

Tentative

12.3" WHD

Part name: TFT LCD module

TECHNICAL SPECIFICATION

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AA123AF01

(ES: Engineering Sample)

MITSUBISHI ELECTRIC CORPORATION
LCD DIVISION

Date: March-13, 2017

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1. APPLICATION

This specification applies to color TFT-LCD module AA123AF01, its development phase is technical sample (ES).

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(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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MITSUBISHI has been making continuous effort to improve the reliability of its products. Customers should implement sufficient reliability design of their application equipments such as redundant system design, fail-safe functions, anti-failure features.

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Please contact and consult a MITSUBISHI sales representative for any questions regarding this product.

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 ²)	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)	TBD
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
Logic supply Voltage for LCD	VI	-0.3	VCC+0.3	V
LED Current	If	--	(150)	mA
LED Peak Current *4)	Ifp	--	(200)	mA
ESD*1)	VESDt	-200	+200	V
	VESDc	-8	+8	kV
	VESDa	-15	+15	kV
Operation Temperature(Ambient) *2)	T _{op(Ambient)}	-40	+85	°C
Storage Temperature *2) *3)	T _{stg}	-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) VESDt: Electric contact discharge to input PIN

VESDc: Electric contact discharge to Module.

VESDa: Electric air discharge to Module

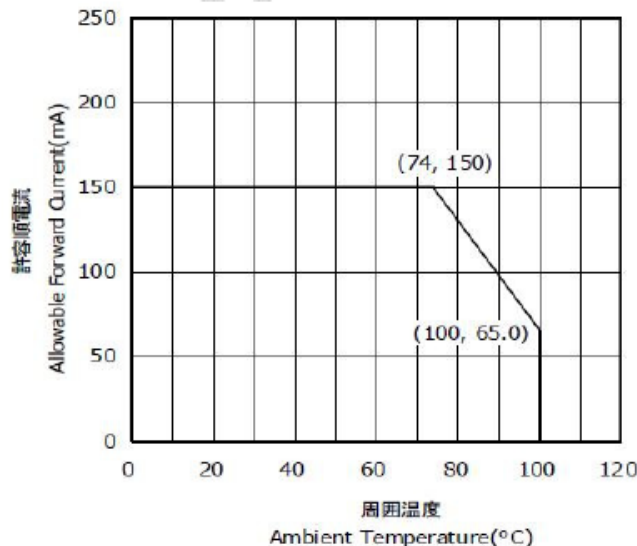
Test condition is defined under IEC 61000-4-2

*2) 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.

*3) Backlight: OFF

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



4. ELECTRICAL CHARACTERISTICS

(1)TFT-LCD

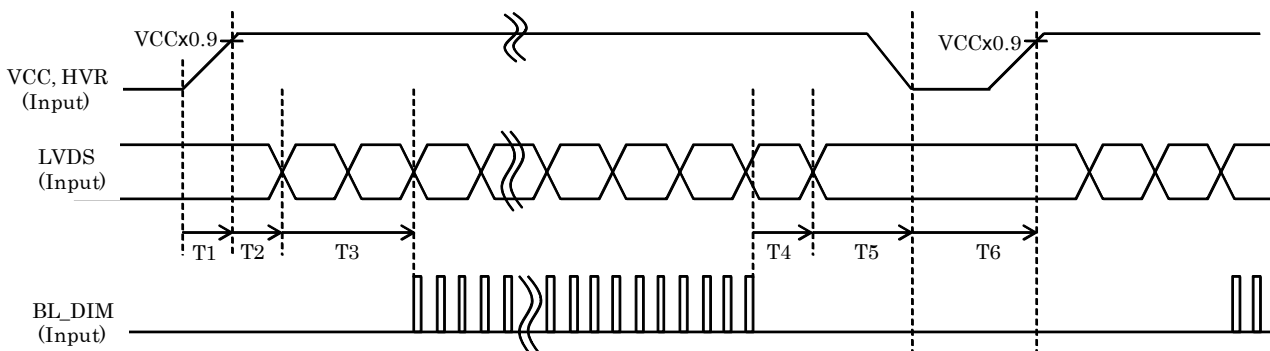
Ambient Temperature: Ta = -40°C~ 85°C

Parameter	Symbol	Extreme Ratings			Unit	Remarks
		Min.	Typ	Max.		
Power Supply Voltage	VCC	(3.0)	(3.3)	(3.6)	V	
TFT Current	VI	--	--	(1.1)	A	
Logic Input Voltage (CMOS)	High	VIH	0.7 x VCC	--	VCC	V
	Low	VIL	(0.0)	--	0.3 x VCC	V
Differential Input Voltage	VID	(100.0)	--	(600.0)	mV	
Differential "H" Threshold	VTH	--	--	(50.0)	mV	
Differential "L" Threshold	VTL	-(50.0)	--	--	mV	
Differential Input Common Mode Voltage	VCM	VID /2	(1.2)	2.4- VID /2	V	VDD=3.3V,V ID=200mV
Differential Input Common Mode Voltage Difference	Rx Vcm	-(50.0)	--	(50.0)	mV	VID=200mV

(2)Power ON/OFF sequence

Ambient Temperature: Ta = -40°C~ 85°C

Sequence	Parameter	SYMBOL	MIN.	MAX.	UNIT
Power ON	VCC 0% to 90%	T1	0.1	(10)	ms
	VCC 90% to LVDS data ON	T2	20	--	ms
	LVDS data ON to Backlight Dimming ON (T2<100ms)	T3	(180)	--	ms
	LVDS data ON to Backlight Dimming ON (T2≥100ms)	T3	(100)	--	ms
Power OFF	Backlight Dimming OFF to LVDS data OFF	T4	(0)	--	ms
	LVDS data OFF to VCC 0%	T5	(60)	--	ms
Restart	Power OFF to Power ON	T6	(200)	--	ms



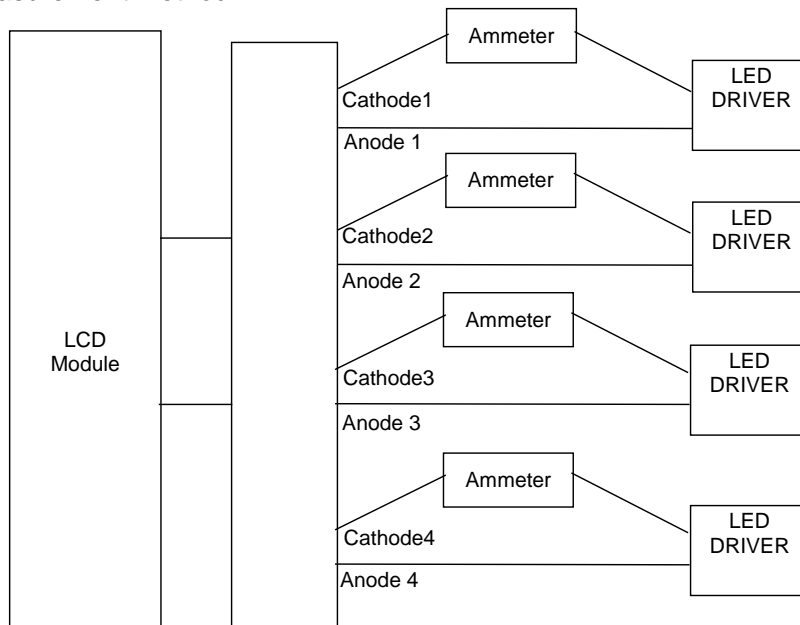
(3) Backlight

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	--	--	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 13/17.
- *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.

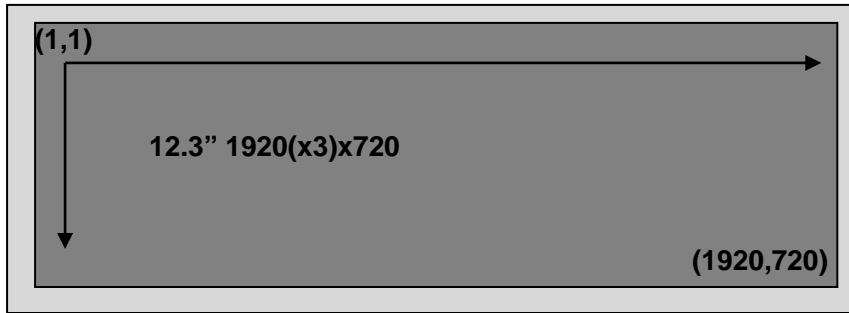
5. INTERFACE PIN CONNECTION

(1) Pin connection

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

No.	Symbol	Description	No.	Symbol	Description
1	LOOP1	Loop back1 -> LOOP2	31	RXC-	LVDS Clock- (*2)
2	VCC	Power Supply (3.3V)	32	GND	Ground
3	VCC	Power Supply (3.3V)	33	RX2+	LVDS Data2 + (*2)
4	VCC	Power Supply (3.3V)	34	RX2-	LVDS Data2 - (*2)
5	VCC	Power Supply (3.3V)	35	GND	Ground
6	GND	Ground	36	RX1+	LVDS Data1 + (*2)
7	GND	Ground	37	RX1-	LVDS Data1 - (*2)
8	GND	Ground	38	GND	Ground
9	SCAN	Input : Scan direction (*1) (Low : Normal , High : Reverse)	39	RX0+	LVDS Data0 + (*2)
10	FAIL	Output : Fail detect signal	40	RX0-	LVDS Data0 - (*2)
11	GND	Ground	41	TEST1	Supplier test pin (*3) "Internal pull-High"
12	NC	No connection	42	TEST2	Supplier test pin (*3) "Internal pull-High"
13	NC	No connection	43	LOOP2	Loop back2 -> LOOP1
14	GND	Ground	44	NTC1	Backlight temperature sensor pin 1
15	NC	No connection	45	NTC2	Backlight temperature
16	NC	No connection	46	BL_C1	Backlight cathode 1
17	GND	Ground	47	NC	No connection
18	NC	No connection	48	BL_A1/2	Backlight anode 1 and 2
19	NC	No connection	49	BL_A1/2	Backlight anode 1 and 2
20	GND	Ground	50	NC	No connection
21	NC	No connection	51	BL_C2	Backlight cathode 2
22	NC	No connection	52	BL_C3	Backlight cathode 3
23	GND	Ground	53	NC	No connection
24	NC	No connection	54	BL_A3/4	Backlight anode 3 and 4
25	NC	No connection	55	BL_A3/4	Backlight anode 3 and 4
26	GND	Ground	56	NC	No connection
27	RX3+	LVDS Data3 + (*2)	57	BL_C4	Backlight cathode 4
28	RX3-	LVDS Data3 - (*2)	58	BL_C5	Backlight cathode 5
29	GND	Ground	59	NC	No connection
30	RXC+	LVDS Clock+ (*2)	60	BL_A5	Backlight anode 5

*1) LCD scan direction



(2) Data mapping

Pin No	Symbol	Description	Data-mapping(VESA 8bit)
25	RX3+	LVDS data 3+	R[6],R[7],G[6],G[7],B[6],B[7]
26	RX3-	LVDS data 3-	R[6],R[7],G[6],G[7],B[6],B[7]
28	RXC+	LVDS clock +	Clock
29	RXC-	LVDS clock -	Clock
31	RX2+	LVDS data 2+	B[2],B[3],B[4],B[5],DENA
32	RX2-	LVDS data 2-	B[2],B[3],B[4],B[5],DENA
34	RX1+	LVDS data 1+	G[1],G[2],G[3],G[4],G[5],B[0],B[1]
35	RX1-	LVDS data 1-	G[1],G[2],G[3],G[4],G[5],B[0],B[1]
37	RX0+	LVDS data 0+	R[0],R[1],R[2],R[3],R[4],R[5],G[0]
38	RX0-	LVDS data 0-	R[0],R[1],R[2],R[3],R[4],R[5],G[0]

*3) TEST Pin

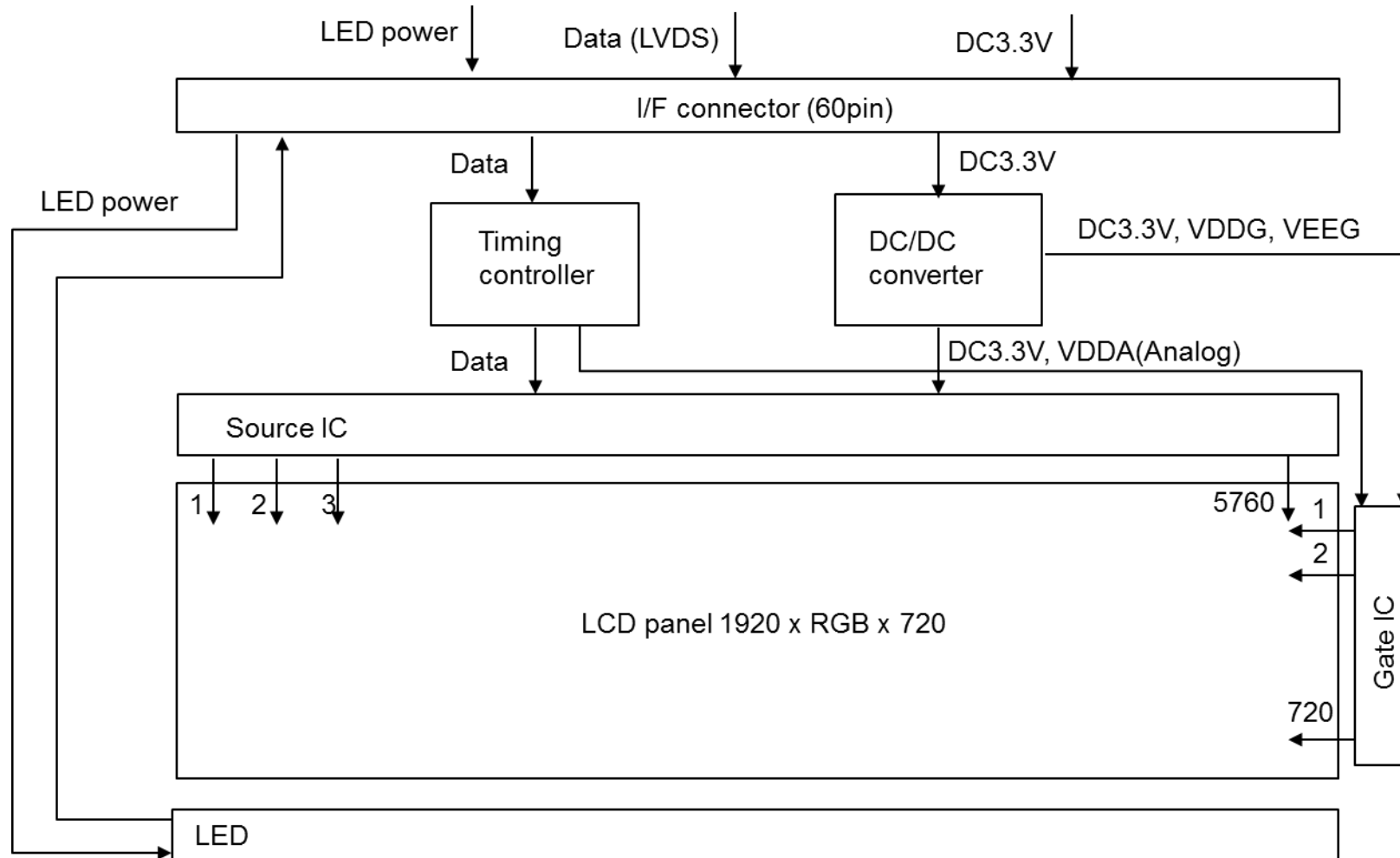
Please keep open or connect to VCC.

6. INTERFACE TIMING

VDDD= 3.0~ 3.6V, Ta= -40~ 85°C

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	13.3	ns
Horizontal	Frequency	t _{HA}	--	1920	--	tCLK
	Period time	t _{HB}	90	112	380	tCLK
	Blanking	f _H	21.3	22.8	30.0	kHz
Vertical	Frequency	t _{VA}	--	720	--	tH
	Period time	t _{VB}	4	10	20	tH
	Blanking	f _V	47.0	60.0	65.0	Hz

7. BLOCK DIAGRAM



8. MECHANICAL SPECIFICATION

TBD

9. OPTICAL CHARACTERISTICS

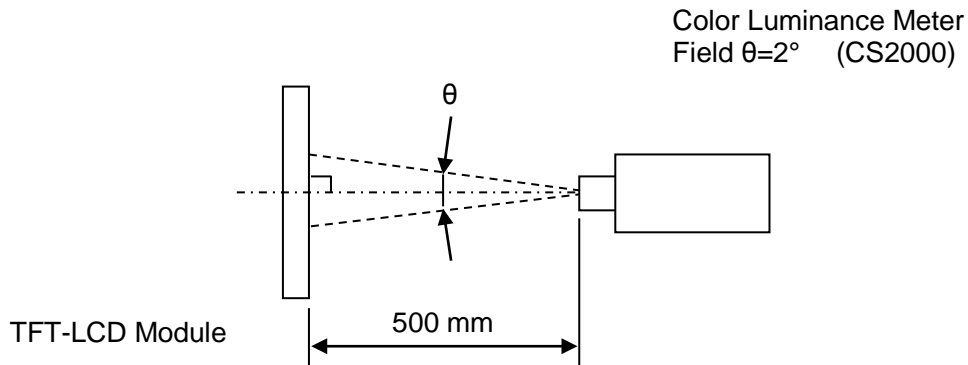
Ta= 25°C, VCC= 3.3 V, Input Signals: Typ. values shown in section* If= 85mA

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 ²	*1) *5)	
Luminance Uniformity	ΔLw	$\theta_V = 0^\circ, \theta_H = 0^\circ$	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	θ_H	CR ≥ 10	-85~85	--	--	°	*1)*5)
	Vertical	θ_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:

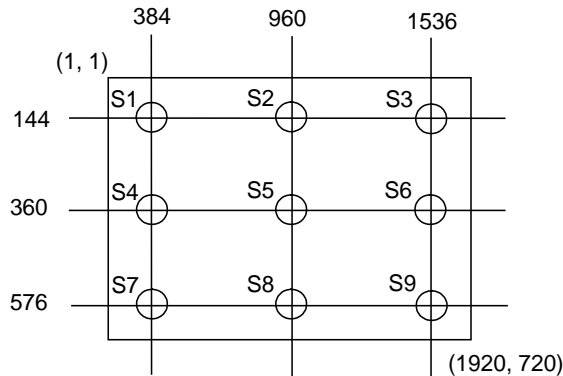


Each item's definition is as follows:

*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.



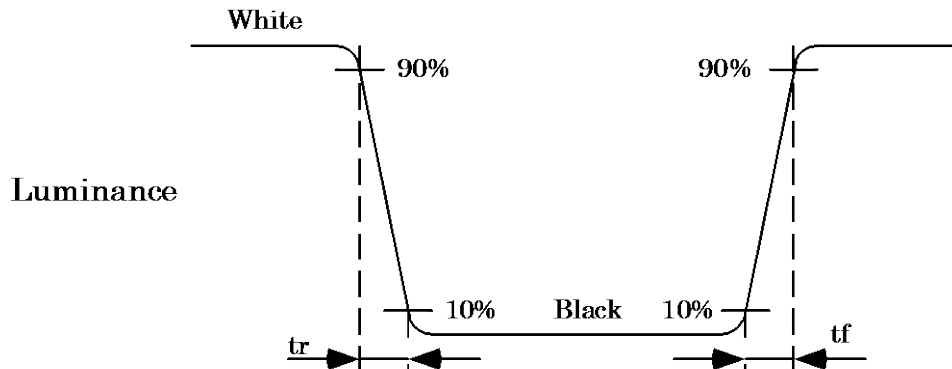
*2) Definition of Contrast Ratio

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

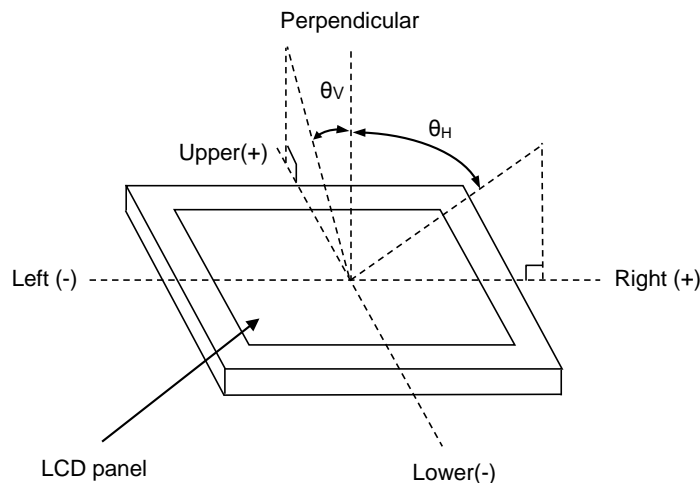
*3) Definition of Luminance Uniformity

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

*4) Definition of Response Time



*5) Definition of Viewing angle (θ_v , θ_H)



10. 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 ² 2msec, 1/2 sin wave, ±X, ±Y, ±Z, each axis	No critical defect *1)
	392m/s ² 11msec, table wave, ±X, ±Y, ±Z, each axis	
Vibration (Non-Operation)	9.8m/s ² (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)

11. 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.

12. REVISION STATUS

Rev.	Description	Date	Prepared	Checked
				Approved
X1	First Revision	Mar.13,'17	T.Tajiri	--
				H. Aoki