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		APPLICABLE DIVISION DEVELOPMENT DEPT. I DESIGN CENTER I LCD DESIGN DEVELOPMENT DISPLAY DEVICE BUSINESS GROUP SHARP (CHINA) INVESTMENT CO.,LTD.

SPECIFICATION

DEVICE SPECIFICATION for
TFT LCD Module
(720× RGB × 1280 dots)

Model No.

LQ055K3SX02

□CUSTOMER'S APPROVAL

DATE _____

BY _____

PRESENTED
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SHARP (CHINA) INVESTMENT CO.,LTD.

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DATE	REF.PAGE PARAGRAPH DRAWING No.	REVISED NO.	SUMMARY
2014.05.08	—	—	First Issue
2014.0730	Page7	A	Changing the Input Terminal Names and Functions (Pin2)
	Page8		Changing the Current consumption and Absolute Maximum Ratings
	Page9		Changing the Color/Luminour Flux Rank
	Page17,18		Changing the waiting time of Sequence
	Page23		Changing Fig.16 (Adding the dot mark)
	Page25,26,27		Adding packing style
	Page29		Changing outline dimensions
	Page30		Adding Appendix about abnormal off condition
2014.10.20	Page25	B	Changing Packaging Quantities Changing Packaging Weight Changing Packaging Materials

NOTICE

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○ The device listed in these specification sheets was designed and manufactured for use in Telecommunication equipment (terminals)

○ In case of using the device for applications such as control and safety equipment for transportation (aircraft, trains, automobiles, etc.), rescue and security equipment and various safety related equipment which require higher reliability and safety, take into consideration that appropriate measures such as fail-safe functions and redundant system design should be taken.

○ Do not use the device for equipment that requires an extreme level of reliability, such as aerospace applications, telecommunication equipment (trunk lines), nuclear power control equipment and medical or other equipment for life support.

○ SHARP assumes no responsibility for any damage resulting from the use of the device which does not comply with the instructions and the precautions specified in these specification sheets.

○ Contact and consult with a SHARP sales representative for any questions about this device.

[For handling and system design]

(1) Do not scratch the surface of the polarizer film as it is easily damaged.

(2) If the cleaning of the surface of the LCD panel is necessary, wipe it swiftly with cotton or other soft cloth. Do not use organic solvent as it damages polarizer.

(3) Water droplets on polarizer must be wiped off immediately as they may cause color changes, or other defects if remained for a long time.

(4) Since this LCD panel is made of glass, dropping the module or banging it against hard objects may cause cracks or fragmentation.

(5) Certain materials such as epoxy resin (amine's hardener) or silicone adhesive agent (de-alcohol or de-oxym) emits gas to which polarizer reacts (color change). Check carefully that gas from materials used in system housing or packaging do not hart polarizer.

(6) Liquid crystal material will freeze below specified storage temperature range and it will not get back to normal quality even after temperature comes back within specified temperature range. Liquid crystal material will become isotropic above specified temperature range and may not get back to normal quality. Keep the LCD module always within specified temperature range.

(7) Do not expose LCD module to the direct sunlight or to strong ultraviolet light for long time.

(8) If the LCD driver IC (COG) is exposed to light, normal operation may be impeded. It is necessary to design so that the light is shut off when the LCD module is mounted.

(9) Do not disassemble the LCD module as it may cause permanent damage.

(10) As this LCD module contains components sensitive to electrostatic discharge, be sure to follow the instructions in below.

① Operators

Operators must wear anti-static wears to prevent electrostatic charge up to and discharge from human body.

② Equipment and containers

Process equipment such as conveyer, soldering iron, working bench and containers may possibly generate electrostatic charge up and discharge. Equipment must be grounded through 100Mohms resistance. Use ion blower.

③ Floor

Floor is an important part to leak static electricity which is generated from human body or equipment.
There is a possibility that the static electricity is charged to them without leakage in case of insulating floor, so the countermeasure(electrostatic earth:$1\times10^{8}\Omega$) should be made.

④Humidity

Proper humidity of working room may reduce the risk of electrostatic charge up and discharge. Humidity should be kept over 50% all the time.

⑤Transportation/storage

Storage materials must be anti-static to prevent causing electrostatic discharge.

⑥Others

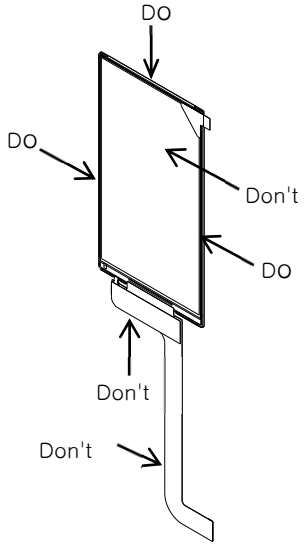
Protective film is attached on the surface of LCD panel to prevent scratches or other damages. When removing this protective film, remove it slowly under proper anti-ESD control such as ion blower.

(11) Hold LCD very carefully when placing LCD module into the system housing. Do not apply excessive stress or pressure to LCD module. Do not to use chloroprene rubber as it may affect on the reliability of the electrical interconnection.

(12) Do not hold or touch LCD panel to flex interconnection area as it may be damaged.

(13) As the binding material between LCD panel and flex connector mentioned in 12) contains an organic material, any type of organic solvents are not allowed to be used. Direct contact by fingers is also prohibited.

(14) When carrying the LCD module, place it on the tray to protect from mechanical damage. It is recommended to use the conductive trays to protect the CMOS components from electrostatic discharge. When holding the module, hold the Plastic Frame of LCD module so that the panel, COG and other electric parts are not damaged.



(15) Do not touch the COG's patterning area. Otherwise the circuit may be damaged.

(16) Do not touch LSI chips as it may cause a trouble in the inner lead connection.

(17) Place a protective cover on the LCD module to protect the glass panel from mechanical damages.

(18) LCD panel is susceptible to mechanical stress and even the slightest stress will cause a color change in background. So make sure the LCD panel is placed on flat plane without any continuous twisting, bending or pushing stress.

(19) Protective film is placed onto the surface of LCD panel when it is shipped from factory. Make sure to peel it off before assembling the LCD module into the system. Be very careful not to damage LCD module by electrostatic discharge when peeling off this protective film. Ion blower and ground strap are recommended.

(20) Make sure the mechanical design of the system in which the LCD module will be assembled matches specified viewing angle of this LCD module.

(21) This LCD module does not contain nor use any ODS (1,1,1-Trichloroethane, CCL4) in all materials used, in all production processes.

[For operating LCD module]

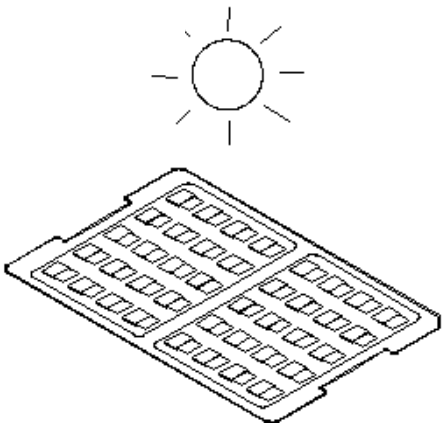
(1) Do not operate or store the LCD module under outside of specified environmental conditions.
(2) At the shipment, adjust the contrast of each LCD module with electric volume. LCD contrast may vary from panel to panel depending on variation of LCD power voltage from system.
(3) As opt-electrical characteristics of LCD will be changed, dependent on the temperature, the confirmation of display quality and characteristics has to be done after temperature is set at 25 °C and it becomes stable.

[Precautions for Storage]

(1) Do not expose the LCD module to direct sunlight or strong ultraviolet light for long periods. Store in a dark place.
(2) The liquid crystal material will solidify if stored below the rated storage temperature and will become an isotropic liquid if stored above the rated storage temperature, and may not retain its original properties. Only store the module at normal temperature and humidity (25±5°C, 60±10%RH) in order to avoid exposing the front polarizer to chronic humidity.
(3) Keeping Method

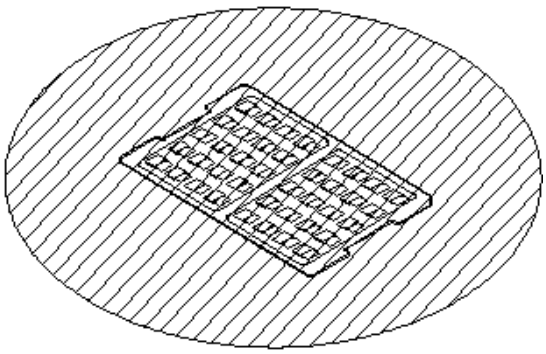
a. Don't keeping under the direct sunlight.

DON'T



b. Keeping in the tray under the dark place.

DO



(1) Do not operate or store the LCD module under outside of specified environmental conditions.
(2) Be sure to prevent light striking the chip surface.

[Other Notice]

(1) Do not operate or store the LCD module under outside of specified environmental conditions.

(2) As electrical impedance of power supply lines (VDD-1V8/VSP/VSN-GND) are low when LCD module is working, place the de-coupling capacitor nearby LCD module as close as possible.

(3) Reset signal must be sent after power on to initialize LSI. LSI does not function properly until initialize it by reset signal.

(4) Generally, at power on, in order not to apply DC charge directly to LCD panel, supply logic voltage first and initialize LSI logic function including polarity alternation. Then supply voltage for LCD bias. At power off, in order not to apply DC charge directly to LCD panel, execute Power OFF sequence and Discharge command.

(5) Don't touch to FPC surface, exposed IC chip, electric parts and other parts, to any electric, metallic materials.

(6) No bromide specific fire-retardant material is used in this module.

(7) Do not display still picture on the display over 2 hours as this will damage the liquid crystal.

(8) The connector used in this LCD module is the one Sharp have not ever used.
Therefore, please note that the quality of this connector concerned is out of Sharp's guarantee.

(9) Be sure to use a power supply with the safety protection circuit such as the fuse for excess voltage, excess current, electric discharge waveform and Latch-up occurring.

(10) Epoxy resin (amine series curing agent), silicone adhesive material (dealcoholization series and oxime series), tray forming agent (azo compound) etc, in the cabinet or the packing materials may induce abnormal display with polarizer film deterioration regardless of contact or noncontact to polarizer film.

Be sure to confirm the component of them.

(11) This module is designed for OCA TP bonding. If you are changing TP system, please contact us.

[Precautions for Discarding Liquid Crystal Modules]

COG: After removing the LSI from the liquid crystal panel, dispose of it in a similar way to circuit boards from electronic devices.

LCD panel: Dispose of as glass waste. This LCD module contains no harmful substances. The liquid crystal panel contains no dangerous or harmful substances. The liquid crystal panel only contains an extremely small amount of liquid crystal (approx.100mg) and therefore it will not leak even if the panel should break.

Its median lethal dose (LD50) is greater than 2,000 mg/kg and a mutagenetic (Aims test: negative) material is employed.

FPC: Dispose of as similar way to circuit board from electric device.

1. Application

This data sheet is to introduce the specification of LQ055K3SX02 active matrix 16,777,216color LCD module.
Main color LCD module is controlled by Driver IC(R69339).
If any problem occurs concerning the items not stated in this specification, it must be solved sincerely by both parties after deliberation.
As to basic specification of driver IC refer to the IC specification and handbook.

2. Construction and Outline

Construction: LCD panel, Driver (COG), FPC with electric components,
12 White LED lump, prism sheet, diffuser, light guide and reflector, plastic frame to fix them mechanically.

Outline: See page 29
Connection: ZIF connector (Hirose,FH26-39S-0.3SHW)
There shall be no scratches, stains, chips, distortions and other external drawbacks that may affect the display function.

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 rise from the module when shipped 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.

3. Mechanical Specification

Table 3-1

Parameter		Specifications	Unit
Outline dimensions (typ)		72.3(W)×130.39 (H)×1.65(D) *2	mm
Main LCD Panel	Active area	68.04(W)×120.96(H)	mm
	Display format	720(W) × RGB × 1280(H)	-
	Dot pitch	0.0315(W)×0.0945(H)	mm
	Base color *1	Normally Black	-
	Illumination mode	Transmissive	
Mass		About:35	g

*1 Due to the characteristics of the LC material, the colors vary with environmental temperature.
*2 The above-mentioned table indicates module sizes without some projections and FPC.

4. Pixel Configuration

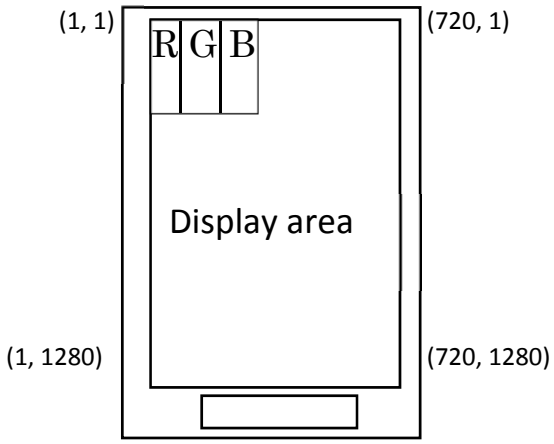


Fig.1 Pixel Configuration

5. Input Terminal Names and Functions ⚠1

Table 5-1

Pin No.	Symbol	I/O	Description	Remarks
1	GND	I	Ground level	
2	GND	I	Ground level	
3	NC		No connect	
4	RESX	I	Reset Pin	
5	TE	I	TE signal output from driver IC	
6	NC		No connect	
7	GND	I	Ground level	
8	D3P	I	MIPI data3 positive signal line	
9	NC		No connect	
10	D3N	I	MIPI data3 negative signal line	
11	GND	I	Ground level	
12	D2P	I	MIPI data2 positive signal line	
13	NC		No connect	
14	D2N	I	MIPI data2 negative signal line	
15	GND	I	Ground level	
16	CLKP	I	MIPI clock positive signal line	
17	NC		No connect	
18	CLKN	I	MIPI clock negative signal line	
19	GND	I	Ground level	
20	D1P	I	MIPI data1 positive signal line	
21	NC		No connect	
22	D1N	I	MIPI data1 negative signal line	
23	GND	I	Ground level	
24	D0P	I/O	MIPI data0 positive signal line	
25	NC		No connect	
26	D0N	I/O	MIPI data0 negative signal line	
27	GND	I	Ground level	
28	NC		No connect	
29	VCI	I	2.8V Analog Power Supply	
30	IOVCC	I	1.8V Digital Power Supply	
31	GND	I	Ground level	
32	LED_ A1	I	LED Anode	
33	LED_ A2	I	LED Anode	
34	LED_K1	I	LED Cathode	
35	LED_K2	I	LED Cathode	
36	GND	I	Ground level	
37	BLU_PWM	O	Backlight LED driver PWM	
38	NC		No connect	
39	NC		No connect	

6. Absolute Maximum Ratings ⚠1

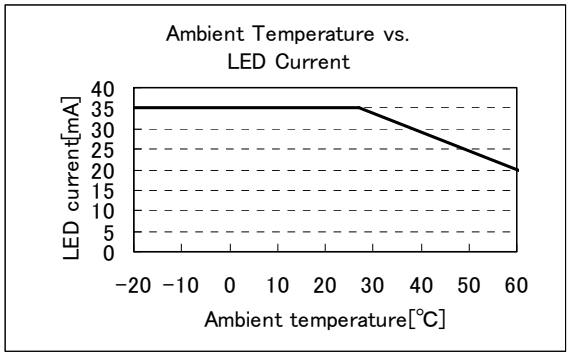
Table 6-1 GND=0V

Parameter	Symbol	Rated value	Unit	Note
Driver IC(Positive Analog) Power Supply Voltage	IOVCC – GND	-0.3～+4.6	V	【Note6-1】
Driver IC(Negative Analog) Power Supply Voltage	AVDD – AGND	-0.3～+6.5	V	【Note6-1】
Driver IC(Digital) Power Supply Voltage	AGND – AVEE	-6.5～-0.3	V	【Note6-1】
Temperature for storage	Tstg	-30～+70	℃	【Note6-2】
Temperature for operation	Topr	-20～+60	℃	【Note6-2】
LED Input electric current	ILED	20	mA	【Note6-3】

【Note6-1】Voltage applied to GND pins. GND pin conditions are based on all the same voltage (0V).
Always connect all GND externally and use at the same voltage.

【Note6-2】Humidity : 95%RHMax.(at Ta≤40°C). Maximum wet-bulb temperature is less than 39°C(at Ta>40°C). Condensation of dew must be avoided.

【Note6-3】Ambient temperature and the maximum input are fulfilling the following operating conditions.



7. Electrical Characteristics

7-1. TFT-LCD Panel Driving Section ⚠1

Table 7-1 Ta=+25°C, GND=0V

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Driver IC(Analog) Power Supply Voltage	VCI	2.65	2.8	2.95	V	【Note7-1】
Driver IC(Digital) Power Supply Voltage	IOVCC	1.65	1.80	1.95	V	【Note7-1】
Input voltage (Low)	V_{IL}	0	-	0.3*IOVCC	V	【Note7-2】
Input voltage (High)	V_{IH}	0.7*IOVCC	-	IOVCC	V	【Note7-2】
Input current (Low)	I_{IL}	-10	-	-	μA	
Input current (High)	I_{IH}	-	-	10	μA	
Output voltage (Low)	V_{OL}	0	-	0.2*IOVCC	V	I_{OL}=+0.1mA
Output voltage (High)	V_{OH}	0.8*IOVCC	-	-	V	I_{OH}=-0.1mA
Current consumption(Video Mode)	I_{VCI}	-	(31)	(56)	mA	【Note7-3】
	I_{IOVCC}	-	(9.2)	(12)	mA	【Note7-3】

【Note7-1】Include Ripple Noise

【Note7-2】Applied overshoot

【Note7-3】Measurement Conditions (Video mode):

Full screen white pattern, VCI=2.8V,IOVCC=1.8V,60Hz Refresh

7-2. Back Light Driving Section

Table 7-2 Ta=+25°C, GND=0V

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
LED Voltage	V_{LED}	-	+18	+21	V	【Note7-5】
LED Current	I_{LED}	-	20*2	-	mA	
Power Consumption	W_{LED}	-	720	-	mW	【Note7-6】
LED Quantity			12		pcs	

【Note7-5】at I_{LED}=20mA

【Note7-6】$W_{LED}=V_L \times I_L$

Color/Luminour Flux Rank : NSSW206C-Z1 Sa62 NW750~. ⚠1

8. Timing characteristics of input signals

8-1.MIPI DC/AC Characteristics

<DC characteristics>

Table 8-1 Ta=+25°C, GND=0V

Parameter	Symbol	Min.	Typ	Max.	Unit	Note
Logic 1 input voltage for LP-RX	V_{IH}	880	-	1350	mV	
Logic 0 input voltage for LP-RX (Not in ULPS state)	V_{IL}	-50	-	550	mV	
I/O Leakage current for LP-RX	ILEAK	-10	-	10	μA	
Logic 1 contention threshold for CD-RX	V_{IHCD}	450	-	-	mV	
Logic 0 contention threshold for CD-RX	V_{ILCD}	-	-	200	mV	
Thevenin output low level for LP-TX	V_{OL}	-50	-	50	mV	
Thevenin output high level for LP-TX	V_{OH}	1.1	1.2	1.3	V	
Output impedance of LP transmitter for LP-TX	ZOLP	110	-	-	Ω	2
Differential input high threshold for HS-RX	V_{IDTH}	-	-	70	mV	3
Differential input low threshold for HS-RX	V_{IDTL}	-70	-	-	mV	3
Single-ended input high voltage for HS-RX	V_{IHHS}	-	-	460	mV	
Single-ended input low voltage for HS-RX	V_{ILHS}	-40	-	-	mV	
Differential input impedance	Z_{ID}	-	100	-	Ω	2
Common-mode voltage for HS-RX	V_{CMRX}	70	-	330	mV	1

Note 1: VCMRX(DC)=(VDP+VDN)/2.
Note 2: Excluding COG Resistance (Contact Resistance and ITO Wiring Resistance).
Note 3: Minimum 110mV/-110mV HS differential swing is required for display data transfer.

<AC Characteristics>

Table 8-2 Ta=+25°C, GND=0V

Parameter	Symbol	Min.	Typ	Max.	Unit	Note
DSI Date Transfer Rate	tDSIR	200	-	600	Mbps	1
Date to Clock Setup Time	tSETUP	0.15	-	-	UI	
		0.18			ns	2
Clock to Date Hold Time	tHOLD	0.15	-	-	UI	
		0.18			ns	2

Note 1: When fDSICLK＜125MHz, change auto load NV setting so that it is compliant with THS-PREPRare+THS- ZERO spec.
Note 2: Minimum tSETUP/tHOLD Time is 0.15UI. This value may change according to DSI transfer rate.

Table 8-3 **MIPI DSI LP-RX/TX Clock and Data-Clock Specifications**

Item	Symbol	Unit	Test condition	Min	Typ	Max	Notes
Time to drive LP-00 to prepare for HS transmission	$T_{HS-PREPARE}$	-	IOVCC=DPHYVCC =1.65 ~ 3.30V	40 ns + 4*UI	-	85ns + 6*UI	
$T_{HS-PREPARE}$ + Time to drive HS-0 before the Sync sequence	$T_{HS-PREPARE}$ + $T_{HS-ZERO}$	-	IOVCC=DPHYVCC =1.65 ~ 3.30V	145ns + 10*UI	-	-	
Time to drive flipped differential state after last payload data bit of a HS transmission burst	$T_{HS-TRAIL}$	-	IOVCC=DPHYVCC =1.65 ~ 3.30V	max (n*8*UI, 60 ns + n*4*UI)	-	-	1,2
Time to drive LP-11after HS burst	$T_{HS-EXIT}$	ns	IOVCC=DPHYVCC =1.65 ~ 3.30V	100	-	-	
Time to drive LP-00 after Turnaround Request	T_{TA-GO}	-	IOVCC=DPHYVCC =1.65 ~ 3.30V	$4*T_{LPTX}$			
Time-out before new TX side starts driving	$T_{TA-SURE}$	-	IOVCC=DPHYVCC =1.65 ~ 3.30V	$1*T_{LPTX}$	-	$2*T_{LPTX}$	
Time to drive LP-00 by new TX	T_{TA-GET}	-	IOVCC=DPHYVCC =1.65 ~ 3.30V	$5*T_{LPTX}$			
Length of any Low-Power state period	T_{LPX}	ns	IOVCC=DPHYVCC =1.65 ~ 3.30V	50	-	-	
Ratio of $T_{LPX(MASTER)}/T_{LPX(SLAVE)}$ between Master and Slave side	Ratio T_{LPX}	-	IOVCC=DPHYVCC =1.65 ~ 3.30V	2/3	-	3/2	
Time that the transmitter shall continue sending HS clock after the last associated Data Lane has transitioned to LP mode	$T_{CLK-POST}$	-	IOVCC=DPHYVCC =1.65 ~ 3.30V	60 ns + 52UI	-	-	3
$T_{CLK-PREPARE}$ +time for lead HS-0 drive period before starting Clock	$T_{CLK-PREPARE}$ +$T_{CLK-ZERO}$	ns	IOVCC=DPHYVCC =1.65 ~ 3.30V	300	-	-	
Time that the HS clock shall be driven prior to any associated Data Lane beginning the transition from LP to HS mode	$T_{CLK-PRE}$	UI	IOVCC=DPHYVCC =1.65 ~ 3.30V	8	-	-	
Time to drive LP-00 to prepare for HS clock transmission	$T_{CLK-PREPARE}$	ns	IOVCC=DPHYVCC =1.65 ~ 3.30V	38	-	95	
Time to drive HS differential state after last payload clock bit of an HS transmission burst	$T_{CLK-TRAIL}$	ns	IOVCC=DPHYVCC =1.65 ~ 3.30V	60	-	-	
Time from start of THS-TRAIL period to start of LP-11 state	T_{EOT}	-	IOVCC=DPHYVCC =1.65 ~ 3.30V	-	-	105 ns + n*12*UI	2
Length of Low-Power TX period in case of using DSI clock	T_{LPTX1}	UI	IOVCC=DPHYVCC =1.65 ~ 3.30V	-	48	-	4
Length of Low-Power TX period in case of using internal OSC clock	T_{LPTX2}	ns	IOVCC=DPHYVCC =1.65 ~ 3.30V	-	4/fosc	-	

Notes:

1. If a > b then max(a, b) = a, otherwise max(a, b) = b
2. Where n = 1 for Forward-direction HS mode.
3. The R69431 can work with this specification although the end part of internal process is remained when Clock Lane enter LP-11 and the R69431 can work without the remained process if tCLK-POST is more than 256 UI.
4. The R69431 uses DSI clock from the Host processor if Clock Lane is active, and internal oscillator clock if Clock Lane is disabled. Here, “fosc” is the frequency of oscillator clock, typical 56 MHz.

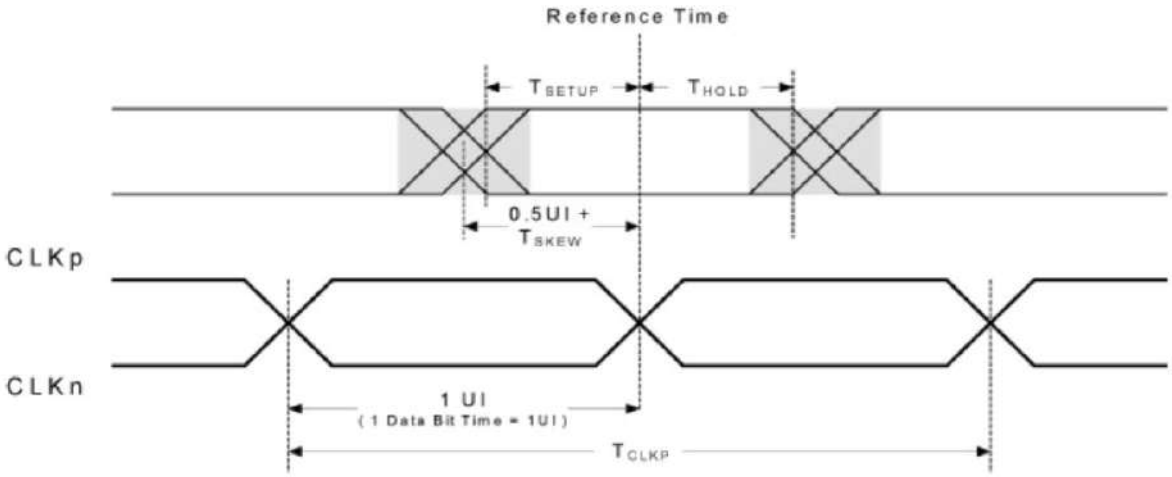


Fig.2 **Data to Clock Timing Definitions**

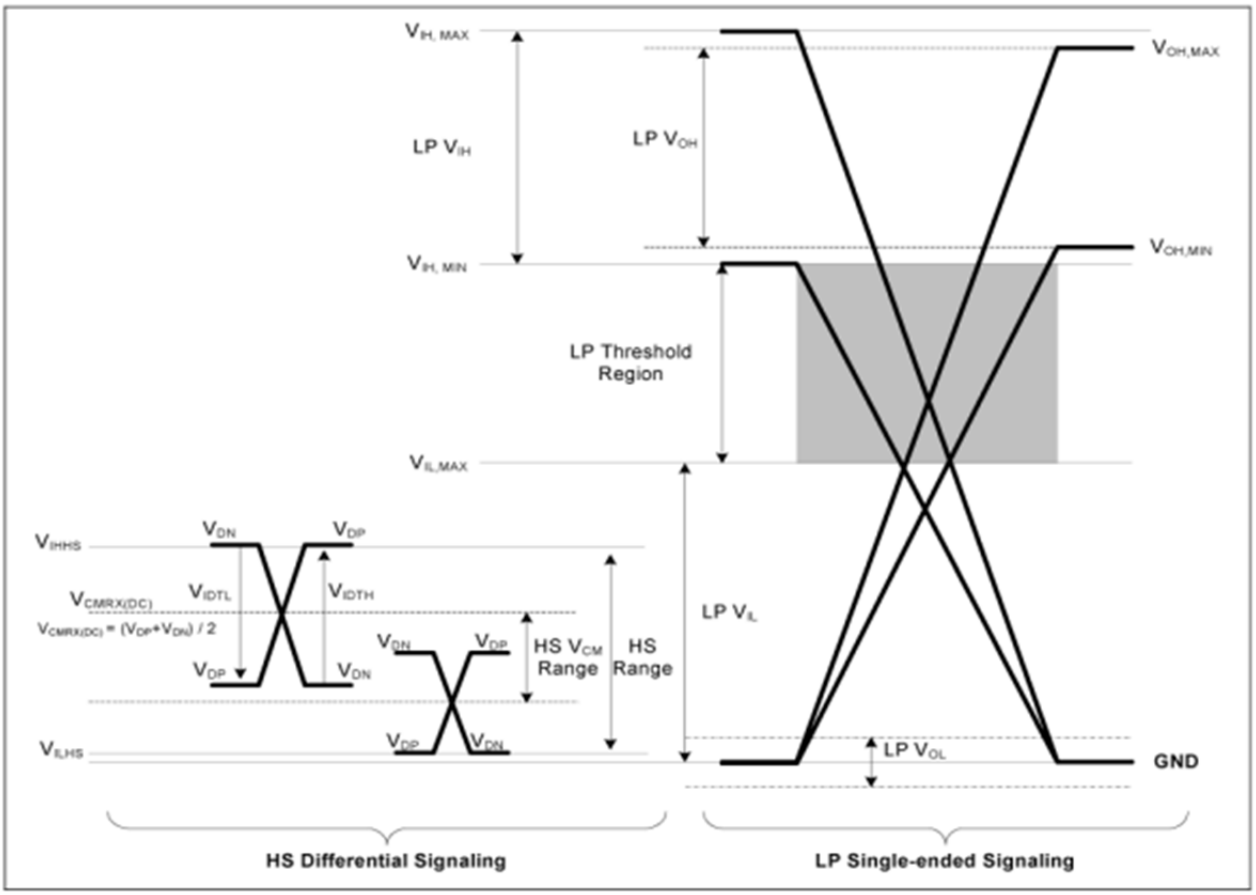


Fig.3 **DSI LP Mode**

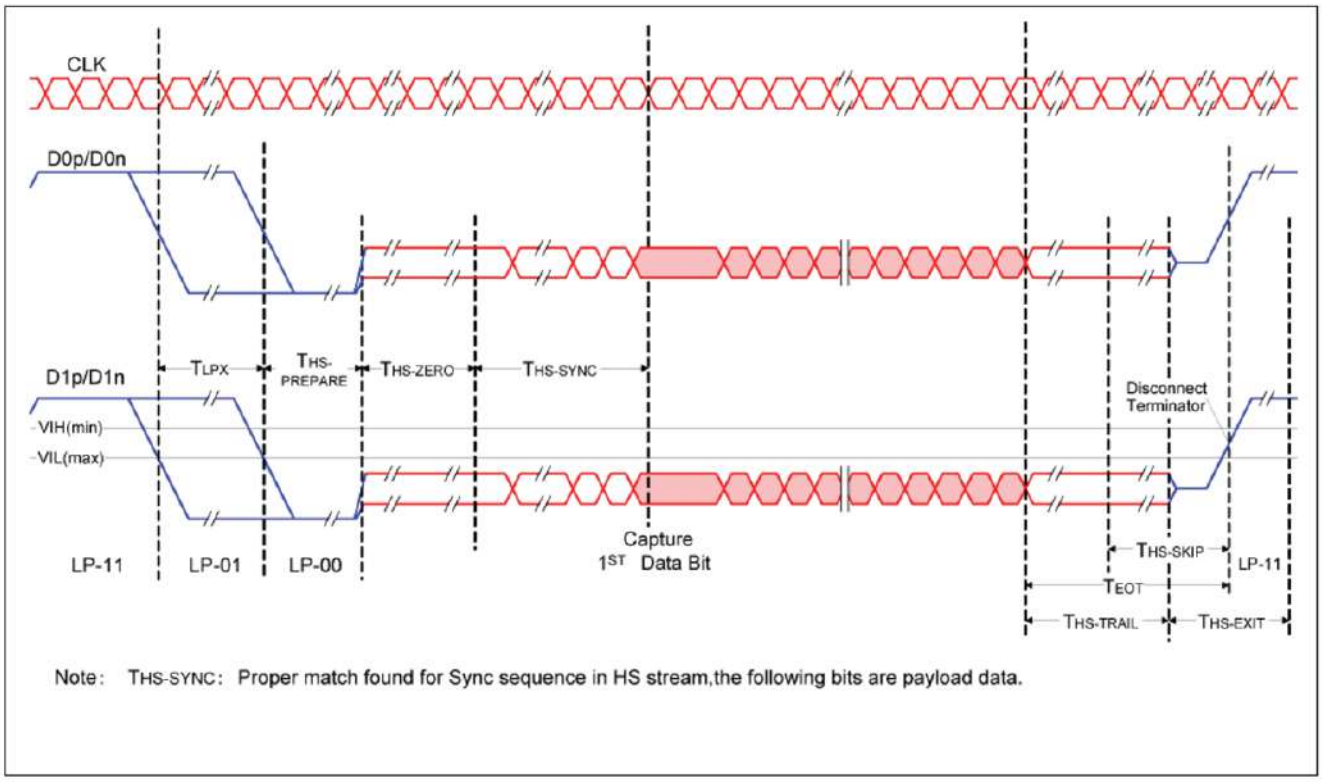


Fig.4 **HS Data Transmission in Bursts**

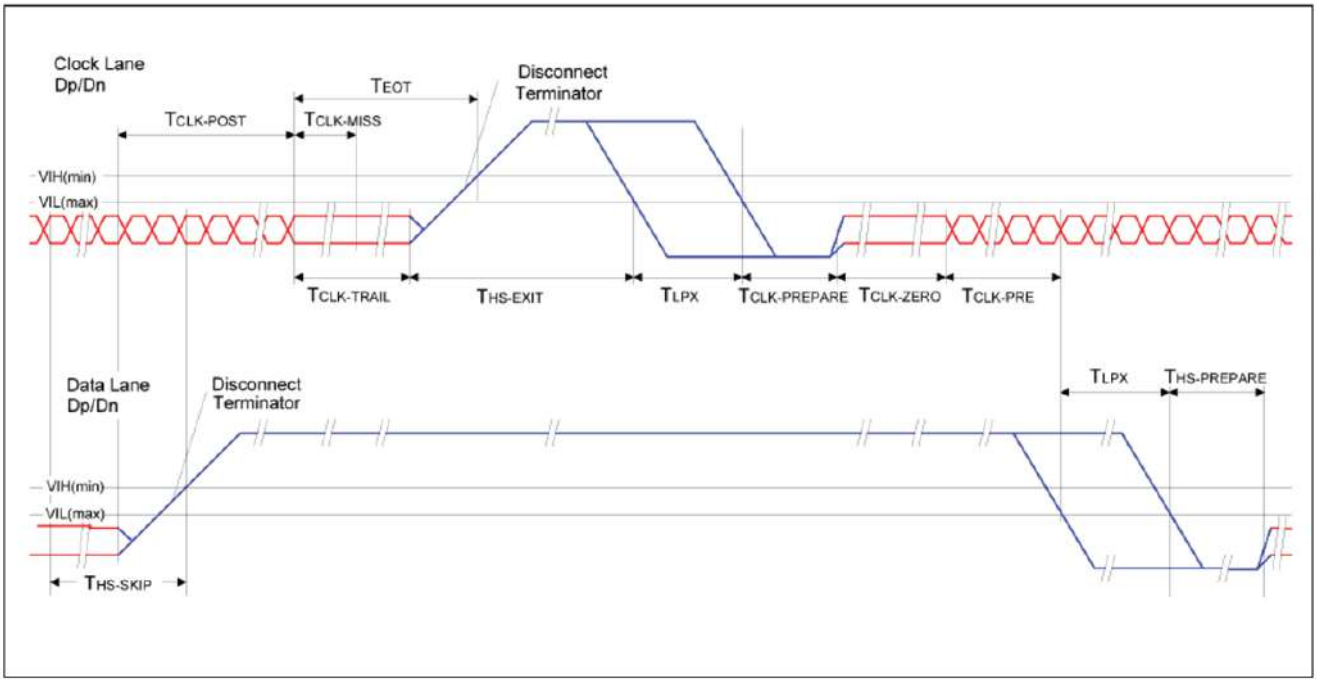


Fig.5 **Switching the Clock Lane between Clock Transmission and LP Mode**

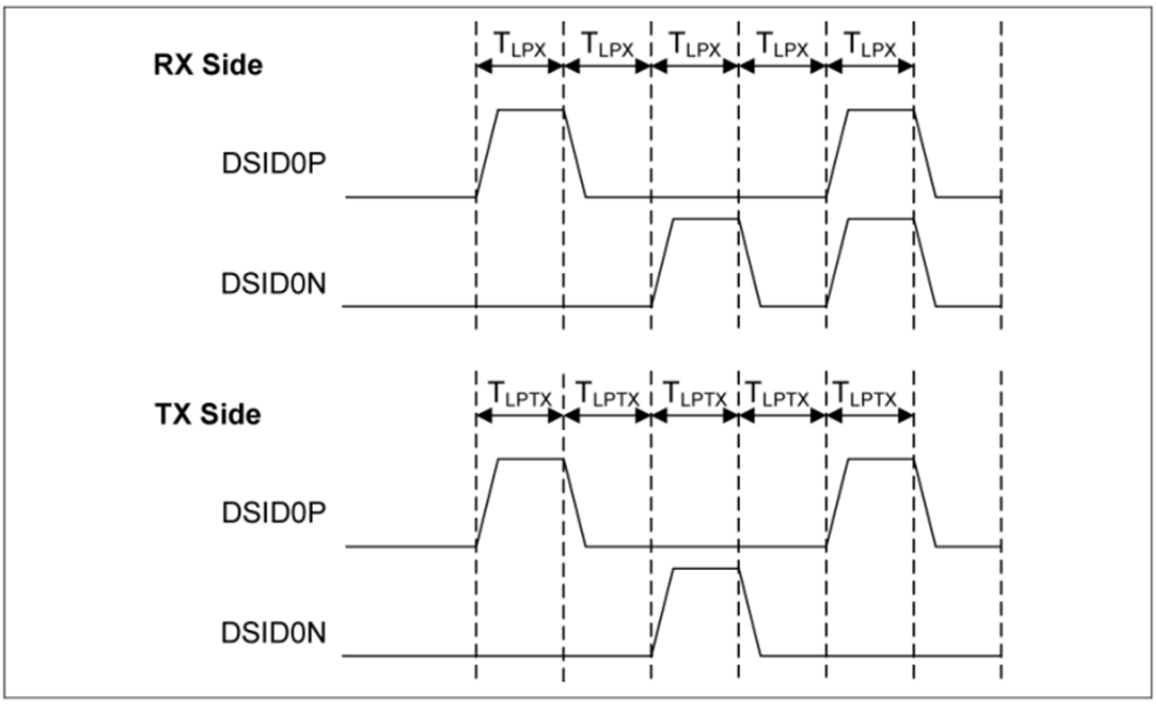


Fig.6 **DSI LP Mode(Rx/Tx)**

8-2.Reset Timing Characteristics

Table 8-4 Ta=-20℃～60°C, IOVCC =1.65～1.95V, VCI=2.8V, GND=0V

Item	Symbol	Condition	Min.	Typ	Max.	Unit	Note
Reset low-level width 1	tRW1	Power supply On	1000	-	-	us	
Reset low-level width 2	tRW2	Operation	12	-	-	us	
Reset time (Sleep IN)	tRT1		-	-	3.5	ms	
Reset time (Sleep OUT)	tRT2				3.5	ms	
Noise reject width	tRESNR				5	us	

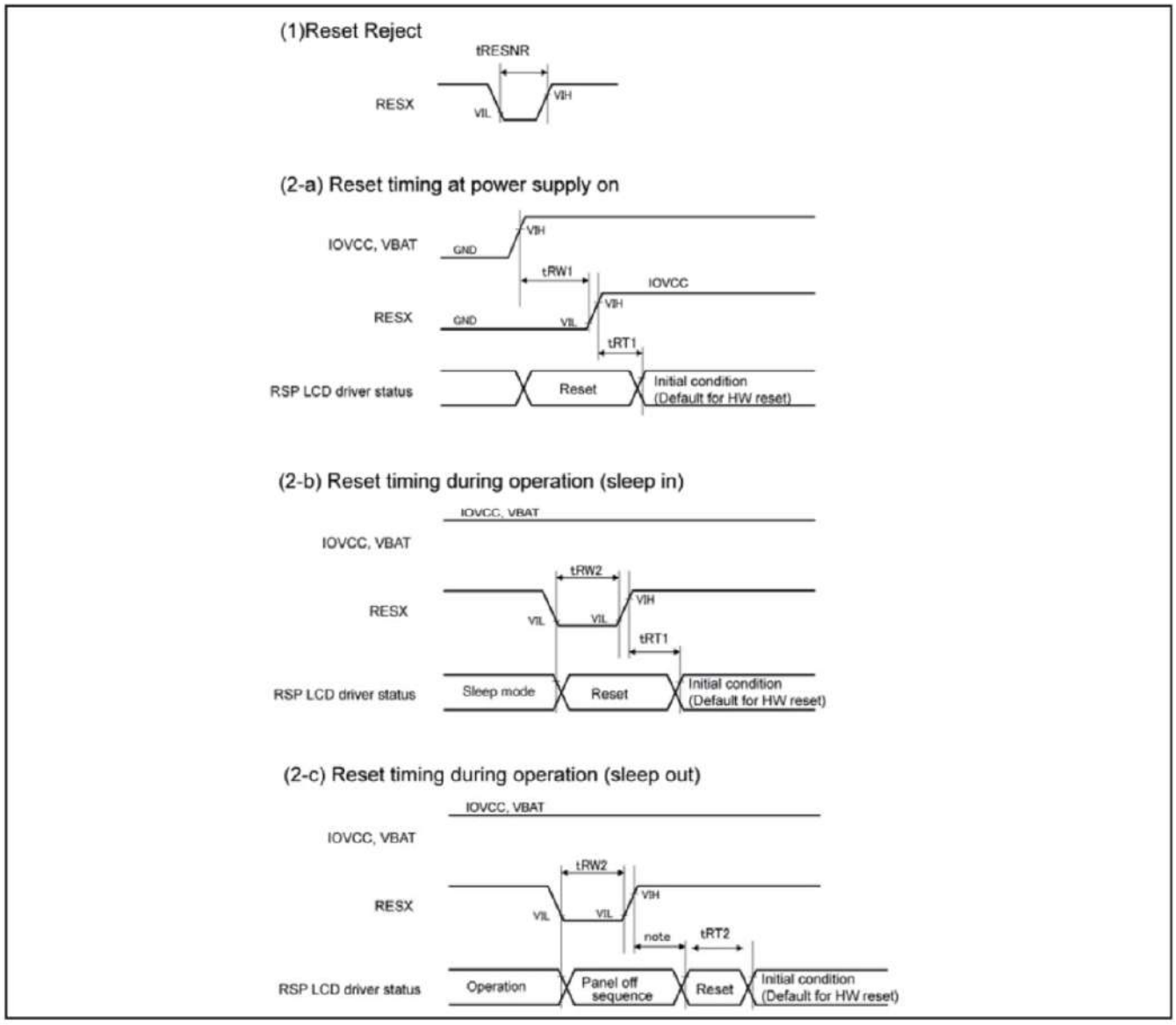


Fig.7 **Reset Timing Characteristics**

8-3. General Timing Diagram

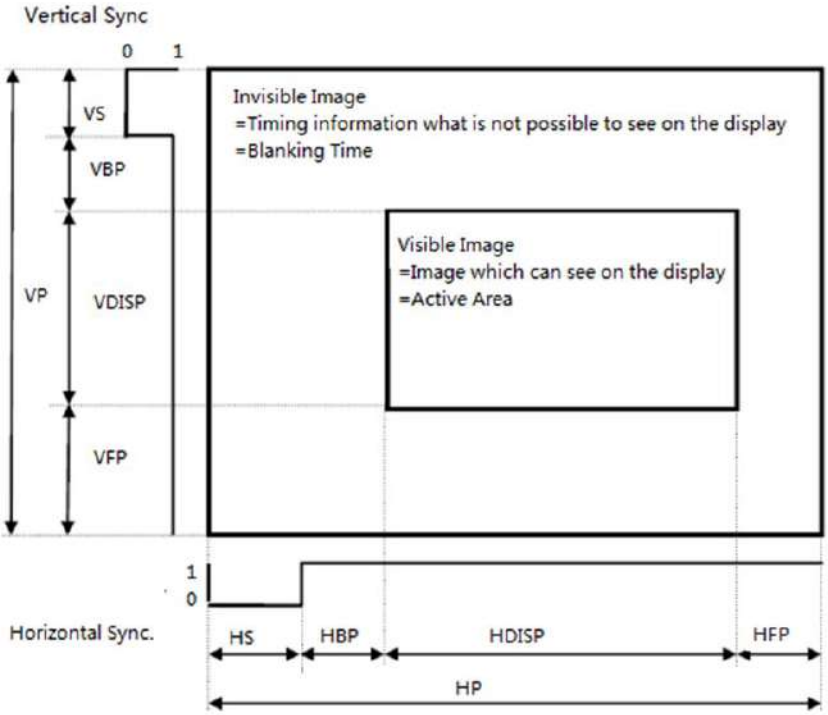


Fig.8

8-4. Vertical Timing.

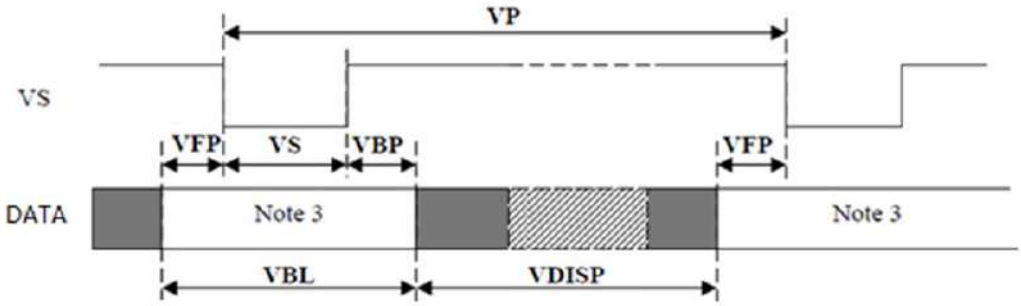


Fig.9

Table 8-5

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Vertical cycle	VP		-	1305	-	Line
Vertical low pulse width	VS		-	1	-	Line
Vertical front porch	VFP		-	13	-	Line
Vertical back porch	VBP		-	11	-	Line
Vertical data start point		VS+VBP	-	12	-	Line
Vertical blanking period	VBL	VFP+VS+VBP	-	25	-	Line
Vertical active area		VDISP	-	1280	-	Line
Vertical Refresh Rate	VRR		57	60	63	Hz

Ta = -20 °C ~ +60°C, IOVCC= 1.8 V, VCI=2.8V, GND = 0 V

8-5. Horizontal Timing

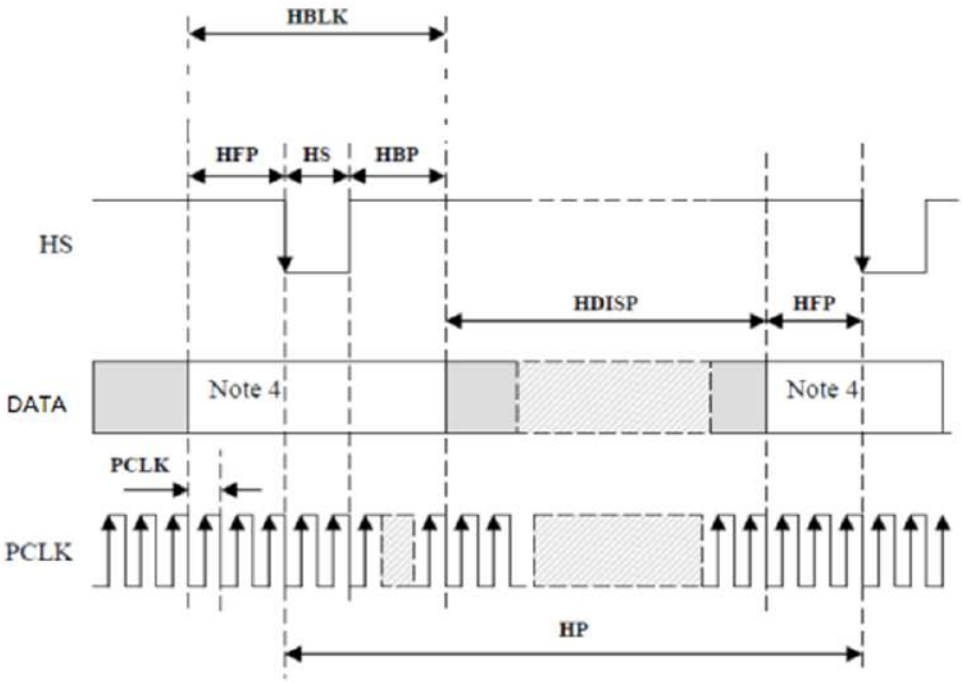


Fig.10

Table 8-6

Item	Symbol	Conditions	Typ.	Unit
HS cycle	HP		870	PCLK
HS low Pulse width	HS		10	PCLK
Horizontal back porch	HBP		40	PCLK
Horizontal front porch	HFP		100	PCLK
Horizontal data start point		HS+HBP	50	PCLK
Horizontal blanking period	HBLK	HFP+HS+HBP	150	PCLK
Horizontal active area	HDISP		720	PCLK
1 Horizontal timing			12.794	us
Pixel clock frequency	PCLK		14.70	ns
			68.0	MHz
MIPI Speed(4 lane)	-	-	440	Mbps/lane

Ta = -20 °C ~ +60°C, IOVCC= 1.8 V, VCI=2.8V, GND = 0 V

9. Power Sequence

9-1 Power On Sequence

Condition ⚠1

I/F:MIPI DSI 4Lane,Video Mode
Dots Size : 720 x RGB x 1280
Power Supply:IOVCC=1.8 V, VCI=2.8V
Color Mode:24bit
Frame frequency :TYP 60Hz

ITEM	Modified Driver IC		REMARK
	Register Address	Register Data list	
Reset (RESET="L")			
IOVCC=1.8V			
WAIT MIN.1ms	(wait to IOVCC=90%,depends on Power Supply Circuit)		
VCI= 2.8V			
WAIT MIN.10ms			
RESET(L⇒H)			
WAIT MIN.10ms			[Automatic] Sleep Mode On
[Automatic] NVM Auto load			
[Automatic] Sleep Mode On			
Display On	Command	29h	DCS no Param(0x05)
SLPOUT	Command	11h	
DSI Video mode transfer start			
WAIT MIN 6frame (120ms)			
WAIT 20ms			
BackLight ON			

9-2 Power Off Sequence

(Normal->power off)

ITEM	Register Address	Register Data list	REMARK
BackLight OFF			
DISPOFF	Command	28h	
WAIT MIN 1V (20ms)			
SLP IN	Command	10h	
WAIT Min 4V (80ms)			For Power Down
DSI Video mode transfer stop			
WAIT Min 1 frame(20ms)			
VCI OFF			
WAIT (10ms)			
HW RESET (RESET='L')			
WAIT (8ms)			
IOVCC OFF			

9-3 Deep Standby Sequence

(Normal-> Deep Standby)

ITEM	Register Address	Register Data list	REMARK
Display Off			
DISPOFF	Command	28h	
WAIT MIN 1V (20ms)			
SLP IN	Command	10h	
WAIT Min 4V (80ms)			For Power Down
Protect off	Command	B0h	Generic Short Packet(0x23)
	P1	00h	
Deep Stanby	Command	B1h	Generic Short Packet(0x23)
	P1	01h	
DSI Video mode transfer stop			
HW RESET (RESET='L')			

9-4 Exit Deep Standby Sequence 

(Deep Standby -> Normal)

ITEM	Register Address	Register Data list	REMARK
Deep Standby State			
RESET(L⇒H)			
WAIT MIN 10ms			
[Automatic] NVM Auto load			
[Automatic] Sleep Mode On			
Display On	Command	29h	DCS no Param(0x05)
SLPOUT	Command	11h	
DSI Video mode transfer start			
WAIT MIN 6V (120ms)			
WAIT 20ms			
BackLight ON			

10. Input Signals, Basic Display Colors and Gray Scale of Each Color

Table 10-1

	Colors & Gray Scale	Gray Scale	Data signals																							
			R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3	B4	B5	B6	B7
			LSB							MSB	LSB							MSB	LSB							MSB
Basic Color	Black	–	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	–	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Green	–	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Cyan	–	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Red	–	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	–	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	–	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	White	–	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gray Scale of Red	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	GS1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	GS2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	↓					↓								↓								↓			
	⇩	↓					↓								↓								↓			
	Brighter	GS253	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇩	GS254	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	GS255	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale of Green	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	GS1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	GS2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	↓					↓								↓								↓			
	⇩	↓					↓								↓								↓			
	Brighter	GS253	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	⇩	GS254	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Green	GS255	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Gray Scale of Blue	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	GS1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	Darker	GS2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	⇧	↓					↓								↓								↓			
	⇩	↓					↓								↓								↓			
	Brighter	GS253	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1
	⇩	GS254	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
	Blue	GS255	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

Low level voltage, 1: High level voltage

Each basic color can be displayed in 256 gray scales from 8 bit data signals. According to the combination of total 24 bit data signals, the 16,777,216-color display can be achieved on the screen.

11. Optical Characteristics

11-1 Driving the Back Light Condition

Table 11-1 Ta=+25°C

Optical Characteristics							
Parameter	symbol	condition	MIN	TYP	MAX	unit	Remark
Brightness	Br	θ=0°		500	-	cd/㎡	Note1,2
Contrast	Co	θ=0°	700	1000	-		Note1,3
Viewing Angle	θ11	CR > 10		80	-	deg	Note1
	θ12			80	-		
	θ21			80	-		
	θ22			80	-		
Response Time	(τr+td)	θ=0°	-	-	35	ms	Note1,4
White chromaticity	x	θ=0°	0.270	0.300	0.330		Note.1,3
	y		0.290	0.320	0.350		
Red	x	θ=0°	0.610	0.640	0.670		Note.1,3
	y		0.309	0.339	0.369		
Green	x	θ=0°	0.276	0.306	0.336		Note.1,3
	y		0.573	0.603	0.633		
Blue	x	θ=0°	0.120	0.150	0.180		Note.1,3
	y		0.032	0.062	0.092		
Uniformity	-	θ=0°	-	80%	-	%	Note.5
NTSC ratio	-	θ=0°	-	70%	-	%	Note.1
Flicker	F	θ=0°	-	-	-25	dB	Note.6
Crosstalk	CT	θ=0°	-	-	6	%	Note.7

*A measurement device is TOPCON luminance meter SR-3. (Viewing cone1.)

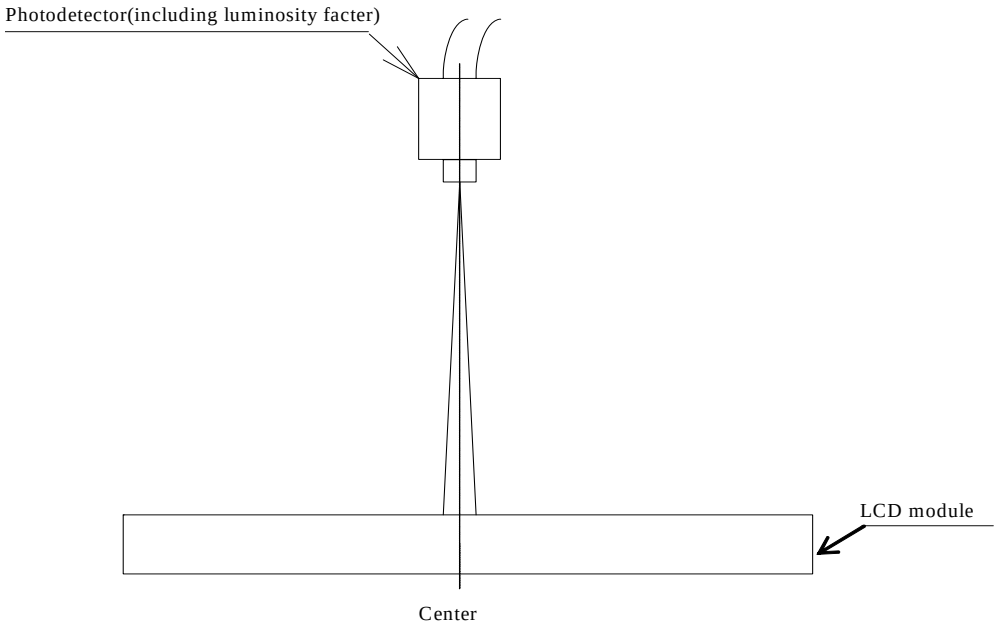


Fig.11 **Measuring method for optical characteristics**

【Note 11-1】Contrast / Viewing angle is defined as follows.

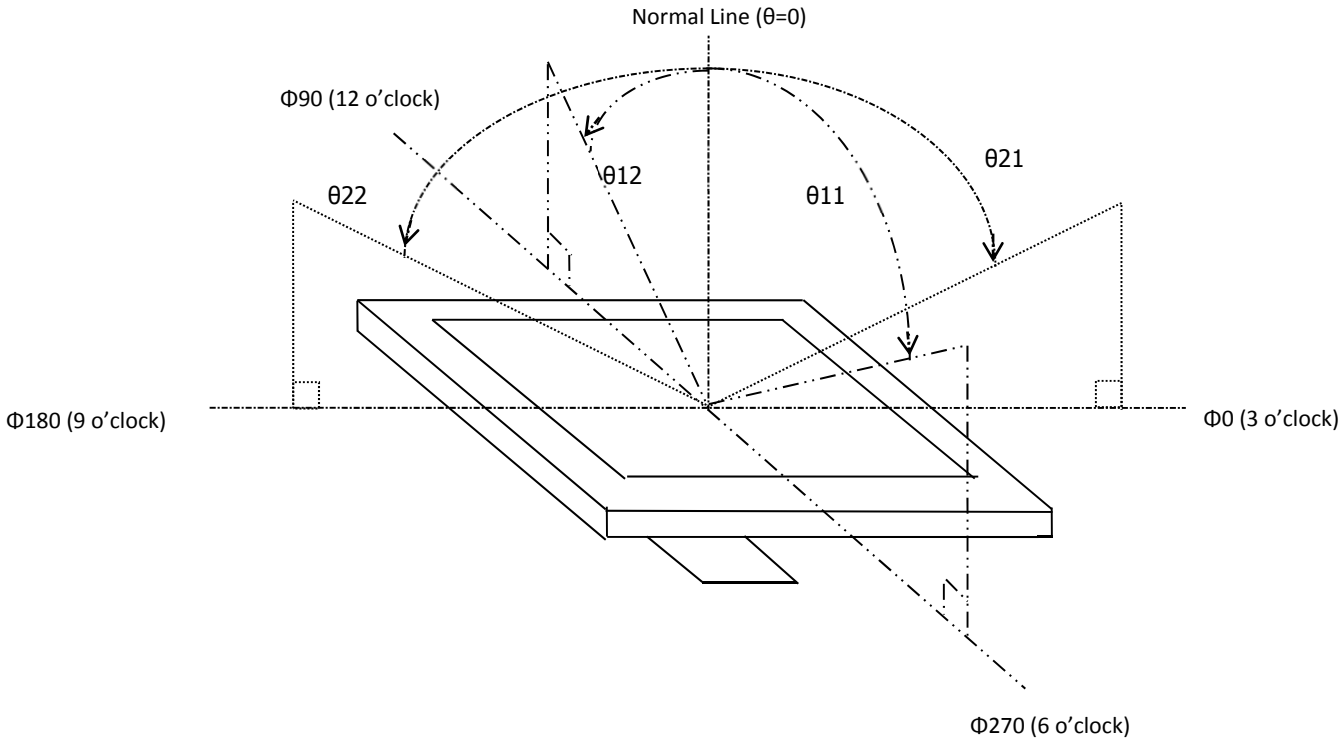


Fig.12

【Note 11-2】Definition of contrast ratio:

The contrast ratio is defined as the follows:

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance (brightness) with all pixels white}}{\text{Luminance (brightness) with all pixels black}}$$

【Note 11-3】Definition of response time:

The response time is defined as the following figure and shall be measured by switching the input signal for “black” and “white”

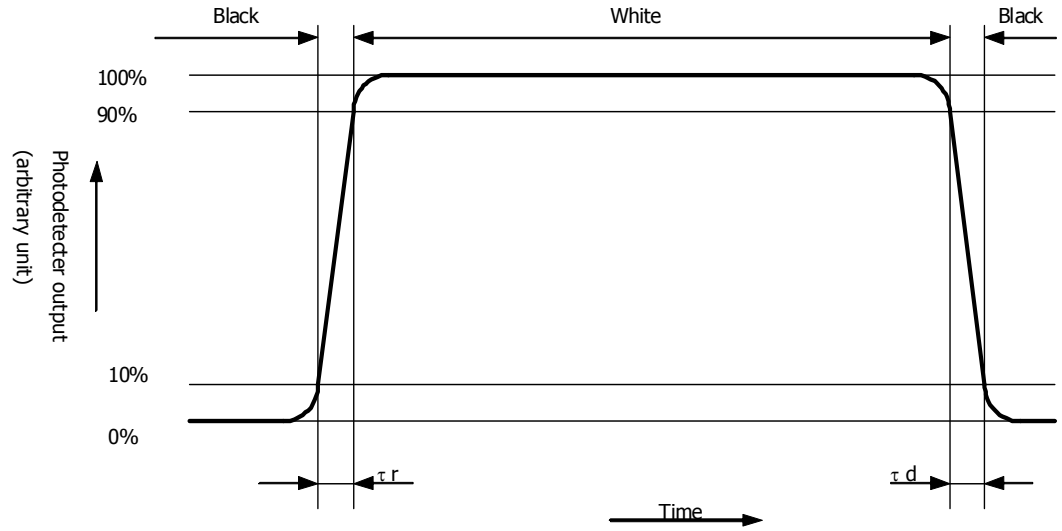


Fig.13

【Note 11-4】Definition of Uniformity.

$$\text{Uniformity} = \frac{\text{MinimumBrightness}}{\text{MaximumBrightness}} \times 100\,(\%)$$

The brightness should be measured on the 9-points as shown in the following figure.

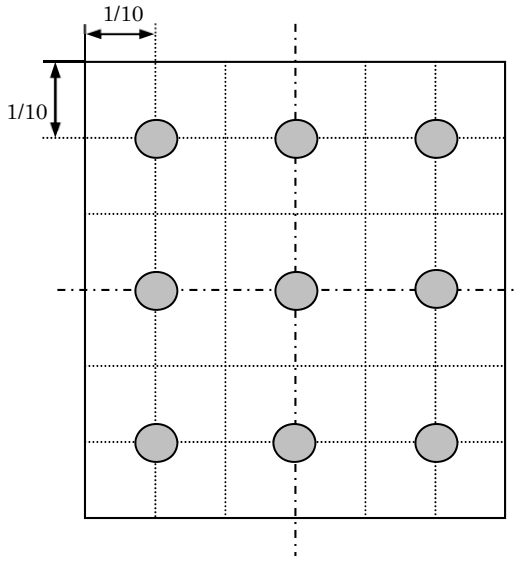


Fig.14

【Note 11-5】Definition of Crosstalk

$$CT = \frac{|Y_W(x_i) - Y_G(x_i)|}{Y_G(x_i)} \times 100\,(\%)$$

x=U,D,L,R

i:Gray Level =V127/V255

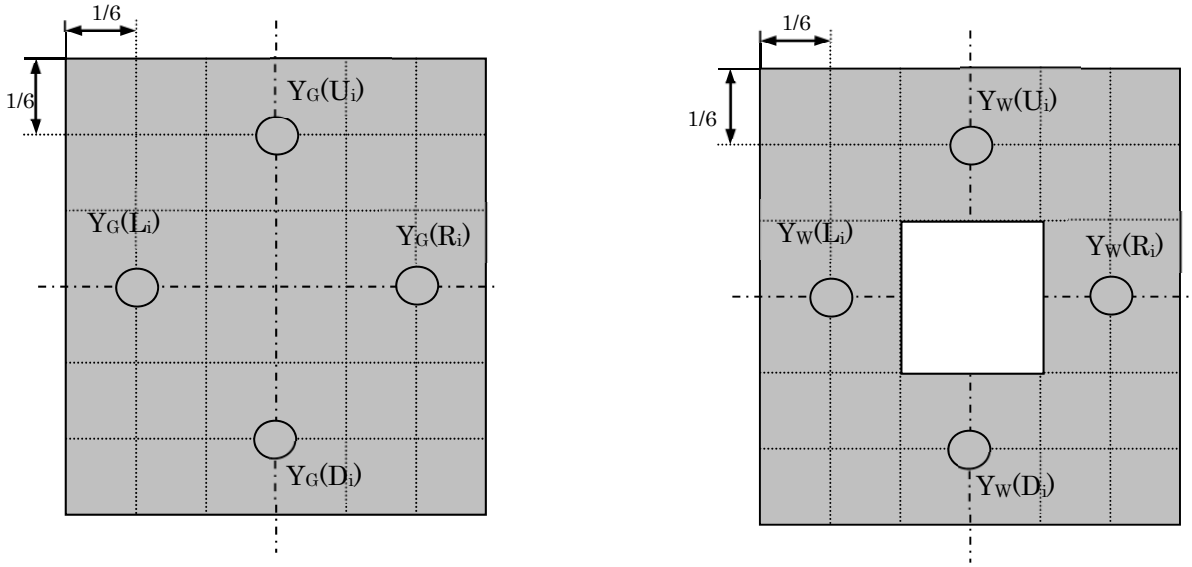


Fig.15

【Note 11-6】Measuring systems: YOKOGAWA 3298_01 + 3298_11

・Temperature = 25℃(±3℃), Frame Frequency = 53Hz~63Hz, LED back-light: ON, Environment brightness < 150 lx

・Measured sample : New sample before a long term aging.

・A measurement point is panel center.

Conversion of Flicker ratio: Flicker[dB]=20log(ACrms/DC)

・Measuring pattern Please refer to figure below.

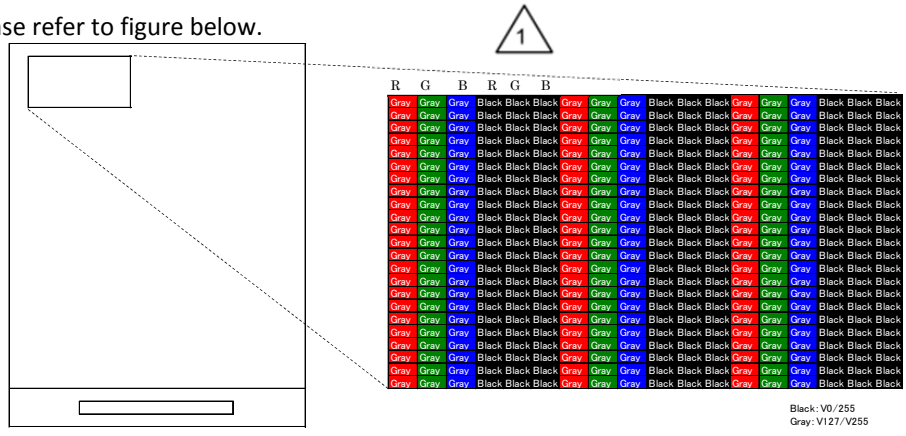


Fig.16

12. Reliability Test Items

Table 12-1

No.	Test	Condition	Judgment criteria
1	Temperature Cycling	Ta = -30 ° C (30min) ～ 70 ° C(30min), 20cycle	Per table in below
2	Humidity Storage	Ta = +40℃ 95%RH, 240h	Per table in below
3	High Temp. Storage	Ta= 70℃ 240h	Per table in below
4	Low Temp. Storage	Ta=-30℃ 240h	Per table in below
6	High Temp. Operation	Ta= 60℃ 240h	Per table in below
7	Low Temp. Operation	Ta=-20℃ 240h	Per table in below
8	ESD	Discharge resistance: 0 Ω Discharge capacitor: 200 pF Discharge voltage: ±200 V Max Discharge 1 time to each input line ※ "GND" of display module is connected GND of test system ground.	Per table in below

*Ta = Ambient temperature

* Check items for other Test

In the standard condition, there shall be no practical problems that may affect the display function.

13. Packaging specifications

(10-1) Details of packaging

1) Packaging materials: Table 10-2

2) Packaging style : Fig. 17、18

(10-2) Reliability

1) Vibration test

Table.10-1

Item	Test			
Frequency	5 Hz to 50 Hz (3 minutes cycle)			
Direction	Up-Down, Left-Right, Front-Back (3 directions)			
Period	Up-Down	Left-Right	Front-Back	Total
	60min	15min	15min	90min

The frequency should start at 5 Hz and vary continuously.

Total amplitude 20mm 0.2mm 20mm 0.2mm

Frequency 5 Hz 50 Hz 5 Hz 50 Hz (For 9.8m/s^2)

2) Drop test

Drop height: 750mm

Number of drop: 10 times (Drop sequence: 1 corner, 3 edges, 6 faces)

(10-3) Packaging quantities

2 160 modules per master carton

(10-4) Packaging weight

2 About 11kg

(10-5) Packaging outline dimensions

530 mm×365 mm×279mm (H) 1

(Packaging materials)

Table.10-2

	Parts name	CRITERION(after test)
1	Master carton	Corrugate card board
2	Inside sleeve	Corrugate card board
3	Outside sleeve	Corrugate card board
4	Tray for packaging	Polystyrene with anti-static treatment +anti-static polystyrene
5	Protective bag	2 aluminum bag
6	OPP tape	Polypropylene
7	Bar code label	anti-static polystyrene
2 8	Deoxidizer	removal of oxygen

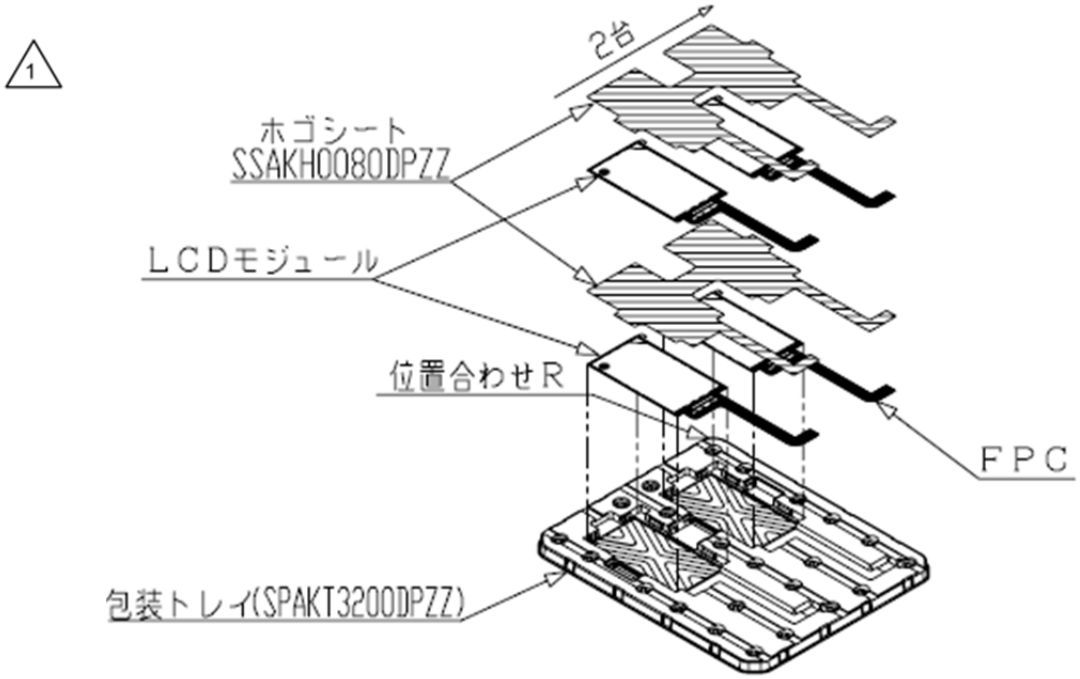
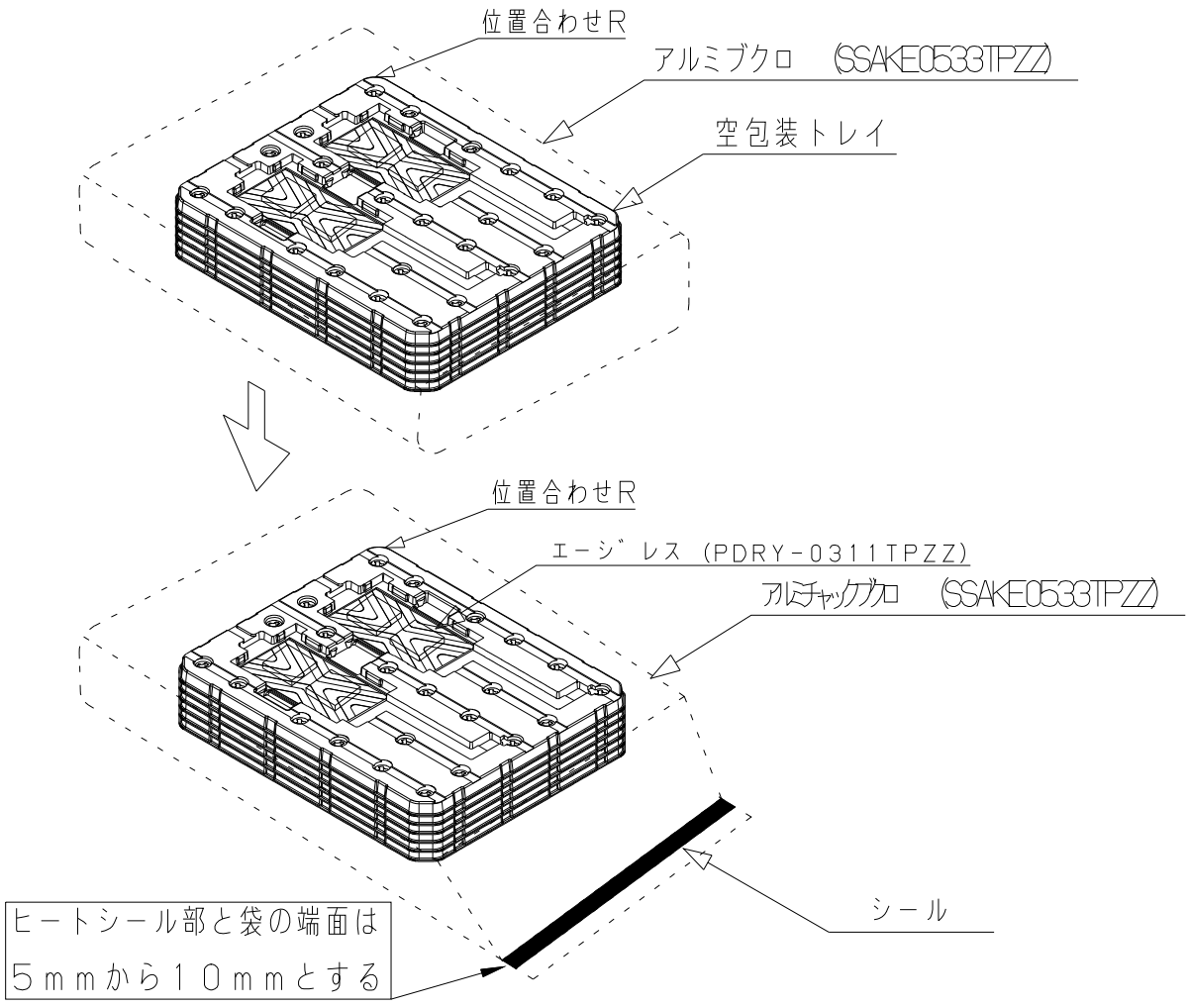
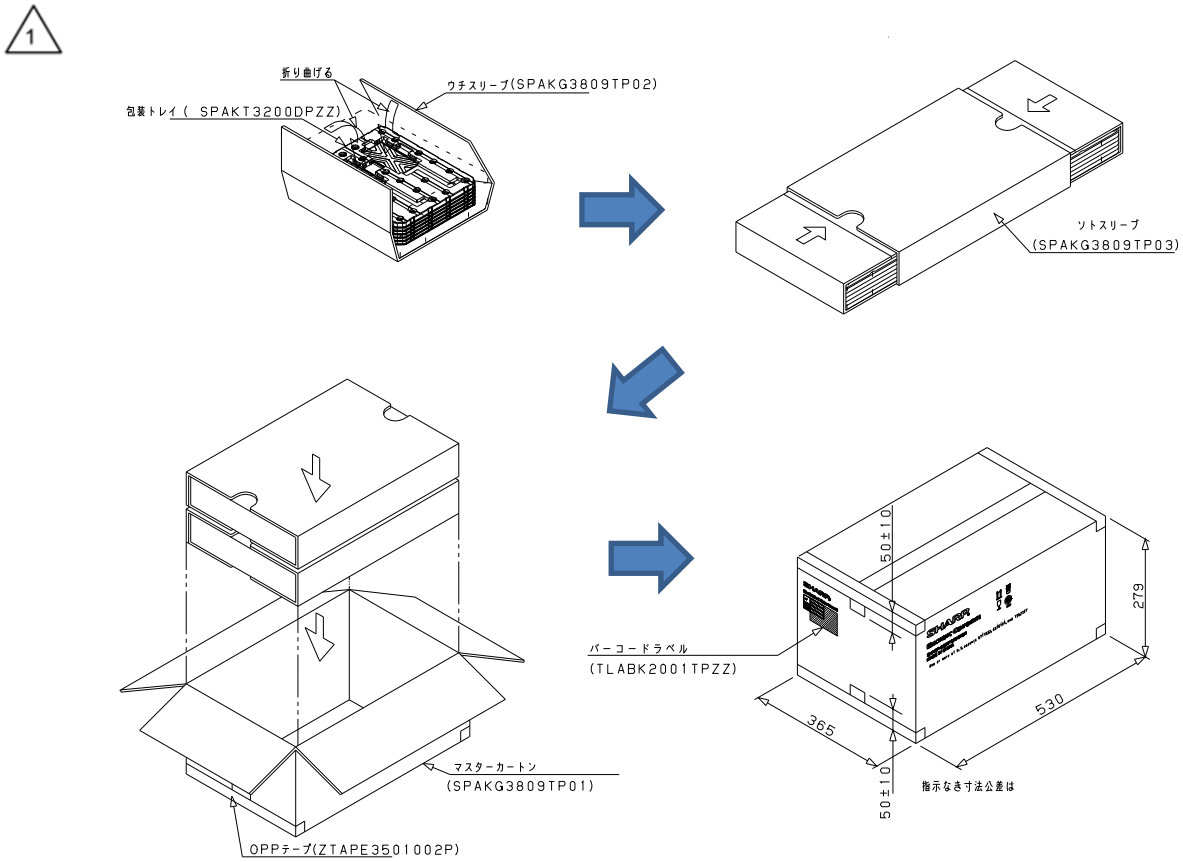


Fig.17 **Packaging style (Tray for packaging)**





Bar code lable

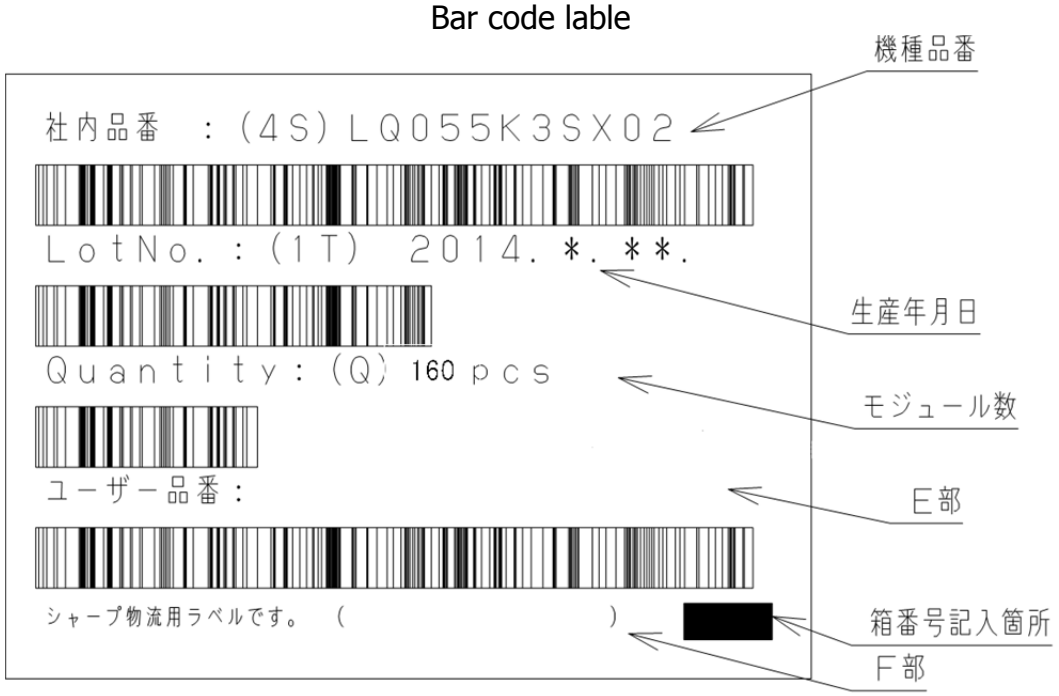


Fig.18 Packaging style (Master carton for packaging)

14. Serial Number Label identification

Numbering is specified as follows.

LQ055K3SX02 4 3 A 0000001 A Q

① ②③④ ⑤ ⑥⑦

①LCD Module Code

②product year (lower 1 digits)

4: 2014

5: 2015

③product month

1: January
2: February
3: March
:
9: September
X: October
Y: November
Z: December

④Line number

A ～ Z、0 ～ 9

⑤serial number

0000001 ～ 9999999

⑥Version number

⑦factory code

15. Outline dimensions

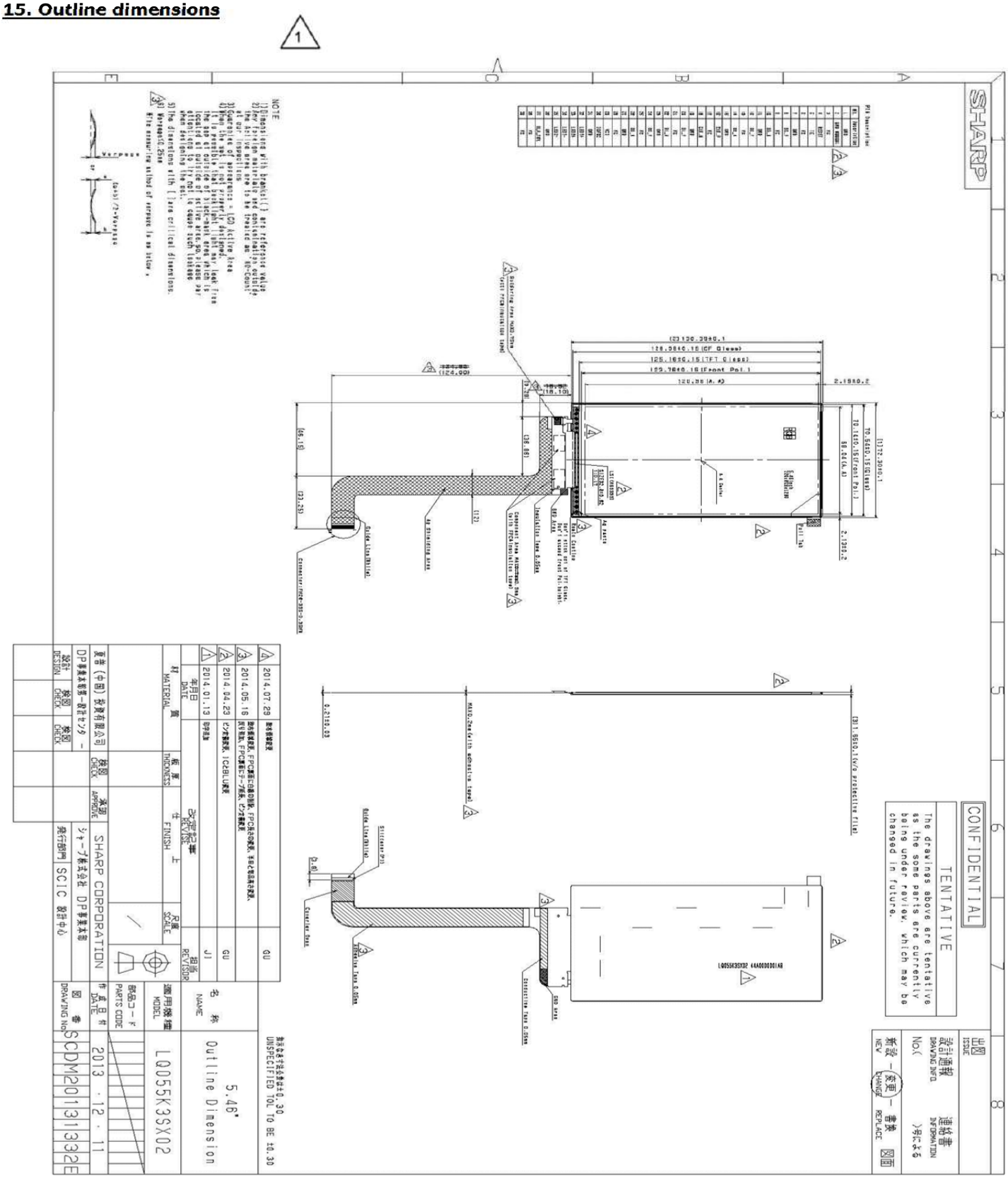
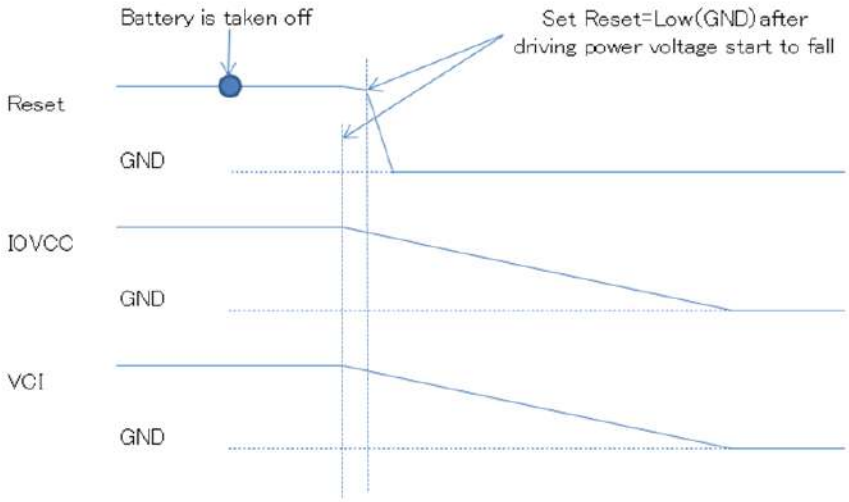


Fig. 19 Outline dimensions

※ Appendix1 ⚠1

About abnormal off condition

When user system's battery is taken off or system is hanged up or any other abnormal conditions(※1), LCD module won't action normally. LCD drive Power(※2) will be discharged slowly to power down. Please set RESET=Low(GND) after driving power voltage start to fall .



(※1) These conditions don't contain POWER OFF Sequence(9-2) and Deep Standby in mode (9-3)

(※2)drive power： IOVCC/VCI