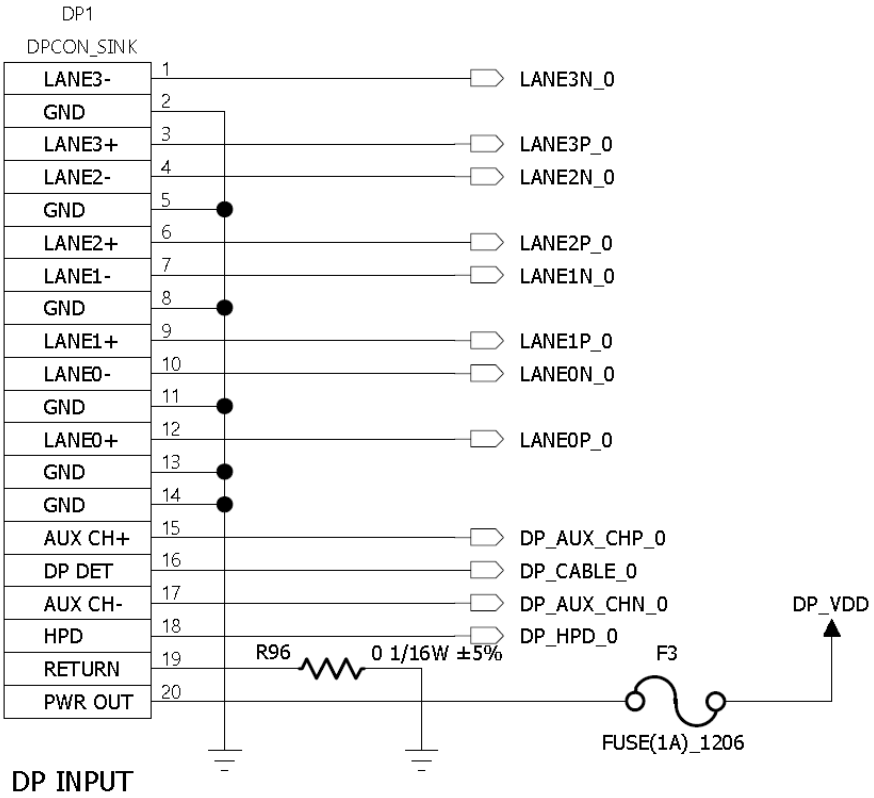
Equivalent Circuit Diagram



5.2.20 DP1, DP3 : for DP Input, DP Jack

Pin No	Symbol	Description	Remarks
1	LANE3-	Negative Signal for Main Link 3	
3	LANE3+	Positive Signal for Main Link 3	
4	LANE2-	Negative Signal for Main Link 2	
6	LANE2+	Positive Signal for Main Link 2	
7	LANE1-	Negative Signal for Main Link 1	
9	LANE1+	Positive Signal for Main Link 1	
10	LANE0-	Negative Signal for Main Link 0	
12	LANE0+	Positive Signal for Main Link 0	
15	AUX CH+	Positive Signal for Auxiliary Channel	
16	DP DET	DP Cable Detect	
17	AUX CH-	Negative Signal for Auxiliary Channel	
18	HPD	Hot Plug Detection	
19	RETURN	NO Connection	
20	PWR OUT	3.3V	
2, 5, 8, 11, 13, 14	GND	Ground	

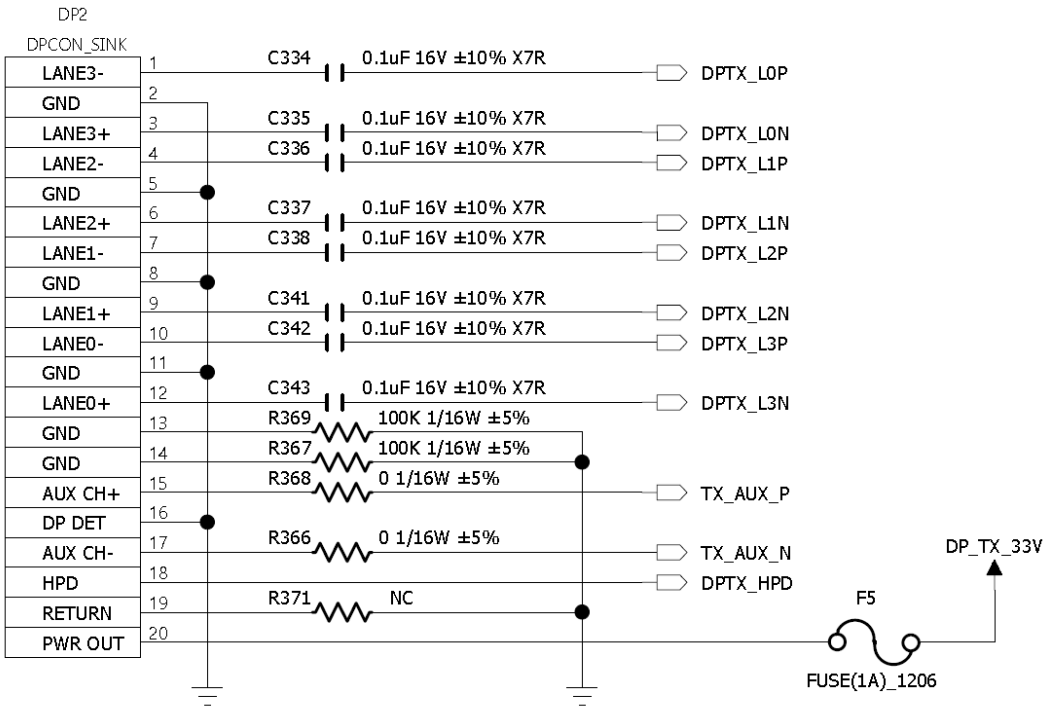
Equivalent Circuit Diagram



5.2.21 DP2 : for DP Output, DP Jack(Daisy chain)

Pin No	Symbol	Description	Remarks
1	LANE0+	Positive Signal for Main Link 0	
3	LANE0-	Negative Signal for Main Link 0	
4	LANE1+	Positive Signal for Main Link 1	
6	LANE1-	Negative Signal for Main Link 1	
7	LANE2+	Positive Signal for Main Link 2	
9	LANE2-	Negative Signal for Main Link 2	
10	LANE3+	Positive Signal for Main Link 3	
12	LANE3-	Negative Signal for Main Link 3	
13	CONFIG1	Pull down resister 100KR	
14	CONFIG2	Pull down resister 100KR	
15	AUX CH+	Positive Signal for Auxiliary Channel	
17	AUX CH-	Negative Signal for Auxiliary Channel	
18	HPD	Hot Plug Detection	
19	RETURN	No Connection	
20	PWR OUT	3.3V	
2, 5, 8, 11, 16	GND	Ground	

Equivalent Circuit Diagram

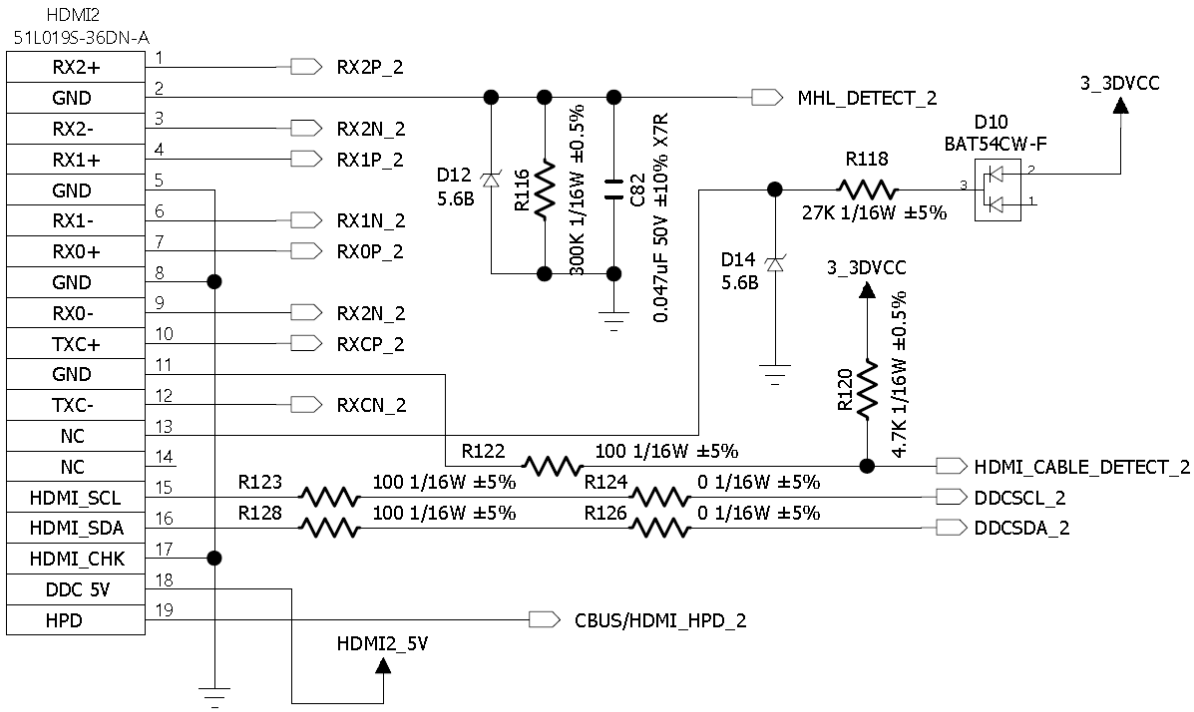


DP OUTPUT, Daisy Chain

5.2.22 HDMI2, HDMI3: for HDMI Input, HDMI Jack

Pin No	Symbol	Description	Remarks
1	RX2+	HDMI DATA2 Differential Positive Signal	
2	GND	Ground	
3	RX2-	HDMI DATA2 Differential Negative Signal	
4	RX1+	HDMI DATA1 Differential Positive Signal	
5	GND	Ground	
6	RX1-	HDMI DATA1 Differential Negative Signal	
7	RX0+	HDMI DATA0 Differential Positive Signal	
8	GND	Ground	
9	RX0-	HDMI DATA0 Differential Negative Signal	
10	RXC+	HDMI CLOCK Differential Positive Signal	
11	GND	Ground	
12	RXC-	HDMI CLOCK Differential Negative Signal	
13,14	NC	NO CONNECTION	
15	HDMI_SCL	HDMI Clock Line	
16	HDMI_SDA	HDMI Data Line	
17	HDMI_CHK	HDMI Check	
18	HDMI_DDC5V	5V Power Supply	
19	HDMI_HOT_PLUG	HDMI Hot Plug	
20,21	GND	Ground	

Equivalent Circuit Diagram

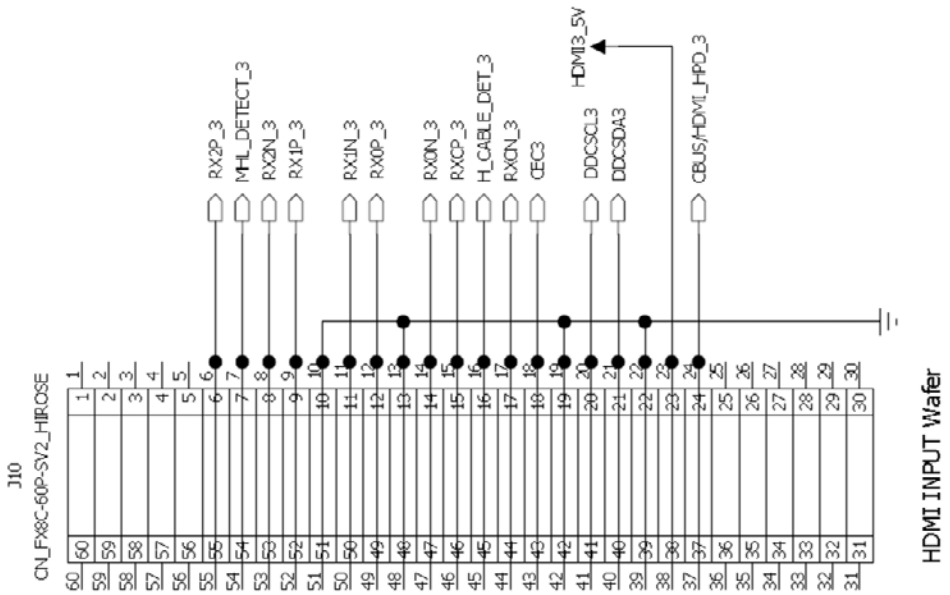


HDMI 2.0 INPUT

5.2.23 J10: for HDMI Input, HDMI Wafer

Pin No	Symbol	Description	Remarks
1~5	NC	NO CONNECTION	
6, 55	RX2+	HDMI DATA2 Differential Positive Signal	
7, 54	GND	Ground	
8, 53	RX2-	HDMI DATA2 Differential Negative Signal	
9, 52	RX1+	HDMI DATA1 Differential Positive Signal	
10, 51	GND	Ground	
11, 50	RX1-	HDMI DATA1 Differential Negative Signal	
12, 49	RX0+	HDMI DATA0 Differential Positive Signal	
13, 48	GND	Ground	
14, 47	RX0-	HDMI DATA0 Differential Negative Signal	
15, 46	RXC+	HDMI CLOCK Differential Positive Signal	
16, 45	GND	Ground	
17, 44	RXC-	HDMI CLOCK Differential Negative Signal	
18, 43	CEC	CEC	
19,42	HDMI_CHK	HDMI	
20, 41	HDMI_SCL	HDMI Clock Line	
21, 40	HDMI_SDA	HDMI Data Line	
22,39	GND	Ground	
23,38	HDMI_DDC5V	5V Power Supply	
24,37	HDMI_HOT_PLUG	HDMI Hot Plug	
25~36	NC	NO CONNECTION	
56~60	NC	NO CONNECTION	

Equivalent Circuit Diagram



6. Applicable Graphic Mode

The microprocessor measures the H-sync, V-sync and V-sync/H-sync polarity for RGB inputs, and uses this timing information to control all of the display operation to get the proper image on a screen. This board can detect all VESA standard and MAC Graphic modes shown on the table below and provide more clear and stable image on a screen.
RGB & DIVI Input format

Resolution	Pixel Freq.	Horizontal Timing				Vertical Timing			
		Sync Polar	Freq.	Total	Active	Sync Polar	Freq.	Total	Active
	MHz		KHz	Pixel	Pixel		Hz	Line	Line
640x350 @70Hz	25.144 VESA	P	31.430	800	640	N	70.000	449	350
720x400 @70Hz	28.287 VESA	N	31.430	900	720	P	70.000	449	400
640x480 @60Hz	25.175 MAC	N	31.469	800	640	N	59.940	525	480
640x480 @60Hz	25.175 VESA	N	31.469	800	640	N	59.940	525	480
640x480 @67Hz	30.240 MAC	N	35.000	864	640	N	66.667	525	480
640x480 @72Hz	31.500 VESA	N	37.861	832	640	N	72.809	520	480
640x480 @75Hz	31.500 VESA	N	37.500	840	640	N	75.000	500	480
832x624 @75Hz	57.284 MAC	N	49.726	1152	832	N	74.551	667	624
800x600 @56Hz	36.000 VESA	P	35.156	1024	800	P	56.250	625	600
800x600 @60Hz	40.000 VESA	P	37.879	1056	800	P	60.317	628	600
800x600 @72Hz	50.000 VESA	P	48.077	1040	800	P	72.188	666	600
800x600 @75Hz	49.500 VESA	P	46.875	1056	800	P	75.000	625	600
1024x768 @60Hz	65.000 VESA	N	48.363	1344	1024	N	60.005	806	768
1024x768 @60Hz	64.000 MAC	N	48.780	1312	1024	N	60.001	813	768
1024x768 @70Hz	75.000 VESA	N	56.476	1328	1024	N	70.070	806	768
1024x768 @75Hz	80.000 MAC	N	60.241	1328	1024	N	74.927	804	768
1024x768 @75Hz	78.750 VESA	P	60.023	1312	1024	P	75.030	800	768
1280x768 @60Hz	79,500 VESA	P	47,780	1664	1280	P	59,870	798	768
1280x1024 @60Hz	108.000 VESA	P	63.981	1688	1280	P	60.020	1066	1024
1280x1024 @75Hz	135.000 VESA	P	79.976	1688	1280	P	75.025	1066	1024
1360X768 @60Hz	85.00 VESA	P	47.712	1792	1360	P	60.015	795	768
1600x1200 @60Hz	160.875 VESA	N	74.479	2160	1600	P	59.967	1242	1200
1680x1050 @60Hz	147.000 VESA	N	65.160	2256	1680	P	59.944	1087	1050
1920x1080 @60Hz	172.750 VESA	N	67.061	2576	1920	P	59.983	1118	1080
1920X1200@60Hz	193.125 VESA	N	74.508	1292	1920	P	59,990	1242	1200
2560X1440@60Hz		N	88.7		2560				1440
2560X1600@60Hz		N	98.7		2560				1600
3840X2160@60Hz		N	135		3840				2160
4096X2160@60Hz		N	135		4096				2160

7. OSD Board Menu Tree

The On Screen Display consists of following menu.
These can be activated by Remote Controller or OSD Key pad manually.

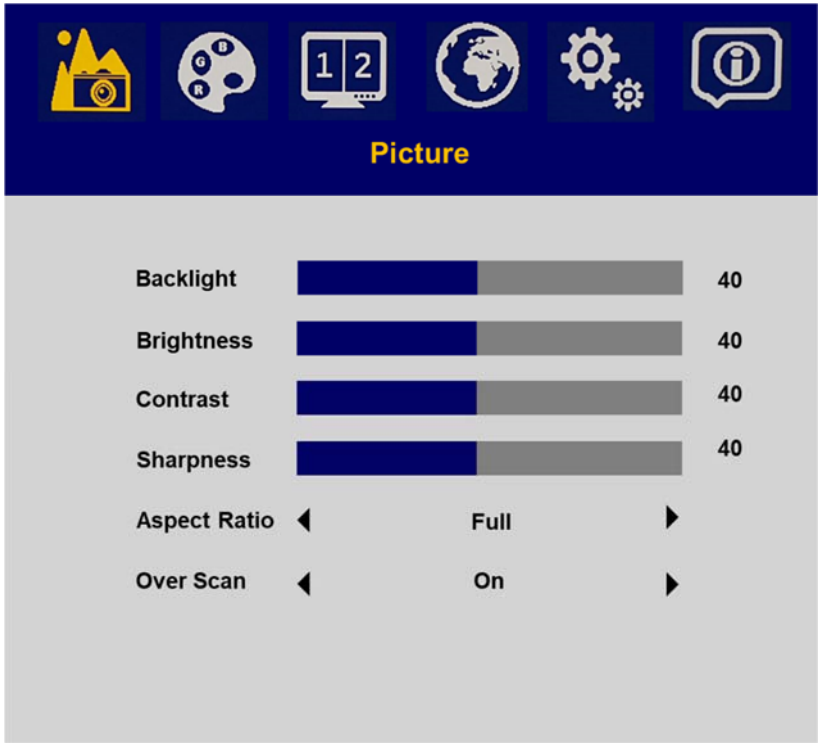
7.1 Summarized Table

Main Menu	Sub Menu	Control	
Picture	Backlight	0 ~ 100	
	Brightness	0 ~ 100	
	Contrast	0 ~ 100	
	Sharpness	0 ~ 4	
	Aspect Ratio	full, 16:9, 4:3, 5:4, 1:1	
	Over scan	On / Off	
Color	Color Effect	Standard, Game, Movie, Photo, Vivid, User	
	Gamma	Off, 1.8, 2.0, 2.2, 2.4	
	Hue	0 ~ 100	
	Saturation	0 ~ 100	
	Temperature	9300, 7500, 6500, 5800, sRGB, User	
	Red	0 ~ 100	
	Green	0 ~ 100	
	Blue	0 ~ 100	
Input	Display Mode	Auto Select, D0:DP, D1:HDMI, D2:MHL, D3:HDMI, D4:HDMI	
	Display Rotate	0°, 90°, 180°, 270°	
	Input Swap	Yes / No	
	LR Ratio	0 ~ 4	
	PIP Size	0 ~ 10	
	PIP Position	RB, RT, LB, LT	
	PIP Transparency	0 ~ 10	
	Video Wall Settings	Video Wall	On / Off
		Display Number	1 ~ 25
		Horizontal Number	1 ~ 5
		Vertical Number	1 ~ 5
		RS232 ID	1~ 25
OSD Setting	Language	English	
	OSD H Position	0 ~ 100	
	OSD V Position	0 ~ 100	
	Transparency	0 ~ 100	
	Menu Time	10 ~ 60	
	Rotate	0°, 90°, 180°, 270°	

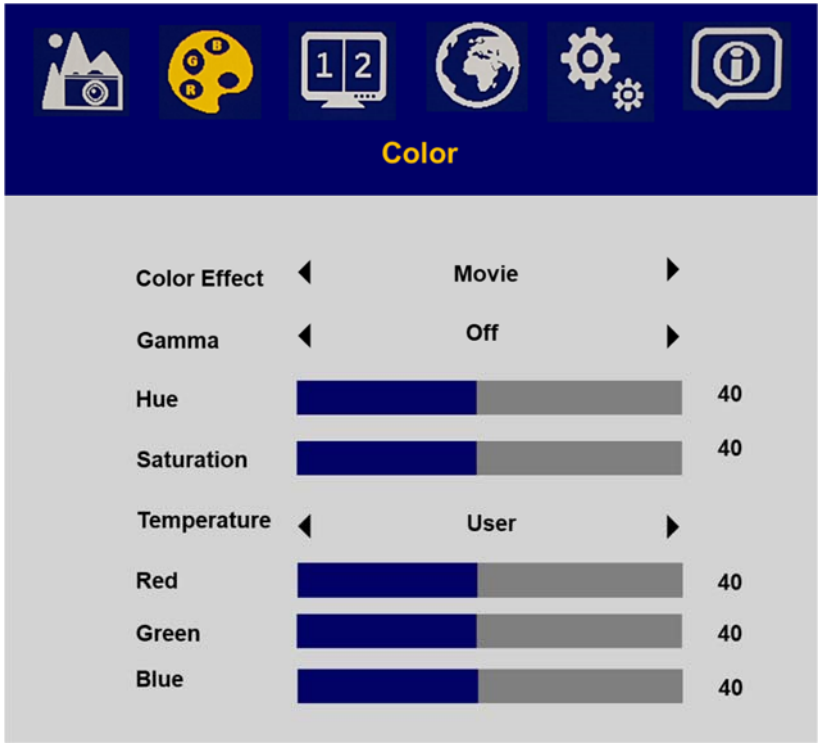
Advance	Reset	Yes / No
	DP Format	Ver 1.1, Ver 1.2,
	DP MST	On / Off
	Clone Mode	On / Off
	Volume	0 ~ 100
	Mute	On / Off
	Audio Source	P1, P2, P3, P4
	Power Save	Off, 5Sec, 30Sec, 1Min, 2Min, 5Min, 30Min, 60Min, 120Min
	***HDR Mode (Option)**	Off, Auto
	***ALCW Setting (some specific AUO panels only)**	Disable, Enable
Information		Display Information

7.2 UI Design shape by the orders of Menu Tree

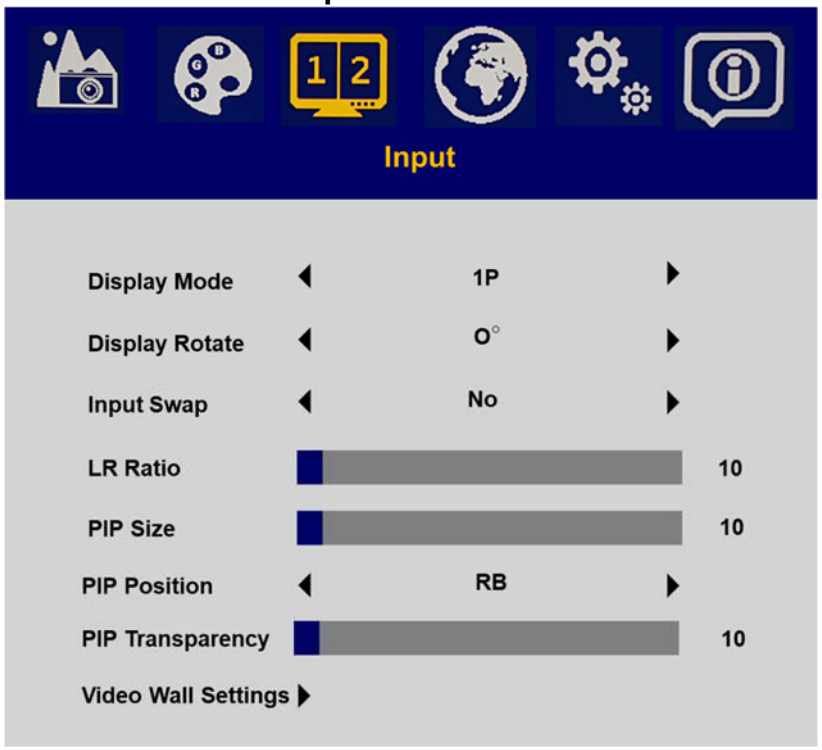
main menu - 1 : Picture



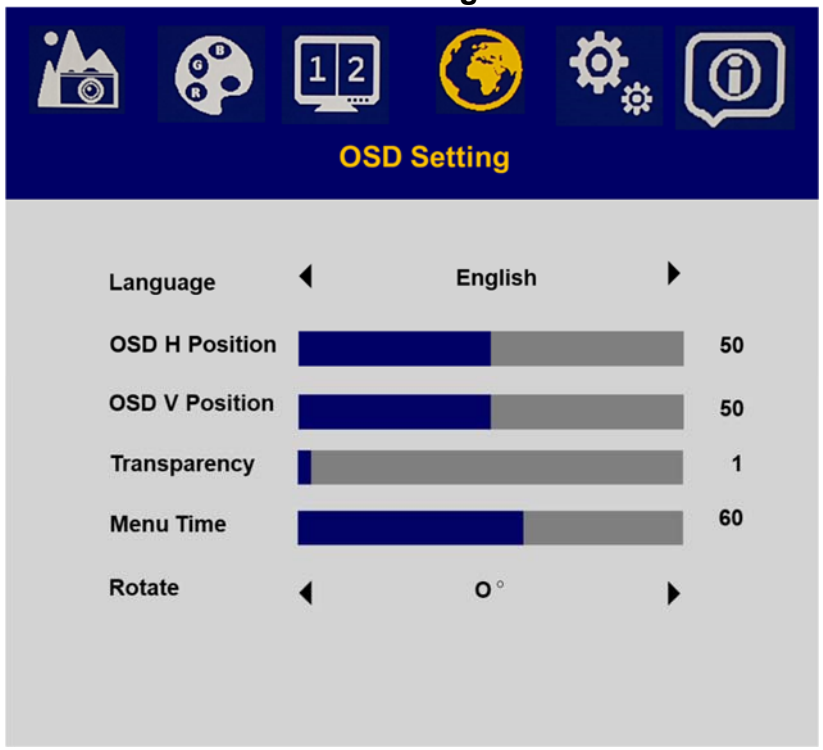
main menu - 2 : Color



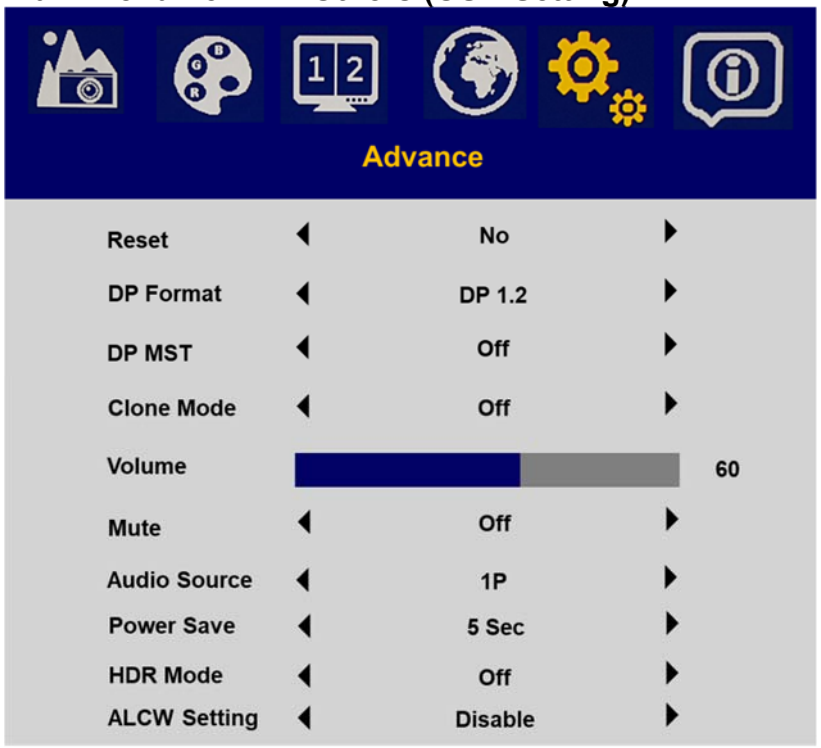
main menu - 3 : Input



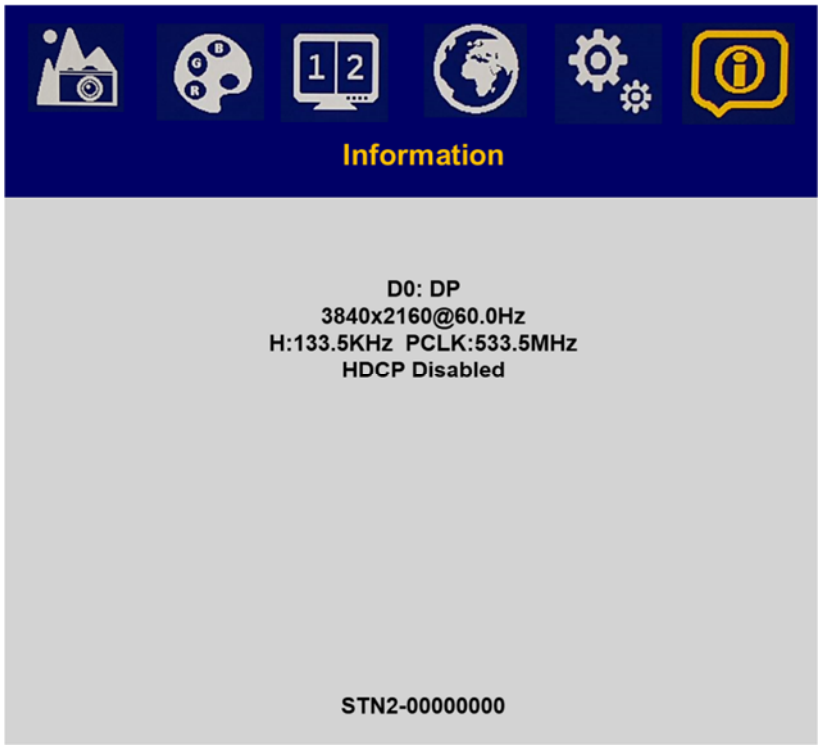
main menu - 4 : OSD Setting



main menu - 5 : Others (OSD Setting)



main menu - 6 : Information



Input Source Selection

: PopUp OSD Menu (Hotkey = EXIT/SOURCE)

Backlight Adjustment

: PopUp OSD Menu (Hotkey = Left/Right)

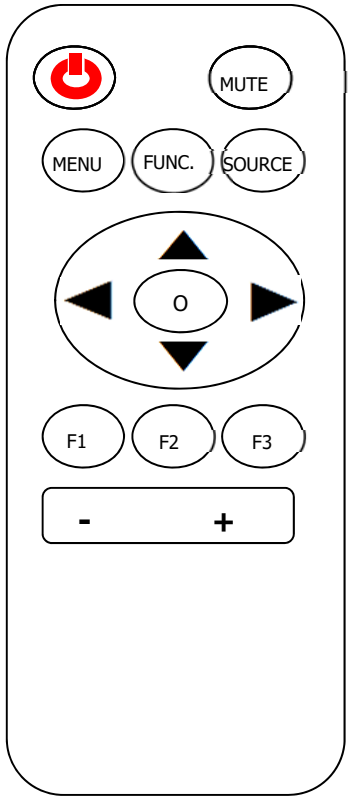
8. Remote Controller

Distance at 7 meters max and 30 degree (left/right) max

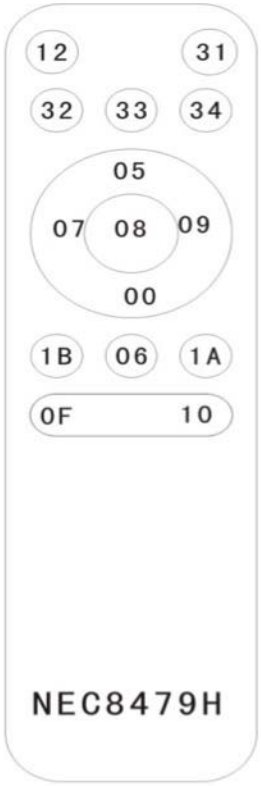
-Part Number : VRC-1340

-Format : NEC

-Custom code : 8479(Hex)



Data Code (Hex)



9. RS232 Communication

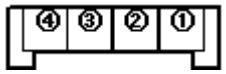
9.1 Communication Parameters

- Baud rate :9600 bps
- Data length : 8 bits
- Parity bit : None
- Stop bit : 1 bit
- Communication : ASCII CODE

9.2 Physical connection :

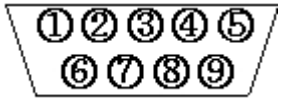
Controller side:
Connector interface: CN11
Mating connector: DB9 Female or
20010HS-04, Yeon-Ho

PIN#	Description
1	Ground
2	RS-232 Tx Data
3	RS-232 Rx Data
4	Power 5V



Computer side:
Connector interface: Serial port
Mating connector: DB9 Male

PIN#	Description
2	RS-232 Rx Data
3	RS-232 Tx Data
5	Ground



9.3 RS-232 Serial Protocols

Video Wall Disable (Normal)

Tx Format : [Command1] [Command2] [Space] [0] [0] [Space] [DataH] [DataL] [CR]
; ASCII : [Space] = 0x20 , [CR] = 0x0D, [0] = 0x30, [a] = 0x61, [A] = 0x41

Rx OK Format : [Command2] [Space] [0] [0] [Space] [O] [K] [DataH] [DataL] [x] [CR]
; OK

Rx NG1 Format : [Command2] [Space] [0] [0] [Space] [N] [G] [0] [1] [x] [CR]
; NG01 : illegal command

Rx NG2 Format : [Command2] [Space] [0] [0] [Space] [N] [G] [0] [2] [x] [CR]
; NG02 : unknown command /data

Video Wall Enable

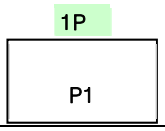
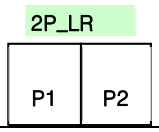
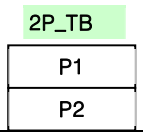
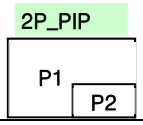
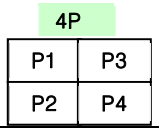
Tx Format : [Command1] [Command2] [Space] [0] [0] [Space] [DataH] [DataL] [Space] **[RS232 ID H] [RS232 ID L]** [CR]
; ASCII : [Space] = 0x20 , [CR] = 0x0D, [0] = 0x30, [a] = 0x61, [A] = 0x41

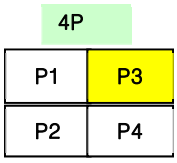
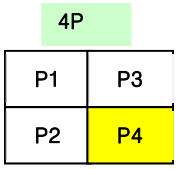
Rx OK Format : [Command2] [Space] [0] [0] [Space] [O] [K] [DataH] [DataL] [Space] **[RS232 ID H] [RS232 ID L]** [x] [CR]
; OK

Rx NG1 Format : [Command2] [Space] [0] [0] [Space] [N] [G] [0] [1] [Space] **[RS232 ID H] [RS232 ID L]** [x] [CR]

Rx NG2 Format : [Command2] [Space] [0] [0] [Space] [N] [G] [0] [2] [Space] **[RS232 ID H] [RS232 ID L]** [x] [CR]
; NG02 : unknown command /data

Serial Command and Protocol

Command Set	Command	Acknowledgement	Comments
Power (ka)			
Power On	ka 00 01(CR)	a 00 OK01x	01
Power Off	ka 00 00(CR)	a 00 OK00x	00
Power Status	ka 00 ff(CR)	a 00 OK01x (On) a 00 OK00x (Off)	read
Display Mode (kb)			
1P	kb 00 00(CR)	b 00 OK00x	
2P_LR (Left, Right)	kb 00 01(CR)	b 00 OK01x	
2P_TB (Top, Bottom)	kb 00 02(CR)	b 00 OK02x	
2P_PIP	kb 00 03(CR)	b 00 OK03x	
4P	kb 00 04(CR)	b 00 OK04x	
Status	kb 00 ff(CR)	b 00 OK00x (1P) b 00 OK01x (2P_LR) b 00 OK02x (2P_TB) b 00 OK03x (2P_PIP) b 00 OK04x (4P)	read
P1 Input selection (k1)			
P1 (1P, 2P_LR_Left, 2P_TB_Top, 2P_PIP_Main, 4P_Left_Top)	k1 00 01(CR) k1 00 02(CR) k1 00 03(CR) k1 00 04(CR)	1 00 OK01x (D0:DP1) 1 00 OK02x (D1:DP3) 1 00 OK03x (D2:HDMI2) 1 00 OK04x (D3:HDMI3)	01 : DP1 (D0 : DP1) 02 : DP3 (D1 :DP3) 03 : HDMI2 (D2 :HDMI2) 04 : HDMI3 (D3 :HDMI3)
Status	k1 00 ff(CR)	1 00 OK01x (D0:DP1) 1 00 OK02x (D1:DP3) 1 00 OK03x (D2:HDMI2) 1 00 OK04x (D3:HDMI3)	read
P2 Input selection (k2)			
P2 (2P_LR_Right, 2P_TB_Bottom, 2P_PIP_Sub,	k2 00 01(CR) k2 00 02(CR) k2 00 03(CR) k2 00 04(CR)	2 00 OK01x (D0:DP1) 2 00 OK02x (D1:DP3) 2 00 OK03x (D2:HDMI2) 2 00 OK04x (D3:HDMI3)	01 : DP1 (D0 : DP1) 02 : DP3 (D1 :DP3) 03 : HDMI2 (D2 :HDMI2) 04 : HDMI3 (D3:HDMI3)

4P_Left_Bottom)			
Status	k2 00 ff(CR)	2 00 OK01x (D0:DP1) 2 00 OK02x (D1:DP3) 2 00 OK03x (D2:HDMI2) 2 00 OK04x (D3:HDMI3)	read
P3 Input selection (k3)			
P3 (4P_Right_Top) 	k3 00 01(CR) k3 00 02(CR) k3 00 03(CR) k3 00 04(CR)	3 00 OK01x (D0:DP1) 3 00 OK02x (D1:DP3) 3 00 OK03x (D2:HDMI2) 3 00 OK04x (D3:HDMI3)	01 : DP1 (D0 : DP1) 02 : DP3 (D1 :DP3) 03 : HDMI2 (D2 :HDMI2) 04 : HDMI3 (D3 :HDMI3)
Status	k3 00 ff(CR)	3 00 OK01x (D0:DP1) 3 00 OK02x (D1:DP3) 3 00 OK03x (D2:HDMI2) 3 00 OK04x (D3:HDMI3)	read
P4 Input selection (k4)			
P4 (4P_Right_Bottom) 	k4 00 01(CR) k4 00 02(CR) k4 00 03(CR) k4 00 04(CR)	4 00 OK01x (D0:DP1) 4 00 OK02x (D1:DP3) 4 00 OK03x (D2:HDMI2) 4 00 OK04x (D3:HDMI3)	01 : DP1 (D0 : DP1) 02 : DP3 (D1 :DP3) 03 : HDMI2 (D2 :HDMI2) 04 : HDMI3 (D3 :HDMI3)
Status	k4 00 ff(CR)	4 00 OK01x (D0:DP1) 4 00 OK02x (D1:DP3) 4 00 OK03x (D2:HDMI2) 4 00 OK04x (D3:HDMI3)	read
Audio selection (kc)			
Display Mode == 1P	kc 00 01(CR)	c 00 OK01x (P1)	01 : P1
Display Mode == (2P_LR, 2P_TB, 2P_PIP)	kc 00 01(CR) kc 00 02(CR)	c 00 OK01x (P1) c 00 OK02x (P2)	01 : P1 02 : P2
Display Mode == 4P	kc 00 01(CR) kc 00 02(CR) kc 00 03(CR) kc 00 04(CR)	c 00 OK01x (P1) c 00 OK02x (P2) c 00 OK03x (P3) c 00 OK04x (P4)	01 : P1 02 : P2 03 : P3 04 : P4
Status	kc 00 ff(CR)	c 00 OK01x (P1) c 00 OK02x (P2) c 00 OK03x (P3) c 00 OK04x (P4)	read
Screen Mute (kd)			
Screen Mute ON (Picture off)	kd 00 01(CR)	d 00 OK01x (Mute ON)	01
Screen Mute OFF (Picture on)	kd 00 00(CR)	d 00 OK00x (Mute OFF)	00
Status	kd 00 ff(CR)	d 00 OK01x (Mute ON)	read

		d 00 OK00x (Mute OFF)	
Audio Mute (ke)			
Audio Mute	ke 00 01(CR) ke 00 00(CR)	e 00 OK01x (Mute ON) e 00 OK00x (Mute OFF)	01 : Mute ON 00 : Mute OFF
Status	ke 00 ff(CR)	e 00 OK01x (Mute ON) e 00 OK00x (Mute OFF)	read
Audio Volume (kf)			
Volume control	kf 00 00(CR)	f 00 OK00x (Volume = 0, Min.)	00 (Hex , Decimal)
(0~100%) (Default = 20%)	kf 00 1A(CR)	f 00 OK1Ax (Volume = 26)	1A (1Ah = 26)
00h ~ 64h (Default = 32h)	kf 00 32(CR)	f 00 OK32x (Volume = 50)	32 (32h = 50)
	kf 00 64(CR)	f 00 OK64x (Volume = 100, Max.)	64 (64h = 100)
Status	kf 00 ff(CR)	f 00 OK2Fx (Volume = 47)	read
Aspect Ratio (kg)			
Aspect Ratio	kg 00 00(CR) kg 00 01(CR) kg 00 02(CR) kg 00 03(CR) kg 00 04(CR)	g 00 OK00x (Full) g 00 OK01x (16:9) g 00 OK02x (4:3) g 00 OK03x (5:4) g 00 OK04x (1:1)	00 : Full 01 : 16:9 02 : 4:3 03 : 5:4 04 : 1:1
Status	kg 00 ff(CR)	g 00 OK00x (Full) g 00 OK01x (16:9) g 00 OK02x (4:3) g 00 OK03x (5:4) g 00 OK04x (1:1)	read
Picture			
BackLight (kh)			
0 ~ 100% (Default = 90%)	kh 00 5A(CR)	h 00 OK5Ax (BackLight = 90)	00h ~ 64h (Default = 5Ah)
Status	kh 00 ff(CR)	h 00 OK5Ax (BackLight = 90)	read
Contrast (ki)			
0 ~ 100% (Default = 50%)	ki 00 32(CR)	i 00 OK32x (Contrast = 50)	00h ~ 64h (Default = 32h)
Status	ki 00 ff(CR)	i 00 OK32x (Contrast = 50)	read
Brightness (kj)			
0 ~ 100% (Default = 50%)	kj 00 32(CR)	j 00 OK32x (Brightness = 50)	00h ~ 64h (Default = 32h)
Status	kj 00 ff(CR)	j 00 OK32x (Brightness = 50)	read
Sharpness (kk)			
0 ~ 4 (Default = 2)	kk 00 02(CR)	k 00 OK02x (Sharpness = 2)	00h ~ 04h (Default = 02h)
Status	kk 00 ff(CR)	k 00 OK02x (Sharpness = 2)	read

Color			
Gamma (kl)			
0 ~ 4 (Default = 0 : OFF)	kl 00 00(CR) kl 00 01(CR) kl 00 02(CR) kl 00 03(CR) kl 00 04(CR)	l 00 OK00x(Gamma=Off) l 00 OK01x(Gamma=1.8) l 00 OK02x(Gamma=2.0) l 00 OK03x(Gamma=2.1) l 00 OK04x(Gamma=2.2)	00 : Gamma OFF 01 : Gamma 1.8 02 : Gamma 2.0 03 : Gamma 2.2 04 : Gamma 2.4
Status	kl 00 ff(CR)	l 00 OK00x(Gamma=Off)	read
Temperature (km)			
0 ~ 4 (Default = 2 : 6500)	km 00 00(CR) km 00 01(CR) km 00 02(CR) km 00 03(CR) km 00 04(CR)	m 00 OK00x (Temperature = 9300) m 00 OK01x (Temperature = 7500) m 00 OK02x (Temperature = 6500) m 00 OK03x (Temperature = 5800) m 00 OK04x (Temperature = sRGB)	00 : 9300 01 : 7500 02 : 6500 03 : 5800 04 : sRGB
Status	km 00 ff(CR)	m 00 OK02x (Temperature = 6500)	read
Color Effect (kn)			
0 ~ 4 (Default = 0 : Standard)	kn 00 00(CR) kn 00 01(CR) kn 00 02(CR) kn 00 03(CR) kn 00 04(CR)	n 00 OK00x (Effect = Standard) n 00 OK01x (Effect = Game) n 00 OK02x (Effect = Movie) n 00 OK03x (Effect = Photo) n 00 OK04x (Effect = Vivid)	00 : Standard 01 : Game 02 : Movie 03 : Photo 04 : Vivid
Status	kn 00 ff(CR)	n 00 OK00x (Effect = Standard)	read
Local Key (mk)			
POWER KEY	mk 00 00(CR)	k 00 OK00x	00h
MENU KEY	mk 00 01(CR)	k 00 OK01x	01h
LEFT KEY	mk 00 02(CR)	k 00 OK02x	02h
RIGHT KEY	mk 00 03(CR)	k 00 OK03x	03h
DOWN KEY (/ ENTER KEY) (/ PIP)	mk 00 04(CR)	k 00 OK04x	04h
UP KEY (/ EXIT KEY) (/ INFO.)	mk 00 05(CR)	k 00 OK05x	05h
SOURCE KEY	mk 00 06(CR)	k 00 OK06x	06h

Command Set	Command	Acknowledgement	Comments
PIP Fast Swap (kq)			
PIP Fast Swap	kq 00 00(CR)	q 00 OK12x q 00 OK21x	12: Main 1, Sub 2 21 : Main 2, Sub 1
Status	kq 00 ff(CR)	q 00 OK12x	read
PIP Transparency (kp)			
0 ~ 10 (Default = 0 : Standard)	kp 00 05(CR)	p 00 OK05x	00h~0Ah (Default = 00h)
Status	kp 00 ff(CR)	p 00 OK05x	read