Technical Document

LCD Specification

LCD Group

LQ025Q3DW02 LCD Module

Product Specification
July 2009

QVGA Normally Black LCD module
featuring very wide viewing angles and
350 nits brightness with 500:1 contrast.

SHARP

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	MOBILE LIQUID CRYSTAL DISPLAY GROUP SHARP CORPORATION **SPECIFICATION**	APPLICABLE GROUP MOBILE LIQUID CRYSTAL DISPLAY GROUP

DEVICE SPECIFICATION FOR

TFT-LCD module

MODEL No. LQ025Q3DW02

These parts have corresponded with the RoHS directive.

CUSTOMER'S APPROVAL

DATE

BY

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RECORDS OF REVISION

MODEL No：LQ025Q3DW02

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1. Applicable Scope

This specification is applicable to TFT-LCD Module “LQ025Q3DW02”.

2. General Description

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 IC, Input FPC, a back light unit.

Graphics and texts can be displayed on a 320 × RGB × 240 dots panel with about 262k colors by supplying 18bit data signals (6bit × RGB), four timing signals, 3wires 9bit serial interface signals, logic (Typ. +3.3V), analog (Typ. +3.3V) supply voltages for TFT-LCD panel driving and supply voltage for back light.

3. Mechanical (Physical) Specifications

Item	Specifications	Unit
Screen size	6.3(2.5” type) diagonal	cm
Active area	49.92 (H) × 37.44 (V)	mm
Pixel format	320 (H) × 240 (V)	pixel
	1 Pixel = R+G+B dots	-
Pixel pitch	0.156 (H) × 0.156(V)	mm
Pixel configuration	R,G,B vertical stripes	-
Display mode	Normally black	-
Unit outline dimensions *	56.8(W) × 48.8 (H) × 3.1(D)	mm
Mass	Max.25	g
Surface treatment	Anti glare	-

*The above-mentioned table indicates module sizes without some projections and FPC.
For detailed measurements and tolerances, please refer to 17. Outline Dimensions.

4. Input Terminal Names and Functions

Recommendation CN：[HIROSE] FH26G-67S-0.3SHBW(05)

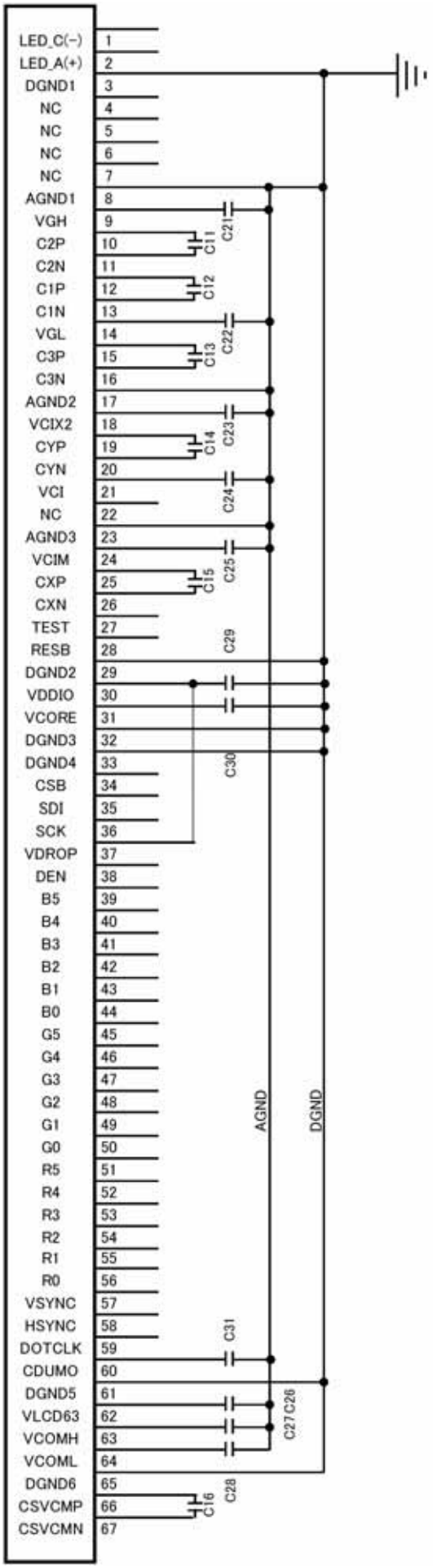
Pin No.	Symbol	I/O	Description	Remarks
1	LED_C (-)	-	Power supply for LED (Low voltage)	
2	LED_A(+)	-	Power supply for LED (High voltage)	
3	DGND1	-	Digital Ground	
4	NC	-	Not connected	Note 1
5	NC	-	Not connected	Note 1
6	NC	-	Not connected	Note 1
7	NC	-	Not connected	Note 1
8	AGND1	-	Analog Ground	
9	V_{GH}	-	Connect to a Stabilizing capacitor	Note 3
10	C2P	-	Connect a Booster capacitor to C2N	Note 2
11	C2N	-	Connect a Booster capacitor to C2P	
12	C1P	-	Connect a Booster capacitor to C1N	
13	C1N	-	Connect a Booster capacitor to C1P	
14	V_{GL}	-	Connect a Stabilizing capacitor to GND	Note 3
15	C3P	-	Connect a Booster capacitor to C3N	Note 2
16	C3N	-	Connect a Booster capacitor to C3P	
17	AGND2	-	Analog Ground	
18	V_{CIX2}	-	Connect a Stabilizing capacitor to GND	Note 3
19	CYP	-	Connect a Booster capacitor to CYN	Note 2
20	CYN	-	Connect a Booster capacitor to CYP	
21	V_{CI}	-	3.3V(Booster input voltage pin)	Note 3
22	NC	-	Not connected	Note 1
23	AGND3	-	Analog Ground	
24	V_{CIM}	-	Connect a Stabilizing capacitor to GND	Note 3
25	CXP	-	Connect a Booster capacitor to CXN	Note 2
26	CXN	-	Connect a Booster capacitor to CXP	
27	TEST	O	TEST	Note 1
28	RESB	I	System reset	
29	DGND2	-	Digital Ground	
30	V_{DDIO}	-	3.3V(Voltage input pin for logic I/O)	
31	V_{CORE}	-	Connect a Stabilizing capacitor to GND	Note 3
32	DGND3	-	Digital Ground	
33	DGND4	I	Digital Ground	
34	CSB	I	Chip select pin of serial interface	
35	SDI	I	Data input pin in serial mode	
36	SCK	I	Clock input pin in serial mode	
37	V_{DROP}	-	Connect a Stabilizing capacitor	
38	DEN	I	Display enable	
39	B5	I	BLUE data signal(MSB)	
40	B4	I	BLUE data signal	
41	B3	I	BLUE data signal	

Pin No.	Symbol	I/O	Description	Remarks
42	B2	I	BLUE data signal	
43	B1	I	BLUE data signal	
44	B0	I	BLUE data signal(LSB)	
45	G5	I	GREEN data signal(MSB)	
46	G4	I	GREEN data signal	
47	G3	I	GREEN data signal	
48	G2	I	GREEN data signal	
49	G1	I	GREEN data signal	
50	G0	I	GREEN data signal(LSB)	
51	R5	I	RED data signal(MSB)	
52	R4	I	RED data signal	
53	R3	I	RED data signal	
54	R2	I	RED data signal	
55	R1	I	RED data signal	
56	R0	I	RED data signal(LSB)	
57	VSYNC	I	Frame synchronization signal	
58	HSYNC	I	Line synchronization signal	
59	DOTCLK	I	Dot-clock signal	
60	CDUM0	-	Connect a Stabilizing capacitor to GND	Note 3
61	DGND5	-	Digital Ground	
62	V_{LCD63}	-	Connect a Stabilizing capacitor to GND	Note 3
63	V_{COMH}	-	Connect a Stabilizing capacitor to GND	
64	V_{COML}	-	Connect a Stabilizing capacitor to GND	
65	DGND6	-	Digital Ground	
66	CSVCMP	-	Connect a Stabilizing capacitor to CSVCMN	Note 3
67	CSVCMN	-	Connect a Stabilizing capacitor to CSVCMP	

Note 1) this pin should be opened.

Note 2) Booster Capacitors

Note 3) Stabilization and charge sharing Capacitors



[Note]
C1N/P,C2N/P,C3N/P,CXN/P,CYN/P are high voltage switching lines on FPC.
Surround/shield by AGND to avoid noise coupling to other pins.
Also aware the PCB design to avoid other components to be affected by noise on those dcdc pins

Recommended Capacitors

Ref No.	Capacitance	Rated Voltage	Temperature Characteristic
C11	0.22uF	16V	B(JIS) or X5R(EIA)
C12	0.22uF	16V	B(JIS) or X5R(EIA)
C13	0.22uF	16V	B(JIS) or X5R(EIA)
C14	0.22uF	10V	B(JIS) or X5R(EIA)
C15	0.22uF	10V	B(JIS) or X5R(EIA)
C16	2.2uF	16V	B(JIS) or X5R(EIA)
C21	2.2uF	25V	B(JIS) or X5R(EIA)
C22	2.2uF	16V	B(JIS) or X5R(EIA)
C23	2.2uF	10V	B(JIS) or X5R(EIA)
C24	2.2uF	6.3V	B(JIS) or X5R(EIA)
C25	2.2uF	6.3V	B(JIS) or X5R(EIA)
C26	2.2uF	10V	B(JIS) or X5R(EIA)
C27	2.2uF	6.3V	B(JIS) or X5R(EIA)
C28	2.2uF	6.3V	B(JIS) or X5R(EIA)
C29	2.2uF	6.3V	B(JIS) or X5R(EIA)
C30	2.2uF	6.3V	B(JIS) or X5R(EIA)
C31	2.2uF	16V	B(JIS) or X5R(EIA)

5. Absolute Maximum Ratings

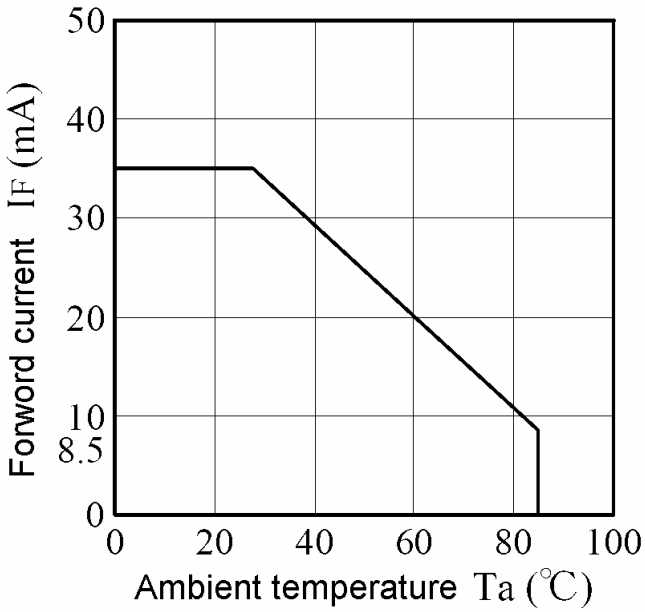
Item	Symbol	Conditions	Rated value	Unit	Remarks
Input voltage	VI	Ta = 25°C	-0.3 ~ V_{DDIO}+0.3	V	Note 1
Logic I/O power supply voltage	V_{DDIO}	Ta = 25°C	-0.3 ~ +4.0	V	
Analog power supply voltage	V_{CI}	Ta = 25°C	AGND-0.3 ~ +5.0	V	
Temperature for storage	Tstg	-	-25 ~ +70	°C	Note 2
Temperature for operation	Topp	-	-10 ~ +60	°C	Note 3
LED input electric current	I_{LED}	Ta_{LED} = 25°C	35	mA	
LED electricity consumption	P_{LED}	Ta_{LED}= 25°C	123	mW	Note 4

Note 1) RESB, CSB, SDI, SCK, DEN, B5~B0, G5~G0, R5~R0, VSYNC, HSYNC, DOTCLK

Note 2) Humidity: 95%RH Max. (Ta≦40°C)
Maximum bulb temperature under 39°C (Ta>40°C) See to it that no dew will be condensed.

Note 3) Panel surface temperature prescribes.

Note 4) Power consumption of one LED (Ta_{LED} = 25°C). (use 4 pieces LED)
Ambient temperature and the maximum input are fulfilling the following operating conditions.



Ambient temperature of LED and the maximum input

6. Electrical Characteristics

6-1. TFT LCD Panel Driving

Ta = 25°C

Item		Symbol	Min.	Typ.	Max.	Unit	Remarks
Logic I/O power supply	DC voltage	V_{DDIO}	+3.0	+3.3	+3.6	V	
	DC Current	I_{VDDIO}	-	0.15	0.30	mA	Note 1
Analog power supply	DC voltage	V_{CI}	+3.0	+3.3	+3.6	V	
	DC Current	I_{VCI}	-	8.5	12	mA	Note 1
Permissive input Ripple voltage		$V_{RFVDDIO}$	-	-	100	mVp-p	Note 2
		V_{RFVCI}	-	-	100	mVp-p	Note 2
Logic Input Voltage	High	V_{IH}	0.8 V_{DDIO}	-	V_{DDIO}	V	Note 3
	Low	V_{IL}	0	-	0.2 V_{DDIO}	V	Note 3
Logic input Current		I_{IH} / I_{IL}	-1	-	1	μA	Note 3

Note 1) V_{DDIO} = V_{CI} = +3.3V,fv=60Hz

Current situation for I_{VDDIO}: Black & White checker flag pattern

Current situation for I_{CI}: All white pattern

Note 2) V_{DDIO} = V_{CI} = +3.3V

Note 3) RESB, CSB, SDI, SCK, DEN, B5~B0, G5~G0, R5~R0, VSYNC, HSYNC, DOTCLK

6-2. Power up sequence

V_{DDIO} / V_{CI} ON (hold RESB = “L”)

↓

Wait min. 80us

↓

Hard Reset (RESB “L” → “H”)

↓

Enter the Sleep Mode

Reg.#	Register	Data	Remark
R28h	Power control (6)	0006 h	
R2Dh	Power control (8)	7F06 h	

↓

Register setting

Reg.#	Register	Data (Gamma 2.2)	Remark
R01 h	Driver output control	0xEF h	Note 1
R02 h	LCD drive AC control	0300h	
R03 h	Power control (1)	0A0E h	
R0B h	Frame cycle control	D000 h	
R0C h	Power control (2)	0005 h	
R0D h	Power control (3)	0002 h	
R0E h	Power control (4)	2C00 h	
R0F h	Gate scan starting Position	0000 h	
R16 h	Horizontal Porch	9F86 h	Note 2
R17 h	Vertical Porch	0002 h	Note 3
R1E h	Power control (5)	0000 h	
R2A h	Power control (7)	0196 h	
R2E h	Gamma control (1)	B945 h	
R30 h	Gamma control (2)	0004 h	
R31 h	Gamma control (3)	0407 h	
R32 h	Gamma control (4)	0002 h	
R33 h	Gamma control (5)	0107 h	
R34 h	Gamma control (6)	0507 h	
R35 h	Gamma control (7)	0003 h	
R36 h	Gamma control (8)	0307 h	
R37 h	Gamma control (9)	0704 h	
R3A h	Gamma control (10)	1F09 h	
R3B h	Gamma control (11)	090E h	

↓

Display Data Start (VSYNC, HSYNC, DOTCLK)

↓

Exit the Sleep Mode

Reg.#	Register	Data	Remark
R2Dh	Power control (8)	7F04 h	

↓

Wait 10 frames time

↓

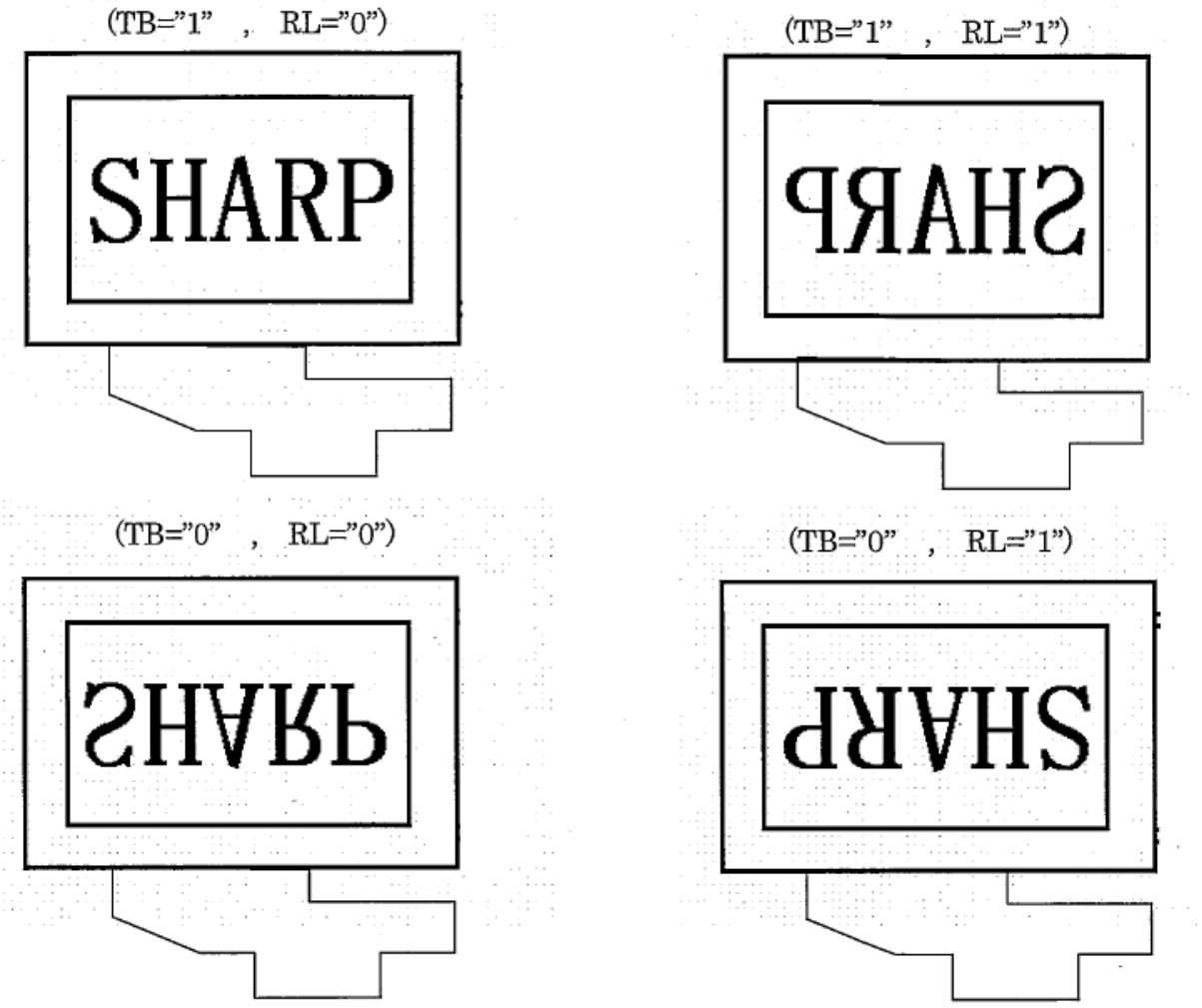
Display On

Note 1)

Driver Output Control (R01h)(POR=0xEFh)

	DC	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
W	1	0	0	0	0	1	0	TB	RL	1	1	1	0	1	1	1	1
POR		0	0	0	0	1	0	x	x	1	1	1	0	1	1	1	1

≪Vertical and Horizontal inversion function(TB, RL)≫



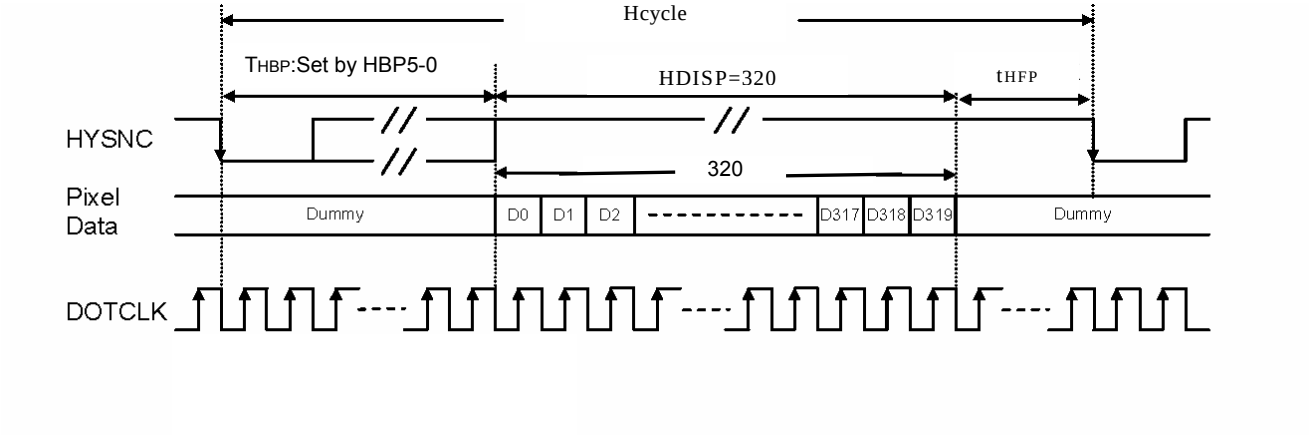
Note 2)

Horizontal Porch(R16h)(POR=9F86h)

R/W	DC	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
W	1	1	0	0	1	1	1	1	1	1	0	HBP5	HBP4	HBP3	HBP2	HBP1	HBP0
POR		1	0	0	1	1	1	1	1	1	0	0	0	0	1	1	0

HBP5-0: Set the delay period from falling edge of HSYNC to first valid line.

HBP5	HBP4	HBP3	HBP2	HBP1	HBP0	No. of clock cycle of DOTCLK
0	0	0	0	0	0	2
0	0	0	0	0	1	3
0	0	0	0	1	0	4
0	0	0	0	1	1	5
0	0	0	1	0	0	6
:	:	:	:	:	:	: Step = 1 :
1	1	1	1	1	0	64
1	1	1	1	1	1	65



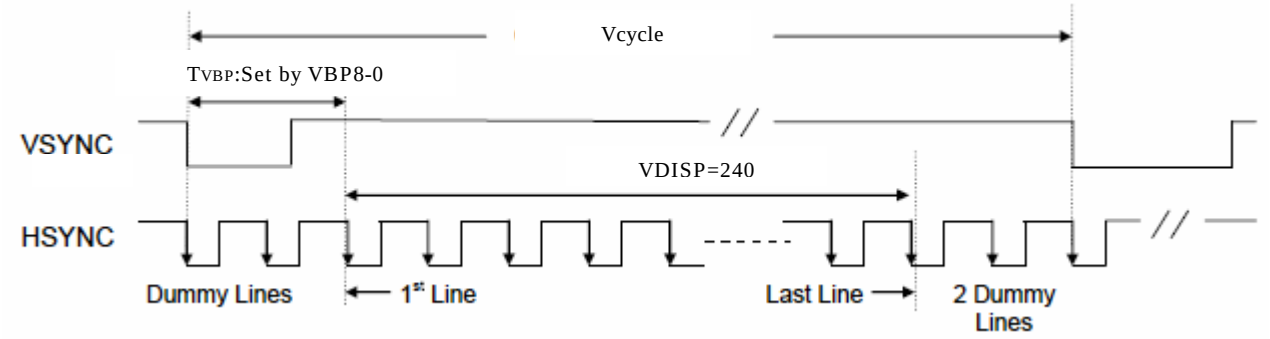
Note 3)

Vertical Porch(R17h)(POR=0002h)

R/W	DC	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
W	1	0	0	0	0	0	0	0	VBP8	VBP7	VBP6	VBP5	VBP4	VBP3	VBP2	VBP1	VBP0
POR		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0

VBP8-0 : Set the delay period from falling edge of VSYNC to first valid line.

VBP8	VBP7	VBP6	VBP5	VBP4	VBP3	VBP2	VBP1	VBP0	No. of clock cycle of HSYNC
0	0	0	0	0	0	0	0	0	0 (only allow when CAD=0)
0	0	0	0	0	0	0	0	1	1
0	0	0	0	0	0	0	1	0	2
				:					: Step = 1 :
1	0	0	1	1	1	1	1	0	319
1	0	0	1	1	1	1	1	1	320
1	0	1	*	*	*	*	*	*	Reserved
1	1	*	*	*	*	*	*	*	Reserved



6-3..Power down sequence

Write Black Data (RGB Data: All “L” level)

↓

Wait min. 1 frame time

↓

Enter the Sleep Mode

Reg.#	Register	Data	Remark
R28h	Power control (6)	0006 h	
R2Dh	Power control (8)	7F06 h	

↓

Wait min. 2 frames time

↓

Display Data Stop (VSYNC, HSYNC, DOTCLK)

↓

V_{DDIO} / V_{CI} OFF

6-4. Enter sleep mode sequence

Write Black Data (RGB Data: All “L” level)

↓

Wait min. 1 frame time

↓

Enter the Sleep Mode

Reg.#	Register	Data	Remark
R28h	Power control (6)	0006 h	
R2Dh	Power control (8)	7F06 h	

↓

Wait min. 2 frames time

↓

Display Data Stop (VSYNC, HSYNC, DOTCLK)

6-5. Exit sleep mode sequence

Display Data Start (VSYNC, HSYNC, DOTCLK)

↓

Exit the Sleep Mode

Reg.#	Register	Data	Remark
R28h	Power control (6)	0006 h	
R2Dh	Power control (8)	7F04 h	

↓

Wait 10 frames time

↓

Display On

6-6. Back light driving

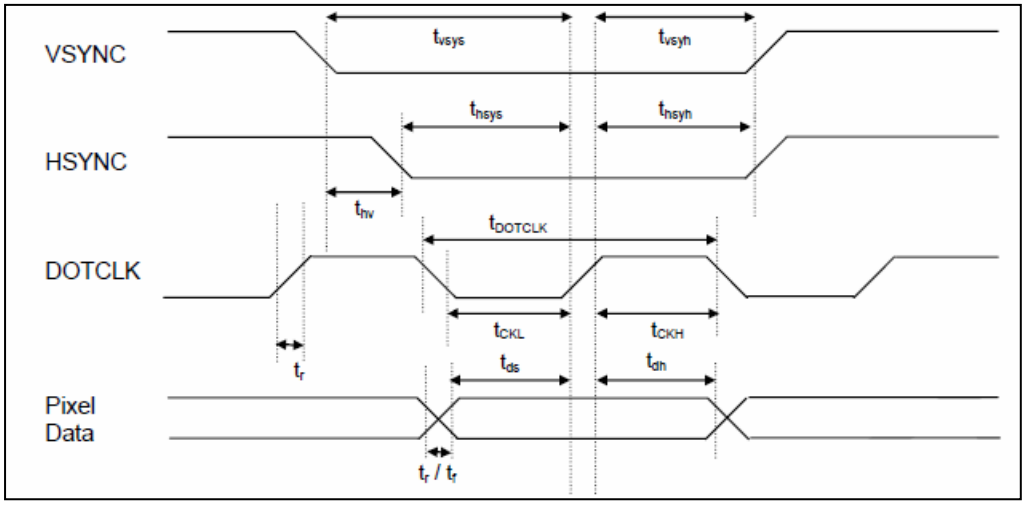
The back light system has 4 LEDs

Used LED : GM4BW64310A[SHARP]

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Rated Voltage	V_{BL}	-	12.8	14.0	V	
Rated Current	I_L	-	20	-	mA	Ta=25°C
Power consumption	W_L	-	256	-	mW	

7. Timing characteristics of input signals

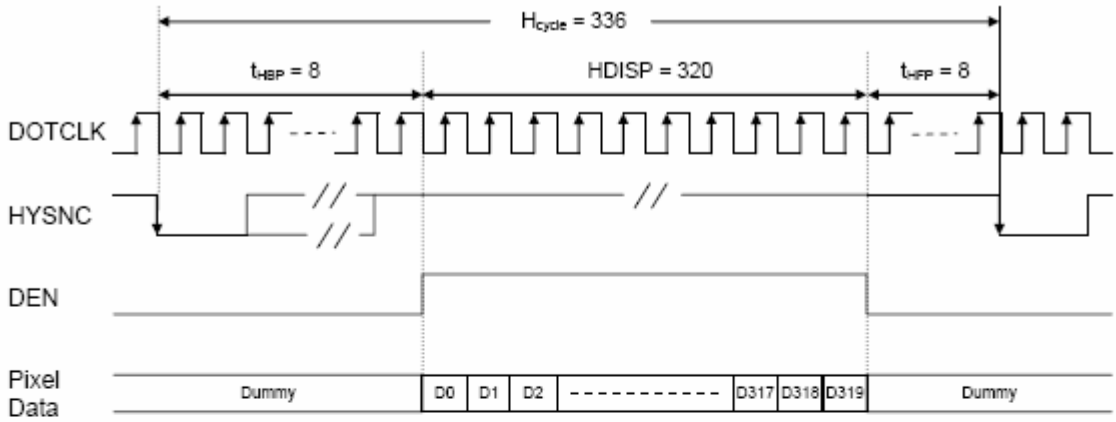
7-1. Pixel Clock Timing



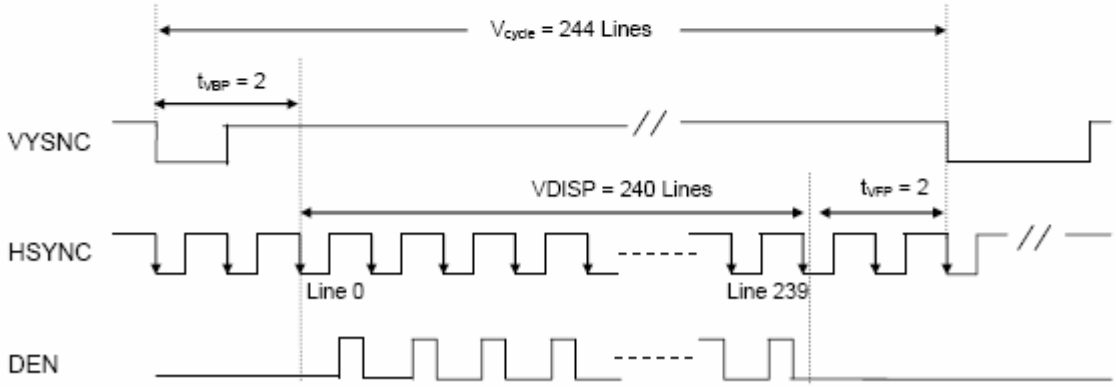
Characteristics		Symbol	Min	Typ	Max	Unit
DOTCLK	Frequency	f_{DOTCLK}	-	5.0	8.0	MHz
	Period	t_{DOTCLK}	125	200	-	nSec
	High Period	t_{CKH}	62	-	-	nSec
	Low Period	t_{CKL}	62	-	-	nSec
Data	Setup Time	t_{ds}	30	-	-	nSec
	Hold Time	t_{dh}	30	-	-	nSec
Vsync	Setup Time	t_{vsys}	20	-	-	nSec
	Hold Time	t_{vsyh}	20	-	-	nSec
Hsync	Setup Time	t_{hsys}	20	-	-	nSec
	Hold Time	t_{hsyh}	20	-	-	nSec
Phase difference of Sync signal Falling edge		t_{hv}	0	-	320	t_{DOTCLK}
Reset Pulse Width		t_{RES}	10	-	-	nSec
Rise / Fall Time		t_r/t_f	-	-	100	nSec

Note: External clock source must be provided to DOTCLK pin.
The module will not operate If absent of the clocking signal.

7-2. Data Transaction Timing in Normal Operating Mode (262k color)



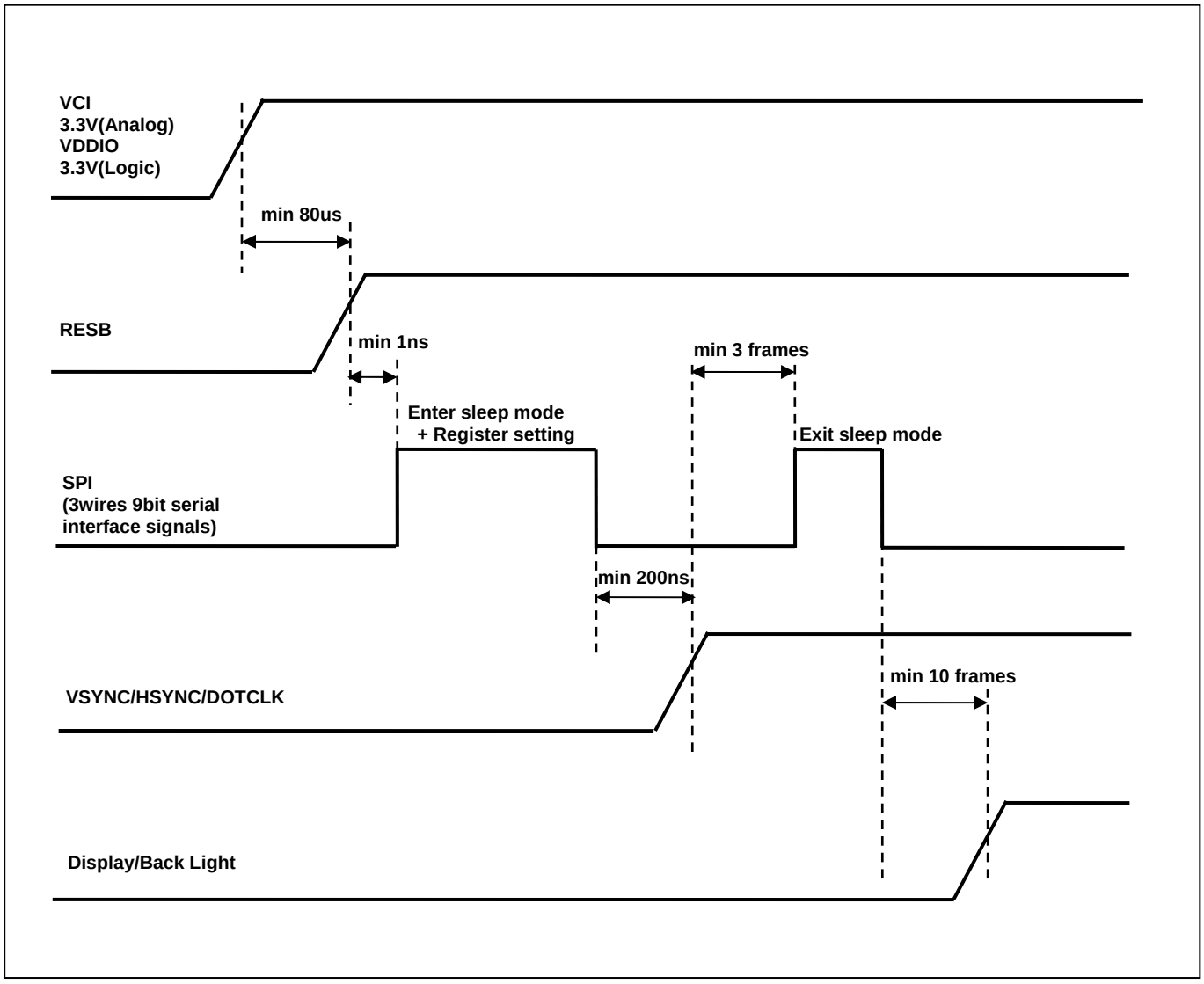
a) Horizontal Data Transaction Timing



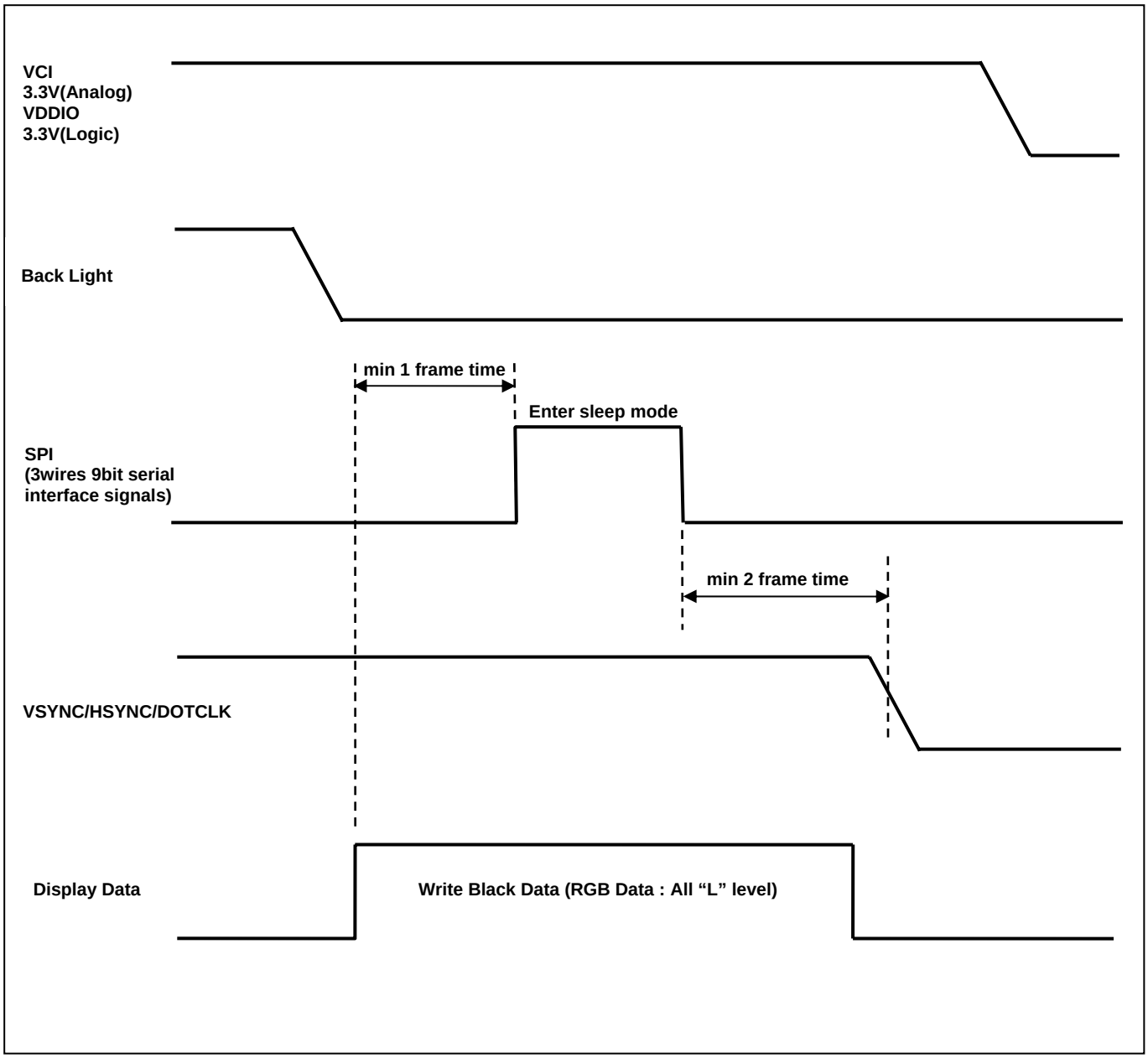
b) Vertical Data Transaction Timing

Characteristics		Symbol	Min	Typ	Max	Unit
DOTCLK	Frequency	f_{DOTCLK}	-	5.0	8.0	MHz
	Period	t_{DOTCLK}	125	200	-	ns
HSYNC	Frequency	f_h	-	14.9	18.18	kHz
	Cycle	H_{cycle}	-	336	-	clock
VSYNC	Frequency	f_v	50	60.1	-	Hz
	Cycle	V_{cycle}	-	244	-	line
Horizontal Back Porch		t_{HBP}	-	8	-	clock
Horizontal Front Porch		t_{HFP}	-	8	-	clock
Horizontal Blanking Period		$t_{HBP}+t_{HFP}$	-	16	-	clock
Horizontal Display Area		HDISP	-	320	-	clock
Vertical Back Porch		t_{VBP}	-	2	-	line
Vertical Front Porch		t_{VFP}	-	2	-	line
Vertical Blanking Period		$t_{HBP}+t_{HFP}$	-	4	-	line
Vertical Display Area		VDISP	-	240	-	line

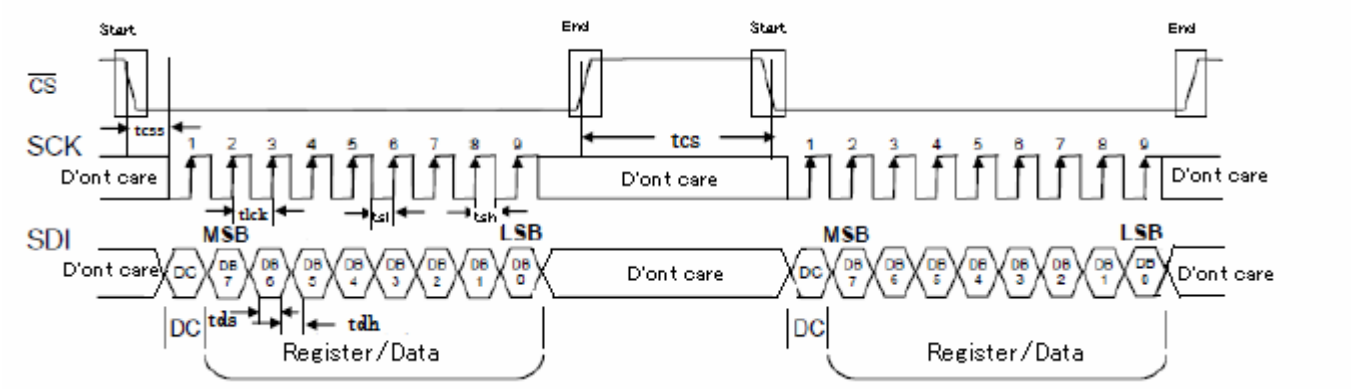
7-3. Power Up Sequence



7-4. Power Down Sequence

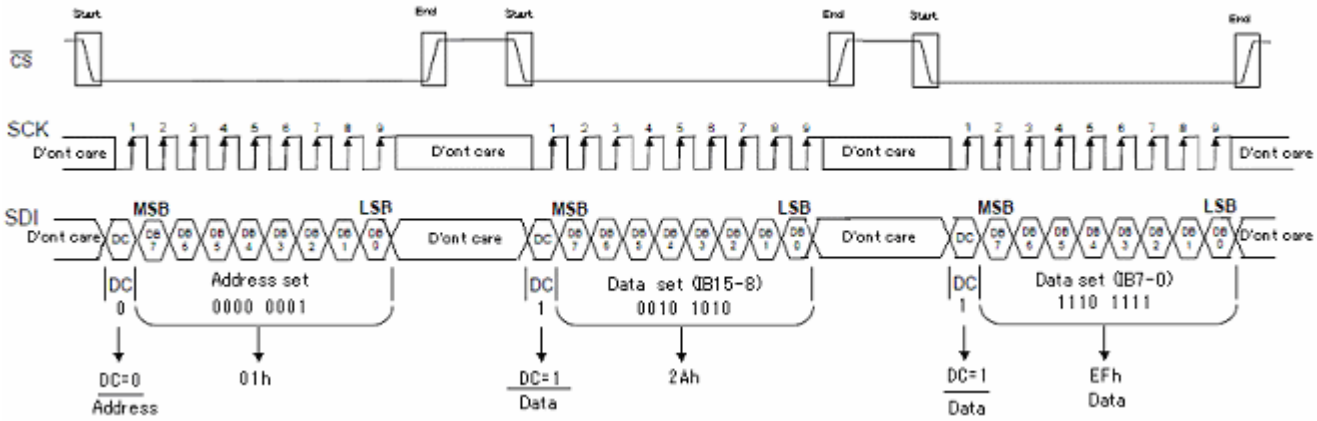


7-5. SPI Interface Timing Diagram & Transaction Example (9 bit)

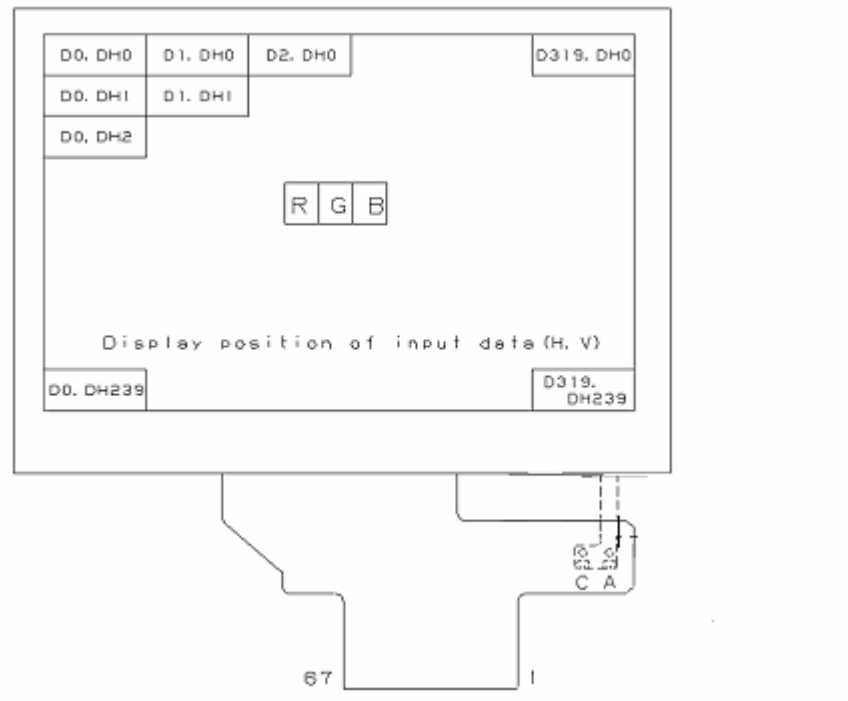


Characteristics		記 号	Min	Typ	Max	単 位
Serial Clock	Frequency	fclk	-	-	20	MHz
	Cycle Time	tclk	50	-	-	ns
	Low Width	tsl	25	-	-	ns
	High Width	tsh	25	-	-	ns
Chip Select	Setup Time	tcss	0	-	-	ns
	Hold time	tcsh	10	-	-	ns
	High Delay Time	tcsd	20	-	-	ns
Data	Setup Time	tds	5	-	-	ns
	Hold Time	tdh	10	-	-	ns

The example transmit “0x2AEFh” to register R01h.



7-6. Input Data Signals and Display Position on the screen



Please refer to Input Terminal Names and Functions

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

	Colors & Gray Scale	Gray Scale	Date signal																	
			R0	R1	R2	R3	R4	R5	G0	G1	G2	G3	G4	G5	B0	B1	B2	B3	B4	B5
			LSB					MSB	LSB					MSB	LSB					MSB
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 18 bit data signals, the 262k color display can be achieved on the screen.

9. Optical Characteristics

Ta = 25°C, V_{DDIO} = +3.3V, V_{CI} = +3.3V

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing angle range (Wide View)	Horizontal	θ21	CR≧10	-	80	-	deg.	【Note1,4】
		θ22		-	80	-	deg.	
	Vertical	θ11		-	80	-	deg.	
		θ12		-	80	-	deg.	
Contrast ratio		CR	Optimum viewing angle	300	500	-		【Note2,4】
Response Time	Rise	Tr	θ=0°	-	15	30	ms	【Note3,4】
	Decay	Td		-	15	30	ms	
Chromaticity of White		x		0.26	0.31	0.36	-	【Note4】
		y		0.29	0.34	0.39	-	
Luminance of white		X_{L1}		250	350	-	cd/m²	I_{LED}=20mA

* The optical characteristics measurements are operated under a stable luminescence (I_{LED} = 20mA) and a dark condition. (Refer to Fig.9-1)

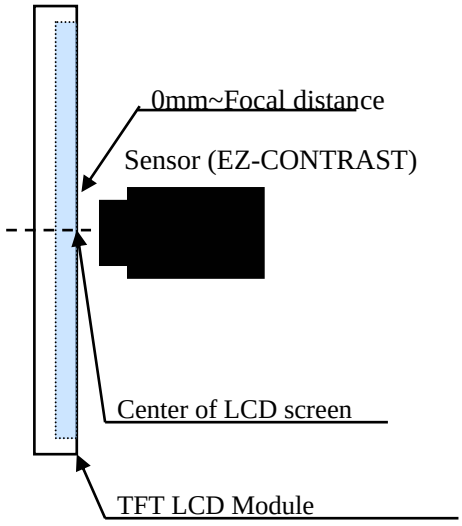


Fig.9-1 Measuring setup for Viewing angle and Contrast ratio
(BM-7 is used for contrast.)

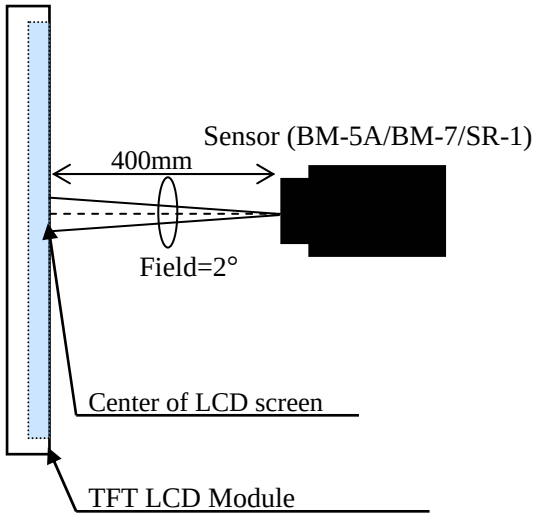
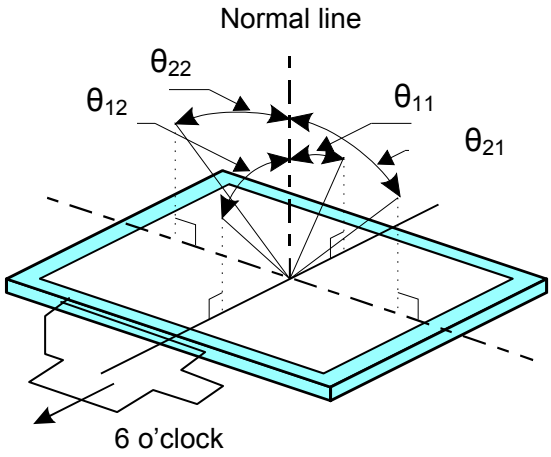


Fig.9-2 Measuring setup for Luminance, Chromaticity and Response time
(BM-7 is used for Luminance, SR-1 is for response)

【 Note 1 】Definitions of viewing angle range



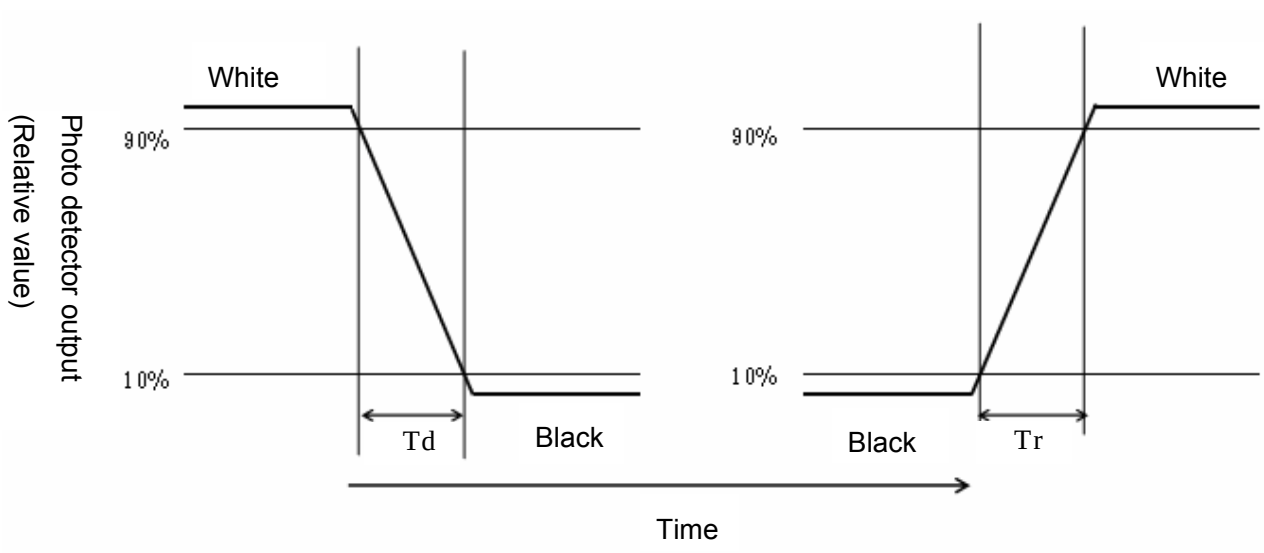
【 Note 2 】Definition of contrast ratio

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 3 】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 4 】This shall be measured at center of the screen.

10 Handling of modules

10-1. Inserting the FPC into its connector and pulling it out

1) Be sure to turn off the power supply and the signals when inserting or disconnecting the cable.
2) Please insert for too much stress not to join FPC in the case of insertion of FPC.

10-2. About handling of FPC

1) The bending radius of the FPC should be more than 1.4mm, and it should be bent evenly.
2) Do not dangle the LCD module by holding the FPC, or do not give any stress to it.

10-3. Mounting of the module

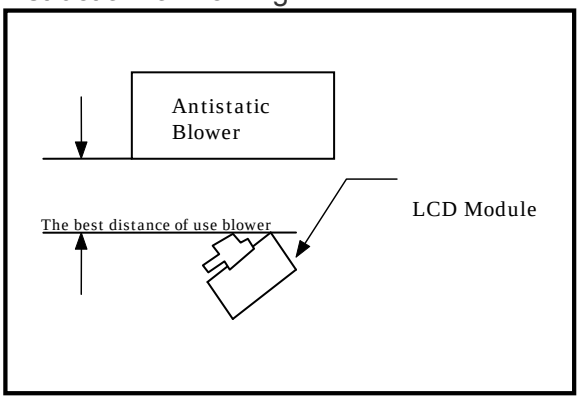
1) The module should be held on to the plain surface. Do not give any warping or twisting stress to the module.
2) Please consider that GND can ground a modular metal portion etc. so that static electricity is not charged to a module.

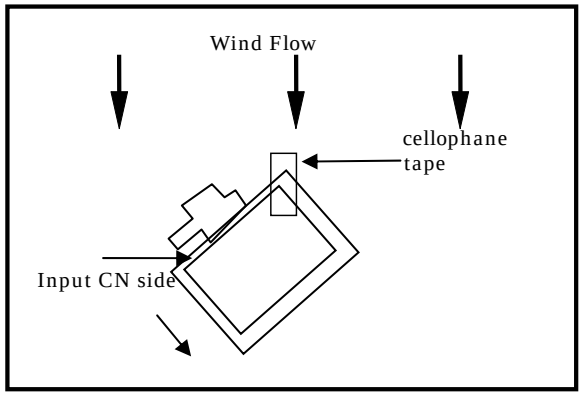
10-4. Cautions in assembly / Handling pre cautions

As the polarizer can be easily scratched, be most careful in handling it.

1) Work environments in assembly.
   Since removing laminator may causes electrostatic charge that tends to attract dust, the following work environment would be desired.
   a) Floor: Conductive treatment having 1MΩ resistance onto floor's tile
   b) The room free from dust coming from outdoor environment, and put an adhesive mat at entrances.
   c) Humidity from 50% to 70% and temperature from 15°C to 27°C are desirable.
   d) Worker should ware conductive shoes, conductive fatigue, conductive glove and earth wrist band.

2) Instruction for working





a) Wind direction of an antistatic blower should slightly downward to properly blow the module. The distance between the blower and the module should be the best distance of use blower. Also, pay attention to the direction of the module.
b) To prevent polarizer from scratching, adhesive tape (cellophane tape) should be stuck at the part of laminator sheet, which is closed to blower. [See the above]
c) Pull slowly adhesive tape to peel the laminator off, with spending more than 5 second.
d) The module without laminator should be moved to the next process to prevent adhesion of dust.

3) How the remove dust on the polarizer

a) Blow out dust by the use of an N2 blower with antistatic measures taken. Use of an ionized air Gun is recommendable.

b) When the panel surface is soiled, wipe it with soft cloth.

4) In the case of the module's metal part (shield case) is stained, wipe it with a piece of dry, soft cloth. If rather difficult, give a breath on the metal part to clean better.

5) If water dropped, etc. remains stuck on the polarizer for a long time, it is apt to get discolored or cause stains. Wipe it immediately.

6) As a glass substrate is used for the TFT-LCD panel, if it is dropped on the floor or hit by something hard, it may be broken or chipped off.

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

10-5. Others

1) Regarding storage of LCD modules, avoid storing them at direct sunlight-situation.

2) If stored at temperatures below the rated values, the inner liquid crystal may freeze, causing cell destruction. At temperatures exceeding the rated values for storage, the liquid crystal may become isotropic liquid, making it no longer possible to come back to its original state in some cases.

3) If the LCD is broken, do not drink liquid crystal in the mouth. If the liquid crystal adheres to a hand or foot or to clothes, immediately cleanse it with soap.

4) If a water drop or dust adheres to the polarizer, it is apt to cause deterioration. Wipe it immediately.

5) Be sure to observe other caution items for ordinary electronic parts and components.

11. Reliability test items

No.	Test item	Conditions
1	High temperature storage test	Leaves the module at Ta=+70°C for 240h
2	Low temperature storage test	Leaves the module at Ta=-25°C for 240h
3	High temperature & high humidity operation test	Operates the module at Ta=+40°C; 95%RH for 240h (No condensation)
4	High temperature operation test	Operates the module with +60°C at panel surface for 240h
5	Low temperature operation test	Operates the module at Ta=--10°C for 240h
6	Vibration test (non- operating)	Frequency range: 10 to 55Hz Stroke: 1.5mm Sweep time: 1minutes Test period: 2 hours for each direction of X,Y,Z
7	Shock test	Direction: ±X, ±Y, ±Z, Time: Third for each direction. Impact value: 980m/s², Action time 6ms
8	Thermal shock test	Ta=-10°C to 70°C /10 cycles (30 min) (30min)

【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.

12. Display Grade

The standard regarding the grade of color LCD displaying modules should be based on the delivery inspection standard.

13. Delivery Form

1) Carton piling-up: Max 8 rows

2) Environments

Temperature: 0～40°C

Humidity: 65% RH or less (at 40°C)

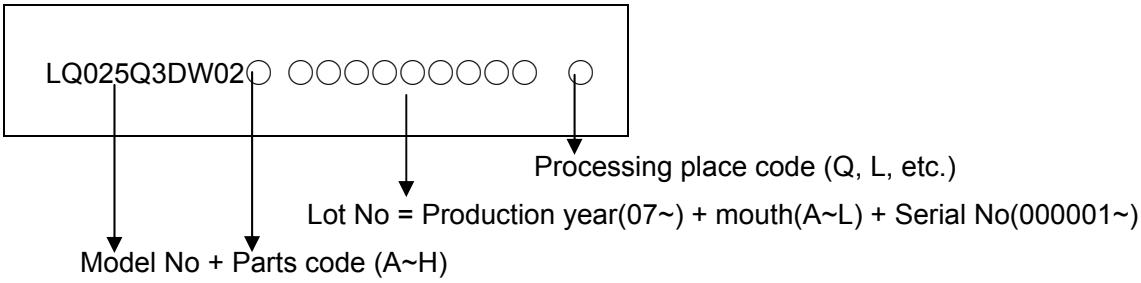
There should be no dew condensation even at a low temperature and high humidity.

3) Packing form: 15. LCD module packing carton

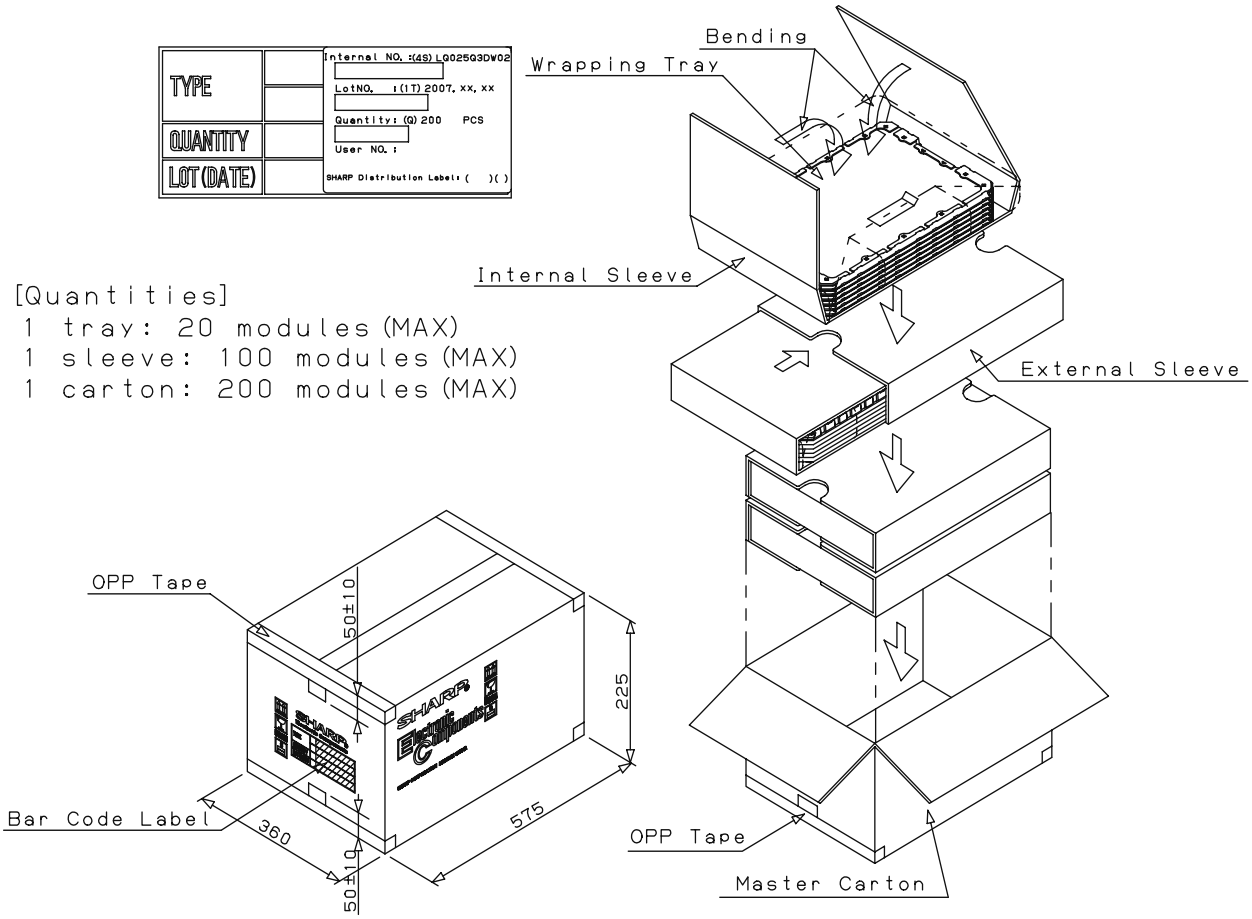
※Cartons are weak against damp, and they are apt to be smashed easily due to the compressive pressure applied when piled up. The above environmental conditions of temperature and humidity are set in consideration of reasonable pile-up for storage.

14. Lot No. marking

The lot No. will be indicated on individual inkjet. The location is as shown



15. LCD module packing carton



16. Others

1 Disassembling the module can cause permanent damage and you should be strictly avoided.

2 Please be careful that you don't keep the screen displayed fixed pattern image for a long time, since retention may occur.

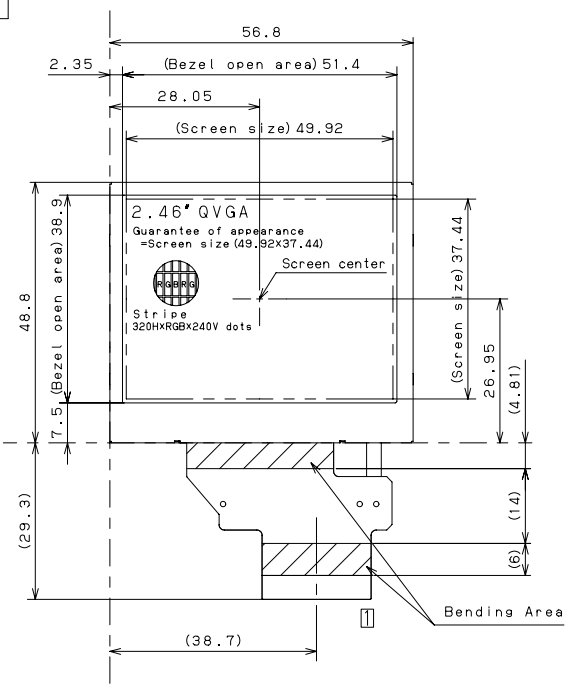
3 If you pressed down a liquid crystal display screen with your finger and so on, the alignment disorder of liquid crystal will occur. And then It will become display fault.
Therefore, be careful not to touch the screen directly, and to consider not stressing to it.

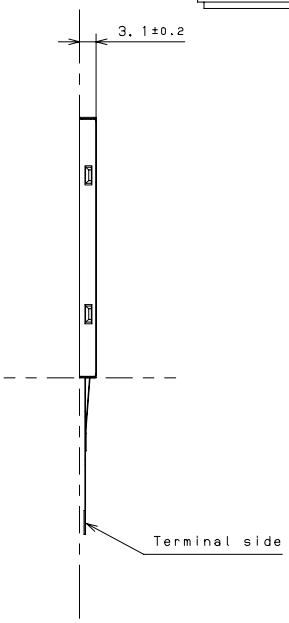
4 If any problem arises regarding the items mentioned in this specification sheet or otherwise, it should be discussed and settled mutually in a good faith for remedy and/or improvement.

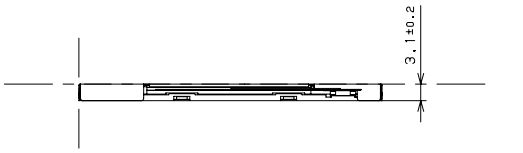
17.Outline Dimensions

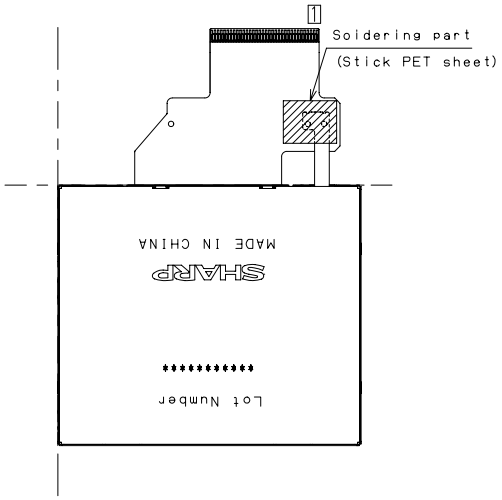
SHARP

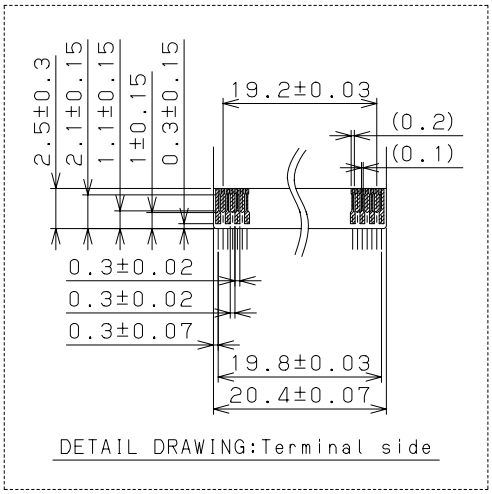
Outline proposal











Recommended connector:FH26G (HIROSE ELECTRIC CO., LTD.) or 6281 (KYOCERA ELCO CORP.)

1) General tolerance is ±0.5.
2) Guarantee of appearance = LCD Active Aarea.
3) Tolerance of thickness does not include any wrinkling of PET tape or any loose PET tape off the FPC.
4) LCD-FPC should bended only bending area.
5) LCD/LED FPC bend larger than 0.6 in radius.
6) Take care in set design to hide the scratches and bubbles appeared on the polariLer or other frame area which is located outside of guarantee area.
7) The light of Back Light is leaking from BM outside, please light shielding by the set.
8) The tolerance of module width are exclude warp of case.

unit:mm	Please do not copy this material and do not disclose this to third party.			
DATE	2009.07.02	SCALE free		
MODEL	LQ02SQ3DW02			
DRAWING NO	2D-09701-0113	size A3	SHARP CO. LTD	ENGINEERING DEPARTMENT 1 MOBILE LIQUID CRYSTAL DIVISION Ⅱ MOBILE LIQUID CRYSTAL DISPLAY GROUP

No.	DATE	REVISION	Sign.
3			
2			
1			

Fig.1 Outline Dimensions

Technical Document

LCD Specification

LCD Group

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