Mitsubishi

TENTATIVE

All information in this technical data sheet is tentative and subject to change without notice

12.1” SVGA

TECHNICAL SPECIFICATION

AA121SK01
AA121SK02
AA121SK03
AA121SK04
AA121SK05

Advanced Display Inc.

Date: Aug.18,’98

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1. OVER VIEW

AA121SK01 / 02 / 03 / 04 / 05 is 12.1" color TFT- LCD (Thin Film Transistor Liquid Crystal Display) module composed of LCD panel, driver ICs, control circuit, and backlight.

By applying 6 bit digital data, 800 × 600, 260 K-color images are displayed on the 12.1 diagonal screen. Input power voltage is either single 3.3 V or 5.0V for LCD driving (factory setting). Both 3.3V-CMOS and 5.0V-CMOS level voltage are acceptable for logic input voltage regardless of input power voltage. Inverter for backlight is not included in this module. General specifications are summarized in the following table:

ITEM	SPECIFICATION
Display Area (mm)	246.0 (H) × 184.5 (V) (12.106 -inch diagonal)
Number of Pixels	800(H) × 600(V)
Pixel Pitch (mm)	0.3075 (H) × 0.3075 (V)
Color Pixel Arrangement	RGB vertical stripe
Display Mode	normally white
Number of Color	260 K
Optimum Viewing Angle	6 o'clock
Brightness (cd/m^2)	(300)
Power Consumption(W)	(7.6)
Module Size (mm)	
AA121SK01, AA121SK04	290.0 (W) × 221.0 (H) × 12.0 (D)
AA121SK02, AA121SK05	280.0 (W) × 210.0 (H) × 12.0 (D)
AA121SK03	290.0 (W) × 210.0 (H) × 12.0 (D)
Module Weight (g)	
AA121SK01, AA121SK04	(760)
AA121SK02, AA121SK05	(760)
AA121SK03	(760)
Backlight Unit	CCFL, 2-tubes, Replaceable

Sign"( )" represents preliminary value.

The LCD products listed on this document are not suitable for use of aerospace equipment, submarine cables, nuclear reactor control system and life support systems. If customers intend to use these LCD products for above application or not listed in "Standard" as follows, please contact our sales people in advance.

Standard: Computer, Office equipment, Communication equipment, Test and Measurement equipment, Machine tool, Industrial robot, Audio and Visual equipment, Other consumer products.

2. ABSOLUTE MAXIMUM RATINGS

ITEMS	SYMBOL	MIN.	MAX.	UNIT
Power Supply Voltage for LCD	VCC	-0.3	(5.0/6.0) *2)	V
Operation Temperature *1)	Top	0	50	°C
Storage Temperature *1)	Tstg	-20	60	°C

[Note]

1) Humidity ≤ 85%RH. No condensation.

2) VCC = 3.3V / 5.0V

3. ELECTRICAL CHARACTERISTICS

(a) TFT-LCD

Ta=25°C

ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT	Remark
Power Supply Voltage for LCD	(VCC=3.3V)	VCC	3.0	3.3	3.6	V	*1)
	(VCC=5.0V)	VCC	4.75	5.0	5.25		
Power Supply Current for LCD	(VCC=3.3V)	ICC		(260)		mA	*2)
	(VCC=5.0V)	ICC		(180)			
Permissive input ripple voltage		VRP			100	mVp-p	VCC = +3.3V VCC = +5.0V
Logic Input Voltage	High	VLH	VCC × 0.7		VCC	V	
	Low	VLL	0		VCC × 0.3	V	

(b) Backlight

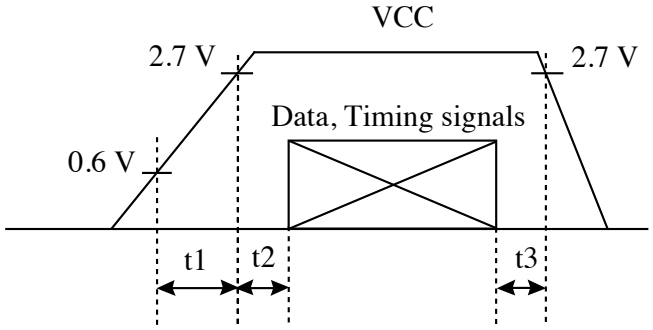
Ta=25°C

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT
Lamp Voltage	VL		(560)		V
Lamp Current	IL		(5.0)		mA
Starting Lamp Voltage	Vs	(1000)			V

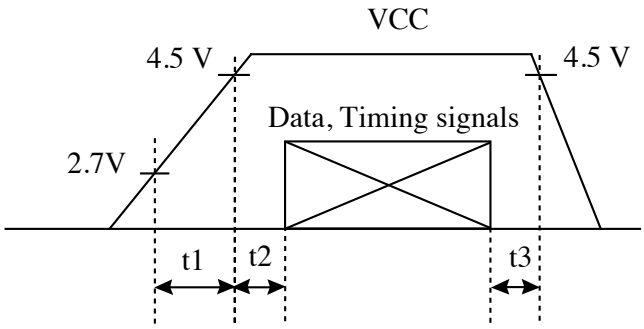
[Note]

*1) VCC-turn-on conditions: t1 ≤ 10ms, 0 < t2 ≤ 50ms, 0 < t3 ≤ 50ms

(a) VCC=3.3V



(b) VCC=5.0V



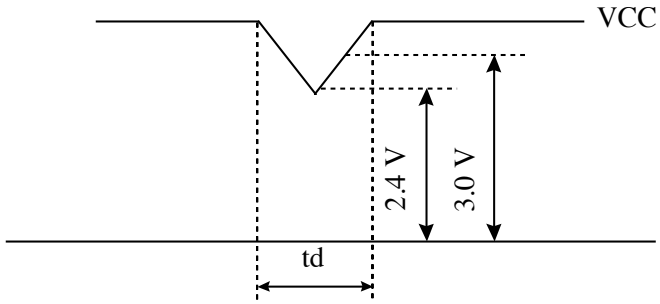
VCC-dip conditions:

(a) VCC=3.3V

(1)When 2.4 V ≤ VCC < 3.0 V, td ≤ 10 ms

(2)When VCC < 2.4 V

VCC-dip conditions should also follow the VCC-turn-on conditions

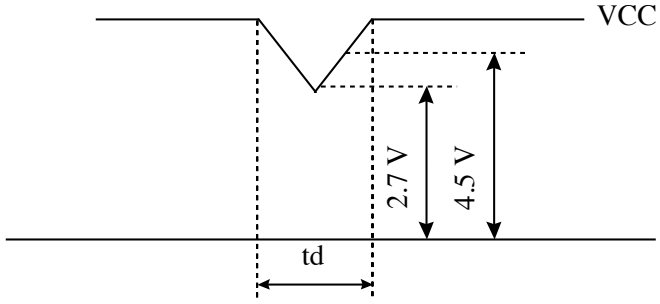


(b) VCC=5.0V

(1)When 2.7 V ≤ VCC < 4.5 V, td ≤ 10 ms

(2)When VCC < 2.7 V

VCC-dip conditions should also follow the VCC-turn-on conditions



*2) Typical current situation:64- gray- bar-pattern, 600 line mode, VCC = +3.3/ 5.0 V

4.INTERFACE PIN CONNECTION

CN 1(INTERFACE SIGNAL)

Used connector: DF9B-41P-1V(Hirose)

Corresponding connector: DF9B-41S-1V (Hirose)

Pin No.	Symbol	Function
1	GND	Signal ground
2	DCLK	Clock signal for sampling catch data signal
3	GND	Signal ground
4	HD	Horizontal sync signal
5	VD	Vertical sync signal
6	GND	Signal ground
7	GND	Signal ground
8	GND	Signal ground
9	R0	RED data signal (LSB)
10	R1	RED data signal
11	R2	RED data signal
12	GND	Signal ground
13	R3	RED data signal
14	R4	RED data signal
15	R5	RED data signal (MSB)
16	GND	Signal ground
17	GND	Signal ground
18	GND	Signal ground
19	G0	GREEN data signal (LSB)
20	G1	GREEN data signal
21	G2	GREEN data signal
22	GND	Signal ground
23	G3	GREEN data signal
24	G4	GREEN data signal
25	G5	GREEN data signal (MSB)
26	GND	Signal ground
27	GND	Signal ground
28	GND	Signal ground
29	B0	BLUE data signal (LSB)
30	B1	BLUE data signal
31	B2	BLUE data signal
32	GND	Signal ground
33	B3	BLUE data signal
34	B4	BLUE data signal
35	B5	BLUE data signal (MSB)
36	GND	Signal ground
37	DENA	Deta enable signal (to settle the viewing area)
38	NC	
39	VCC	+3.3V / 5.0V Power supply
40	VCC	+3.3V / 5.0V Power supply
41	TEST	Should be open during operation (for internal test only)

*The shielding case is connected with GND.

CN 2(BACKLIGHT)

Backlight-side connector: BHR-04VS-1 (JST)

Inverter-side connector: SM04(4.0)B-BHS (JST)

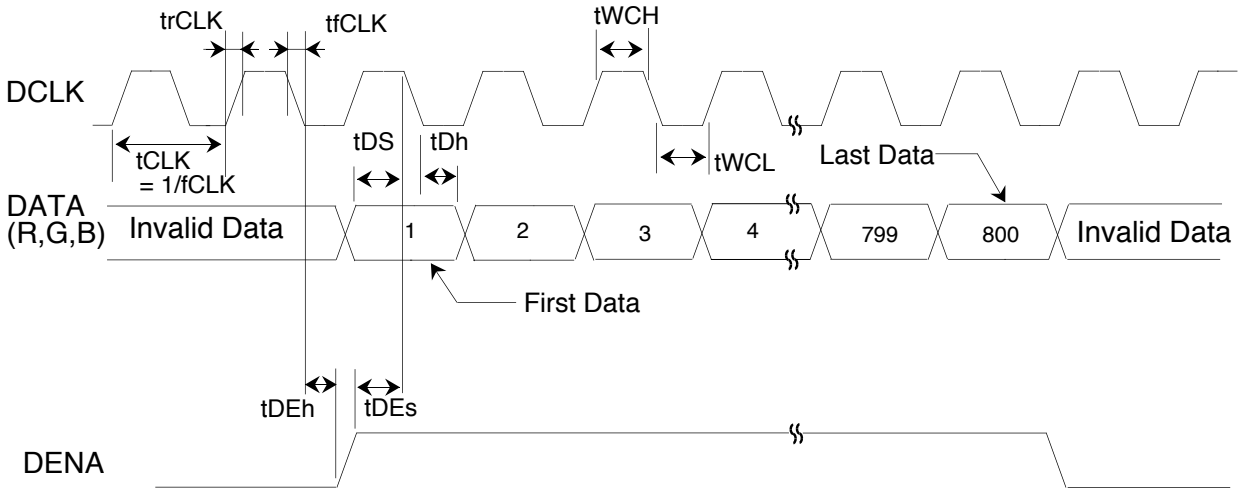
Pin No.	Symbol	Function
1, 2	CTH	VBLH (High voltage)
4	CTL	VBLL (Low voltage)

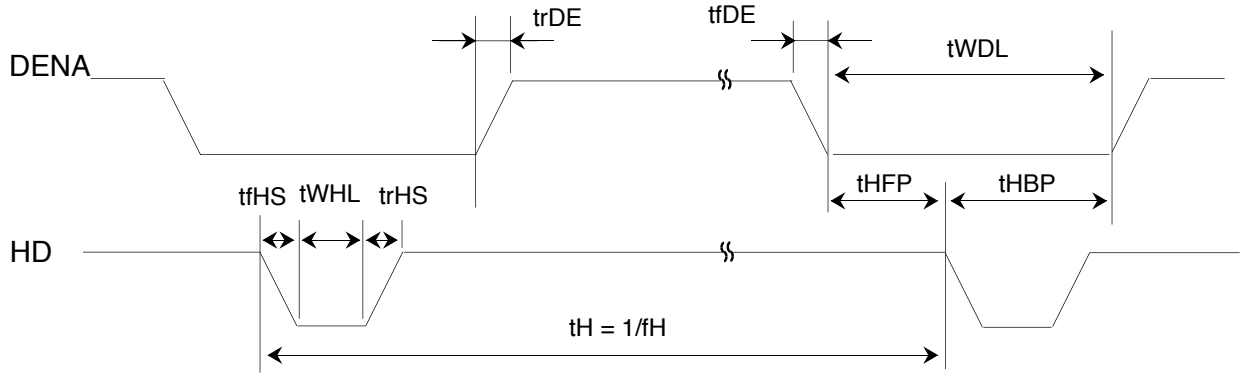
[Note]

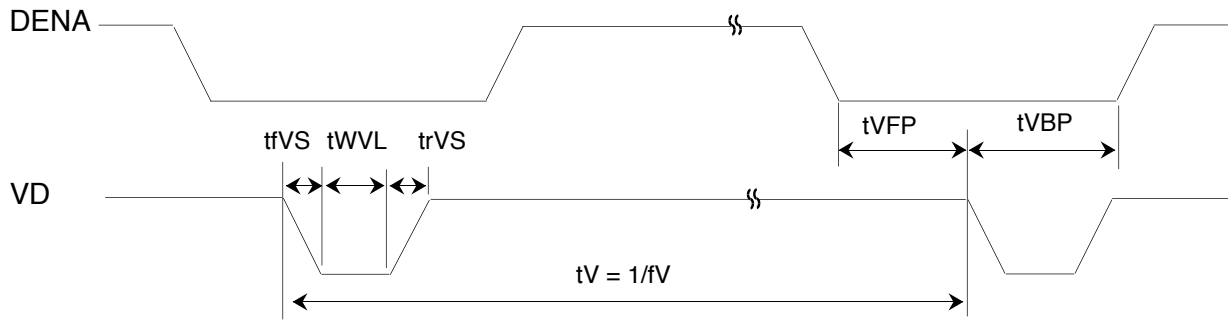
VBLH-VBLL=VL

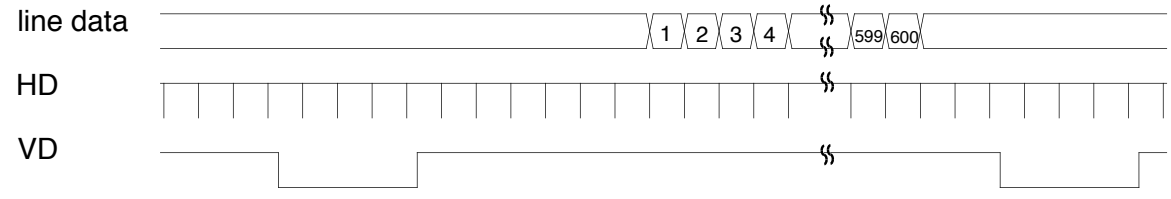
5.INTERFACE TIMING

(a) Timing Chart
(AA121SK01, 02, 03)

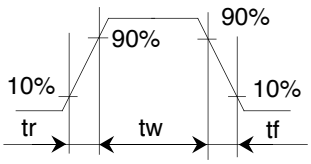




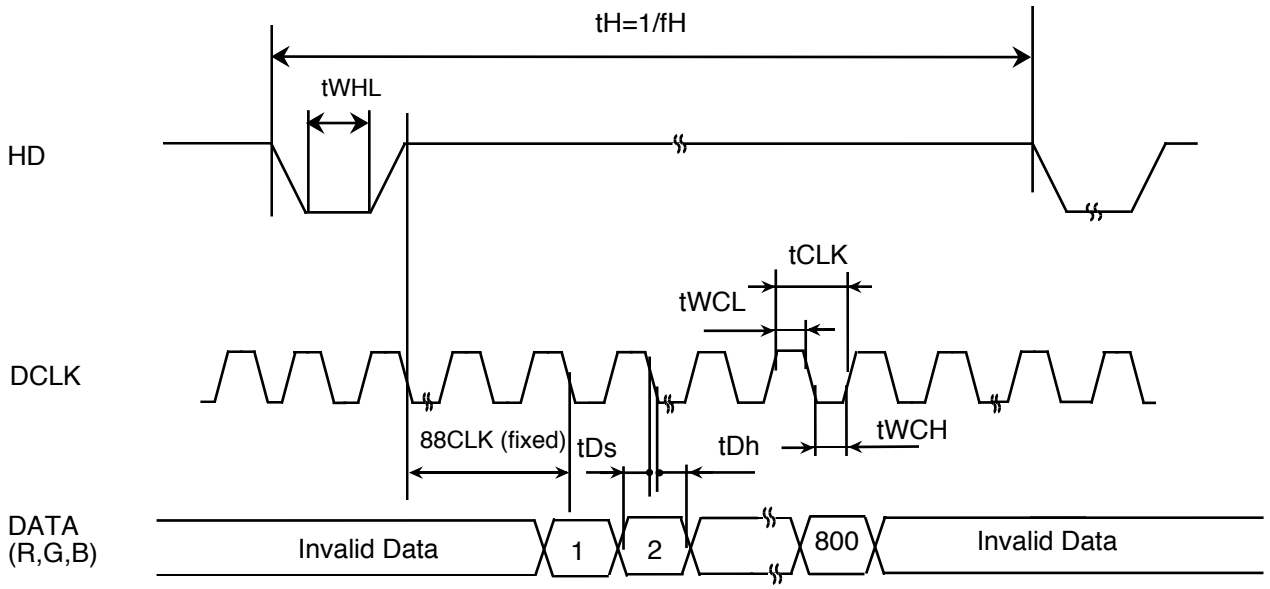


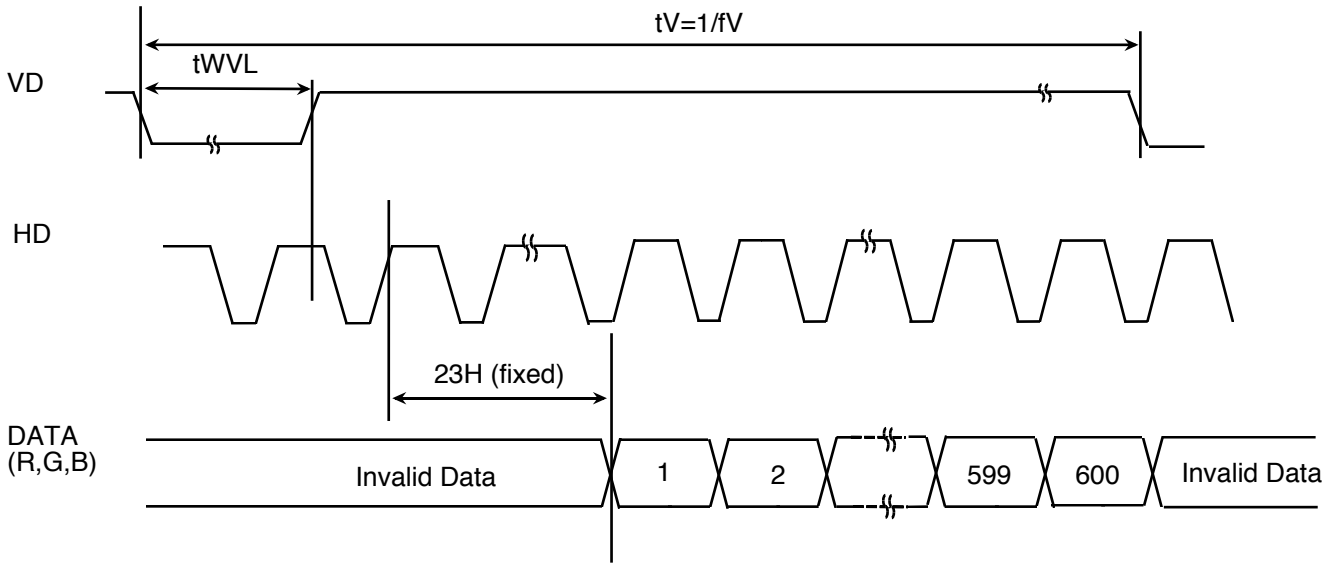


definition of tr / tw / tf

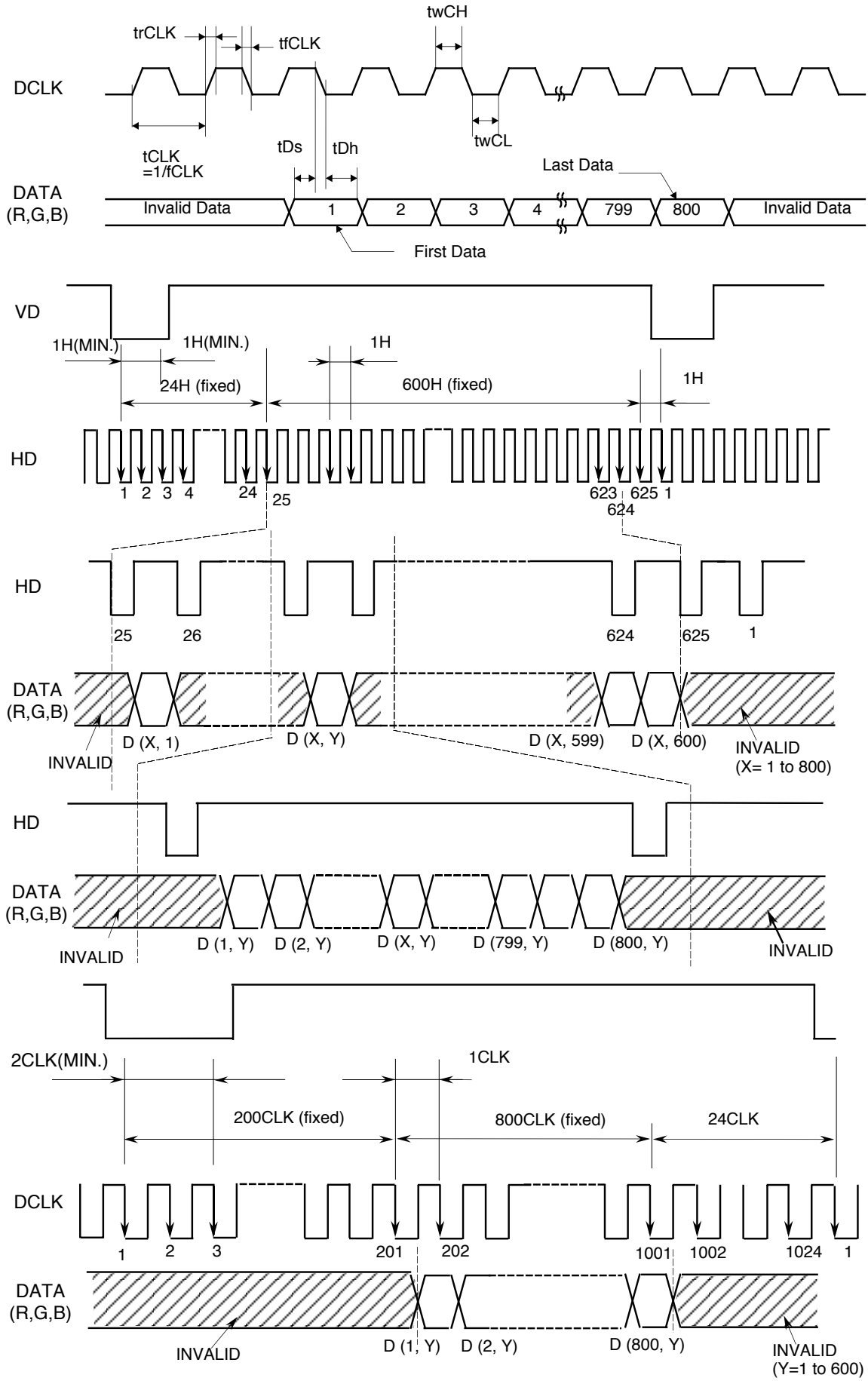


(AA121SK04)


tH=1/fH
tWHL
HD
tCLK
tWCL
DCLK
88CLK (fixed)
tDs
tDh
tWCH
DATA
(R,G,B)
Invalid Data
1
2
800
Invalid Data


tV=1/fV
tWVL
VD
HD
23H (fixed)
DATA
(R,G,B)
Invalid Data
1
2
599
600
Invalid Data

(AA121SK05)


DCLK
trCLK
tfCLK
twCH
twCL
tCLK
=1/fCLK
tDs
tDh
DATA
(R,G,B)
Invalid Data
1
2
3
4
799
800
Invalid Data
Last Data
First Data
VD
1H(MIN.)
1H(MIN.)
1H
24H (fixed)
600H (fixed)
1H
HD
1 2 3 4
24
25
623
625 1
624
HD
25
26
624
625
1
DATA
(R,G,B)
INVALID
D (X, 1)
D (X, Y)
D (X, 599)
D (X, 600)
INVALID
(X= 1 to 800)
HD
DATA
(R,G,B)
INVALID
D (1, Y)
D (2, Y)
D (X, Y)
D (799, Y)
D (800, Y)
INVALID
2CLK(MIN.)
1CLK
200CLK (fixed)
800CLK (fixed)
24CLK
DCLK
1
2
3
201
202
1001
1002
1024
1
DATA
(R,G,B)
INVALID
D (1, Y)
D (2, Y)
D (800, Y)
INVALID
(Y=1 to 600)

(b) Timing Specifications

ITEM		SYMBOL	MIN	TYP	MAX	UNIT
DCLK	Frequency	fCLK	(35)	--	(40)	MHz
	Period	tCLK	(25)	--	(27.8)	ns
	Width-Low	tWCL	(10)	--	--	ns
	Width-High	tWCH	(10)	--	--	ns
	Rise Time	trCLK	--	--	(10)	ns
	Fall Time	tfCLK	--	--	(10)	ns
DATA (R,G,B)	Set up Time	tDs	(5)	--	--	ns
	Hold Time	tDh	(5)	--	--	ns
DENA *3)	Set up Time	tDEs	(5)	--	--	ns
	Hold Time	tDEh	(5)	--	--	ns
	Low Period	tWDL	(10)	--	--	tclk
	Rise Time	trDE	--	--	(10)	ns
	Fall Time	tfDE	--	--	(10)	ns
	Horizontal Front Porch	tHFP	(0)	--	--	tclk
	Horizontal Back Porch	tHBP	(10)	--	--	tclk
	Vertical Front Porch	tVFP	(1)	15	--	tH
	Vertical Back Porch	tVBP	(10)	15	--	tH
HD	Frequency	fH	--	37.8	(39.2)	kHz
	Period	tH	(960)	1056	(1068)	tclk
	Width-Low	tWHL	(5)	--	--	tclk
	Rise Time	trHS	--	--	(10)	ns
	Fall Time	tfHS	--	--	(10)	ns
VD	Frequency	fV	(55)	60.2	(64.2)	Hz
	Period	tV	(611)	628	(713)	tH
	Width-Low	tWVL	(5)	--	--	tH
	Rise Time	trVS	--	--	(10)	ns
	Fall Time	tfVS	--	--	(10)	ns

[Note]

1) DATA is latched at fall edge of DCLK in this specification.
2) Polarities of HD and VD are negative in this specification.
3) DENA (Data Enable) should always be positive polarity as shown in the timing specification.
4) DCLK should appear during all invalid period, and HD should appear during invalid period of frame cycle.

(c) Color Data Assignment

COLOR	INPUT DATA	R DATA						G DATA						B DATA					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
		MSB					LSB	MSB					LSB	MSB					LSB
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	BLUE(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	CYAN	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	MAGENTA	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	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
RED	RED(0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(1)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	RED(2)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN(0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN(1)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	GREEN(2)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	GREEN(62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	GREEN(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
BLUE	BLUE(0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BLUE(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	BLUE(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	BLUE(62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	BLUE(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

[Note]

1) Definition of gray scale

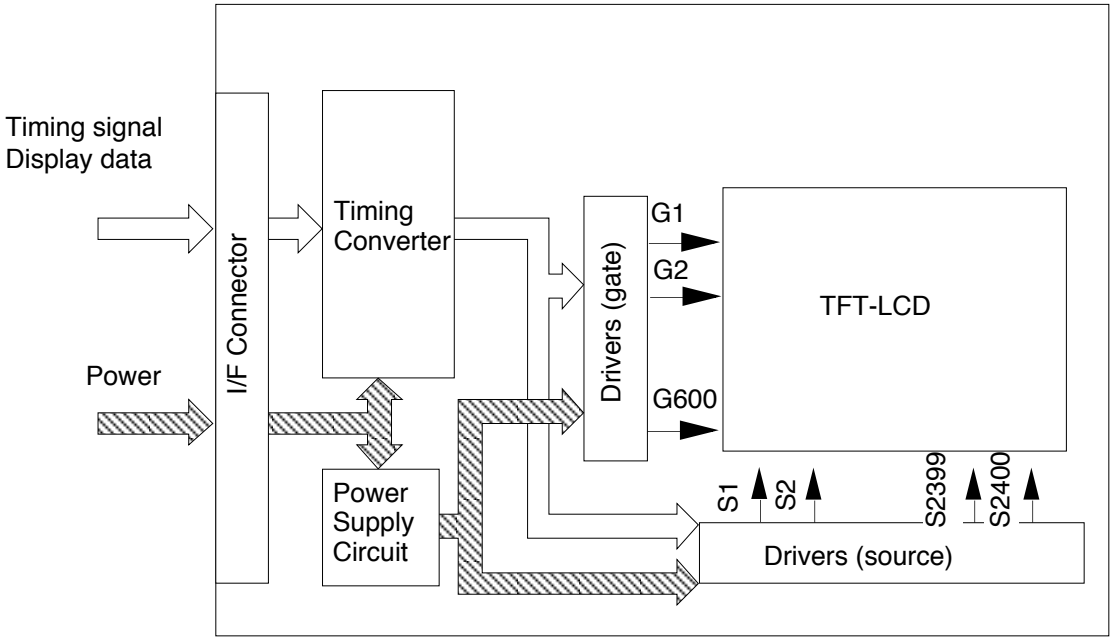
Color (n)--- n indicates gray scale level.

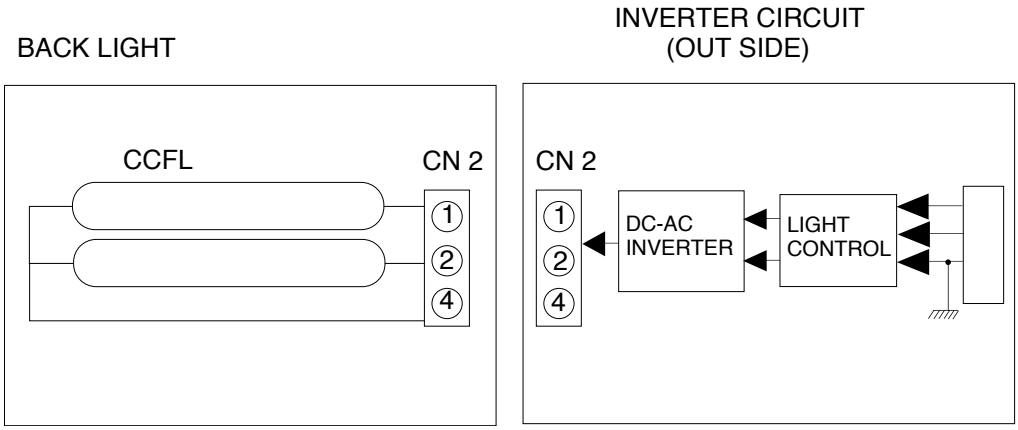
Higher n means brighter level.

2) Data

1: High, 0:Low

6.BLOCK DIAGRAM

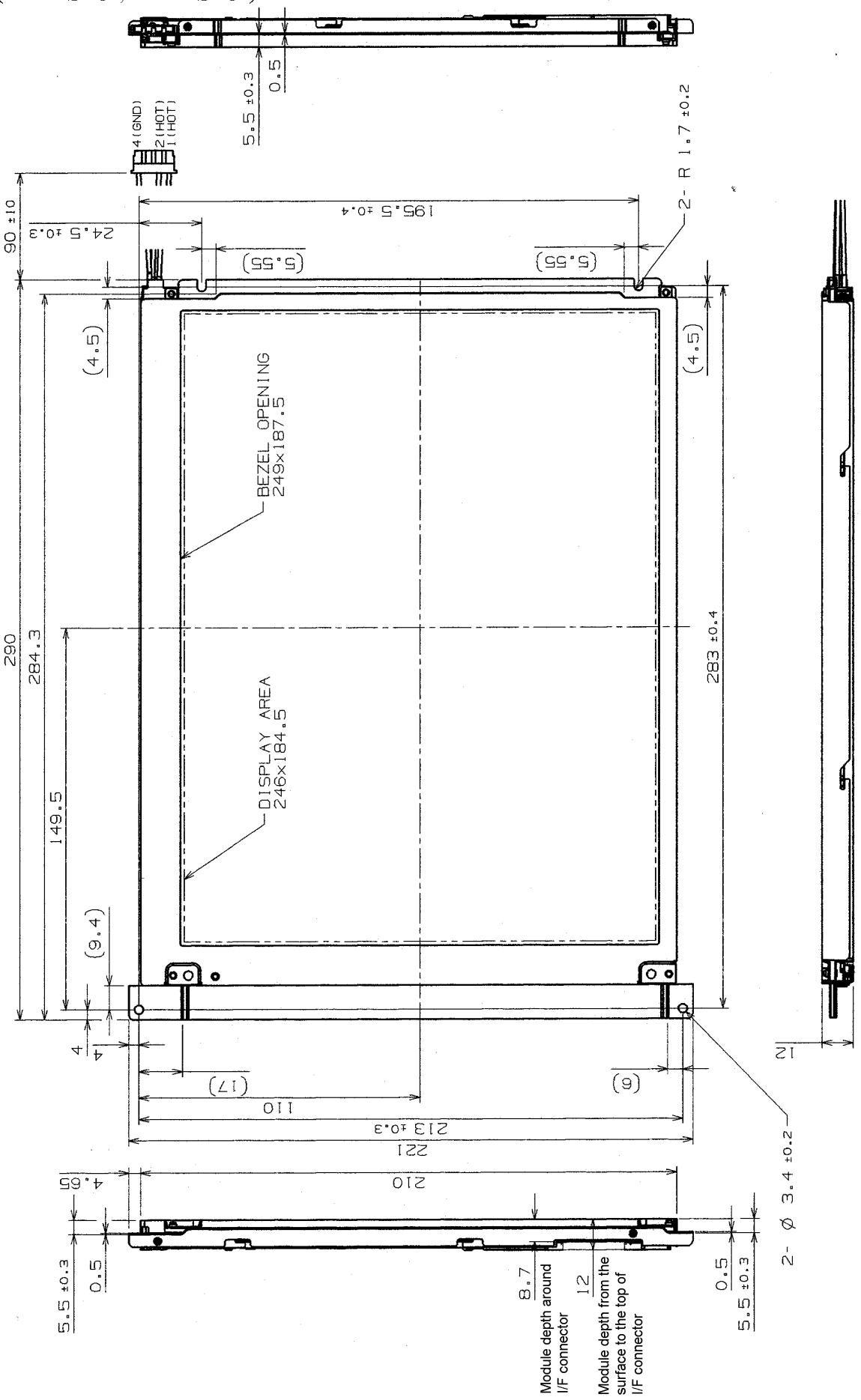




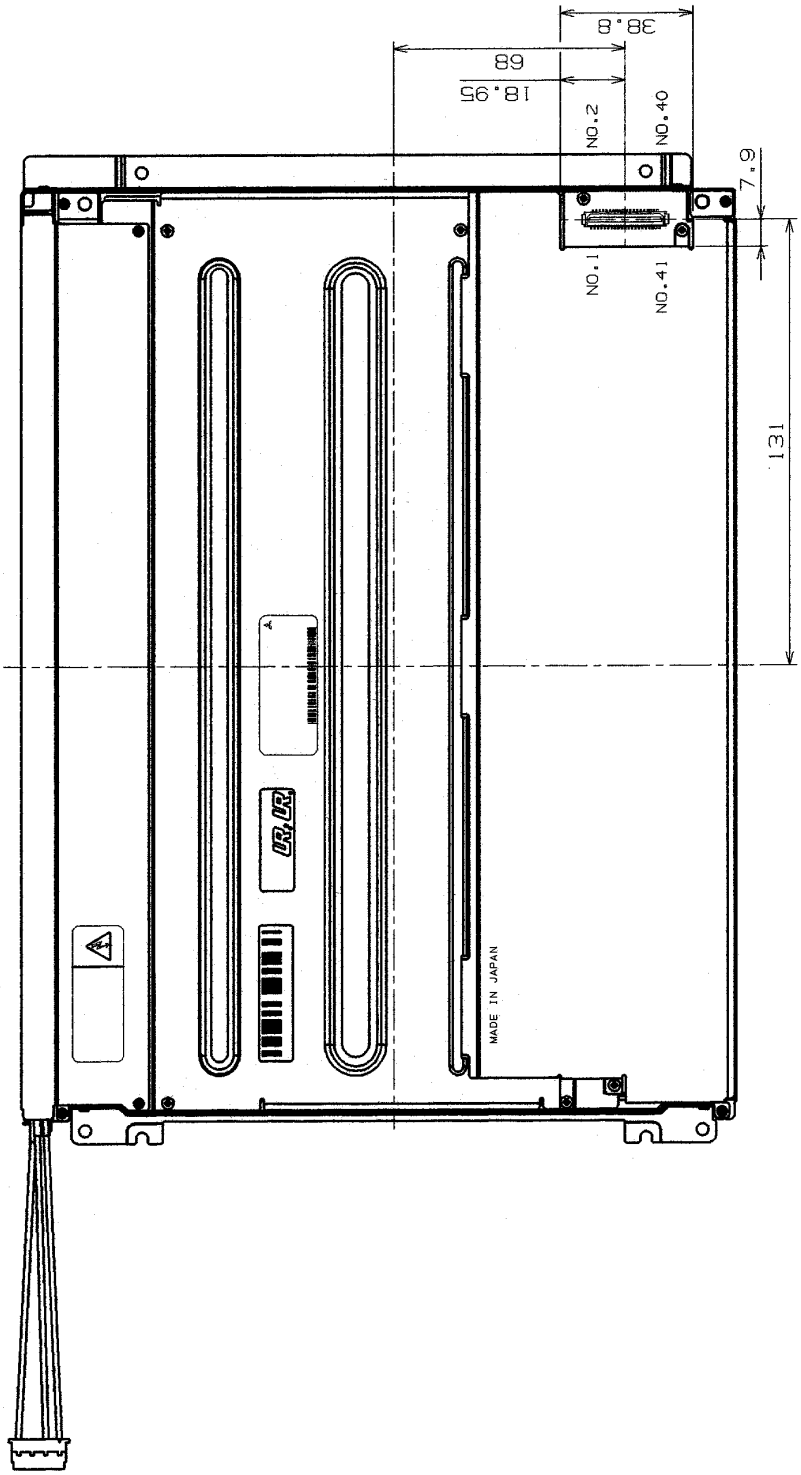
7. MECHANICAL SPECIFICATION

(a) Front side

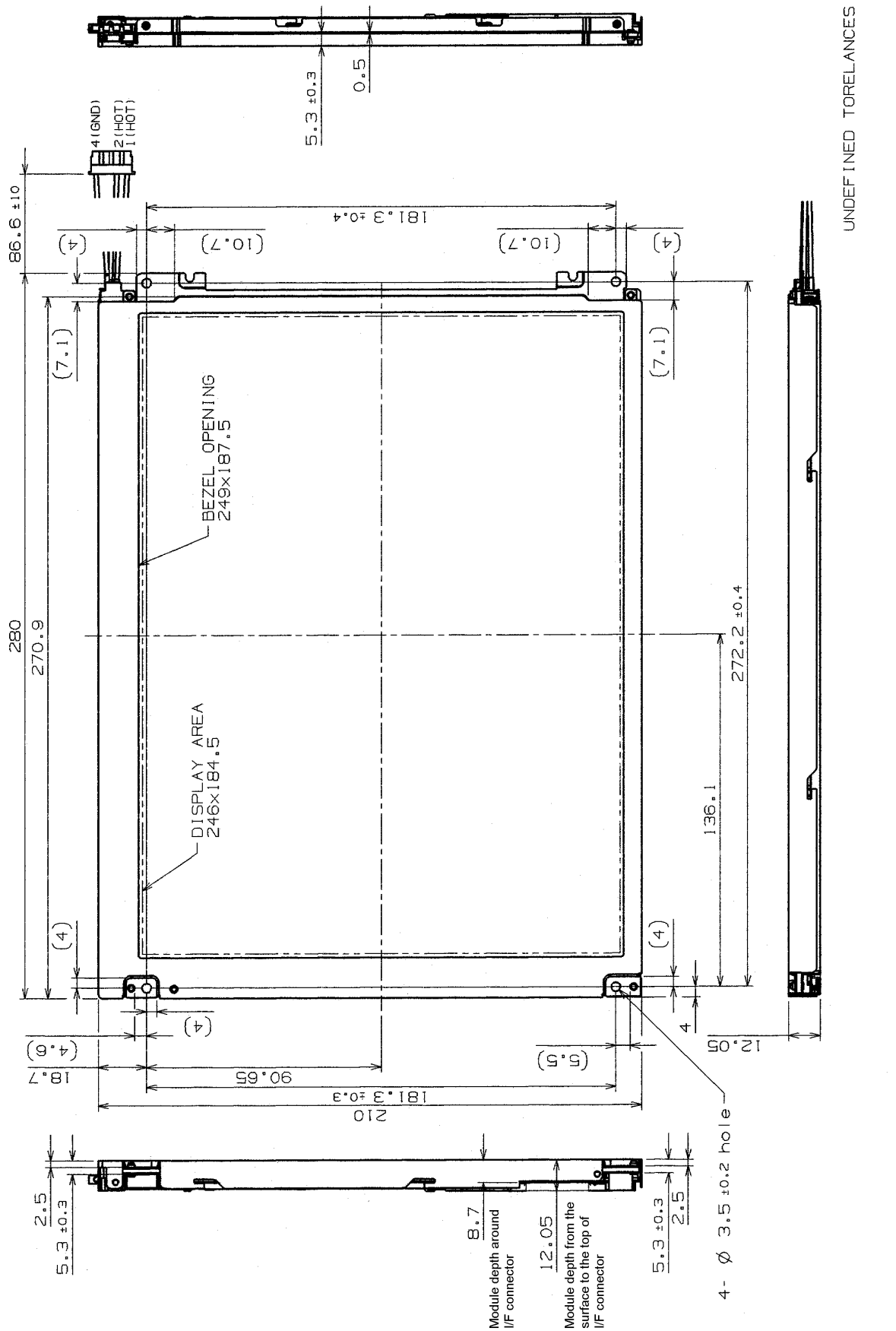
(AA121SK01, AA121SK04)



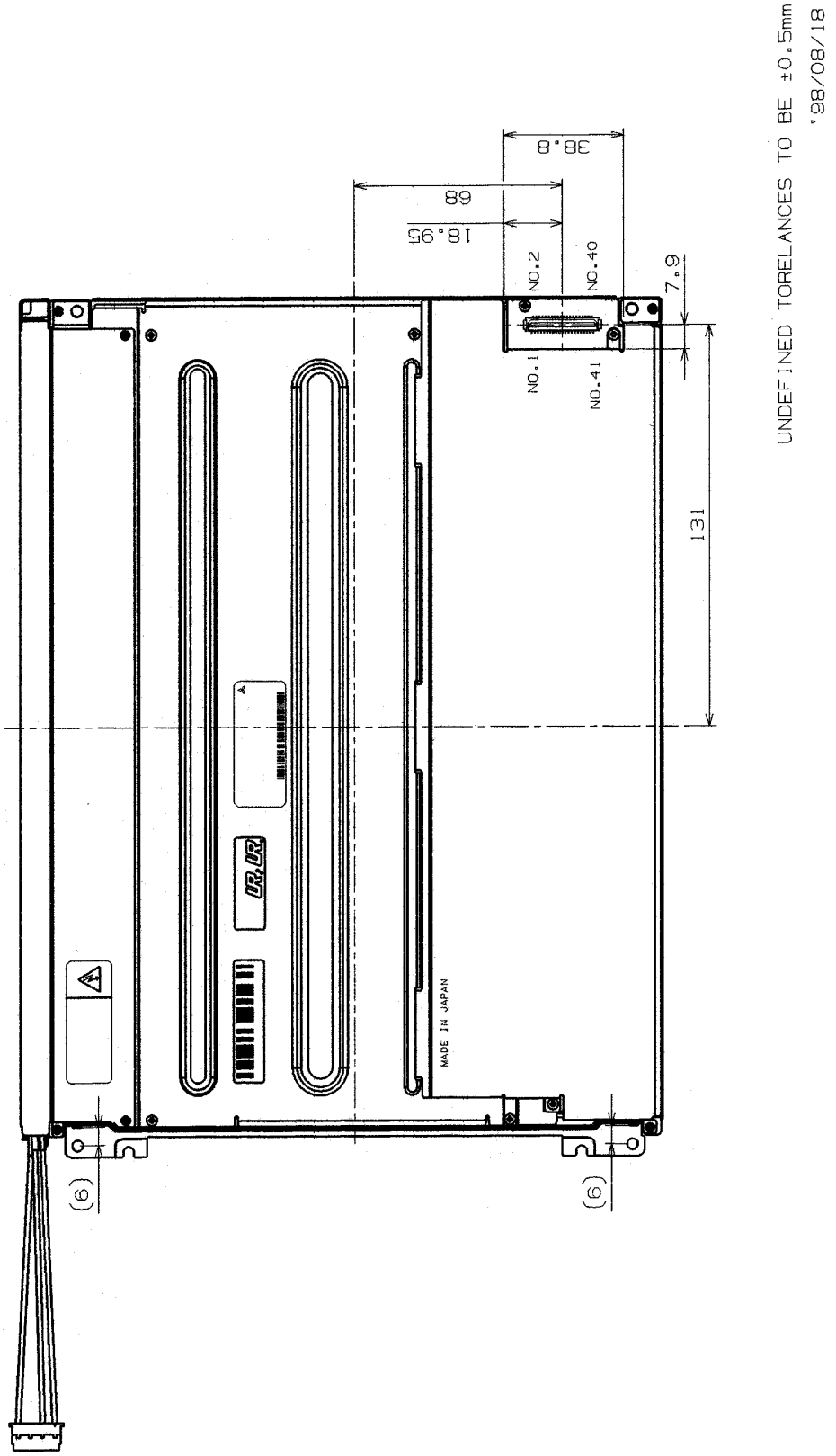
(b) Rear side
(AA121SK01, AA121SK04)



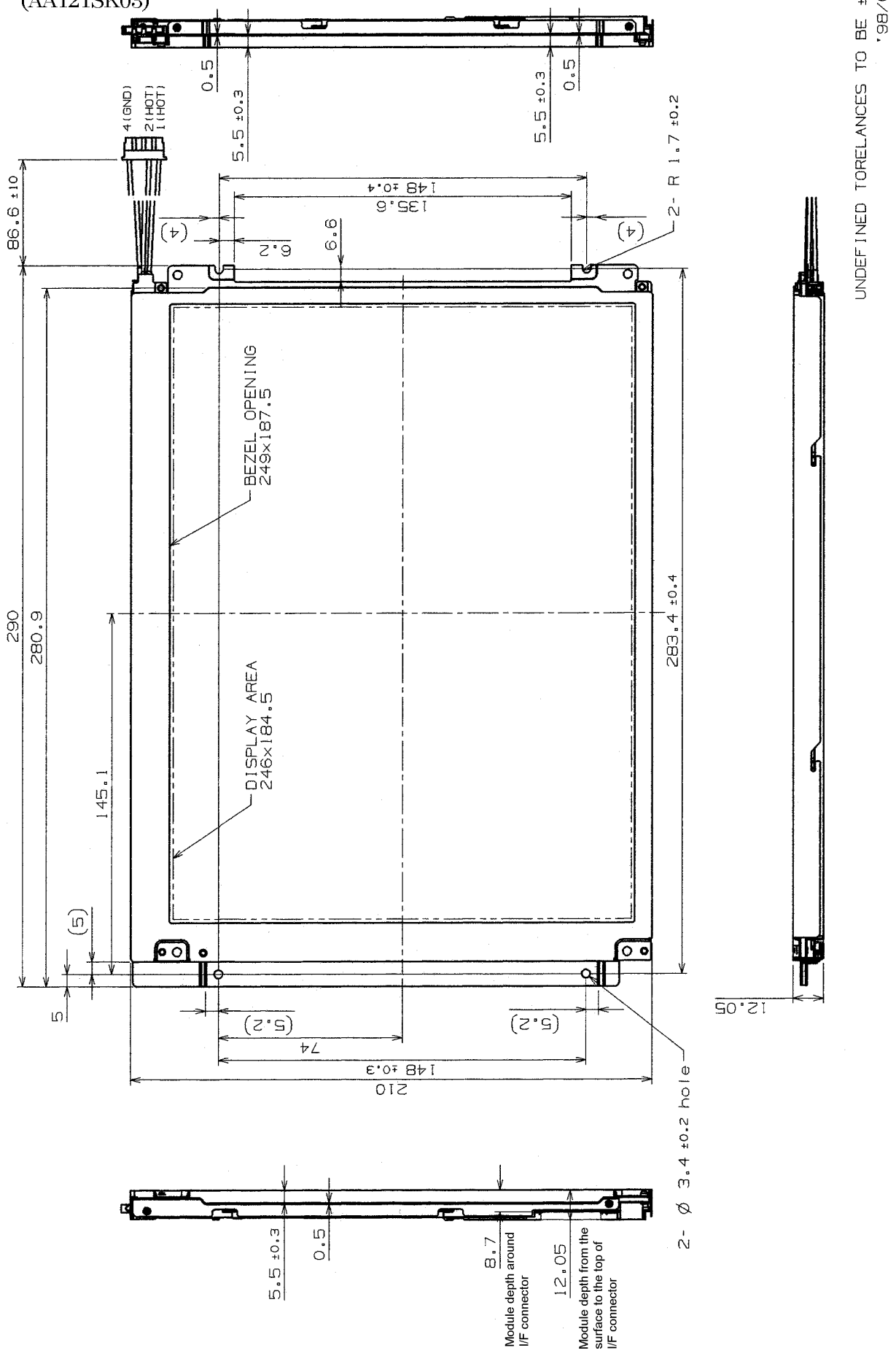
(c) Front side
(AA121SK02, AA121SK05)



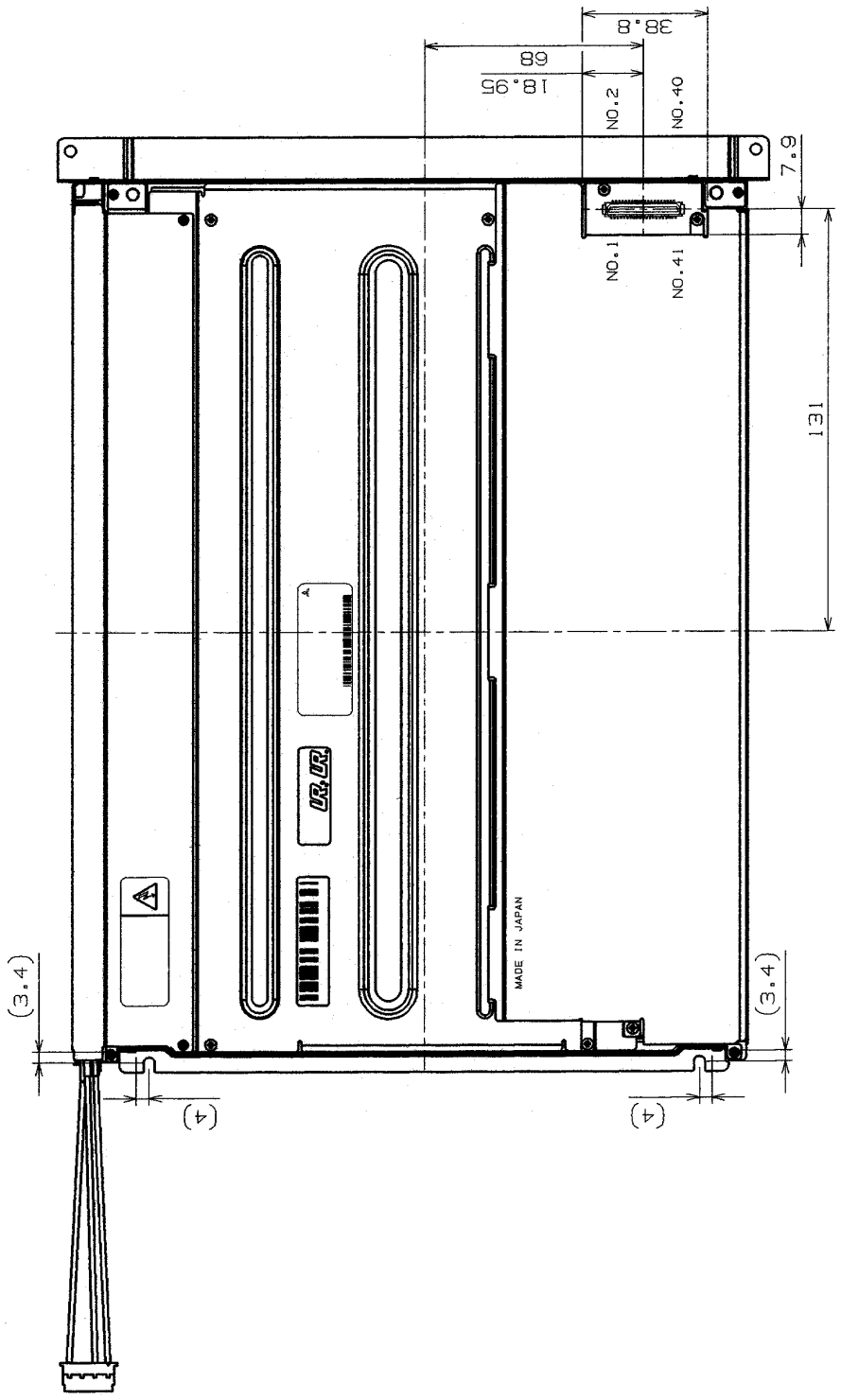
(d) Rear side
(AA121SK02, AA121SK05)



(e) Front side
(AA121SK03)



(f) Rear side
(AA121SK03)



UNDEFINED TORELANCES TO BE±0.5mm

'98/08/18

8.OPTICAL CHARACTERISTICS

Ta=25°C VCC=3.3V / 5.0V

ITEM		SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Contrast Ratio		CR	θ = ϕ = 0°	--	200	--	--
Luminance *1)		L	θ = ϕ = 0°	--	(300)	--	cd/m^2
Response Time		tr	θ = ϕ = 0°	--	20	--	ms
		tf	θ = ϕ = 0°	--	30	--	ms
Viewing	Horizontal	ϕ	CR ≥ 10	--	-60 ~ 60	--	°
Angle	Vertical	θ		--	-50 ~ 40	--	°
Color Coordinates	Red	x	θ = ϕ = 0°	--	(0.58)	--	--
		y		--	(0.35)	--	
	Green	x		--	(0.34)	--	
		y		--	(0.55)	--	
	Blue	x		--	(0.18)	--	
		y		--	(0.20)	--	
	White	x		--	(0.35)	--	
		y		--	(0.38)	--	

[Note]

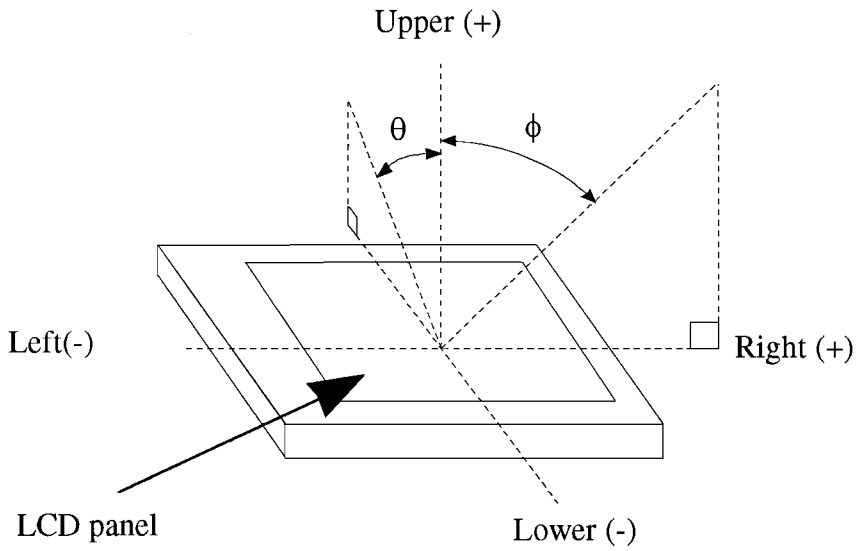
These items are measured using BM-5A (TOPCON) or LCD-7000 (Otsuka Electronic) under the dark room condition (no ambient light).

*1); Condition: IL= 5.0 mA

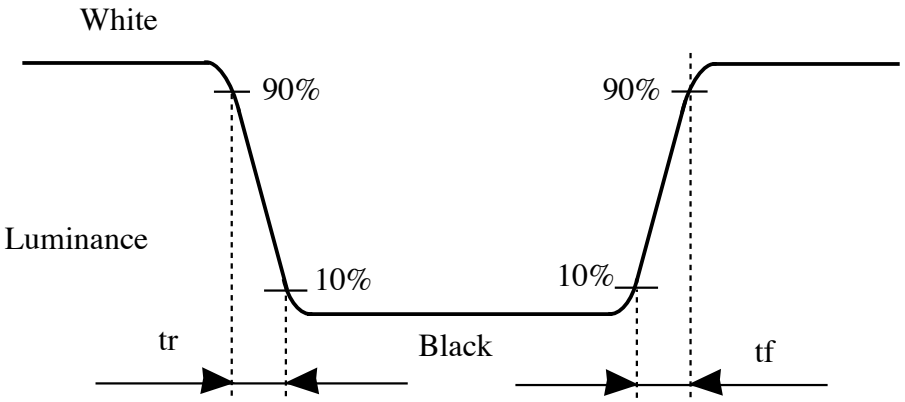
Definition of these measurement items are as follows:

1) Definition of Contrast Ratio
CR=ON (White) luminance / OFF(Black) Luminance

2) Definition of Viewing Angle (θ , ϕ)



3) Definition of Response Time



9. RELIABILITY TEST CONDITIONS

(1) Temperature and Humidity

TEST ITEMS	CONDITIONS
HIGH TEMPERATURE HIGH HUMIDITY OPERATION	40°C, 90%RH, 500 h
HIGH TEMPERATURE HIGH HUMIDITY STORAGE	60°C, 90%RH, 96 h
LOW TEMPERATURE STORAGE	-20°C, 96 h
THERMAL SHOCK	BETWEEN -20°C (1h) AND 60°C(1h), 5 CYCLES

(2) Shock & Vibration

ITEMS	CONDITIONS
SHOCK (NON-OPERATION)	Shock level: T.B.D. Waveform: half sinusoidal wave, 2ms Number of shocks: one shock input in each direction of three mutually perpendicular axes for a total of six shock inputs
VIBRATION (NON-OPERATION)	Vibration level: T.B.D. zero to peak Waveform: sinusoidal Frequency range: 5 to 500 Hz Frequency sweep rate: 0.5 octave /min Duration: one sweep from 5 to 500 to 5 Hz in each of three mutually perpendicular axis (each x, y, z axis: 1 hour, total 3 hours)

(3) Judgment standard

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

Pass: Normal display image with no obvious non-uniformity and no line defect.
Partial transformation of the module parts should be ignored.

Fail: No display image, obvious non-uniformity, or line defects.

10. HANDLING PRECAUTIONS FOR TFT-LCD MODULE

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

1 ASSEMBLY PRECAUTION

(1)Please use the mounting hole on the module corners in installing and do not bending or wrenching LCD in assembling. And please do not drop, bend or twist LCD module in handling.

(2)Please design display housing in accordance with the following guide lines.

(2 - 1)Housing case must be designed carefully so as not to put stresses on LCD all sides and not to wrench module. The stresses may cause non-uniformity even if there is no non-uniformity statically.

(2 - 2)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.

(2 - 3)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.

(2 - 4)Design the inverter location and connector position carefully so as not to give stress to lamp cable, or not to interface the LCD module by the lamp cable.

(2 - 5)Keep sufficient clearance between LCD module and the others parts, such as inverter and speaker so as not to interface the LCD module. Approximately 1.0mm of the clearance in the design is recommended.

(3)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.)

(4)Please do not press any parts on the rear side such as source TCP, gate TCP, control circuit board and FPCs during handling LCD module. If pressing rear part is unavoidable, handle the LCD module with care not to damage them.

(5)Please wipe out LCD panel surface with absorbent cotton or soft cloth in case of it being soiled.

(6)Please wipe out drops of adhesives like saliva and water on LCD panel surface immediately. They might damage to cause panel surface variation and color change.

(7)Please do not take a LCD module to pieces and reconstruct it. Resolving and reconstructing modules may cause them not to work well.

(8)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.

(9)Please pay attention to handling lead wire of backlight so that it is not tugged in connecting with inverter.

2 OPERATING PRECAUTIONS

(1) Please be sure to turn off the power supply before connecting and disconnecting signal input cable.
(2) 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.
(3) Please consider that LCD backlight takes longer time to become stable of radiation characteristics in low temperature than in room temperature.
(4) A condensation might happen on the surface and inside of LCD module in case of sudden change of ambient temperature.
(5) Please pay attention to displaying the same pattern for very long time. Image might stick on LCD. If then, time going on can make LCD work well.
(6) Please obey the same caution descriptions as ones that need to pay attention to ordinary electronic parts.

3 PRECAUTIONS WITH ELECTROSTATICS

(1) This LCD module use CMOS-IC on circuit board and 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.
(2) Please remove protection film very slowly on the surface of LCD module to prevent from electrostatics occurrence.

4 STORAGE PRECAUTIONS

(1) When you store LCDs for a long time, it is recommended to keep the temperature between 0°C~40°C without the exposure of sunlight and to keep the humidity less than 90%RH.
(2) Please do not leave the LCDs in the environment of high humidity and high temperature such as 60°C90%RH.
(3) Please do not leave the LCDs in the environment of low temperature; below -20°C.

5 SAFETY PRECAUTIONS

(1) When you waste LCDs, it is recommended to crush damaged or unnecessary LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.
(2) If any liquid leaks out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

6 OTHERS

(1) A strong incident light into LCD panel might cause display characteristics changing inferior because of polarizer film, color filter, and other materials becoming inferior. Please do not expose LCD module direct sunlight and strong UV rays.

(2) Please pay attention to a panel side of LCD module not to contact with other materials in preserving it alone.

(3) For the packaging box, please pay attention to the followings;

(3 - 1) Packaging box and inner case for LCD are designed to protect the LCDs from the damage or scratching during transportation. Please do not open except picking LCDs up from the box.

(3 - 2) Please do not pile them up more than 5 boxes. (They are not designed so.) And please do not turn over.

(3 - 3) Please handle packaging box with care not to give them sudden shock and vibrations. And also please do not throw them up.

(3 - 4) Packaging box and inner case for LCDs are made of cardboard. So please pay attention not to get them wet. (Such like keeping them in high humidity or wet place can occur getting them wet.)