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SPECIFICATION

CUSTOMER : _____

MODULE NO.: **WF65BTIAFLO#**

<p>APPROVED BY: (FOR CUSTOMER USE ONLY)</p>	<p>PCB VERSION: _____</p> <p>DATA: _____</p>
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SALES BY	APPROVED BY	CHECKED BY	PREPARED BY

VERSION	DATE	REVISED PAGE NO.	SUMMARY
A	2012/04/11	4,13	Modify Number7 is L(LVDS) , and Scanning Direction Mark to delete



RECORDS OF REVISION

DOC. FIRST ISSUE

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0	2011/08/03		First issue
A	2011/04/11	4,13	Modify Number7 is LVDS, Scanning Direction Mark to delete

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1. Module Classification Information

W F 65 B T I A F L 0 #
① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ○,9○,10 ○,11

- ① Brand : WINSTAR DISPLAY CORPORATION
- ② Display Type : H→Character Type, G→Graphic Type F→TFT Type
- ③ Display Size : 6.5" TFT
- ④ Model serials no.
- ⑤ Backlight Type : F→CCFL, White T→LED, White
- ⑥ LCD Polarize A→Reflective, N.T, 6:00 H→Transflective, W.T,6:00
Type/ Temperature D→Reflective, N.T, 12:00 K→Transflective, W.T,12:00
range/ View G→Reflective, W. T, 6:00 C→Transmissive, N.T,6:00
direction J→Reflective, W. T, 12:00 F→Transmissive, N.T,12:00
 B→Transflective, N.T,6:00 I→Transmissive, W. T, 6:00
 E→Transflective, N.T.12:00 L→Transmissive, W.T,12:00
- ⑦ A: TFT LCD
B: TFT+FR+CONTROL BOARD
C: TFT+FR+A/D BOARD
D:TFT+FR+A/D BOARD+CONTROL BOARD
- ⑧ Solution: A: 128160 B:320234 C:320240 D:480234 F:640480
- Option**D: Digital L: LVDS
- Option** Version
- Option** Special Code #:Fit in with ROHS directive regulations

2. General Description

6.5 TFT-LCD V2 is designed for industrial display applications with VGA (640 x RGB x 480) resolution and 16.2M (RGB 6-bits + FRC) or 262k colors (RGB 6-bits). It is composed of a TFT-LCD panel, driver ICs, control and power supply circuits board and a backlight unit including LED driving circuit.

6.5 TFT-LCD V2 offers LVDS interface for display signal input.

2.1 Display Characteristics

The following items are 6.5 TFT-LCD V2 characteristics summary at 25°(Room Temperature).

Items	Unit	Specifications
Screen Diagonal	inch	6.5
Active Area	mm	132.48(H) x 99.36(V)
Pixels H x V		640x3(RGB) x 480
Pixel Pitch	mm	0.207 x 0.207
Pixel Arrangement		R.G.B. Vertical Stripe
Display Mode		TN, Normally White
Nominal Input Voltage VDD	Volt	3.3 typ.
Typical Power Consumption	Watt	3.9W (LCD:0.9W/LED BLU: 3.0W) All black pattern
Weight	Grams	170g (typ.)
Physical Size	mm	153.0(H)x 118.0(V) x 10.9(D) (typ.)
Electrical Interface		1 channel LVDS
Surface Treatment		Glare, AR, Hardness: 3H
Support Color		16.2M / 262K colors
The most suitable view angle		6 o'clock
Temperature Range Operating Storage (Non-Operating)	oC oC	-30 to +85 -30 to +85
RoHS Compliance		RoHS Compliance

2.2 Optical Characteristics

The optical characteristics are measured under stable conditions at 25°(Room Temperature).

Item	Unit	Conditions	Min.	Typ.	Max.	Remark
White Luminance	cd/m2	FPWM = 100% (center point)	500	800	-	Note 1
Uniformity	%	5 Points		-	1.25	Note 1, 2, 3
Contrast Ratio			400	600	-	Note 4
Response Time	msec	Rising	-	15	20	Note 5
	msec	Falling	-	10	15	
	msec	Rising + Falling	-	25	35	
Viewing Angle	degree degree	Horizontal (Right) CR = 10 (Left)	70 70	80 80	--	Note 6
	degree degree	Vertical (Upper) CR = 10 (Lower)	60 60	70 70	--	
Color / Chromaticity Coordinates (CIE 1931)		White x	0.263	0.313	0.363	
		White y	0.279	0.329	0.379	
		Red x	TBD	TBD	TBD	
		Red y	TBD	TBD	TBD	
		Green x	TBD	TBD	TBD	
		Green y	TBD	TBD	TBD	
		Blue x	TBD	TBD	TBD	
		Blue y	TBD	TBD	TBD	
Color Gamut	%		-	55	-	

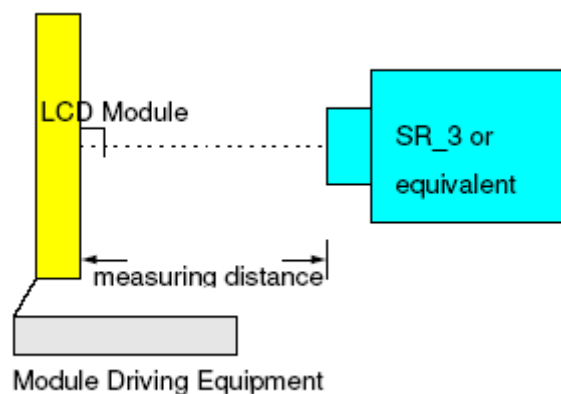
Note 1: Measurement method

Equipment Pattern Generator, Power Supply, Digital Voltmeter, Luminance meter (SR_3 or equivalent)

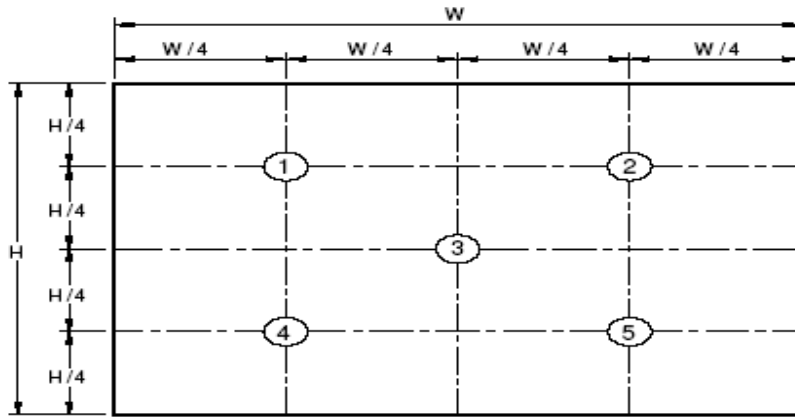
Aperture 1° with 50cm viewing distance

Test Point Center

Environment < 1 lux



Note 2: Definition of 5 points position (Display active area: 132.48mm(W) x 99.36mm(H))



Note 3:

The luminance uniformity of 5 points is defined by dividing the maximum luminance value by the minimum luminance value at full white condition.

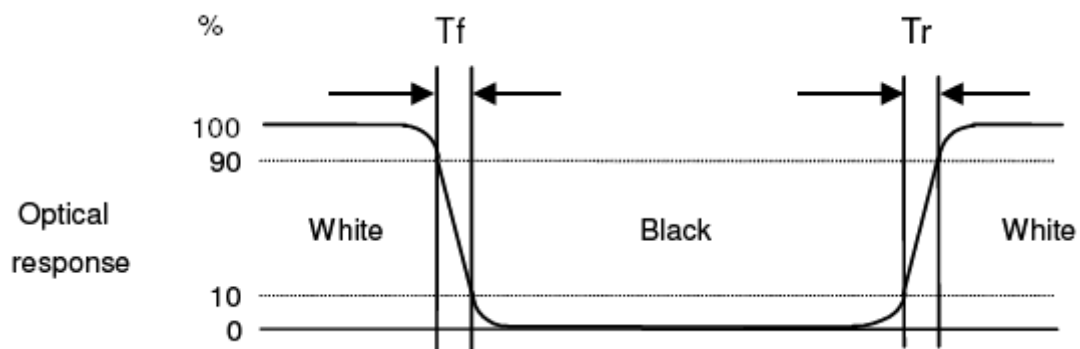
$$\delta_{w5} = \frac{\text{Maximum Brightness of five points}}{\text{Minimum Brightness of five points}}$$

Note 4: Definition of contrast ratio (CR):

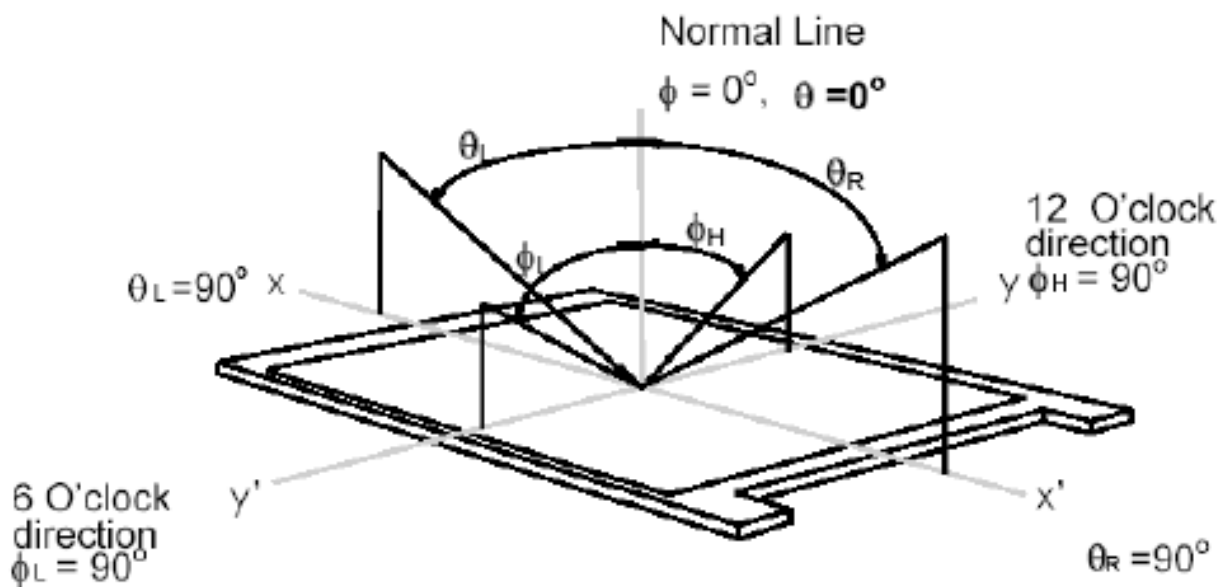
$$\text{Contrast ratio (CR)} = \frac{\text{Brightness @ "White" state}}{\text{Brightness @ "Black" state}}$$

Note 5: Definition of response time:

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

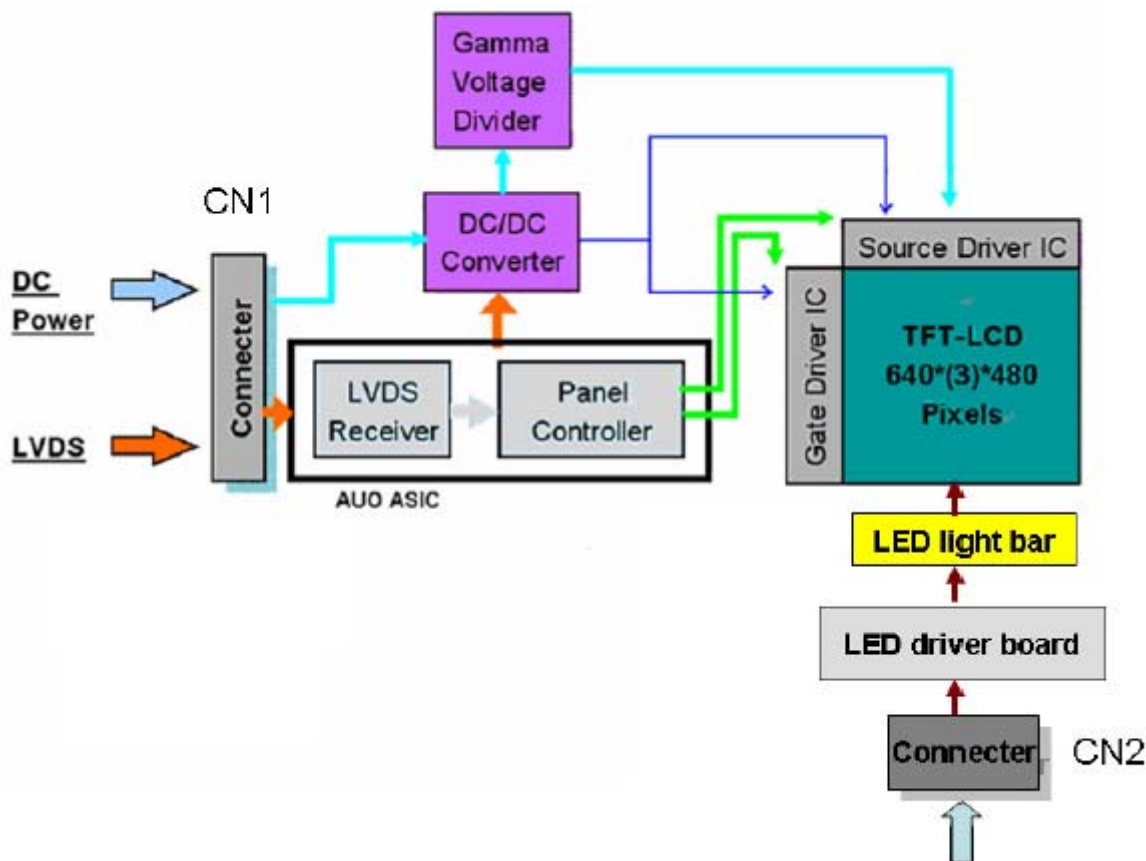


Note 6: Definition of viewing angle Viewing angle is the measurement of contrast ratio ≥ 10 , at the screen center, over 180° horizontal and 180° vertical range. The 180° horizontal (θ_L, θ_R) and 180° vertical (ϕ_H, ϕ_L) range are illustrated as following figure.



3. Functional Block Diagram

The following diagram shows the functional block of the 6.5 TFT-LCD V2 color TFT/LCD module.



4. Absolute Maximum Ratings

4.1 Absolute Ratings

Item	Symbo	Min	Max	Unit	Remark
Logic/LCD Drive Voltage	VDD	-0.3	+4.0	Volt	Ta= 25oC
LCD Input Signal Voltage	VIN	-0.3	+4.0	Volt	Ta= 25oC
LED BLU Drive Voltage	VLED	0	25	Volt	Ta= 25oC
LED Dimming Input Voltage	VPWM	0	6	Volt	Ta= 25oC

4.2 Absolute Ratings of Environment

Item	Symbol	Min	Max	Unit	Remark
Operating Temperature	TOP	-30	+85		Note 1, 2
Operation Humidity	HOP	5	95	%RH	Note 1, 2
Storage Temperature	TST	-30	+85		Note 1
Storage Humidity	HST	5	95	%RH	Note 1

Note 1: Maximum Wet-Bulb should be 39□ and no condensation.

Note 2: Only operation is guaranteed. Optical performance should be evaluated at 25□ only.

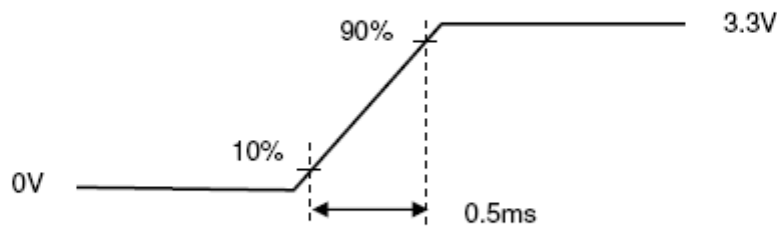
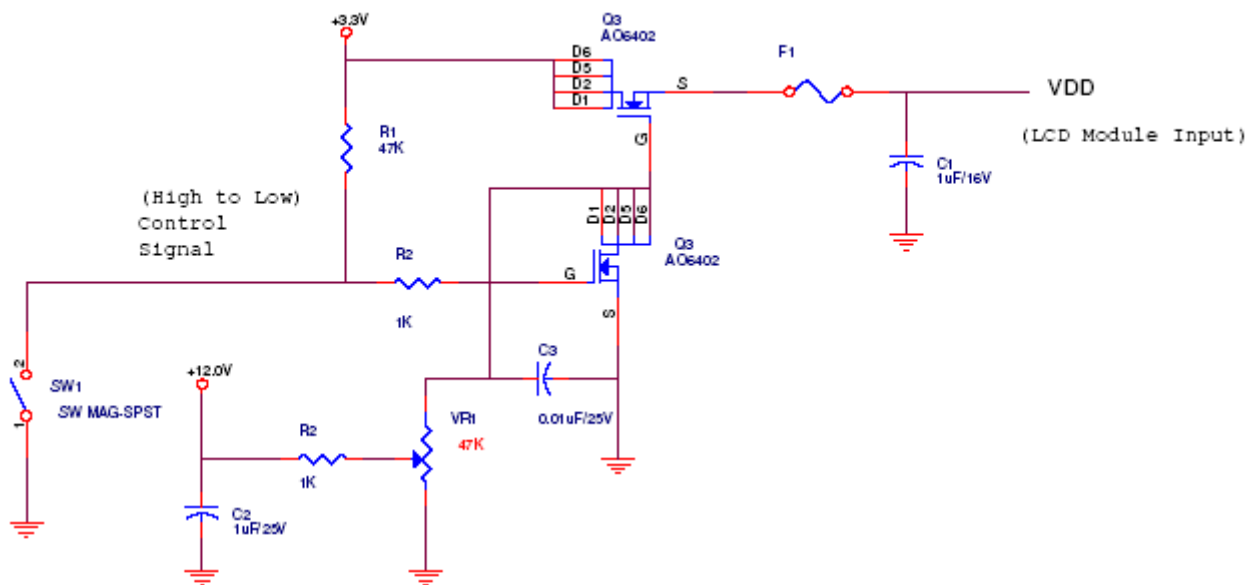
5. Electrical Characteristics

5.1 TFT-LCD Driving

5.1.1 Power Specification

Symbol	Parameter	Min	Typ	Max	Units	Remark
VDD	Logic/LCD Drive Voltage	3.0	3.3	3.6	Volt	
IDD	VDD Current	-	260		mA	All Black Pattern (VDD=3.3V, at 60Hz)
Irush	LCD Inrush Current	-	-	1.5	A	Note 1
PDD	VDD Power	-	0.86		Watt	All Black Pattern (VDD=3.3V, at 60Hz)
VDDrp	Allowable Logic/LCD Drive Ripple Voltage	-	-	100	mVp-p	All Black Pattern (VDD=3.3V, at 60Hz)

Note 1: Measurement condition:



VDD rising time

5.1.2 Signal Electrical Characteristics

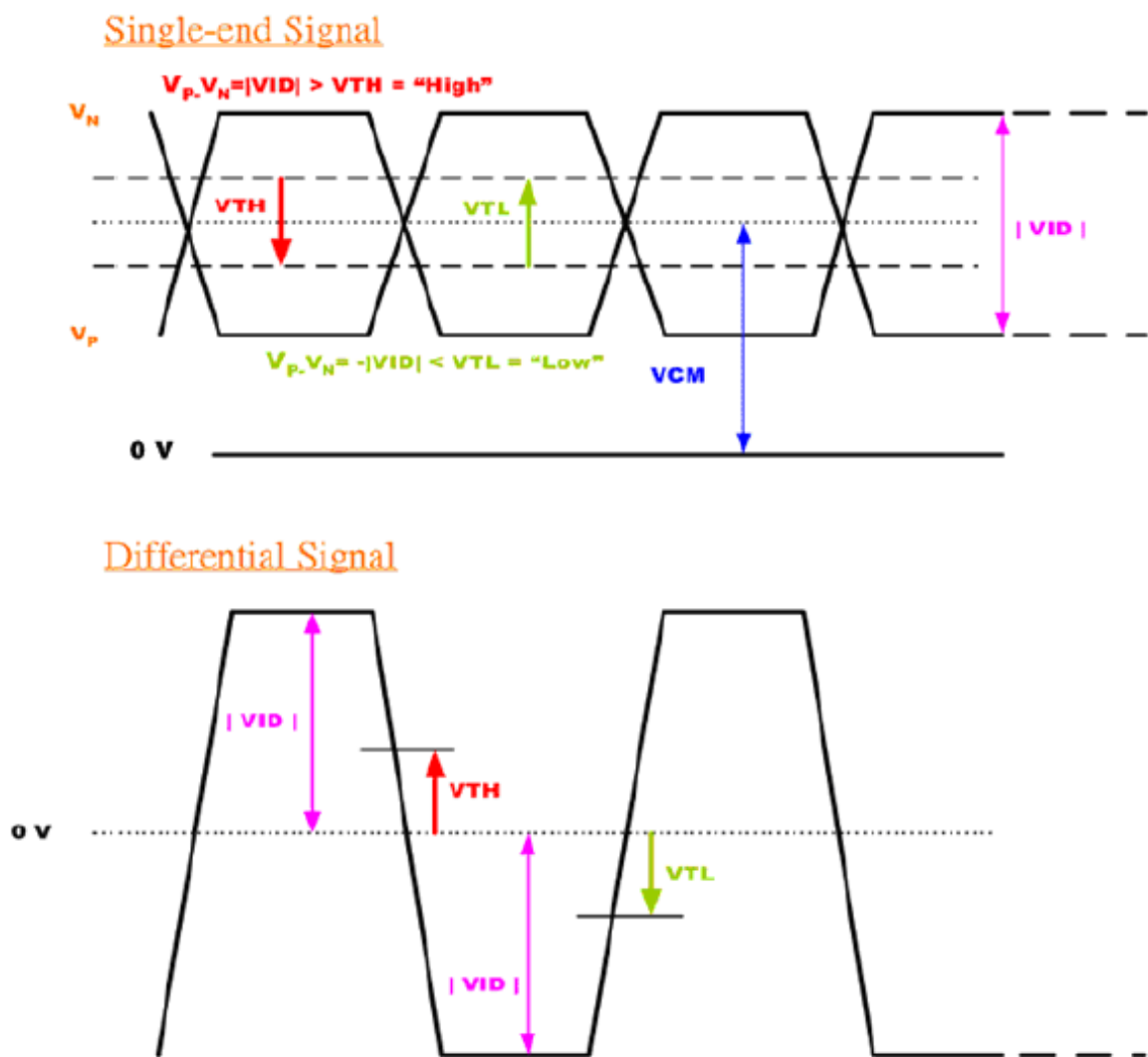
Input signals shall be low or Hi-Z state when VDD is off.

LVDS signal (Note 1)

LVDS Transmitter: THC63LVDM83A (THINE) or equivalent

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Differential Input High Threshold	VTH	-	-	100	mV	VCM=1.20V
Differential Input Low Threshold	VTL	-100	-	-	mV	VCM=1.20V
Input Differential Voltage	VID	100	400	600	mV	
Differential Input Common Mode Voltage	VCM	1.1	-	1.45	V	VTH, VTL=±100mV

Note 1: LVDS Signal Waveform.



5.2 Backlight Unit Driving

5.2.1 Parameter guideline for LED driver

Following characteristics are measured under stable condition at 25°C (Room Temperature).

Symbol	Parameter	Min	Typ	Max	Units	Remark
VLED	Input Voltage	9	12	20	Volt	
ILED	Input Current	-	0.25		A	100% PWM duty
PLED	Power Consumption	-	3.0		W	100% PWM duty
IrushLED	Inrush Current	-	0.37	0.41	A	100% PWM duty
VLED On/Off	On Control Voltage		3.3		Volt	
	Off Control Voltage		0		Volt	
VPWM	Dimming control Voltage High	3.0	3.3	5.5	Volt	
	Dimming control Voltage Low	0		0.1	Volt	
FPWM	Dimming Frequency	200		30K	Hz	
DPWM	Dimming duty cycle	1		100	%	
Operating Life		50000			Hrs	Note 2, 3

Note 1: See Section 6.6 for LED Backlight Unit Interface Signal Description.

Note 2: If 6.5 TFT-LCD V2 module is driven at high ambient temperature & humidity condition. The operating life will be reduced.

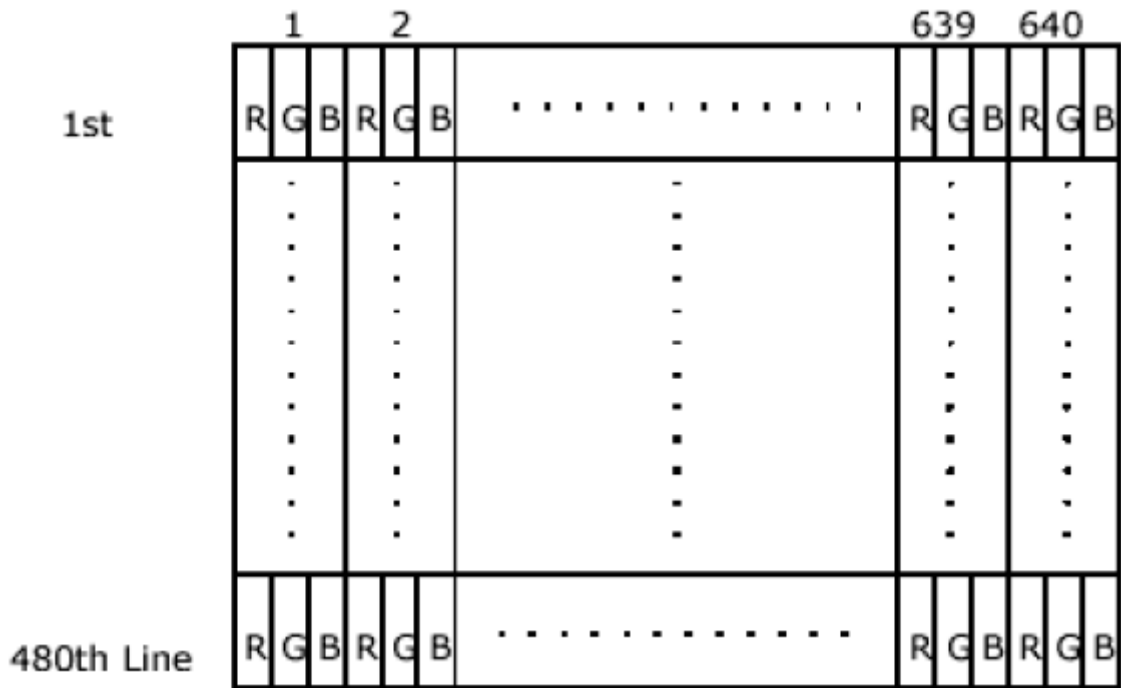
Note 3: Operating life means brightness goes down to 50% initial brightness.

Typical operating life time is estimated data.

6. Signal Characteristic

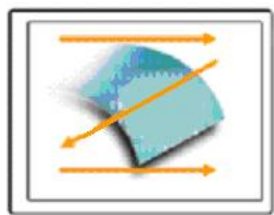
6.1 Pixel Format Image

Following figure shows the relationship between input signal and LCD pixel format.

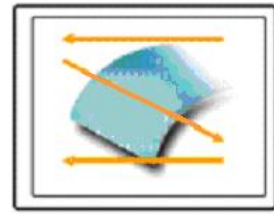


6.2 Scanning Direction

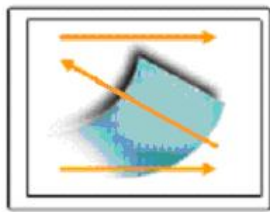
The following figures show the image seen from the front view. The arrow indicates the direction of scan.



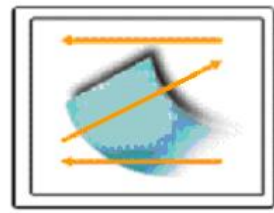
R/L=Low or NC; U/D= Low or NC



R/L=High; U/D= Low or NC



R/L=Low or NC; U/D=High

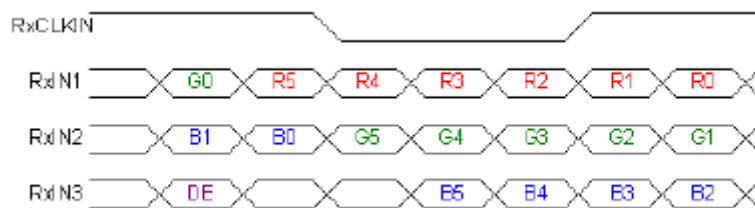


R/L=High; U/D= High

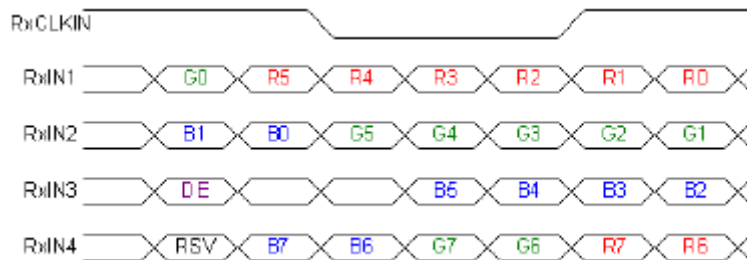
Note 1: TFT-LCD interface signal description is shown in section 6.4.

6.3 The Input Data Format

SEL68 = "Low" or "NC" for 6 bits LVDS Input



SEL68 = "High" for 8 bits LVDS Input



Signal Name	Description	Remark
R7	Red Data 7	Red-pixel Data For 8Bits LVDS input MSB: R7 ; LSB: R0 For 6Bits LVDS input MSB: R5 ; LSB: R0
R6	Red Data 6	
R5	Red Data 5	
R4	Red Data 4	
R3	Red Data 3	
R2	Red Data 2	
R1	Red Data 1	
R0	Red Data 0	
G7	Green Data 7	Green-pixel Data For 8Bits LVDS input MSB: G7 ; LSB: G0 For 6Bits LVDS input MSB: G5 ; LSB: G0
G6	Green Data 6	
G5	Green Data 5	
G4	Green Data 4	
G3	Green Data 3	
G2	Green Data 2	
G1	Green Data 1	
G0	Green Data 0	
B7	Blue Data 7	Blue-pixel Data For 8Bits LVDS input MSB: B7 ; LSB: B0 For 6Bits LVDS input MSB: B5 ; LSB: B0
B6	Blue Data 6	
B5	Blue Data 5	
B4	Blue Data 4	
B3	Blue Data 3	
B2	Blue Data 2	
B1	Blue Data 1	
B0	Blue Data 0	
RxCLKIN	LVDS Data Clock	
DE	Data Enable Signal	When the signal is high, the pixel data shall be valid to be displayed.
RSV	Reserved Signal	"High" or "Low" is acceptable

Note 1: Output signals from any system shall be low or Hi-Z state when VDD is off.

6.4 TFT- LCD Interface Signal Description

Pin No.	Symbol	Pin Description
1	VDD	Power supply, 3.3V (typical)
2	VDD	Power supply, 3.3V (typical)
3	GND	Ground
4	SEL68	Selection for either 6bit or 8bit LVDS input: SEL68 = "Low" or "NC", accepts 6bit LVDS data input; SEL68 = "High", accepts 8bit LVDS data input.
5	RxIN0-	Negative LVDS differential input(R0-R5, G0)
6	RxIN0+	Positive LVDS differential input(R0-R5, G0)
7	GND	Ground
8	RxIN1-	Negative LVDS differential input(G1-G5, B0-B1)
9	RxIN1+	Positive LVDS differential input(G1-G5, B0-B1)
10	GND	Ground
11	RxIN2-	Negative LVDS differential input(B2-B5, Hsync, Vsync, DE)
12	RxIN2+	Positive LVDS differential input(B2-B5, Hsync, Vsync, DE)
13	GND	Ground
14	RxCLKIN-	Negative LVDS differential clock input
15	RxCLKIN+	Positive LVDS differential clock input
16	NC	No connection
17	U/D	Vertical Reverse ("L" or Open: Normal, "H": Reverse)
18	R/L	Horizontal Reverse ("L" or Open: Normal, "H": Reverse)
19	RxIN3-	Negative LVDS differential input (R6-R7, G6-G7, B6-B7) NC for 6bit LVDS input.
20	RxIN3+	Positive LVDS differential input (R6-R7, G6-G7, B6-B7) NC for 6bit LVDS input.

Note 1: "Low" stands for 0V. "High" stands for 3.3V. "NC" stands for "No Connection".

6.5 TFT- LCD Interface Timing

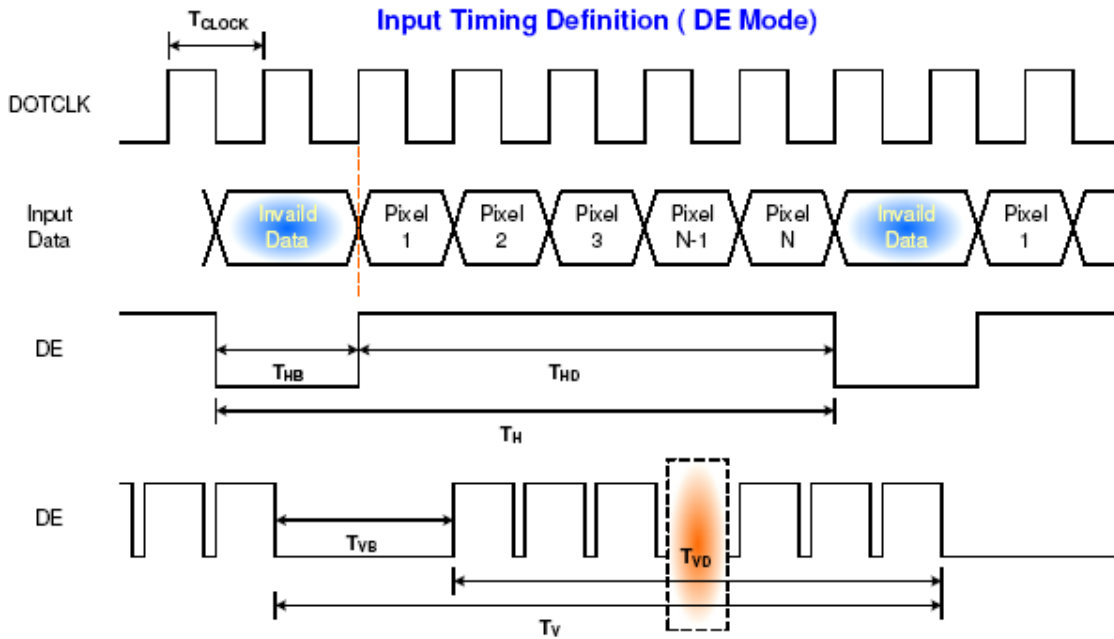
6.5.1 Timing Characteristics

DE mode only

Signal	Symbol	Min.	Typ.	Max.	Unit	Remark	
Clock frequency (DOTCLK)	$1/T_{\text{Clock}}$	20	25.2	50	MHz	Note1	
Horizontal Section	Period	T_H	770	800	1070	T_{Clock}	Note1
	Active	T_{HD}	640				
	Blanking	T_{HB}	130	160	430		
Vertical Section	Period	T_V	520	525	622	T_{LINE}	Note1
	Active	T_{VD}	480				
	Blanking	T_{VB}	40	45	142		

Note 1: Recommended frame rate is 60 Hz.

6.5.2 Input Timing Diagram

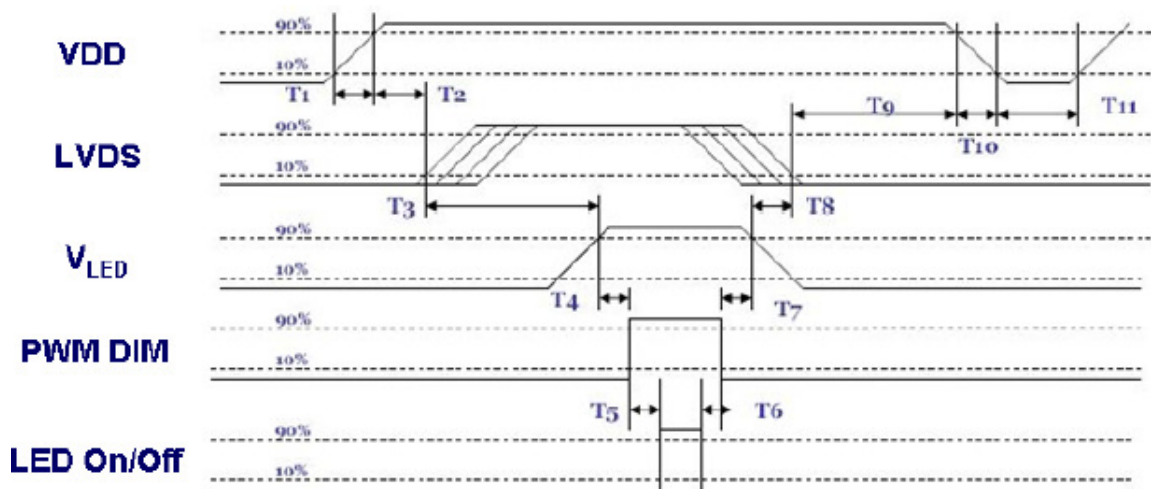


6.6 LED Backlight Unit Interface Signal Description

Pin #	Symbol	Pin Description
1	V_{LED}	12V input
2	V_{LED}	12V input
3	GND	Ground
4	GND	Ground
5	LED On/Off	3.3V-On; 0V-Off
6	PWM DIM	1~100%

6.7 Power ON/OFF Sequence

VDD power, LCD interface signals and backlight on/off sequence are shown in the following chart. Signals from any system shall be Hi-Z state or low level when VDD is off.



Power ON/OFF sequence timing

Parameter	Value			Units
	Min.	Typ.	Max.	
T1	0.5	-	10	ms
T2	30	40	50	ms
T3	200	-	-	ms
T4	10	-	-	ms
T5	10	-	-	ms
T6	0	-	-	ms
T7	10	-	-	ms
T8	100	-	-	ms
T9	0	16	50	ms
T10	-	-	10	ms
T11	1000	-	-	ms

ON/OFF sequence should be applied to avoid abnormal function in the display. Please make sure to turn off the power when you plug the cable into the input connector or pull the cable out of the connector.

7. Connector & Pin Assignment

7.1 TFT- LCD Signal (CN1): LCD Connector

Manufacturer	STM
Connector Model Number	MSB24013P20, compatible with I-PEX 20268-020E
Mating Connector Model Number	Hirose DF19 -20S-1C or compatible

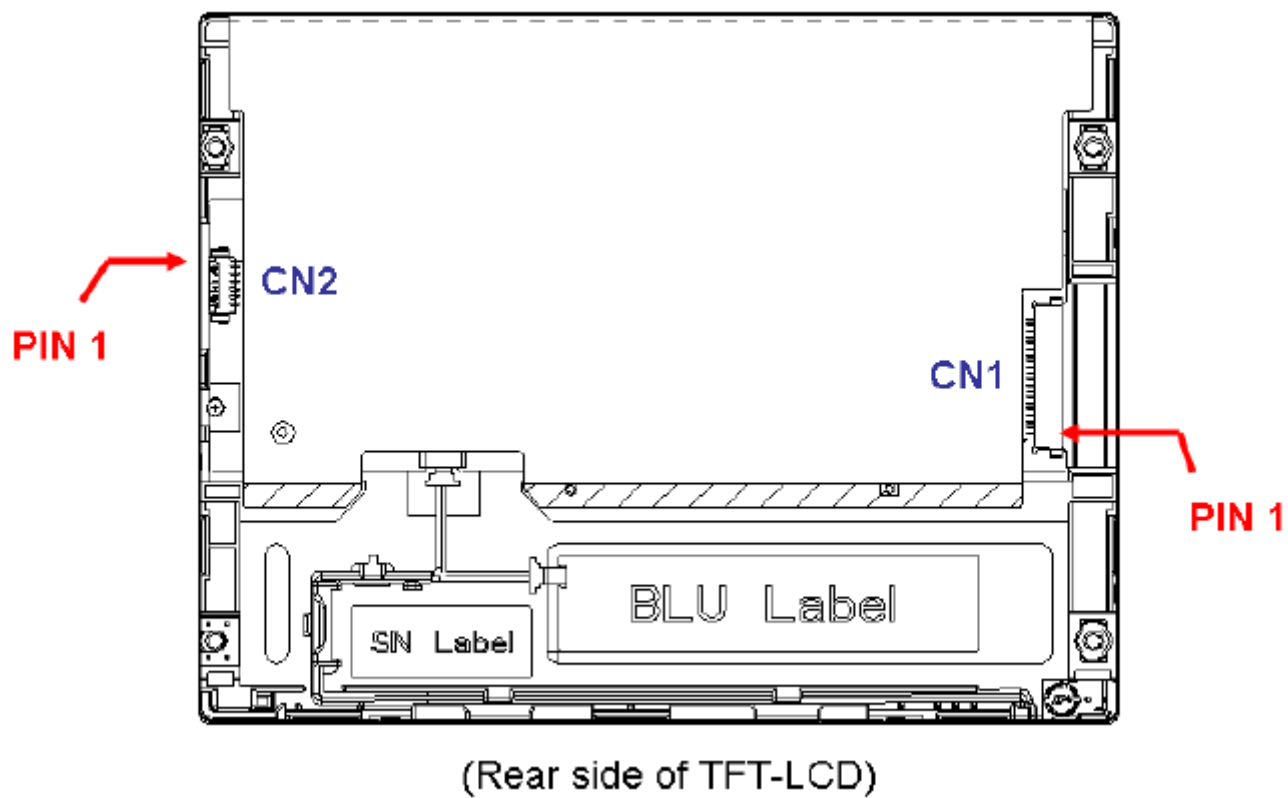
Pin#	Symbol	Pin#	Symbol
1	VDD	11	RxIN2-
2	VDD	12	RxIN2+
3	GND	13	GND
4	SEL68	14	RxCLKIN-
5	RxIN0-	15	RxCLKIN+
6	RxIN0+	16	NC
7	GND	17	U/D
8	RxIN1-	18	R/L
9	RxIN1+	19	RxIN3-
10	GND	20	RxIN3+

7.2 LED Backlight Unit (CN2): Backlight Connector

Manufacturer	STM
Connector Model Number	MS24016RHD, compatible with MOLEX 53261-0671
Mating Connector Model Number	STM P24016 or compatible

Pin #	Symbol	Pin #	Symbol
1	V _{LED}	4	GND
2	V _{LED}	5	LED ON/OFF
3	GND	6	PWM DIM

7.3 PIN 1 definition of CN1 and CN2



8. Mechanical Characteristics

