

MDT240001	1920x1200	LVDS Interface	TFT Module
Specification			
Version: 1		Date: 12/12/2018	
Revision			
1	10/12/2018	First issue	

Display Features			
Display Size	24"		
Resolution	1920x1200		
Orientation	Landscape		
Appearance	RGB		
Logic Voltage	12V		
Interface	LVDS		
Brightness	1000 cd/m ²		
Touchscreen	---		
Module Size	546.40 x 352.00 x 11.70 mm		
Operating Temperature	-10°C ~ +50°C	Created By	Checked By
Pinout	30 way connector	CL	TSB
Pitch	1.00 mm	Box Quantity	Weight / Display
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DESIGN • MANUFACTURE • SUPPLY

Display Accessories	
Part Number	Description
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) In case if a Module has to be put back into the packing container slot after once it was taken out from the container, do not press the center.
- 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

MDT240001 is a Color Active Matrix Liquid Crystal Display composed of a TFT-LCD panel, a driver circuit, and a backlight system. The screen format is intended to support the WUXGA (1920(H) x 1200(V)) screen and 16.7M colors (8bit -RGB). All input signals are 2-channel LVDS interface compatible.

2.2 Features

- High brightness display, 1000nits.
- LED backlight
- Long lifetime
- Wide operation temperature
- RoHS Compliance

2.3 Application

Industrial Application.



2.4 Display Specifications

Items	Unit	Specification
Screen Diagonal	inch	24.1 (61.13 cm), Aspect ratio 16:10
Active Area	mm	518.4(H) x 324.0(V)
Pixels H x V	pixels	1920x3(RGB) x 1200
Pixels Pitch	mm	0.27(H) x 0.27 (V)
Pixel Arrangement		RGB Vertical stripe
Display mode		Transmissive mode, normally black
White luminance (center)	Cd/m ²	1000 (Typ.)
Contrast ratio		1000 :1(Typ.)
Optical Response Time	msec	14 ms (Typ. Gray to Gray)
Normal Input Voltage VDD	Volt	12
Power Consumption	Watt	41.3 (Typ) Logic: 5.3 W(typ); BLU: 36 W(typ)
Weight	Grams	(TBD)
Physical size	mm	546.4(H)x352.0(V) x 11.7(D) (LED driver is not included)
Electrical Interface		2 Channel LVDS
Support Colors		16.7M colors (8bit-RGB)
Surface Treatment		Anti-Glare, SAG25
Temperature range		
Operating	°C	-10 ~ 50
Storage (Shipping)	°C	-20 ~ 60
RoHS Compliance		RoHS Compliance



2.5 Optical Characteristics

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

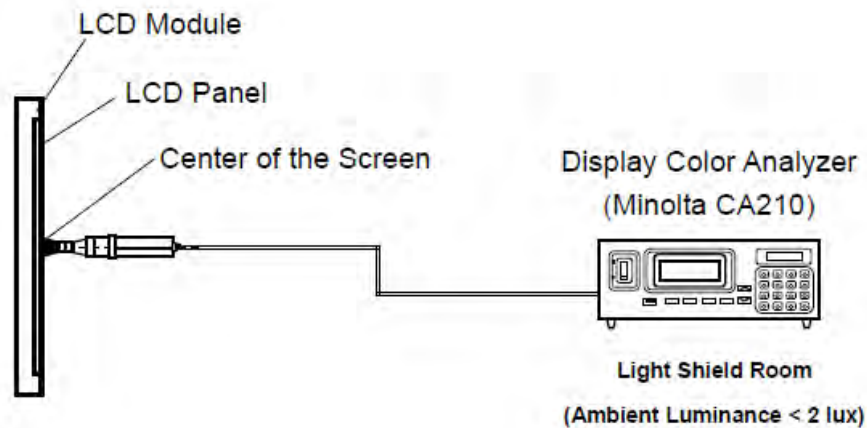
Items	Unit	Conditions	Min.	Typ.	Max.	Note
Viewing angle	Deg.	Horizontal (Right) CR $\geq$ 20 (Left)	150	178		2
		Vertical (Up) CR $\geq$ 20 (Down)	150	178		
Contrast Ratio		Normal Direction	600	1000		3
Response Time	msec	Gray to Gray		14		4
Color / Chromaticity Coordinates (CIE)		Red x	-0.05	0.66	+0.05	5
		Red y		0.33		
		Green x		0.30		
		Green y		0.63		
		Blue x		0.15		
		Blue y		0.06		
Color coordinates (CIE) White		White x		0.31		
		White y		0.33		
Center Luminance	Cd/m ²		800	1000		6
Luminance Uniformity	%			70		7
Crosstalk (in 60 Hz)	%				4.0	

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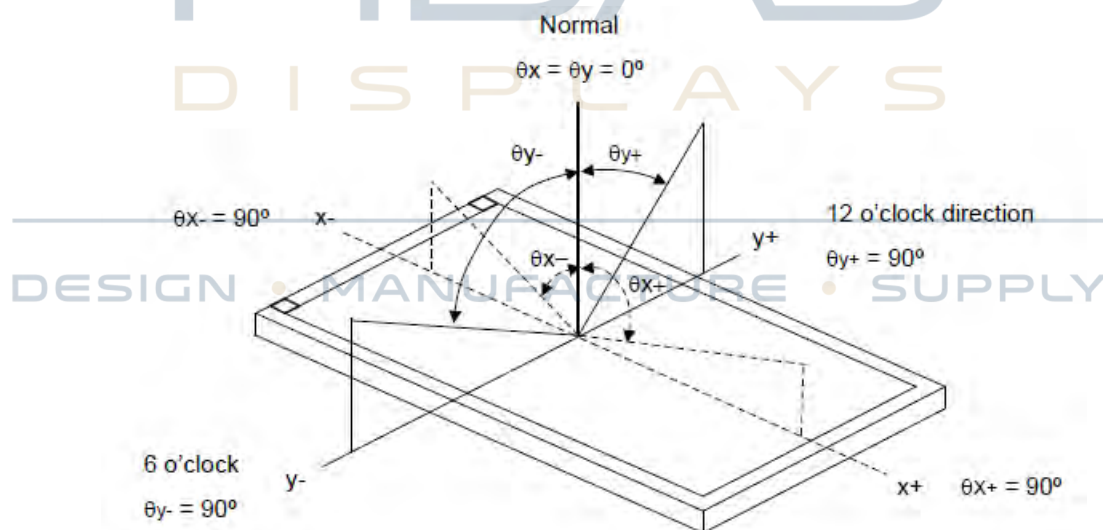


Note 1: Measurement method

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.



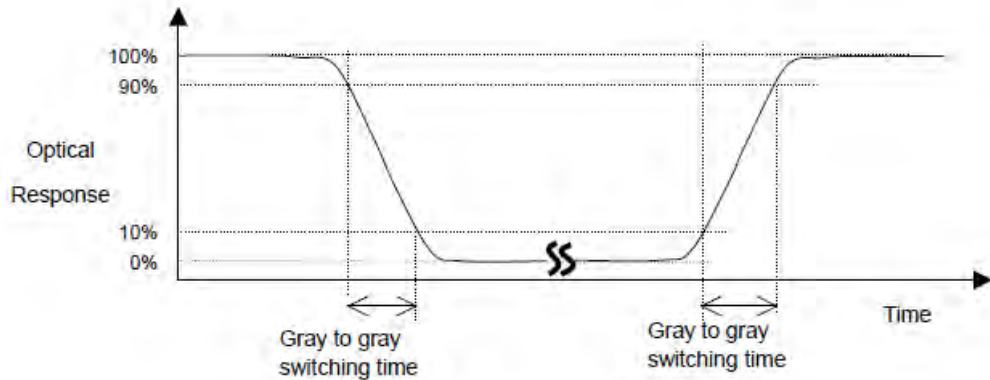
Note 2: Definition of viewing angle



Note 3: Contrast ratio is measured by Minolta CA 210

Note 4: Definition of Response time

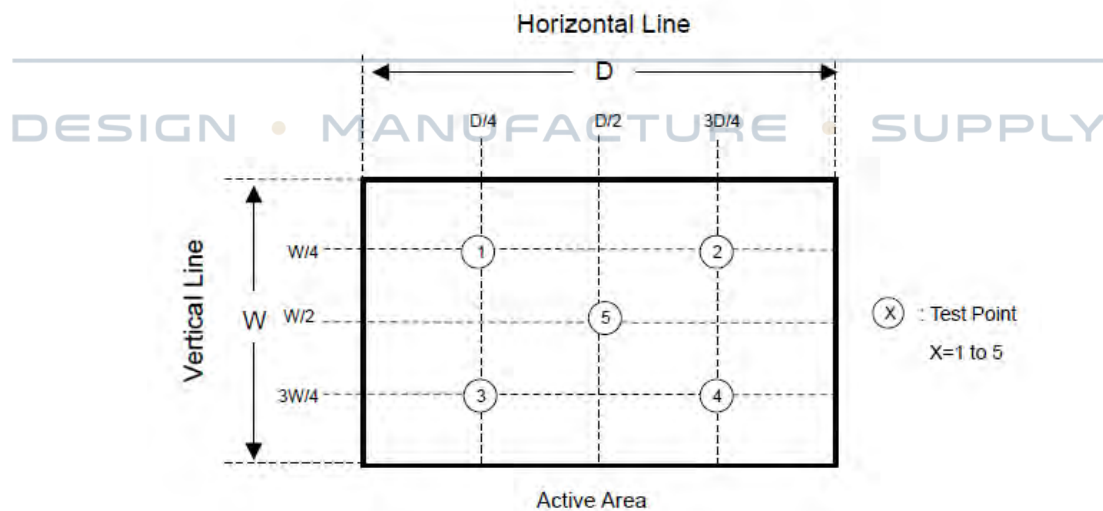
The output signals of photo detector are measured when the input signals are changed from "Full Black" to "Full White" (rising time), and from "Full White" to "Full Black" (falling time), respectively. The response time is interval between the 10% and 90% of amplitudes. Please refer to the figure as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



Note 5: Color chromaticity and coordinates (CIE) is measured by Minolta CA 210

Note 6: Center luminance is measured by Minolta CA 210

Note 7: Luminance uniformity of these 5 points is defined as below and measured by Minolta CA 210



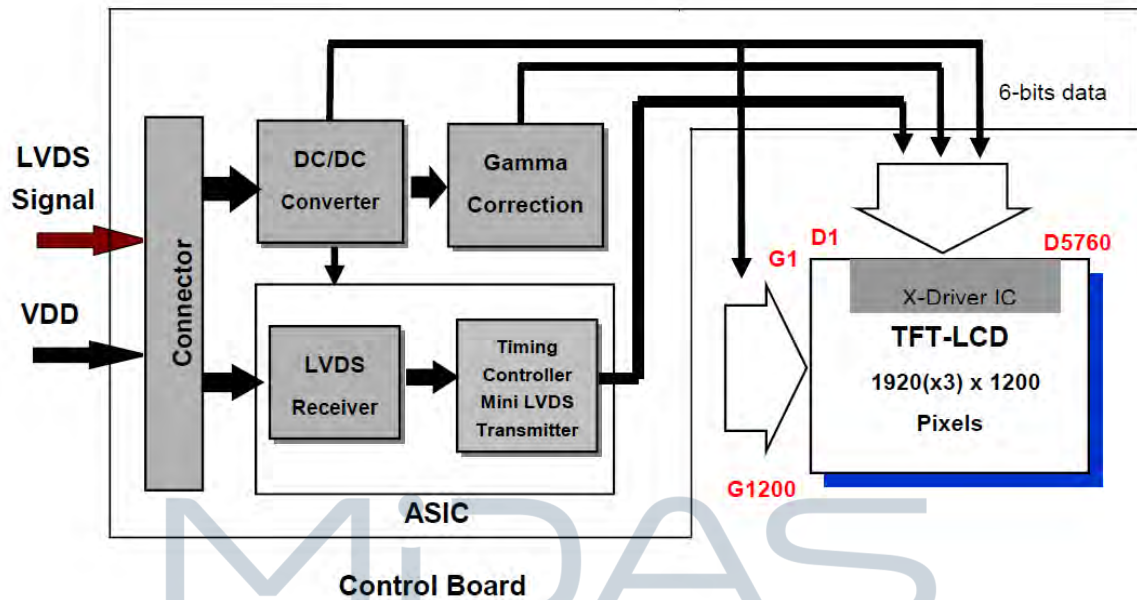
$$\text{Uniformity} = (\text{Min. Luminance of 5 points}) / (\text{Max. Luminance of 5 points})$$



3. Functional Block Diagram

3.1 Block Diagram

The following diagram shows the functional block of the 24 inches Color TFT-LCD Module:



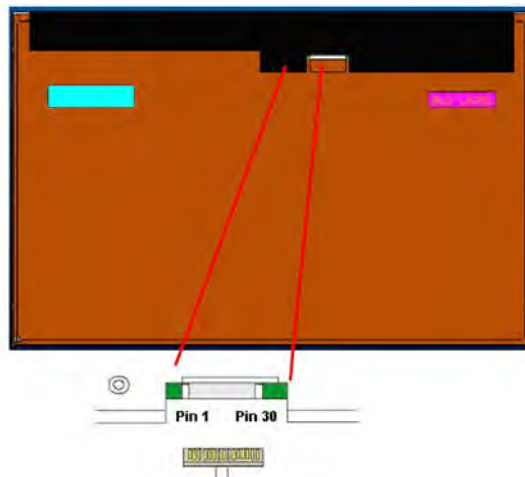
3.2 Interface Connection

3.2.1 Connector Type

TFT-LCD Connector	Manufacturer	P-TWO	STM
	Part Number	187034-3009	MSBKT2407P30HB
Mating Connector	Manufacturer	JAE or Compatible	
	Part Number	FI-X30HL (Locked Type)	

3.2.2 Connector Pin Assignment

PIN #	Symbol	Description	Remark
1	RxO0-	Negative LVDS differential data input (Odd data)	
2	RxO0+	Positive LVDS differential data input (Odd data)	
3	RxO1-	Negative LVDS differential data input (Odd data)	
4	RxO1+	Positive LVDS differential data input (Odd data)	
5	RxO2-	Negative LVDS differential data input (Odd data)	
6	RxO2+	Positive LVDS differential data input (Odd data)	
7	GND	Ground	
8	RxOCLK-	Negative LVDS differential clock input (Odd	
9	RxOCLK+	Positive LVDS differential clock input (Odd clock)	
10	RxO3-	Negative LVDS differential data input (Odd data)	
11	RxO3+	Positive LVDS differential data input (Odd data)	
12	RxE0-	Negative LVDS differential data input (Even data)	
13	RxE0+	Positive LVDS differential data input (Even data)	
14	GND	Ground	
15	RxE1-	Negative LVDS differential data input (Even data)	
16	RxE1+	Positive LVDS differential data input (Even data)	
17	GND	Ground	
18	RxE2-	Negative LVDS differential data input (Even data)	
19	RxE2+	Positive LVDS differential data input (Even data)	
20	RxECLK-	Negative LVDS differential clock input (Even	
21	RxECLK+	Positive LVDS differential clock input (Even clock)	
22	RxE3-	Negative LVDS differential data input (Even data)	
23	RxE3+	Positive LVDS differential data input (Even data)	
24	GND	Ground	
25	NC	No connection (for AUO test only. Do not	
26	NC	No connection (for AUO test only. Do not	
27	NC	No connection (for AUO test only. Do not	
28	VDD	Power Supply Input Voltage	
29	VDD	Power Supply Input Voltage	
30	VDD	Power Supply Input Voltage	



3.3. Absolute Maximum Ratings

Absolute maximum ratings of the module are as following:

TFT LCD Module

Items	Symbol	Min	Max	Unit	Conditions
Power supply voltage	VDD	-0.3	14.0		Note 1
Logic/ LCD drive voltage	Vin	-0.3	4.0	Volt	Note 1

Backlight converter unit

Items	Symbol	Min	Max	Unit	Conditions
Light bar voltage	V _W		(TBD)	V	T=25 °C
Converter input voltage	V _{BL}	0	(TBD)	V	
Control signal level		-0.3	7	V	Note 1, 2

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

Absolute Ratings of Environment

Items	Symbol	Values			Unit	Conditions
		Min.	Typ.	Max.		
Operation temperature	T _{OP}	-10	-	50	°C	Note 3
Operation Humidity	H _{OP}	5		90	%	
Storage temperature	T _{ST}	-20		60	°C	
Storage Humidity	H _{ST}	5		90	%	

Note 1: With in Ta= 25°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

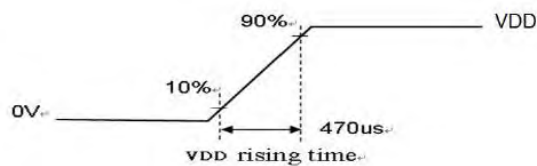
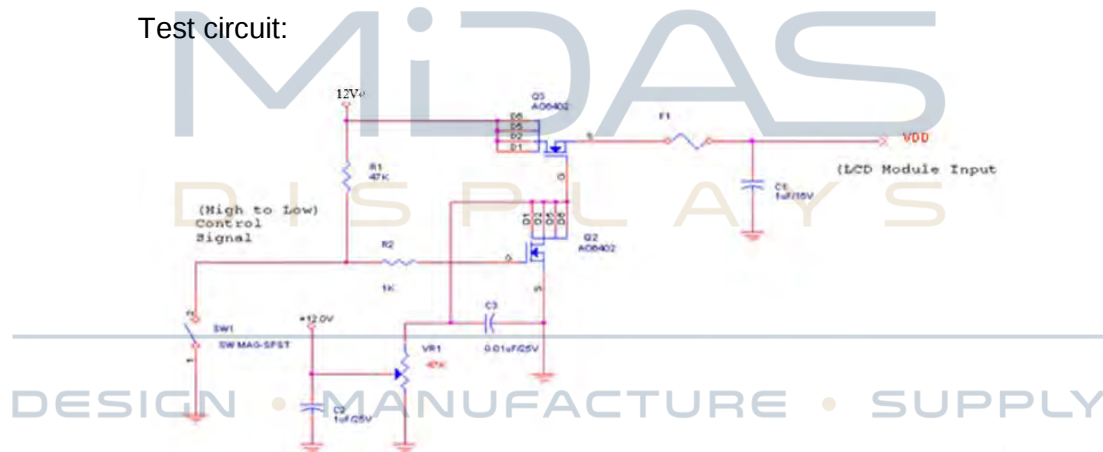
4.1 Electrical Characteristic

4.1.1: DC Characteristics

Symbol	Description	Min	Typ	Max	Unit	Remark
VDD	Power supply Input voltage	10.8	12	13.2	[Volt]	
IDD	Power supply Input Current (RMS)	-	0.4	0.48	[A]	VDD= 12V, White Pattern, Fv=60Hz
			0.44	0.53	[A]	VDD= 12V, White Pattern, Fv=66Hz
PDD	VDD Power Consumption	-	4.8	5.76	[Watt]	VDD= 12V, White Pattern, Fv=60Hz
			5.28	6.36	[Watt]	VDD= 12V, White Pattern, Fv=66Hz
IRush	Inrush Current	-	-	3.0	[A]	Note 3-1
VDDrp	Allowable VDD Ripple Voltage	-	-	500	[mV]	VDD= 12V, White Pattern, Fv=66Hz

Note : Inrush Current measurement:

Test circuit:



The duration of VDD rising time: 470us.

4.1.2: Backlight Characteristics

Parameter guideline is under stable conditions at 25°C (Room Temperature):

Parameter	Min	Typ	Max	Unit	Note
LED voltage (VL)		36		[V]	
LED current (IL)		500		[mA]	,
LED power (PL)		36		W	
LED Life Time(LTLED)		50000		[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 500 mA .

Note 2: $PL = VL \times IL \times 2$

Backlight module

Input Pin Assignment (CN2) (2 connectors)

Pin No.	Symbol	I/O	Function	Remark
1	VLED+	P	Power for LED backlight anode	Red
2	VLED-	P	Power for LED backlight cathode	Black

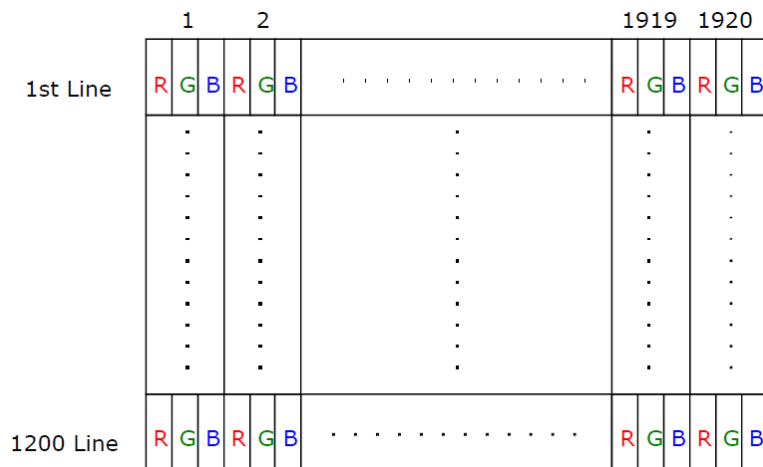
LED Light Bar Connector is used for the integral backlight system. The recommended model is BHSR-02VS-1 manufactured by JST.

LED driver (Option)

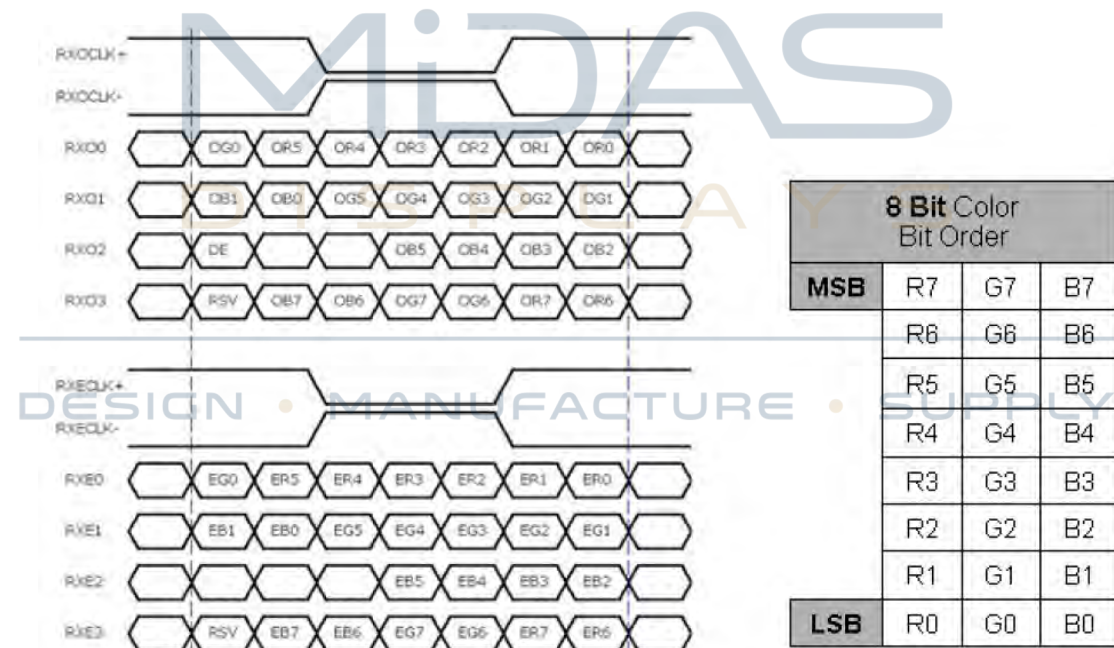
Parameter	Min	Typ	Max	Unit	Note
Input voltage		24		[V]	
Input current			(TBD)	[A]	,

4.2 Signal Characteristics

4.2.1 LCD Pixel Format



4.2.2 LVDS Data Format



Note:

- O = "Odd Pixel Data" E = "Even Pixel Data"
- Refer to 4.2.1 LCD pixel format, the 1st data is 1 (Odd Pixel Data), the 2nd data is 2 (Even Pixel Data) and the last data is 1920 (Even Pixel Data).

4.3 Color versus Input Data

The following table is for color versus input data (8bit). The higher the gray level, the brighter the color.

Color	Gray Level	Color Input Data																								Remark
		RED data (MSB:R7, LSB:R0)								GREEN data (MSB:G7, LSB:G0)								BLUE data (MSB:B7, LSB:B0)								
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0	
Black	-	0	0	0	0	0	0	0	0	0	0	0	0	0	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	
Gray 127	-	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	
Red	L0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Black
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	L255	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Green	L0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Black
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	L255	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	
Blue	L0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Black
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	L255	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	

4.4. LVDS Specification

a. DC Characteristics:

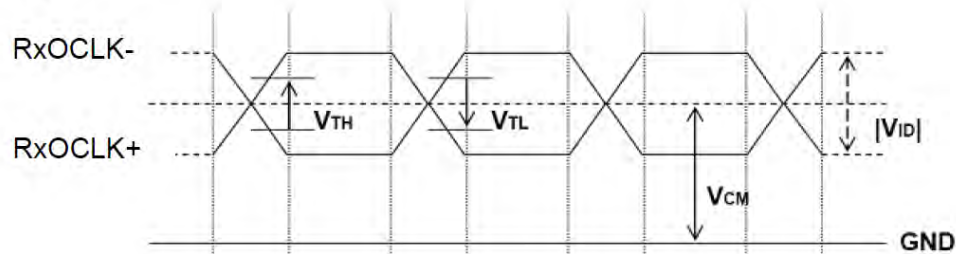
Symbol	Description	Min	Typ	Max	Units	Condition
V_{TH}	LVDS Differential Input High Threshold	-	-	+100	[mV]	$V_{CM} = 1.2V$
V_{TL}	LVDS Differential Input Low Threshold	-100	-	-	[mV]	$V_{CM} = 1.2V$
$ V_{ID} $	LVDS Differential Input Voltage	100	-	600	[mV]	
V_{CM}	LVDS Common Mode Voltage	+1.0	+1.2	+1.5	[V]	$V_{TH}-V_{TL} = 200mV$



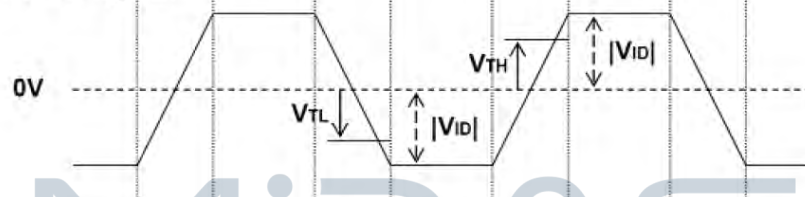
LVDS Signal Waveform:

Use RxOCLK- & RxOCLK+ as example.

Single-End

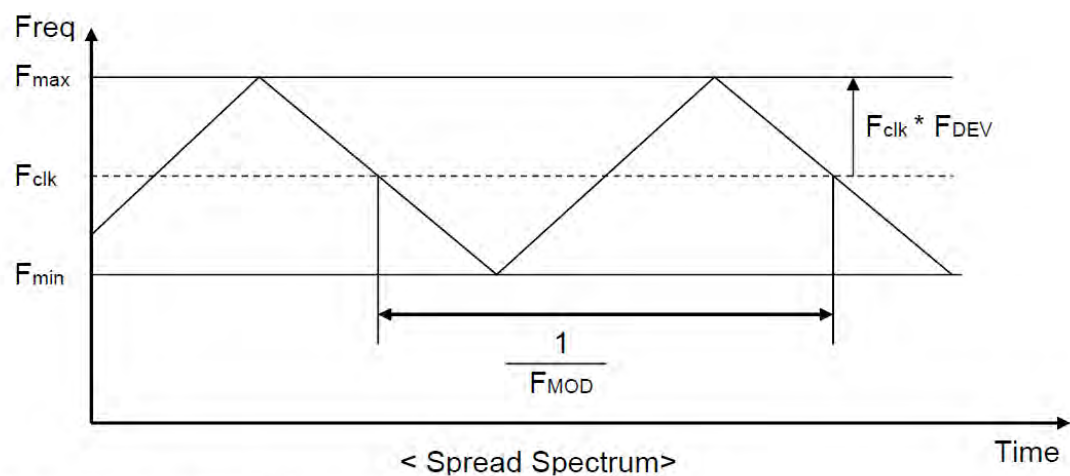


Differential Signal



b. AC Characteristics:

Symbol	Description	Min	Max	Unit	Remark
F_{DEV}	Maximum deviation of input clock frequency during Spread Spectrum	-	± 3	%	
F_{MOD}	Maximum modulation frequency of input clock during Spread Spectrum	-	200	KHz	



F_{clk} : LVDS Clock Frequency

4.5 Input Timing Specification

It only support DE mode, and the input timing are shown as the following table.

Symbol	Description	Min.	Typ.	Max.	Unit	Remark
Tv	Vertical Section	Period	1214	1235	1734	Th
Tdisp (v)		Active	1200	1200	1200	Th
Tblk (v)		Blanking	14	35	534	Th
Fv		Frequency	49	60	66	Hz
Th	Horizontal Section	Period	1000	1040	1428	Tclk
Tdisp (h)		Active	960	960	960	Tclk
Tblk (h)		Blanking	40	80	468	Tclk
Fh		Frequency	59.5	74.0	85.0	KHz Note 3-3
Tclk	LVDS Clock	Period	11.8	13.0	16.8	ns
Fclk		Frequency	59.5	77.0	85.0	MHz Note 3-4

Note 3-3: The equation is listed as following. Please don't exceed the above recommended value.

$$Fh (\text{Min.}) = Fclk (\text{Min.}) / Th (\text{Min.});$$

$$Fh (\text{Typ.}) = Fclk (\text{Typ.}) / Th (\text{Typ.});$$

$$Fh (\text{Max.}) = Fclk (\text{Max.}) / Th (\text{Min.});$$

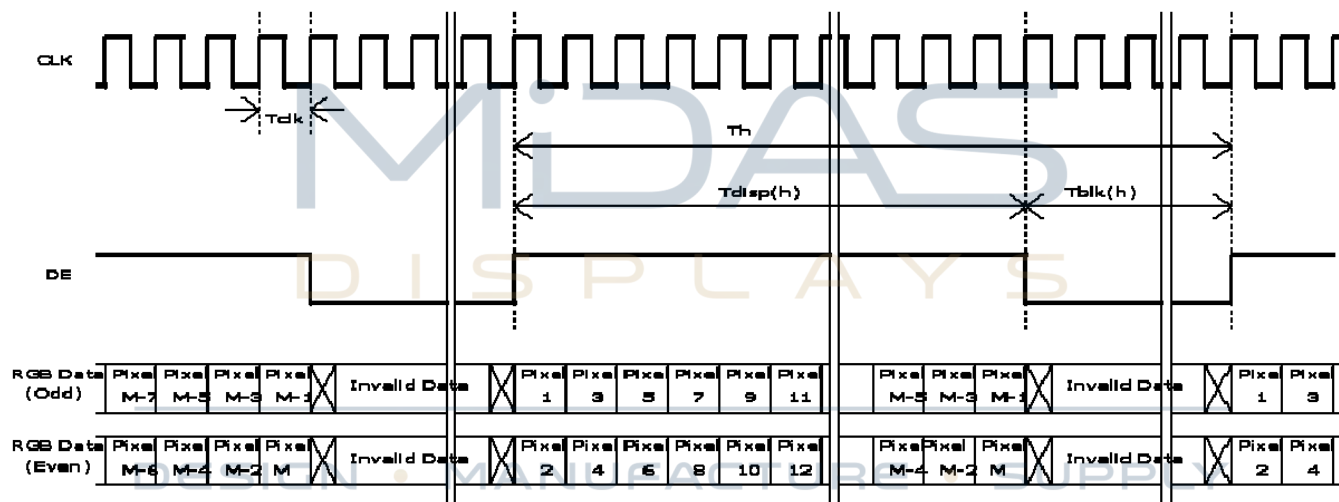
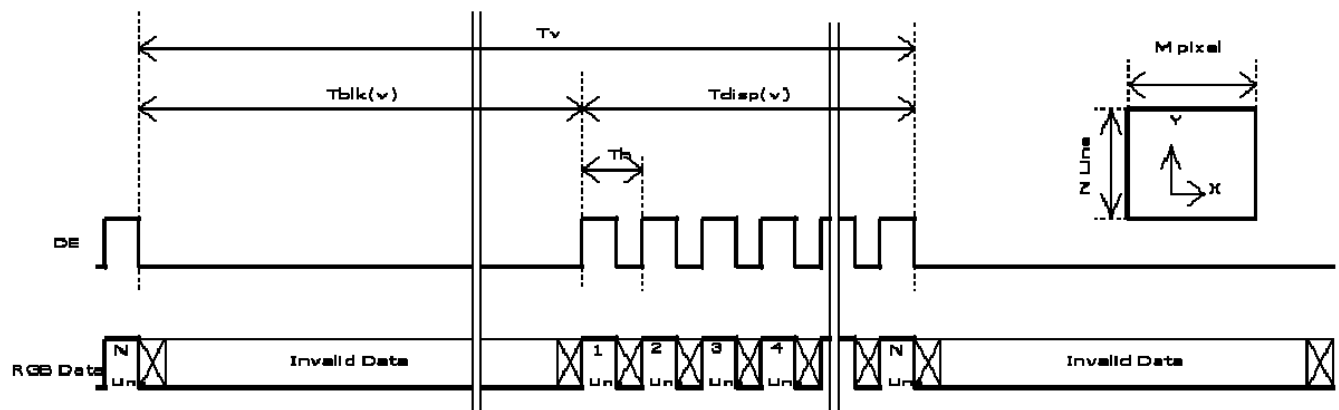
Note 3-4: The equation is listed as following. Please don't exceed the above recommended value.

$$Fclk (\text{Min.}) = Fv (\text{Min.}) \times Th (\text{Min.}) \times Tv (\text{Min.});$$

$$Fclk (\text{Typ.}) = Fv (\text{Typ.}) \times Th (\text{Typ.}) \times Tv (\text{Typ.});$$

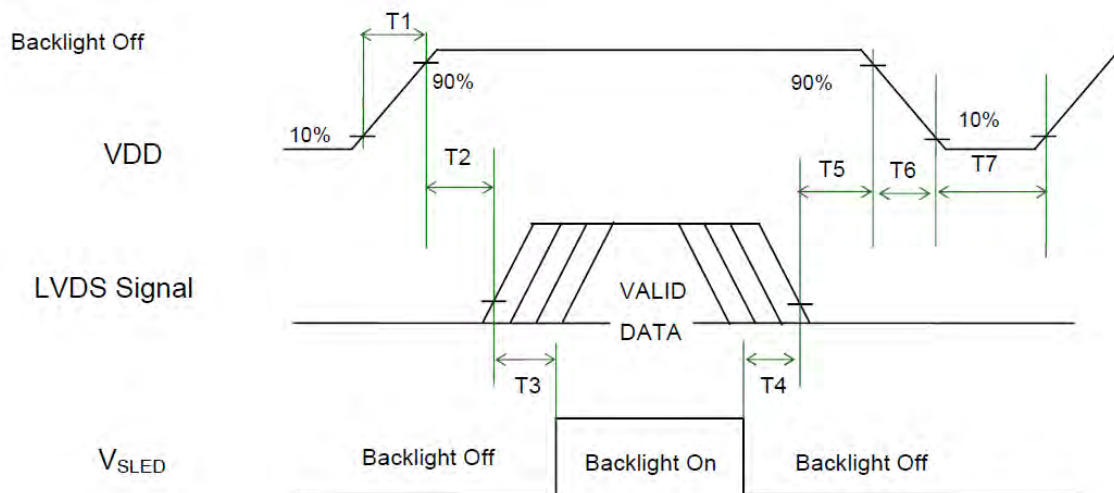
$$Fclk (\text{Max.}) = Fv (\text{Max.}) \times Th (\text{Typ.}) \times Tv (\text{Typ.});$$

4.6 Input Timing Diagram



4.7 Power Sequence for LCD

VDD power, LVDS signal and backlight on/off sequence are as following. LVDS signals from any system shall be Hi-Z state when VDD is off.



Power Sequence Timing

Symbol	Value			Unit	Remark
	Min.	Typ.	Max.		
T1	0.5	-	10	[ms]	
T2	0	-	50	[ms]	
T3	500	-	-	[ms]	
T4	100	-	-	[ms]	
T5	0	-	50	[ms]	Note 3-5 Note 3-6
T6	0	-	200	[ms]	Note 3-6 Note 3-7
T7	1000	-	-	[ms]	

Note 1 : Recommend setting T5 = 0ms to avoid electronic noise when VDD is off.

Note 2 : During T5 and T6 period , please keep the level of input LVDS signals with Hi-Z state.

Note 3 : Voltage of VDD must decay smoothly after power-off. (customer system decide this value)

5. Reliability Test

Environment test conditions are listed as following table.

Items	Required Condition	Note
Temperature Humidity Bias (THB)	Ta= 50°C , 80%RH, 120hours	
High Temperature Operation (HTO)	Ta= 50°C , 50%RH, 120hours	3
Low Temperature Operation (LTO)	Ta= -10°C , 120hours	
High Temperature Storage (HTS)	Ta= 60°C , 120hours	
Low Temperature Storage (LTS)	Ta= -20°C , 120hours	
Drop Test	Height: 60 cm, package test	
Thermal Shock Test (TST)	-20°C/30min, 60°C/30min, 100 cycles	1
On/Off Test	On/10sec, Off/10sec, 30,000 cycles	
ESD (Electrostatic Discharge)	Contact Discharge: $\pm$ 8KV, 150pF(330 Ω) 1sec, 9 points, 25 times/ point.	2
	Air Discharge: $\pm$ 15KV, 150pF(330 Ω) 1sec 9 points, 25 times/ point.	2

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 -20°C to 60°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: The test items are tested by open frame type chassis.

7. Mechanical Characteristic (mm)

