

July 22, 2004

No. 3284LTD-1468-5

HITACHI

LIQUID CRYSTAL DISPLAY MODULE TECHNICAL DATA

TX06D15VM1EAA

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3. GENERAL DATA

(1) Part Name	TX06D15VM1EAA
(2) Module Dimensions	41.85(W) mm x 56.0(H) mm x 4.6(t) mm
(3) Active Area Dimensions	34.848(W) mm x 43.56(H) mm
(4) Pixel Pitch	0.198(W) mm x 0.198(H) mm
(5) Resolution	176 x 3 (R,G,B)(W) x 220 (H) dots
(6) Color Pixel Arrangement	RGB Vertical Stripe
(7) Display Mode	Transflective Type, Normally Black Mode
(8) Color Number	65K or 262K Colors
(9) Viewing Direction	6 O'clock
(10) Back Light	Light Emitting Diode (LED)
(11) Weight	13.8g (typ)
(12) Power Supply Voltage	Vcc=Vci=2.8V (typ)
(13) LCD Driver IC	Source IC : HD66772 Gate and Power IC : HD66774S
(14) Interface	Clock Synchronized Serial Interface (SPI) + RGB Interface (18bit) 16bit RGB - V/F → 65k colors (Use 16bit of the 18bit bus interface) 18bit RGB - V/F → 262k colors

4. ABSOLUTE MAXIMUM RATINGS

4. 1 ELECTRICAL ABSOLUTE MAXIMUM RATINGS OF LCD

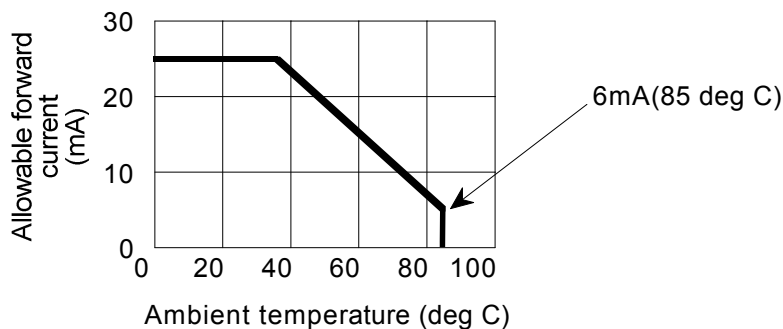
VSS=0V

ITEM	SYMBOL	MIN	MAX	UNIT	COMMENT
Power Supply for Logic	Vcc	-0.3	4.6	V	Note 1
Power Supply for Analog	Vci	-0.3	4.6	V	Note 1
Input Voltage	Vi	-0.3	Vcc+0.3	V	Note 1, 2
Input Current	Ii	0	100	mA	
LED Reverse Voltage	VR	-	5	V	
LED Forward Current	I LED	-	Note 3	mA	
Static Electricity	-	-	(+/-2)	kV	Note 4

Note 1 Voltage from GND.

Note 2 Applies to the RESET, ID, SDO, SDI, SCL, CS*, VLD, VSYNC, HSYNC, DOTCLK ENABLE, and PD17-0 pins.

Note 3 Ambient Temperature vs. Allowable Forward Current



Note 4 150pF-1.5Kohm/200pF-0 ohm, 25 deg C-70%RH.
The Surface of LCD center are subjected.

4. 2 ENVIRONMENTAL ABSOLUTE MAXIMUM RATINGS

ITEM	OPERATING		STORAGE		COMMENT
	MIN	MAX	MIN	MAX	
Ambient Temperature	-20 deg C	70 deg C	-30 deg C	80 deg C	Note 2
Humidity	Note 1		Note 1		Without condensation
Corrosive Gas	Not Acceptable		Not Acceptable		

Note 1 $T_a \leq 40$ deg C : 85%RH max.

$T_a > 40$ deg C : Absolute humidity must be lower than the humidity of 85%RH at 40 deg C.

Note 2 Background color changes slightly depending on ambient temperature.
This phenomenon is reversible.

5. ELECTRICAL CHARACTERISTICS

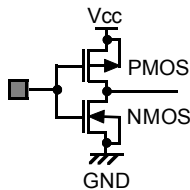
TFT-LCD Module

Ta=25 deg C, VSS=0V

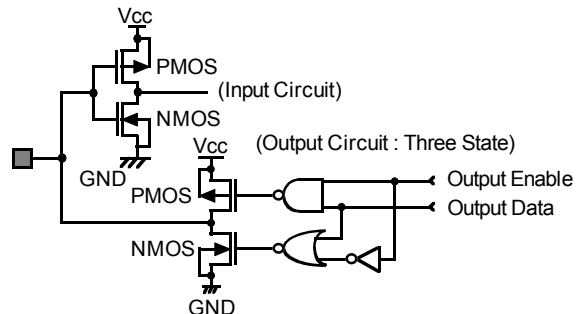
ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	NOTE	
Power Supply Voltage	Logic	Vcc	-	2.72	2.8	2.89	V	
	Analog	Vci	-	2.72	2.8	2.89		
Input Voltage for Logic Circuits	Vi	"H" level	0.7xVcc	-	Vcc	V	1)	
		"L" level	-0.3	-	0.15xVcc			
Output Voltage for Logic Circuits	Vo	"H" level	0.75xVcc	-	-	V	1)	
		"L" level	-	-	0.15xVcc			
Input/Output Leak Current	ILi	-	-1	-	1	uA	2)	
Power Supply Current	Icc + Ici	All White	-	2000	-	uA	3), 5)	
		Partial	-	650	-		4), 5)	
		Sleep	-	40	-		6)	
		Standby	-	3	-		7)	
		Moving Picture(Full)	-	(10.3)	-	mA	8)	
Frame Frequency	fFLM	-	-	90	-	Hz		
LED Forward Voltage	VLED	-	-	3.6	-	V		
LED Forward Current	ILED	-	-	15.0	(Note 9)	mA		

(Note 1) RESET, ID, SDO, SDI, SCL, CS*, VLD, VSYNC, HSYNC, DOTCLK, ENABLE, PD17-0

Pins: RESET, CS*, SCL, VLD, ID
VSYNC, HSYNC, DOTCLK
ENABLE, PD17-0



Pins: SDO, SDI

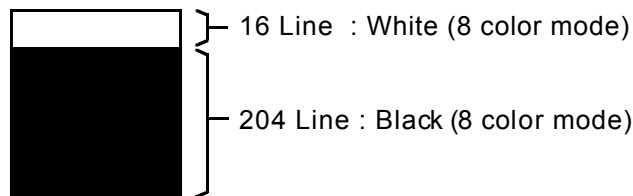


(Note 2) Excepted the current of out driving MOS.

(Note 3) Vcc=Vci=2.8V, Internal clock operation mode & No RGB I/F input signals.

(Note 4) Vcc=Vci=2.8V, 8 colors mode, fFLM=45Hz, No RGB I/F input signals.

Partial Pattern



(Note 5) Still picture is internal RAM.

(Note 6) Vcc=Vci=2.8V, Sleep mode & No RGB I/F input signals.

(Note 7) Vcc=Vci=2.8V, Standby mode & No RGB I/F input signals.

(Note 8) Vcc=Vci=2.8V, 18bit- RGB I/F & High speed write mode. (fFLM=90Hz, Black & White Checker)

All data written via the RGB-I/F are written to the internal RAM.

(Note 9) Refer to the 4. 1 ELECTRICAL ABSOLUTE MAXIMUM RATINGS OF LCD.(Page 4-1/1)

6. OPTICAL CHARACTERISTICS

6.1 OPTICAL CHARACTERISTICS OF LCD (BACKLIGHT ON)

Ta=25 deg C

ITEM		SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	NOTE	
Brightness		B	f=0 deg, q=0 deg	50	60	-	cd/m ²	1)	
Uniformity		-	f=0 deg, q=0 deg	-	-	+/-30	%	3),5)	
Viewing angle		f2-f1	q=0 deg, K _≥ 2.0	-	60	-	deg	4),6),7)	
			q=90 deg, K _≥ 2.0	-	60	-			
Contrast ratio		K	f=0 deg, q=0 deg	30	40	-	-	6)	
Response time (rise+fall)		tr+tf	f=0 deg	Ta=25 deg C	-	35	70	ms	8)
			q=0 deg	Ta=0 deg C	-	140	280		
Color tone (Primary Color)		Red	x	f=0 deg q=0 deg	0.47	0.52	0.57	-	9)
			y		0.28	0.33	0.38		
		Green	x		0.27	0.32	0.37		
			y		0.44	0.49	0.54		
		Blue	x		0.10	0.15	0.20		
			y		0.09	0.14	0.19		
		White	x		0.24	0.29	0.34		
			y		0.26	0.31	0.36		

(Measurement condition : Hitachi standard)

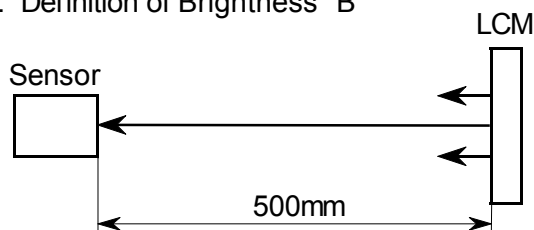
6.2 OPTICAL CHARACTERISTICS OF LCD (BACKLIGHT OFF)

Ta=25 deg C

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	NOTE	
Reflectance	R	f=0 deg, q=0 deg	15	20	-	%	2)	
Viewing angle	f2-f1	q=0 deg, K _≥ 2.0	-	60	-	deg	4),6)	
		q=90 deg, K _≥ 2.0	-	60	-			
Contrast ratio	K	f=0 deg, q=0 deg	5	15	-	-	6)	
Response time (rise+fall)	tr+tf	f=0 deg q=0 deg	Ta=25 deg C	-	25	50	ms	8)
			Ta=0 deg C	-	100	200		
Color tone (Primary Color)	Red	x	f=0 deg q=0 deg (B/L:turned off)	0.44	0.49	0.54	-	9),10)
		y		0.29	0.34	0.39		
	Green	x		0.30	0.35	0.40		
		y		0.39	0.44	0.49		
	Blue	x		0.15	0.20	0.25		
		y		0.12	0.17	0.22		
	White	x		0.33	0.38	0.43		
		y		0.31	0.36	0.41		

(Measurement condition : Hitachi standard)

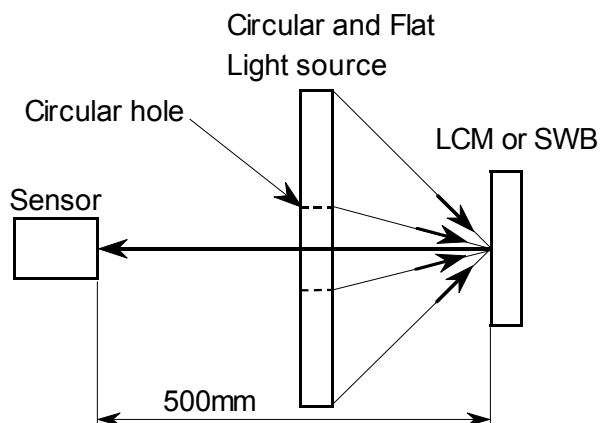
Note 1. Definition of Brightness "B"



Sensor : TOPCON/BM-5A
or same level equipment

Measuring point : Active area center

Note 2. Definition of Reflectance "R"



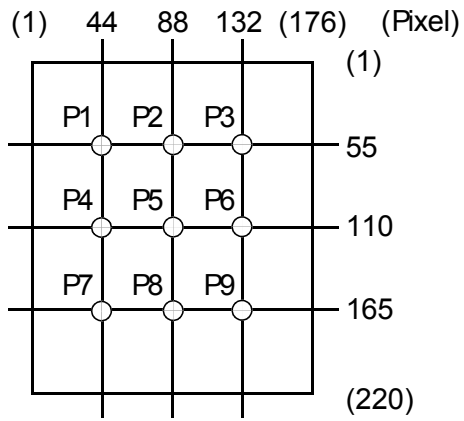
$$R = \frac{B_{LCM}}{B_{SWB}} \times 100(\%)$$

B_{LCM} : Brightness of LCM at optimum voltage.
(displaying white pattern)

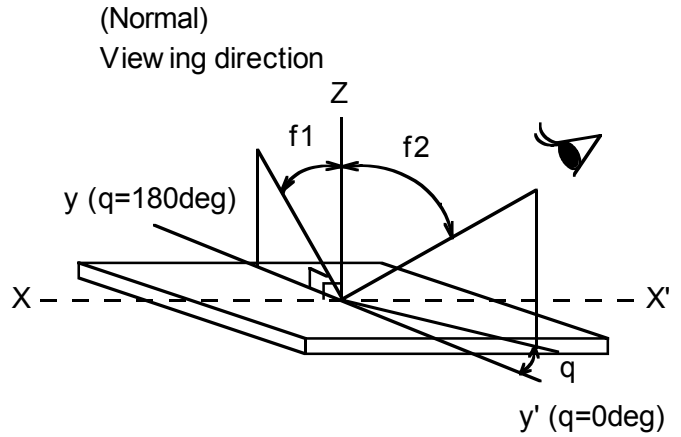
B_{SWB} : Brightness of SWB.

SWB : Standard white board.

Note 3. Measuring point



Note 4. Definition of q and f



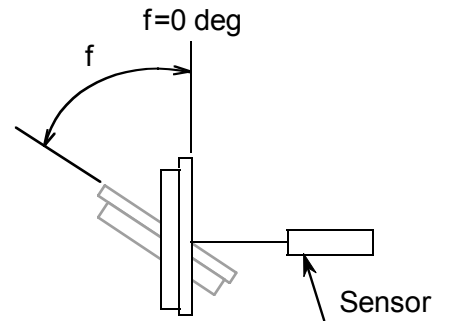
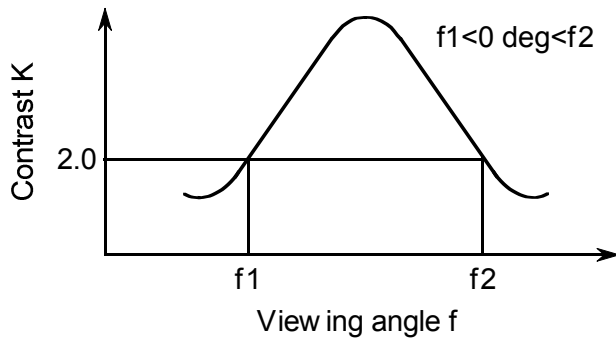
Note 5. Definition of the brightness uniformity

$$\frac{(\text{Max brightness or Min brightness}) - (\text{Average brightness})}{(\text{Average brightness})}$$

Note 6. Definition of Contrast "K"

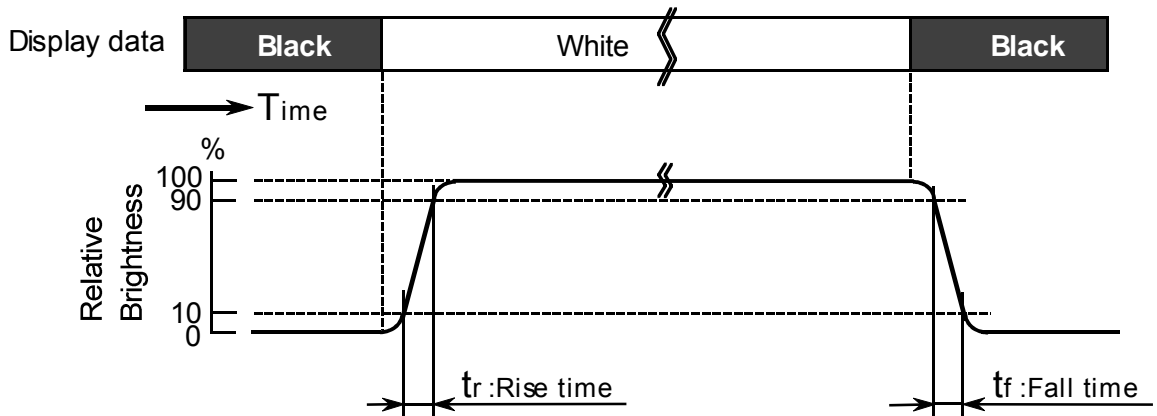
$$K = \frac{\text{Brightness when displaying White raster}}{\text{Brightness when displaying Black raster}}$$

Note 7. Definition of viewing angle f1 and f2



Sensor : BM-5 or similar equipment

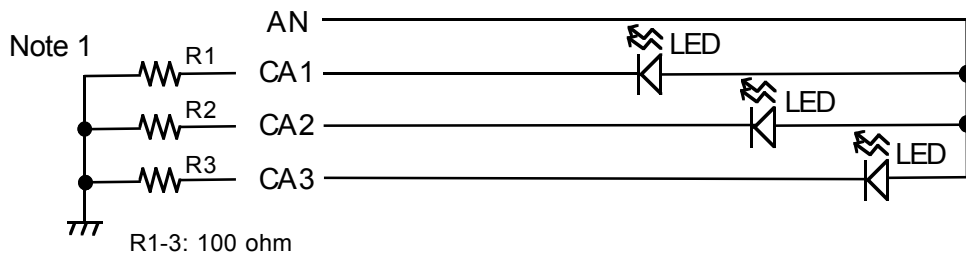
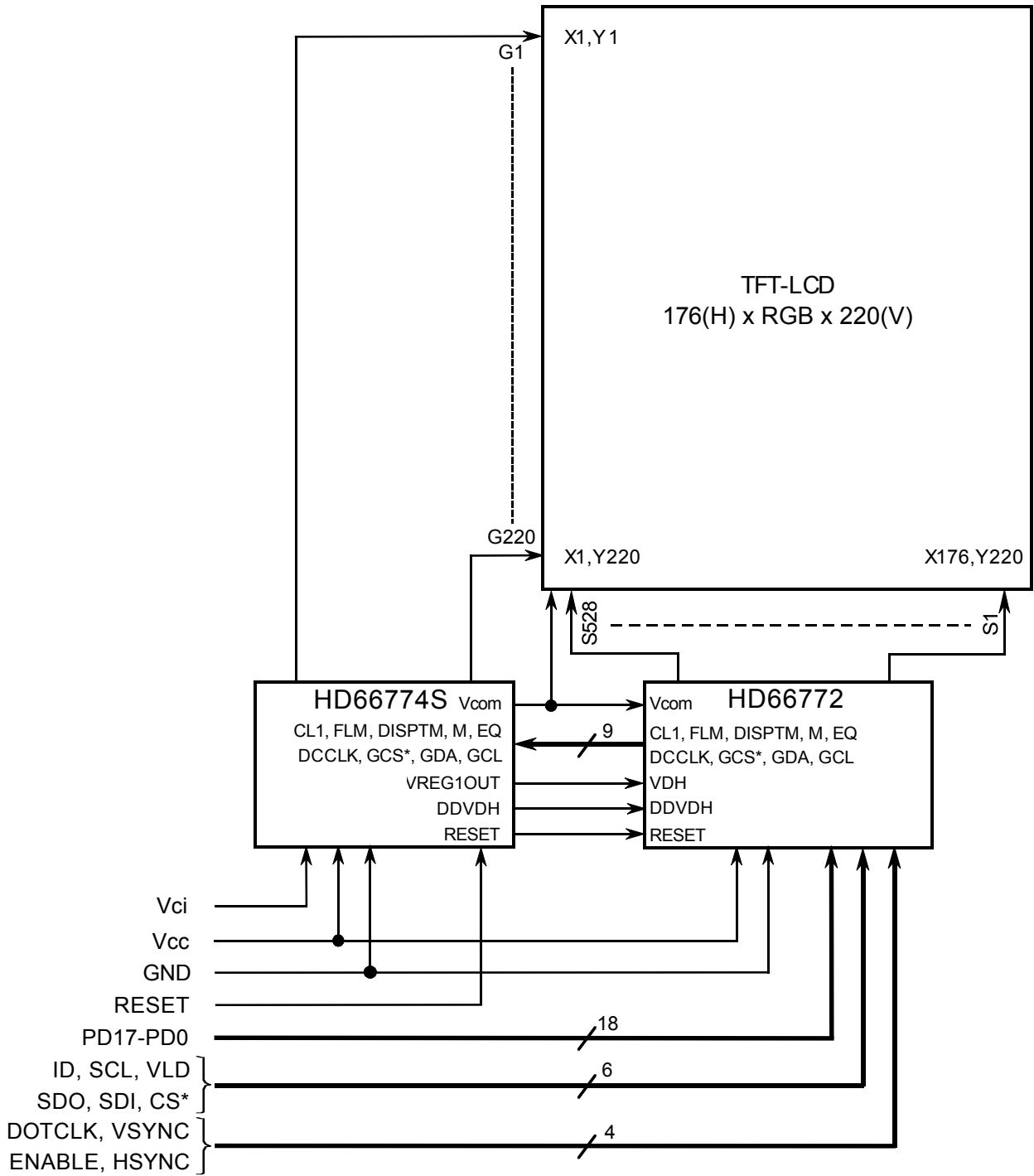
Note 8. Definition of optical response time



Note 9. The LCD driving voltage should be adjusted so as to obtain maximum contrast.

Note 10. The color temperature of light source is 5200K.

7. BLOCK DIAGRAM



Note 1 Connect the resistor for overcurrent protection between CA(Cathode) and GND.

8. INTERFACE

8.1 INTERNAL PIN CONNECTION

PIN No.	SIGNAL	FUNCTION
1	AN	Power Supply for LED
2	CA1	GND for LED1
3	CA2	GND for LED2
4	CA3	GND for LED3
5	RESET	Reset
6	ID	ID
7	NC	NC
8	NC	NC
9	NC	NC
10	NC	NC
11	NC	NC
12	NC	NC
13	NC	NC
14	SDO	Serial Instruction Data Out
15	SDI	Serial Instruction Data In
16	SCL	Synchronous Clock Signal
17	NC	NC
18	CS*	Chip Select
19	VLD	Active Data signal for write operation
20	VSYNC	Vertical synchronous for Display Data
21	HSYNC	Horizontal synchronous for Display Data
22	DOTCLK	Clock signal for Display Data
23	ENABLE	Enable signal for Display Data
24	PD17	Display Data(R5)
25	PD16	Display Data(R4)
26	PD15	Display Data(R3)
27	PD14	Display Data(R2)
28	PD13	Display Data(R1)
29	PD12	Display Data(R0)
30	PD11	Display Data(G5)
31	PD10	Display Data(G4)
32	PD9	Display Data(G3)
33	PD8	Display Data(G2)
34	PD7	Display Data(G1)
35	PD6	Display Data(G0)
36	PD5	Display Data(B5)
37	PD4	Display Data(B4)
38	PD3	Display Data(B3)
39	PD2	Display Data(B2)
40	PD1	Display Data(B1)
41	PD0	Display Data(B0)
42	Vci	Power Supply for Analog
43	Vcc	Power Supply for Logic
44	GND	GND
45	AGND	GND for Analog

I/F:
Suitable Connector
JAE:FF0245SA1
(JAE:FF0245SS1)

8.2 RGB INTERFACE MODE SETTING

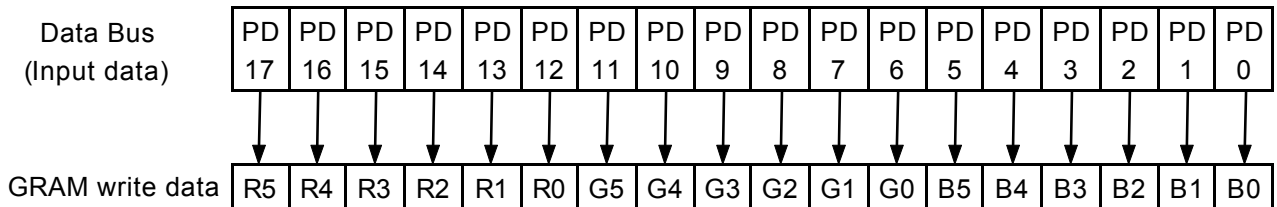
RGB INTERFACE MODE & UNUSED PIN CONNECTION

RGB Interface Mode		18-bit	16-bit
Colors		262k	65k
RGB Data Bus	Used Pins	PD17-0	PD17-13, PD11-1
	Unused Pins	—	PD12, PD0
Pin No.	Signal	—	—
29	PD12	—	GND
41	PD0	—	GND

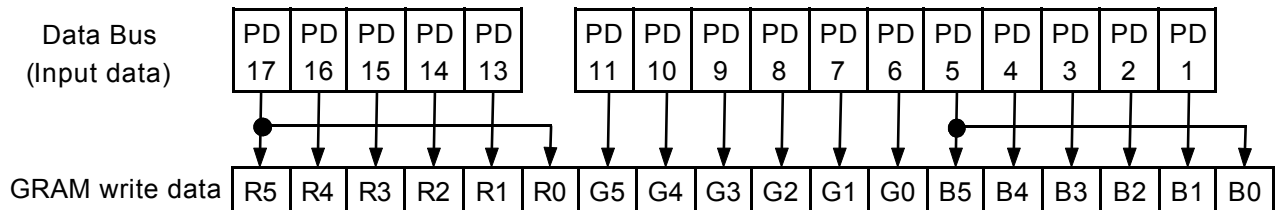
When the 16-bit RGB-I/F is selected, PD12 and PD0 pins must be fixed to the GND level.

INPUT DATA & GRAM WRITE DATA

18-bit RGB INTERFACE



16-bit RGB INTERFACE



In 16-bit RGB-I/F, the input data are expanded into 18-bit by adding one bit (the same data as the MSB of RB) to the LSB of RB data within HD66772.

NUMBER OF COLOR

RGB-I/F MODE	NUMBER OF GRAYSCALE			NUMBER OF COLOR
	R	G	B	
18-bit	64	64	64	262,144
16-bit	32	64	32	65,536

8.3 GRAM ADDRESS MAP

SS=1,GS=0

Y	X	1			2			3			4			-----			173			174			175			176		
		S528	S527	S526	S525	S524	S523	S522	S521	S520	S519	S518	S517	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1			
1	G1	"0000"H	"0001"H	"0002"H	"0003"H	-----	"00AC"H	"00AD"H	"00AE"H	"00AF"H																		
2	G2	"0100"H	"0101"H	"0102"H	"0103"H	-----	"01AC"H	"01AD"H	"01AE"H	"01AF"H																		
3	G3	"0200"H	"0201"H	"0202"H	"0203"H	-----	"02AC"H	"02AD"H	"02AE"H	"02AF"H																		
4	G4	"0300"H	"0301"H	"0302"H	"0303"H	-----	"03AC"H	"03AD"H	"03AE"H	"03AF"H																		
5	G5	"0400"H	"0401"H	"0402"H	"0403"H	-----	"04AC"H	"04AD"H	"04AE"H	"04AF"H																		
6	G6	"0500"H	"0501"H	"0502"H	"0503"H	-----	"05AC"H	"05AD"H	"05AE"H	"05AF"H																		
215	G215	"D600"H	"D601"H	"D602"H	"D603"H	-----	"D6AC"H	"D6AD"H	"D6AE"H	"D6AF"H																		
216	G216	"D700"H	"D701"H	"D702"H	"D703"H	-----	"D7AC"H	"D7AD"H	"D7AE"H	"D7AF"H																		
217	G217	"D800"H	"D801"H	"D802"H	"D803"H	-----	"D8AC"H	"D8AD"H	"D8AE"H	"D8AF"H																		
218	G218	"D900"H	"D901"H	"D902"H	"D903"H	-----	"D9AC"H	"D9AD"H	"D9AE"H	"D9AF"H																		
219	G219	"DA00"H	"DA01"H	"DA02"H	"DA03"H	-----	"DAAC"H	"DAAD"H	"DAAE"H	"DAAF"H																		
220	G220	"DB00"H	"DB01"H	"DB02"H	"DB03"H	-----	"DBAC"H	"DBAD"H	"DBAE"H	"DBAF"H																		

8.4 INTERFACE TIMING

Clock synchronized Serial Interface Timing Characteristics

Item		Symbol	Unit	Min	Typ	Max
Serial clock cycle time	Write	tSCYC	us	0.1	-	20
	Read			0.35	-	20
Serial clock "High" level pulse width	Write	tSCH	ns	40	-	-
	Read			150	-	-
Serial clock "Low" level pulse width	Write	tSCL	ns	40	-	-
	Read			150	-	-
Serial clock rise / fall time		tscr, tscf	ns	-	-	20
Chip select set up time		tCSU	ns	20	-	-
Chip select hold time		tCH	ns	60	-	-
Serial input data set up time		tSISU	ns	30	-	-
Serial input data hold time		tSIH	ns	30	-	-
Serial output data delay time		tSOD	ns	-	-	130
Serial output data hold time		tSOH	ns	5	-	-

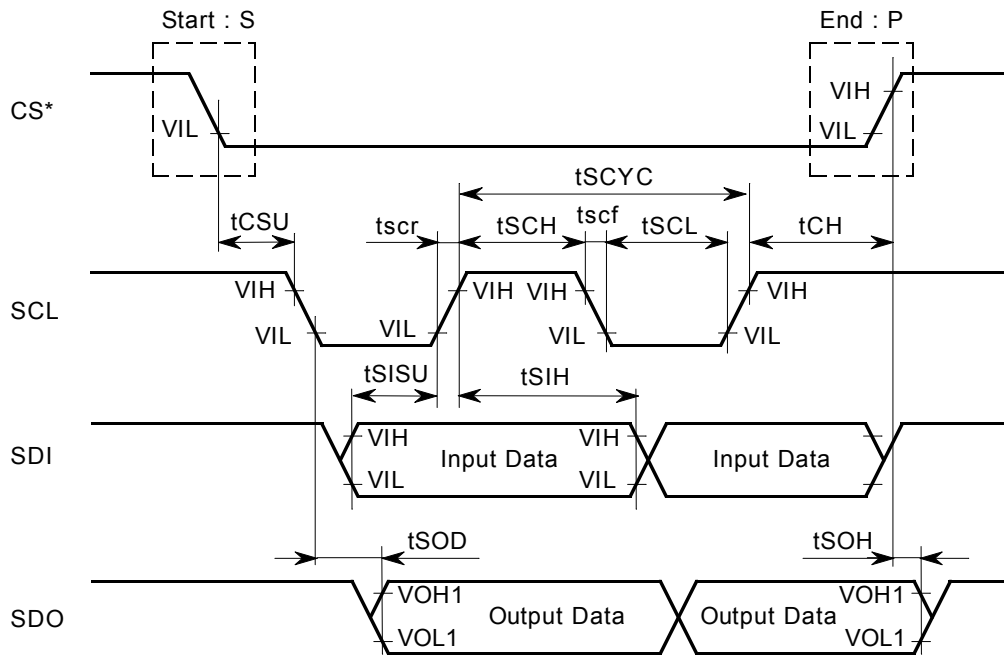
RGB Interface Timing Characteristics

<<18/16bit RGB Interface Mode(HWM=1)>>

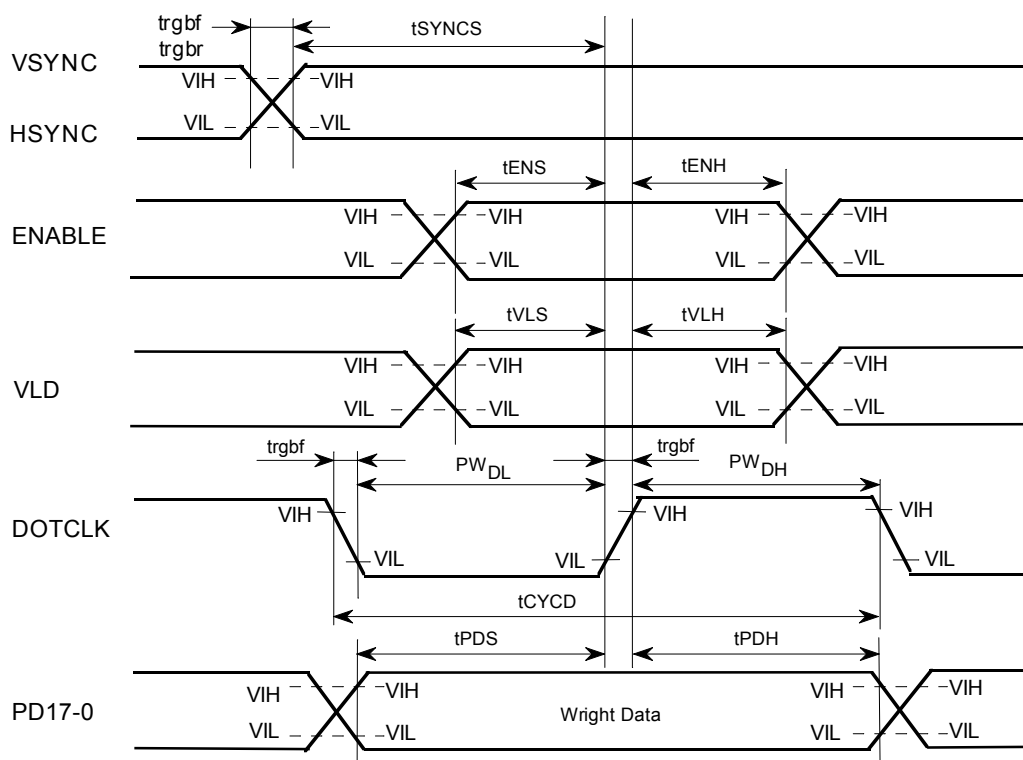
Item	Symbol	Unit	Min	Typ	Max
VSYNC/HSYNC set up time	tSYNCS	clock	0	-	1
ENABLE set up time	tENS	ns	10	-	-
ENABLE hold time	tENH	ns	20	-	-
VLD set up time	tVLS	ns	10	-	-
VLD hold time	tVLH	ns	40	-	-
DOTCLK "Low" level pulse width	PW _{DL}	ns	40	-	-
DOTCLK "High" level pulse width	PW _{DH}	ns	40	-	-
DOTCLK cycle time	tCYCD	ns	100	-	-
Data set up time	tPDS	ns	10	-	-
Data hold time	tPDH	ns	40	-	-
DOTCLK,VSYNC,HSYNC rise/fall time	trgbr, trgbf	ns	-	-	25

Reset Timing Characteristics

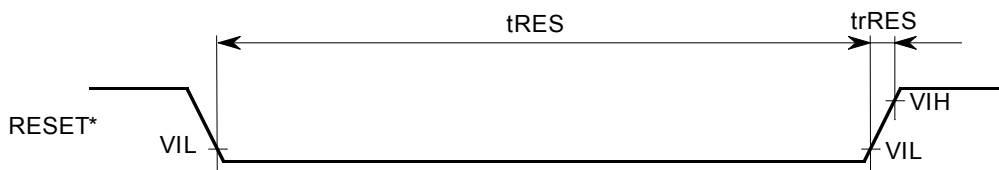
Item	Symbol	Unit	Min	Typ	Max
Reset "low" level width	tRES	ms	1	-	-
Reset rise time	trRES	us	-	-	10



Clock Synchronized Serial Interface Timing

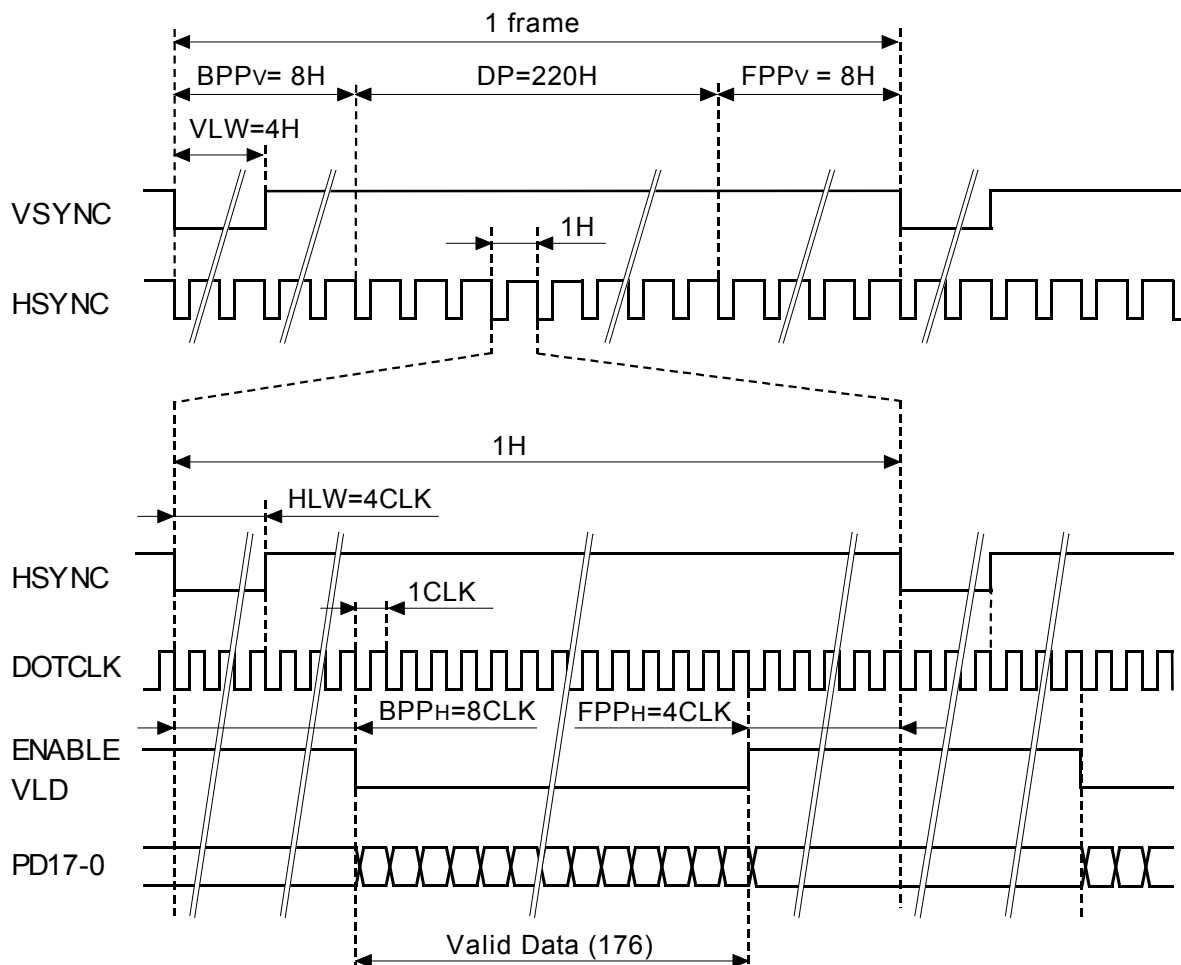


RGB Interface Timing



Reset Timing

16-/18-bit RGB Interface Timing



FPP : Front porch period
 BPP : Back porch period
 DP : Display operation period
 VLW : The period in which VSYNC is low level
 HLW : The period in which HSYNC is low level

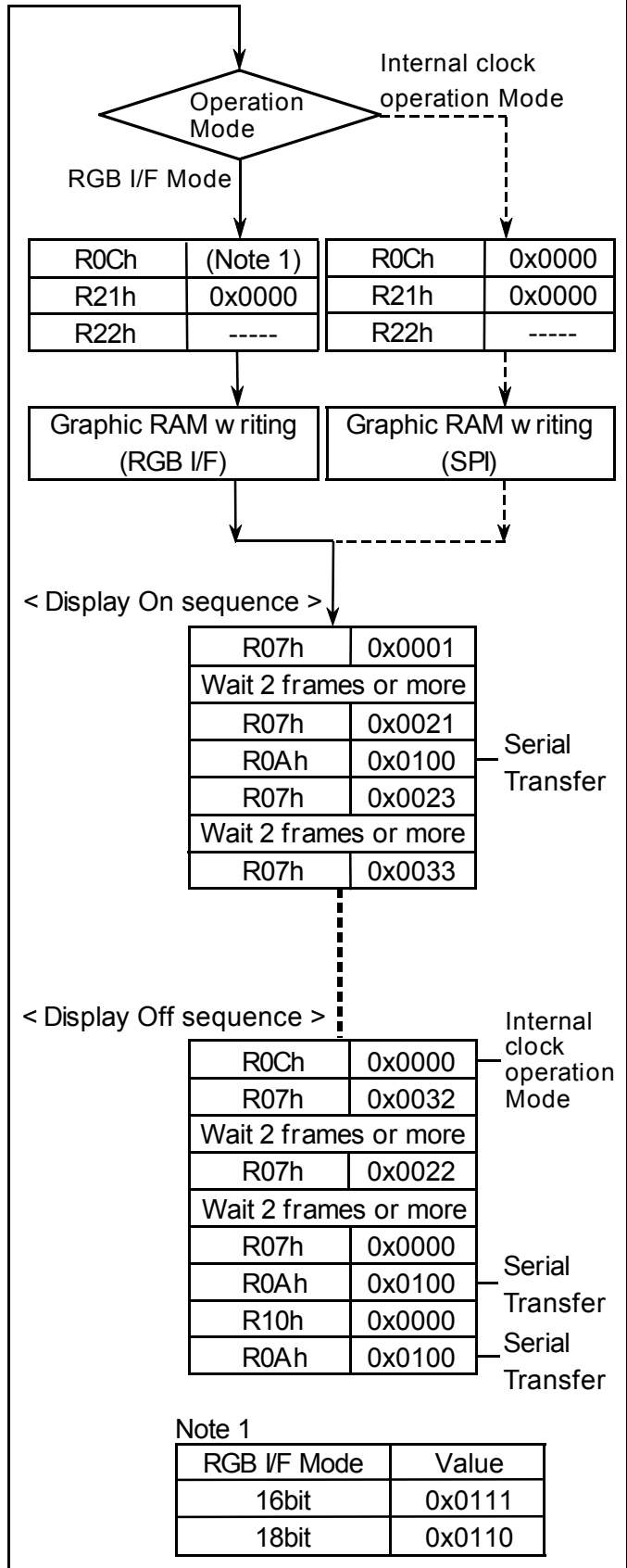
Item	min	typ	max	Note
HLW	1DOTCLK	4DOTCLK	-	HLW ≥ 1DOTCLK
BPP _H	HLW (1DOTCLK)	2HLW (8DOTCLK)	-	BPP _H ≥ HLW
FPP _H	-	4DOTCLK	-	
VLW	1H	4H	-	VLW ≥ 1H
BPP _v	2H	8H	14H	BPP _v + FPP _v = 16H
FPP _v	2H	8H	14H	
DP	-	220H	240H	
The number of raster-rows of 1frame	-	-	-	BPP _v + DP + FPP _v

$$f_{\text{DOTCLK}} = f_{\text{FLM}} \times (220 + \text{BPP}_v + \text{FPP}_v) \times (176 + \text{BPP}_H + \text{FPP}_H)$$

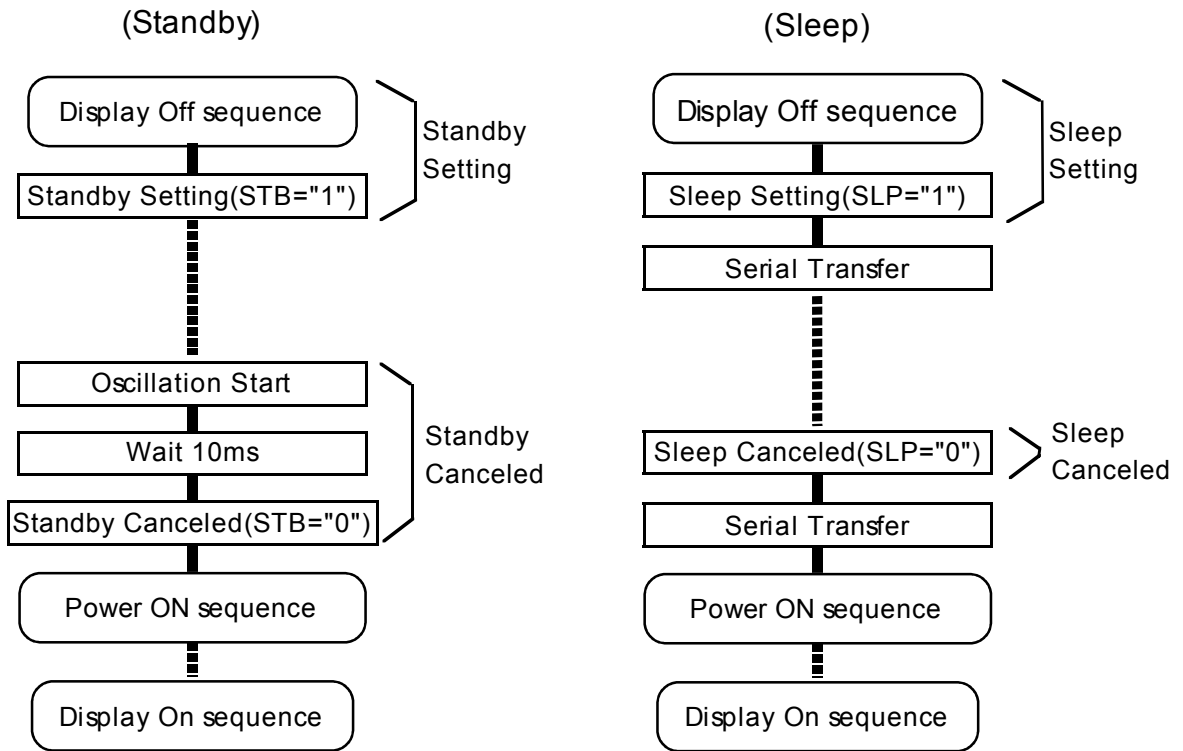
8.5 REGISTER SETTING FLOW

< Power ON sequence >

	Index	Value		
Power supply setting(1)	R11h	0x1010	Serial Transfer	
	R12h	0x0000		
	R13h	0x0609		
	R14h	0x2D0F		
	R0Ah	0x0100		
	R0Ah	0x0101		
	R0Ah	0x0102		
Power supply setting(2)	R10h	0x0808	Serial Transfer	
	R0Ah	0x0100		
	Wait 20ms or more			
Power supply setting(3)	R13h	0x0619	Serial Transfer	
	R0Ah	0x0101		
	Wait 20ms or more			
	(Note 2) More than 100ms To : Display On sequence			
Mode Setting	R01h	0x011B	High-speed Write Mode	
	R02h	0x0500		
	R03h	0x1230		
	R04h	0x0000		
	R05h	0x0000		
	R08h	0x0808		
	R0Bh	0x0000		
	R23h	0x0000		
	R24h	0x0000		
	R40h	0x0000		
	R41h	0x0000		
	R42h	0xDB00		
	R43h	0xEFEF		
	R44h	0xAF00		
	R45h	0xDB00		
	R30h	0x0100		
	R31h	0x0707		
	R32h	0x0102		
	R33h	0x0204		
	R34h	0x0506		
	R35h	0x0000		
	R36h	0x0706		
	R37h	0x0402		
	R3Fh	0x0003		
	R0Ah	0x0106		Serial Transfer
	R0Ah	0x0107		

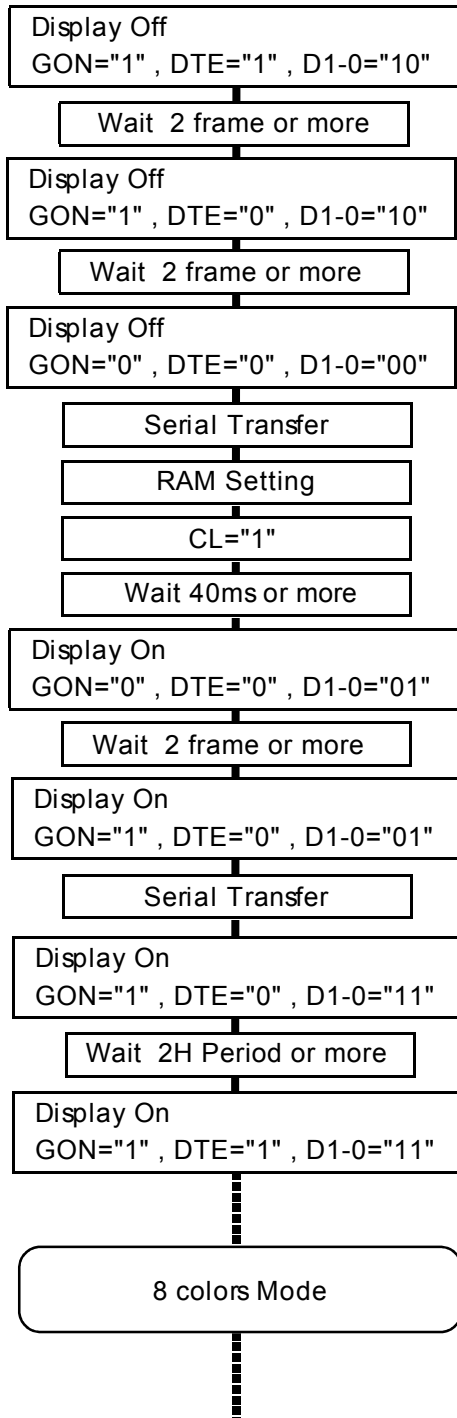


< Standby & Sleep Sequence >

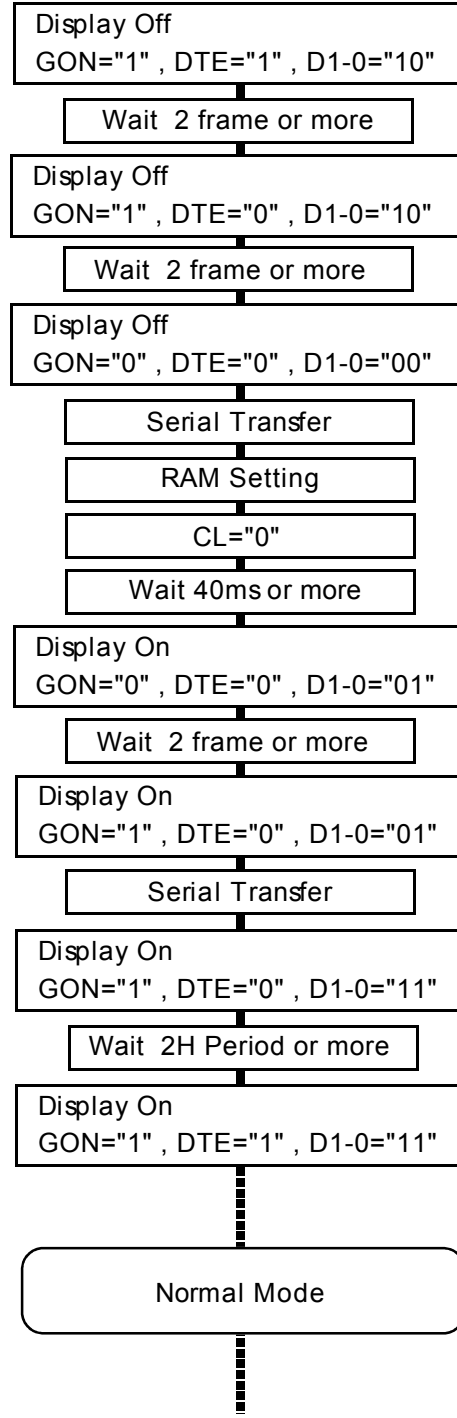


< 8 Colors Mode Setting >

(Normal Mode → 8 Colors Mode)

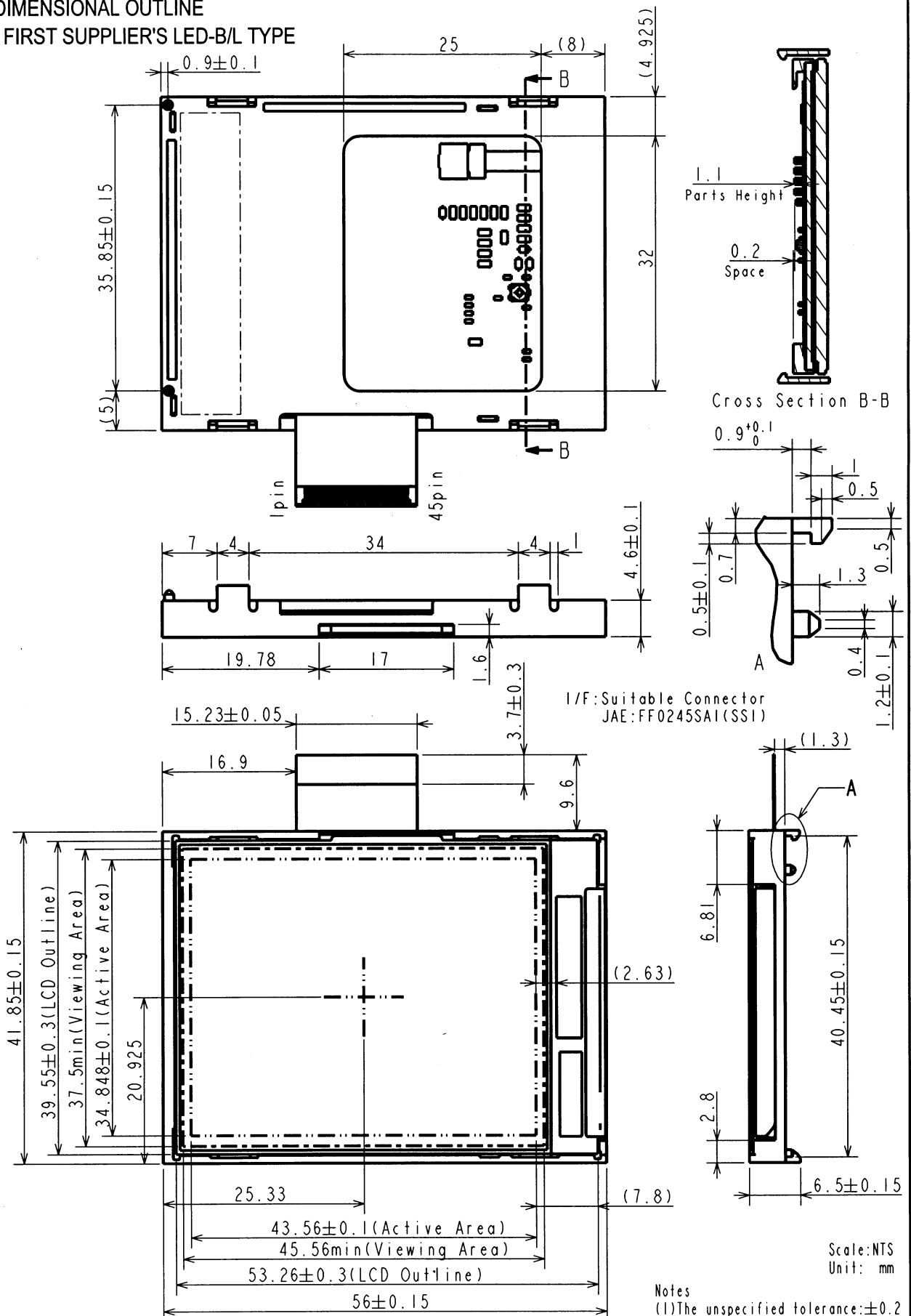


(8 Colors Mode → Normal Mode)



9. DIMENSIONAL OUTLINE

9.1 FIRST SUPPLIER'S LED-B/L TYPE

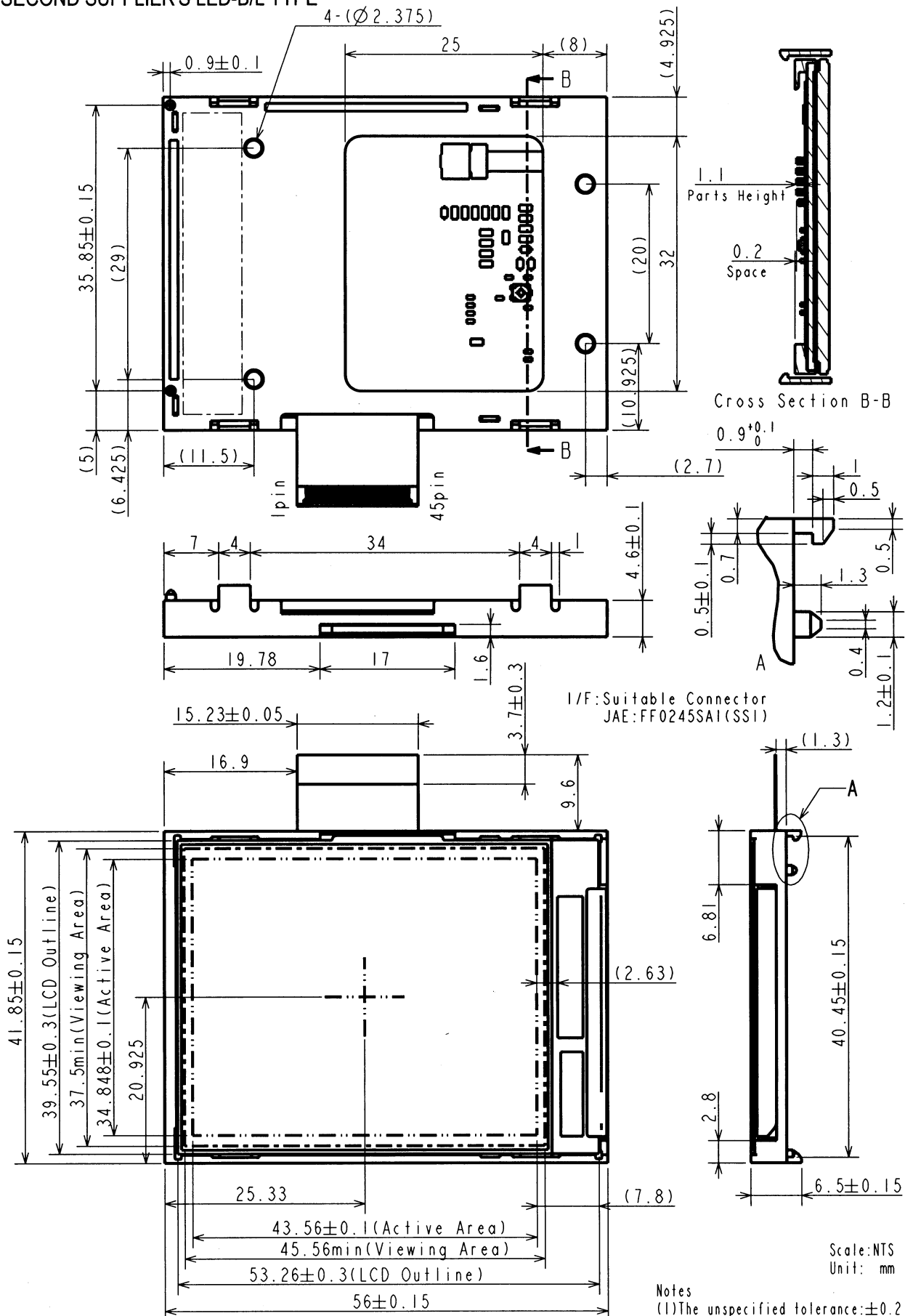


I/F: Suitable Connector
JAE: FF0245SA1 (SSI)

Scale: NTS
Unit: mm

Notes
(1) The unspecified tolerance: ± 0.2

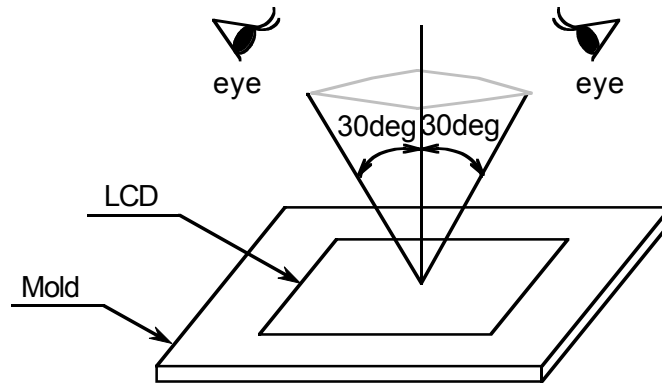
9.2 SECOND SUPPLIER'S LED-B/L TYPE



10. VISUAL INSPECTION

10.1 INSPECTION CONDITION

- 1) Ambient illumination : 1000 - 1500 [lx]
- 2) Distance between eyes of an inspector and the LCD Module : Approximately 20 [cm]
- 3) Viewing angle : $\leq 30\text{deg}$



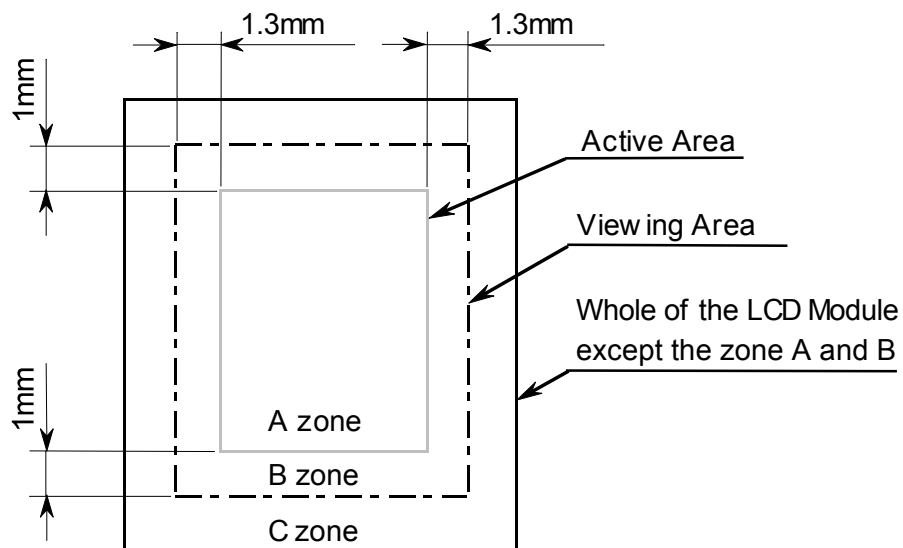
10.2 DEFINITION OF ZONE

The visual inspection zone of a LCD Module is divided into three.

A zone : The inside of the Active Area.

B zone : The outer periphery of the Active Area.

C zone : Whole of the LCD Module except the zone A and B. (Including FPC & Plastic Mold)



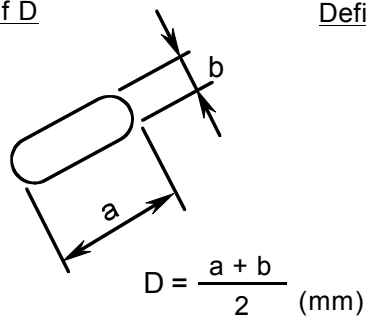
10.3 COSMETIC SPECIFICATION

No.	ITEM		Maximum Acceptable number	Unit	Applied Zone	Inspection Mode	Remarks
1	Dot defect	Sparkle Mode	1 dot	0	pcs	A	Light-On 1),2),4)
			Adjacent dots	0	unit	A	
	Black Mode	1 dot	2	pcs	A		
		Adjacent dots	0	unit	A		
	The Total number		2	pcs	A		
2	Line defects		None	—	A	Light-On	—
3	Uneven Brightness: Line shape		Serious one is not allowed	—	A	Light-On	6)
4	Uneven Brightness: Dot shape						
5	Stain Inclusion : Line shape [mm] Width, Length	$W \leq 0.01$	L: Ignored	Ignored	A,B	Light-On Light-Off	5),6),7)
		$0.01 < W \leq 0.05$	$L \leq 2.0$	2			
			$L > 2.0$	0			
		$0.05 < W$	—	see Dot shape			
6	Stain Inclusion : dot shape [mm] Diverge diameter	$D \leq 0.1$	Ignore	A,B	Light-On Light-Off	5),6),7)	
		$0.1 < D \leq 0.2$	2				
		$0.2 < D$	0				
7	Uneven Anti Reflection		By Limited sample	—	A,B	Light-Off	6)
8	Scratch, Dent of Plastic Mold		Serious one is not allowed	—	C	Light-Off	6)
9	Scratch of FPC		By Limited sample	—	C	Light-Off	6)

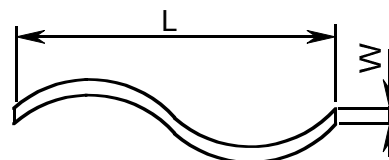
Note:

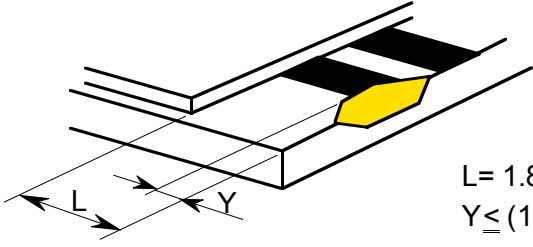
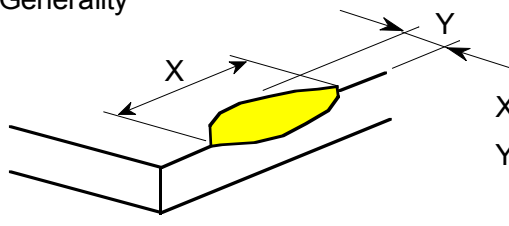
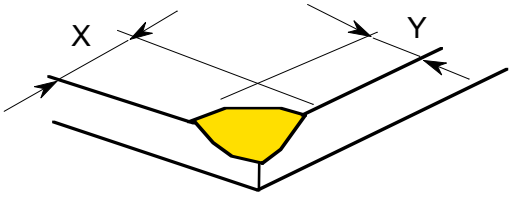
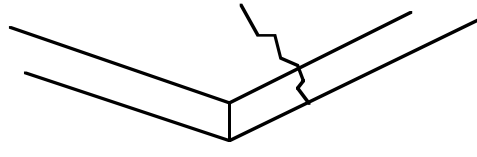
- 1) Defect whose area per each dot is over 50 % is regarded as Dot defect.
- 2) Defect whose brightness at all black screen is more than 30% is regarded as Bright Dot defect.
- 3) Defect whose brightness at all white screen is less than 70% is regarded as Dark Dot defect.
- 4) Defect dots which are not adjacent are regarded as single Dot defect each.
- 5) Defect which can be easily wiped off is disregarded
- 6) In case any problems would be brought out, both parties should discuss needed items such as limited samples.
- 7) In case of gray scale pattern, obvious defect is to be rejected.

Definition of D



Definition of W and L



No.	ITEM	CRITERIA	A	B	C
10	Glass crack	(1) Electrode  $L = 1.8 \text{ [mm]}$ $Y \leq (1/4) \times L$	-	-	○
		(2) Generality  $X \leq 5.0 \text{ [mm]}$ $Y \leq 1.5 \text{ [mm]}$ * No crack allowed to reach seal area. $Y \leq 1$, in case of two cracks found.			
		(3) Corner  $X \leq 1.5$ $Y \leq 1.5$ * No crack allowed to reach seal area. $Y \leq 1$, in case of two cracks found.			
		(4) The crack that has potential to enlarge  <p style="text-align: right;">None</p>			

11. PRECAUTION IN DESIGN

11.1 GENERAL ATTENTION

- (1) The LCD module is designed as display for mobile phone. When it is used for other purposes, we do not guarantee these specifications at all about the contents, quality, safety etc..
Moreover, this module is not particularly developed as an object for equipment in connection with a human life such as medical apparatus of life support relation.
- (2) Please do not decompose this LCD module. There is danger such as a burn, electric shock, and an injury. Moreover, when module is decomposed, we do not guarantee these specifications at all about the contents, quality, safety etc..

11.2 PRECAUTIONS AGAINST ELECTROSTATIC DISCHARGE

As this module contains C-MOS LSIs, it is not strong against electrostatic discharge. Make certain that the operator's body is connected to the ground through a wrist band etc. And don't touch V/F pins directly.

11.3 HANDLING PRECAUTIONS

- (1) Please do not leave on a humid environment for a long time. In storage, when the ambient temperature is over 35 degrees C, please avoid high humidity.
The polarizers degradation is easily caused in high temperature and high humidity. Moreover, it is also the cause of bubble and peeling of polarizer. Please store/operate the LCD module within the relative temperature and normal humidity.
- (2) Since the polarizer on the top tend to be easily scratched, they should be handled with full care so as not to get them touched, pushed or rubbed by a piece of glass, tweezers and anything else which are harder than a pencil lead 3H.
- (3) Maximum pressure to the surface must be less than 1.96Pa.
And if the pressure area is less than 1cm², maximum pressure must be less than 1.96N.
- (4) As the adhesives used for adhering upper/lower polarizers which will be deteriorated by a chemical reaction with such chemicals as acetone, toluene, hexane, ethanol and isopropyl alcohol.
Don't let the organic solvent or chemicals adhere to polarizers.
- (5) Lightly wipe to clean the dirty surface with absorbent cotton or other soft material like chamois, soaked in the recommended chemicals without scrubbing it hardly.
Always wipe the surface horizontally or vertically. Never give a wipe in a circle. To prevent the display surface from damage and keep the appearance in good state, it is sufficient, in general, to wipe it with absorbent cotton.

Hitachi Displays, Ltd.	Date	Mar. 16, 2004	Sh. No.	3284PS 2611-TX06D15VM1EAA-4	Page	11-1/3
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- (6) Immediately wipe off saliva or water drop attached on the display area because it may cause deformation or faded color.
- (7) Foggy dew deposited on the surface may cause a damage, stain or dirt to the polarizer. When you need to take out the LCD module from some place at low temperature for test, etc. It is required to be warmed them up to be temperature higher than room temperature before taking them out.
- (8) Touching the display area or I/F pins with bare hands or contaminating them are prohibited, because the stain on the display area and poor insulation between terminals are often caused by being touched with bare hands.
(Some cosmetics are detrimental to polarizers.)
- (9) In general, the glass is fragile so that it, especially on its periphery, tends to be cracked or chipped in handling. Please do not give the LCD module sharp shocks caused by falling etc.
- (10) The LCD is a product made from glass. It is possible to be damaged by the strong shock. Please be careful and prevent to drop it.
- (11) It doesn't bend and scratch the I/F part. These are cause of no good contact. Please be careful.

11.4 OPERATION PRECAUTION

- (1) The spike noise causes the mis-operation of circuits. Recommended condition of spike noise level is as follows : $V_{cc} = \pm 200\text{mV}$ (Over and under shoot voltage)
- (2) Response time depends on the temperature. (In lower temperature, it becomes longer). And also brightness and color depend on the temperature.
- (3) Be careful for condensation at sudden temperature change. Condensation make damage to polarizer or electrical contact part. And after fading condensation, smear or spot will occur.
- (4) When fixed patterns are displayed at long times, afterimage is likely to occur.
- (5) Module has high frequency circuit. If you need to shield the electromagnetic noise, please do in yours.
- (6) Do not connect or remove the module from main system with power applied.
- (7) Strong light exposure causes mis-operation of driver.

Hitachi Displays, Ltd.	Date	Mar. 16, 2004	Sh. No.	3284PS 2611-TX06D15VM1EAA-4	Page	11-2/3
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11.5 STORAGE

When storing LCD module as spare parts for a long time, the following precautions are necessary.

- (1) Store the LCD modules in a dark place ; do not expose them to sunlight or fluorescent light. Keep the temperature between 10 degrees C and 30 degrees C, and the humidity between 55% and 75%.
- (2) The polarizer surface should not come in contact with any other object. It is recommended that they be stored in the container in which they were shipped.

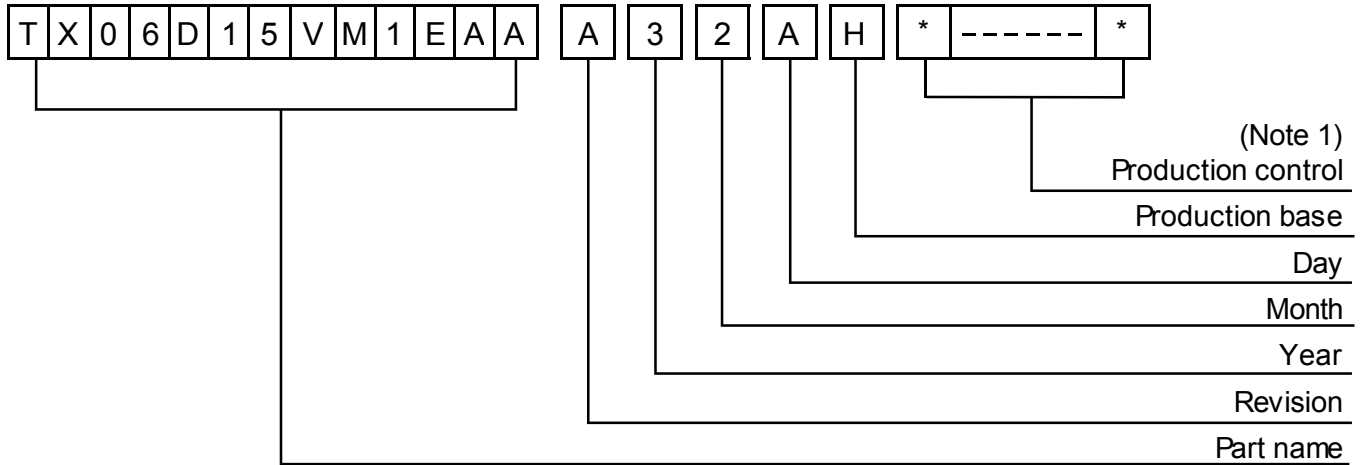
11.6 SAFETY

- (1) This liquid crystal display module is using glass. When it damages, please wear a protection glove to deal it. Moreover, when any liquid leaked out of a damaged glass cell comes in contact with your hands, please wash it off well with soap and water.
- (2) Solder is used for mounting of internal electronic component at print circuit board. Since the Lead(Pb) is contained in solder. When you want to discard this LCD module, please follow local ordinances or regulations for disposal.

12. DESIGNATION OF LOT MARK

12.1 LOT MARK

The lot mark consists of 7 or 10-digit production control number.



13. PRECAUTION FOR USE

- (1) A limit sample should be provided by the both parties on an occasion when the both parties agree to its necessity.
Judgment by a limit sample shall take effect after the limit sample has been established and confirmed by the both parties.
- (2) On the following occasions, the handling of the problem should be decided through discussion and agreement between responsible persons of the both parties.
 - (1) When a question is arisen in the specifications.
 - (2) When a new problem is arisen which is not specified in the specifications.
 - (3) When an inspection specification change or operating condition change by customer is reported to HITACHI, and some problem is arisen in the specification due to the change.
 - (4) When a new problem is arisen at the customer's operating set for sample evaluation
- (3) Regarding the treatment for maintenance and repairing, both parties will discuss it in six month later after latest delivery of this product.

The precaution that should be observed when handling LCM have been explained above.
If any points are unclear or if you have any requests, please contact Hitachi.

Hitachi Displays, Ltd.	Date	Mar. 16, 2004	Sh. No.	3284PS 2613-TX06D15VM1EAA-4	Page	13-1/1
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