SPECIFICATIONS № 22TLM061	Issue:Oct.11,2022

> **This product is under development and specifications are subject to change.**

Specifications for

Blanview TFT-LCD Monitor (TENTATIVE)
(2.4" QVGA 240 x RGB x 320 Portrait)

Version 0.0
(Please be sure to check the specifications latest version.)

MODEL   COM24H2P96ULC

Customer's Approval

Signature :

Name :

Section :

Title :

Date :

ORTUSTECH

TOPPAN INC.
Electronics Division
Ortus Subdivision

Approved by

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Checked by

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Prepared by

_____

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Version History

Ver.	Date	Page		Description
0.0	Oct.11,2022	-	-	Tentative issue
0.0	Oct.11,2022	-	-	Tentative issue

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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

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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 Data : Paralell interface	
Backlight type	Long life & High bright white LED	
NTSC ratio	50%	
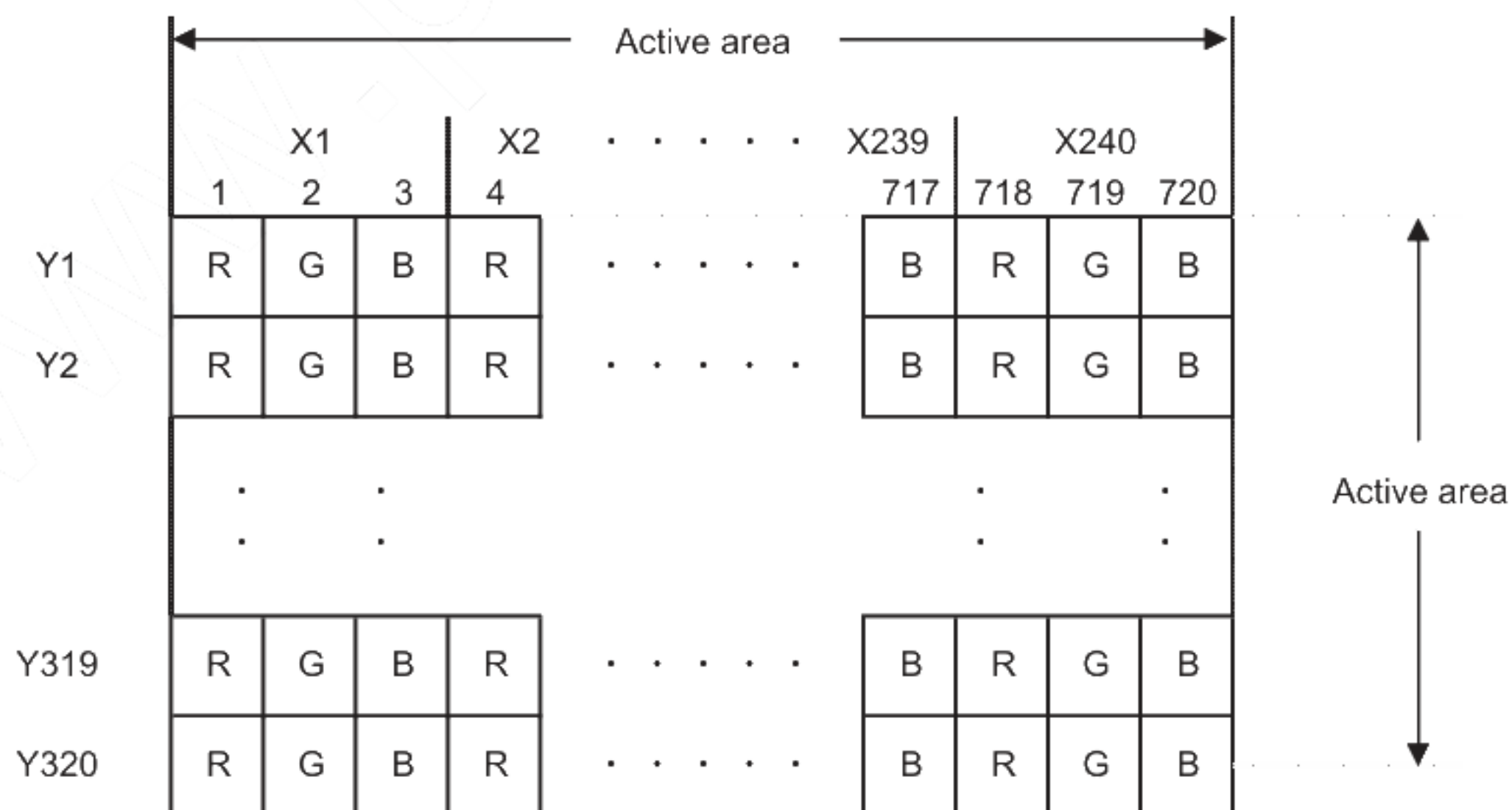
Dot arrangement (FPC cable placed left side)

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<Features of Blanview>

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

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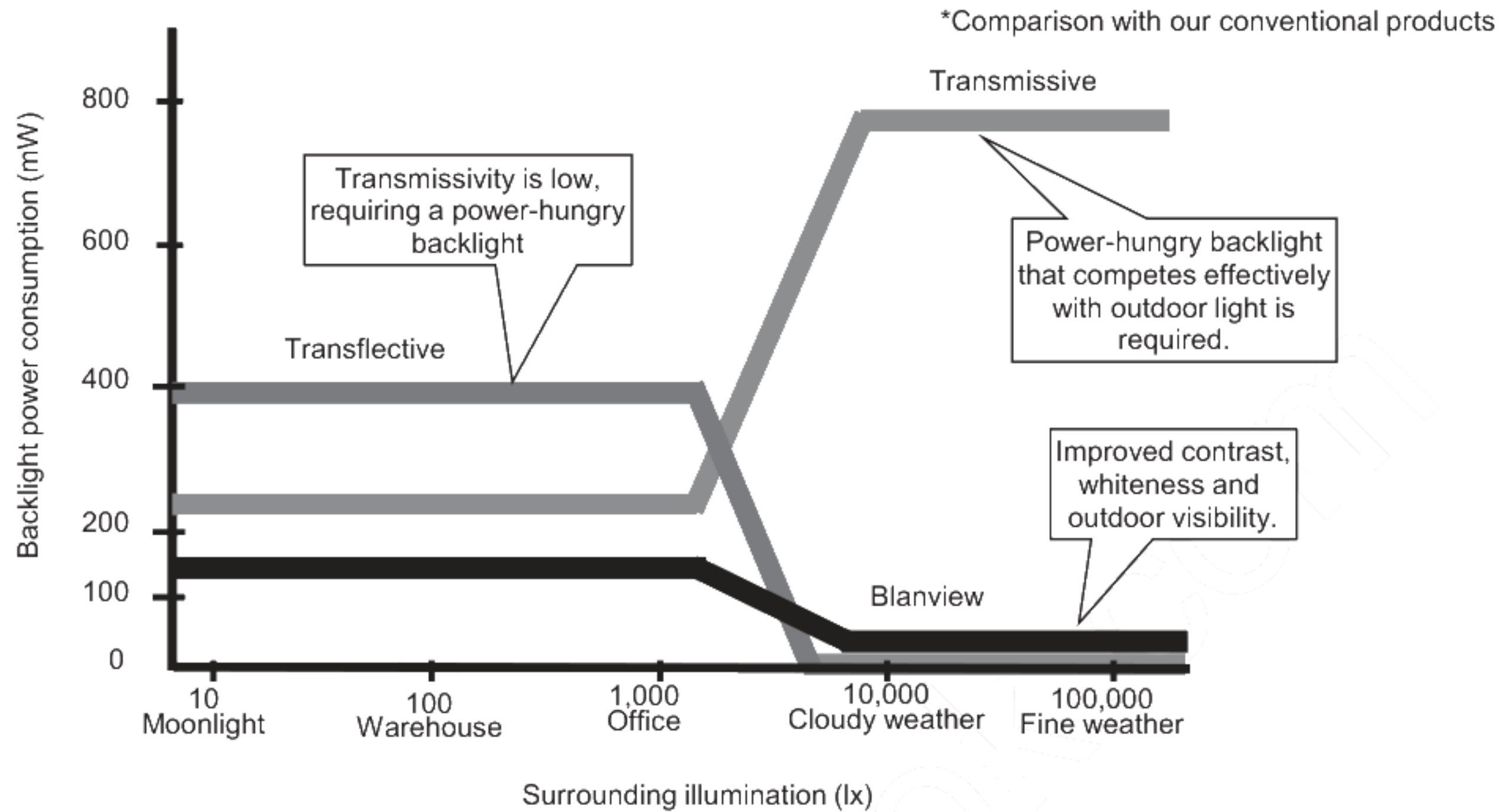
- Contrast characteristics under 100,000lx. （same condition as direct sunlight.）
  With better contrast (higher contrast ratio), Blanview TFT-LCD has the best outdoor readability
  in three different types of TFT-LCD.
  Below chart shows contrast value against panel surface brightness. (Horizontal: Panel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

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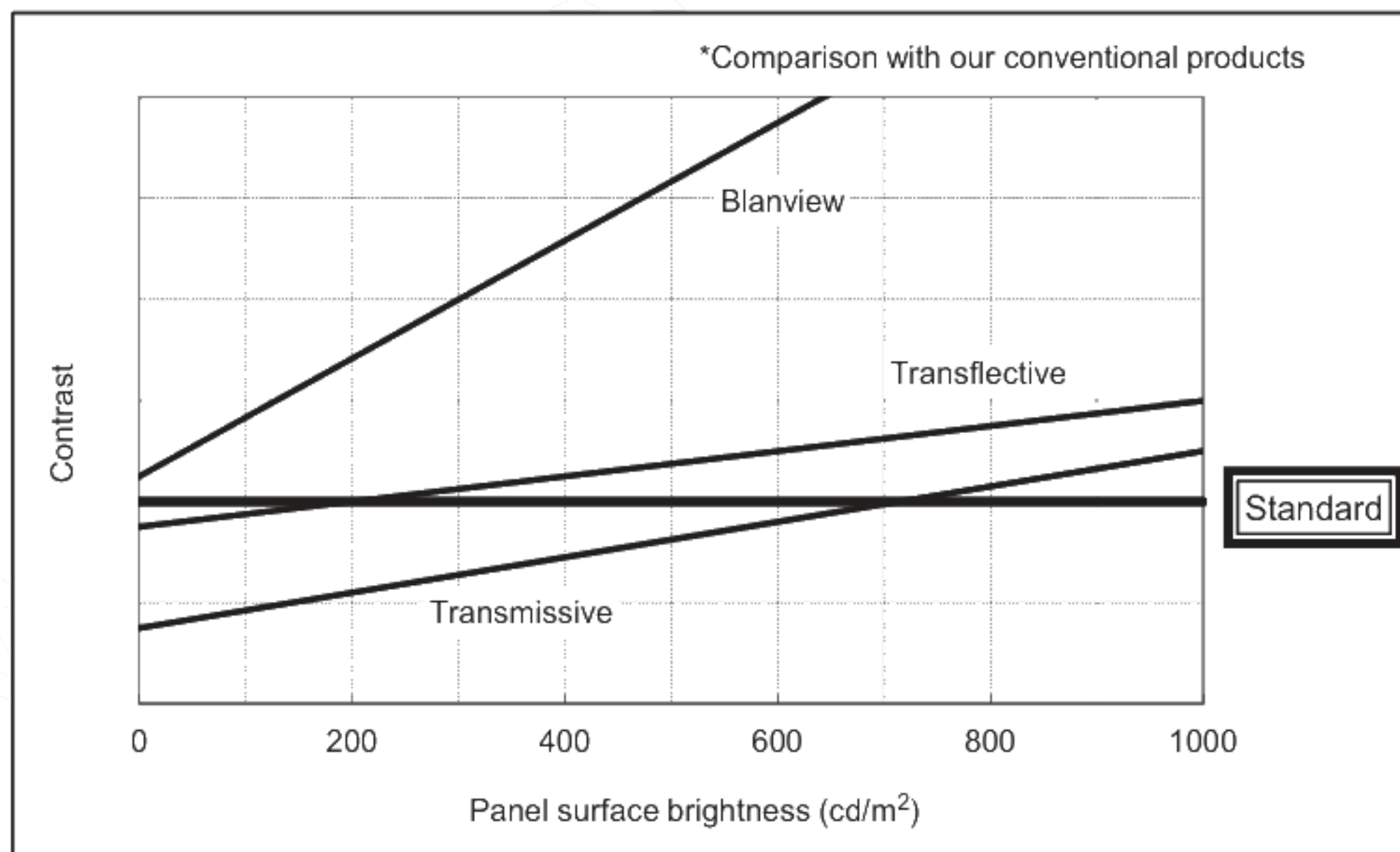
3. Dimensions and Shape

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

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3.2 Outward Form

2.4

OUTLINE-D2P96

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SJDA0233D301 サ

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 Feb-B Mar-C Apr-D	May-E Jun-F Jul-G Aug-H	Sep-I Oct-J Nov-K 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.

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4. Pin Assignment

No.	Symbol	Function	Processing of Unused
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:index, Hi:command / Display data）	-
9	WRB	Write signal	-
10	VSS	GND	-
11	D0	Data I/O	GND
12	D1	Data I/O	GND
13	D2	Data I/O	GND
14	D3	Data I/O	GND
15	D4	Data I/O	GND
16	D5	Data I/O	GND
17	D6	Data I/O	GND
18	D7	Data I/O	GND
19	D8	Data I/O	GND
20	D9	Data I/O	GND
21	D10	Data I/O	GND
22	D11	Data I/O	GND
23	D12	Data I/O	GND
24	D13	Data I/O	GND
25	D14	Data I/O	GND
26	D15	Data I/O	GND
27	D16	Data I/O (16-bit interface should be fixed to VSS)	GND
28	D17	Data I/O (16-bit interface should be fixed to VSS)	GND
29	VSS	GND	-
30	BS0	Interface mode setting terminal	-
31	BS1	Interface mode setting terminal	-
32	RDB	Read signal	IOVCC
33	NC	OPEN	OPEN
34	NC	OPEN	OPEN
35	NC	OPEN	OPEN
36	NC	OPEN	OPEN
37	TE	Synchronization signal output	OPEN
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

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5. Absolute Maximum Rating

VSS=0V

Item	Symbol	Condition	Rating		Unit	Applicable terminal
			MIN	MAX		
Supply voltage	VCI	Ta=25°C	-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)	2.7	(3.6)	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.

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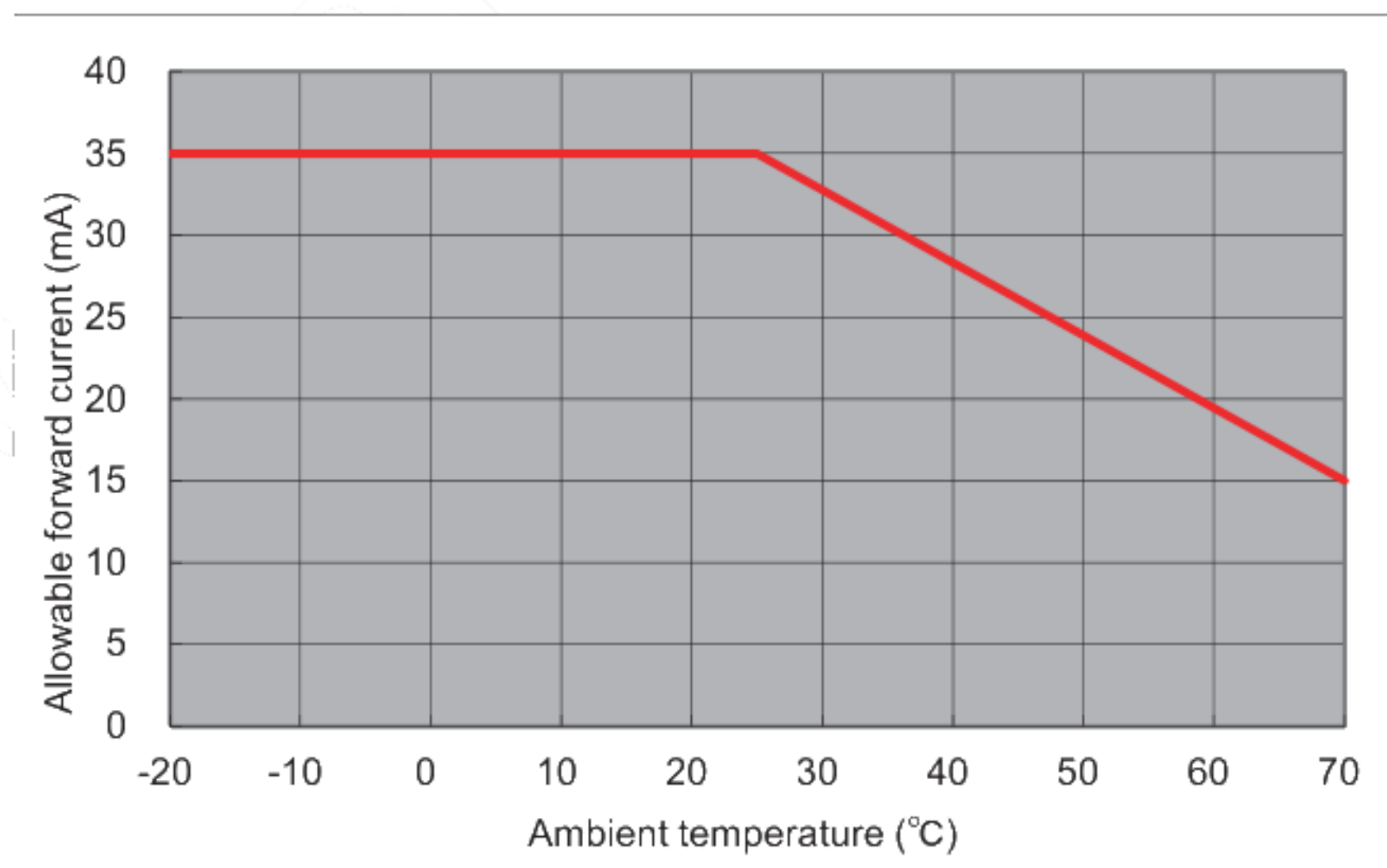
7. Electrical Characteristics

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	VIH		0.7×IOVCC	—	IOVCC	V	RESETB,CSB,RS,WRB,
Voltage	VIL		0	—	0.3×IOVCC	V	D0-D17,BS0,BS1,RDB
Output Signal	VOH	IOH = -0.1mA	0.8×IOVCC	—	—	V	D0-D17,TE
Voltage	VOL	IOL = 0.1mA	—	—	0.2×IOVCC	V	
Operating	ICI	Color bar/Still image	—	TBD	TBD	mA	VCI
Current	IOICC	display state *note	—	TBD	TBD	mA	IOVCC
Standby	ICI	Other input with	—	TBD	TBD	uA	VCI
Current	IOICC	constant voltage	—	TBD	TBD	uA	IOVCC

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	IL25	Ta=25°C	—	7.5	35.0	mA	BLH - BLL
current	IL70	Ta=70°C	—	—	15.0	mA	
Forward voltage	VL	Ta=25°C, IL=(7.5)mA	—	5.4	5.6	V	
Estimated Life of LED	LL	Ta=25°C, IL=(7.5)mA 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.

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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.
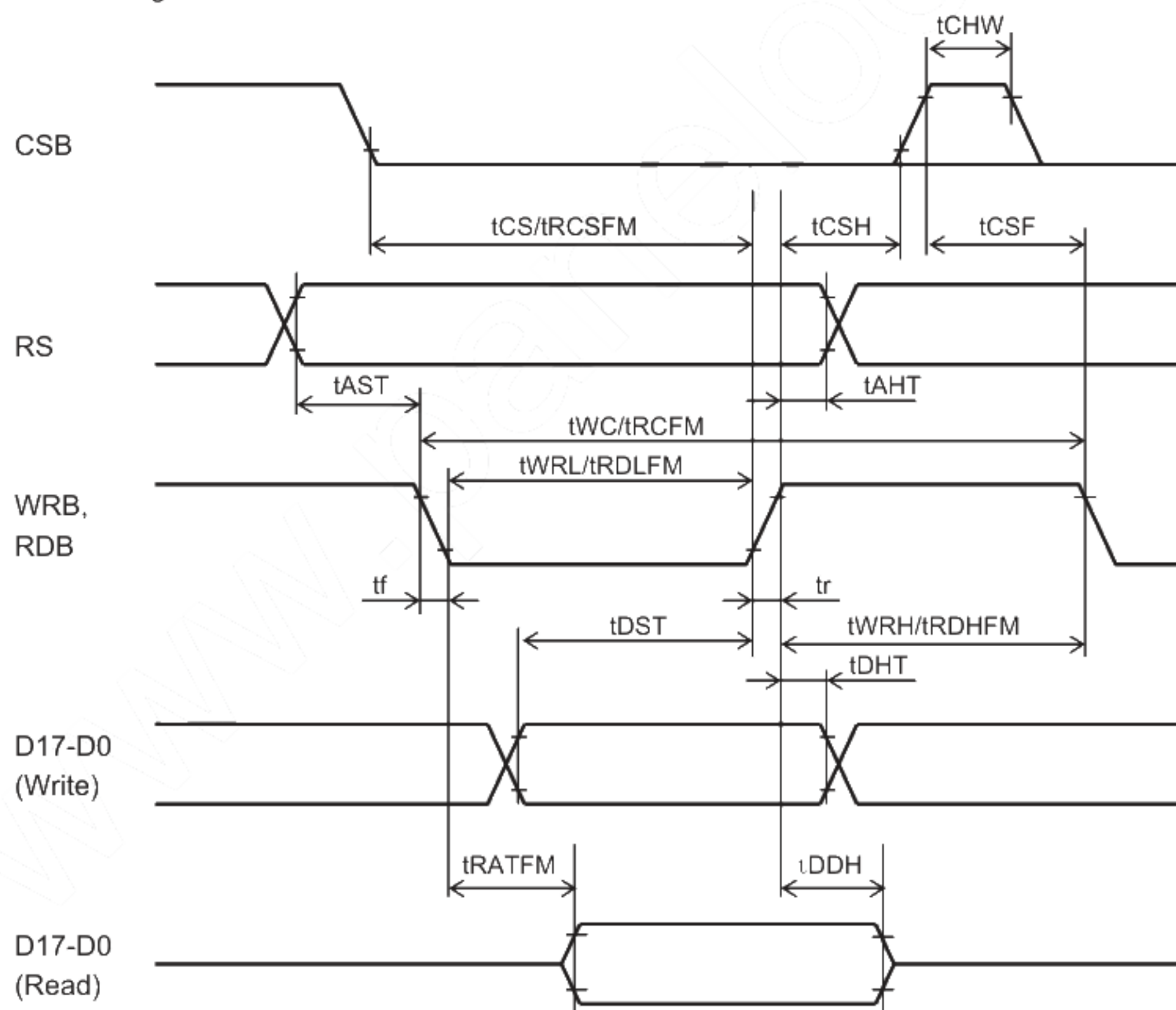
8. Interface

	Index /Command 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		
D17			R5				
D16			R4				
D15			R3	R5/R0			
D14			R2	R4			
D13			R1	R3			
D12			R0	R2			
D11			G5	R1			
D10			G4	G5			
D9			G3	G4			
D8			G2	G3			
D7	ID7	RB7	G1	G2	R5	G5	B5
D6	ID6	RB6	G0	G1	R4	G4	B4
D5	ID5	RB5	B5	G0	R3	G3	B3
D4	ID4	RB4	B4	B5/B0	R2	G2	B2
D3	ID3	RB3	B3	B4	R1	G1	B1
D2	ID2	RB2	B2	B3	R0	G0	B0
D1	ID1	RB1	B1	B2			
D0	ID0	RB0	B0	B1			

* Unused terminal "D0～D17" should be connected to VSS.

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9. Sequence
9.1 Power ON Sequence

No.			DCX	IB[7:0]	Remarks
	VCI/IOVCC ON				
	RESETB High	RESETB Low			(RESETB High) can be omitted
	RESETB High → Low				
	Wait (10 usec) or more				
	RESETB Low → High				
	Wait (120 msec) or more				
1	Sleep Out		0	(11h)	
	Wait 120 msec or more				
2	Memory access control		0	(36h)	
		para 1	1	(00h)	MX=MY=0
3	LCM Control		0	(C0h)	
		para 1	1	(3Ch)	XINV=XMV=XMX=XBGR=1
4	Pixel format		0	(3Ah)	
		para 1	1	(05h)	3h:4K,5h:65K,6h:260K
5	CMD2EN		0	(DFh)	
		para 1	1	(5Ah)	
		para 2	1	(69h)	
		para 3	1	(02h)	
		para 4	1	(01h)	Command2 enable
6	GATECTRL 1		0	(E4h)	
		para 1	1	(27h)	NL=320
		para 2	1	(00h)	SCN=G0
		para 3	1	(10h)	TMG=1,SM=GS=0
7	GATECTRL 2		0	(B7h)	
		para 1	1	(75h)	VGH=14.9,VGL=-10.4
8	VCOMS setting		0	(BBh)	
		para 1	1	(15h)	Δv=0.625typ
9	VAP/VAN signal		0	(D2h)	
		para 1	1	(4Ch)	
10	VRH set		0	(C3h)	
		para 1	1	(17h)	VAP=4.7+
11	Frame rate		0	(C6h)	
		para 1	1	(EFh)	Column inversion,60Hz
12	Power control 1		0	(D0h)	
		para 1	1	(A4h)	
		para 2	1	(A1h)	
13	Positive gamma		0	(E0h)	
		para 1	1	(F0h)	
		para 2	1	(04h)	
		para 3	1	(0Bh)	
		para 4	1	(11h)	
		para 5	1	(10h)	
		para 6	1	(1Bh)	
		para 7	1	(2Fh)	
		para 8	1	(33h)	
		para 9	1	(40h)	
		para 10	1	(27h)	
		para 11	1	(17h)	
		para 12	1	(14h)	
		para 13	1	(19h)	
		para 14	1	(23h)	
	Wait 10 msec or more				

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No.		DCX	IB[7:0]	Remarks
14	Negative gamma	0	(E1h)	
	para 1	1	(F0h)	
	para 2	1	(04h)	
	para 3	1	(0Bh)	
	para 4	1	(11h)	
	para 5	1	(10h)	
	para 6	1	(1Bh)	
	para 7	1	(2Fh)	
	para 8	1	(33h)	
	para 9	1	(40h)	
	para 10	1	(27h)	
	para 11	1	(17h)	
	para 12	1	(14h)	
	para 13	1	(19h)	
	para 14	1	(23h)	
	Wait 10 msec or more			
15	Equalize control	0	(E9h)	
	para 1	1	(08h)	
	para 2	1	(08h)	
	para 3	1	(08h)	
16	RGB interface control	0	(B1h)	
	para 1	1	(00h)	
	para 2	1	(04h)	
	para 3	1	(14h)	
17	RAM Control	0	(B0h)	
	para 1	1	(00h)	RM=0,DM=00:CPU interface
	para 2	1	(E0h)	EPF=10b
18	CA SET	0	(2Ah)	
	para 1	1	(00h)	XS[15:8]
	para 2	1	(00h)	XS[7:0]
	para 3	1	(00h)	XE[15:8]
	para 4	1	(EFh)	XE[7:0]
19	RA SET	0	(2Bh)	
	para 1	1	(00h)	YS[15:8]
	para 2	1	(00h)	YS[7:0]
	para 3	1	(01h)	YE[15:8]
	para 4	1	(3Fh)	YE[7:0]
20	Tearing Effect On	0	(35h)	
	para 1	1	(00h)	TEM = 0
21	RAMWR	0	(2Ch)	
	data 1	1	**** h	write data
	data 2	1	**** h	write data
	. . . .	. . .	. . . . h	
	data n	1	**** h	write data
	wait 10 msec or more			
22	Display ON	0	(29h)	
	wait 10 msec or more			
23	Backlight ON			

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9.2 Sleep IN Sequence

No.		DCX	IB[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.		DCX	IB[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.		DCX	IB[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			

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9.5 Refresh Sequence

(1/2)

No.		DCX	IB[7:0]	Remarks
1	Sleep Out	0	(11h)	
	Wait 120 msec or more			
2	Memory access control	0	(36h)	
	para 1	1	(00h)	MX=MY=0
3	LCM Control	0	(C0h)	
	para 1	1	(3Ch)	XINV=XMV=XMX=XBGR=1
4	Pixel format	0	(3Ah)	
	para 1	1	(05h)	3h:4K,5h:65K,6h:260K
5	CMD2EN	0	(DFh)	
	para 1	1	(5Ah)	
	para 2	1	(69h)	
	para 3	1	(02h)	
	para 4	1	(01h)	Command2 enable
6	GATECTRL 1	0	(E4h)	
	para 1	1	(27h)	NL=320
	para 2	1	(00h)	SCN=G0
	para 3	1	(10h)	TMG=1,SM=GS=0
7	GATECTRL 2	0	(B7h)	
	para 1	1	(75h)	VGH=14.9,VGL=-10.4
8	VCOMS setting	0	(BBh)	
	para 1	1	(15h)	Δv=0.625typ
9	VAP/VAN signal	0	(D2h)	
	para 1	1	(4Ch)	
10	VRH set	0	(C3h)	
	para 1	1	(17h)	VAP=4.7+
11	Frame rate	0	(C6h)	
	para 1	1	(EFh)	Column inversion,60Hz
12	Power control 1	0	(D0h)	
	para 1	1	(A4h)	
	para 2	1	(A1h)	
13	Positive gamma	0	(E0h)	
	para 1	1	(F0h)	
	para 2	1	(04h)	
	para 3	1	(0Bh)	
	para 4	1	(11h)	
	para 5	1	(10h)	
	para 6	1	(1Bh)	
	para 7	1	(2Fh)	
	para 8	1	(33h)	
	para 9	1	(40h)	
	para 10	1	(27h)	
	para 11	1	(17h)	
	para 12	1	(14h)	
	para 13	1	(19h)	
	para 14	1	(23h)	
	Wait 10 msec or more			

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No.		DCX	IB[7:0]	Remarks
14	Negative gamma	0	(E1h)	
	para 1	1	(F0h)	
	para 2	1	(04h)	
	para 3	1	(0Bh)	
	para 4	1	(11h)	
	para 5	1	(10h)	
	para 6	1	(1Bh)	
	para 7	1	(2Fh)	
	para 8	1	(33h)	
	para 9	1	(40h)	
	para 10	1	(27h)	
	para 11	1	(17h)	
	para 12	1	(14h)	
	para 13	1	(19h)	
	para 14	1	(23h)	
	Wait 10 msec or more			
15	Equalize control	0	(E9h)	
	para 1	1	(08h)	
	para 2	1	(08h)	
	para 3	1	(08h)	
16	RGB interface control	0	(B1h)	
	para 1	1	(00h)	
	para 2	1	(04h)	
	para 3	1	(14h)	
17	RAM Control	0	(B0h)	
	para 1	1	(00h)	RM=0,DM=00:CPU interface
	para 2	1	(E0h)	EPF=10b
18	CA SET	0	(2Ah)	
	para 1	1	(00h)	XS[15:8]
	para 2	1	(00h)	XS[7:0]
	para 3	1	(00h)	XE[15:8]
	para 4	1	(EFh)	XE[7:0]
19	RA SET	0	(2Bh)	
	para 1	1	(00h)	YS[15:8]
	para 2	1	(00h)	YS[7:0]
	para 3	1	(01h)	YE[15:8]
	para 4	1	(3Fh)	YE[7:0]
20	Tearing Effect On	0	(35h)	
	para 1	1	(00h)	TEM = 0
21	RAMWR	0	(2Ch)	
	data 1	1	**** h	write data
	data 2	1	**** h	write data
	....	...	· · · · h	
	data n	1	**** h	write data
	wait 10 msec or more			
22	Display ON	0	(29h)	
	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.

VCI

IOVCC

$\geq$(10us) $\geq$(120ms)

RESETB

CMD

$\geq$(120ms)

or

RESETB

CMD

$\geq$(10us)
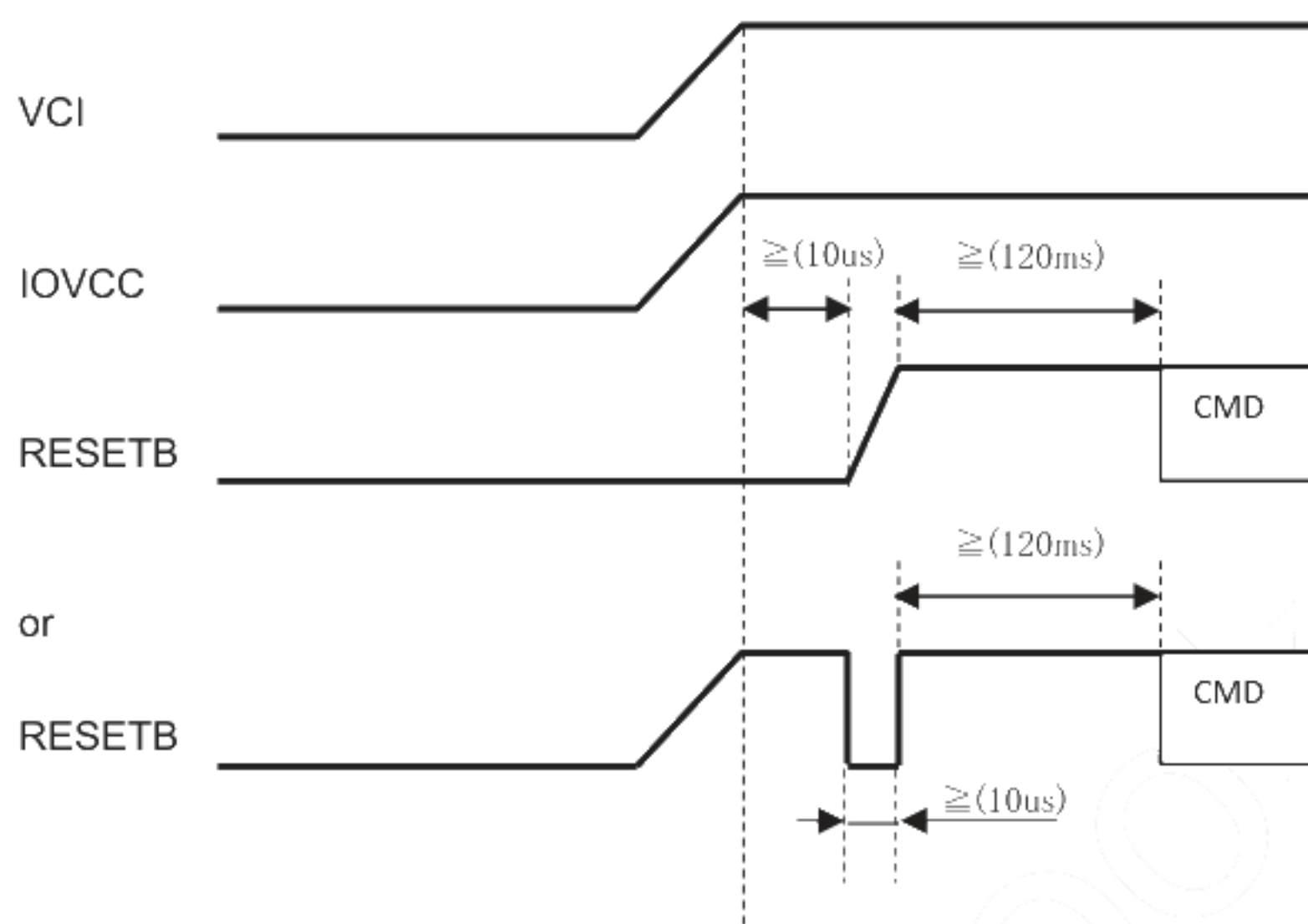
Power Supply OFF Sequence

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

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10. LED Circuit

BLH ○─────────────────────────────

BLL ○─────────────────────────────

TOPPAN INC.
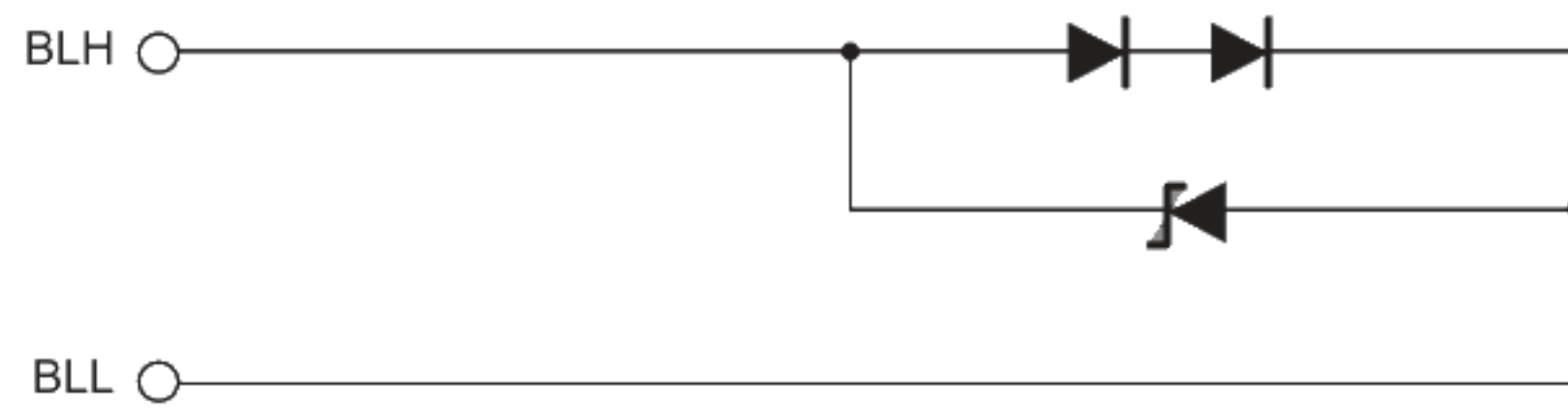
11. Characteristics

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
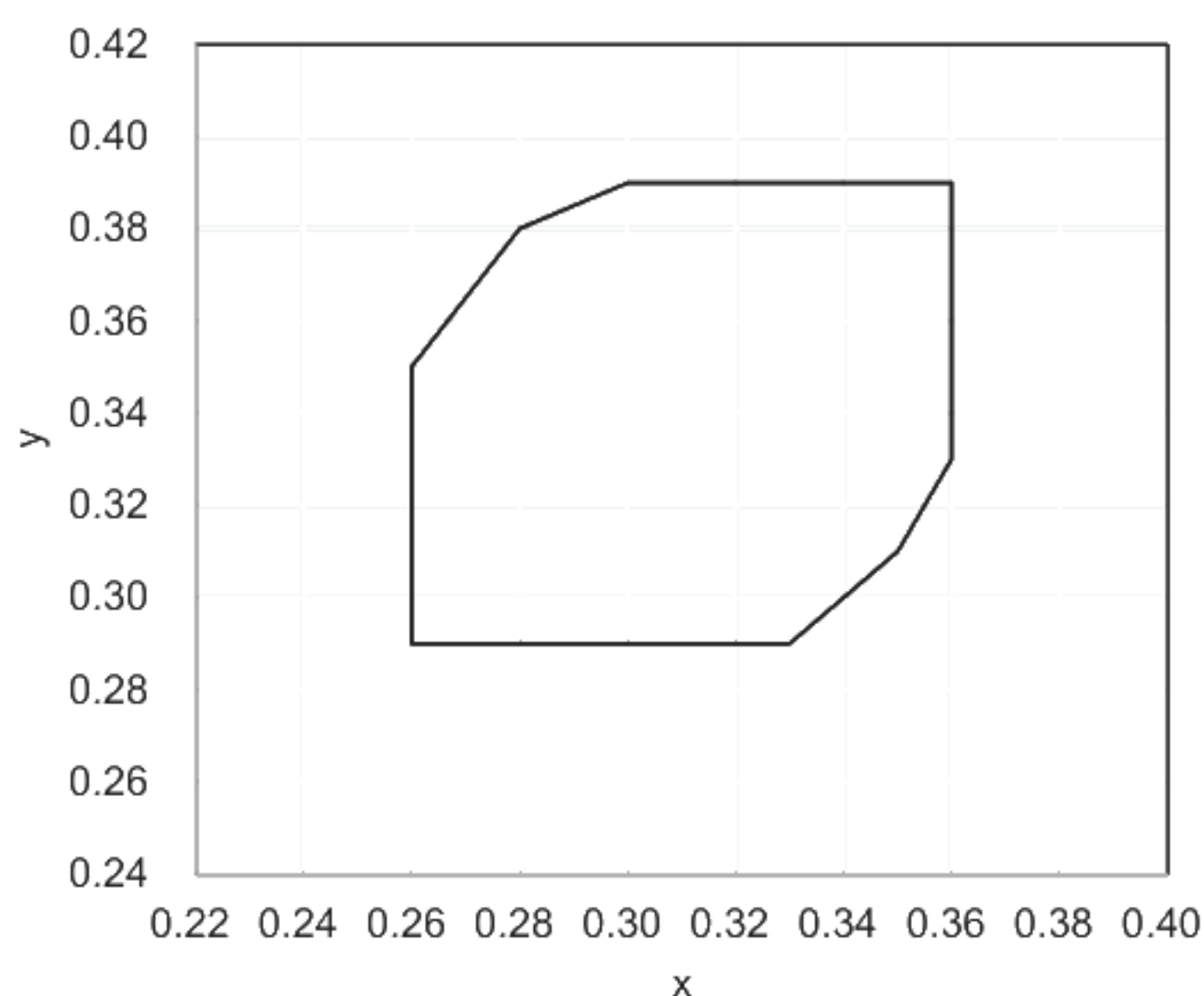
(White Chromaticity Range)

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)

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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.		

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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
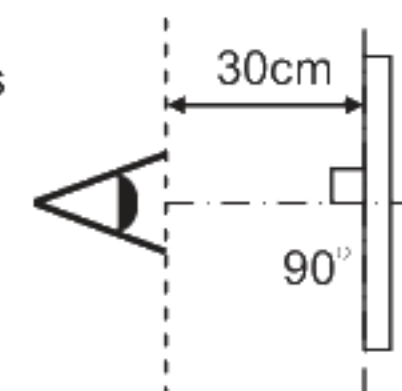Driving Signal: Raster Patter (RGB, white, black)
Signal condition: [Data]:00h, (TBD)h, 3Fh (3steps)
Observation distance: 30 cm
Illuminance: 200 to 350 lx
Backlight: IL=(7.5)mA

30cm
90°

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]=(TBD)h		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 < length and 0.08mm < width	N=0
			length ≦ 3.0mm or width ≦ 0.08mm	Acceptable
	Others			Use boundary sample for judgment when necessary

φ(mm): Average diameter = (major axis + minor axis)/2
Permissible number: N

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>

B zone
A zone
1
4
1

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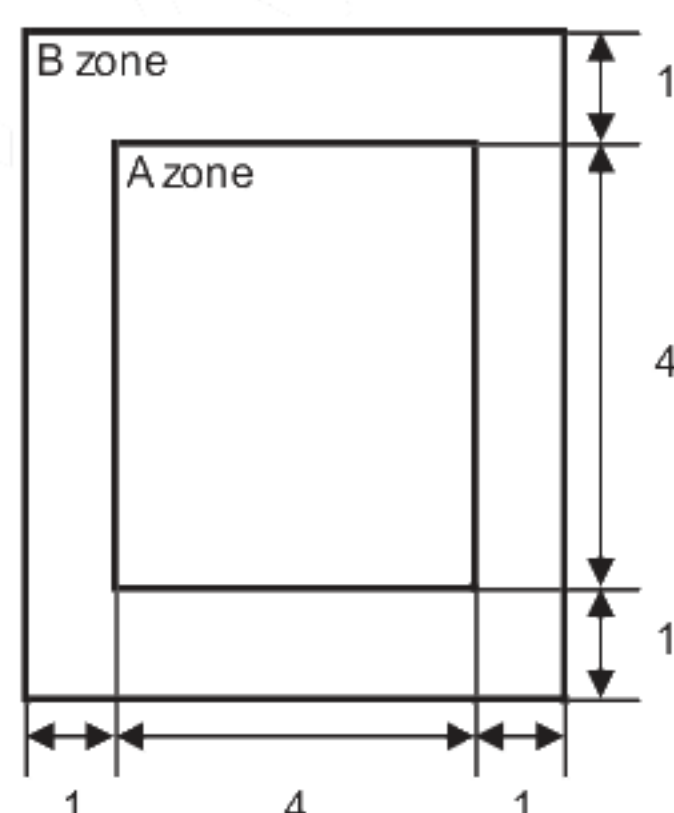
Division of A and B areas
  B area: Active area
  Dimensional ratio between A and B areas: 1: 4: 1
  (Refer to the left figure)

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12.2 Screen and Other Appearance

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

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

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13. Reliability Test

<table>
<tr><td colspan="2" style="text-align:center">Test item</td><td style="text-align:center">Test condition</td><td style="text-align:center">number of failures /
number of examinations</td></tr>
<tr><td rowspan="8">Durability test</td><td>High temperature storage</td><td>Ta = 80°C   240hrs</td><td>TBD</td></tr>
<tr><td>Low temperature storage</td><td>Ta = -30°C   240hrs</td><td>TBD</td></tr>
<tr><td>High temperature &
high humidity storage</td><td>Ta = 60°C, RH = 90%,   240hrs
non condensing   ※</td><td>TBD</td></tr>
<tr><td>High temperature operation</td><td>Tp = 70°C   240hrs</td><td>TBD</td></tr>
<tr><td>Low temperature operation</td><td>Tp = -20°C   240hrs</td><td>TBD</td></tr>
<tr><td>High temperature &
high humidity operation</td><td>Tp = 40°C, RH = 90%,   240hrs
non condensing   ※</td><td>TBD</td></tr>
<tr><td>Thermal shock storage</td><td>-30°C ↔ 80°C (30min / 30min)   100cycles</td><td>TBD</td></tr>
<tr><td>Lightfastness</td><td>Xenon Blackpanel 63±3°C non-shower
450W/㎡(300~700nm) non-operating Integral dose 800MJ/㎡</td><td>TBD</td></tr>
<tr><td rowspan="5">Mechanical environmental test</td><td>Electrostatic discharge test
(Non operation)</td><td>Confirms to EIAJ ED-4701/300, C=200pF,R=0Ω,V=±200V
Each 3 times of discharge on and power supply
and other terminals.</td><td>TBD</td></tr>
<tr><td>Surface discharge test
(Non operation)</td><td>C=250pF, R=100Ω, V=±(TBD)kV
Each 5 times of discharge in both polarities
on the center of screen with the case grounded.</td><td>TBD</td></tr>
<tr><td>Vibration test</td><td>Total amplitude 1.5mm, f=10~55Hz,
X,Y,Z directions for each 2 hours</td><td>TBD</td></tr>
<tr><td>Impact test</td><td>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.</td><td>TBD</td></tr>
<tr><td rowspan="2">Packing test</td><td>Packing vibration-proof test</td><td>Acceleration of $19.6m/s^2$ with frequency of 10→55→10Hz,
X,Y, Zdirection for each 30 minutes.</td><td>TBD</td></tr>
<tr><td>Packing drop test</td><td>Drop from 75cm high.
1 time to each 6 surfaces, 3 edges, 1 corner</td><td>TBD</td></tr>
</table>

Note:Ta=ambient temperature   Tp=Panel temperature

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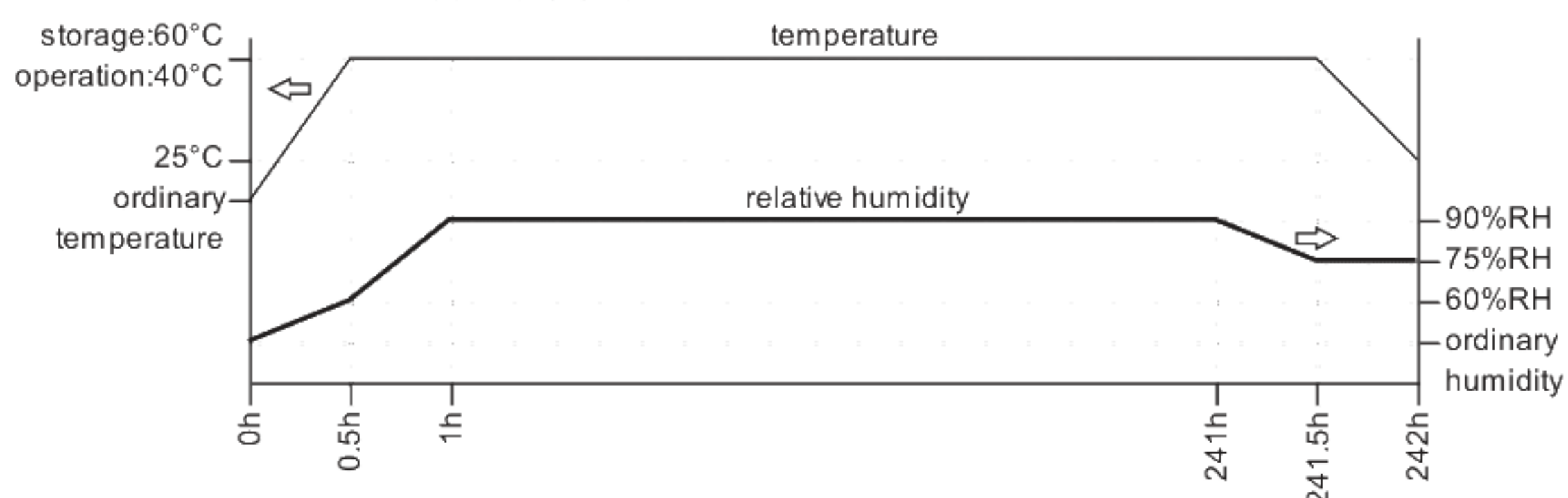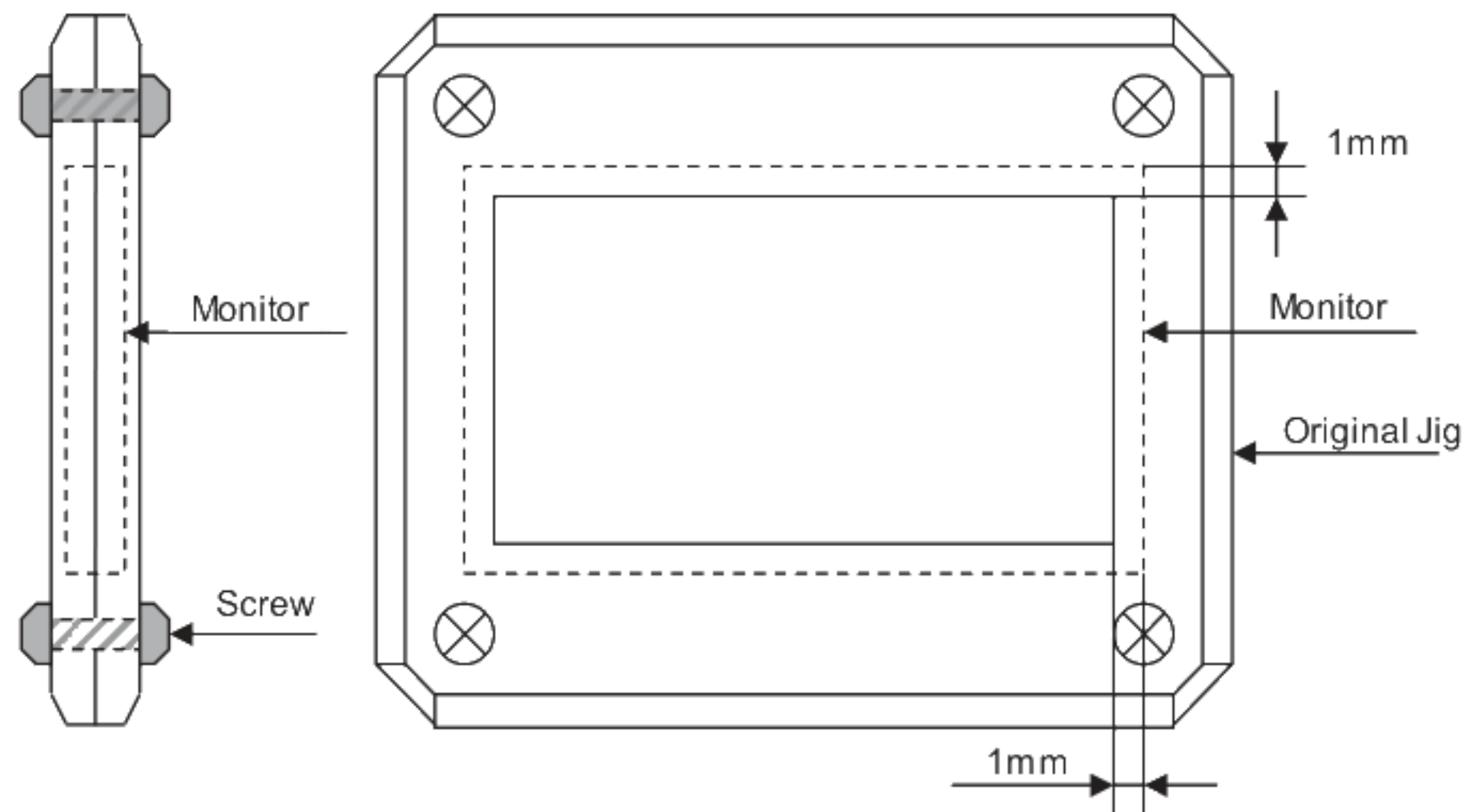(Pure water of over 10MΩ·cm shall be used.）
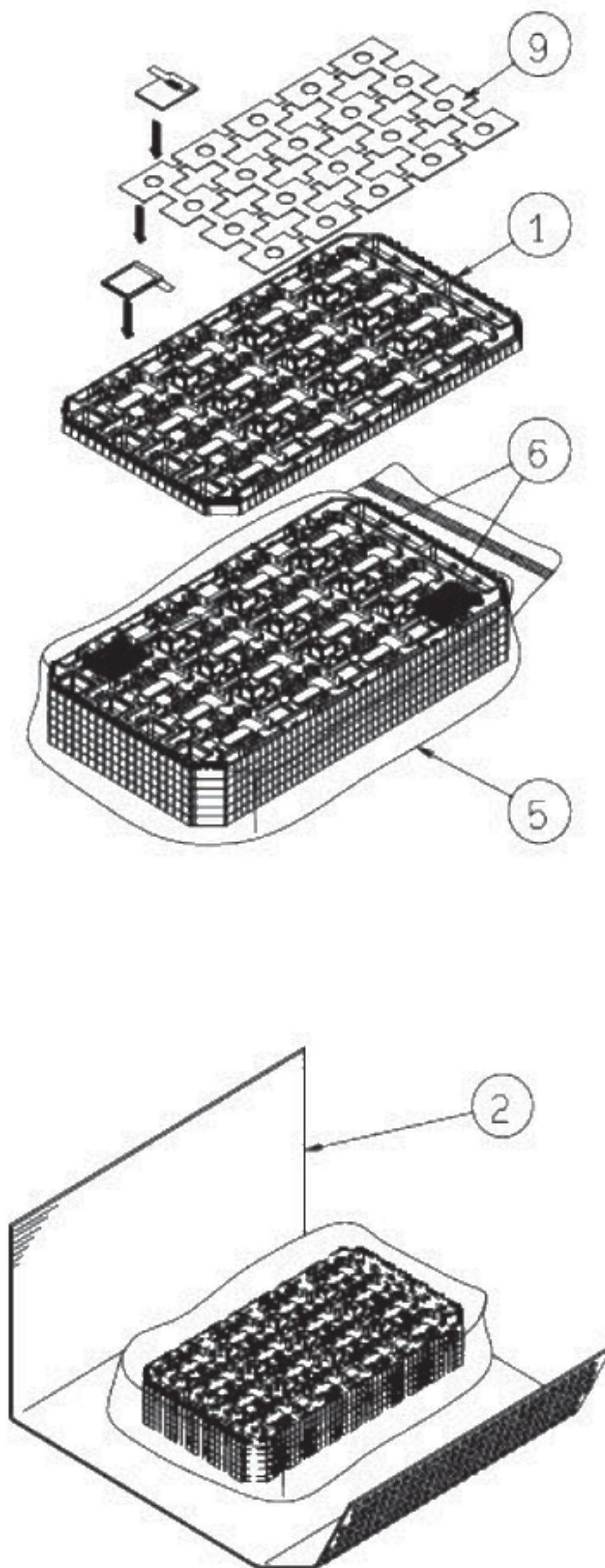

Table2. Reliability Criteria
The parameters should be measured after leaving the monitor at the ordinary temperature for 24 hours
or more after the test completion.

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

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TOPPAN Original Jig

Monitor

Screw

1mm

Monitor

Original Jig

1mm

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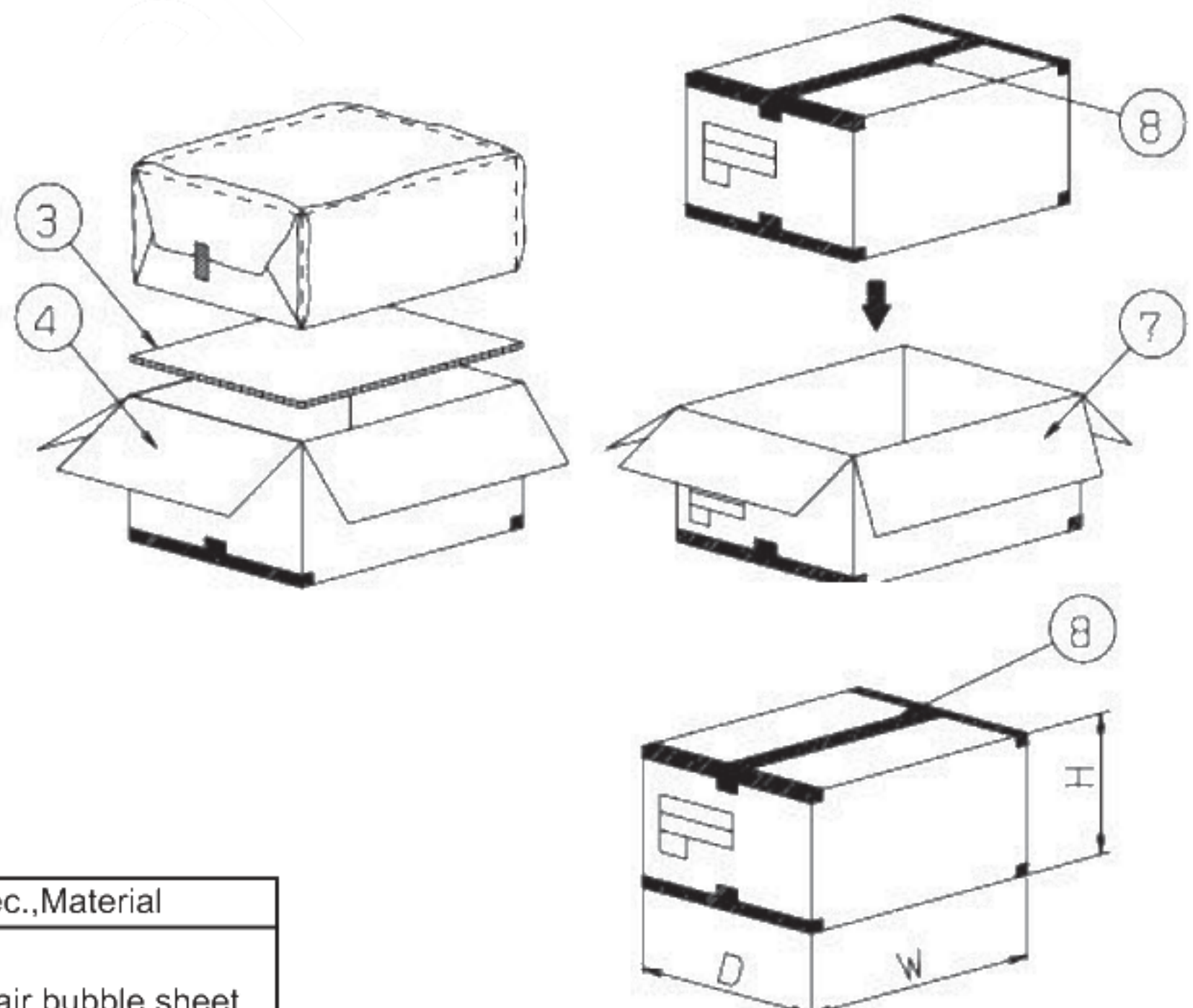
Packing item name		Spec.,Material
①	Tray	A-PET
②	B Sheet A	Anti-static air bubble sheet
③	Inner Board	Corrugated cardboard
④	Outer Carton	Corrugated cardboard
⑤	Sealing Bag	
⑥	Drier	Moisture absorber
⑦	Extra Outer Carton	Corrugated cardboard
⑧	Packing Tape	
⑨	Foam Sheet	Anti-static polyethylene

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

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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.

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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.

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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.

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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.)
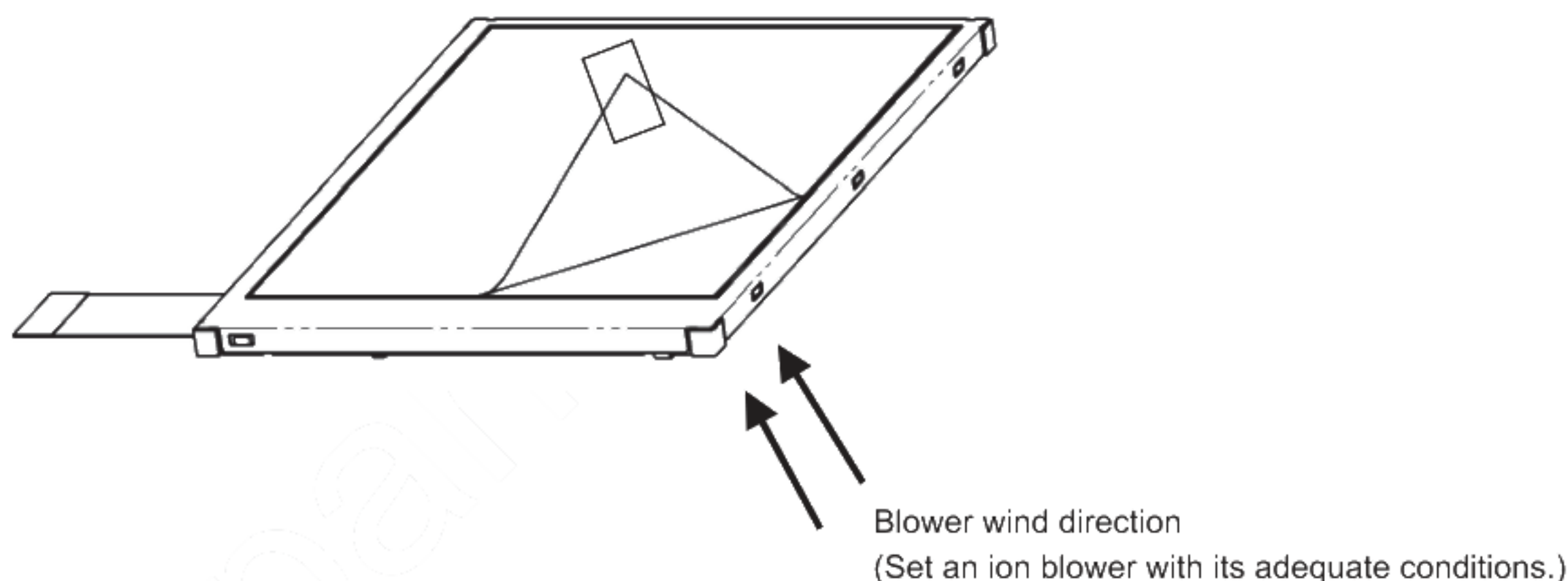
15.6 Warranty

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.

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APPENDIX

Reference Method for Measuring Optical Characteristics and Performance

1. Measurement Condition (Backlight ON)

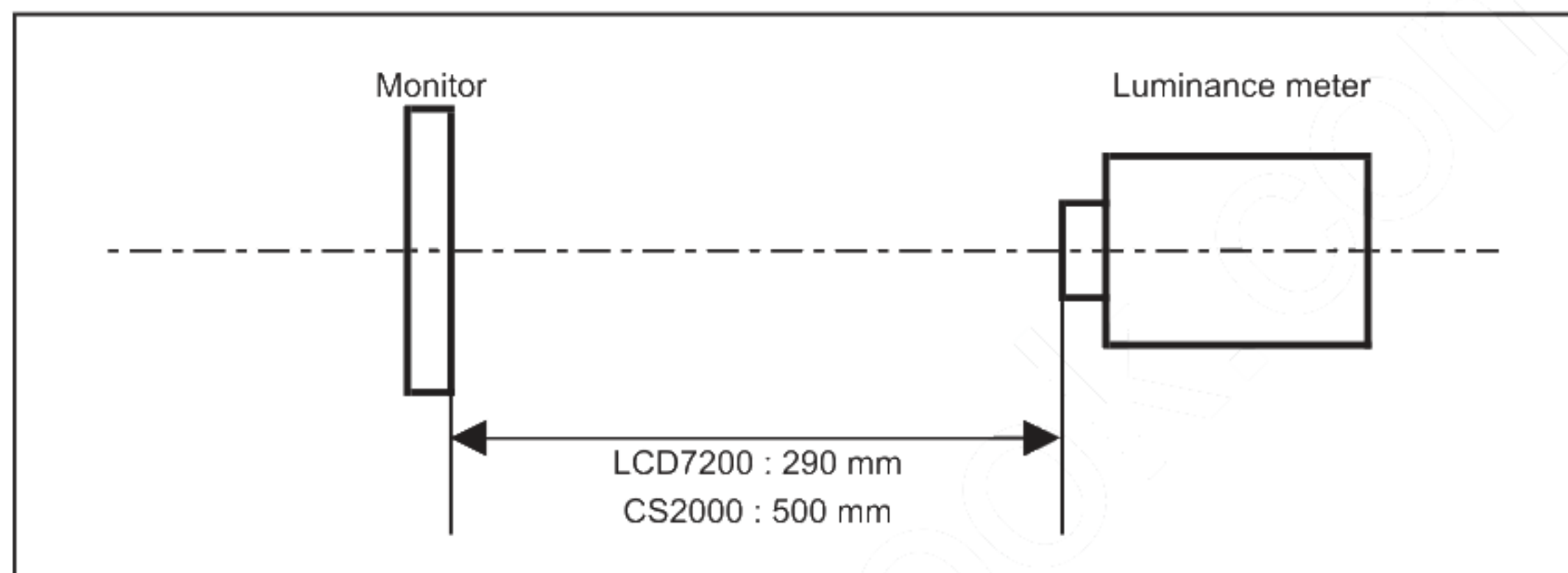Measuring instruments: CS2000（KONICA MINOLTA）, LCD7200(OTSUKA ELECTRONICS),EZcontrastXL88（ELDIM）
Driving condition: Refer to the section "Optical Characteristics"
Measured temperature: 25°C unless specified
Measurement system: See the chart below. The luminance meter is placed on the normal line of measurement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

Dark box at constant temperature

Monitor   Luminance meter

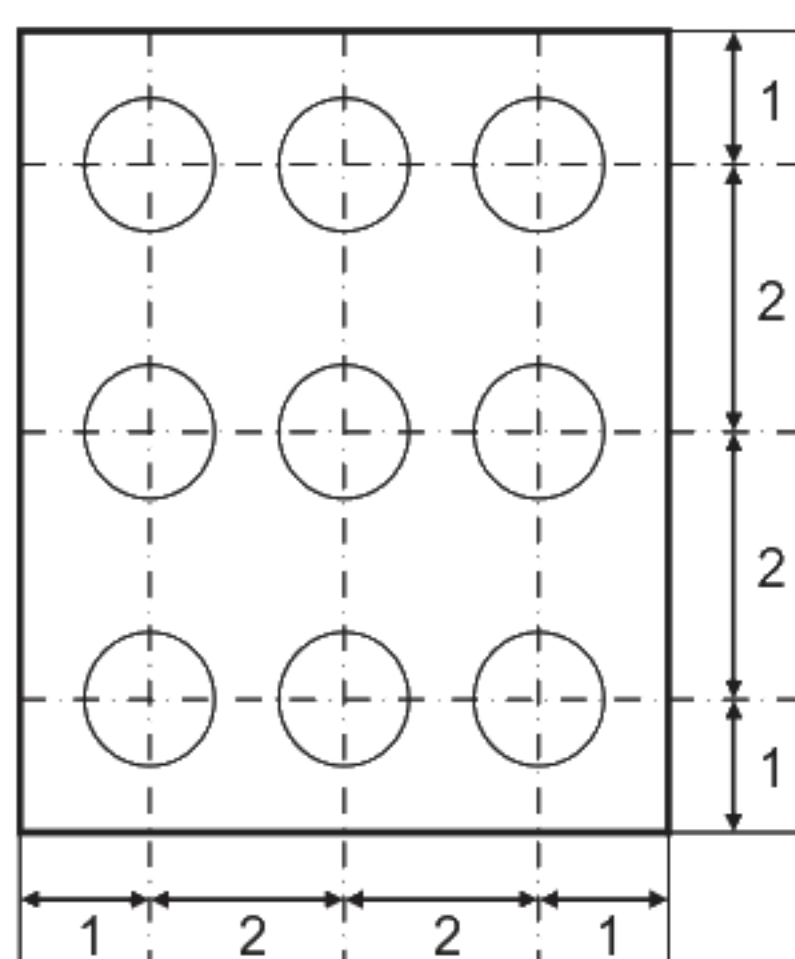LCD7200 : 290 mm
CS2000 : 500 mm

*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=(7.5)mA

TOPPAN INC.
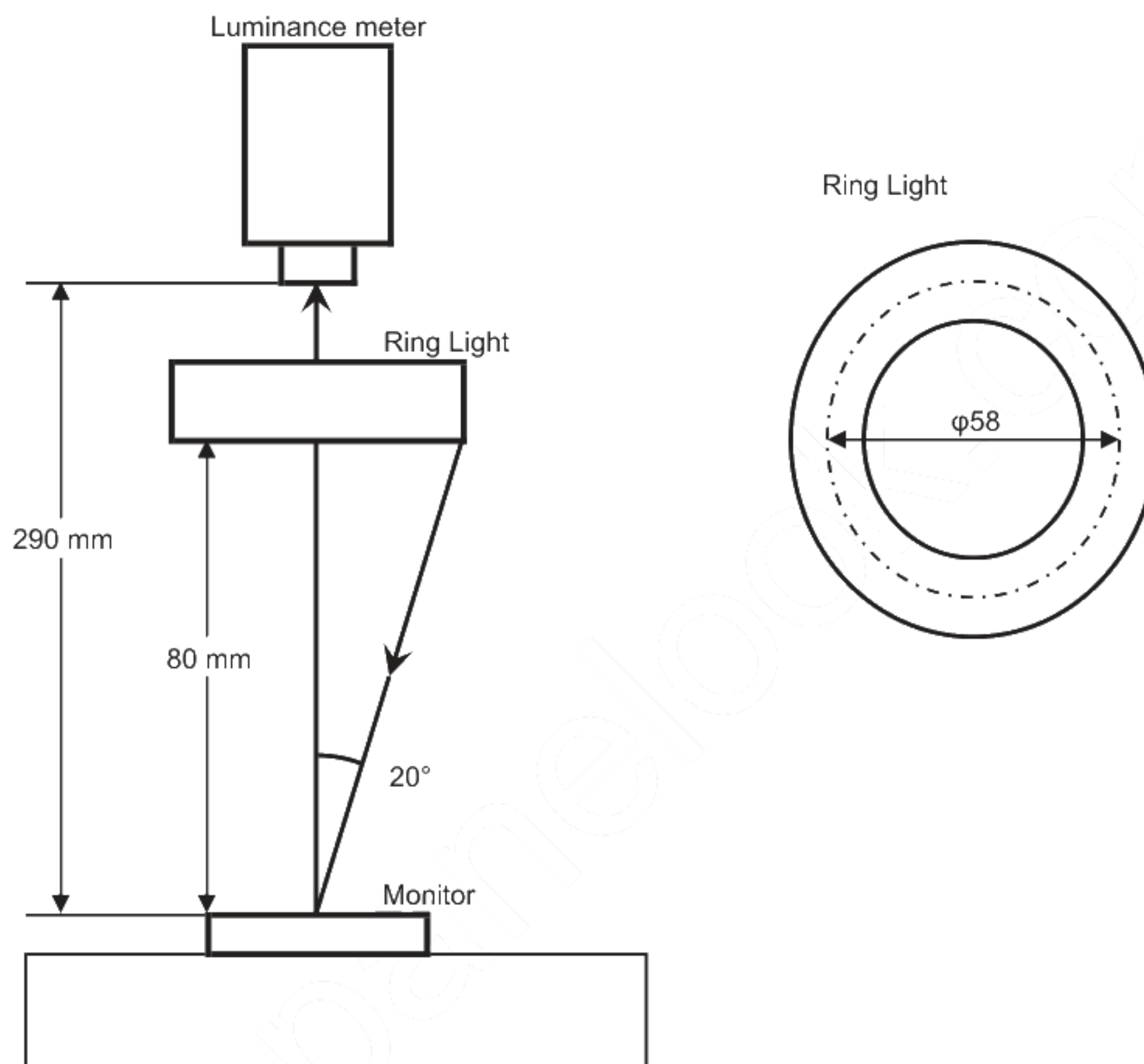
Measurement Condition (Contrast ratio Backlight OFF only)

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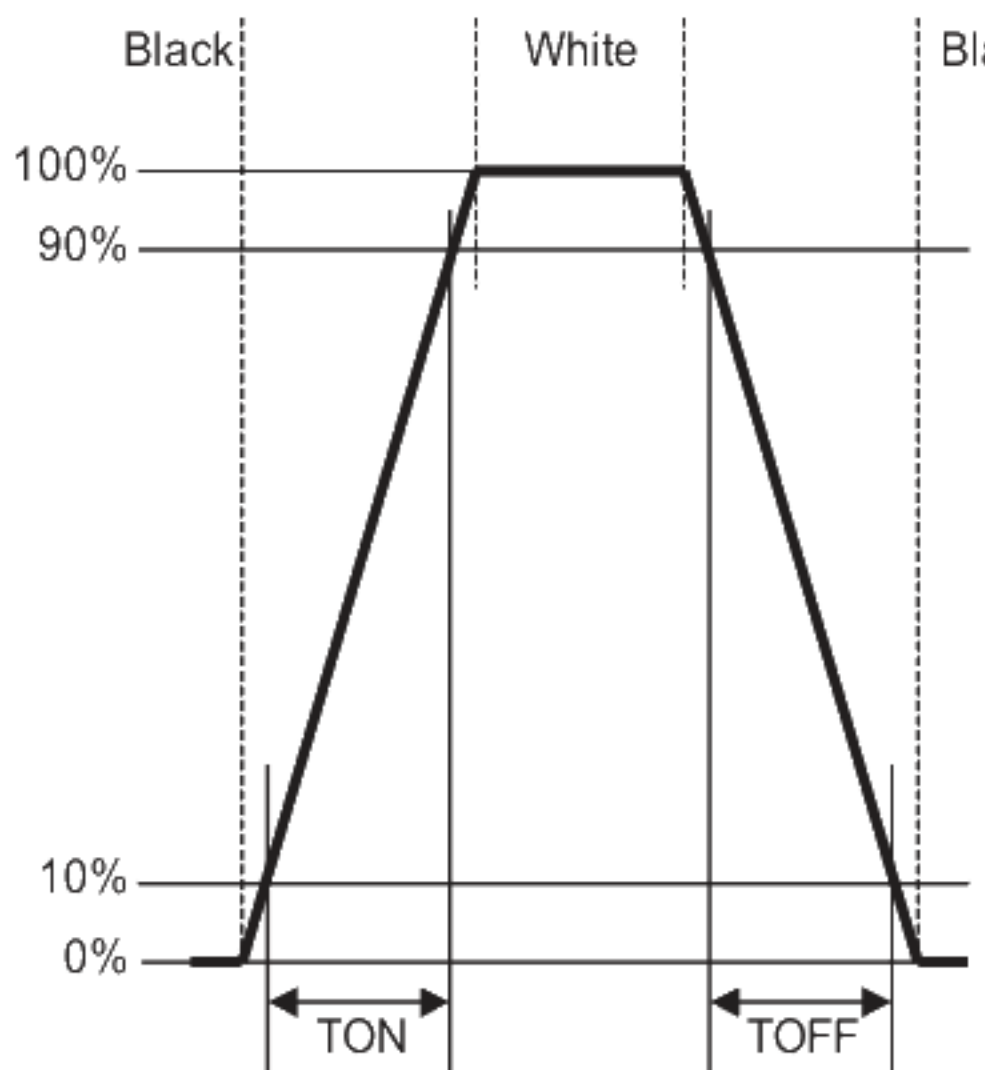Driving condition: Refer to the section "Optical Characteristics"
Measured temperature: 25°C unless specified
Measurement system: See the chart below.
Measurement point: At the center of the screen unless otherwise specified

Luminance meter

Ring Light

Ring Light

290 mm

80 mm

20°

Monitor

φ58

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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. Black White Black 100% ─ 90% ─ 10% ─ 0% ─ TON TOFF	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

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