

Tentative

# 12.3" WHD (1920x720)

Part name: TFT LCD module

## TECHNICAL SPECIFICATION

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AA123AF01

(CS: Commercial Sample)

MITSUBISHI ELECTRIC CORPORATION  
LCD DIVISION

Date: March 5, 2018

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# 1. APPLICATION

This specification applies to color TFT-LCD module AA123AF01, its development phase is **commercial sample (CS)**.

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MITSUBISHI classifies the usage of the TFT-LCD module as follows. Please confirm the usage before using the product.

## (1) Standard Usage

Computers, office equipment, factory automation equipment, test and measurement equipment, communications, transportation equipment (automobiles, ships, trains, etc.), provided, however, that operation is not influenced by TFT-LCD directly.

## (2) Special Usage

Medical equipment, safety equipment, transportation equipment, provided, however, that TFT-LCD is necessary to its operation.

## (3) Specific Usage

Cockpit equipment, military systems, aerospace equipment, nuclear reactor control systems, life support systems and any other equipment. MITSUBISHI should make a contract that stipulate apportionment of responsibilities between MITSUBISHI and our customer.

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## 2. OVERVIEW

AA123AF01 is 12.3" color TFT-LCD (Thin Film Transistor Liquid Crystal Display) module composed of LCD panel, driver ICs, controller PCB, metal housing and backlight unit. By applying 8 bit digital data, 1920x720, 16.7M-color images are displayed on the 12.3" diagonal screen. The type of data and control signals are digital and transmitted via LVDS interface per Typ. 89MHz clock cycle.

### 2-1. General

LED driver for backlight is not included in this module. General specifications are summarized in the following table: (Model name: AA123AF01)

ITEM	SPECIFICATION
Display Active Area (mm)	292.32(H) x 109.62(V) (12.3-inch diagonal)
Number of Dots	1920 x 3(H) x 720(V)
Pixel Pitch (mm)	0.15225(H) x 0.15225(V)
Color Pixel Arrangement	RGB vertical stripe
Display Mode	Normally black, In-plane switching
Number of Color	16.7M(8bit/color)
Luminance (cd/m <sup>2</sup> )	1000
CR	1000:1
Viewing angle (CR≤10)	Min. -85~85°(Horizontal) Min. -85~85°(Vertical)
Surface Treatment	AG
Interface	1ch LVDS
Inversion viewing angle	N/A
Module Size (mm)	305.3(W) x 127.9 (H) x 7.4(D) without PCB and bosses for mounting
Module Mass (g)	460
Backlight Unit	LED (edge light)

Characteristic value without any note is typical value.

### 3. ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	MIN.	MAX.	UNIT
Power Supply Voltage for LCD	VCC	0	+4.0	V
Input signal voltage	VI	-0.3	VCC+0.3	V
LED Current	If	--	(150)	mA
LED Peak Current *4)	Ifp	--	(200)	mA
Operation Temperature(Ambient) *2)	T <sub>op(Ambient)</sub>	-40	+85	°C
Storage Temperature *2) *3)	T <sub>stg</sub>	-40	+90	°C

[Note]

Absolute maximum ratings are the value that should never pass. If used beyond the absolute ratings, LCD may not recover to specified characteristics and it may also cause permanent damage.

When designing circuit, power supply, connector, surge of input signal, and surrounding temperature, please be careful not to pass absolute maximum ratings.

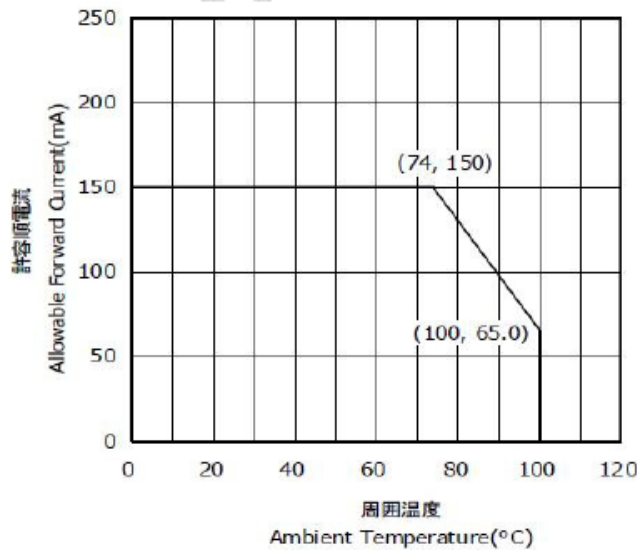
[Note]

\*1) Top, Tstg -40°C: 90%RH max. without condensation

Top, Tstg -40°C: Absolute humidity shall be less than the value of 90%RH at 40°C without condensation.

\*2) Backlight: OFF

\*3) The characteristics diagram of LED current (If) vs. ambient temperature (Ta)



## 4. ELECTRICAL CHARACTERISTICS

(1)TFT-LCD

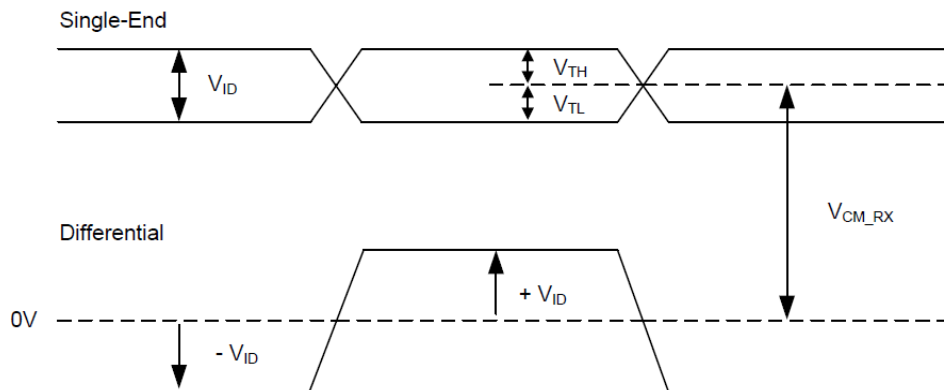
Ambient Temperature:  $T_a = 25^{\circ}\text{C}$

Parameter	Symbol	Extreme Ratings			Unit	Remarks
		Min.	Typ	Max.		
Power supply voltage	VCC	3.0	3.3	3.6	V	
Power supply current	VI	--	430	730	mA	
Input voltage 'H' level of logic	VIH	$0.8 \times \text{VCC}$	--	VCC	V	
Input voltage 'L' level	VIL	GND	--	$0.2 \times \text{VCC}$	V	
High level output voltage	VOH	$\text{VCC}-0.4$	--	--	V	$\text{IOH}=-4\text{mA}$
Low level output voltage	VOL	--	--	0.4	V	$\text{IOL}=4\text{mA}$
Loop back resistance	RLB	--	--	(100)	ohm	

(2)LVDS receiver DC characteristics

VCC=3.3V, Ambient Temperature:  $T_a = 25^{\circ}\text{C}$

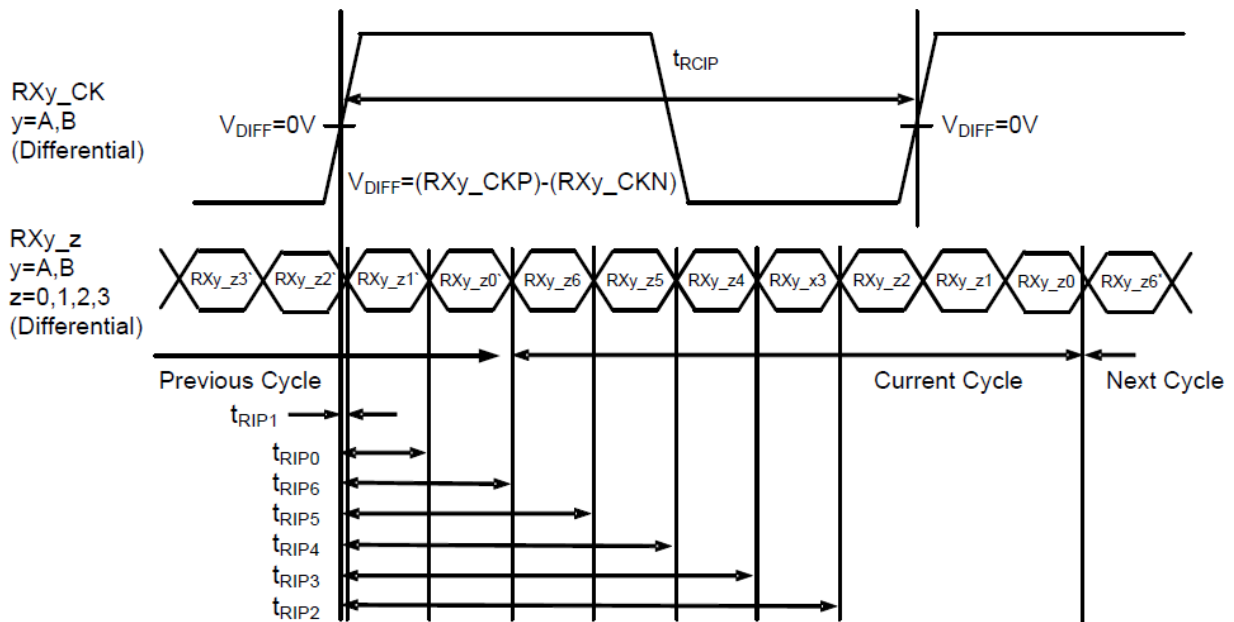
Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Differential Input Voltage	$ \text{VID} $	100		600	mV	
Differential Input "H" Threshold	VTH	-	-	+50	mV	$\text{VCM} = 1.2\text{V}$
Differential Input "L" Threshold	VTL	-50	-	-	mV	$\text{VCM} = 1.2\text{V}$
Differential Input VID = 200mV Common Mode Voltage	VCM	$ \text{VID} /2$	1.2	$2.4- \text{VID} /2$	V	



LVDS Receiver DC Characteristics Definition

(3) LVDS receiver AC characteristics

Parameter	Symbol	Limit			Unit	Conditions
		Min	Typ	Max		
LVDS Clock Frequency	$f_{IN}$	80	-	94.6	MHz	
LVDS Clock Period	$t_{RCIP}$	10.5	-	12.5	ns	
Receiver Skew Margin	$t_{SK}$	0	-	0.4	ns	$f_{IN} = 90\text{MHz}$
Input Data Position 1	$t_{RIP1}$	-tSK	0	+tSK	ns	
Input Data Position 0	$t_{RIP0}$	$t_{RCIP}/7 - t_{sk}$	$t_{RCIP}/7$	$t_{RCIP}/7 + t_{sk}$	ns	
Input Data Position 6	$t_{RIP6}$	$2(t_{RCIP}/7) - t_{sk}$	$2(t_{RCIP}/7)$	$2(t_{RCIP}/7) + t_{sk}$	ns	
Input Data Position 5	$t_{RIP5}$	$3(t_{RCIP}/7) - t_{sk}$	$3(t_{RCIP}/7)$	$3(t_{RCIP}/7) + t_{sk}$	ns	
Input Data Position 4	$t_{RIP4}$	$4(t_{RCIP}/7) - t_{sk}$	$4(t_{RCIP}/7)$	$4(t_{RCIP}/7) + t_{sk}$	ns	
Input Data Position 3	$t_{RIP3}$	$5(t_{RCIP}/7) - t_{sk}$	$5(t_{RCIP}/7)$	$5(t_{RCIP}/7) + t_{sk}$	ns	
Input Data Position 2	$t_{RIP2}$	$6(t_{RCIP}/7) - t_{sk}$	$6(t_{RCIP}/7)$	$6(t_{RCIP}/7) + t_{sk}$	ns	
Input Modulation Frequency	$f_{IMOD}$	30	-	300	kHz	
Input Modulation Ratio	$f_{IMOD}$	(-3.0)	-	(+3.0)	%	

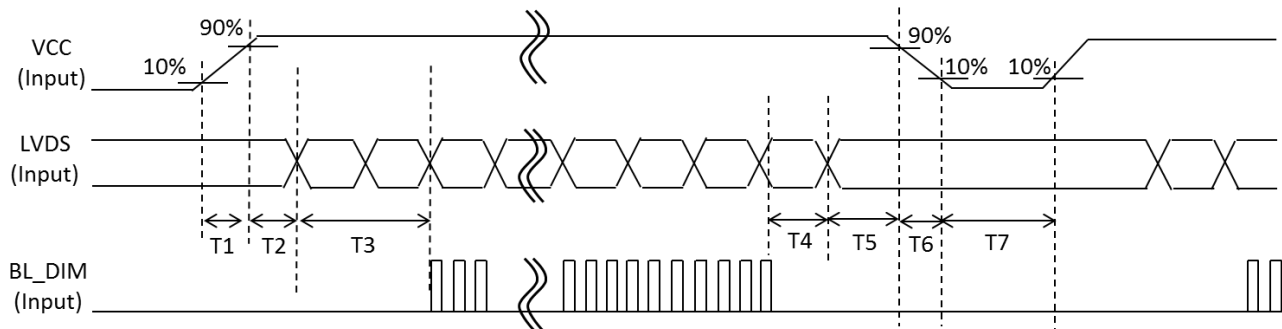


LVDS Receiver AC Characteristics Definition

(4) Power ON/OFF sequence

Ambient Temperature: Ta = 25°C

Sequence	Parameter	SYMBOL	MIN.	MAX.	UNIT
Power ON	VCC rising time	T1	0.1	(10)	ms
	VCC 90% to signal	T2	0	--	ms
	Signal to Backlight ON (T2<100ms)	T3	(100)	--	ms
Power OFF	Backlight OFF to signal stop	T4	0	--	ms
	Signal stop to VCC fall	T5	(60)	--	ms
	VCC falling time	T6	0.1	10	ms
Restart	Restart VCC time	T7	(400)	--	ms





(5) Backlight

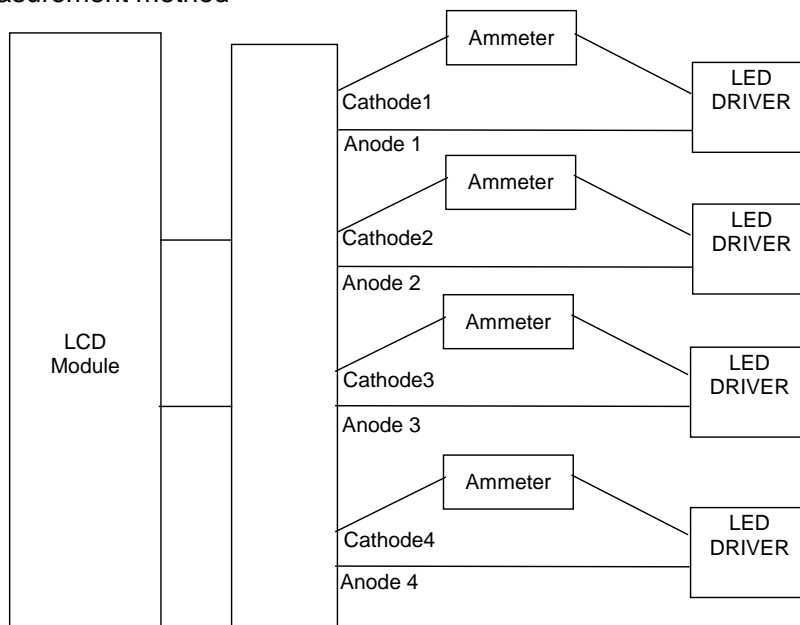
Ta= 25°C

Item	SYMBOL	MIN.	TYP.	MAX.	UNIT	REMARKS
LED Voltage	VL	--	29.2	32.1	V	IL=62mA
LED Current	IL	--	62	--	mA	*1), *2)
LED Life Time (Continuous)	LTC	25,000	30,000	--	h	*3), *4)
LED type	--	Nichia NSSW157H			--	10p x 4chains

[Note]

\*1) Constant Current Driver

\*2) LED Current measurement method



\*3) LED life time is defined as the time when the LCD module brightness becomes 50% compared to the initial value under the measurement condition shown in page 18 and 19.

\*4) The life time of the backlight depends on the ambient temperature. The life time will decrease under high temperature.

\*5) LED PWM frequency of driver may produce interference with horizontal synchronous frequency, and this may cause horizontal beat on the display. Therefore, please adjust LED PWM frequency, and keep driver as far from module as possible or use electronic shielding between driver and module to avoid the interference.

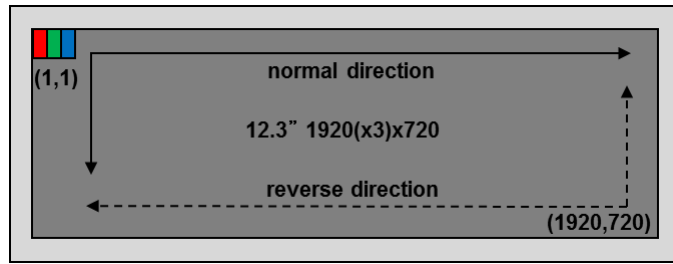
## 5. INTERFACE PIN CONNECTION

### (1) Pin connection

CN1 (Signal and power interface) 60pin, pitch0.5mm, Connector type: 505110-6091(MOLEX)

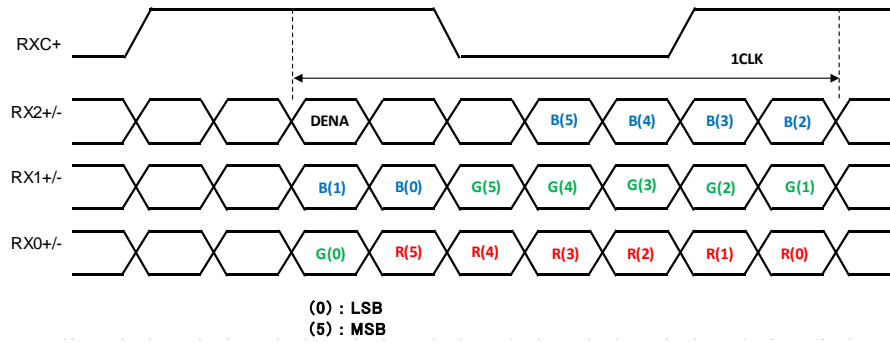
No.	Symbol	Description	No.	Symbol	Description
1	LOOP1	Loop back1 -> LOOP2 (*4)	31	RX3-	LVDS Data3 - (*2)
2	VCC	Power Supply (3.3V)	32	GND	Ground
3	VCC	Power Supply (3.3V)	33	RXC+	LVDS Clock+ (*2)
4	VCC	Power Supply (3.3V)	34	RXC-	LVDS Clock- (*2)
5	VCC	Power Supply (3.3V)	35	GND	Ground
6	NC	No connected	36	RX2+	LVDS Data2 + (*2)
7	GND	Ground	37	RX2-	LVDS Data2 - (*2)
8	GND	Ground	38	GND	Ground
9	GND	Ground	39	RX1+	LVDS Data1 + (*2)
10	GND	Ground	40	RX1-	LVDS Data1 - (*2)
11	LVMD	Input : LVDS MAP (*2) (Low : JEIDA , High : VESA)	41	GND	Ground
12	SCAN	Input : Scan direction (*1) (Low : Normal , High : Reverse)	42	RX0+	LVDS Data0 + (*2)
13	FAIL	Output : Fail detect signal (*5) (Normal: High, Fail: Low)	43	RX0-	LVDS Data0 - (*2)
14	GND	Ground	44	I2C_SCL	I2C (Serial Clock) (*3) "Internal pull-High"
15	Reserved	Keep to VCC level	45	I2C_SDA	I2C (Serial Data) (*3) "Internal pull-High"
16	Reserved	Keep to VCC level	46	LOOP2	Loop back2 -> LOOP1 (*4)
17	GND	Ground	47	NTC1	Backlight temperature (*6) sensor pin 1
18	Reserved	Keep to VCC level	48	NTC2	Backlight temperature (*6) sensor pin 2
19	Reserved	Keep to VCC level	49	BL_C4	Backlight cathode 4
20	GND	Ground	50	BL_C3	Backlight cathode 3
21	Reserved	Keep to VCC level	51	BL_C2	Backlight cathode 2
22	Reserved	Keep to VCC level	52	BL_C1	Backlight cathode 1
23	GND	Ground	53	NC	No connecting
24	Reserved	Keep to VCC level	54	NC	No connecting
25	Reserved	Keep to VCC level	55	NC	No connecting
26	GND	Ground	56	NC	No connecting
27	Reserved	Keep to VCC level	57	BL_A1	Backlight anode 1
28	Reserved	Keep to VCC level	58	BL_A2	Backlight anode 2
29	GND	Ground	59	BL_A3	Backlight anode 3
30	RX3+	LVDS Data3 + (*2)	60	BL_A4	Backlight anode 4

\*1) LCD scan direction

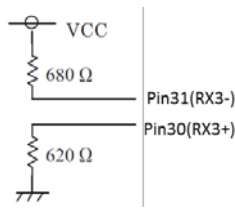


\*2) Data mapping

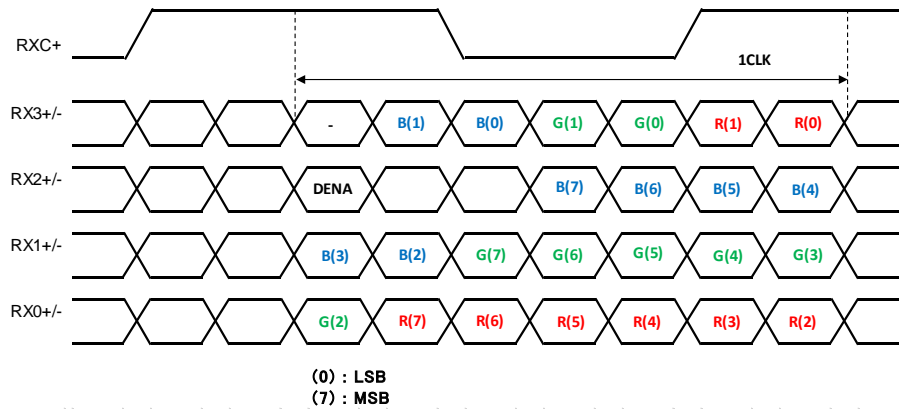
a. JEIDA mapping mode (LVMD = L ) (6bit input)



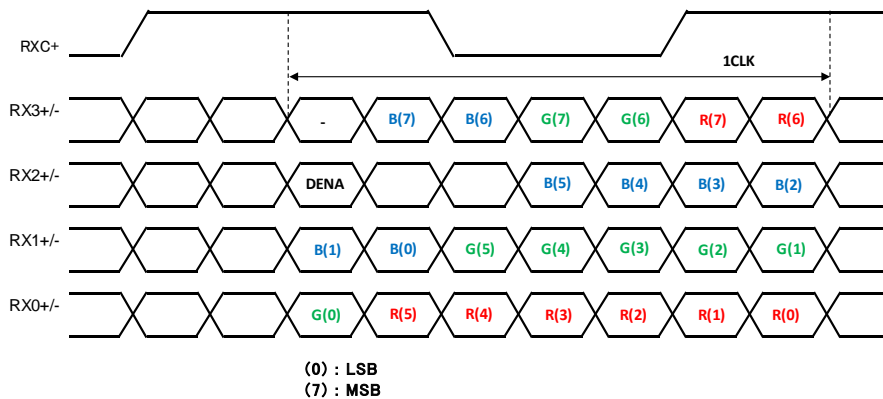
When LVMD is "L" and 6 bit input, the following connection is recommended.



b. JEIDA mapping mode (LVMD = L ) (8bit input)



c. VESA mapping mode (LVMD = H ) (8bit input)



\*3) I2C\_SCL/I2C\_SDA

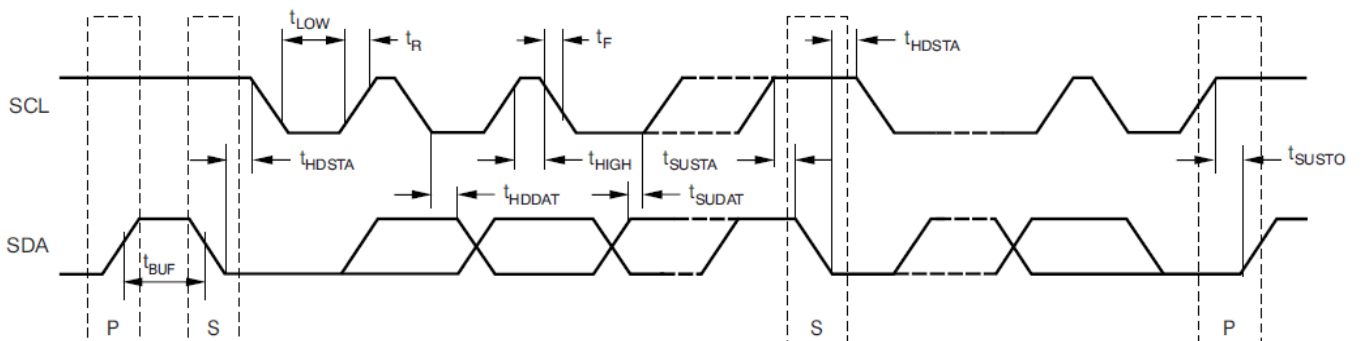
I2C line is connected to TCON(Timing controller) and PMIC(Power Management IC) with pull-up internal resistor;4.7kΩ on PCB. It is possible to access the register of TCON via I2C. Please do not access to PMIC.

(a)I2C device address

Parts	Slave address (binary)	Remark
TCON	1100_PPP	PPP: Page Address
PMIC(DCDC)	1000_000	
PMIC(VCOM cal)	1001_111	

(b)Interface I2C line electrical characteristics

Parameter	Symbol	Min	Typ	Max	Unit
Input voltage ' H ' level of logic	V <sub>IH</sub>	0.7V <sub>CC</sub>	-	V <sub>CC</sub>	V
Input voltage ' L ' level	V <sub>IL</sub>	GND	-	0.3V <sub>CC</sub>	V
High Level Output Voltage	V <sub>OH</sub>	V <sub>CC</sub> -0.4	-	V <sub>CC</sub>	V
Low Level Output Voltage	V <sub>OL</sub>	-	-	0.4	V
Pull Up Resistor	R <sub>UP</sub>	4.5	4.7	4.9	kΩ
SCL operating frequency	f <sub>SCL</sub>	10	-	225	kHz
Bus free time between START and STOP condition	t <sub>BUF</sub>	1200	-	-	ns
START condition hold time	t <sub>HDSTA</sub>	600	-	-	ns
START condition setup time	t <sub>SUSTA</sub>	600	-	-	ns
Stop condition setup time	t <sub>SUSTO</sub>	600	-	-	ns
Data hold time	t <sub>HDDAT</sub>	0	-	-	ns
Data setup time	t <sub>SUDAT</sub>	100	-	-	ns
SCL clock low period	t <sub>LOW</sub>	1200	-	-	ns
SCL clock high period	t <sub>HIGH</sub>	600	-	-	ns
Clock/data fall time	t <sub>F</sub>	-	-	300	ns
Clock/data rise time	t <sub>R</sub>	-	-	300	ns



\*4) LOOP1, LOOP2

The details are shown in section "7. FAILURE DETECTION". Please connect to GND when it is not used.

\*5) FAIL

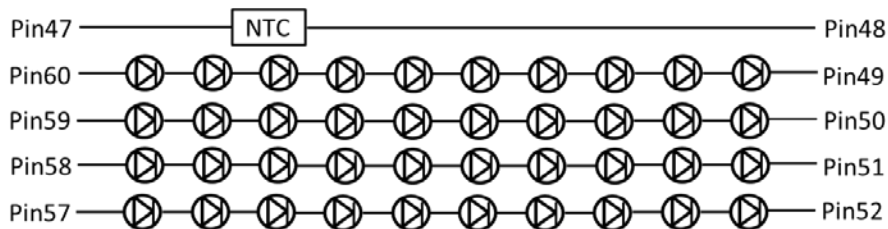
The details are shown in section "7. FAILURE DETECTION". Please keep open when it is not used

\*6) NTC1, NTC2

**THERMISTOR CHARACTERISTICS (MITSUBISHI Material : TD05-3H103FR)**

Item	Specification	Condition
Resistance	10k ohm $\pm$ 1%	zero-power resistance at 25°C
B-constant	3370K $\pm$ 1%	B-value between 25 to 50°C
Maximum power dissipation	300mW	
Heat dissipation	2.4mW/°C	at 25°C
Operating temperature range	-40°C~150°C	
Rohs	Compliant	

Note: Placed in the edge of Backlight close to LED.



LED arrangement

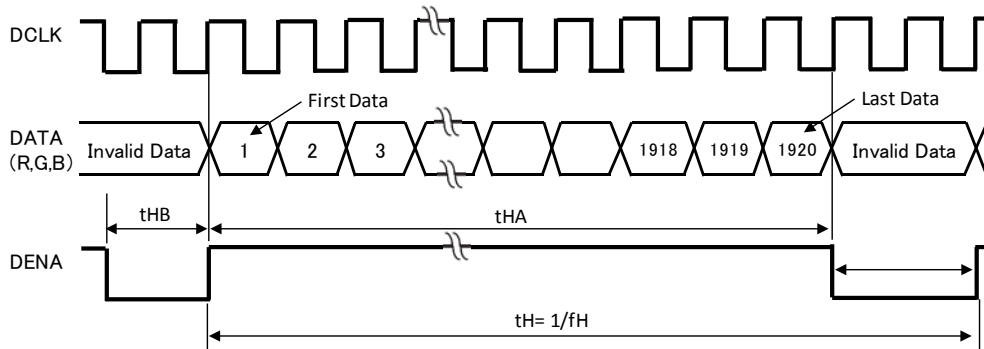
## 6. INTERFACE TIMING

### (1) Timing specification

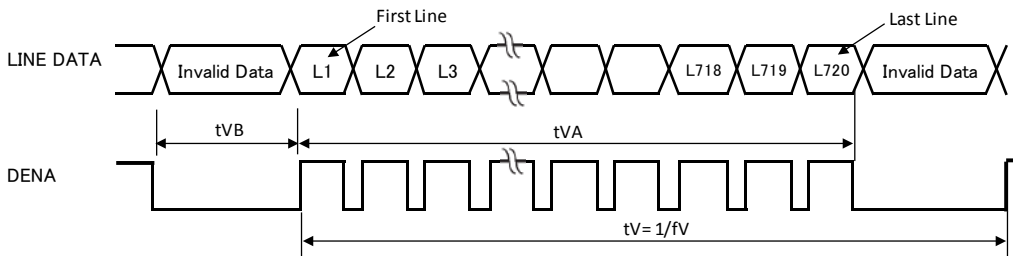
ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT
Data clock	Frequency	$f_{CLK}$	80.0	89.0	94.6	MHz
	Period	$t_{CLK}$	10.6	11.2	12.5	ns
Horizontal	Period time	$t_{HA}$	--	1920	--	$t_{CLK}$
	Blanking	$t_{HB}$	64	112	798	$t_{CLK}$
	Frequency	$f_H$	34.8	43.8	47.1	kHz
Vertical	Period time	$t_{VA}$	--	720	--	tH
	Blanking	$t_{VB}$	4	10	282	tH
	Frequency	$f_V$	47.0	60.0	65.0	Hz

### (2) Timing Chart

#### a. Horizontal Timing Chart



#### b. Vertical Timing Chart



## 7. FAILURE DETECTION

### (1)LOOP

LOOP1 and LOOP2 are connected in the LCD module through PCB and panel (PCB→FPC→Glass→FPC→PCB). This can be used for internal broken wire detection. The normal resistance (RLB) is shown in page 6.

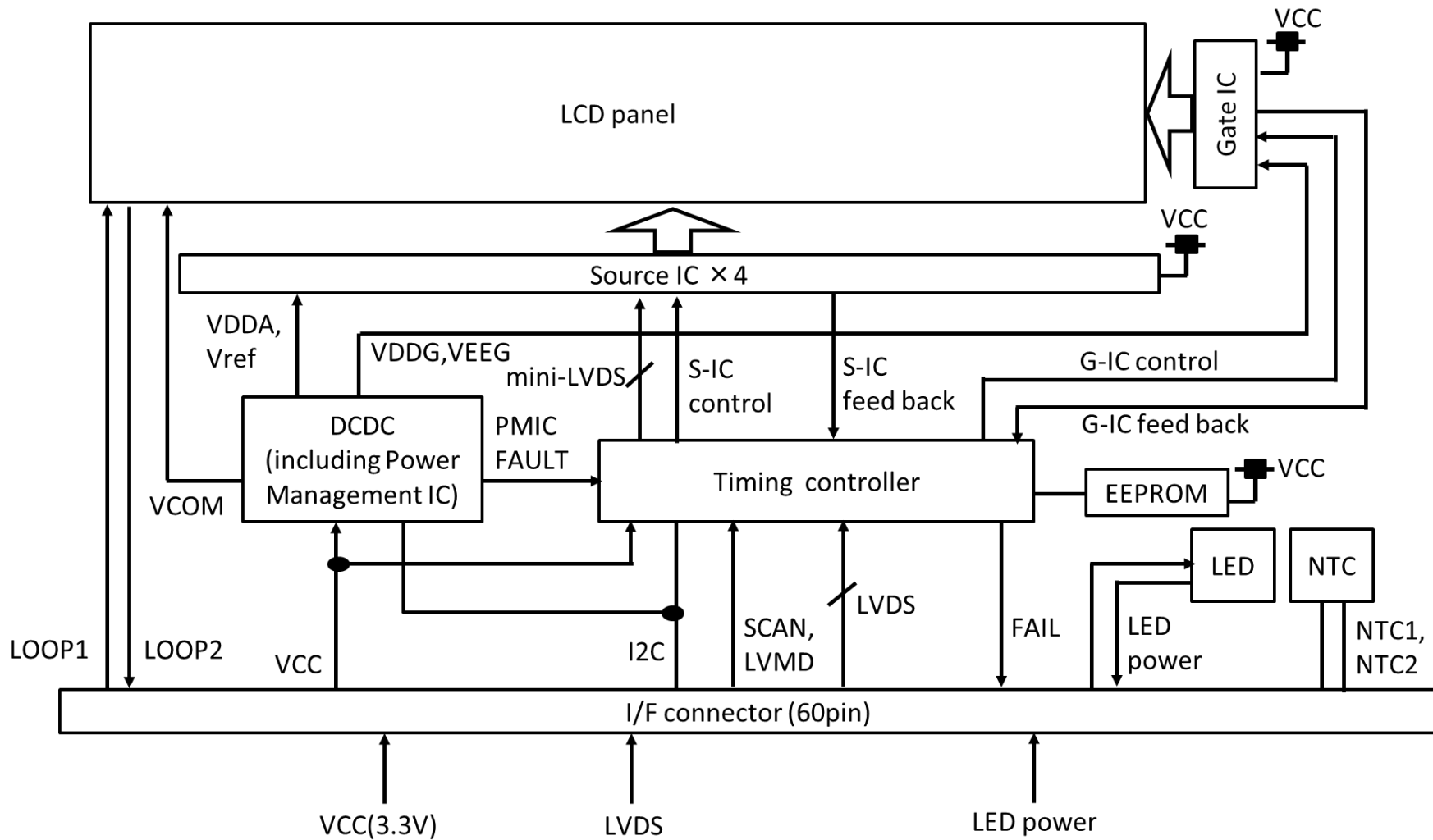
### (2)FAIL

FAIL signal at pin #13 of CN1 indicates following failures (Normal: High, Fail: Low).

The reason of failure (Fail category) can be checked from I2C access.

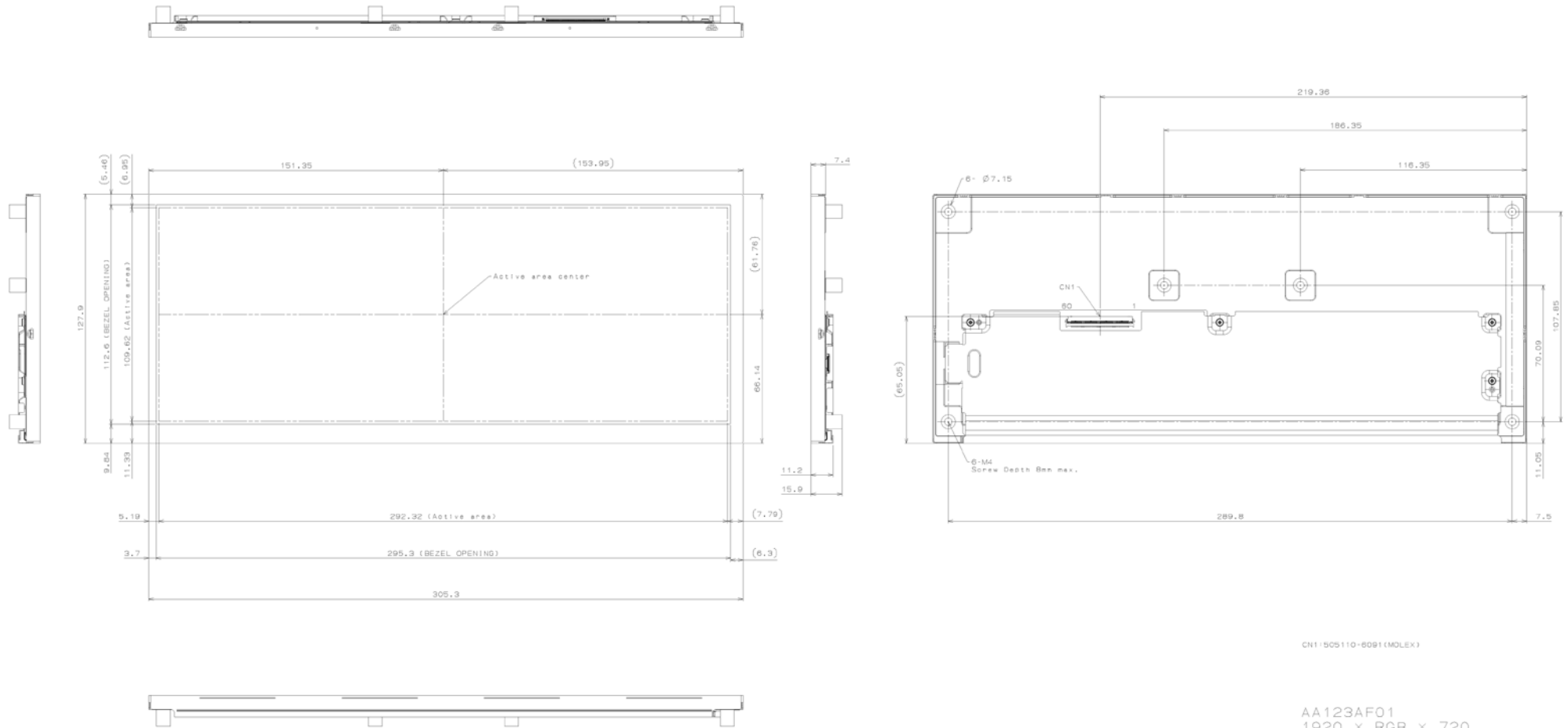
Fail Category	Description	Action
System Fail	LCD detects input LVDS clock and/or Sync signal is completely out of range. It will be caused by signal generator failure on system side or transmission line failure.	LCD indicates FAIL pin to be Low and draws Black image by itself.
CRC Fail	LCD calculates CRC of input data stream in specific area. The additional control via I2C is necessary to activate this function. (set CRC area, expected CRC etc.)	No action
EEPROM Fail	There is an EEPROM in LCD to configure the timing controller. The configuration data is periodically reloaded to avoid soft error. If an error is detected during loading, FAIL signal is asserted.	LCD indicates FAIL pin to be Low.
Gate Driver Fail	LCD detects gate feedback pulse to make sure the gate driver is correctly working. If an error is detected, FAIL signal is asserted.	LCD indicates FAIL pin to be Low.
Source Driver Fail	LCD detects gate feedback pulse to make sure the source driver is correctly working. If an error is detected, FAIL signal is asserted.	LCD indicates FAIL pin to be Low.
miniLVDS Fail	"miniLVDS" is transmission line between internal timing controller and source drivers. The timing controller monitors failure of these line. If an error is detected, FAIL signal is asserted.	LCD indicates FAIL pin to be Low.
PMIC Fail	LCD monitors the internal voltage is correctly generated, input voltage drop and thermal shut down. If an error is detected, FAIL signal is asserted.	LCD indicates FAIL pin to be Low.

## 8. BLOCK DIAGRAM





# 9. MECHANICAL SPECIFICATION



CN1:50S110-6091(MOLEX)

AA123AF01  
1920 × RGB × 720

1)Tolerance is  $\pm 0.5$ mm unless noted.  
2)Third angle projection.

[Note] Tolerance TBD

# 10. OPTICAL CHARACTERISTICS

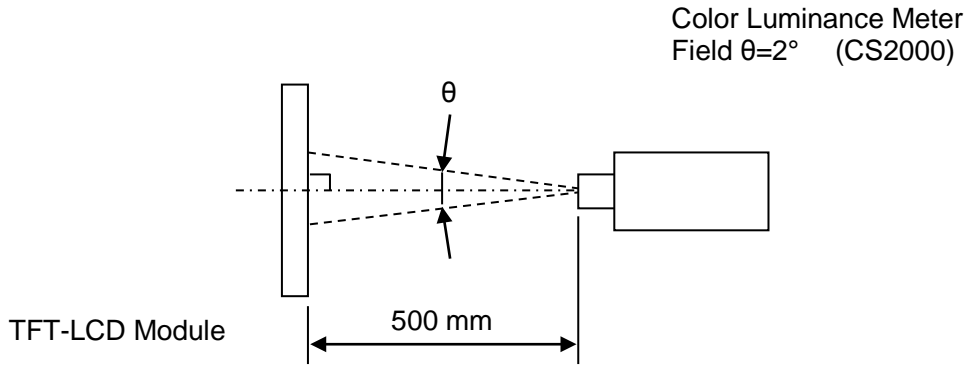
Ta= 25°C, VCC= 3.3 V, Input Signals: Typ. values shown in section\* If= 85mA

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	Remarks	
Contrast Ratio	CR	$\theta_V = 0^\circ, \theta_H = 0^\circ$	800	1000	--		*1)*2)*5)	
Luminance	Lw	$\theta_V = 0^\circ, \theta_H = 0^\circ$	800	1000	--	cd/m <sup>2</sup>	*1) *5)	
Luminance Uniformity	$\Delta Lw$	$\theta_V = 0^\circ, \theta_H = 0^\circ$	80	--	--	%	*1)*3)*5)	
Color Coordinate	Red	Rx	$\theta_V = 0^\circ, \theta_H = 0^\circ$	--	(0.634)	--	--	*1) *5) Gamut=72%(typ.)
		Ry		--	(0.315)	--		
	Green	Gx		--	(0.319)	--		
		Gy		--	(0.625)	--		
	Blue	Bx		--	(0.151)	--		
		By		--	(0.067)	--		
	White	Wx		(0.283)	(0.313)	(0.343)		
		Wy		(0.299)	(0.329)	(0.359)		
Response time	tr + tf	$\theta_V = 0^\circ, \theta_H = 0^\circ$	--	--	30	ms	*1)*4)*5)	
Viewing Angle range	Horizontal	$\theta_H$	CR $\geq 10$	-85~85	--	--	°	*1)*5)
	Vertical	$\theta_V$		-85~85	--	--		

[Note]

These items of transmissive mode are measured using EZ Contrast(ELDIM) for viewing angle and CS2000(KONICAMINOLTA) for others under the dark room condition (no ambient light) after more than 30 minutes from turning on the backlight unless noted.

Luminance and Viewing angle measurement method is as follows:

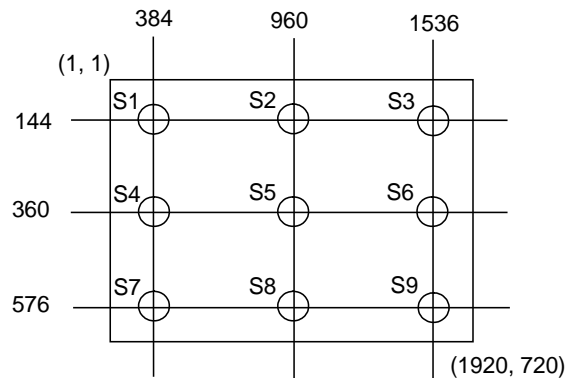


Each item's definition is as follows:

\*1) Measurement Point

Contrast Ratio, Luminance, Response Time, Viewing Angle, Color Coordinates, Brightness "Black", "White": Display center (S5)

Luminance Uniformity: point 1 ~9 shown in a figure below.



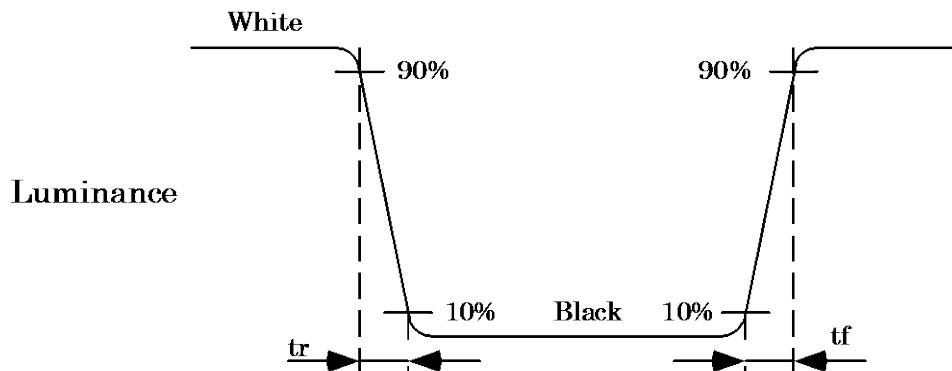
\*2) Definition of Contrast Ratio

$$CR = \text{Luminance with all white pixels} / \text{Luminance with all black pixels}$$

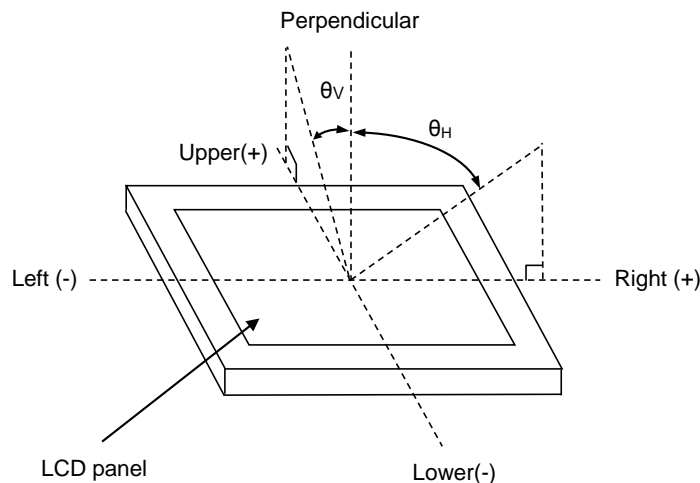
\*3) Definition of Luminance Uniformity

$$\Delta Lw = [Lw(\text{MIN}) / Lw(\text{MAX})] \times 100, \text{ Lw is the luminance value at 9 points shown in *1).}$$

\*4) Definition of Response Time



\*5) Definition of Viewing angle ( $\theta_v$ ,  $\theta_H$ )



# 11. RELIABILITY TEST CONDITION

## (1) Temperature and humidity

TEST ITEM	CONDITION	JUDGEMENT STANDARD
High Temperature High Humidity Operation	60°C, 90%RH, 500h	No critical defect *1)
High Temperature Operation	85°C, 500h	
Low Temperature Operation	-40°C, 500h	
High Temperature Storage	90°C, 500h	
Low Temperature Storage	-40°C, 500h	
Thermal Shock (Non-Operation)	-40°C (0.5h) ~ 85°C (0.5h), 500 cycles	

## (2) Shock and vibration

TEST ITEM	CONDITION	JUDGEMENT STANDARD
Shock (Non-Operation)	1470m/s <sup>2</sup> 2msec, 1/2 sin wave, ±X, ±Y, ±Z, each axis	No critical defect *1)
	392m/s <sup>2</sup> 11msec, table wave, ±X, ±Y, ±Z, each axis	
Vibration (Non-Operation)	9.8m/s <sup>2</sup> (sine wave) 5~500Hz (0.5 octave /m) 3axis(X, Y, Z) each 1hour, total 3 hours	

## (3) ESD test

TEST ITEM	CONDITION	JUDGEMENT STANDARD
Contact Discharge	150pF, 330ohm, ±8kV	Recover display function after restart
Air Discharge	150pF, 330ohm, ±15kV	
Signal Pin Discharge	200pF, 0ohm, ±200V	

### \*1) Judgment standard

The judgment of the above tests should be made as follow:

Pass: Normal display image, no damage of the display function. (e.g. no line defect)

Partial transformation of the module parts should be ignored.

Fail: No display image, damage of the display function. (e.g. line defect)

## 12. HANDLING PRECAUTIONS FOR TFT- LCD MODULE

Please pay attention to the followings in handling TFT-LCD products;

### (1) ASSEMBLY PRECAUTION

- a. Please use the mounting hole on the module in installing and do not bending or wrenching LCD in assembling. And please do not drop, bend or twist LCD module in handling.
- b. Please design display housing in accordance with the following guide lines.
  - (i) Housing case must be designed carefully so as not to put stress on LCD and not to wrench module. If customer uses compression mounting, please evaluate housing case with LCD carefully to avoid image quality issue caused by mechanical stress.
  - (ii) Under high temperature environment, performance and life time of LED may heavily shorten. When you design with our LCD product, please consider radiating heat and ventilation for good heat management.
  - (iii) Keep sufficient clearance between LCD module back surface and housing when the LCD module is mounted. Approximately 1.0mm of the clearance in the design is recommended taking into account the tolerance of LCD module thickness and mounting structure height on the housing.
  - (iv) When some parts, such as, FPC cable and ferrite plate, are installed underneath the LCD module, still sufficient clearance is required, such as 0.5mm. This clearance is, especially, to be reconsidered when the additional parts are implemented for EMI countermeasure.
  - (v) Design the connector and plate position carefully so as not to give stress to FPC cable, or not to interface the LCD module by the connector.
  - (vi) Keep sufficient clearance between LCD module and the others parts, such as speaker so as not to interface the LCD module. Approximately 1.0mm of the clearance in the design is recommended.
  - (vii) To avoid local elevation/decrease of temperature, considering location of heating element, heat release, and thermal design should be done.
- c. Please do not push or scratch LCD panel surface with anything hard. And do not soil LCD panel surface by touching with bare hands. (Polarizer film, surface of LCD panel is easy to be flawed.)
- d. Please wipe off LCD panel surface with absorbent cotton or soft cloth in case of it being soiled.
- e. Please wipe off drops of adhesives like saliva and water on LCD panel surface immediately. They might damage to cause panel surface variation and color change.
- f. Please do not take a LCD module to pieces and reconstruct it. Resolving and reconstructing modules may cause them not to work well.
- g. Please do not touch metal frames with bare hands and soiled gloves. A color change of the metal frames can happen during a long preservation of soiled LCD modules.
- h. Please handle metal frame carefully because edge of metal frame is very sharp.
- i. Please connect the metal frame of LCD module to GND in order to minimize the effect of external noise and EMI.
- j. Be sure to connect the cables and the connectors correctly.

## **(2) OPERATING PRECAUTIONS**

- a. Please be sure to turn off the power supply before connecting and disconnecting signal input cable.
- b. Please do not change variable resistance settings in LCD module. They are adjusted to the most suitable value. If they are changed, it might happen LCD does not satisfy the characteristics specification.
- c. The interface signal speed is very high. Please pay attention to transmission line design and other high speed signal precautions to satisfy signal specification.
- d. A condensation might happen on the surface and inside of LCD module in case of sudden change of ambient temperature.
- e. Please pay attention not to display the same pattern for very long time. Image sticking might happen on LCD. Although image sticking may disappear as the operation time proceeds, screen saver function is recommended not to cause image sticking.
- f. Please obey the same safe instructions as ones being prepared for ordinary electronic products.

## **(3) PRECAUTIONS WITH ELECTROSTATICS**

- a. This LCD module use CMOS-IC on TFT-LCD panel, and so it is easy to be affected by electrostatics. Please be careful with electrostatics by the way of your body connecting to the ground and so on.
- b. Please remove protection film very slowly from the surface of LCD module to prevent from electrostatics occurrence.

## **(4) STORAGE PRECAUTIONS**

LCD should be stored in the room temperature environment with normal humidity. The LCD inventory should be processed by first-in first-out method.

## **(5) SAFETY PRECAUTIONS**

- a. When you waste damaged or unnecessary LCDs, it is recommended to crush LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.
- b. If any liquid leaks out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.
- c. Be sure to turn off the power supply when inserting or disconnecting the cable.
- d. LED driver should be designed carefully so as not to keep working in case of detecting over current or open circuit on the LED light.

## **(6) Others**

- a. A strong incident light into LCD panel may cause deterioration to polarizer film, color filter, and other materials, which will degrade the quality of display characteristics.
- b. Please pay attention to a panel side of LCD module not to contact with other materials in preserving it alone.
- c. For the packaging box handling, please see and obey with the packaging specification datasheet.

### 13. REVISION STATUS

Rev.	Description	Date	Prepared	Checked
				Approved
X1	First Revision	Mar.13,'17	T.Tajiri	-- H. Aoki
X2	4. ELECTRICAL CHARACTERISTICS (3)Backlight Add LED typical value of lifetime, P7 5. INTERFACE PIN CONNECTION (1)Pin connection Change CN1 pin connection, P8 (2)Data mapping Change data mapping and separate into LVMD=L and H, P9 8. MECHANICAL SPECIFICATION Add drawing, P12	Mar.13,'17	T.Tajiri	--
				H. Aoki
X3	4. ELECTRICAL CHARACTERISTICS (3) Backlight Correct reference page number of life time condition, P7 5. INTERFACE PIN CONNECTION (1)Pin connection Add note *4) and *5), P8, P9 Correct Pin No of *2) Data mapping, P9 6. INTERFACE TIMING Revise Min. and max. values of tHB, max. value of tVB, P10 8. MECHANICAL SPECIFICATION Revise drawing (Bezel opening is updated), P12	Sep.08,'17	T.Tajiri	--
				H. Aoki
X4	1.APPLICATION Revised for CS, P3 2.OVER VIEW Add module mass value, P4 3.ABSOLUTE MAXIMUM RATINGS Change item name Logic supply voltage for LCD→Input signal voltage, P4 Delete ESD and note *1) related to ESD, P4 Renumbering note from *2)~*4) to *1)~*3), P4 4.ELECTRICAL CHARACTERISTICS (1)TFT-LCD Correct temperature -40°C~85°C→25°C, P6 Update table of TFT-LCD, P6 [Change item name] TFT current→Power supply current Logic input voltage High→Input voltage 'H' level of logic Logic input voltage Low→Input voltage 'L' level Differential input common mode voltage→ Differential input VID=200mV common mode voltage [Add new items] High level output voltage Low level output voltage Loop back resistance [Delete items] Differential input common mode voltage differential [Update specified values] VI Typ; – →430, Max; (1.1)→730, unit; A→mA VIH Min; 0.8xVCC→0.7xVCC, VIL Max; 0.3xVCC→0.2xVCC (2)LVDS receiver DC characteristics Separate items of LVDS receiver from (1)TFT-LCD table. Add chart of LVDS receiver DC characteristics, P6 (3)LVDS receiver AC characteristics	Mar.05,'18	T. Tajiri	--

<p>Add table of LVDS receiver AC characteristics and chart, P7  (4)Power ON/OFF sequence  Correct temperature -40°C~85°C→25°C, P8  Update table of power ON/OFF sequence and chart, P8  [Change item name]  VCC 0% to 90%→VCC rising time  VCC 90% to LVDS data ON→VCC 90% to signal  LVDS data ON to BL dimming ON→signal to BL ON  BL dimming OFF to LVDS data OFF→BL OFF to signal stop  LVDS data OFF to VCC 0%→Signal stop to VCC fall  Power OFF to Power ON→Restart VCC time  [Update specified values]  T2 Min; 20→0  T3 Min; (180)→(100)  T6 Min; (200)→T7 Min; (400)  [Add new item]  VCC falling time  [Delete item]  LVDS data ON to Backlight dimming ON (T2≥200ms)  (5)Backlight  Change reference pages of measurement condition *3), P9  5.INTERFACE PIN CONNECTION  (1)Pin connection  Update connector models; 505110→505110-6091, P10  Update table of pin connection  [Change function]  No.6 VCC→NC (Connect VCC at user side is still no problem)  No.44 TEST1→I2C_SCL, No.45 TEST2→I2C_SDA  [Add note]  No.13, No.47 and No.48  *1)LCD scan direction  Replace sketch, P11  *2)Data mapping  Replace table to chart, P11  *3)I2C_SCL/I2C_SDA  Change the contents from test pins to I2C function pins, P12  Add specification of I2Cfunctions and chart, P12  *4)Loop1, Loop2  Update comments, P13  *5)FAIL  Update comments, P13  *6)NTC1, NTC2  Add table of NTC characteristics and LED alignment, P13  6.INTERFACE TIMING  (1)Timing specification  Update table of interface timing and add chart, P14  [Change item name]  Horizontal frequency, period time and blanking  Vertical frequency, period time and blanking  [Update specified values]  fH Min;21.3→34.8, Typ; 22.8→43.8, Max; 28.6→47.1  7.FAILURE DETECTION  Add new section of failure detection, P15  8.BLOCK DIAGRAM  Replace block diagram, P16</p>			<p>H. Aoki</p>
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