Technical Document

LCD Specification

LCD Group

LQ030B7UB02 LCD Module

Product Specification
December 2009

Wide-QVGA, LED-backlit Transflective Portrait-mode panel featuring a symmetrical viewing cone of 160° (reflective mode). Module has 10% reflectivity and 15:1 contrast (reflective) and brightness of 150 nits and contrast of 100:1 in transmissive mode.

Full Specifications Listing

SHARP

PREPARED BY: K. Toyota	SHARP	SPEC No. LCY-09083C
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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. LQ030B7UB02

These parts have corresponded with the RoHS directive.

CUSTOMER'S APPROVAL

DATE

BY

PRESENTED

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RECORDS OF REVISION

MODEL No : LQ030B7UB02

SPEC No : LCY-09083C

	NO.	PAGE	SUMMARY	NOTE
2009.10. 13	A	-	-	1st Issue
2009.10.30	B	23	Correct ; LCD outline dimension Outline−ActiveArea (8.3mm→7.9mm)	2nd Issue
2009.12.4	C	2～23	Addition; interface mode	3rd Issue
			・16bit system interface mode	
			・VSYNC interface mode	
			・RGB interface mode	
		5,30	Correct; Temperature for operation	
			-20℃～70℃ → -10℃～70℃	

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1. Applicable Scope

This specification is applicable to TFT-LCD Module “LQ030B7UB02”.

2. General Description

This module is a color reflective and active matrix LCD module incorporating amorphous silicon TFT (Thin Film Transistor), named AD-TFT(Advanced TFT). It is composed of a color TFT-LCD panel, driver IC, a FPC and metal bezels.

1) When it is used by system interface mode, Graphics and texts can be displayed on a 240 x RGB x 400 dots panel with about 262k or 65K colors by supplying 18 or 16bit system interface signals , three control signals (RS/CS/WR), logic (Typ. +1.8V), analog (Typ. +3.0V or +2.8V) supply voltages for TFT-LCD panel driving and supply voltage for back light.

2) When it is used by RGB interface mode, Graphics and texts can be displayed on a 240 x RGB x 400 dots panel with about 262k colors by supplying 18 bit data signals (6bit x RGB), four timing signals , 3wires 24bit serial interface signals, logic (Typ. +1.8V), analog (Typ. +3.0V or +2.8V) supply voltages for TFT-LCD panel driving and supply voltage for back light.

Optimum view angle is 12 o’clock.

3. Mechanical (Physical) Specifications

Item	Specifications	Unit
Screen size	7.6 (3.0” type) diagonal	cm
Active area	38.88 (H) × 64.8 (V)	mm
Pixel format	240 (H) x 400 (V)	Pixel
	1Pixel =R+G+B dots	-
Pixel pitch	0.162 (H) x 0.162 (V)	mm
Pixel configuration	R,G,B vertical stripes	-
Display mode	Normally white	-
Unit outline dimensions	47.28 (W) x 76.4 (H) x3.25 (D)	mm
Mass	Approx.24	g
Surface hardness	3H	-
Surface treatment	Anti reflection	

*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/Output terminal and Functions

Recommendation CN：[HIROSE] FH19SC-45S-0.5SH(05)

≪When it is used by 18 or16bits system Interface≫

Pin No.	Symbol	I/O	Description	Remarks
1	GND	-	Ground	
2	LED-K	-	Power supply for LED (Cathode)	
3	LED-A2	-	Power supply for LED of 1pc (Anode)	
4	LED-A1	-	Power supply for LED of full(Anode)	
5	GND	-	Ground	
6	GND	-	Ground	
7	RESB	I	System reset	
8	GND	-	Ground	
9	DB17	I	Data signal	
10	DB16	I	Data signal	
11	DB15	I	Data signal	
12	DB14	I	Data signal	
13	DB13	I	Data signal	
14	DB12	I	Data signal	
15	DB11	I	Data signal	
16	DB10	I	Data signal	
17	DB9	I	Data signal	
18	DB8	I	Data signal	
19	DB7	I	Data signal	
20	DB6	I	Data signal	
21	DB5	I	Data signal	
22	DB4	I	Data signal	
23	DB3	I	Data signal	
24	DB2	I	Data signal	
25	DB1	I	Data signal	
26	DB0	I	Data signal	
27	GND	-	Ground	
28	NC	-	Not connect	
29	VCCIO	-	Voltage input pin for logic I/O	
30	WR	I	Write control input pin	Note 4-1
31	RS	I	Register select input pin	Note 4-2
32	CS	I	Chip select pin	Note 4-3
33	GND	-	Ground	
34	VSYNC	I	Frame synchronization signal (VSYNC interface)	Note 4-4
35	GND	-	Ground	
36	GND	-	Ground	
37	NC	-	Not connect	
38	VCCIO	-	Voltage input pin for logic I/O	
39	VCC	-	Booster input voltage pin	
40	IM0	I	Select a mode to interface	Note 4-5
41	IM1	I	Select a mode to interface	Note 4-5
42	IM2	I	Select a mode to interface	Note 4-5
43	GND	-	Ground	
44	GND	-	Ground	
45	GND	-	Ground	

≪When it is used by RGB system Interface≫

Pin No.	Symbol	I/O	Description	Remarks
1	GND	-	Ground	
2	LED-K	-	Power supply for LED (Cathode)	
3	LED-A2	-	Power supply for LED of 1pc (Anode)	
4	LED-A1	-	Power supply for LED of full(Anode)	
5	GND	-	Ground	
6	GND	-	Ground	
7	RESB	I	System reset	
8	GND	-	Ground	
9	R5	I	RED data signal(MSB)	
10	R4	I	RED data signal	
11	R3	I	RED data signal	
12	R2	I	RED data signal	
13	R1	I	RED data signal	
14	R0	I	RED data signal(LSB)	
15	G5	I	GREEN data signal(MSB)	
16	G4	I	GREEN data signal	
17	G3	I	GREEN data signal	
18	G2	I	GREEN data signal	
19	G1	I	GREEN data signal	
20	G0	I	GREEN data signal(LSB)	
21	B5	I	BLUE data signal(MSB)	
22	B4	I	BLUE data signal	
23	B3	I	BLUE data signal	
24	B2	I	BLUE data signal	
25	B1	I	BLUE data signal	
26	B0	I	BLUE data signal(LSB)	
27	SDI	I	Data input pin in serial mode	
28	NC	-	Not connect	
29	VCCIO	-	Voltage input pin for logic I/O	
30	SCL	I	Serial clock signal	
31	VCCIO	-	Voltage input pin for logic I/O	
32	CS	I	Chip select pin	Note 4-3
33	ENABLE	I	Data enable signal	
34	VSYNC	I	Frame synchronization signal	
35	HSYNC	I	Line synchronization signal	
36	DOTCLK	I	Dot-clock signal	
37	NC	-	Not connect	
38	VCCIO	-	Voltage input pin for logic I/O	
39	VCC	-	Booster input voltage pin	
40	IM0	I	Select a mode to interface	Note 4-5
41	IM1	I	Select a mode to interface	Note 4-5
42	IM2	I	Select a mode to interface	Note 4-5
43	GND	-	Ground	
44	GND	-	Ground	
45	GND	-	Ground	

Note 4-1) Write strobe signal in system interface operation and enables write operation when WR* is low.

Note 4-2) “L”=Select status Register. “H”=Select control Register

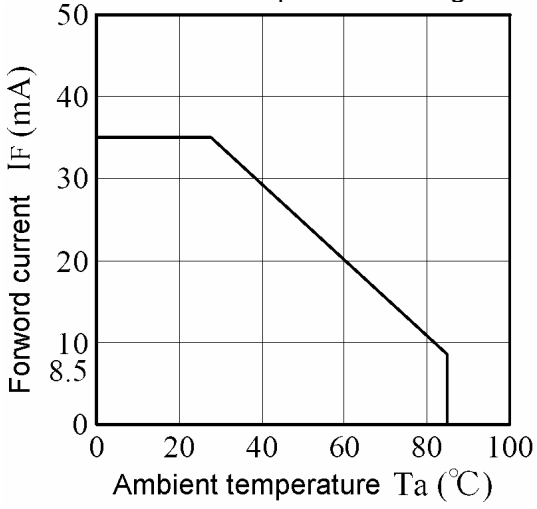
Note 4-3) “L”= Selected and accessible. “H”=Not selected and not accessible.
Note 4-4) This terminal (VSYNC) is used at the VSYNC interface mode.
Please fix to GND when not in used.
※Please refer to 7-1-2) for the VSYNC interface mode.
Note 4-5)

Display interface mode	IM2	IM1	IM0
16bit system interface	“L”	“H”	“L”
18bit system interface	“L”	“L”	“L”
RGB interface	“H”	“L”	“L”

5. Absolute Maximum Ratings

Item	Symbol	Conditions	Rated value	Unit	Remarks
Input voltage	VI	Ta = 25°C	-0.3 ~VCCIO+0.3	V	Note5-1
Logic I/O power supply voltage	VCCIO	Ta = 25°C	-0.3 ~ +4.0	V	
Analog power supply voltage	VCC	Ta = 25°C	GND-0.3 ~ +4.6	V	
Temperature for storage	Tstg	-	-30 ~ +80	°C	Note5-2
Temperature for operation	Topr	-	-10 ~ +70	°C	Note5-2,3
LED input electric current	I_{LED}	Ta = 25°C	35	mA	Note5-4
LED electricity consumption	P_{LED}	Ta = 25°C	123	mW	Note5-4

Note5-1) WR, RS, CS, SCL, SDI, ENABLE, VSYNC, HSYNC, DOTCLK, RESB, IM2~IM0, DB17~DB0, R5~R0, G5~G0, B5~B0
Note5-2) Humidity: 95%RH Max. (Ta≦40°C)
Note5-3) Panel surface temperature prescribes.
Note5-4) Power consumption of one LED (Ta = 25°C). (use 6 pieces LED)
Ambient temperature and the maximum input are fulfilling the following operating conditions.



Ambient temperature 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_{CCIO}	+1.65	+1.8	VCC	V	
	DC current	I_{VCCIO}	-	0.04	0.10	mA	Note6-1
	DC voltage	V_{CCIO}	+1.65	+1.8	VCC	V	
	DC current	I_{VCCIO}	-	0.04	0.10	mA	Note6-2
Analog power supply	DC voltage 1	V_{CC}	+2.9	+3.0	+3.1	V	Note6-3
	DC current 1	I_{VCC}	-	13.5	20	mA	Note6-4
	DC voltage 2	V_{CC}	+2.7	+2.8	+2.9	V	Note6-3
	DC current 2	I_{VCC}	-	13.5	20	mA	Note6-5
	DC voltage 3	V_{CC}	+2.9	+3.0	+3.1	V	Note6-3
	DC current 3	I_{VCC}	-	15.5	23	mA	Note6-6
	DC voltage 4	V_{CC}	+2.7	+2.8	+2.9	V	Note6-3
	DC current 4	I_{VCC}	-	15.5	23	mA	Note6-7
Permissive input Ripple voltage		$V_{RFVCCIO}$	-	-	100	mVp-p	Note6-8
		V_{RFVCC}	-	-	100	mVp-p	Note6-8
Logic Input Voltage	High	V_{IH}	0.8 * V_{CCIO}	-	V_{CCIO}	V	Note6-9
	Low	V_{IL}	0	-	0.2 * V_{CCIO}	V	Note6-9
Logic input Current		I_{IH} / I_{IL}	-1	-	1	μA	Note6-9

Note 6-1) 18 or 16bit system interface mode, V_{CCIO} = +1.8V, V_{CC} = +3.0 or +2.8V

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

Note 6-2) RGB interface mode, V_{CCIO} = +1.8V, V_{CC} = +3.0 or +2.8V

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

Note 6-3) Please refer to Register setting

Note 6-4) 18 or 16bit system interface mode, V_{CCIO} = +1.8V, V_{CI} = +3.0V

Current situation for I_{CI}: All black pattern

Note 6-5) 18 or 16bit system interface mode, V_{CCIO} = +1.8V, V_{CI} = +2.8V

Current situation for I_{CI}: All black pattern

Note 6-6) RGB interface mode, V_{CCIO} = +1.8V, V_{CI} = +3.0V

Current situation for I_{CI}: All black pattern

Note 6-7) RGB interface mode, V_{CCIO} = +1.8V, V_{CI} = +2.8V

Current situation for I_{CI}: All black pattern

Note 6-8) V_{CCIO} = +1.8V, V_{CI} = +3.0V or +2.8V

Note 6-9) WR, RS, CS, SCL, SDI, ENABLE, VSYNC, HSYNC, DOTCLK, RESB, IM2~IM0, DB17~DB0, R5~R0, G5~G0, B5~B0

6-2. Power up sequence

≪When it is used by 18 or 16bits system Interface≫

V_{CC} ON (hold Pin No.7:RESB = "L")

↓

Wait min. 0ms

↓

V_{CCIO} ON (hold Pin No.7:RESB = "L")

↓

Wait min. 1ms

↓

Hard Reset (No.7:RESB "L" → "H")

↓

Wait min. 1ms

↓

Reg. #	Register	Data		Remark
		VCC=3.0V	VCC=2.8V	
R000h	Dummy Transfer	-	-	
R000h	Dummy Transfer	-	-	
R000h	Dummy Transfer	-	-	
R000h	Dummy Transfer	-	-	

↓

Instruction setting

Reg. #	Register	Data(Gamma 2.2)		Remark
R001 h	Power control 1	0100 h	0100 h	
R002 h	LCD Driving Wave Control	0100 h	0100 h	
R003 h	Entry mode	x030 h	x030 h	Note 6-7
R008 h	Power control 2	0622 h	0622 h	
R009 h	Power control 3	0001 h	0001 h	
R00B h	Power control 4	0030 h	0030 h	
R00F h	Power control 5	0002 h	0002 h	
R010 h	Power control 6	0019 h	0019 h	
R011 h	Power control 7	0101 h	0101 h	
R012 h	Power control 8	0000 h	0000 h	
R013 h	Power control 9	0001 h	0001 h	
R100 h	Power control 10	0230 h	0130 h	
R101 h	Power control 11	0247 h	0247 h	
R103 h	Power control 12	1300 h	1300 h	
R210 h	Power control 13	0000 h	0000 h	
R211 h	Power control 14	00EF h	00EF h	
R212 h	Power control 15	0000 h	0000 h	
R213 h	Power control 16	018F h	018F h	
R300 h	Gamma control 1	010D h	010D h	
R301 h	Gamma control 2	A805 h	A805 h	
R302 h	Gamma control 3	0802 h	0802 h	
R303 h	Gamma control 4	011C h	011C h	
R304 h	Gamma control 5	0000 h	0000 h	
R305 h	Gamma control 6	0A10 h	0A10 h	
R306 h	Gamma control 7	A805 h	A805 h	
R307 h	Gamma control 8	0804 h	0804 h	
R308 h	Gamma control 9	010E h	010E h	
R309 h	Gamma control 10	0000 h	0000 h	
R400 h	Power control 17	6A08 h	6A08 h	
R401 h	Power control 18	0001 h	0001 h	
R404 h	Power control 19	0000 h	0000 h	
R200 h	Power control 20	0000 h	0000 h	
R201 h	Power control 21	0000 h	0000 h	
R102 h	Power control 23	A1B0 h	A1B0 h	

↓

Wait min.200ms

↓

Exit the Sleep mode

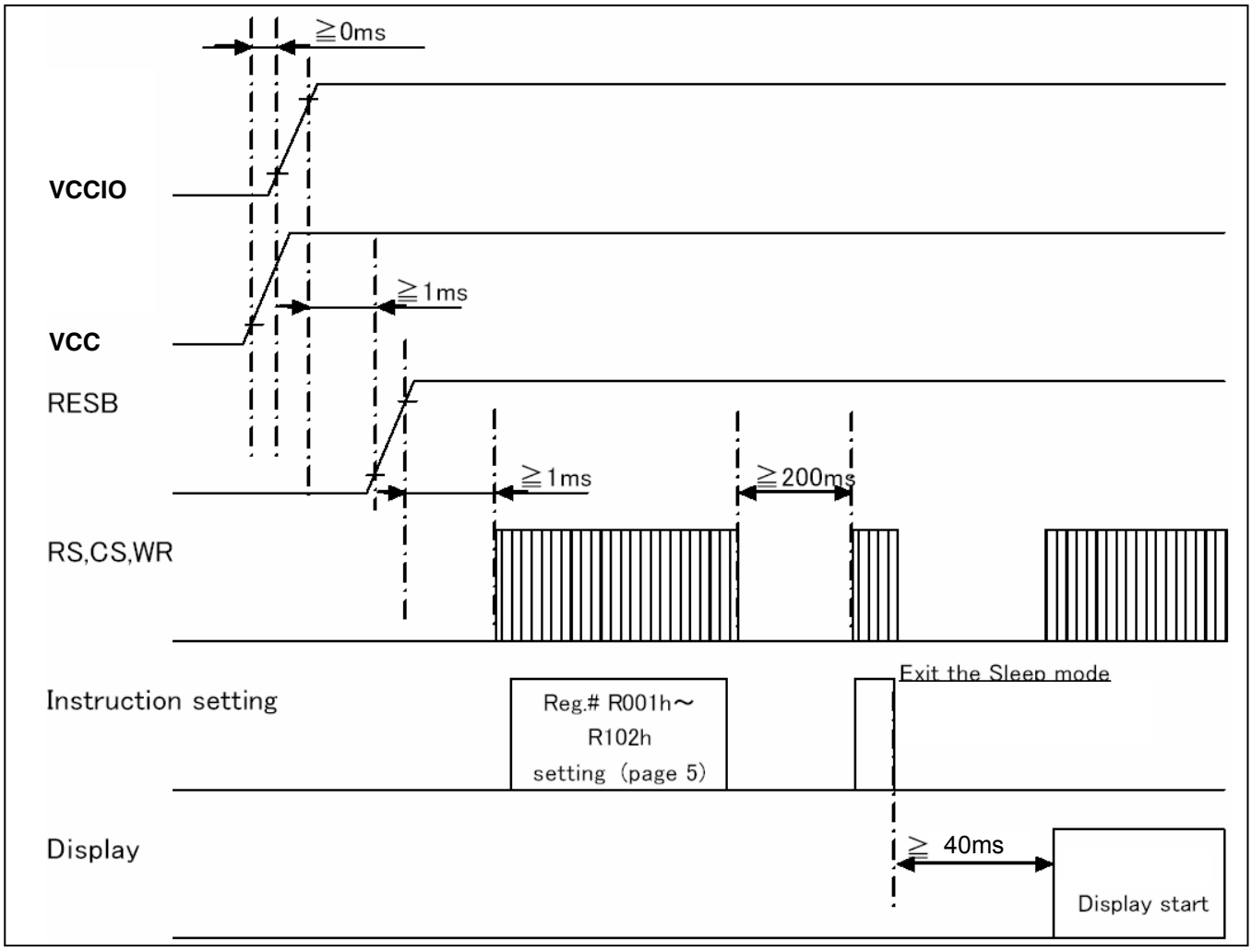
Reg. #	Register	Data(Gamma 2.2)		Remark
R007 h	Power control 24	0100 h	0100 h	Note 6-9
R00C h	Display interface control 5	0xx0 h	0xx0 h	Note 6-8
R202 h	Power control 22	-	-	

↓

Wait min.40 ms

↓

Back Light ON/Display ON



≪When it is used by RGB interface≫

V_{CC} ON (hold Pin No.7:RESB = “L”)

↓

Wait min. 0ms

↓

V_{CCIO} ON (hold Pin No.7:RESB = “L”)

↓

Wait min. 1ms

↓

Hard Reset (No.7:RESB “L” → “H”)

↓

Wait min. 1ms

↓

Reg. #	Register	Data		Remark
		VCC=3.0V	VCC=2.8V	
R000h	Dummy Transfer	-	-	
R000h	Dummy Transfer	-	-	
R000h	Dummy Transfer	-	-	
R000h	Dummy Transfer	-	-	

↓

Instruction setting

Reg. #	Register	Data(Gamma 2.2)		Remark
R001 h	Power control 1	0100 h	0100 h	
R002 h	LCD Driving Wave Control	0100 h	0100 h	
R003 h	Entry mode	1030 h	1030 h	Note 6-7
R008 h	Power control 2	0622 h	0622 h	
R009 h	Power control 3	0001 h	0001 h	
R00B h	Power control 4	0030 h	0030 h	
R00F h	Power control 5	0002 h	0002 h	
R014 h	Power control 6	0055 h	0055 h	
R020 h	Power control 7	0019 h	0019 h	
R021 h	Power control 8	0101 h	0101 h	
R022 h	Power control 9	0000 h	0000 h	
R023 h	Power control 10	0001 h	0001 h	
R100 h	Power control 11	0230 h	0130 h	
R101 h	Power control 12	0247 h	0247 h	
R103 h	Power control 13	1300 h	1300 h	
R210 h	Power control 14	0000 h	0000 h	
R211 h	Power control 15	00EF h	00EF h	
R212 h	Power control 16	0000 h	0000 h	
R213 h	Power control 17	018F h	018F h	
R300 h	Gamma control 1	010D h	010D h	
R301 h	Gamma control 2	A805 h	A805 h	
R302 h	Gamma control 3	0802 h	0802 h	
R303 h	Gamma control 4	011C h	011C h	
R304 h	Gamma control 5	0000 h	0000 h	
R305 h	Gamma control 6	0A10 h	0A10 h	
R306 h	Gamma control 7	A805 h	A805 h	
R307 h	Gamma control 8	0804 h	0804 h	
R308 h	Gamma control 9	010E h	010E h	
R309 h	Gamma control 10	0000 h	0000 h	
R400 h	Power control 18	6A08 h	6A08 h	
R401 h	Power control 19	0001 h	0001 h	
R404 h	Power control 20	0000 h	0000 h	
R200 h	Power control 21	0000 h	0000 h	
R201 h	Power control 22	0000 h	0000 h	
R102 h	Power control 24	A1B0 h	A1B0 h	
R206 h	Power control 25	0008 h	0008 h	

↓

Wait min.200ms

↓

Display Data Start (DOTCLK, HSYNC, VSYNC)

↓

Exit the Sleep mode

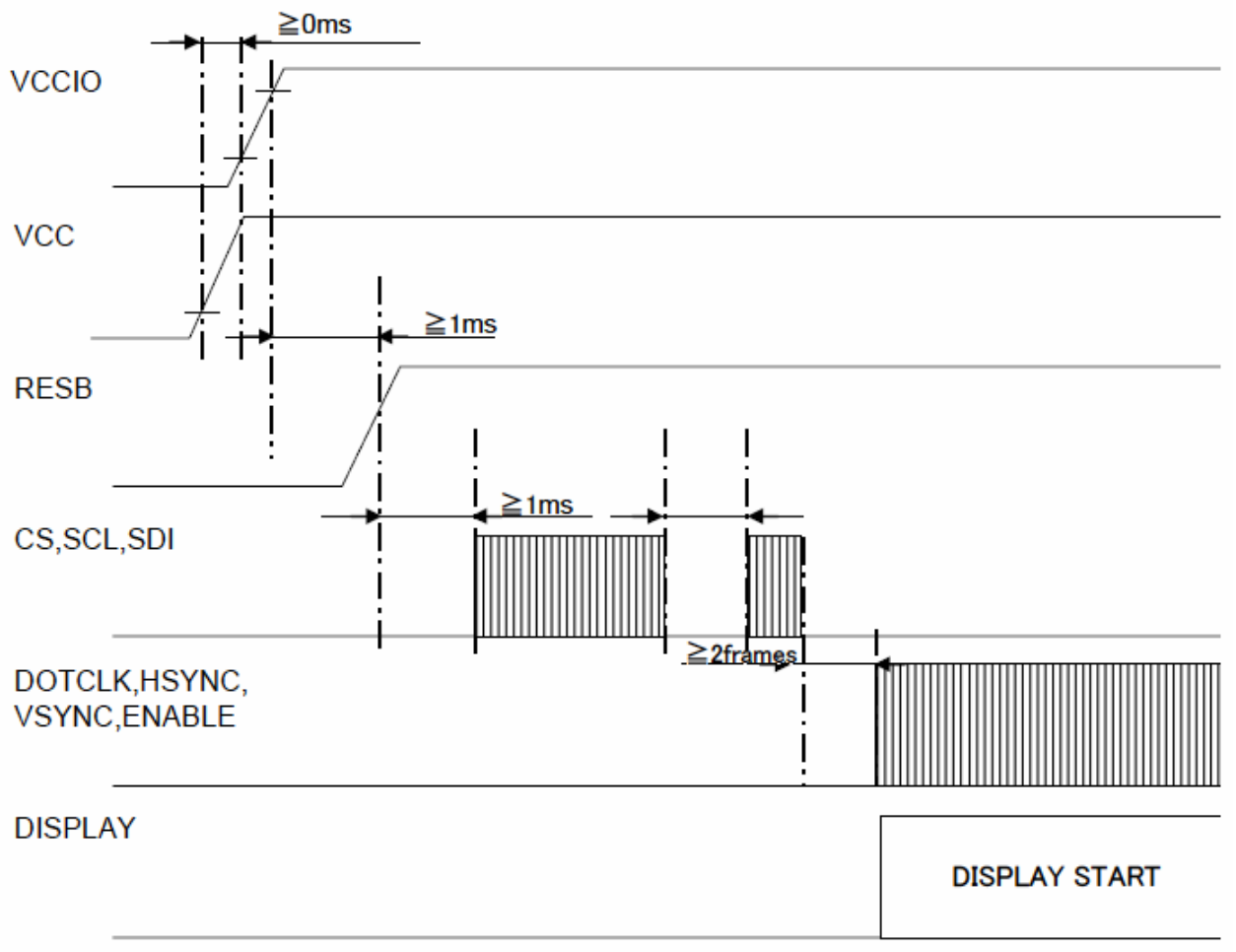
Reg. #	Register	Data(Gamma 2.2)		Remark
R007 h	Power control 26	0100 h	0100 h	Note 6-9
R00C h	Display interface mode	0110 h	0110 h	Note 6-8
R202 h	Power control 23	-	-	

↓

Wait min.40 ms

↓

Back Light ON/Display ON

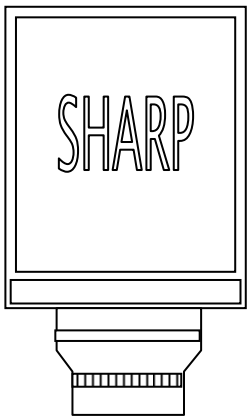
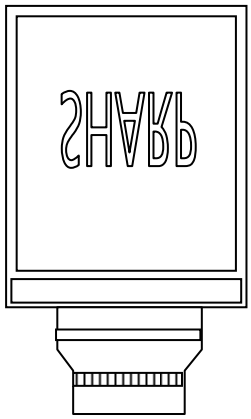
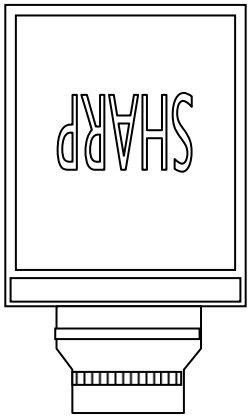


Note 6-7)

Entry mode(R003h)

W	RS	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
W	1	0	DFM	0	1	0	0	0	0	0	0	ID1	ID0	0	0	0	0
POR		0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0

ID: Selects the output shift direction of the source driver and gate driver
The ID0 bit sets in horizontal direction. The ID1 bit sets in vertical direction.

	ID1=”1”	ID1=”0”
ID0=”1”		
ID0=”0”		

DFM: When it is used by system interface mode, 18 bits or 16 bits modes are selected.
When DFM=”0”, 18bits modes. When DFM=”1”, 16bits mode.

Note 6-8)

Display interface mode(R00Ch)

W	RS	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	RM	0	0	DM1	DM0	0	0	0	0
POR		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

RM: Selects the interface for RAM access operation.

When RM=”0”, system interface.

When RM=”1”, RGB interface mode.

DM: The DM[1:0] setting allows switching between internal clock operation mode and external display interface operation mode.

DM1	DM0	Display interface mode
0	0	18 or 16bits system interface
0	1	RGB interface
1	0	VSYNC interface
1	1	Setting inhibited

Note 6-9)

Sleep mode

W	RS	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	Disp	0	0	0	0	0	0	0	0
POR		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

When Disp = “1”, operation mode. When Disp = “0”, sleep mode.

6-3. Power down sequence

Back light OFF

↓

Write White Data (RGB Data: All “H” level)

↓

Wait min. 20 ms

↓

Enter the Sleep Mode

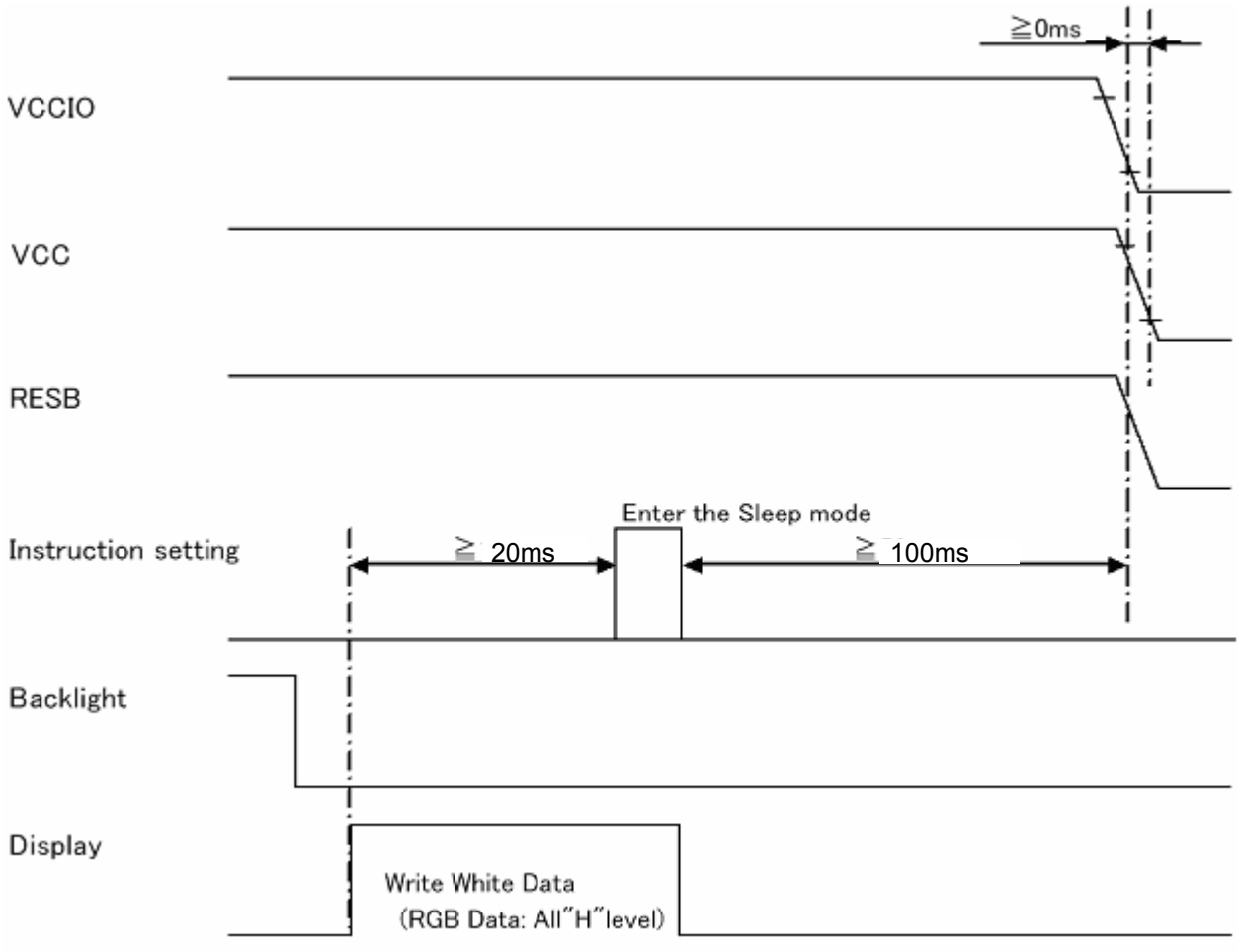
Reg. #	Register	Data	Remark
R007h	Power control 24	0000 h	
R102 h	Power control 23	A180 h	

↓

Wait min. 100 ms

↓

V_{CCIO} / V_{CI} OFF

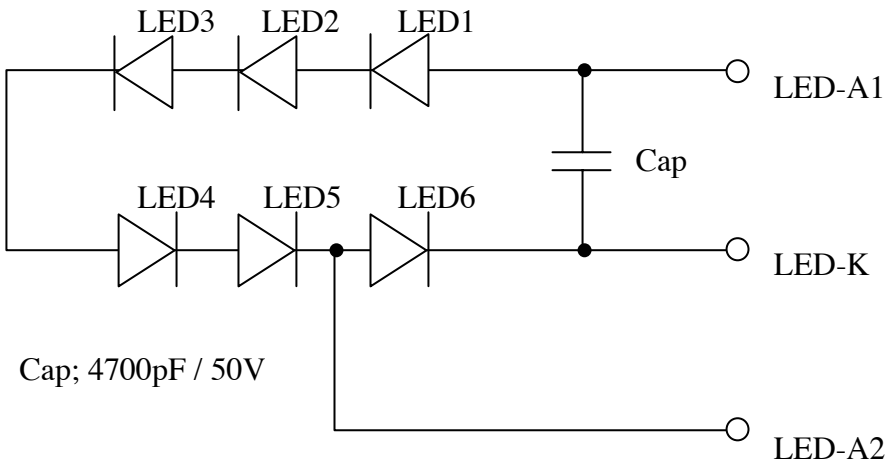


6-4. Backlight driving

The back light system has 6 pieces LED

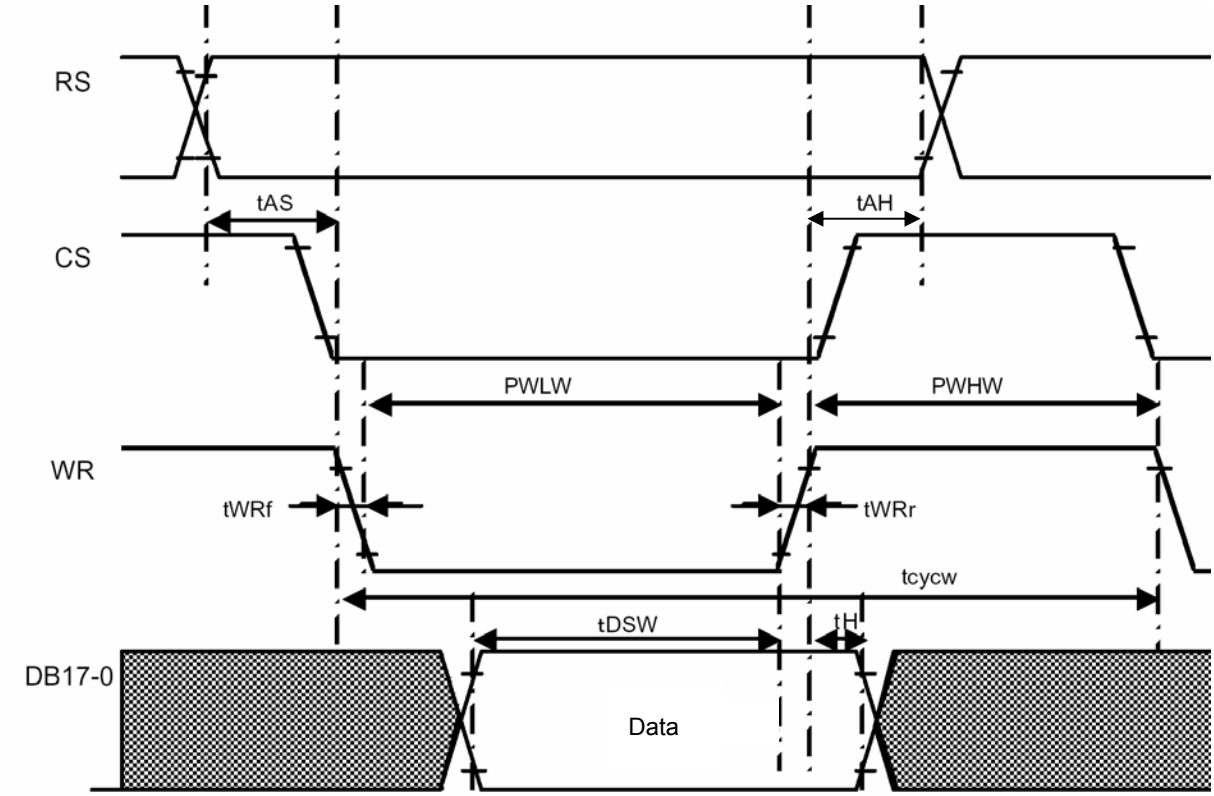
Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Rated Voltage 1	$V_{BL-full}$	-	19.2	21	V	Power supply for LED of full
Rated Voltage 2	V_{BL-1pc}	-	3.2	3.5	V	Power supply for LED of 1pc
Rated Current	I_L	-	20	-	mA	Ta=25°C
Power consumption 1	W_{L-full}	-	384	-	mW	Power supply for LED of full
Power consumption 2	W_{L-1pc}	-	64	-	mW	Power supply for LED of 1pc

[LED-FPC circuit]



7. Timing characteristics of input signals

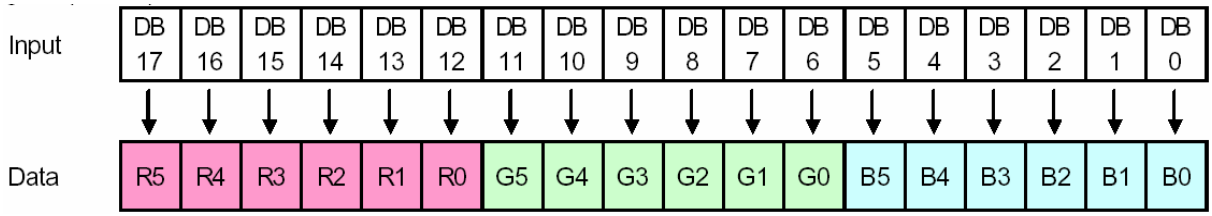
7-1) 18 or 16bits system interface or VSYNC interface mode



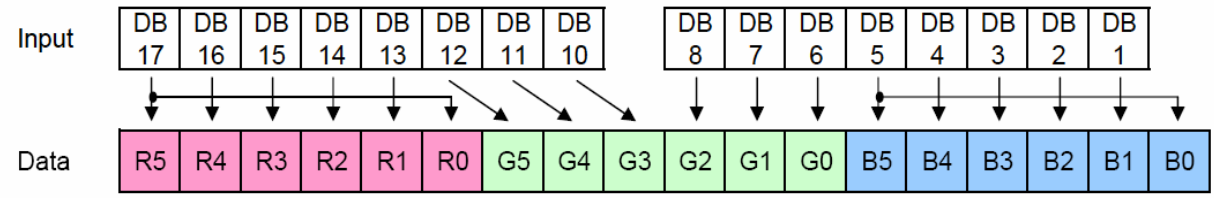
Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Bus cycle time	tcycw	75	-	-	ns	
Low-level pulse width	PW_{LW}	30	-	-	ns	
High-level pulse width	PW_{HW}	25	-	-	ns	
Rise/Fall time	t_{WRf}／t_{WRr}	-	-	15	ns	
Setup time	t_{AS}	0	-	-	ns	
Address hold time	t_{AH}	2	-	-	ns	
Data setup time	t_{DSW}	25	-	-	ns	
Data hold time	t_H	10	-	-	ns	

1) Data write

a) 18bit mode



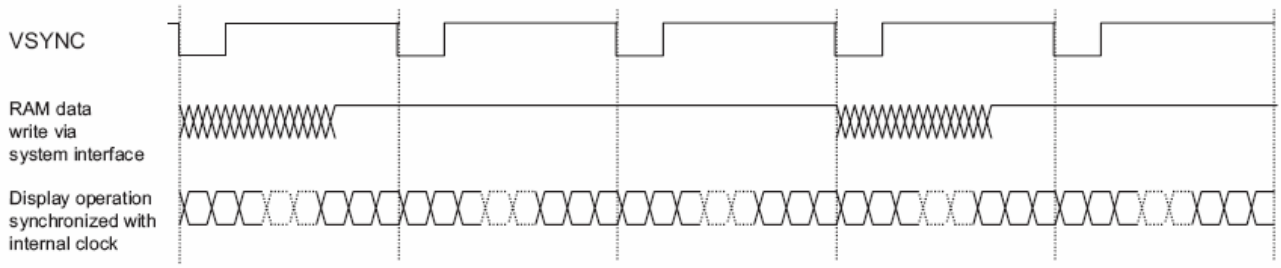
b) 16bit mode



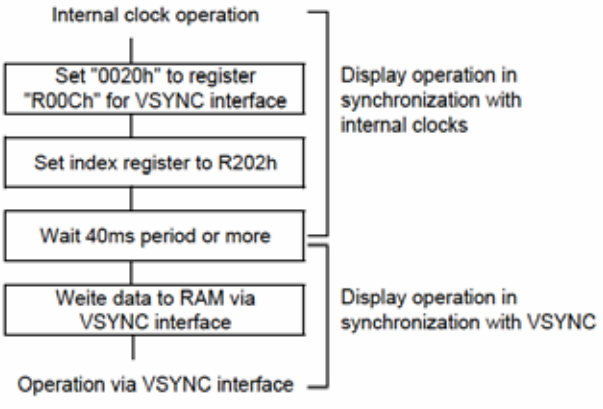
2) Moving picture data transfers via VSYNC interface

※VSYNC interface mode :

The internal display operation is synchronized with the frame synchronous signal (VSYNC) in this mode. The VSYNC interface is selected by setting Register#.R00Ch. In VSYNC interface operation, the internal display operation is synchronized with the VSYNC signal. By writing data to the internal RAM at faster than the calculated minimum speed (internal display operation speed + margin), it becomes possible to rewrite the moving picture data without flickering the display and display a moving picture via system interface.

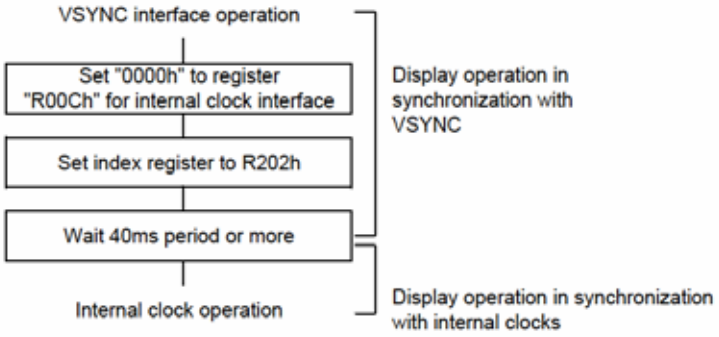


≪Internal Clock Operation to VSYNC Interface≫



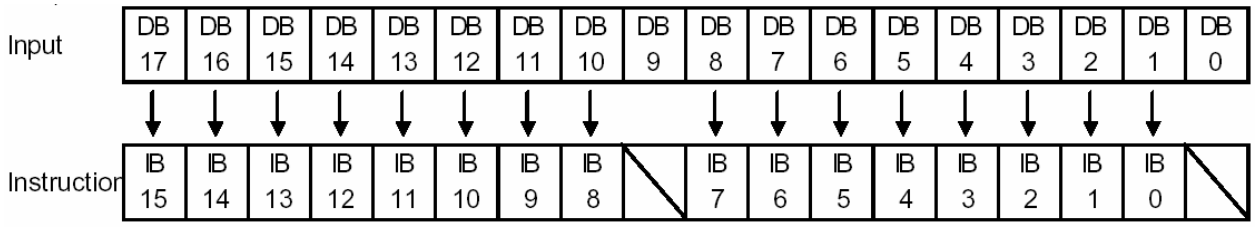
※Input the VSYNC interface signals before setting the register "R00Ch" to the VSYNC interface operation.

≪VSYNC interface to Internal Clock Operation≫



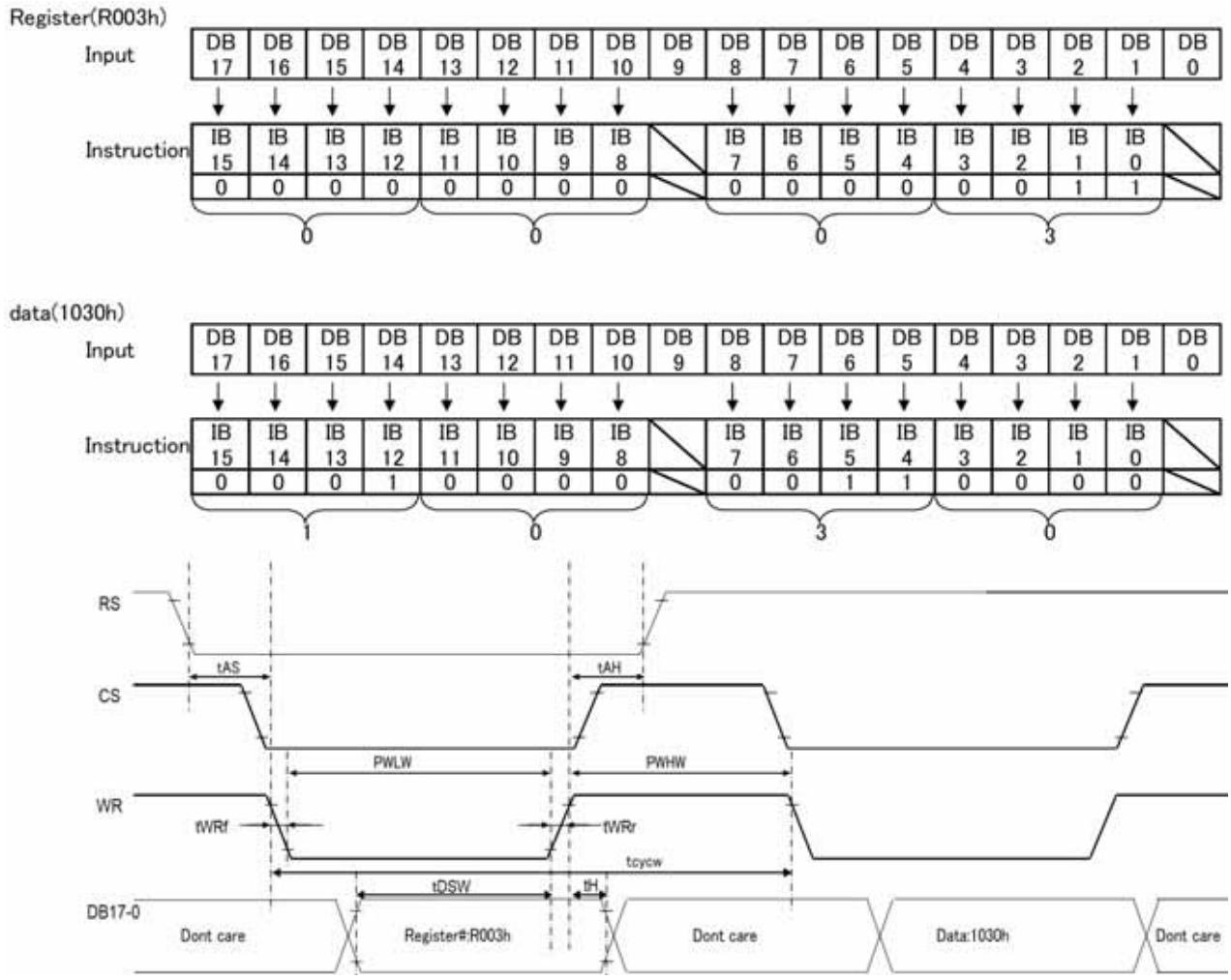
※ Continue VSYNC interface signals at least for one frame period after setting the register "R00Ch" to internal clock operation.

3) Instruction write

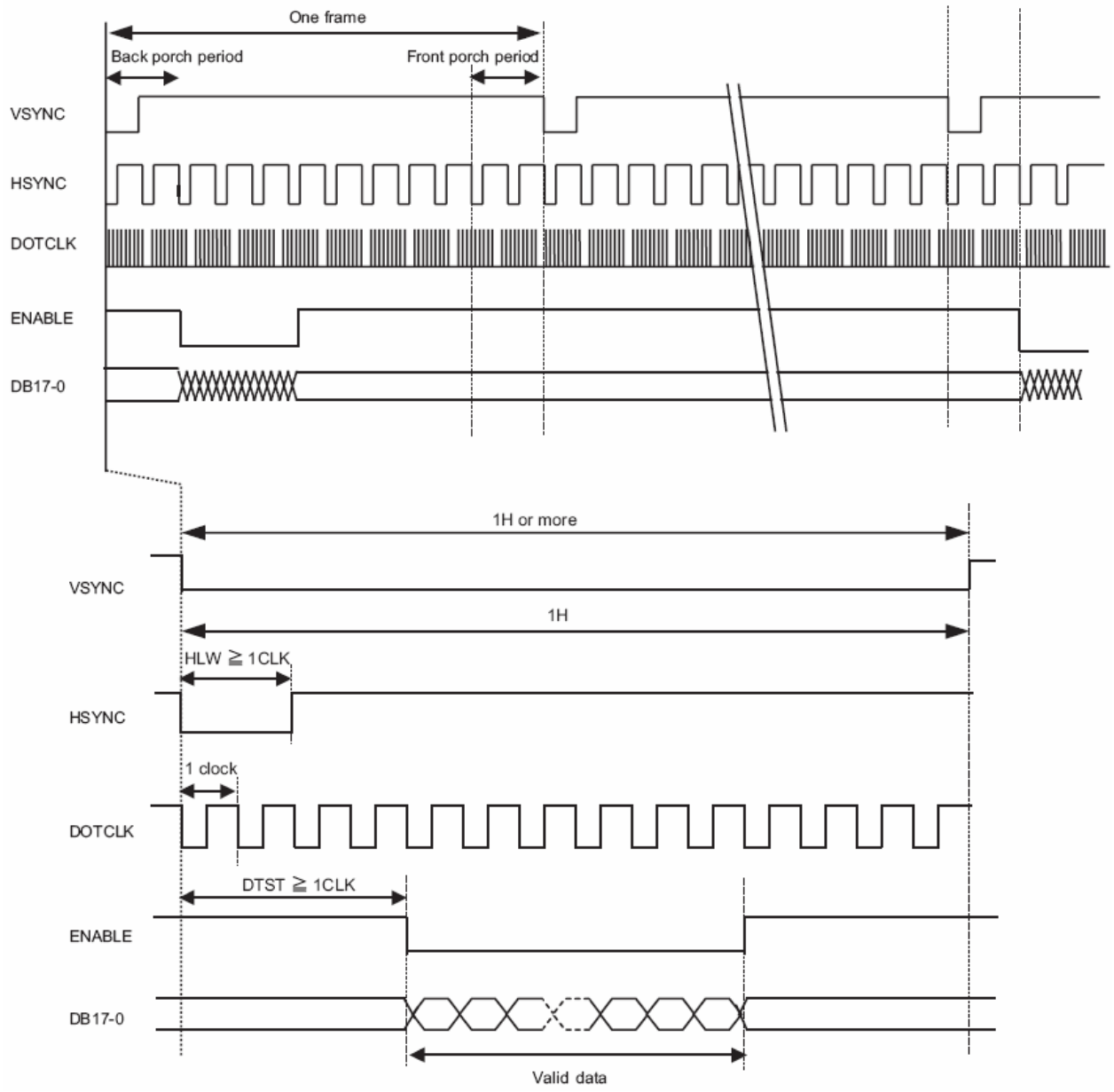


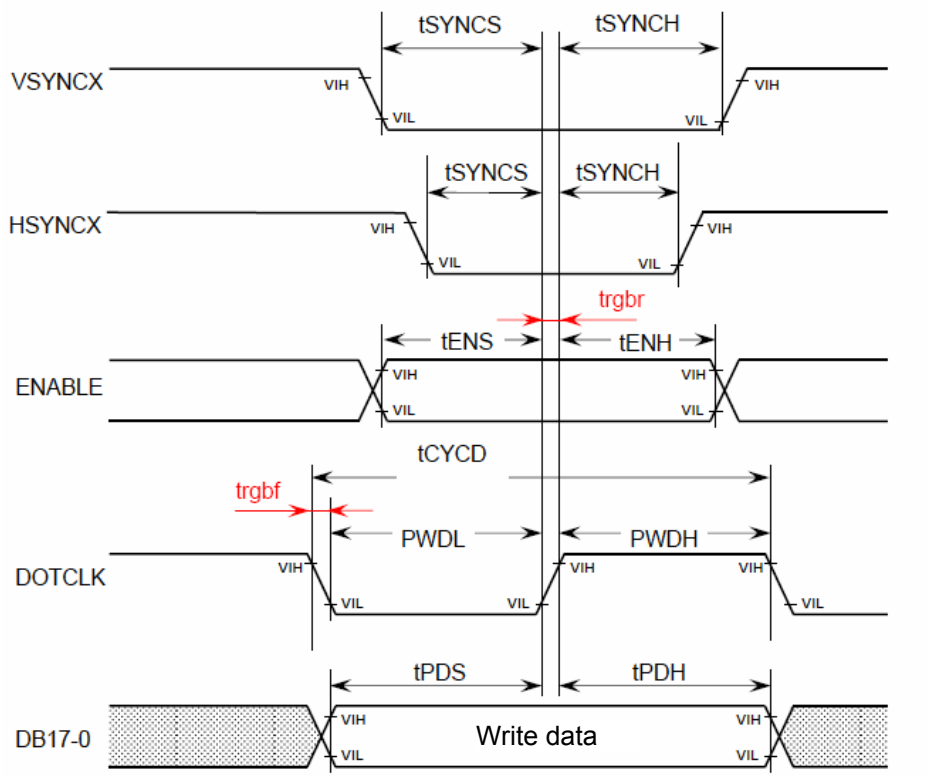
※Unused DB pins must be fixed at "VCCIO" or "GND".

The example transmit “1030h” to register R003h.



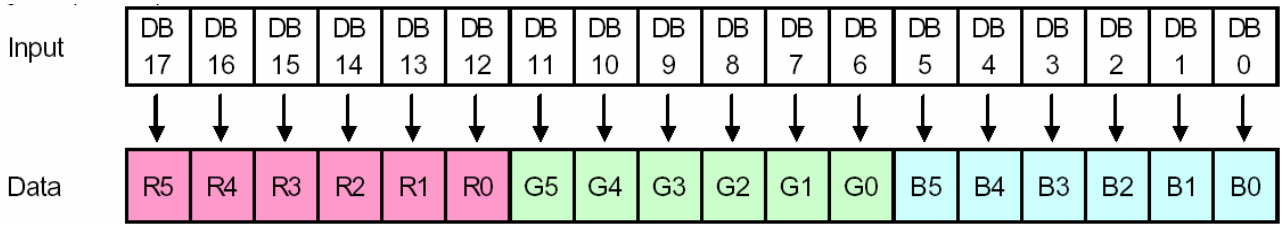
7-2) RGB interface mode



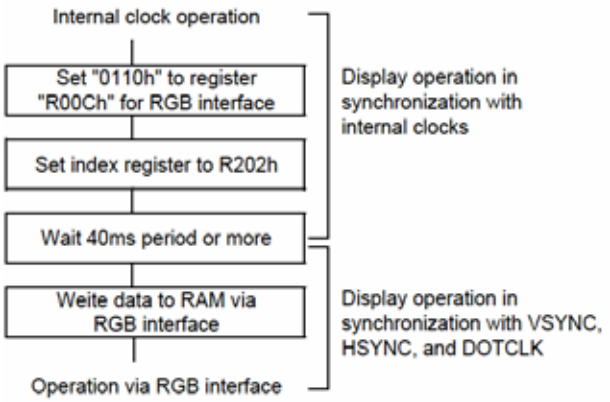


Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
VSYNCX/HSYNCX setup time	tSYNCS	30	-	-	ns	
VSYNC/HSYNC hold time	tSYNCH	30	-	-	ns	
ENABLE setup time	tENS	30	-	-	ns	
ENABLE hold time	tENH	30	-	-	ns	
DOTCLK low-level pulse width	PWDL	40	-	-	ns	
DOTCLK high –level pulse width	PWDH	40	-	-	ns	
DOTCLK cycle time	tCYCD	100	-	-	ns	
Data setup time	tPDS	40	-	-	ns	
Data hold time	tPDH	40	-	-	ns	
DOTCLK,VSYNCX,HSYNCX rise/fall time	trgbr, trgbf	-	-	15	ns	

1) Data write

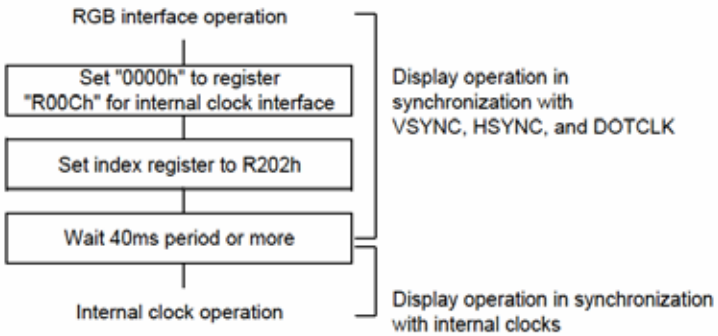


≪Internal Clock Operation to RGB Interface≫



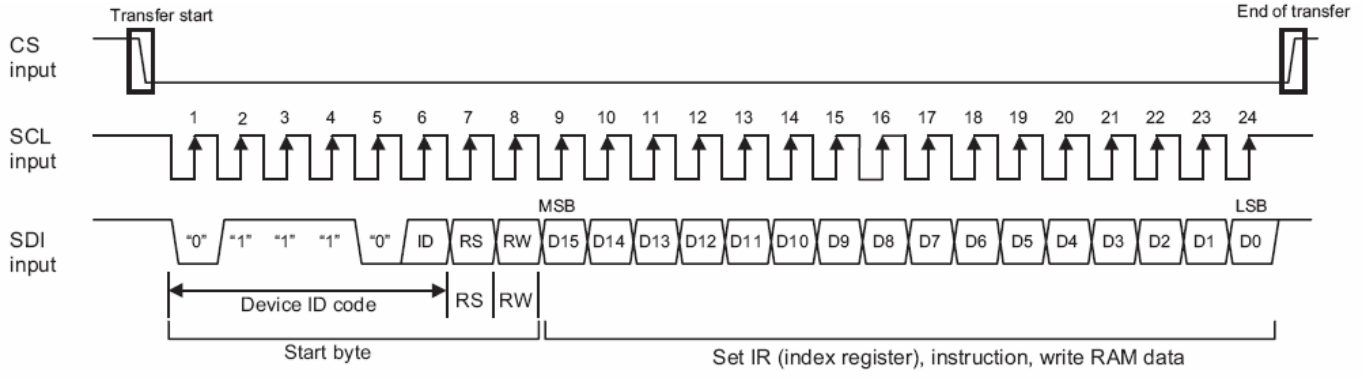
※Input the RGB interface signals before setting the register "R00Ch" to the RGB interface operation.

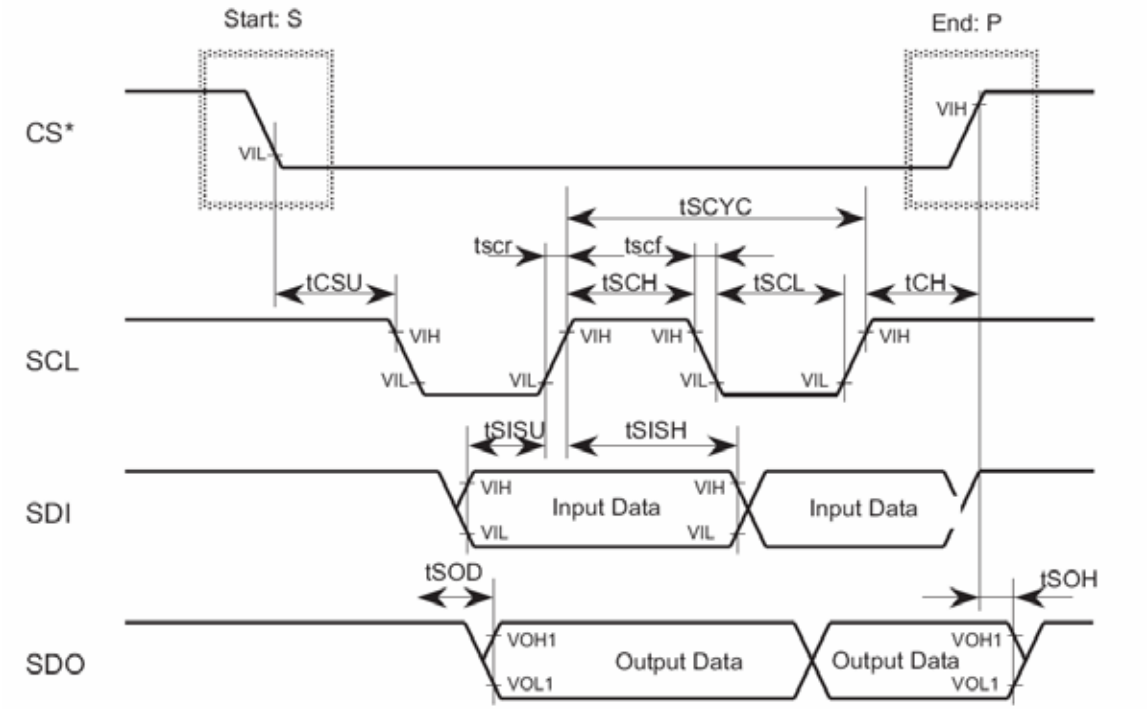
≪RGB interface to Internal Clock Operation≫



※ Continue RGB interface signals at least for one frame period after setting the register "R00Ch" to internal clock operation.

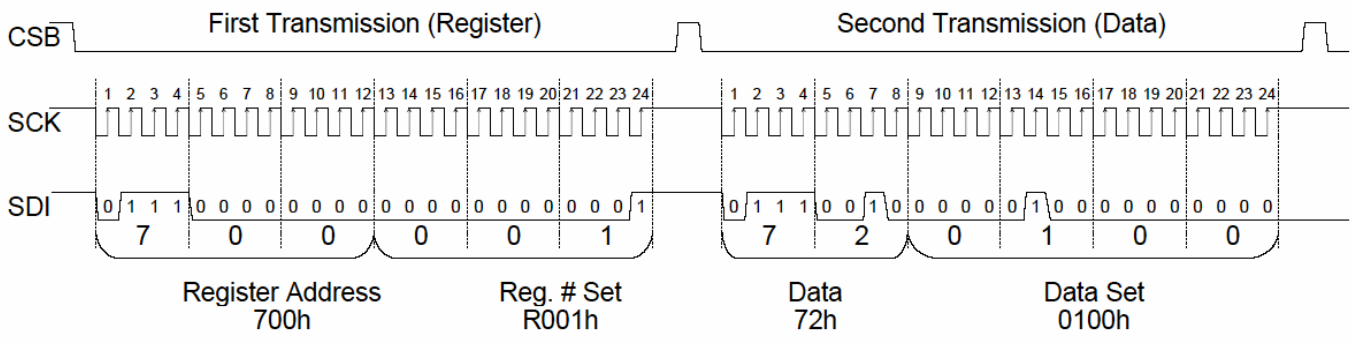
2) Instruction write



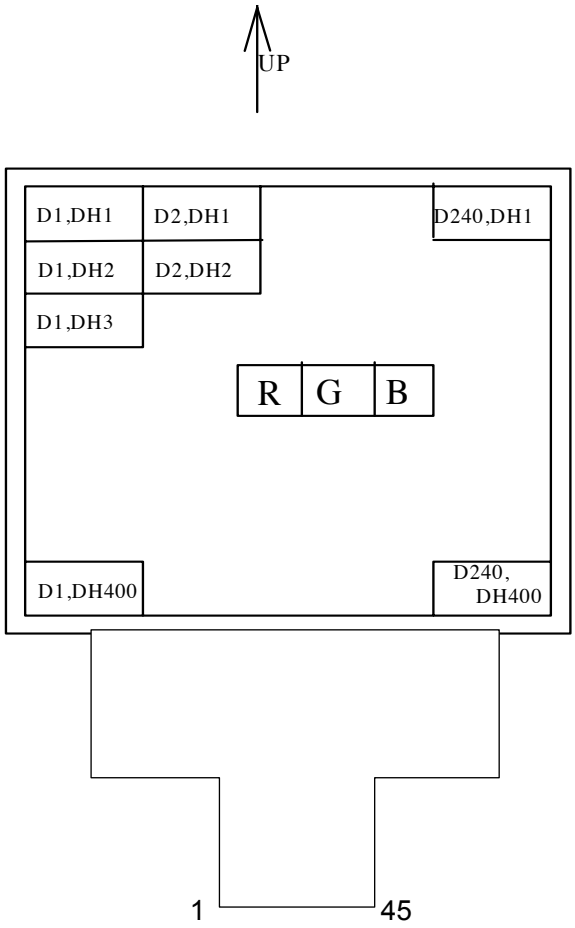


Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Serial clock cycle time	Tscyc	100	-	-	ns	
Serial clock high-level width	TscH	40	-	-	ns	
Serial clock low-level width	tscL	40	-	-	ns	
Serial clock rise/fall time	Tscr,tscf	-	-	15	ns	
Chip select setup time	Tcsu	20	-	-	ns	
Chip select hold time	tcH	60	-	-	ns	
Serial input data setup time	tsIsu	30	-	-	ns	
Serial input data hold time	tsIH	30	-	-	ns	
Serial output data delay time	tsoD	-	-	130	ns	
Serial output data hold time	tsOH	0	-	-	ns	

The example transmit “0100h” to register “R001h”.



7-1. Input Data Signals and Display Position on the screen



8. Input Signals, Basic 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

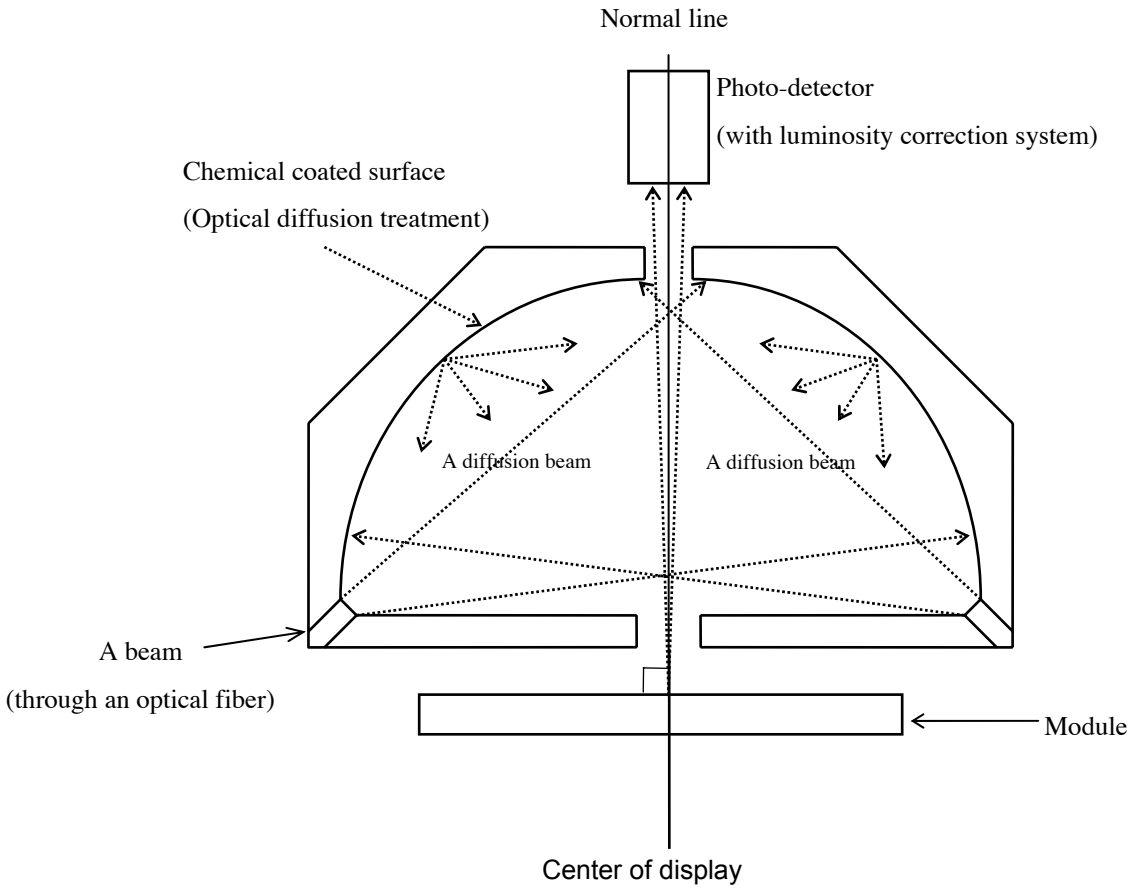
9-1)Not driving the Back light condition

Ta=25℃ V_{CCIO}=+1.8V,V_{CC}=3.0V

Parameter		Symbol	Condition	Min	Typ	Max	Unit	Remarks
Viewing angle Range		θ21,22	CR≥2	50	80	-	degree	【Note 9-1,5】
		θ11		50	80	-	degree	
		θ12		50	80	-	degree	
Contrast ratio		CRmax	θ =0°	7	15	-	-	【Note 9-2,4,5】
Response Time	Rise	τ r	θ =0°	-	30	50	ms	【Note 9-3】
	Fall	τ d		-	30	50	ms	
White chromaticity		X		0.26	0.31	0.36	-	【Note 9-4,5】
		Y		0.29	0.34	0.39	-	
Reflection ratio		R	θ =0°	7	10	-	%	【Note 9-6,7】

* The measuring method of the optical characteristics is shown by the following figure.

* A measurement device is luminance meter Conoscope.(With the diffusion reflection unit.)



Measuring method (a) for optical characteristics

9-2)Driving the Back light condition

Ta=25℃ V_{CCIO}=+1.8V,V_{CC}=3.0V

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing angle range (Without Wide View)	Horizontal	Θ21	CR≥2	45	60	-	deg.	[Note9-1,5]
		Θ22		40	50	-	deg.	
	Vertical	Θ11		50	65	-	deg.	
		Θ12		40	50	-	deg.	
Contrast ratio		CR	Optimum viewing angle	60	100	-	-	[Note9-2,5]
Response Time	Rise	Tr	θ=0°	-	30	50	ms	[Note9-3,5]
	Decay	Td		-	30	50	ms	
Chromaticity of White		X		0.26	0.31	0.36	-	[Note9-5]
		Y		0.29	0.34	0.39	-	
Luminance of white		L		100	150	-	cd/m²	ILED=20mA [Note9-5]

* The optical characteristics measurements are operated under a stable luminescence (I_{LED} = 20mA) and a dark condition. (Refer to Fig.9-1, 9-2)

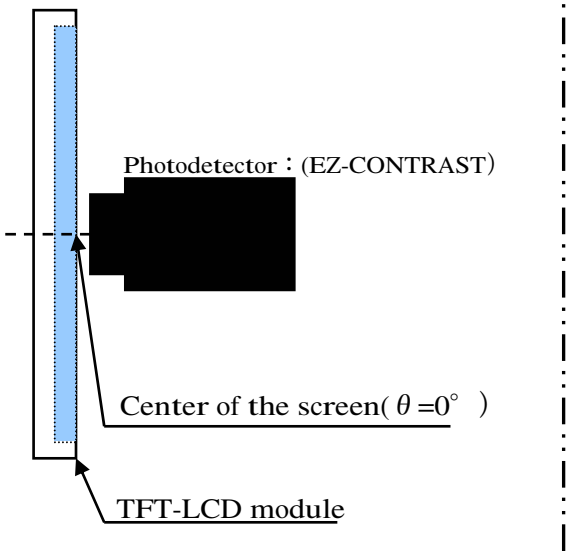


Fig.9-1 Viewing angle range/Response time measurement method

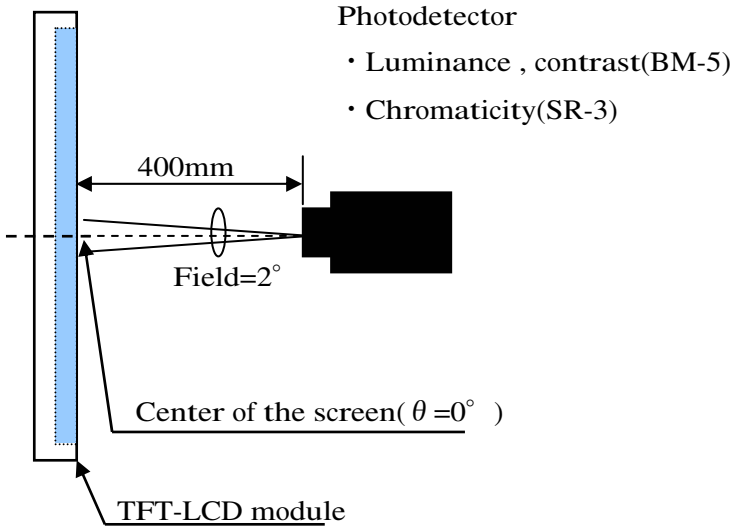
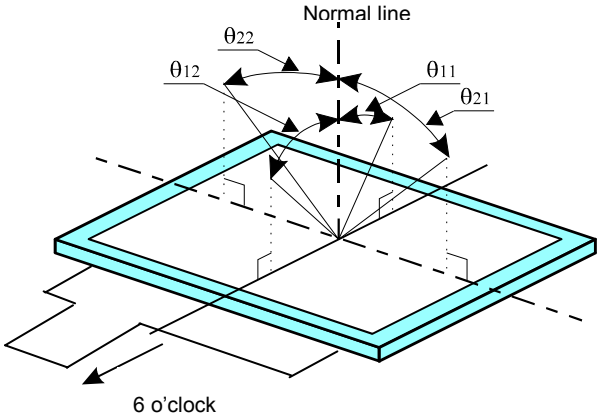


Fig9-2 Luminance/Contrast/Chromaticity measurement method

[Note9-1] Definitions of viewing angle range



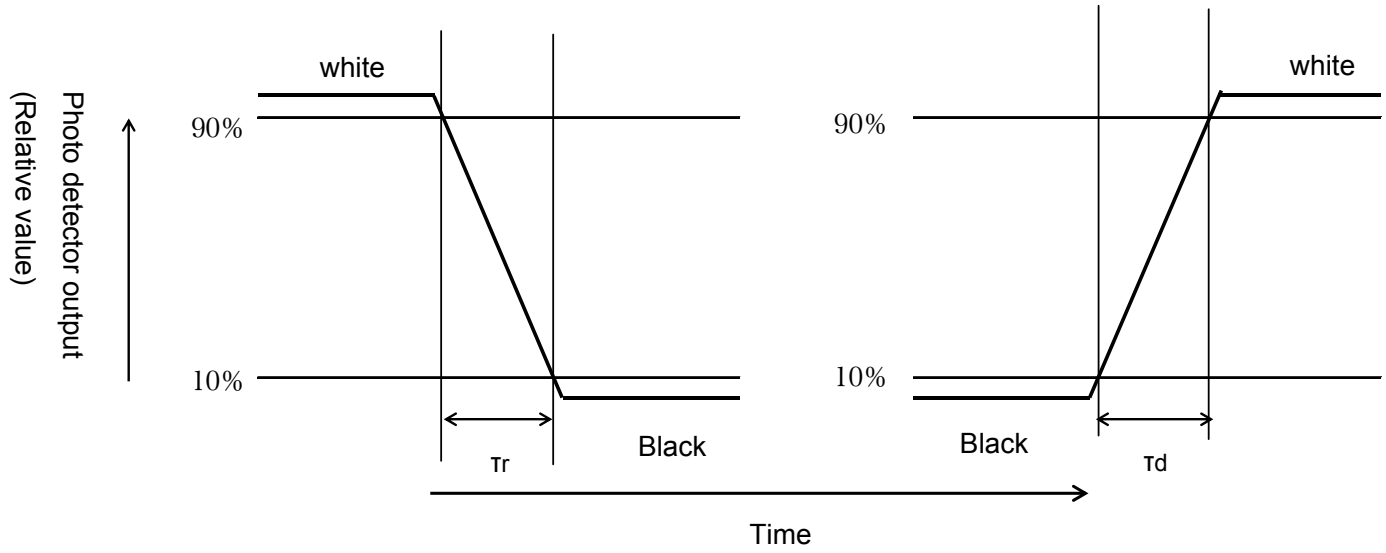
[Note9-2] Definition of contrast ratio

The contrast ratio is defined as the following

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

[Note9-3] 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"



[Note9-4] A measurement device is Minolta CM-2002

[Note9-5] This shall be measured at center of the screen.

[Note9-6]Definition of reflection ratio

$$\text{Reflection ratio} = \frac{\text{Light detected level of the reflection by the LCD module}}{\text{Light detected level of the reflection by the standard white board}}$$

[Note 9-7]A measurement device is Minolta CM-2002.

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 R0.6 mm, 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.

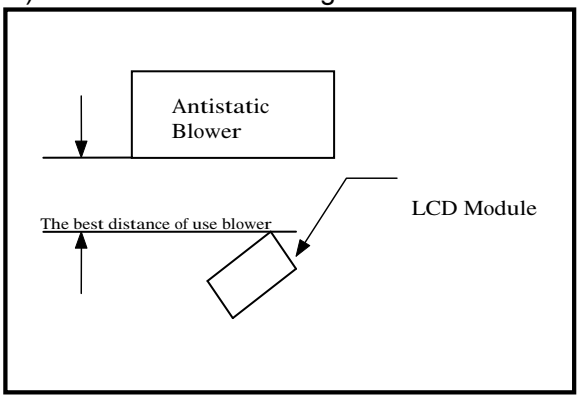
As the polarizer can be easily scratched, be most careful in handling it.

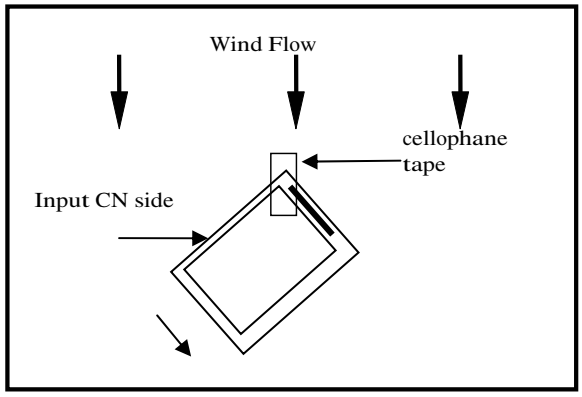
1) Work Environment

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.

e) How to eliminate dust on polarizer.

Blow dust away by N_2 blower having measures of electrostatics

Since the front polarizer is easily damaged, wiping dust off is not adequate.

If the polarizer is soiled, it is suggested to peel dust off by using adhesive surface of adhesive tape.

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.

You are requested to store under the following conditions:

(Environmental conditions of temperature/humidity for storage)

a) Temperature: 0 to 40°C

b) Relative humidity : 95% or less

- As average values of environments (temperature and humidity) for storing, use the following control guidelines:

Summer season: 20 to 35°C, 85% or less Winter season: 5 to 15°C, 85% or less

- If stored under the conditions of 40°C and 95% RH, cumulative time of storage must be less than 240 hours.

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.

6) Don't use or store the module in corrosive gas environment.

7) When the liquid crystal display is seen wearing a polarizing sunglasses, It darkens and distort by the angle.

11. Reliability test items

No.	Test item	Conditions
1	High temperature storage test	Ta = 80°C 240h
2	Low temperature storage test	Ta = -30°C 240h
3	High temperature & high humidity operation test	Ta = 40°C ; 95%RH 240h *No condensation
4	High temperature operation test	Tp = 70°C 240h
5	Low temperature operation test	Ta = -10°C 240h
6	Thermal shock test	Ta=-10°C to 70°C /10 cycles (30 min) (30min)
7	Electro static discharge test	±200V/200pF(0Ω) to Terminals(Contact) *1 time for each terminals
8	Vibration test	Frequency range: 10Hz～55Hz Stroke: 1.5 mm Sweep: 10Hz～55Hz X,Y,Z 2 hours for each direction (total 6 hours) (JIS C0040,A-10 Condition A)
9	Shock test	980 m/s^2, 6 ms ±X,±Y,±Z 3 times for each direction (JIS C0041, A-7 Condition C)

*Note Ta = Ambient temperature, Tp = Panel temperature

[Check items]

Test No.1 to No.7

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

13-1. Carton storage conditions

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.

Period : Approximately 3 month

3) Packing form: As shown in Figure.

*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.

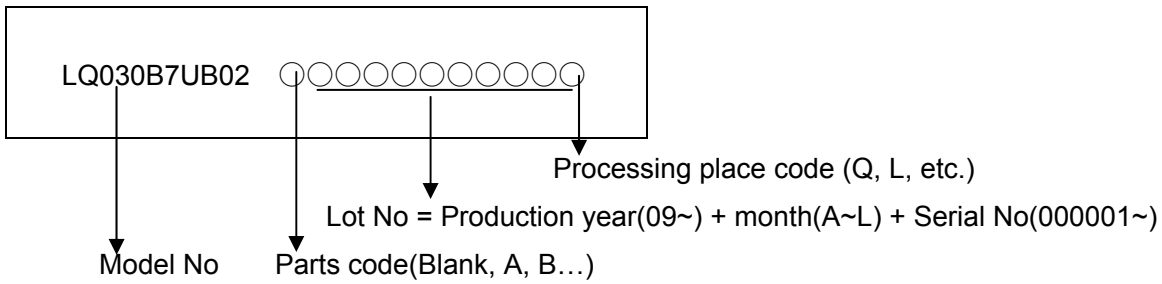
13-2. Packing composition

Name	quantity	Note
Carton size	1	525×360×225 (mm)
Tray	22	Material: Electrification prevention polypropylene
(The number of Module)	320	16 unit/tray: 320 unit/carton
Electrification prevention bag	2	Material: Electrification prevention polyethylene

Carton weight (320 modules): Approx. 13.0 kg

14. Lot No. marking

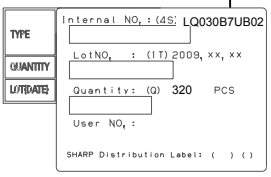
The lot No. will be indicated on individual inkjet. The location is as shown



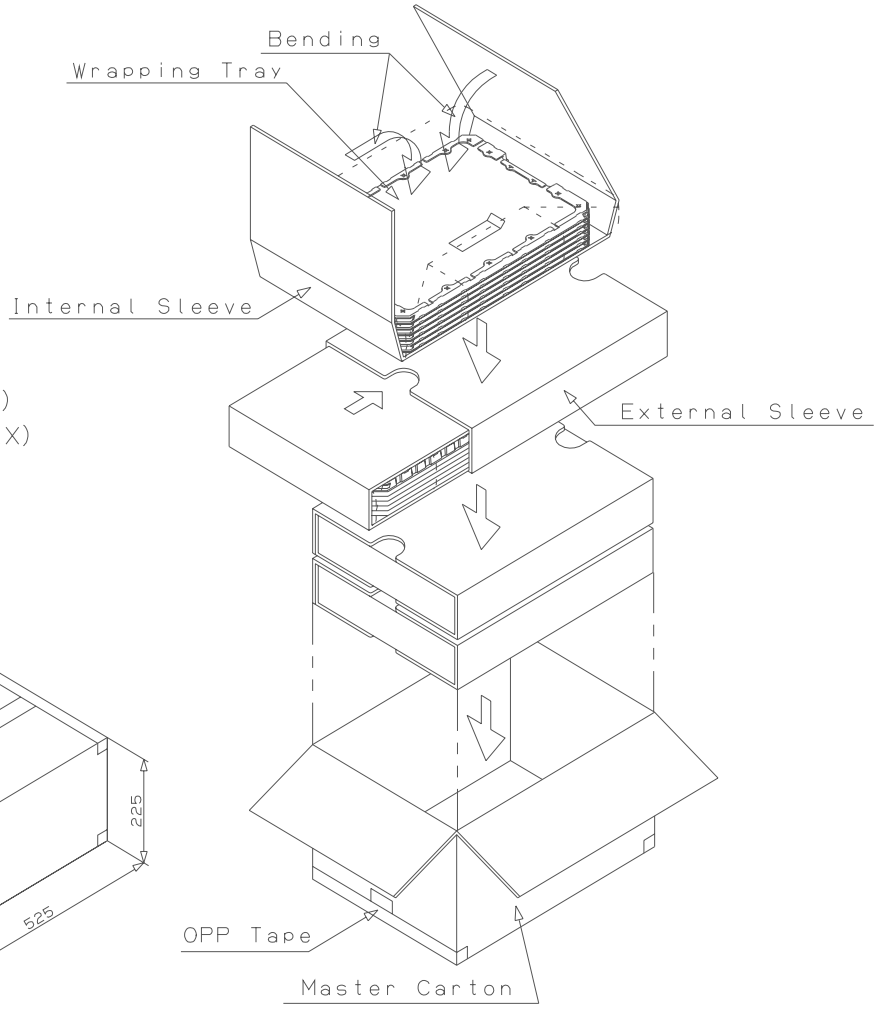
15. LCD module packing carton

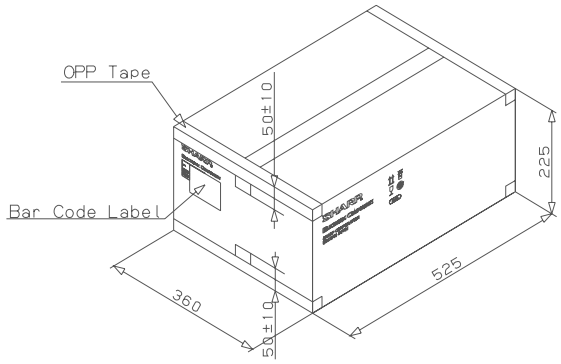
Carton label

Internal No.:	LQ030B7UB02
Lot No. :	Production Year. Month. Day
Quantity :	Max. 320 pcs
User No. :	Model No + Parts code



[Quantities]
1 tray: 16 modules (MAX)
1 sleeve: 160 modules (MAX)
1 carton: 320 modules (MAX)





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.

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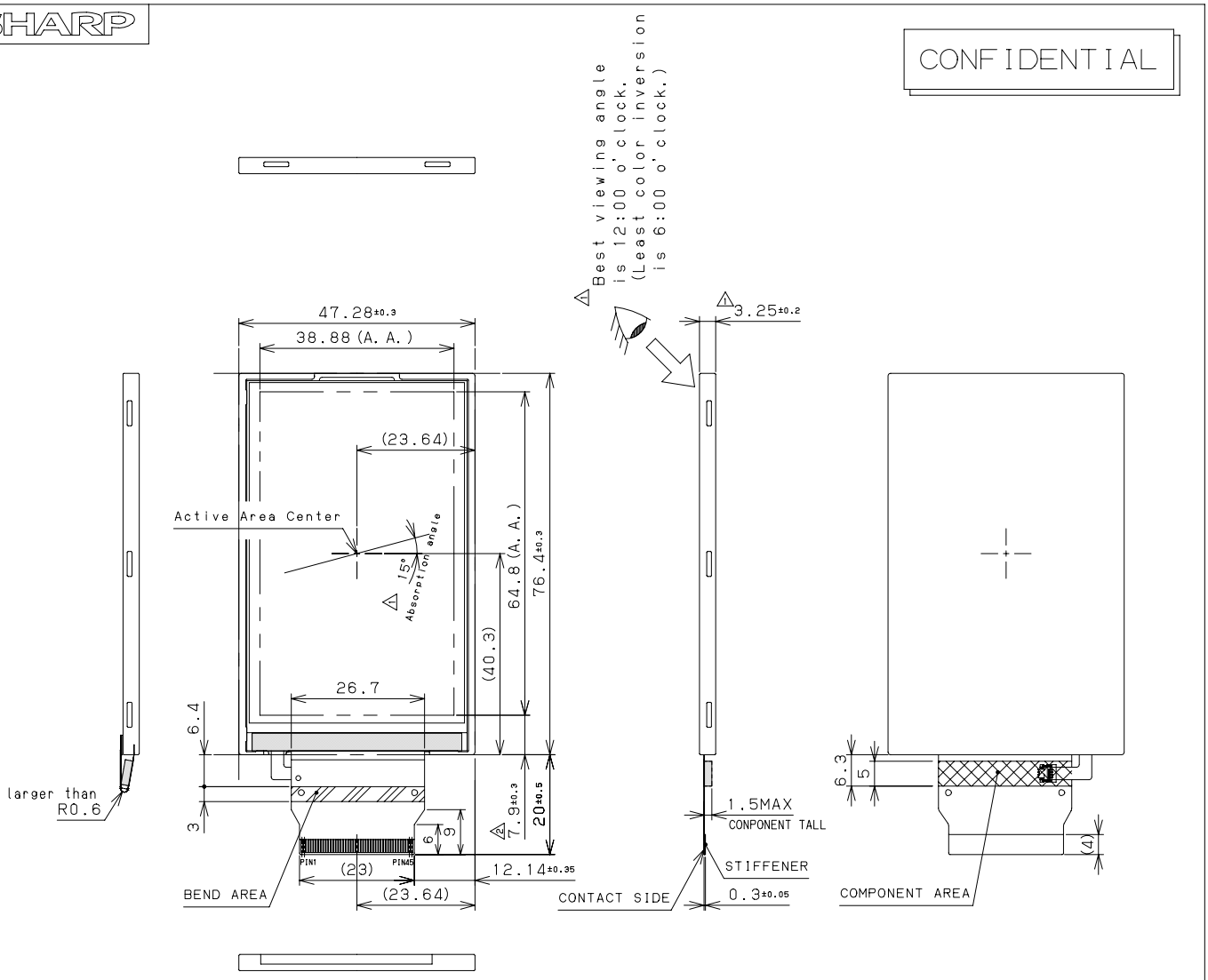

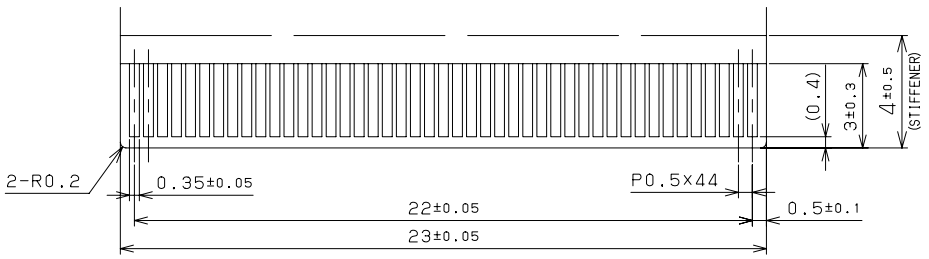

DETAIL OF FPC terminal (5/1)

Recommendation CN:
[HIROSE] FH19SC-45S-0.5SH (05)

1) General tolerance is ±0.3.
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-FPC bend larger than 0.6 in radius.
6) Take care in set design to hide the scratches and bubbles appeared on the polarizer 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	2009.06.19	SCALE free	③	
MODEL	LQ030B7UB02		② 09.10.29	Correct dimension — Miwa
			① 09.08.20	Add view angle , Change thickness — Miwa
			No. DATE	REVISION — Sign.
DRAWING NO	LCM1-08211C	size A4	SHARP CO. LTD	ENGINEERING DEPARTMENT MOBILE LIQUID CRYSTAL DIVISION II MOBILE LIQUID CRYSTAL DISPLAY GROUP

Technical Document

LCD Specification

LCD Group

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