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DEVICE SPECIFICATION FOR

TFT-LCD module

MODEL No. LQ088K9LA02

CUSTOMER'S APPROVAL

DATE

BY

PRESENTED

BY

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SHARP CORPORATION

RECORDS OF REVISION

MODEL No. : LQ088K9LA02

SPEC No.	Date	NO.	PAGE	SUMMARY	NOTE
LCY-07071	2007. 11. 21		–	–	1st Issue
LCY-07071A	2007. 12. 18		8	Table6-1 Common electrode driving signal part Remark part was modified	2nd Issue
			9	Table7-2 [caution] Turn off part : REVV -> REV	
			10	Table7-3 VLED remark part : [Note7-11] added (By customer request)	
			12	Table7-5 Gate part Start pulse frequency part : Symbol was modified Fsp -> fsp	
			17	Table9-1 Surface reflectance remarks part [Note9-8] -> [Note9-9]	
			24	Packing form(carton size, Total mass of one carton)	
			29	Fig3-1 Tcf / Tcr position was changed.	

TFT－LCD MODULE

L Q 0 8 8 K 9 L A 0 2

DEVICE SPECIFICATIONS

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(1) Summary

This TFT-LCD module is a color active matrix LCD module incorporating amorphous silicon TFT.

An outline of the module is given in Table 4-1.

(2) Features

・SHARP SM-LCD panel and LED Backlight is adopted in this module.

・6bit RSDS™ *(Reduced Swing Differential Signaling) interface is adopted in this module.

・Utilizes a panel with a 8:3 aspect ratio, which makes the module suitable for use in wide-screen systems.

・The 8.8 screen produces a high resolution image that is composed of 614,400 pixels elements in a stripe arrangement.

・Graphics and texts can be displayed on a 1280×3×480 dots panel with 262,144 colors by supplying 18 bit data signals(6 bit/color).

・This module features both transmissive and reflective display technology.

・Wide viewing field angle technology is employed.(The most suitable viewing angle is in the All directions.)

・Viewing angle control technology is employed.

・By adopting an active matrix drive, a picture with high contrast is realized.

・Reduced reflection as a result of low reflection black matrix and an AG(antiglare)AR(antireflection) top polarizer.

・By COG method, realized a slim, lightweight, and compact module.

・Transparent intensity is raised by adoption of the rate LCD panel of a high aperture, a high transparently color filter, and a high transparently polarizing plate.

・An inverted video display in the vertical and horizontal directions is possible.

* RSDS™ is a trademark of National Semiconductor Corporation.

(3) Structure and Outline dimensions

Outline dimensions of the module are given in Fig.1.

Structure of the TFT-LCD module is given in Fig.2.

This TFT-LCD module is composed of the color TFT-LCD panel, driver ICs, FPC, frame, shielding front case, shielding back case and LED backlight unit.(LED circuit to drive the backlight is not built into this module.)

(4) Mechanical specifications

Table4-1

Parameter	Specifications	Units	Remarks
Screen size (Diagonal)	22.35 [8.8″]	cm	
Active area	209.28(W) × 78.48(H)	mm	
Display format	1280 × RGB(W) × 480(H)	dots	
Dot pitch	0.0545(W) × 0.1635(H)	mm	
Pixel configuration	R,G,B Stripe configuration		
Display mode	Normally black		
Outline dimension	231.6(W) × 94.7(H) × 11.25(D)	mm	【Note4-1】
Mass	Max 320	g	

【Note4-1】Typical values are shown.

For detailed measurements and tolerances, please refer to Fig.1.

(Projection portions, Backlight harness, FPC are excepted.)

(5) I/O terminal name and functions

5-1) TFT-LCD panel driving part

Table5-1-A Source part Recommended connector : Hirose FH28-50S-0.5SH

Pin No.	Symbol	i/o	Description	Remarks
1	CS	—	CS Signal input	
2	VCOM	—	COM Signal input	
3	GND	—	Ground	
4	VLS	—	Power supply source part	
5	SPOI	i/o	Source Start Pulse Input signal	[Note5-3]
6	X0P	i	Data Input signal(X0P)	[Note5-6]
7	X0N	i	Data Input signal(X0N)	[Note5-6]
8	X1P	i	Data Input signal(X1P)	[Note5-6]
9	X1N	i	Data Input signal(X1N)	[Note5-6]
10	X2P	i	Data Input signal(X2P)	[Note5-6]
11	X2N	i	Data Input signal(X2N)	[Note5-6]
12	LP	i	Source data transfer signal	
13	GND	—	Ground	
14	CKP	i	Source clock signal(CKP)	
15	CKN	i	Source clock signal(CKN)	
16	VL	i	Gammer reference power supply	[Note5-5]
17	VH	i	Gammer reference power supply	[Note5-5]
18	VP2	i	Power supply of gray image	
19	VN2	i	Power supply of gray image	
20	REV	i	Polarity reversing signal of LCD output	
21	LBR	i	Setting signal of horizontal display position.	[Note5-3]
22	VCCS	—	Power supply of Source part	[Note5-1]
23	Y0P	i	Data Input signal(Y0P)	[Note5-6]
24	Y0N	i	Data Input signal(Y0N)	[Note5-6]
25	Y1P	i	Data Input signal(Y1P)	[Note5-6]
26	Y1N	i	Data Input signal(Y1N)	[Note5-6]
27	Y2P	i	Data Input signal(Y2P)	[Note5-6]
28	Y2N	i	Data Input signal(Y2N)	[Note5-6]
29	GND	—	Ground	
30	Z0P	i	Data Input signal(Z0P)	[Note5-6]
31	Z0N	i	Data Input signal(Z0N)	[Note5-6]
32	Z1P	i	Data Input signal(Z1P)	[Note5-6]
33	Z1N	i	Data Input signal(Z1N)	[Note5-6]
34	Z2P	i	Data Input signal(Z2P)	[Note5-6]
35	Z2N	i	Data Input signal(Z2N)	[Note5-6]
36	GND	—	Ground	
37	SPIO	i/o	Source Start Pulse output signal	[Note5-3]

Table5-1-A(sequel)

Pin No.	Symbol	i/o	Description	Remarks
38	OPEN	—	Non connection	
39	N.C.	—	Non connection	
40	OPEN	—	Non connection	
41	N.C.	—	Non connection	
42	OPEN	—	Non connection	
43	N.C.	—	Non connection	
44	OPEN	—	Non connection	
45	OPEN	—	Non connection	
46	N.C.	—	Non connection	
47	OPEN	—	Non connection	
48	N.C.	—	Non connection	
49	OPEN	—	Non connection	
50	N.C.	—	Non connection	

Table5-1-B Gate part Recommended connector : Hirose FH28E-20S-0.5SH

Pin No.	Symbol	i/o	Description	Remarks
1	VEE			
2	OPEN	—	Non connection	
3	GND	—	Ground	
4	MODE1	i	Output mode setting signal 1 of gate driver	[Note5-2]
5	MODE2	i	Output mode setting signal 2 of gate driver	[Note5-2]
6	R/L	i	Setting signal of horizontal display position.	[Note5-3]
7	CLS	i	Gate Shift Clock Pulse Input	
8	SPS	i	Gate Start Pulse Input	
9	XDON	i	Gate Output Enable Signal Input	[Note5-4]
10	VCCG	—	Gate driver power supply	[Note5-1]
11	OPEN	—	Non connection	
12	VDD	—	Gate VDD Power Input	
13	OPEN	—	Non connection	
14	GND	—	Ground	
15	OPEN	—	Non connection	
16	GND	—	Ground	
17	OPEN	—	Non connection	
18	COM	i	COM Signal input	
19	OPEN	—	Non connection	
20	CS	i	CS Signal input	

[Note5-1] VCCS and VCCG can input same level voltage.

[Note5-2] The mode of the gate driver output can be selected by setting MODE1 and MODE2.

Table5-2

MODE1	MODE2	Output mode
Hi	Hi	Normal mode(1 line writing)
Lo	Hi	Out of use
Hi	Lo	2 line simultaneous writing mode
Lo	Lo	All output terminals is fixed at the VEE level.

*Refer to "[caution] Notes when power supply is turned on." in 7-1).

*Refer to Fig.5-2.

*Please set the signal voltage level when use the Rueko DCC.

MODE1=Hi , MODE2=Lo

Caution) Lo=GND , Hi=VCCG

[Note5-3] Setting signal of horizontal and vertical display position

	R/L	LBR	SPOI	SPIO
Normal displayed	Lo	Hi	Input mode	Output mode
Right/Left reverse mode	Lo	Lo	Output mode	Input mode
Up/Down reverse mode	Hi	Hi	Input mode	Output mode
Right/Left & Up/Down reverse mode	Hi	Lo	Output mode	Input mode

Caution) Hi=VCCS , Lo=GND(0V)

*Please set the signal voltage level when use the Rueko DCC.

R/L=Lo , LBR=Hi

[Note5-4] XDON signal controls all the GATE output signals.

Table5-3

XDON	Function
Lo	At the normally use
Hi	all the GATE output signals are VDD level.

Caution) Lo=GND , Hi=VCCG

Caution) The setting of XDON=Hi might momentarily generate current surge.

[Note5-5] Please set the following.

VH = 5.3V, VL = GND (0V)

[Note5-6] Refer to (8), Table8-1, Fig8-1.

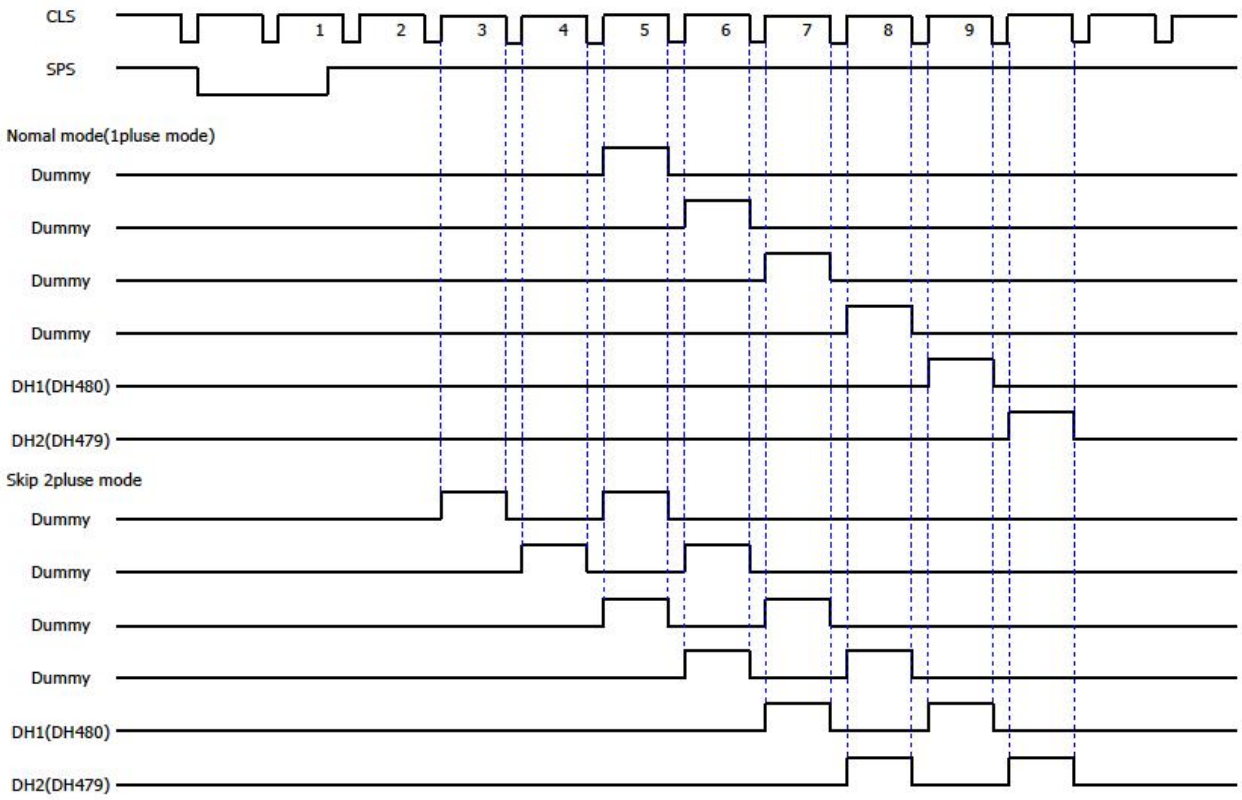


Fig.5-2 Gate output timing

5-2) LED Backlight system driving part

Table5-4 Recommended connector : Hirose FH28E-20S-0.5SH

Pin No.	Symbol	Description	Remarks
1	A1	LED power supply input (+)	Anode side
2	A1	LED power supply input (+)	Anode side
3	A2	LED power supply input (+)	Anode side
4	A2	LED power supply input (+)	Anode side
5	N.C.	OPEN	
6	N.C.	OPEN	
7	C1	LED power supply input 1 (−)	Cathode side 1
8	C1	LED power supply input 1 (−)	Cathode side 1
9	C2	LED power supply input 2 (−)	Cathode side 2
10	C2	LED power supply input 2 (−)	Cathode side 2
11	C3	LED power supply input 3 (−)	Cathode side 3
12	C3	LED power supply input 3 (−)	Cathode side 3
13	C4	LED power supply input 4 (−)	Cathode side 4
14	C4	LED power supply input 4 (−)	Cathode side 4
15	N.C.	Open	
16	TH	Sensor(+)	Terminal for temperature sensor
17	TH_G	Sensor(−)	Terminal for temperature sensor
18	PH_V	Open	
19	PH_G	Open	
20	PH_O	Open	

(6) Absolute maximum ratings

Teble6-1 GND=0V

Parameter		Symbol	MIN	MAX	Unit	Remark
Power supply of source part	Analog	VLS	−0.3	+6.0	V	Ta=25 °C
	Digital	VCCS	−0.3	+4.3	V	〃
Power supply of gate part		VDD	−0.3	+35.0	V	〃
		VCCG	−0.3	+6.0	V	〃
		VEE	−20	+0.3	V	〃
		VDD−VEE	−0.3	+35.0	V	〃
Input signal	Digital	VID	−0.3	VCCS(G)+0.3	V	〃,[Note6-1]
	Analog	VIA	−0.3	VLS+0.3	V	〃,[Note6-2]
Common electrodedriving signal		VCOM	−20	+35.0	V	〃,VCOM <35Vp-p
Power supply of LED Back Light		ILED	-	0.4	A	〃
Storage temperature		Tstg	−40	+95	°C	[Note6-3,4,7]
Operating temperature (LCD panel surface)		Topr1	−40	+85	°C	[Note6-3,4,5,7]
Operating temperature (Ambient temperature)		Topr2	−40	+85	°C	[Note6-6]

[Note6-1] SPOI,SPIO, X0P~X2N,Y0P~Y2N,Z0P~Z2N,LP,CKP,CKN,REV,LBR,MODE1,MODE2,R/L,SPS,CLS,XDON

[Note6-2] VH、VL、VP2、VN2

[Note6-3] This rating applies to all parts of the module and should not be exceeded.
Operating temp: -40 to -31 °C, does not provide a correct image on the LCD, but no damage of the display function will occur.

[Note6-4] Maximum wet-bulb temperature is 49 °C . Avoid dew condensation on the module.
Otherwise electrical current leaks will occur , and it cannot meet the specifications.

[Note6-5] The operating temperature guarantees only operation of the circuit. For contrast, speed of response, and other factors related to display quality are determined in the circumstances with Ta=+25 °C.

[Note6-6] Ambient temperature when the backlight is lit (reference value).
At a temperature specified by the application LED current must be reduced in order to keep the agreed panel operating temperature of +85°C(max)

[Note6-7] Refer to Table 15-1.

(7) Electrical characteristics

7-1) TFT-LCD panel driving section

Table7-1 Recommended operating conditions GND=0V , Ta=25 °C

Parameter			Symbol	MIN	TYP	MAX	Unit	Remarks
Power supply of source driver	Analog		VLS	+5.2	+5.3	+5.4	V	
	Digital		VCCS	+3.0	+3.3	+3.6	V	[Note7-1]
Power supply of gate driver	TFT driving	Hi	VDD	+14.5	+15.0	+15.5	V	
		Lo	VEEDC	−11.5	−12.0	−12.5	V	VEEDC Bias
			VEEAC		VCOMAC		Vp-p	[Note7-2]
	Logic	Hi	VCCG	+3.0	+3.3	+3.6	V	[Note7-1]
			VDD-VEE	−	−	+33V	V	
Power supply of gray image			VH,Vp2,VN2	0	−	VLS	V	

[Note7-1] VCCS and VCCG can input same level voltage.

[Note7-2] This is must be made into common electrode driving signal, this phase, and this amplitude.

Table7-2 Electric characteristic Ta=-40 °C ~+95 °C

Parameter		Symbol	MIN	TYP	MAX	Unit	Remarks
Input voltage of source part	Hi input	VIHS	0.8×VCCS	−	VCCS	V	[Note7-3]
	Lo input	VILS	GND	−	0.2×VCCS	V	
	Hi input	VIHRSDS	70	200	−	mV	[Note7-4]
	Lo input	VILRSDS	−	-200	-70	mV	
	RSDS standard voltage range	VCOM RSDS	GND+0.1	1.2	VCC-1.2	V	
Input current of source part	Hi input	IIHS1	-60	−	−	μA	[Note7-5]
	Lo input	IILS1	−	−	60	μA	
Input voltage of gate part	Hi input	VIHG	0.8×VCCG	−	VCCG	V	[Note7-6]
	Lo input	VILG	GND	−	0.2×VCCG	V	
Input current of gate part	Hi input	IIHG	2.0	−	−	μA	VI=GND,[Note7-7]
	Lo input	IILG	−	−	2.0	μA	VI=VCCG,[Note7-8]
Common electrode driving signal	AC component	COM AC	−	±4.2	±5.0	V	
	DC component	COM DC	+0.5	−	+2.5	V	[Note7-9]
CS driving signal	AC component	VCSAC	−	VCOM AC	−	V	[Note7-10]
	DC component	VCSDC	−	VCOM DC	−	V	

* The supply voltage condition is a range in Table 7-1.

[caution] Notes when power supply is turned on.

Please do a power supply on and the power-off in the following order. And, please input the signal after turning on all power supplies.

Turn on VCCS,VCCG → Logic signal → VLS → VEE , VDD → REV → MODE1,MODE2

Turn off VLS → REV → XDON 1H output → MODE1,2 → VDD,VEE → Logic signal → VCCS,VCCG

At the terminals of MODE1/MODE2 signals, input low voltage when applying the power supply, and hold low voltage for more than 2 vertical synchronous terms after VDD rises completely.

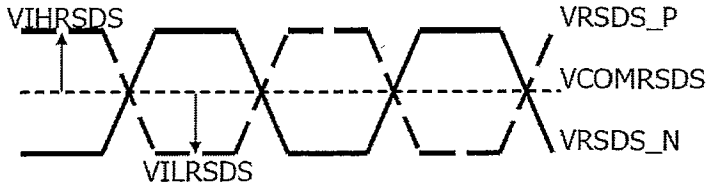
Then, either or both of them should hold high voltage until the power supply is turned off.

[Note7-3] SPIO,SPOI,LP,LBR,REV

[Note7-4] X0P~X2N,Y0P~Y2N,Z0P~Z2N,CKP,CKN

Please refer to the following for VIHRSDS, VILRSDS, and VCOMRSDS.

RSDS Single end wave form



VRSDS_P:Wave form on P side of single end
VRSDS_N:Wave form on N side of single end

[Note7-5] Apply the each terminals of SPIO, SPOI, LS, LBR, REV, X0P~X2N,Y0P~Y2N,Z0P~Z2N,CKP,CKN.

[Note7-6] CLS, SPS, MODE1, MODE2, XDON

[Note7-7] Apply the each terminal of CLS, SPS, MODE1, MODE2, XDON.

[Note7-8] Apply the each terminal of CLS, SPS.

[Note7-9] Please switch polarity of amplitude VCOMAC by center value of amplitude that is VCOMDC for every one level scan and every one vertical scan. Moreover, please adjust VCOMDC so that contrast becomes the maximum and a flicker becomes the minimum for every module.

[Note7-10] This is must be made into common electrode driving signal, this phase, and this amplitude.

7-2) LED backlight unit driving section

Table7-3 Ta=25°C

Parameter	symbol	MIN	TYP	MAX	UNIT	Remark
Input Voltage	VLED	21.0	24.8	26.9	V	ILED=0.320A, [Note7-11]
Current consumption	ILED	—	0.320	—	A	
PWM Frequency	fL	—	150	—	Hz	[Note7-11]
Power consumption	WLED	—	7.6	—	W	
Specification of LED-Type	white LED					
Detection of defect LEDs	by current detection					

[Note7-11] This value is reference value. Please refer to your LED backlight driving circuit.

7-3) LED Monitoring interface

Temperature Sensor Thermister Type : TH11-3T223GT made by MITSUBISHI MATERIALS CORPORATION

Table7-4 (Reference data)

Temperature °C	R-Thermistor kΩ (AVE)	Remark	Temperature °C	R-Thermistor kΩ (AVE)	Remark
-	-	[Note7-12]	40	11.93	[Note7-12]
-40	568.60		50	8.165	
-30	326.60		60	5.71	
-20	193.90		70	4.07	
-10	115.10		80	2.96	
0	69.41		90	2.19	
10	42.97		100	1.65	
20	27.32		110	1.26	
30	17.83		120	0.97	

[Note7-12] The above-mentioned value is a characteristic value of the thermally sensitive resistor unit at LED backlight off. Please confirm the characteristic in the state of the product when using it.

7-4) AC characteristics of input signals

AC characteristics of input signals are shown in Fig3-1, Fig3-2

Table7-5 VCCS、VCCG=3.3V,VLS=5.3V,GND=0V,Ta=25℃

Parameter		Symbol	MIN	TYP	MAX	Unit	Terminal
Source part	Operating Clock frequency	fck	—	—	60	MHz	CKP CKN
	High level clock width	Tcwh	6	—	—	ns	
	Low level clock width	Tcwl	6	—	—	ns	
	Clock rise time	Tcr	—	—	5	ns	
	Clock fall time	Tcf	—	—	5	ns	
	Start pulse set up time	Tsusp	3	—	—	ns	SPOI ,SPIO [Note7-9]
	Start pulse hold time	Thsp	2	—	—	ns	
	CKP rise time → Start pulse rise time	Tcksp	6	—	—	ns	
	Start pulse fall time → CKP rise time	Tspck	3	—	—	ns	
	Start pulse width	Twsp	1	—	2	Tcwh(l)	
	LP pulse set up time	Tsulp	5	—	—	ns	LP
	LP pulse hold time	Thlp	6	—	—	ns	
	High level LP pulse width	Twlp	1/fck	—	—	ns	
	LP pulse frequency	flp	—	fsp	—	Hz	
	LP pulse Start pulse set up time	tLSLP	1/fck	—	—	ns	
	Data set up time	Tsud	3	—	—	ns	X0P~X2N,Y0P~Y2N ,Z0P~Z2N
	Data hold time	Thd	2	—	—	ns	
Gate part	Operating Clock frequency	fcls	—	-	250	kHz	CLS
	Clock pulse width	Twl	500	—	-	μs	
	Clock rise time	Trcl	—	—	100	ns	
	Clock fall time	Tfcl	—	—	100	ns	
	Start pulse frequency	fsp	—	60	65	Hz	SPS
	Start pulse set up time	Tsusps	100	—	—	ns	
	Start pulse hold time	Thsps	300	—	—	ns	
	Start pulse rise time	Trsp	—	—	100	ns	
	Start pulse fall time	Tfsp	—	—	100	ns	
VCOM signal set up time		Tsucom	4	—	—	μs	VCOM CS
VCOM signal hold time		Thcom	0	—	—	μs	
VCOM signal rise time		Trcom	—	—	2	μs	
VCOM signal fall time		Tfcom	—	—	2	μs	

[Note7-9] The rising pulse in CKP is existed only 1 time during Hi period (Twsp) on start pulse.

7-5) Timing characteristics of input signals

Please refer to special DCC specifications of the separate volume for the timing characteristic when special DCC is used.

7-6) Electric power consumption

Table7-6 Ta = 25°C

Parameter		symbol	Voltage conditions	Min	Typ	Max	Unit
Current for source driver	Analog	ILS	VLS=+5.3V	—	30	45	mA
	Digital	ICCS	VCCS,VCCG=+3.3V	—	28	40	mA
Current for gate driver	Hi	IDD	VDD=＋15.0V	—	0.5	1	mA
	Lo	IEE	VEEAC=－12.0	—	60	90	mA
	Logic	ICCG	VEEDC=8.4Vp-p	—	0.2	0.5	mA

*Conditions

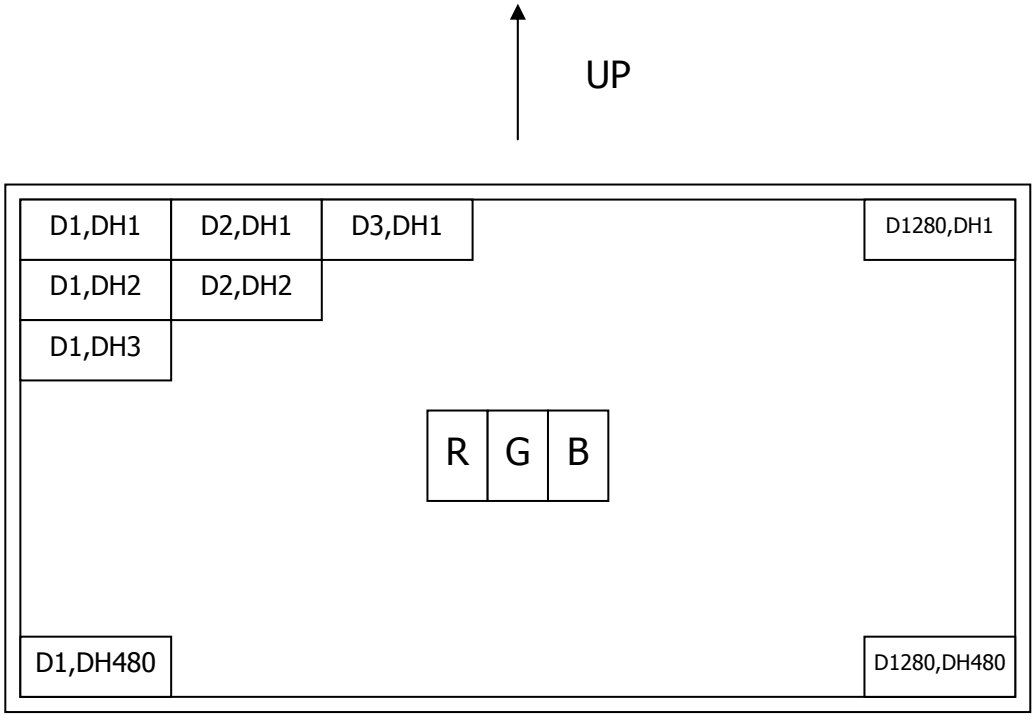
Driving conditions:

fck=42MHz , fcls=30kHz , fsp=60Hz , Normal displayed

Display pattern:

Vertical stripe pattern alternating 21 gray scale (GS21) with 42 gray scale (GS42) every 1 dot.

7-7) Input Data Signals and Display Position on the screen



(8) Input signals, basic display color and gray scale of each color

Table8-1

	Colors &	Data signal							0 :Low level voltage						1 :High level voltage					
	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

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.

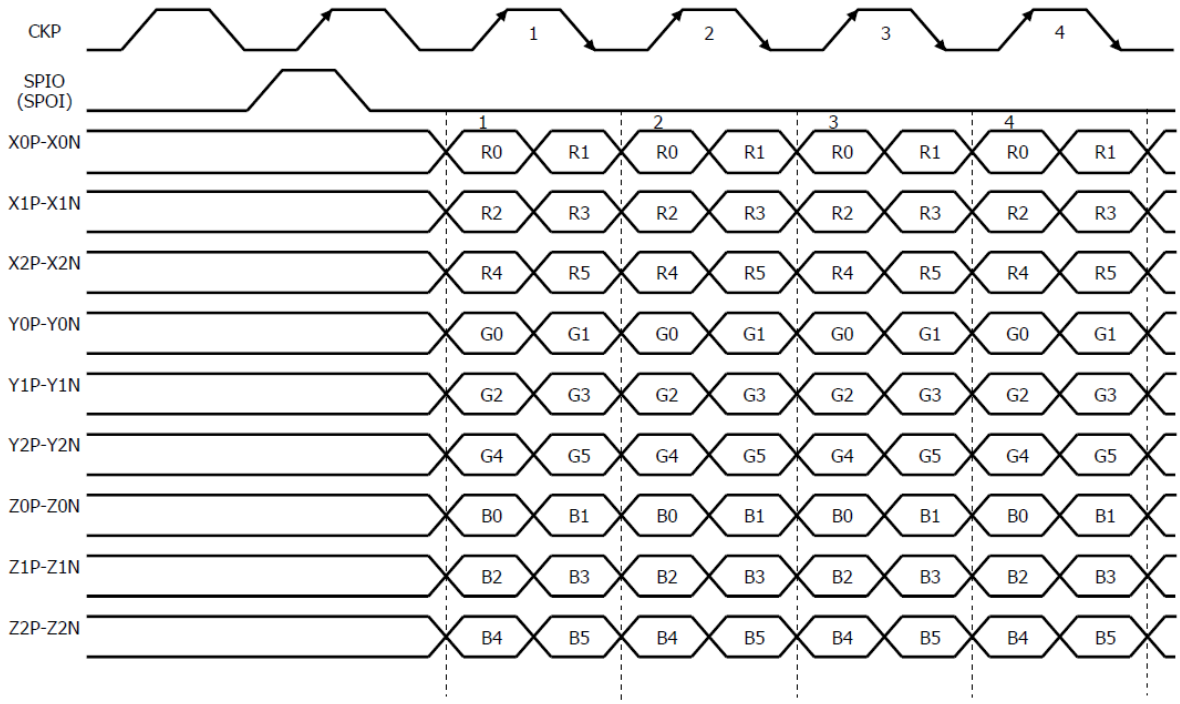


Fig.8-1 Timing Diagram

(9) Optical characteristics

Table9-1 Ta=25°C

Parameter			Symbol	Condition	MIN	TYP	MAX	Unit	Remarks
Transmissive mode	Viewing angle range		θ11,θ12	20degree	80	150	—		[Note9-1,2] CR value
			θ21, θ22	60degree	15	25	—		
	Contrast ratio		CRmax	Optimal (Ta=25℃)	220	360	—		[Note9-2]
			-	θ=0°,Ta=80℃	—	-25	—	%	[Note9-2,3]
			-	θ=0°,Ta=60℃	—	-15	—	%	[Note9-2,3]
			-	θ=0°,Ta=-10℃	—	-10	—	%	[Note9-2,3]
			-	θ=0°,Ta=-30℃	—	-25	—	%	[Note9-2,3]
	Response Time *with O/S driving	Ta=25℃	τ r	θ=0°, B→W	—	8	10	ms	[Note9-4]
			τ r(B-L10)	θ=0°, B→L10	—	45	70	ms	[Note9-4]
			τ d	θ=0°, W→B	—	5	10	ms	[Note9-4]
			τ d(L16-L10)	θ=0°,L16→L10	—	13	20	ms	[Note9-4]
		Ta=0℃	τ r_0	θ=0°,B→W	—	13	20	ms	[Note9-4]
			τ r_0(B-L10)	θ=0°,B→L10	—	135	180	ms	[Note9-4]
			τ d_0	θ=0°,W→B	—	15	20	ms	[Note9-4]
			τ d_0(L16-L10)	θ=0°,L16→L10	—	20	50	ms	[Note9-4]
		Ta=-20℃	τ r_{-20}	θ=0°,B→W	—	70	100	ms	[Note9-4]
			τ r_{-20}(B-L10)	θ=0°,B→L10	—	440	590	ms	[Note9-4]
			τ d_{-20}	θ=0°,W→B	—	55	70	ms	[Note9-4]
			τ d_{-20}(L16-L10)	θ=0°,L16→L10	—	130	210	ms	[Note9-4]
		Ta=-30℃	τ r_{-30}	θ=0°,B→W	—	190	250	ms	[Note9-4]
			τ r_{-30}(B-L24)	θ=0°, B→L24	—	600	770	ms	[Note9-4]
			τ d_{-30}	θ=0°,W→B	—	140	180	ms	[Note9-4]
			τ d_{-30} (L24-L16)	θ=0°,L24→L16	—	235	340	ms	[Note9-4]
	White luminance		Lw	θ=0°	210	240	—	cd/m^2	[Note9-5,6]
	Black luminance		Lb	θ=0°	—	—	1.2	cd/m^2	[Note9-5,6]
	Uniformity of luminance		-	θ=0°	77	81	-	%	[Note9-5,6,7]
	Gamma		-	Value at L31	1.83	-	2.55		[Note9-12]
	White chromaticity		X	θ=0°	0.270	0.300	0.330		[Note9-5,6]
			Y	θ=0°	0.290	0.320	0.350		[Note9-5,6]
	Red chromaticity		X	θ=0°	0.502	0.542	0.582		[Note9-5,6]
			Y	θ=0°	0.287	0.327	0.367		[Note9-5,6]
	Green chromaticity		X	θ=0°	0.290	0.330	0.370		[Note9-5,6]
			Y	θ=0°	0.532	0.572	0.612		[Note9-5,6]
	Blue chromaticity		X	θ=0°	0.107	0.147	0.187		[Note9-5,6]
			Y	θ=0°	0.073	0.113	0.153		[Note9-5,6]
	BLACK chromaticity		X	θ=0°	0.242	0.312	0.382		[Note9-5,6]
			Y	θ=0°	0.208	0.278	0.348		[Note9-5,6]
	NTSC ratio		-	θ=0°	-	45	-	%	

Table9-1 (sequel) Ta=25°C

Parameter		Symbol	Condition	MIN	TYP	MAX	Unit	Remarks
Reflective mode	Viewing angle range	θ11,θ12	20degree	3	4.5	-		[Note9-1,8]
		θ21, θ22	40degree	2	3			
	Contrast ratio	CR_{ref}	θ=0°,Optimal	3	5	—		[Note9-1,8]
	Response Time	$\tau r_{ref} + \tau d_{ref}$	B→W/W→B	—	20	—	ms	[Note9-4]
	Reflection ratio	Rf	θ=0°	—	3.8	—	%	[Note9-9]
	White chromaticity	X	θ=0°	0.269	0.319	0.369		[Note9-10]
		Y	θ=0°	0.299	0.349	0.399		
	Red chromaticity	X	θ=0°	0.405	0.455	0.505		
		Y	θ=0°	0.220	0.270	0.320		
	Green chromaticity	X	θ=0°	0.210	0.260	0.310		
		Y	θ=0°	0.397	0.447	0.497		
	Blue chromaticity	X	θ=0°	0.126	0.176	0.226		
		Y	θ=0°	0.117	0.167	0.217		
	BLACK chromaticity	X	θ=0°	0.171	0.241	0.311		
		Y	θ=0°	0.121	0.191	0.261		
	NTSC ratio	-	θ=0°	-	22	-	%	
Surface reflectance		SRf		-	0.6	-	%	[Note9-9]
LED lifetime	+25°C	—	continuation	10000	—	—	Hour	[Note9-11]

*The measurement data of above optical characteristics are measured 30 minutes after lighting the B/L. they are measured in a dark room or an equivalent state by the method shown in the following figure.

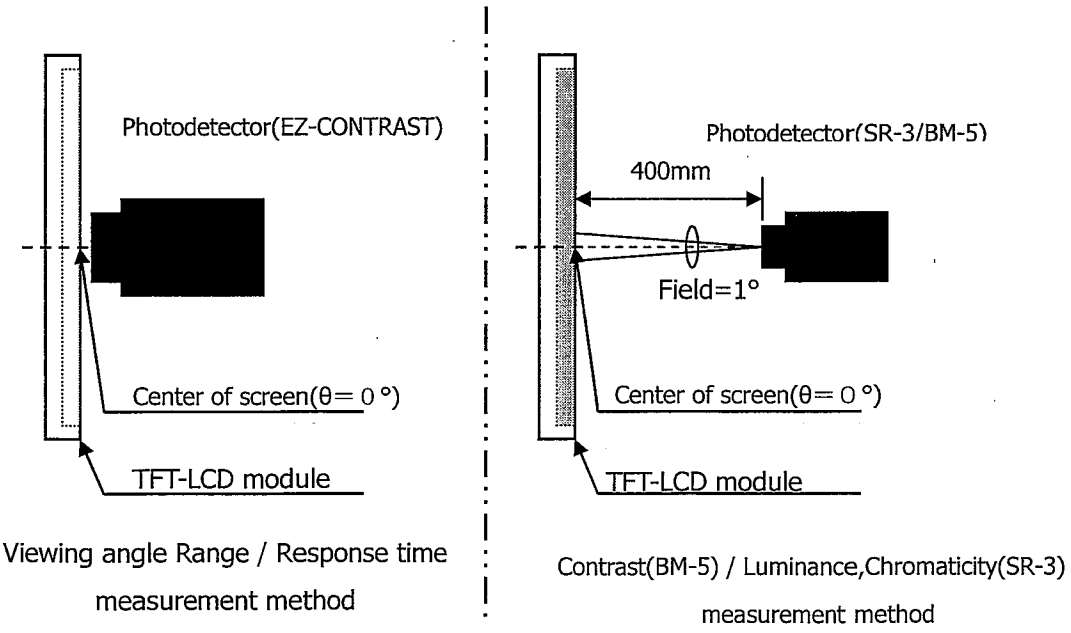
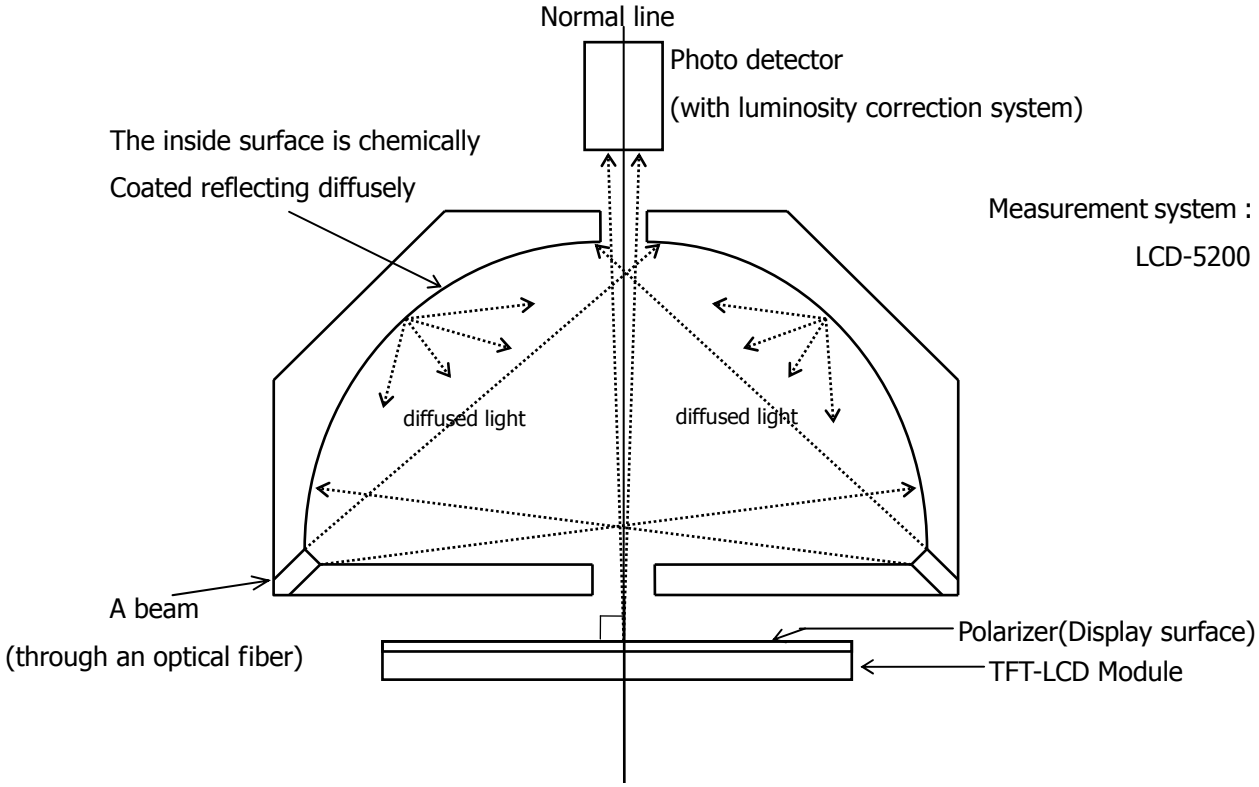


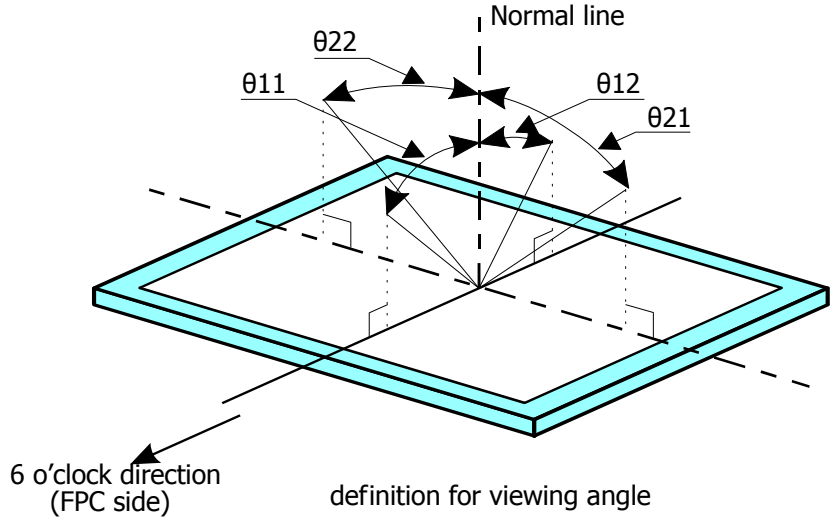
Fig.9-1 Optical characteristics measurement method (Transmissive mode)



Contrast / Viewing angle Range / Response time measurement method

Fig.9-2 Optical characteristics measurement method (Reflective mode)

[Note 9-1] Viewing angle range is defined as follows.



[Note 9-2] Contrast ratio is defined as follows:

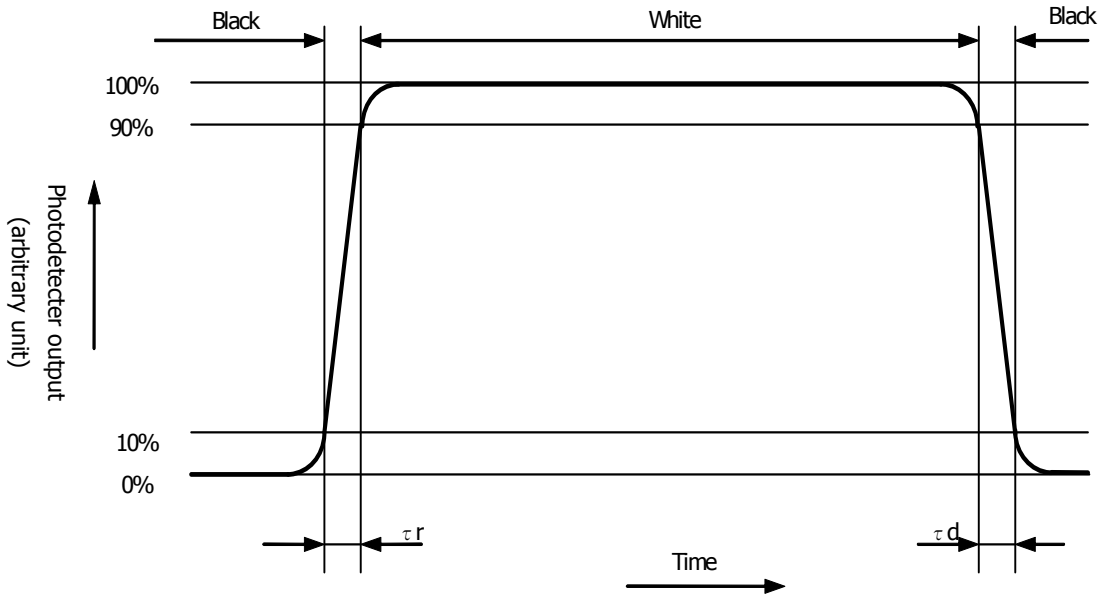
$$\text{Contrast ratio(CR)} = \frac{\text{Photo detector output with LCD being "white(GS63)"}}{\text{Photo detector output with LCD being "black(GS0)"}}$$

[Note 9-3] The change rate by the ambient temperature of the contrast is defined as follows.

It is a change rate against the CR value of 25℃ in ambient temperature of the module.

[Note 9-4] Response time is defined as follows:

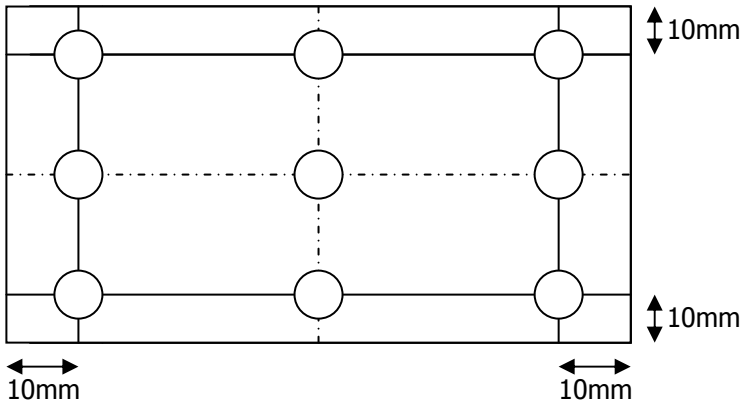
Response time is obtained by measuring the transition time of photo detector output, when input signals are applied so as to make the area "black" to and from "white".



[Note 9-5] LED driving condition is refer to Table7-3.

[Note 9-6] Measured on the center area of the panel at a viewing cone 1-degree by TOPCON luminance meter SR-3.(After 30 minutes operation)

[Note 9-7] Uniformity of luminance is measured in the measurement part shown in the figure below.
The measurement part is "○" symbol it shown.



$$\text{Uniformity of luminance} \Rightarrow \frac{\text{Minimum luminance}}{\text{Maximum luminance}} \times 100\%$$

[Note 9-8] Contrast ratio of reflection mode is defined as follows:

$$\text{Contrast ratio(CR)} = \frac{\text{Photo detector output with all pixels "white"}}{\text{Photo detector output with all pixels "black"}}$$

[Note 9-9] Reflectance is defined as follows

$$\text{Reflection ratio} = \frac{\text{Light detected level of the reflection by the LCD}}{\text{Light detected level of the reflection by the standard}} \times 100$$

[Note 9-10] It is assumed that chromaticity of the light source is (x=0.313,y=0.329).
The measuring system is CM-2002(with the unit reflecting diffusely) made by MINOLTA co.,ltd.

[Note 9-11] LED life is the time when the Brightness level of the panel surface doesn't become equal or less than 50% of the brightness of the initial value on the following conditions.

* LED driving condition is refer to Table7-3. PWM dimming 100%~5%(Ta=25°C)

[Note 9-12] When you adjust the power supply voltage level and signal voltage level to the following set value .

VLS=5.3V±0.05V(5.25V～5.35V) , VCOMAC=8.4Vp-p±0.1Vp-p(8.3Vp-p～8.5Vp-p)

(10) Mechanical characteristics

10-1) External appearance

No significant defects permitted. (See Fig. 1)

10-2) Panel toughness

The panel should not be broken, when press to the center of the panel by 30N power using smooth surface with 15mm diameter.

Caution: If the pressure is added on the active area of the panel over the long time, even if the pressure is very small weight , the functional damage might occur in the panel.

10-3) I/O connector performance

A) Input/output connectors to control the LCD module

1) Applicable Connector : FH28-50S-0.5SH (HIROSE)

2) FPC flexibility :

Slit on the film cover lay coat part of one side printing

If it had been tested bending under radius nothingness and bending angle 180degrees, the FPC should not be cut.

(It should be bend by hand and only at once).

B) Input/output connector of LED backlight driving circuit

1) Applicable Connector : FH28E-20S-0.5SH (HIROSE)

2) FPC flexibility :

Slit on the film cover lay coat part of one side printing

If it had been tested bending under radius nothingness and bending angle 180degrees, the FPC should not be cut.

(It should be bend by hand and only at once).

(11) Display quality

The display quality of the color TFT-LCD module is controlled by the Incoming Inspection Standard.

(12) Handling instruction of TFT-LCD module

12-1) Handling of FPC

①FPC can be bent only in the input part straight wiring part.

②Please do not hang the LCD module from the FPC or do not apply excessive force to FPC.

③Please do not impact on the part equipped with parts of FPC.

12-2) Installation of TFT-LCD module

①When assembling the TFT-LCD module, ensure module is fixed in its natural flat plane, and avoid stressing the module causing it to twist or wrap.
Do not apply pressure to the module from the user application (user push-buttons etc.) since this may distort the display images.

②Remove all electrical power before connecting or disconnecting the module FPCs.

③Be sure to connect the metallic shielding cases of the module and the GND of the LED B/L driving circuit surely.

④The sensor hall on the back of the module is a part that dust especially enters easily. Please the process design the equipment and design the structure so that dust should not invade after the built-in time and building in.

12-3) Precautions in mounting

①Polarizer adhesion the surface of the LCD is made of a soft material and should be handled carefully to avoid damage. Protection sheet is applied on the LCD top surface to safeguard the polarizer against scratches and dirt. It is recommended to remove the protection sheet immediately before use, taking care to avoid static electric charges.

②Precautions in removing the protection sheet

A) Work environment
When the protection sheet is removed off, static electricity may cause dust to stick to the polarizer surface. To avoid this, the following working environment is desirable.

a) Floor : Conductive treatment of 1MΩ or more on the tile.
(conductive mat or conductive paint on the tile)

b) Clean room free form dust and with an adhesive mat on the doorway

c) Advisable humidity:50%～70%　Advisable temperature:15 °C～27 °C

d) Workers shall wear conductive shoes, conductive work clothes, conductive gloves and an earth band.

B) Working procedures

a) Direct the air of discharging blower in downward to ensure that module is blown sufficiently. Keep the distance between module and discharging blower within 20 cm.

b) Attach adhesive tape to the protection sheet part near discharging blower so as to protect polarizer against flaw.

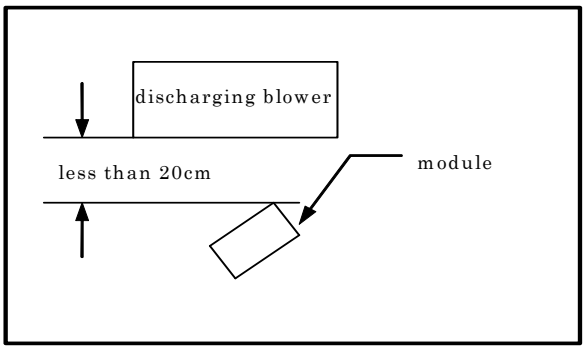
c) Remove the protection sheet , pulling adhesive tape slowly to your side.

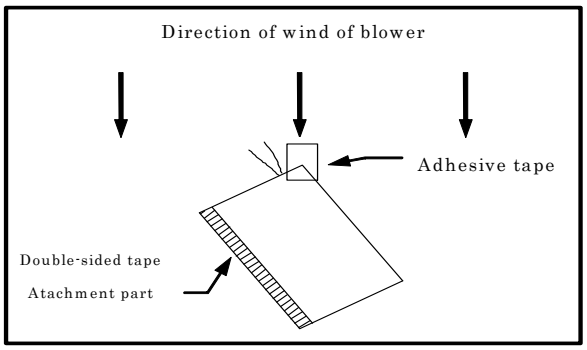
d) On removing off the protection sheet, pass the module to the next work process to prevent the module to get dust.

e) Method of removing dust from polarizer

・Blow off dust with N2 blower for which static electricity preventive measure has been taken.

・Since polarizer is vulnerable, wiping should be avoided if necessary.
However, please wipe it carefully with the cloth for a lens wipe when it is necessary to wipe the surface.





③When metal part of the TFT-LCD module (shielding case) soiled, wipe it with soft dry cloth.

④The LCD used in the module is made of glass. If drop the module or bump it on hard surface, the LCD should be broken.Please handle with care.

⑤Since CMOS LSI is used in this module, take care of static electricity and earth your body when handling the module.

12-4) Caution of product design

①Protect the LCD module from water/salt-water by the waterproof cover, etc.

②Please implement electromagnetic shielding measures to prevent interference from radiated emissions originating from the module, which could affect peripheral appliances.

12-5) Other

①Do not expose the module to direct sunlight or intensive ultraviolet rays for many hours. Liquid crystal is deteriorated by ultraviolet rays.

②Store the module at a temperature near the room temperature. At lower than the rated storage temperature, liquid crystal solidifies, causing the panel to be damaged. At higher than the rated storage temperature, liquid crystal turns into isotropic liquid and may not recover.

③If LCD panel breaks, there may be a possibility that the liquid crystal escapes from the panel. Since the liquid crystal is hazardous, do not put it into the eyes or mouth. When liquid crystal sticks to hands, feet or clothes, wash it out immediately with soap.

④Be sure to adjust DC bias voltage of common electrode driving signal(VCOM DC) in the state of the last product. When not adjusted, it becomes the cause of a deterioration of display quality.

⑤Observe all precautionary requirements of general electronic components.

(13) Packing form

13-1) Package form (Refer to Fig.4)

a) Maximum number of cartons for stacking : 7

b) Package quantity in one carton : 20pcs

c) carton size :594×379×246(H)

d) Total mass of one carton :8.6kg

13-2) Carton keeping conditions

Environments

Temperature	:	0~40°C
Humidity	:	60%RH or less(at 40 °C) No dew condensation at low temperature and high humidity.
Atmosphere	:	Harmful gas such as acid or alkaline that corrodes electronic components or wires, must not be avoided.
Storage periods	:	Max of approx 3 months
Opening of the package	:	In order to prevent the LCD module from breakdown by electrostatic charges, please control the humidity over 50%RH and open the package taking sufficient countermeasures against electrostatic charges, such as earth, etc.

(14) Other

14-1) Indication of the lot number

The lot number is shown on a label. Attached location is shown in Fig.1 (Outline Dimensions).

Indicated contents of the label :

LQ088K9LA02 ○○○○○○○○○
Model name lot number

contents of lot No.	the 1st figure	production year (ex. 2007 : 7)
	the 2nd figure	production month 1,2,3,…,9,X,Y,Z
	the 3rd～8th figure	serial No. 000001～
	the 9th figure	revision marks A,B,C…

14-2) RoHS

This TFT-LCD module is RoHS compliant products.

14-3) Instructions for disposing of LCD modules.

Please dispose in accordance to regulations for this module.

14-4) The country of origin of the TFT-LCD module

JAPAN

14-5) Other

About RUEKO DCC

RUEKO DCC (Display CORE CHIP) is a display controller whom ALPINE and SHARP developed.

(15) Reliability test contents

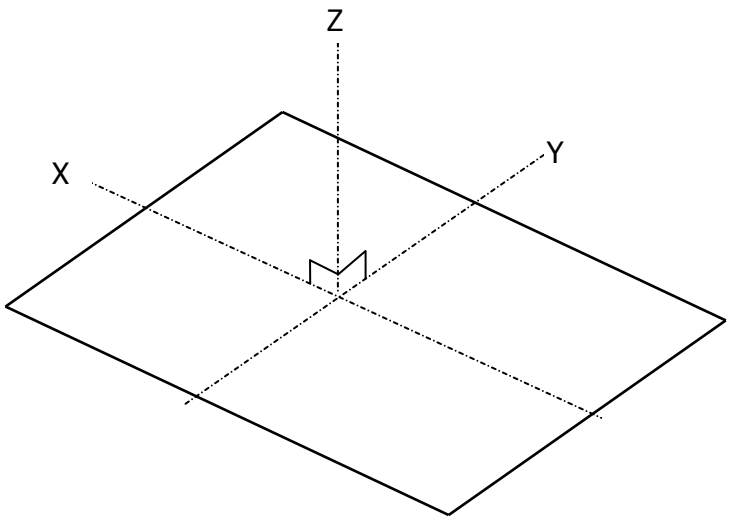
Table 15-1 Temperature condition is based on operating temperature condition

No.	Test items	Test condition
1	High temperature storage test	Ta = +85 °C 240h
2	High temperature storage test	Ta = +95 °C 120h
3	Low temperature storage test	Ta = −40 °C 240h
4	High temperature and high humidity operation test	Tp = +50 °C , 95%RH 240h
5	Hi temperature operating test	Tp = +85 °C 240h
6	Low temperature operating test	Ta = −40 °C 240h
7	Electro static discharge test	±200V・200pF(0Ω) 1 time for each terminals ±2KV・150pF(330Ω) 3 time for each terminals ±15KV・150pF(330Ω) 3 time for the display center
8	Shock test	980m/s^2・6ms, ±X ; ±Y ; ±Z 3 times for each direction （JIS C0041, A-7 Condition C）【caution】
9	Vibration test	Frequency : 8～33.3Hz , Stroke : 1.3mm Frequency : 33.3Hz～400Hz,Acceleration : 28.4m/s^2 Cycle : 15 minutes X,Z 2 hours for each directions, 4 hours for Y direction (total 8 hours) 【caution】（JIS D1601）
10	Heat shock test(Storage)	Ta= −30 °C ～ +85 °C / 200 cycles (0.5h) (0.5h)

【Note】 Ta = Ambient temperature, Tp = Panel temperature

【Check items】 In the standard condition, there shall be no practical problems that may affect the display function.

【caution】 Definition of X, Y, Z direction is shown as follows



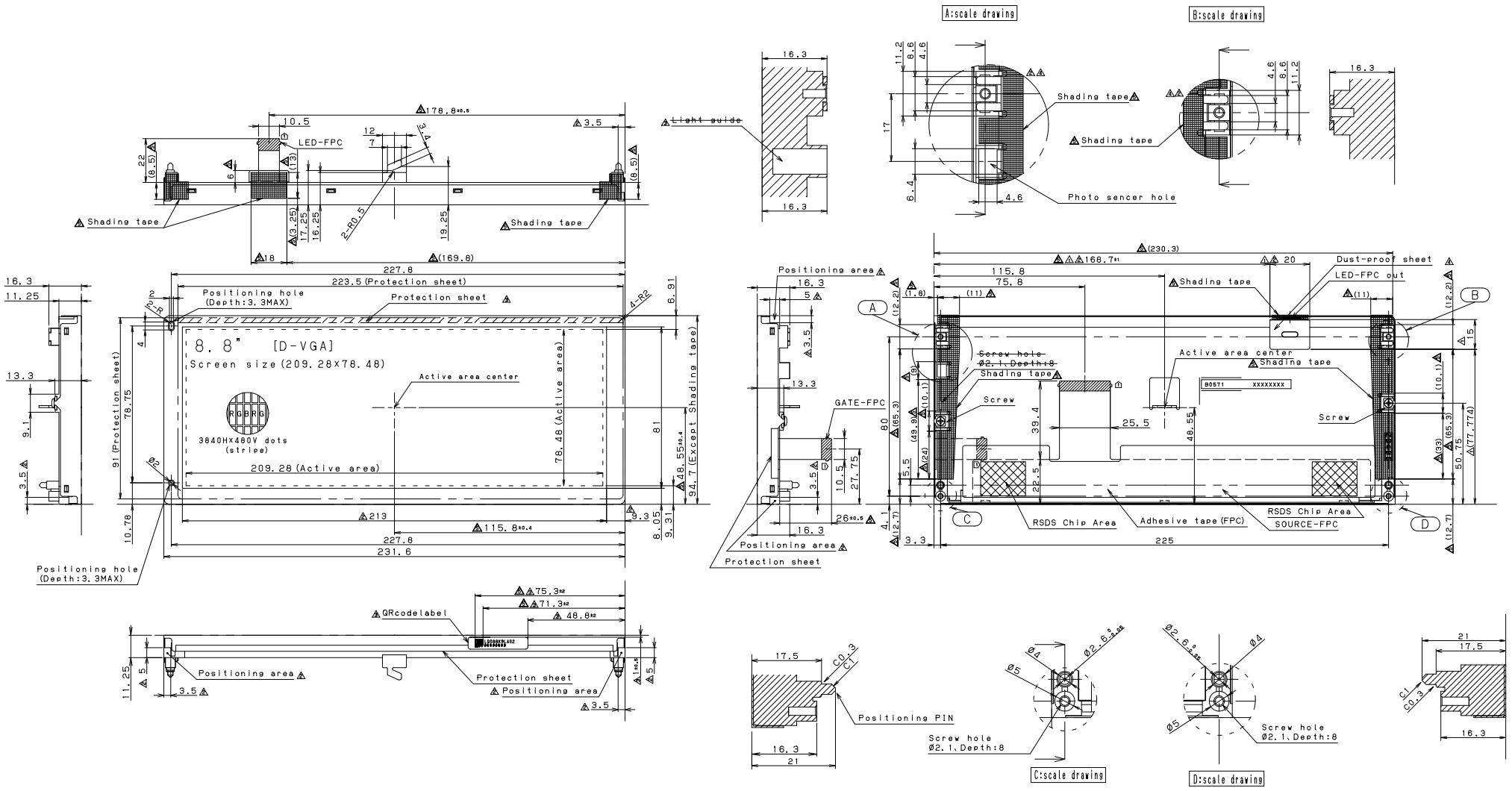


Fig.1 OUTLINE DIMENSIONS

LED-FPC connector:FH28E-20S-0.5SH(HRS)
GATE-FPC connector:FH28E-20S-0.5SH(HRS)
SOURCE-FPC connector:FH28-50S-0.5SH(HRS)

Take care in set design to hide the scratches and bubbles appeared on the polarizer or other frame area which is located outside of active area.

Since this module is under development, all the specified value is tentative, the technical literature is subject to change without notice.

unit:mm
General tolerance is ±0.30

DATE	2006.07.26
MODEL	LQ088K9LA02
DRAWING NO	LCM-06039E
size	A1
SCALE	1/1

No.	DATE	REVISION	sign.
1	OCT.10.25	Addition of tolerance,Change of general tolerance,Addition of Shading tape,	Y. sato
2	OCT.05.30	Dust-proof sheet dimensions change,Raised dais(screw hole) change,	Y. sato
3	OCT.03.26	Shape change of light guide, Addition of QR code label,Protection sheet inverted,	K. sasaki
4	OCT.02.27	Case open area dimensions change, Addition of Positioning area, Dust-proof sheet dimensions change,Raised dais(screw hole) change,	K. sasaki
5	OCT.01.24	Addition of dust-proof sheet dimensions,	K. sasaki

SHARP CORPORATION Engineering Department
Mobile LCD Division,4 Mobile LCD Group

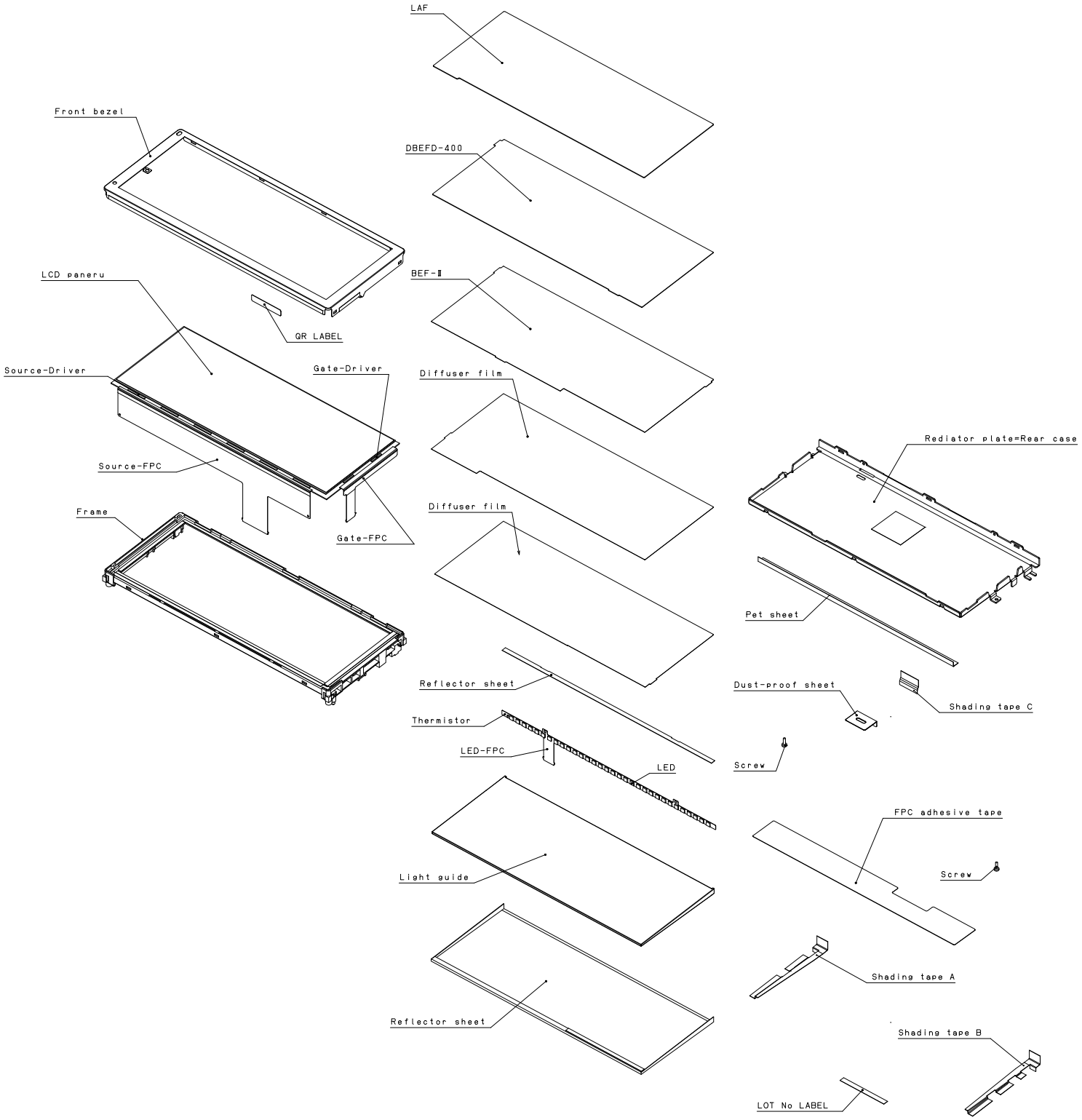


Fig.2 Stucture of LCD module

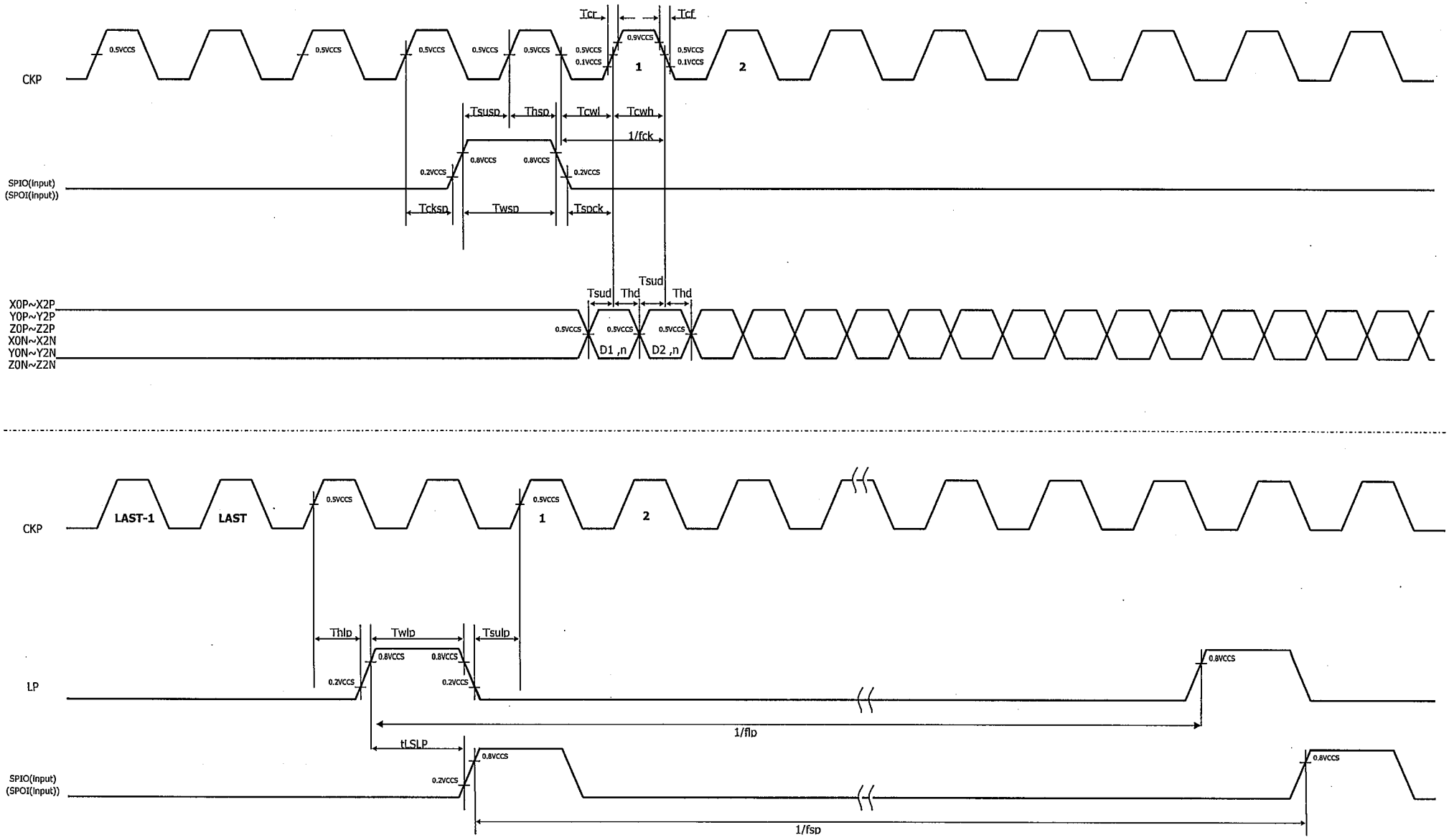


Fig.3-1 AC characteristics of input signals waveform

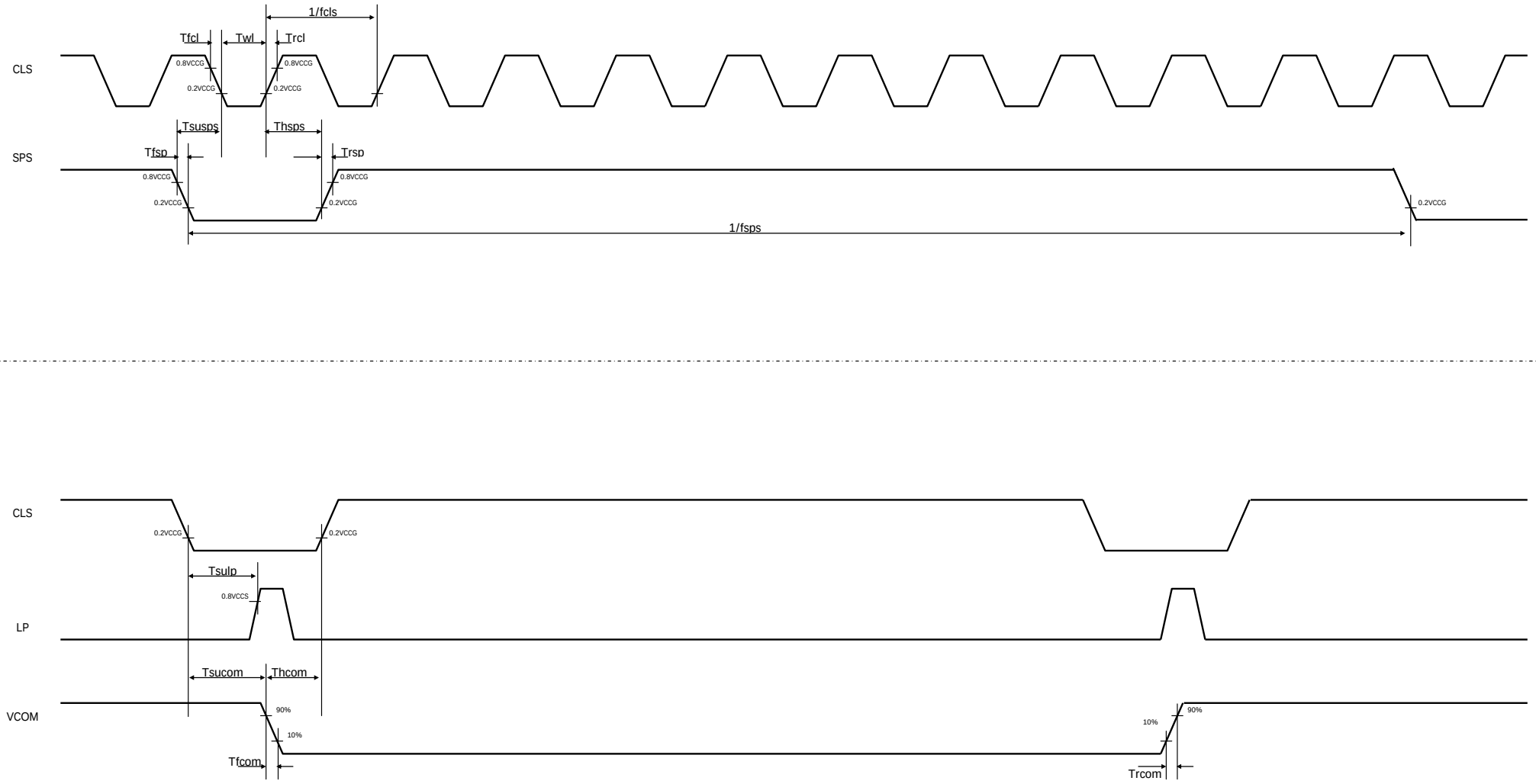


Fig.3-2 AC characteristics of input signals waveform

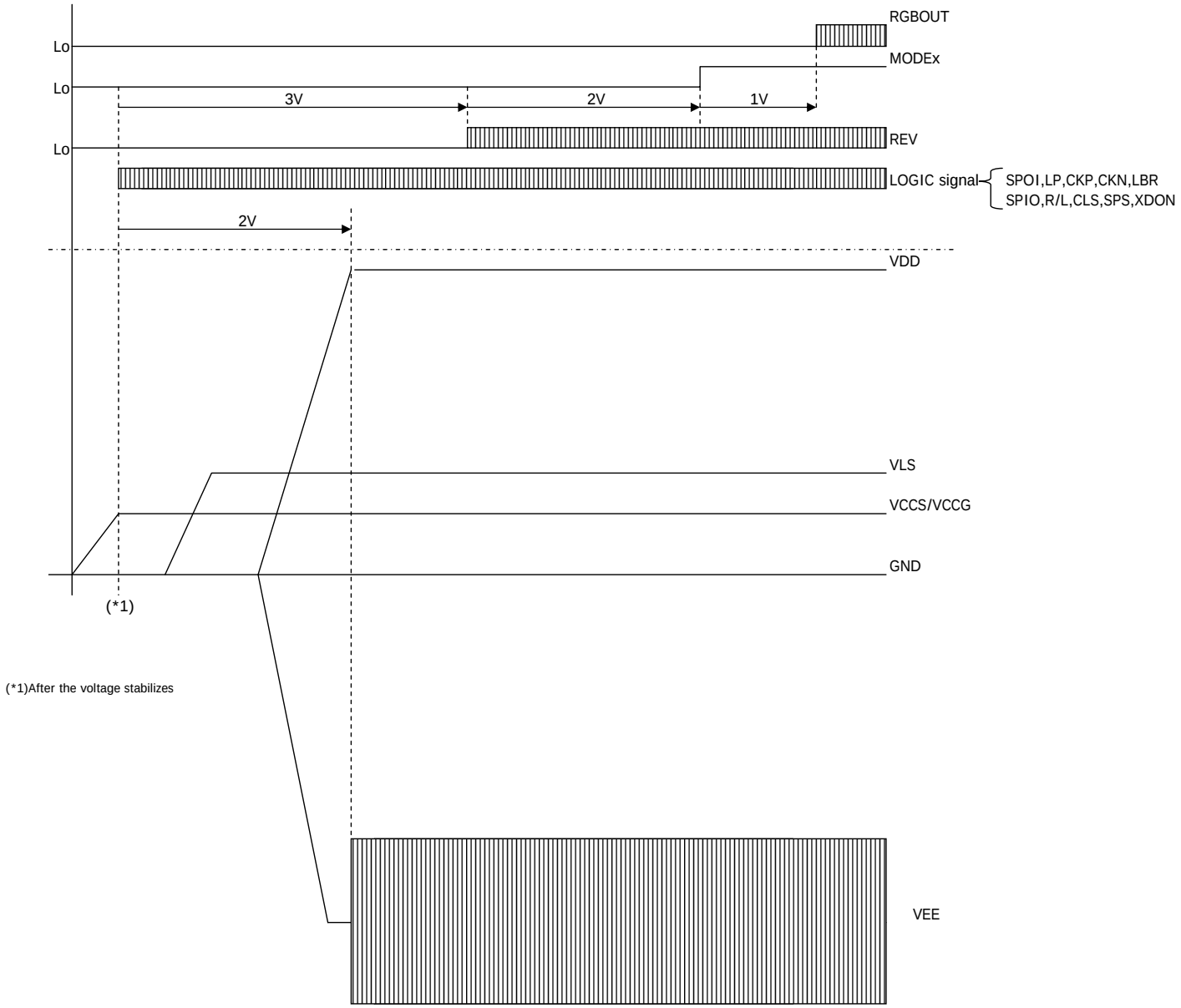


Fig.3-3 Reference information of power supply sequence "Turn on"

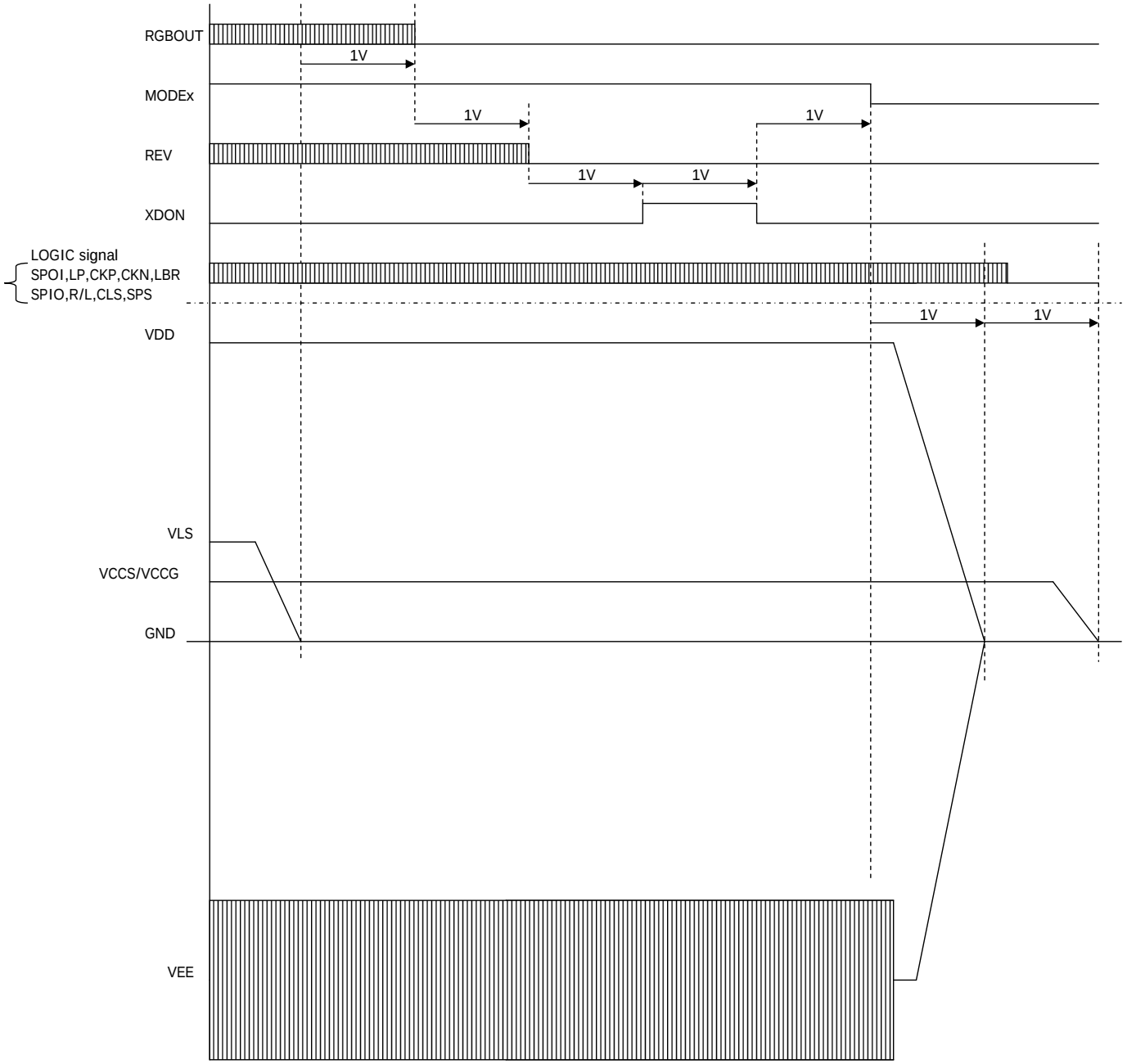


Fig.3-4 Reference information of power supply sequence "Turn off"

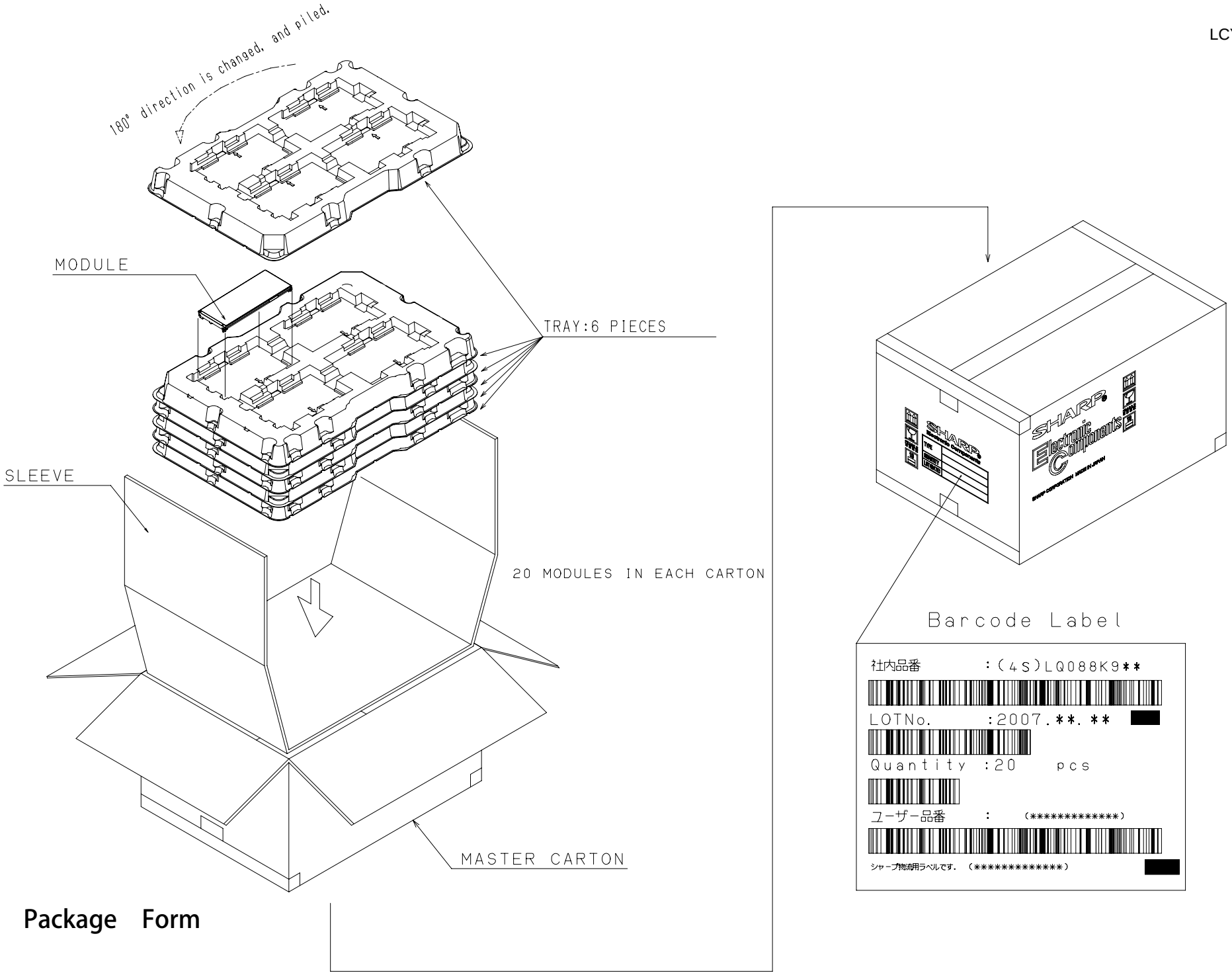


Fig.4 Package Form

(Appendix)

Adjusting method of optimum DC bias voltage of common electrode driving signal

Photoelectric devices are very effective to obtain optimum DC bias voltage of common electrode driving signal accurately, and the accuracy is with 0.1V. (In visual examination method, the accuracy is about 0.5V because of the difference among individuals.)

Adjusting method of DC bias voltage using the photoelectric devices is as follows

Measurement of flicker

Adjust the DC baias voltage so as to minimize flicker at NTSC : 60Hz(30Hz) / PAL : 50Hz(25Hz).

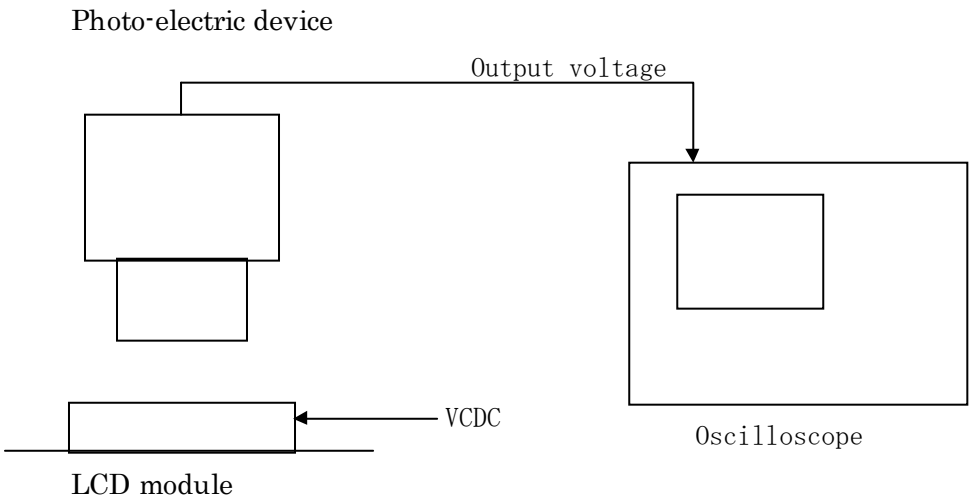
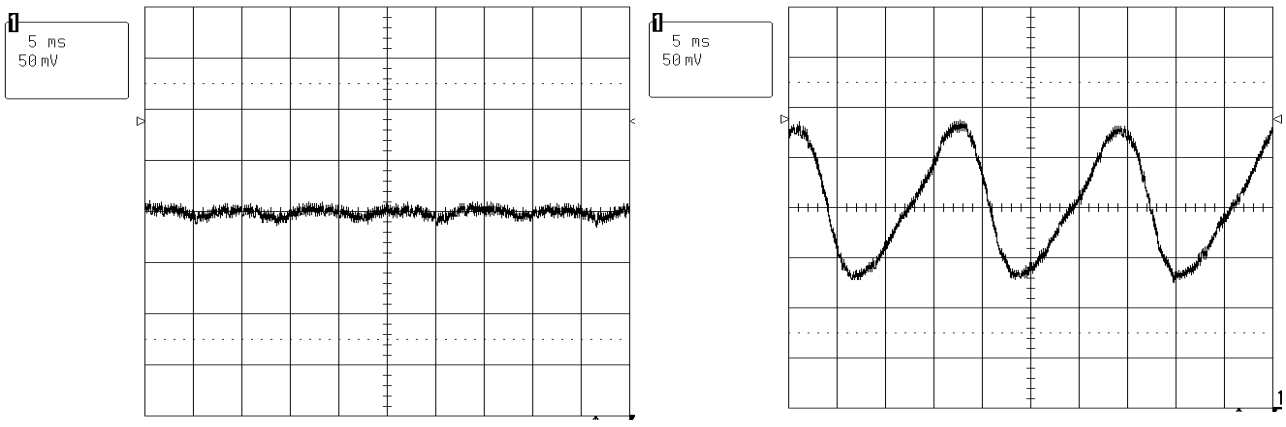


Fig. A Measurement system

Adjusting method of DC bias voltage

Measure the output voltage from Photoelectric device using the oscilloscope at the measurement system of Fig. A.

Then, change the DC bias voltage in small steps, and adjust it so as to minimize the flicker at NTSC 60Hz(30Hz) / PAL : 50Hz(25Hz). (Fig.B)



DC bias : Optimum DC bias : Optimum + 1

Fig. B Waveforms of flicker