DATA MODUL

ORTUSTECH

Specification

COM24H2P96ULC

2,4" - 240 x 320 – QVGA - RGB

Spec Revision: 1.0
Revision Date: 18.10.2023

Note: This specification is subject to change without prior notice

Passion Displayed

SPECIFICATIONS № 22TLM061	Issue:Oct.18,2023

△C

Specifications for

Blanview TFT-LCD Monitor

(2.4" QVGA 240 x RGB x 320 Portrait)

Version 1.0
(Please be sure to check the specifications latest version.)

MODEL COM24H2P96ULC

Customer's Approval
Signature :
Name :
Section :
Title :
Date :

ORTUSTECH

TOPPAN INC.
Electronics Division
Technological Development Department III

Approved by S. Eguchi

Checked by T. Matsuzaki

Prepared by M. Tojo

Version History

Ver.	Date	Page		Description
0.0	Oct.11,2022	-	-	Tentative issue
0.1	Jun.6,2023	P.1		Cover
			Change	Department name
Ⓐ ×19		P.3		Contents
			Add	Contents
			Change	Page №
		P.5		2.2 Display Method
			Correct	Signal input method
		P.10		4. Pin Assignment
			Correct	Pin Assignment
		P.11		5. Absolute Maximum Rating
			Delete	Condition
				6. Recommended Operating Conditions
			Correct	Rating
		P.12		7.1 DC Characteristics
			Add	Operating current / Standby current
		P.14		8.1 Interface
			Add	Item
		P.15		8.2 Command transfer
			Add	Item
		P.16-18		8.3 Data transfer
			Add	Item
		P.19,20		9.1 Power ON Sequence
			Correct	Sequence
		P.21		9.2 Sleep IN Sequence
			Correct	Table head
				9.3 Sleep OUT Sequence
			Correct	Table head
				9.4 Power OFF Sequence
			Correct	Table head
		P.22,23		9.5 Refresh Sequence
			Correct	Sequence
0.2	Jul.28,2023	P.15		8.2 Command transfer
			Add	RDB signal wave form
Ⓑ ×4		P.16-18		8.3 Data transfer
			Add	RDB signal wave form
1.0	Oct.18,2023	-	-	First issue
		All		All
			Change	Company name logo
Ⓒ ×3		P.28		12.1 Defective Display and Screen Quality
			Add	Signal condition
			Correct	Notation
		P.30		13. Reliability Test
			Add	Applied voltage (Surface discharge test)
			Add	number of failures / number of examinations

Contents

1. Application

This Specification is applicable to 60.0 mm (2.4 inch) Blanview TFT-LCD monitor for non-military use.

◎ TOPPAN makes no warranty or assume no liability that use of this Product and/or any information including drawings in this Specification by Purchaser is not infringing any patent or other intellectual property rights owned by third parties, and TOPPAN shall not grant to Purchaser any right to use any patent or other intellectual property rights owned by third parties. Since this Specification contains TOPPAN's confidential information and copy right, Purchaser shall use them with high degree of care to prevent any unauthorized use, disclosure, duplication, publication or dissemination of TOPPAN's confidential information and copy right.

◎ If Purchaser intends to use this Products for an application which requires higher level of reliability and/or safety in functionality and/or accuracy such as transport equipment (aircraft, train, automobile, etc.), disaster-prevention/security equipment or various safety equipment, Purchaser shall consult TOPPAN on such use in advance.

◎ This Product shall not be used for application which requires extremely higher level of reliability and/or safety such as aerospace equipment, telecommunication equipment for trunk lines, control equipment for nuclear facilities or life-support medical equipment.

◎ It must be noted as an mechanical design manner, especial attention in housing design to prevent arcuation/flexure caused by stress to the LCD module shall be considered.

◎ TOPPAN assumes no liability for any damage resulting from misuse, abuse, and/or miss-operation of the Product deviating from the operating conditions and precautions described in the Specification.

◎ It shall be mutually conferred if nonconforming defect which result from unspecified cause in this specification arises.

◎ If any issue arises as to information provided in this Specification or any other information, TOPPAN and Purchaser shall discuss them in good faith and seek solution.

◎ TOPPAN assumes no liability for defects such as electrostatic discharge failure occurred during peeling off the protective film or Purchaser's assembly process.

◎ This Product is compatible for RoHS(2.0) directive.

Object substance	Maximum content [ppm]
Cadmium and its compound	100
Hexavalent Chromium Compound	1000
Lead & Lead compound	1000
Mercury & Mercury compound	1000
Polybrominated biphenyl series（PBB series）	1000
Polybrominated biphenyl ether series（PBDE series）	1000
Bis(2-ethylhexyl)phthalate series(DEHP series)	1000
Butyl benzyl phthalate series(BBP series)	1000
Dibutyl phthalate series(DBP series)	1000
Diisobutyl phthalate series(DIBP series)	1000

2. Outline Specifications

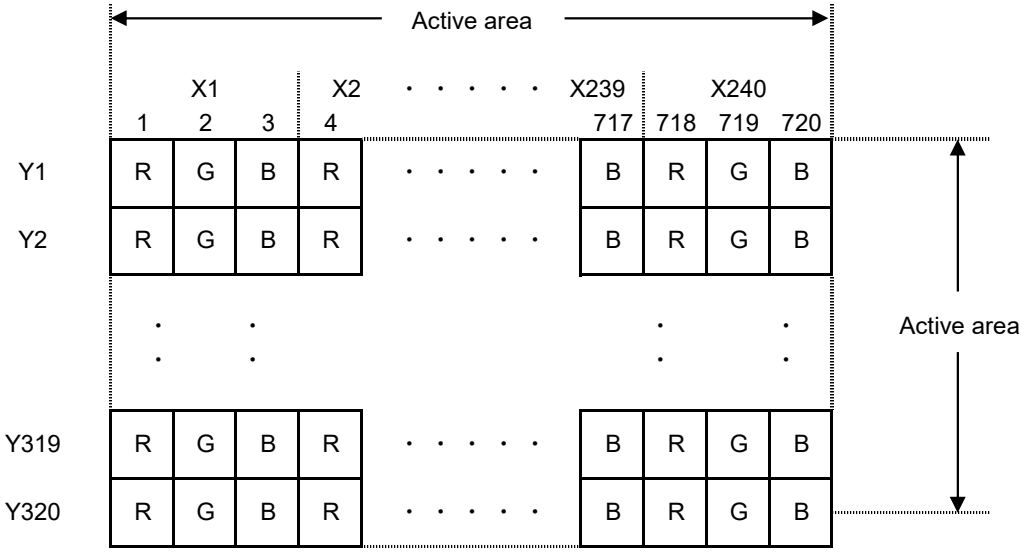
2.1 Features of the Product

- 2.4 inch diagonal display, 720 [H] x 320 [V] dots. 240RGB x 320 pixel.
- 6-bit / 262,144 colors.
- Single power supply operation of 2.7V.
- Timing generator [TG], Counter-electrode driving circuitry, Built-in power supply circuit.
- Long life & High bright white LED back-light.
- Blanview TFT-LCD, improved outdoor visibility.

	Indoor		Outdoor	
	Readability	Power Efficiency (Battery Life)	Readability	Power Efficiency (Battery Life)
Transmissive	Good	Good	Fair	Poor
Transflective	Fair	Poor	Good	Good
Blanview	Good	Good	Good	Good

2.2 Display Method

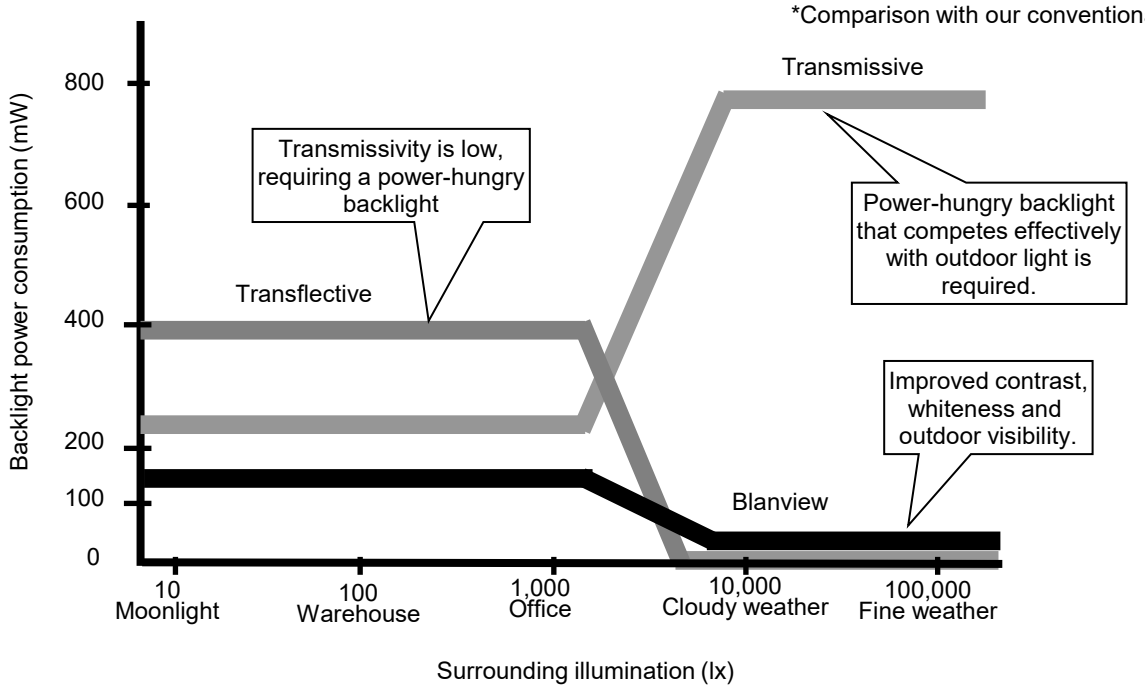
Items	Specifications	Remarks
Display type	VA type 262,144 colors Blanview, Normally Black	
Driving method	a-Si TFT Active matrix Line-scanning, Non-interlace	
Dot arrangement	RGB stripe arrangement	Refer to "Dot arrangement"
Signal input method	6-bit CPU Interface	
Backlight type	Long life & High bright white LED	
NTSC ratio	50%	



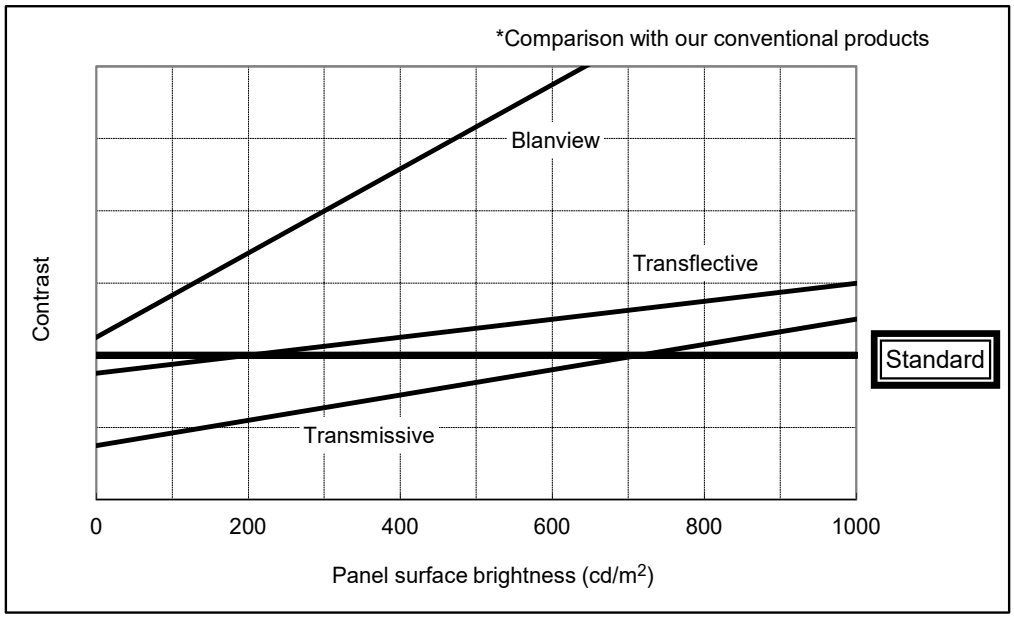
Dot arrangement (FPC cable placed left side)

<Features of Blanview>

- Backlight power consumption required to assure visibility. (equivalent to 3.5"QVGA)



- Contrast characteristics under 100,000lx.（same condition as direct sunlight.）
  With better contrast (higher contrast ratio), Blanview TFT-LCD has the best outdoor readability in three different types of TFT-LCD.
  Below chart shows contrast value against panel surface brightness. (Horizontal: Panel surface brightness/ Vertical: Contrast value) LCD panel has enough outdoor readability above our Standard line. (TOPPAN criteria)



3. Dimensions and Shape

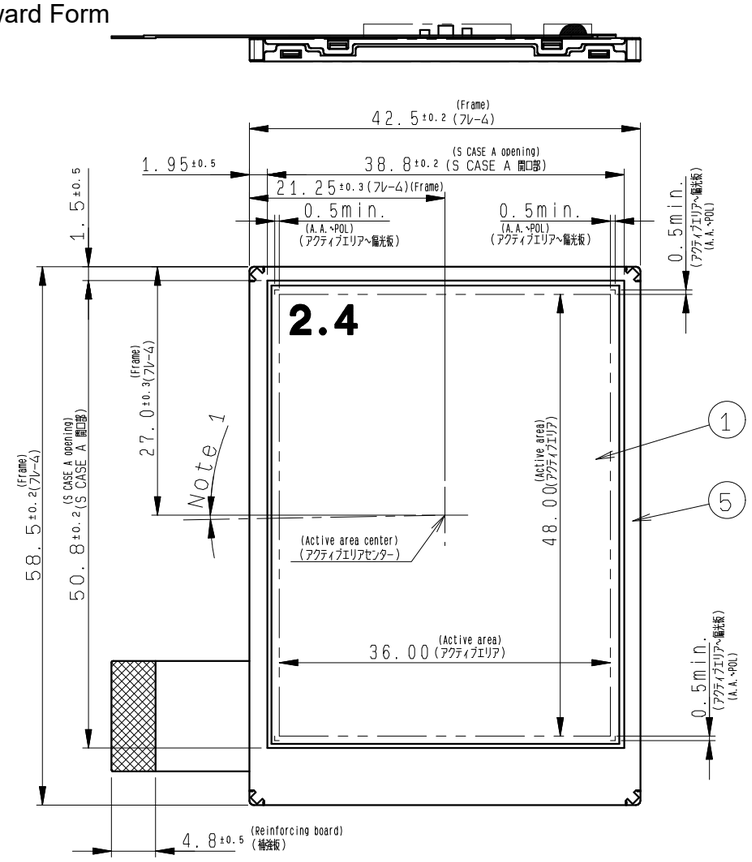
3.1 Dimensions

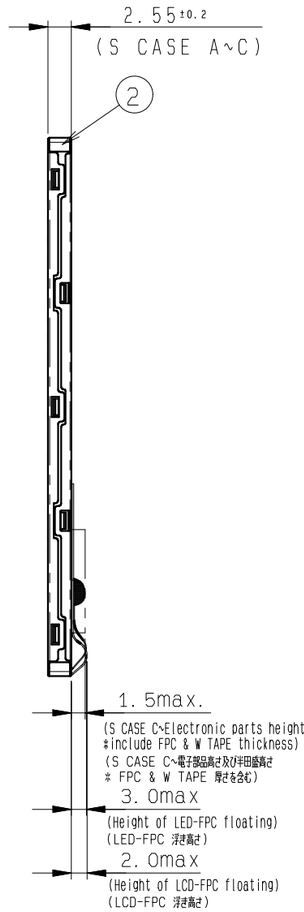
Items	Specifications	Unit	Remarks
Outline dimensions	42.50[H] × 58.50[V] × 2.55[D]	mm	exclude FPC and components on the FPC
Active area	36.00[H] × 48.00[V]	mm	60.00mm diagonal
Number of dots	720[H] × 320[V]	dot	
Dot pitch	50.0[H] × 150.0[V]	um	
Surface hardness of the polarizer	2	H	
Weight	13.6	g	Include FPC cable

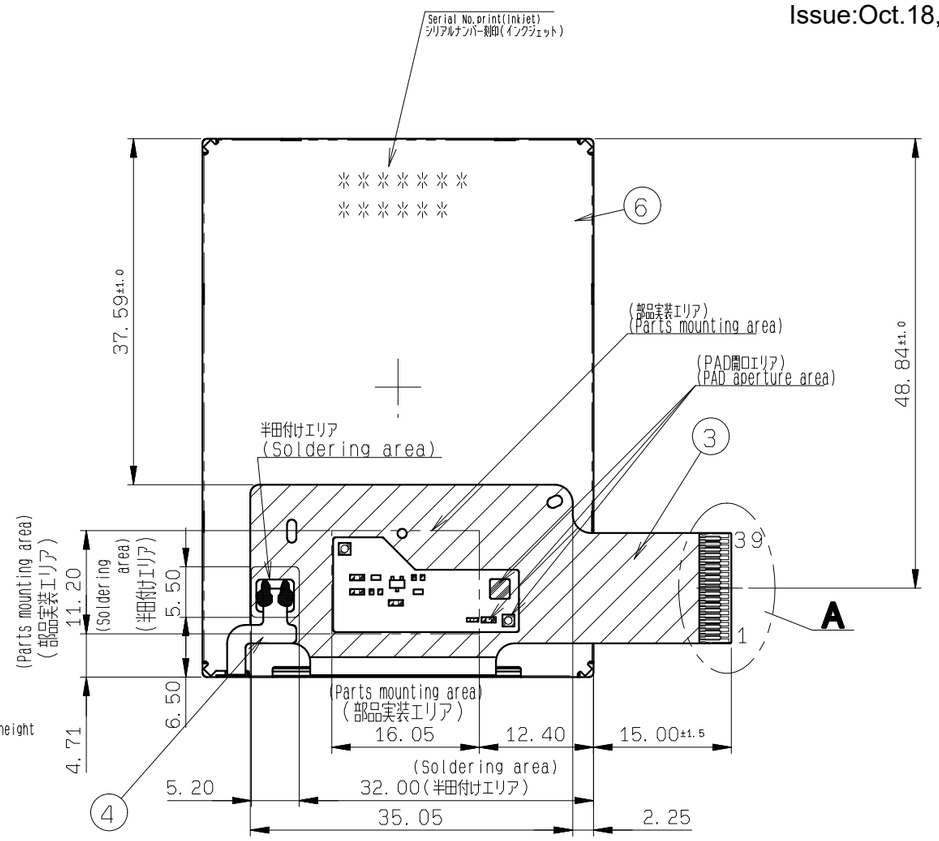
3.2 Outward Form

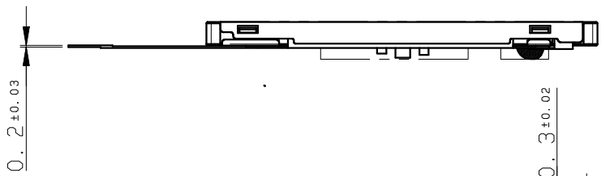
EC No.	REV. No.	REVISE	DATE (Y:M:D)	APPROVED	CHECKED	PREPARED
####			##:##:##	##	##	

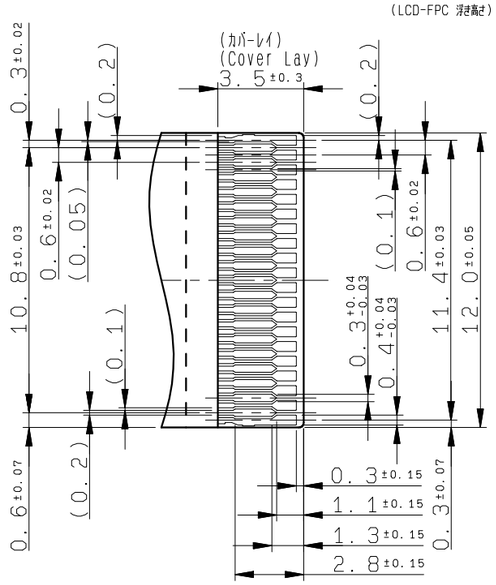
(8/39)
22TLM061
Issue:Oct.18,2023











Detail A
(S=5/1)

Angular deviation of LCD cell from the TFT-LCD monitor's reference axis shall be less than【±40'】.

1. LCD PANELの角度ズレは、モニター基準軸に対し【±40'】以下とする。

Recommended FPC connectors
For LCD : HIROSE, part number:FH23-39S-0.3SHW(05) (Bottom contact)

2. FPCの推奨コネクターの規格(単品)を下記に示す。
ヒロセ電機
単品規格:FH23-39S-0.3SHW(05) (下接点)

PART NAME	ITEM	PART CODE	MODEL NUMBER	REMARK
	7			
S CASE C	6			
S CASE A	5			
FPC B	4			Use for LED
FPC A	3			Use for LCD
FRAME	2		PC	
LCD	1		Glass substrate thickness=0.5t	with protection sheet

APPROVED 木下大輔	GENERAL TOLERANCE ±0.5	SCALE Free	UNIT mm	TOPPAN INC.
CHECKED 加藤真一	ISSUE (Y:M:D) 23:07:31	MODEL COM24H2P96U**		DO NOT DUPLICATE, CONFIDENTIAL AND PROPRIETARY
CHECKED	NAME	OUTLINE-D2P96		DRAWING NO. RJD604307D301 / REV. # / SHEET / DIV. / ASS'Y
DESIGN 富田恵太				
DRAW 富田恵太				

3.3 Serial № print (S-print)

3.3.1 Display Items

S-print indicates the least significant digit of manufacture year (1digit), manufacture month with below alphabet (1letter), model code (5characters), serial number (6digits).

* Contents of Display

*	*	*****	******
a	b	c	d

	Contents of display			
a	The least significant digit of manufacture year			
b	Manufacture month	Jan-A	May-E	Sep-I
		Feb-B	Jun-F	Oct-J
		Mar-C	Jul-G	Nov-K
		Apr-D	Aug-H	Dec-L
c	Model code	24CAC (Made in Japan) 24CBC (Made in Malaysia)		
d	Serial number			

* Example of indication of Serial № print (S-print)

・Made in Japan

2L24CAC000125

means "manufactured in December 2022, 2.4" CA type, C specifications, serial number 000125"

・Made in Malaysia

2L24CBC000125

means "manufactured in December 2022, 2.4" CB type, C specifications, serial number 000125"

3.3.2 Location of Serial № print (S-print)

Refer to 3.2 "Outward Form".

3.3.3 Others

Please note that it is likely to disappear with an organic solvent about the Serial print.

4. Pin Assignment

No.	Symbol	Function
1	VSS	GND
2	VSS	GND
3	VCI	Power supply for main circuit
4	IOVCC	Power supply for I/O circuit
5	VSS	GND
6	RESETB	Reset signal (Lo-active)
7	CSB	Chip selection signal（Lo：Select, Hi：Unselect）
8	RS	Register selection signal（Lo:command, Hi:parameter / Display data）
9	WRB	Write signal
10	VSS	GND
11	D0	Data I/O
12	D1	Data I/O
13	D2	Data I/O
14	D3	Data I/O
15	D4	Data I/O
16	D5	Data I/O
17	D6	Data I/O
18	D7	Data I/O
19	D8	Data I/O
20	D9	Data I/O
21	D10	Data I/O
22	D11	Data I/O
23	D12	Data I/O
24	D13	Data I/O
25	D14	Data I/O
26	D15	Data I/O
27	D16	Data I/O
28	D17	Data I/O
29	VSS	GND
30	BS0	Interface mode setting terminal
31	BS1	Interface mode setting terminal
32	RDB	Read signal
33	NC	OPEN
34	NC	OPEN
35	NC	OPEN
36	NC	OPEN
37	TE	Synchronization signal output
38	BLH	LED drive power source. (Anode side)
39	BLL	LED drive power source. (Cathode side)

Note :

- Recommended connector : Hirose FH23 series "FH23-39S-0.3SHW(05) "
- In the circuit design, the terminal array of connector for use with terminal sequence of the "3.2 Outward Form", please be sure to check.
  If the array of the signal input to the product is different, it may cause a malfunction.
- FPC of the terminal has been decorated with gold-plated.
  Connector contact terminals is recommended the use of gold-plated products.
- Interface mode setting terminals are fixed as follows on the FPC.
  BS2=GND

5. Absolute Maximum Rating

VSS=0V

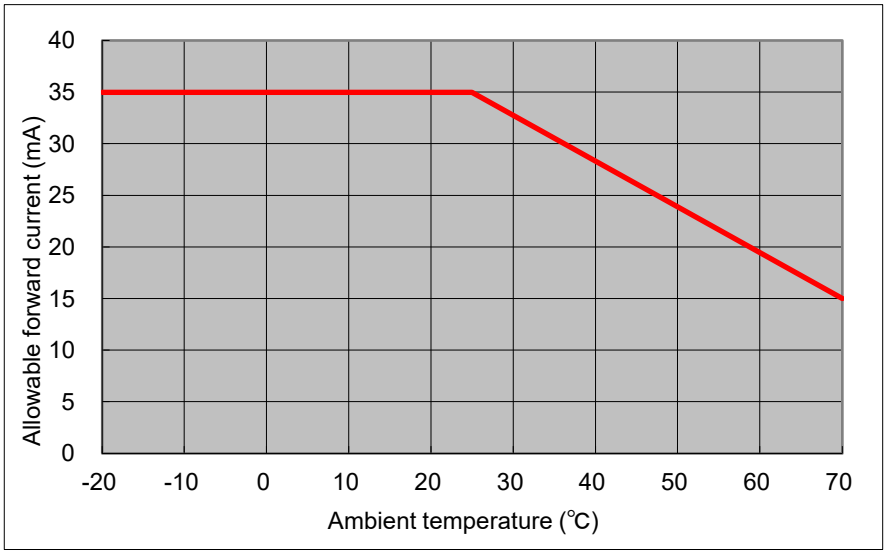
Item	Symbol	Condition	Rating		Unit	Applicable terminal
			MIN	MAX		
Supply voltage	VCI		-0.3	4.6	V	VCI
Supply voltage	IOVCC		-0.3	VCI	V	IOVCC
Input voltage for logic	VI		-0.3	IOVCC+0.3	V	RESETB,CSB,RS,WRB,D0-D17, BS0,BS1,RDB
LED Forward current	IL	Ta=25°C	—	35.0	mA	BLH - BLL
		Ta=70°C	—	15.0		
Storage temperature range	Tstg		-30	80	°C	
Storage atmospheruc range	Hstg	40°C90%RH or less of moisture content with no condensation				

6. Recommended Operating Conditions

VSS=0V

Item	Symbol	Condition	Rating			Unit	Applicable terminal
			MIN	TYP	MAX		
Supply voltage	VCI		2.6	2.7	3.6	V	VCI
Supply voltage	IOVCC		1.65	VCI	VCI	V	IOVCC
Input voltage for logic	VI		0	—	IOVCC	V	RESETB,CSB,RS,WRB, D0-D17,BS0,BS1,RDB
Operational temperature range	Top	*note	-20	25	70	°C	LCD Panel surface temperature
Operating humidity range	Hop	Ta≦40°C	20	—	85	%	
		Ta> 40°C	40°C85%RH or less of moisture content with no condensation				

note： The maximum value of LED Forward current "IL", do not exceed the following allowable current value.



7. Electrical Characteristics

7.1 DC Characteristics

7.1.1 Display section

(Unless otherwise noted, Ta=25°C,VCI=2.7V,IOVCC=2.7V,VSS=0V)

Item	Symbol	Condition	Rating			Unit	Applicable terminal
			MIN	TYP	MAX		
Input Signal Voltage	VIH		0.7×IOVCC	—	IOVCC	V	RESETB,CSB,RS,WRB,
	VIL		0	—	0.3×IOVCC	V	D0-D17,BS0,BS1,RDB
Output Signal Voltage	VOH	IOH = -0.1mA	0.8×IOVCC	—	—	V	D0-D17,TE
	VOL	IOL = 0.1mA	—	—	0.2×IOVCC	V	
Operating Current	ICI	BS0=0	—	5.9	11.8	mA	VCI
	IOICC	Color bar *note	—	2	10	μA	IOVCC
		BS0=1	—	30	60	μA	
Standby Current	ICI	BS=0	—	6	30	uA	VCI
	IOICC	Other input with constant voltage	—	2	10	uA	IOVCC
		BS0=1	—	30	60	uA	

note : CPU is not accessing the display RAM, still image display state (Color bar display)

7.1.2 Backlight section

Item	Symbol	Condition	Rating			Unit	Applicable terminal
			MIN	TYP	MAX		
Forward current	IL25	Ta=25°C	—	7.5	35.0	mA	BLH - BLL
	IL70	Ta=70°C	—	—	15.0	mA	
Forward voltage	VL	Ta=25°C, IL=7.5mA	—	5.4	5.6	V	
Estimated Life of LED	LL	Ta=25°C, IL=7.5mA Note	—	50,000	—	hrs	

note :

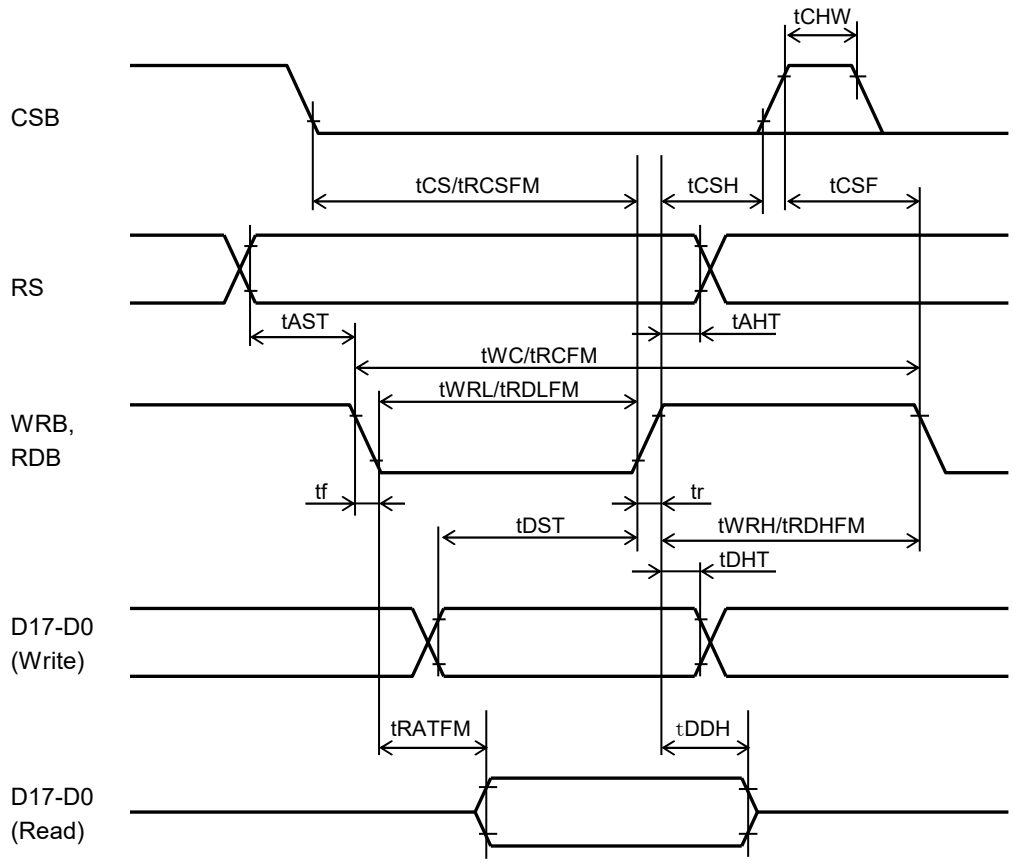
- The lifetime of the LED is defined as a period till the brightness of the LED decreases to the half of its initial value.
- This figure is given as a reference purpose only, and not as a guarantee.
- This figure is estimated for an LED operating alone.
  As the performance of an LED may differ when assembled as a monitor.
- Estimated lifetime could vary on a different temperature and usually higher temperature could reduce the life significantly.

7.2 AC Characteristics

(Unless otherwise noted, Ta=25°C,VCI=2.7V,IOVCC=2.7V,VSS=0V)

Item	Symbol	Condition	Rating		Unit
			MIN	MAX	
Address setup time	tAST	RS	0	-	ns
Address hold time	tAHT	RS	10	-	ns
CSB "High" level pulse width	tCHW	CSB	0	-	ns
CSB setup time	tCS	CSB-WRB	15	-	ns
	tRCSFM	CSB-RDB	355	-	ns
CSB wait time	tCSF	CSB	10	-	ns
CSB hold time	tCSH	CSB	10	-	ns
WRB bus cycle time	tWC	WRB	66	-	ns
WRB "High" level pulse width	tWRH	WRB	15	-	ns
WRB "Low" level pulse width	tWRL	WRB	15	-	ns
RDB bus cycle time	tRCFM	RDR	450	-	ns
RDB "High" level pulse width	tRDHFM	RDR	90	-	ns
RDB "Low" level pulse width	tRDLFM	RDR	355	-	ns
WRB data setup time	tDST	D17-D0	10	-	ns
WRB data hold time	tDHT	D17-D0	10	-	ns
RDB data delay time	tRATFM	D17-D0	-	340	ns
RDB output disable time	tDDH	D17-D0	20	80	ns
Input signal rise time	tr		-	15	ns
Input signal fall time	tf		-	15	ns

All timing is defined as the reference to the 30-70% of IOVCC.



8. Interface

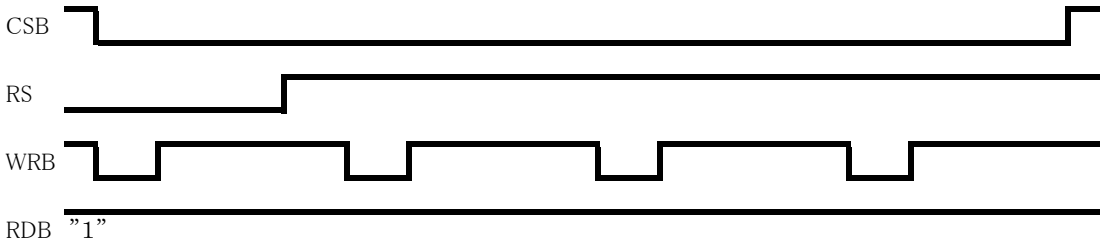
8.1 Interface

	Command /Parameter writing	Display RAM writing		
		CPU		
Data width		18bit	16bit	8bit
Transfer method		18	16	6+6+6
1 pixel data		18	16	18
BS1	*	H	L	H
BS0	*	L	L	H
R3Ah (Pixel Format)		06h	05h	06h
RB0h (RAM control Para2)		E0h	E0h	E1h

D17		R5				
D16		R4				
D15		R3	R5			
D14		R2	R4			
D13		R1	R3			
D12		R0	R2			
D11		G5	R1			
D10		G4	G5			
D9		G3	G4			
D8		G2	G3			
D7	ID7	G1	G2	R5	G5	B5
D6	ID6	G0	G1	R4	G4	B4
D5	ID5	B5	G0	R3	G3	B3
D4	ID4	B4	B5	R2	G2	B2
D3	ID3	B3	B4	R1	G1	B1
D2	ID2	B2	B3	R0	G0	B0
D1	ID1	B1	B2			
D0	ID0	B0	B1			

note - When swiching the interface, it is necessary to change the BS PIN and register settings.
- Unused terminal "D0～D17" should be connected to VSS.

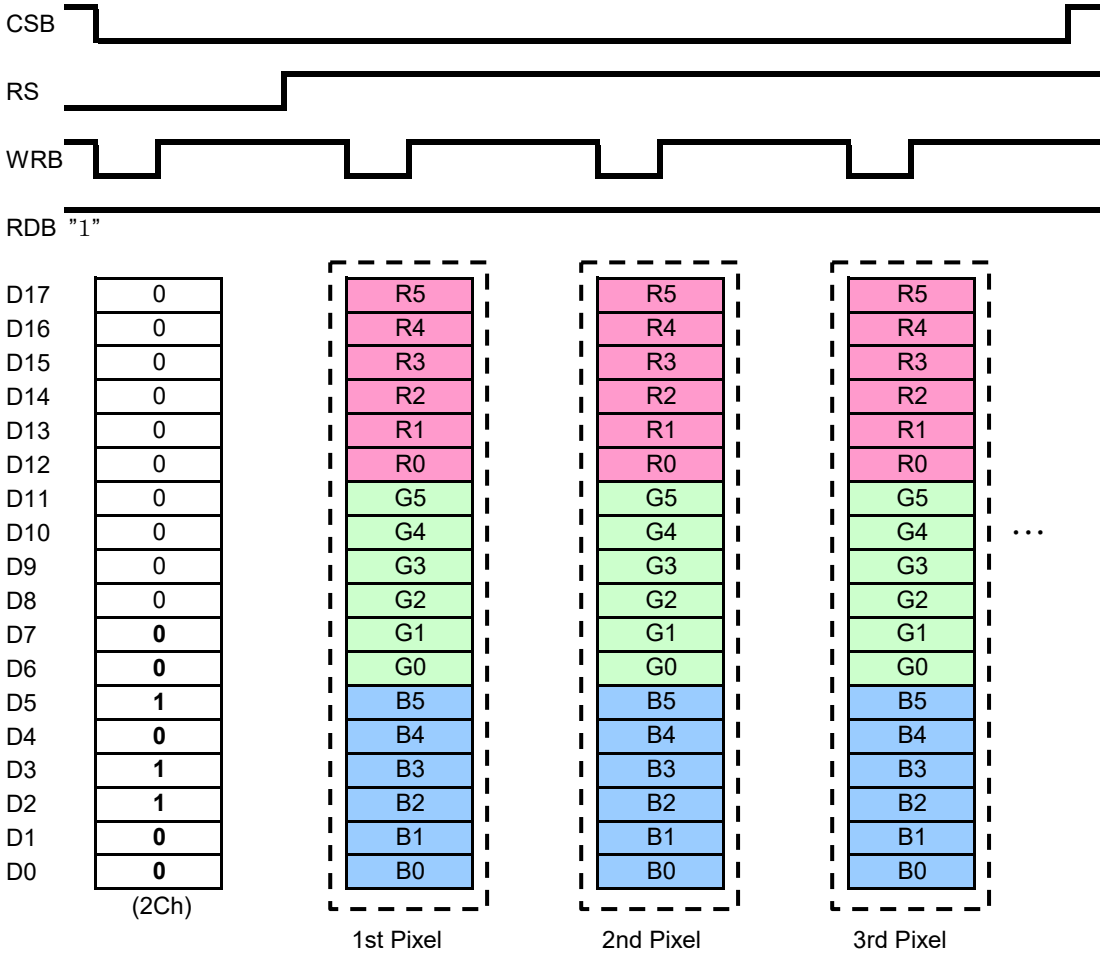
8.2 Command transfer



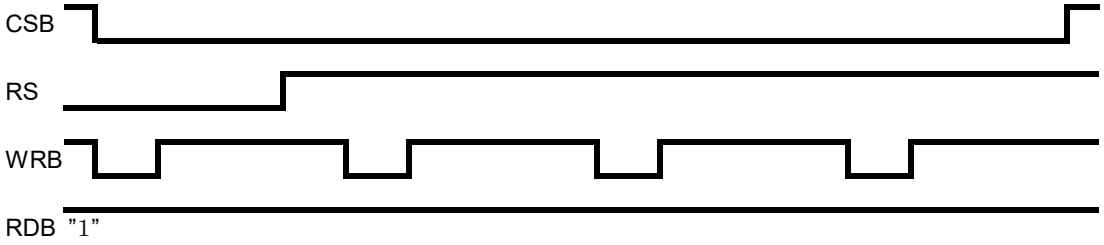
	Command	Parameter1	Parameter2	Parameter3	
D17	*	*	*	*	
D16	*	*	*	*	
D15	*	*	*	*	
D14	*	*	*	*	
D13	*	*	*	*	
D12	*	*	*	*	
D11	*	*	*	*	
D10	*	*	*	*	...
D9	*	*	*	*	
D8	*	*	*	*	
D7	ID7	ID7	ID7	ID7	
D6	ID6	ID6	ID6	ID6	
D5	ID5	ID5	ID5	ID5	
D4	ID4	ID4	ID4	ID4	
D3	ID3	ID3	ID3	ID3	
D2	ID2	ID2	ID2	ID2	
D1	ID1	ID1	ID1	ID1	
D0	ID0	ID0	ID0	ID0	

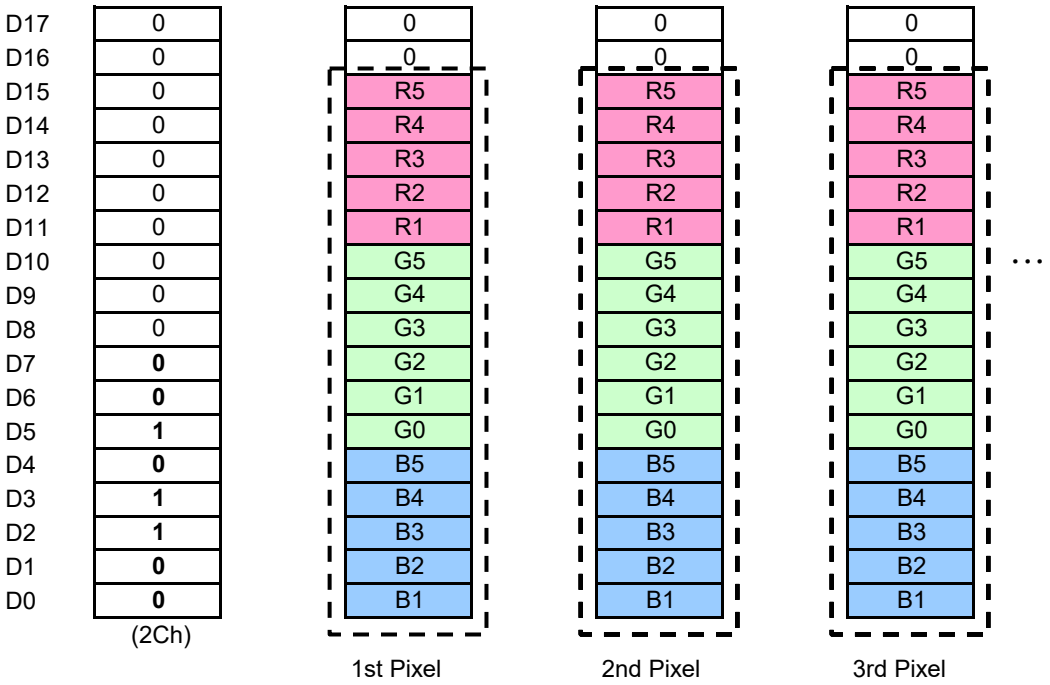
8.3 Data transfer

8.3.1 262k Display (18bpp) (R3Ah = 06h, RB0h para2 = E0h)

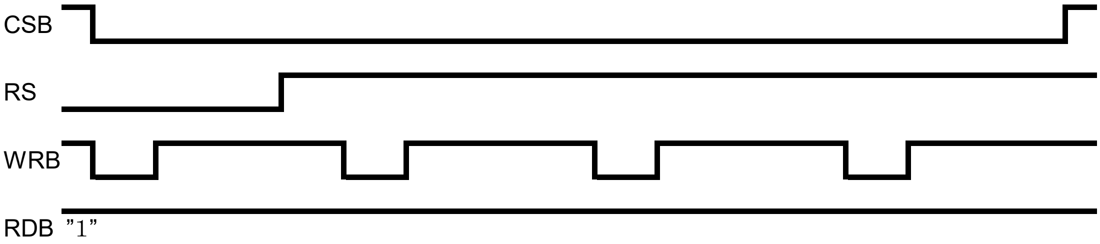


8.3.2 65k Display (16bpp) (R3Ah = 05h, RB0h para2 = E0h)





8.3.3 262k Display (18bpp) (R3Ah = 06h, RB0h para2 = E1h))



	(2Ch)	1Pixel / 3 times transfer			
D17	0	0	0	0	
D16	0	0	0	0	
D15	0	0	0	0	
D14	0	0	0	0	
D13	0	0	0	0	
D12	0	0	0	0	
D11	0	0	0	0	
D10	0	0	0	0	…
D9	0	0	0	0	
D8	0	0	0	0	
D7	**0**	R5	G5	B5	
D6	**0**	R4	G4	B4	
D5	**1**	R3	G3	B3	
D4	**0**	R2	G2	B2	
D3	**1**	R1	G1	B1	
D2	**1**	R0	G0	B0	
D1	**0**	0	0	0	
D0	**0**	0	0	0	

9. Sequence

9.1 Power ON Sequence (1/2)

No.		RS	ID[7:0]	Remarks
	VCI/IOVCC ON			
	RESETB High			RESETB High can be omitted
	RESETB High → Low	RESETB Low		
	Wait 10 usec or more			
	RESETB Low → High			
	Wait 120 msec or more			
1	Sleep Out	0	11 h	
	Wait 120 msec or more			
2	Memory access control	0	36 h	
	para 1	1	00 h	MX=MY=0
3	LCM Control	0	C0 h	
	para 1	1	3C h	XINV=XMV=XMX=XBGR=1
4	Pixel format	0	3A h	
	para 1	1	05 h	05h:65k,06h:262k
5	CMD2EN	0	DF h	
	para 1	1	5A h	
	para 2	1	69 h	
	para 3	1	02 h	
	para 4	1	01 h	Command2 enable
6	GATECTRL 1	0	E4 h	
	para 1	1	27 h	NL=320
	para 2	1	00 h	SCN=G0
	para 3	1	10 h	TMG=1,SM=GS=0
7	GATECTRL 2	0	B7 h	
	para 1	1	75 h	VGH=14.9,VGL=-10.4
8	VCOMS setting	0	BB h	
	para 1	1	20 h	Δv=0.9typ
9	VAP/VAN signal	0	D2 h	
	para 1	1	4C h	
10	VRH set	0	C3 h	
	para 1	1	17 h	VAP=4.7+
11	Frame rate	0	C6 h	
	para 1	1	EF h	Column inversion,60Hz
12	Power control 1	0	D0 h	
	para 1	1	A4 h	
	para 2	1	A1 h	
13	Positive gamma	0	E0 h	
	para 1	1	F0 h	
	para 2	1	04 h	
	para 3	1	0B h	
	para 4	1	11 h	
	para 5	1	10 h	
	para 6	1	1B h	
	para 7	1	2F h	
	para 8	1	33 h	
	para 9	1	40 h	
	para 10	1	27 h	
	para 11	1	17 h	
	para 12	1	14 h	
	para 13	1	19 h	
	para 14	1	23 h	
	Wait 10 msec or more			

(2/2)

No.		RS	ID[7:0]	Remarks
14	Negative gamma	0	E1 h	
	para 1	1	F0 h	
	para 2	1	04 h	
	para 3	1	0B h	
	para 4	1	11 h	
	para 5	1	10 h	
	para 6	1	1B h	
	para 7	1	2F h	
	para 8	1	33 h	
	para 9	1	40 h	
	para 10	1	27 h	
	para 11	1	17 h	
	para 12	1	14 h	
	para 13	1	19 h	
	para 14	1	23 h	
	Wait 10 msec or more			
15	Equalize control	0	E9 h	
	para 1	1	08 h	
	para 2	1	08 h	
	para 3	1	00 h	
16	RGB interface control	0	B1 h	
	para 1	1	00 h	
	para 2	1	04 h	
	para 3	1	14 h	
17	RAM Control	0	B0 h	
	para 1	1	00 h	RM=0,DM=00:CPU interface
	para 2	1	E0h / E1 h	When Data with 8bit, set "E1h".
18	CA SET	0	2A h	
	para 1	1	00 h	XS[15:8]
	para 2	1	00 h	XS[7:0]
	para 3	1	00 h	XE[15:8]
	para 4	1	EF h	XE[7:0]
19	RA SET	0	2B h	
	para 1	1	00 h	YS[15:8]
	para 2	1	00 h	YS[7:0]
	para 3	1	01 h	YE[15:8]
	para 4	1	3F h	YE[7:0]
20	GT ADJ	0	B8 h	
	para 1	1	2A h	
	para 2	1	2B h	
	para 3	1	14 h	
	para 4	1	F5 h	
21	Tearing Effect On	0	35 h	
	para 1	1	00 h	TEM = 0
22	RAMWR	0	2C h	
	data 1	1	**** h	write data
	data 2	1	**** h	write data
	....	...	.... h	
	data n	1	**** h	write data
	wait 10 msec or more			
23	Display ON	0	29 h	
	wait 10 msec or more			
24	Backlight ON			

9.2 Sleep IN Sequence

No.		RS	ID[7:0]	Remarks
1	Backlight OFF			
2	Display OFF	0	28 h	
	Wait 10 msec or more			
3	Sleep In	0	10 h	

9.3 Sleep OUT Sequence

No.		RS	ID[7:0]	Remarks
1	Sleep Out	0	11 h	
	Wait 120 msec or more			
2	Display ON	0	29 h	
	Wait 50 msec or more			
3	Backlight ON			

9.4 Power OFF Sequence

No.		RS	ID[7:0]	Remarks
1	Backlight OFF			
2	Display OFF	0	28 h	
	Wait 10 msec or more			
3	Sleep In	0	10 h	
	Wait 120 msec or more			
4	RESETB High → Low			
5	VCI/IOVCC OFF			

9.5 Refresh Sequence

(1/2)

No.		RS	ID[7:0]	Remarks
1	Sleep Out	0	11 h	
	Wait 120 msec or more			
2	Memory access control	0	36 h	
	para 1	1	00 h	MX=MY=0
3	LCM Control	0	C0 h	
	para 1	1	3C h	XINV=XMV=XMX=XBGR=1
4	Pixel format	0	3A h	
	para 1	1	05 h	05h:65k,06h:262k
5	CMD2EN	0	DF h	
	para 1	1	5A h	
	para 2	1	69 h	
	para 3	1	02 h	
	para 4	1	01 h	Command2 enable
6	GATECTRL 1	0	E4 h	
	para 1	1	27 h	NL=320
	para 2	1	00 h	SCN=G0
	para 3	1	10 h	TMG=1,SM=GS=0
7	GATECTRL 2	0	B7 h	
	para 1	1	75 h	VGH=14.9,VGL=-10.4
8	VCOMS setting	0	BB h	
	para 1	1	20 h	Δv=0.9typ
9	VAP/VAN signal	0	D2 h	
	para 1	1	4C h	
10	VRH set	0	C3 h	
	para 1	1	17 h	VAP=4.7+
11	Frame rate	0	C6 h	
	para 1	1	EF h	Column inversion,60Hz
12	Power control 1	0	D0 h	
	para 1	1	A4 h	
	para 2	1	A1 h	
13	Positive gamma	0	E0 h	
	para 1	1	F0 h	
	para 2	1	04 h	
	para 3	1	0B h	
	para 4	1	11 h	
	para 5	1	10 h	
	para 6	1	1B h	
	para 7	1	2F h	
	para 8	1	33 h	
	para 9	1	40 h	
	para 10	1	27 h	
	para 11	1	17 h	
	para 12	1	14 h	
	para 13	1	19 h	
	para 14	1	23 h	
	Wait 10 msec or more			

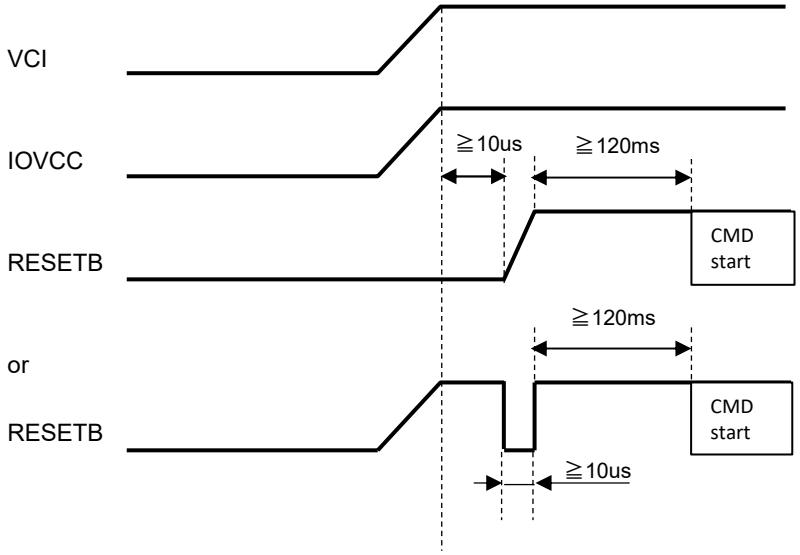
(2/2)

No.		RS	ID[7:0]	Remarks
14	Negative gamma	0	E1 h	
	para 1	1	F0 h	
	para 2	1	04 h	
	para 3	1	0B h	
	para 4	1	11 h	
	para 5	1	10 h	
	para 6	1	1B h	
	para 7	1	2F h	
	para 8	1	33 h	
	para 9	1	40 h	
	para 10	1	27 h	
	para 11	1	17 h	
	para 12	1	14 h	
	para 13	1	19 h	
	para 14	1	23 h	
	Wait 10 msec or more			
15	Equalize control	0	E9 h	
	para 1	1	08 h	
	para 2	1	08 h	
	para 3	1	00 h	
16	RGB interface control	0	B1 h	
	para 1	1	00 h	
	para 2	1	04 h	
	para 3	1	14 h	
17	RAM Control	0	B0 h	
	para 1	1	00 h	RM=0,DM=00:CPU interface
	para 2	1	E0h / E1 h	When Data with 8bit, set "E1h".
18	CA SET	0	2A h	
	para 1	1	00 h	XS[15:8]
	para 2	1	00 h	XS[7:0]
	para 3	1	00 h	XE[15:8]
	para 4	1	EF h	XE[7:0]
19	RA SET	0	2B h	
	para 1	1	00 h	YS[15:8]
	para 2	1	00 h	YS[7:0]
	para 3	1	01 h	YE[15:8]
	para 4	1	3F h	YE[7:0]
20	GT ADJ	0	B8 h	
	para 1	1	2A h	
	para 2	1	2B h	
	para 3	1	14 h	
	para 4	1	F5 h	
21	Tearing Effect On	0	35 h	
	para 1	1	00 h	TEM = 0
22	RAMWR	0	2C h	
	data 1	1	**** h	write data
	data 2	1	**** h	write data
	....	...	.... h	
	data n	1	**** h	write data
	wait 10 msec or more			
23	Display ON	0	29 h	
	wait 10 msec or more			

9.6 Power ON/OFF timing

Power Supply ON Sequence

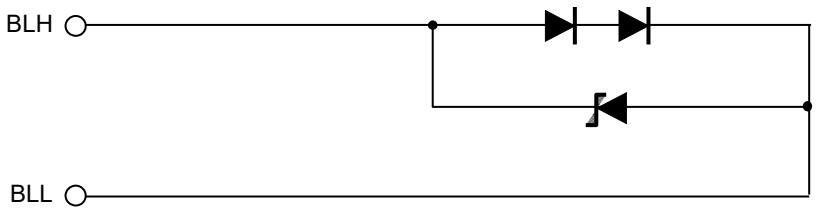
We recommend that you supplied at the same time VCI and IOVCC.
However, there is no problem even if the supply IOVCC later than VCI.
Please release the reset from at least 10us after each power supply.



Power Supply OFF Sequence

We recommend that you removed at the same time VCI and IOVCC.
However, there is no problem even if IOVCC OFF faster than VCI .

10. LED Circuit



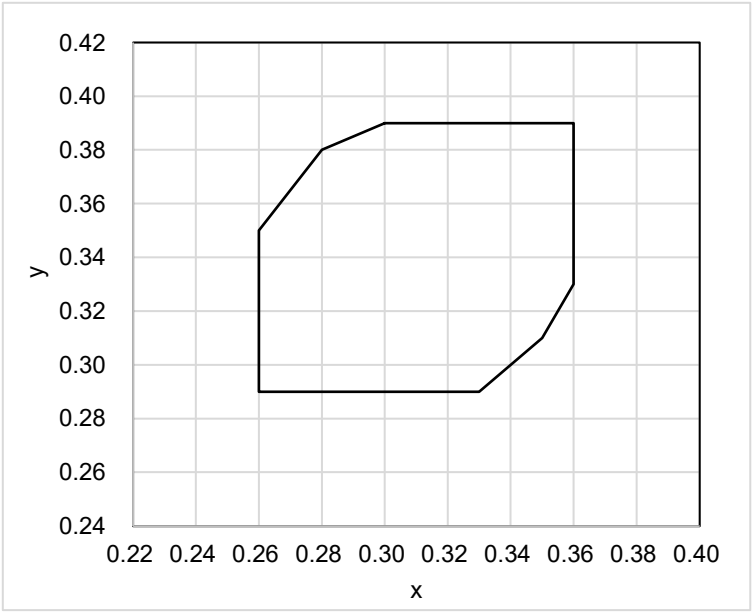
11. Characteristics

11.1 Optical Characteristics

(Measurement Condition)
Measuring instruments: CS2000 (KONICA MINOLTA), LCD7200 (OTSUKA ELECTRONICS), EZcontrastXL88 (ELDIM)
Driving condition: VCI=IOVCC=2.7V, VSS=0V, Optimized VCOMDC
Backlight: IL= 7.5 mA
Measured temperature: Ta = 25°C

Item		Symbol	Condition	MIN	TYP	MAX	Unit	Note №	Remark
Response time	Rise time + Fall time	TON + TOFF	[Data]= 00h← → 3Fh	-	-	100	ms	1	
Contrast ratio	Backlight ON	CR	[Data]= 3Fh / 00h	400	800	-		2	
	Backlight OFF			-	2.0	-			
Viewing angle	Left	θL	[Data]= 3Fh / 00h CR ≧ 10	80	-	-	deg	3	
	Right	θR		80	-	-	deg		
	Up	φU		80	-	-	deg		
	Down	φD		80	-	-	deg		
White Chromaticity		x	[Data]= 3Fh	White chromaticity range				4	
		y							
Center Brightness			[Data]= 3Fh	210	300	-	cd/㎡	5	
Brightness distribution			[Data]= 3Fh	70	-	-	%	6	
Burn-in				No noticeable burn-in image shall be observed after 2 hours of window pattern display.				7	

* Note number 1 to 7: Refer to the APPENDIX of "Reference Method for Measuring Optical Characteristics and Performance".



White Chromaticity Range

(White Chromaticity Range)

x	y
0.30	0.39
0.28	0.38
0.26	0.35
0.26	0.29
0.33	0.29
0.35	0.31
0.36	0.33
0.36	0.39

11.2 Temperature Characteristics

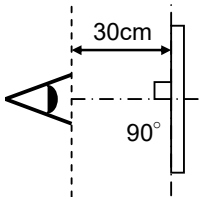
(Measurement Condition)
Measuring instruments: CS2000 (KONICA MINOLTA), LCD7200 (OTSUKA ELECTRONICS)
Driving condition: VCI=IOVCC=2.7V, VSS=0V, Optimized VCOMDC
Backlight: IL= 7.5 mA

Item		Symbol	Specification		Remark
			Ta = -20 °C	Ta = 70 °C	
Response time	Rise time + Fall time	TON + TOFF	1000 msec or less	80 msec or less	
Contrast ratio		CR	200 or more	200 or more	Backlight ON
Display Quality			No noticeable display defect or ununiformity should be observed.		

12. Criteria of Judgment

12.1 Defective Display and Screen Quality

Test Condition: Observed TFT-LCD monitor from front during operation with the following conditions
Driving Signal: Raster Patter (RGB, white, black)
Signal condition: [Data]:00h, 28h, 3Fh (3steps)
Observation distance: 30 cm
Illuminance: 200 to 350 lx
Backlight: IL=7.5mA



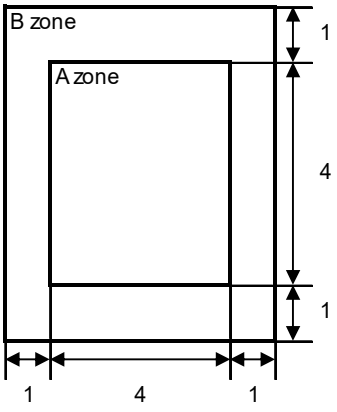
Defect item		Defect content		Criteria
Display Quality	Line defect	Black, white or color line, 3 or more neighboring defective dots		Not exists
	Dot defect	Uneven brightness on dot-by-dot base due to defective TFT or CF, or dust is counted as dot defect (brighter dot, darker dot) High bright dot: Visible through 2% ND filter at [Data]=00h Low bright dot: Visible through 5% ND filter at [Data]=00h Dark dot: Appear dark through white display at [Data]=28h		Refer to table 1
		Invisible through 5% ND filter at [Data]=00h		Acceptable
Screen Quality	Stain	Uneven brightness (white stain, black stain etc)		Invisible through 5% ND filter at Black screen. Invisible through 1% ND filter at other screen.
	Foreign particle	Point-like	0.25mm< φ	N=0
			0.20mm< φ ≦0.25mm	N≦2
			φ ≦0.20mm	Acceptable
		Liner	3.0mm < L and 0.08mm < W	N=0
			L ≦ 3.0mm or W ≦ 0.08mm	Acceptable
	Others			Use boundary sample for judgment when necessary

* φ (mm): Average diameter = (major axis + minor axis) / 2, W (mm): Width, L (mm): Length, N: Permissible number

Table1

Area	High bright dot	Low bright dot	Dark dot	Total	Criteria
A	0	2	2	3	Permissible distance between same color bright dots (includes neighboring dots): 3 mm or more
B	2	4	4	5	Permissible distance between same color high bright dots (includes neighboring dots): 5 mm or more
Total	2	4	4	5	

<Portrait model>



Division of A and B areas
B area: Active area
Dimensional ratio between A and B areas: 1: 4: 1
(Refer to the left figure)

12.2 Screen and Other Appearance

Testing conditions
Observation distance: 30 cm
Illuminance: 1200 ～ 2000 lx

Item		Criteria	Remark
Polarizer	Flaw Stain Dirt Bubble Dust Dent	Ignore invisible defect when the backlight is on.	Applicable area: Active area only (Refer to the section 3.2 Outward Form)
S case		No functional defect occurs	
FPC		No functional defect occurs	

C

13. Reliability Test

Test item		Test condition		number of failures / number of examinations
Durability test	High temperature storage	Ta = 80°C	240hrs	0 / 3
	Low temperature storage	Ta = -30°C	240hrs	0 / 3
	High temperature & high humidity storage	Ta = 60°C, RH = 90%, non condensing ※	240hrs	0 / 3
	High temperature operation	Tp = 70°C	240hrs	0 / 3
	Low temperature operation	Tp = -20°C	240hrs	0 / 3
	High temperature & high humidity operation	Tp = 40°C, RH = 90%, non condensing ※	240hrs	0 / 3
	Thermal shock storage	-30°C ↔ 80°C (30min / 30min)	100cycles	0 / 3
	Lightfastness	Xenon Blackpanel 63±3°C non-shower 450W/㎡(300～700nm) non-operating Integral dose 800MJ/㎡		0 / 3
Mechanical environmental test	Electrostatic discharge test (Non operation)	Confirms to EIAJ ED-4701/300, C=200pF,R=0Ω,V=±200V Each 3 times of discharge on and power supply and other terminals.		0 / 3
	Surface discharge test (Non operation)	C=250pF, R=100Ω, V=±12kV Each 5 times of discharge in both polarities on the center of screen with the case grounded.		0 / 3
	Vibration test	Total amplitude 1.5mm, f=10～55Hz, X,Y,Z directions for each 2 hours		0 / 3
	Impact test	Use TOPPAN original jig (see next page) and make an impact with peak acceleration of 1000m/s^2 for 6 msec with half sine-curve at 3 times to each X, Y, Z directions in conformance with JIS C 60068-2-27-2011.		0 / 3
Packing test	Packing vibration-proof test	Acceleration of 19.6m/s^2 with frequency of 10→55→10Hz, X,Y, Zdirection for each 30 minutes.		0 / 1 packing
	Packing drop test	Drop from 75cm high. 1 time to each 6 surfaces, 3 edges, 1 corner		0 / 1 packing

Note:Ta=ambient temperature Tp=Panel temperature

※ The profile of high temperature/humidity storage and High Temperature/humidity operation
(Pure water of over 10MΩ･cm shall be used.)

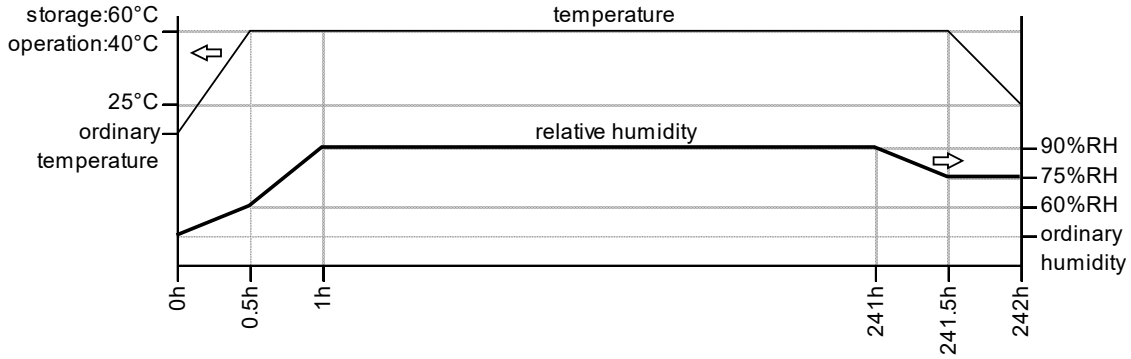
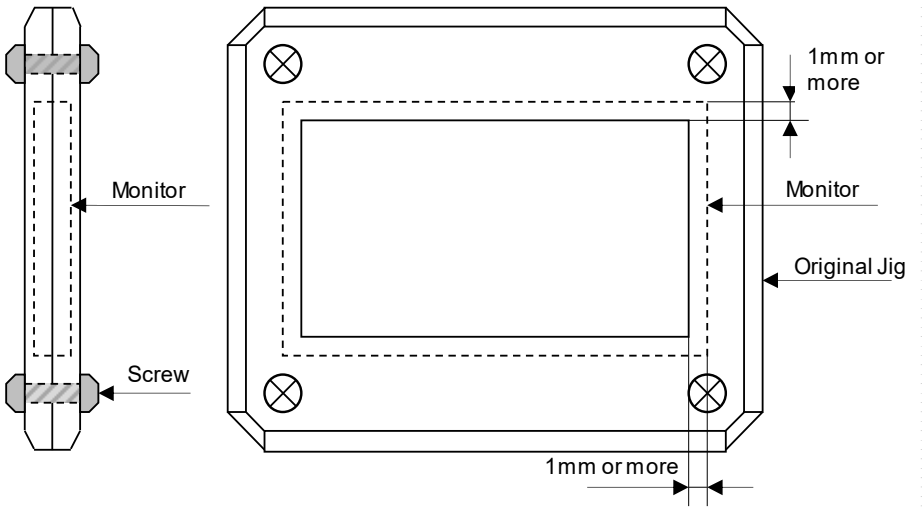


Table2. Reliability Criteria

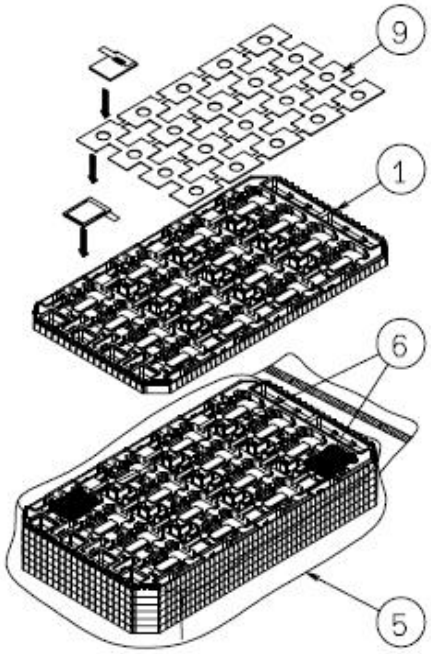
The parameters should be measured after leaving the monitor at the ordinary temperature for 24 hours or more after the test completion.

Item	Standard	Remark
Display quality	No visible abnormality shall be seen. (Except for unevenness by Pol deterioration.)	
Contrast ratio	200 or more	Backlight ON

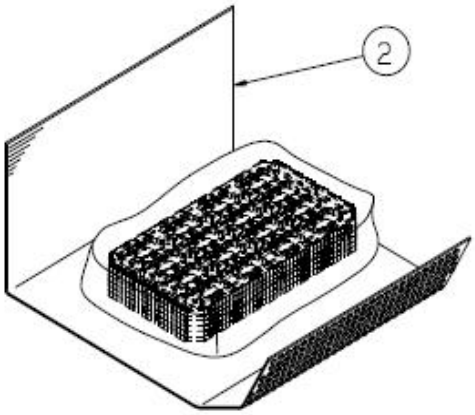
TOPPAN Original Jig

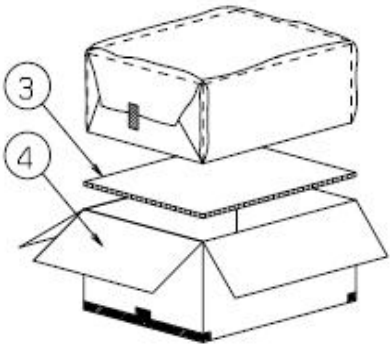


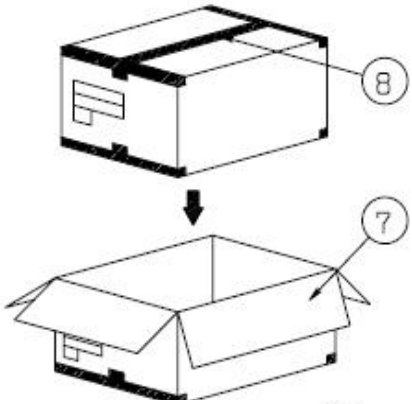
14. Packing Specifications

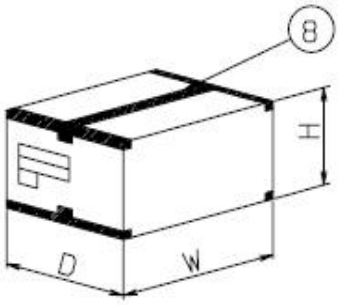


Step1. ・Each lower products are to be placed in one of the cut-outs of the tray with the LCD surface facing upward, and foam-sheet is put on products.
・Upper products are to be placed with the LCD surface facing downward.
Step2. ・Trays be in a stack of 5.
・One empty tray is to be put on the top of stack of 5 packed trays.
Step3. ・2 packs of moisture absorbers are to be placed on the top tray as shown in the drawing.
・Put piled trays into a sealing bag.
Step4. ・Vacuum and seal the sealing bag with the vacuum sealing machine.
Step5. ・The piled trays are to be wrapped with a bubble cushioning sheet., and to be fixed with adhesive tape.
Step6. ・A corrugated board is to be placed in the bottom of an outer carton.
・The wrapped trays are to be put on the corrugated board in the outer carton.
Step7. ・The outer carton is to be sealed in H-shape with packing tape as shown in the drawing.
・The model number, quantity of products, and shipping date are to be printed on the 2 opposite sides of the outer carton with black ink.
・In necessary, shipping labels or impression markings are to be put on the outer carton.
Step8. ・The outer carton is to be inserted into a extra outer carton with same orientation.
・The extra outer carton is to be sealed H-shape with packing tape as shown in the drawing.
Step9. ・The model number, quantity of products, and shipping date are to be printed on the 2 opposite sides of the extra outer carton with black ink.
・In necessary, shipping labels or impression markings are to be put on the extra outer carton.









Packing item name		Spec.,Material
①	Tray	A-PET
②	B Sheet A	Anti-static air bubble sheet
③	Inner Board	Corrugated cardboard
④	Outer Carton	Corrugated cardboard
⑤	Sealing Bag	
⑥	Drier	Moisture absorber
⑦	Extra Outer Carton	Corrugated cardboard
⑧	Packing Tape	
⑨	Foam Sheet	Anti-static polyethylene

Dimension of extra outer carton	
D : Approx.	(337mm)
W: Approx.	(618mm)
H: Approx.	(179mm)
Quantity of products packed in one carton:	200
Gross weight : Approx.	5.4kg

15. Handling Instruction

15.1 Cautions for Handling LCD panels

⚠ Caution

(1) Do not make an impact on the LCD panel glass because it may break and you may get injured from it.

(2) If the glass breaks, do not touch it with bare hands.
（Fragment of broken glass may stick you or you cut yourself on it.

(3) If you get injured, receive adequate first aid and consult a medial doctor.

(4) Do not let liquid crystal get into your mouth.
（If the LCD panel glass breaks, try not let liquid crystal get into your mouth even toxic property of liquid crystal has not been confirmed.)

(5) If liquid crystal adheres, rinse it out thoroughly.
（If liquid crystal adheres to your cloth or skin, wipe it off with rubbing alcohol or wash it thoroughly with soap.
If liquid crystal gets into eyes, rinse it with clean water for at least 15 minutes and consult an eye doctor.

(6) If you scrap this products, follow a disposal standard of industrial waste that is legally valid in the community, country or territory where you reside.

(7) Do not connect or disconnect this product while its application products is powered on.

(8) Do not attempt to disassemble or modify this product as it is precision component.

(9) If a part of soldering part has been exposed, and avoid contact (short-circuit) with a metallic part of the case etc. about FPC of this model, please.
Please insulate it with the insulating tape etc. if necessary.
The defective operation is caused, and there is a possibility to generation of heat and the ignition.

(10) Since excess current protection circuit is not built in this TFT module, there is the possibility that LCD module or peripheral circuit become feverish and burned in case abnormal operation is generated.
We recommend you to add excess current protection circuit to power supply.

(11) The devices on the FPC are damageable to electrostatic discharge, because the terminals of the devices are exposed.
Wear grounded wrist-straps and use electrostatic neutralization blowers to prevent static charge and discharge when handling the TFT monitors.
Designate an appropriate operating area, and set equipment, tools, and machines properly when handling this product.

Caution

⚠ **This mark is used to indicate a precaution or an instruction which, if not correctly observed, may result in bodily injury, or material damages alone.**

15.2 Precautions for Handling

1) Wear finger tips at incoming inspection and for handling the TFT monitors to keep display quality and keep the working area clean.
Do not touch the surface of the monitor as it is easily scratched.

2) Wear grounded wrist-straps and use electrostatic neutralization blowers to prevent static charge and discharge when handling the TFT monitors as the LED in this TFT monitors is damageable to electrostatic discharge.
Designate an appropriate operating area, and set equipment, tools, and machines properly when handling this product.

3) Avoid strong mechanical shock including knocking, hitting or dropping to the TFT monitors for protecting their glass parts.
Do not use the TFT monitors that have been experienced dropping or strong mechanical shock.

4) Do not use or storage the TFT monitors at high temperature and high humidity environment.
Particularly, never use or storage the TFT monitors at a location where condensation builds up.

5) Avoid using and storing TFT monitors at a location where they are exposed to direct sunlight or ultraviolet rays to prevent the LCD panels from deterioration by ultraviolet rays.

6) Do not stain or damage the contacts of the FPC cable .
FPC cable needs to be inserted until it can reach to the end of connector slot.
During insertion, make sure to keep the cable in a horizontal position to avoid an oblique insertion.
Otherwise, it may cause poor contact or deteriorate reliability of the FPC cable.

7) The FPC cable is a design very weak to the bend and the pull as it is fixed with the tape.
Do not bend or pull the FPC cable or carry the TFT monitor by holding the FPC cable.

8) Peel off the protective film on the TFT monitors during mounting process.
Refer to the section 15.5 on how to peel off the protective film.
We are not responsible for electrostatic discharge failures or other defects occur when peeling off the protective film.

15.3 Precautions for Operation

1) Since this TFT monitors are not equipped with light shielding for the driver IC, do not expose the driver IC to strong lights during operation as it may cause functional failures.

2) In case of powering up or powering off this LCD module, be sure to comply the sequence as instructed in this specification.

3) Do not plug in or out the FPC cable while power supply is switch on.
Plug the FPC cable in and out while power supply is switched off.

4) Do not operate the TFT monitors in the strong magnetic field. It may break the TFT monitors.

5) Do not display a fixed image on the screen for a long time.
Use a screen-saver or other measures to avoid a fixed image displayed on the screen for a long time.
Otherwise, it may cause burn-in image on the screen due the characteristics of liquid crystal.

15.4 Storage Condition for Shipping Cartons

(Storage environment)

- Temperature: 0 to 40˚C
- Humidity: 60%RH or less
  No-condensing occurs under low temperature with high humidity condition.
- Atmosphere: No poisonous gas that can erode electronic components and/or wiring materials should be detected.
- Time period: 1 year
- Unpacking: To prevent damages caused by static electricity, anti-static precautionary measures (e.g. earthing, anti-static mat) should be implemented.
  After unpack, keep product in the appropriate condition, otherwise bubble seal of Protective film may be printed on Polarizer.
- Maximum piling up: 8 cartons (excluding the bottom)

*Conditions to storage after unpacking

(Storage environment)

- Temperature: 0 to 40˚C
- Humidity: 60%RH or less
  No-condensing occurs under low temperature with high humidity condition.
- Atmosphere: No poisonous gas that can erode electronic components and/or wiring materials should be detected.
- Time period: 1 year (Shelf life)
- Others: Keep/ store away from direct sunlight
  Storage goods on original tray made by TOPPAN.

15.5 Precautions for Peeling off the Protective film

The followings work environment and work method are recommended to prevent the TFT monitors from static damage or adhesion of dust when peeling off the protective films.

A) Work Environment

a) Humidity: 50 to 70 %RH, Temperature15 to 27˚C

b) Operators should wear conductive shoes, conductive clothes, conductive finger tips and grounded wrist-straps. Use an electrostatic neutralization blower.

c) Anti-static treatment should be implemented to work area's floor. Use a room shielded against outside dust with sticky floor mat laid at the entrance to eliminate dirt.

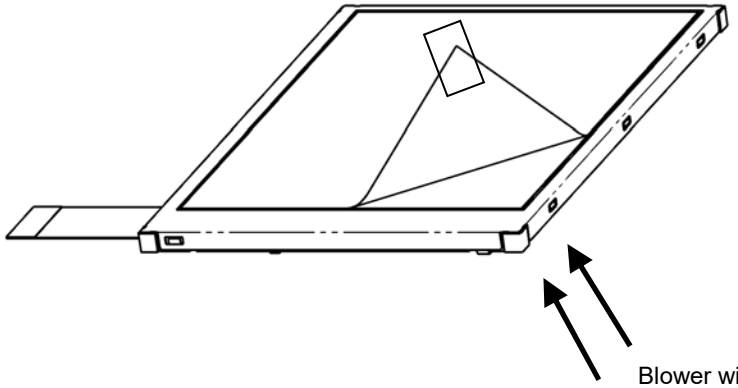
B) Work Method

The following procedures should taken to prevent the driver ICs from charging and discharging.

a) Use an electrostatic neutralization blower to blow air on the TFT monitors to its lower right when FPC is placed at the left. Optimize direction of the blowing air and the distance between the TFT monitors and the electrostatic neutralization blower.

b) Put an adhesive tape (Scotch tape, etc) at the lower right corner area of the protective film to prevent scratch on surface of TFT monitors.

c) Peel off the adhesive tape slowly (spending more than 2 secs to complete) by pulling it to opposite direction.



Blower wind direction
(Set an ion blower with its adequate conditions.)

15.6 Warranty

TOPPAN is only liable to defective goods which is stored and used under the condition complying with this specifications and returned within 1 (one) year.
Warranty caused by manufacturing defect shall be conducted by replacement of goods or refundment at unit price.

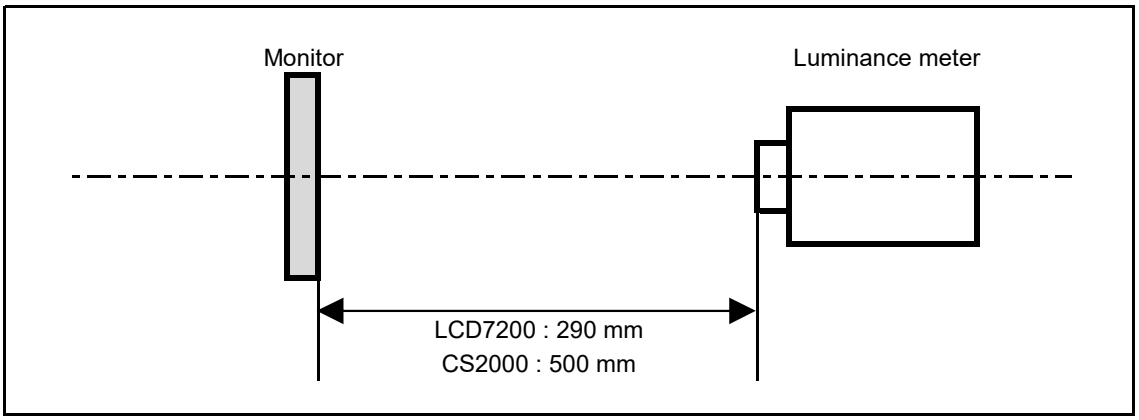
APPENDIX

Reference Method for Measuring Optical Characteristics and Performance

1. Measurement Condition (Backlight ON)

Measuring instruments: CS2000（KONICA MINOLTA）, LCD7200(OTSUKA ELECTRONICS）,EZcontrastXL88（ELDIM）
Driving condition: Refer to the section "Optical Characteristics"
Measured temperature: 25˚C unless specified
Measurement system: See the chart below. The luminance meter is placed on the normal line of measurement system.
Measurement point: At the center of the screen unless otherwise specified

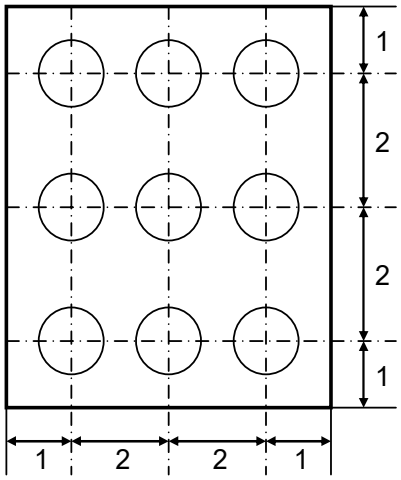
Dark box at constant temperature



*Measurement is made after 30 minutes of lighting of the backlight.

Measurement point: At the center point of the screen
Brightness distribution: 9 points shown in the following drawing.

<Portrait model>

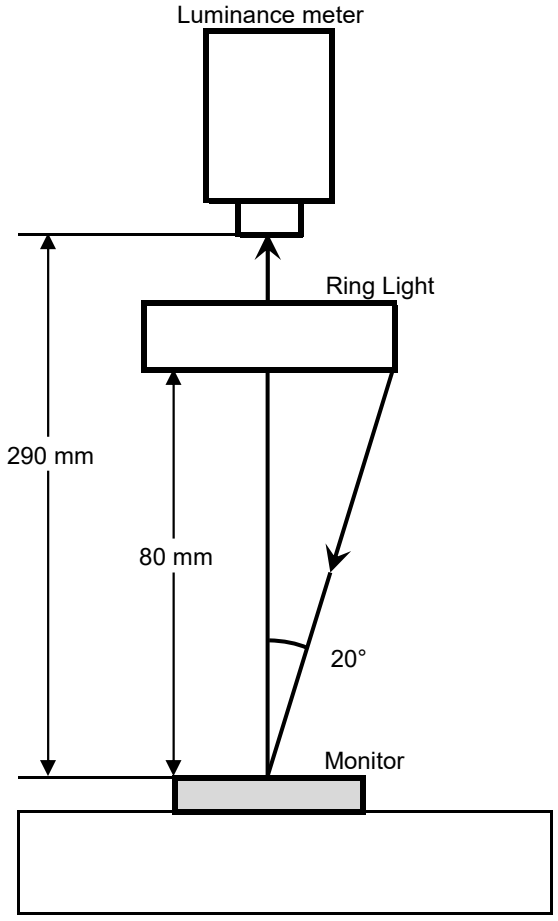


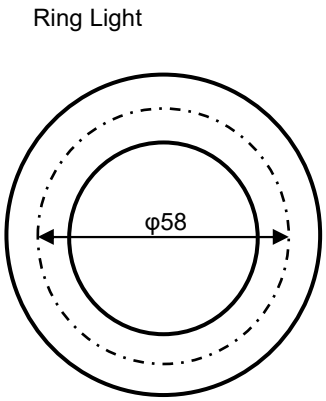
Dimensional ratio of active area

Backlight IL=7.5mA

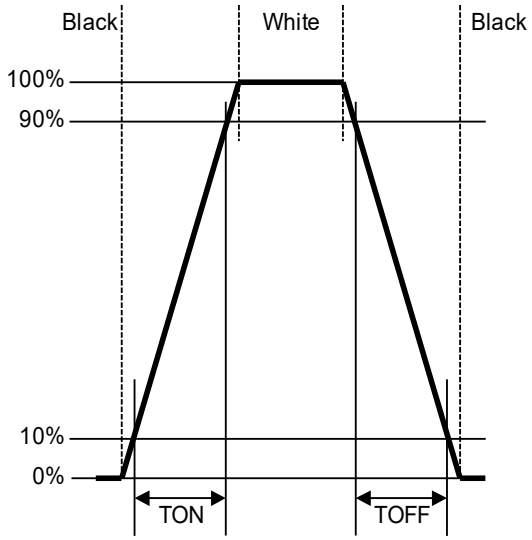
Measurement Condition (Contrast ratio Backlight OFF only)

Measuring instruments: LCD7200(OTSUKA ELECTRONICS), Ring Light (40,000 lx, φ58)
Driving condition: Refer to the section "Optical Characteristics"
Measured temperature: 25˚C unless specified
Measurement system: See the chart below.
Measurement point: At the center of the screen unless otherwise specified



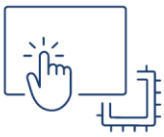


2. Test Method

Notice	Item	Test method	Measuring instrument	Remark
1	Response time	Measure output signal waveform by the luminance meter when raster of window pattern is changed from white to black and from black to white.  	LCD7200	Black display [Data]=00h White display [Data]=3Fh TON Rise time TOFF Fall time
2	Contrast ratio	Measure maximum luminance Y1([Data]=3Fh) and minimum luminance Y2([Data]=00h) at the center of the screen by displaying raster or window pattern. Then calculate the ratio between these two values. Contrast ratio = Y1/Y2 Diameter of measuring point: 7.8mmφ(CS2000) Diameter of measuring point: 3mmφ(LCD7200)	CS2000 LCD7200	Backlight ON Backlight OFF
3	Viewing angle Horizontalθ Verticalφ	Move the luminance meter from right to left and up and down and determine the angles where contrast ratio is 10.	EZcontrastXL88	
4	White chromaticity	Measure chromaticity coordinates x and y of CIE1931 colorimetric system at [Data] = 3Fh Color matching function: 2°view measurement angle: 1°	CS2000	
5	Center brightness	Measure the brightness at the center of the screen.	CS2000	
6	Brightness distribution	(Brightness distribution) = 100 x B/A % A : max. brightness of the 9 points B : min. brightness of the 9 points	CS2000	
7	Burn-in	Visually check burn-in image on the screen after 2 hours of "window display" ([Data]=00h/3Fh).		At optimized VCOMDC

DATA MODUL

Passion Displayed



All good things come in threes:

With **Hardware**, **Software** and **Services**, we realise unique display solutions that turn your ideas into reality.

www.data-modul.com