SPECIFICATIONS № 17TLM013	Issue: Apr. 18, 2017

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

Specifications for

Blanview TFT-LCD Monitor (TENTATIVE)

(5.0" HD 720 x RGB x 1280 Portrait)

Version 0.0

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

MODEL COM50H5N03ULC

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 126.0 mm (5.0 inch) Blanview TFT-LCD monitor for non-military use.

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

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

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

◎ 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

- 5.0 inch diagonal display, 720 x RGB [H] x 1280 [V] dots.
- 24bitRGB (8-8-8 Format) / 16.7 Million colors.
- MIPI DSI as high-speed interface. Video mode only.
- Timing generator [TG], Counter-electrode driving circuitry, Built-in power supply circuit.
- Various display controls and functional selection.
- Long life & High bright white LED back-light.
- Blanview TFT-LCD, improved outdoor readability.

* MIPI : Mobile Industrial Processor Interface , DSI : Display Serial Interface

	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	16.7 Million 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	MIPI DSI 4-lanes : 4 data lanes and 1 clock lane	
Backlight type	Long life & High bright white LED.	
NTSC ratio	50%	

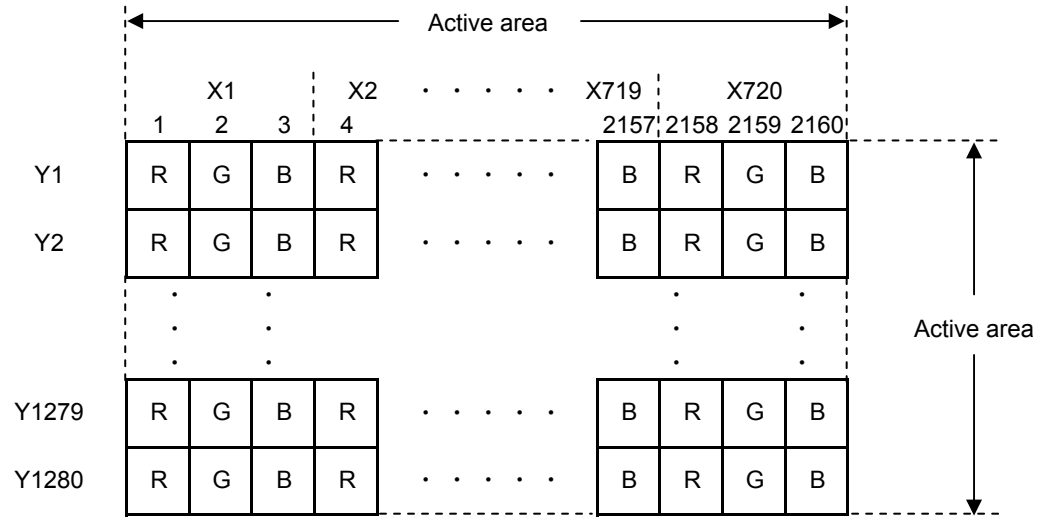
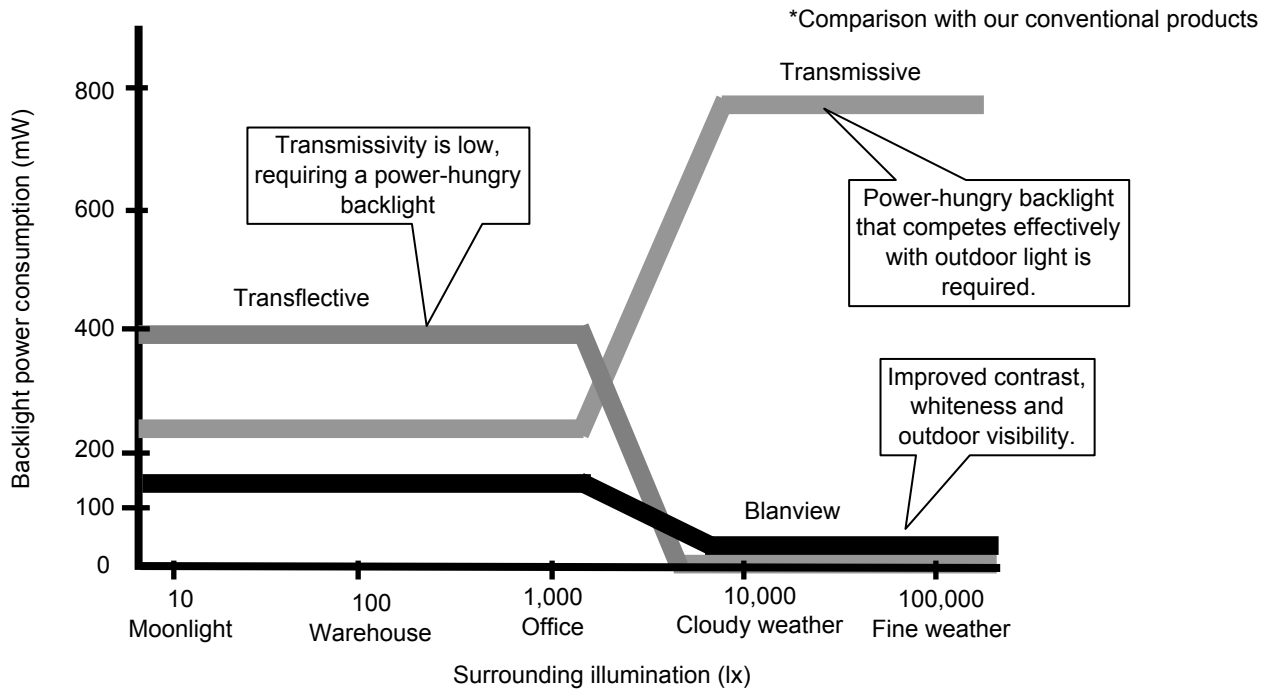


Fig.1 Dot arrangement (FPC cable placed (TBD))

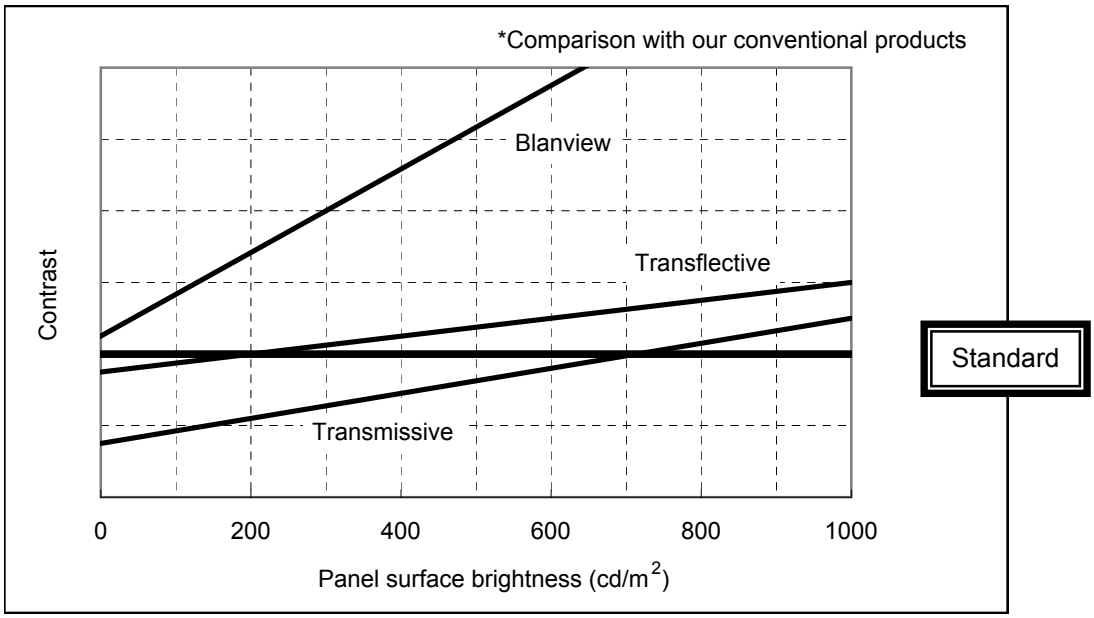
<Features of Blanview>

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



- Contrast characteristics under 100,000lx.（same condition as direct sunlight.）

With better contrast (higher contrast ratio), Blanview TFT-LCD has the best outdoor readability in three different types of TFT-LCD.
Below chart shows contrast value against panel surface brightness. (Horizontal: Panel surface brightness/ Vertical: Contrast value) LCD panel has enough outdoor readability above our Standard line.
(ORTUS TECHNOLOGY criteria)



3. Dimensions and Shape

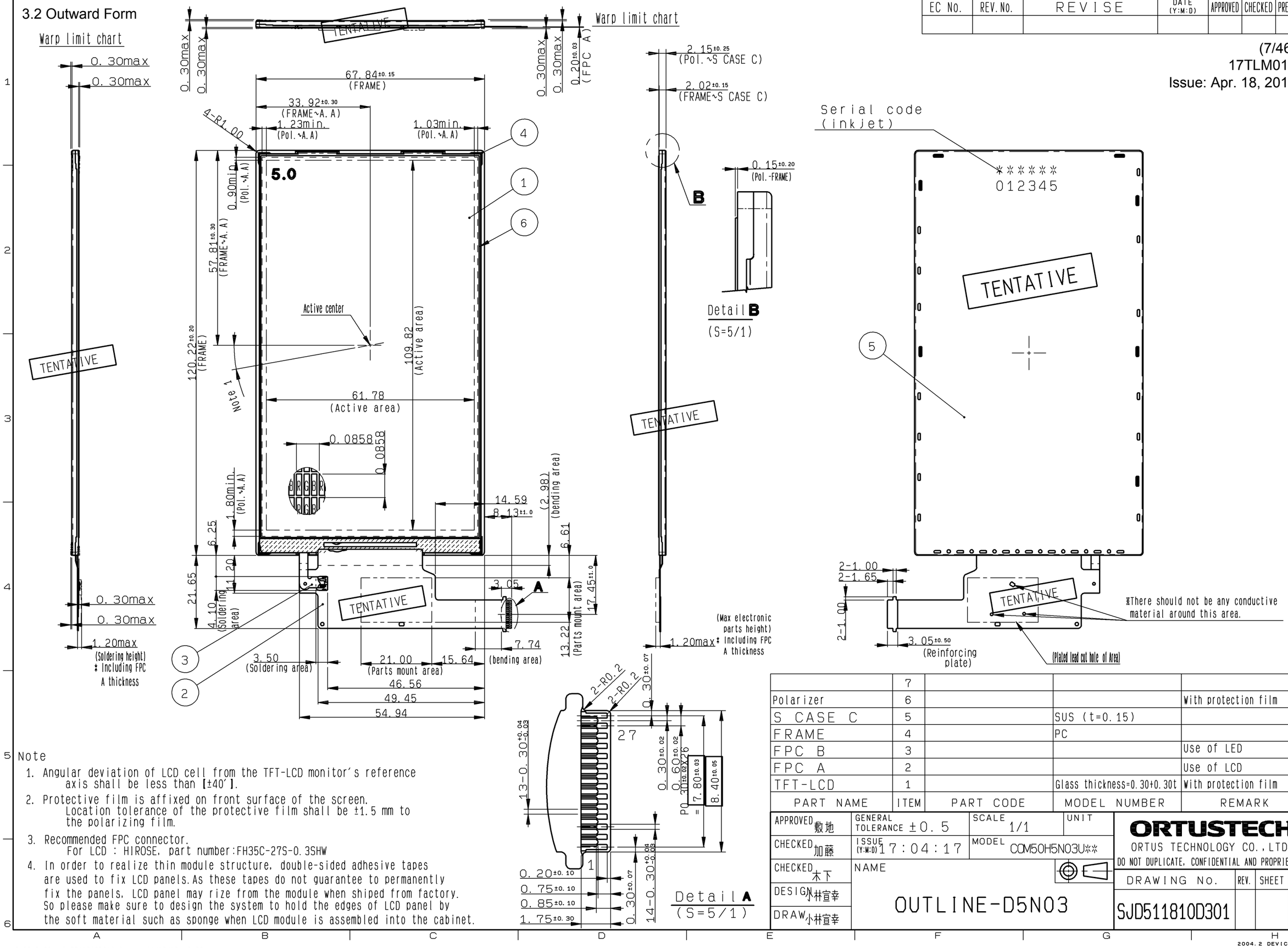
3.1 Dimensions

Items	Specifications	Unit	Remarks
Outline dimensions	(67.84 [H] × 120.22 [V] ×2.15 [D])	mm	Exclude FPC cable
Active area	(61.776[H] × 109.824[V])	mm	(126.0mm diagonal)
Number of dots	(2160[H] × 1280[V])	dot	
Dot pitch	(28.6[H] × 85.8[V])	um	
Surface hardness of the polarizer	T.B.D.	H	T.B.D.
Weight	T.B.D.	g	

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

(7/46)
17TLM013
Issue: Apr. 18, 2017

3.2 Outward Form



	7			
Polarizer	6			With protection film
S CASE C	5		SUS (t=0.15)	
FRAME	4		PC	
FPC B	3			Use of LED
FPC A	2			Use of LCD
TFT-LCD	1		Glass thickness=0.30+0.30t	With protection film
PART NAME	ITEM	PART CODE	MODEL NUMBER	REMARK

Note

1. Angular deviation of LCD cell from the TFT-LCD monitor's reference axis shall be less than 【±40'】.
2. 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.
3. Recommended FPC connector. For LCD : HIROSE, part number:FH35C-27S-0.3SHW
4. In order to realize thin module structure, double-sided adhesive tapes are used to fix LCD panels. As these tapes do not guarantee to permanently fix the panels, LCD panel may rize from the module when shiped from factory. So please make sure to design the system to hold the edges of LCD panel by the soft material such as sponge when LCD module is assembled into the cabinet.

APPROVED 敷地	GENERAL TOLERANCE ±0.5	SCALE 1/1	UNIT
CHECKED 加藤	ISSUE (Y:M:D) 17:04:17	MODEL COM50H5N03U**	
CHECKED 木下	NAME		
DESIGN 小林宣幸	OUTLINE-D5N03		
DRAW 小林宣幸			

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DRAWING NO.	REV.	SHEET	DIV.
SJD511810D301			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	May-E	Sep-I
		Feb-B	Jun-F	Oct-J
		Mar-C	Jul-G	Nov-K
		Apr-D	Aug-H	Dec-L
c	Model code	50BTC (Made in Japan) 50BVC (Made in Malaysia)		
d	Serial number			

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

・Made in Japan

8J50BTC000125

means "manufactured in October 2018, 5.0" BT type, C specifications, serial number 000125"

・Made in Malaysia

8J42BVC000125

means "manufactured in October 2018, 5.0" BV 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	Details	Remark	IO
1	GND	Ground		P
2	NC	Non connection		-
3	LED+	Backlight LED Anode		P
4	NC	Non connection		-
5	LED-	Backlight LED Cathode		P
6	VDD	Analog Power Supply	VDD = 2.9V (TYP)	P
7	GND	Ground		P
8	VCCIO	DSI and I/O Power Supply	VCCIO = 1.9V (TYP)	P
9	RESETB	LCD Reset	L:Initialize Power_ON Reset is Required when Turning on the Power	I
10	GND	Ground		P
11	PWM	CACB PWM OUT		O
12	GND	Ground		P
13	DSI_D3P	MIPI-DSI Data differential signal input pin (Data lane 3)		I
14	DSI_D3N	MIPI-DSI Data differential signal input pin (Data lane 3)		I
15	GND	Ground		P
16	DSI_D2P	MIPI-DSI Data differential signal input pin (Data lane 2)		I
17	DSI_D2N	MIPI-DSI Data differential signal input pin (Data lane 2)		I
18	GND	Ground		P
19	DSI_CP	MIPI-DSI Clock differential signal input pin		I
20	DSI_CN	MIPI-DSI Clock differential signal input pin		I
21	GND	Ground		P
22	D1P	MIPI-DSI Data differential signal input pin (Data lane 1)		I
23	D1N	MIPI-DSI Data differential signal input pin (Data lane 1)		I
24	GND	Ground		P
25	DSI_D0P	MIPI-DSI Data differential signal input pin (Data lane 0)		IO
26	DSI_D0N	MIPI-DSI Data differential signal input pin (Data lane 0)		IO
27	GND	Ground		P

- Recommended connector : (FH35C-27S-0.3SHW(50) /HIROSE ELECTRIC)
- 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. Absolute Maximum Rating

GND=0V

Item	Symbol	Condition	Rating		Unit	Applicable terminal
			MIN	MAX		
Supply voltage	VDD	Ta=25 °C	-0.3	4.4	V	VDD
DSI and I/O Power Supply voltage	VCCIO		-0.3	3.6	V	VCCIO
Input voltage for logic	VI		-0.3	VCCIO+0.3	V	RESETB TEST1-4
DSI Input voltage	VDSIIN		-0.15	1.45	V	DSI_D0P/N , DSI_D1P/N DSI_CP/N
LED forward current	IL	Ta = 25 °C	-	35	mA	LED+ - LED-
		Ta = 70 °C	-	15		
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.				

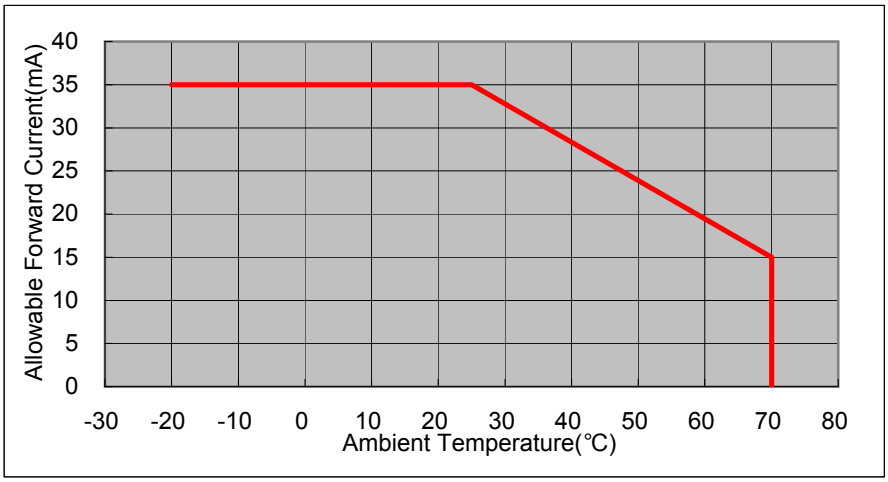
6. Recommended Operating Conditions

GND=0V

Item	Symbol	Condition	Rating			Unit	Applicable terminal
			MIN	TYP	MAX		
Supply voltage	VDD		2.8	2.9	3.0	V	VDD
DSI and I/O Power Supply voltage	VCCIO		1.8	1.9	2.0	V	VCCIO
Input voltage for logic	VI		0	-	VCCIO	V	RESETB TEST1-4
DSI Input voltage	VI		-0.15	-	1.45	V	DSI_D0P/N DSI_D2P/N DSI_D1P/N DSI_D3P/N DSI_CP/N
Operational temperature range	Top	Note1,2	-20	25	70	°C	Panel surface temperature
Operating humidity range	Hop	Ta<=30 °C	20	-	80	%	
		Ta>30 °C	Non condensing in an environmental moisture at or less than 30 °C 80%RH.				

Note1: This monitor is operatable in this temperature range. With regard to optical characteristics, refer to Item 12."Characteristics".

Note 2: Acceptable Forward Current to LED is up to 15 mA, when Ta=+70 °C.
Do not exceed Allowable Forward Current shown on the chart below.



7. Characteristics

7.1 DC Characteristics

7.1.1 Display Module

(Unless otherwise noted, Ta=25 °C,VDD=2.9V,VCCIO=1.9V,GND=0V)

Item	Symbol	Condition	Rating			Unit	Applicable terminal
			MIN	TYP	MAX		
Input Signal Voltage	VIH	VCCIO=1.8-2.0V	0.8×VCCIO	-	VCCIO	V	RESETB
	VIL		0	-	0.2×VCCIO	V	
Operating Current	IDD	fDSICLK=150 MHz	-	TBD	TBD	mA	VDD
	ICCIO	Color bar display	-	TBD	TBD	mA	VCCIO
Sleep_mode Current	IDDS	Clock/Data=LP11	-	TBD	TBD	uA	VDD
	ICCIOS	Sleep_mode	-	(10)	TBD	uA	VCCIO
Output Signal Voltage	VOH	VCCIO=1.8-2.0V	0.8×VCCIO	-	VCCIO	V	PWM
	VOL	IOH/L=+/- 1mA	0	-	0.2×VCCIO	V	

7.1.2 MIPI DSI Interface

Item		Symbol	Condition	Rating			Unit	Note
				MIN	TYP	MAX		
HS-RX	Differential input high threshold	VIDTH		-	-	70	mV	
	Differential input low threshold	VIDTL		-70	-	-	mV	
	Single-ended input high voltage	VIHHS		-	-	460	mV	
	Single-ended input low voltage	VILHS		-40	-	-	mV	
	Common-mode voltage HS receive mode	VCMRXDC		70	-	330	mV	
	Differential input impedance	ZID		80	100	125	Ohm	
LP-RX	Logic 1 input voltage	VIH		880	-	-	mV	
	Logic 0 input voltage	VIL		-	-	550	mV	
LP-TX	Thevenin output low level	VOL		-50	-	50	mV	
	Thevenin output high level	VOH		1.1	1.2	1.3	V	
	Output impedance of LP transmitter	ZOLP		110	-	-	Ohm	
CD-RX	Logic 1 contention threshold	VIHCD		450	-	-	mV	
	Logic 0 contention threshold	VILCD		-	-	200	mV	

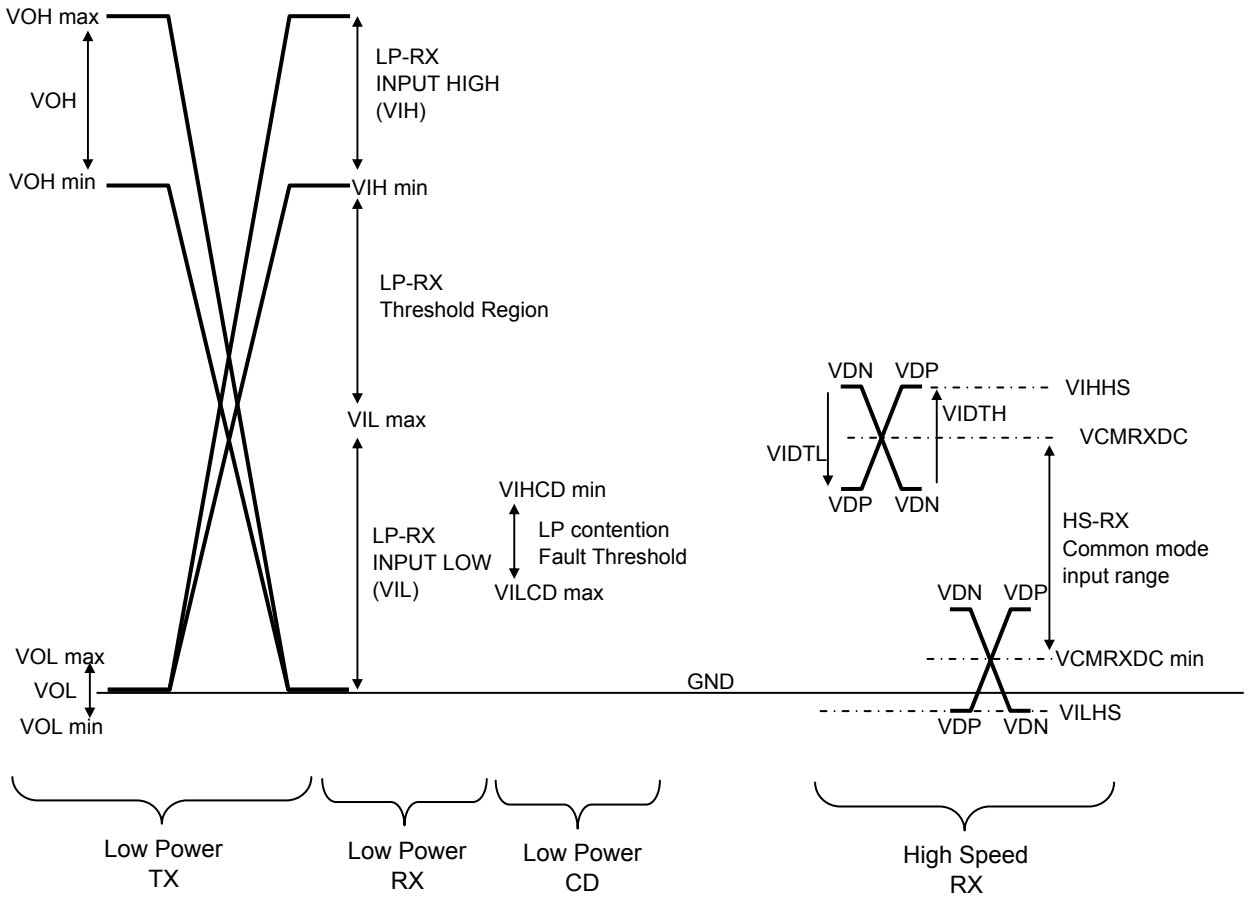


Fig.A The signal levels for the LP and HS .

7.1.3 Backlight

Item	Symbol	Condition	Rating			Unit	Applicable terminal
			MIN	TYP	MAX		
Forward current	IL25	Ta=25 ℃	--	(10)	35	mA	LED+ - LED-
	IL70	Ta=70 ℃	--	--	15	mA	
Forward voltage	VL	Ta=25 ℃ IL=10mA	--	(22.8)	(25.2)	V	
Estimated Life of LED	LL	Ta=25 ℃ IL=10mA Note	--	TBD	--	hrs	

Note: - The lifetime of the LED is defined as a period till the brightness of the LED decreases to the half of its initial value.
- This figure is given as a reference purpose only, and not as a guarantee.
- This figure is estimated for an LED operating alone.
As the performance of an LED may differ when assembled as a monitor 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

7.2.1 HS-RX Specifications

(Unless otherwise noted, Ta=25 °C,VDD=2.9V,VCCIO=1.9V,GND=0V)

Item	Symbol	Condition	Rating			Unit	Applicable terminal
			MIN	TYP	MAX		
DSICLK Frequency	f DSICLK	Fig.B	40	-	250	MHz	CP/N
DSICLK Cycle time	TCLKP		4.0	-	25.0	ns	
DSI Data Transfer Rate	UI		2.0	-	12.5	ns	D0P/N,D1P/N
	t DSIR		80	-	500	Mbps	D2P/N,D3P/N
Data to Clock Setup Time	Tsetup		0.15	-	-	UI	D0P/N,D1P/N
Clock to Data Hold Time	Thold		0.15	-	-	UI	D2P/N,D3P/N,CP/N

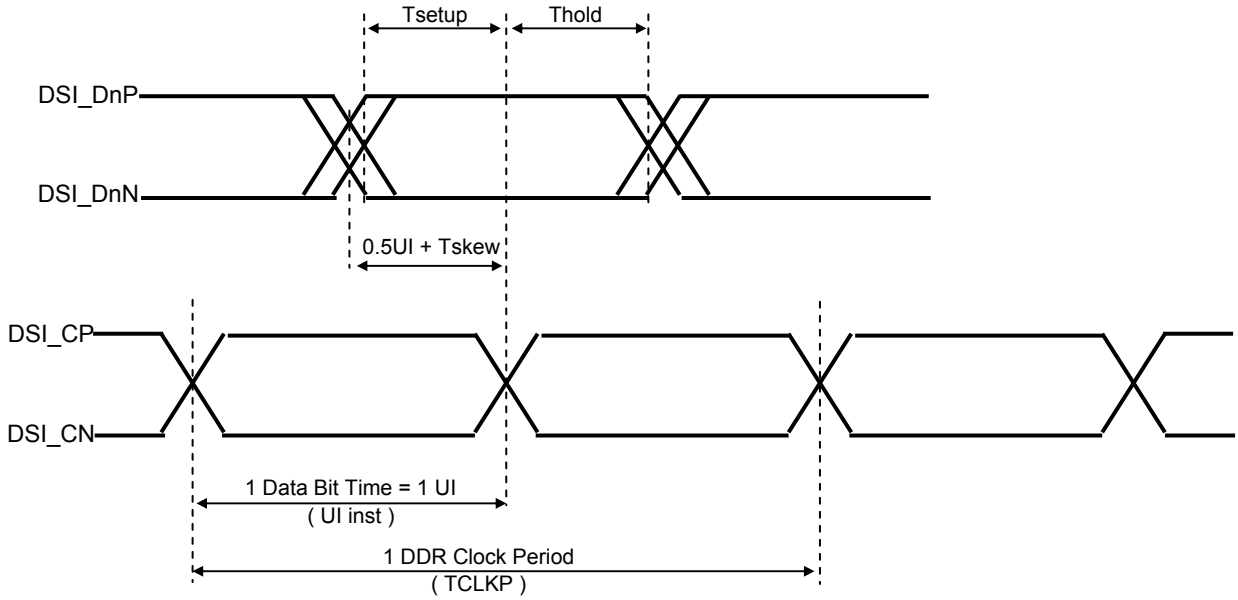


Fig.B Data to Clock Timing Definitions

7.2.2 LP-TX Specifications

(Unless otherwise noted, Ta=25 °C,VDD=3.3V,VCCIO=1.8V,GND=0V)

Item	Symbol	Condition	Rating			Unit	Applicable terminal
			MIN	TYP	MAX		
15% - 85% rise time	TRLP		-	-	25	ns	D0P/N
85% - 15% fall time	TFLP		-	-	25	ns	
Slew rate	ΔV / ⊿tSR	Cload = 70pF	-	-	150	mV/ns	

7.2.3 RX/TX Specifications

(Unless otherwise noted, Ta=25 °C,VDD=2.9V,VCCIO=1.9V,GND=0V)

Item	Description	Rating			Unit
		MIN	TYP	MAX	
$T_{HS-PREPARE}$	Time to drive LP00 to prepare for HS transmission	40 ns + 4UI	-	85 ns + 6UI ≦ 100 ns	
$T_{HS-PREPARE} + T_{HS-ZERO}$	$T_{HS-PREPARE}$ + Time to drive HS0 before the SYNC sequence	145 ns +10UI	-	-	
$T_{HS-TRAIL}$	Time to drive flipped differential state after last payload data bit of a HS transmission burst	max(n*8UI,60 ns+n*4UI)	-	-	
$T_{HS-EXIT}$	Time to drive LP11 after HS burst	100	-	-	ns
T_{TA-GO}	Time to drive LP00 after Tumaround Request	$4*T_{LPTX}$			
$T_{TA-SURE}$	Time out before new TX side starts driving	TLPTX	-	$2*T_{LPTX}$	
T_{TA-GET}	Time to drive LP00 by new TX	$5*T_{LPTX}$			
T_{LPX}	Length of any Low Power state period	50	-	-	ns
Ratio T_{LPX}	Ratio of T_{LPX}(MASTER)/T_{LPX}(SLAVE) between Master and Slave side	2/3	-	3/2	
$T_{CLK-POST}$	Time that the transmitter shall continue sending HS clock after the last associated Data Lane has transitioned to LP mode	60 ns + 52UI	-	-	
$T_{CLK-PREPARE} + T_{CLK-ZERO}$	$T_{CLK-PREPARE}$ +time for lead HS-0 drive period before starting Clock	300	-	-	ns
$T_{CLK-PRE}$	Time that the HS clock shall be driven prior to any associated Data Lane beginning the transition from LP to HS mode	8	-	-	UI
$T_{CLK-PREPARE}$	Time to drive LP-00 to prepare for HS clock transmission	38	-	95	ns
$T_{CLK-TRAIL}$	Time to drive HS differential state after last payload clock bit of a HS transmission burst	60	-	-	ns
T_{EOT}	Time from start of THS-TRAIL period to start of LP-11 state	-	-	105 ns + n*12UI	
T_{LPTX1}	Length of Low-Power TX state period in case of using DSI clock	-	n*DSITX	-	UI
T_{LPTX2}	Length of Low-Power TX state period in case of using internal OSC clock	-	1/fosc	-	ns

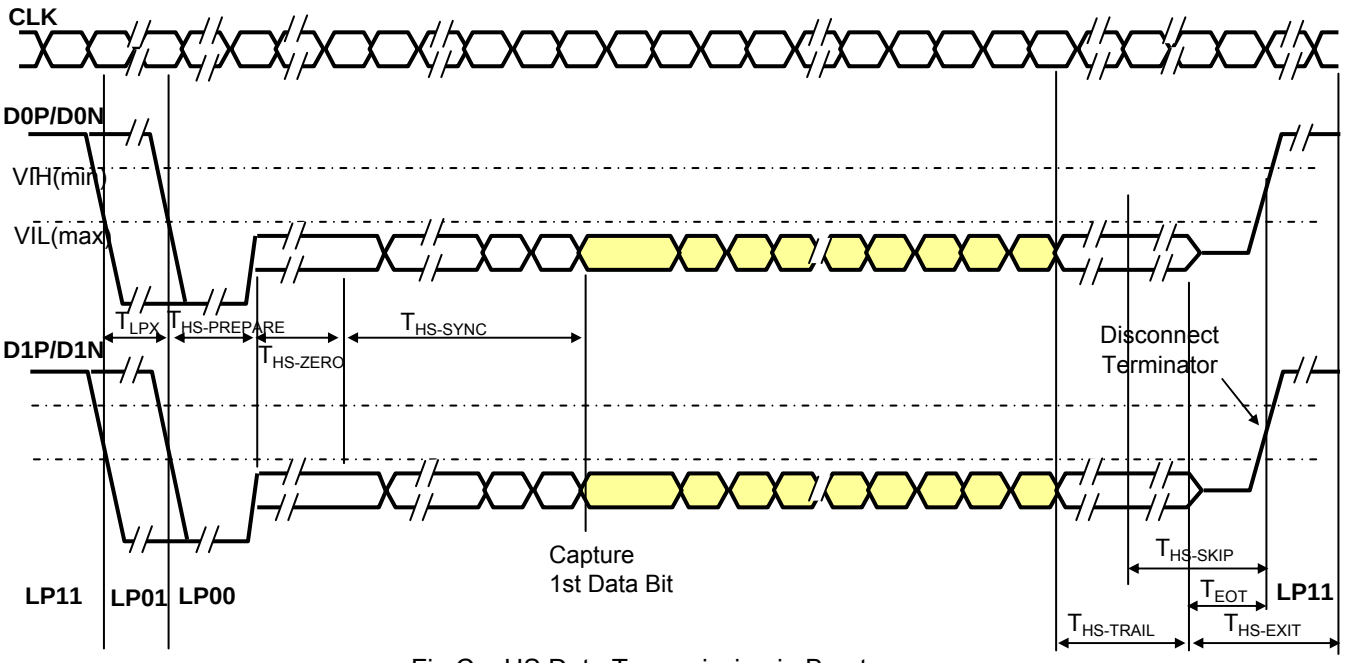


Fig.C HS Data Transmission in Bursts

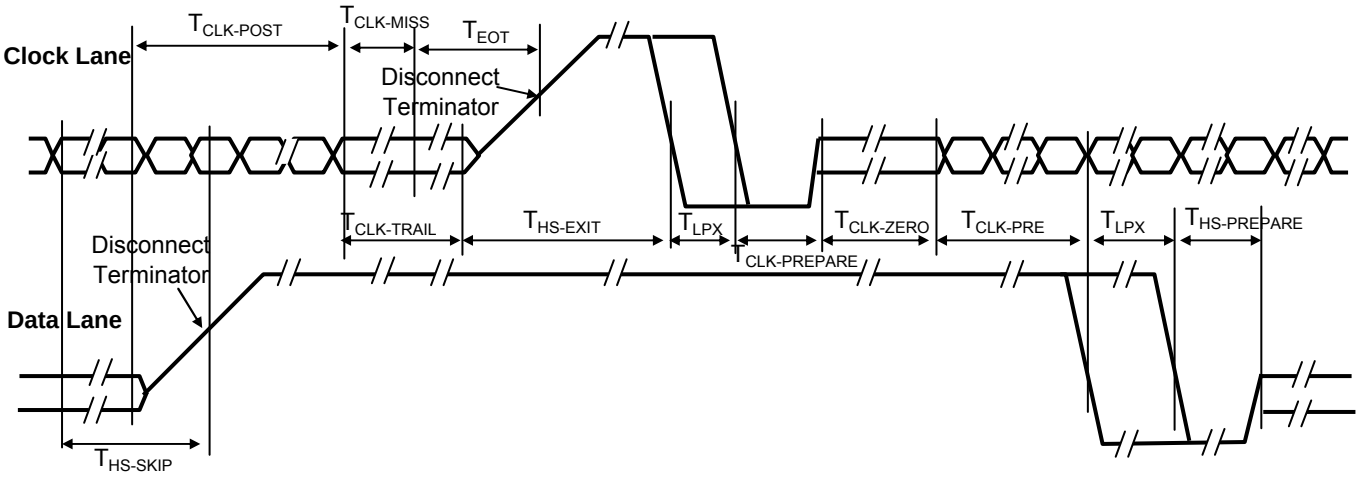


Fig.D Switching the Clock Lane between Clock Transmission and LP mode

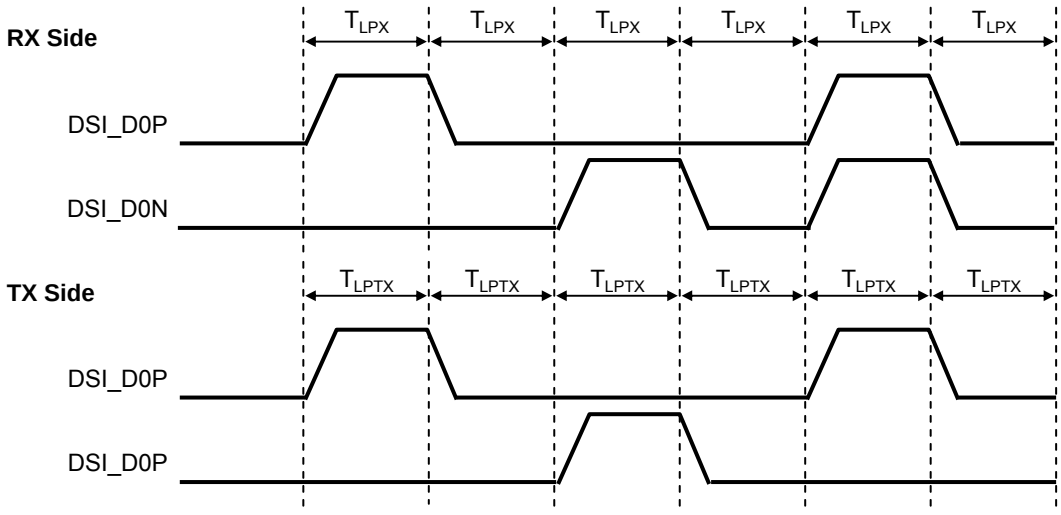


Fig.E DSI LP Mode

7.2.4 Reset input timing

Item	Symbol	Condition	Rating			Unit	Remark
			MIN	TYP	MAX		
Reset Low Pulse width	tRESW		20	-	-	us	
Reset Complete time	tREST	during Sleep In	10	-	-	ms	
		during Sleep Out	120	-	-	ms	

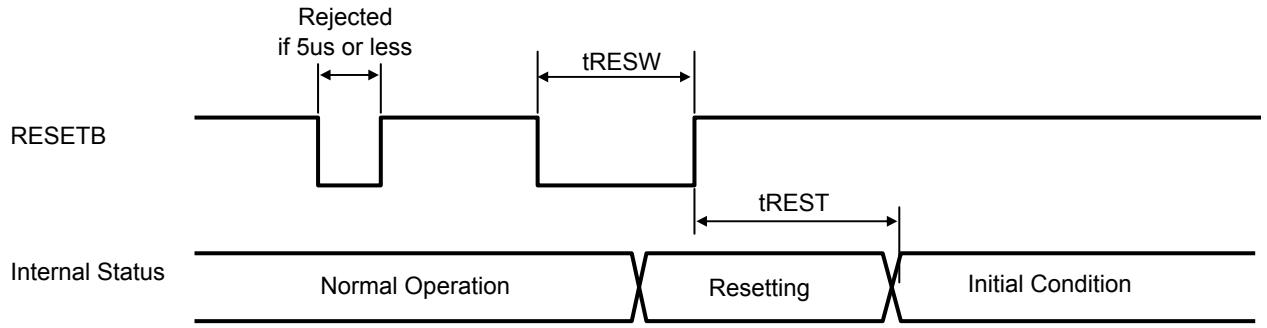


Fig.F RESETB input timing

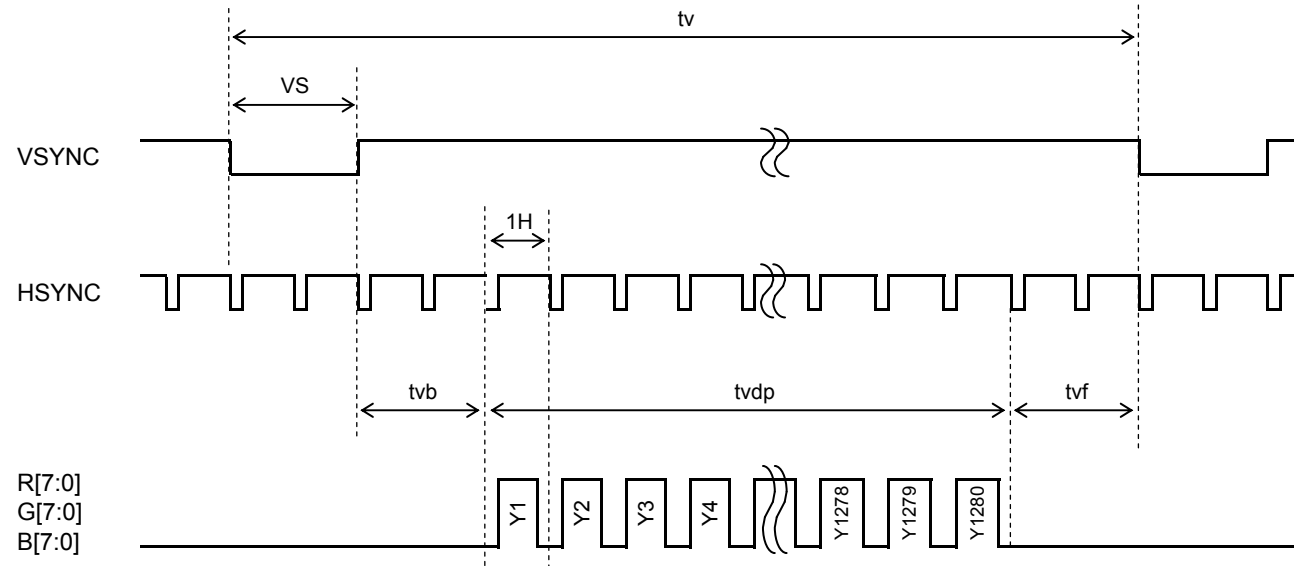
7.3 Input Timing Characteristics

Item	Symbol	Condition	Rating			Unit	Remark
			MIN	TYP	MAX		
CLK Frequency	fPCLK	Fig.G	62.5	67.3	-	MHz	PCLK
VSYNC Frequency Note	fVSYNC		54	58.1	66	Hz	VSYNC
VSYNC Cycle	tv		1292	1292	-	H	
VSYNC Pulse Width	VS		3	3	-	H	
Vertical Back Porch	tvb		3	3	-	H	
Vertical Front Porch	tvf		6	6	-	H	
Vertical data start Point	VS+tvb		6	6	-	H	
Vertical Blanking Period	VS+tvb+tvf		12	12	-	H	
Vertical Display Period	tvdp		--	1280	--	H	
HSYNC frequency	fHSYNC		69.8	75.1	-	kHz	HSYNC
HSYNC Cycle	th		-	896	-	CLK	
HSYNC Pulse Width	HS		-	15	-	CLK	
Horizontal Back Porch	thb		-	70	-	CLK	
Horizontal Front Porch	thf		-	91	-	CLK	
Horizontal data start Point	HS+thb		-	85	-	CLK	
Horizontal Blanking Period	HS+thb+thf		-	176	-	CLK	
Horizontal Display Period	thdp		-	720	-	CLK	

Note: This is recommended spec to get high quality picture on display. It is customer's risk to use out of this frequency.

7.4 Input Signal Timing Chart

-Vertical Timing



-Horizontal Timing

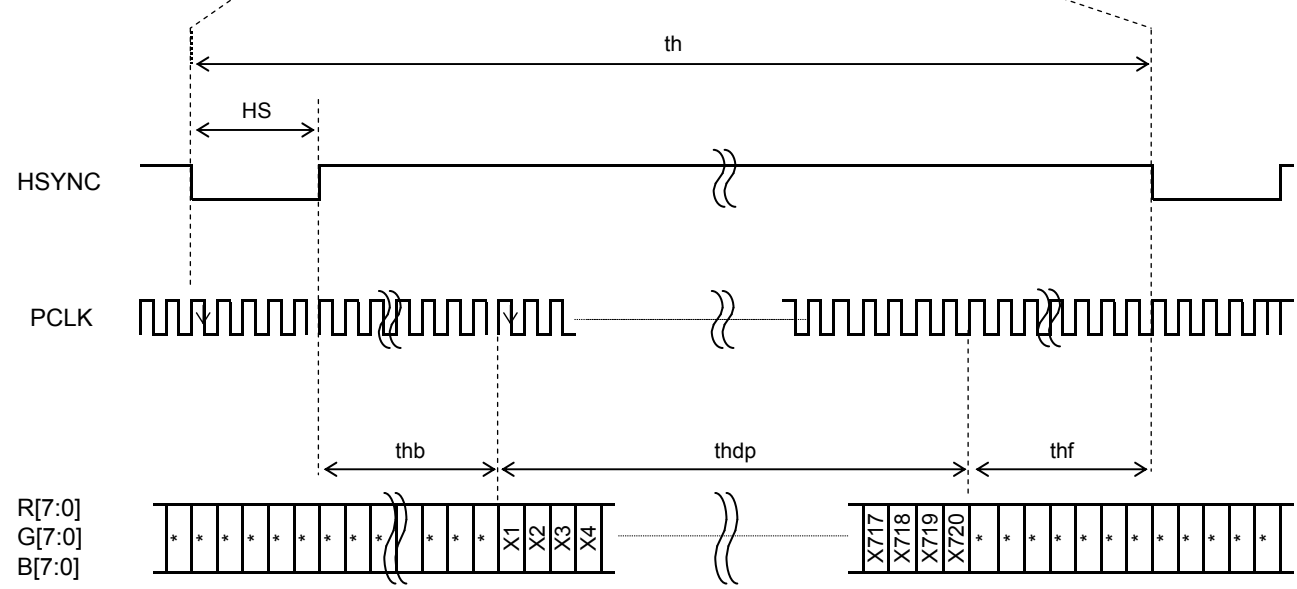


Fig.G Timing Characteristics of input signals

8. About MIPI Interface

8.1 Version

The DSI incorporated in the LCD-Driver complies with the following standards.

MIPI DSI : Version 1.02

MIPI D-PHY : Version 1.00

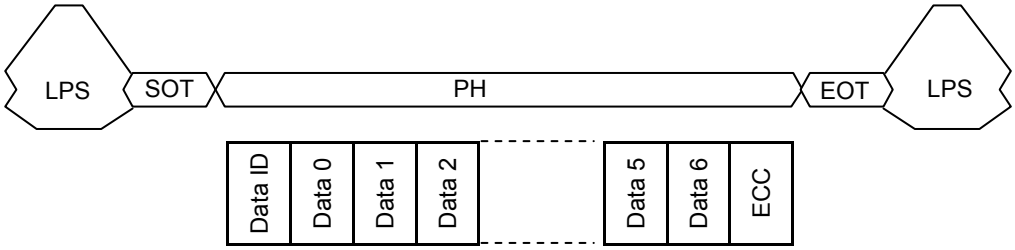
Data transfer mode : Video mode only.

It is recommended to turn DSI_CLK OFF (LP 00) during the blanking period.

Virtual Channel : Set to VC[1:0]=00.

8.2 DSI protocol

- Short packets specify the payload length using the Data Type field and are from 2 to 9 bytes in length. Short packets is used for most Command Mode commands and associated parameters.



LPS : Low power state

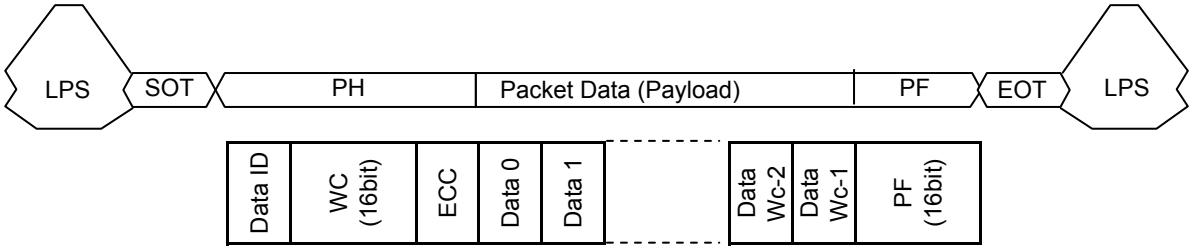
SOT : Start of Transmission

PH : Packet Header

DI(Data ID) : Contain Virtual Channel Identifier and Data Type

ECC : Error Correction Code

- Long packets specify the payload length using a two-byte Word Count field and then the payload maybe 0 to 65,541 bytes in length. Long packets permit transmission of large blocks of pixel or other data.



LPS : Low power state

SOT : Start of Transmission

PH : Packet Header

DI(Data ID) : Contain Virtual Channel Identifier and Data Type

WC(Word Count) : The receiver use WC to define packet end.

ECC : Error Correction Code

PF(Packet Footer) : Mean 16-bit Checksum.

8.3 Packet data types

LCD-Driver has the following restriction.

Generic short / Long Write Cmd is not supported.

It is only DCS Short / Long Write Cmd.

Processor to peripheral direction

Data Type Hex	Description	Size
01 h	Sync Event , V Sync Start (01,00,00,07)	Short
11 h	Sync Event , V Sync End (11,00,00,14)	Short
21 h	Sync Event , H Sync Start (21,00,00,12)	Short
31 h	Sync Event , H Sync End (31,00,00,01)	Short
22 h	Shut Down Peripheral Command (22,00,00,1E)	Short
32 h	Turn On Peripheral Command (32,00,00,0D)	Short
05 h	DCS WRITE , no parameters	Short
15 h	DCS WRITE , one parameters	Short
06 h	DCS READ , no parameters	Short
37 h	Set Maximum Return Packet Size	Short
08 h	End of Transmission Packet (08,0F,0F,01)	Short
09 h	Null Packet , no data	Long
19 h	Blanking Packet , no data	Long
39 h	DCS Long Write Command Packet	Long
0E h	Packed Pixel Stream , 16-bit RGB , 5-6-5 Format	Long
1E h	Packed Pixel Stream , 18-bit RGB , 6-6-6 Format	Long
2E h	Loosely Packed Pixel Stream , 18-bit RGB ,6-6-6 Format	Long
3E h	Packed Pixel Stream , 24-bit RGB , 8-8-8 Format	Long

Peripheral to processor direction

Data Type Hex	Description	Size
02 h	Acknowledge with Error Report	Short
1C h	DCS Long READ Response	Long

8.4 Packet Footer on the long packet

After Packet Data, Packet Footer is added in Long packet. Packet Footer adds CRC calculated from Packet Data as Checksum.

Checksum(2byte) = CRC(Packet Data)

CRC = X^16 + X^12 + X^5 + X^0

9.Sequence

PH :Packet Header
PD :Packet Data
PF:Packet Footer (=Checksum)

9.1 Power-ON Sequence

0		Function	DNC	Command /Parameter	Type	Command/Parameter
	Power on	VDD, VCCIO On				
	Wait	wait 1 msec or more				
	MIPI signal state	Keep CLKN/P, D0N/P, D1N/P D2N/P,D3N/P in STOP state LP-11 (Must be set to LP-11 is all lanes of MIPI before rising edge of RESX.)				
	H/W RESET	RESETB=1				
		RESETB=0 (Keep 10usec or more)				
		RESETB=1				
	Wait	wait 10 msec or more				
1	SETEXTC	Set extension command	0	B9h	PH	[39 04 00 2C]
		Parameter 1	1	FFh	PD	[B9 FF 83 94]
		Parameter 2	1	83h	PF	[XX XX]
		Parameter 3	1	94h		
2	SETPOWER	Set power	0	B1h	PH	[39, 11, 00, 33]
		Parameter 1	1	7Ch	PD	[B1 7C 00 24 06 01 10 10 26 2E 1D 1D 57 12 01 E6 E2]
		Parameter 2	1	00h		
		Parameter 3	1	24h	PF	[XX XX]
		Parameter 4	1	06h		
		Parameter 5	1	01h		
		Parameter 6	1	10h		
		Parameter 7	1	10h		
		Parameter 8	1	26h		
		Parameter 9	1	2Eh		
		Parameter 10	1	1Dh		
		Parameter 11	1	1Dh		
		Parameter 12	1	57h		
		Parameter 13	1	12h		
		Parameter 14	1	01h		
		Parameter 15	1	E6h		
		Parameter 16	1	E2h		
3	SETDISP	Setdisp	0	B2h	PH	[39, 07, 00, 2A]
		Parameter 1	1	00h	PD	[B2 00 C8 04 04 00 22]
		Parameter 2	1	C8h		
		Parameter 3	1	04h	PF	[XX XX]
		Parameter 4	1	04h		
		Parameter 5	1	00h		
		Parameter 6	1	22h		
4	INVOFF	Exit_inversion_mode	0	20h	PH	[05 20 00 23]
5	MADCTL	Set_address_mode	0	36h	PH	[15 36 00 29]
		Parameter 1	1	00h		
6	COLMOD	Set_pixel_format	0	3Ah	PH	[15 3A 70 28]
		Parameter 1(24bit/pixel)	1	70h		
7	SETCYC	Set display waveform cycle	0	B4h	PH	[39 1F 00 29]
		Parameter 1	1	00h	PD	[B4 00 04 32 10 00 32 15 05 32 10 08 27 01 43 03 37 01 43 01 61 61 01 01 43 01 43 01 61 61 01]
		Parameter 2	1	04h		
		Parameter 3	1	32h		
		Parameter 4	1	10h	PF	[XX XX]
		Parameter 5	1	00h		
		Parameter 6	1	32h		
		Parameter 7	1	15h		
		Parameter 8	1	05h		
		Parameter 9	1	32h		
		Parameter 10	1	10h		
		Parameter 11	1	08h		
		Parameter 12	1	27h		
		Parameter 13	1	01h		
		Parameter 14	1	43h		
		Parameter 15	1	03h		
		Parameter 16	1	37h		
		Parameter 17	1	01h		
		Parameter 18	1	43h		

No.		Function	DNC	Command /Parameter	Type	Command/Parameter
		Parameter 19	1	01h		
		Parameter 20	1	61h		
		Parameter 21	1	61h		
		Parameter 22	1	01h		
		Parameter 23	1	01h		
		Parameter 24	1	43h		
		Parameter 25	1	01h		
		Parameter 26	1	43h		
		Parameter 27	1	01h		
		Parameter 28	1	61h		
		Parameter 29	1	61h		
		Parameter 30	1	01h		
8	Not open		0	BFh	PH	[39, 05, 00, 36]
		Parameter 1	1	06h	PD	[BF 06 02 10 04]
		Parameter 2	1	02h		
		Parameter 3	1	10h	PF	[XX XX]
		Parameter 4	1	04h		
9	Not open		0	C7h	PH	[39, 05, 00, 36]
		Parameter 1	1	00h	PD	[C7 00 10 00 10]
		Parameter 2	1	10h		
		Parameter 3	1	00h	PF	[XX XX]
		Parameter 4	1	10h		
10	Not open		0	C6h	PH	[39, 03, 00, 09]
		Parameter 1	1	08h	PD	[C6 08 08]
		Parameter 2	1	08h		
					PF	[XX XX]
11	Not open		0	C0h	PH	[39, 03, 00, 09]
		Parameter 1	1	0Ch	PD	[C0 0C 15]
		Parameter 2	1	15h		
					PF	[XX XX]
12	SETGIP	Set GIP	0	D5h	PH	[39 21 00 3C]
		Parameter 1	1	00h	PD	[D5 00 00 04 00 0A 00 01 33 00 00 33 00 10 32 54 76 10 32 88 88 88 88 88 88 88 99 99 99 54 76 88 88]
		Parameter 2	1	00h		
		Parameter 3	1	04h		
		Parameter 4	1	00h	PF	[XX XX]
		Parameter 5	1	0Ah		
		Parameter 6	1	00h		
		Parameter 7	1	01h		
		Parameter 8	1	33h		
		Parameter 9	1	00h		
		Parameter 10	1	00h		
		Parameter 11	1	33h		
		Parameter 12	1	00h		
		Parameter 13	1	10h		
		Parameter 14	1	32h		
		Parameter 15	1	54h		
		Parameter 16	1	76h		
		Parameter 17	1	10h		
		Parameter 18	1	32h		
		Parameter 19	1	88h		
		Parameter 20	1	88h		
		Parameter 21	1	88h		
		Parameter 22	1	88h		
		Parameter 23	1	88h		
		Parameter 24	1	88h		
		Parameter 25	1	88h		
		Parameter 26	1	99h		
		Parameter 27	1	99h		
		Parameter 28	1	99h		
		Parameter 29	1	54h		
		Parameter 30	1	76h		
		Parameter 31	1	88h		
		Parameter 32	1	88h		

No.		Function	DNC	Command /Parameter	Type	Command/Parameter
13	SETDGC	Set Digital Gamma Correction setting	0	C1h	PH	[39 80 00 23]
		Parameter 1	1	01h	PD	[C1 01 00 06 0E 16 1E 26 2E 36 3E 46 4E 56 5E 66 6E 76 7E 86 8E 96 9E A6 AE B6 BE C6 CE D6 DE E6 EE F6 FE 00 00 00 00 00 00 00 00 00 03 0B 13 1B 23 2B 33 3B 43 4B 53 5B 63 6B 73 7B 83 8B 93 9B A3 AB B3 BB C3 CB D3 DB E3 EB F3 FB 00 00 00 00 00 00 00 00]
		Parameter 2	1	00h		
		Parameter 3	1	06h		
		Parameter 4	1	0Eh		
		Parameter 5	1	16h		
		Parameter 6	1	1Eh		
		Parameter 7	1	26h		
		Parameter 8	1	2Eh		
		Parameter 9	1	36h		
		Parameter 10	1	3Eh		
		Parameter 11	1	46h		
		Parameter 12	1	4Eh		
		Parameter 13	1	56h		
		Parameter 14	1	5Eh		
		Parameter 15	1	66h		
		Parameter 16	1	6Eh	PF	[XX XX]
		Parameter 17	1	76h		
		Parameter 18	1	7Eh		
		Parameter 19	1	86h		
		Parameter 20	1	8Eh		
		Parameter 21	1	96h		
		Parameter 22	1	9Eh		
		Parameter 23	1	A6h		
		Parameter 24	1	AEh		
		Parameter 25	1	B6h		
		Parameter 26	1	BEh		
		Parameter 27	1	C6h		
		Parameter 28	1	CEh		
		Parameter 29	1	D6h		
		Parameter 30	1	DEh		
		Parameter 31	1	E6h		
		Parameter 32	1	EEh		
		Parameter 33	1	F6h		
		Parameter 34	1	FEh		
		Parameter 35	1	00h		
		Parameter 36	1	00h		
		Parameter 37	1	00h		
		Parameter 38	1	00h		
		Parameter 39	1	00h		
		Parameter 40	1	00h		
		Parameter 41	1	00h		
		Parameter 42	1	00h		
		Parameter 43	1	00h		
		Parameter 44	1	00h		
		Parameter 45	1	03h		
		Parameter 46	1	0Bh		
		Parameter 47	1	13h		
		Parameter 48	1	1Bh		
		Parameter 49	1	23h		
		Parameter 50	1	2Bh		
		Parameter 51	1	33h		
		Parameter 52	1	3Bh		
		Parameter 53	1	43h		
		Parameter 54	1	4Bh		
		Parameter 55	1	53h		
		Parameter 56	1	5Bh		
		Parameter 57	1	63h		
		Parameter 58	1	6Bh		
		Parameter 59	1	73h		
		Parameter 60	1	7Bh		
		Parameter 61	1	83h		

No.		Function	DNC	Command /Parameter	Type	Command/Parameter
		Parameter 62	1	8Bh		
		Parameter 63	1	93h		
		Parameter 64	1	9Bh		
		Parameter 65	1	A3h		
		Parameter 66	1	ABh		
		Parameter 67	1	B3h		
		Parameter 68	1	BBh		
		Parameter 69	1	C3h		
		Parameter 70	1	CBh		
		Parameter 71	1	D3h		
		Parameter 72	1	DBh		
		Parameter 73	1	E3h		
		Parameter 74	1	EBh		
		Parameter 75	1	F3h		
		Parameter 76	1	FBh		
		Parameter 77	1	00h		
		Parameter 78	1	00h		
		Parameter 79	1	00h		
		Parameter 80	1	00h		
		Parameter 81	1	00h		
		Parameter 82	1	00h		
		Parameter 83	1	00h		
		Parameter 84	1	00h		
		Parameter 85	1	00h		
		Parameter 86	1	00h		
		Parameter 87	1	00h		
		Parameter 88	1	08h		
		Parameter 89	1	10h		
		Parameter 90	1	18h		
		Parameter 91	1	1Eh		
		Parameter 92	1	26h		
		Parameter 93	1	2Eh		
		Parameter 94	1	36h		
		Parameter 95	1	3Eh		
		Parameter 96	1	46h		
		Parameter 97	1	4Eh		
		Parameter 98	1	56h		
		Parameter 99	1	5Eh		
		Parameter 100	1	66h		
		Parameter 101	1	6Eh		
		Parameter 102	1	76h		
		Parameter 103	1	7Eh		
		Parameter 104	1	86h		
		Parameter 105	1	8Eh		
		Parameter 106	1	96h		
		Parameter 107	1	9Eh		
		Parameter 108	1	A6h		
		Parameter 109	1	AEh		
		Parameter 110	1	B6h		
		Parameter 111	1	BEh		
		Parameter 112	1	C6h		
		Parameter 113	1	CEh		
		Parameter 114	1	D6h		
		Parameter 115	1	DEh		
		Parameter 116	1	E6h		
		Parameter 117	1	EDh		
		Parameter 118	1	F5h		
		Parameter 119	1	00h		
		Parameter 120	1	00h		
		Parameter 121	1	00h		
		Parameter 122	1	00h		
		Parameter 123	1	00h		
		Parameter 124	1	00h		
		Parameter 125	1	00h		
		Parameter 126	1	00h		
		Parameter 127	1	00h		

No.		Function	DNC	Command /Parameter	Type	Command/Parameter
14	SETGAMMA	Set gamma curve related setting	0	E0h	PH	[39 2B 00 05]
		Parameter 1	1	00h	PD	[E0 00 00 00 12 1D 34 13 2A 04 0C 12 16 19 16 16 0E 11 00 00 00 18 24 3F 16 2C 04 0D 10 16 18 16 16 10 11 07 16 06 0F 08 16 07 10]
		Parameter 2	1	00h		
		Parameter 3	1	00h		
		Parameter 4	1	12h		
		Parameter 5	1	1Dh	PF	[XX XX]
		Parameter 6	1	34h		
		Parameter 7	1	13h		
		Parameter 8	1	2Ah		
		Parameter 9	1	04h		
		Parameter 10	1	0Ch		
		Parameter 11	1	12h		
		Parameter 12	1	16h		
		Parameter 13	1	19h		
		Parameter 14	1	16h		
		Parameter 15	1	16h		
		Parameter 16	1	0Eh		
		Parameter 17	1	11h		
		Parameter 18	1	00h		
		Parameter 19	1	00h		
		Parameter 20	1	00h		
		Parameter 21	1	18h		
		Parameter 22	1	24h		
		Parameter 23	1	3Fh		
		Parameter 24	1	16h		
		Parameter 25	1	2Ch		
		Parameter 26	1	04h		
		Parameter 27	1	0Dh		
		Parameter 28	1	10h		
		Parameter 29	1	16h		
		Parameter 30	1	18h		
		Parameter 31	1	16h		
		Parameter 32	1	16h		
		Parameter 33	1	10h		
		Parameter 34	1	11h		
		Parameter 35	1	07h		
		Parameter 36	1	16h		
		Parameter 37	1	06h		
		Parameter 38	1	0Fh		
		Parameter 39	1	08h		
		Parameter 40	1	16h		
		Parameter 41	1	07h		
		Parameter 42	1	10h		
15	SETCABC	Set CABC Control (PWM=35kHz)	0	C9h	PH	[39 0A 00 36]
		Parameter 1	1	0Fh	PD	[C9 0F 00 1E 1E 00 00 00 01 3E]
		Parameter 2	1	00h		
		Parameter 3	1	1Eh		
		Parameter 4	1	1Eh		
		Parameter 5	1	00h	PF	[XX XX]
		Parameter 6	1	00h		
		Parameter 7	1	00h		
		Parameter 8	1	01h		
		Parameter 9	1	3Eh		
16	WRDISBV	Write display brightness	0	51h	PH	[15 51 FF 3C]
		Parameter 1(255/255)	1	FFh		
17	WRCTRLD	Write CTRL display(PWM OFF)	0	53h	PH	[15 53 00 13]
		Parameter 1	1	00h		
18	SETVDC	SETVDC	0	BCh	PH	[15 BC 07 0B]
		Parameter 1	1	07h		
	Wait	wait 5 msec or more				
19	SETPANEL	Set panel	0	CCh	PH	[15 CC 09 10]
		Parameter 1	1	09h		
	Wait	wait 50 msec or more				
20	SETMIPI	Set_MIPI_control	0	BAh	PH	[15 BA 03 00]
		Parameter 1(4 lane)	1	03h		
21	SLEEP OUT	Sleep out	0	11h	PH	[05 11 00 36]
	Wait	wait 200 msec or more				
22	DISPON	Display on	1	29h	PH	[05 29 00 1C]
	Wait	wait 50 msec or more				
23	Video stream					

PH :Packet Header
PD :Packet Data
PF:Packet Footer (=Checksum)

9.2 Power-OFF Sequence

No.		Function	DNC	Command /Parameter	Type	Command/Parameter
1	DISPOFF	Display off	0	28h	PH	[05 28 00 06]
2	SLPIN	Sleep in	0	10h	PH	[05 10 00 2C]
	Wait	wait 120 msec or more				
3	Video signals	Video signals stop				

Power off

9.3 Sleep Sequence

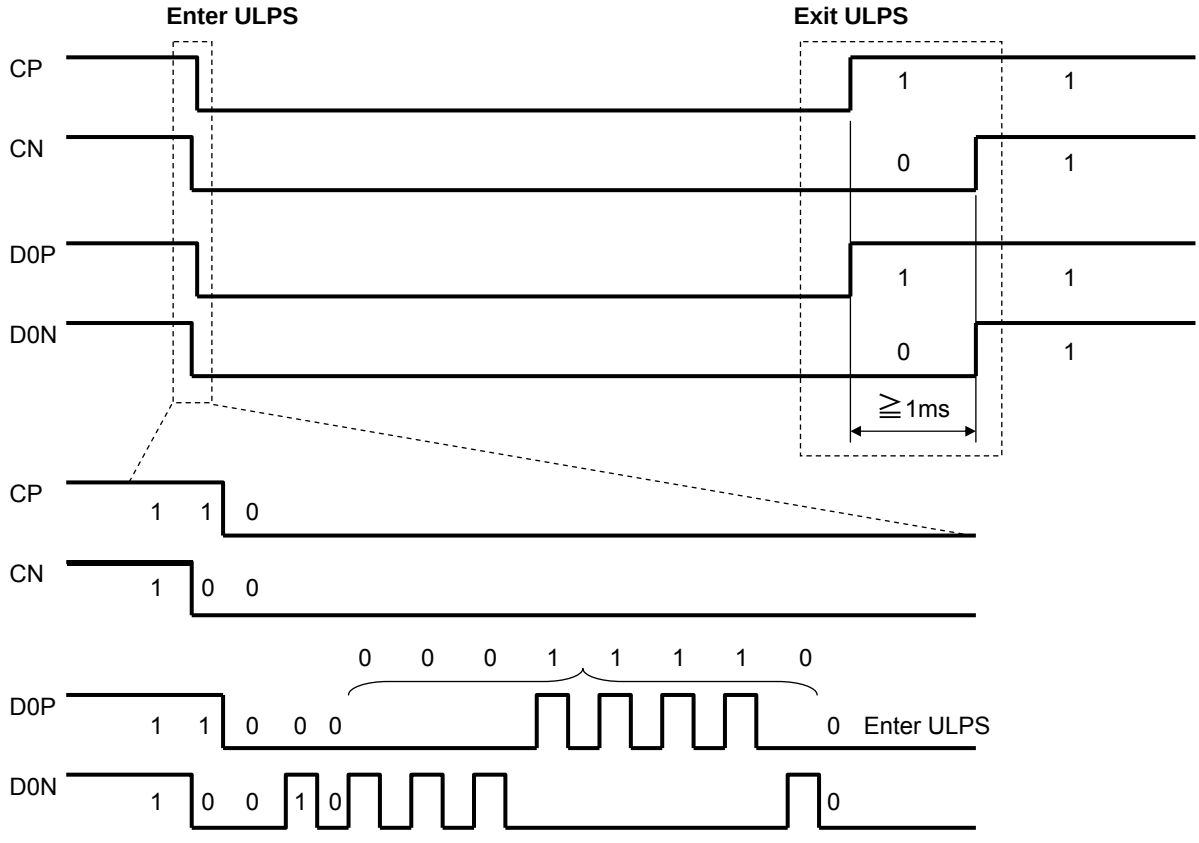
No.		Function	DNC	Command /Parameter	Type	Command/Parameter
1	SLPIN	Sleep in	0	10h	PH	[05 10 00 2C]
	Wait	wait 120 msec or more				
2	Video signals	Video signals stop				

9.4 Sleep Release Sequence

No.		Function	DNC	Command /Parameter	Type	Command/Parameter
1	Video signals	Video signals start				
	Wait	wait 120 msec or more				
2	SLPOUT	Sleep out	0	11h	PH	[05 11 00 36]

9.5 ULPS (Ultra-low power state) Enter/Exit Sequence

Lane	Mode	Sequence
D0P,D0N	Enter ULPS	LP11 → LP10 → LP00 → LP01 → LP00 → (78h) → LP00(ULPS)
	Exit ULPS	LP10 (keeps for at least 1 ms) → LP11
CP,CN	Enter ULPS	LP11 → LP10 → LP00(ULPS)
	Exit ULPS	LP10 (keeps for at least 1 ms) → LP11

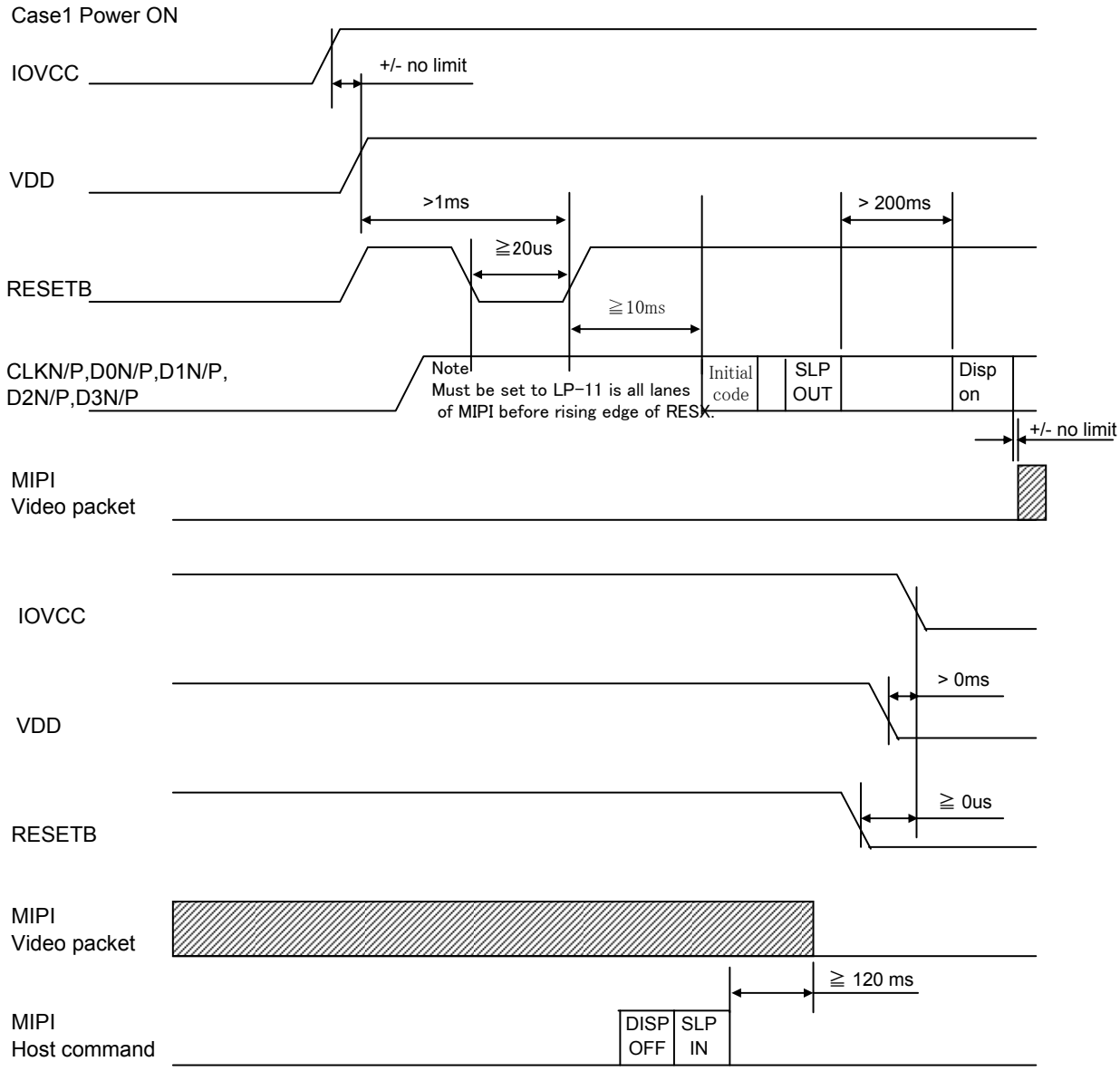


9.6. External Power on/off Sequence

VDD and IOVCC can be applied in any order.
VDD and IOVCC can be powered down in any order.

Case 1. RESX line is held high or unstable by host at power on

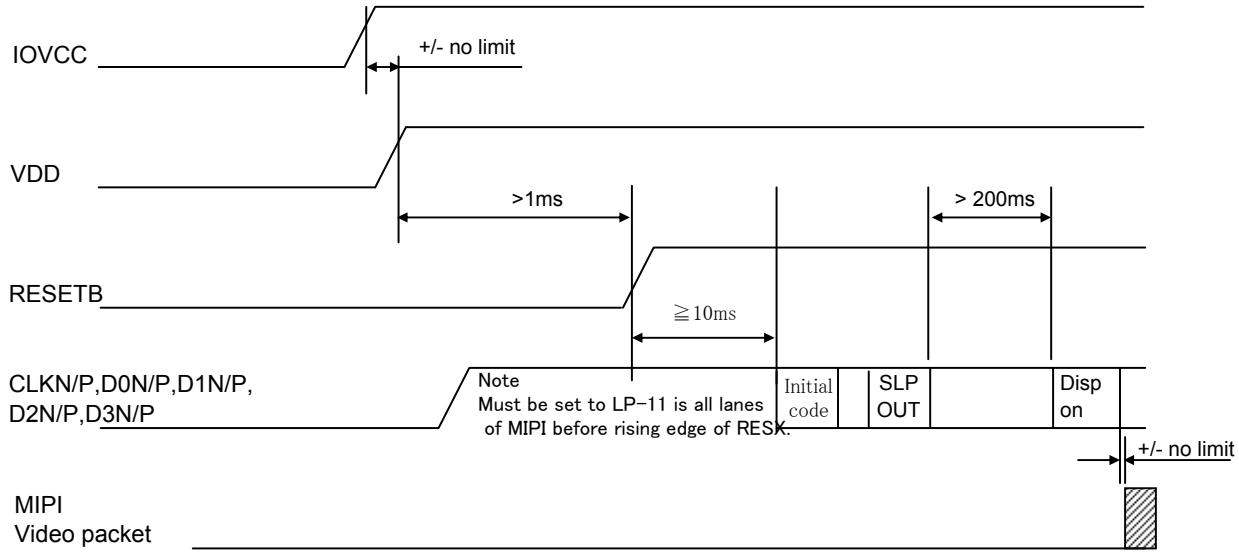
If RESX line is held high or unstable by the host during power on, then a Hardware Reset must be applied after both IOVCC and VCC have been applied-otherwise correct functionality is not guaranteed. There is no timing restriction upon this hardware reset.
And, before the rising edge of RESX, must be set to LP-11 all lanes of MIPI.



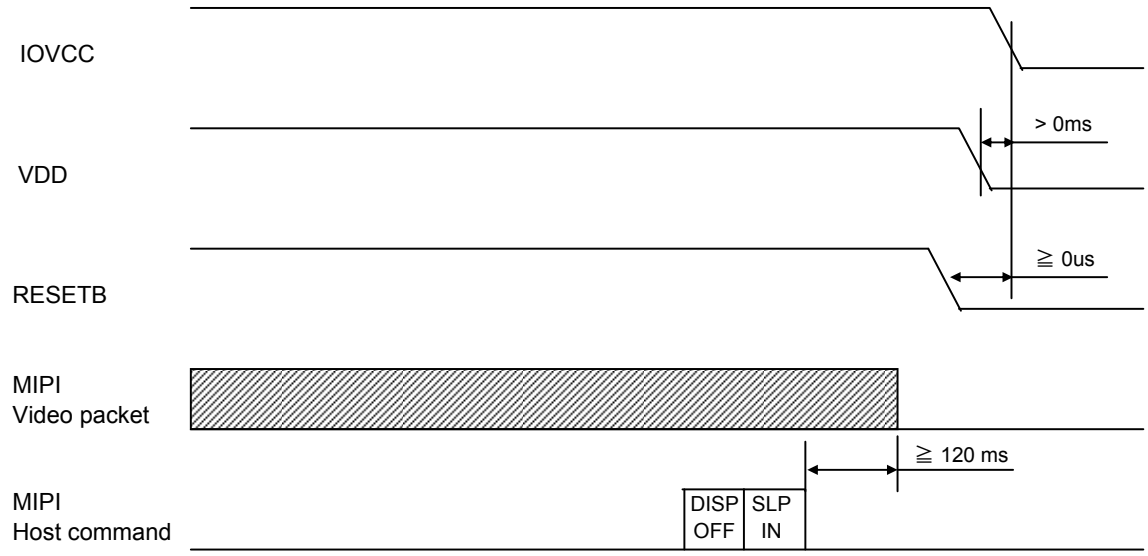
Case 2. RESETB line is held low by host at power on

If RESETB line is held low (and stable) by the host during power on, then the RESETB must be low for minimum 1 msec after both IOVCC and VDD have been applied.

And, before the rising edge of RESETB, must be set to LP-11 all lanes of MIPI.



Case2 Power OFF



10. CABC: Content adaptive brightness control function

10.1 CABC Block diagram

The general block diagram of the CABC and the brightness control is illustrated below:

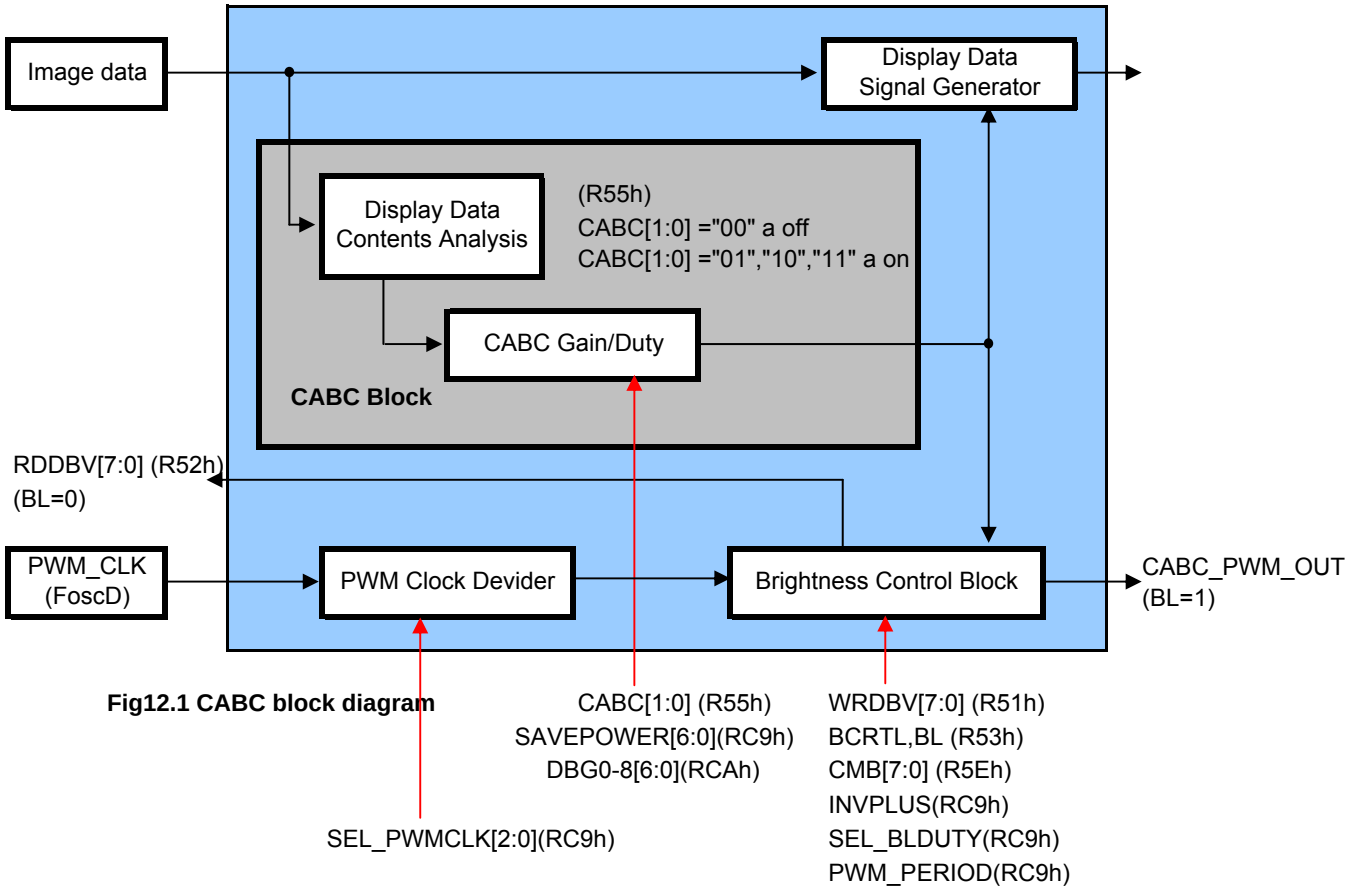


Fig12.1 CABC block diagram

10.2 CABC Block

There are register bits,DBG0-8[6:0] of RCAh, in CABC block to define the "CABC gain/CABC duty"table.
Every DBGx[6:0] has 33 gain/duty value setting
After one-frame display data content analysis,LSI will generate one CABC gain / CABC duty value calculated from DBG0-8[6:0] register bit setting(by using interpolated method) for display data generating and for backlight PWM pulse generating.

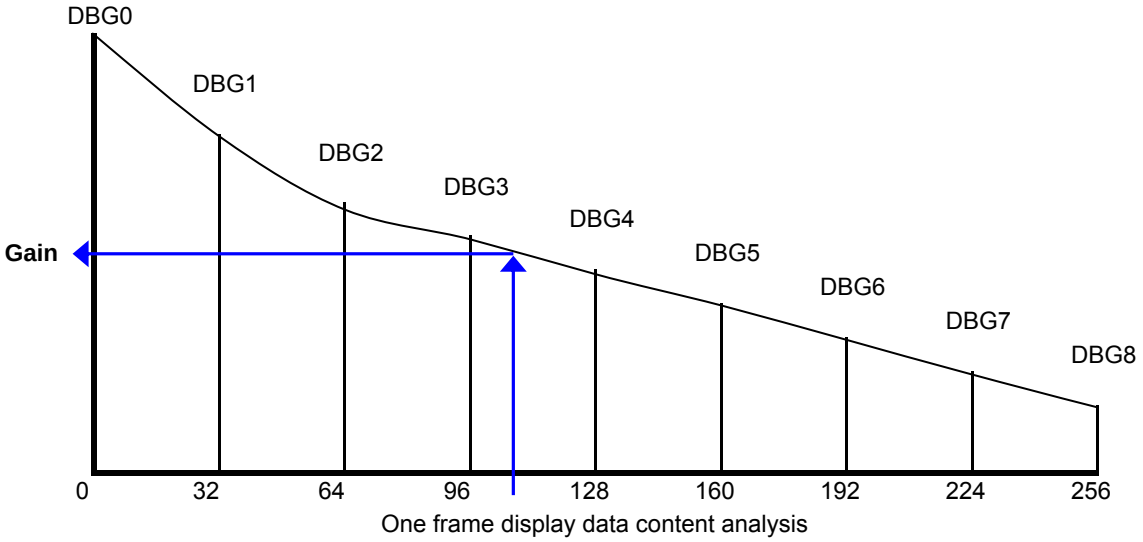


Fig12.2:CABCgain/CABC duty generation

10.3 Brightness control block

There is an external output signal from brightness block, CABC_PWM_OUT, to control theLED driver IC in order to control display brightness.

There are resister bits, DBV[7:0] of R51h, for display brightness of manual brightness setting.
The CABC_PWM_OUT duty is calculated as (DBV[7:0]/255)x CABC duty
(generated after one-frame display data content analysis).

10.4 Minimum brightness setting of CABC function

CABC function is automatically reduced backlight brightness based on image contents.
In the case of the combination with the CABC or manual brightness setting, display brightness is too dark.
It must affect to image quality degradation.
CABC minimum brightness setting (CMB[7:0] bits of R5Eh) is to avoid too much brightness reduction.

When CABC is active, CABC can not reduce the display brightness to less than CABC minimum brightness setting.
Image processing function is worked as normal, even if the brightness can not be changed.

10.5 CABC commnd list

Command

(Hex)	Register	DCX	D7	D6	D5	D4	D3	D2	D1	D0
51h	WRDISBV	0	0	1	0	1	0	0	0	1
		1	DBV[7:0]							
53h	WRCTRLD	0	0	1	0	1	0	0	1	1
		1	-	-	BCTRL	-	DD	BL	-	-
55h	WRCABC	0	0	1	0	1	0	1	0	1
		1	-	-	-	-	-	-	CABC[1:0]	
5Eh	WRCABCMB	0	0	1	0	1	1	1	1	0
		1	CMB[7:0]							
C9h	SETCABC	0	1	1	0	0	1	0	0	1
		1	-	SEL_PWMCLK[2:0]			SEL_GAIN[1:0]		INVPULS	SEL_BL DUTY
		1	PWM_PERIOD[7:0]							
		1	CABC_FSYNC	DIM_FRAME[6:0]						
		1	CABC_STEP[7:0]							
		1	CABC_CLKEN[7:0]							
		1	CABC_DD	SAVEPOWER[6:0]						
		1	MEAN_OFFSET[7:0]							
		1	-	-	-	-	CABC_FLM[3:0]			
		1	-	-	EN_DIM_MIX	EN_COST_ME	EN_COST	EN_NLN_GAIN	EN_JUDGE	EN_TEMP
		1	RATIO_VAQLUE[3:0]				DATAGAIN_EN	RATIO_EN	DATAGAIN[9:8]	
		1	DATAGAIN[7:0]							
CAh	SETCABC GAIN	0	1	1	0	0	1	0	1	0
		1	DBG0-8{6:0] 1-9th parameter							

・Command 51h (WRDISBV)

This command is used to adjust the brightness value of the display.
The CABC_PWM_OUT duty is caiculated as (DBV[7:0]/255)xCABC duty

・Command 53h (WRCTRLD)

This command is used to control display brightness.

BCTRL: Brightness Control Block On/Off, This bit is always used to switch brightness for display.

0 = Off (Brightness registers are 00h, DBV[7..0])

1 = On (Brightness registers are active, according to the other parameters.)

Display Dimming (DD): (Only for manual brightness setting)

DD = 0: Display Dimming is off DD = 1: Display Dimming is on

BL: Backlight Control On/Off

0 = Off (Completely turn off backlight circuit. Control lines must be low.) 1 = On

・Command 55h (WRCABC)

This command is used to set parameters for image content based adaptive brightness control functionality.

There is possible to use 4 different modes for content adaptive image functionality.

Which are defined on a table below.

D1	D0	Function
0	0	Off
0	1	User Interface Image
1	0	Still Picture
1	1	Moving Image

・Command 5Eh (WRCABCMB)

This command is used to set the minimum brightness value of the display for CABC function.

In principle relationship is that 00h value means the lowest brightness for CABC and FFh value means the highest brightness for CABC.

・Command C9h(SETCABC)

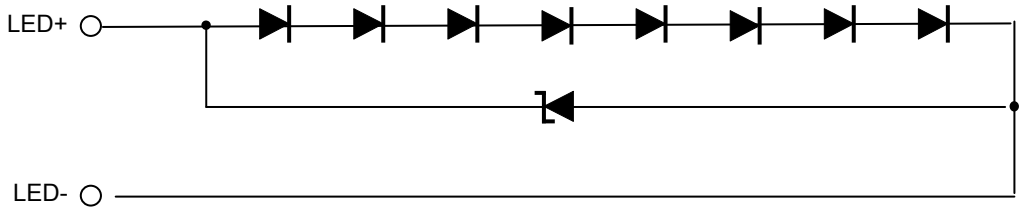
SEL_PWMCLK[2:0]	Internal PWM_CLK divider for CABC clock.
SEL_GAIN	CABC gain select
INPULS	0=PWM output is low level active. 1= High level active
SEL_BLDUTY	0=PWM output duty is 100% 1= Duty is calculate CABC operation
PWM_PERIOD[7:0]	PWM output period setting.
CABC_FSYNC DIM_FRAME[7:0] CABC_STEP[7:0] CABC_CLKEN[7:0]	In-house function,and not open
CABC_DD	0=Disable CABC dimming. 1=Enable CABC dimming.
SAVEPOWER	Minimum CABC gain / maximum CABC duty output select.

・Command CAh(SETCABCGAIN)

DBG0-8[6:0]: Gain select register.

Refer to "10.2 CABC_Block".

11. LED Circuit



12. Characteristics

12.1 Optical Characteristics

< Measurement Condition >

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

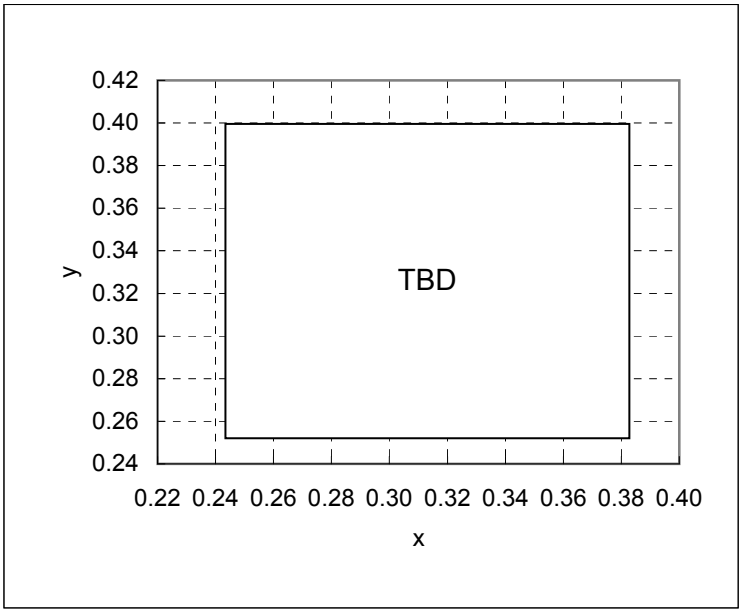
Driving condition: VDD=2.9V, VCCIO=1.9V
Optimized VCOMDC

Backlight: IL=(10.0)mA

Measured temperature: Ta=25°C

Item		Symbol	Condition	MIN	TYP	MAX	Unit	Note No.	Remark
Response time	Rise time	TON	[Data]= (00)h→(FF)h	—	—	(40)	ms	1	
	Fall time	TOFF	[Data]= (FF)h→(00)h	—	—	(60)	ms		
Contrast ratio	Backlight ON	CR	[Data]= (FF)h / (00)h	(400)	(800)	—		2	
	Backlight OFF			—	(TBD)	—			
Viewing angle	Left	θL	[Data]= (FF)h / (00)h 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]=(FF)h	(260)	(430)	—	cd/m^2	6	
Brightness distribution			[Data]=(FF)h	(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
TBD	TBD
TBD	TBD
TBD	TBD
TBD	TBD
TBD	TBD
TBD	TBD
TBD	TBD

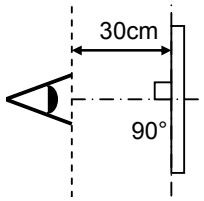
12.2 Temperature Characteristics

< Measurement Condition >
Measuring instruments: CS1000（KONICA MINOLTA）, LCD7200(OTSUKA ELECTRONICS）
Driving condition: VDD=2.9V, VCCIO=1.9V
Optimized VCOMDC
Backlight: IL=(10.0)mA

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	(300) msec or less	(30) msec or less	
	Fall time	TOFF	(300) msec or less	(50) msec or less	
Display Quality			No noticeable display defect or ununiformity should be observed.		

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]:(00)h, (TBD)h, (FF)h (3steps)
Observation distance	30 cm
Illuminance	200 to 350 lx
Backlight	IL=(10.0)mA

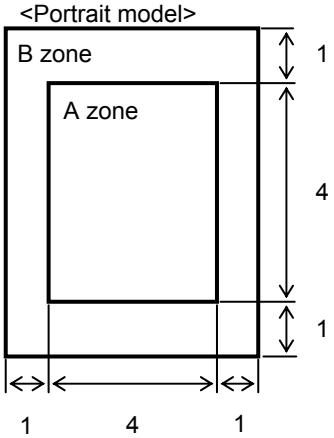
Defect item		Defect content		Criteria
Display Quality	Line defect	Black, white or color line, 3 or more neighboring defective dots		Not exists
	Dot defect	Uneven brightness on dot-by-dot base due to defective TFT or CF, or dust is counted as dot defect (brighter dot, darker dot) High bright dot: Visible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

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 Permissible distance between same color high bright dots (includes neighboring dots): 5 mm or more
B	2	4	4	6	
Total	2	4	4	7	

<Portrait model>



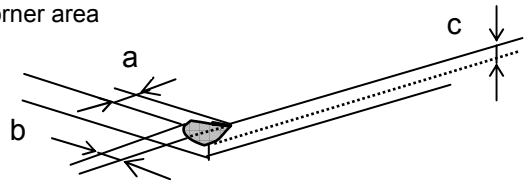
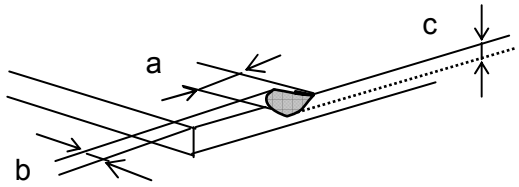
Division of A and B areas
B area: Active area
Dimensional ratio between A and B areas: 1: 4: 1
(Refer to the left figure)

13.2 Screen and Other Appearance

Testing conditions

Observation distance	30cm
Illuminance	1200～2000 lx

Item		Criteria	Remark
Polarizer	Flaw 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 a≦3 b≦3 c≦t （t: glass thickness） a,b≦0.5 is acceptable
	Others 	Unit:mm a≦5 b≦1 c≦t （t:glass thickness） a,b≦0.5 is acceptable Maximum permissible number of chipping off on a side is 5.
	Progressive crack	None

14. Reliability Test

Test item		Test condition	number of failures /number of examinations
Durability test	High temperature storage	Ta=80°C 240hr	TBD／3
	Low temperature storage	Ta=-30°C 240hr	TBD／3
	High temperature & high humidity storage	Ta=60°C, RH=90% 240hr non condensing ※	TBD／3
	High temperature operation	Tp=70°C 240hr	TBD／3
	Low temperature operation	Tp=-20°C 240hr	TBD／3
	High temp & humid operation	Tp=40°C, RH=90% 240hr non condensing ※	TBD／3
	Thermal shock storage	-30←→80°C(30min/30min) 100 cycles	TBD／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.	TBD／3
	Surface discharge test (Non operation)	C=250pF, R=100Ω, V=±(TBD)kV Each 5 times of discharge in both polarities on the center of screen with the case grounded.	TBD／3
	FPC tension test	Pull the FPC with the force of 3N for 10 sec. in the direction - 90-degree to its original direction.	TBD／3
	FPC bend test	Pull the FPC with the force of 3N for 10 sec. in the direction -180-degree to its original direction. Reciprocate it 3 times.	TBD／3
	Vibration test	Total amplitude 1.5mm, f=10～55Hz, X,Y,Z directions for each 2 hours	TBD／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.	TBD／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	TBD／1 Packing
	Packing drop test	Drop from 75cm high. 1 time to each 6 surfaces, 3 edges, 1 corner	TBD／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.）

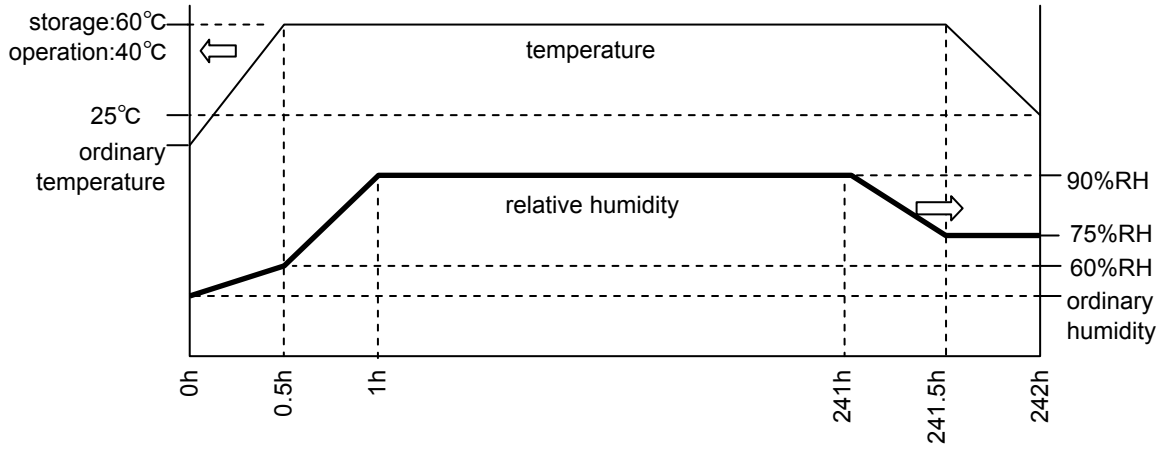
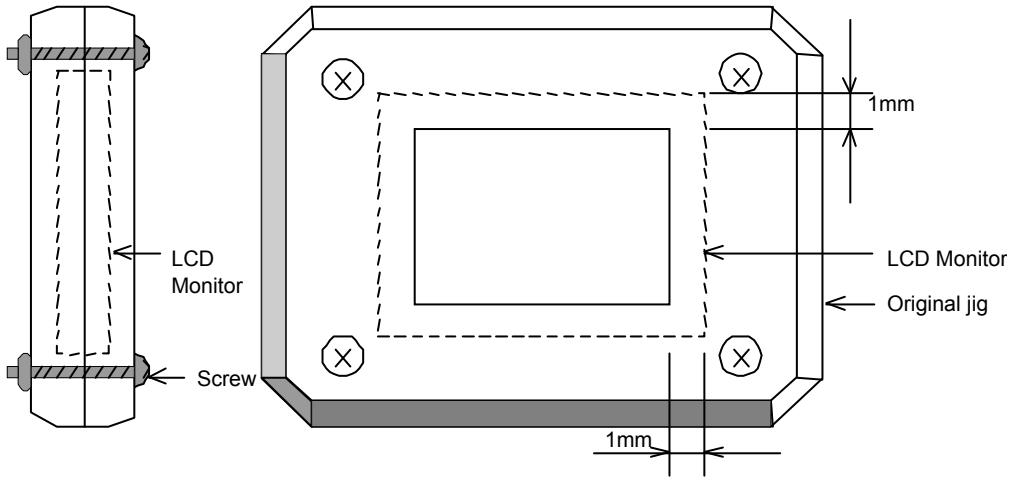


Table2.Reliability Criteria

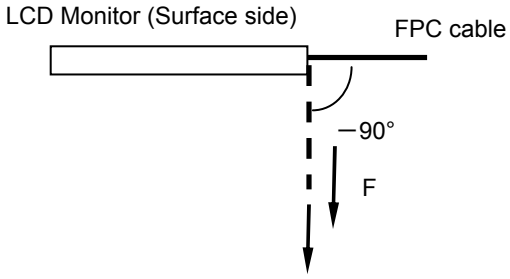
The parameters should be measured after leaving the monitor at the ordinary temperature for 24 hours or more after the test completion.

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

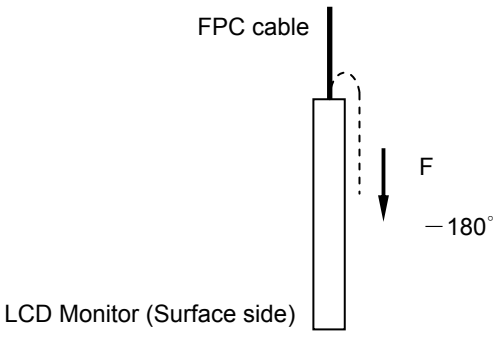
ORTUS TECHNOLOGY Original Jig



Tension Test Method for FPC cable



Bend Test Method for FPC cable



15. Packing Specifications

TBD

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 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.

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.

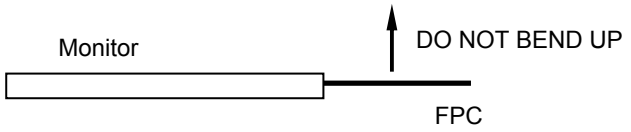
3) Avoid strong mechanical shock including knocking, hitting or dropping to the TFT monitors for protecting their glass parts. Do not use the TFT monitors that have been experienced dropping or strong mechanical shock.

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.
Especially, it will cause mechanical damage or critical defect if FPC is pull up or bent up to short of display.



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.

9) It is recommended to employ the structure of which polarizer peripheral area of LCD panel being pressed by cushioning materials, in order to prevent a cause of display brightness unevenness.

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: (TBD) 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

TBD

16.6 Warranty

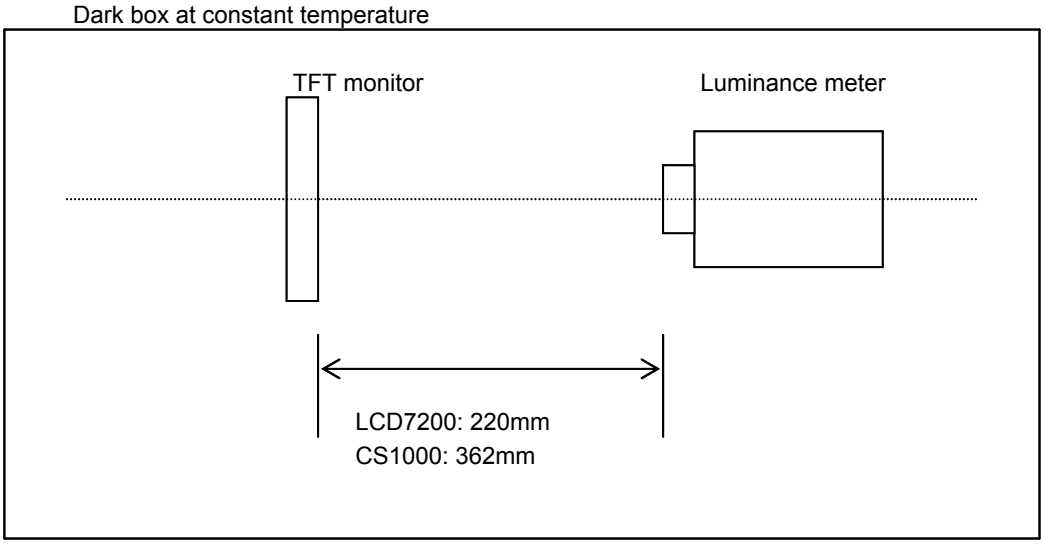
ORTUS is only liable to defective goods which is stored and used under the condition complying with this specifications and returned within 1 (one) year.
Warranty caused by manufacturing defect shall be conducted by replacement of goods or refundment at unit price.

APPENDIX

Reference Method for Measuring Optical Characteristics and Performance

1. Measurement Condition (Backlight ON)

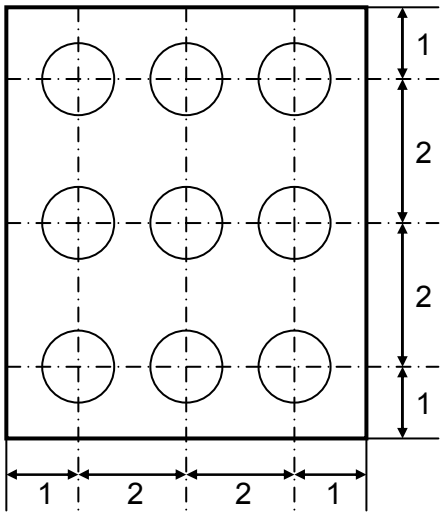
Measuring instruments: CS1000（KONICA MINOLTA）, LCD7200(OTSUKA ELECTRONICS）,EZcontrast160D（ELDIM）
Driving condition: Refer to the section "Optical Characteristics"
Measured temperature: 25˚C unless specified
Measurement system: See the chart below. The luminance meter is placed on the normal line of measurement 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>

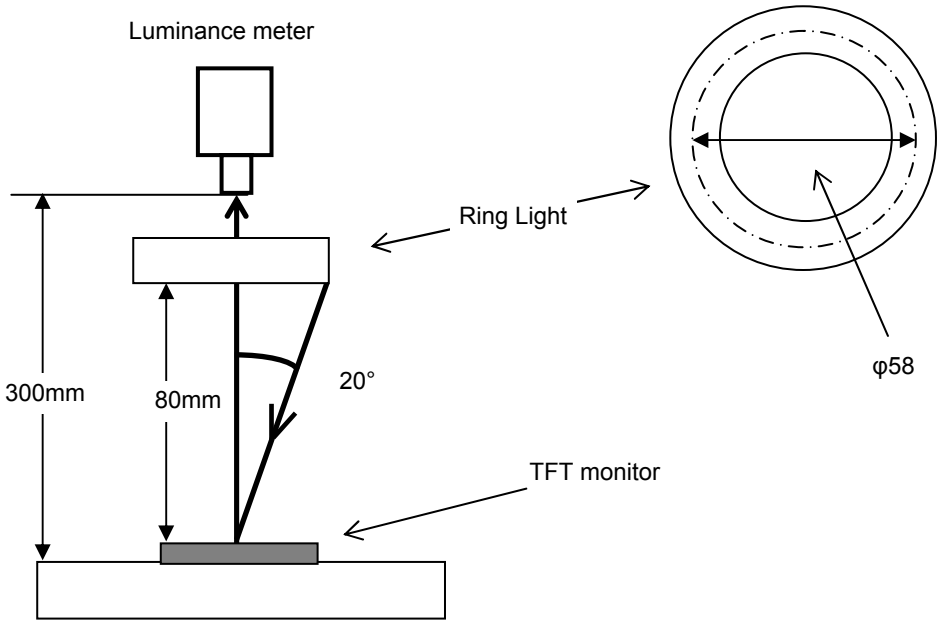


Dimensional ratio of active area

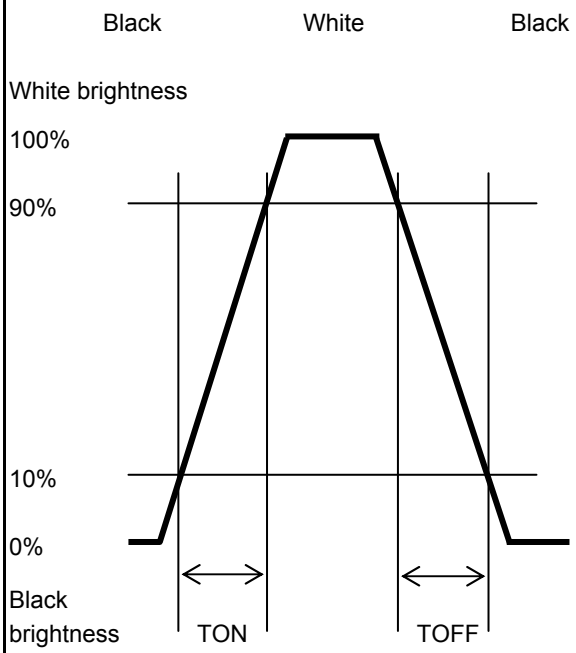
Backlight IL=(10.0)mA

Measurement Condition (Contrast ratio Backlight OFF only)

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



2. Test Method

Notice	Item	Test method	Measuring instrument	Remark
1	Response time	Measure output signal waves with a brightness meter when the raster or window pattern is changed over from white to black and from black to white 	LCD7200	Black display [Data]=(00)h White display [Data]=(FF)h TON Rise time TOFF Fall time
2	Contrast ratio	Measure maximum luminance Y1([Data]=(FF)h) and minimum luminance Y2([Data]=(00)h) 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) Diameter of measuring point: 3mmφ(LCD7200)	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	Measure chromaticity coordinates x and y of CIE1931 colorimetric system at [Data] = (FF)h Color matching function: 2°view	CS1000	
5	Burn-in	Visually check burn-in image on the screen after 2 hours of "window display" ([Data]=(00)h/(FF)h).		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	
0.0	Apr. 18, 2017	-	-	Tentative issue