

MDT156004	3840 x 2160	eDP Interface	TFT Module
Specification			
Version: 1		Date: 28/06/2024	
Revision			
1	26/06/2024	First issue	

Display Features			
Display Size	15.6"		
Resolution	3840 x 2160		
Orientation	Landscape		
Appearance	RGB		
Logic Voltage	3.3V		
Interface	eDP		
Brightness	1500 cd/m ²		
Touchscreen	---		
Module Size	350.72 x 216.14 x 4.0 mm		
Operating Temperature	-10°C ~ +50°C	Created By	Checked By
Pinout	40 way FFC	RV	TSB
Pitch	0.5 mm	Box Quantity	Weight / Display
		---	---

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Display Accessories	
Part Number	Description
MBID-40FP	40 Way FFC to cable and wires. Driven by any driver board that can be wired to a 1mm pitch SHDR-40V-S-B receptacle.
MDIB-CC1	Interconnect board for standard pitch pinouts to fine pitch wires. Providing pinouts for 2.54 pinout. 1.27, 1, 0.845, 0.8, 0.7, 0.65, 0.62, 0.6, 0.5 & 0.3 pads.

Optional Variants	
Appearances	Voltage



1. Handling Precautions

- 1) Since front polarizer is easily damaged, pay attention not to scratch it.
- 2) Be sure to turn off power supply when inserting or disconnecting from input connector.
- 3) Wipe off water drop immediately. Long contact with water may cause discoloration or spots.
- 4) When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.
- 5) Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface.
- 6) Since CMOS LSI is used in this module, take care of static electricity and insure human earth when handling.
- 7) Do not open or modify the Module Assembly.
- 8) Do not press the reflector sheet at the back of the module to any directions.
- 9) At the insertion or removal of the Signal Interface Connector, be sure not to rotate nor tilt the Interface Connector of the TFT Module.
- 10) After installation of the TFT Module into an enclosure, do not twist nor bend the TFT Module even momentary. At designing the enclosure, it should be taken into consideration that no bending/twisting forces are applied to the TFT Module from outside. Otherwise the TFT Module may be damaged.

2. General Description

2.1 Overview

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This specification applies to the Color Active Matrix Liquid Crystal Display composed of a TFT-LCD display with LED backlight system. The screen format is intended to support 4K (3840(H) x 2160(V)) screen and 1.06B (8 bits + FRC) color support.

2.2 Features

- 282 ppi retinal based resolution
- 1500 nits high brightness display with low power consumption
- Long operation lifetime BLU design
- Wide view angle
- Wide operation temperature
- Face mounting chassis design
- RoHS Compliance



2.4 Display specifications

Items	Unit	Specification
Screen Diagonal	inch	15.6"
Active Area	mm	344.2176 (H) X 193.6224 (V)
Pixels H x V	pixels	3840 x3(RGB) x 2160
Pixels Pitch	um	89.64 (per one triad) x 89.64
Pixel Arrangement		RGB Vertical stripe
Display mode		Normally black
White luminance (center)	Cd/m ²	1500 (Typ)
Contrast ratio		1500:1 (Typ.)
Optical Response Time	msec	25 ms (Typ. On/off)
Normal Input Voltage	Volt	3.3V
Power Consumption (Vcc Line + LED backlight)	Watt	18.65 W (TBD) (VDD line=1.1 W; LED lines= 17.55 W, TBD)
Weight	Grams	TBD
Physical size	mm	350.72 (W)× 216.14 (H)× 4.0 (D, typ)
Electrical Interface		eDP
Support colors		1.06B colors (8 bits + FRC)
Surface Treatment		AG type, 3H hard coating
Temperature range		
Operating	°C	-10 ~ 50
Storage	°C	-20 ~ 60
RoHS Compliance		RoHS Compliance



2.5 Optical characteristics

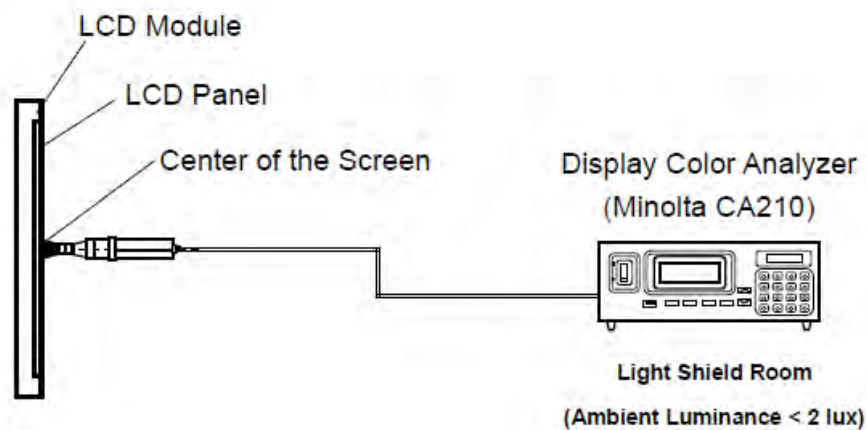
The following optical characteristics are measured under stable condition at 25 °C

Items	Unit	Conditions	Min.	Typ.	Max.	Note
Viewing angle	Deg.	Horizontal (Right)	80	85		2
		CR=10 (Left)	80	85		
		Vertical (Up)	80	85		
		CR=10 (Down)	80	85		
Contrast Ratio		Normal Direction	1000	1500		3
Response Time	msec	Raising + Falling		25	35	4
Color coordinates (CIE) White		Red x	-0.05	0.663	+0.05	
		Red y		0.321		
		Green x		0.211		
		Green y		0.716		
		Blue x		0.149		
		Blue y		0.061		
		White x		0.313		5
		White y		0.329		
Center Luminance	Cd/m ²		1200	1500		6
Luminance Uniformity	%		70	75		7
Crosstalk (in 60 Hz)	%				1.5	
Flicker	dB				-20	

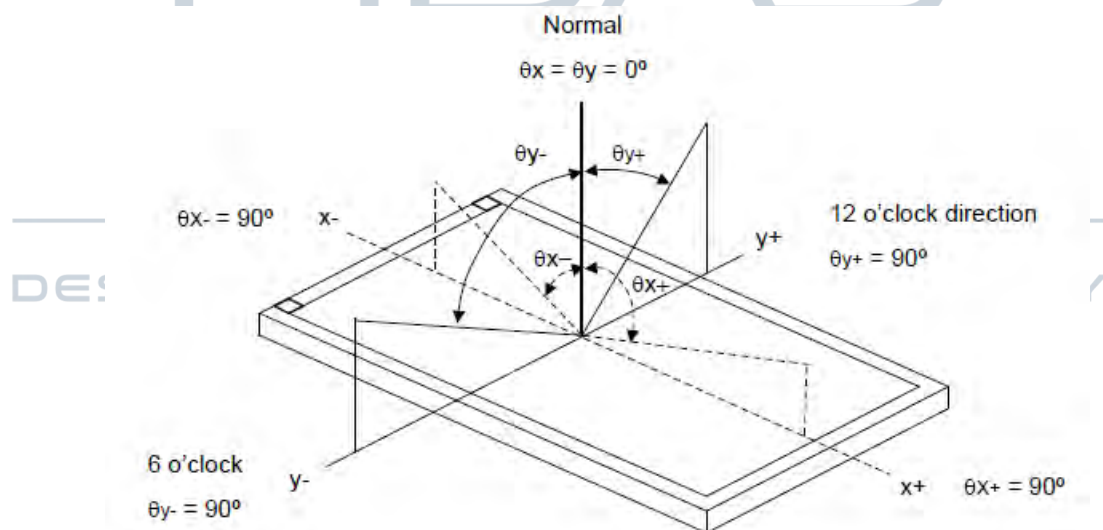


Note 1: Measurement method

The LCD module should be stabilized at given temperature for 0.5 hour to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 1 hour in a windless room.



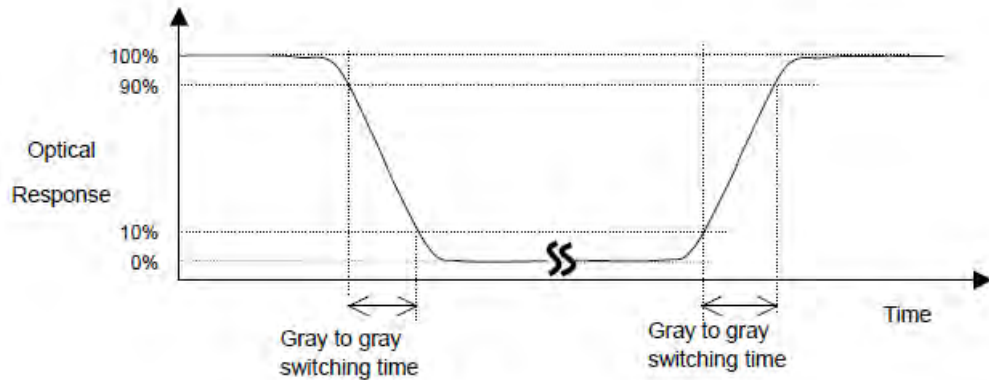
Note 2: Definition of viewing angle



Note 3: Contrast ratio is measured by Minolta CA310

Note 4: Definition of Response time

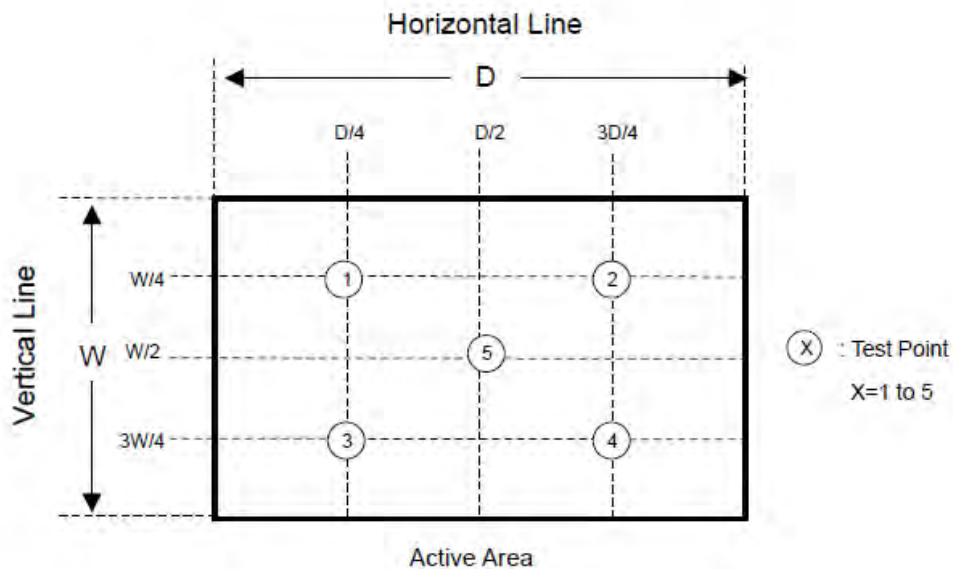
The output signals of photo detector are measured when the input signals are changed from “Full Black” to “Full White” (rising time), and from “Full White” to “Full Black” (falling time), respectively. The response time is interval between the 10% and 90% of amplitudes. Please refer to the figure as below.



Note 5: Color chromaticity and coordinates (CIE) is measured by Minolta CA310

Note 6: Center luminance is measured by Minolta CA310

Note 7: Luminance uniformity of these 5 points is defined as below and measured by Minolta CA310



$$\text{Uniformity} = (\text{Min. Luminance of 5 points}) / (\text{Max. Luminance of 5 points})$$



3. Absolute Maximum Ratings

Absolute maximum ratings of the module are as following:

3.1 TFT LCD module

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

Parameter	Symbol	Min.	Max.	Unit	Remarks
Power Supply Voltage	V_{DD}	-0.3	4.0	V	Note 1
eDP input Voltage	V_{eDP}	0	2.0	V	
Logic Supply Voltage	V_{IN}	$V_{SS}-0.3$	$V_{DD}+0.3$	V	
Operating Temperature	T_{OP}	0	+50	$^{\circ}\text{C}$	Note 2
Storage Temperature	T_{ST}	-20	+60	$^{\circ}\text{C}$	

3.2 Backlight unit

Items	Symbol	Min	Max	Unit	Conditions
LED bar input current			600	mA	

3.3 Environment

Items	Symbol	Values			Unit	Conditions
		Min.	Typ.	Max.		
Operation temperature	T_{OS}	-10	-	50	$^{\circ}\text{C}$	Note 3
Operation Humidity	H_{OP}	10		85	%	
Storage temperature	T_{ST}	-20		60	$^{\circ}\text{C}$	
Storage Humidity	H_{ST}	5		90	%	

Note 1: With in $T_a=25^{\circ}\text{C}$

Note 2: Permanent damage to the device may occur if exceed maximum values

Note 3: For quality performance, please refer to IIS (Incoming Inspection Standard).

4. Electrical characteristics

4.1 LCD electronics specification

4.1.1 Power specification

Ta=25+/-2°C

Parameter		Min.	Typ.	Max.	Unit	Remarks	
Power Supply Voltage		V _{DD}	3.0	3.3	3.6	V	Note 1
Permissible Input Ripple Voltage		V _{RF}	-10% VDD	-	+10% VDD	V	@ V _{DD} = 3.3V
BIST Control Level		High Level	1.5	-	3.3	V	@V _{DDIO} =1.8
		Low Level	0	-	0.2	V	
Power Supply Inrush Current		I _{inrush}	-	-	2	A	Note3
Power Supply Current	Mosaic	I _{DD}	-	-	333.3	mA	Note 1
	Sub-pixel		-	-	606	mA	
Power Consumption	Mosaic	P _M	-	-	1.1	W	
	Sub-pixel	P _{sub-pixel}	-	-	2	W	

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4.2 Backlight unit

Parameter	Min	Typ	Max	Unit	Note
LED voltage (VL)		39		[V]	2
LED current (IL)		(450)		[mA]	2
LED power (PL)		(17.5)		[W]	
LED lite time (MTBF)		50,000		[Hour]	1

Note 1: The “LED lift time” is defined as the module brightness decrease to 50% original brightness that the ambient temperature is 25°C and typical LED Current at 450 mA

Note 2: The variance of LED Light Bar power consumption is ±10%. Calculator value for reference ($IL \times VL = PLED$)



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4.3 Interface connector

4.3.1 TFT connector(CN1)

The electronics interface connector is STM MSAK24025P40G.

The connector interface pin assignments are listed in Table 6.

Terminal	Symbol	Functions
Pin No.	Symbol	Description
1	NC	No Connection
2	H_GND	Ground
3	LANE3_N	eDP RX Channel 3 Negative
4	LANE3_P	eDP RX Channel 3 Positive
5	H_GND	Ground
6	LANE2_N	eDP RX Channel 2 Negative
7	LANE2_P	eDP RX Channel 2 Positive
8	H_GND	Ground
9	LANE1_N	eDP RX Channel 1 Negative
10	LANE1_P	eDP RX Channel 1 Positive
11	H_GND	Ground
12	LANE0_N	eDP RX Channel 0 Negative
13	LANE0_P	eDP RX Channel 0 Positive
14	H_GND	Ground
15	AUX_CH_P	eDP AUX CH Positive
16	AUX_CH_N	eDP AUX CH Negative
17	H_GND	Ground
18	LCD_VCC	Power Supply, 3.3V (typ.)
19	LCD_VCC	Power Supply, 3.3V (typ.)
20	LCD_VCC	Power Supply, 3.3V (typ.)
21	LCD_VCC	Power Supply, 3.3V (typ.)
22	BIST	Panel Self Test Enable
23	H_GND	Ground
24	H_GND	Ground
25	H_GND	Ground
26	H_GND	Ground
27	HPD	Hot Plug Detect Output
28	NC	No Connection
29	NC	No Connection
30	NC	No Connection

31	NC	No Connection
32	NC	No Connection
33	NC	No Connection
34	NC	No Connection
35	NC	No Connection
36	NC	No Connection
37	NC	No Connection
38	NC	No Connection
39	NC	No Connection
40	NC	No Connection

4.3.2 Backlight connector(CN2)

Recommended connector : BHSR-02VS-1 manufactured by JST

Pin no	Symbol	I/O	Description	Remark
1	VLED+	P	Backlight LED anode	Red
2	VLED-	P	Backlight LED cathode	Black

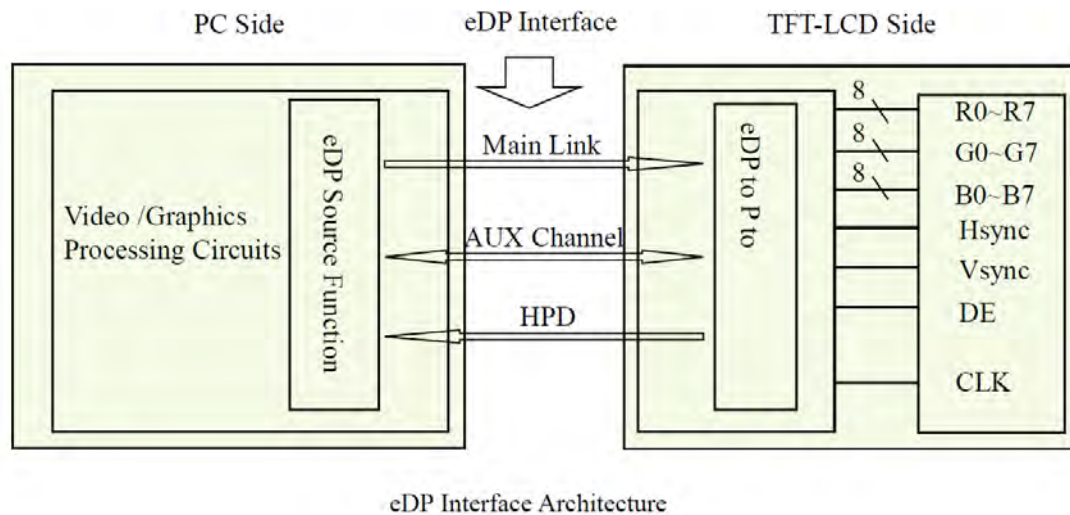
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5. Signal characteristics

5.1 eDP interface



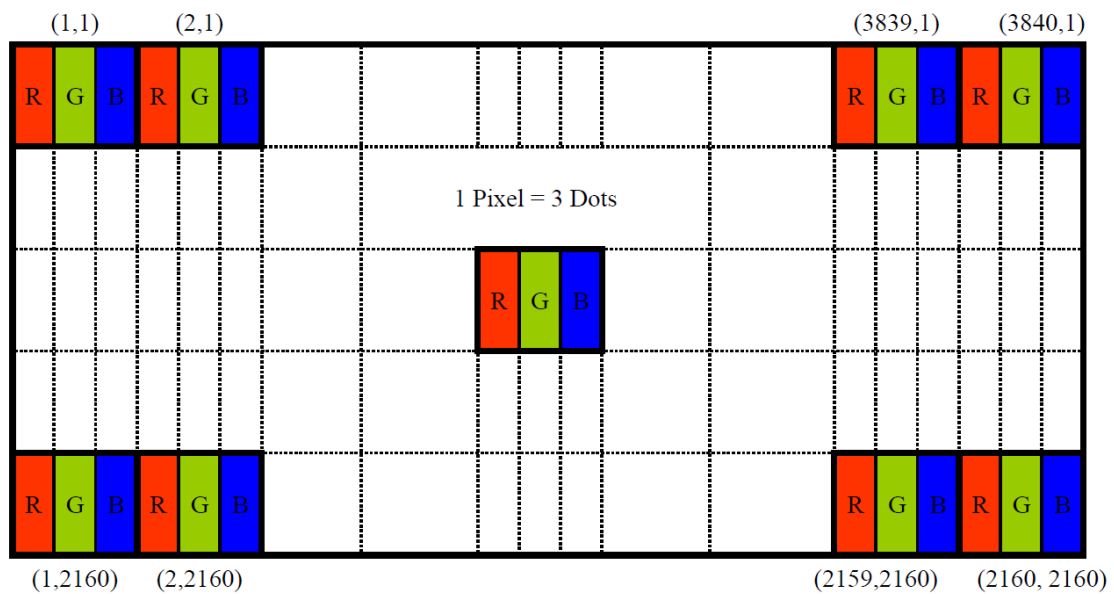
Note:

Transmitter : Parade DP501 or equivalent.

Transmitter is not contained in module.

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5.2 Data input format



Display Position of Input Data (V-H)



6. Signal timing specification

6.1 The panel is operated by the DE only

Item		Symbols	Min	Typ	Max	Unit
Clock	Frequency	1/Tc	531.4	533.28	535.1	MHz
Frame Period		Tv	2219	2222	2225	lines
			-	60	-	Hz
			-	16.67	-	ms
Vertical Display Period		Tvd	-	2160	-	lines
One line Scanning Period		Th	3992	4000	4008	clocks
Horizontal Display Period		Thd	-	3840	-	clocks

Note : The above is as optimized setting.

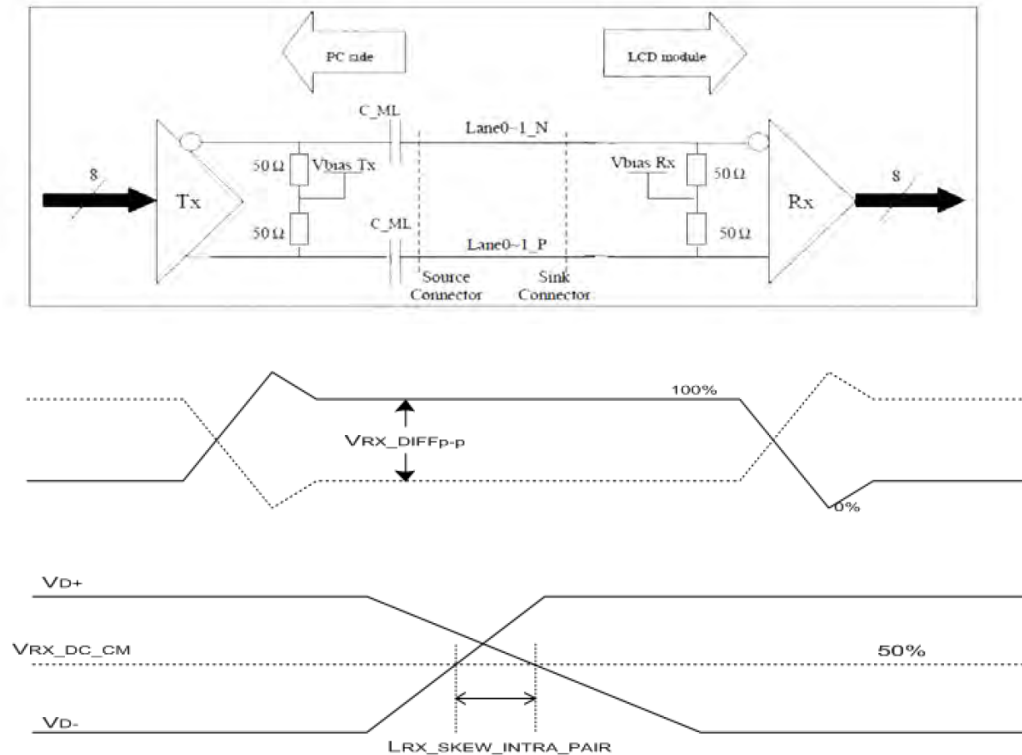
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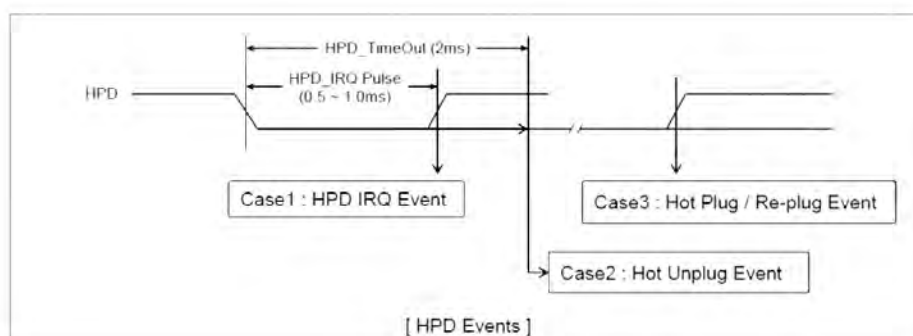


6.2 eDP Rx interface timing parameter is shown as below

Item	Symbol	Min	Typ	Max	Unit	Remark
Spread spectrum clock (Link clock down-spreading)	ssc	0	-	0.5	%	
EYE width at package pins	VRX-EYE	0.6			UI	
Differential peak-to-peak input voltage at package pins	VRX-DIFFp-p	120	-	1200	mV	
Rx input DC common mode voltage	VRX_DC_CM	0	-	2	V	
Differential termination resistance	RRX-DIFF	80	100	120	Ω	
Single-ended termination resistance	RRX-SE	40	-	60	Ω	
Rx short circuit current limit	IRX_SHORT	-	-	50	mA	
Intra-pair skew at Rx package pins (HBR2) RX intra-pair skew tolerance at HBR2	LRX_SKEW_ INTRA_PAIR	-	-	50	ps	
AC Coupling Capacitor	CSOURCE_ML	75		200	nF	Source side



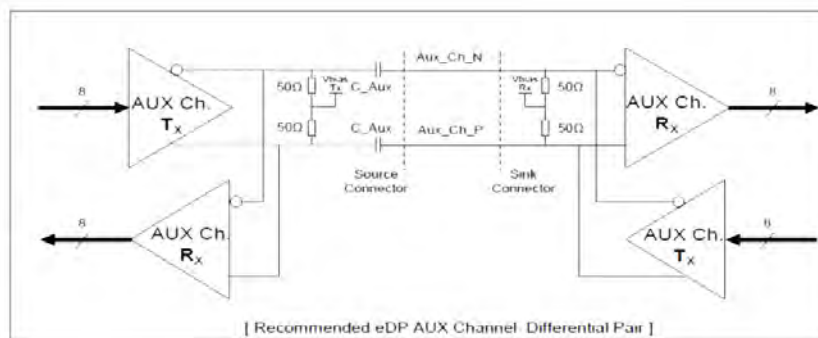
Item	Symbol	Min	Typ	Max	Unit	Remark
HPD voltage	V _{HPD}	2.25	-	3.6	V	
Hot Plug Detection Threshold	-	2.0	-	-	V	Source side Detecting
Hot Unplug Detection Threshold	-	-	-	0.8V	V	
HPD_IRQ Pulse Width	HPD_IRQ	0.5	-	1	ms	
HPD_TimeOut	-	2.0	-	-	ms	



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Item	Symbol	Min	Typ	Max	Unit	Remark
AUX unit interval	UIAUX	0.4	0.5	0.6	Us	
AUX peak-to-peak input differential voltage	VAUX-RX-DIFFp-p	0.29	-	1.38	V	
AUX CH termination DC resistance	RAUX-TERM	80	100	120	Ohm	
AUX DC common mode voltage	VAUX-DC-CM	0	-	2	V	
AUX turn around common mode voltage	VAUX-TURN-CM	-	-	0.3	V	
AUX short circuit current limit	IAUX-SHORT	-	-	90	mA	
AUX AC Coupling Capacitor	CSOURCE-AUX	75	-	200	nf	Source side



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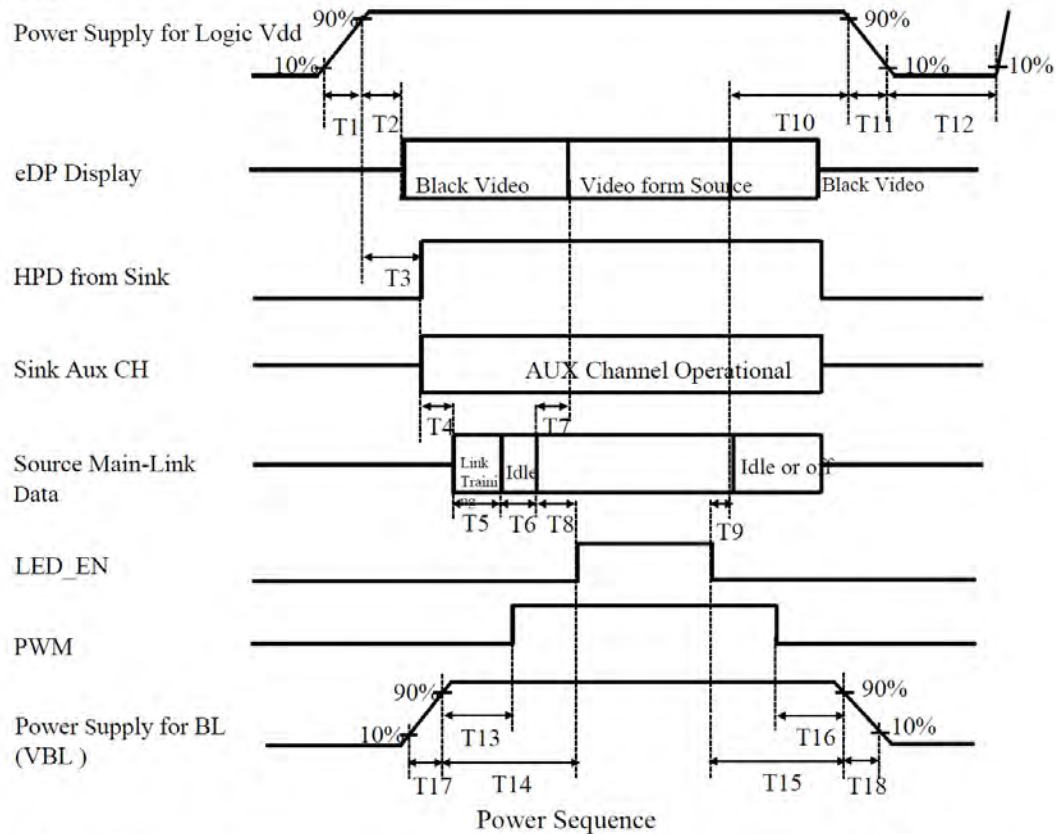
7. Input signal basic display colors & gray scale of colors

	Colors & Gray scale	Data signal																														
		R0	R1	R2	R3	R4	R5	R6	R7	R8	R9	G0	G1	G2	G3	G4	G5	G6	G7	G8	G9	B0	B1	B2	B3	B4	B5	B6	B7	B8	B9	
Basic colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	
	Green	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	
	Light Blue	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	Red	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Purple	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Gray scale of Red	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	△	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Darker	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	△	↑									↑									↑												
	▽	↓									↓									↓												
	Brighter	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	▽	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray scale of Green	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	↑									↑									↑												
	▽	↓									↓									↓												
	Brighter	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
	▽	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
Gray scale of Blue	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Darker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	△	↑									↑									↑												
	▽	↓									↓									↓												
	Brighter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	1
	▽	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
Gray scale of White & Black	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Darker	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	△	↑									↑									↑												
	▽	↓									↓									↓												
	Brighter	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1
	▽	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1



8. Power ON / OFF sequence

To prevent a latch-up or DC operation of the LCD module, the power on/off sequence shall be as shown in below.



- | | | |
|--|---|---------------------------|
| ● $0.5\text{ms} \leq T1 \leq 10\text{ ms}$ | ● $0\text{ms} < T10 < 500\text{ ms}$ | ● $0.5\text{ms} \leq T17$ |
| ● $0\text{ms} < T2 \leq 200\text{ ms}$ | ● $0.5\text{ms} \leq T11 \leq 10\text{ ms}$ | ● $0.5\text{ms} \leq T18$ |
| ● $0\text{ms} < T3 \leq 200\text{ ms}$ | ● $500\text{ms} \leq T12$ | |
| ● $T4+T5+T6+T8 > 80\text{ms}$ | ● $0\text{ms} < T13$ | |
| ● $0\text{ms} < T7 \leq 50\text{ms}$ | ● $0\text{ms} < T14$ | |
| ● $50\text{ms} < T8$ | ● $0\text{ms} < T15$ | |
| ● $0\text{ms} < T9$ | ● $0\text{ms} < T16$ | |

Notes:

1. When the power supply VDD is 0V, keep the level of input signals on the low or keep high impedance.
2. Do not keep the interface signal high impedance when power is on. Back Light must be turn on after power for logic and interface signal are valid.

9. Reliability Test

Environment test conditions are listed as following table.

Items	Required Condition	Note
Temperature Humidity Bias (THB)	Ta=40°C, 80%RH, 120hours	
High Temperature Operation (HTO)	Ts= 50°C, 120hours	
Low Temperature Operation (LTO)	Ta= -10°C, 120hours	
High Temperature Storage (HTS)	Ta= 60°C, 120hours	
Low Temperature Storage (LTS)	Ta= -20°C, 120hours	
Thermal Shock Test (TST)	-20°C/30min, 60°C/30min, 100 cycles	
On/Off Test	On/10sec, Off/10sec, 30,000 cycles	
ESD (ElectroStatic Discharge)	Contact Discharge: $\pm 8KV$, 150pF(330 Ω) 1sec/cycle	
	Air Discharge: $\pm 15KV$, 150pF(330 Ω) 1sec/cycle	

Note 1: The TFT-LCD module will not sustain damage after being subjected to 100 cycles of rapid temperature change. A cycle of rapid temperature change consists of varying the temperature from -10°C to 50°C, and back again. Power is not applied during the test. After temperature cycling, the unit is placed in normal room ambient for at least 4 hours before power on.

Note 2: According to EN61000-4-2, ESD class B: Some performance degradation — allowed. No data lost. Self-recoverable. No hardware failures.

Note 3: TFT surface

Note 4: There should be no condensation on the surface of panel during test.

Note 5: In the standard conditions, there is no function failure issue occurred. All the cosmetic specification is judged before reliability test.

Note 6: Before cosmetic and function test, the product must have enough recovery time, at least 4 hours at room temperature.

10. Mechanical Characteristics

