



# SPECIFICATION

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**ORTUSTECH**

## **COM24H2P39ULC**

2.4" TFT - QVGA - 6-bit TTL

Version: 1.0

Date: 28.04.2016

Note: This specification is subject to change without prior notice

# Specifications for

## Blanview TFT-LCD Monitor

( 2.4" QVGA 240 x RGB x 320 Portrait)

Version 1.0

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

MODEL COM24H2P39ULC

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

# ORTUSTECH

ORTUS TECHNOLOGY CO., LTD.

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## 1. Application

This Specification is applicable to 60.0mm (2.4 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.
- ◎ It must be noted as a mechanical design manner, especial attention in housing design to prevent arcuation/flexure or 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

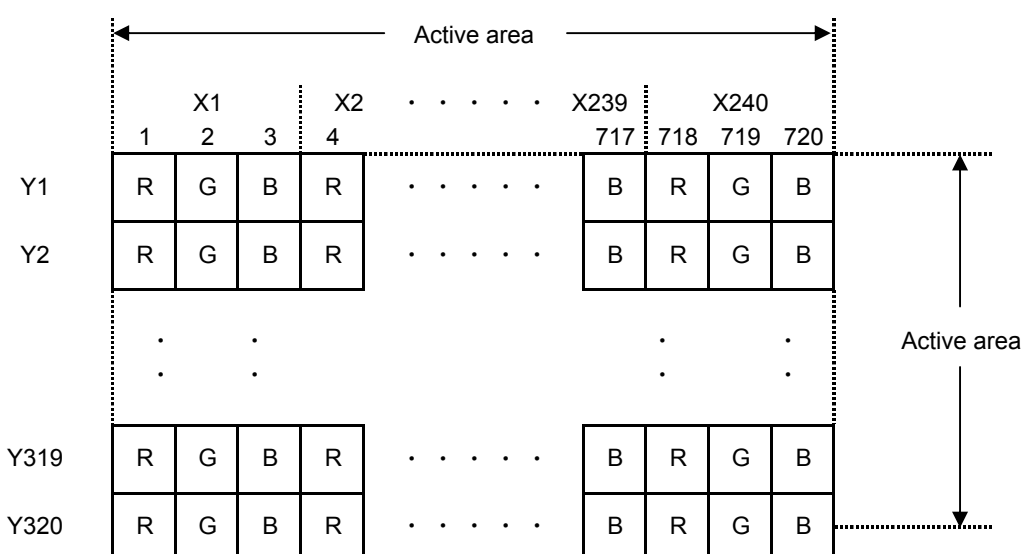
### 2.1 Features of the Product

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

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

### 2.2 Display Method

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



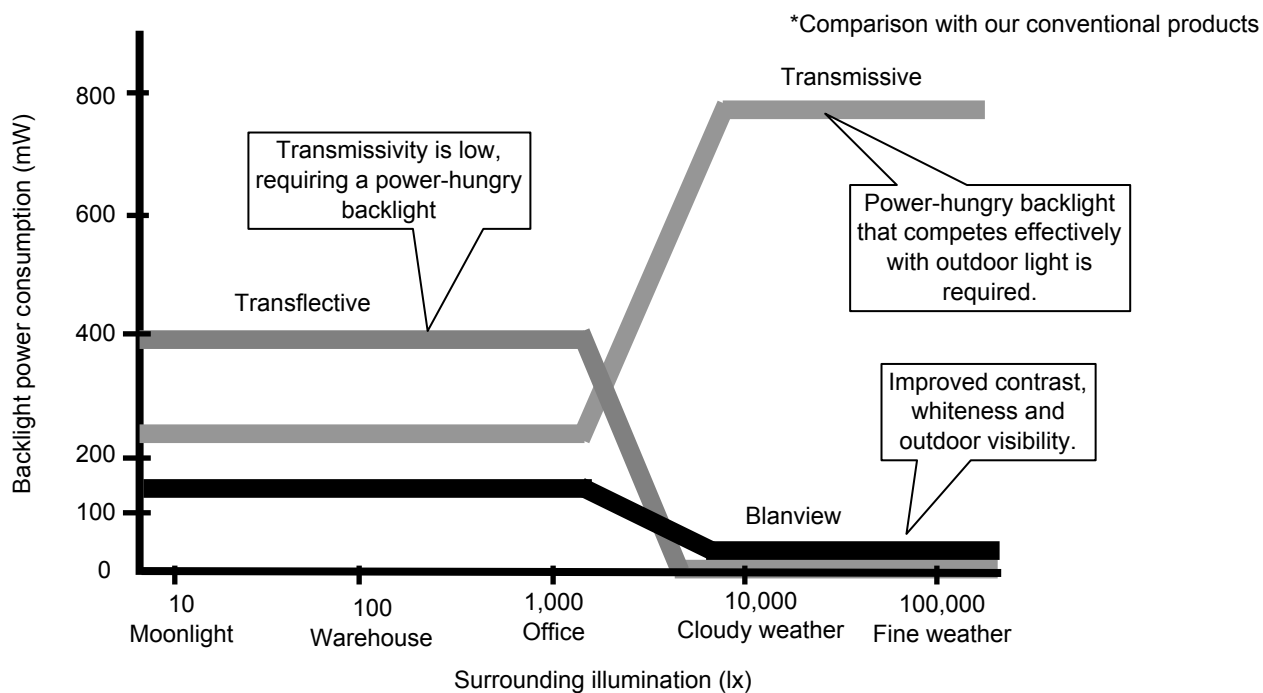
## 3. Dimensions and Shape

## 3.1 Dimensions

Items	Specifications	Unit	Remarks
Outline dimensions	42.50[H] × 58.50[V] × 2.55[D]	mm	exclude FPC and components on the FPC
Active area	36.00[H] × 48.00[V]	mm	6.00cm diagonal
Number of dots	720[H] × 320[V]	dot	
Dot pitch	50.0[H] × 150.0[V]	μm	
Surface hardness of the polarizer	2	H	
Weight	13.6	g	Include FPC cable

<Features of Blanview>

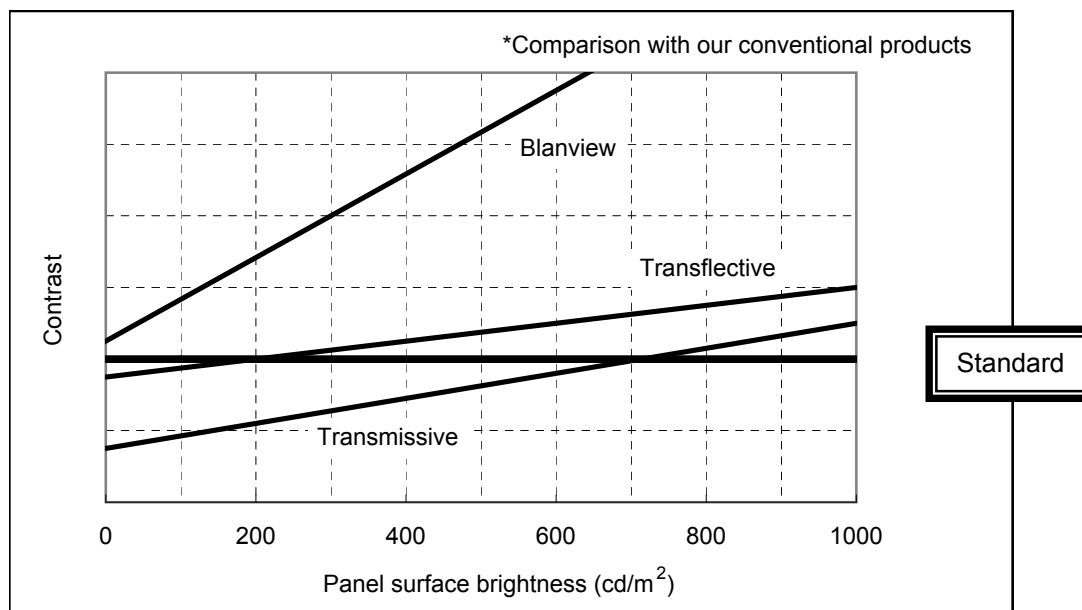
- Backlight power consumption required to assure visibility. (equivalent to 3.5"QVGA )



- 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.

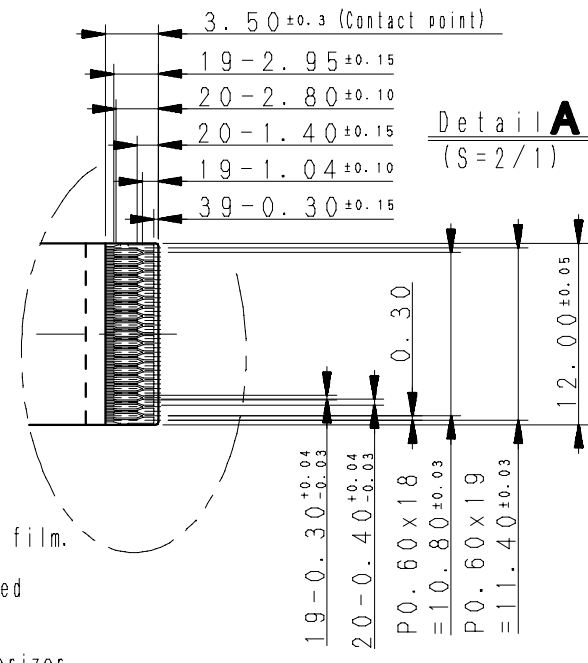
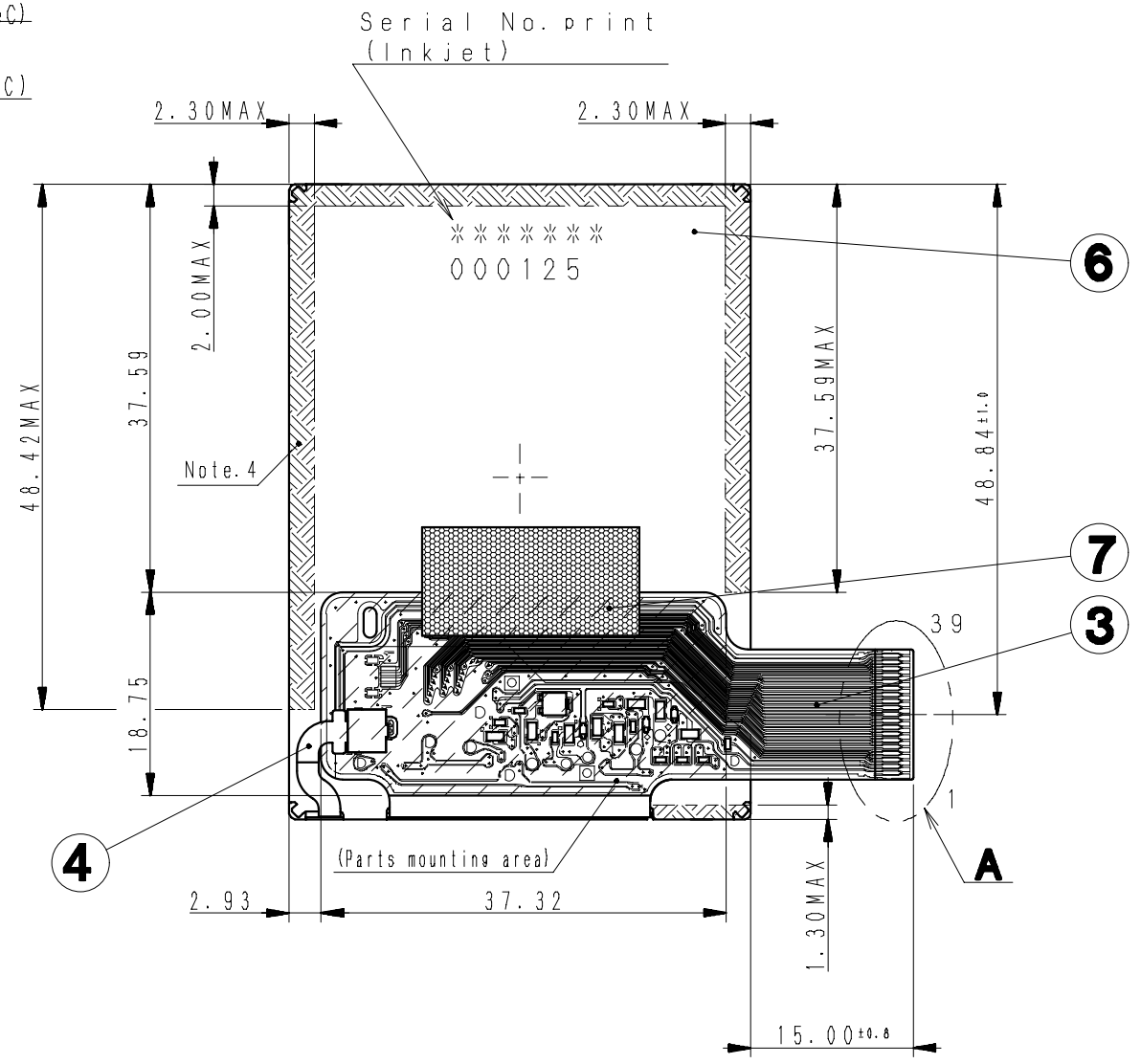
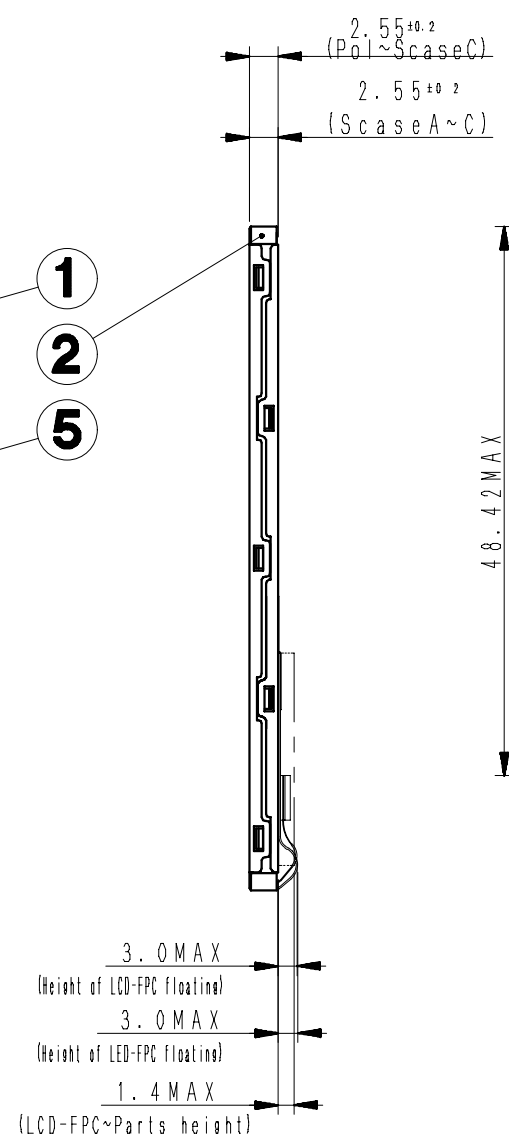
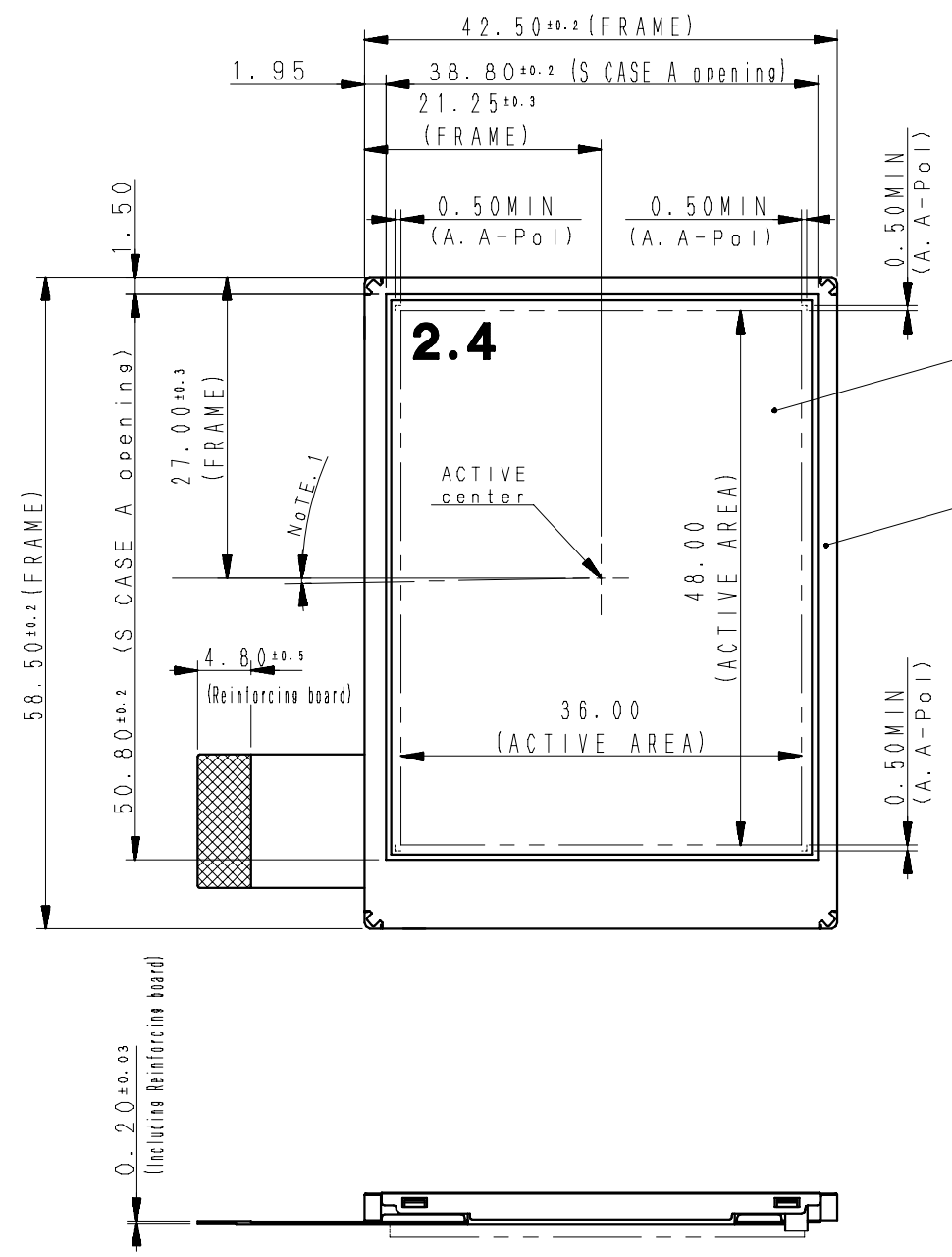
Below chart shows contrast value against panel surface brightness. (Horizontal: Panel surface brightness/ Vertical: Contrast value) LCD panel has enough outdoor readability above our Standard line. (ORTUS TECHNOLOGY criteria)



EC No.	REV.No.	REVISE	DATE (Y:M:D)	APPROVED	CHECKED	PREPARED
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(7/42)  
16TLM004  
Issue; Apr. 28, 2016

3.2 Outward Form



I-TAPE	8			
S CASE C	7			
S CASE A	6			
LED-FPC	5			
LCD-FPC	4			
FRAME	3		PC	
LCD	2		Glass substrate thickness=0.5t	
PART NAME	ITEM	PART CODE	MATERIAL GRADE	REMARK

APPROVED K.Hashizume	GENERAL TOLERANCE ±0.5	SCALE FREE (2/1)	UNIT mm	<b>ORTUSTECH</b> ORTUS TECHNOLOGY CO., LTD. DO NOT DUPLICATE, CONFIDENTIAL AND PROPRIETARY
CHECKED J.Hiranobu	ISSUE (Y:M:D) 16:01:20	MODEL COM24H2P39U**		
CHECKED	NAME			DRAWING No. RJD527905D301
DESIGN J.Hiranobu	OUTLINE-D2P39		REV.	SHEET
DRAW J.Hiranobu				DIV.

- Note 1. Angular deviation of LCD cell from the TFT-LCD monitor's reference axis shall be less than [±40'].
- Note 2. Recommended FPC connectors  
For LCD : HIROSE, part number: FH23-39S-0.3SHW (05)
- Note 3. Protective film is affixed on front surface of the screen.  
Location tolerance of the protective film shall be ±1.5 mm to the polarizing film.
- Note 4. In case TFT-LCD monitor is fixed to the case of your product, it's recommended that monitor is fixed in to area.
- Note 5. Refer to "13. CRITERIA OF JUDGMENT" about the appearance specification of a polarizer.



### 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	24BHC (Made in Japan) 24BJC (Made in Malaysia)		
d	Serial number			

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

##### •Made in Japan

6J24BHC000125

means "manufactured in October 2016, 2.4" BH type, C specifications, serial number 000125"

##### •Made in Malaysia

6J24BJC000125

means "manufactured in October 2016, 2.4" BJ 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	Processing of Unused
1	VSS	GND	P	-
2	VSS	GND	P	-
3	VCI	Power supply for main circuit	P	-
4	IOVCC	Power supply for I/O circuit	P	-
5	VSS	GND	P	-
6	RESETB	Reset signal (Lo-active)	I	-
7	CSB	Chip selection signal (Lo: Select, Hi: Unselect)	I	-
8	RS	Register selection signal (Lo:index, Hi:command / Display data)	I	-
9	WRB	Write signal	I	-
10	VSS	GND	P	-
11	D0	Data I/O	I	GND
12	D1	Data I/O	I	GND
13	D2	Data I/O	I	GND
14	D3	Data I/O	I	GND
15	D4	Data I/O	I	GND
16	D5	Data I/O	I	GND
17	D6	Data I/O	I	GND
18	D7	Data I/O	I	GND
19	D8	Data I/O	I	GND
20	D9	Data I/O	I	GND
21	D10	Data I/O	I	GND
22	D11	Data I/O	I	GND
23	D12	Data I/O	I	GND
24	D13	Data I/O	I	GND
25	D14	Data I/O	I	GND
26	D15	Data I/O	I	GND
27	D16	Data I/O (16-bit interface should be fixed to VSS)	I	GND
28	D17	Data I/O (16-bit interface should be fixed to VSS)	I	GND
29	VSS	GND	P	-
30	BS0	Interface mode setting terminal	I	-
31	BS1	Interface mode setting terminal	I	-
32	RDB	Read signal	I	IOVCC
33	NC	OPEN	-	OPEN
34	NC	OPEN	-	OPEN
35	NC	OPEN	-	OPEN
36	NC	OPEN	-	OPEN
37	TE	Synchronization signal output	O	OPEN
38	BLH	LED drive power source. (Anode side)	P	-
39	BLL	LED drive power source. (Cathode side)	P	-

## Note :

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

## 5. Absolute Maximum Rating

VSS=0V

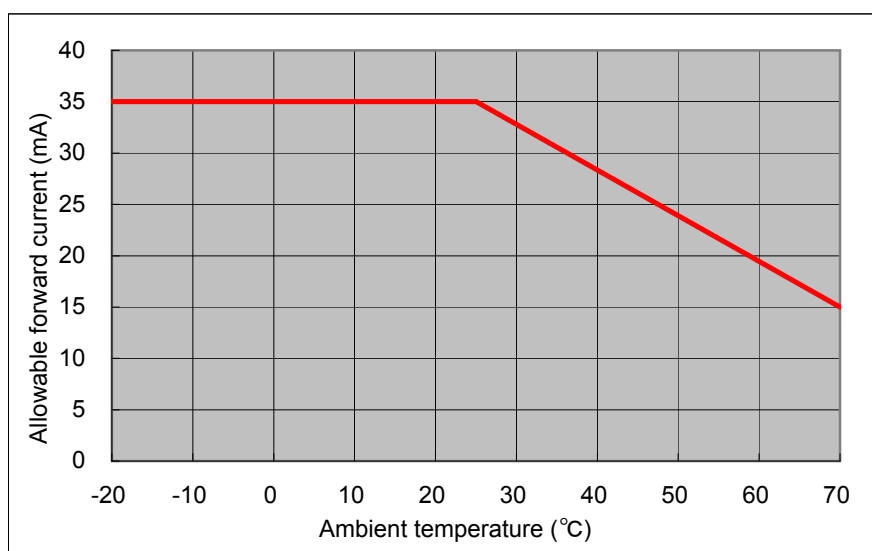
Item	Symbol	Condition	Rating		Unit	Applicable terminal
			MIN	MAX		
Supply voltage	VCI	Ta=25°C	-0.3	4.6	V	VCI
Supply voltage	IOVCC		-0.3	VCI	V	IOVCC
Input voltage for logic	VI		-0.3	IOVCC+0.3	V	RESETB,CSB,RS,WRB,D0-D17,BS0,BS1,RDB
LED Forward current	IL	Ta=25°C	—	35.0	mA	BLH - BLL
		Ta=70°C	—	15.0		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

## 6. Recommended Operating Conditions

VSS=0V

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

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



## 7. Characteristics

## 7.1 DC Characteristics

## 7.1.1 Display section

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

Item	Symbol	Condition	Rating			Unit	Applicable terminal
			MIN	TYP	MAX		
Input Signal Voltage	VIH		0.7×IOVCC	—	IOVCC	V	RESETB,CSB,RS,WRB, D0-D17,BS0,BS1,RDB
	VIL		0	—	0.3×IOVCC	V	
Output Signal Voltage	VOH	IOH = -0.1mA	0.8×IOVCC	—	—	V	D0-D17,TE
	VOL	IOL = 0.1mA	—	—	0.2×IOVCC	V	
Operating Current	ICI	Color bar/Still image display state *note	—	8.0	16.0	mA	VCI
	IOICC		—	0.6	1.2	mA	IOVCC
Standby Current	ICI	Other input with constant voltage	—	1.0	2.0	uA	VCI
	IOICC		—	6.0	20.0	uA	IOVCC

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

## 7.1.2 Backlight section

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

note :

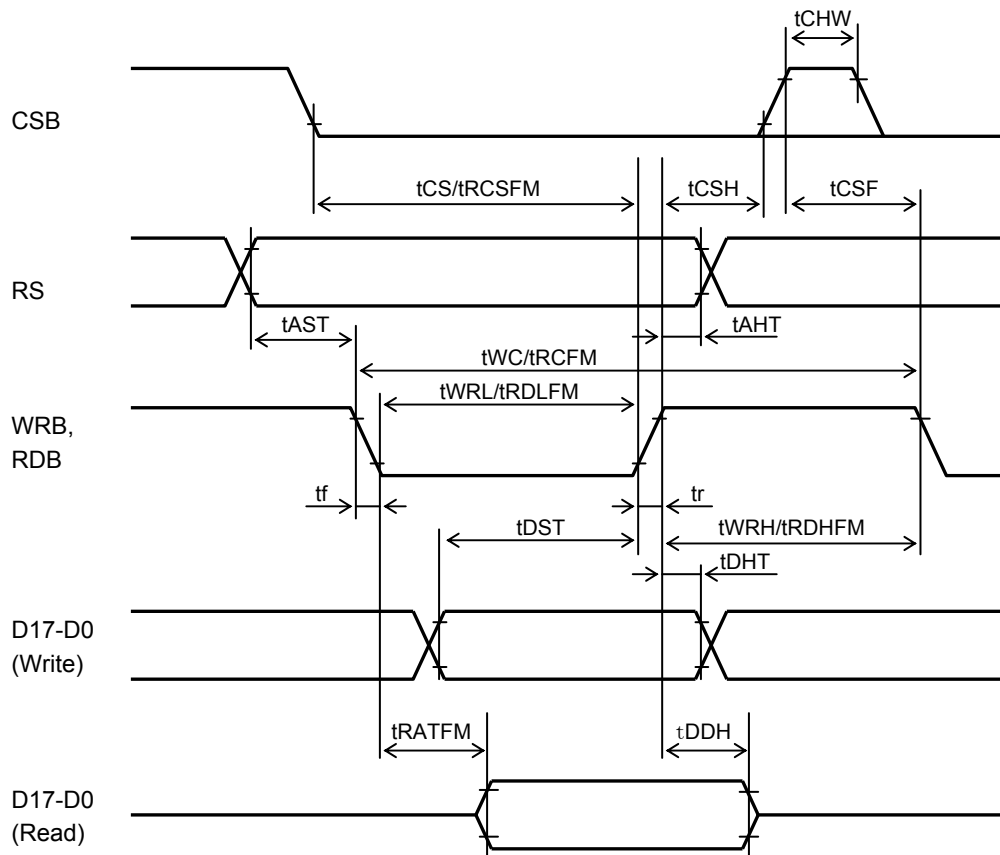
- The lifetime of the LED is defined as a period till the brightness of the LED decreases to the half of its initial value.
  - This figure is given as a reference purpose only, and not as a guarantee.
  - This figure is estimated for an LED operating alone.
- As the performance of an LED may differ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

## 7.2 AC Characteristics

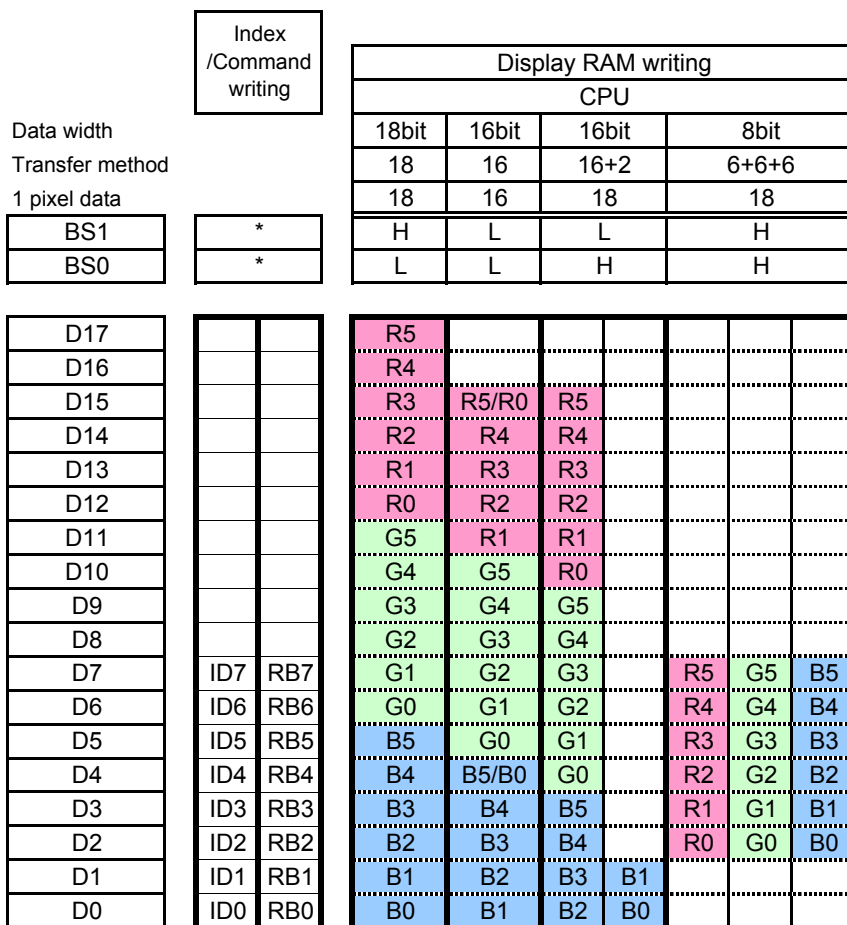
(Unless otherwise noted,  $T_a=25^\circ\text{C}$ ,  $V_{CI}=2.7\text{V}$ ,  $\text{IOVCC}=2.7\text{V}$ ,  $V_{SS}=0\text{V}$ )

Item	Symbol	Condition	Rating		Unit
			MIN	MAX	
Address setup time	$t_{AST}$	RS	10	-	ns
Address hold time	$t_{AHT}$	RS	10	-	ns
CSB "High" level pulse width	$t_{CHW}$	CSB	0	-	ns
CSB setup time	$t_{CS}$	CSB-WRB	35	-	ns
	$t_{RCSFM}$	CSB-RDB	180	-	ns
CSB wait time	$t_{CSF}$	CSB	10	-	ns
CSB hold time	$t_{CSH}$	CSB	10	-	ns
WRB bus cycle time	$t_{WC}$	WRB	100	-	ns
WRB "High" level pulse width	$t_{WRH}$	WRB	15	-	ns
WRB "Low" level pulse width	$t_{WRL}$	WRB	20	-	ns
RDB bus cycle time	$t_{RCFM}$	WRB	250	-	ns
RDB "High" level pulse width	$t_{RDHFM}$	WRB	15	-	ns
RDB "Low" level pulse width	$t_{RDLFM}$	WRB	180	-	ns
WEB data setup time	$t_{DST}$	D17-D0	10	-	ns
WEB data hold time	$t_{DHT}$	D17-D0	10	-	ns
RDB data delay time	$t_{RATFM}$	D17-D0	-	340	ns
RDB output disable time	$t_{DDH}$	D17-D0	20	80	ns
Input signal rise time	$t_r$		-	15	ns
Input signal fall time	$t_f$		-	15	ns

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



8. Interface



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

## 9. Register list

Register		D17-8	D7	D6	D5	D4	D3	D2	D1	D0
R01h	Display Mode control	*	*	*	*	*	IDMON	INVON	NORON	PTLON
	Initial value	(0006h)					0	1	1	0
	Recommended value	(0002h)					0	0	1	0
R02h	Column address start 2	*	SC[15:8]							
	Initial value	(0000h)	0	0	0	0	0	0	0	0
	Recommended value	(0000h)	0	0	0	0	0	0	0	0
R03h	Column address start 1	*	SC[7:0]							
	Initial value	(0000h)	0	0	0	0	0	0	0	0
	Recommended value	(0000h)	0	0	0	0	0	0	0	0
R04h	Column address end 2	*	EC[15:8]							
	Initial value	(0000h)	0	0	0	0	0	0	0	0
	Recommended value	(0000h)	0	0	0	0	0	0	0	0
R05h	Column address end 1	*	EC[7:0]							
	Initial value	(00EFh)	1	1	1	0	1	1	1	1
	Recommended value	(00EFh)	1	1	1	0	1	1	1	1
R06h	Row address start 2	*	SP[15:8]							
	Initial value	(0000h)	0	0	0	0	0	0	0	0
	Recommended value	(0000h)	0	0	0	0	0	0	0	0
R07h	Row address start 1	*	SP[7:0]							
	Initial value	(0000h)	0	0	0	0	0	0	0	0
	Recommended value	(0000h)	0	0	0	0	0	0	0	0
R08h	Row address end 2	*	EP[15:8]							
	Initial value	(0001h)	0	0	0	0	0	0	0	1
	Recommended value	(0001h)	0	0	0	0	0	0	0	1
R09h	Row address end 1	*	EP[7:0]							
	Initial value	(003Fh)	0	0	1	1	1	1	1	1
	Recommended value	(003Fh)	0	0	1	1	1	1	1	1
R0Ah	Partial area start row 2	*	PSL[15:8]							
	Initial value	(0000h)	0	0	0	0	0	0	0	0
	Recommended value	(0000h)	0	0	0	0	0	0	0	0
R0Bh	Partial area start row 1	*	PSL[7:0]							
	Initial value	(0000h)	0	0	0	0	0	0	0	0
	Recommended value	(0000h)	0	0	0	0	0	0	0	0
R0Ch	Partial area end row 2	*	PEL[15:8]							
	Initial value	(0001h)	0	0	0	0	0	0	0	1
	Recommended value	(0001h)	0	0	0	0	0	0	0	1
R0Dh	Partial area end row 1	*	PEL[7:0]							
	Initial value	(003Fh)	0	0	1	1	1	1	1	1
	Recommended value	(003Fh)	0	0	1	1	1	1	1	1
R0Eh	Vertical Scroll Top fixed area 2	*	TFA[15:8]							
	Initial value	(0000h)	0	0	0	0	0	0	0	0
	Recommended value	(0000h)	0	0	0	0	0	0	0	0
R0Fh	Vertical Scroll Top fixed area 1	*	TFA[7:0]							
	Initial value	(0000h)	0	0	0	0	0	0	0	0
	Recommended value	(0000h)	0	0	0	0	0	0	0	0
R10h	Vertical Scroll height area 2	*	VSA[15:8]							
	Initial value	(0001h)	0	0	0	0	0	0	0	1
	Recommended value	(0001h)	0	0	0	0	0	0	0	1
R11h	Vertical Scroll height area 1	*	VSA[7:0]							
	Initial value	(0040h)	0	1	0	0	0	0	0	0
	Recommended value	(0040h)	0	1	0	0	0	0	0	0
R12h	Vertical Scroll Button area 2	*	BFA[15:8]							
	Initial value	(0000h)	0	0	0	0	0	0	0	0
	Recommended value	(0000h)	0	0	0	0	0	0	0	0

Register		D17-8	D7	D6	D5	D4	D3	D2	D1	D0
R13h	Vertical Scroll Button area 1	*	BFA[7:0]							
	Initial value	(0000h)	0	0	0	0	0	0	0	0
	Recommended value	(0000h)	0	0	0	0	0	0	0	0
R14h	Vertical Scroll Start address 2	*	VSP[15:8]							
	Initial value	(0000h)	0	0	0	0	0	0	0	0
	Recommended value	(0000h)	0	0	0	0	0	0	0	0
R15h	Vertical Scroll Start address 1	*	VSP[7:0]							
	Initial value	(0000h)	0	0	0	0	0	0	0	0
	Recommended value	(0000h)	0	0	0	0	0	0	0	0
R16h	Memory Access control	*	MY	MX	MV	*	BGR	*	*	*
	Initial value	(0000h)	0	0	0		0			
	Recommended value	(0008h)	0	0	0		1			
R18h	Gate Scan control	*	*	*	*	*	*	*	SCROLL_ON	SM
	Initial value	(0000h)							0	0
	Recommended value	(0001h)							0	1
R19h	OSC Control 1	*	CADJ[3:0]				CUADJ[2:0]			OSC_EN
	Initial value	(0086h)	1	0	0	0	0	1	1	0
	Recommended value	(0087h)	1	0	0	0	0	1	1	1
R1Ah	OSC Control 2	*	*	*	*	*	*	*	*	OSC_TEST
	Initial value	(0000h)								0
	Recommended value	(0000h)								0
R1Bh	Power Control 1	*	GAS_ENB	*	*	PON	DK	XDK	VLCD_TRI	STB
	Initial value	(0000h)	0			0	0	0	0	0
	Recommended value	(0014h)	0			1	0	1	0	0
R1Ch	Power Control 2	*	*	*	*	*	*	AP[2:0]		
	Initial value	(0004h)						1	0	0
	Recommended value	(0004h)						1	0	0
R1Dh	Power Control 3	*	*	*	*	*	*	VC1[2:0]		
	Initial value	(0004h)						1	0	0
	Recommended value	(0005h)						1	0	1
R1Eh	Power Control 4	*	*	*	*	*	*	VC3[2:0]		
	Initial value	(0000h)						0	0	0
	Recommended value	(0000h)						0	0	0
R1Fh	Power Control 5	*	*	*	*	*	VRH[3:0]			
	Initial value	(0006h)					0	1	1	0
	Recommended value	(0007h)					0	1	1	1
R20h	Power Control 6	*	BT[3:0]				*	*	*	*
	Initial value	(0060h)	0	1	1	0				
	Recommended value	(0000h)	0	0	0	0				
R21h	Power Control 7	*	*	*	FS1[1:0]		*	*	FS0[1:0]	
	Initial value	(0010h)			0	1			0	0
	Recommended value	(0010h)			0	1			0	0
R22h	Write Data	GRAM Write								
	Initial value	(0000h)								
	Recommended value	(0000h)								
R23h	Cycle Control 1	*	N_DC[7:0]							
	Initial value	(0095h)	1	0	0	1	0	1	0	1
	Recommended value	(0095h)	1	0	0	1	0	1	0	1
R24h	Cycle Control 2	*	PI_DC[7:0]							
	Initial value	(0095h)	1	0	0	1	0	1	0	1
	Recommended value	(0095h)	1	0	0	1	0	1	0	1



Register		D17-8	D7	D6	D5	D4	D3	D2	D1	D0
R25h	Cycle Control 3	*	I_DC[7:0]							
	Initial value	(00FFh)		1	1	1	1	1	1	1
	Recommended value	(00FFh)		1	1	1	1	1	1	1
R26h	Display Control 1	*	PT[1:0]		GON	DTE	D[1:0]		*	*
	Initial value	(00A0h)		1	0	1	0	0	0	
	Recommended value	(00BCh)		1	0	1	1	1	1	
R27h	Display Control 2	*	*	*	*	*	N_BP[3:0]			
	Initial value	(0002h)					0	0	1	0
	Recommended value	(0002h)					0	0	1	0
R28h	Display Control 3	*	*	*	*	*	N_FP[3:0]			
	Initial value	(0002h)					0	0	1	0
	Recommended value	(0003h)					0	0	1	1
R29h	Display Control 4	*	*	*	*	*	PI_BP[3:0]			
	Initial value	(0002h)					0	0	1	0
	Recommended value	(0008h)					1	0	0	0
R2Ah	Display Control 5	*	*	*	*	*	PI_FP[3:0]			
	Initial value	(0002h)					0	0	1	0
	Recommended value	(0008h)					1	0	0	0
R2Bh	Power Control 11	*	*	*	PI_PRE_REFRESH[1:0]		BLANK_DIV[3:0]			
	Initial value	(0000h)			0	0	0	0	0	0
	Recommended value	(0000h)			0	0	0	0	0	0
R2Ch	Display Control 6	*	*	*	*	*	I_BP[3:0]			
	Initial value	(0002h)					0	0	1	0
	Recommended value	(0008h)					1	0	0	0
R2Dh	Display Control 7	*	*	*	*	*	I_FP[3:0]			
	Initial value	(0002h)					0	0	1	0
	Recommended value	(0008h)					1	0	0	0
R35h	Display Control 9	*	EQS[7:0]							
	Initial value	(0009h)		0	0	0	0	1	0	0
	Recommended value	(0009h)		0	0	0	0	1	0	0
R36h	Display Control 10	*	EQP[7:0]							
	Initial value	(0009h)		0	0	0	0	1	0	0
	Recommended value	(0009h)		0	0	0	0	1	0	0
R37h	Display Control 12	*	*	*	PTG[1:0]		ISC[3:0]			
	Initial value	(0000h)			0	0	0	0	0	0
	Recommended value	(0000h)			0	0	0	0	0	0
R38h	RGB interface control 1	*	*	*	*	RGB_EN	DPL	HSPL	VSPL	EPL
	Initial value	(0000h)				0	0	0	0	0
	Recommended value	(0000h)				0	0	0	0	0
R39h	RGB interface control 2	*	DOTCLK_DIV[7:0]							
	Initial value	(0000h)		0	0	0	0	0	0	0
	Recommended value	(0000h)		0	0	0	0	0	0	0
R3Ah	Cycle Control 1	*	N_RTN[3:0]				*	N_NW[2:0]		
	Initial value	(0001h)		0	0	0	0	0	0	1
	Recommended value	(00A1h)		1	0	1	0	0	0	1
R3Bh	Cycle Control 2	*	PI_RTN[3:0]				*	PI_NW[2:0]		
	Initial value	(0001h)		0	0	0	0	0	0	1
	Recommended value	(00A1h)		1	0	1	0	0	0	1
R3Ch	Cycle Control 3	*	I_RTN[3:0]				*	I_NW[2:0]		
	Initial value	(00F0h)		1	1	1	1	0	0	0
	Recommended value	(00A0h)		1	0	1	0	0	0	0

Register		D17-8	D7	D6	D5	D4	D3	D2	D1	D0
R3Dh	Cycle Control 4	*	*	*	DIV_I[1:0]		DIV_PI[1:0]		DIV_N[1:0]	
	Initial value	(0000h)			0	0	0	0	0	0
	Recommended value	(0000h)			0	0	0	0	0	0
R3Eh	Cycle Control 5	*	SON[7:0]							
	Initial value	(0038h)	0	0	1	1	1	0	0	0
	Recommended value	(002Dh)	0	0	1	0	1	1	0	1
R40h	Cycle Control 6	*	GDON[7:0]							
	Initial value	(0003h)	0	0	0	0	0	0	1	1
	Recommended value	(0003h)	0	0	0	0	0	0	1	1
R41h	Cycle Control 7	*	GDOF[7:0]							
	Initial value	(00F8h)	1	1	1	1	1	0	0	0
	Recommended value	(00CCh)	1	1	0	0	1	1	0	0
R42h	BGP Control	*	*	*	*	V <sub>BGP</sub> OF	BGP[3:0]			
	Initial value	(0008h)				0	1	0	0	0
	Recommended value	(0008h)				0	1	0	0	0
R43h	VCOM Control 1	*	VCOMG	*	*	*	*	*	*	*
	Initial value	(0080h)	1							
	Recommended value	(0080h)	1							
R44h	VCOM Control 2	*	*	VCM[6:0]						
	Initial value	(005Ah)		1	0	1	1	0	1	0
	Recommended value	(007Fh)		1	1	1	1	1	1	1
R45h	VCOM Control 3	*	*	*	*	VDV[4:0]				
	Initial value	(0011h)				1	0	0	0	1
	Recommended value	(0014h)				(1)	(0)	(1)	(0)	(0)
R46h	r Control 1	*	GSEL	CP1[2:0]			*	CP0[2:0]		
	Initial value	(0000h)	0	0	0	0	0	0	0	0
	Recommended value	(0083h)	(1)	(0)	(0)	(0)		(0)	(1)	(1)
R47h	r Control 2	*	*	CN1[2:0]			*	CN0[2:0]		
	Initial value	(0000h)		0	0	0		0	0	0
	Recommended value	(0031h)			(1)	(1)		(0)	(0)	(1)
R48h	r Control 3	*	*	NP1[2:0]			*	NP0[2:0]		
	Initial value	(0000h)		0	0	0		0	0	0
	Recommended value	(0001h)		(0)	(0)	(0)		(0)	(0)	(1)
R49h	r Control 4	*	*	NP3[2:0]			*	NP2[2:0]		
	Initial value	(0000h)		0	0	0		0	0	0
	Recommended value	(0056h)		(1)	(0)	(1)		(1)	(1)	(0)
R4Ah	r Control 5	*	*	NP5[2:0]			*	NP4[2:0]		
	Initial value	(0000h)		0	0	0		0	0	0
	Recommended value	(0024h)		(0)	(1)	(0)		(1)	(0)	(0)
R4Bh	r Control 6	*	*	NN1[2:0]			*	NN0[2:0]		
	Initial value	(0000h)		0	0	0		0	0	0
	Recommended value	(0005h)		(0)	(0)	(0)		(1)	(0)	(1)
R4Ch	r Control 7	*	*	NN3[2:0]			*	NN2[2:0]		
	Initial value	(0000h)		0	0	0		0	0	0
	Recommended value	(0000h)		(0)	(0)	(0)		(0)	(0)	(0)
R4Dh	r Control 8	*	*	NN5[2:0]			*	NN4[2:0]		
	Initial value	(0000h)		0	0	0		0	0	0
	Recommended value	(0067h)		(1)	(1)	(0)		(1)	(1)	(1)
R4Eh	r Control 9	*	CGMP1[1:0]		CGMP0[1:0]		OP0[3:0]			
	Initial value	(0000h)	0	0	0	0	0	0	0	0
	Recommended value	(0001h)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(1)

Register		D17-8	D7	D6	D5	D4	D3	D2	D1	D0
R4Fh	r Control 10	*	CGMP3	CGMP2	*	OP1[4:0]				
	Initial value	(0000h)	0	0	0	0	0	0	0	0
	Recommended value	(001Fh)	(0)	(0)	(0)	(1)	(1)	(1)	(1)	(1)
R50h	r Control 11	*	CGMN1[1:0]		CGMN0[1:0]	ON0[3:0]				
	Initial value	(0000h)	0	0	0	0	0	0	0	0
	Recommended value	(000Fh)	(0)	(0)	(0)	(0)	(1)	(1)	(1)	(1)
R51h	r Control 12	*	CGMN3	CGMN2	*	ON1[4:0]				
	Initial value	(0000h)	0	0	0	0	0	0	0	0
	Recommended value	(000Ah)	(0)	(0)	(0)	(0)	(1)	(0)	(1)	(0)
R52h	OTP Control 1	*	OTP_MASK[7:0]							
	Initial value	(0000h)	0	0	0	0	0	0	0	0
	Recommended value	(0000h)	0	0	0	0	0	0	0	0
R53h	OTP Control 2	*	OTP_INDEX[7:0]							
	Initial value	(00FFh)	1	1	1	1	1	1	1	1
	Recommended value	(00FFh)	1	1	1	1	1	1	1	1
R54h	OTP Control 3	*	OTP_LOAD_DISABLE	DCCLK_DISABLE	OTP_POR	OTP_PWE	OTP_PTM	0	VPP_SELECT	OTP_PROG
	Initial value	(0008h)	0	0	0	0	1		0	0
	Recommended value	(0008h)	0	0	0	0	1		0	0
R64h	Internal Use 16	*	ID1[7:0]							
	Initial value	(0000h)	0	0	0	0	0	0	0	0
	Recommended value	(0000h)	0	0	0	0	0	0	0	0
R65h	Internal Use 17	*	*	ID2[6:0]						
	Initial value	(0000h)		0	0	0	0	0	0	0
	Recommended value	(0000h)		0	0	0	0	0	0	0
R66h	Internal Use 18	*	ID3[7:0]							
	Initial value	(0000h)	0	0	0	0	0	0	0	0
	Recommended value	(0000h)	0	0	0	0	0	0	0	0
R67h	Internal Use 19	*	ID4[7:0]							
	Initial value	(0047h)	0	1	0	0	0	1	1	1
	Recommended value	(0047h)	0	1	0	0	0	1	1	1
R70h	Internal Use 28	*	*	GS	SS	TE_MODE	TEON	CSEL[2:0]		
	Initial value	(0006h)		0	0	0	0	1	1	0
	Recommended value	(0066h)		1	1	0	0	1	1	0
R72h	Data control	*	*	*	DFM[1:0]		*	*	TRI[1:0]	
	Initial value	(0000h)			0	0			0	0
	Recommended value	(0000h)			0	0			0	0
R90h	Display Control 8	*	SAP[7:0]							
	Initial value	(000Ah)	0	0	0	0	1	0	1	0
	Recommended value	(007Fh)	0	1	1	1	1	1	1	1
R91h	Display Control 11	*	GEN_OFF[7:0]							
	Initial value	(0014h)	0	0	0	1	0	1	0	0
	Recommended value	(0014h)	0	0	0	1	0	1	0	0
R93h	OSC Control 3	*	*	*	*	*	RADJ[3:0]			
	Initial value	(000Fh)					1	1	1	1
	Recommended value	(000Fh)					1	1	1	1
R94h	SAP Idle mode	*	SAP_[7:0]							
	Initial value	(000Ah)	0	0	0	0	1	0	1	0
	Recommended value	(000Ah)	0	0	0	0	1	0	1	0
R95h	DCCLK SYNC TO CL1	*	*	*	*	*	*	*	*	DCCLK_SYNC
	Initial value	(0000h)								0
	Recommended value	(0001h)								1
R96h	TEST1	*	*	*	*	*	*	*	*	TEST1
	Initial value	(0000h)	0	0	0	0	0	0	0	0
	Recommended value	(0000h)	0	0	0	0	0	0	0	0

## 10. Sequence

## 10.1 Power-ON Sequence

	Function	Register	Recom	D17-8	D7	D6	D5	D4	D3	D2	D1	D0	
	RESETB=1												
	wait 1 msec or more												
	RESETB=0												
	wait 10 usec or more												
	RESETB=1												
	wait 120 msec or more												
TEST1 setting	TEST1	R96h	01h	*	0	0	0	0	0	0	0	1	
OSC control setting	OSC Control 1	R19h	87h	*	CADJ[3:0]			CUADJ[2:0]			OSC_EN		
					1	0	0	0	0	1	1	1	
	wait 10 msec or more												
Display OFF setting	Display Control 1	R26h	80h	*	PT[1:0]		GON	DTE	D[1:0]		*	*	
					1	0	0	0	0	0	0	0	0
	Power Control 1	R1Bh	0Ch	*	GAS_ENB	*	*	PON	DK	XDK	VLCD_TRI	STB	
					0	0	0	0	1	1	0	0	
	VCOM Control 1	R43h	00h	*	VCOM_G	*	*	*	*	*	*	*	
					0	0	0	0	0	0	0	0	0
Power supply setting initializing	Power Control 6	R20h	00h	*	BT[3:0]			*	*	*	*		
					0	0	0	0	0	0	0	0	
	Power Control 5	R1Fh	07h	*	*	*	*	*	VRH[3:0]				
					0	0	0	0	0	1	1	1	
	VCOM Control 2	R44h	7Fh	*	*	VCM[6:0]							
					0	1	1	1	1	1	1	1	
Power supply operation start setting	Power Control 3	R45h	(14h)	*	*	*	*	*	*	VDV[4:0]			
					(0)	(0)	(0)	(1)	(0)	(1)	(0)	(0)	
	Power Control 3	R1Dh	05h	*	*	*	*	*	*	VC1[2:0]			
					0	0	0	0	0	0	1	0	1
	Power Control 4	R1Eh	00h	*	*	*	*	*	*	VC3[2:0]			
					0	0	0	0	0	0	0	0	0
Power supply operation start setting	Power Control 2	R1Ch	04h	*	*	*	*	*	*	AP[2:0]			
					0	0	0	0	0	1	0	0	
	Power Control 1	R1Bh	14h	*	GAS_ENB	*	*	PON	DK	XDK	VLCD_TRI	STB	
					0	0	0	1	0	1	0	0	
	wait 40 msec or more												
	VCOM Control 1	R43h	80h	*	VCOM_G	*	*	*	*	*	*	*	
					1	0	0	0	0	0	0	0	
Power control setting	BGP Control	R42h	08h	*	*	*	*	VBGP_OE	BGP[3:0]				
					0	0	0	0	1	0	0	0	
	Cycle Control 1	R23h	95h	*	N_DC[7:0]								
					1	0	0	1	0	1	0	1	
	Cycle Control 2	R24h	95h	*	PI_DC[7:0]								
					1	0	0	1	0	1	0	1	
	Cycle Control 3	R25h	FFh	*	I_DC[7:0]								
				1	1	1	1	1	1	1	1		
Power Control 7	R21h	10h	*	*	*	FS1[1:0]		*	*	FS0[1:0]			
				0	0	0	1	0	0	0	0		
Power Control 11	R2Bh	00h	*	*	*	PI_PRE_REFRESH[1:0]		BLANK_DIV[3:0]					
				0	0	0	0	0	0	0	0		
DCCLK SYNC TO CL1	R95h	01h	*	*	*	*	*	*	*	*	*	DCCLK_SYNC	
					0	0	0	0	0	0	0	1	

	Function	Register	Recom	D17-8	D7	D6	D5	D4	D3	D2	D1	D0
OSC control setting	OSC Control 2	R1Ah	00h	*	*	*	*	*	*	*	*	OSC_TEST
				0	0	0	0	0	0	0	0	
	OSC Control 3	R93h	0Fh	*	*	*	*	*	RADJ[3:0]			
				0	0	0	0	1	1	1	1	
Internal Use 28	R70h	66h	*	*	GS	SS	TE	TEON	CSEL[2:0]			
			0	1	1	0	0	1	1	0		
	Gate Scan control	R18h	01h	*	*	*	*	*	*	SCROL	SM	
				0	0	0	0	0	0	0	1	
r control setting	r Control 1	R46h	( 83h )	*	GSEL	CP1[2:0]			*	CP0[2:0]		
				( 1 )	( 0 )	( 0 )	( 0 )	( 0 )	( 0 )	( 1 )	( 1 )	
	r Control 2	R47h	( 31h )	*	*	CN1[2:0]			*	CN0[2:0]		
				( 0 )	( 0 )	( 1 )	( 1 )	( 0 )	( 0 )	( 0 )	( 1 )	
	r Control 3	R48h	( 01h )	*	*	NP1[2:0]			*	NP0[2:0]		
				( 0 )	( 0 )	( 0 )	( 0 )	( 0 )	( 0 )	( 0 )	( 1 )	
	r Control 4	R49h	( 56h )	*	*	NP3[2:0]			*	NP2[2:0]		
				( 0 )	( 1 )	( 0 )	( 1 )	( 0 )	( 1 )	( 1 )	( 0 )	
	r Control 5	R4Ah	( 24h )	*	*	NP5[2:0]			*	NP4[2:0]		
				( 0 )	( 0 )	( 1 )	( 0 )	( 0 )	( 1 )	( 0 )	( 0 )	
	r Control 6	R4Bh	( 05h )	*	*	NN1[2:0]			*	NN0[2:0]		
				( 0 )	( 0 )	( 0 )	( 0 )	( 0 )	( 1 )	( 0 )	( 1 )	
	r Control 7	R4Ch	( 00h )	*	*	NN3[2:0]			*	NN2[2:0]		
				( 0 )	( 0 )	( 0 )	( 0 )	( 0 )	( 0 )	( 0 )	( 0 )	
r Control 8	R4Dh	( 67h )	*	*	NN5[2:0]			*	NN4[2:0]			
			( 0 )	( 1 )	( 1 )	( 0 )	( 0 )	( 1 )	( 1 )	( 1 )		
r Control 9	R4Eh	( 01h )	*	CGMP1[1:0]	CGMP0[1:0]	OP0[3:0]						
			( 0 )	( 0 )	( 0 )	( 0 )	( 0 )	( 0 )	( 0 )	( 1 )		
r Control 10	R4Fh	( 1Fh )	*	CGMP3	CGMP2	*	OP1[4:0]					
			( 0 )	( 0 )	( 0 )	( 1 )	( 1 )	( 1 )	( 1 )	( 1 )		
r Control 11	R50h	( 0Fh )	*	CGMN1[1:0]	CGMN0[1:0]	ON0[3:0]						
			( 0 )	( 0 )	( 0 )	( 0 )	( 1 )	( 1 )	( 1 )	( 1 )		
r Control 12	R51h	( 0Ah )	*	CGMN3	CGMN2	*	ON1[4:0]					
			( 0 )	( 0 )	( 0 )	( 0 )	( 1 )	( 0 )	( 1 )	( 0 )		
RGB interface control setting	RGB interface control 1	R38h	00h	*	*	*	*	RGB_EN	DPL	HSPL	VSPL	EPL
				0	0	0	0	0	0	0	0	
RGB interface control setting	RGB interface control 2	R39h	00h	*	DOTCLK_DIV[7:0]							
				0	0	0	0	0	0	0	0	
Display control setting	Display Control 2	R27h	02h	*	*	*	*	*	N_BP[3:0]			
				0	0	0	0	0	0	1	0	
	Display Control 3	R28h	03h	*	*	*	*	*	N_FP[3:0]			
				0	0	0	0	0	0	1	1	
	Display Control 4	R29h	08h	*	*	*	*	*	PI_BP[3:0]			
				0	0	0	0	1	0	0	0	
	Display Control 5	R2Ah	08h	*	*	*	*	*	PI_FP[3:0]			
				0	0	0	0	1	0	0	0	
	Display Control 6	R2Ch	08h	*	*	*	*	*	I_BP[3:0]			
				0	0	0	0	1	0	0	0	
	Display Control 7	R2Dh	08h	*	*	*	*	*	I_FP[3:0]			
				0	0	0	0	1	0	0	0	
	Display Control 9	R35h	09h	*	EQS[7:0]							
				0	0	0	0	1	0	0	1	
Display Control 10	R36h	09h	*	EQP[7:0]								
			0	0	0	0	1	0	0	1		
Display Control 11	R91h	14h	*	GEN_OFF[7:0]								
			0	0	0	1	0	1	0	0		
Display Control 12	R37h	00h	*	*	*	PTG[1:0]		ISC[3:0]				
			0	0	0	0	0	0	0	0		

	Function	Register	Recom	D17-8	D7	D6	D5	D4	D3	D2	D1	D0
Display control setting	Display Mode control	R01h	02h	*	*	*	*	*	IDMON	INVON	NORON	PTLON
				0	0	0	0	0	0	1	0	
	Cycle Control 1	R3Ah	A1h	*	N_RTN[3:0]			*	N_NW[2:0]			
				1	0	1	0	0	0	0	1	
	Cycle Control 2	R3Bh	A1h	*	PI_RTN[3:0]			*	PI_NW[2:0]			
				1	0	1	0	0	0	0	1	
	Cycle Control 3	R3Ch	A0h	*	I_RTN[3:0]			*	I_NW[2:0]			
				1	0	1	0	0	0	0	0	
Cycle Control 4	R3Dh	00h	*	*	*	DIV_I[1:0]		DIV_PI[1:0]		DIV_N[1:0]		
			0	0	0	0	0	0	0	0		
Cycle Control 5	R3Eh	2Dh	*	SON[7:0]								
			0	0	1	0	1	1	0	1		
Cycle Control 6	R40h	03h	*	GDON[7:0]								
			0	0	0	0	0	0	1	1		
Cycle Control 7	R41h	CCh	*	GDOF[7:0]								
			1	1	0	0	1	1	0	0		
Patial Image Display setting	Partial area start row 2	R0Ah	00h	*	PSL[15:8]							
				0	0	0	0	0	0	0	0	
	Partial area start row 1	R0Bh	00h	*	PSL[7:0]							
				0	0	0	0	0	0	0	0	
Partial area end row 2	R0Ch	01h	*	PEL[15:8]								
			0	0	0	0	0	0	0	1		
Partial area end row 1	R0Dh	3Fh	*	PEL[7:0]								
			0	0	1	1	1	1	1	1		
Vertical Scroll setting	Vertical Scroll Top fixed area 2	R0Eh	00h	*	TFA[15:8]							
				0	0	0	0	0	0	0	0	
	Vertical Scroll Top fixed area 1	R0Fh	00h	*	TFA[7:0]							
				0	0	0	0	0	0	0	0	
	Vertical Scroll height area 2	R10h	01h	*	VSA[15:8]							
				0	0	0	0	0	0	0	1	
	Vertical Scroll height area 1	R11h	40h	*	VSA[7:0]							
				0	1	0	0	0	0	0	0	
Vertical Scroll Button area 2	R12h	00h	*	BFA[15:8]								
			0	0	0	0	0	0	0	0		
Vertical Scroll Button area 1	R13h	00h	*	BFA[7:0]								
			0	0	0	0	0	0	0	0		
Vertical Scroll Start address 2	R14h	00h	*	VSP[15:8]								
			0	0	0	0	0	0	0	0		
Vertical Scroll Start address 1	R15h	00h	*	VSP[7:0]								
			0	0	0	0	0	0	0	0		
Window address setting	Column address start 2	R02h	00h	*	SC[15:8]							
				0	0	0	0	0	0	0	0	
	Column address start 1	R03h	00h	*	SC[7:0]							
				0	0	0	0	0	0	0	0	
	Column address end 2	R04h	00h	*	EC[15:8]							
				0	0	0	0	0	0	0	0	
	Column address end 1	R05h	EFh	*	EC[7:0]							
				1	1	1	0	1	1	1	1	
	Row address start 2	R06h	00h	*	SP[15:8]							
				0	0	0	0	0	0	0	0	
Row address start 1	R07h	00h	*	SP[7:0]								
			0	0	0	0	0	0	0	0		
Row address end 2	R08h	01h	*	EP[15:8]								
			0	0	0	0	0	0	0	1		
Row address end 1	R09h	3Fh	*	EP[7:0]								
			0	0	1	1	1	1	1	1		
Memory Access control	R16h	08h	*	MY	MX	MV	*	BGR	*	*	*	
			0	0	0	0	1	0	0	0		
Data control	R72h	00h	*	*	*	DFM[1:0]		*	*	TRI[1:0]		
			0	0	0	0	0	0	0	0	0	

	Function	Register	Recom	D17-8	D7	D6	D5	D4	D3	D2	D1	D0
Window address setting	Write Data	R22h		GRAM Write Data								
	wait 60 msec or more											
Display on setting	SAP Idle mode	R94h	0Ah	*	SAP_[7:0]							
					0	0	0	0	1	0	1	0
	Display Control 8	R90h	7Fh	*	SAP[7:0]							
					0	1	1	1	1	1	1	1
	Display Control 1	R26h	84h	*	PT[1:0]		GON	DTE	D[1:0]		*	*
					1	0	0	0	0	1	0	0
	wait 40 msec or more											
	Display Control 1	R26h	A4h	*	PT[1:0]		GON	DTE	D[1:0]		*	*
				1	0	1	0	0	1	0	0	
Display Control 1	R26h	ACh	*	PT[1:0]		GON	DTE	D[1:0]		*	*	
				1	0	1	0	1	1	0	0	
wait 40 msec or more												
Display Control 1	R26h	BCh	*	PT[1:0]		GON	DTE	D[1:0]		*	*	
				1	0	1	1	1	1	0	0	
TEST1 setting	TEST1	R96h	00h	*	0	0	0	0	0	0	0	0

## 10.2 Power-OFF Sequence (Standby mode transition sequence)

	Function	Register	Recom	D17-8	D7	D6	D5	D4	D3	D2	D1	D0	
TEST1 setting	TEST1	R96h	01h	*	0	0	0	0	0	0	0	1	
	Display Control 1	R26h	B8h	*	PT[1:0]		GON	DTE	D[1:0]		*	*	
					1	0	1	1	1	0	0	0	
	wait 40 msec or more												
	Display Control 1	R26h	A8h	*	PT[1:0]		GON	DTE	D[1:0]		*	*	
					1	0	1	0	1	0	0	0	
	Display Control 1	R26h	84h	*	PT[1:0]		GON	DTE	D[1:0]		*	*	
				1	0	0	0	0	1	0	0		
wait 40 msec or more													
Display Control 1	R26h	80h	*	PT[1:0]		GON	DTE	D[1:0]		*	*		
				1	0	0	0	0	0	0	0		
Power off setting	Display Control 8	R90h	00h	*	SAP[7:0]								
					0	0	0	0	0	0	0	0	
	Power Control 2	R1Ch	00h	*	*	*	*	*	*	AP[2:0]			
					0	0	0	0	0	0	0	0	
	Power Control 1	R1Bh	04h	*	GAS ENB		*	*	PON	DK	XDK	VLCD_TRI	STB
				0	0	0	0	0	0	1	0	0	
VCOM Control 1	R43h	00h	*	VCOM G		*	*	*	*	*	*	*	
				0	0	0	0	0	0	0	0	0	
Power Control 1	R1Bh	0Ch	*	GAS ENB		*	*	PON	DK	XDK	VLCD_TRI	STB	
				0	0	0	0	0	1	1	0	0	
TEST1 setting	TEST1	R96h	00h	*	0	0	0	0	0	0	0	0	
Power off setting	Power Control 1	R1Bh	0Dh	*	GAS ENB		*	*	PON	DK	XDK	VLCD_TRI	STB
				0	0	0	0	0	1	1	0	1	
OSC control setting	OSC Control 1	R19h	86h	*	CADJ[3:0]				CUADJ[2:0]			OSC_EN	
					1	0	0	0	0	1	1	0	

## 10.3 Sleep Release Sequence

	Function	Register	Recom	D17-8	D7	D6	D5	D4	D3	D2	D1	D0
OSC control setting	OSC Control 1	R19h	87h	*	CADJ[3:0]				CUADJ[2:0]			OSC_EN
					1	0	0	0	0	1	1	
	wait 10 msec or more											
	Power Control 1	R1Bh	0Ch	*	GAS ENB	*	*	PON	DK	XDK	VLCD _TRI	STB
					0	0	0	0	1	1	0	0
	Power supply setting initializing	Power Control 6	R20h	00h	*	BT[3:0]			*	*	*	*
					0	0	0	0	0	0	0	0
		Power Control 5	R1Fh	07h	*	*	*	*	VRH[3:0]			
					0	0	0	0	0	1	1	1
		VCOM Control 2	R44h	7Fh	*	*	VCM[6:0]					
					0	1	1	1	1	1	1	1
		VCOM Control 3	R45h	( 14h )	*	*	*	*	VDV[4:0]			
					( 0 )	( 0 )	( 0 )	( 1 )	( 0 )	( 1 )	( 0 )	( 0 )
		Power Control 3	R1Dh	05h	*	*	*	*	*	VC1[2:0]		
					0	0	0	0	0	1	0	1
		Power Control 4	R1Eh	00h	*	*	*	*	*	VC3[2:0]		
					0	0	0	0	0	0	0	0
	Power supply operation start setting	Power Control 2	R1Ch	04h	*	*	*	*	*	*	AP[2:0]	
					0	0	0	0	0	1	0	0
	Power Control 1	R1Bh	14h	*	GAS ENB	*	*	PON	DK	XDK	VLCD _TRI	STB
					0	0	0	1	0	1	0	0
	wait 40 msec or more											
	VCOM Control 1	R43h	80h	*	VCOM G	*	*	*	*	*	*	*
					1	0	0	0	0	0	0	0
	wait 60 msec or more											
Display on setting	Display Control 8	R90h	7Fh	*	SAP[7:0]							
					0	1	1	1	1	1	1	1
TEST1 setting	TEST1	R96h	01h	*	0	0	0	0	0	0	0	1
Display on setting	Display Control 1	R26h	84h	*	PT[1:0]		GON	DTE	D[1:0]		*	*
					1	0	0	0	0	1	0	0
	wait 40 msec or more											
	Display Control 1	R26h	A4h	*	PT[1:0]		GON	DTE	D[1:0]		*	*
					1	0	1	0	0	1	0	0
	Display Control 1	R26h	ACh	*	PT[1:0]		GON	DTE	D[1:0]		*	*
					1	0	1	0	1	1	0	0
	wait 40 msec or more											
	Display Control 1	R26h	BCh	*	PT[1:0]		GON	DTE	D[1:0]		*	*
					1	0	1	1	1	1	0	0
TEST1 setting	TEST1	R96h	00h	*	0	0	0	0	0	0	0	0



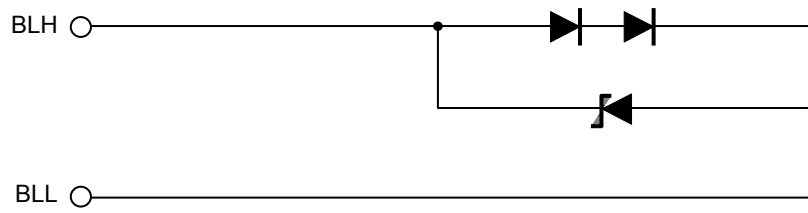
## 10.4 Refresh Sequence

	Function	Register	Recom	D17-8	D7	D6	D5	D4	D3	D2	D1	D0
OSC control setting	OSC Control 1	R19h	87h	*	CADJ[3:0]			CUADJ[2:0]			OSC_EN	
					1	0	0	0	0	1		1
Power supply setting initializing	Power Control 6	R20h	00h	*	BT[3:0]			*	*	*	*	
					0	0	0	0	0	0	0	
	Power Control 5	R1Fh	07h	*	*	*	*	*	VRH[3:0]			
					0	0	0	0	0	1	1	1
	VCOM Control 2	R44h	7Fh	*	*	VCM[6:0]						
					0	1	1	1	1	1	1	1
	VCOM Control 3	R45h	(14h)	*	*	*	*	VDV[4:0]				
				(0)	(0)	(0)	(1)	(0)	(1)	(0)	(0)	
	Power Control 3	R1Dh	05h	*	*	*	*	*	*	VC1[2:0]		
					0	0	0	0	0	1	0	1
	Power Control 4	R1Eh	00h	*	*	*	*	*	*	VC3[2:0]		
					0	0	0	0	0	0	0	0
Power supply operation start setting	Power Control 2	R1Ch	04h	*	*	*	*	*	*	AP[2:0]		
					0	0	0	0	0	1	0	0
	Power Control 1	R1Bh	14h	*	GAS ENB	*	*	PON	DK	XDK	VLCD _TRI	STB
					0	0	0	1	0	1	0	0
	VCOM Control 1	R43h	80h	*	VCOM G	*	*	*	*	*	*	*
					1	0	0	0	0	0	0	0
Power control setting	BGP Control	R42h	08h	*	*	*	*	VBGP _OE	BGP[3:0]			
					0	0	0	0	1	0	0	0
	Cycle Control 1	R23h	95h	*	N_DC[7:0]							
					1	0	0	1	0	1	0	1
	Cycle Control 2	R24h	95h	*	PI_DC[7:0]							
					1	0	0	1	0	1	0	1
	Cycle Control 3	R25h	FFh	*	I_DC[7:0]							
				1	1	1	1	1	1	1	1	
	Power Control 7	R21h	10h	*	*	*	FS1[1:0]		*	*	FS0[1:0]	
					0	0	0	1	0	0	0	0
	Power Control 11	R2Bh	00h	*	*	*	PI_PRE_ REFRESH[1:0]		BLANK_DIV[3:0]			
					0	0	0	0	0	0	0	0
	DCCLK SYNC TO CL1	R95h	01h	*	*	*	*	*	*	*	*	DCCLK _SYNC
					0	0	0	0	0	0	0	1
OSC control setting	OSC Control 2	R1Ah	00h	*	*	*	*	*	*	*	*	OSC_ TEST
					0	0	0	0	0	0	0	0
	OSC Control 3	R93h	0Fh	*	*	*	*	*	RADJ[3:0]			
					0	0	0	0	1	1	1	1
	Internal Use 28	R70h	66h	*	*	GS	SS	TE MODE	TEON	CSEL[2:0]		
					0	1	1	0	0	1	1	0
	Gate Scan control	R18h	01h	*	*	*	*	*	*	*	SCROL L_ON	SM
					0	0	0	0	0	0	0	1

	Function	Register	Recom	D17-8	D7	D6	D5	D4	D3	D2	D1	D0
r control setting	r Control 1	R46h	( 83h )	*	GSEL	CP1[2:0]			*	CP0[2:0]		
				(1)	(0)	(0)	(0)	(0)	(0)	(1)	(1)	
	r Control 2	R47h	( 31h )	*	*	CN1[2:0]			*	CNO[2:0]		
				(0)	(0)	(1)	(1)	(0)	(0)	(0)	(1)	
	r Control 3	R48h	( 01h )	*	*	NP1[2:0]			*	NP0[2:0]		
				(0)	(0)	(0)	(0)	(0)	(0)	(0)	(1)	
	r Control 4	R49h	( 56h )	*	*	NP3[2:0]			*	NP2[2:0]		
				(0)	(1)	(0)	(1)	(0)	(1)	(1)	(0)	
	r Control 5	R4Ah	( 24h )	*	*	NP5[2:0]			*	NP4[2:0]		
				(0)	(0)	(1)	(0)	(0)	(1)	(0)	(0)	
	r Control 6	R4Bh	( 05h )	*	*	NN1[2:0]			*	NNO[2:0]		
				(0)	(0)	(0)	(0)	(0)	(1)	(0)	(1)	
r Control 7	R4Ch	( 00h )	*	*	NN3[2:0]			*	NN2[2:0]			
			(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)		
r Control 8	R4Dh	( 67h )	*	*	NN5[2:0]			*	NN4[2:0]			
			(0)	(1)	(1)	(0)	(0)	(1)	(1)	(1)		
r Control 9	R4Eh	( 01h )	*	CGMP1[1:0]	CGMP0[1:0]	OP0[3:0]						
			(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(1)	
r Control 10	R4Fh	( 1Fh )	*	CGMP3	CGMP2	*	OP1[4:0]					
			(0)	(0)	(0)	(1)	(1)	(1)	(1)	(1)	(1)	
r Control 11	R50h	( 0Fh )	*	CGMN1[1:0]	CGMN0[1:0]	ON0[3:0]						
			(0)	(0)	(0)	(0)	(1)	(1)	(1)	(1)		
r Control 12	R51h	( 0Ah )	*	CGMN3	CGMN2	*	ON1[4:0]					
			(0)	(0)	(0)	(0)	(1)	(0)	(1)	(0)		
RGB interface control setting	RGB interface control 1	R38h	00h	*	*	*	*	RGB_EN	DPL	HSPL	VSPL	EPL
				0	0	0	0	0	0	0	0	
RGB interface control setting	RGB interface control 2	R39h	00h	*	DOTCLK_DIV[7:0]							
				0	0	0	0	0	0	0	0	
Display control setting	Display Control 2	R27h	02h	*	*	*	*	*	N_BP[3:0]			
				0	0	0	0	0	0	1	0	
	Display Control 3	R28h	03h	*	*	*	*	*	N_FP[3:0]			
				0	0	0	0	0	0	1	1	
	Display Control 4	R29h	08h	*	*	*	*	*	PI_BP[3:0]			
				0	0	0	0	1	0	0	0	
	Display Control 5	R2Ah	08h	*	*	*	*	*	PI_FP[3:0]			
				0	0	0	0	1	0	0	0	
	Display Control 6	R2Ch	08h	*	*	*	*	*	I_BP[3:0]			
				0	0	0	0	1	0	0	0	
	Display Control 7	R2Dh	08h	*	*	*	*	*	I_FP[3:0]			
				0	0	0	0	1	0	0	0	
	Display Control 9	R35h	09h	*	EQS[7:0]							
				0	0	0	0	1	0	0	1	
	Display Control 10	R36h	09h	*	EQP[7:0]							
				0	0	0	0	1	0	0	1	
Display Control 11	R91h	14h	*	GEN_OFF[7:0]								
			0	0	0	1	0	1	0	0		
Display Control 12	R37h	00h	*	*	*	PTG[1:0]		ISC[3:0]				
			0	0	0	0	0	0	0	0		
Display Mode control	R01h	02h	*	*	*	*	*	IDMON	INNON	NORON	PTLON	
			0	0	0	0	0	0	1	0		
Cycle Control 1	R3Ah	A1h	*	N_RTN[3:0]				*	N_NW[2:0]			
			1	0	1	0	0	0	0	1		
Cycle Control 2	R3Bh	A1h	*	PI_RTN[3:0]				*	PI_NW[2:0]			
			1	0	1	0	0	0	0	1		
Cycle Control 3	R3Ch	A0h	*	I_RTN[3:0]				*	I_NW[2:0]			
			1	0	1	0	0	0	0	0		
Cycle Control 4	R3Dh	00h	*	*	DIV_I[1:0]		DIV_PI[1:0]		DIV_N[1:0]			
			0	0	0	0	0	0	0	0		

	Function	Register	Recom	D17-8	D7	D6	D5	D4	D3	D2	D1	D0
Display control setting	Cycle Control 5	R3Eh	2Dh	*	SON[7:0]							
					0	0	1	0	1	1	0	1
	Cycle Control 6	R40h	03h	*	GDON[7:0]							
					0	0	0	0	0	0	1	1
	Cycle Control 7	R41h	CCh	*	GDOF[7:0]							
					1	1	0	0	1	1	0	0
Patial Image Display setting	Partial area start row 2	R0Ah	00h	*	PSL[15:8]							
					0	0	0	0	0	0	0	0
	Partial area start row 1	R0Bh	00h	*	PSL[7:0]							
					0	0	0	0	0	0	0	0
	Partial area end row 2	R0Ch	01h	*	PEL[15:8]							
					0	0	0	0	0	0	0	1
	Partial area end row 1	R0Dh	3Fh	*	PEL[7:0]							
					0	0	1	1	1	1	1	1
Vertical Scroll setting	Vertical Scroll Top fixed area 2	R0Eh	00h	*	TFA[15:8]							
					0	0	0	0	0	0	0	0
	Vertical Scroll Top fixed area 1	R0Fh	00h	*	TFA[7:0]							
					0	0	0	0	0	0	0	0
	Vertical Scroll height area 2	R10h	01h	*	VSA[15:8]							
					0	0	0	0	0	0	0	1
	Vertical Scroll height area 1	R11h	40h	*	VSA[7:0]							
					0	1	0	0	0	0	0	0
	Vertical Scroll Button area 2	R12h	00h	*	BFA[15:8]							
					0	0	0	0	0	0	0	0
	Vertical Scroll Button area 1	R13h	00h	*	BFA[7:0]							
					0	0	0	0	0	0	0	0
	Vertical Scroll Start address 2	R14h	00h	*	VSP[15:8]							
					0	0	0	0	0	0	0	0
	Vertical Scroll Start address 1	R15h	00h	*	VSP[7:0]							
					0	0	0	0	0	0	0	0
Window address setting	Column address start 2	R02h	00h	*	SC[15:8]							
					0	0	0	0	0	0	0	0
	Column address start 1	R03h	00h	*	SC[7:0]							
					0	0	0	0	0	0	0	0
	Column address end 2	R04h	00h	*	EC[15:8]							
					0	0	0	0	0	0	0	0
	Column address end 1	R05h	EFh	*	EC[7:0]							
					1	1	1	0	1	1	1	1
	Row address start 2	R06h	00h	*	SP[15:8]							
					0	0	0	0	0	0	0	0
Row address start 1	R07h	00h	*	SP[7:0]								
				0	0	0	0	0	0	0	0	
Row address end 2	R08h	01h	*	EP[15:8]								
				0	0	0	0	0	0	0	0	1
Row address end 1	R09h	3Fh	*	EP[7:0]								
				0	0	1	1	1	1	1	1	1
	Memory Access control	R16h	08h	*	MY	MX	MV	*	BGR	*	*	*
					0	0	0	0	1	0	0	0
	Data control	R72h	00h	*	*	*	DFM[1:0]	*	*	*	TRI[1:0]	
					0	0	0	0	0	0	0	0
Display on setting	SAP Idle mode	R94h	0Ah	*	SAP_I[7:0]							
					0	0	0	0	1	0	1	0
	Display Control 8	R90h	7Fh	*	SAP[7:0]							
					0	1	1	1	1	1	1	1
	Display Control 1	R26h	BCh	*	PT[1:0]	GON	DTE	D[1:0]	*	*		
					1	0	1	1	1	1	0	0
TEST1 setting	TEST1	R96h	00h	*	0	0	0	0	0	0	0	0

11. LED Circuit



## 12. Characteristics

## 12.1 Optical Characteristics

&lt; Measurement Condition &gt;

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

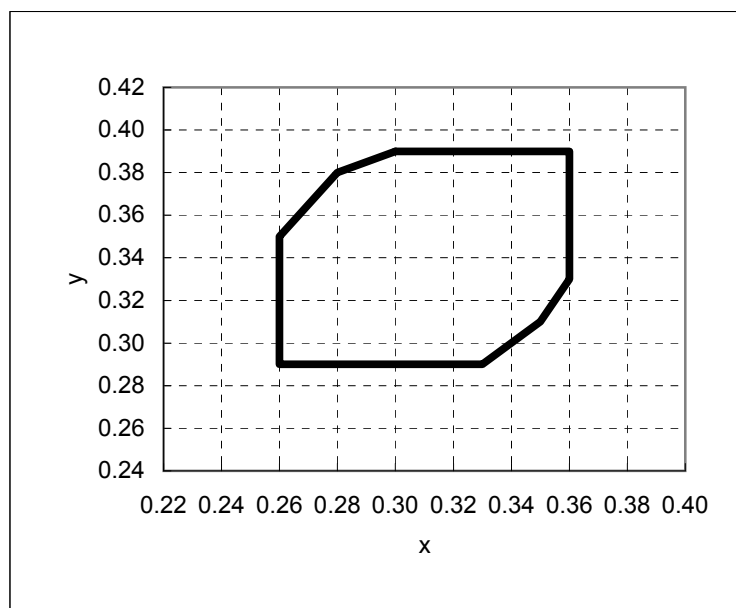
Driving condition: VCI=2.7V, IOVCC=2.7V, VSS=0V  
Optimized VCOMDC

Backlight: IL=7.5mA

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	Backlight ON	CR	[Data]= 3Fh / 00h	400	800	—		2	
	Backlight OFF			—	2	—			
Viewing angle	Left	θL	[Data]= 3Fh / 00h CR ≥ 10	80	—	—	deg	3	
	Right	θR		80	—	—	deg		
	Up	φU		80	—	—	deg		
	Down	φD		80	—	—	deg		
White Chromaticity	x		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	210	300	—	cd/m <sup>2</sup>	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
0.30	0.39
0.28	0.38
0.26	0.35
0.26	0.29
0.33	0.29
0.35	0.31
0.36	0.33
0.36	0.39

## 12.2 Temperature Characteristics

< Measurement Condition >

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

Driving condition: VCI=2.7V, IOVCC=2.7V, VSS=0V

Optimized VCOMDC

Backlight: IL=7.5mA

Item		Specification		Remark	
		Ta=-20°C	Ta=70°C		
Contrast ratio	CR	200 or more	200 or more	Backlight ON	
Response time	Rise time	TON	600 msec or less	50 msec or less	
	Fall time	TOFF	400 msec or less	30 msec or less	
Display Quality		No noticeable display defect or nonuniformity should be observed.			

13. Criteria of Judgment

13.1 Defective Display and Screen Quality

Test Condition: Observed TFT-LCD monitor from front during operation with the following conditions

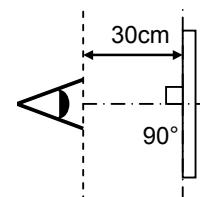
Driving Signal Raster Patter (RGB, white, black)

Signal condition [Data]: 00h, 28h, 3Fh (3steps)

Observation distance 30 cm

Illuminance 200 to 350 lx

Backlight IL=7.5mA



Defect item	Defect content	Criteria	
Display Quality	Line defect	Black, white or color line, 3 or more neighboring defective dots	
	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	
Screen Quality	Dirt	Uneven brightness (white stain, black stain etc)	
	Foreign particle	Point-like	0.25mm < φ
			0.20mm < φ ≤ 0.25mm
			φ ≤ 0.20mm
		Liner	3.0mm < length and 0.08mm < width
		length ≤ 3.0mm or width ≤ 0.08mm	
Others			

Not exists

Refer to table 1

ignored

Invisible through 5% ND filter at Black screen.  
Invisible through 1% ND filter at other screen.

N=0

N ≤ 2

Ignored

N=0

Ignored

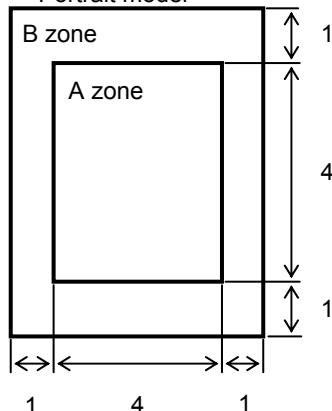
Use boundary sample for judgment when necessary

Permissible number: N

Table 1

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

## 13.2 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	



## 14. 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% non condensing	240hr	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% non condensing	240hr	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
	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 <sup>2</sup> 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 <sup>2</sup> 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.)

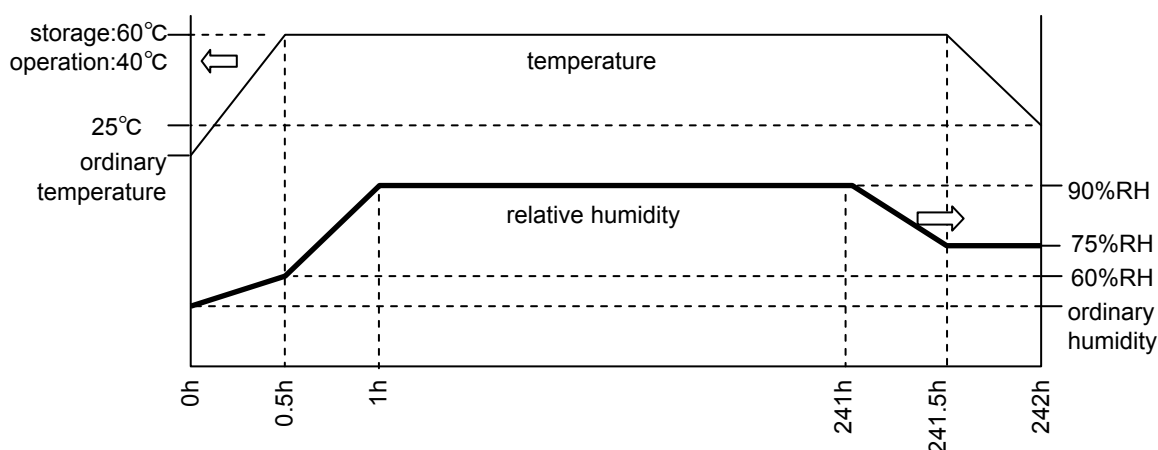
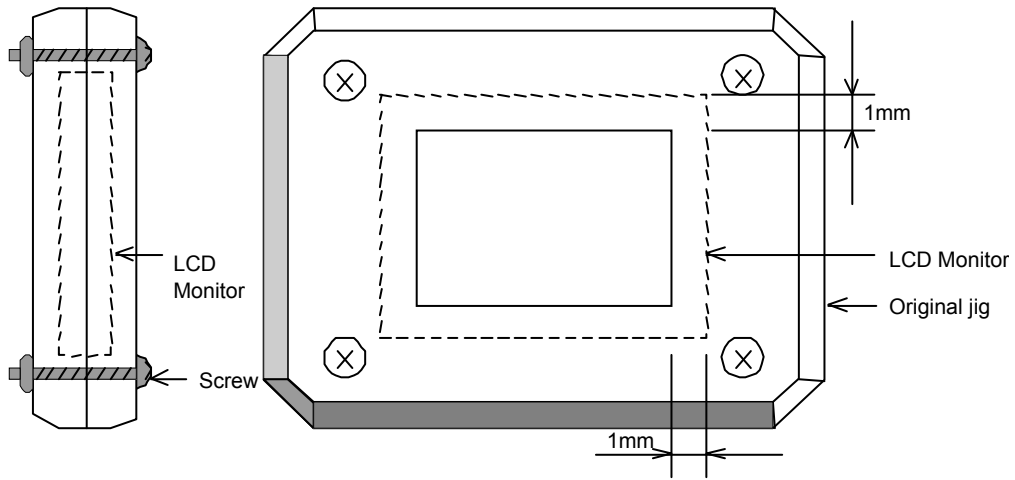


Table2.Reliability Criteria

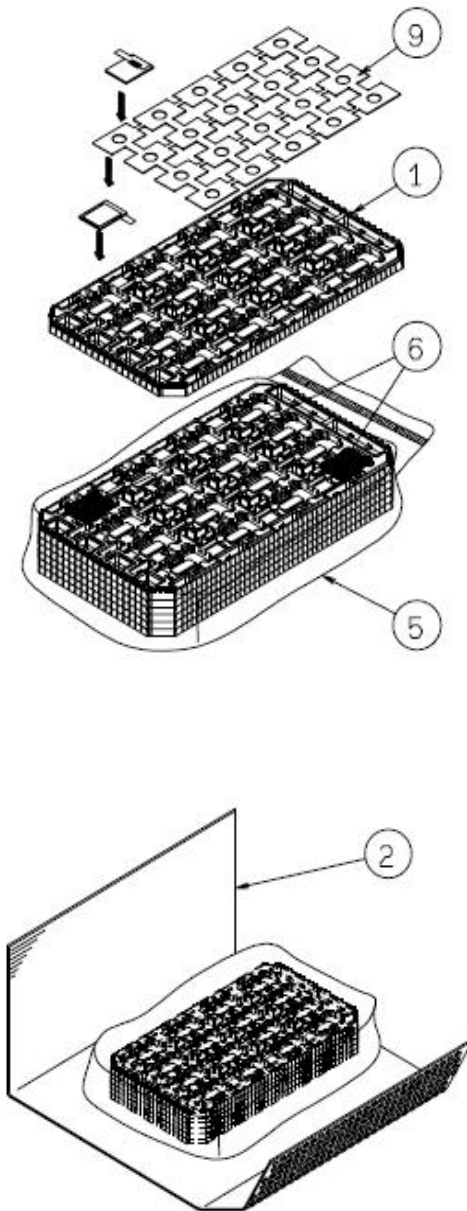
The parameters should be measured after leaving the monitor at the ordinary temperature for 24 hours or more after the test completion.

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

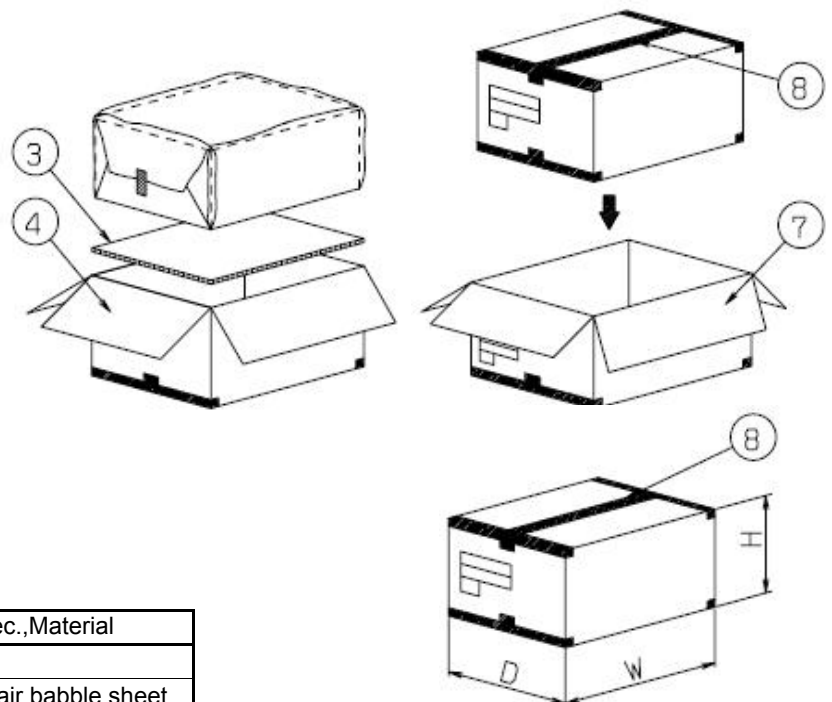
ORTUS TECHNOLOGY Original Jig



## 15. Packing Specifications



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



Packing item name		Spec.,Material
①	TRAY	A-PET
②	B SHEET A	Anti-static air babble sheet
③	INNER BOARD	Corrugated cardboard
④	OUTER CARTON	Corrugated cardboard
⑤	SEALING BAG	
⑥	Drier	Moisture absorber
⑦	EXTRA OUTER CARTON	Corrugated cardboard
⑧	Packing tape	
⑨	FOAM SHEET	Anti-static polyethylene

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

## 16. Handling Instruction

## 16.1 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 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.**

## 16.2 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) 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 16.5 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.

## 16.3 Precautions for Operation

- 1) Since this TFT monitors are not equipped with light shielding for the driver IC, do not expose the driver IC to strong lights during operation as it may cause functional failures.
- 2) In case of powering up or powering off this LCD module, be sure to comply the sequence as instructed in this specification.
- 3) Do not plug in or out the FPC cable while power supply is switch on.  
Plug the FPC cable in and out while power supply is switched off.
- 4) Do not operate the TFT monitors in the strong magnetic field. It may break the TFT monitors.
- 5) Do not display a fixed image on the screen for a long time.  
Use a screen-saver or other measures to avoid a fixed image displayed on the screen for a long time.  
Otherwise, it may cause burn-in image on the screen due the characteristics of liquid crystal.

## 16.4 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.

### 16.5 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.

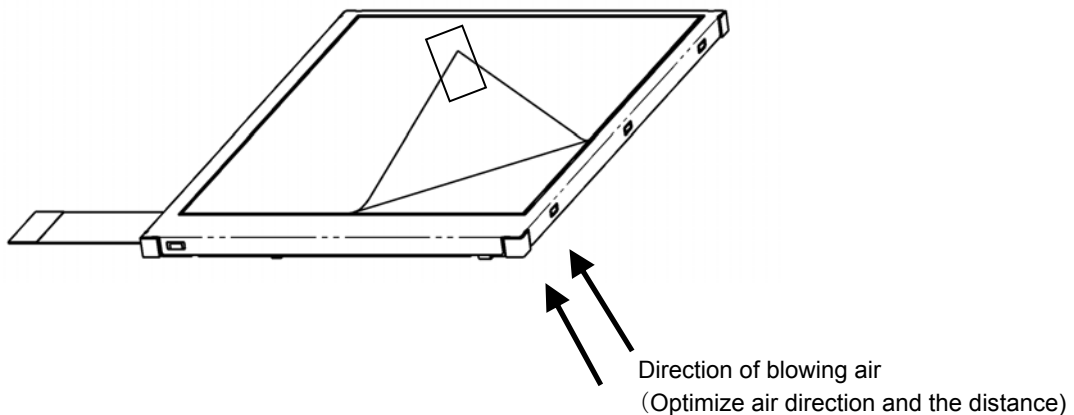
#### B) Work Method

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

- a) Use an electrostatic neutralization blower to blow air on the TFT monitors to its lower right when FPC is placed at the left.

Optimize direction of the blowing air and the distance between the TFT monitors and the electrostatic neutralization blower.

- b) Put an adhesive tape (Scotch tape, etc) at the lower right corner area of the protective film to prevent scratch on surface of TFT monitors.
- c) Peel off the adhesive tape slowly (spending more than 2 secs to complete) by pulling it to opposite direction.



### 16.6 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 (Backlight ON)

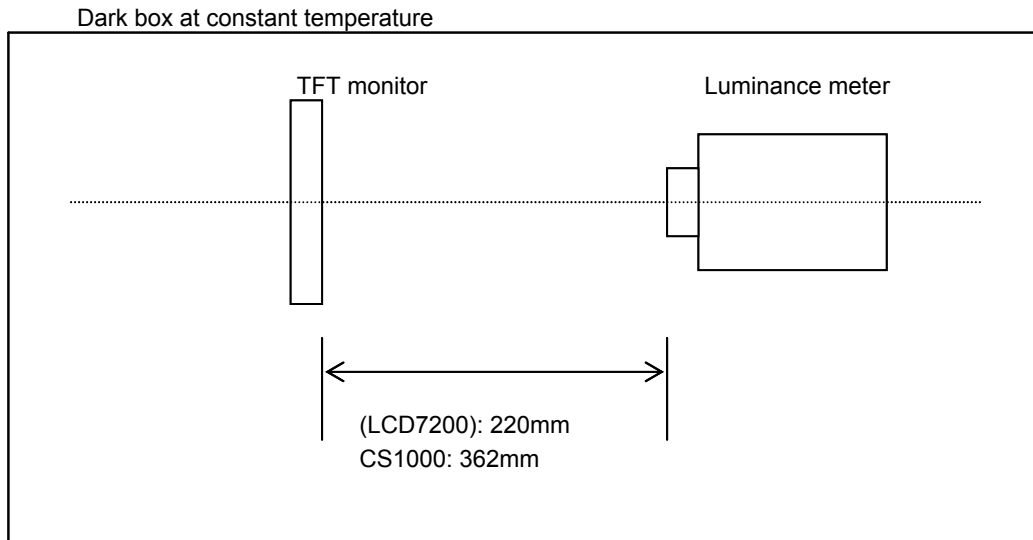
Measuring instruments: CS1000(KONICA MINOLTA), LCD7200(OTSUKA ELECTRONICS),EZcontrast160D (ELDIM)

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.

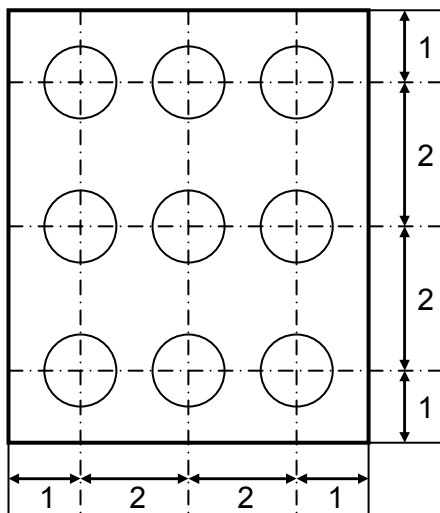
Measurement point: At the center of the screen unless otherwise specified



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

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

<Portrait model>



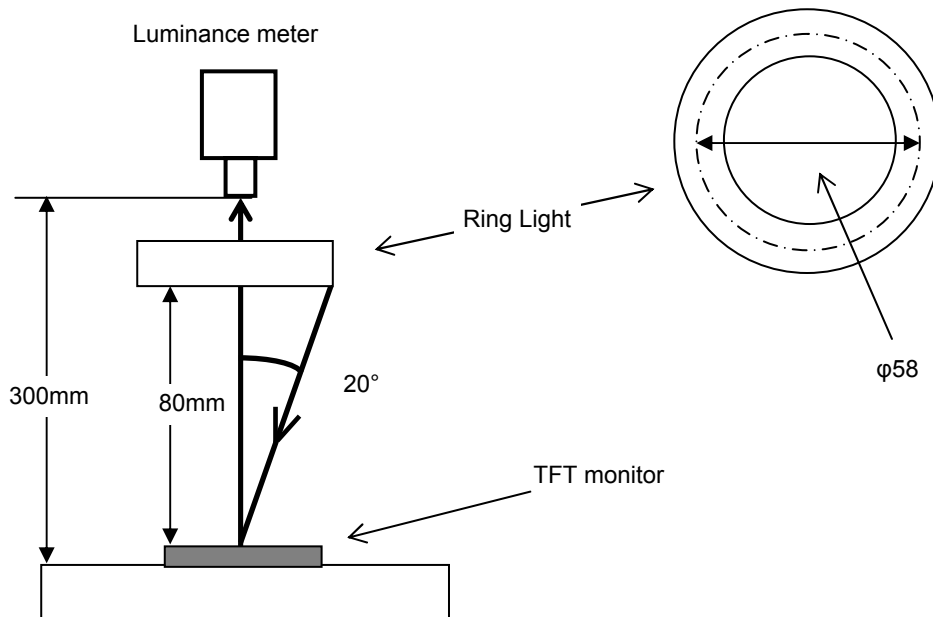
Dimensional ratio of active area

Backlight IL=7.5mA



Measurement Condition (Contrast ratio Backlight OFF only)

- Measuring instruments: LCD7200(OTSUKA ELECTRONICS),Ring Light(40,000 lx, $\phi$ 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	<p>Measure output signal waveform by the luminance meter when raster of window pattern is changed from white to black and from black to white.</p> <p style="text-align: center;">Black                      White                      Black</p> <p>White brightness</p> <p>100%</p> <p>90%</p> <p>10%</p> <p>0%</p> <p>Black brightness</p> <p>TON</p> <p>TOFF</p>	LCD7200	<p>Black display [Data]=00h</p> <p>White display [Data]=3Fh</p> <p>TON</p> <p>Rise time</p> <p>TOFF</p> <p>Fall time</p>
2	Contrast ratio	<p>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.</p> <p style="text-align: center;">Contrast ratio = Y1/Y2</p> <p style="text-align: center;">Diameter of measuring point: 8mmφ(CS1000)</p> <p style="text-align: center;">Diameter of measuring point: 3mmφ(LCD7200)</p>	CS1000 LCD7200	Backlight ON Backlight OFF
3	Viewing angle Horizontalθ Verticalφ	Move the luminance meter from right to left and up and down and determine the angles where contrast ratio is 10	EZcontrast160D	
4	White chromaticity	<p>Measure chromaticity coordinates x and y of CIE1931 colorimetric system at [Data] = 3Fh</p> <p style="text-align: center;">Color matching function: 2°view</p>	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	<p>(Brightness distribution) = 100 x B/A %</p> <p>A : max. brightness of the 9 points</p> <p>B : min. brightness of the 9 points</p>	CS1000	

Version History

Ver.	Date	Page	Description
1.0	Apr. 28, 2016	-	-
			First issue

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