

Specifications for

Blanview TFT-LCD Monitor

MODEL COM50H5M23XTX

Customer's Approval

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Section:

Title:

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1. Application

This Specification is applicable to 12.7cm (5.0 inch) Blanview TFT-LCD monitor for non-military use.

- ◎ ORTUS TECHNOLOGY 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 ORTUS TECHNOLOGY shall not grant to Purchaser any right to use any patent or other intellectual property rights owned by third parties. Since this Specification contains ORTUS TECHNOLOGY'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 ORTUS TECHNOLOGY'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 ORTUS TECHNOLOGY 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.
- ◎ ORTUS TECHNOLOGY 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.
- ◎ If any issue arises as to information provided in this Specification or any other information, ORTUS TECHNOLOGY and Purchaser shall discuss them in good faith and seek solution.
- ◎ ORTUS TECHNOLOGY 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 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

2. Outline Specifications

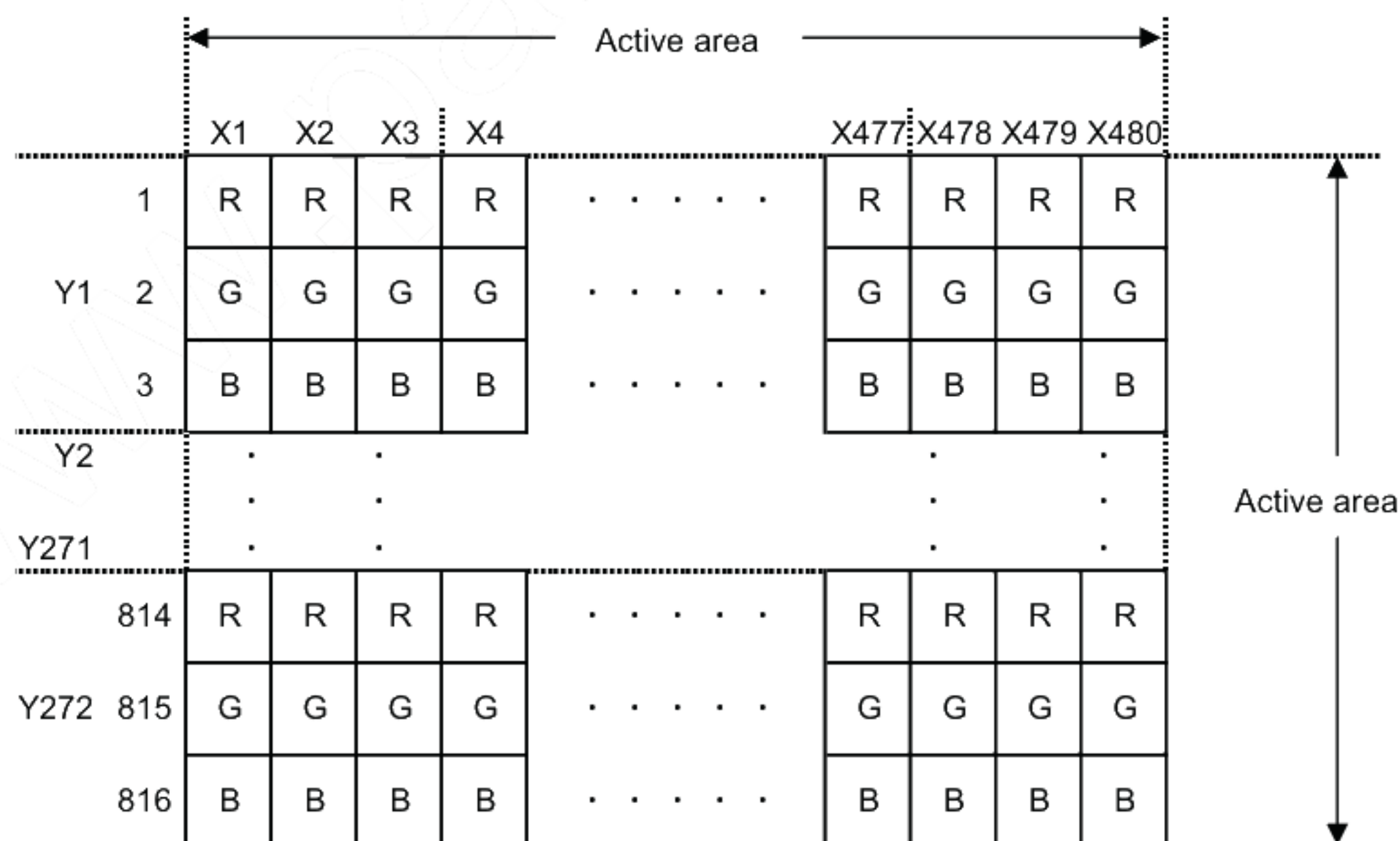
2.1 Features of the Product

- 5.0 inch diagonal display, 480 [H] x 816 [V] dots.
- 8-bit 16,777,216 color display capability.
- Built in Timing generator (TG), Counter-electrode driving circuitry and power supply circuit.
- Display on/off mode capable.
- High bright white LED back-light and Touch panel operation monitor.

	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

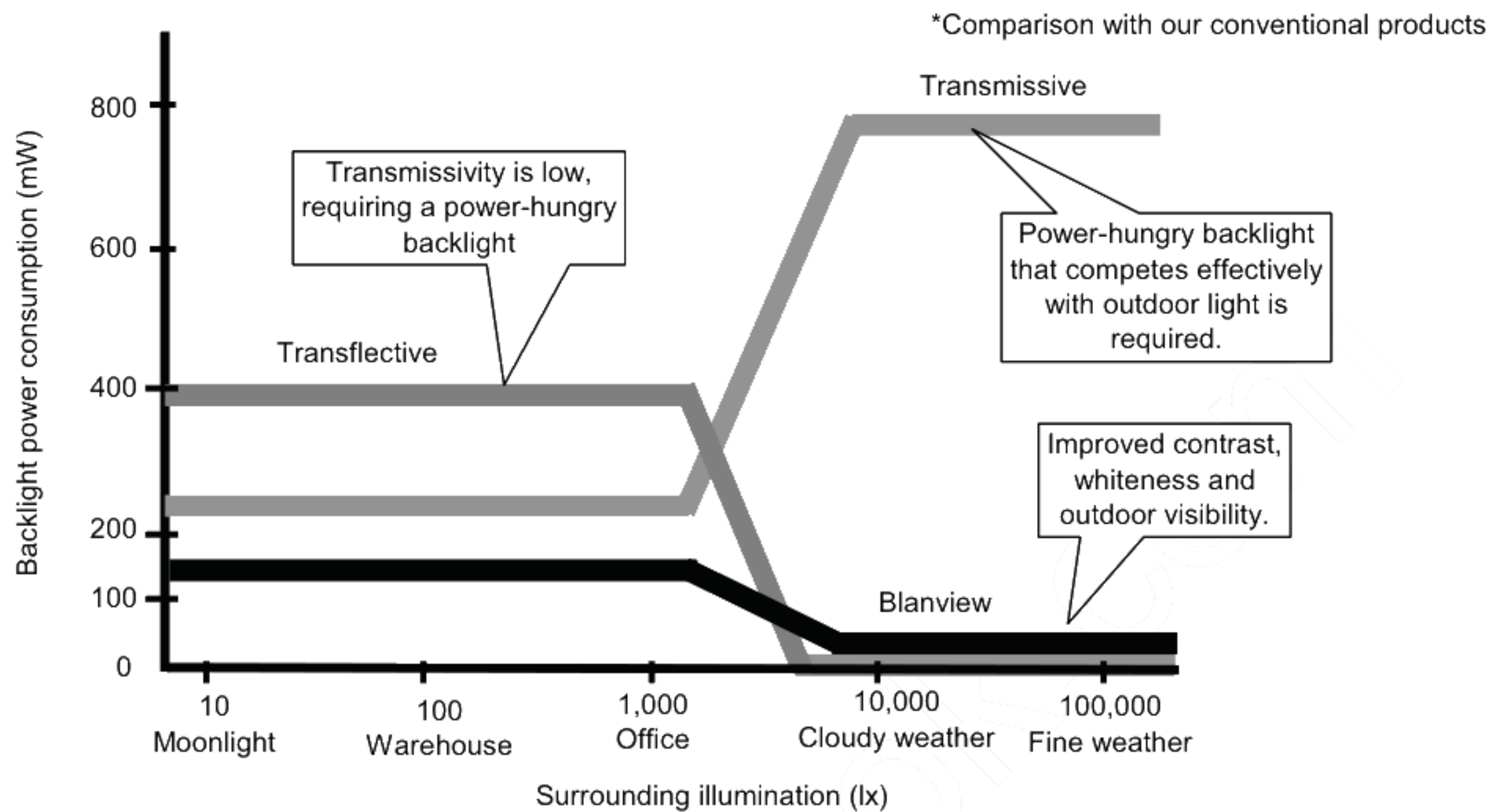
2.2 Display Method

Items	Specifications	Remarks
Display type	TN type 16,777,216 colors. Transmissive mode, Normally white.	
Driving method	a-Si TFT Active matrix. Line-scanning, Non-interlace.	
Dot arrangement	RGB side-stripe arrangement	Refer to "Dot arrangement"
Signal input method	8-bit RGB, parallel input	
Backlight type	High bright white LED	
Touch panel	Resistance type, transmissive analog tablet	Surface finishing: Clear



<Features of Blanview>

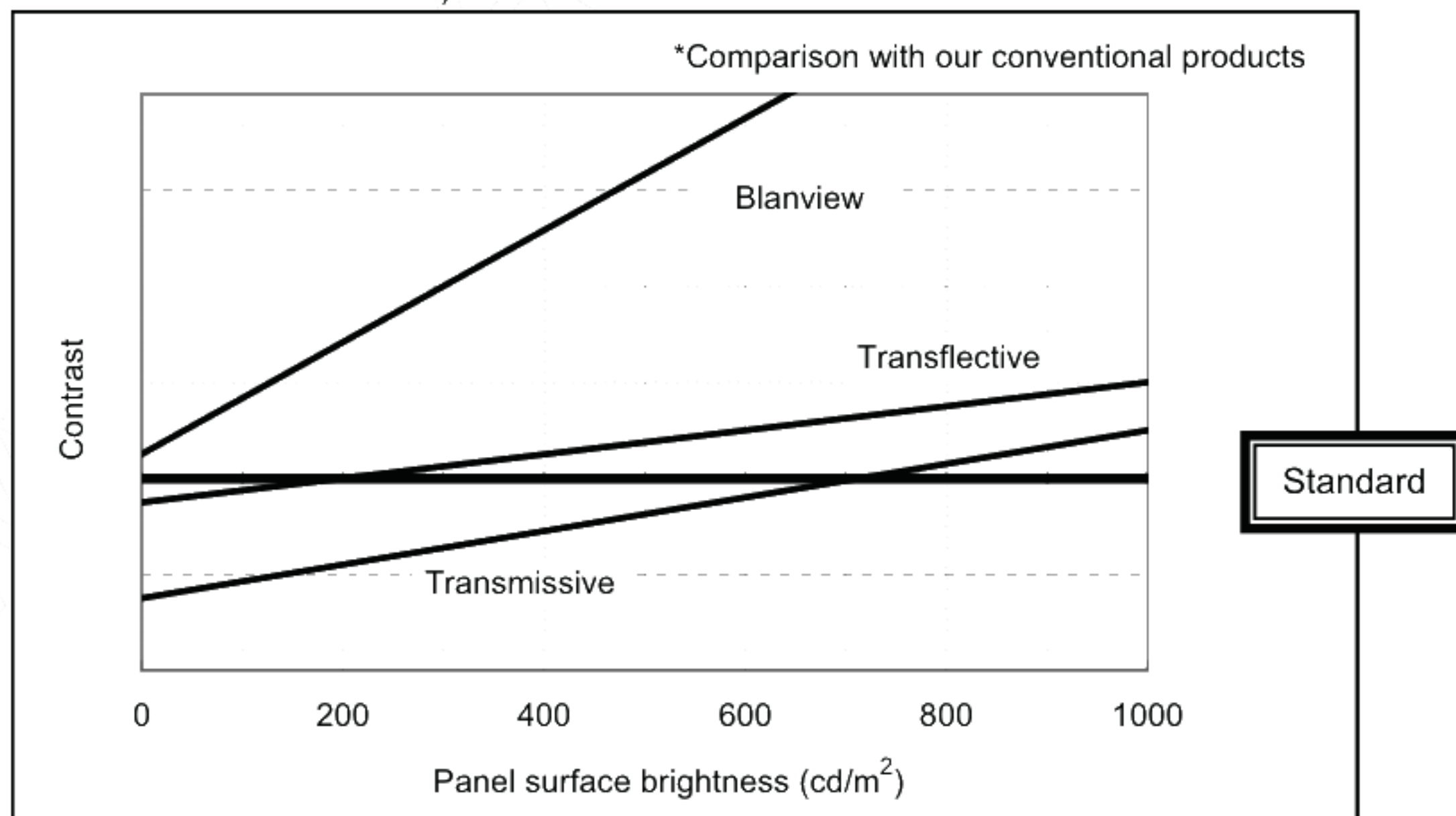
- Backlight power consumption required to assure visibility. (equivalent to 3.5"QVGA)



- 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. (ORTUS TECHNOLOGY criteria)



3. Dimensions and Shape

3.1 Dimensions

Items	Specifications	Unit	Remarks
Outline dimensions	121.28[H]×75.23[V]×4.18[D]	mm	Exclude FPC cable and parts on FPC.
Active area	110.88[H]×62.83[V]	mm	12.7cm diagonal
Number of dots	480[H]×816[V]	dot	
Dot pitch	231.0[H]×77.0[V]	μm	
Hardness of Touch Panel surface	3	H	Load:4.9N,Angle:45° Reference judgment standard:JIS-K5600
Weight	69.0	g	Include FPC cable

3.3 Serial Label (S-label)

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	50APX (Made in Japan) 50AQX (Made in Malaysia) 50ARX (Made in China)		
d	Serial number			

* Example of indication of Serial label (S-label)

• Made in Japan

1E50APX000125

means "manufactured in May 2011, 5.0" AP type, X specifications, serial number 000125"

• Made in Malaysia

1E50AQX000125

means "manufactured in May 2011, 5.0" AQ type, X specifications, serial number 000125"

• Made in China

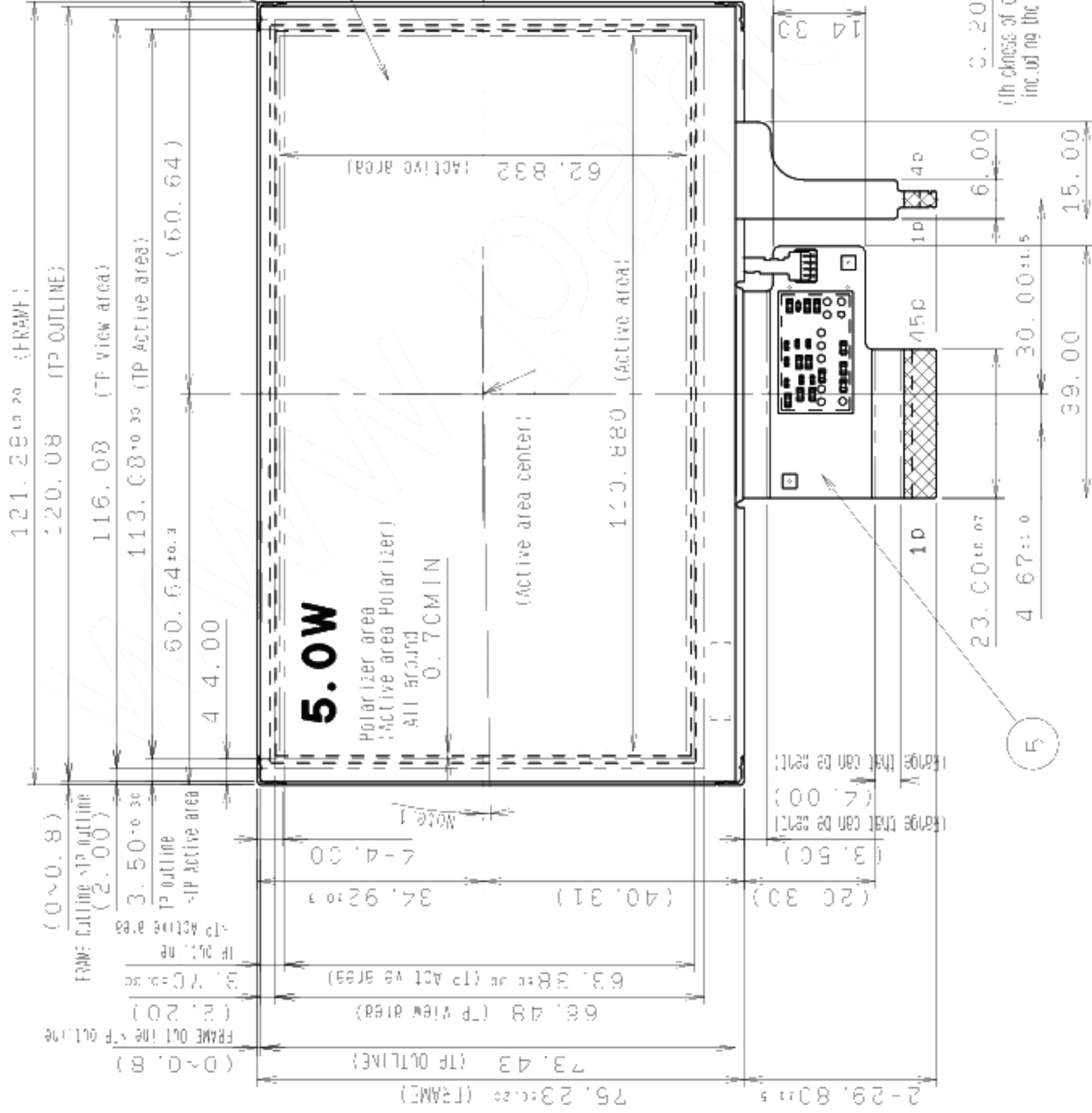
1E50ARX000125

means "manufactured in May 2011, 5.0" AR type, x specifications, serial number 000125"

2) Location of Serial Label (S-label)

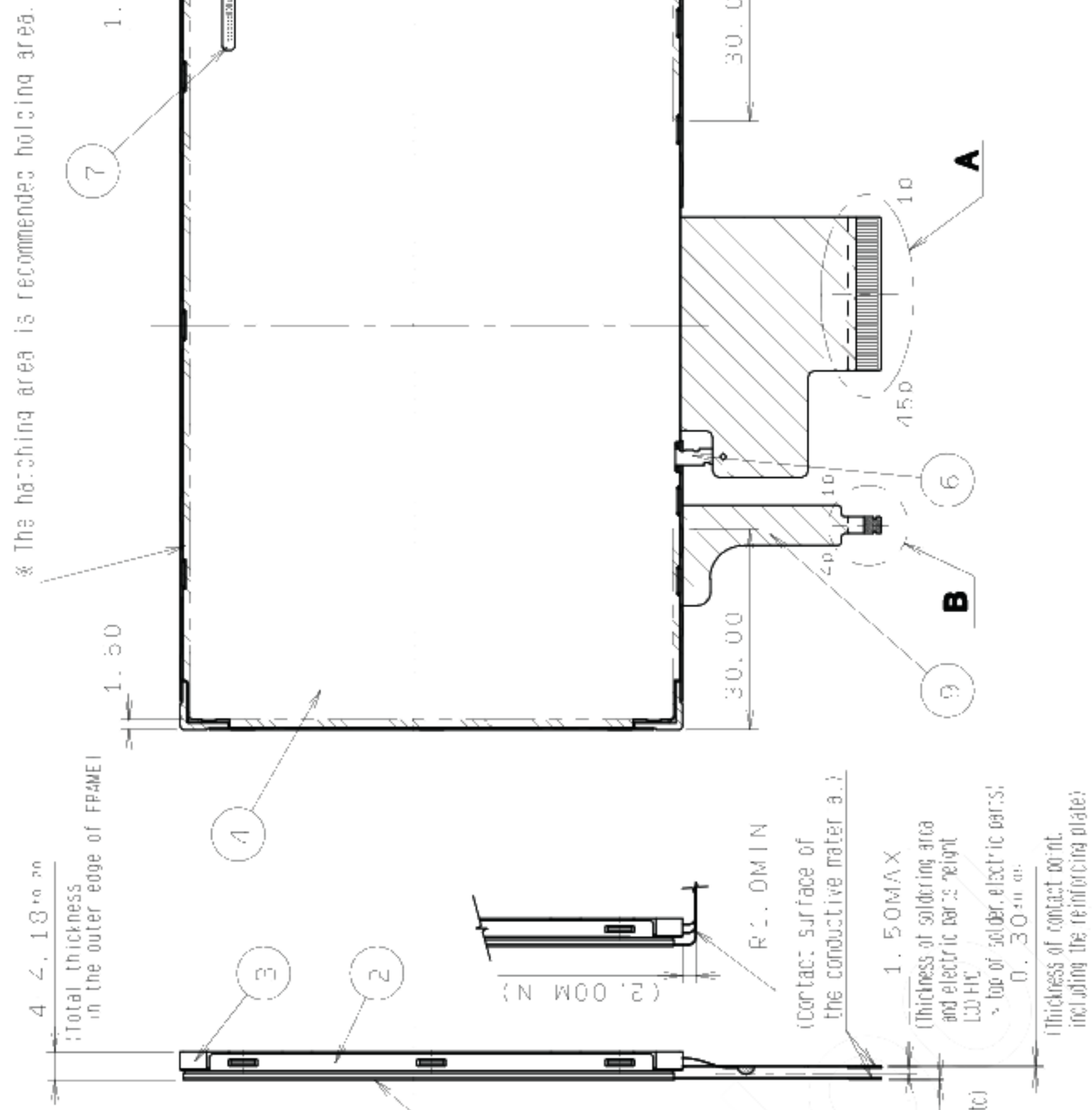
Refer to 3.2 "Outward Form".

3.2 Outward Form



- Note 1. Angular deviation of ICD gel, from the TFT-ICD monitor's reference axis shall be less than $\pm 50^\circ$.
- Note 2. S-label is affixed the area shown in the drawing. The thickness of the S-label will be added to that of S case's surface.
- Note 3. Recommended FPC connectors:
For ICD: Hirose, part number: FH12-455-0.55H(55) (lower contact)
For TP: FCI, part number: 59453-041110 (lower contact)
- FPC pin assignment differs from a position of Datur P n of recommended FPC connector.
- Please notice the difference when designing your circuit with much care.
- Note 4. Protective film is affixed on front surface of the screen.
Location tolerance of the protective film shall be ± 1.5 mm to the touch panel.
- Note 5. Keep a gap, for example 0.3 to 0.7mm between the bezel edge and touch panel surface to avoid the bezel edge from making contacting with the touch panel surface that may cause a "false touch" with the bottom layer.
- Note 6. Recommended dimensions of housing in case of using cent(0.0) (refer to "Example of Housing Design")
- Note 7. Linearity is guaranteed in the area surrounded by 3mm inside lines from Touch Panel Active Area.
- Note 8. Refer to "PERFORMANCE OF ELEMENT" about the appearance specification of a polarizer and touch panel.
- Note 9. TP: TOUCH PANEL
- Note 10. The area outside Active Area will not be covered under the specification of product appearance. He sure to take this into consideration when the window frame of your products will be designed.

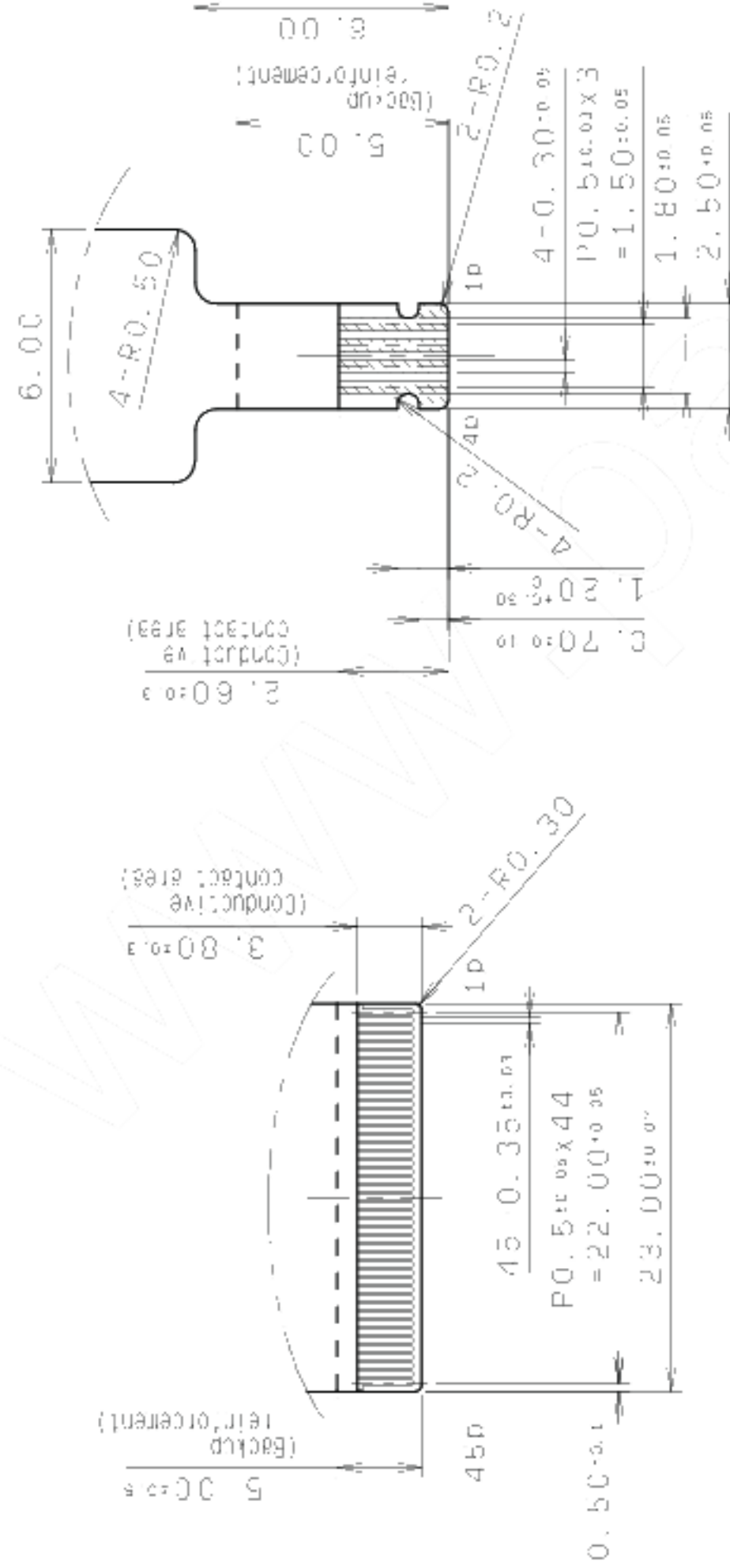
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(8/44)



TP-FPC	9
TOUCH PANEL	8
S LABEL	7
ICD FPC	6
ICD FPC	5
S CASE C	4
FRAME	3
S CASE A	2
TFT ICD PANEL	1
PART NAME	FILM
GENERAL TOLERANCE	±0.5
SCALE	1/1 (2/1.5/1)
UNIT	mm
CHECKED	平信
ISSUE	0: 11: 25
MODEL	OCV5015M23X**
CHUCKLU	NAML
DESIGN	井出明彦
DRAW	井出明彦

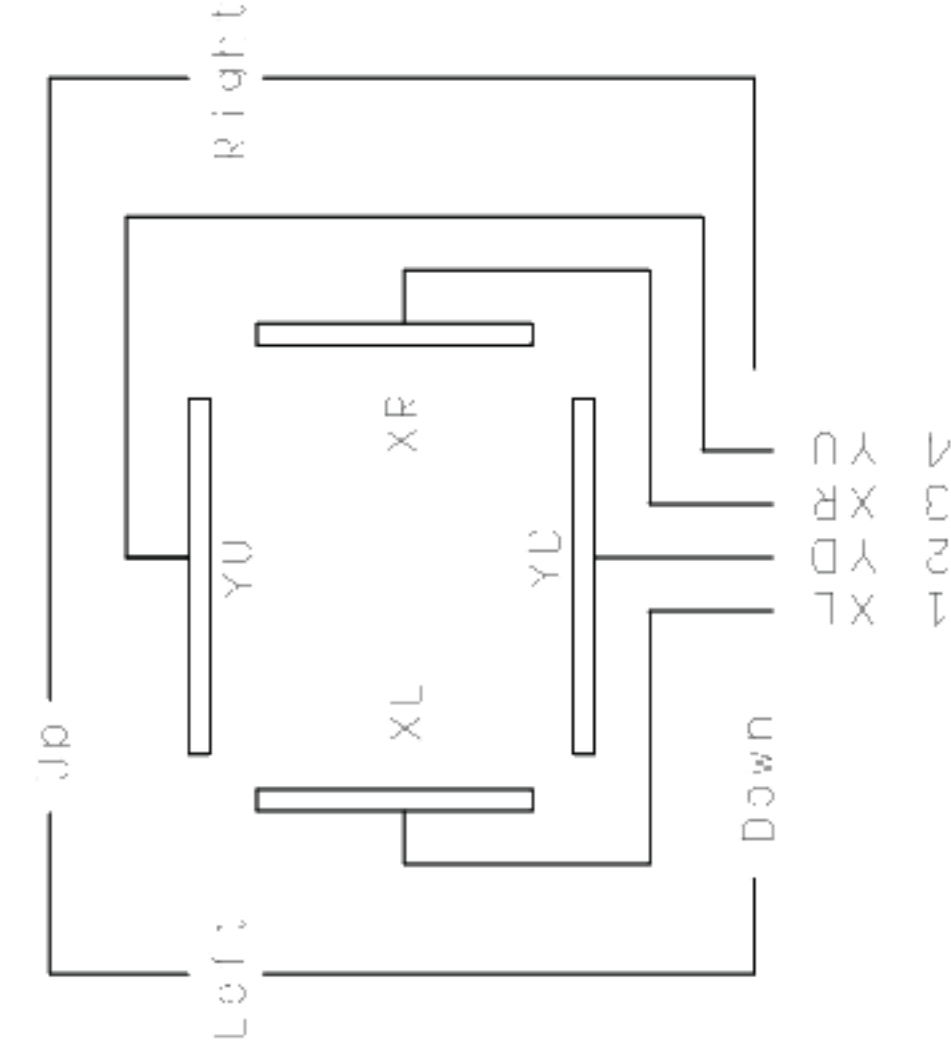
TP-FPC	9
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(9/44)
10TLM107
Issue: Jan. 31, 2011



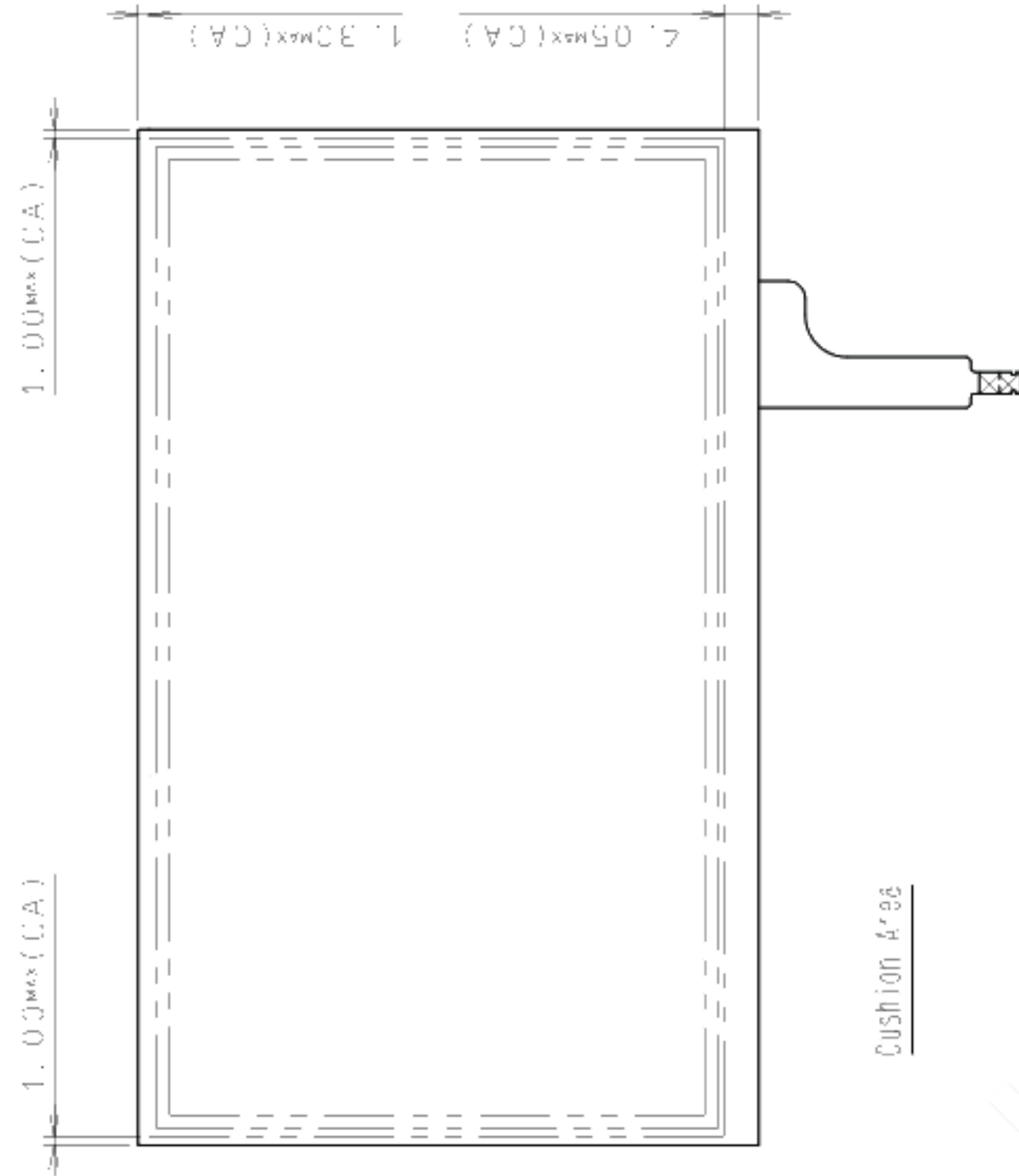
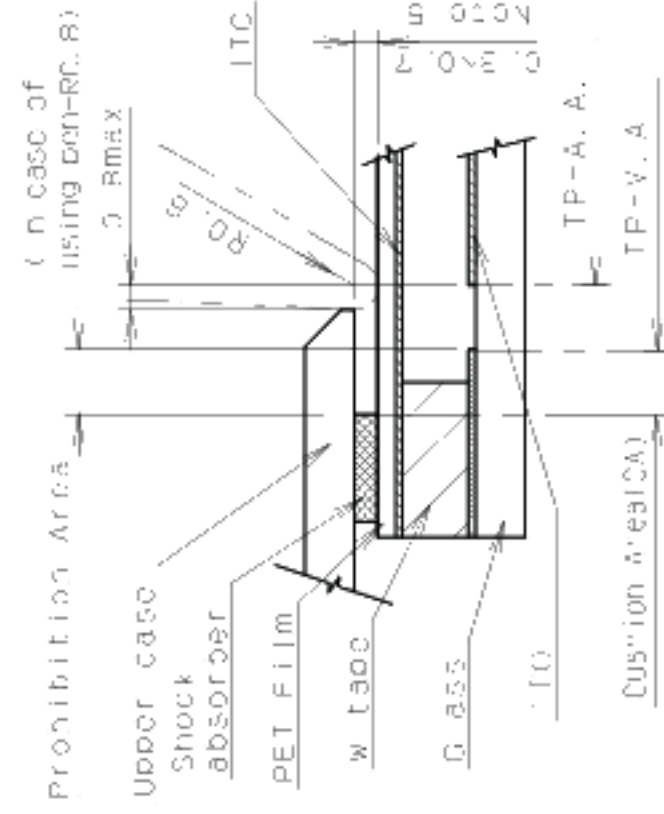
Detail A (S-2/1)

Detail B (S-5/1)



Fretting diagram

Example of housing Design



Cushion Area

Design guidance for the housing & the cushion

Note 11 Upper case opening

- a. Please place the upper case opening to maintain the operation by a stylus pen inside the TP response area.
- b. The any pressures in the area between TP response area and TP viewing area is prohibited.
- c. Please use the appropriate material (PMMA, PC, etc.) as the upper case.

Note 12 Cushion design

- a. Please put the cushion on the upper case.
- b. Do not use an adhesives tape to stick on the TP surface.
- c. Please position the cushion over the cushion area to avoid a short.

APPROVED 核准	GENERAL TOLERANCE ±0.5	SCALE 1/1 (2/1, 5/1)	UNIT mm
CHECKED 审核	ISSUE 10:11:25	MODEL CCM501B/23X	
DRAWN 制图	NAME		
DESIGN 设计	NAME		
DRAW 制图	NAME		

ORTI INF-D5M23

RVD52112D301

2/2

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4. Pin Assignment

LCD Terminal

No	Symbol	I/O	Functions
1	VSS	P	ground
2	CLK	I	Clock signal for data latching and internal counter of the timing controller
3	HSYNC	I	Horizontal sync signal
4	VSYNK	I	Vertical sync signal
5	VSS	P	ground
6	D00	I	Display data(R) 00h: Black Driver has internal gamma conversion.
7	D01	I	
8	D02	I	
9	D03	I	
10	D04	I	
11	D05	I	
12	D06	I	
13	D07	I	
14	D10	I	Display data(G) 00h: Black Driver has internal gamma conversion.
15	D11	I	
16	D12	I	
17	D13	I	
18	D14	I	
19	D15	I	
20	D16	I	
21	D17	I	
22	D20	I	Display data(B) 00h: Black Driver has internal gamma conversion.
23	D21	I	
24	D22	I	
25	D23	I	
26	D24	I	
27	D25	I	
28	D26	I	
29	D27	I	
30	VSS	P	ground
31	DEN	I	Display enable
32	SCK	I	Clock input pin in serial mode
33	SDI	I	Data input pin in serial mode
34	CS	I	Chip select pin of serial interface
35	SHUT	I	Sleep mode control
36	VSS	P	ground
37	VDDIO	P	Voltage input pin for logic I/O
38	RESET	I	System reset
39	SDO	P	Data output pin in serial mode
40	VCI	P	Booster voltage input pin
41	VSS	P	ground
42	BLL1	P	Backlight drive (cathode side)
43	BLH1	P	Backlight drive (anode side)
44	BLL2	P	Backlight drive (cathode side)
45	BLH2	P	Backlight drive (anode side)

- Recommended connector: HIROSE ELECTRIC [FH12-45S-0.5SH(55)](Lower contact)
- Please make sure to check a consistency between pin assignment in "3.2 Outward Form" and your connector pin assignment when designing your circuit.
Inconsistency in input signal assignment may cause a malfunction.
- Since FPC cable has gold plated terminals, gilt finish contact shoe connector is recommended.

Touch Panel Terminal

No	Symbol	I/O	Functions
1	XL	I	X-axis left terminal.
2	YD	I	Y-axis downside terminal.
3	XR	I	X-axis right terminal.
4	YU	I	Y-axis upside terminal.

- Recommended connector: FCI [59453-041110](Lower contact)
- Please make sure to check a consistency between pin assignment in "3.2 Outward Form" and your connector pin assignment when designing your circuit.
Inconsistency in input signal assignment may cause a malfunction.
- Since FPC cable has gold plated terminals, gilt finish contact shoe connector is recommended.

VSS=0V

5. Absolute Maximum Rating

Item	Symbol	Condition	Rating		Unit	Applicable terminals
			MIN	MAX		
Supply voltage	VCI	Ta=25℃	VSS-0.3	5.0	V	VCI
Logic I/O power supply voltage	VDDIO		-0.3	4.0	V	VDDIO
Logic input voltage	VI		-0.3	VDDIO+0.3	V	Note1
LED direction current of order	IL	Ta=25℃	--	35	mA	BLH1 - BLL1,BLH2 - BLL2
		Ta=70℃	--	15		
Touch Panel input voltage	VIT		--	7.0	V	XL,XR,YU,YD
Storage temperature	Tstg		-20	80	℃	

Note1 : RESET,CS,SCK,SDI,DEN,VSYN,HSYN,CLK,D00~D07,D10~D17,D20~D27,SHUT

6. Recommended Operating Conditions

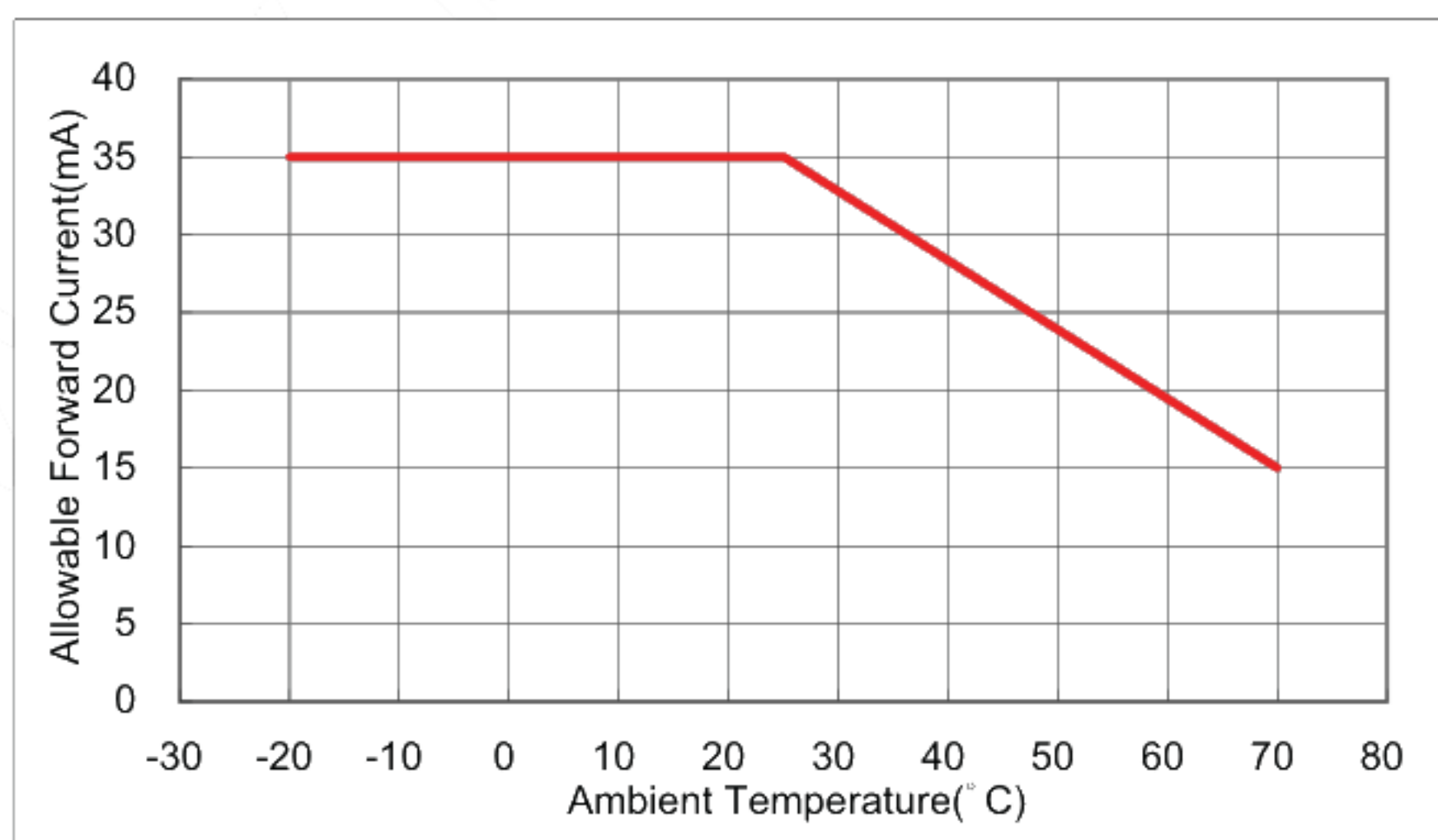
VSS=0V

Item	Symbol	Condition	Rating			Unit	Applicable terminals
			MIN	TYP	MAX		
Supply voltage	VCI	R0Bh=1000h	3.1	3.3	3.5	V	VCI
Logic IO DC voltage	VDDIO		1.6	1.8	3.5	V	VDDIO
Input voltage for logic	VI		0	--	VDDIO	V	Note2
Operational temperature	Top	Note3,Note4	-10	+25	+70	℃	Touch panel surface temperature
Operating humidity range	Hop	Ta≤30℃	20	--	80	%	
		Ta>30℃	Non condensing in an environmental moisture at or less than 30℃80%RH.				

Note2 : RESET,CS,SCK,SDI,DEN,VSYN,HSYN,CLK,D00~D07,D10~D17,D20~D27,SHUT

Note3 : This monitor is operatable in this temperature range. With regard to optical characteristics, refer to Item 15."CHARACTERISTICS".

Note4 : Acceptable Forward Current to LED is up to 15mA, when Ta=+70℃.
Do not exceed Allowable Forward Current shown on the chart below.



7. Characteristics

7.1 DC Characteristics

7.1.1 Display Module

(Unless otherwise noted, Ta=25°C, VCI=3.3V, VDDIO=1.8V, VSS=0V)

Item	Symbol	Condition	Rating			Unit	Application terminals
			MIN	TYP	MAX		
Input voltage for logic	VIH		0.80×VDDIO	--	VDDIO	V	Note1
	VIL		0	--	0.20×VDDIO	V	
Logic input current	IIH/IIL		-1	--	1	μA	CSB,SCK,SDI
Output voltage for logic	VOH	I _{OUT} =-100μA	0.90×VDDIO	--	VDDIO	V	SDO
	VOL	I _{OUT} =100μA	0	--	0.10×VDDIO	V	
Logic output of Leak	IOZ		-1	--	1	μA	
Current consumption	IDDIO	fCLK=8.54MHz Color bar display	--	2.3	4.6	μA	VDDIO
	ICI	R0Bh=1000h	--	18.0	36.0	mA	VCI

Note1 : RESET,CS,SCK,SDI,DEN,VSYN,HSYN,CLK,D00~D07,D10~D17,D20~D27,SHUT

7.1.2 Back-light

Item	Symbol	Condition	Rating			Unit	Application terminals
			MIN	TYP	MAX		
Forward direction current	IL	Ta=25°C	--	20.0	30.0	mA	BLH1-BLL1
	IL	Ta=70°C	--	--	15.0	mA	BLH2-BLL2
Forward direction voltage	VL	Ta=25°C IL=20.0mA	16.8	--	21.0	V	

7.1.3 Touch Panel

Ta=25℃

Item	Symbol	Condition	Rating			Unit	Application terminals
			MIN	TYP	MAX		
Linearity	LE	Note1	-1.5	--	1.5	%	
Insulation resistance	RI	DC 25V 1mm	20	--	--	MΩ	XR,XL-YU,YD
Terminal resistance		X	200	--	900	Ω	XR,XL
		Y	160	--	640		YU,YD
Rated voltage		DC	--	5	7	V	XR,XL,YU,YD
on/off chattering		Note2	--	--	10	ms	

Note1: After environmental and life test. 80gf less input with stylus pen (R0.8mm)

Note2: on/off chattering: Tip R 3.75mm , hardness 10~20degree , silicon rubber , 500gf operation , 40 mm/sec

Mechanical Characteristics

Item	Rating			Unit	Remark
	MIN	TYP	MAX		
Detectable activation force	0.05	--	0.5	N	R0.8mm Polyacetal pen. Resistance between X and Y axis must be equal or lower than 2KΩ. Activation force guarantee area: 2.0mm inside of Active Area.
Keystroke durability	1,000,000	--	--	times	key the same part by silicon rubber. -Rubber tip part: R8mm -Load: 2.45N -speed: 3times/second

7.2 AC Characteristics

7.2.1 Display Block

(Unless otherwise noted, Ta=25°C, VCI=3.3V, VDDIO=1.8V, VSS=0 V)

Item	Symbol	Condition	Rating			Unit	Applicable terminal
			MIN	TYP	MAX		
Clock Low period	tw1L		18	--	--	ns	CLK
Clock High period	tw1H		18	--	--	ns	CLK
HSYNC setup time	tsp1		5	--	--	ns	HSYNC,CLK
HSYNC hold time	thd1		5	--	--	ns	HSYNC,CLK
Data setup time	tsp2		10	--	--	ns	D00:D07,D10:17
Data hold time	thd2		15	--	--	ns	,D20:D27,CLK
VSYNC setup time1	tsp3		5	--	--	ns	VSYNC,CLK
VSYNC hold time1	thd3		5	--	--	ns	VSYNC,CLK
RESET Pulse width	tRES		10	--	--	μs	RESET
Rise/Fall time	tr/tf		5	--	25	ns	
Clock frequency	fCLK		--	8.54	8.69	MHz	CLK

Note: External clock source must be provided to CLK pin of this monitor.

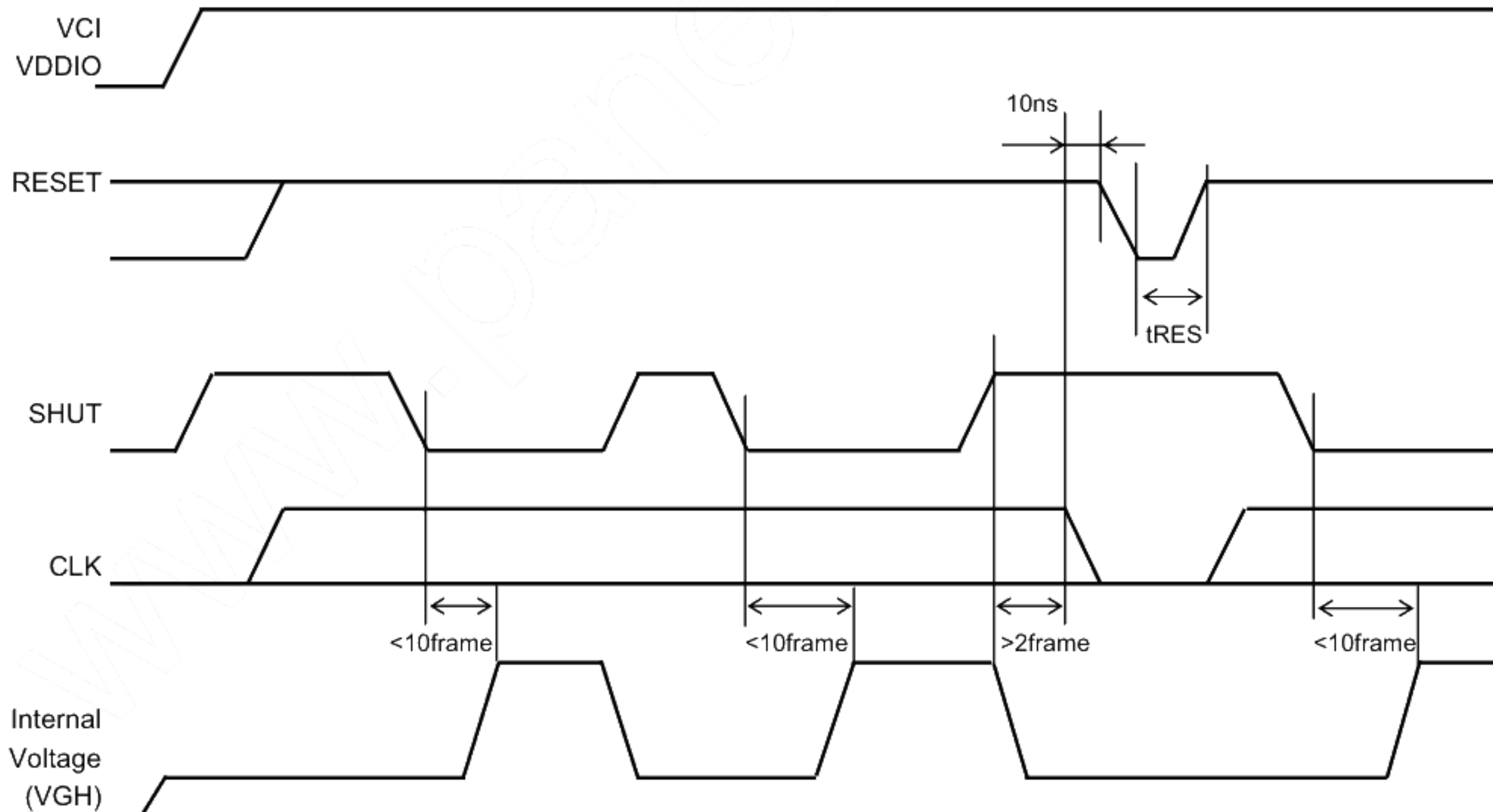
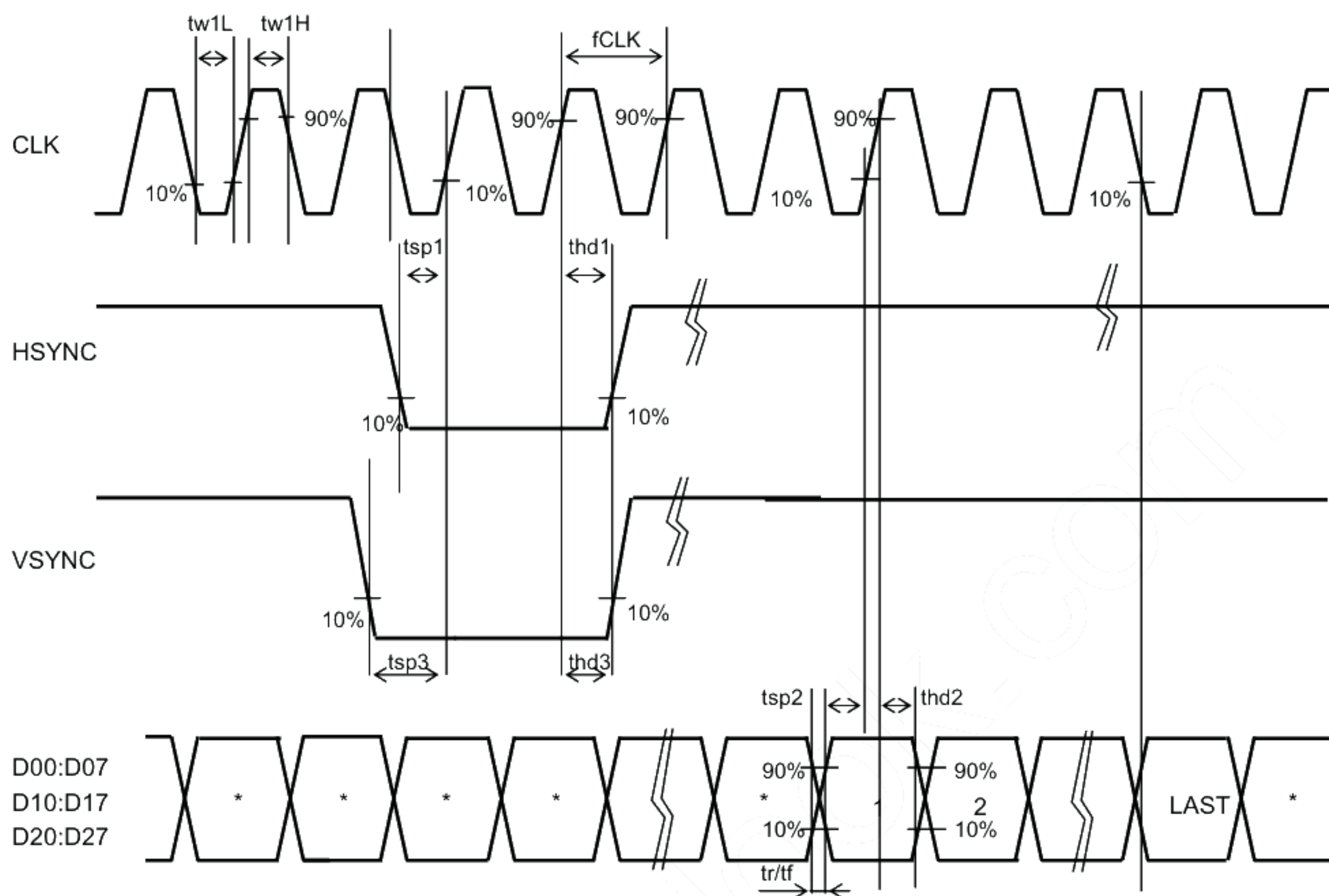
This Monitor will not operate if absent of the clocking signal.

7.2.2 Serial Communication Block

(Unless otherwise noted, Ta=25°C, VCI=3.3V, VDDIO=1.8V, VSS=0 V)

Item	Symbol	Condition	Rating			Unit	Applicable terminal
			MIN	TYP	MAX		
CS Setup time	tsp4		5	--	--	ns	CS
CS Hold Time	thd4		10	--	--	ns	CS
DI Setup Time	tsp5		5	--	--	ns	SDI
DI Hold Time	thd5		15	--	--	ns	SDI
CS puls High Period	tw3H		20	--	--	ns	CS
SCK puls Low Period	tw2L		25	--	--	ns	SCK
SCK puls High Period	tw2H		25	--	--	ns	SCK

Switching Characteristics Wave Form1



Note2: The minimum cycle time of SHUT is $10 + 2$ frames.

Note3: CLK must be provided for boosting of VGH.

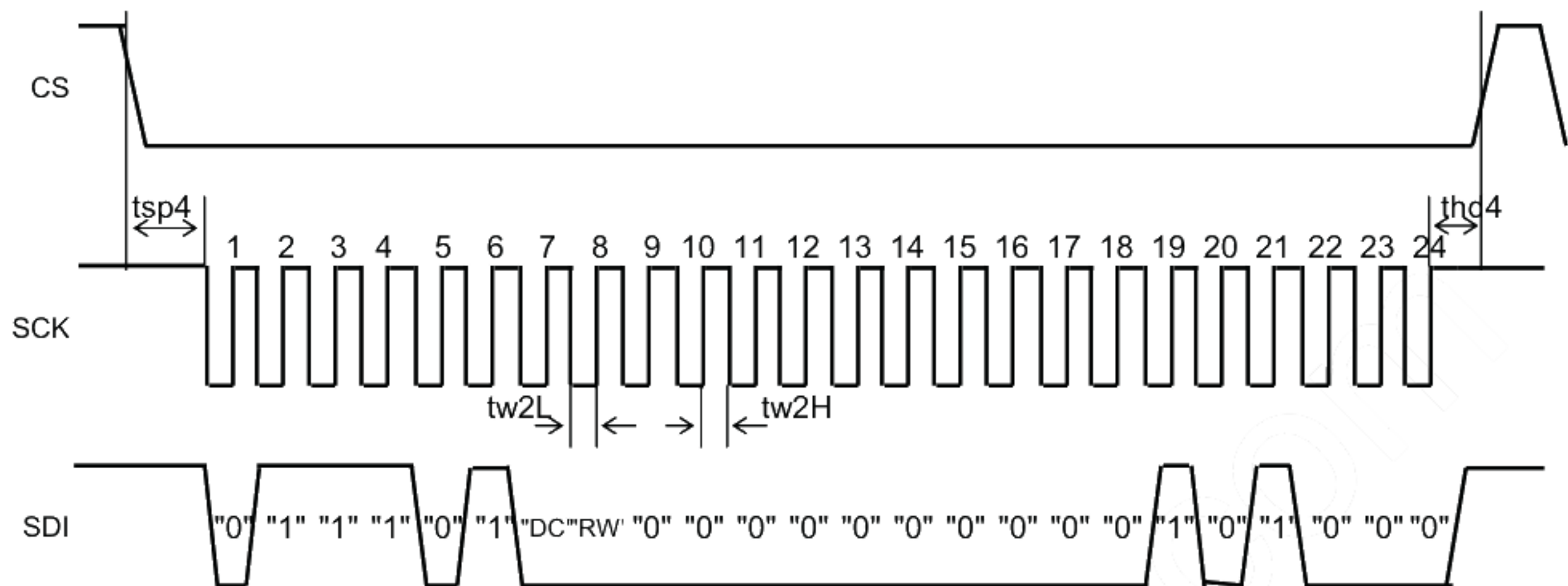
The above timing diagram assumed voltages and CLK are continuous supplied after power on.

Note4: VGH will be forced to VCI at the low stage of RESET.

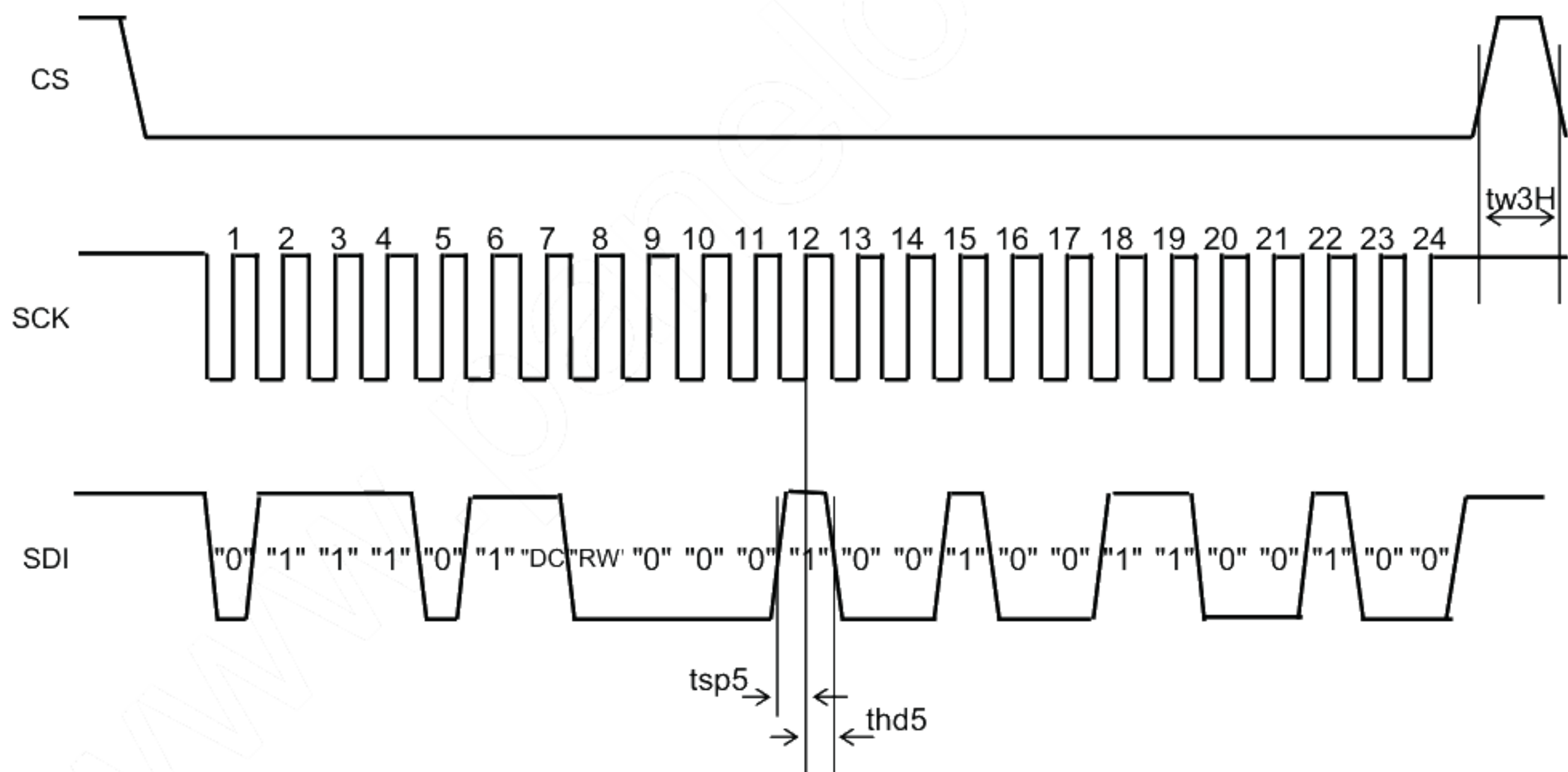
Note5: The minimum pulse width of RESET is $10\mu s$.

Switching Characteristics Wave Form2

First Transmission (Register)



Second Transmission (Data)



Note : Regulation between 50% of each signal amplitude

8. Input timing

8.1 Input timing

(Unless otherwise noted, Ta=25°C, VCI=3.3V, VDDIO=1.8V, VSS=0 V)

Item	Symbol	Rating			Unit	Applicable terminals
		MIN	TYP	MAX		
VSYNC signal cycle time	tv	—	278	—	H	VSYNC,HSYNC
VSYNC frequency	f _{VSYNC}	—	59.72	—	Hz	VSYNC
VSYNC pulse width	tw _{4H}	1	2	—	H	VSYNC,HSYNC
Vertical back porch	tvb	1	4	—	H	VSYNC,HSYNC,DEN,D00:D07, D10:D17,D20:D27
Vertical display period	tvd _p	—	272	—	H	VSYNC,HSYNC,DEN,D00:D07, D10:D17,D20:D27
Vertical front porch	tvf	1	2	—	H	VSYNC,HSYNC,DEN,D00:D07, D10:D17,D20:D27
HSYNC signal cycle time	th	—	512	—	CLK	HSYNC,CLK
HSYNC frequency	f _{HSYNC}	—	16.68	—	KHz	HSYNC
HSYNC pulse width	tw _{5H}	2	8	—	CLK	HSYNC,CLK
Horizontal back porch	thb	—	16	—	CLK	HSYNC,CLK,DEN,D00:D07, D10:D17,D20:D27
Horizontal display period	thd _p	—	480	—	CLK	HSYNC,CLK,DEN,D00:D07, D10:D17,D20:D27
Horizontal front porch	thf	2	16	—	CLK	HSYNC,CLK,DEN,D00:D07, D10:D17,D20:D27

Note1: The characteristic of this item is recommended standard.

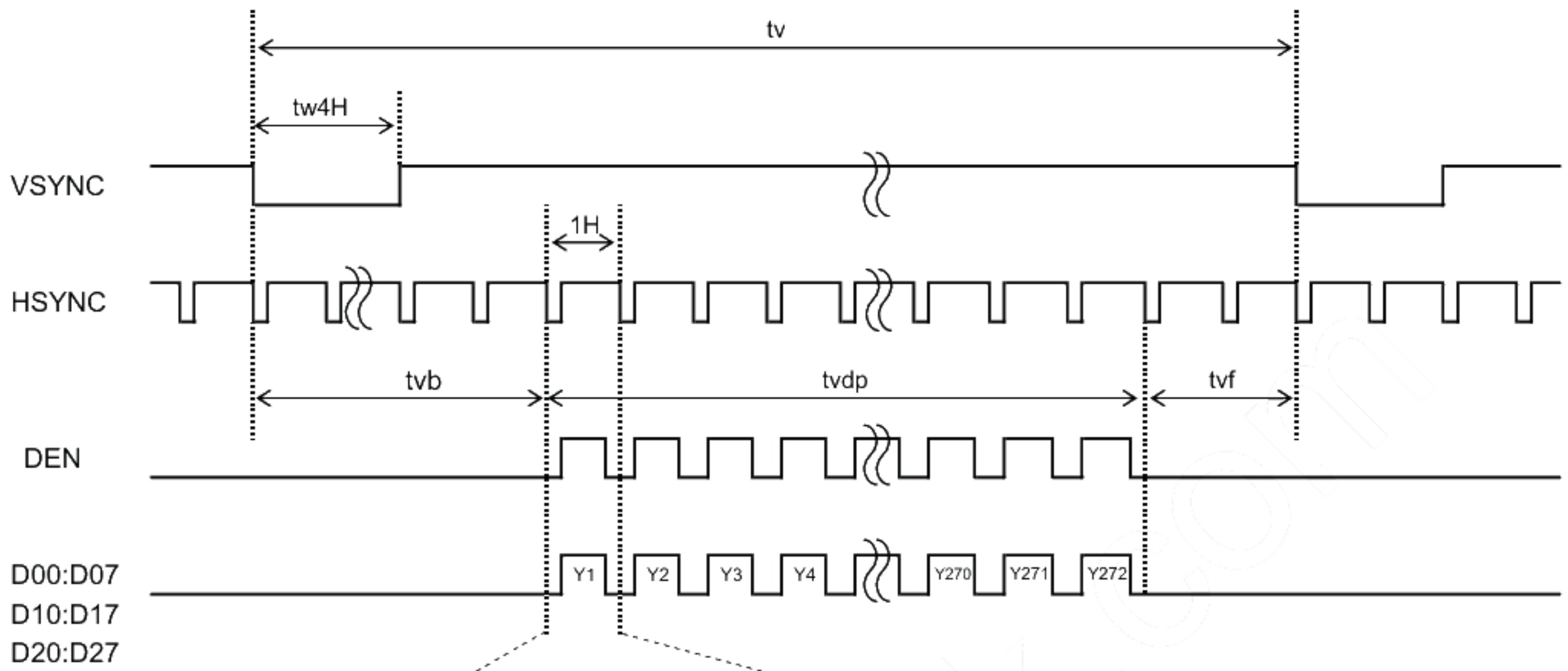
Please use it after it confirms it enough like the display fineness etc.

When it comes off from this characteristic and it is used.

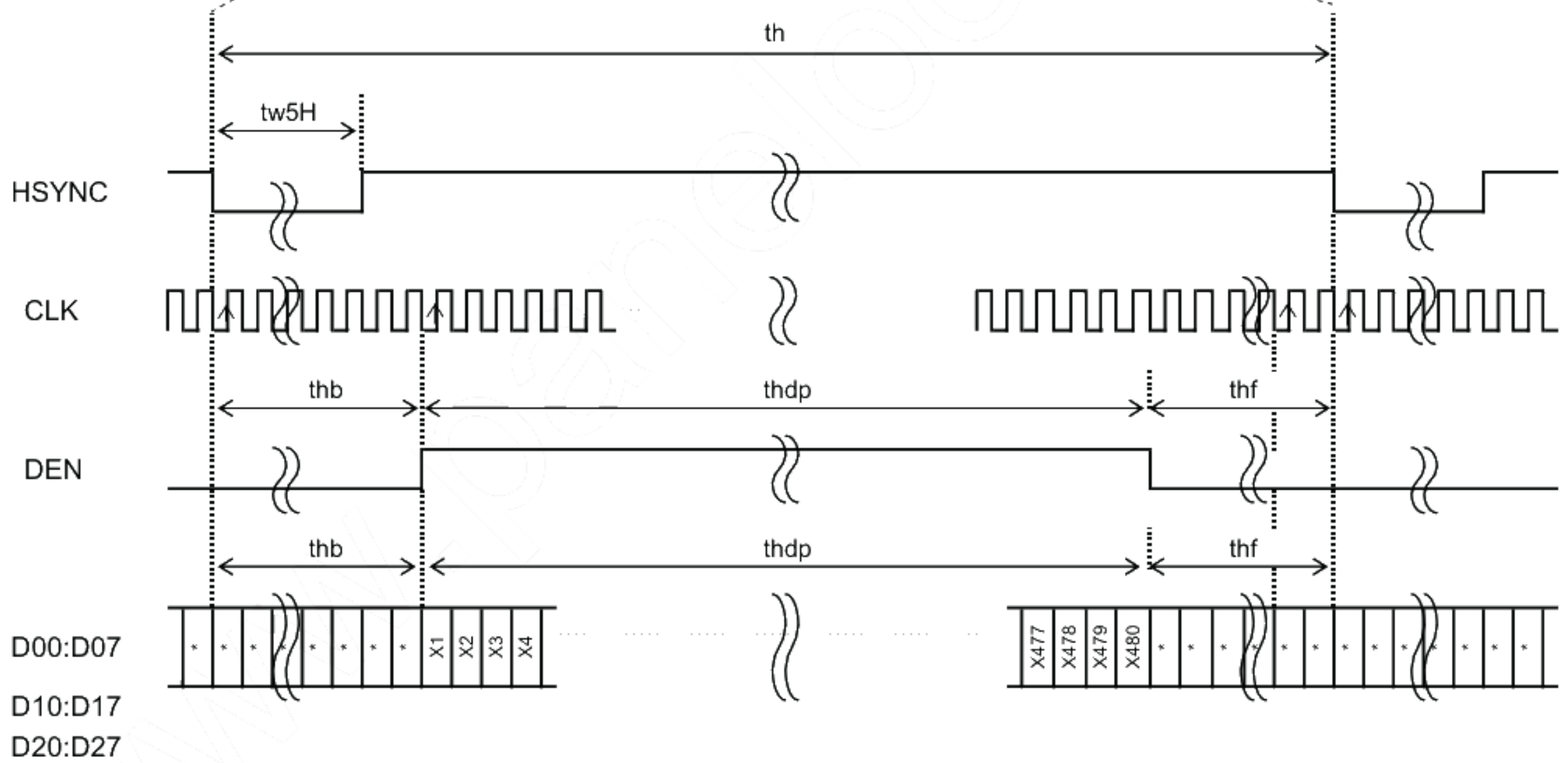
Note2: thf+thdp+thb=512DOTCLK tvf+tvbp+tvf=278H This condition must be necessary.

8.2 Input timing chart

8.2.1 Vertical Timing

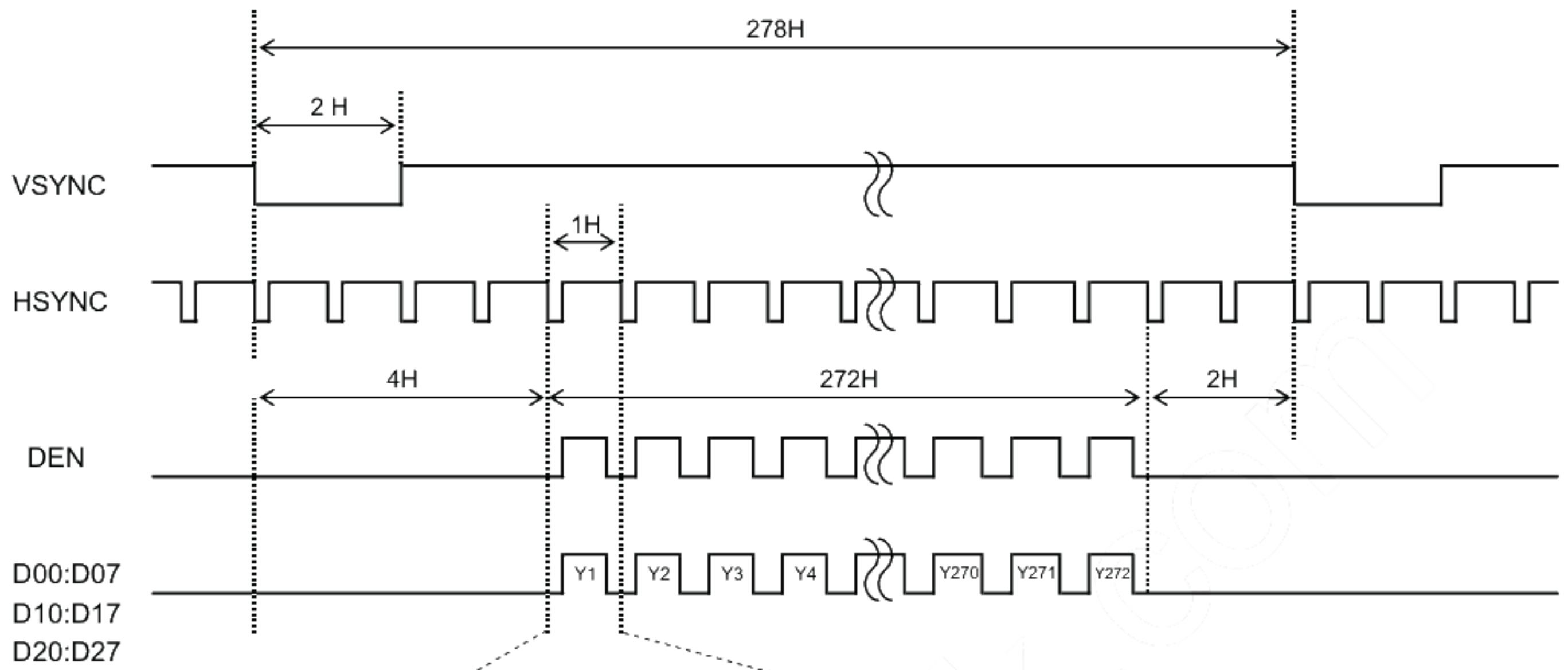


8.2.2 Horizontal Timing

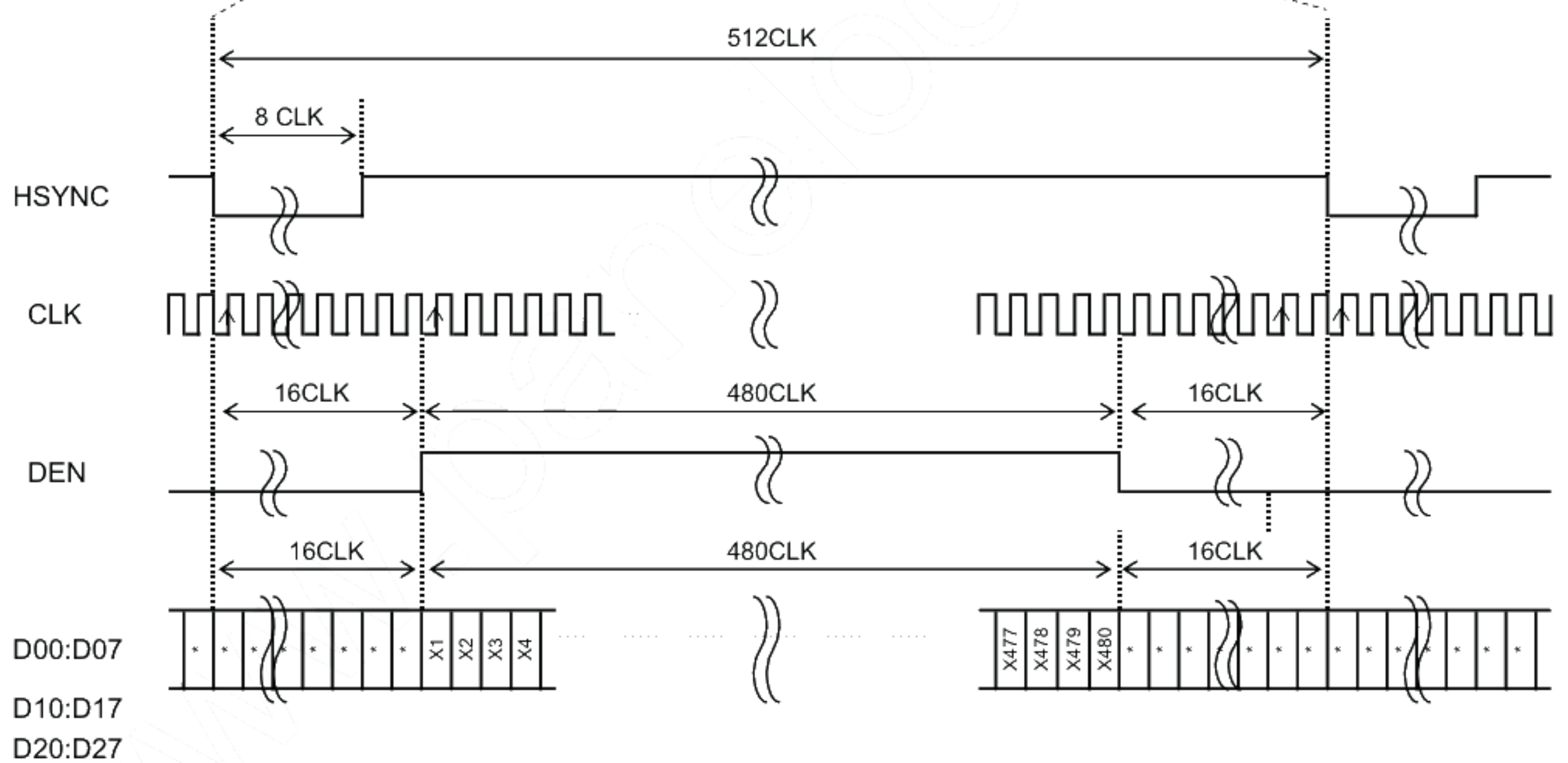


8.3 Input timing example ($f_{CLK} = (8.54)MHz$)

8.3.1 Vertical Timing



8.3.2 Horizontal Timing



9.Register Setting

Register address	Register name	Data	Remark
R01h	Driver output control 1	230Fh	
R02h	LCD Driving Waveform Control	0C02h	
R03h	Power Control 1	010Fh	
R04h	Driver output control 2	0414h	
R0Bh	Frame cycle control	1000h	
R0Ch	Power Control 2	0005h	
R0Dh	Power Control 3	000Ch	
R0Eh	Power Control 4	2900h	
R16h	Pixel per line	EF8Eh	
R17h	Vertical Porch	0003h	
R1Eh	Power Control 5	02**h	Note1
R30h	Gamma control 1	0705h	
R31h	Gamma control 2	0707h	
R32h	Gamma control 3	0607h	
R33h	Gamma control 4	0003h	
R34h	Gamma control 5	0702h	
R35h	Gamma control 6	0707h	
R36h	Gamma control 7	0307h	
R37h	Gamma control 8	0500h	
R3Ah	Gamma control 9	1F00h	
R3Bh	Gamma control 10	0008h	
R28h	Extended Command 1	0006h	
R2Ah	Extended Command 2	01D0h	
R10h	Extended Command 3	02CCh	
R26h	Extended Command 4	2800h	
R15h	Extended Command 5	0090h	
R2Ch	Extended Command 6	3BBDh	
R27h	Extended Command 7	0078h	
R13h	Extended Command 8	0D5Ah	

Note1 : [register for VcomDC adjustment]

Please adjust to the optimal value for every panel by the 8-bit data of 「IB0~IB7」.

IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
0	0	0	0	0	0	1	0	The optimal setup for every monitor							

10. Sequence

< Power ON Sequence >

1	VDDIO ON / Keep Hi or Low level (CLK, HSYNC, VSYNC, DEN, RGB-DATA) / Keep Low level (RESET) / Keep Hi level (SHUT)
2	Wait more than 0.1 msec



3	VCI ON
4	Wait more than 0.1 msec



5	Change Hi level (RESET)
6	Wait more than 100 msec



DC=Data / Command

No.	Item	Function	Recommended register		DC
7	Initial setting Display mode setting Timing setting Power control setting	Driver Output Control 1	R01	230Fh	1
		LCD-Driving-Waveform Control	R02	0C02h	1
		Power Control 1	R03	010Fh	1
		Driver Output Control 2	R04	0414h	1
		Frame Cycle Control	R0B	1000h	1
		Power Control 2	R0C	0005h	1
		Power Control 3	R0D	000Ch	1
		Power Control 4	R0E	2900h	1
		Pixel per line	R16	EF8Eh	1
		Vertical Porch	R17	0003h	1
		Power Control 5	R1E	02**h	1
8	γ setting	γ setting register 1	R30	0705h	1
		γ setting register 2	R31	0707h	1
		γ setting register 3	R32	0607h	1
		γ setting register 4	R33	0003h	1
		γ setting register 5	R34	0702h	1
		γ setting register 6	R35	0707h	1
		γ setting register 7	R36	0307h	1
		γ setting register 8	R37	0500h	1
		γ setting register 9	R3A	1F00h	1
		γ setting register 10	R3B	0008h	1
9	Power control setting	VCOM MTP	R28	0006h	1
		VCOM EQ	R2A	01D0h	1
		software 8 color mode / VCI detector mode	R10	02CCh	1
		Gamma Buffer basing current	R26	2800h	1
		Double Source amp	R15	0090h	1
		2nd Booster freq	R2C	3BBDh	1
		VCOM BIAS	R27	0078h	1
		Sleep mode control	R13	0D5Ah	1



10	Wait more than 200 msec
11	Start CLK, HSYNC, VSYNC, DEN, RGB-DATA



12	Wait more than 1usec
13	Exit Sleep Mode by S/W command or H/W signal (SHUT)



14	Wait more than 10 frames
----	--------------------------



15	Display ON
----	------------



16	Normal Display
----	----------------

< Power OFF Sequence >

1	Normal Display
↓	
2	Wait 1 frame min
3	Enter the Sleep mode by S/W command or H/W signal
↓	
4	Wait 2 frame min
5	Stop CLK,HSYNC,VSYNC, DEN, RGB-DATA (Keep Hi or Low level)
↓	
6	Wait more than 0 msec
7	VCI OFF
↓	
8	Wait about 0.1 msec
9	VDDIO OFF

< Enter Sleep Mode Sequence >

1	Normal Display
↓	
2	Wait 1 frame min
3	Enter the Sleep mode by S/W command or H/W signal ※note
↓	
4	Wait 2 frame min
5	Stop CLK,HSYNC,VSYNC, DEN, RGB-DATA (Keep Hi or Low level)
↓	
6	LED OFF

< Exit Sleep Mode Sequence >

1	Start CLK,HSYNC,VSYNC, DEN, RGB-DATA(Keep Hi or Low level)
↓	
2	Exit the Sleep mode by S/W command or H/W signal (SHUT)
↓	
3	Wait 10 frames
4	LED ON
↓	
5	Normal Display

Note: When canceling sleep mode immediately after shifting to sleep mode,
it is a period from the shift start of sleep mode to release of sleep mode.
Please set up more than 300msec.

< Refreshment Sequence >

Malfunction may be caused when a register preset value is rewritten

by the unsuitable value under the influence of static electricity, a noise, etc.

If it drives in the state for a long time, there is a possibility of causing degradation of a liquid crystal etc.

In order to cancel this malfunction, please perform a refreshment sequence periodically.

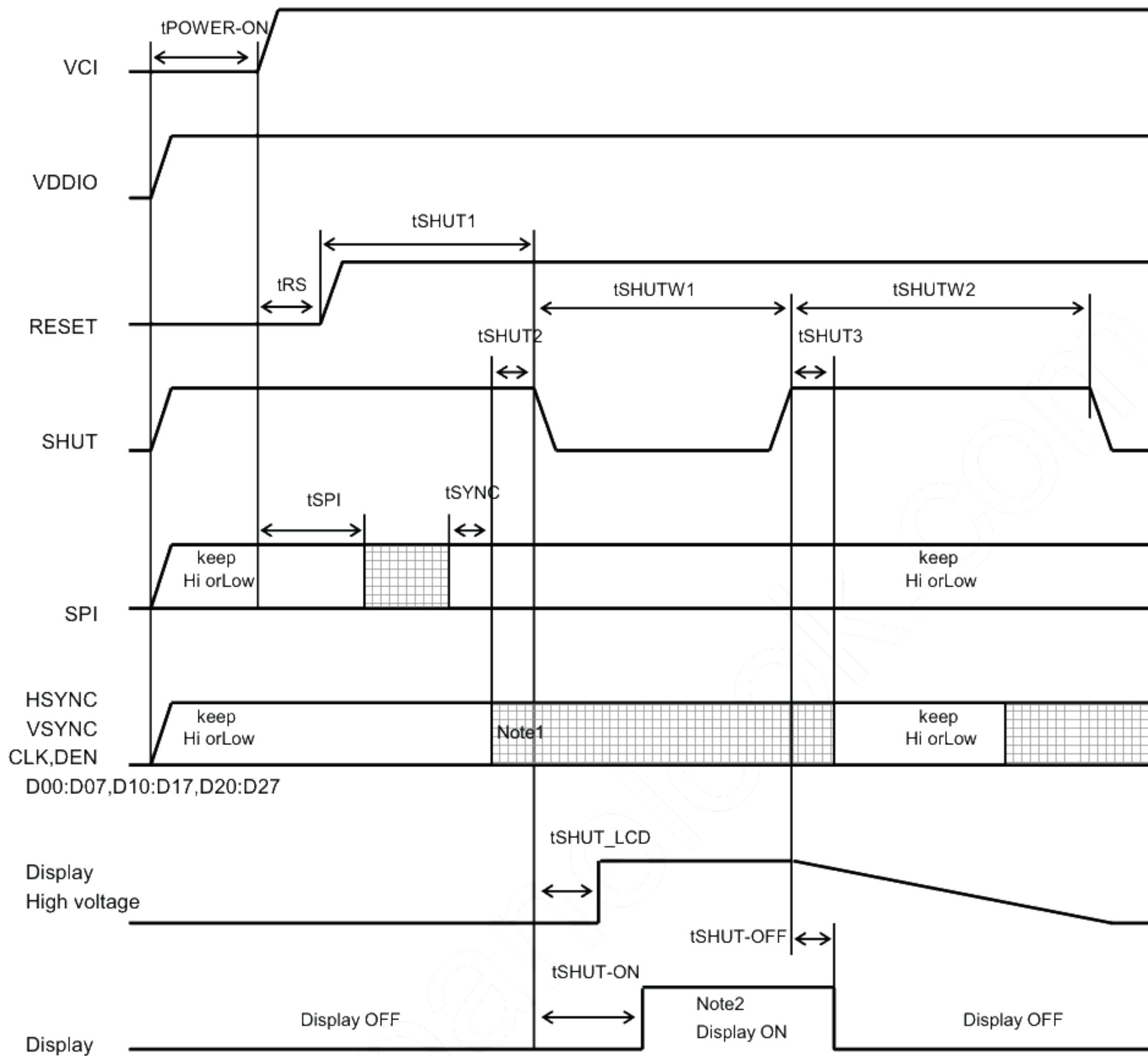
(Recommendation 500msec interval)

DC=Data / Command

No.	Item	Function	Recommended register	DC
1	Initial setting Display mode setting Timing setting Power control setting	Driver Output Control 1	R01 230Fh	1
		LCD-Driving-Waveform Control	R02 0C02h	1
		Power Control 1	R03 010Fh	1
		Driver Output Control 2	R04 0414h	1
		Frame Cycle Control	R0B 1000h	1
		Power Control 2	R0C 0005h	1
		Power Control 3	R0D 000Ch	1
		Power Control 4	R0E 2900h	1
		Pixel per line	R16 EF8Eh	1
		Vertical Porch	R17 0003h	1
		Power Control 5	R1E 02**h	1
2	γ setting	γ setting register 1	R30 0705h	1
		γ setting register 2	R31 0707h	1
		γ setting register 3	R32 0607h	1
		γ setting register 4	R33 0003h	1
		γ setting register 5	R34 0702h	1
		γ setting register 6	R35 0707h	1
		γ setting register 7	R36 0307h	1
		γ setting register 8	R37 0500h	1
		γ setting register 9	R3A 1F00h	1
		γ setting register 10	R3B 0008h	1
3	Power control setting	VCOM MTP	R28 0006h	1
		VCOM EQ	R2A 01D0h	1
		software 8 color mode / VCI detector mode	R10 02CCh	1
		Gamma Buffer basing current	R26 2800h	1
		Double Source amp	R15 0090h	1
		2nd Booster freq	R2C 3BBDh	1
		VCOM BIAS	R27 0078h	1
		Sleep mode control	R13 0D5Ah	1
		Gate Scan starting position	R0F 0000h	1
		Power Control 6	R1F 1890h	1
		Enable SDO	R2B 0520h	1
		Read SDO	R2E B544h	1
		Software SHUT(5)	R2D 3F40h	1

11. Power Sequence

11.1 Power On Sequence

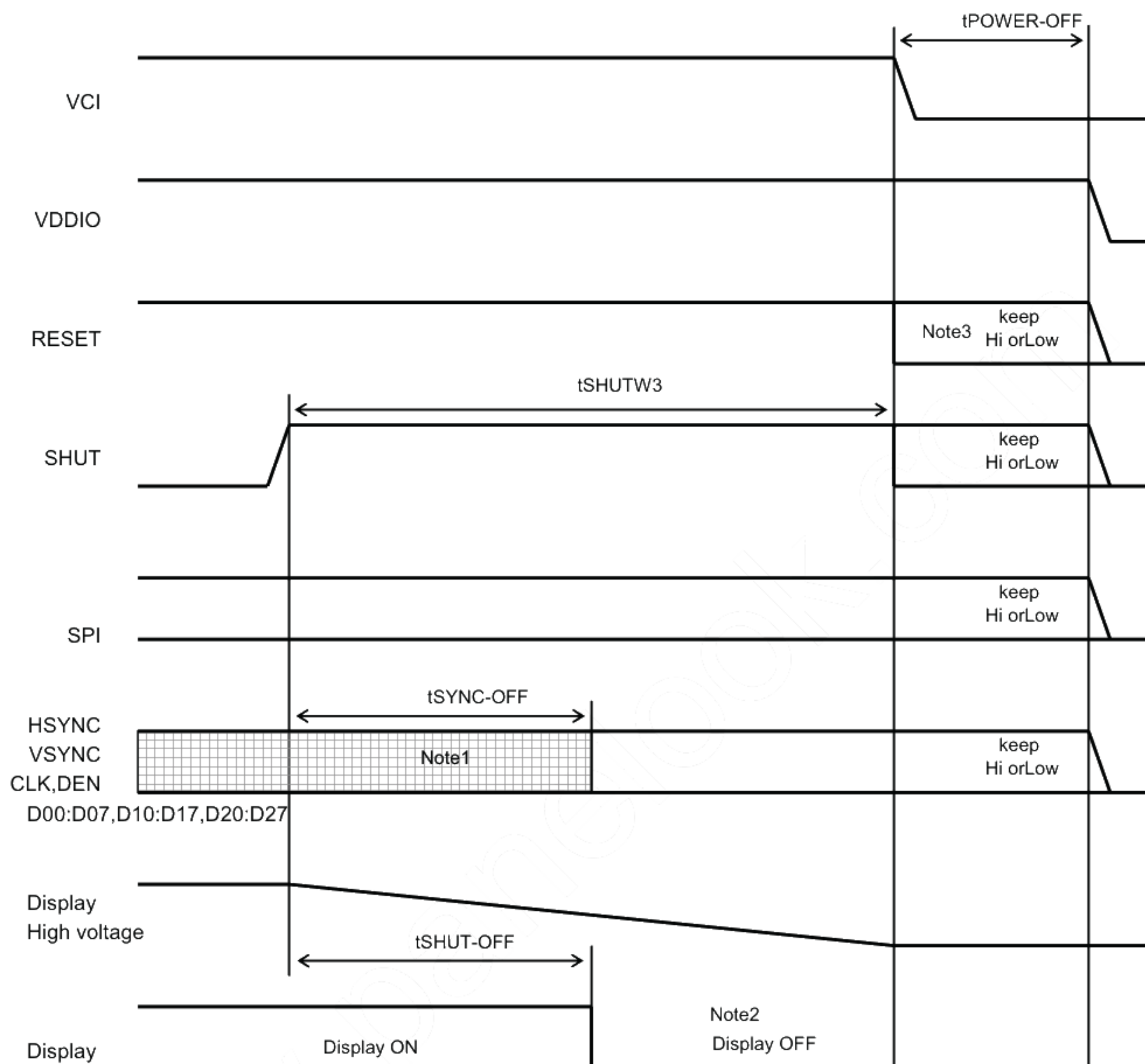


Item	Symbol	Condition	Rating			Unit
			MIN	TYP	MAX	
MAIN_Power on	$t_{POWER-ON}$	2power supply	0.1	--	--	ms
RESET Input	t_{RS}		0.1	--	--	ms
SHUT input-1	t_{SHUT1}		0.1	--	--	ms
SHUT input-2	t_{SHUT2}		1	--	--	CLK
SHUT input-3	t_{SHUT3}		2	--	--	frame
SHUT width-1	t_{SHUTW1}		10	--	--	ms
SHUT width-2	t_{SHUTW2}		300	--	--	ms
SPI Input	t_{PSI}		300	--	--	ms
SYNC Input	t_{SYNC}		0.1	--	--	ms
LCD_Power on	$t_{SHUT-LCD}$	1H=512CLK 1frame=278H fCLK=8.54MHz	--	--	167	ms
Disp On	$t_{SHUT-ON}$		--	167	--	ms
			--	10	--	frame
Disp Off	$t_{SHUT-OFF}$		--	33.4	--	ms
			--	2	--	frame

Note1: It is necessary to input CLK before the falling edge of SHUT.

Note2: Display starts at 10th falling edge of VSYNC after the falling edge of SHUT.

11.2 Power Off Sequence



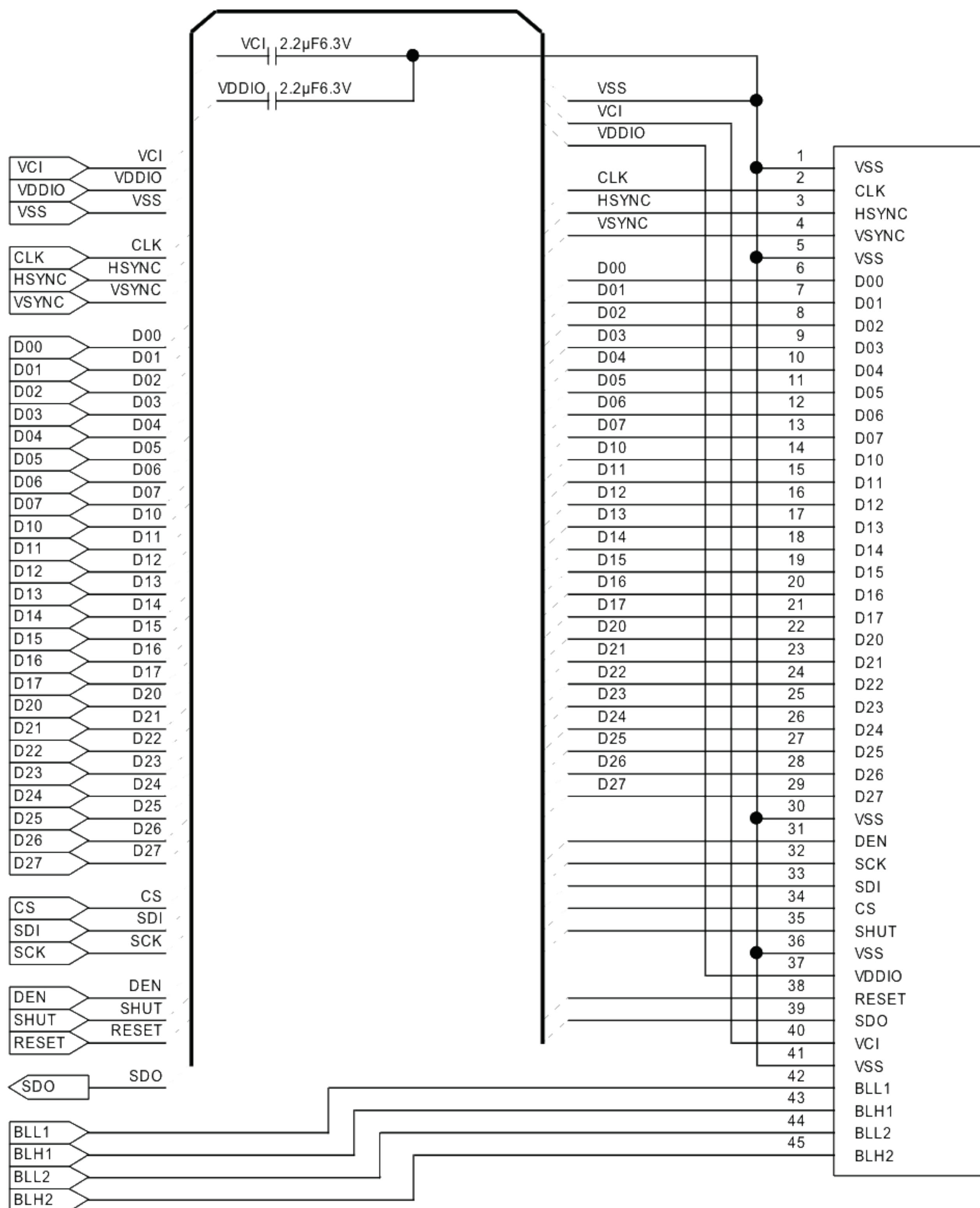
Item	Symbol	Condition	Rating			Unit
			MIN	TYP	MAX	
MAIN_Power off	$t_{POWER-OFF}$	2power supply	0.1	--	--	ms
SHUT width-3	t_{SHUTW3}	1H=512CLK	2	--	--	ms
SYNC Off	$t_{SYNC-OFF}$	1frame=278H	2	--	--	frame
Disp Off	$t_{SHUT-OFF}$	fCLK=8.54MHz	--	33.4	--	ms
			--	2	--	frame

Note1: CLK must be maintained at lease 2 frames after the rising edge of SHUT.

Note2: Display become off at the 2nd falling edge of VSYNC after the falling edge of SHUT.

Note3: If RESET signal is necessary for power down,provide it after the 2-frames-cycle of the SHUT period.

12. Driving Circuit Example



The example of a TFT-LCM application circuit

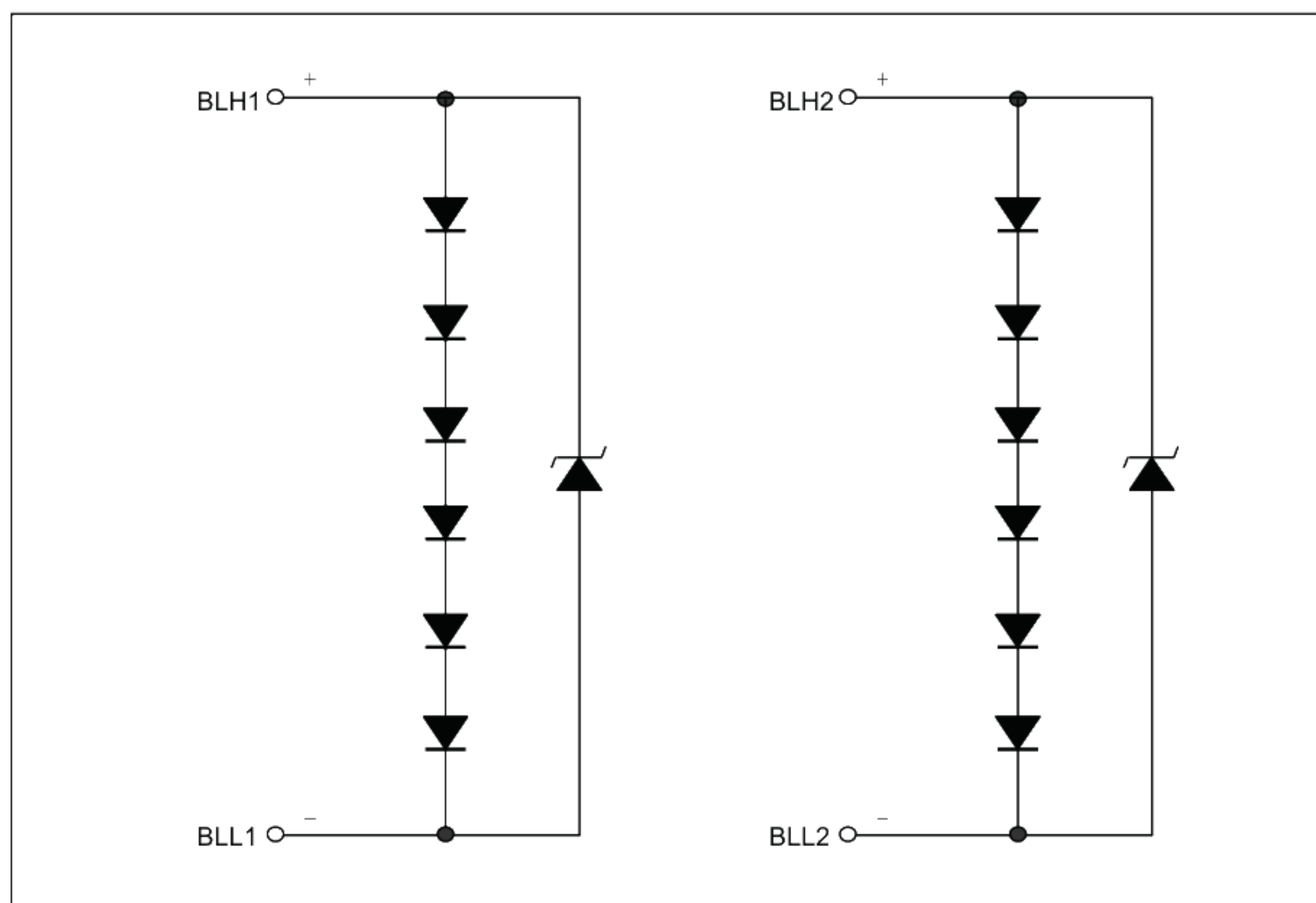
[Related with a ceramic capacitor]

Temperature characteristics should use B characteristic.

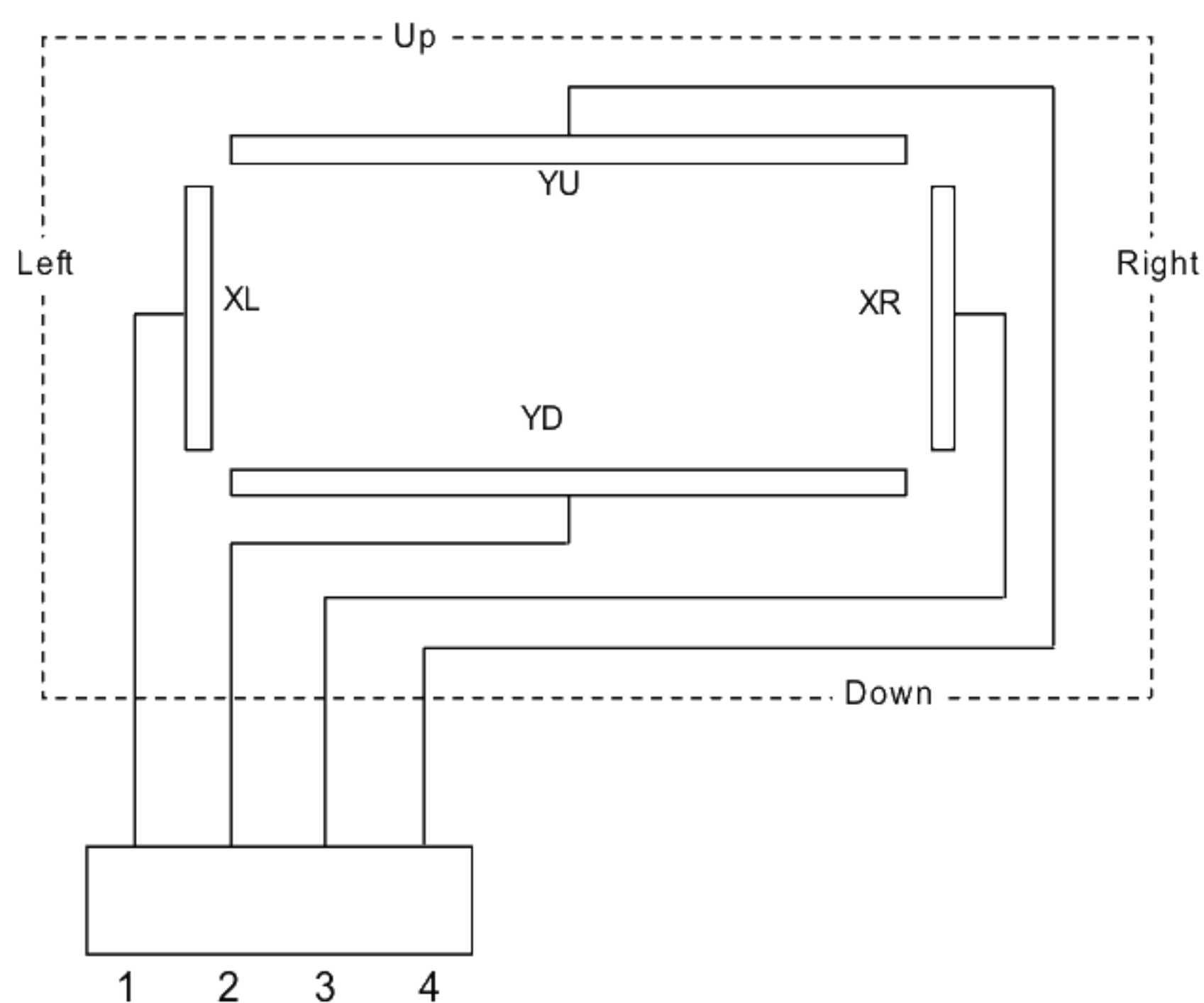
Depending on the substrate of a set, it may have to be made still bigger capacity.

Please perform design and evaluation, assuming that a constant becomes large.

13.LED Circuit



14.Touch Panel Circuit



15. Characteristics

15.1 Optical Characteristics

< Measurement Condition >

Measuring instruments: CS1000 (KONICA MINOLTA), LCD7000(OTSUKA ELECTRONICS),
EZcontrast160D (ELDIM)Driving condition: Typical Rating of "6. Recommended operating conditions".
Optimized VCOMDC
VLCD= Vsigpp /2

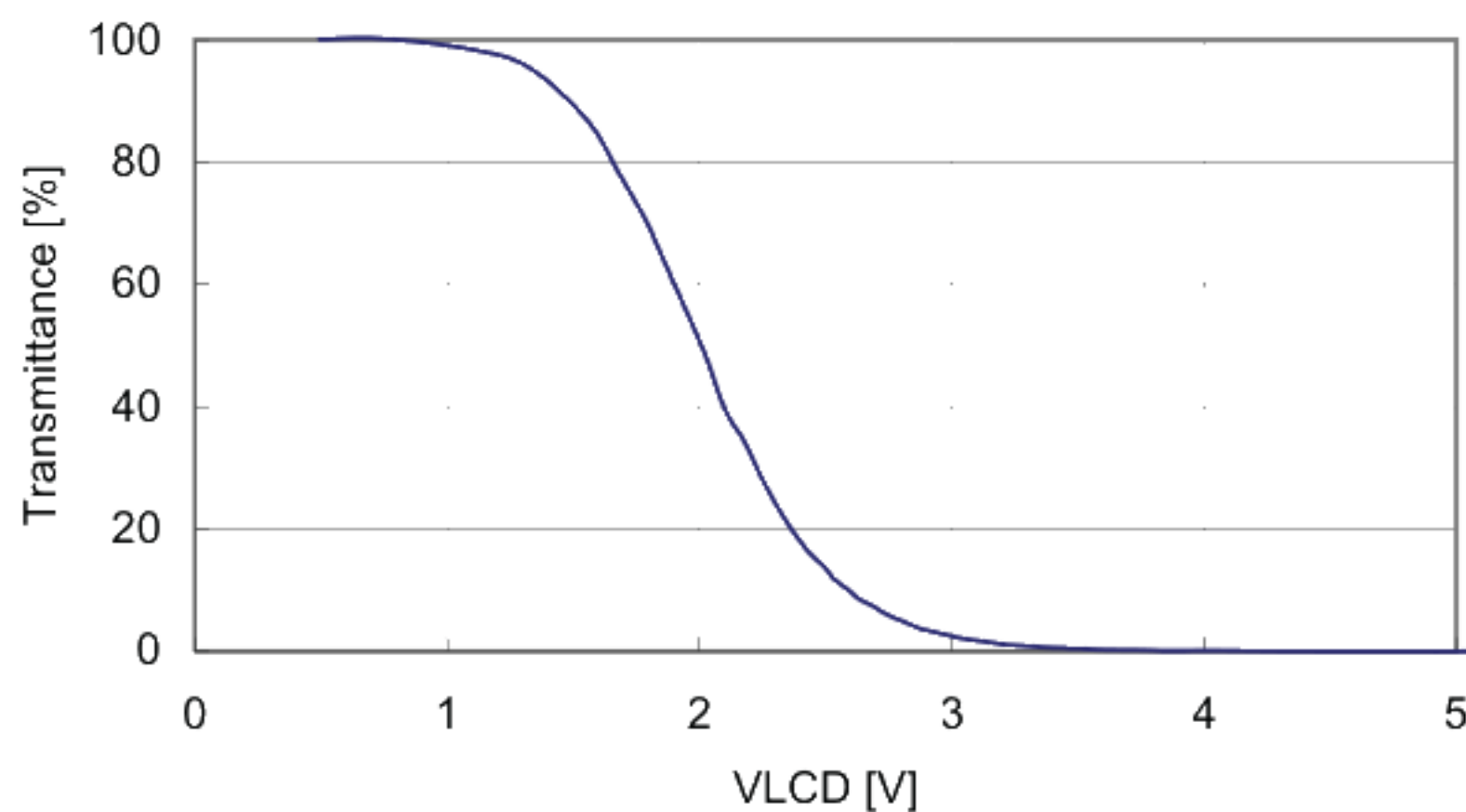
Backlight: IL=20.0mA

Measured temperature: Ta=25° C

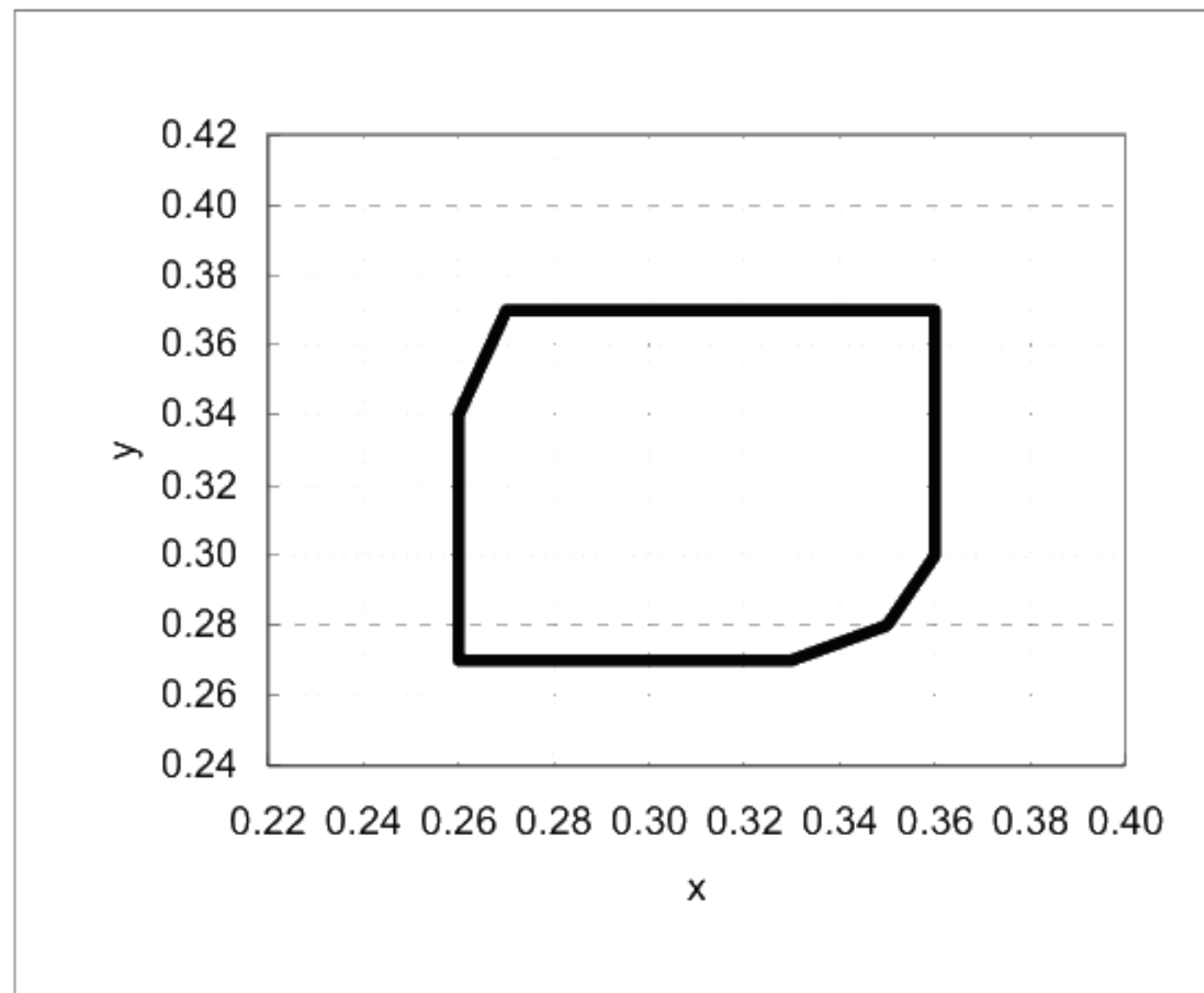
Item		Symbol	Condition	MIN	TYP	MAX	Unit	Note No.	Remark
Response time	Rise time	TON	VLCD= 5.03V→0.96V	—	—	40	ms	1	※
	Fall time	TOFF	VLCD= 0.96V→5.03V	—	—	60	ms		
Contrast ratio	Backlight ON	CR	VLCD= 0.96V/5.03V	240	400	—		2	
	Backlight OFF			—	5.5	—			
Viewing angle	Left	θL	VLCD= 0.96V/5.03V CR≥10	80	—	—	deg	3	※
	Right	θR		80	—	—	deg		
	Up	φU		80	—	—	deg		
	Down	φD		80	—	—	deg		
V-T threshold voltage		V90		1.2	1.5	1.8	V	4	※
		V50		1.7	2.0	2.3	V		
		V10		2.3	2.6	2.9	V		
White V-T Curve				White V-T Curve					Reference
White Chromaticity		x	VLCD=0.96V	White chromaticity range				5	
		y							
Burn-in				No noticeable burn-in image should be observed after 2 hours of window pattern display.				6	
Center brightness			VLCD=0.96V	470	680	—	cd/m ²	7	
Brightness distribution			VLCD=0.96V	70	—	—	%	8	

* Note number 1 to 8: Refer to the APPENDIX of "Reference Method for Measuring Optical Characteristics".

※ Measured in the form of LCD module.



White V-T Curve



White Chromaticity Range

【White Chromaticity Range】

x	y
0.26	0.27
0.33	0.27
0.35	0.28
0.36	0.30
0.36	0.37
0.27	0.37
0.26	0.34
0.26	0.27

15.2 Temperature Characteristics

< Measurement Condition >

Measuring instruments: CS1000 (KONICA MINOLTA), LCD7000 (OTSUKA ELECTRONICS)

Driving condition: Typical Rating of "6. Recommended operating conditions".

Optimized VCOMDC

VLCD= Vsigpp /2

Backlight: IL=20.0mA

Item			Specification		Remark
			Ta= -10° C	Ta= 70° C	
Contrast ratio		CR	40 or more	40 or more	Backlight ON
Response time	Rise time	TON	200 msec or less	30 msec or less	※
	Fall time	TOFF	300 msec or less	50 msec or less	※
Display Quality			No noticeable display defect or ununiformity should be observed.		Use the criteria for judgment specified in the section 16.

※ Measured in the form of LCD module.

16. Criteria of Judgment

16.1 Defective Display and Screen Quality

Test Condition:	Observed TFT-LCD monitor from front during operation with the following conditions
Driving Signal	Raster Patter (RGB in monochrome, white, black)
Signal condition	VLCD:0.96V,2.75V,5.03V(3steps)
Observation distance	30 cm
Illuminance	200 to 350 lx
Backlight	IL=20.0mA

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) Bright dot: Visible through 5% ND filter at VLCD=5.03V Dark dot: Appear dark through white display at VLCD=0.96V		Refer to table 1	
Screen Quality	Dirt	Point-like uneven brightness (white stain, black stain etc)		Invisible through 1% ND filter	
	Foreign particle	Point-like	0.30mm<φ		N=0
			0.20<φ≤0.30mm		N≤3
			φ≤0.20mm		Ignored
		Liner	0.1mm<W		Conform to the criteria of point-like foreign particles.
			0.05<W≤0.1mm	2<L≤5mm	N≤5
				L≤2mm	Ignored
			W≤0.05mm		Ignored
	Flaw	Flaw on the surface of the Touch panel	0.1mm<W		Conform to the criteria of point-like foreign particles.
			0.05<W≤0.1mm	2<L≤5mm	N≤5
				L≤2mm	Ignored
			W≤0.05mm		Ignored
	Others				Use boundary sample for judgment when necessary

$\phi(\text{mm})$: Average diameter = (major axis + minor axis)/2
Permissible number: N

Table 1

Bright dot	Dark dot	Total
3	2	3

16.2 Screen and Other Appearance

Testing conditions

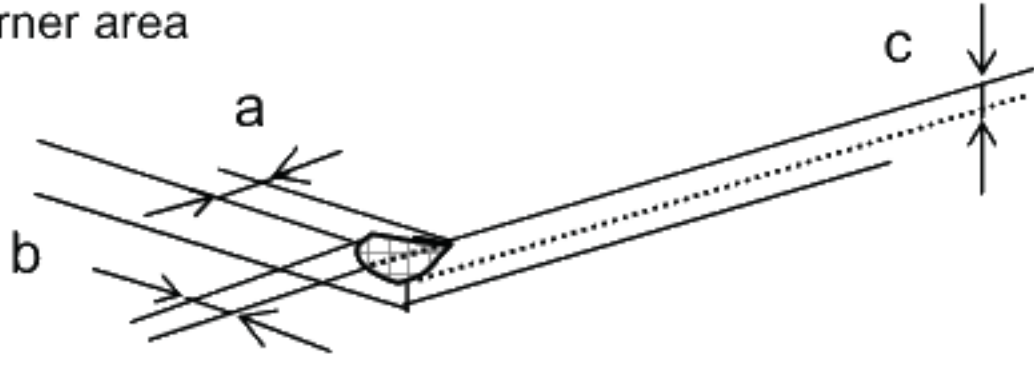
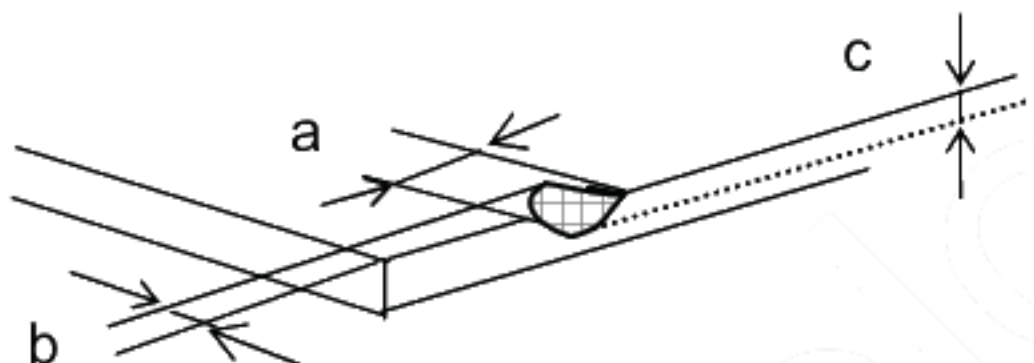
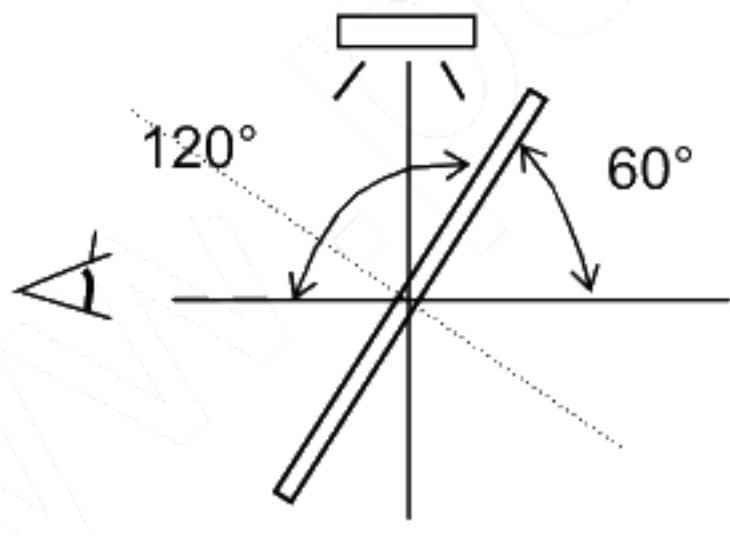
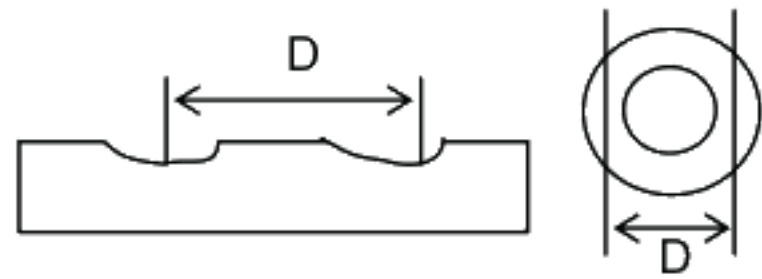
Observation distance

30cm

Illuminance

1200~2000 lx

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

Item		Appearance	Criteria
Touch Panel	Glass chipping	Corner area 	Unit:mm $a \leq 3$ $b \leq 3$ $c \leq t$ (t: glass thickness) a,b ≤ 0.5 is ignored $n \leq 2$
		Others 	Unit:mm $a \leq 5$ $b \leq 2$ $c \leq t$ (t:glass thickness) a,b ≤ 0.5 is ignored Maximum permissible number of chipping off on a side is 5.
		Progressive crack	None
	Interference fringe	Concentric interference fringe (Test method) Observe the Panel surface from 60 degrees angle to the surface under white fluorescent lamp (Triple wavelength lamp) 	Average diameter $d \leq 20\text{mm}$ is acceptable. Darkness: comply with the boundary sample
	Fisheye Film surface	 (D: Average diameter of valley part)	$D \leq \phi 0.2\text{mm}$ Ignored $\phi 0.2 < D \leq \phi 0.6\text{mm}$ $N \leq 4$ $\phi 0.6\text{mm} < D$ $N = 0$

17. Reliability Test

Test item		Test condition	number of failures /number of examinations
Durability test	High temperature storage	Ta=80° C 240H	0/3
	Low temperature storage	Ta=-30° C 240H	0/3
	High temperature & high humidity storage	Ta=60° C, RH=90% 240H non condensing ※	0/3
	High temperature operation	Tp=70° C 240H	0/3
	Low temperature operation	Tp=-20° C 240H	0/3
	High temp & humid operation	Tp=40° C, RH=90% 240H non condensing ※	0/3
	Thermal shock storage	-30←→80° C(30min/30min) 100 cycles	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
	FPC tension test (FPC of LCD only)	Pull the FPC with the force of 3N for 10 sec. in the direction - 90-degree to its original direction.	0/3
	FPC bend test (FPC of LCD only)	Pull the FPC with the force of 3N for 10 sec. in the direction -180-degree to its original direction. Reciprocate it 3 times.	0/3
	Vibration test	Total amplitude 1.5mm, f=10~55Hz, X,Y,Z directions for each 2 hours	0/3
	Impact test	Use ORTUS TECHNOLOGY 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 60068-2-27-1995.	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.)

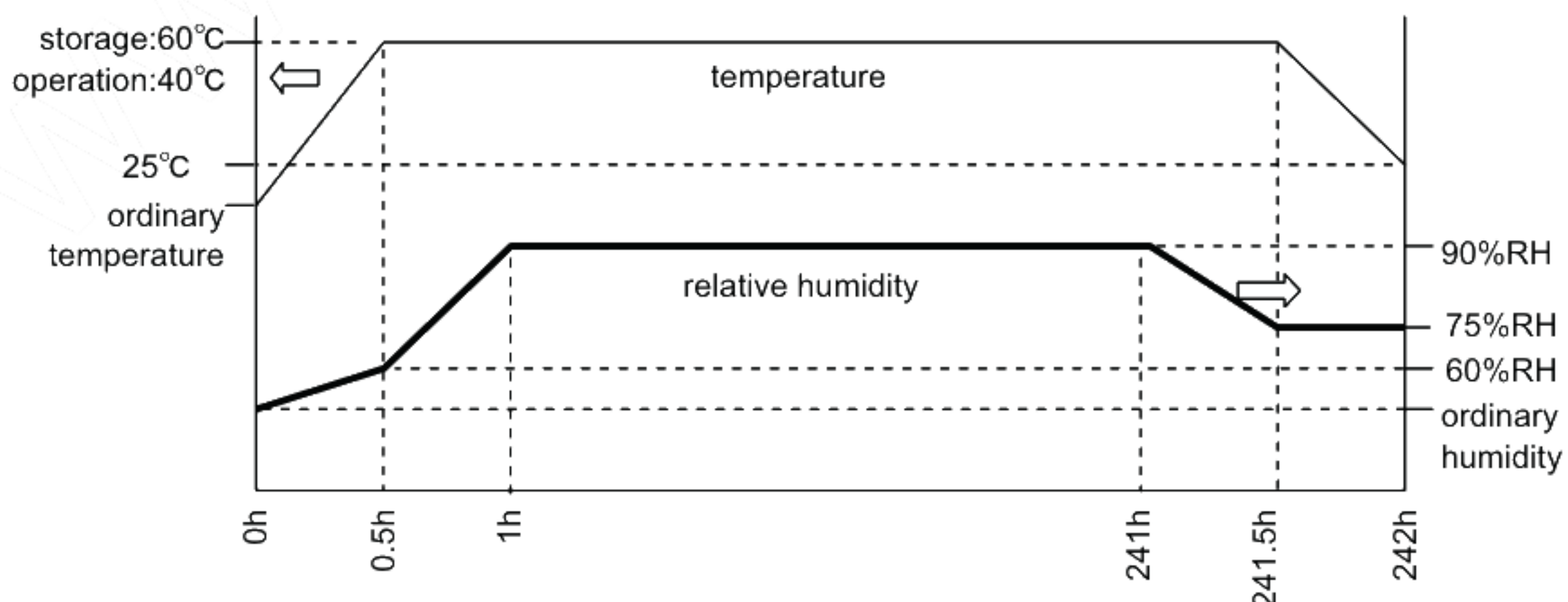
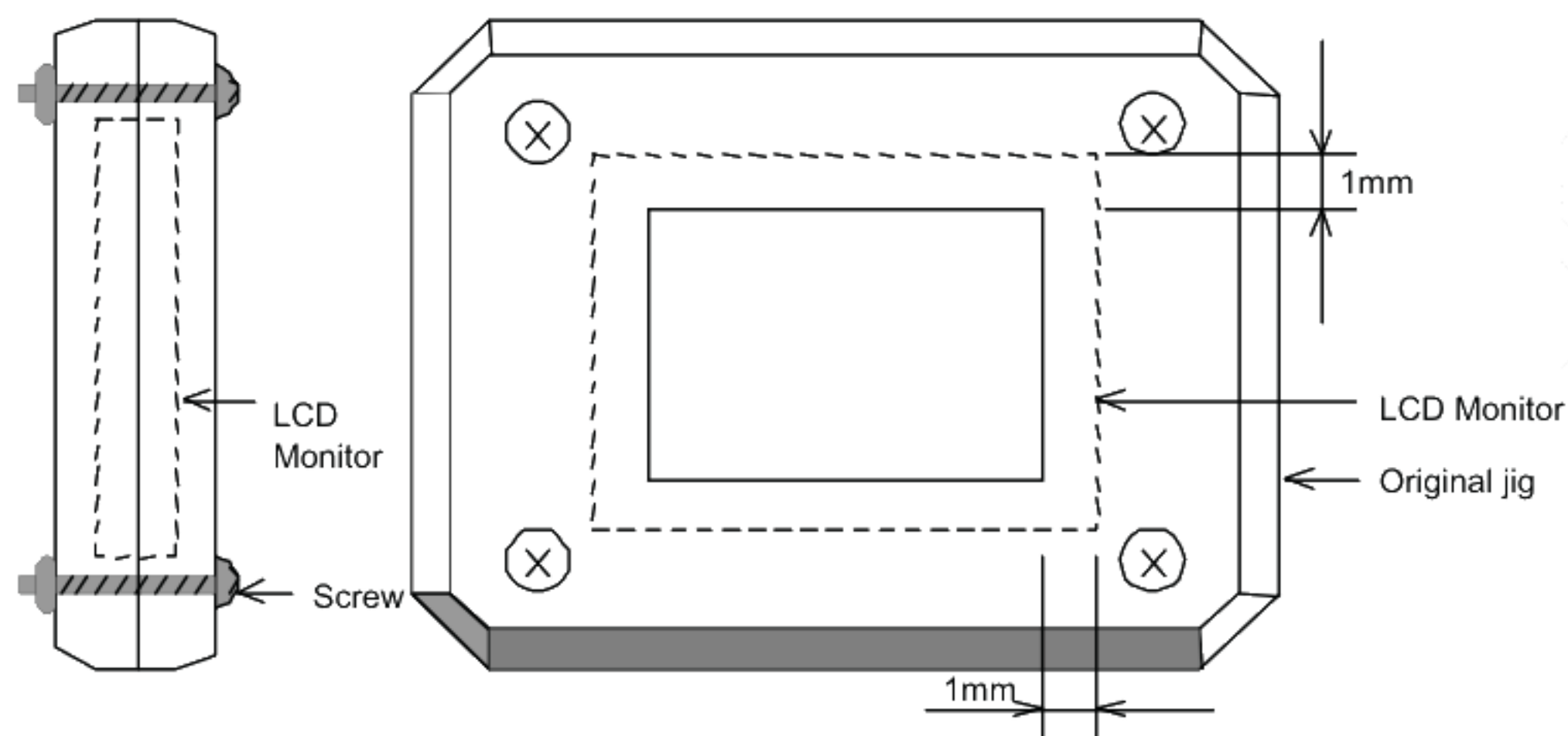


Table 2. Reliability Criteria

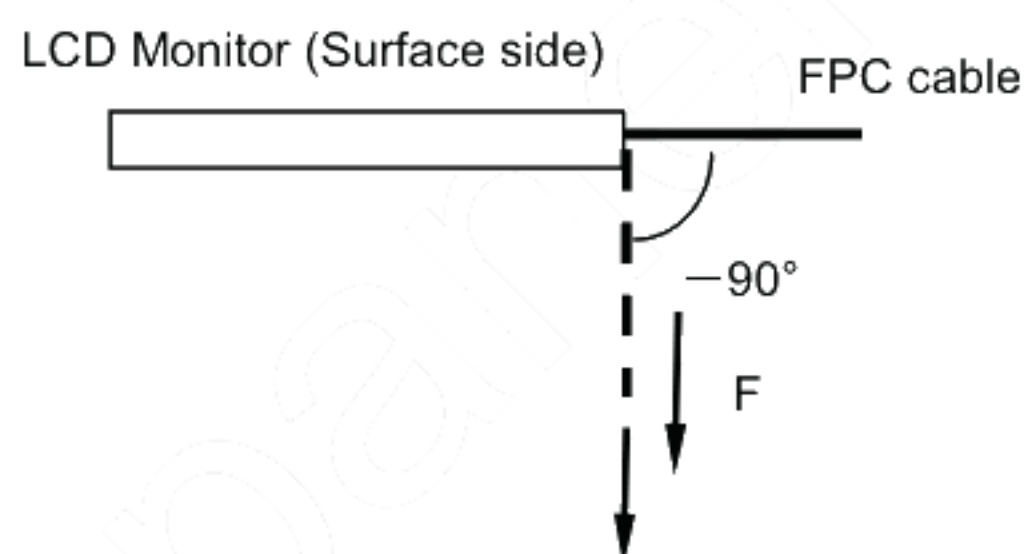
Measure the parameters after leaving the monitor at the ordinary temperature for 2 hours or more after the test completion.

item	Standard	Remarks
Display quality	No visible abnormality shall be seen.	As criteria of "16 Criteria of Judgment".
Contrast ratio	40 or more	Backlight ON

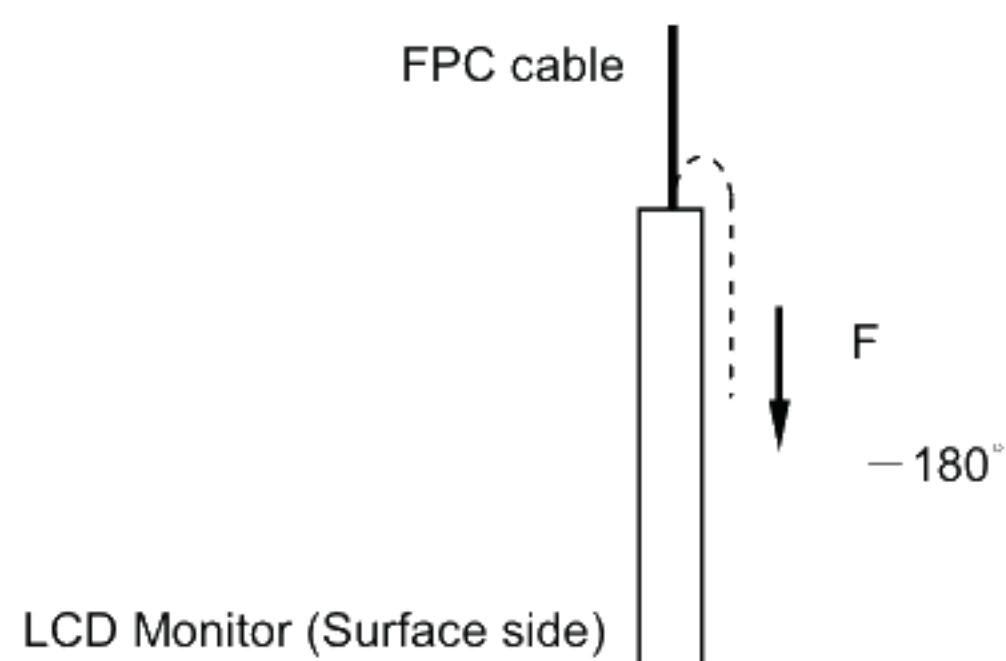
ORTUS TECHNOLOGY Original Jig



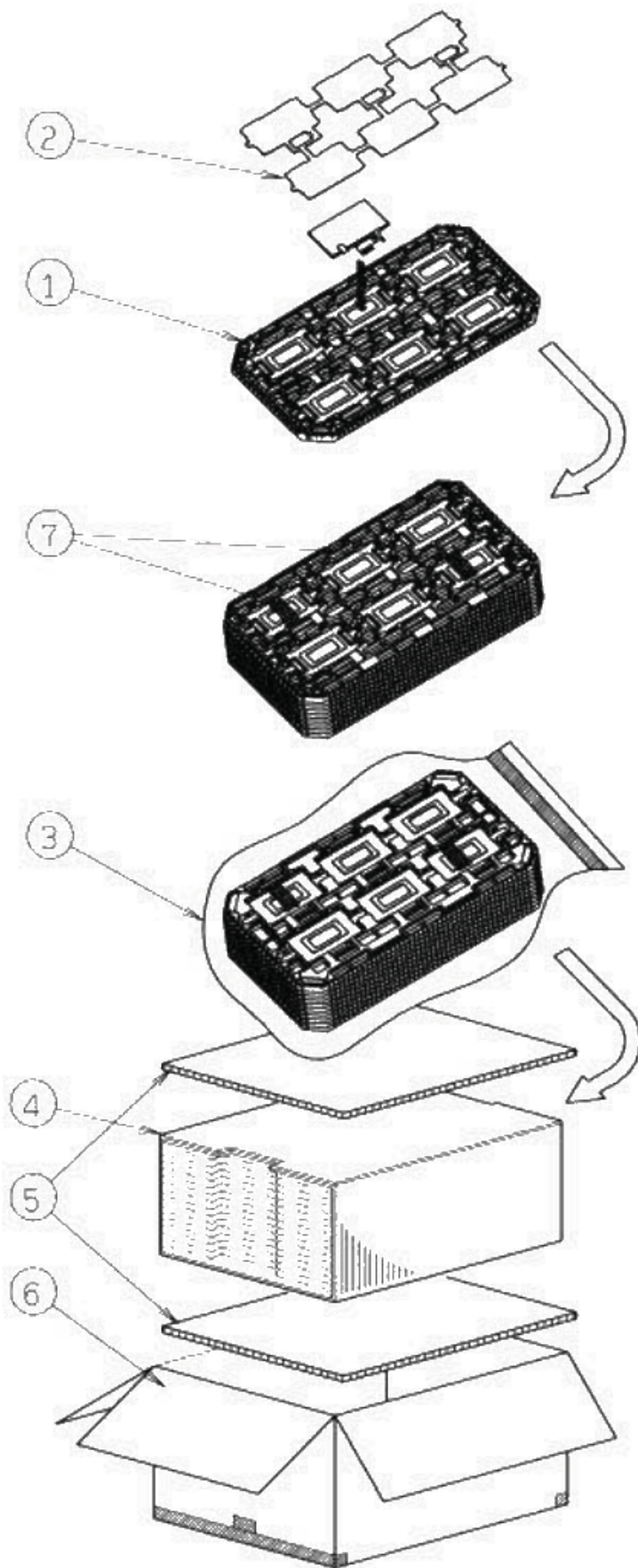
Tension Test Method for FPC cable



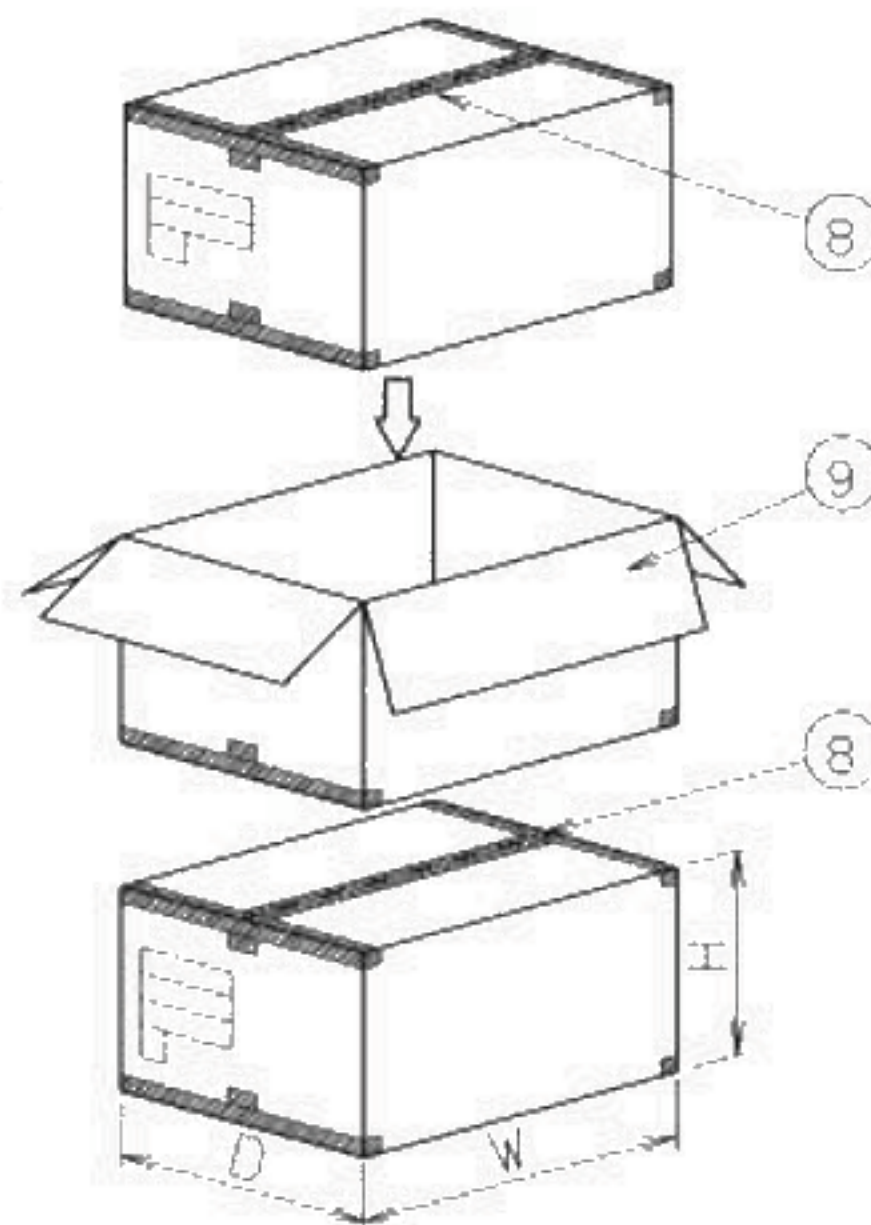
Bend Test Method for FPC cable



18. Packing Specifications



- Step 1. Each product is to be placed in one of the cut-outs of the tray with the display surface facing upward. (6 products per tray)
Antistatic foam sheet is to be placed on the products in the tray.
- Step 2. Each tray needs to be same orientation respect to the tray below or above it and the trays be in a stack of 10.
One empty tray is to be put on the top of stack of 10 trays.
- Step 3. 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.
Vacuum and seal the sealing bag with the vacuum sealing machine.
- Step 4. The stack of trays in the plastic bag is to be inserted into a inner carton.
- Step 5. A corrugated board is to be placed on the top and on the bottom of the inner carton.
The two corrugated boards and the inner carton is to be inserted into an outer carton.
- Step 6. The outer carton needs to sealed with packing tape as shown in the drawing.
The model number, quantity of products, and shipping date are to be printed on the outer carton.
If necessary, shipping labels or impression markings are to be put on the outer carton.
- Step 7. The outer carton is to be inserted into a extra outer carton with same direction.
The extra outer carton needs to sealed with packing tape as shown in the drawing.
- Step 8. The model number, quantity of products, and shipping date are to be printed on the extra outer carton.
If necessary, shipping labels or impression markings are to be put on the extra outer carton.



Remark: The return of packing materials is not required.

Packing item name	Specs., Material
① Tray	A-PET
② Foam sheet	
③ Sealing bag	
④ Inner carton	Corrugated cardboard
⑤ Inner board	Corrugated cardboard
⑥ Outer carton	Corrugated cardboard
⑦ Drier	Moisture absorber
⑧ Packing tape	
⑨ Extra outer carton	Corrugated cardboard

Dimension of extra outer carton	
D : Approx.	(338mm)
W : Approx.	(549mm)
H : Approx.	(198mm)
Quantity of products packed in one carton:	6pcsx10=60pcs
Gross weight : Approx.	8.2Kg

19. Handling Instruction

19.1 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 medical 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 end part of glass and film of touch panel has conductivity, and avoid contact (short-circuit) with electroconductive case etc.. There is a possibility of setting up a defective touch panel, and insulate it for the case suppression (cushion etc.) if necessary, please.
- (12) 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.

19.2 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 19.5 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.

19.3.3 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) When turning off the power, turn off the input signal before or at the same timing of switching off the power.
- 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.

19.4 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 3 months
- Unpacking To prevent damages caused by static electricity, anti-static precautionary measures (e.g. earthing, anti-static mat) should be implemented.
- Maximum piling up 7 cartons

19.5 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.

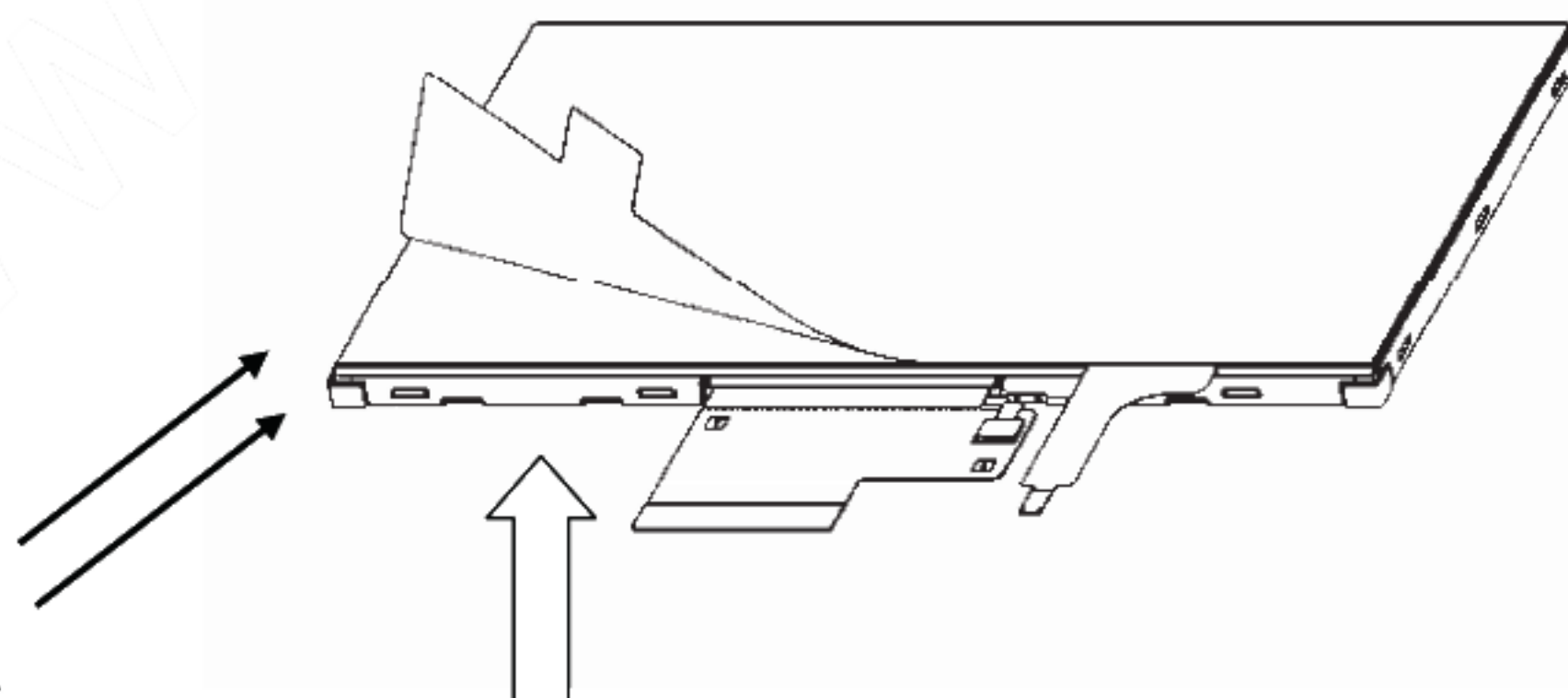
A) Work Environment

- a) Humidity: 50 to 70 %RH, Temperature 15 to 27° C
- b) Operators should wear conductive shoes, conductive clothes, conductive finger tips and grounded wrist-straps. Anti-static treatment should be implemented to work area's floor.
- c) 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 be 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 left when the FPC cable is facing to the left side.
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 left corner area of the protective film to prevent scratch on surface of TFT monitor.
- c) Peel off the adhesive tape slowly (spending more than 2 seconds to complete) by pulling it to opposite direction.



Direction of blowing air

(Optimize air direction and the distance)

Direction of Peeling off the Protective film

APPENDIX

Reference Method for Measuring Optical Characteristics and Performance

1. Measurement Condition (Backlight ON)

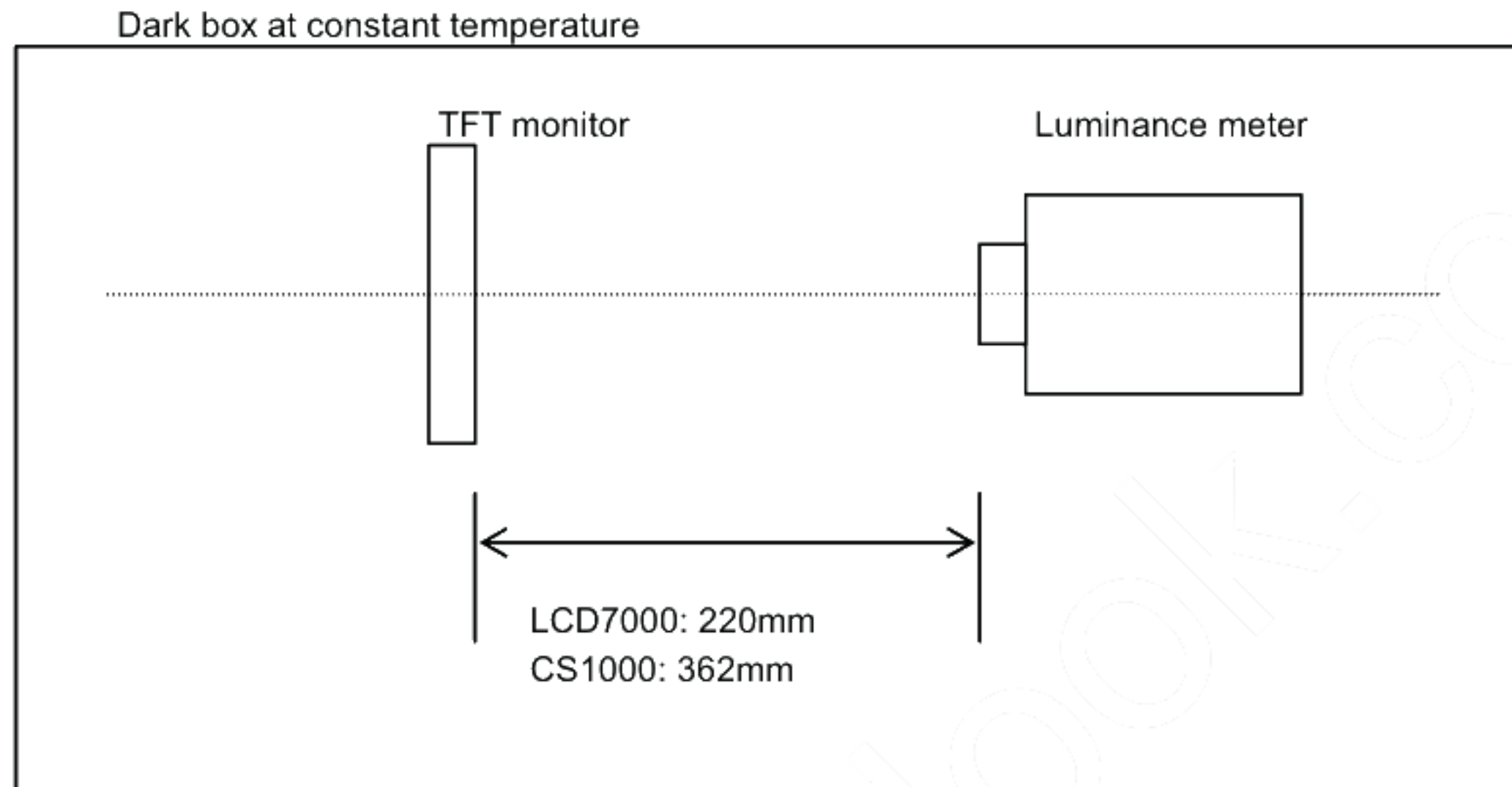
Measuring instruments: CS1000 (KONICA MINOLTA), LCD7000(OTSUKA ELECTRONICS), EZcontrast160D (ELDIM)

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.

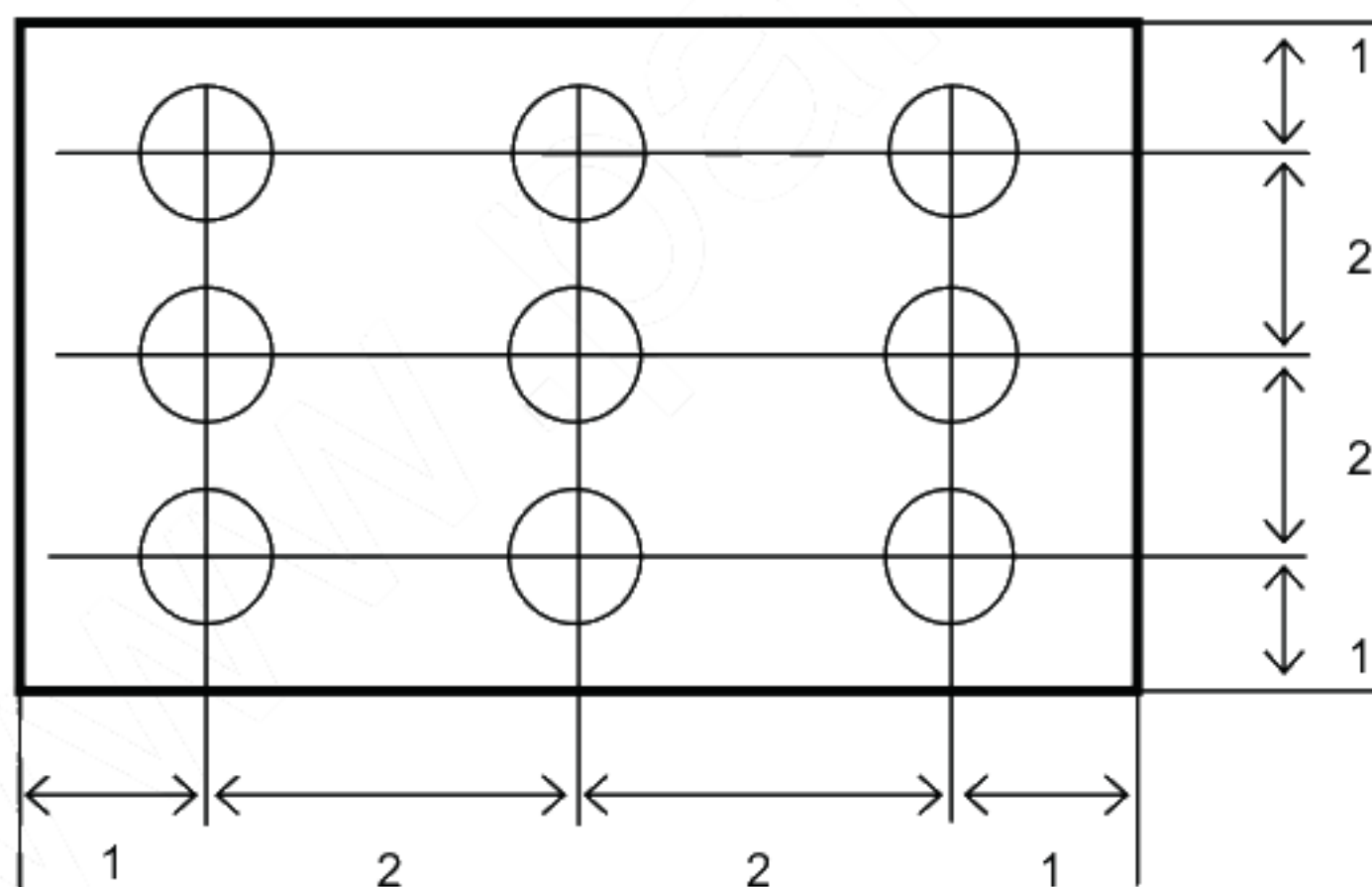
Measurement point: At the center of the screen unless otherwise specified



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.

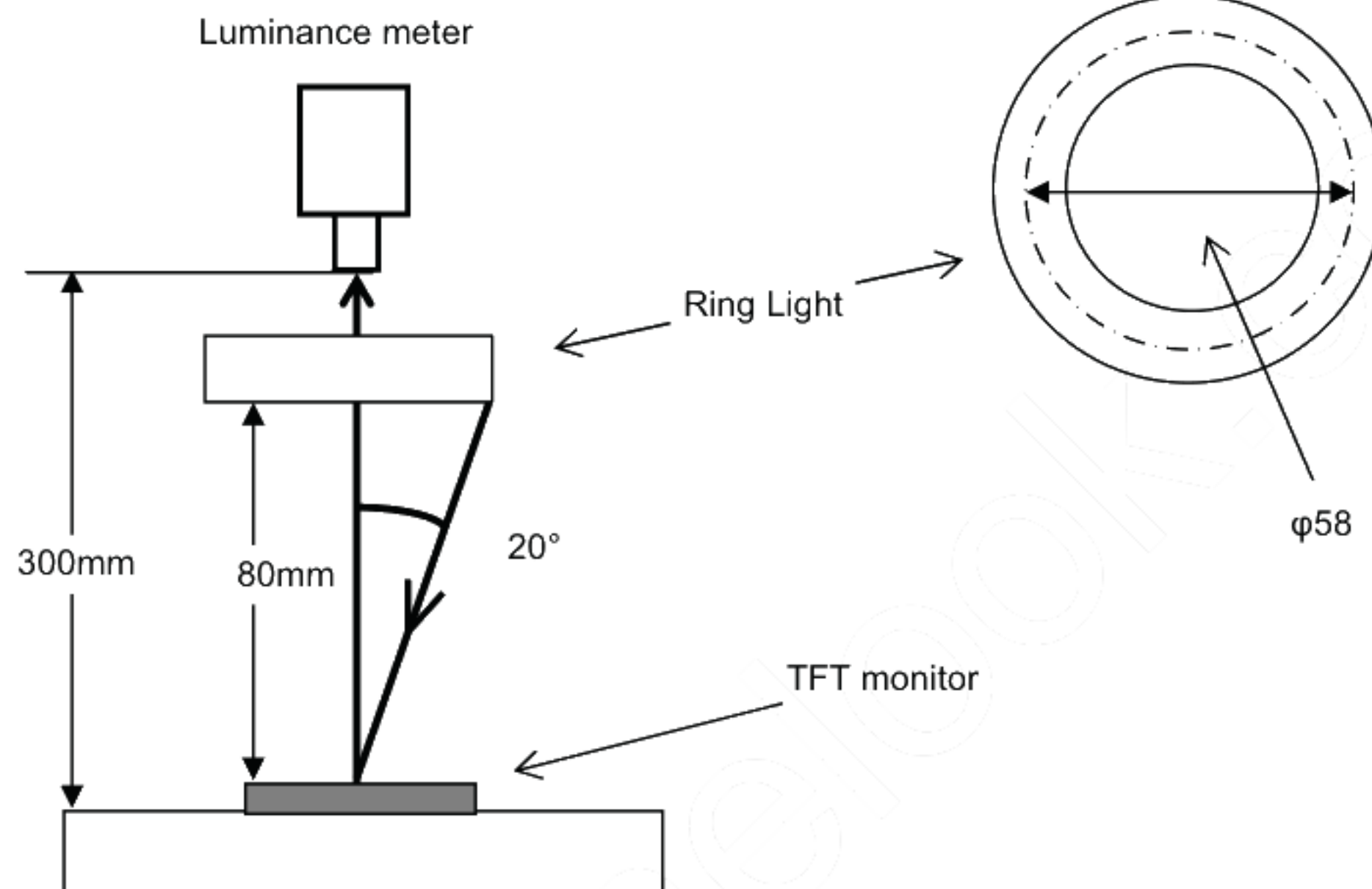


Dimensional ratio of active area

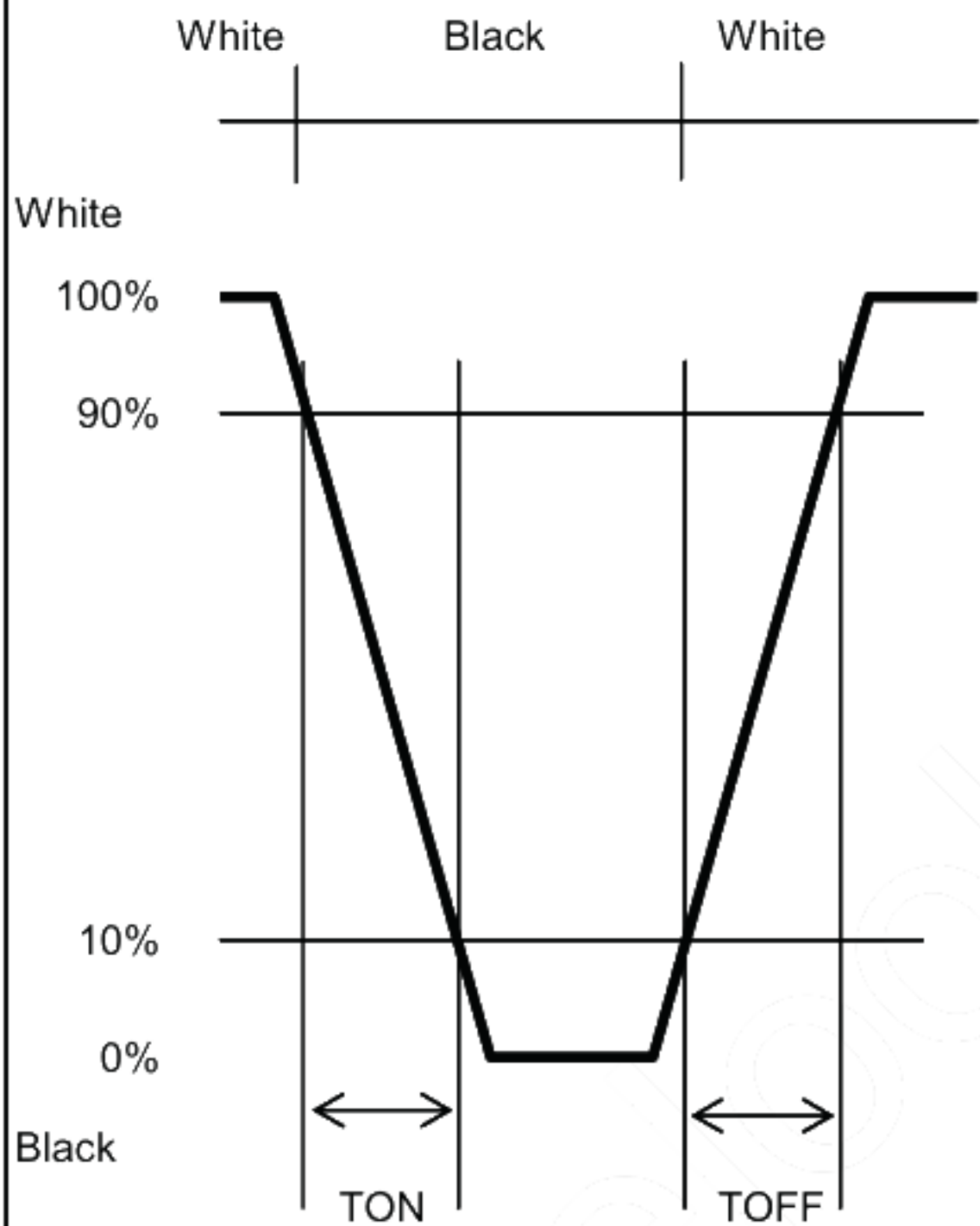
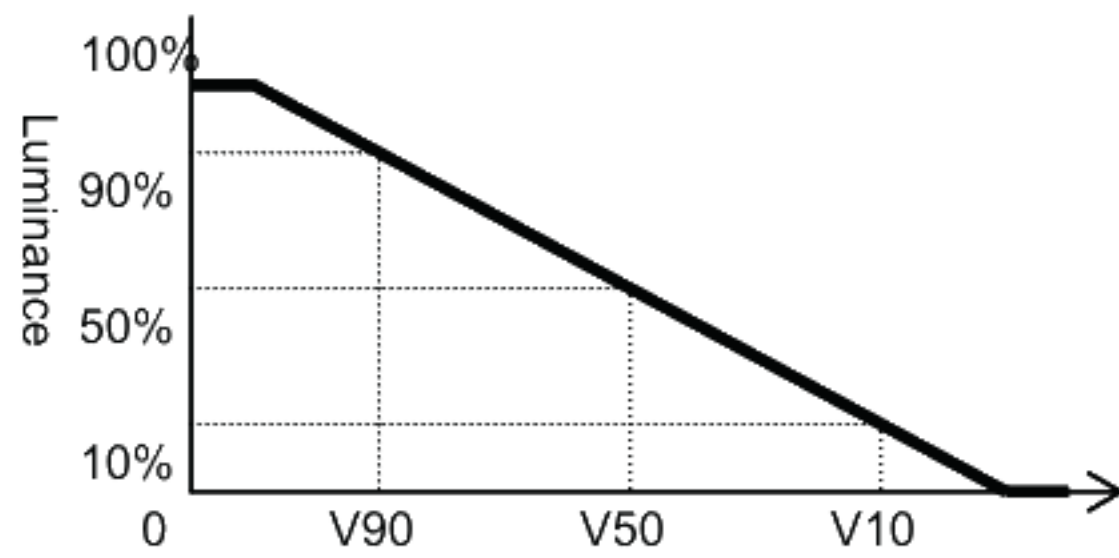
Backlight IL=20.0mA

Measurement Condition (Contrast ratio Backlight OFF only)

Measuring instruments: LCD7000(OTSUKA ELECTRONICS), Ring Light(40,000 lx, $\phi 58$)
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.



2. Test Method

Notice	Item	Test method	Measuring instrument	Remark
1	Response time	Measure output signal waves with a brightness meter when the raster or window pattern is changed over from white to black and from black to white 	LCD7000	Black display VLCD=5.03V White display VLCD=0.96V TON Rise time TOFF Fall time
2	Contrast ratio	Measure maximum luminance Y1(VLCD=0.96V) and minimum luminance Y2(VLCD=5.03V) 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: 8mmφ	CS1000 LCD7000	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.	EZcontrast160D	
4	V-T threshold value	Change VLCD by 0.1V step and plot the points where the luminance is 90% as V90, 50% as V50 and 10% as V10 of maximum luminance. 	LCD7000	
5	White chromaticity	Measure chromaticity coordinates x and y of CIE1931 colorimetric system at VLCD = 0.96V Color matching faction: 2°view	CS1000	

Notice	Item	Test method	Measuring instrument	Remark
6	Burn-in	Visually check burn-in image on the screen after 2 hours of "window display" (VLCD=0.96V/5.03V).		
7	Center brightness	Measure the brightness at the center of the screen.	CS1000	
8	Brightness distribution	(Brightness distribution) = $100 \times B/A \%$ A : max. brightness of the 9 points B : min. brightness of the 9 points	CS1000	