

## Product Specification

Part Number #REV : FLC-104GML2000SA2#00

Description: 10.4" TFT LCD MVA Type 500CD with LVDS interface, 1024x768 format can display 262K/16.2M colors

Preliminary Specification

Approved Specification

<b>Customer Name:</b>	
<b>Signature:</b>	<b>Date:</b>

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## Revision History

Version	Date	Page	Description	Note
V1.0	2020/07/17		First Edition	
V1.1	2020/07/25		Update spec	
V1.2	2020/09/01		Update drawing and Reliability test criteria	
V1.3	2021/08/05		Update parameter of power supply consumption Update Block Diagram	

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# 1. GENERAL DESCRIPTION

## 1.1 Description

10.4" is a Color Active Matrix Liquid Crystal Display Module composed of a TFT LCD panel and LED backlight system. The screen format is intended to support the XGA, 1024x768 screen and 16.2M colors (6-bits colors with FRC).

## 1.2 Product Summary

The following items are summary on the table under Ta=25 °C condition:

No.	Item	Specification	Unit
1	Display Size	10.4"	Inch
2	Pixel Number	1024 (H) x RGB x 768 (V)	Pixels
3	Outline Dimension	225.5 (H) x 176.3 (V) x 8.7 (D)	mm
4	Active Area	210.4 (H) x 157.8 (V)	mm
5	Display Colors	16.2M / 262K	--
6	Pixel Arrangement	RGB vertical stripe	--
7	Display Mode	Transmissive mode / Normally black	--
8	Electrical Interface	LVDS	--
9	Surface Treatment	Anti-Glare	--
10	Brightness	500 (Typ.)	cd/m2
11	Contrast Ratio	1000 (Typ.)	--
12	Total Power Consumption (Typ)	Total 7.47W(Typ) @cell 1.67W(Typ) , BL 5.8W(Typ)	W

## 2. ABSOLUTE MAXIMUM RATING

### 2.1 Electrical Absolute Rating

Item	Symbol	Values		Unit	Note
		Min	Max.		
Power supply voltage	VCC	-0.3	3.6	V	
Logic Input Voltage	Vin	-0.3	3.6	V	
Converter Voltage	Vi	-0.3	18	V	
Enable Voltage	EN	-0.3	5.5	V	
Backlight Adjust	ADJ	-0.3	5.5	V	

Note Permanent damage to the device may occur if max. values are exceeded. Function operation should be restricted to the conditions described under normal operating conditions.

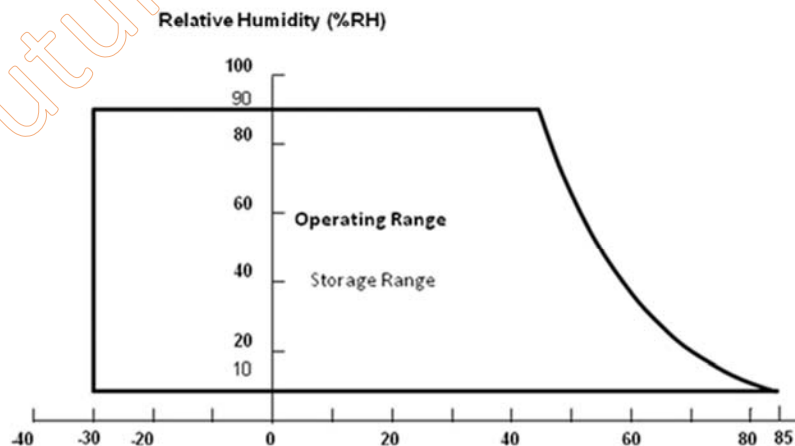
### 2.2 Environment Absolute Rating

Item	Symbol	Values			Unit	Note
		Min	Typ	Max.		
Operating Temperature	Top	-30		+85	°C	Ta=25°C
Storage Temperature	Tst	-30		+85	°C	

Note (1) Temperature and relative humidity range is shown in the figure below.

- (a) 90 %RH Max. (Ta < 39 °C).
- (b) Wet-bulb temperature should be 39 °C Max. (Ta > 39 °C).
- (c) No condensation

Note (2) Panel surface temperature should be 0°C min. and 85°C max under Vcc=5.0V, fr =60Hz, typical LED string current, 25°C ambient temperature, and no humidity control . Any condition of ambient operating temperature ,the surface of active area should be keeping not higher than 85°C.



### 3. ELECTRICAL CHARACTERISTICS

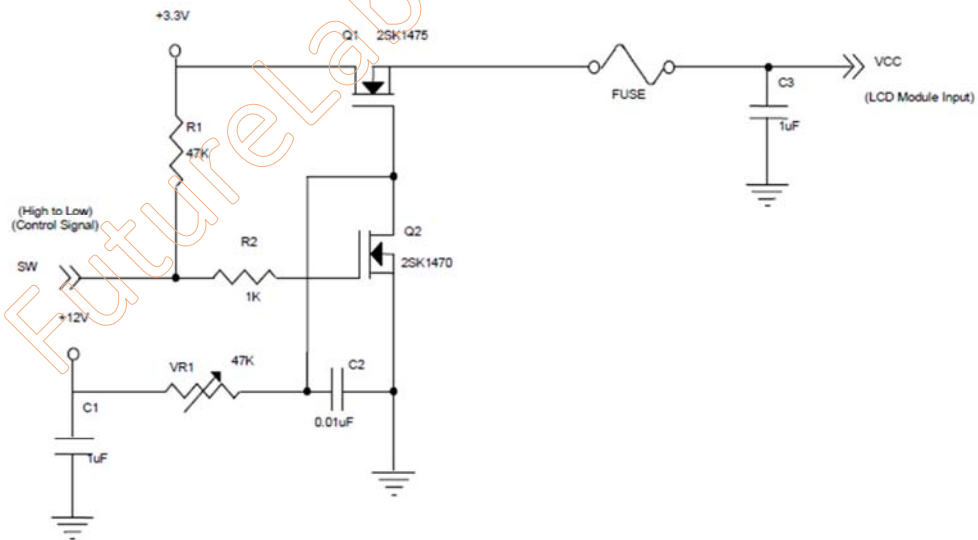
#### 3.1 LCM

Parameter	Symbol	Value			Unit	Note	
		Min.	Typ.	Max.			
Power Supply Voltage	VCC	3.15	3.3	3.45	V	(1)	
Power Supply Ripple Voltage	VRP	-	-	100	mV		
Rush Current	IRUSH	-	-	4.0	A	(2)	
Power Supply Current	White	ICC	-	505	610	mA	(3)
	Black		-	315	380	mA	
Power Consumption	PL		1.67	2.01	W	-	
LVDS differential input voltage	VID	100	-	600	mV		
LVDS common input voltage	VIC	1.0	1.2	1.4	V	-	
Logic High Input Voltage	VIH	2.3	-	VCC	V		
Logic Low Input Voltage	VIL	0	-	0.7	V		
LVDS terminating resistor	RT	-	100	-	ohm		

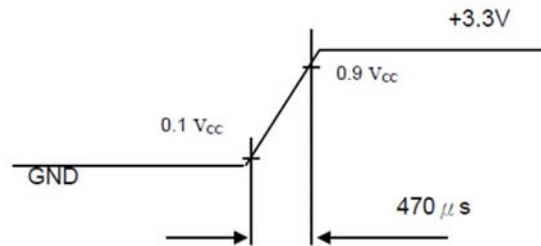
Note (1) The assembly should be always operated within above ranges.

Ta = 25 ± 2 °C

Note (2) Measurement Conditions:



VCC rising time is 470us



Note (3) The specified power supply current is under the conditions at VDD=3.3V, T<sub>a</sub>=25 ± 2 °C, DC current and f<sub>v</sub>=60Hz, whereas a power dissipation check pattern below is displayed.

a. White Pattern



Active Area

b. Black Pattern



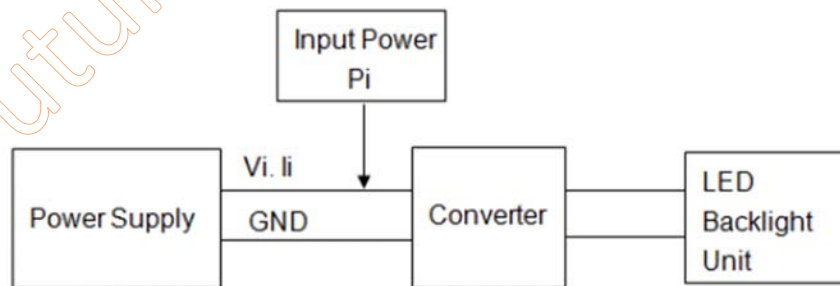
Active Area

### 3.2 Backlight Unit

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

Symbol	Parameter	Min.	Typ.	Max.	Unit	Note	
Vi	Converter Power Supply Voltage	10.8	12.0	13.2	V	Duty 100%	
ViRP	Converter Power Supply Ripple Voltage			350	mV		
li	Converter Power Supply Current	-	0.48	0.55	A	@Vi=12V (Duty 100%)	
liRUSH	Converter Inrush Current	-	-	3.0	A	@Vi rising time= 20ms(Vi=12V)	
PLED	LED Power consumption	-	5.8	6.6	W	(1)	
BLON	EN Control Level	Backlight on	2.5	3.3	5.0	V	
		Backlight off	0	-	0.3	V	
E_PWM	PWM Dimming Control Level	PWM High Level	2.5	3.3	5.0	V	
		PWM Low Level	0	-	0.15	V	
VNoise	PWM Noise Range	-	-	0.1	V		
fPWM	PWM Control Frequency	190	200	20K	Hz	(2)	
-	PWM control Duty Ratio	5	-	100	%	(2) Suggestion@ 190Hz<fPWM<1kHz	
		20	-	100	%	(2),@ 1kHz ≤ fPWM<20kHz	
LL	LED life Time (Typical)	50,000		-	Hrs	(3)	

Note (1) LED current is measured by utilizing a high frequency current meter as shown below:



Note (2) At 190 ~1kHz PWM control frequency, duty ratio range is restricted from 5% to 100%.

1K ~20kHz PWM control frequency, duty ratio range is restricted from 20% to 100%.

If PWM control frequency is applied in the range from 1KHz to 20KHz, The “non-linear” phenomenon on the Backlight Unit may be found. So It’s a suggestion that PWM control frequency should be less than 1KHz.

Note (3) The lifetime of LED is estimated data and defined as the time when it continues to operate under the conditions at Ta = 25 ±2 °C and Duty=100% until the brightness becomes ≤ 50% of its original value. Operating LED under high temperature environment will reduce lifetime and lead to color shift.



## 4. SIGNAL CHARACTERISTICS

### 4.1 Interface Timing

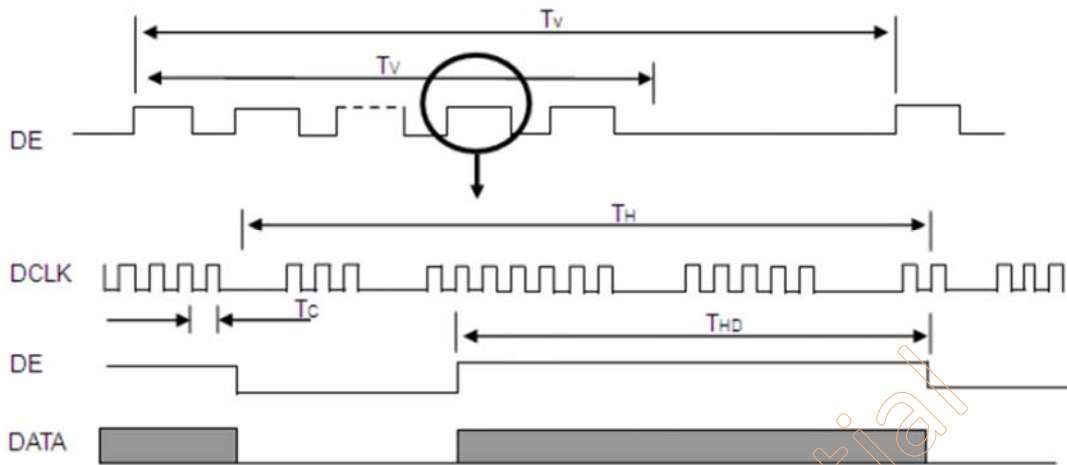
#### 4.1.1 Timing Characteristics:

Signal	Item	Symbol	Min	Typ	Max	Unit	Note
LVDS Clock	Frequency	Fc	57.7	65	73.6	MHz	
	Period	Tc	13.6	15.4	17.3	ns	
	Input cycle to cycle jitter	Trd	--	--	200	ns	(a)
	Input Clock to data skew	TLVCCS	-0.02*Tc	--	0.02*Tc	ps	(b)
	Spread spectrum modulation range	F <sub>clk<sub>in</sub>_mod</sub>	0.987*Fc	--	1.013*Fc	MHz	(c)
	Spread spectrum modulation frequency	F <sub>SSM</sub>	--	--	200	KHz	
	High Time	Tch	--	4/7	--	Tch	
	Low Time	Tcl	--	3/7	--	Tch	
Vertical Display Term	Frame Rate	Fr	--	60	--	Hz	Tv=Tvd+Tvb
	Total	Tv	776	806	838	Th	
	Active Display	Tvd	768			Th	
	Blank	Tvb	8	38	70	Th	
Horizontal Display Term	Total	Th	1240	1344	1464	Tc	Th=Thd+Thb
	Active Display	Thd	1024			Tc	
	Blank	Thb	216	320	440	Tc	

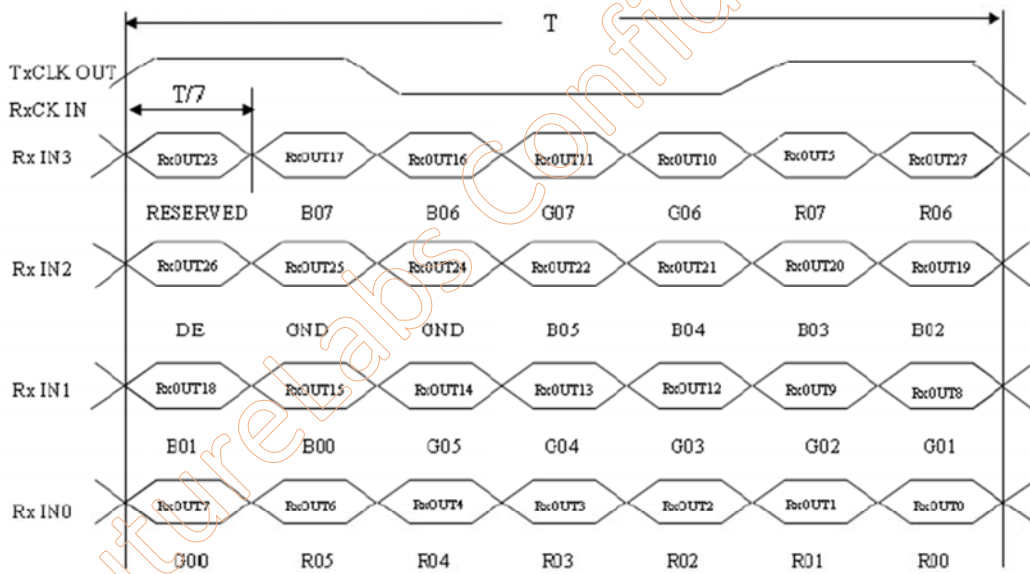
Note (1) Because this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module would operate abnormally.

Note (2) The Tv(Tvd+Tvb) must be integer, otherwise, the module would operate abnormally.

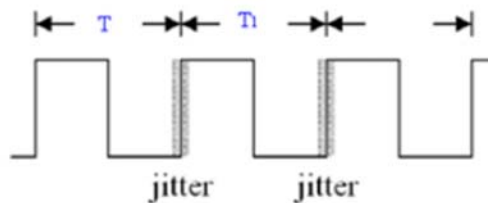
### INPUT SIGNAL TIMING DIAGRAM



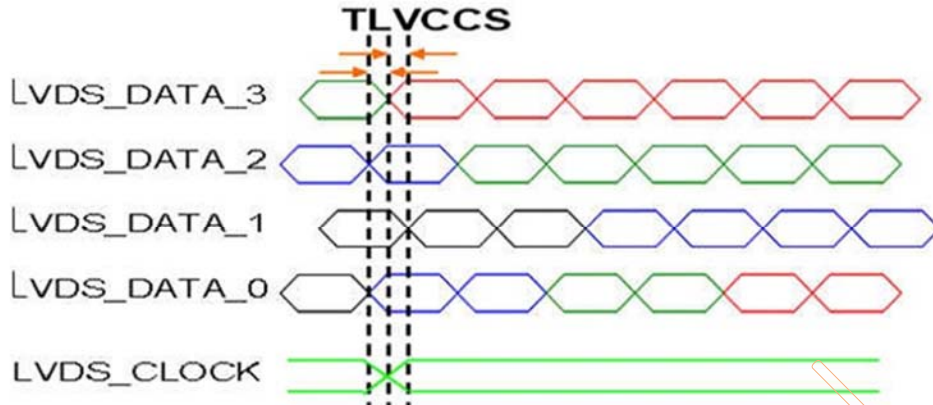
### TIMING DIAGRAM of LVDS



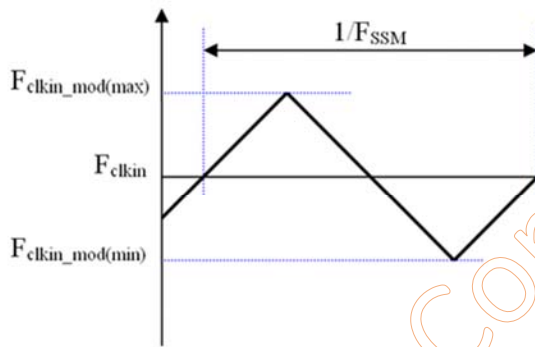
Note (a) The input clock cycle-to-cycle jitter is defined as below figures.  $Trcl = |T1 - T1|$



Note (b) Input Clock to data skew is defined as below figures.

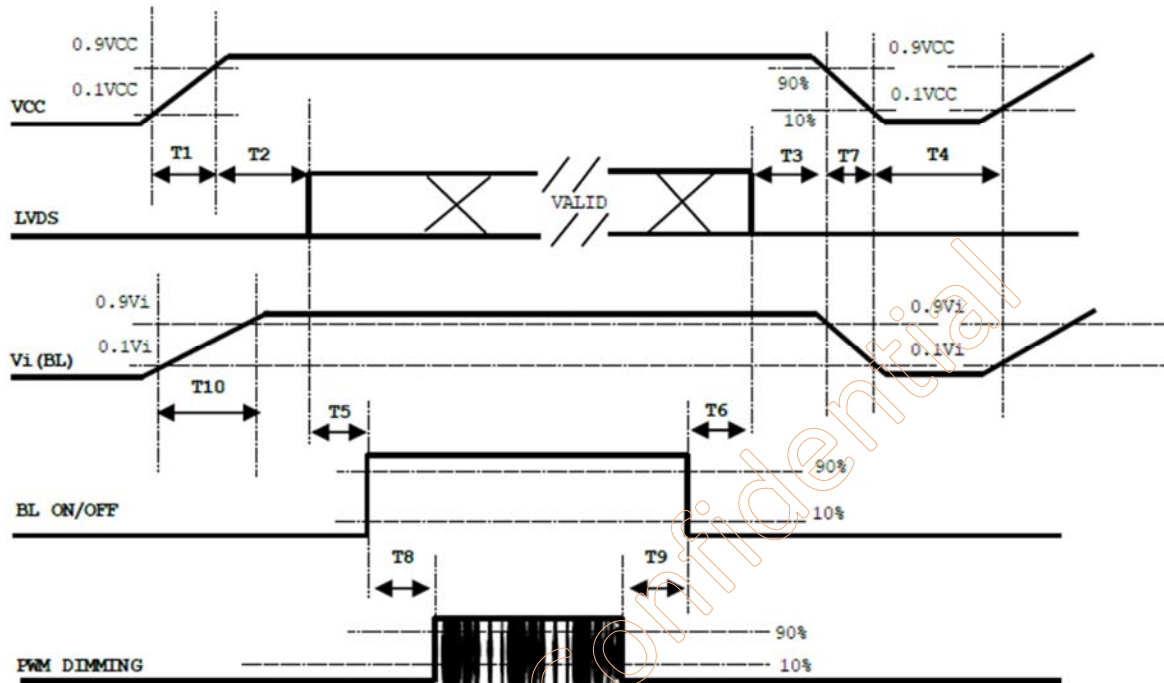


Note (c) The SSCG (Spread spectrum clock generator) is defined as below figures.



## 4.2 Power ON/OFF Sequence

To prevent a latch-up or DC operation of LCD assembly, the power on/off sequence should be as the diagram below.



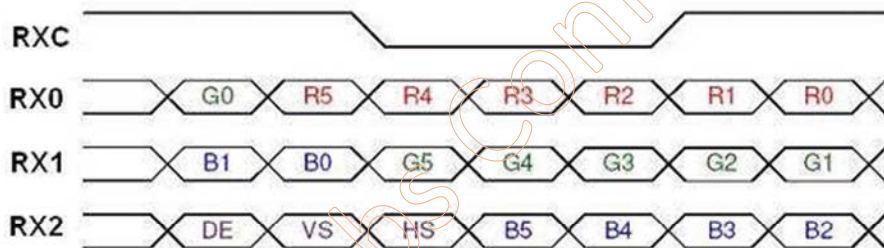
Note:

- (1) The supply voltage of the external system for the module input should be the same as the definition of Vcc.
- (2) When the backlight turns on before the LCD operation of the LCD turns off, the display may momentarily become abnormal screen.
- (3) In case of VCC = off level, please keep the level of input signals on the low or keep a high impedance.
- (4) T4 should be measured after the module has been fully discharged between power off and on period.
- (5) Interface signal shall not be kept at high impedance when the power is on.
- (6) Futurelabs won't take any responsibility for the products which are damaged by the customers not following the Power Sequence.
- (7) There might be slight electronic noise when LCD is turned off (even backlight unit is also off). To avoid this symptom, we suggest "Vcc falling timing" to follow "T7 spec".

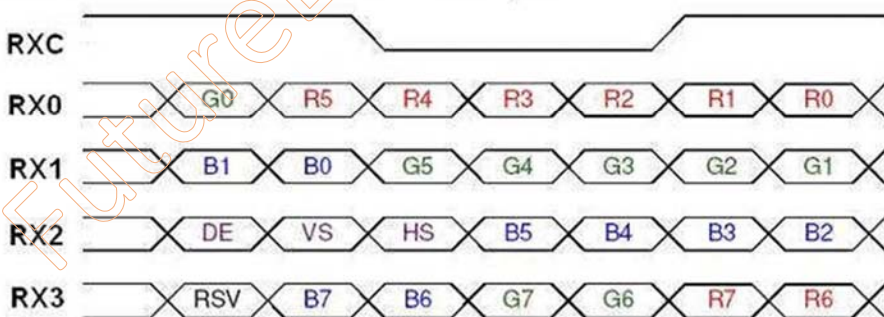
Parameter	Value			Units
	Min	Typ	Max	
T1	0.5	---	10	ms
T2	0	---	50	ms
T3	0	---	50	ms
T4	500	---	---	ms
T5	450	---	---	ms
T6	200	---	---	ms
T7	10	---	100	ms
T8	10	---	---	ms
T9	10	---	---	ms
T10	20	---	50	ms

#### 4.3 THE INPUT DATA FORMAT

##### SEL 6/8 = "High" for 6 bits LVDS Input



##### SEL 6/8 = "Low" or "NC" for 8 bits LVDS Input



Note (1) R/G/B data 7: MSB, R/G/B data 0: LSB

Note (2) Please follow PSWG

Signal Name	Description	Remark
R7	Red Data 7 (MSB)	Red-pixel Data
R6	Red Data 6	Each red pixel's brightness data consists of these 8bits pixel data.
R5	Red Data 5	8 bits pixel data.
R4	Red Data 4	
R3	Red Data 3	
R2	Red Data 2	
R1	Red Data 1	
R0	Red Data 0 (LSB)	
G7	Green Data 7 (MSB)	Green-pixel Data
G6	Green Data 6	Each red pixel's brightness data consists of these 8bits pixel data.
G5	Green Data 5	8 bits pixel data.
G4	Green Data 4	
G3	Green Data 3	
G2	Green Data 2	
G1	Green Data 1	
G0	Green Data 0 (LSB)	
B7	Blue Data 7 (MSB)	Blue-pixel Data
B6	Blue Data 6	Each red pixel's brightness data consists of these 8bits pixel data.
B5	Blue Data 5	8 bits pixel data.
B4	Blue Data 4	
B3	Blue Data 3	
B2	Blue Data 2	
B1	Blue Data 1	
B0	Blue Data 0 (LSB)	
RXCLKIN+	LVDS Clock Input	
RXCLKIN-		
DE	Display Sync	
VS	Vertical Sync	
HS	Horizontal Sync	

#### 4.4 SCANNING DIRECTION

Fig. 1 Normal Scan



PCBA on the top side

Fig. 2 Reverse Scan



PCBA on the top side

Fig. 1 Normal scan ( pin 7, RPI = Low or NC )

Fig. 2 Reverse scan ( pin 7, RPI = High )

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## 5. INTERFACE PIN DESCRIPTION

### 5.1 LCM Connector PIN Assignment

Pin No.	Symbol	Description	Note
1	VCC	Power supply: +3.3V	-
2	VCC	Power supply: +3.3V	-
3	VCC	Power supply: +3.3V	-
4	GND	Ground	-
5	GND	Ground	-
6	GND	Ground	-
7	RPMI	Reverse Panel Function (Display Rotation)	( 3 )
8	NC	No Connection	( 4 )
9	NC	No Connection	( 4 )
10	NC	No Connection	( 4 )
11	SEL6/8	LVDS 6/8 bit select function control, Low or NC 8bit Input Mode High 6bit Input Mode	( 3 )
12	GND	Ground	-
13	NC	No Connection	( 4 )
14	GND	Ground	-
15	RX0-	Negative transmission data of pixel 0	-
16	RX0+	Positive transmission data of pixel 0	-
17	GND	Ground	-
18	RX1-	Negative transmission data of pixel 1	-
19	RX1+	Positive transmission data of pixel 1	-
20	GND	Ground	-
21	RX2-	Negative transmission data of pixel 2	-
22	RX2+	Positive transmission data of pixel 2	-
23	GND	Ground	-
24	RXCLK-	Negative of clock	-
25	RXCLK+	Positive of clock	-
26	GND	Ground	-
27	RX3-	Negative transmission data of pixel 3	-
28	RX3+	Positive transmission data of pixel 3	-
29	GND	Ground	-
30	NC	No Connection	( 4 )

Note (1) Connector Part No. : P-TWO 187106-30091 or STM, MSCK2407P30.D or equivalent.

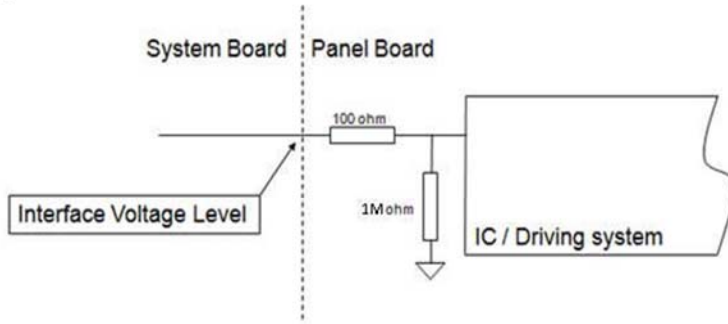
Note (2) User's connector Part No.: JAE FI-X30H(L) or equivalent.

Note (3) "Low" stands for 0V. "High" stands for 3.3V. "NC" stands for "No Connected"

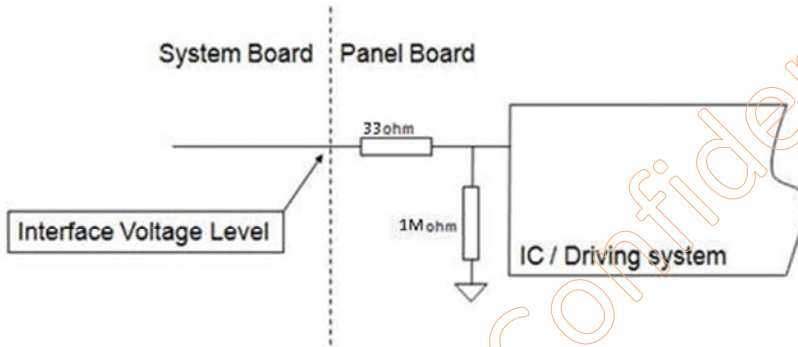
Note (4) Pin8, Pin9, Pin10, Pin13, Pin30 input signals should be set to no connection or ground, this module would operate normally.



RPI pin:



SEL6/8 pin:



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