

Specification for Approval

Customer: _____

Model Name: _____

Supplier Approval			Customer approval
R&D Designed	R&D Approved	QC Approved	
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RECORD OF REVISION

REV NO.	REV DATE	CONTENTS	Note
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1.0 GENERAL DESCRIPTION

1.1 Introduction

12.3 inch FOB is a color active matrix TFT LCD FOB using amorphous silicon TFT's (Thin Film Transistors) as an active switching devices. It is a transmissive type display operating in the normal black. The TFT-LCD has a 12.3 inch diagonally measured active area with resolutions (1920 horizontal by 720 vertical pixel arrays). Each pixel is divided into RED, GREEN, BLUE dots which are arranged in vertical stripe and this panel can display 16.7M colors.

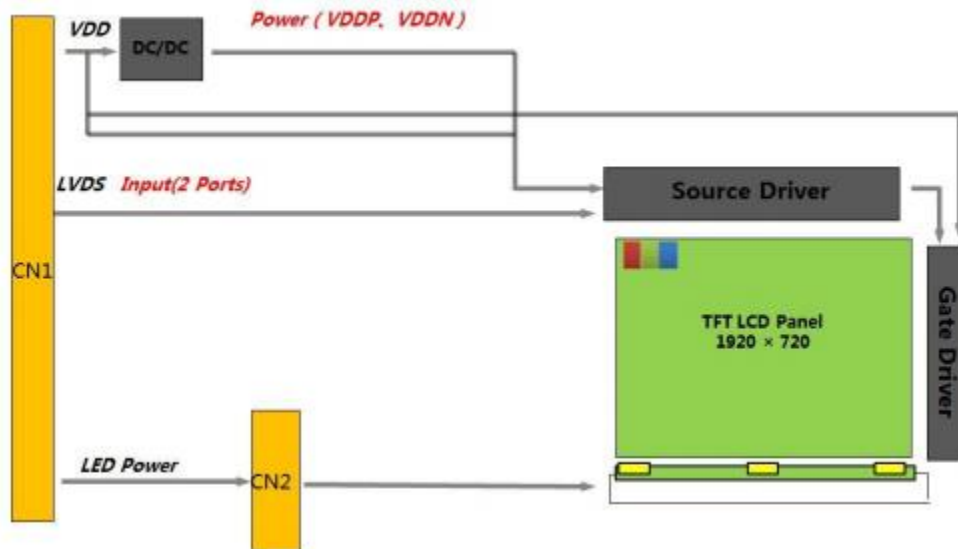


Figure 1-1 Block Diagram

1.2 Features

- Wide viewing angle (U/D/L/R) : 88/88/88/88
- Color Gamut : 70% Typ. On C-light
- Cell thickness : 1.0t
- LVDS Interface

1.3 Application

- Vehicle-mounted Production

1.4 General Specification

<Table 1-1 General Specifications>

Parameter	Specification	Unit	Remarks
Module Outline	309.31(H) × 127.36 (V)× 6.45(T)	mm	8 : 3
Number of pixels	1920(H) × 720(V)	pixels	
Active area	292.032 (H) × 109.512 (V)	mm	
Pixel arrangement	RGB Vertical stripe		
Display colors	16.7M	colors	
Color gamut	70%	%	C-light Typ.
Display mode	Normally black		
Viewing Direction (Human Eye)	U/D/L/R Min: 80/80/80/80 Typ: 88/88/88/88		
Surface Treatment	HC		CF&TFT Pol
Driver IC	FL5894CA / ST5086CA		

Note:

1. At the U/D/L/R direction, the viewing angle is same;
2. The TFT and CF Align Direction;

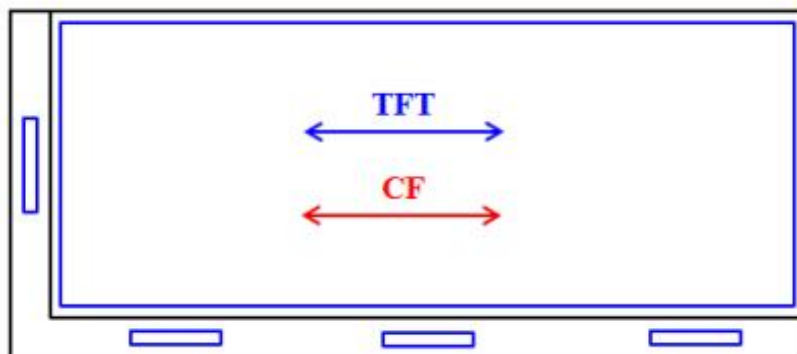


Figure 1-2 The TFT and CF Align Direction

2.0 ABSOLUTE MAXIMUM RATINGS

The followings are maximum values which, if exceed, may cause faulty operation or damage to the unit. The operational and non-operational maximum voltage and current values are listed in Table 2-1

< Table 2-1 Environment Absolute Maximum Ratings >

Parameter	Symbol	Min.	Max.	Unit	Remarks
LC operating Voltage *1)	V _{OP}	-	5.7	V	Ta=25+/-2°C
Operating Temperature (Humidity)	T _{OP}	-30	+80	°C	
	RH	-	90	%	At 60°C
Storage Temperature (Humidity)	T _{ST}	-30	+80	°C	
	RH	-	90	%	At 60°C

*1) Liquid Crystal driving voltage

Due to the characteristics of LC Material, this voltage varies with environmental temperature.

3.0 ELECTRICAL SPECIFICATIONS

3.1 Electrical Specifications

Ta=25+/-2°C

Parameter	Symbol	Values			Unit	Notes
		Min	Typ.	Max		
Voltage of VCC		3	-	3.6	V	
Current of VCC			350	550	mA	

Notes:

- 1: AVDD should be set to satisfy the characteristic of LC.
- 2: VGH should be set to satisfy charging ratio of TFT pixel.
- 3: VCOM should be adjusted to make the flicker level be minimum and optimize display quality.
- 4: Frame rate=60HZ

4.0 OPTICAL SPECIFICATION

4.1 Overview

The test of Optical specifications shall be measured in a dark room (ambient luminance ≤ 1 lux and temperature = $25 \pm 2^\circ\text{C}$) with the equipment of Luminance meter system (Goniometer system and TOPCON BM-5) and test unit shall be located at an approximate distance 50cm from the LCD surface at a viewing angle of θ and Φ equal to 0. The center of the measuring spot on the Display surface shall stay fixed.

The backlight should be operating for 30 minutes prior to measurement.

<Table 4-1 Optical Specifications>

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark				
Viewing Angle range	Horizontal	Θ_3	CR > 10	80	88	-	Deg.	Note 1				
		Θ_9		80	88	-	Deg.					
	Vertical	Θ_{12}		80	88	-	Deg.					
		Θ_6		80	88	-	Deg.					
Luminance Contrast ratio		CR		-	1000	-						
White luminance uniformity		ΔY		-	-	-	%	Note 4				
NTSC		%		-	70%	-	%	@ c-light				
Transmittance		Tr.		3.25	3.65		%	@ c-light				
White Chromaticity		x_w	$\Theta = 0^\circ$ (Center) Normal Viewing Angle	Typ-0.05	0.296	Typ+0.05	-	TBD, update after locking spec Note 5				
		y_w			0.334		-					
Red	x_R	0.650			-							
	y_R	0.328			-							
	Green	x_G			0.330		-					
		y_G			0.625		-					
Blue	x_B	0.146			-							
	y_B	0.058			-							
Response Time (Rising / Falling)		T_{RT}			25°C -20°C -30°C		-		-	30 250 500	ms	Note 6

Parameter	Condition	Min.	Typ.	Max.	Remark
Flicker	25°C	-	-	10%	@L127
Gamma	25°C	1.9	2.2	2.5	

Note:

- Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing are determined for the horizontal or 3, 9 o'clock direction and the vertical or 6, 12 o'clock direction with respect to the optical axis which is normal to the LCD surface.
- Contrast measurements shall be made at viewing angle of $\theta = 0^\circ$ and at the center of the LCD surface. Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black) state. (See FIGURE 1 shown in Appendix) Luminance Contrast Ratio (CR) is defined mathematically.

$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$

- Center trans of white is defined as the LCD surface. Luminance shall be measured with all pixels in the view field set first to white. This measurement shall betaken at the locations shown in FIGURE 4 for a total of the measurements per display.
- The White luminance uniformity on LCD surface is then expressed as :
 $\Delta Y = (\text{Minimum Luminance of 9points} / \text{Maximum Luminance of 9points}) * 100$
- The color chromaticity coordinates specified in Table 4. shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurement condition is C - light source.
- The electro-optical response time measurements shall be made as FIGURE 5 shown in Appendix by switching the "data" input signal ON and OFF. The times needed for the transmittance to change from 10% to 90% is T_r , and 90% to 10% is T_f .

5.0 OPTICAL TEST APPENDIX

Figure 5-1 The Definition of V_{th} & V_{sat}

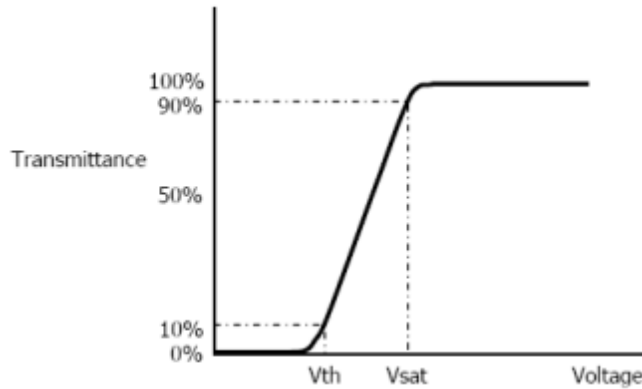


Figure 5-2 Measurement Set Up

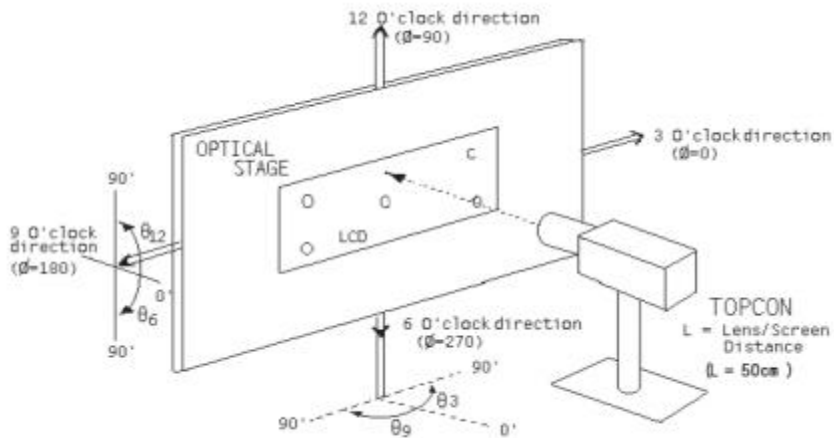
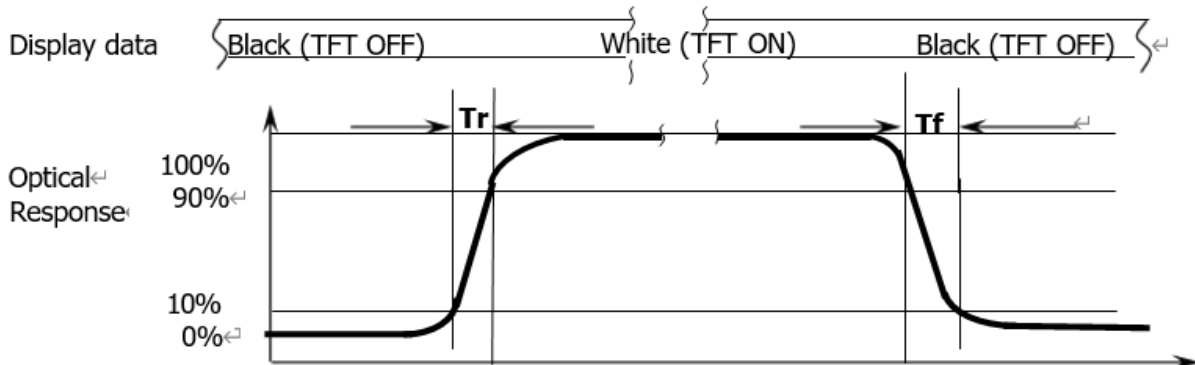


Figure 5-3 Response Time Testing



6.0 MECHANICAL CHARACTERISTICS

6.1 Dimensional Requirements

Figure in next page shows mechanical outlines for the panel
 <Table 6-1 Dimensional Parameters>

Parameter	Specification	Unit
Active Area	292.032 (H) × 109.512 (V)	mm
Number of pixels	1920(H) ×720(V)	Pixels
Pixel pitch	0.1521(H) ×RGB×0.1521 (V)	mm
Pixel arrangement	RGB Vertical stripe	
Display colors	16.7M	colors
Display mode	Normally black	
FOB thickness	1.24	mm
FOG outline	300.2x119.7	mm
AA-FOB outline L / R / U / D	7.07 / 3.6 / 2.5 / 7.69	mm

6.2 Backlight Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit
Forward Voltage	V _F	T _a =25 °C, I _F =60mA/LED	22.4	24	25.6	V
Forward Current	I _F	T _a =25 °C, V _F =3.2V/LED	-	360	-	mA
Power dissipation	P _D		-	8.640	-	W
Uniformity	Avg		70	75	-	%
LED working life(25°C)	-		-	30000	-	Hrs
Drive method	Constant current					
LED Configuration	48White LEDs (8LEDs in one string and 6 groups in parallel)					

Note1: LED life time defined as follows: The final brightness is at 50% of original brightness.

The environmental conducted under ambient air flow, at T_a=25 ± 2 °C, 60%RH ± 5%, I_F=60mA

8.0 RELIABILITY TEST

<Table 8-1 Reliability test>

No	Test Items	Conditions	Remark
1	High temperature storage test	Ta = 85 °C, 240 hrs	Note 1
2	Low temperature storage test	Ta = -30 °C, 240 hrs	
3	High temperature operation test	Ta = 80°C, 240 hrs	
4	Low temperature operation test	Ta = -30 °C, 240 hrs	
5	High temperature & high humidity operation test	Ta = 60 °C, 90%RH, 240 hrs	
6	Thermal shock	Ta = -30 °C ⁺⁺ 80 °C (0.5 hr), 200 cycle	Note 2
7	Image Sticking	5*5 Pattern 4hrs Recovery Time:5min (25°C)	

Notes

- 1: Customer specified POL Type UHLC25610SU407; The POL storage temperature in the polarizer specifications ranges from -30 °C to +80 °C. Above 80°C is not guaranteed Reliability.
- 2: The POL Thermal shock temperature in the polarizer specifications ranges from -30 °C to +70 °C. Above 70°C is not guaranteed Reliability.
- 3: After the reliability test, the product only guarantee function normally without any fatal defect (non-display, line defect, abnormal display etc). All the cosmetic specification is judged before the reliability test.
- 4: For module internal structure robustness test purpose only. Customer application cluster design should take care of overall mounting robustness with display module.

9.0 INTERFACE CONNECTION

9.1 The LCD FOB Electrical Interface Connection

The Recommended connector is 101049-205050

The connector interface pin assignments are listed in Table 9-1

<Table 9-1 Pin Assignments for the LCD Connector>

PIN	SYMBOL	Description	Remark
1	NC	NO CONNECTION	BOE for VDDOTP
2	GND	Ground	
3	GND	Ground	
4	GND	Ground	
5	NC	NO CONNECTION	
6	VDD	Power Supply	
7	VDD	Power Supply	
8	VDD	Power Supply	
9	NC	NO CONNECTION	
10	NC	NO CONNECTION	BOE for ATREN
11	GND	Ground	
12	GND	Ground	
13	ORXIN0-	LVDS Receiver Signal(-)	
14	ORXIN0+	LVDS Receiver Signal(+)	
15	GND	Ground	
16	ORXIN1-	LVDS Receiver Signal(-)	
17	ORXIN1+	LVDS Receiver Signal(+)	
18	GND	Ground	
19	ORXIN2-	LVDS Receiver Signal(-)	
20	ORXIN2+	LVDS Receiver Signal(+)	
21	GND	Ground	
22	ORXCLKIN-	LVDS Receiver Signal(-)	
23	ORXCLKIN+	LVDS Receiver Signal(+)	
24	GND	Ground	
25	ORXIN3-	LVDS Receiver Signal(-)	
26	ORXIN3+	LVDS Receiver Signal(+)	
27	GND	Ground	

PIN	SYMBOL	Description	Remark
28	ERXIN0-	LVDS Receiver Signal(-)	
29	ERXIN0+	LVDS Receiver Signal(+)	
30	GND	Ground	
31	ERXIN1-	LVDS Receiver Signal(-)	
32	ERXIN1+	LVDS Receiver Signal(+)	
33	GND	Ground	
34	ERXIN2-	LVDS Receiver Signal(-)	
35	ERXIN2+	LVDS Receiver Signal(+)	
36	GND	Ground	
37	ERXCLKIN-	LVDS Receiver Signal(-)	
38	ERXCLKIN+	LVDS Receiver Signal(+)	
39	GND	Ground	
40	ERXIN3-	LVDS Receiver Signal(-)	
41	ERXIN3+	LVDS Receiver Signal(+)	
42	GND	Ground	
43	STBYB	STBYB Signal	L:Standby H:Normal
44	RESET	RESET Signal	L:Reset H:Normal
45	CSB	SPI Signal	
46	NC	NO CONNECTION	
47	SCL	SPI Signal	
48	SDA	SPI Signal	
49	NC	NO CONNECTION	
50	GND	Ground	

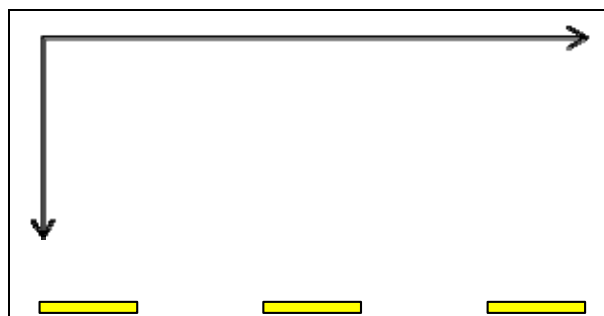


Figure 3-1 Scan direction Setting

10.0 SIGNAL SPECIFICATION

10.1 LVDS Signal Timing

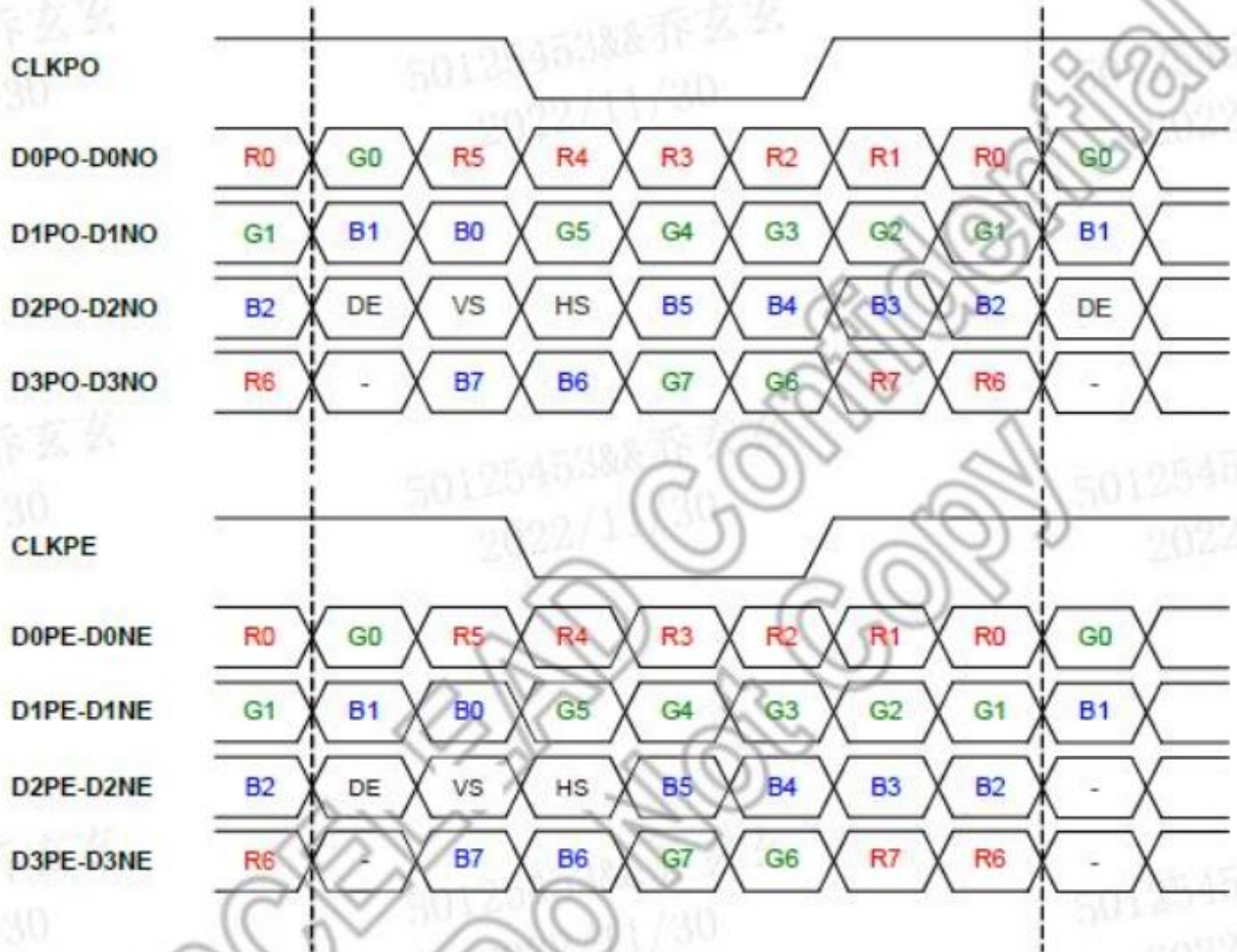
<Table 10-1 LVDS Signal Timing(DE Mode)>

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Clock frequency	RxFCLK	43.1	45.7	70.1	MHz	Note1
Horizontal Display Area	thd	960			DCLK	
HS Period	th	989	1002	1248	DCLK	
HS Blanking	Thb+thfp		42		DCLK	
Vertical Display Area	tvd	720			TH	
VS Period	tv	727	760	936	TH	
VS Blanking	Tvbp+tvfp		40		TH	
Frame Rate	FR	60	60	60	Hz	
Clock period	TLVCYC	14.28			ns	
Clock high time	TLVCH		4		UI	
Clock low time	TLVCL		3		UI	
LVDS wake-up time	TENLVDS			150	us	

Note 1: Advise the customer to use the Typ. value

10.2 Signal Format

<Table 10-2 2-port LVDS signals, VESA format, 8-bit mode>

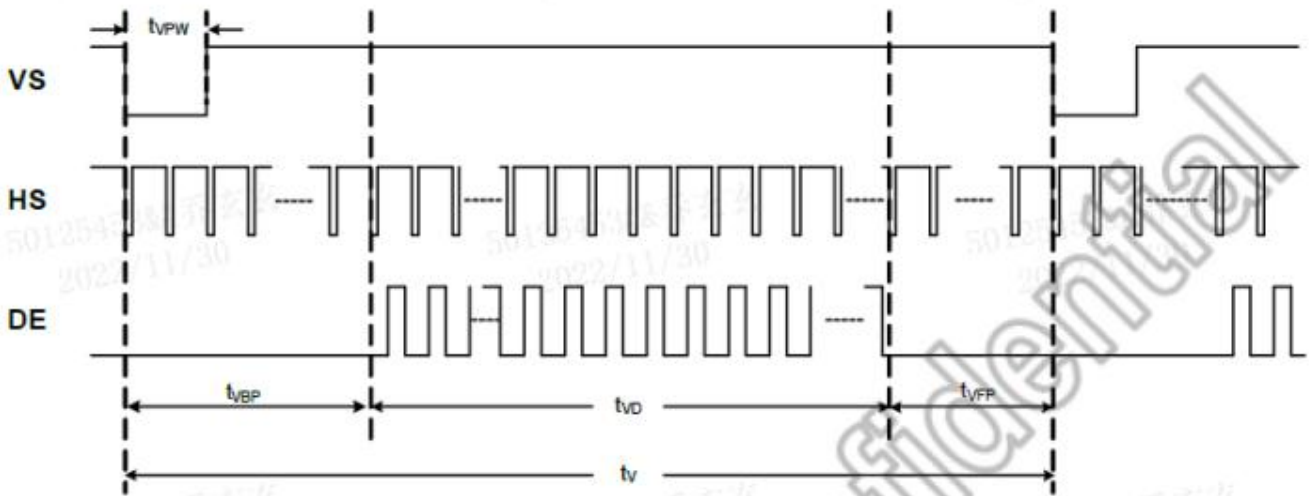


Note:

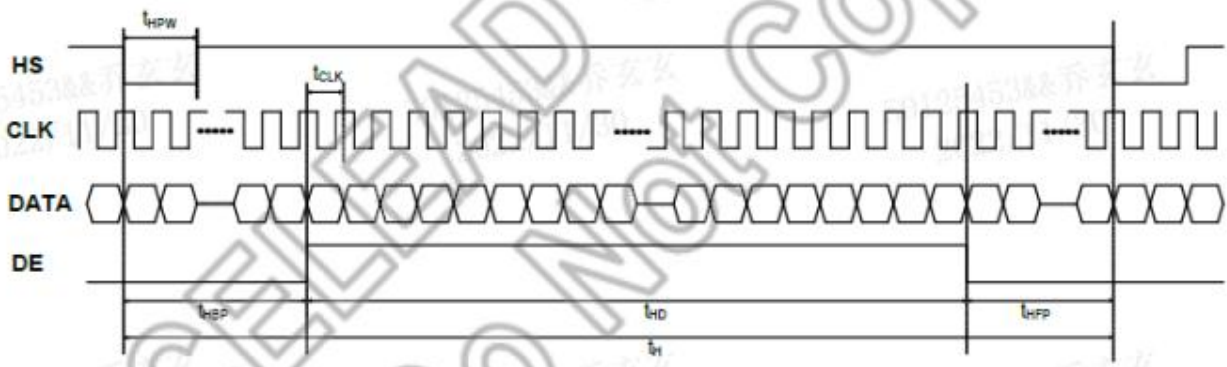
1. For 6 bit mode, MSB are R/G/B[5] and LSB are R/G/B[0]
2. For 8 bit mode, MSB are R/G/B[7] and LSB are R/G/B[0]
3. For single port LVDS only ODD port (CLKxO and DxxO) are used

10.3 Parallel RGB at DE only mode

Vertical input timing



Horizontal input timing

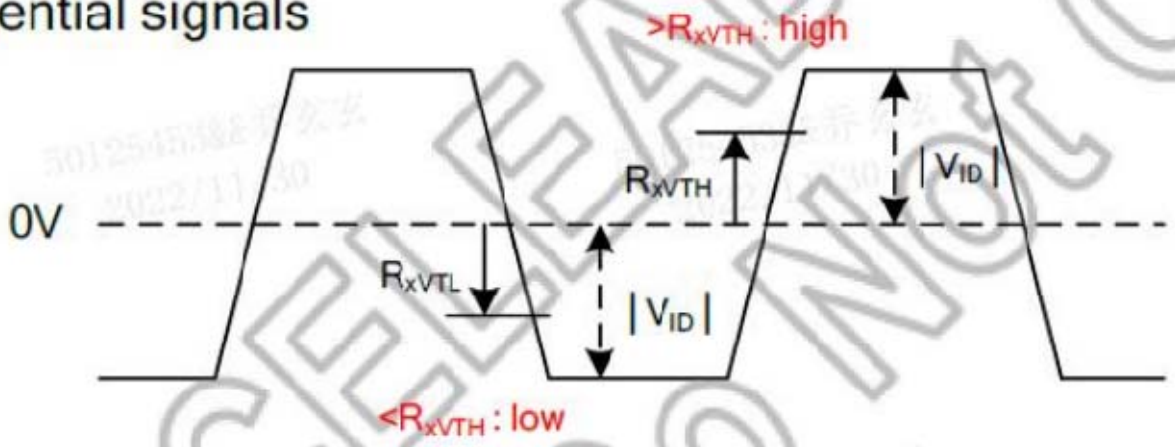


10.4 LVDS DC Characteristics

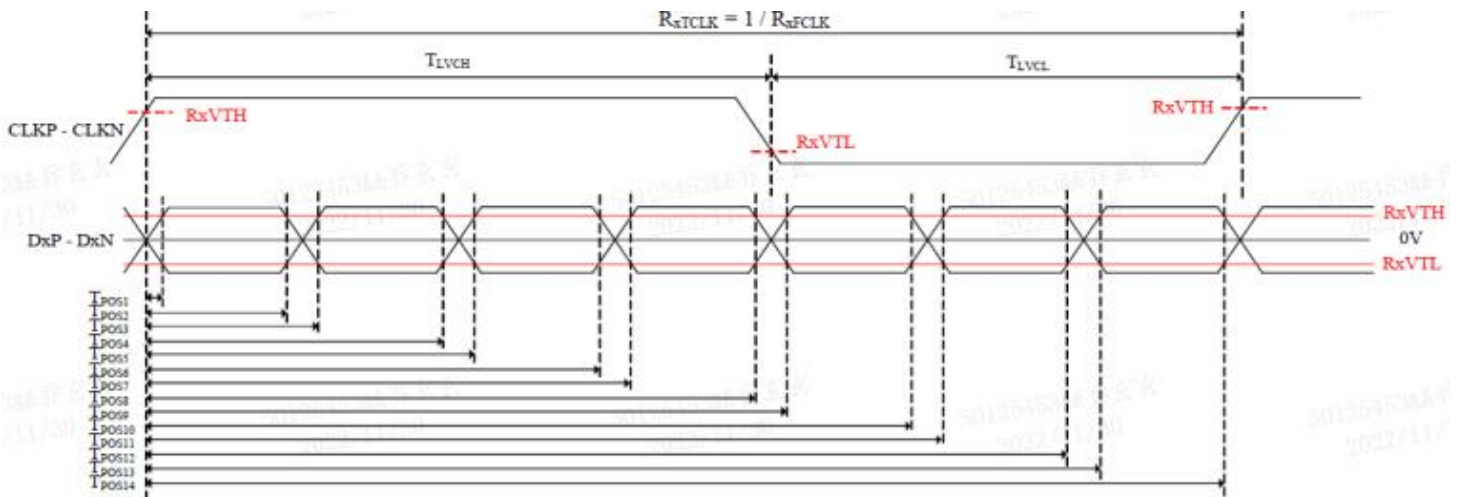
<Table 10-4 LVDS DC Characteristics>

Parameter	Symbol	Min	Typ.	Max.	Unit	Conditions
Differential input high threshold voltage	R_{xVTH}			0.1	V	$R_{xVCM} = 1.2V$
Differential input low threshold voltage	R_{xVTL}	-0.1			V	
Input voltage range (singled-end)	R_{xVIN}	0		$V_{DD}-1.2$	V	
Differential input common mode voltage	R_{xVCM}	0.8	1.2	1.4	V	
Differential input voltage	$ V_{ID} $	0.2	0.4	0.6	V	
Differential input leakage current	$R_{V_{xIz}}$	-10		10	μA	

Differential signals



10.5 LVDS AC Characteristics

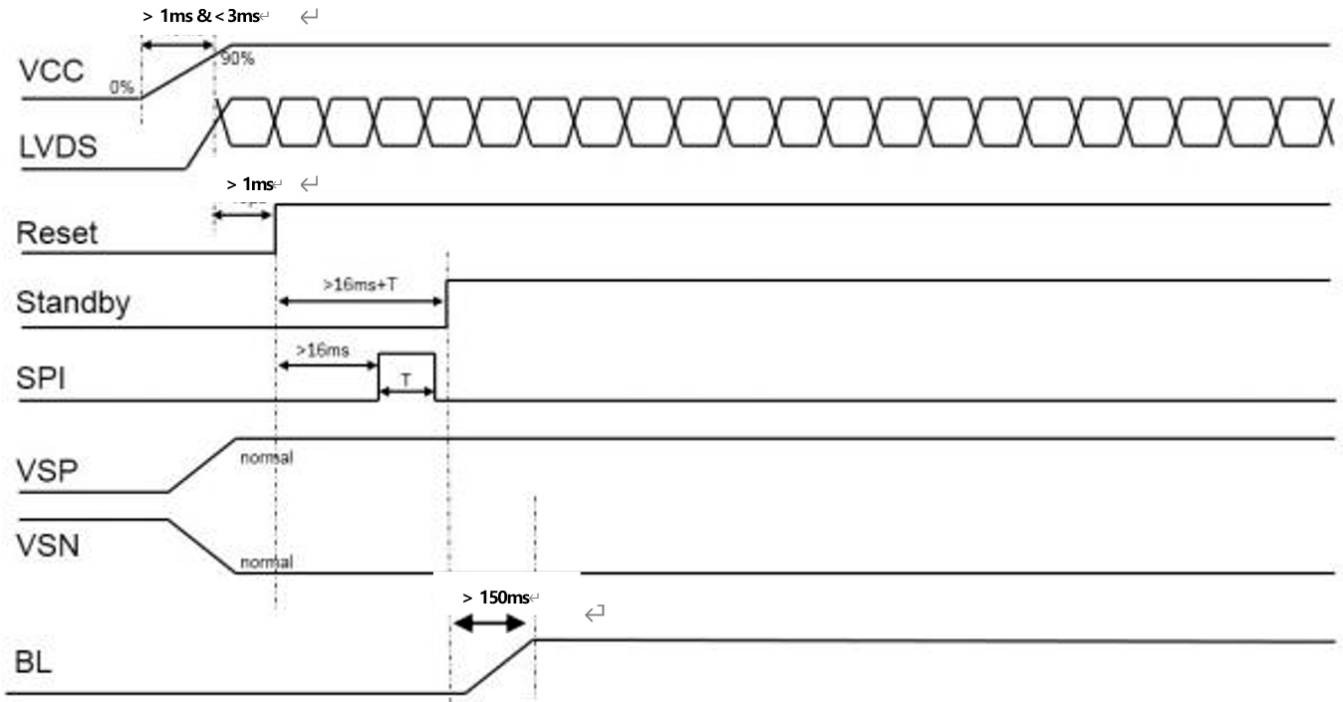


Parameter	Symbol	Min	Typ.	Max.	Unit
Clock Frequency	R _x FCLK	20		90	MHz
Clock Period	R _x TCLK	11.1		50	ns
1 data bit time	UI	-	1/7	-	R _x TCLK
Clock high time	T _{LVCH}		4		UI
Clock low time	T _{LVCL}		3		UI
Position 1	T _{POS1}	-0.25	0	0.25	UI
Position 2	T _{POS2}	0.75	-	1.25	UI
Position 3	T _{POS3}	0.75	1	1.25	UI
Position 4	T _{POS4}	1.75	-	2.25	UI
Position 5	T _{POS5}	1.75	2	2.25	UI
Position 6	T _{POS6}	2.75	-	3.25	UI
Position 7	T _{POS7}	2.75	3	3.25	UI
Position 8	T _{POS8}	3.75	-	4.25	UI
Position 9	T _{POS9}	3.75	4	4.25	UI
Position 10	T _{POS10}	4.75	-	5.25	UI
Position 11	T _{POS11}	4.75	5	5.25	UI
Position 12	T _{POS12}	5.75	-	6.25	UI
Position 13	T _{POS13}	5.75	6	6.25	UI
Position 14	T _{POS14}	6.75	-	7.25	UI
Input eye width	T _{EYEW}	0.5	-	-	UI
Input eye border	T _{EX}	-	-	0.25	UI
PLL wake-up time	T _{enPLL}			150	us

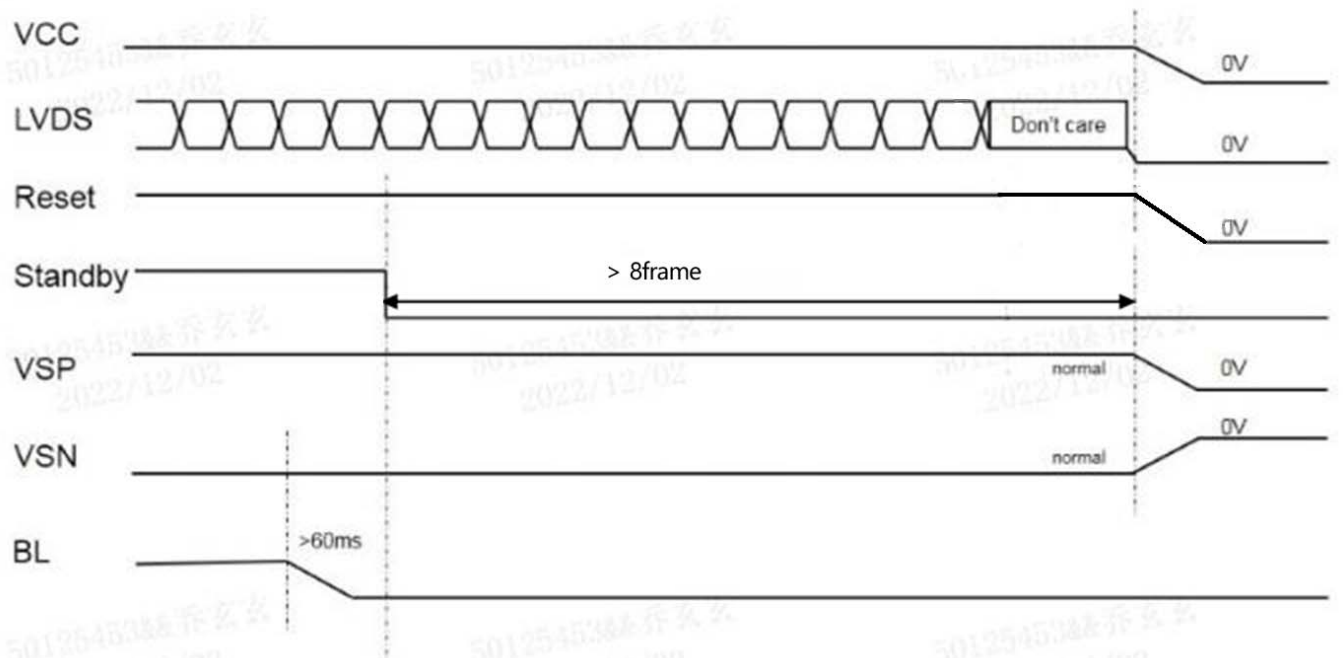
<Table 10-5 LVDSAC Characteristics>

11.0 POWER ON/OFF SEQUENCE

11.1 POWER ON SEQUENCE



11.2 POWER OFF SEQUENCE



Note: Reset can be synchronized with VCC power-off

12. Package

TBD.