SHARP

No.	**LD-18954B**
DATE	Jan.16. 2007

TECHNICAL LITERATURE

FOR

TFT - LCD module

MODEL No. LK520D3LZ1x

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DEVELOPMENT DEPT. Ⅰ, Ⅱ
DEVELOPMENT CENTER
AVC LIQUID CRYSTAL DISPLAY GROUP
SHARP CORPORATION

RECORDS OF REVISION

LK520D3LZ1x

SPEC No.	DATE	REVISED No.	PAGE	SUMMARY	NOTE
LD-18954	Sep.15.2006	-	-	-	1st. Issue
	Oct.20.2006	A	2	Changed the unit outline dimensions	2nd. Issue
			16	Added the chromaticity value Changed the luminance value of white	
	Jan.16. 2007	B	1	Changed the display colors	3rd. Issue
			3,5,6,7,11 12,15	Changed input signals (8bit -> 10bit)	
			9	Changed CN103 (Pin No.11) function	
			20	Changed of reliability test (shock test)	
			23	Changed of outline dimensions (CN1,2 position, user holes)	

1. Application

This technical literature applies to the color 52.0” TFT-LCD module LK520D3LZ1x.

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* This module is not designed to use in dusty environment and to prevent image retention caused by long-term display of fixed pattern. So please consider items mentioned above before use and design equipment.

* In case of using the device for applications such as control and safety equipment for transportation (aircraft, trains, automobiles, etc.), rescue and security equipment and various safety related equipment which require higher reliability and safety, take into consideration that appropriate measures such as fail-safe functions and redundant system design should be taken.

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2. Overview ▲B

This module is a color active matrix LCD module incorporating amorphous silicon TFT (Thin Film Transistor). It is composed of a color TFT-LCD panel, driver ICs, control circuit, power supply circuit, inverter circuit and back light system etc. Graphics and texts can be displayed on a 1920×RGB×1080 dots panel with TBD colors by using LVDS (Low Voltage Differential Signaling) to interface, +12V of DC supply voltages.

This module also includes the DC/AC inverter to drive the CCFT. (+24V of DC supply voltage)

And in order to improve the response time of LCD, this module applies the Over Shoot driving (O/S driving) technology for the control circuit .In the O/S driving technology, signals are being applied to the Liquid Crystal according to a pre-fixed process as an image signal of the present frame when a difference is found between image signal of the previous frame and that of the current frame after comparing them.

And this LCD module adopts IP1 driving.

With these technologies, image signals can be set so that liquid crystal response completes within one frame. As a result, motion blur reduces and clearer display performance can be realized.

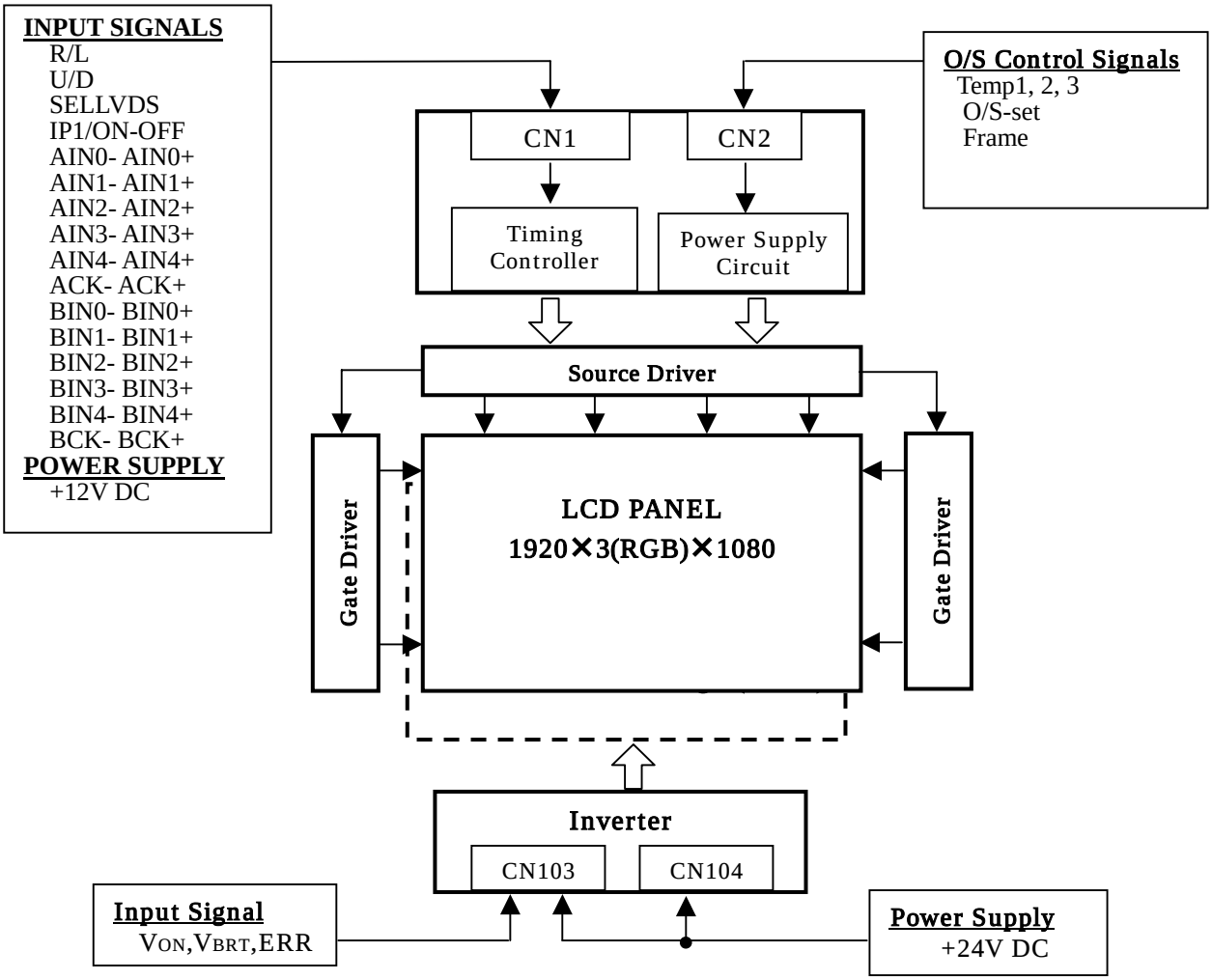
3. Mechanical Specifications

Parameter	Specifications	Unit
Display size	132.174 （Diagonal）	cm
	52.0 （Diagonal）	inch
Active area	1152.0(H) x 648.0(V)	mm
Pixel Format	1920(H) x 1080(V) （1pixel = R + G + B dot）	pixel
Pixel pitch	0.600(H) x 0.600(V)	mm
Pixel configuration	R, G, B vertical stripe	
Display mode	Normally black ▲A	
Unit Outline Dimensions (*1)	1219.0(W) x 706.7(H) x (64.6)(D)	mm
Mass	(21.0) ± 1.0	kg
Surface treatment	Anti glare, low reflection coating Hard coating: 2H	

(*1) Outline dimensions are shown in Fig.1 (excluding protruding portion)

4. Input Terminals ▲B

4.1. Block Diagram



4.2. TFT panel driving

CN1 (Interface signals and +12V DC power supply) (Shown in Fig.1)

Using connector : FI-RE51S-HF (Japan Aviation Electronics Ind. , Ltd.)

Mating connector :FI-RE51HL, FI-RE51CL (Japan Aviation Electronics Ind. , Ltd.)

Mating LVDS transmitter :THC63LVD1023 or equivalent device

Pin No.	Symbol	Function	Remark
1	Reserved	Open	
2	TEST	Fix to Low level or open usually.	
3	TEST	Fix to Low level or open usually.	
4	Reserved	Open	
5	R/L	Horizontal shift direction [Note1]	Pull down : (GND)
6	U/D	Vertical shift direction [Note1]	Pull down : (GND)
7	SELLVDS	Select LVDS data order [Note3]	Pull up : (3.3V)
8	IP1/ON_OFF	IP1 function control [Note 2]	Pull down : (GND)
9	Reserved	Open	
10	Reserved	Open	
11	GND		
12	AIN0-	Aport (-)LVDS CH0 differential data input	
13	AIN0+	Aport (+)LVDS CH0 differential data input	
14	AIN1-	Aport (-)LVDS CH1 differential data input	
15	AIN1+	Aport (+)LVDS CH1 differential data input	
16	AIN2-	Aport (-)LVDS CH2 differential data input	
17	AIN2+	Aport (+)LVDS CH2 differential data input	
18	GND		
19	ACK-	Aport LVDS Clock signal(-)	
20	ACK+	Aport LVDS Clock signal(+)	
21	GND		
22	AIN3-	Aport (-)LVDS CH3 differential data input	
23	AIN3+	Aport (+)LVDS CH3 differential data input	
24	AIN4-	Aport (-)LVDS CH4 differential data input	▲B
25	AIN4+	Aport (+)LVDS CH4 differential data input	
26	GND		
27	GND		
28	BIN0-	Bport (-)LVDS CH0 differential data input	
29	BIN0+	Bport (+)LVDS CH0 differential data input	
30	BIN1-	Bport (-)LVDS CH1 differential data input	
31	BIN1+	Bport (+)LVDS CH1 differential data input	
32	BIN2-	Bport (-)LVDS CH2 differential data input	
33	BIN2+	Bport (+)LVDS CH2 differential data input	
34	GND		
35	BCK-	Bport LVDS Clock signal(-)	
36	BCK+	Bport LVDS Clock signal(+)	
37	GND		
38	BIN3-	Bport (-)LVDS CH3 differential data input	
39	BIN3+	Bport (+)LVDS CH3 differential data input	
40	BIN4-	Bport (-)LVDS CH4 differential data input	
41	BIN4+	Bport (+)LVDS CH4 differential data input	▲B
42	GND		
43	GND		
44	GND		
45	GND		
46	GND		
47	VCC	+12V Power Supply	

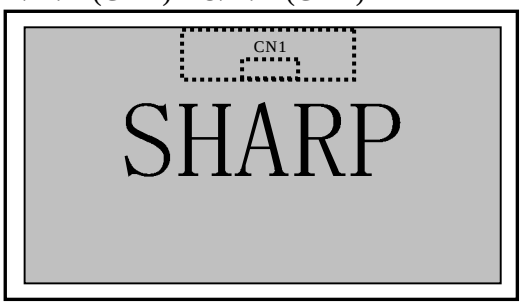
48	VCC	+12V Power Supply	
49	VCC	+12V Power Supply	
50	VCC	+12V Power Supply	
51	VCC	+12V Power Supply	

[Note]GND of a liquid crystal panel drive part has connected with a module chassis.

[Note 1]Display reversal function

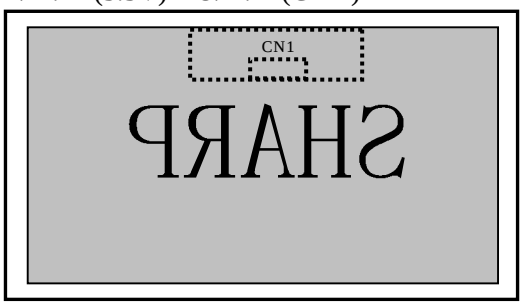
Normal (Default)

R/L : L (GND) U/D: L (GND)



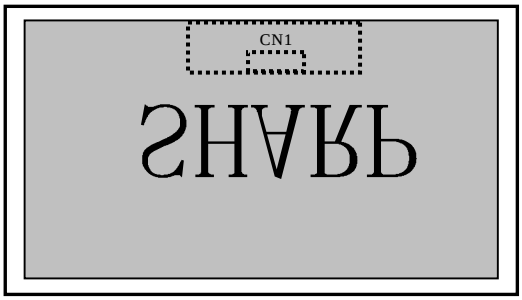
Horizontal reverse image

R/L : H (3.3V) U/D: L (GND)



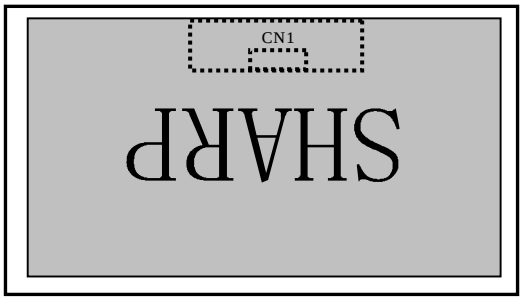
Vertical reverse image

R/L : L (GND) U/D: H (3.3V)



Horizontal and vertical reverse image

R/L : H(3.3V) U/D: H (3.3V)



[Note 2] IP1 function setting

By using this terminal, it is possible to select IP1 function.

Input voltage	function	Remark
0V	IP1 : off	default
3.3V	IP1 : on	

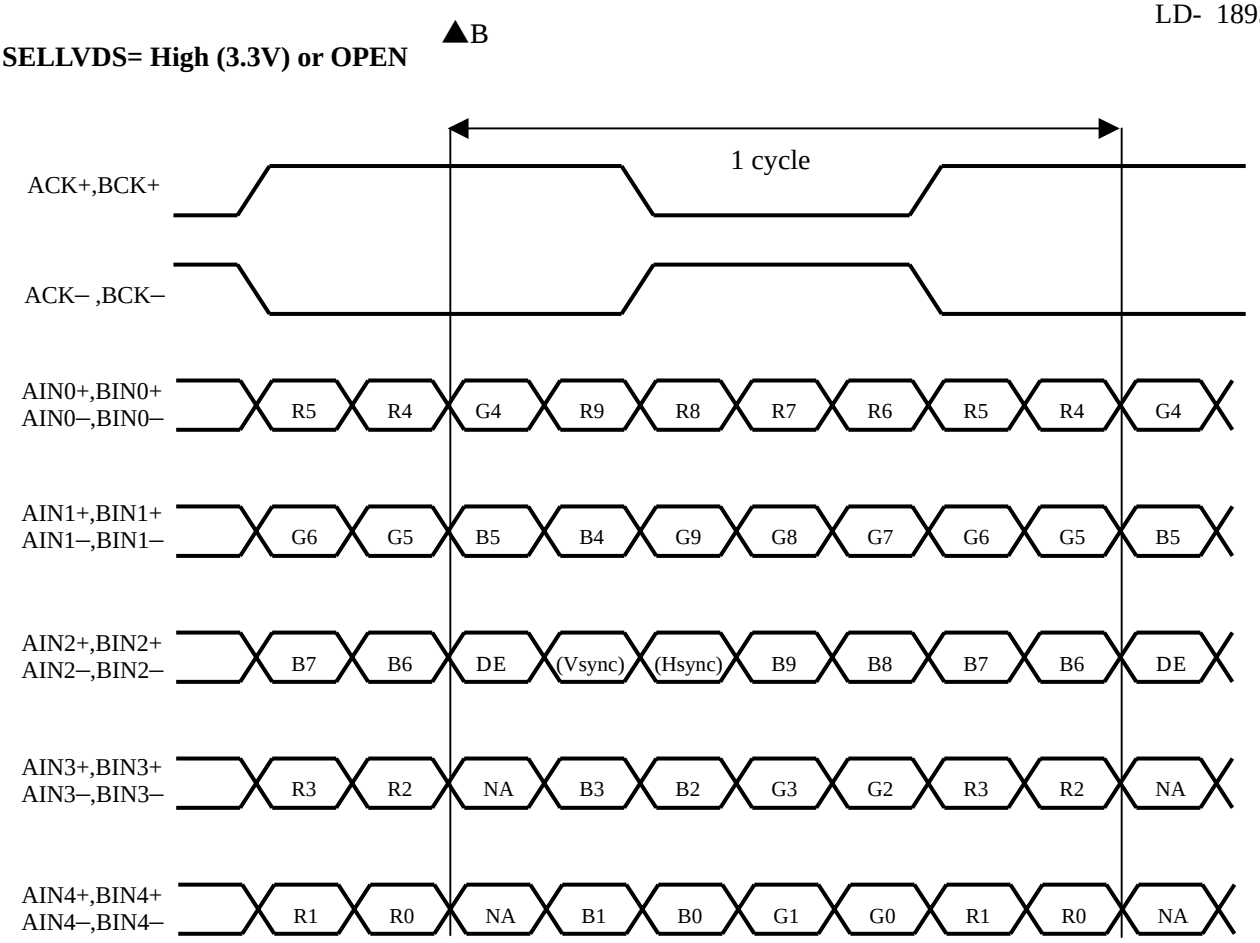
[Note 3] SELLVDS ▲B

SELLVDS		
Data	L(GND)	H(3.3V) or Open
TA0	R2	R4
TA1	R3	R5
TA2	R4	R6
TA3	R5	R7
TA4	R6	R8
TA5	R7	R9(MSB)
TA6	G2	G4
TB0	G3	G5
TB1	G4	G6
TB2	G5	G7
TB3	G6	G8
TB4	G7	G9(MSB)
TB5	B2	B4
TB6	B3	B5
TC0	B4	B6
TC1	B5	B7
TC2	B6	B8
TC3	B7	B9(MSB)
TC4	(HSYNC)	(HSYNC)
TC5	(VSYNC)	(VSYNC)
TC6	DE(*)	DE(*)
TD0	R8	R2
TD1	R9(MSB)	R3
TD2	G8	G2
TD3	G9(MSB)	G3
TD4	B8	B2
TD5	B9(MSB)	B3
TD6	N/A	N/A
TE0	R0(LSB)	R0(LSB)
TE1	R1	R1
TE2	G0(LSB)	G0(LSB)
TE3	G1	G1
TE4	B0(LSB)	B0(LSB)
TE5	B1	B1
TE6	N/A	N/A

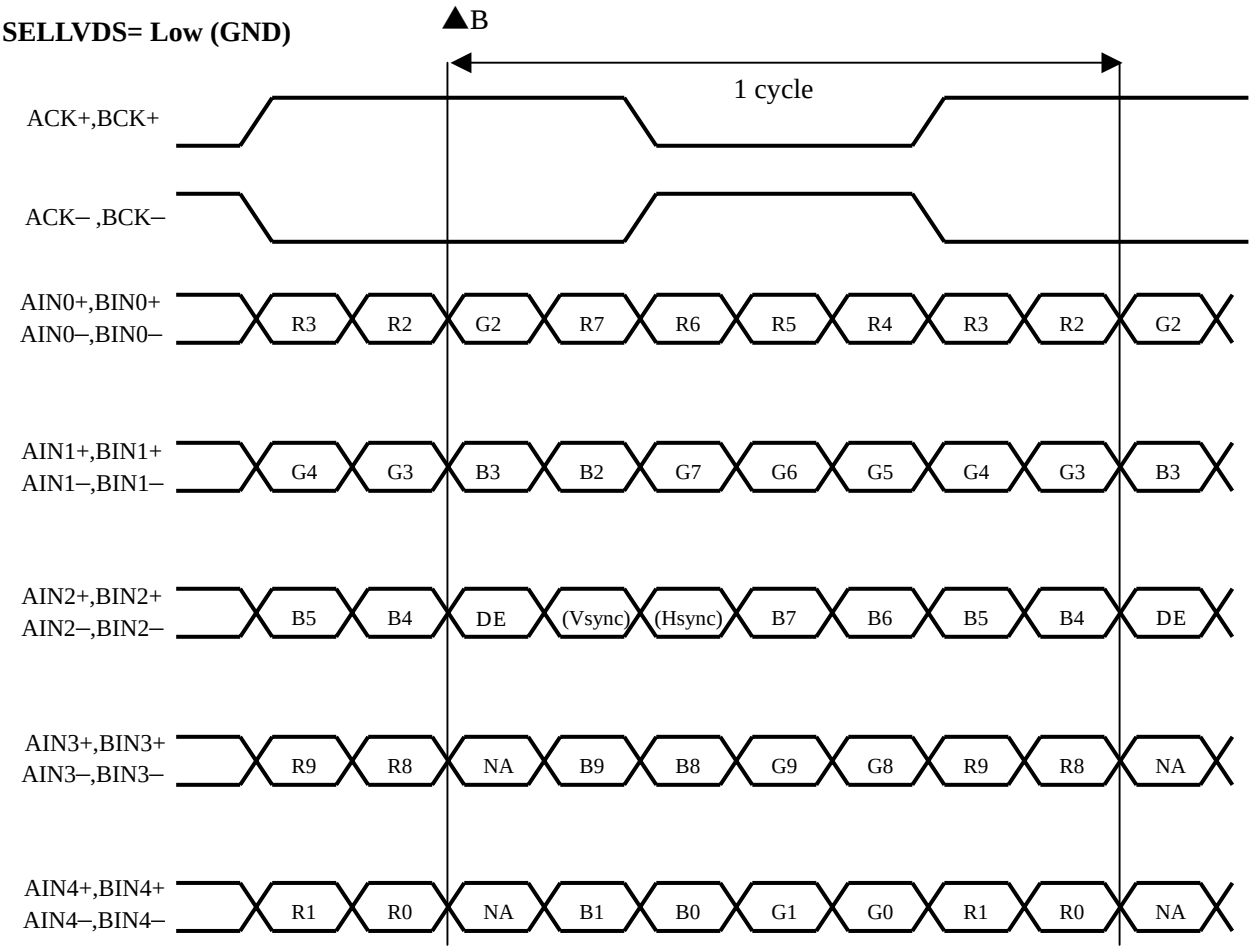
NA: Not Available

(*)Since the display position is prescribed by the rise of DE (Display Enable) signal, please do not fix DE signal during operation at ”High”.

SELLVDS= High (3.3V) or OPEN



SELLVDS= Low (GND)

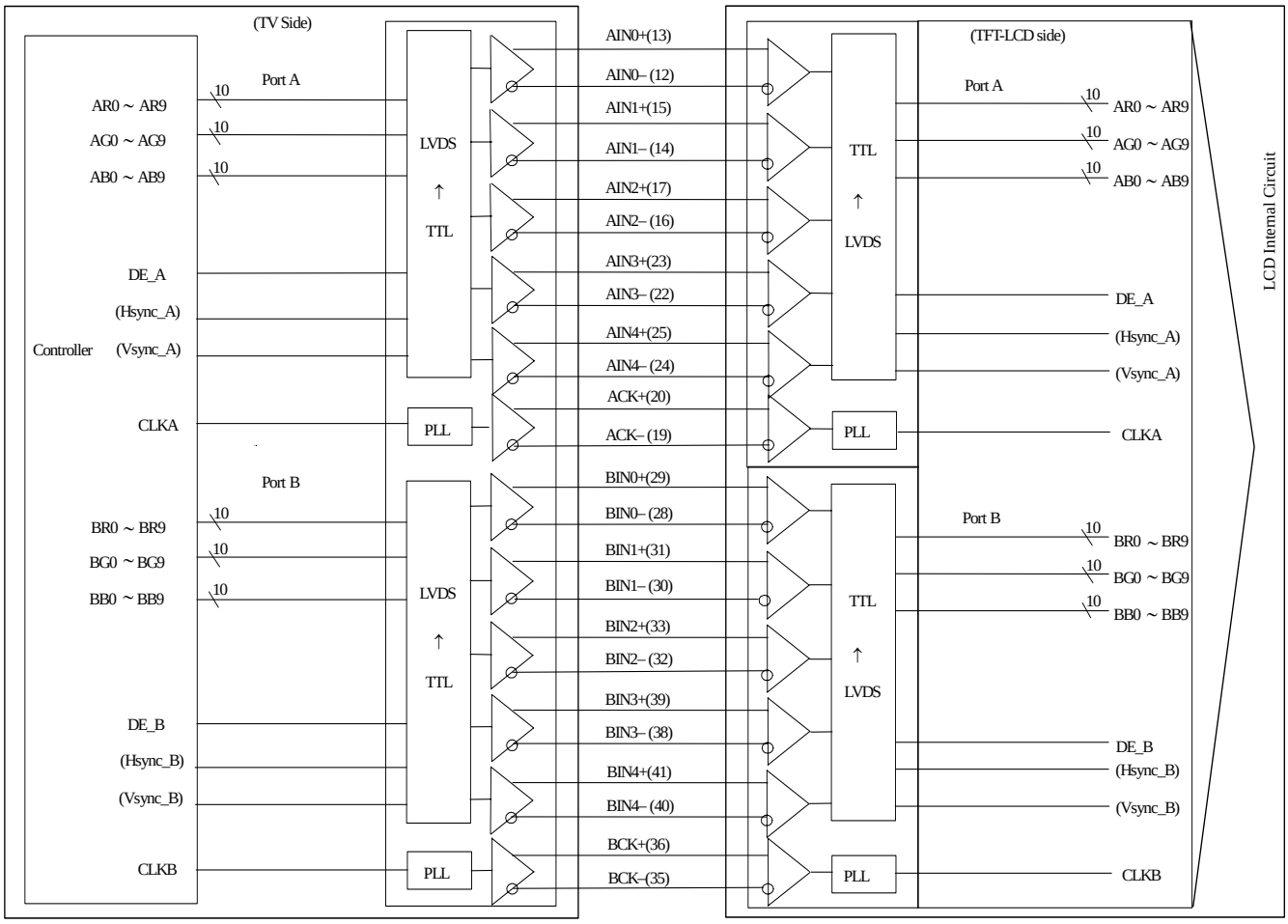


DE: Display Enable, Vsync: Vertical Sync, Hsync: Horizontal Sync

NA: Not Available (Fixed Low)

4.3. Interface block diagram▲B

Corresponding Transmitter: THC63LVD1023 (THine) or equivalent device



CN2 (O/S control) (Shown Fig 1)

O/S Driving Pin No and function

Using connector : SM07B-SRSS-TB-A (JST)

Mating connector : SHR-07V-S or SHR-07V-S-B（JST）

Pin No.	Symbol	Function	Default	Remark
1	Frame	Frame frequency setting H:60Hz, L:50Hz	Pull down GND	[Note 1]
2	O/S_set	O/S operation setting H:O/S_ON, L:O/S_OFF	Pull up 3.3V	[Note 2]
3	TEST	Not Available	Pull down GND	
4	Temp3	Data3 of panel surface temperature	Pull up 3.3V	[Note 2]
5	Temp2	Data2 of panel surface temperature	Pull up 3.3V	[Note 2]
6	Temp1	Data1 of panel surface temperature	Pull up 3.3V	[Note 2]
7	GND	GND		

*L: Low level voltage (GND) H: High level voltage(3.3V)

[Note 1] Frame frequency setting

Symbol	Function	Remark
Frame	Frame frequency setting H:60Hz, L:50Hz	Pull down TBDkΩ: (GND)

[Note 2] O/S control

Symbol	Function	Remark
O/S_set	O/S operating setting H:O/S_ON, L:O/S_OFF	Pull up TBDkΩ: (3.3V) (*)
Temp3	Data3 of panel surface temperature	Pull up TBDkΩ: (3.3V) (*)
Temp2	Data2 of panel surface temperature	Pull up TBDkΩ: (3.3V) (*)
Temp1	Data1 of panel surface temperature	Pull up TBDkΩ: (3.3V) (*)

(*) In case of OS/ON-OFF setting “L”(OS_OFF), it should be set the Temp1~3 to “H”.

According as the surface temperature of the panel, enter the optimum 3 bit signal into pin No.4, 5 and 6. Measuring the correlation between detected temperature by the sensor on PWB in user’s side and actual surface temperature of panel at center, convert the temperature detected by the sensor to the surface temperature of panel to enter the 3 bits temperature data.

For overlapping temperatures (such as 5°C, 10°C, 15°C, 20°C, 25°C, 30°C, 35°C) select the optimum parameter, judging from the actual picture image.

Pin no.	Surface temperature of panel (assembled to the set)							
	0-5°C	5-10°C	10-15°C	15-20°C	20-25°C	25-30°C	30-35°C	35°C and above
Temp3	0	0	0	0	1	1	1	1
Temp2	0	0	1	1	0	0	1	1
Temp1	0	1	0	1	0	1	0	1

*0: Low level voltage (GND) 1: High level voltage(3.3V)

4.4. Backlight driving ▲B

CN103 (Inverter control and +24V DC power supply) (Shown in Fig.1)

Using connector: S14B-PH-K-SB(LF) (J.S.T. Mfg Co.,Ltd.)

Mating connector: PHR-14 (J.S.T. Mfg Co.,Ltd.)

Pin No.	Symbol	Function	Remark
1	V_{INV}	24V	
2	V_{INV}	24V	
3	V_{INV}	24V	
4	V_{INV}	24V	
5	V_{INV}	24V	
6	GND	GND	
7	GND	GND	
8	GND	GND	
9	GND	GND	
10	GND	GND	
11	ERR	Error signal output	[Note 1]
12	V_{ON}	Inverter ON/OFF	[Note 2]
13	V_{BRT}	Brightness Control	[Note 3]
14	Reserved	For LCD module internal usage, should be open	

*GND of an inverter board is not connected to GND of a module chassis and a liquid crystal panel drive part.

CN104 (+24V DC power supply) (Shown in Fig.1)

Using connector: S14B-PH-K-SB(LF) (J.S.T. Mfg Co.,Ltd.)

Mating connector: PHR-14 (J.S.T. Mfg Co.,Ltd.)

Pin No.	Symbol	Function	Remark
1	V_{INV}	24V	
2	V_{INV}	24V	
3	V_{INV}	24V	
4	V_{INV}	24V	
5	V_{INV}	24V	
6	GND	GND	
7	GND	GND	
8	GND	GND	
9	GND	GND	
10	GND	GND	
11	Reserved	For LCD module internal usage, should be open	
12	Reserved	For LCD module internal usage, should be open	
13	Reserved	For LCD module internal usage, should be open	
14	Reserved	For LCD module internal usage, should be open	

*GND of an inverter board is not connected to GND of a module chassis and a liquid crystal panel drive part.

[Note 1] Inverter error signal output ▲B

In case protection circuit of inverter functions due to abnormal operation, this terminal outputs error signal ”Low” level. (Normally, this terminal outputs “High” level.)

[Note 2] Inverter ON/OFF

Pin No.12 is used for the control of the Inverter ON / OFF.

Input voltage	Function
3.3V	Inverter : ON
0V	Inverter : OFF

[Note 3] Brightness control

PWM brightness control is regulated by analog input voltage (0V to 3.3V).

Input voltage	Function
3.3V	Brightness Maximum (Bright)
0V	Brightness Minimum (Dark)

4.5. The back light system characteristics

The back light system is direct type with 24 CCFTs (Cold Cathode Fluorescent Tube).

The characteristics of the lamp are shown in the following table.

The value mentioned below is at the case of one CCFT.

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
Life time	T_L	-	(60000)	-	Hour	[Note]

[Note]

- Lamp life time is defined as the time when brightness becomes 50% of the original value in the continuous operation under the condition of Ta=25°C.
- Above value is applicable when the long side of LCD module is placed horizontally (Landscape position).

5. Absolute Maximum Ratings

Parameter	Symbol	Condition	Ratings	Unit	Remark
Input voltage (for Control)	V_I	Ta=25 °C	-0.3 ~ 3.6	V	[Note 1]
12V supply voltage (for Control)	VCC	Ta=25 °C	0 ~ +14	V	
Input voltage (for Inverter)	V_{BRT} V_{ON} ERR	Ta=25 °C	0 ~ +6	V	
24V supply voltage (for Inverter)	V_{INV}	Ta=25 °C	0 ~ +29	V	
Storage temperature	Tstg	-	-25 ~ +60	°C	[Note 2]
Operation temperature (Ambient)	Topa	-	0 ~ +50	°C	

[Note 1] SELLVDS, R/L, U/D, IP1/ON-OFF, Frame, O/S_set, Temp3, Temp2, Temp1

[Note 2]Humidity 95%RH Max.(Ta≦40°C)

Maximum wet-bulb temperature at 39 °C or less.(Ta>40 °C)

No condensation.

6. Electrical Characteristics

6.1. Control circuit driving Ta=25 °C

Parameter		Symbol	Min.	Typ.	Max.	Uniit	Remark
+12V supply voltage	Supply voltage	Vcc	11.4	12.0	12.6	V	[Note 1]
	Current	Icc	-	(1.05)	(TBD)	A	[Note 2]
Permissible input ripple voltage		V_{RP}	-	-	100	mV_{P-P}	Vcc = +12.0V
Differential input threshold voltage	High	V_{TH}	-	-	100	mV	V_{CM} = +1.2V [Note 6]
	Low	V_{TL}	-100	-	-	mV	
Input Low voltage		V_{IL}	-	-	0.8	V	[Note 3]
Input High voltage		V_{IH}	2.0	-	3.3	V	
Input leak current (Low)		I_{IL}	-	-	400	µA	V_I = 0V [Note 4]
Input leak current (High)		I_{IH}	-	-	400	µA	V_I = 3.3V [Note 5]
Terminal resistor		R_T	-	100	-	Ω	Differential input

[Note]V_{CM}: Common mode voltage of LVDS driver.

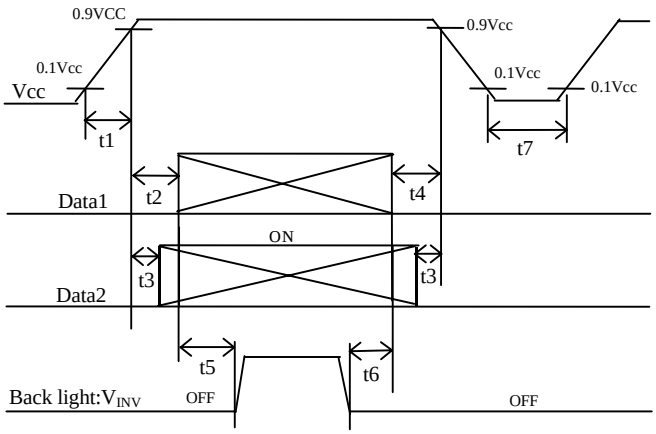
[Note 1]

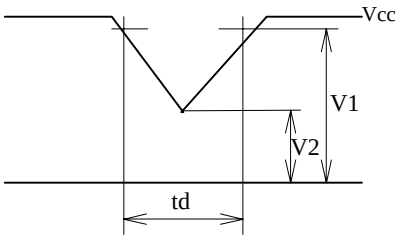
Input voltage sequences

0 < t1 ≦ 20ms
0 < t2 ≦ 20ms
0 < t3 ≦ 50ms
0 < t4 ≦ 50ms
t5 ≧ 200ms
t6 ≧ 0
t7 ≧ 300ms

Dip conditions for supply voltage

a) 6.5V ≦ Vcc < 10.8V
td ≦ 10ms
b) Vcc < 6.5V
Dip conditions for supply voltage is based on input voltage sequence.





V1:10.8V
V2:6.5V

▲B

※ Data1: ACK±, AIN0±, AIN1±, AIN2±, AIN3±, AIN4±, BCK±, BIN0±, BIN1±, BIN2±, BIN3±, BIN4±
*V_{CM} voltage pursues the sequence mentioned above.

※ Data2: R/L,U/D,SELLVDS,IP1/ON-OFF

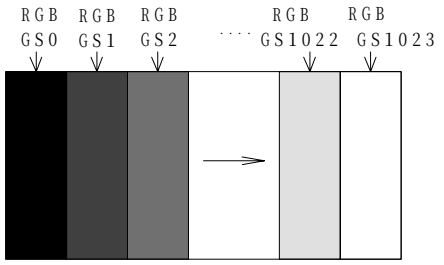
About the relation between data input and back light lighting, please base on the above-mentioned input sequence.

When backlight is switched on before panel operation or after a panel operation stop, it may not display normally. But this phenomenon is not based on change of an incoming signal, and does not give damage to a liquid crystal display.

[Note 2] Maximum current situation: white (RGB GS1023)

Typical current situation: 1024 gray-bar pattern

The explanation of RGB gray scale is seen in section 8.



Vcc＝12.0V
CK＝74.25MHz
Th＝14.8μs

[Note 3] R/L, U/D, SELLVDS, IP1/ON-OFF, Frame, O/S_set, Temp3, Temp2, Temp1

[Note 4] SELLVDS, O/S_set, Temp3, Temp2, Temp1

[Note 5] R/L,U/D, Frame, IP1/ON-OFF

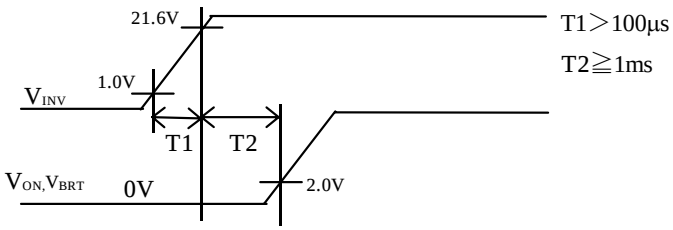
[Note 6] ACK±, AIN0±, AIN1±, AIN2±, AIN3±, AIN4±, BCK±, BIN0±, BIN1±, BIN2±, BIN3±, BIN4±

6.2. Inverter driving for back light

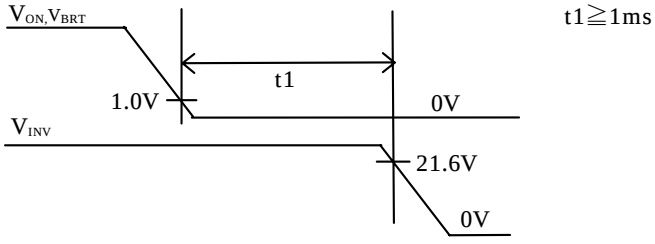
The back light system is direct type with 24 CCFTs (Cold Cathode Fluorescent Tube). Ta=25°C

Parameter		Symbol	Min.	Typ.	Max.	Unit	Remark
+24V	Current 1	I_{INV1}	-	(10.8)	(TBD)	A	V_{INV} = 24V V_{BRT} = 3.3V, V_{ON}= 3.3V [Note 2]
	Current 2	I_{INV2}	-	(9.7)	(TBD)	A	
	Supply voltage	V_{INV}	22.8	24.0	25.2	V	
Permissible input ripple voltage		V_{RF}	-	-	200	mV	V_{INV} = +24V
Input voltage (Low)		V_{ONL}	0	-	1.0	V	V_{ON} impedance=(TBD)kΩ
Input voltage (High)		V_{ONH}	3.0	3.3	5.0	V	
Input voltage		V_{BRT}	0	-	3.3	V	V_{BRT} impedance=(TBD)kΩ

[Note 1] 1) V_{INV}(+24V) turn-on condition



2) V_{INV}(+24V) turn-off condition



[Note 2] Current1) Definition within 60 minutes after turn on. (Rush current is excluded.)

Current2) Definition more than 60minutes after turn on.

7. Timing characteristics of input signals

7.1 Timing characteristics

Timing diagrams of input signal are shown in Fig.2.

Item		Symbol	Min	Typ	Max	Unit
DCLK	Frequency	1/Tc	55	74.25	80	MHz
DE (Data Enable)	Horizontal total	TH	1030	1100	1650	CLOCK
			14.8	14.8	-	μs
	Horizontal valid	THd	960	960	960	CLOCK
	Horizontal retrace period	TH-THd	1.80	1.87	-	μs
	Vertical total	TV	1111	1125	1350	LINE
	Vertical valid	TVd	1080	1080	1080	LINE

[Note] 1) When vertical period is very long, flicker and etc. may occur.

2) Please turn off the module after it shows the black screen.

3) Please make sure that length of vertical period should become of an integral multiple of horizontal length of period. Otherwise, the screen may not display properly.

4) In case of CSI_ON, it will happen to a different brightness between upper side and lower side. Because of depending on vertical line setting, so please judge a vertical line from the actual picture image.

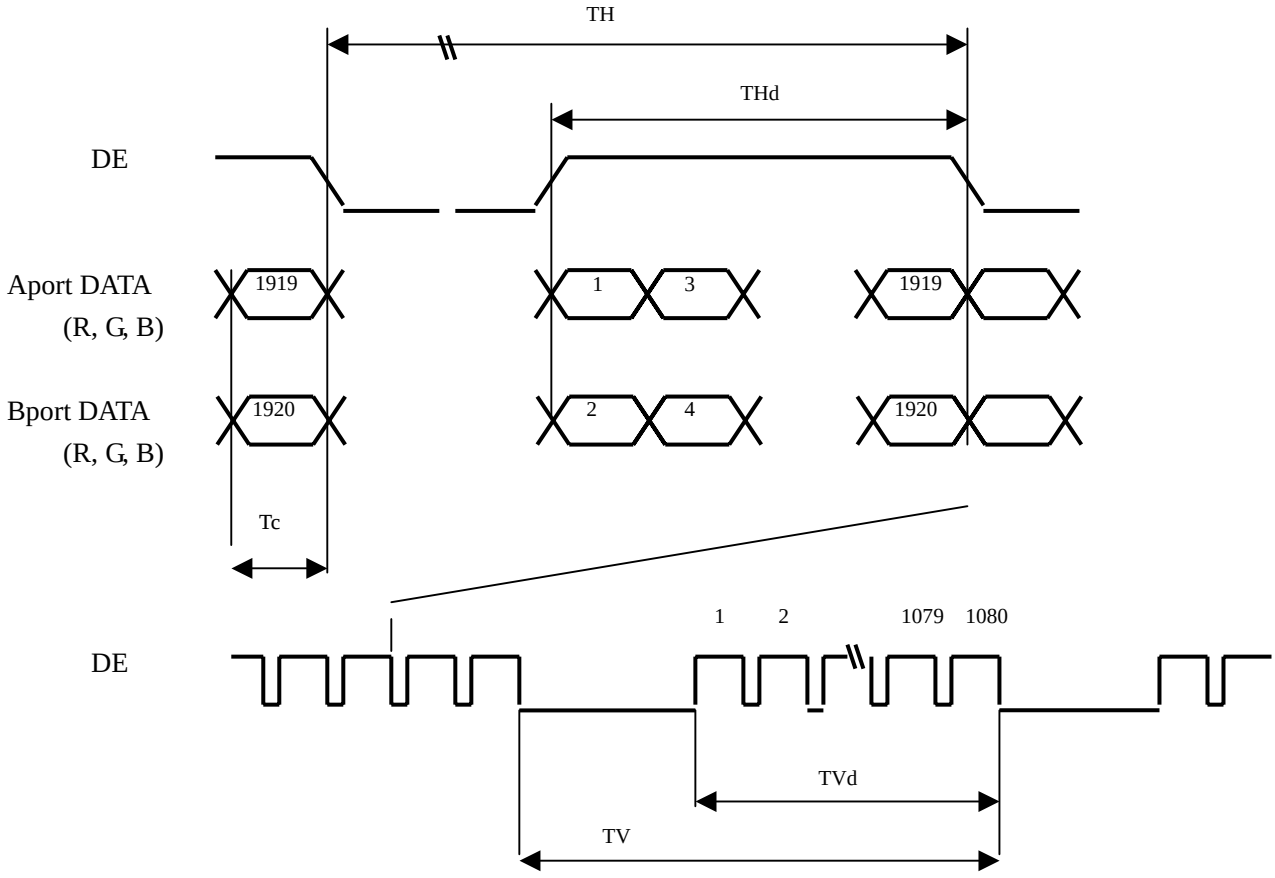
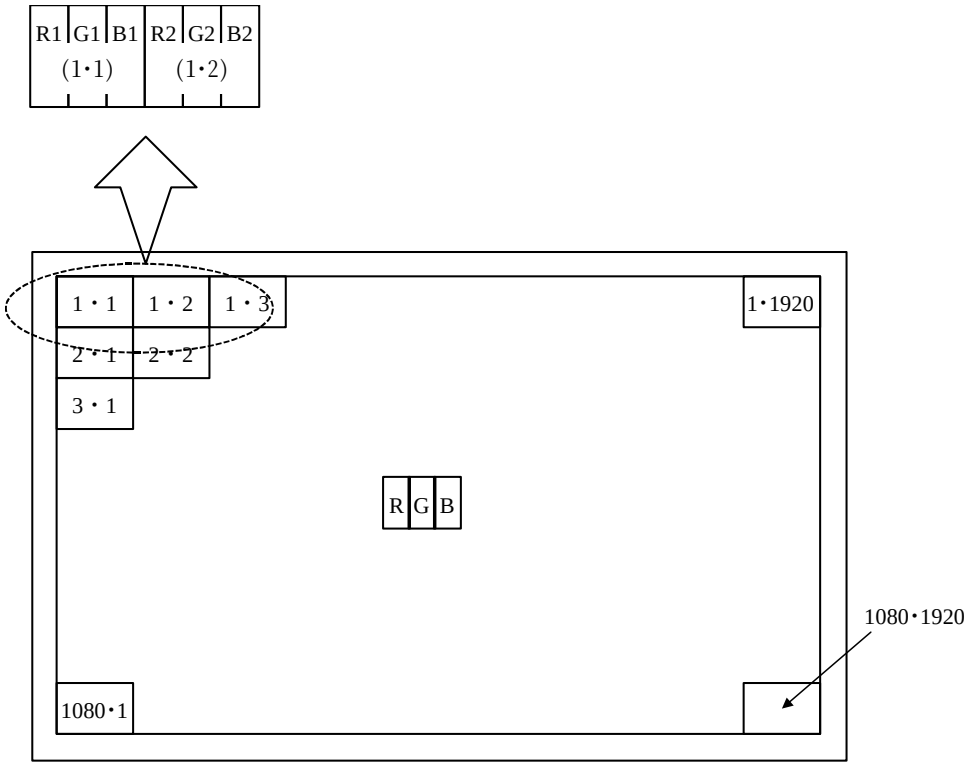


Fig.2 Timing characteristics of input signals

7.2 Input data signal and display position on the screen



Display position of Data (V,H)

8. Input Signal, Basic Display Colors and Gray Scale of Each Color ▲B

	Colors & Gray scale	Data signal																															
		Gray Scale	R0	R1	R2	R3	R4	R5	R6	R7	R8	R9	G0	G1	G2	G3	G4	G5	G6	G7	G8	G9	B0	B1	B2	B3	B4	B5	B6	B7	B8	B9
Basic Color	Black	–	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	–	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	Green	–	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
	Cyan	–	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Red	–	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	–	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	Yellow	–	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	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	1	1	1	1	1	1	1	1	1	1	1	1
Gray Scale of Red	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	GS1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	GS2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	↓						↓										↓										↓				
	⇩	↓						↓										↓										↓				
	Brighter	GS1021	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇩	GS1022	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	GS1023	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale of Green	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	GS1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	GS2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	↓						↓										↓										↓				
	⇩	↓						↓										↓										↓				
	Brighter	GS1021	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
	⇩	GS1022	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
	Green	GS1023	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
Gray Scale of Blue	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	GS1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	Darker	GS2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	⇩	↓						↓										↓										↓				
	⇩	↓						↓										↓										↓				
	Brighter	GS1021	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1
	⇩	GS1022	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
	Blue	GS1023	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1

0: Low level voltage, 1: High level voltage.

Each basic color can be displayed in 1024 gray scales from 10 bits data signals. According to the combination of total 30 bits data signals, the **TBD**-color display can be achieved on the screen.

9. Optical characteristics

Ta=25°C, Vcc = 12.0V, V_{INV} = 24.0V, V_{BRT} = 3.3V

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing angle range	Vertical	θ 11,12	CR≧10	70	88	-	Deg.	[Note1,4]
	Horizontal	θ 21,22		70	88	-	Deg.	
Contrast ratio		CR1	θ=0 deg.	(1500)	(2000)	-		[Note2,4] V_{BRT}=3.3V IP1:OFF
		CR2	θ=0 deg.	(1100)	(1500)	-		[Note2,4] V_{BRT}=3.3V IP1:ON
Response time		τ_{d1}, τ_{r1}	θ=0 deg.	-	(6)	-	ms	[Note3,4,5] V_{BRT}=3.3V IP1:OFF
		τ_{d2}, τ_{r2}		-	(4)	-	ms	[Note3,4,5] V_{BRT}=3.3V IP1:ON
▲A Chromaticity	White	Wx	θ=0 deg.	(0.242)	(0.272)	(0.302)	-	[Note 4] V_{BRT}=3.3V IP1:OFF
		Wy		(0.247)	(0.277)	(0.307)	-	
	Red	Rx	θ=0 deg.	(0.617)	(0.647)	(0.677)	-	
		Ry		(0.290)	(0.320)	(0.350)	-	
	Green	Gx	θ=0 deg.	(0.237)	(0.267)	(0.297)	-	
		Gy		(0.580)	(0.610)	(0.640)	-	
	Blue	Bx	θ=0 deg.	(0.111)	(0.141)	(0.171)	-	
		By		(0.045)	(0.075)	(0.105)	-	
▲A Luminance of white		Y_{L1}	θ=0 deg.	(360)	(450)	-	cd/m^2	[Note 4] V_{BRT}=3.3V IP1:OFF
		Y_{L2}	θ=0 deg.	(270)	(340)	-	cd/m^2	[Note 4] V_{BRT}=3.3V IP1:ON
Luminance uniformity		δ_W	θ=0 deg.	-	-	(1.25)		[Note 6]

Measurement condition : Set the value of V_{BRT} to maximum luminance of white.

*The measurement shall be executed 60 minutes after lighting at rating.

[Note]The optical characteristics are measured using the following equipment.

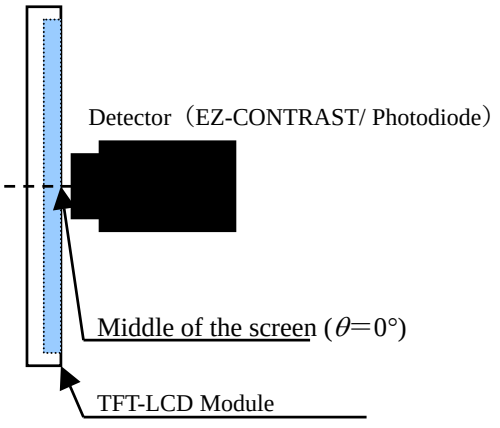


Fig.4-1 Measurement of viewing angle range and Response time.

Viewing angle range: EZ-CONTRAST

Response time: Photodiode

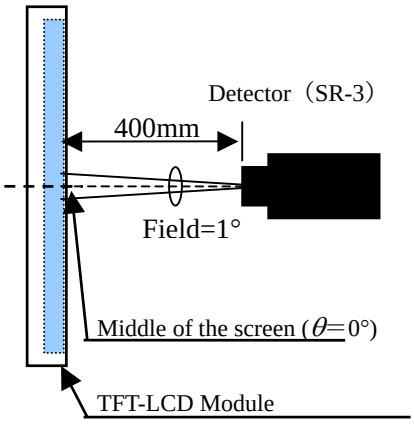
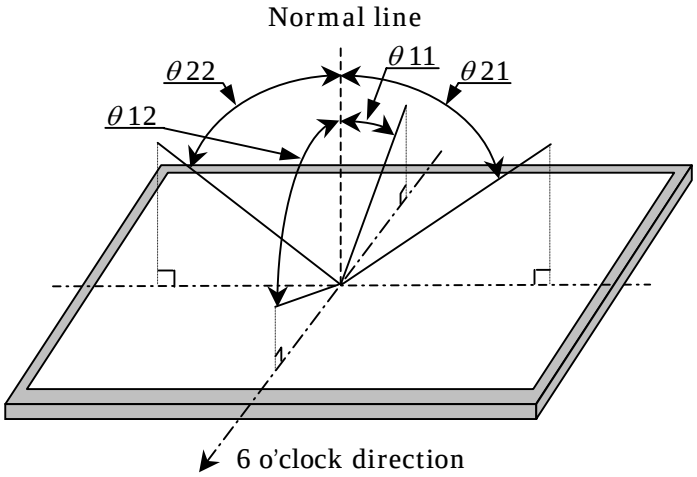


Fig.4-2 Measurement of Contrast, Luminance, Chromaticity.

[Note 1]Definitions of viewing angle range :



[Note 2]Definition of contrast ratio :

The contrast ratio is defined as the following.

$$\text{Contrast Ratio} = \frac{\text{Luminance (brightness) with all pixels white}}{\text{Luminance (brightness) with all pixels black}}$$

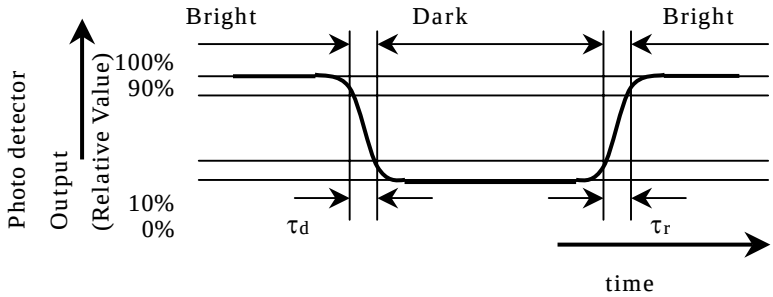
[Note 3]Definition of response time

The response time (τ_d and τ_r) is defined as the following figure and shall be measured by switching the input signal for "any level of gray (0%, 25%, 50%, 75% and 100%)" and "any level of gray (0%, 25%, 50%, 75% and 100%)".

	0%	25%	50%	75%	100%
0%		tr:0%-25%	tr:0%-50%	tr:0%-75%	tr:0%-100%
25%	td: 25%-0%		tr: 25%-50%	tr25%-75%	tr: 25%-100%
50%	td: 50%-0%	td: 50%-25%		tr: 50%-75%	tr: 50%-100%
75%	td: 75%-0%	td: 75%-25%	td: 75%-50%		tr: 75%-100%
100%	td: 100%-0%	td: 100%-25%	td: 100%-50%	td:100%-75%	

t*:x-y...response time from level of gray(x) to level of gray(y)

$\tau_r = \Sigma(tr:x\text{-}y)/10$, $\tau_d = \Sigma(td:x\text{-}y)/10$



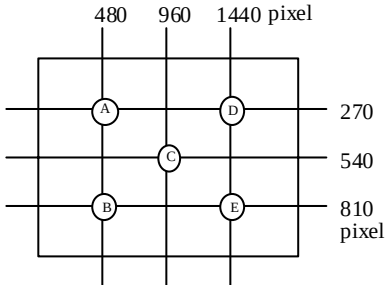
[Note 4] This shall be measured at center of the screen.

[Note 5] This value is valid when O/S driving is used at typical input time value.

[Note 6] Definition of white uniformity ;

White uniformity is defined as the following with five measurements. (A~E)

$$\delta_W = \frac{\text{Maximum luminance of five points (brightness)}}{\text{Minimum luminance of five points (brightness)}}$$



10. Handling Precautions of the module

a) Be sure to turn off the power supply when inserting or disconnecting the cable.

b) This product is using the parts (inverter, CCFT etc), which generate the high voltage. Therefore, during operating, please don't touch these parts.

c) Brightness control voltage is switched for “ON” and “OFF”, as shown in Fig.4. Voltage difference generated by this switching, $\Delta V_{INV,}$ may affect a sound output, etc. when the power supply is shared between the inverter and its surrounding circuit. So, separate the power supply of the inverter circuit with the one of its surrounding circuit.

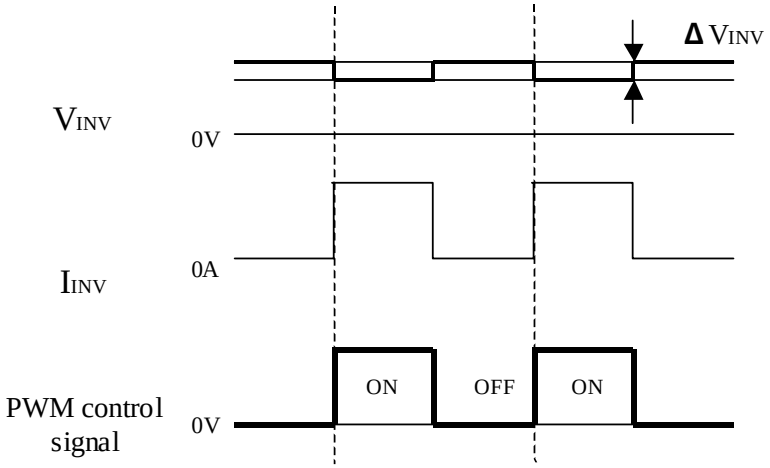


Fig.4 Brightness control voltage.

*Since inverter board’s GND is not connected to the frame of the LCD module, please connect it with the Customer’s GND of inverter power supply.

d) Be sure to design the cabinet so that the module can be installed without any extra stress such as warp or twist.

e) Since the front polarizer is easily damaged, pay attention not to scratch it.

f) Since long contact with water may cause discoloration or spots, wipe off water drop immediately.

g) When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.

h) Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface. Handle with care.

i) Since CMOS LSI is used in this module, take care of static electricity and take the human earth into consideration when handling.

j) Please consider to minimize the influence of EMI and the exogenous noise before designing the grounding of LCD module.

k) The module has some printed circuit boards (PCBs) and lamp cables on the back side, take care to keep them form any stress or pressure when handling or installing the module; otherwise some of electronic parts on the PCBs may be damaged.

l) Observe all other precautionary requirements in handling components.

m) When some pressure is added onto the module from rear side constantly, it causes display non-uniformity issue, functional defect, etc.. So, please avoid such design.

n) When handling LCD modules and assembling them into cabinets, please be noted that long-term storage in the environment of oxidization or deoxidization gas and the use of such materials as reagent, solvent, adhesive, resin, etc. which generate these gasses, may cause corrosion and discoloration of the LCD modules.

o) Lamps of the backlight are placed horizontally to the long side of LCD module. So make sure that the LCD module are placed horizontally (landscape position), as lifetime of backlight becomes shorter if placed at a tilt.

p) Make sure that the LCD module is operated within specified temperature and humidity.
Measures against dust, water, vibration, and heat radiation, etc. are required at the cabinet or equipment side. And image retention may occur if same fixed pattern is displayed for a long time. In some cases, it may not disappear. Please consider the design and operating environment.

q) This LCD module is designed to prevent dust from entering into it. However, there would be a possibility to have a bad effect on display performance in case of having dust inside of LCD module. Therefore, please ensure to design your TV set to keep dust away around LCD module.

11. Packing form

a) Piling number of cartons : TBD

b) Packing quantity in one carton : TBD

c) Carton size : TBD

d) Total mass of one carton filled with full modules : TBD

12. Reliability test item

No.	Test item	Condition	
1	High temperature storage test	Ta=60°C 240h	
2	Low temperature storage test	Ta=-25°C 240h	
3	High temperature and high humidity operation test	Ta=40°C ; 95%RH 240h (No condensation)	
4	High temperature operation test	Ta=50°C 240h (Panel surface temperature is below 60°C)	
5	Low temperature operation test	Ta=0°C 240h	
6	Vibration test (non-operation)	Frequency: 10~57Hz/Vibration width (one side): 0.075mm : 58~500Hz/Acceleration: 9.8 m/ s^2 Sweep time: 11 minutes Test period: 3 hours (1h for each direction of X, Y, Z)	[Note]
7	Shock test (non-operation)	Maximum acceleration: 296m/s^2 ▲B Pulse width: 11ms, sinusoidal half wave Direction: ±X, ±Y, ±Z, once for each direction.	[Note]
8	ESD	* At the following conditions, it is a thing without incorrect operation and destruction. (1)Non-operation: Contact electric discharge ±10kV Non-contact electric discharge ±20kV (2)Operation: Contact electric discharge ±8kV Non-contact electric discharge ±15kV Conditions: 150pF, 330ohm	

[Note] LCD panel misalignment is within tolerance levels after vibration and shock tests.

LCD module is supposed to be installed at the right position mentioned in the outline dimensions during vibration and shock tests.

[Result evaluation criteria]

Under the display quality test condition with normal operation state, there shall be no change, which may affect practical display function.

13. Others

1) Lot No. Label ;

TBD

2) Packing Label

TBD

3) Disassembling the module can cause permanent damage and should be strictly avoided.

4) Please be careful since image retention may occur when a fixed pattern is displayed for a long time.

5) Cold cathode fluorescent lamp in LCD PANEL contains a small amount of mercury. Please follow local ordinances or regulations for disposal. This sentence is displayed on the backside of the module.

> COLD CATHODE FLUORESCENT LAMP IN LCD PANEL
> CONTAINS A SMALL AMOUNT OF MERCURY,PLEASE FOLLOW
> LOCAL ORDINANCES OR REGULATION FOR DISPOSAL
> 当該液晶ディスプレイパネルは蛍光管が組み込まれていますので、地方自治体の条例、または、規則に従って廃棄ください。

6) Lead-free soldering is applied.

7) The chemical compound, which causes the destruction of ozone layer, is not being used.

8) Appearance quality and standard are referred to the outgoing incoming inspections.

14. Carton storage condition

Temperature	0°C to 40°C
Humidity	95%RH or less
Reference condition	: 20°C to 35°C, 85%RH or less (summer) : 5°C to 15°C, 85%RH or less (winter) • the total storage time (40°C, 95%RH) : 240H or less
Sunlight	Be sure to shelter a product from the direct sunlight.
Atmosphere	Harmful gas, such as acid and alkali which bites electronic components and/or wires must not be detected.
Notes	Be sure to put cartons on palette or base, don’t put it on floor, and store them with removing from wall Please take care of ventilation in storehouse and around cartons, and control changing temperature is within limits of natural environment
Storage life	1 year

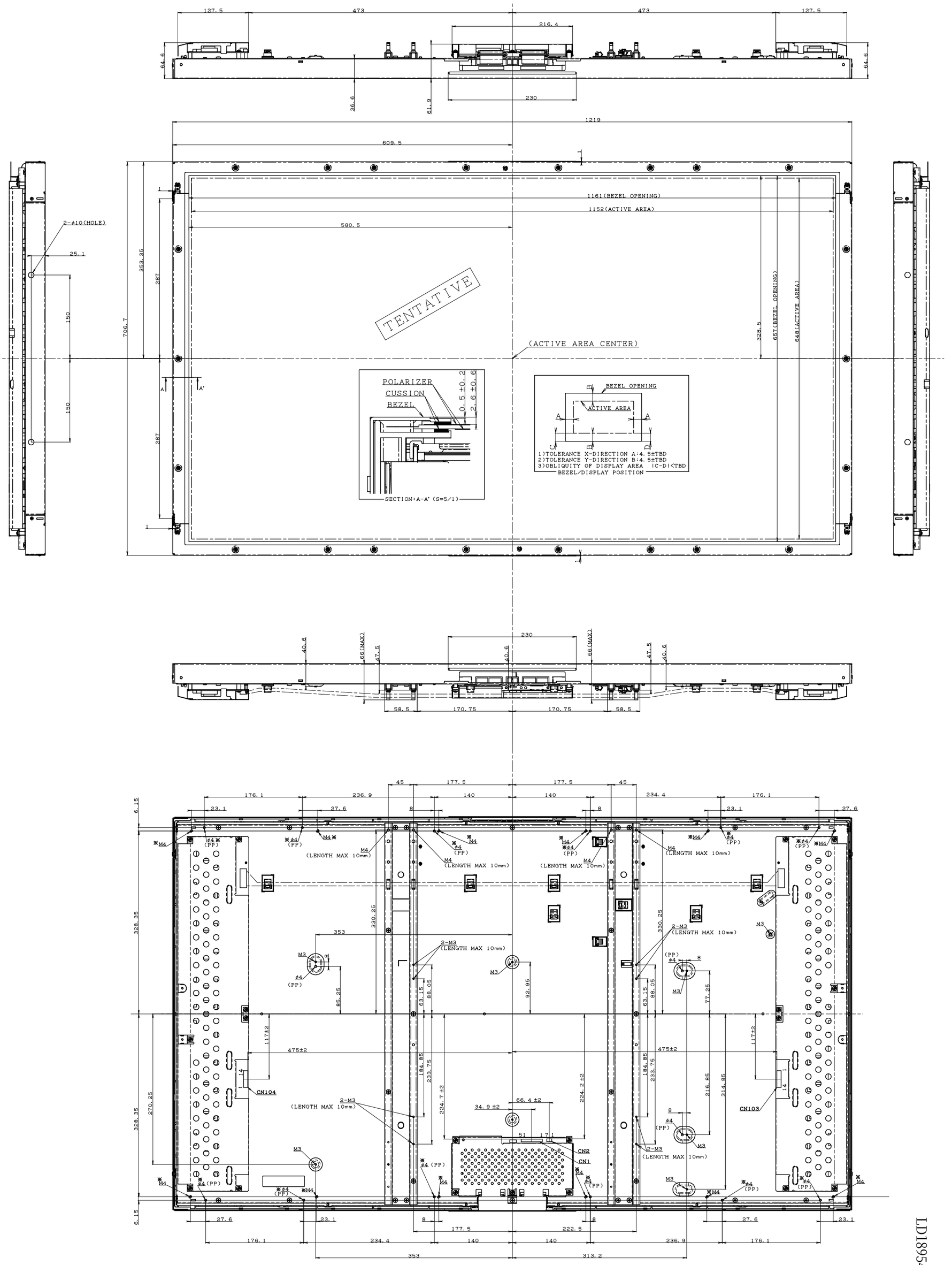


Fig1. LK520D3LZ1× TFT-LCD MODULE
OUTLINE DIMENSIONS

NOTE)
1. UNSPECIFIED TOLERANCE TO BE ±1.7
2. RIGHT AND LEFT SIDEPIECE IS SYMMETRIC SHAPE
※ PP:A POSITIONING PROJECTION

LD18954-23