SPECIFICATIONS № 15TLM057	Issue: Jul. 11, 2016

Specifications for

TFT-LCD Monitor

(2.0" QVGA 240 x RGB x 320 Portrait)

Version 3.0

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

MODEL COM20T2P31ILC

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

ORTUSTECH

ORTUS TECHNOLOGY CO., LTD.

Approved by

Checked by

Prepared by

Contents

1. Application

This Specification is applicable to 51.0mm (2.0 inch) 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.

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

◎ 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.

◎ 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, 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

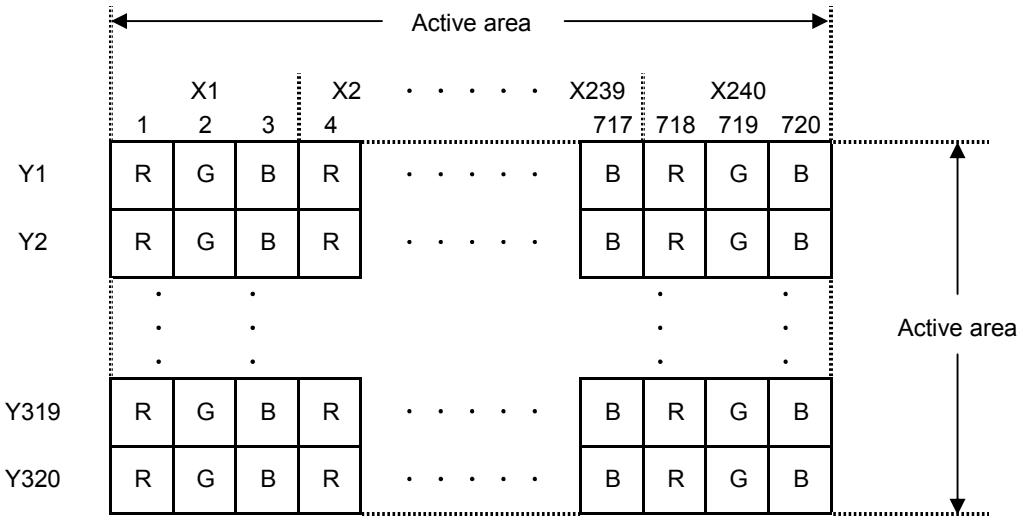
2. Outline Specifications

2.1 Features of the Product

- 2.0 inch diagonal display, 720 [H] x 320 [V] dots. 240RGB x 320 Pixel.
- 262,144 colors (18-bit RGB I/F, 6-bit for RGB, single transfer mode)
- 65,536 colors (16-bit CPU I/F, 5-bit for RB/6-bit for G, single transfer mode)
- Single power supply (3.0V)
- Timing generator [TG], Counter-electrode driving circuitry, Built-in power supply circuit.
- High bright white LED back-light.

2.2 Display Method

Items	Specifications	Remarks
Display type	262,144 colors. Transmissive mode, 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	RGB I/F, CPU I/F	
Backlight type	High bright white LED.	
NTSC ratio	35%	



Dot arrangement (FPC cable placed down side)

3. Dimensions and Shape

3.1 Dimensions

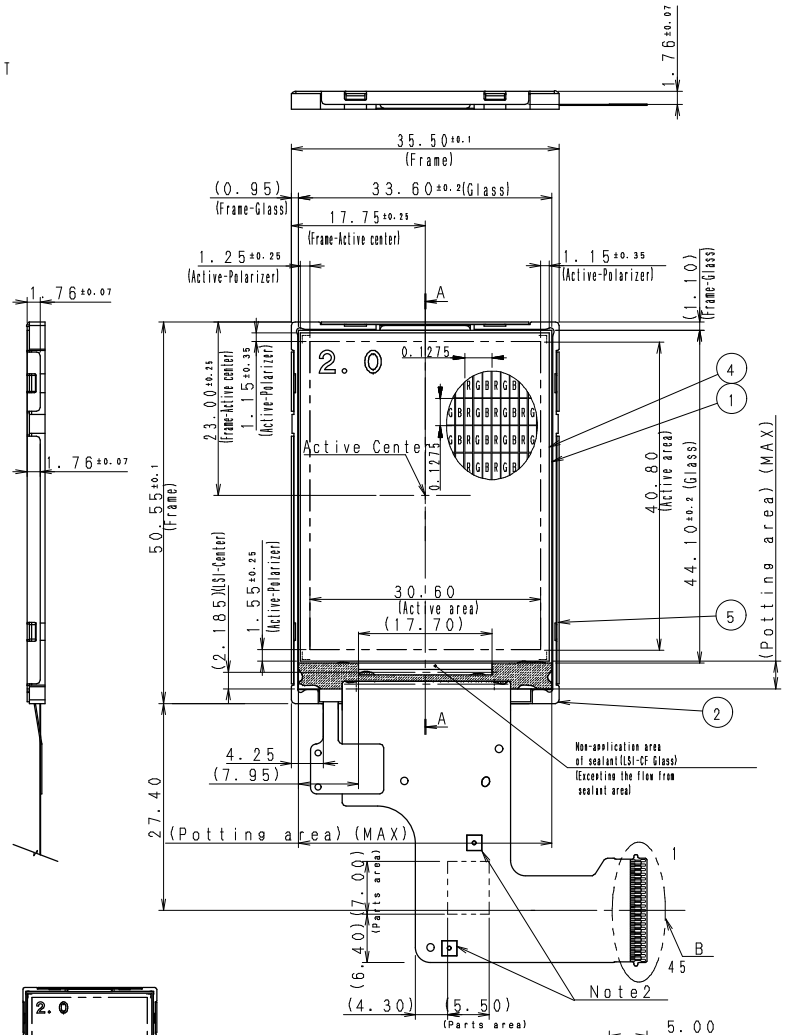
Items	Specifications	Unit	Remarks
Outline dimensions	35.50[H] × 50.55[V] ×2.38[D]	mm	Exclude FPC cable and parts on FPC.
Active area	30.6[H] × 40.8[V]	mm	51.0mm diagonal
Number of dots	720[H] × 320[V]	dot	
Dot pitch	42.5[H] × 127.5[V]	um	
Surface hardness of the polarizer	3	H	Load:2.0N
Weight	10.7	g	Include FPC cable

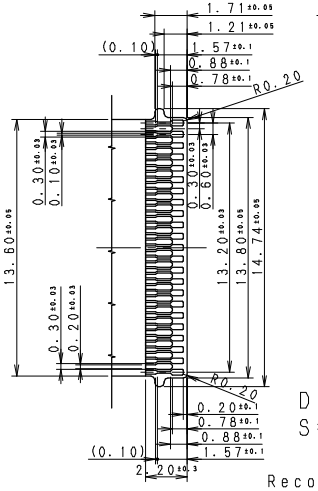
(5/42)
15TLM057
Issue: Jul. 11, 2016

EC No.	REV. No.	REVISE	DATE (Y-M-D)	APPROVED	CHECKED	PREPARED
	⚠x 1	Changed ITEM3 connector	16:06:21			平信

PIN ARRANGEMENT

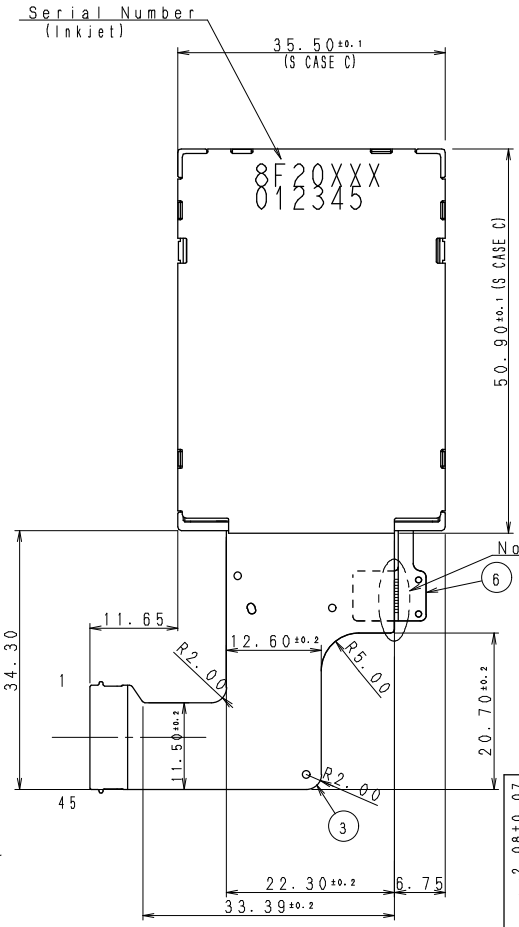
No.	Symbol
1	GND
2	GND
3	IM1
4	IM2
5	IM3
6	RESETX
7	VSYNC
8	HSYNC
9	DOTCLK
10	DE
11	DB17
12	DB16
13	DB15
14	DB14
15	DB13
16	DB12
17	DB11
18	DB10
19	DB9
20	DB8
21	DB7
22	DB6
23	DB5
24	DB4
25	DB3
26	DB2
27	DB1
28	DB0
29	SDO
30	SDI
31	RDX
32	WRX
33	RS
34	CSX
35	GND
36	FMARK
37	IOVCC
38	GND
39	VCI
40	VCI
41	VLED
42	VLED
43	LED3
44	LED2
45	LED1

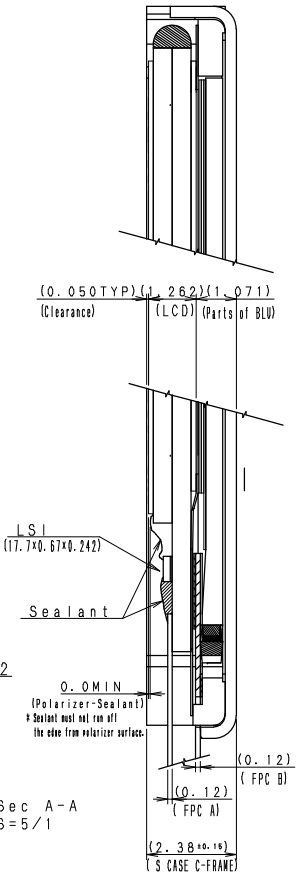




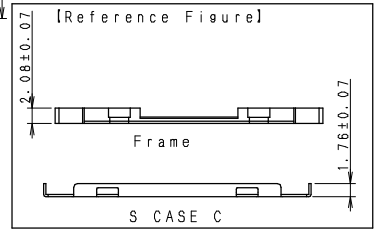
Detail B
S=5/1

Recommended connector:
~~FB10S045JA2~~ JAE
⚠FB10S045JT1





Sec A-A
S=5/1



	7			
FPC B	6			Use of LED
S CASE C	5		SUS304 (t=0.3)	
Polarizer	4			with protection sheet
FPC A	3			Use of LCD
Frame	2		PC	
TFT-LCD	1		Total thickness=1.0t	
PART NAME	ITEM	PART CODE	MODEL NUMBER	REMARK

Note1. Constant-current circuit is required for the LED drive circuit to make full use of original visual quality of the display. When other driving method is used for the LED driving circuit, original visual quality of the display is not guaranteed.

Note2. As shown in diagram, GND-pattern and LED-FPC are opening. Their facing contact surface must be covered by solder resist.

APPROVED 橋爪	GENERAL TOLERANCE ±0.5	SCALE 2/1	UNIT mm
CHECKED 平信	ISSUE (Y-M-D) 15:08:19	MODEL	COM20T2P31I**
CHECKED	NAME	OUTLINE-D2P31	
DESIGN 渡辺			
DRAW 渡辺			

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RJD527383D201	B		ASS'Y

3.3 Serial № print (S-print)

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	20GLC (Made in Japan) 20GMC (Made in Malaysia)		
d	Serial number			

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

・Made in Japan

6L20GLC000125

means "manufactured in December 2016, 2.0" GL type, C specifications, serial number 000125"

・Made in Malaysia

6L20GMC000125

means "manufactured in December 2016, 2.0" GM type, C specifications, serial number 000125"

2) Location of Serial № print (S-print)

Refer to 3.2 "Outward Form".

3)Others

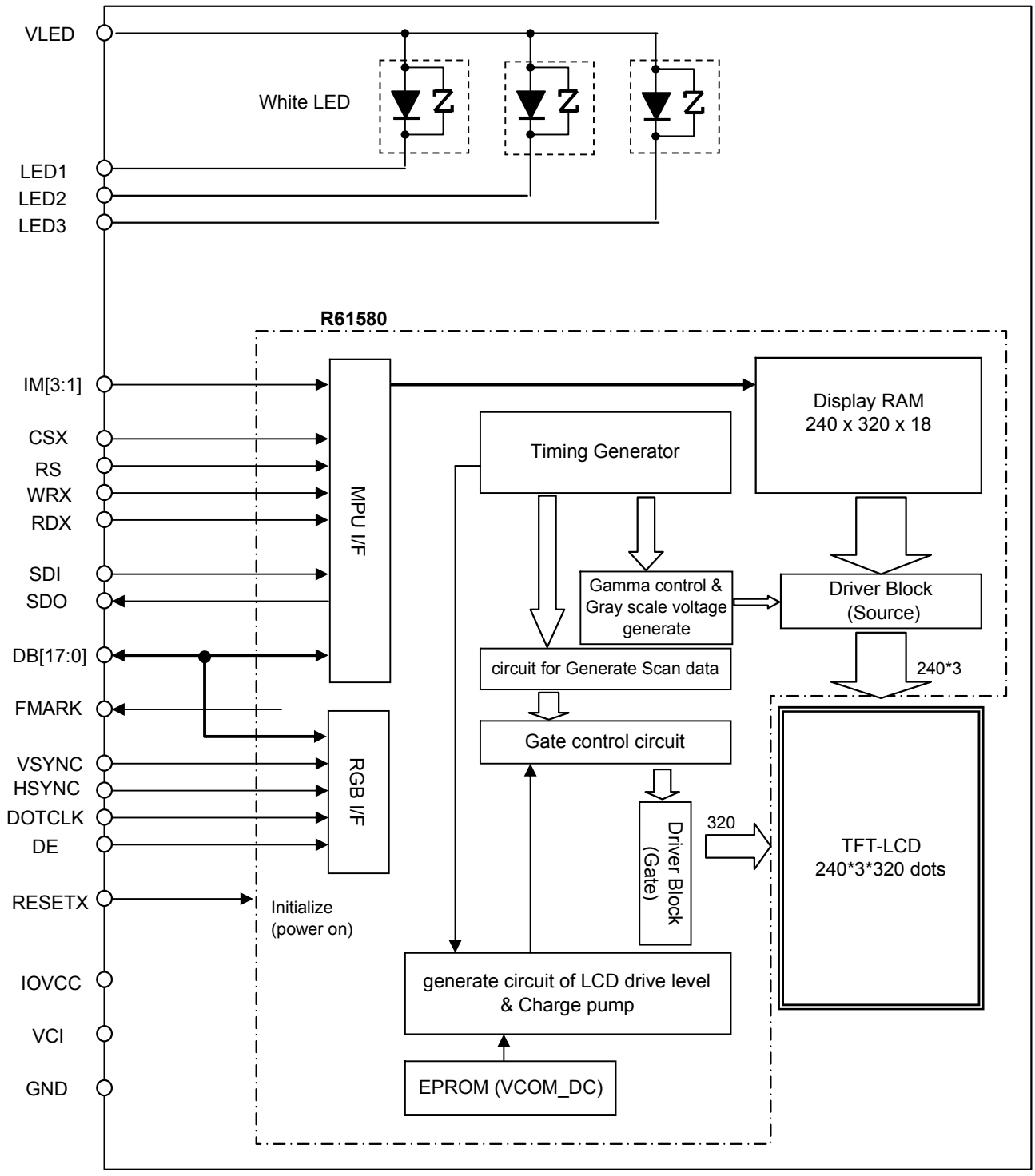
Please note that it is likely to disappear with an organic solvent about the Serial print.

4. Pin Assignment

No.	Symbol	Function	I/O
1	GND	Ground	P
2	GND	Ground	P
3	IM1	Select the MPU system I/F mode. (16 bit CPU I/F : IOVCC)	I
4	IM2	Select the MPU system I/F mode. (16 bit CPU I/F : GND)	I
5	IM3	Select the MPU system I/F mode. (16 bit CPU I/F : GND)	I
6	RESETX	System reset signal input.(Lo: active)	I
7	VSYNC	Vertical sync signal input for RGB I/F.	I
8	HSYNC	Horizontal sync signal input for RGB I/F.	I
9	DOTCLK	Dot clock signal input for RGB I/F.	I
10	DE	Data Enable signal for RGB I/F.	I
11	DB17	Bi-directional data bus	IO
12	DB16	Bi-directional data bus	IO
13	DB15	Bi-directional data bus	IO
14	DB14	Bi-directional data bus	IO
15	DB13	Bi-directional data bus	IO
16	DB12	Bi-directional data bus	IO
17	DB11	Bi-directional data bus	IO
18	DB10	Bi-directional data bus	IO
19	DB9	Bi-directional data bus	IO
20	DB8	Bi-directional data bus	IO
21	DB7	Bi-directional data bus	IO
22	DB6	Bi-directional data bus	IO
23	DB5	Bi-directional data bus	IO
24	DB4	Bi-directional data bus	IO
25	DB3	Bi-directional data bus	IO
26	DB2	Bi-directional data bus	IO
27	DB1	Bi-directional data bus	IO
28	DB0	Bi-directional data bus	IO
29	SDO	SPI interface input .	O
30	SDI	SPI interface input .	I
31	RDX	Read strobe signal.	I
32	WRX	Write strobe signal.	I
33	RS	Register select signal.	I
34	CSX	Chip select signal.	I
35	GND	Ground	P
36	FMARK	Output a frame head pulse.	O
37	IOVCC	Logic Interface Power supply input.	P
38	GND	Ground	P
39	VCI	Power supply input.	P
40	VCI	Power supply input.	P
41	VLED	LED drive power source. (Anode side)	P
42	VLED	LED drive power source. (Anode side)	P
43	LED 3	LED drive power source. (Cathode side 3)	P
44	LED 2	LED drive power source. (Cathode side 2)	P
45	LED 1	LED drive power source. (Cathode side 1)	P

- Recommended connector: JAE FB10 series (45pin)
- 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.

5. Block Diagram

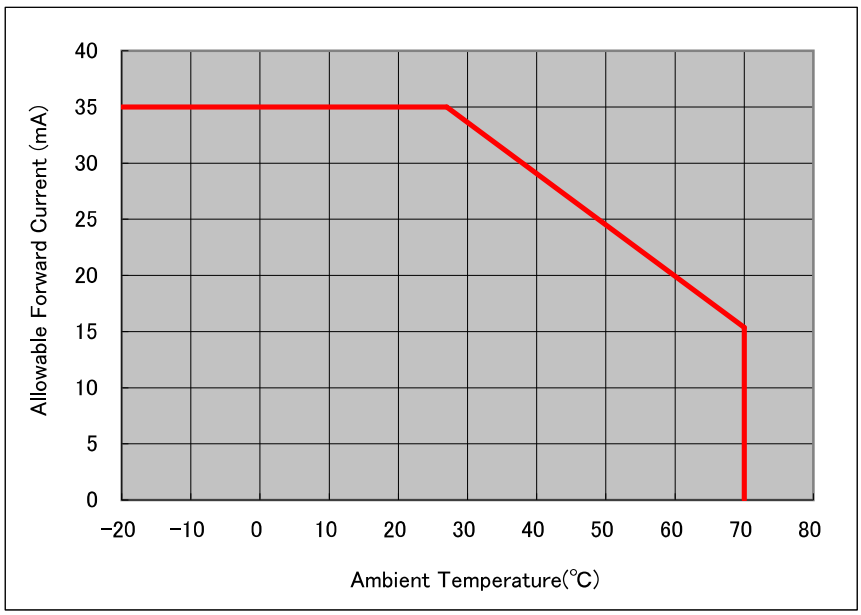


6. Absolute Maximum Rating

VSS=0V

Item	Symbol	Condition	Rating		Unit	Applicable terminal
			MIN	MAX		
Supply voltage	VCI	Ta = 25 °C	-0.3	4.6	V	VCI
Logic interface voltage	IOVCC		-0.3	4.6	V	IOVCC
Input voltage for logic	VI		-0.3	VCCIO+0.3	V	CSX,RS,WRX,RDX, RESETX,DB[17:0],IM[3:1], VSYNC,HSYNC,DE,SDI
LED Forward current	IL	Ta = 25 °C	--	35	mA	VLED - LED[3:1]
		Ta = 70 °C	--	15	mA	
Storage temperature range	Tstg		-30	80	°C	
Storage humidity range	Hstg	Non condensing in an environmental moisture at or less than 40 °C 90%RH.				

Note: Do not exceed Allowable Forward Current shown on the chart below.



7. Recommended Operating Conditions

VSS=0V

Item	Symbol	Condition	Rating			Unit	Applicable terminal
			MIN	TYP	MAX		
Supply voltage	VCI	Ta=-20～70°C	2.7	3.0	3.3	V	VCI
Logic interface voltage	IOVCC		2.7	3.0	3.3	V	IOVCC
Input voltage for logic	VI		0	—	IOVCC	V	CSX,RS,WRX,RDX,RESETX, DB[17:0],SDI,IM[3:1],VSYNC, HSYNC,DE
Operational temperature range	Top	Note1	-20	25	70	°C	Panel surface temperature
Operating humidity range	Hop	Ta≦40°C	20	—	85	%	
		Ta>40°C	Non condensing in an environmental moisture at or less than 40 °C 85%RH.				

Note1: This monitor is operatable in this temperature range. With regard to optical characteristics, refer to Item 14."Characteristics".

8. Characteristics

8.1 DC Characteristics

8.1.1 LCD DISPLAY

(Unless otherwise noted, Ta=25 °C,VCI=IOVCC=3.0V)

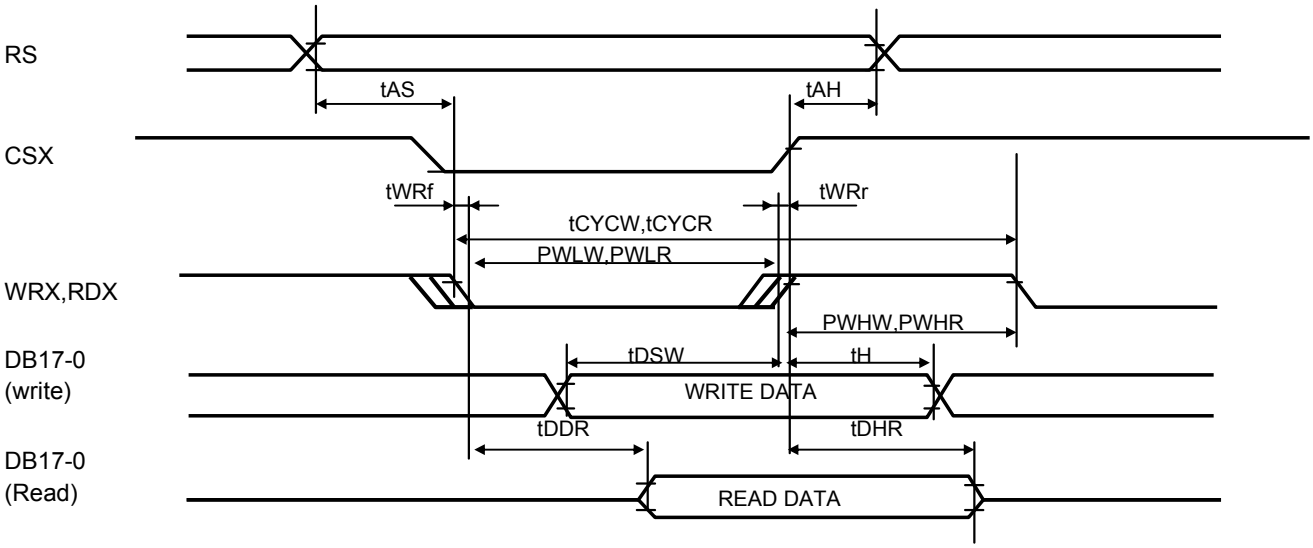
Item	Symbol	Condition	Rating			Unit	Applicable terminal
			MIN	TYP	MAX		
Input Signal Voltage 1	VIH 1	IOVCC=2.7-3.3V	0.8×IOVCC	--	IOVCC	V	CSX,RS,WRX,RDX, DB[17:0],SDI,IM[3:1], VSYNC,HSYNC,DE
	VIL 1		0	--	0.2×IOVCC	V	
Input Signal Voltage 2	VIH 2	IOVCC=2.7-3.3V	0.9×IOVCC	--	IOVCC	V	RESETX
	VIL 2		0	--	0.1×IOVCC	V	
Output Signal Voltage	VOH	IOH = -0.1 mA	0.8×IOVCC	--	IOVCC	V	DB[17:0], FMARK,SDO
	VOL	IOL = 0.1 mA	0	--	0.2×IOVCC	V	
Operating Current	ICI	Color bar display	--	6.5	13.0	mA	VCI + IOVCC
Stand-by Current	ICIS	Other input with constant voltage	--	--	2.0	uA	VCI + IOVCC

8.1.2 LED

Item	Symbol	Condition	Rating			Unit	Applicable terminal
			MIN	TYP	MAX		
LED current	IL25	Ta=25°C	--	9.5	35.0	mA	VLED-LED[3:1]
	IL70	Ta=70°C	--	--	15.0	mA	
LED Forward voltage	VL	Ta=25°C、 IL=9.5mA	--	2.7	3.0	V	

8.2 AC Characteristics

8.2.1 System I/F timing Characteristics

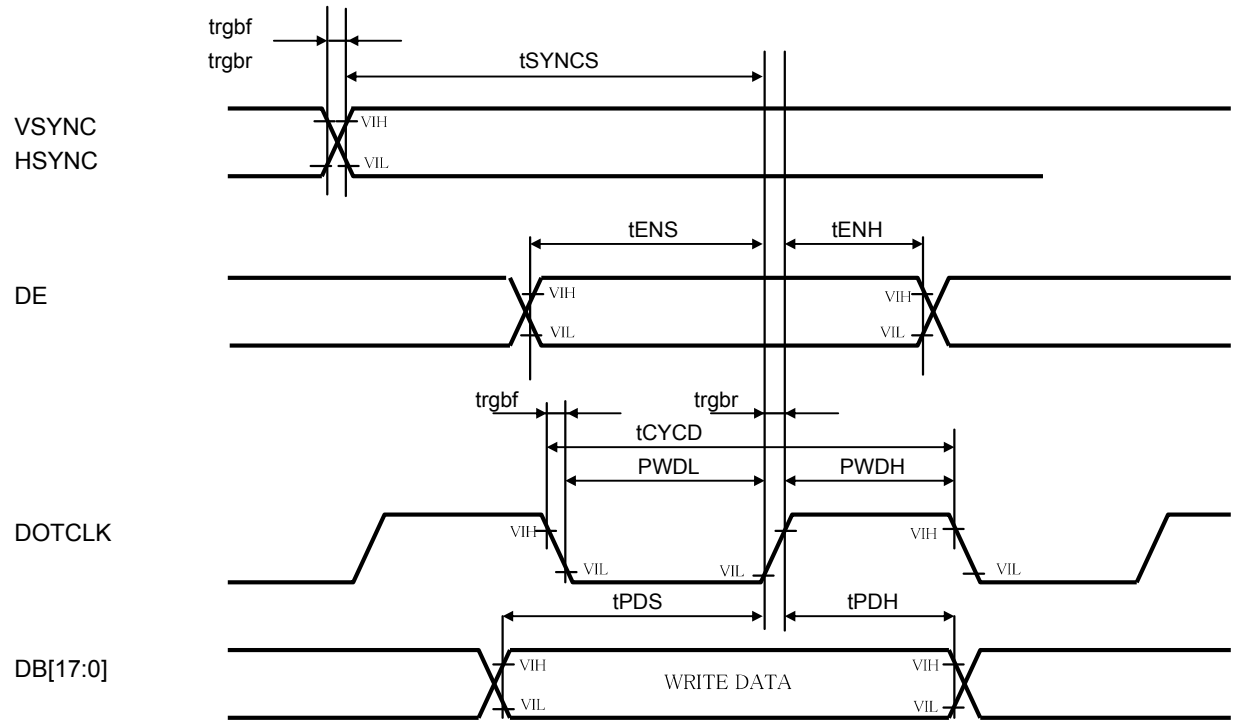


Note : PWLW and PWLR are determined by the overlap period of low CSX and low WRX or low CSX and low RDX.

VCI=IOVCC=2.7～3.3[V]、Ta=-20～70°C

Item		Symbol	Condition	Rating		Unit
				MIN	MAX	
Bus cycle time	Write	tCYCW		75	-	ns
	Read	tCYCR		450	-	ns
WRX Low pulse width	Write	PWLW		40	-	ns
WRX High pulse width	Write	PWHW		25	-	ns
RDX Low pulse width	Read	PWLR		170	-	ns
RDX High pulse width	Read	PWHR		250	-	ns
Write / Read rise / fall time		tWRr, tWRf		-	25	ns
Setup time	RS to CSX,WRX	tAS		0		ns
	RS to CSX,RDX			10		ns
Address hold time		tAH		2		ns
Write data setup time		tDSW		25		ns
Write data hold time		tH		10		ns
Read data delay time		tDDR		-	150	ns
Read data hold time		tDHR		5	-	ns

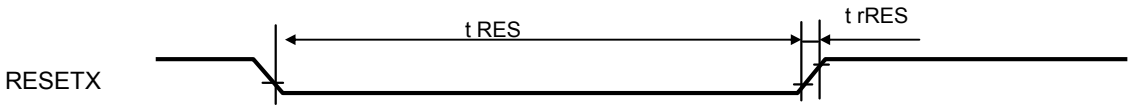
8.2.2 RGB I/F timing Characteristics



VCI=IOVCC=2.7～3.3[V]、Ta=-20～70°C

Item	Symbol	Condition	Rating			Unit
			MIN	TYP	MAX	
VSYNC/HSYNC Setup time	tSYNCS		0.5	-	1.5	DOTCLK
DE Setup time	tENS		10	-	-	ns
DE Hold time	tENH		20	-	-	ns
Data Setup time DB[17:0]	tPDS		10	-	-	ns
Data Hold time DB[17:0]	tPDH		40	-	-	ns
DOTCLK Cycle Time	tCYCD		100	-	-	ns
DOTCLK Low period	PWDL		40	-	-	ns
DOTCLK High period	PWDH		40	-	-	ns
DOTCLK,VSYNC,HSYNC rise time, fall time	trgbr,trgbf		-	-	25	ns

8.2.3 RESET Timing

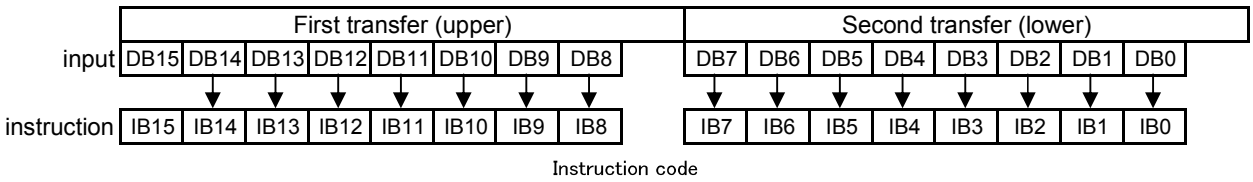


VCI=IOVCC=2.7～3.3[V]、Ta=-20～70°C

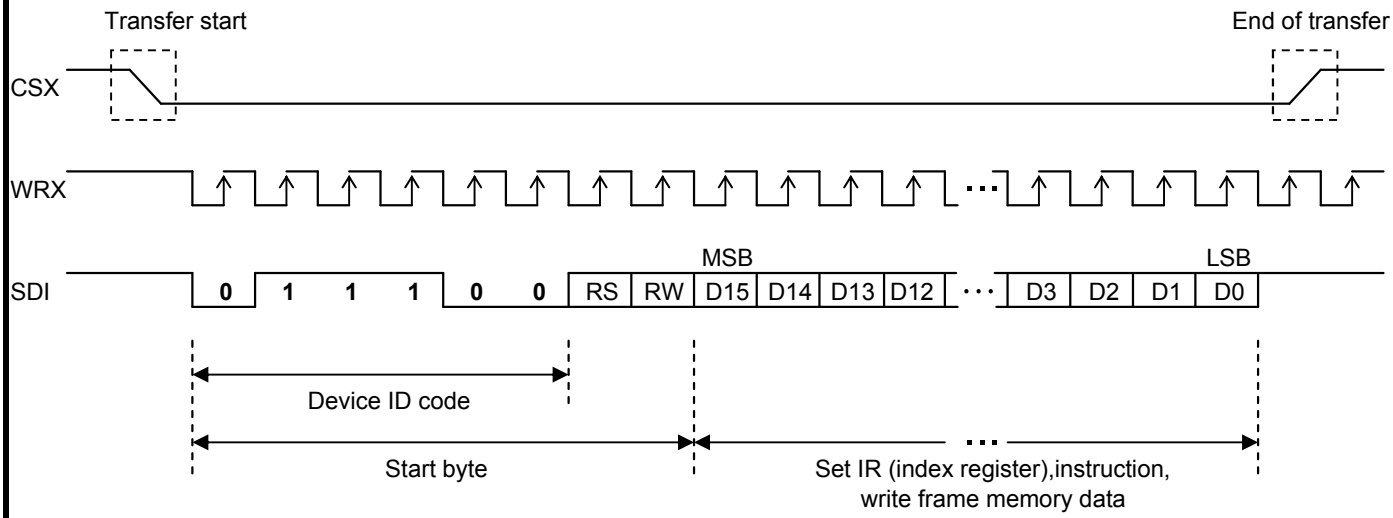
Item	Symbol	Condition	Rating			Unit
			MIN	TYP	MAX	
Reset low pulse width	t RES		1	—	—	ms
Reset rise time	t rRES		—	—	10	us

8.2.4 Serial Data Format

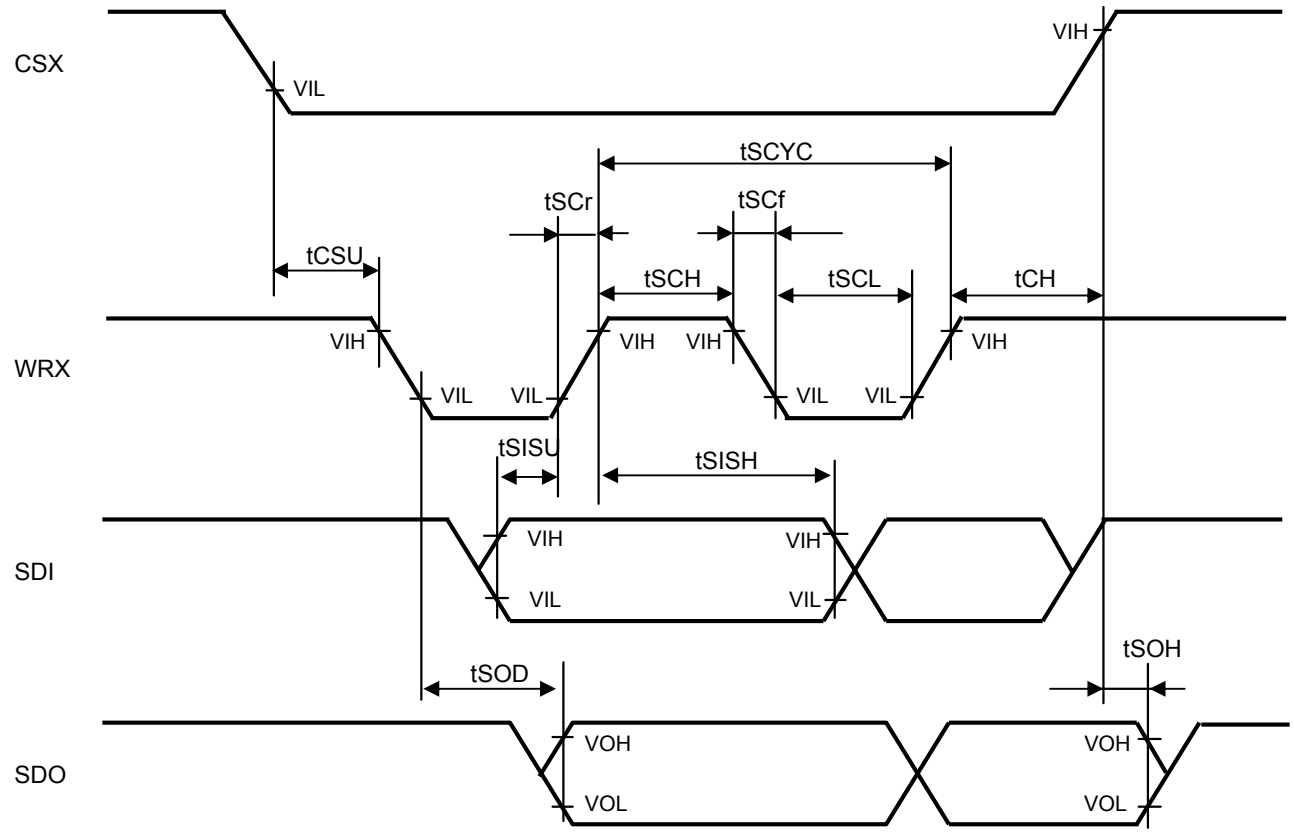
RS	RW	Function
0	0	Set index register
0	1	setting inhibited
1	0	Write instruction or frame memory data
1	1	Read register settings or frame memory data



「Clock synchronization serial data transfer (basic mode)」



8.2.5 Serial I/F timing Characteristics



VCI=IOVCC=2.7～3.3[V]、Ta=-20～70°C

Item		Symbol	Condition	Rating			Unit
				MIN	TYP	MAX	
Serial Clock cycle time	Write	tSCYC		(100)	-	(20000)	ns
	Read	tSCYC		(350)	-	(20000)	ns
Serial Clock	Write	tSCH		(40)	-	-	ns
High pulse width	Read	tSCH		(150)	-	-	ns
Serial Clock	Write	tSCL		(40)	-	-	ns
Low pulse width	Read	tSCL		(150)	-	-	ns
Write/Read rise/fall time		tSCr/tSCf		-	-	(20)	ns
CSX setup time		tCSU		(20)	-	-	ns
CSX hold time		tCH		(60)	-	-	ns
Write data setup time		tSISU		(30)	-	-	ns
Write data hold time		tSISH		(30)	-	-	ns
Read data delay time		tSOD		-	-	(130)	ns
Read data hold time		tSOH		(5)	-	-	ns

9. Interface

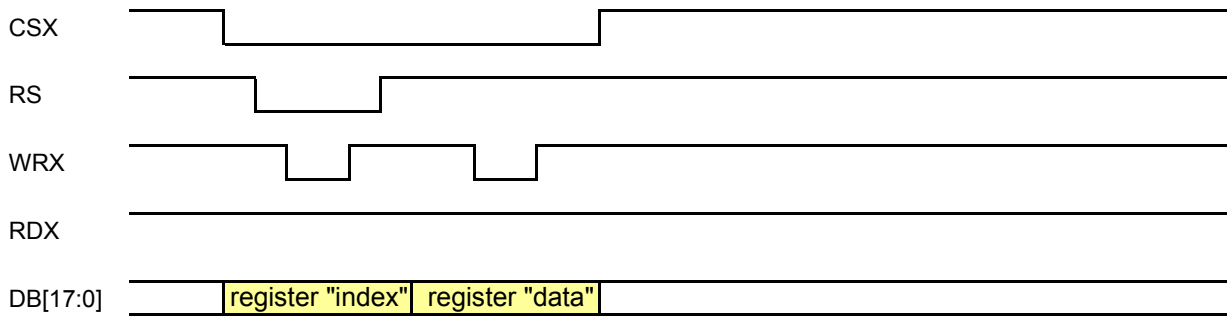
9.1 Interface Mode

			RGB I/F	CPU I/F
			18bit	16bit
	IM3		GND	GND
	IM2		IOVCC	GND
	IM1		GND	IOVCC
R03h D15	TRIREG		0	0
R03h D14	DFM		0	*
R0Ch D8	RM		1	0
R0Ch D5	DM[1]		0	0
R0Ch D4	DM[0]		1	0
R0Ch D1	RIM[1]		0	0
R0Ch D0	RIM[0]		0	0
DB17	*	IB15	R5	R5/R0
DB16	*	IB14	R4	R4
DB15	*	IB13	R3	R3
DB14	*	IB12	R2	R2
DB13	*	IB11	R1	R1
DB12	*	IB10	R0	G5
DB11	*	IB9	G5	G4
DB10	*	IB8	G4	G3
DB9	*	*	G3	0
DB8	IR7	IB7	G2	G2
DB7	IR6	IB6	G1	G1
DB6	IR5	IB5	G0	G0
DB5	IR4	IB4	B5	B5/B0
DB4	IR3	IB3	B4	B4
DB3	IR2	IB2	B3	B3
DB2	IR1	IB1	B2	B2
DB1	IR0	IB0	B1	B1
DB0	*	*	B0	0
VSYNC			valid (L active)	GND
HSYNC			valid (L active)	GND
DOTCLK			valid (L -> H)	GND
DE			valid (L active)	GND

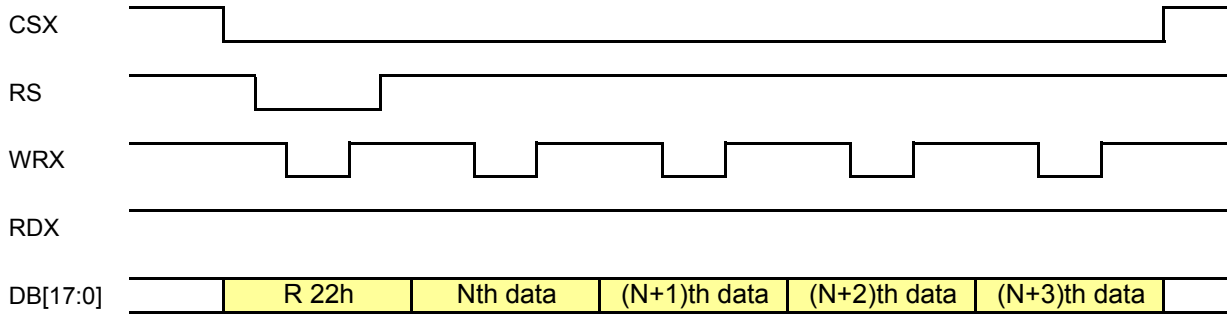
9.2 System interface timing

Send registers and data in accordance with the following transfer format.

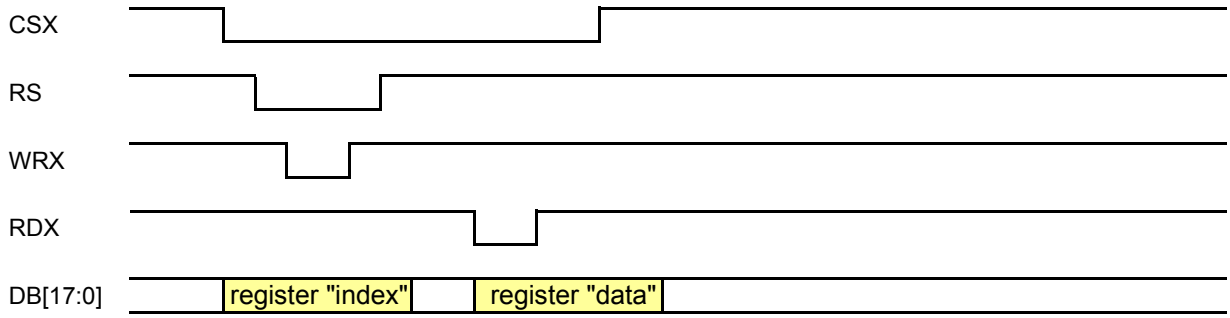
a) Write to register



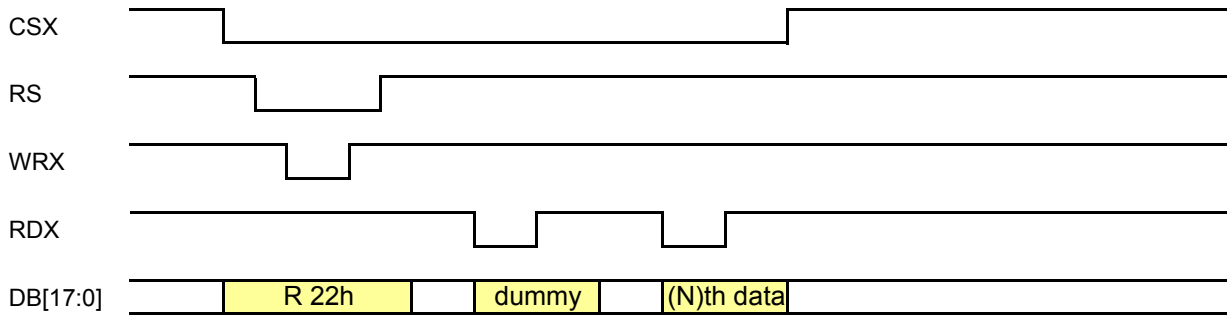
b) Write to GRAM (CPU 16-bit I/F)



c) Read from register



d) Read from GRAM (CPU 16-bit I/F)

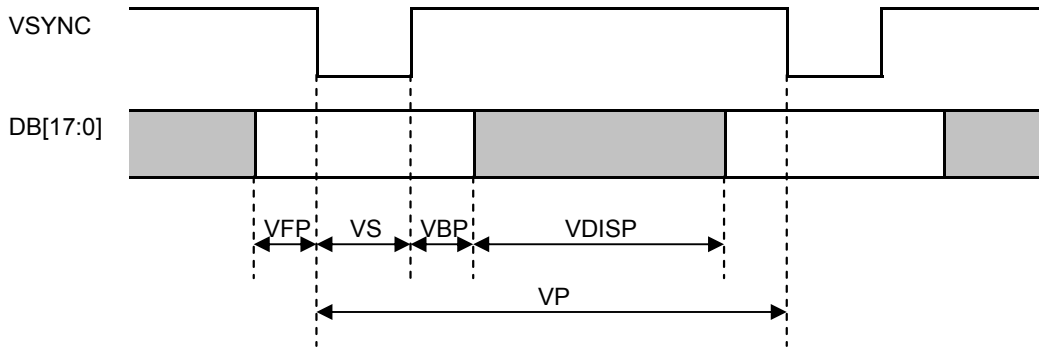


* If you want to continue reading, please set the new address because it does not address the auto-increment.

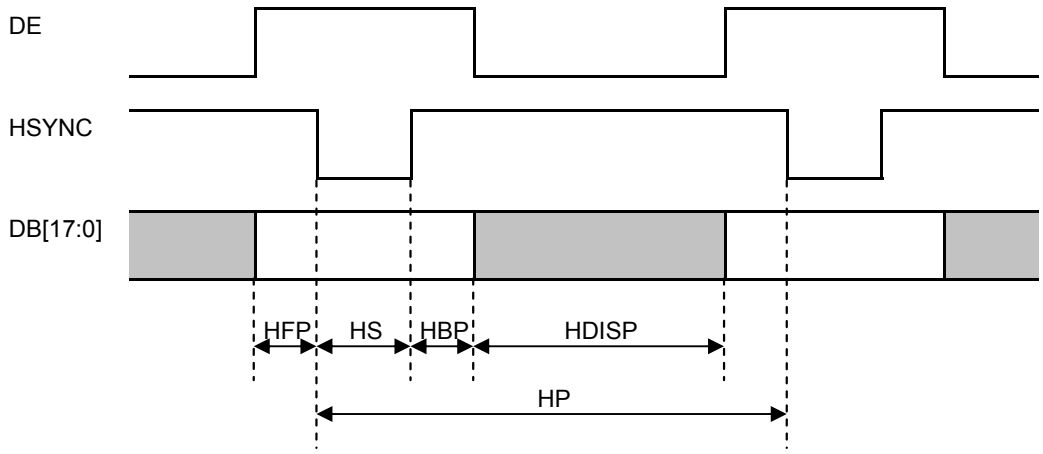
9.3 RGB I/F Timing

Item	Symbol	MIN	TYP	MAX	Unit
VSYNC Cycle	VP	325	328		Line
VSYNC Low Width	VS	1	2	4	Line
Vertical Front Porch	VFP	3	4		Line
Vertical Back Porch	VBP	1	2		Line
Vertical Display Period	VDISP	320	320	320	Line
Vertical Refresh Rate	VRR	70	71		Hz
HSYNC Cycle	HP	246	280		DOTCLK
HSYNC Low Width	HS	2	10	16	DOTCLK
Horizontal Front Porch	HFP	2	10	16	DOTCLK
Horizontal Back Porch	HBP	2	20	24	DOTCLK
Horizontal Display Period	HDISP	240	240	240	DOTCLK
Pixel CLK Frequency	PCLK		6.55	10	MHz

Vertical Timing



Horizontal Timing



10. Register List

IR	Registers Name	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
	Index Register (RS=0)	*	*	*	*	*	*	*	*	IR7	IR6	IR5	IR4	IR3	IR2	IR1	IR0
R00h	Driver Code Read	Read out only															
	Initial 1580h	0	0	0	1	0	1	0	1	1	0	0	0	0	0	0	0
	recommend	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R01h	Driver Output Control 1	0	0	0	0	0	SM	0	SS	0	0	0	0	0	0	0	0
	Initial 0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend 0500h	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
R02h	LCD Driving Control	0	0	0	0	0	0	BC0	0	0	0	0	0	0	0	0	NW0
	Initial 0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend 0200h	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
R03h	Entry Mode	TRIREG	DFM	0	BGR	0	0	0	0	ORG	0	I/D[1:0]		AM	0	0	0
	Initial 0030h	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
	recommend 1030h	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0
R07h	Display Control 1	0	0	0	PTDE	0	0	0	BASEE	0	0	0	0	COL	0	0	0
	Initial 0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend 0100h	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
R08h	Display Control 2	FP[7:0]								BP[7:0]							
	Initial 0808h	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
	recommend 0503h	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	1
R09h	Display Control 3	0	0	0	0	0	PTS[2:0]			0	0	PTG	0	ISC[3:0]			
	Initial 0001h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	recommend 0001h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
R0Ah	Display Control 4	0	0	0	0	0	0	0	0	0	0	0	0	FMARKOE	FM[2:0]		
	Initial 0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend 0008h	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
R0Ch	RGB I/F Control 1	0	ENC[2:0]			0	0	0	RM	0	0	DM[1:0]		0	0	RIM[1:0]	
	Initial 0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend 0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R0Dh	FMARK Position	0	0	0	0	0	0	0	0	FMP[8:0]							
	Initial 0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend 0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R0Eh	VCOML voltage Control	0	0	0	0	0	0	0	0	0	0	VEM[1:0]		0	0	0	0
	Initial 0030h	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
	recommend 0030h	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
R0Fh	RGB I/F Control 2	0	0	0	0	0	0	0	0	0	0	0	VSPL	HSPL	0	EPL	DPL
	Initial 0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend 0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R10h	Power Control 1	0	0	0	0	0	BT[2:0]			0	0	AP[1:0]		0	DSTB	0	0
	Initial 0530h	0	0	0	0	0	1	0	1	0	0	1	1	0	0	0	0
	recommend 0310h	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0
R11h	Power Control 2	0	0	0	0	0	DC1[2:0]			0	DC0[2:0]			0	VC[2:0]		
	Initial 0237h	0	0	0	0	0	0	1	0	0	0	1	1	0	1	1	1
	recommend 0232h	0	0	0	0	0	0	1	0	0	0	1	1	0	0	1	0
R12h	Power Control 3	0	0	0	VRH0	0	0	0	VCMR	1	0	PSON	PON	VRH[4:1]			
	Initial 018Fh	0	0	0	0	0	0	0	1	1	0	0	0	1	1	1	1
	recommend 018Ch	0	0	0	0	0	0	0	1	1	0	0	0	1	1	0	0
R13h	Power Control 4	0	0	0	VDV[4:0]					0	0	0	0	0	0	0	0
	Initial 0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend 1400h	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0

IR	Registers Name		IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
R20h	Horizontal RAM Address Set		0	0	0	0	0	0	0	0	AD[7:0]							
	Initial	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R21h	Vertical RAM Address Set		0	0	0	0	0	0	0	AD[16:8]								
	Initial	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R22h	Write/Read Data		RAM write/read data															
	Initial	- - - -																
	recommend	- - - -																
R29h	VCOMH voltage Control		0	0	0	0	0	0	0	0	0	VCM1[6:0]						
	Initial	00FFh	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	recommend	0065h	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	1
R30h	Gamma Control 1		0	0	0	PR0P01[4:0]					0	0	0	PR0P00[4:0]				
	Initial	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend	0500h	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
R31h	Gamma Control 2		PR0P04[3:0]				PR0P03[3:0]				0	0	0	PR0P02[4:0]				
	Initial	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend	3711h	0	0	1	1	0	1	1	1	0	0	0	1	0	0	0	1
R32h	Gamma Control 3		0	0	0	PR0P06[4:0]					0	0	0	0	PR0P05[3:0]			
	Initial	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend	0605h	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	1
R33h	Gamma Control 4		0	0	0	PR0P08[4:0]					0	0	0	PR0P07[4:0]				
	Initial	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend	120Dh	0	0	0	1	0	0	1	0	0	0	0	0	1	1	0	1
R34h	Gamma Control 5		0	0	PIR0P3[1:0]		0	0	PIR0P2[1:0]		0	0	PIR0P1[1:0]		0	0	PIR0P0[1:0]	
	Initial	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend	1202h	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0
R35h	Gamma Control 6		0	0	0	PR0N01[4:0]					0	0	0	PR0N00[4:0]				
	Initial	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend	0D0Ah	0	0	0	0	1	1	0	1	0	0	0	0	1	0	1	0
R36h	Gamma Control 7		PR0N04[3:0]				PR0N03[3:0]				0	0	0	PR0N02[4:0]				
	Initial	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend	3506h	0	0	1	1	0	1	0	1	0	0	0	0	0	1	1	0
R37h	Gamma Control 8		0	0	0	PR0N06[4:0]					0	0	0	0	PR0N05[3:0]			
	Initial	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend	1107h	0	0	0	1	0	0	0	1	0	0	0	0	0	1	1	1
R38h	Gamma Control 9		0	0	0	PR0N08[4:0]					0	0	0	PR0N07[4:0]				
	Initial	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend	0005h	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
R39h	Gamma Control 10		0	0	PIR0N3[1:0]		0	0	PIR0N2[1:0]		0	0	PIR0N1[1:0]		0	0	PIR0N0[1:0]	
	Initial	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend	0212h	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0
R50h	Window Horizontal RAM Start Address		0	0	0	0	0	0	0	0	HSA[7:0]							
	Initial	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R51h	Window Horizontal RAM End Address		0	0	0	0	0	0	0	0	HEA[7:0]							
	Initial	00EFh	0	0	0	0	0	0	0	0	1	1	1	0	1	1	1	1
	recommend	00EFh	0	0	0	0	0	0	0	0	1	1	1	0	1	1	1	1
R52h	Window Vertical RAM Start Address		0	0	0	0	0	0	0	VSA[8:0]								
	Initial	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R53h	Window Vertical RAM End Address		0	0	0	0	0	0	0	VEA[8:0]								
	Initial	013Fh	0	0	0	0	0	0	0	1	0	0	1	1	1	1	1	1
	recommend	013Fh	0	0	0	0	0	0	0	1	0	0	1	1	1	1	1	1

IR	Registers Name		IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
R60h	Driver Output Control 2		GS	0	NL[5:0]						0	0	SCN[5:0]					
	Initial	2700h	0	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0
	recommend	A700h	1	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0
R61A	Base Image Display Control		0	0	0	0	0	0	0	0	0	0	0	0	0	NDL	VLE	REV
	Initial	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R6Ah	Vertical Scroll Control		0	0	0	0	0	0	0	VL[8:0]								
	Initial	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R80h	Partial Image Display Position		0	0	0	0	0	0	0	PTDP[8:0]								
	Initial	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R81h	Partial Image Area (Start Line)		0	0	0	0	0	0	0	PTSA[8:0]								
	Initial	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R82h	Partial Image Area (End Line)		0	0	0	0	0	0	0	PTEA[8:0]								
	Initial	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R90h	Panel I/F Control 1		0	0	0	0	0	0	DIVI[1:0]		0	0	0	RTNI[4:0]				
	Initial	0111h	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1
	recommend	001Dh	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1
R91h	Panel I/F Control 1-1		0	0	0	0	0	0	0	0	0	0	0	0	SPCWI[3:0]			
	Initial	0001h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	recommend	0003h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
R92h	Panel I/F Control 2		0	0	0	0	0	NOWI[2:0]			0	0	0	0	0	0	0	0
	Initial	0100h	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	recommend	0100h	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
R93h	Panel I/F Control 3		0	0	0	0	0	VEQWI[2:0]			0	0	0	0	0	MCPI[2:0]		
	Initial	0101h	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
	recommend	0201h	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
R94h	Panel I/F Control 4		0	0	0	0	0	0	0	0	0	0	0	0	0	SDTI[2:0]		
	Initial	0001h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	recommend	0001h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
R95h	Panel I/F Control 5		0	0	0	0	0	0	DIVE[1:0]		0	0	RTNE[4:0]					
	Initial	001Fh	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
	recommend	001Fh	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
R96h	Panel I/F Control 5-1		0	0	0	0	0	0	0	0	0	0	0	0	SPCWE[3:0]			
	Initial	0001h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	recommend	0001h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
R97h	Panel I/F Control 6		0	0	0	0	0	NOWE[2:0]			0	0	0	0	0	0	0	0
	Initial	0100h	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	recommend	0100h	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
R98h	Panel I/F Control 7		0	0	0	0	0	VEQWE[2:0]			0	0	0	0	0	MCPE[2:0]		
	Initial	0101h	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
	recommend	0101h	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
R99h	Panel I/F Control 8		0	0	0	0	0	0	0	0	0	0	0	0	0	SDTE[2:0]		
	Initial	0001h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	recommend	0001h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
R9Ch	Panel I/F Control 9		0	0	0	0	0	0	0	0	0	PCDIVH[2:0]			0	PCDIVL[2:0]		
	Initial	0043h	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1
	recommend	0043h	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1
RA4h	NVM Calibration		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	CALB
	Initial	0000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recommend	0001h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

11. Sequence

11.1 RGB I/F

11.1.1 Power ON Sequence

(1/2)

No.		Function	Register	recommend	Remarks
1	Power ON	VCI,IOVCC ON			
2		RESETX=0			
3	Wait	1msec or more			
4		RESETX=1			
5	Wait	2msec or more			
6	data transfer synchronization	RS=0	-	0000 h	
		RS=0	-	0000 h	
		RS=0	-	0000 h	
		RS=0	-	0000 h	
7		NVM Calibration	RA4h	0001 h	
8	Wait	0.2msec or more			
9	Instruction user setting	Driver Output Control 2	R60h	A700 h	
		Display Control 2	R08h	0503 h	
		Gamma Control 1	R30h	0500 h	
		Gamma Control 2	R31h	3711 h	
		Gamma Control 3	R32h	0605 h	
		Gamma Control 4	R33h	120D h	
		Gamma Control 5	R34h	1202 h	
		Gamma Control 6	R35h	0D0A h	
		Gamma Control 7	R36h	3506 h	
		Gamma Control 8	R37h	1107 h	
		Gamma Control 9	R38h	0005 h	
		Gamma Control 10	R39h	0212 h	
		Panel I/F Control 1	R90h	001D h	RTNI,DVI (71Hz)
		Panel I/F Control 2	R9Ch	0054 h	
		Power Control 1	R10h	0310 h	
		Power Control 2	R11h	0232 h	VCI1=0.89xVCI
		Power Control 4	R13h	1400 h	
		Power Control 3	R12h	01BC h	VCMR=1
10	Wait	wait 100 msec or more			
11	Other mode setting	Driver Output Control 1	R01h	0500 h	
		LCD Driving Control	R02h	0200 h	
		Entry Mode	R03h	1030 h	16bit-I/F(TRIREG=DFM=0)
		Display Control 3	R09h	0001 h	
		Display Control 4	R0Ah	0008 h	
		FMARK Position	R0Dh	0000 h	
		VCOML voltage Control	R0Eh	0030 h	
		External Display Control 2	R0Fh	0000 h	DPL,EPL,HSPL,VSPL
		Window Horizontal RAM Start Address	R50h	0000 h	
		Window Horizontal RAM End Address	R51h	00EF h	
		Window Vertical RAM Start Address	R52h	0000 h	
		Window Vertical RAM End Address	R53h	013F h	
		Base Image Display Control	R61h	0000 h	
		Vertical Scroll Control	R6Ah	0000 h	
12	Partial Display Control	Partial Image Display Position	R80h	0000 h	
		Partial Image RAM Start Line Address	R81h	0000 h	
		Partial Image RAM End Line Address	R82h	0000 h	

(2/2)

No.		Function	Register	recommend	Remarks
13	Panel interface Control	Panel interface control 1-1	R91h	0003 h	
		Panel interface control 2	R92h	0100 h	
		Panel interface control 3	R93h	0201 h	
		Panel interface control 4	R94h	0001 h	
		Back Light Control	RC0h	0000 h	
14	Test Register	Test Register	RF3h	0020 h	
15	Address Setting	Horizontal RAM Address Set	R20h	0000 h	
		Vertical RAM Address Set	R21h	0000 h	
		External Display Control 1	R0Ch	0110 h	
Start RGB I/F signal input (VSYNC,HSYNC,DOTCLK,DE)					
16	Display ON	Display Control 1	R07h	0100 h	
17	Data transfer	GRAM Data Write	R22h	0000 h	
18	Wait	wait 34 msec(2 frame) or more			
19	Back-Light ON				

11.1.2 Power OFF Sequence

No.		Function	Register	recommend	Remarks
1	Power OFF	Display Control 1	R07h	0000 h	BASEE=0
Stop RGB I/F signal input (VSYNC,HSYNC,DOTCLK,DE)					
2	Power Control	Power Control 3	R12h	018C h	PSON=0, PON=0
3	Wait	wait 120 msec or more			
4		VCI,IOVCC OFF			

11.1.3 Deep-Standby Sequence

No.		Function	Register	recommend	Remarks
1	Display OFF	Display Control 1	R07h	0000 h	BASEE=0
Stop RGB I/F signal input (VSYNC,HSYNC,DOTCLK,DE)					
2	Power Control	Power Control 3	R12h	018C h	PSON=0, PON=0
3	Wait	wait 1 frame or more			
4	Power Control	Power Control 1	R10h	0634 h	

11.1.4 Deep-Standby Release Sequence

No.		Function	Register	recommend	Remarks
1	Dummy	DB = 0000 h		0000 h	
		DB = 0000 h		0000 h	
2	Wait	wait 1 msec or more			
3	Dummy	DB = 0000 h		0000 h	
		DB = 0000 h		0000 h	
		DB = 0000 h		0000 h	
		DB = 0000 h		0000 h	
4	Wait	wait 1 msec or more			
5	Power ON Sequence	Power ON Sequence No.7 --			

11.1.5 Refresh Sequence

To prevent false operation by static electricity and such, please refresh register setting as follows regularly.

No.		Function	Register	recommend	Remarks
1	data transfer synchronization	RS=0	-	0000 h	
		RS=0	-	0000 h	
		RS=0	-	0000 h	
		RS=0	-	0000 h	
2		NVM Calibration	RA4h	0001 h	
3	Wait	0.2msec or more			
4	Instruction user setting	Driver Output Control 2	R60h	A700 h	
		Display Control 2	R08h	0503 h	
		Gamma Control 1	R30h	0500 h	
		Gamma Control 2	R31h	3711 h	
		Gamma Control 3	R32h	0605 h	
		Gamma Control 4	R33h	120D h	
		Gamma Control 5	R34h	1202 h	
		Gamma Control 6	R35h	0D0A h	
		Gamma Control 7	R36h	3506 h	
		Gamma Control 8	R37h	1107 h	
		Gamma Control 9	R38h	0005 h	
		Gamma Control 10	R39h	0212 h	
		Panel I/F Control 1	R90h	001D h	70Hz
		Power Control 1	R10h	0310 h	
		Power Control 2	R11h	0232 h	
		Power Control 3	R13h	1400 h	
		Power Control 4	R12h	01BC h	
5	Wait	wait 100 msec or more			
		Driver Output Control 1	R01h	0500 h	
		LCD Driving Control	R02h	0200 h	
		Entry Mode	R03h	1030 h	
		Display Control 3	R09h	0001 h	
		Display Control 4	R0Ah	0008 h	
		RGB I/F Control 1	R0Ch	0000 h	
		FMARK Position	R0Dh	0000 h	
		VCOML voltage Control	R0Eh	0030 h	
		RGB I/F Control 2	R0Fh	0000 h	
		Window Horizontal RAM Start Address	R50h	0000 h	
		Window Horizontal RAM End Address	R51h	00EF h	
		Window Vertical RAM Start Address	R52h	0000 h	
		Window Vertical RAM End Address	R53h	013F h	
		Base Image Display Control	R61h	0000 h	
		Vertical Scroll Control	R6Ah	0000 h	
6	Partial Display Control	Partial Image Display Position	R80h	0000 h	
		Partial Image RAM Start Line Address	R81h	0000 h	
		Partial Image RAM End Line Address	R82h	0000 h	
7	Panel interface Control	Panel interface control 1-1	R91h	0003 h	
		Panel interface control 2	R92h	0100 h	
		Panel interface control 3	R93h	0201 h	
		Panel interface control 4	R94h	0001 h	
		Back Light Control	RC0h	0000 h	
8	Test Register	Test Register	RF3h	0020 h	
9	Address Setting	Horizontal RAM Address Set	R20h	0000 h	
		Vertical RAM Address Set	R21h	0000 h	
10	Display ON	Display Control 1	R07h	0100 h	
	Data transfer	GRAM Data Write	R22h	0000 h	

11.2 CPU 16-bit I/F

11.2.1 Power ON Sequence

(1/2)

No.		Function	Register	recommend	Remarks
1	Power ON	VCI,IOVCC ON			
2		RESETX=0			
3	Wait	1msec or more			
4		RESETX=1			
5	Wait	2msec or more			
6	data transfer synchronization	RS=0	-	0000 h	
		RS=0	-	0000 h	
		RS=0	-	0000 h	
		RS=0	-	0000 h	
7		NVM Calibration	RA4h	0001 h	
8	Wait	0.2msec or more			
9	Instruction user setting	Driver Output Control	R60h	A700 h	
		Display Control 2	R08h	0503 h	
		Gamma Control 1	R30h	0500 h	
		Gamma Control 2	R31h	3711 h	
		Gamma Control 3	R32h	0605 h	
		Gamma Control 4	R33h	120D h	
		Gamma Control 5	R34h	1202 h	
		Gamma Control 6	R35h	0D0A h	
		Gamma Control 7	R36h	3506 h	
		Gamma Control 8	R37h	1107 h	
		Gamma Control 9	R38h	0005 h	
		Gamma Control 10	R39h	0212 h	
		Panel I/F Control	R90h	001D h	RTNI,DVI (70Hz)
		Power Control 1	R10h	0310 h	
		Power Control 2	R11h	0232 h	VCI1=0.89xVCI
		Power Control 4	R13h	1400 h	
		Power Control 3	R12h	01BC h	VCMR=1
10	Wait	wait 100 msec or more			
11	Other mode setting	Driver Output Control	R01h	0500 h	
		LCD Driving Control	R02h	0200 h	
		Entry Mode	R03h	1030 h	16bit-I/F(TRIREG=DFM=0)
		Display Control 3	R09h	0001 h	
		Display Control 4	R0Ah	0008 h	
		External Display Control 1	R0Ch	0000 h	
		FMARK Position	R0Dh	0000 h	
		VCOML voltage Control	R0Eh	0030 h	
		External Display Control 2	R0Fh	0000 h	DPL,EPL,HSPL,VSPL
		Window Horizontal RAM Address Start	R50h	0000 h	
		Window Horizontal RAM Address End	R51h	00EF h	
		Window Vertical RAM Address Start	R52h	0000 h	
		Window Vertical RAM Address End	R53h	013F h	
		Base Image Display Control	R61h	0000 h	
		Vertical Scroll Control	R6Ah	0000 h	
12	Partial Display Control	Partial Image Display Position	R80h	0000 h	
		Partial Image RAM Start Line Address	R81h	0000 h	
		Partial Image RAM End Line Address	R82h	0000 h	

(2/2)

No.		Function	Register	recommend	Remarks
13	Panel interface Control	Panel interface control 1-1	R91h	0003 h	
		Panel interface control 2	R92h	0100 h	
		Panel interface control 3	R93h	0201 h	
		Panel interface control 4	R94h	0001 h	
		Back Light Control	RC0h	0000 h	
14	Test Register	Test Register	RF3h	0020 h	
15	Address Setting	Horizontal RAM Address Set	R20h	0000 h	
		Vertical RAM Address Set	R21h	0000 h	
16	Data transfer	GRAM Data Write	R22h	**** h	
17	Display ON	Display Control	R07h	0100 h	
18	Wait	wait 34 msec(2 frame) or more			
19	Back-Light ON				

11.2.2 Power OFF Sequence

No.		Function	Register	recommend	Remarks
1	Display OFF	Display Control 1	R07h	0000 h	BASEE=0
2	Power Control	Power Control	R12h	018C h	PSON=0, PON=0
3	Wait	wait 120 msec or more			
4		VCI,IOVCC OFF			

11.2.3 Deep-Standby Sequence

No.		Function	Register	recommend	Remarks
1	Display OFF	Display Control 1	R07h	0000 h	BASEE=0
2	Power Control	Power Control 3	R12h	018C h	PSON=0, PON=0
3	Wait	wait 1 frame or more			
4	Power Control	Power Control 1	R10h	0634 h	

11.2.4 Deep-Standby Release Sequence

No.		Function	Register	recommend	Remarks
1	Dummy	DB = 0000 h		0000 h	
		DB = 0000 h		0000 h	
2	Wait	wait 1 msec or more			
3	Dummy	DB = 0000 h		0000 h	
		DB = 0000 h		0000 h	
		DB = 0000 h		0000 h	
		DB = 0000 h		0000 h	
4	Wait	wait 1 msec or more			
5	Power ON Sequence	Resume from Power ON Sequence No.7			

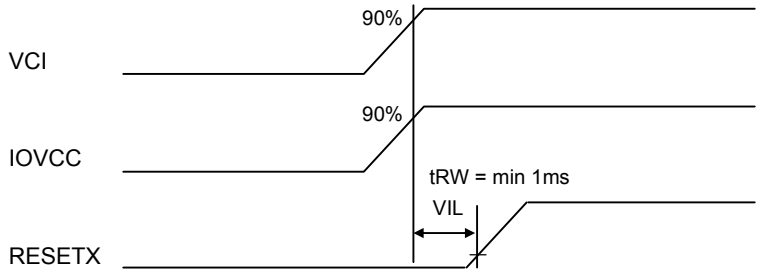
11.2.5 Refresh Sequence

To prevent false operation by static electricity and such, please refresh register setting as follows regularly.

No.		Function	Register	recommend	Remarks
1	data transfer synchronization	RS=0	-	0000 h	
		RS=0	-	0000 h	
		RS=0	-	0000 h	
		RS=0	-	0000 h	
2		NVM Calibration	RA4h	0001 h	
3	Wait	0.2msec or more			
4	Instruction user setting	Driver Output Control	R60h	A700 h	
		Display Control 2	R08h	0503 h	
		Gamma Control 1	R30h	0500 h	
		Gamma Control 2	R31h	3711 h	
		Gamma Control 3	R32h	0605 h	
		Gamma Control 4	R33h	120D h	
		Gamma Control 5	R34h	1202 h	
		Gamma Control 6	R35h	0D0A h	
		Gamma Control 7	R36h	3506 h	
		Gamma Control 8	R37h	1107 h	
		Gamma Control 9	R38h	0005 h	
		Gamma Control 10	R39h	0212 h	
		Panel I/F Control	R90h	001D h	70Hz
		Power Control 1	R10h	0310 h	
		Power Control 2	R11h	0232 h	
		Power Control 4	R13h	1400 h	
		Power Control 3	R12h	01BC h	
5	Wait	wait 100 msec or more			
		Driver Output Control	R01h	0500 h	
		LCD Driving Control	R02h	0200 h	
		Entry Mode	R03h	1030 h	
		Display Control 3	R09h	0001 h	
		Display Control 4	R0Ah	0008 h	
		External Display Control 1	R0Ch	0000 h	
		FMARK Position	R0Dh	0000 h	
		VCOML voltage Control	R0Eh	0030 h	
		External Display Control 2	R0Fh	0000 h	
		Window Horizontal RAM Address Start	R50h	0000 h	
		Window Horizontal RAM Address End	R51h	00EF h	
		Window Vertical RAM Address Start	R52h	0000 h	
		Window Vertical RAM Address End	R53h	013F h	
		Base Image Display Control	R61h	0000 h	
		Vertical Scroll Control	R6Ah	0000 h	
6	Partials Display Control	Partial Image Display Position	R80h	0000 h	
		Partial Image RAM Start Line Address	R81h	0000 h	
		Partial Image RAM End Line Address	R82h	0000 h	
7	Panel interface Control	Panel interface control 1-1	R91h	0003 h	
		Panel interface control 2	R92h	0100 h	
		Panel interface control 3	R93h	0201 h	
		Panel interface control 4	R94h	0001 h	
		Back Light Control	RC0h	0000 h	
8	Test Register	Test Register	RF3h	0020 h	
9	Address Setting	Horizontal RAM Address Set	R20h	0000 h	
		Vertical RAM Address Control	R21h	0000 h	
	Data transfer	GRAM Data Write	R22h	**** h	
10	Display ON	Display Control	R07h	0100 h	

11.3 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 1ms after each power supply.



11.4 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 .

12. About LED Driving Circuit

As the light source of the backlight, has adopted a high-brightness white LED.
Then there is the anode and the cathode of the output LED.
Shows an example of the drive circuit in Figures 1 and 2
Fig.1 is a constant voltage driving method , and Fig.2 is a constant current driving method.
In the sense that it suppresses the variation in brightness, we recommend a constant current circuit system.

VF-IF characteristics of LED you are using, the difference occurs for each LED.
In the constant voltage drive, therefore, the current flowing through the LED difference occurs for each LED.
When viewed on the screen, it will be uneven in surface brightness.
In the case of the constant current drive, LED luminance difference between the three is so little control.

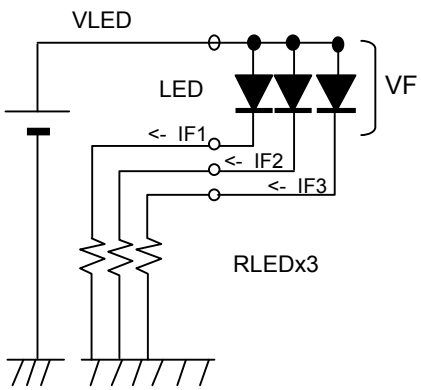


Fig.1 Constant Voltage Driving

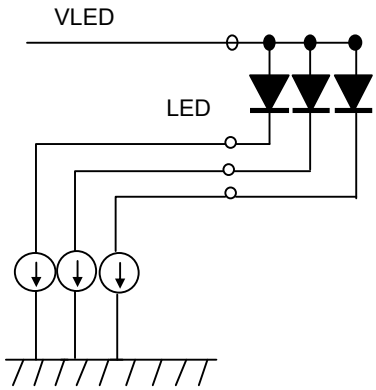
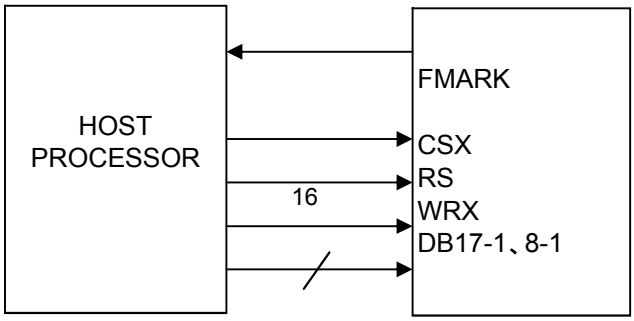


Fig.2 Constant Current Driving

13. FMARK FUNCTION (CPU 16-bit I/F)

In the FMARK interface operation, data is written to internal frame memory via system interface synchronizing with the frame mark signal (FMARK), realizing tearing less video image while using conventional system interface. FMARK output position is set in units of line using FMP bit. (register R0Dh). Set the bit considering data transfer speed.



1 On Frame-1, LCD is displaying Fig-1 picture from top to bottom. (as black arrow)
2 At the FMARK signal, CPU start transferring Fig-2 picture. (as red arrow)
3 On Frame-2, LCD is displaying Fig-2 picture correctly.
4 CPU start transferring Fig-1 picture without synchronizing with LCD. (as green arrow)
5 On Frame-3, top half of display has already changed to Fig-1 while bottom half remains Fig-2.
6 On Frame-4, transferring Fig-1 picture has completed and LCD is displaying correctly.

FMARK is used to avoid Tearing shown on Fig-3.

【Tearring】

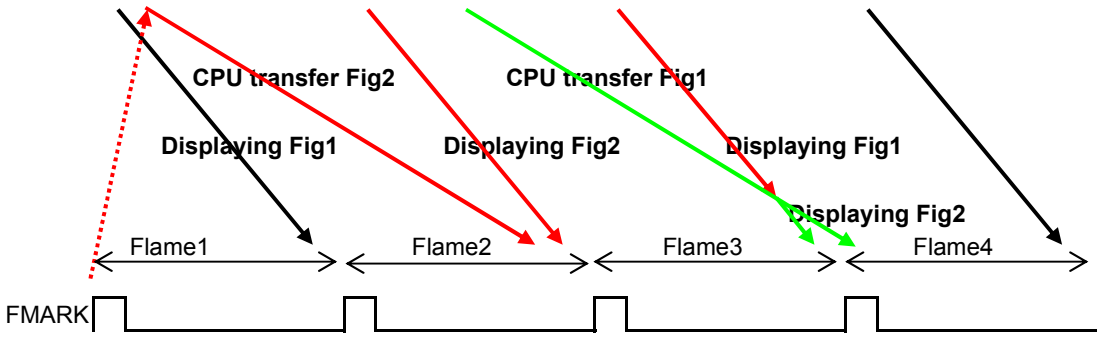


Fig.1 Fig.2 Fig.3 Fig.4

14. Characteristics

14.1 Optical Characteristics

< Measurement Condition >

Measuring instruments: CS1000（KONICA MINOLTA）, LCD7200(OTSUKA ELECTRONICS）, EZcontrast160D（ELDIM）

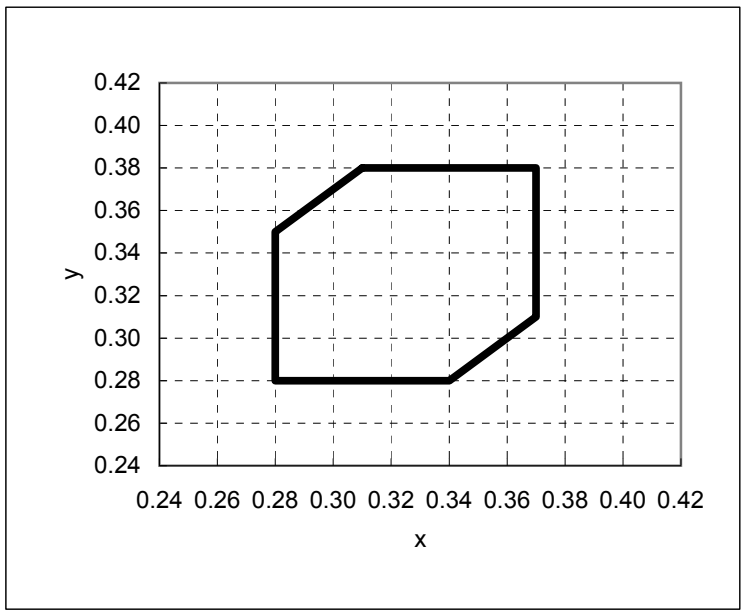
Driving condition: VCI = IOVCC = 3.0V
Optimized VCOMDC

Backlight: IL=9.5mA

Measured temperature: Ta=25°C

Item		Symbol	Condition	MIN	TYP	MAX	Unit	Note No.	Remark
Response time	Rise time	TON	[Data]= 00h ⇒ 3Fh	—	—	60	ms	1	
	Fall time	TOFF	[Data]= 3Fh ⇒ 00h	—	—	40	ms		
Contrast ratio		CR	[Data]= 3Fh / 00h	400	800	—		2	
Viewing angle	Left	θL	[Data]= 3Fh / 00h CR≧5	—	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							
Burn-in				No noticeable burn-in image shall be observed after 2 hours of window pattern display.				5	
Center brightness			[Data]= 3Fh	310	450	—	cd/m^2	6	
Brightness distribution			[Data]= 3Fh	70	—	—	%	7	

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



White Chromaticity Range

【White Chromaticity Range】

x	y
0.31	0.38
0.28	0.35
0.28	0.28
0.34	0.28
0.37	0.31
0.37	0.38

14.2 Temperature Characteristics

< Measurement Condition >
Measuring instruments: CS1000（KONICA MINOLTA）, LCD7200(OTSUKA ELECTRONICS）
Driving condition: VCI = IOVCC = 3.0V
Optimized VCOMDC
Backlight: IL=9.5mA

Item			Specification		Remark
			Ta＝－20˚C	Ta＝70˚C	
Contrast ratio		CR	40 or more	40 or more	
Response time	Rise time	TON	300 msec or less	50 msec or less	
	Fall time	TOFF	200 msec or less	30 msec or less	
Display Quality			No noticeable display defect or ununiformity should be observed.		

14.3 Service life of Backlight

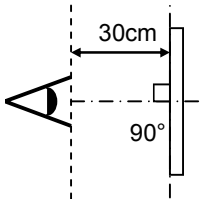
When the center luminance drops to 50% of the initial value,
the back light is considered to have reached the end of its effective service life.
Back light: IL=9.5mA

	Average life	Ambient temperature
Continuously lit	10000hrs	25 ± 5°C

*Average life means the period which the survival rate falls under 50%.

15. Criteria of Judgment

15.1 Defective Display and Screen Quality



Test Condition:	Observed TFT-LCD monitor from front during operation with the following conditions
Driving Signal	Raster Pattern (RGB, white, black)
Signal condition	[Data] : 00h, 2Ah, 3Fh (3steps)
Observation distance	30 cm
Illuminance	200 to 350 lx
Backlight	IL=9.5mA

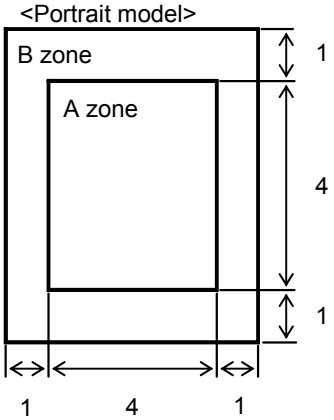
Defect item		Defect content		Criteria
Display Quality	Line defect	Black, white or color line, 3 or more neighboring defective dots		Not exists
	Dot defect	Uneven brightness on dot-by-dot base due to defective TFT or CF, or dust is counted as dot defect (brighter dot, darker dot) High bright dot: Visible through 2% ND filter at [Data]=00h Low bright dot: Visible through 5% ND filter at [Data]=00h Dark dot: Appear dark through white display at [Data]=2Ah		Refer to table 1
		Invisible through 5% ND filter at [Data]=00h		Acceptable
Screen Quality	Dirt	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

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 Permissible distance between same color high bright dots (includes neighboring dots): 5 mm or more
B	2	4	4	5	
Total	2	4	4	5	

<Portrait model>



Division of A and B areas

B area: Active area

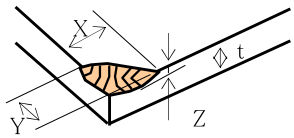
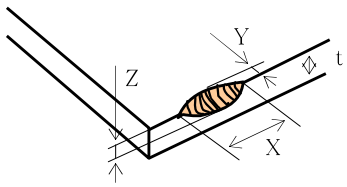
Dimensional ratio between A and B areas: 1: 4: 1 (Refer to the left figure)

15.2 Screen and Other Appearance

Testing conditions

Observation distance	30cm
Illuminance	1200～2000 lx

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

Item	Appearance	Criteria
Glass chipping	Corner area  	Unit:mm X≦3 Y≦3 Z≦t （t: glass thickness） X,Y≦0.5 is acceptable.
	Others  	Unit:mm X≦5 Y≦1 Z≦t （t:glass thickness） X,Y≦0.5 is ignored Maximum permissible number of chipping off on a side is 5.
	Progressive crack	None

16. Reliability Test

Test item		Test condition	number of failures /number of examinations
Durability test	High temperature storage	Ta=80°C 240hr	0/3
	Low temperature storage	Ta=-30°C 240hr	0/3
	High temperature & high humidity storage	Ta=60°C, RH=90% 240hr non condensing ※	0/3
	High temperature operation	Tp=70°C 240hr	0/3
	Low temperature operation	Tp=-20°C 240hr	0/3
	High temp & humid operation	Tp=40°C, RH=90% 240hr 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=±6.0kV Each 5 times of discharge in both polarities on the center of screen with the case grounded.	0/3
	Vibration test	Total amplitude 1.5mm, f=10～55Hz, X,Y,Z directions for each 2 hours	0/3
	Impact test	Use ORTUS TECHNOLOGY original jig (see next page)and make an impact with peak acceleration of 1000m/s2 for 6 msec with half sine-curve at 3 times to each X, Y, Z directions in conformance with JIS C 60068-2-27-2011.	0/3
Packing test	Packing vibration-proof test	Acceleration of 19.6m/s^2 with frequency of 10→55→10Hz, X,Y, Zdirection for each 30 minutes	0/1 Packing
	Packing drop test	Drop from 75cm high. 1 time to each 6 surfaces, 3 edges, 1 corner	0/1 Packing

Note:Ta=ambient temperature Tp=Panel temperature

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

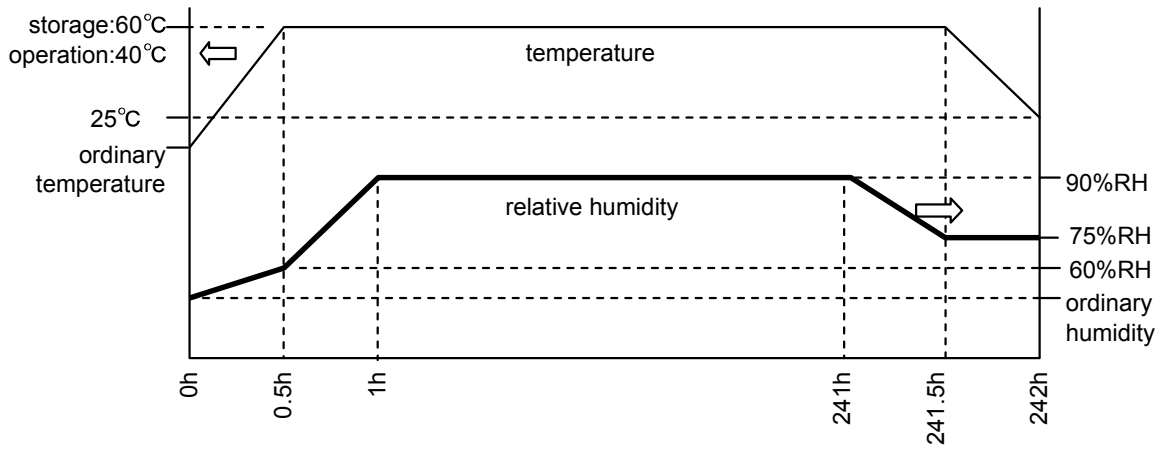
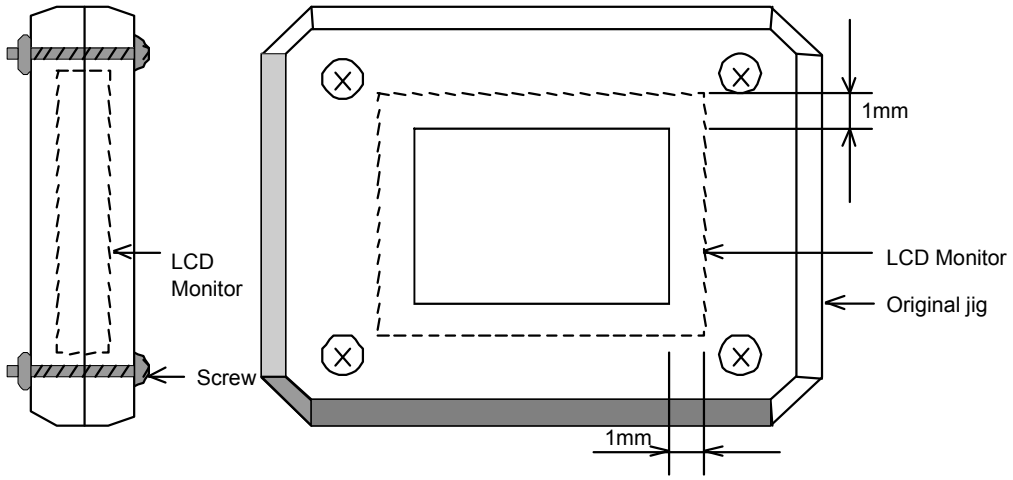


Table2.Reliability Criteria

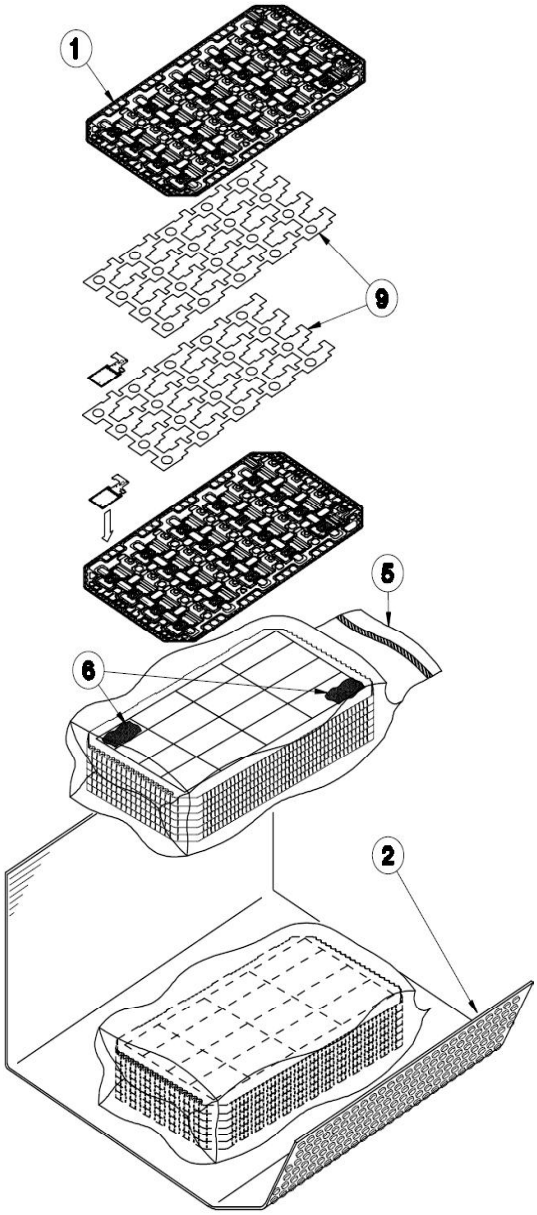
The parameters should be measured after leaving the monitor at the ordinary temperature for 24 hours or more after the test completion.

item	Standard	Remarks
Display quality	No visible abnormality shall be seen.	
Contrast ratio	40 or more	

ORTUS TECHNOLOGY Original Jig



17. Packing Specifications



Step 1. Each product is to be placed in one of the cut-outs of the tray with its the display surface facing upward, and FOAM SHEET is put on products.(20 products / 1 step) Each product is to be placed on the FOAM SHEET with the LCD display surface facing upward, and FOAM SHEET is put on products.(40 products / tray)

Step 2. Each tray filled with products is to be piled up in stack of 5. One empty tray is to be put on the top of stack of 5 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.

Step 4. Vacuum and seal the sealing bag with the vacuum sealing machine.

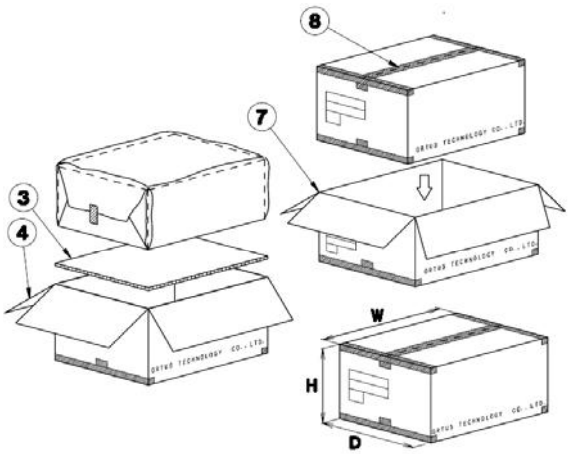
Step 5. The pilled trays are to be wrapped with a bubble cushioning sheet, and to be fixed with adhesive tape.

Step 6. 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.

Step 7. 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 8. 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 9. 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	B SHEET A	Antistatic air babble sheet
③	Inner board	Corrugated cardboard
④	Outer carton	Corrugated cardboard
⑤	Selling bag	
⑥	Drier	Moisture absorber
⑦	Extra outer carton	Corrugated cardboard
⑧	Packing tape	
⑨	FOAM SHEET	Antistatic 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.	5.0Kg

18. Handling Instruction

18.1 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.**

18.2 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 18.5 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.

9) Please make it to the structure to suppress surroundings of the front polarizer for the display irregularity prevention.

18.3 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 starting 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.

18.4 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: 7 cartons

*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 ORTUS.

18.5 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.

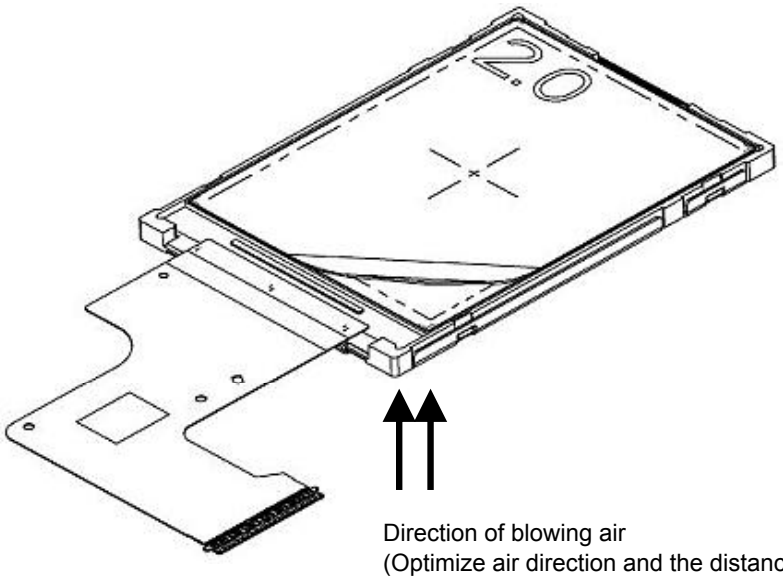
A) Work Environment

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



Direction of blowing air
(Optimize air direction and the distance)

18.6 Warranty

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

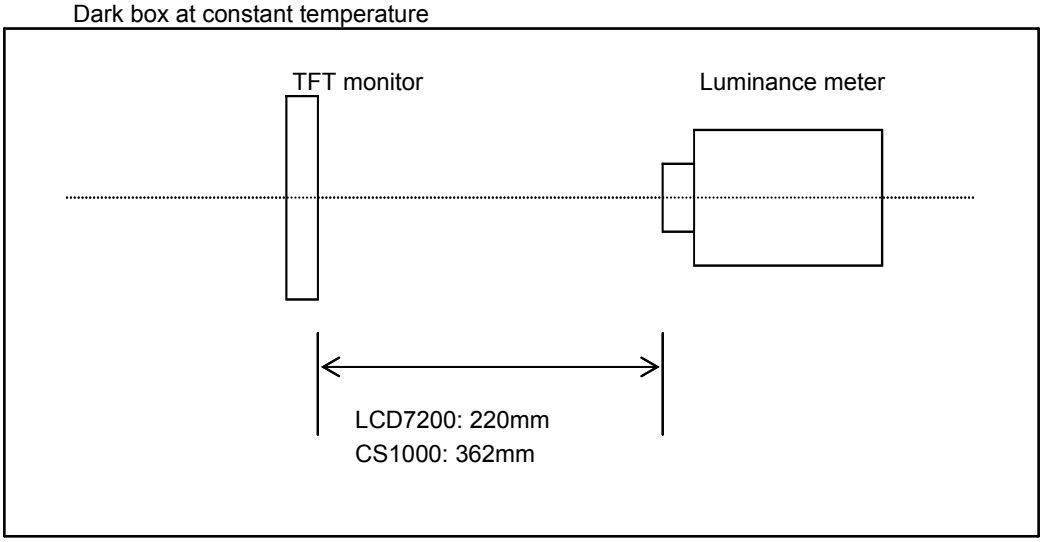
APPENDIX

Reference Method for Measuring Optical Characteristics and Performance

1. Measurement Condition

Measuring instruments:	CS1000（KONICA MINOLTA）, LCD7200(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

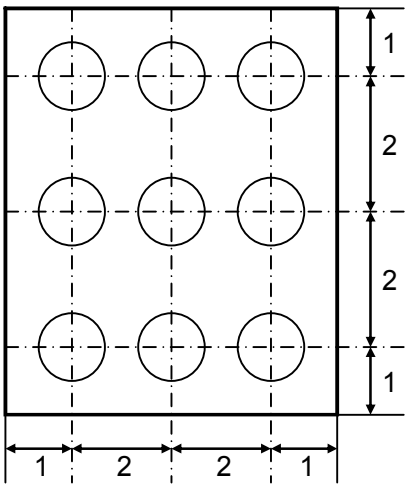
Dark box at constant temperature



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

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

<Portrait model>



Dimensional ratio of active area

Backlight IL=9.5mA

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 White brightness 100% 90% 10% 0% Black brightness 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: 8mmφ	CS1000	
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 5.	EZcontrast160D	
4	White chromaticity	Measure chromaticity coordinates x and y of CIE1931 colorimetric system at [Data] = 3Fh Color matching faction: 2°view	CS1000	
5	Burn-in	Visually check burn-in image on the screen after 2 hours of "window display" ([Data]=00h/3Fh).		At optimized VCOMDC
6	Center brightness	Measure the brightness at the center of the screen.	CS1000	
7	Brightness distribution	(Brightness distribution) = 100 x B/A % A : max. brightness of the 9 points B : min. brightness of the 9 points	CS1000	

Version History

Ver.	Date	Page		Description
1.0	Sep. 9, 2015	-	-	First issue
2.0	May. 31, 2016	P.1		Cover
			Add	Model outline
		P.2		Contents
			Change	Page number
A ×22		P.3		1. Application
			Correct	Note
		P.4		2.1 Features of the Product
			Add	Number of pixels
				2.2 Display Method
			Add	NTSC ratio
		P.7		4. Pin Assignment
			Delete	When not in use
		P.8		5. Block Diagram
			Change	Parts
		P.10		7. Recommended Operating Conditions
			Change	Condition / Rating
				8.1.2 LED
			Add	Content
		P.12		8.2.2 RGB I/F timing Characteristics
			Add	Driving condition
				8.2.3 RESET Timing
			Add	Content
		P.13		8.2.4 Serial Data Format
			Add	Content
		P.14		8.2.5 Serial I/F timing Characteristics
			Add	Content
		P.15		9.1 Interface Mode
			Correct	Error correct
		P.22		11.1.1 Power ON Sequence
			Correct	Sequence
		P.23		11.1.5 Refresh Sequence
			Correct	Sequence
		P.29		14.1 Optical Characteristics
			Delete	Note
		P.30		14.2 Temperature Characteristics
			Delete	Note
		P.31		15.1 Defective Display and Screen Quality
			Add	Reference diagram
			Correct	Criteria (Dart)
		P.38		18.4 Storage Condition for Shipping Cartons
			Add	Conditions to storage after unpacking
		P.39		18.5 Precautions for Peeling off the Protective film
			Correct	Work Environment
				18.6 Warranty
			Add	Content
2.0 B ×1	Jul. 11, 2016	P.5		3.2 Outward Form
			Change	Connector model №