SHARP

TECHNICAL   LITERATURE

FOR

TFT - LCD   module

MODEL No. LQ072K1LAxx

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Engineering Department III
Mobile LCD Design Center I
MOBILE LIQUID CRYSTAL DISPLAY GROUP
SHARP CORPORATION

RECORDS OF REVISION

LQ072K1LAxx

SPEC No.	DATE	REVISED No.	PAGE	SUMMARY	NOTE
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Table of contents

1. Application

This technical literature applies to a color TFT-LCD module, LQ072K1LAxx.

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 1024×3×768 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.

In this TFT-LCD panel , low reflection / color filters of excellent color performance and backlights of high brightness are incorporated to realize brighter and clearer pictures, making this model optimum for use in multi-media applications.

Optimum viewing direction is 6 o'clock.

White-LED Backlight-driving DC/DC converter is not built in this module.

3. Mechanical Specifications

Parameter	Specifications	Unit
Display size	18.4 (7.2") Diagonal	cm
Active area	157.44 (H)×94.464 (V)	mm
Pixel format	1280 (H)×768 (V)	pixel
	(1 pixel = R+G+B dots)	
Aspect ratio	15 : 9	
Pixel pitch	0.123 (H)×0.123 (V)	mm
Pixel configuration	R,G,B vertical stripe	
Display mode	Normally white	
Surface treatment	Glare and hard-coating 2H Low reflection	

Parameter		Min.	Typ.	Max.	Unit
Unit outline dimensions [Note 1]	Width	184.5	185.0	185.5	mm
	Height	115.4	115.9	116.4	mm
	Depth	—	—	7.5	mm
Mass		—	140	155	g

[Note 1] Outline dimensions is shown in Fig.2

4. Input Terminals

4-1. TFT-LCD panel driving

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

Pin No.	Symbol	Function	Remark
1	Vcc	+3.3V power supply	
2	Vcc	+3.3V power supply	
3	GND		
4	GND		
5	RxIN0-	Receiver signal of LVDS CH0 (-)	[Note 1]
6	RxIN0+	Receiver signal of LVDS CH0 (+)	[Note 1]
7	RxIN1-	Receiver signal of LVDS CH1 (-)	[Note 1]
8	RxIN1+	Receiver signal of LVDS CH1 (+)	[Note 1]
9	RxIN2-	Receiver signal of LVDS CH2 (-)	[Note 1]
10	RxIN2+	Receiver signal of LVDS CH2 (+)	[Note 1]
11	CK IN-	Receiver signal of LVDS CLK (-)	[Note 1]
12	CK IN+	Receiver signal of LVDS CLK (+)	[Note 1]
13	GND		
14	GND		

[Note 1] Relation between RxINi(i=0,1,2) and actual data is shown in following section (4-2)(7-2).

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

CN2 (White-LED Backlight power supply)

Pin No.	Symbol	Function	Remark
1	$V_{LEDGND4}$	LED-GND4	
2	$V_{LEDGND3}$	LED-GND3	
3	$V_{LEDGND2}$	LED-GND2	
4	$V_{LEDGND1}$	LED-GND1	
5	$V_{LEDvcc4}$	LED-VCC4	
6	$V_{LEDvcc3}$	LED-VCC3	
7	$V_{LEDvcc2}$	LED-VCC2	
8	$V_{LEDvcc1}$	LED-VCC1	

Connector part No.

	Connector part No.	User's Connector part No.
CN1	20268-014E-01F (I-PEX)	20230-014B (I-PEX) or equivalent
CN2	DF19G-8P-1H (HIROSE)	DF19-8S-1C (HIROSE) or equivalent

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

4-2   LVDS interface block diagram

LVDS receiver : Single LVDS interface contained in a control IC

Corresponding Transmitter : THC63LVDM63A (THINE) or equivalent
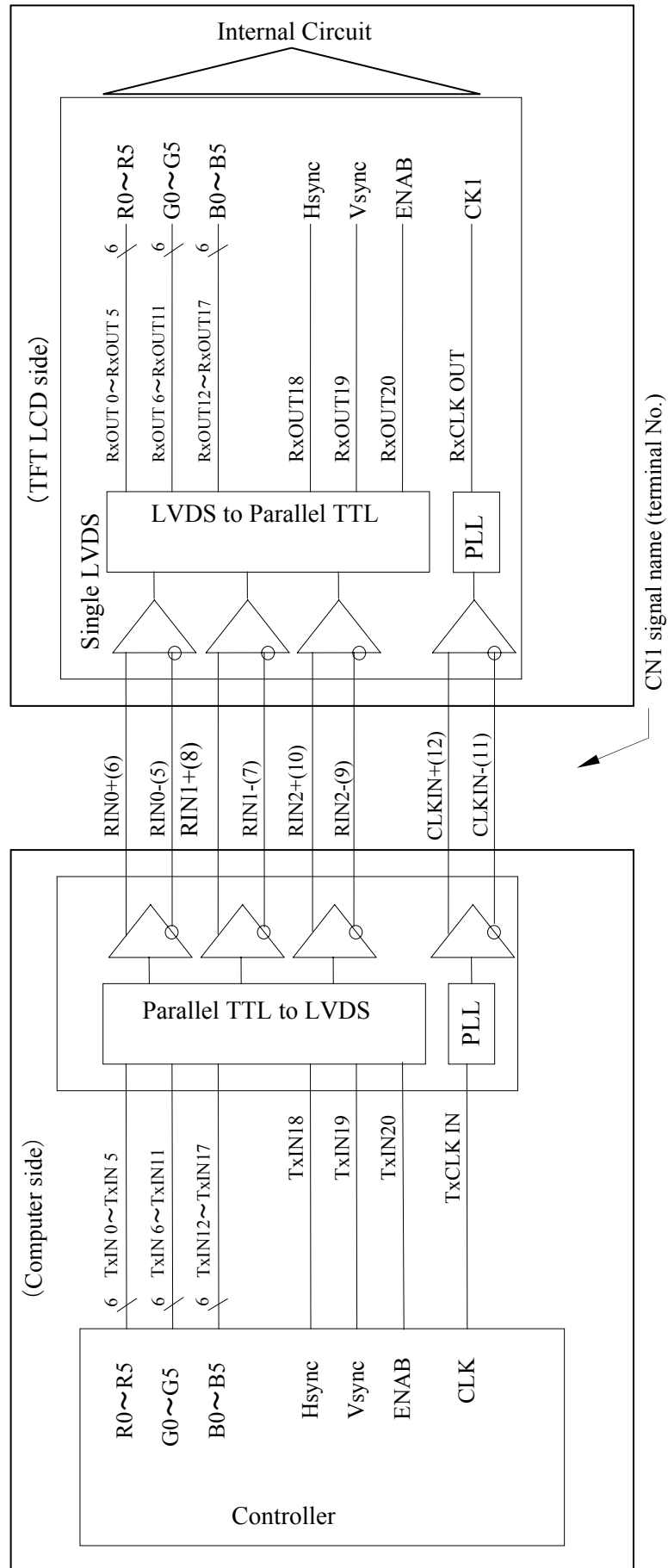
5. Absolute Maximum Ratings

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	
LED forward current	I_{LED}	Ta=25℃	0	30	mA	
LED reverse voltage	V_{LED_R}	Ta=25℃	—	5	V	
Storage temperature	Tstg	—	-25	+60	℃	[Note 2]
Operating temperature (Ambient)	Topa	—	0	+50	℃	

[Note 1] LVDS signals

[Note 2] 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	—	330	450	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_{OH}	—	—	±10	μA	V_I = +2.4V Vcc = +3.6V
Input current (Low)		I_{OL}	—	—	±10	μA	V_I = 0V Vcc = 3.6V
Terminal resistor		R_T	—	100	—	Ω	Differential input

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

[Note 2]
On-off conditions for supply voltage
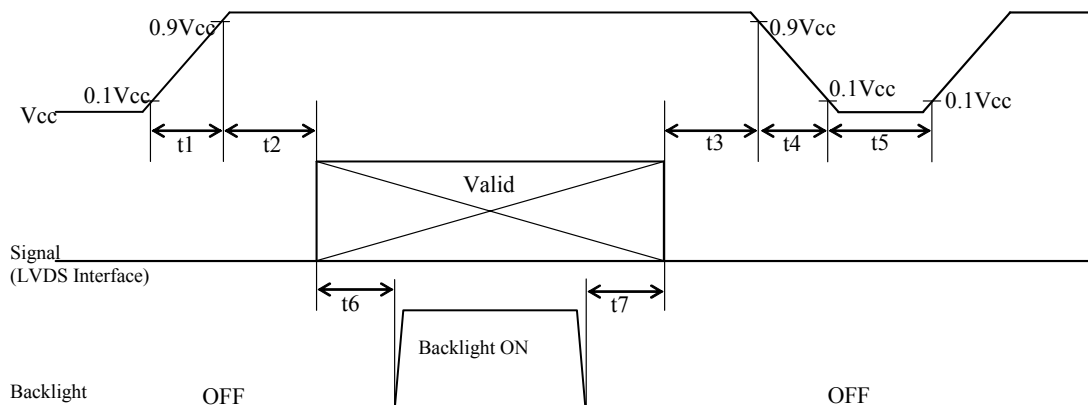
Symbol	Min.	Max.	Unit	Remark
t1	0	10	ms	
t2	0	100	ms	
t3	0	50	ms	
t4	0	400	ms	
t5	200	—	ms	
t6	180	—	ms	*1
t7	5	—	ms	*1

*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.

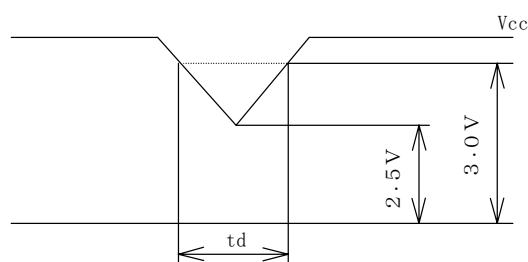[Note] Do not keep the interface signal high-impedance or unusual signal when power is on.

Vcc-dip conditions
1) $2.5\,V \leqq Vcc < 3.0\,V$
  $td \leqq 10\,ms$

Under above condition, the display image should return
to an appropriate figure after Vcc voltage recovers.
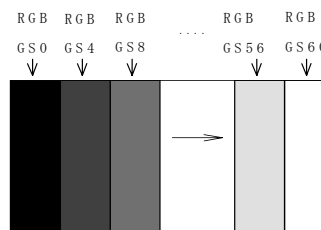
2) $Vcc < 2.5\,V$
Vcc-dip conditions should also follow the
On-off conditions for supply voltage

[Note 3] Typical current situation :
  16-gray-bar pattern.
  Vcc=+3.3V,clock frequency 81MHz

6-2. Backlight driving

The backlight system is edge-lighting type with 32 White-LED(White Light Emitting Diode).

The characteristics of White-LED are shown in the following table.   (Ta=25 ^{o}C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
LED voltage	V_L	—	27.44	30.96	V	
LED current range	V_L	2	15	15	mA	Value for one string
Number of circuit strings		—	4	—		[Note 1]
Lamp power consumption	W_L	—	1.65	—	W	[Note 2]
LED life time	L_L	10000	—	—	Hour	[Note 3]

[Note 1] The LED backlight is composed by 4 strings from which 8 LED is connected with the series.

The figure below shows the circuit chart of each string.

In each circuit, there is a ceramic capacitor for the electrostatic protection.

Ceramic capacitor 0.1uF/B   White LED×8

$V_{LEDVCC1\sim4}$

$V_{LEDGND1\sim4}$
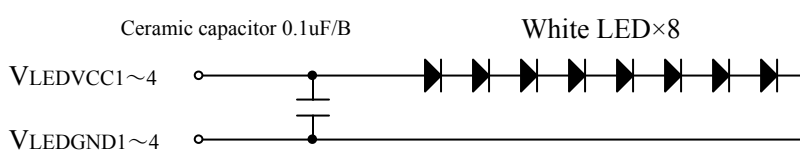
[Note 2] Calculated value for reference ($I_L \times V_L$)

[Note 3] LED life time is defined as the time when Brightness becomes 50 % of the original value.

under the condition of Ta = 25℃ and I_f = 15 mA,and continuous lighting.

[Note 4] Figure 3 shows the reference circuit to drive the LED circuit.

6-3. LVDS input specification

6-3-1. AC characteristics

Vcc=+3.0V～+3.6V,　Ta＝0℃～+50℃

Parameter	Symbol	Min	Typ.	Max.	Unit
Input Data Position 0 (tRCIP=15.38ns)	t_{RIP1}	-0.25	0.0	+0.25	ns
Input Data Position 1 (tRCIP=15.38ns)	t_{RIP0}	$t_{RCIP}/7-0.25$	$t_{RCIP}/7$	$t_{RCIP}/7+0.25$	ns
Input Data Position 2 (tRCIP=15.38ns)	t_{RIP6}	$2\,t_{RCIP}/7-0.25$	$2\,t_{RCIP}/7$	$2\,t_{RCIP}/7+0.25$	ns
Input Data Position 3 (tRCIP=15.38ns)	t_{RIP5}	$3\,t_{RCIP}/7-0.25$	$3\,t_{RCIP}/7$	$3\,t_{RCIP}/7+0.25$	ns
Input Data Position 4 (tRCIP=15.38ns)	t_{RIP4}	$4\,t_{RCIP}/7-0.25$	$4\,t_{RCIP}/7$	$4\,t_{RCIP}/7+0.25$	ns
Input Data Position 5 (tRCIP=15.38ns)	t_{RIP3}	$5\,t_{RCIP}/7-0.25$	$5\,t_{RCIP}/7$	$5\,t_{RCIP}/7+0.25$	ns
Input Data Position 6 (tRCIP=15.38ns)	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}	14.9	15.4	20	ns

LVDS input timing
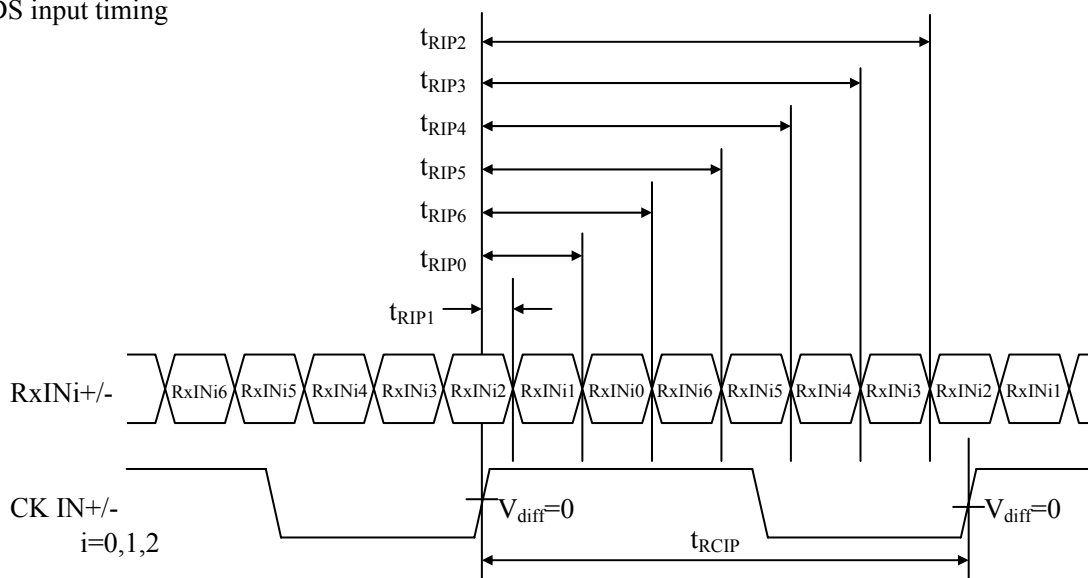
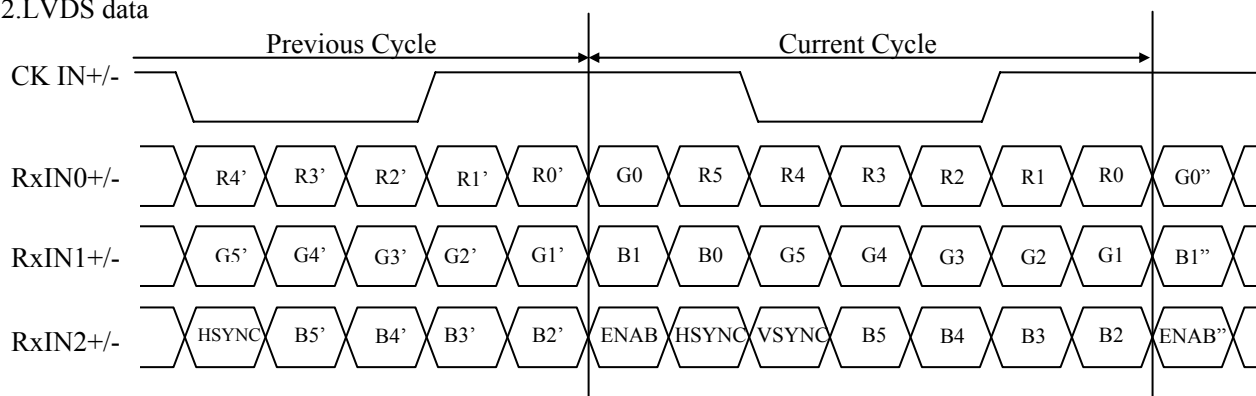※Note
Vdiff=(RxINi+)-(RxINi-),　(CK IN+)-(CK IN-)
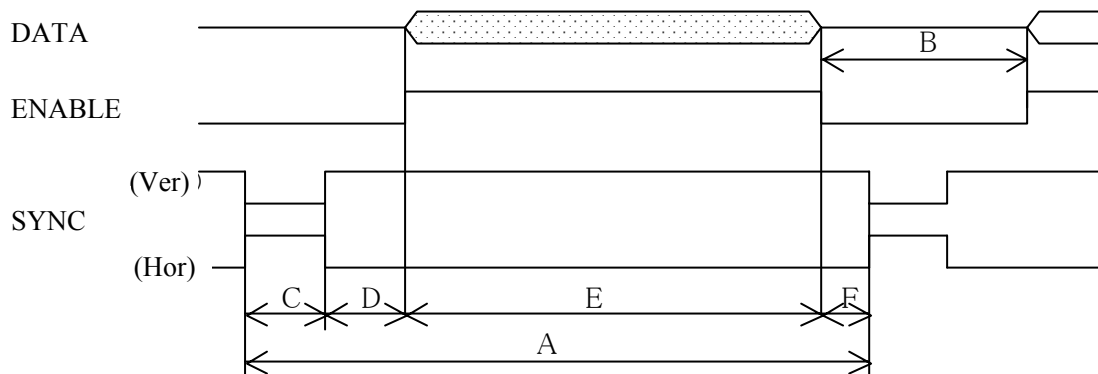
LVDS phase lock loop set
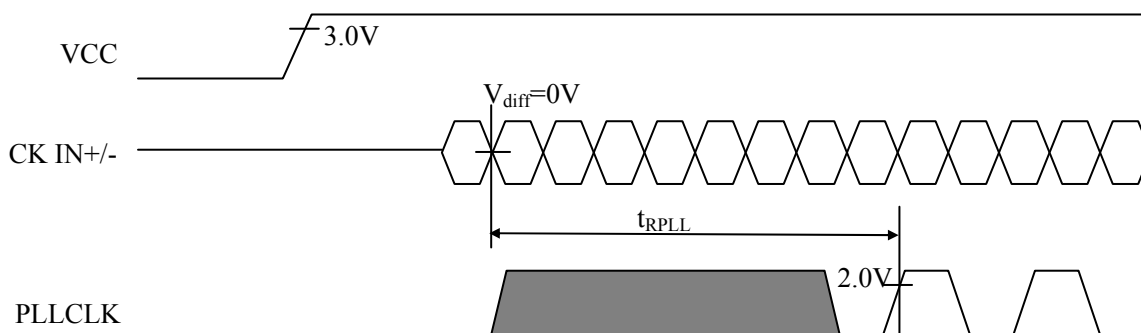
6-3-2.LVDS data

7. Timing Characteristics of Input Signals

7-1. Timing characteristics

(This is specified at digital outputs of LVDS driver.)

(Vertical)

Item (symbol)	Min.	Typ.	Max.	Unit	Remark
Vsync cycle (T_{VA})	-	16.7	-	ms	Negative
	800	802	900	line	
Blanking period (T_{VB})	32	34	132	line	
Sync pulse width (T_{VC})	2	6	-	line	
Sync pulse width + Back porch($T_{VC}+T_{VD}$)	31	31	31	line	
Active display area (T_{VE})	768	768	768	line	
Front porch (T_{VF})	1	3	-	line	

(Horizontal)

Item (symbol)	Min.	Typ.	Max.	Unit	Remark
Hsync cycle (T_{HA})	20.26	20.8	24.70	us	Positive
	1652	1688	1856	clock	
Blanking period (T_{HB})	372	408	576	clock	
Sync pulse width (T_{HC})	2	112	-	clock	
Sync pulse width + Back porch ($T_{HC} + T_{HD}$)	4	360	T_{HA}-1280	clock	
Active display area (T_{HE})	1280	1280	1280	clock	

(Clock)

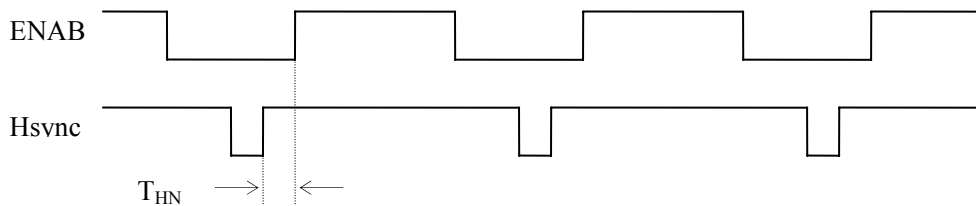| Item (symbol)	Min.	Typ.	Max.	Unit	Remark
Frequency	70	81	81	MHz	[Note1]

[Note1] In case of lower frequency, the deterioration of display quality, flicker etc., may be occurred.

(Hsync-Vsync Phase difference)
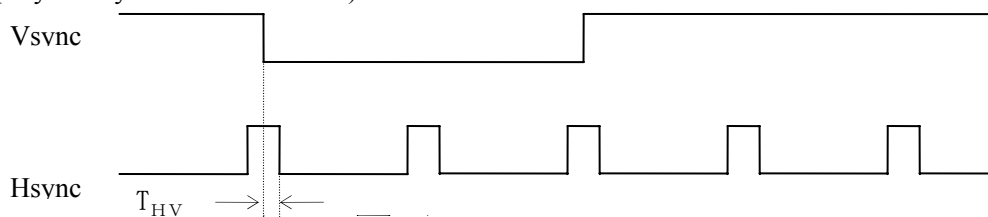
Item (symbol)	Min.	Typ.	Max.	Unit	Remark
Hsync-Vsync Phase difference (T_{HV})	1	-	T_{HA}-T_{HC}	clock	

(Hsync-ENAB Phase difference)

ENAB

Hsync

T_{HN} → ←

Item	Min.	Typ.	Max.	Unit	Remark
Hsync-ENAB Phase difference (T_{HN})	2	-	376	clock	

7-2. Display position

Item	Standards	Beginning	Ending	Unit	Remark
Horizontal	rising edge of ENAB	0	1280	clock	
	falling edge of Hsync	360	1640	clock	[Note 1]
Vertical	falling edge of Vsync	31	799	clock	

[Note 1] ENAB signal must be fixed to low.

[Note]

(Horizontal display direction)

When ENAB is fixed low, 360 clocks are counted from Hsync negative edge and data from after are available. If you need other timing, please use ENAB signal.

(Vertical display direction)

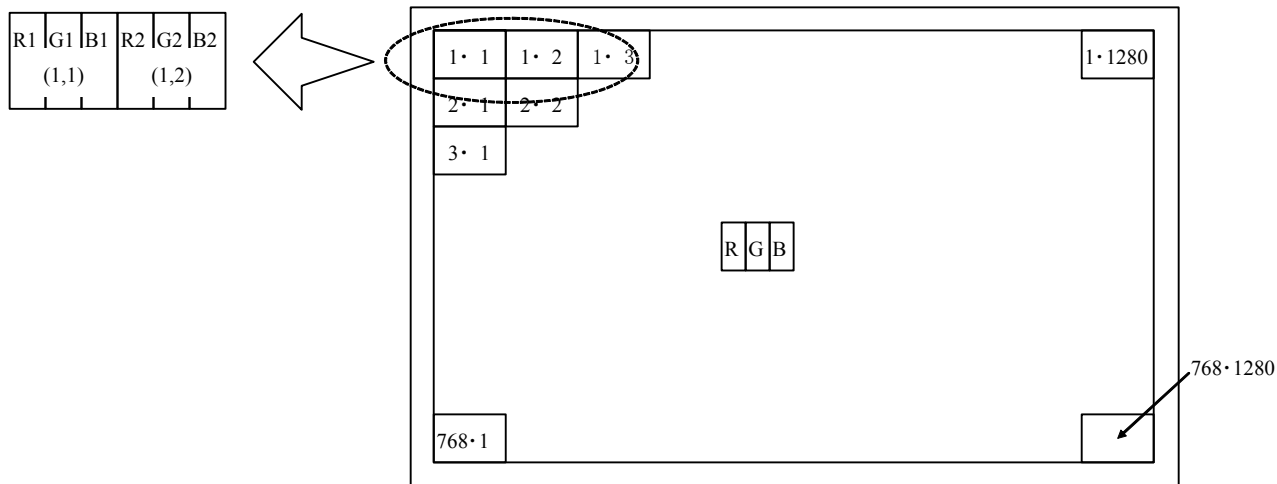31 lines are counted from Vsync negative edge and data from next line are available.

(ENAB signal)

ENAB could not be used for the purpose of the vertical display start timing.

Caution

Image will not be displayed on the right position otherwise.

7-3. 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	R0	R1	R2	R3	R4	R5	G0	G1	G2	G3	G4	G5	B0	B1	B2	B3	B4	B5
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.
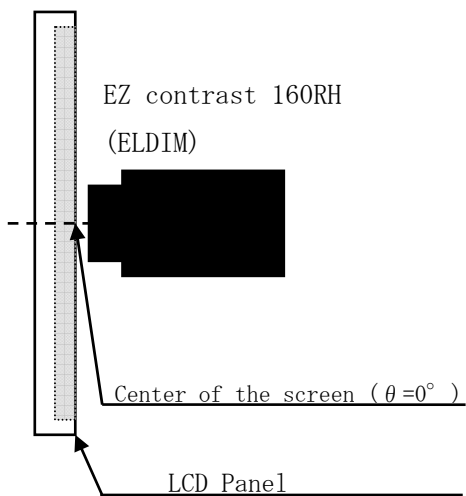
9. Optical Characteristics

Ta=+25℃, Vcc=+3.3V

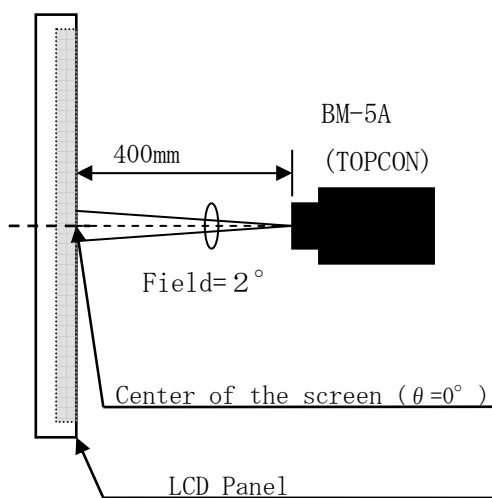| Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing angle range	Horizontal	$\theta 21, \theta 22$	CR>10	50	60	—	Deg.	[Note 1,3,6]
	Vertical	$\theta 11$		35	45	—	Deg.	
		$\theta 12$		50	60	—	Deg.	
Contrast ratio		CRn	$\theta =0°$	150	—	—		[Note 2,4,6]
		CRo	Optimum viewing angle	150	350	—		
Response time		$\tau r+ \tau d$		—	45	—	ms	[Note 2,5,6]
Chromaticity of white		x	$\theta =0°$	0.280	0.330	0.380		[Note 2,6]
		y		0.306	0.356	0.406		
Luminance of white		Y_{LI}		175	235	—	cd/m^2	I_f=15mA [Note 2,7]
White Uniformity		δw		—	—	2.0		[Note 2,8]

※ The measurement shall be executed 30 minutes after lighting at rating. Condition : (I_f=15mA)

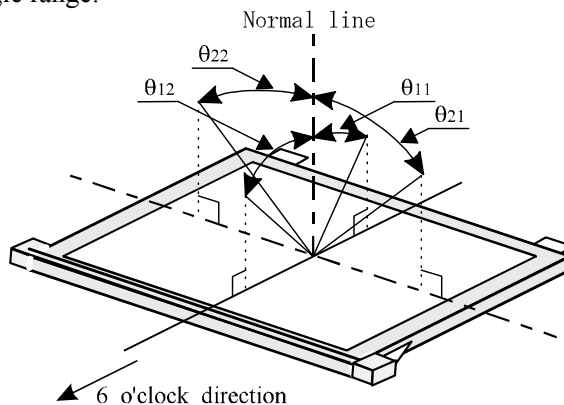The optical characteristics shall be measured in a dark room or equivalent.

[Note 1] Measuring Viewing Angle Range

[Note 2] Other Measurements

EZ contrast 160RH
(ELDIM)

Center of the screen (θ=0°)

LCD Panel

BM-5A
(TOPCON)

400mm

Field=2°

Center of the screen (θ=0°)

LCD Panel

[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".
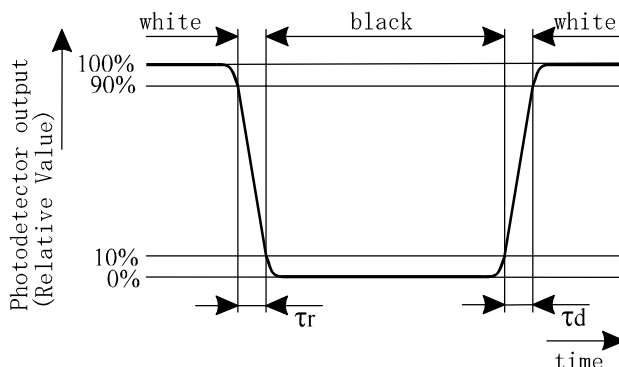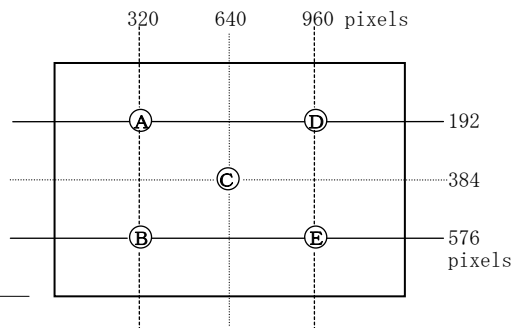

[Note 6] This shall be measured at center of the screen.

[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).

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

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) 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..

j) 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.

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

l) 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.

m) 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.

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

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

12. Packing Form

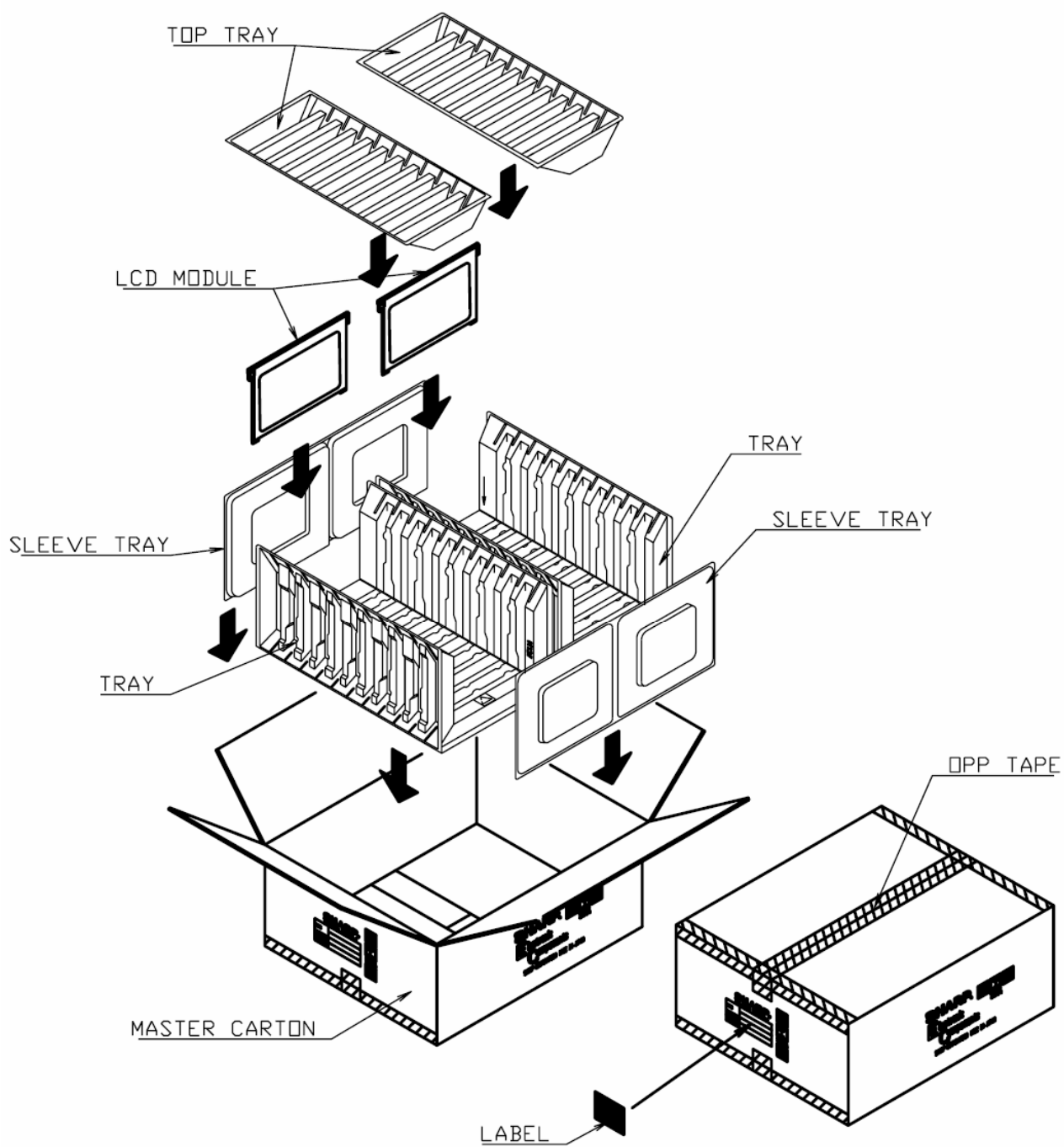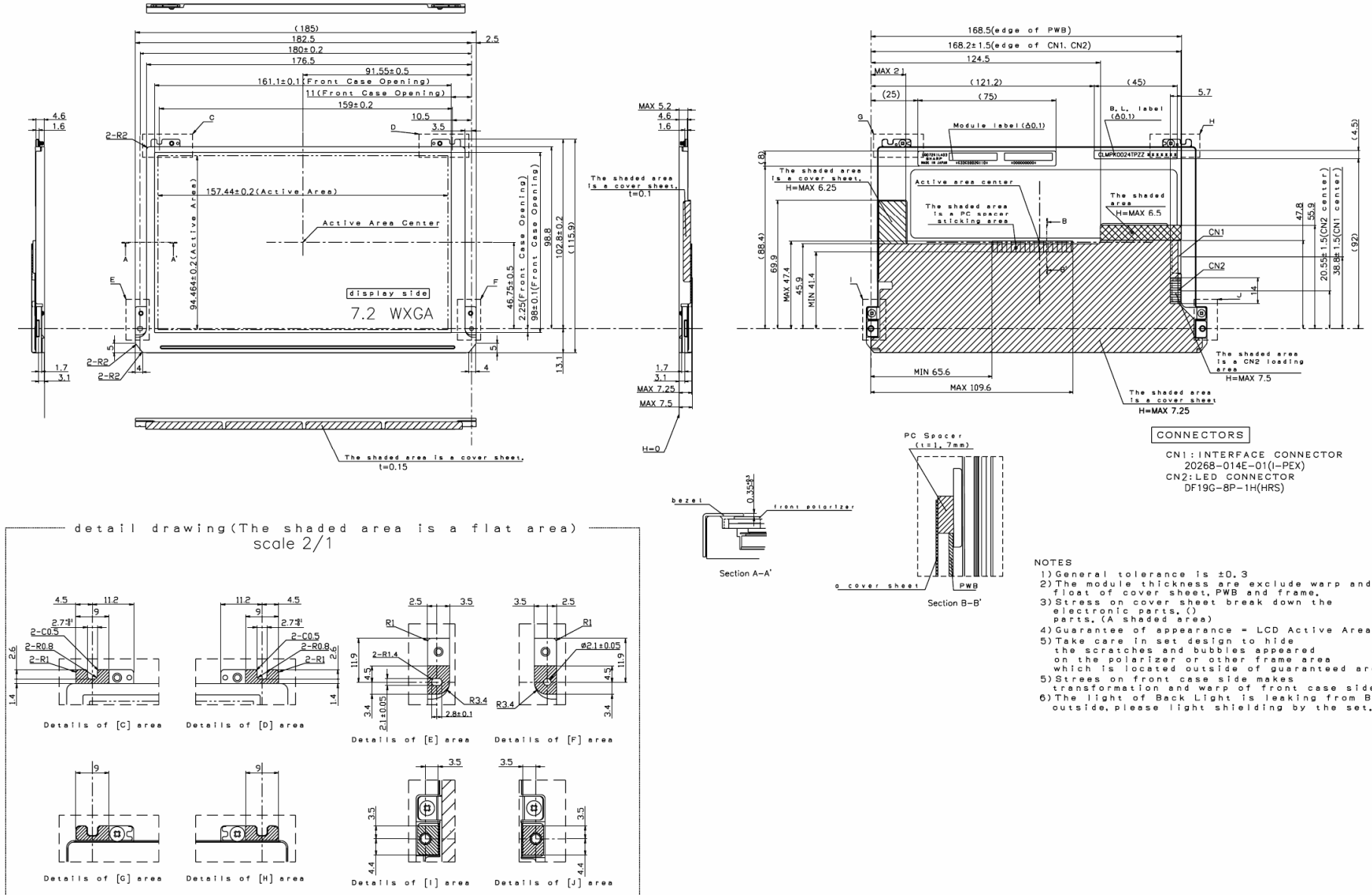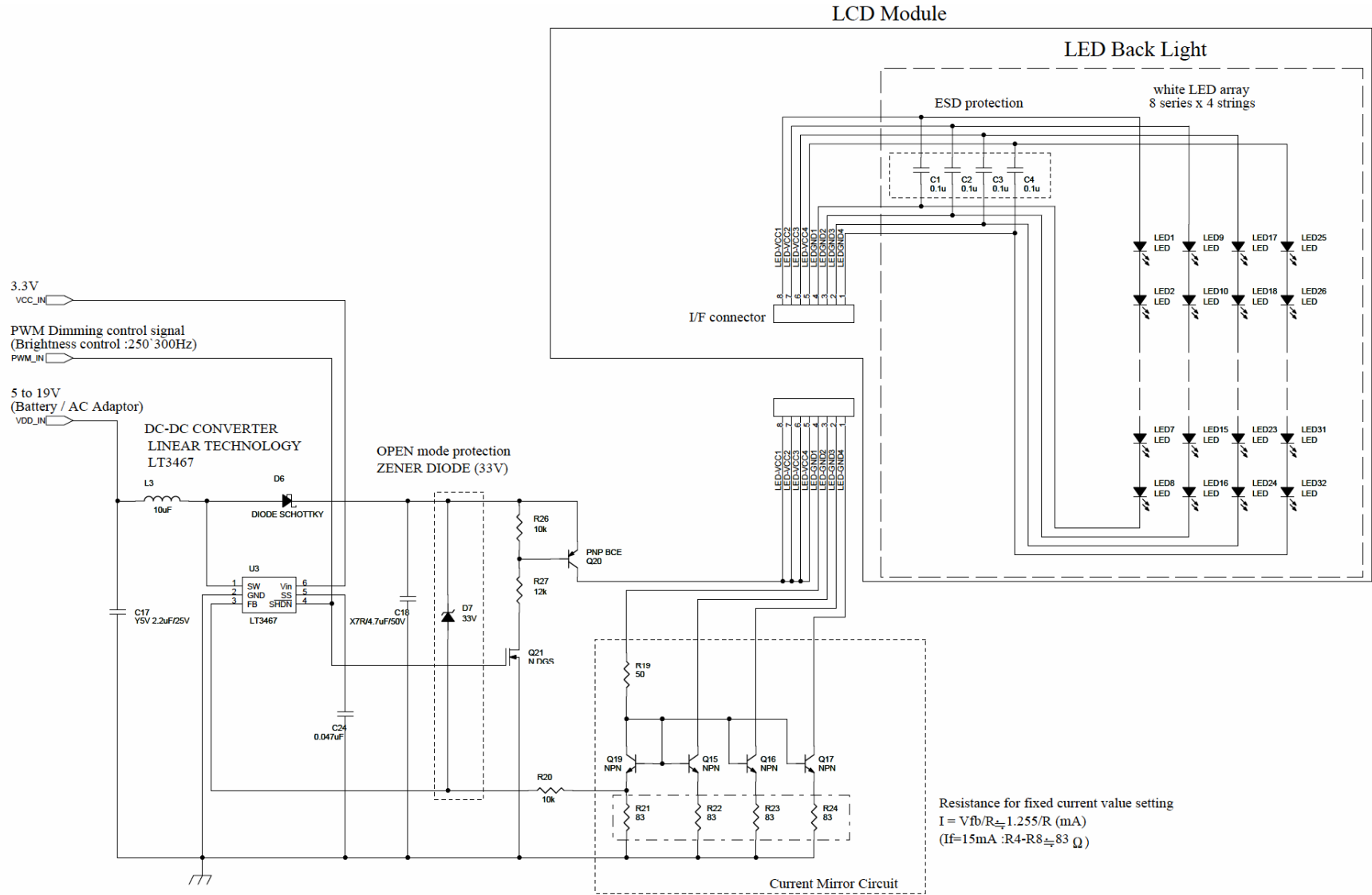| Piling number of cartons	Max.10
Package quantity in one carton	20 pcs
Carton size	439(W)×363(D)×175(H) mm
Total mass of one carton filled with full modules	3.9kg
Packing form	Fig2

TOP TRAY

LCD MODULE

SLEEVE TRAY

TRAY

TRAY

SLEEVE TRAY

OPP TAPE

MASTER CARTON

LABEL

Fig1 Packing Form

Fig.2 Outline Dimensions

LCD Module

LED Back Light

ESD protection

white LED array
8 series x 4 strings

C1 0.1u C2 0.1u C3 0.1u C4 0.1u

LEDVCC1
LEDVCC2
LEDVCC3
LEDVCC4
LEDGND1
LEDGND2
LEDGND3
LEDGND4

LED1 LED LED9 LED LED17 LED LED25 LED

LED2 LED LED10 LED LED18 LED LED26 LED

I/F connector

3.3V
VCC_IN

PWM Dimming control signal
(Brightness control :250`300Hz)
PWM_IN

5 to 19V
(Battery / AC Adaptor)
VDD_IN

DC-DC CONVERTER
LINEAR TECHNOLOGY
LT3467

L3
10uF

D6
DIODE SCHOTTKY

OPEN mode protection
ZENER DIODE (33V)

LEDVCC1
LEDVCC2
LEDVCC3
LEDVCC4
LEDGND1
LEDGND2
LEDGND3
LEDGND4

LED7 LED LED15 LED LED23 LED LED31 LED

LED8 LED LED16 LED LED24 LED LED32 LED

R26
10k

PNP BCE
Q20

U3
1 SW   Vin 6
2 GND   SS 5
3 FB   SHDN 4
LT3467

C17
Y5V 2.2uF/25V

C18
X7R/4.7uF/50V

D7
33V

R27
12k

Q21
N DGS

C24
0.047uF

R19
50

R20
10k

Q19 NPN   Q15 NPN   Q16 NPN   Q17 NPN

R21 83   R22 83   R23 83   R24 83

Current Mirror Circuit

Resistance for fixed current value setting
$I = Vfb/R \doteqdot 1.255/R$ (mA)
(If=15mA :R4-R8 $\doteqdot$ 83 Ω)

Fig. 3 LED-Driver Reference Circuit