SPEC No.LD－19305A

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PAGE:23 pages

DEVICE SPECIFICATION FOR

TFT-LCD Module

MODEL No.

LQ0DZA0096

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.

Do not use the device for equipment that requires an extreme level of reliability, such as aerospace applications, telecommunication equipment(trunk lines), nuclear power control equipment and medical or other equipment for life support.

SHARP assumes no responsibility for any damage resulting from the use of the device which does not comply with the instructions and the precautions specified in these specification sheets.

This specification sheets sheet is to guarantee the quality of the LCD module itself, only Should you need to evaluate and confirm the performance of the module, please do so when the LCD module is assembled into your finished product.

If any problem occurs in relation to the description of this specification sheets , it shall be resolved through discussion with spirit of cooperation.

Contact and consult with a SHARP sales representative for any questions about this device.

Table of contents

1. Application

These specification sheets applies to a color TFT-LCD module, LQ0DZA0096.

2. Overview

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 and power supply circuit and a backlight unit. Graphics and texts can be displayed on a 1920×3×1200 dots panel with 262,144 colors by using LVDS (Low Voltage Differential Signaling) to interface and supplying +3.3V DC supply voltage for TFT-LCD panel driving and supply voltage for backlight.

Optimum viewing direction is 6 o'clock.

Backlight-driving DC/AC inverter is built in this module.

3. Mechanical Specifications

Parameter	Specifications	Unit
Display size	43(17.0") Diagonal	cm
Active area	365.76 (H)×228.60 (V)	mm
Pixel format	1920 (H)×1200 (V)	pixel
	(1 pixel = R+G+B dots)	
Aspect ratio	16 : 10	
Pixel pitch	0.1905 (H)×0.1905 (V)	mm
Pixel configuration	R,G,B vertical stripe	
Display mode	Normally white	
Surface treatment	Anti-glare and hard-coating 5H Low reflection	

Parameter		Min.	Typ.	Max.	Unit
Unit outline dimensions [Note 1]	Width	381.7	382.2	382.7	mm
	Height	244.0	244.5	245.0	mm
	Depth	—	—	7.0	mm
Mass [Note 2]		—	730	750	g

[Note 1] excluding inverter unit, backlight cables and the mounting tab.

[Note 2] including inverter unit.

Outline dimensions is shown in Fig.1

4. Input Terminals

4-1. TFT-LCD panel driving

CN1 (LVDS signals and +3.3V DC power supply)

Pin No.	Symbol	Function	Remark
1	GND		
2	V_{CC}	+3.3V power supply	
3	V_{CC}	+3.3V power supply	
4	V_{EDID}	DCC+3.3V power supply	
5	NC	Reserved	
6	NC	Reserved	
7	NC	Reserved	
8	R1IN0-	Receiver signal of A side pixel (-)	[Note 1]
9	R1IN0+	Receiver signal of A side pixel (+)	[Note 1]
10	GND		
11	R1IN1-	Receiver signal of A side pixel (-)	[Note 1]
12	R1IN1+	Receiver signal of A side pixel (+)	[Note 1]
13	GND		
14	R1IN2-	Receiver signal of A side pixel (-)	[Note 1]
15	R1IN2+	Receiver signal of A side pixel (+)	[Note 1]
16	GND		
17	CK1 IN-	Clock signal of A side pixel (-)	[Note 1]
18	CK1 IN+	Clock signal of A side pixel (+)	[Note 1]
19	GND		
20	R2IN0-	Receiver signal of B side pixel (-)	[Note 1]
21	R2IN0+	Receiver signal of B side pixel (+)	[Note 1]
22	GND		
23	R2IN0-	Receiver signal of B side pixel (-)	[Note 1]
24	R2IN0+	Receiver signal of B side pixel (+)	[Note 1]
25	GND		
26	R2IN0-	Receiver signal of B side pixel (-)	[Note 1]
27	R2IN0+	Receiver signal of B side pixel (+)	[Note 1]
28	GND		
29	CK2 IN-	Clock signal of B side pixel (-)	[Note 1]
30	CK2 IN+	Clock signal of B side pixel (+)	[Note 1]

[Note 1] Relation between LVDS signals and actual data is shown in following section (4-2)(7-2).

[Note 2] The shielding case is connected with signal GND.

Using connector : FI-XB30SL-HF10 (JAE) or equivalent.

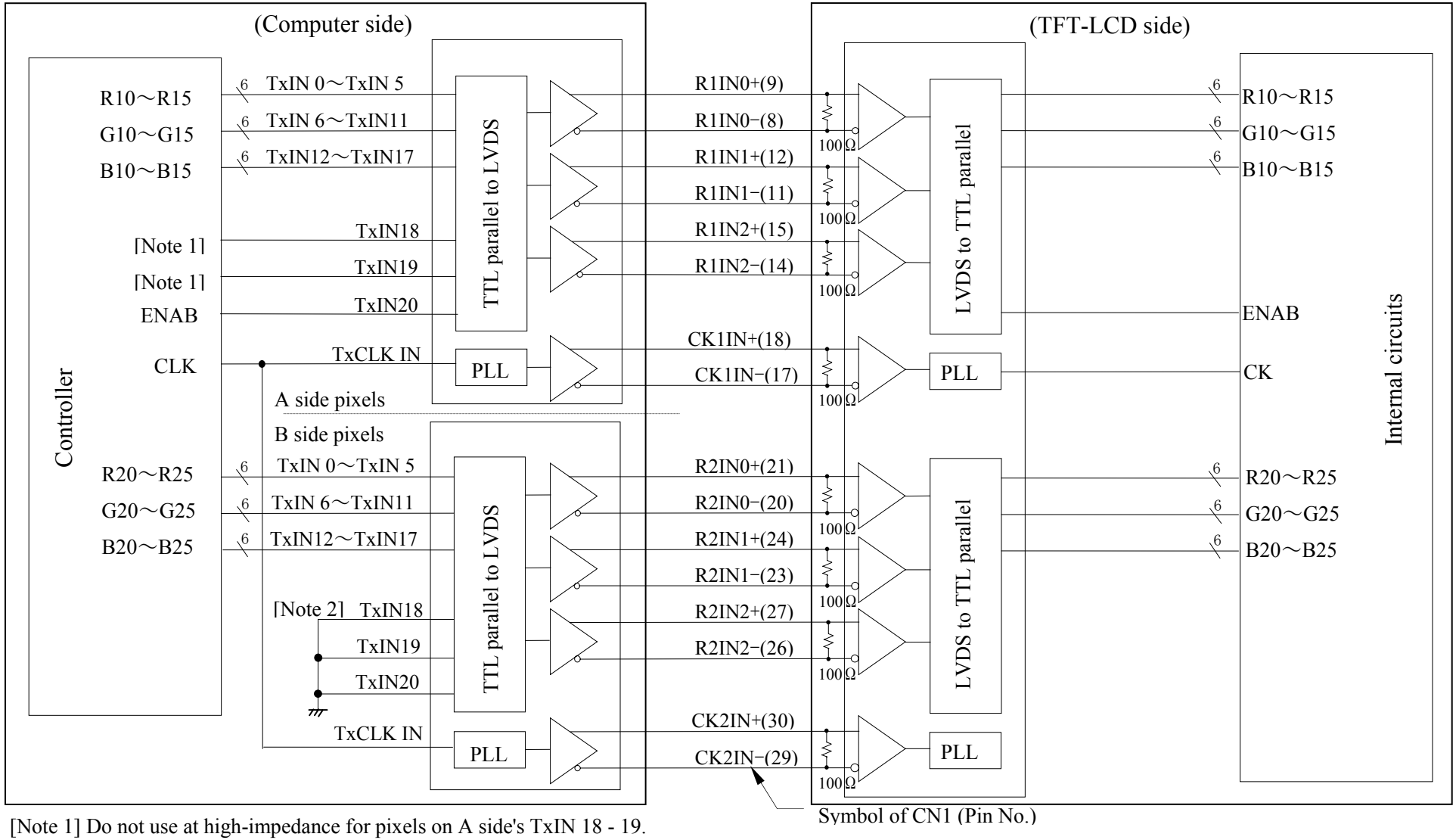
Corresponding connector : FI-X30M,FI-X30ML or FI-X30H (JAE)

(Sharp is not responsible to its product quality, if the user applies a connector not corresponding to the above model.)

4-2 Interface block diagram

Using receiver : Dual LVDS interface contained in a control IC

Corresponding Transmitter : THC63LVDM63A (THINE) or equivalent



[Note 1] Do not use at high-impedance for pixels on A side's TxIN 18 - 19.
[Note 2] Please connect B side pixels, TxIN 18 - 19 to GND.

4-3. Backlight driving

CN2 : (Inverter signals and Inverter Power Supply)

Using connector : LVC-D20SFYG(HONDA TSUSHIN KOGYO CO.,LTD.)

Corresponding connector : LVC-D20LPMSG (HONDA TSUSHIN KOGYO CO.,LTD)

Pin no.	Symbol	Function	Remark
1	INV_SRC	Inverter power supply voltage	
2	INV_SRC	Inverter power supply voltage	
3	INV_SRC	Inverter power supply voltage	
4	INV_SRC	Inverter power supply voltage	
5	GND		
6	N.C.	This is electrically opened	
7	V_{5VALW}	+5V power supply voltage	
8	GND		
9	SMB_DAT	Brightness control serial data signal	
10	SMB_CLK	Brightness control serial clock signal	
11	GND		
12	INV_PWM	PWM signal for brightness control	
13	GND		
14	N.C.	This is electrically opened	
15	N.C.	This is electrically opened	
16	N.C.	This is electrically opened	
17	N.C.	This is electrically opened	
18	N.C.	This is electrically opened	
19	N.C.	This is electrically opened	
20	N.C.	This is electrically opened	

5. Absolute Maximum Ratings

Parameter	Symbol	Condition	Ratings		Unit	Remark
			Min.	Max.		
Input voltage	V_I	Ta=+25℃	-0.3	Vcc+0.3	V	[Note 1]
+3.3V supply voltage	Vcc	Ta=+25℃	0	+4.0	V	
Inverter power supply voltage	V_{INV}	Ta=+25℃	0	+23.5	V	
+5V power supply voltage	V_{5VALW}	Ta=+25℃	-0.3	+5.5	V	
Inverter control signal voltage	V_{SMB}	Ta=+25℃	-0.3	+5.5	V	[Note 2]
	V_{FBK}	Ta=+25℃	-1.0	+5.5	V	[Note 3]
Storage temperature	Tstg	—	-25	+60	℃	[Note 4]
Operating temperature (Ambient)	Topa	—	0	+50	℃	

[Note 1] LVDS signals , BIST

[Note 2] SMB signals

[Note 3] FPBACK signals

[Note 4] Humidity：95%RH Max. at Ta≦+40℃.

Maximum wet-bulb temperature at +39℃ or less at Ta>+40℃.

No condensation.

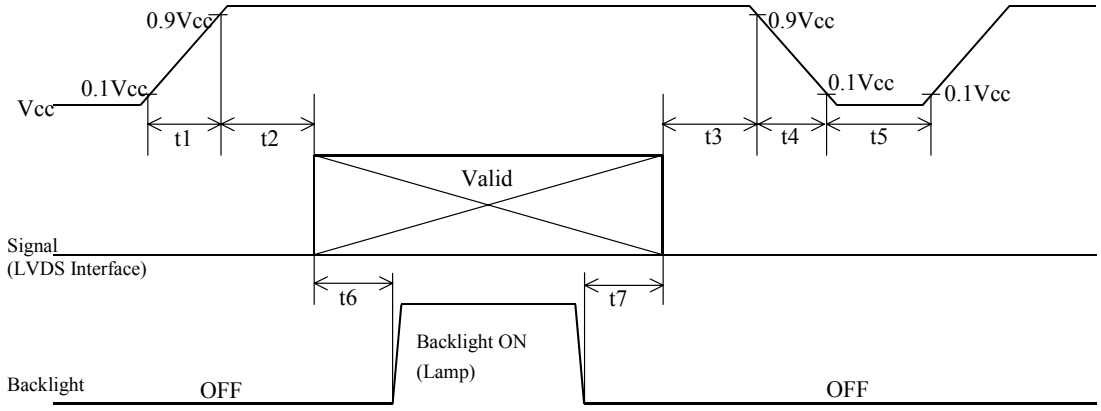
6. Electrical Characteristics

6-1.TFT-LCD panel driving Ta＝+25℃

Parameter		Symbol	Min.	Typ.	Max.	Unit	Remark
Supply voltage		Vcc	+3.0	+3.3	+3.6	V	[Note 2]
Current dissipation		Icc	—	580	920	mA	[Note 3]
Permissive input ripple voltage		V_{RP}	—	—	100	mV_{P-P}	Vcc = +3.3V
Input voltage range		V_I	0		2.4	V	LVDS signals
Differential input threshold voltage	High	V_{TH}	—	—	+100	mV	V_{CM} = +1.2V
	Low	V_{TL}	-100	—	—	mV	[Note 1]
Input current	High	I_{OH1}	—	—	±10	μA	V_I = +2.4V Vcc = +3.6V
	Low	I_{OL1}	—	—	±10	μA	V_I = 0V Vcc = 3.6V
Terminal resistor		R_T	—	100	—	Ω	Differential input
Input voltage	High	V_{IH}	2.5	-	-	V	BIST
	Low	V_{IL}	-	-	0.7	V	
Input current	High(V_{IH}=Vcc)	I_{OH2}	-	-	200	μA	
	Low(V_{IL}=0V)	I_{OL2}	-10.0	-	-	μA	

[Note 1] V_{CM} : Common mode voltage of LVDS driver.

[Note 2] On-off conditions for supply voltage



Symbol	Min.	Max.	Unit	Remark
t1	0	10	ms	
t2	0	1	S	
t3	0	1	S	
t4	0	400	ms	
t5	200	—	ms	
t6	180	—	ms	*1
t7	5	—	ms	*1

*1 : As for the power sequence for backlight, it is recommended to apply above mentioned input timing. If the backlight is lit on and off at a timing other than shown above, displaying image may get disturbed. This is due to variation of output signal from timing generator when LVDS signal is changed from on to off or vice versa, but has no harm to the module itself.

[Note] Do not keep the interface signal high-impedance or unusual signal when power is on.

Vcc-dip conditions

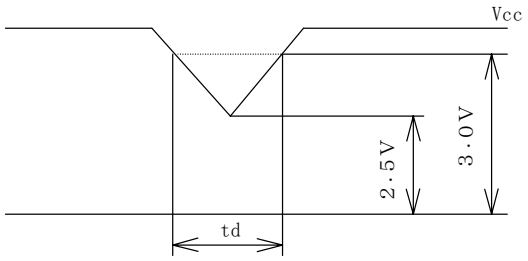
1) 2.5 V≦Vcc＜3.0 V

td≦10 ms

Under above condition, the display image should return to an appropriate figure after Vcc voltage recovers.

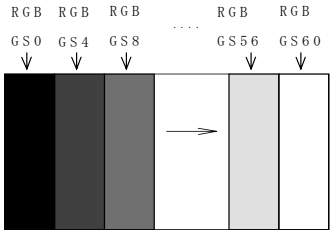
2) Vcc＜2.5 V

Vcc-dip conditions should also follow the On-off conditions for supply voltage



[Note 3] Typical current situation : 16-gray-bar pattern.

Vcc=+3.3V

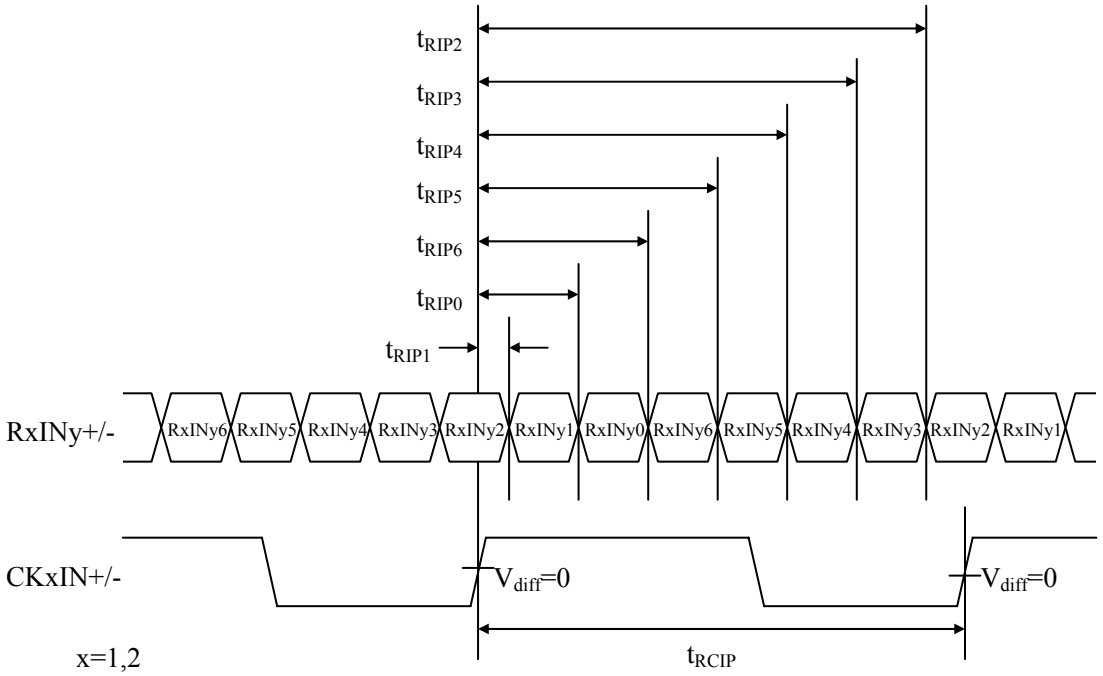


6-2. LVDS Input Specification

6.2.1.Switching Characteristics Vcc=+3.0V～+3.6V, Ta＝0℃～+50℃

Parameter	Symbol	Min	Typ.	Max.	Unit
Input Data Position 0 (tRCIP=18.52ns)	t_{RIPI}	-0.25	0.0	+0.25	ns
Input Data Position 1 (tRCIP=18.52ns)	t_{RIP0}	t_{RCIP}/7-0.25	t_{RCIP}/7	t_{RCIP}/7+0.25	ns
Input Data Position 2 (tRCIP=18.52ns)	t_{RIP6}	2 t_{RCIP}/7-0.25	2 t_{RCIP}/7	2 t_{RCIP}/7+0.25	ns
Input Data Position 3 (tRCIP=18.52ns)	t_{RIP5}	3 t_{RCIP}/7-0.25	3 t_{RCIP}/7	3 t_{RCIP}/7+0.25	ns
Input Data Position 4 (tRCIP=18.52ns)	t_{RIP4}	4 t_{RCIP}/7-0.25	4 t_{RCIP}/7	4 t_{RCIP}/7+0.25	ns
Input Data Position 5 (tRCIP=18.52ns)	t_{RIP3}	5 t_{RCIP}/7-0.25	5 t_{RCIP}/7	5 t_{RCIP}/7+0.25	ns
Input Data Position 6 (tRCIP=18.52ns)	t_{RIP2}	6 t_{RCIP}/7-0.25	6 t_{RCIP}/7	6 t_{RCIP}/7+0.25	ns
Phase Lock Loop Set	t_{RPLL}			10	ms
Input Clock Period	t_{RCIP}	12.1	13.1	20	ns
Skew Time between CK1IN and CK2IN	t_{CK12}	-2.0	0.0	+2.0	ns

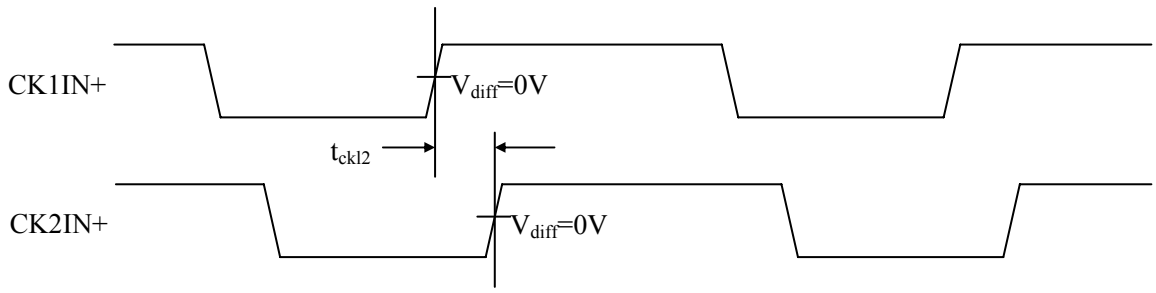
AC Timing Diagrams LVDS Inputs



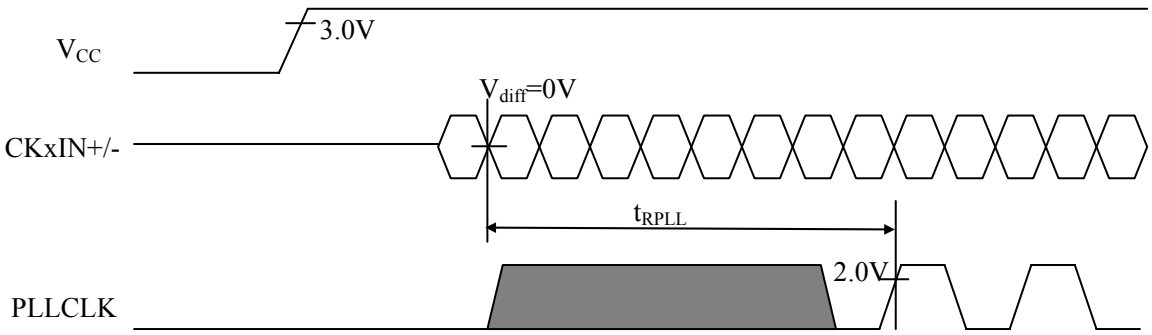
x=1,2
y=0,1,2

※Note
Vdiff=(RxINy+)-(RxINy-), (CKxIN+)-(CKxIN-)

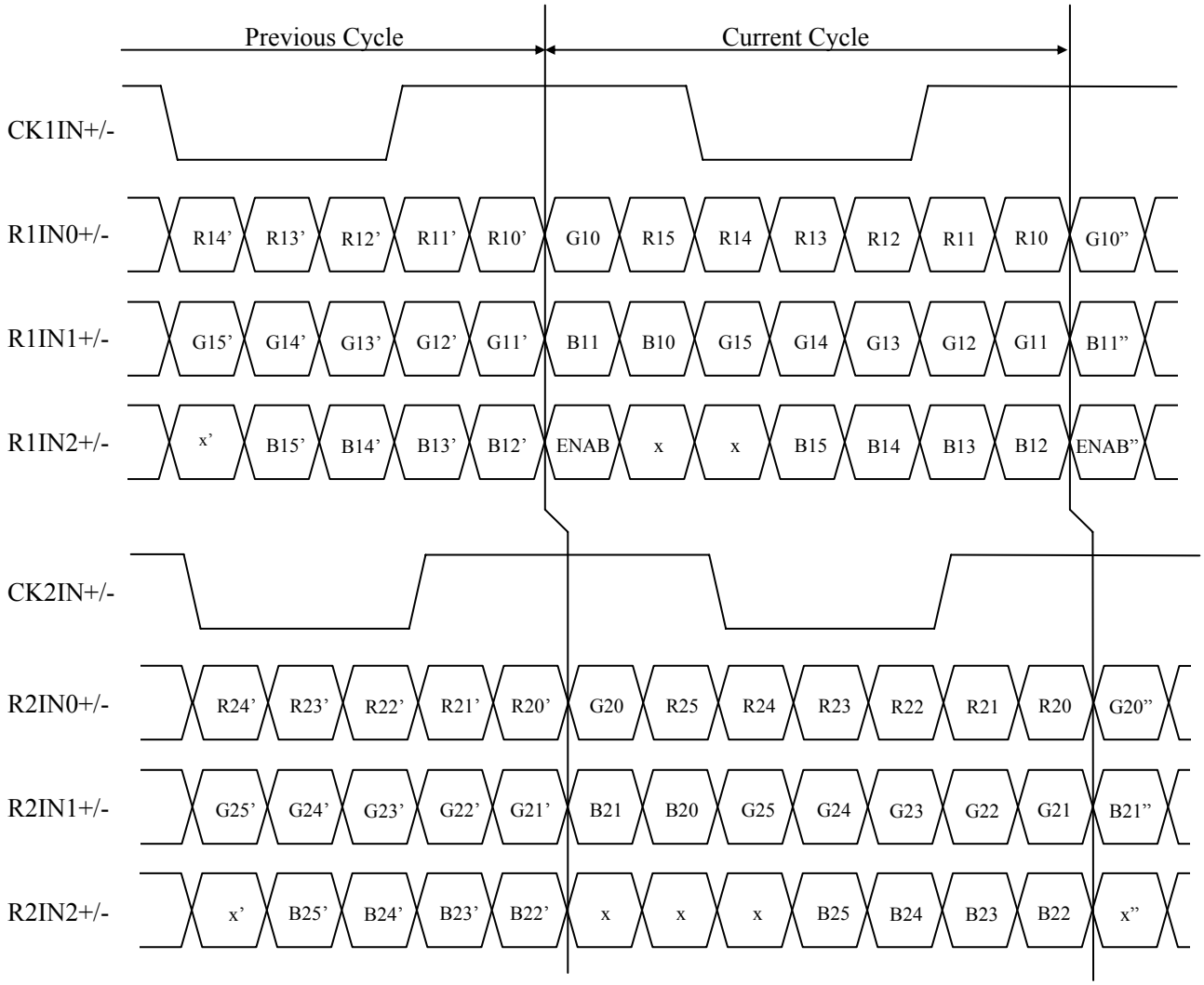
AC Timing Diagrams LVDS Input CLK Skew



LVDS Phase Lock Loop Set



6.2.2.LVDS Data Input Timing



6-3. Backlight driving

6.3.1.Backlight lifetime

The backlight system is an edge-lighting type with single CCFT (Cold Cathode Fluorescent Tube).

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

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Lamp life time	L_L	12,000	—	—	Hour	[Note]

[Note] Lamp life time is defined as the time when ① occurs in the continuous operation under the condition of Ta = 25℃ and SMB_DAT=FF_{HEX}

① Brightness becomes 50 % of the original value under standard condition.

6.3.2. Inverter unit driving Ta=+25℃

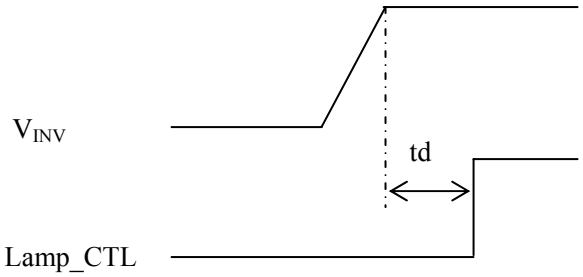
Parameter		Symbol	Condition	Min.	Typ	Max	Unit	Remark
Inverter supply voltage		V_{INV}	—	7.5	—	20.48	V	
Inverter current dissipation		I_{INV}	V_{INV}=7.5V V_{5VALW}=5.0V	60	—	880	mA	[Note]
			V_{INV}=20.48V V_{5VALW}=5.0V	20	—	380		
Brightness control IC supply voltage		V_{5VALW}	—	4.75	5.0	5.2	V	
Brightness control IC current dissipation		I_{5VALW}	V_{5VALW} = 4.75～5.2V SMB_DAT=FF_{HEX}	—	—	15	mA	
SMB_DAT SMB_CLK	Input voltage Low	V_{SMB_H}	V_{5VALW} = 4.75～5.2V	0	—	0.7	V	
	Input voltage High	V_{SMB_L}	V_{5VALW} = 4.75～5.2V	2.1	—	—	V	
INV_PWM	Input voltage Low	V_{PWM_H}	V_{5VALW} = 4.75～5.2V	0	—	0.7	V	
	Input voltage High	V_{PWM_L}	V_{5VALW} = 4.75～5.2V	2.1	—	—	V	

[Note]：Brightness control from minimum to maximum

6.3.3. Power ON/OFF sequence

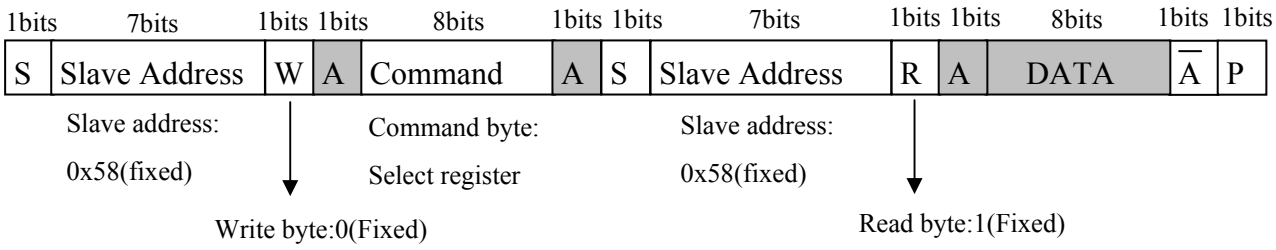
7.5V≦V_{INV}≦20.48 V

20 ms ≦td

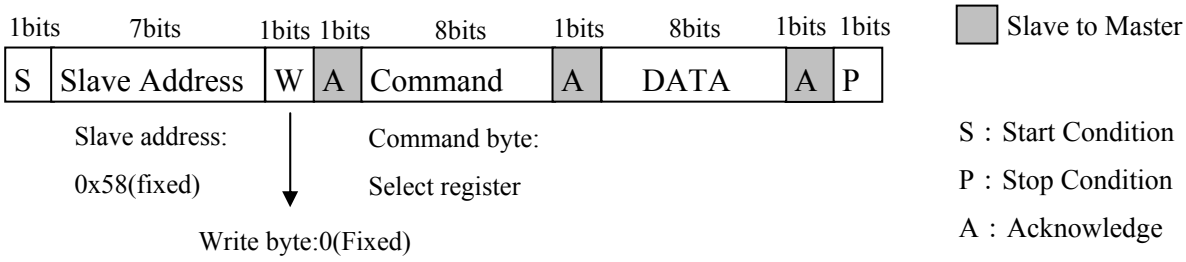


6.3.3 SMB PROTOCOL

1)Read byte format



2)Write byte format



6.3.4 Register Definition

SMBus Protocol	Command byte	Data-Register Bit Assignment							
		Bit7 (MSB)	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0 (LSB)
Read/Write	0x00	BRT7	BRT6	BRT5	BRT4	BRT3	BRT2	BRT1	BRT0
Read/Write	0x01	Reserved	Reserved	ALSDEL1	ALSDEL0	ALS_CTL	PWM_MD	PWM_SEL	LAMP_CTL
Read only	0x02	Reserved	Reserved	Reserved	Reserved	LAMP_STAT	OV_CURR	Reserved	FAULT
Read only	0x03	MFG4	MFG3	MFG2	MFG1	MFG0	REV2	REV1	REV0
Read only	0x04	ALS7	ALS6	ALS5	ALS4	ALS3	ALS2	ALS1	ALS0
Read/Write	0x05	ALSLL7	ALSLL6	ALSLL5	ALSLL4	ALSLL3	ALSLL2	ALSLL1	ALSLL0
Read/Write	0x06	ALSHL7	ALSHL6	ALSHL5	ALSHL4	ALSHL3	ALSHL2	ALSHL1	ALSHL0

1)Brightness Control Register [0x00]

A write-byte cycle to register 0x00 sets the brightness level if the inverter is in SMBus mode.A write-byte cycle to register 0x00 has no effect if the inverter is not in SMBus mode.

A read-byte cycle to register 0x00 returns the current brightness level regardless of the operation mode.

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
BRT7	BRT6	BRT5	BRT4	BRT3	BRT2	BRT1	BRT0

BRT[7..0]：256 Brightness Level

FF: Max. Brightness

↓

00: Min. Brightness

2)Device Control Register [0x01]

This register has a single bit that controls the inverterON/OFF state, 3 bits that control the operating mode of the inverter, and 2 bits for setting ALS delay time.

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Reserved	Reserved	ALSDEL1	ALSDEL0	ALS_CTL	PWM_MD	PWM_SEL	LAMP_CTL

ALSDEL1, ALSDEL0 : ALS delay select bit.

ALS_CTL: Ambient-light-sensor select bit (1 = use ALS, 0 = not use ALS).

PWM_MD: PWM mode select bit (1 = absolute brightness, 0 = percentage change).

PWM_SEL: Brightness control select bit (1 = control by PWM, 0 = control by SMBus).

LAMP_CTL: Inverter on/off bit (1 = on, 0 = off).

A value of 1 written to LAMP_CTL turns on the lamp. A value of zero written to LAMP_CTL turns off the lamp.
The PWM_SEL bit determines whether the SMBus or PWM input should control brightness when the inverter is not in ALS mode. This bit has no effect when ALS_CTL is set to 1.
The PWM_MD bit selects the manner in which the PWM input is to be interpreted. When this bit is zero, the PWM input reflects a percentage change in the current brightness and follows the following equation:

$DPST_{brightness} = BRT_{CURRENT} \times DPWM$

$BRT_{CURRENT}$: the current brightness setting from either ALS or SMBus without influence from the PWM input

DPWM : Duty cycle of the PWM signal

When PWM_MD bit is 1, the PWM input has no effect on the brightness setting unless the inverter is in PWM mode.
When ALS_CTL is 1, the inverter controls brightness based primarily on the light reading from the ALS.However, the ALS brightness setting can be modified if the PWM_MD bit is set to zero. When the ALS_CTL bit is zero, the inverter controls the brightness according to the PWM input (PWM mode), the SMBus setting(SMBus mode), or a combination of the two (SMBus mode with DPST).

Delay Time Setting

ALSDEL1	ALSDEL1	DELAY TIME(ms)
1	1	25
1	0	15
0	1	10
0	0	20 (default)

3)Fault/Status Register [0x02]

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Reserved	Reserved	Reserved	Reserved	LAMP_STAT	OV_CURR	Reserved	FAULT

LAMP_STAT: Lamp status bit (1 = lamp on, 0 = lamp off).

OV_CURR: Secondary/UL overcurrent fault (1 = secondary/UL overcurrent fault, 0 = no secondary/UL overcurrent).

FAULT: Fault bit (1 = open-lamp or primary overcurrent fault, 0 = no fault).

This register has 3 status bits that allow monitoring the inverter's operating state.

Bit 0 is a logical OR of open-lamp fault and overcurrent fault.Bit 2 indicates secondary/UL overcurrent fault.

Bit 3 always indicates the current lamp on/off status.

The remaining bits are reserved. All reserved bits return 0 when read. All the bits in this register are read only. A write-byte cycle to register 0x02 has no effect.

Write zero to bit 0 of register 0x01 to clear the fault bit.

4)Identification Register [0x03]

The identification register contains two bit fields to denote the manufacturer and the silicon revision.

This register is read only. A write-byte cycle to register 0x03 has no effect.

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
MFG4	MFG3	MFG2	MFG1	MFG0	REV2	REV1	REV0

MFG[4..0]: Manufacturer ID (the vendor ID for Maxim is 0).

REV[2..0]: Silicon rev (revs 0–7 allowed for silicon spins).

5)ALS Status Register [0x04]

The ALS should return a value reflecting the brightness setting based on the ALS input. The register has 8 bits that define a full range of 256 brightness levels.

The register is read only and a write-byte cycle has no effect. A read-byte cycle to register 0x04 returns the current reading of ALS, regardless of the operating mode set in register 0x01.

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
ALS7	ALS6	ALS5	ALS4	ALS3	ALS2	ALS1	ALS0

ALS[7..0]: 256 steps of ambient-light sensor reading.

6)ALS Low-Limit Register [0x05]

A write-byte cycle to register 0x05 sets the lowest possible brightness value that can be set based on ALS inputs.

If the brightness setting due to ALS is lower than the value written to this register, the inverter increases the brightness setting to the written value.

A read-byte cycle to register 0x05 returns the current minimum brightness value that can be set based on ALS inputs.

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
ALSLL7	ALSLL6	ALSLL5	ALSLL4	ALSLL3	ALSLL2	ALSLL1	ALSLL0

ALSLL[7..0]: The lowest brightness setting that can be set based on ALS inputs.

7)ALS High-Limit Register [0x06]

A write-byte cycle to register 0x06 sets the highest possible brightness value that can be set based on ALS inputs.

If the brightness setting due to ALS is higher than the value written to this register, the inverter decreases the brightness setting to the written value.

A read-byte cycle to register 0x06 returns the current maximum brightness value that can be set based on ALS inputs.

The default value of register 0x06 is 0xFF,which corresponds to the maximum brightness.

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
ALSHL7	ALSHL6	ALSHL5	ALSHL4	ALSHL3	ALSHL2	ALSHL1	ALSHL0

ALSHL[7..0]: The highest brightness setting that can be set based on ALS inputs.

6.3.5. Brightness Control

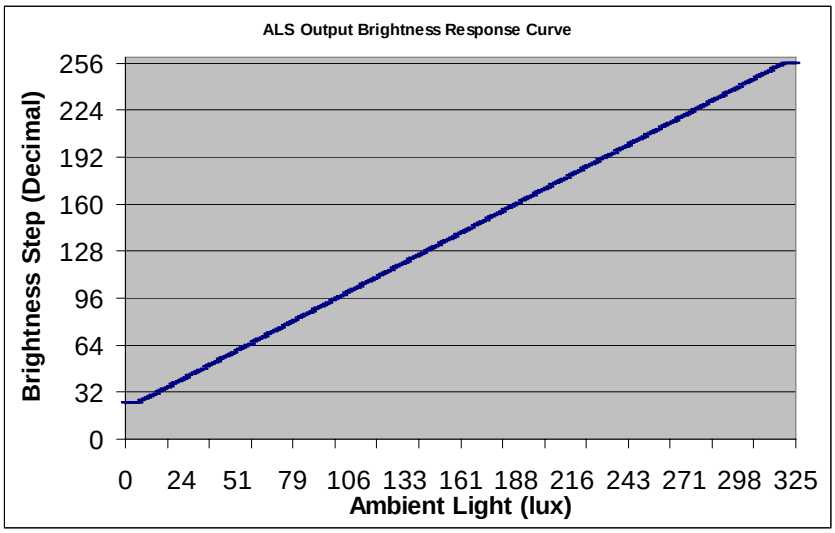
Three inputs can be provided to the inverter for brightness control of the LCD panel SMBus, System PWM, and ALS.

ALS_CTL	PWM_MD	PWM_SEL	MODE
1	1	X	ALS mode
1	0	X	ALS mode with DPST
0	X	1	PWM mode
0	1	0	SMBus mode
0	0	0	SMBus mode with DPST

X : arbitrary

1)ALS Mode

Max. Brightness	Ambient lihgt :320 lux	Hex Setting:0xFF
Min. Brightness	Ambient lihgt :3.2 lux	Hex Setting:0x19
ALS torelance	+/- 12 SMBus brightness steps (For a given ambient light)	
Response time	5sec +/-0.5sec from Min to Max Brightness	



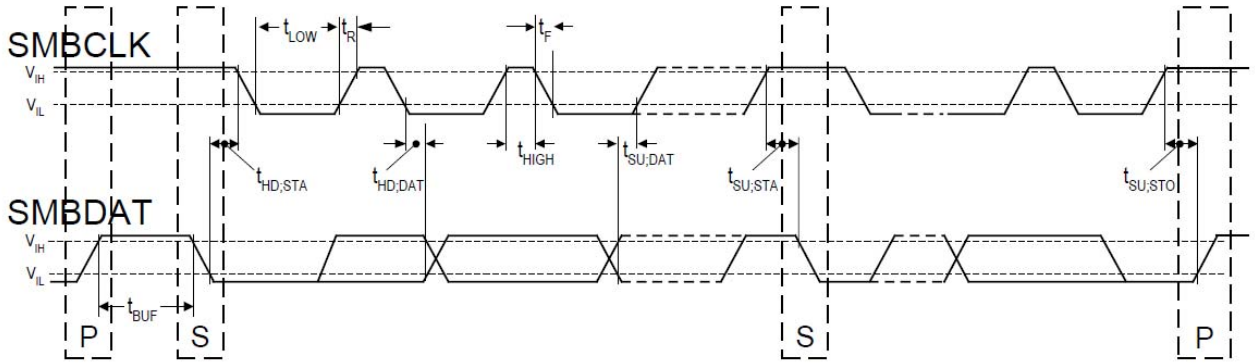
2)PWM Mode

	Condition	Min	Typ	Max	Unit
PWM Input Frequency		5		50	kHz
PWM Brightness Setting	PWM Input Duty=100%	98	100		%
	PWM Input Duty=50%	48	50	52	%
	PWM Input Duty=0%	9.7	10	10.3	%

3)SMBus Mode

Max. Brightness	Hex Setting:0xFF
Min. Brightness	Hex Setting:0x00

6.3.6 AC Characteristics（SMB_DAT,SMB_CLK）



5VALW=4.75～5.2V,Ta=0～50℃

Parameter	Symbol	Min.	Typ.	Max.	Unit.	Remark
SMB_CLK frequency	f_{SMB}	10	—	100	k Hz	
Bus Free Time Between STOP and START Condition	t_{BUF}	4.7	—	—	μ s	
Hold Time after (Repeated) START Condition	$t_{HD:STA}$	4.0	—	—	μ s	
Repeated Start Condition setup time	$t_{SU:STA}$	4.7	—	—	μ s	
STOP Condition setup time	$t_{SU:STO}$	4.0	—	—	μ s	
Data hold time	$t_{HD:DAT}$	0	—	—	ns	
Data setup time	$t_{SU:DAT}$	250	—	—	ns	
Clock low period	t_{LOW}	4.7	—	—	μ s	
Clock high period	t_{HIGH}	4.0	—	50	μ s	

7. Timing characteristics of input signals

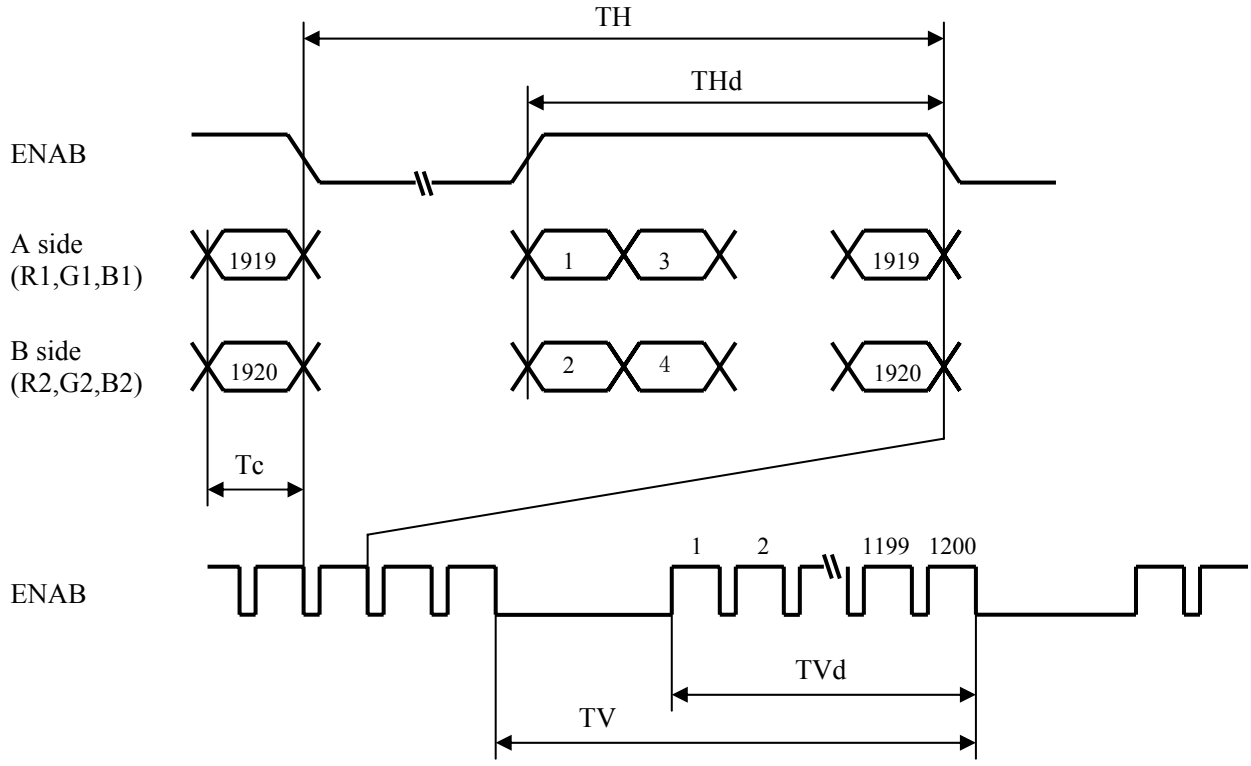
7-1. Timing characteristics

Vcc=+3.0V～+3.6V, Ta＝0℃～+50℃

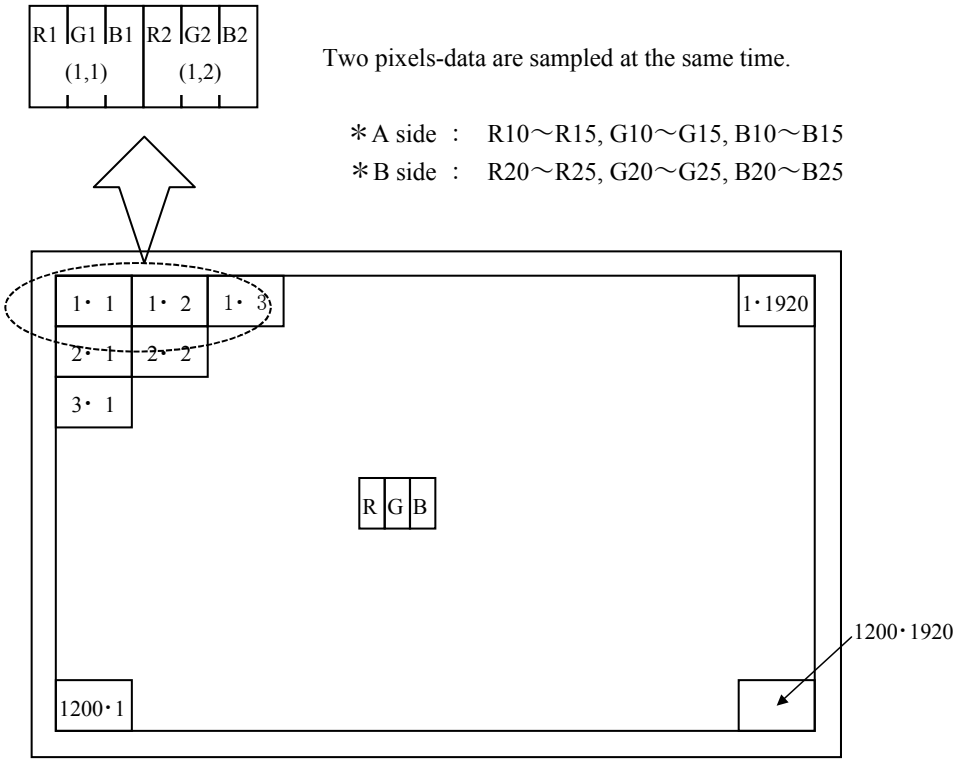
Parameter		Symbol	Min.	Typ.	Max.	Unit	Remark
Clock	Frequency	1/Tc	50	75.875	82.5	MHz	[Note 1]
Data enable Signal	Horizontal period	TH	1000	1024	1106	clock	
			13.2	13.5	－	μs	
	Horizontal period (High)	THd	960	960	960	clock	
	Vertical period	TV	1202	1235	1280	Line	[Note 2]
			16.22	16.67	－	ms	
	Vertical period (High)	TVd	1200	1200	1200	line	

[Note 1] Two pixels-data are sampled at the same time.

[Note 2] In case of using the long vertical period, the deterioration of display quality, flicker, etc, may occur.



7-2. Input Data Signals and Display Position on the screen



Display position of input data(V・ H)

8. Input Signals, Basic Display Colors and Gray Scale of Each Color

	Colors & Gray scale	Gray Scale	Data signal																	
			R10	R11	R12	R13	R14	R15	G10	G11	G12	G13	G14	G15	B10	B11	B12	B13	B14	B15
			R20	R21	R22	R23	R24	R25	G20	G21	G22	G23	G24	G25	B20	B21	B22	B23	B24	B25
Basic Color	Black	—	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	1	1	1	1	1	1
	Green	—	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Cyan	—	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Red	—	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	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
Gray Scale of Red	Black	GS0	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
	Darker	GS2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑	↓				↓						↓						↓		
	↓	↓				↓						↓						↓		
	Brighter	GS61	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	↓	GS62	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red	GS63	1	1	1	1	1	1	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
	↑	GS1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	Darker	GS2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	↑	↓				↓						↓						↓		
	↓	↓				↓						↓						↓		
	Brighter	GS61	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0	0	0
	↓	GS62	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0
	Green	GS63	0	0	0	0	0	0	1	1	1	1	1	1	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
	↑	GS1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	Darker	GS2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	↑	↓				↓						↓						↓		
	↓	↓				↓						↓						↓		
	Brighter	GS61	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1
	↓	GS62	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
	Blue	GS63	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

0 : Low level voltage, 1 : High level voltage

Each basic color can be displayed in 64 gray scales from 6 bit data signals. According to the combination of total 18 bit data signals, the 262,144-color display can be achieved on the screen.

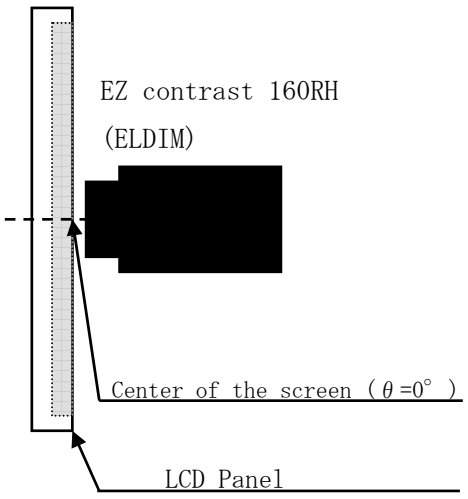
9. Optical Characteristics

Ta=+25℃, Vcc=+3.3V

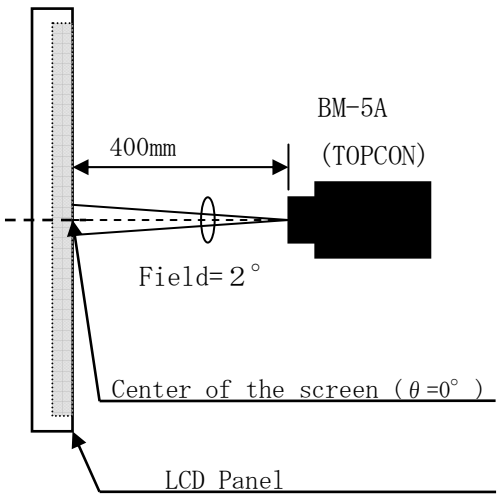
Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing angle range	Horizontal	θ 21, θ 22	CR>10	60	70	—	Deg.	[Note 1,3,6]
	Vertical	θ 11		40	50	—	Deg.	
		θ 12		50	60	—	Deg.	
Contrast ratio		CRn	θ =0°	300	—	—		[Note 2,4,6]
		Cro	Optimum viewing angle	300	550	—		
Response time		τ r+ τ d	θ =0°	—	30	35	ms	[Note 2,4,6]
Chromaticity of white		x		0.263	0.313	0.363		[Note 2,6]
		y		0.279	0.329	0.379		
Chromaticity of red		x		0.543	0.593	0.643		
		y		0.275	0.325	0.375		
Chromaticity of green		x		0.265	0.315	0.365		
		y		0.499	0.549	0.599		
Chromaticity of blue		x		0.101	0.151	0.201		
		y		0.078	0.128	0.178		
Luminance of white		Y_{LI}		180	230	—	cd/m^2	[Note 2,7] Vin= 21V SDA＝FF_{HEX}
White Uniformity		Δ_W		—	0.1	0.25		[Note 2,8]

※ The measurement shall be executed 30 minutes after lighting at rating.
(typical condition : SDA=FF_{HEX})
The optical characteristics shall be measured in a dark room or equivalent.

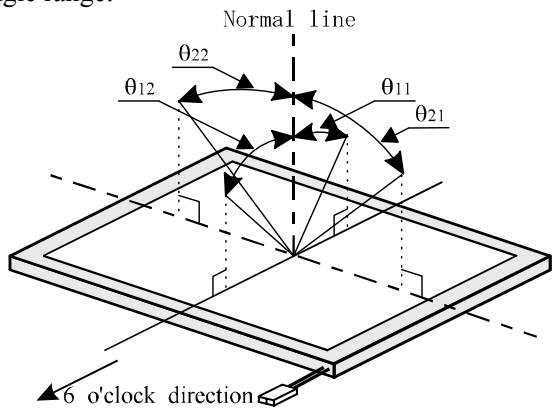
[Note 1] Measuring Viewing Angle Range



[Note 2] Other Measurements



[Note 3] Definitions of viewing angle range:



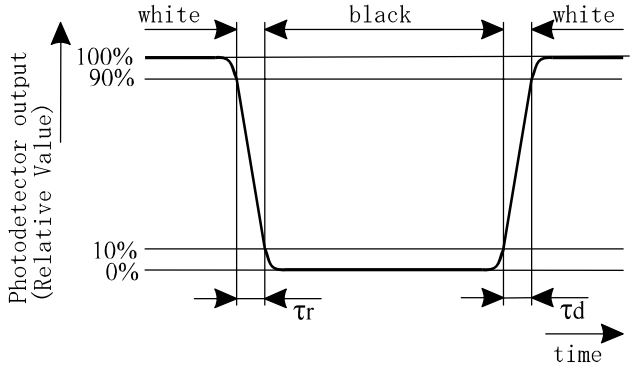
[Note 4] Definition of contrast ratio:

The contrast ratio is defined as the following.

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

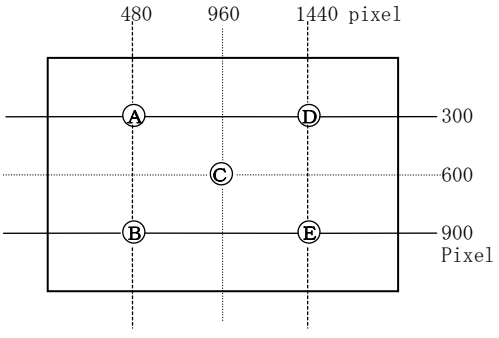
[Note 5] Definition of response time:

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white" .



[Note 6] This shall be measured at center of the screen.

[Note 7] Average of five point.(A~E)



[Note 8] Definition of white uniformity:

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

$$\delta w = \frac{\text{Maximum Luminance of five points (brightness)} - \text{Minimum Luminance of five points (brightness)}}{\text{Maximum Luminance of five points (brightness)}}$$

10. Display Quality

The display quality of the color TFT-LCD module shall be in compliance with the Incoming Inspection Standard.

11. Handling Precautions

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

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

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

d) Wipe off water drop immediately. Long contact with water may cause discoloration or spots.

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

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

g) Since CMOS LSI is used in this module, take care of static electricity and injure the human earth when handling. Observe all other precautionary requirements in handling components.

h) This module has its circuitry PCBs on the rear side and should be handled carefully in order not to be stressed.

i) Please handle carefully not to charge excessive stress onto the back of the module. Excessive stress may cause unrepairable damage to the module.

j) Protect sheet is attached to the module surface to prevent it from being scratched. Peel the sheet off slowly just before the use with strict attention to electrostatic charges. Ionized air shall be blown over during the action. Blow off the 'dust' on the polarizer by using an ionized nitrogen gun, etc..

k) Do not expose the LCD module to a direct sunlight, for a long period of time to protect the module from the ultra violet ray.

l) Connect GND of mounting holes to stabilize against EMI and external noise.

m) There are high voltage portions on the backlight and very dangerous. Careless touch may lead to electrical shock. When exchange lamps or service, turn off the power without tail.

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) Cold cathode fluorescent lamp in LCD panel contains a small amount of mercury, please follow local ordinances or regulations for disposal.

p) Be sure not to apply tensile stress to the lamp lead cable.

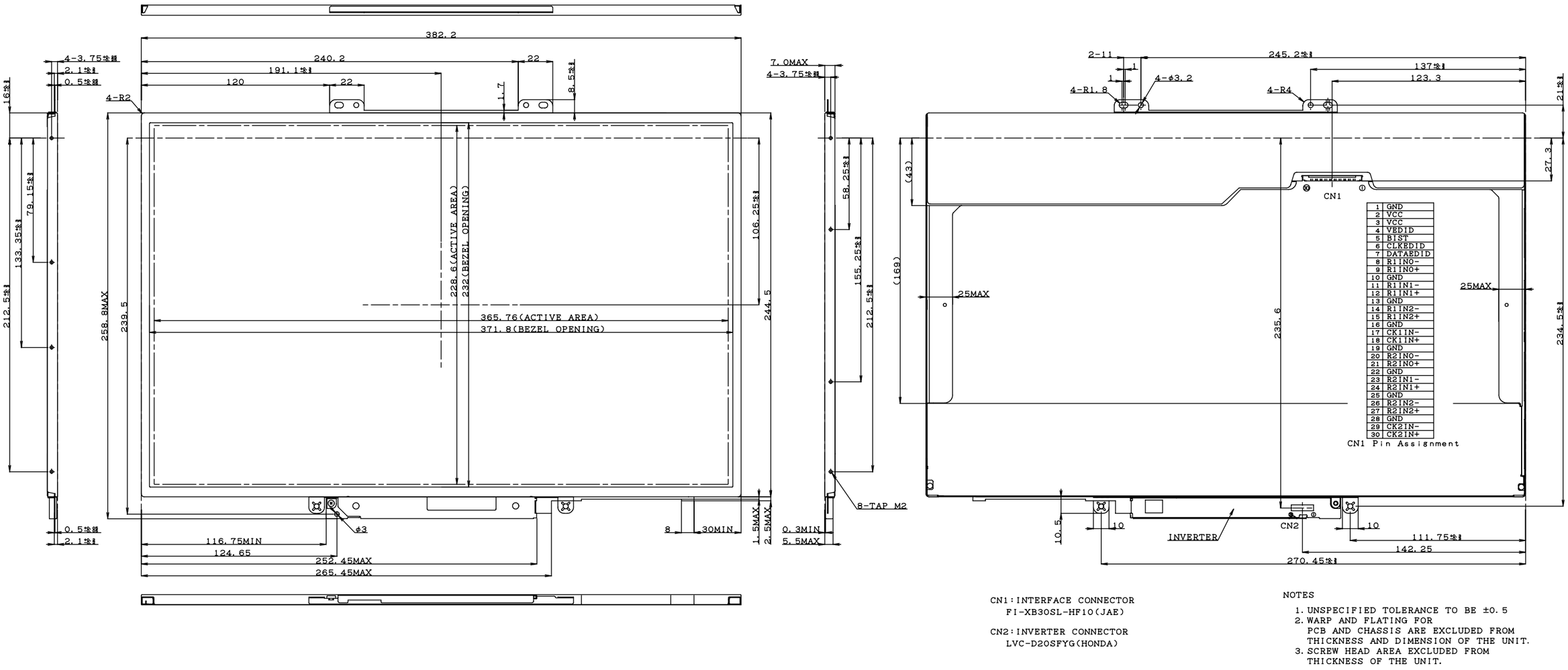
q) Adjusting volume have been set optimally before shipment, so do not change any adjusted value. If adjusted value is changed, the specification may not be satisfied.

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

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

12. Packing form

Piling number of cartons	Max.5
Package quantity in one carton	10 pcs
Carton size	463(W)×380(D)×318(H) mm
Total mass of one carton filled with full modules	9.4kg



CN1:INTERFACE CONNECTOR
FI-XB30SL-HF10(JAE)

CN2:INVERTER CONNECTOR
LVC-D20SFYG(HONDA)

NOTES

1. UNSPECIFIED TOLERANCE TO BE ±0.5
2. WARP AND FLATING FOR PCB AND CHASSIS ARE EXCLUDED FROM THICKNESS AND DIMENSION OF THE UNIT.
3. SCREW HEAD AREA EXCLUDED FROM THICKNESS OF THE UNIT.

D/N:2D-05Z-087-00

Fig1. OUTLINE DIMENSIONS