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SPECIFICATION

DEVICE SPECIFICATION for
TFT LCD Module
(2160x2(RG,GB,BR)x3840 dots)

Model No.

LS055D1SX05(G)

☐CUSTOMER'S APPROVAL

DATE _____

BY _____

PRESENTED
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[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 counter measure (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

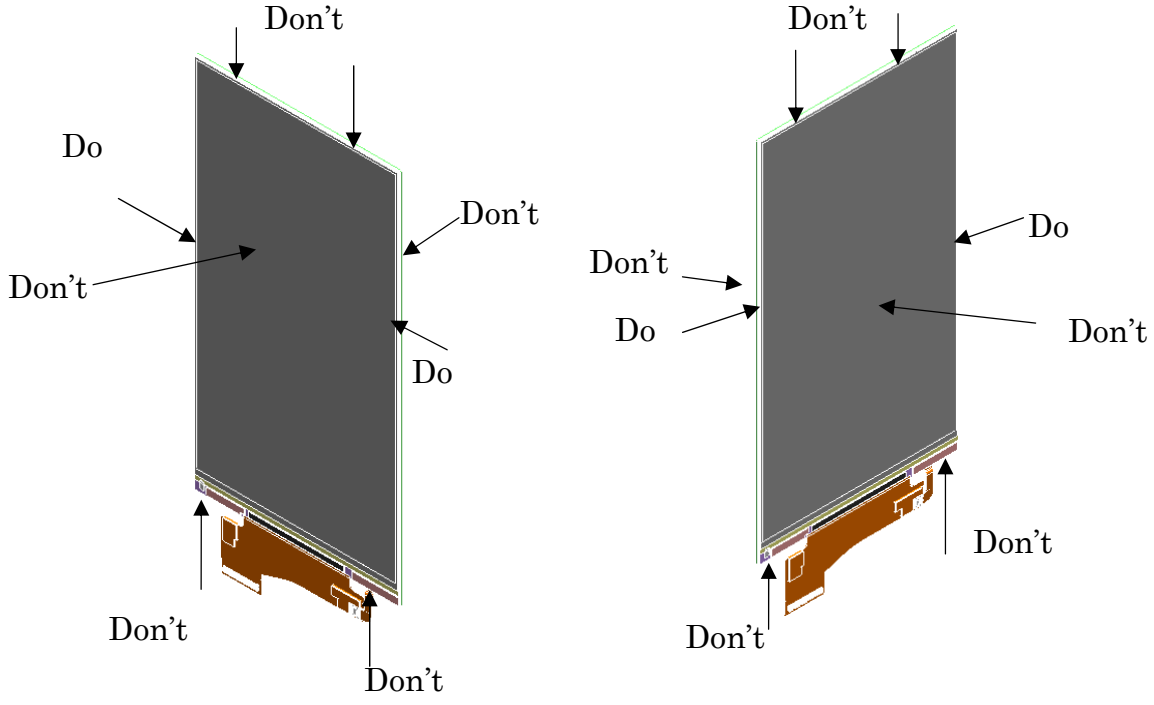
Protective film is attached on the surface of LCD panel to prevent scratches or other damages. When removing this protective film, remove it slowly under proper anti-ESD control such as ion blower.

(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.

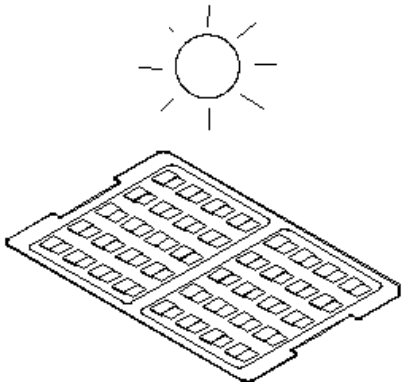
[Precautions for Storage]

(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

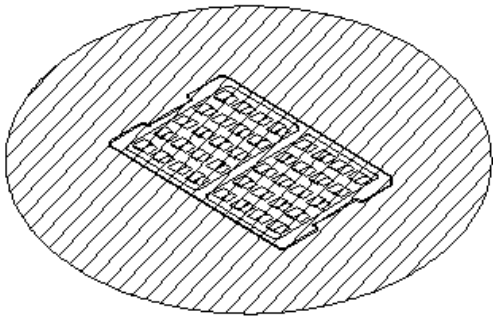
a. Don't keeping under the direct sunlight.

b. Keeping in the tray under the dark place.

DON'T



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 (VDDIO-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.

[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 LS055D1SX05 active matrix 16,777,216 color LCD module.
Main color LCD module is controlled by Driver IC (NT35950 with 1/3 RAM).
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 and touch controller refer to the each specification and handbook.

2. Construction and Outline

Construction: LCD panel Driver (COG), and electric components,
18 White LED lumps, prism sheet, diffuser, light guide and reflector, plastic frame and PET Sheet to fix them mechanically.
Outline: See page 31
Connection: B to B connector (FB35-RC60-3A 60 pins)
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 1

Parameter		Specifications	Unit
Outline dimensions (typ)		69.84 (W) x 128.76 (H) x1.24 (D)	mm
Main LCD Panel	Active area	68.04 (W)×120.96 (H)	mm
	Display format	2160 (W)x 2(RG,GB,BR) x 3840(H)	-
	Dot pitch	0.01575(W) x 0.0315(H)	mm
	Base color *1	Normally Black	-
Mass		Approx 17.0	g

*1 Due to the characteristics of the LC material, the colors vary with environmental temperature.

4. Absolute Maximum Ratings

(4-1) Electrical absolute maximum ratings

Table 2 Ta=25 ℃

Parameter	Symbol	Min	Max	Unit	Remark
Supply Voltage	VDDI_LCD-GND	-0.3	+4.0	V	*1,2
	DVDD	+1.29	+1.4	V	*2,3
	VSP-GND	+4.5	+6.3	V	*1,2
	VSN-GND	-6.3	-4.5	V	*1,2

*1)VDDI=1.70to2.05V,VSP=4.5~6.3V,VSN=-4.5~-6.3V, DVSS=DVSS1=DVSS2=AVSS=VSSAM1=VSSAM2=0V, DVDD/DVDD1/DVDD2=Based on NVT setting, Ta=-30 to 70 ºC (to +85 ºC no damage).

* 2) When the measurements are performed with module, measurement points are like below.

* 3) DVDD=DVDD1=DVDD2=external DVDD input voltage when EXT_DVDD_EN="1".

(4-2) Environment Conditions

Table 3

Item	Top		Tstg		Remark
	MIN.	MAX.	MIN.	MAX.	
Ambient temperature	-20 °C	+60°C	-30 °C	+70°C	Note 2)
Humidity	Note 1)		Note 1)		No condensation

Note1) Ta ≤ 40 °C.....95 % RH Max

Note2) Ta > 40 °C.....Absolute humidity shall be less than Ta=40 °C /95 % RH.

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.

Be sure not to exceed the rated voltage, otherwise a malfunction may occur.

5. Electrical Specifications

(5-1) Absolute Maximum Ratings (LCD Module)

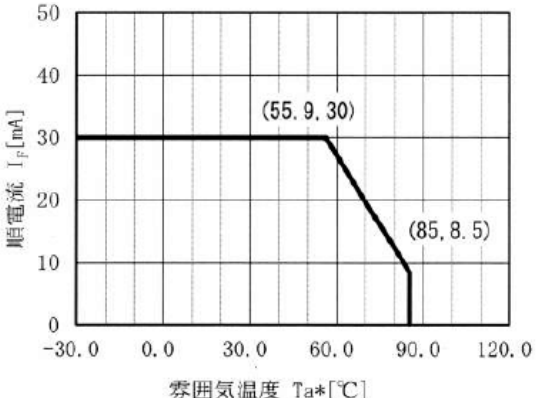
T_{AMB}=+25C, Frm=60Hz

ITEM	Symbol	MIN.	MAX.	Unit
Supply voltage range VDDI	V_{VDDI}	-0.3	2.15	V
Supply voltage range DVDD	V_{DVDD}	-0.3	1.45	V
Storage temperature	T_{stg}	-30	+80	C
Supply voltage range VSP	V_{VSP}	-0.3	6.6	V
Supply voltage range VSN	V_{VSN}	-6.6	+0.3	V
Input voltage range	V_{IN}	-0.3	VDDI+0.3	V
Operating temperature [#1]	T_{op}	-20	+60	C
LED Input electric current[#2]	I_{LED}	--	25	mA/pcs

Notes:

[#1] Optical specs do not need to be met beyond the Operating Temperature range.

[#2] Ambient temperature and the maximum input are fulfilling the following operating conditions.



#Figure 1

As shown in the derating data submitted separately, higher LED current causes lower LED characteristics vs driving period. Please supply the proper LED current in consideration of the VR glass inside temperature and the reported derating data.

(5-2)Normal Operating Range (LCD Module)

T_{AMB}=+25C, Frm=60Hz

ITEM	Symbol	Min.	Typ.	Max.	Unit
Supply voltage range VDDI (*2)	V_{VDDI}	1.75	1.85	1.95	V
Supply voltage range DVDD (*2)	V_{VDDI}	1.34	1.36	1.38	V
Supply voltage range VSP (*2)	V_{VSP}	5.6	5.8	6.0	V
Supply voltage range VSN (*2)	V_{VSN}	-5.8	-5.6	-5.4	V
Output voltage range low @ Iout=1mA	V_{ol1}	GND	--	$0.2*V_{VDDI}$	V
Output voltage range high @ Iout=1mA	V_{oh1}	$0.8*V_{VDDI}$	--	V_{VDDI}	V
Input voltage range low(RESX)	V_{il1-R}	GND	--	$0.2*V_{VDDI}$	V
Input voltage range high(RESX)	V_{ih1-R}	$0.8*V_{VDDI}$	--	V_{VDDI}	V
Input voltage range low(Except RESX)	V_{il1}	GND	--	$0.3\ V_{VDDI}$	V
Input voltage range high(Except RESX)	V_{ih1}	$0.7\ V_{VDDI}$	--	V_{VDDI}	V
Input current	I_{inh1}	--	--	1	uA
	I_{iol1}	-1	--	--	uA
Max Load Current (2sub pix Checker)	P_{max}	--	696(*1)	839(*1)	mW
Deep Standby Mode	P_{LCD}	Not supported			
LED Current	I_{LED}	--	20	--	mA/pcs

(*1) Command mode(Still image), DVDD=1.36V, VDDI =1.85V, VSP=5.8V, VSN=-5.6V

(*2) Voltage shall be at the point of module input.

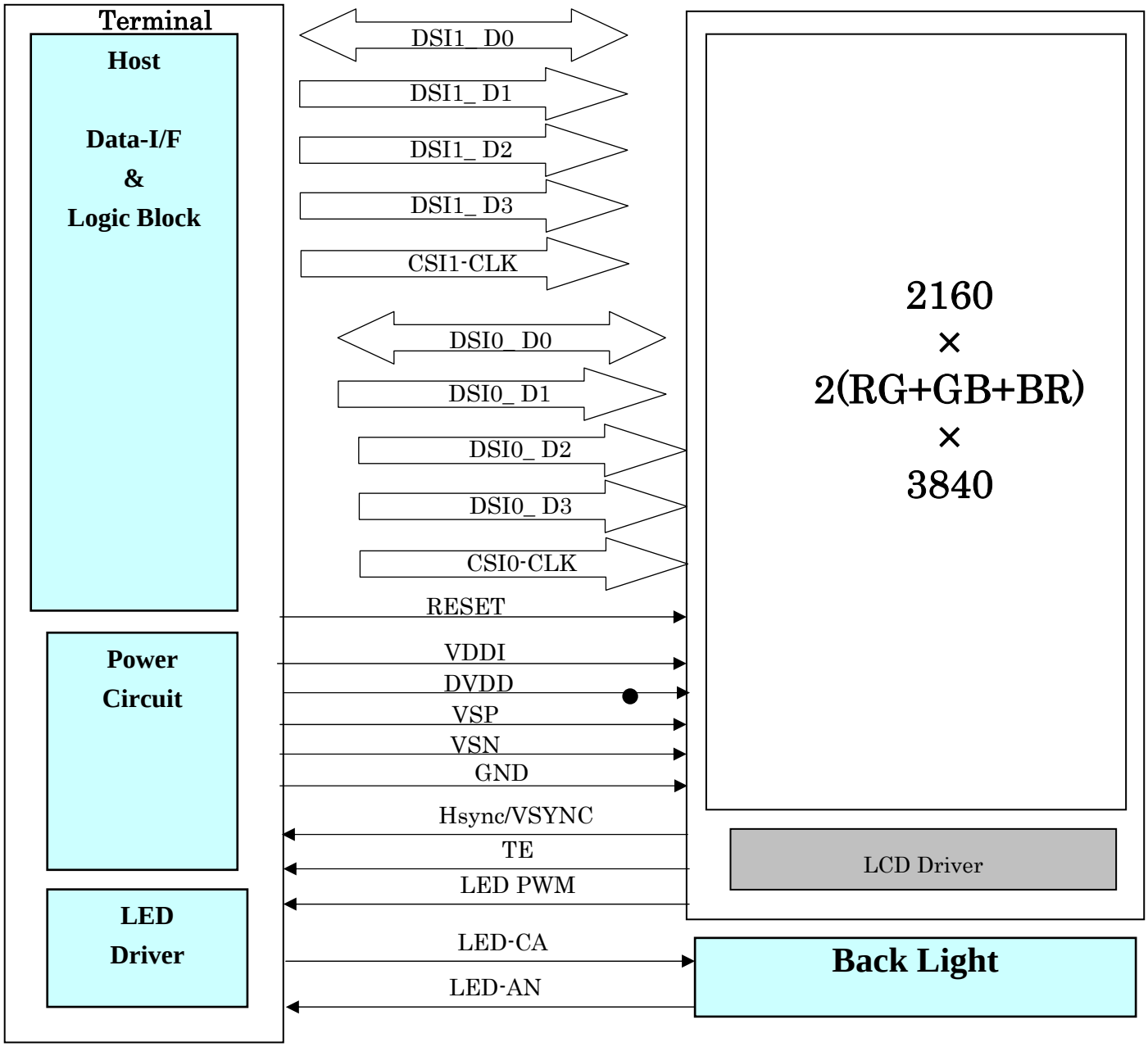
(5-3) Interface signals

Pin layout for the display BtoB connector FB35-RC60-3A

Pin No.	Pin Name	Type	Function
A1	GND	PWR	Ground
A2	ATTN	NC	-
A3	SCL	NC	-
A4	SDA	NC	-
A5	GND	PWR	Ground
A6	GND	PWR	Ground
A7	VSN	PWR	Power Supply for LCD Driver-IC (-5.6V Typ.)
A8	VSP	PWR	Power Supply for LCD Driver-IC (+5.8V Typ.)
A9	VDDI	PWR	Power Supply for LCD Driver-IC (1.85V Typ.)
A10	VDDI	PWR	Power Supply for LCD Driver-IC (1.85V Typ.)
A11	GND	PWR	Ground
A12	DSI0_D2_P	I/O	Data 2 channel+(DSI0)
A13	DSI0_D2_N	I/O	Data 2 channel-(DSI0)
A14	GND	PWR	Ground
A15	DSI0_CLK_P	I	Clock channel+(DSI0)
A16	DSI0_CLK_N	I	Clock channel-(DSI0)
A17	GND	PWR	Ground
A18	DSI0_D3_P	I/O	Data 3 channel+(DSI0)
A19	DSI0_D3_N	I/O	Data 3 channel-(DSI0)
A20	GND	PWR	Ground
A21	DSI1_D1_P	I/O	Data 1 channel+(DSI1)
A22	DSI1_D1_N	I/O	Data 1 channel-(DSI1)
A23	GND	PWR	Ground
A24	DSI1_D0_P	I/O	Data 0 channel+(DSI1)
A25	DSI1_D0_N	I/O	Data 0 channel-(DSI1)
A26	GND	PWR	Ground
A27	BL_THERM	NC	-
A28	GND	PWR	Ground
A29	LED_CA3	LED	LED Cathode-3
A30	LED_AN	LED	LED Anode
B1	GND	PWR	Ground

B2	VDDL	NC	-
B3	VDDH	NC	-
B4	GND	PWR	Ground
B5	GND	PWR	Ground
B6	NC	NC	-
B7	GND	PWR	Ground
B8	DVDD	PWR	Power Supply for LCD Driver-IC (1.36V Typ.)
B9	LCD_RESET	I	LCD Reset
B10	LCD_ID	NC	-
B11	VSYNC	O	Vsync signal from LCD Driver IC
B12	GND	PWR	Ground
B13	GND	PWR	Ground
B14	DSI0_D1_P	I/O	Data 1 channel+(DSI0)
B15	DSI0_D1_N	I/O	Data 1 channel-(DSI0)
B16	GND	PWR	Ground
B17	DSI0_D0_P	I/O	Data 0 channel+(DSI0)
B18	DSI0_D0_N	I/O	Data 0 channel-(DSI0)
B19	GND	PWR	Ground
B20	DSI1_D2_P	I/O	Data 2 channel+(DSI1)
B21	DSI1_D2_N	I/O	Data 2 channel-(DSI1)
B22	GND	PWR	Ground
B23	DSI1_CLK_P	I	Clock channel+(DSI1)
B24	DSI1_CLK_N	I	Clock channel-(DSI1)
B25	GND	PWR	Ground
B26	DSI1_D3_P	I/O	Data 3 channel+(DSI1)
B27	DSI1_D3_N	I/O	Data 3 channel-(DSI1)
B28	GND	PWR	Ground
B29	LED_CA1	LED	LED Cathode-1
B30	LED_CA2	LED	LED Cathode-2

(5-4) Schematic of LCD module system



#Figure 2

(5-5) Circuit Diagrams

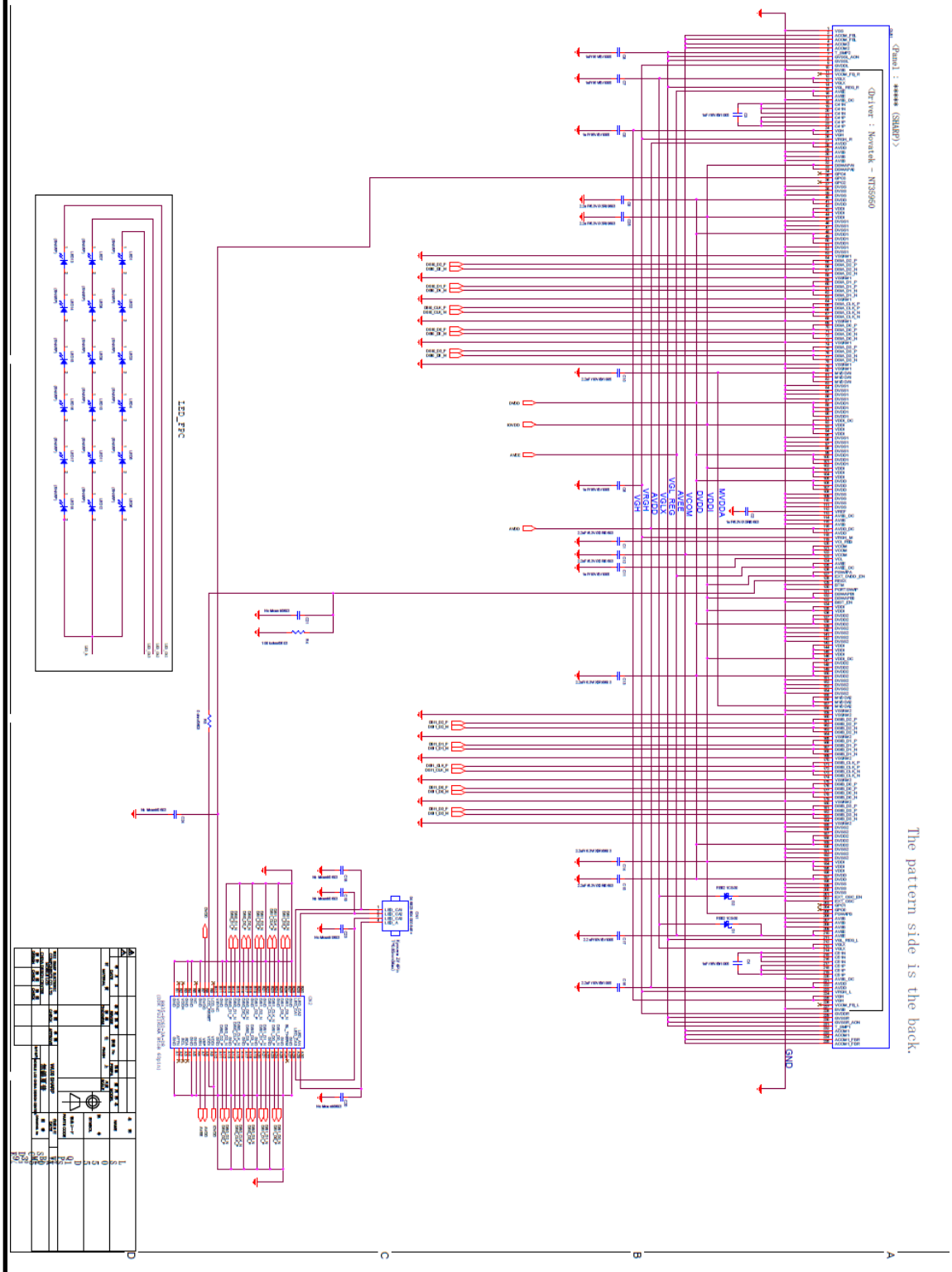
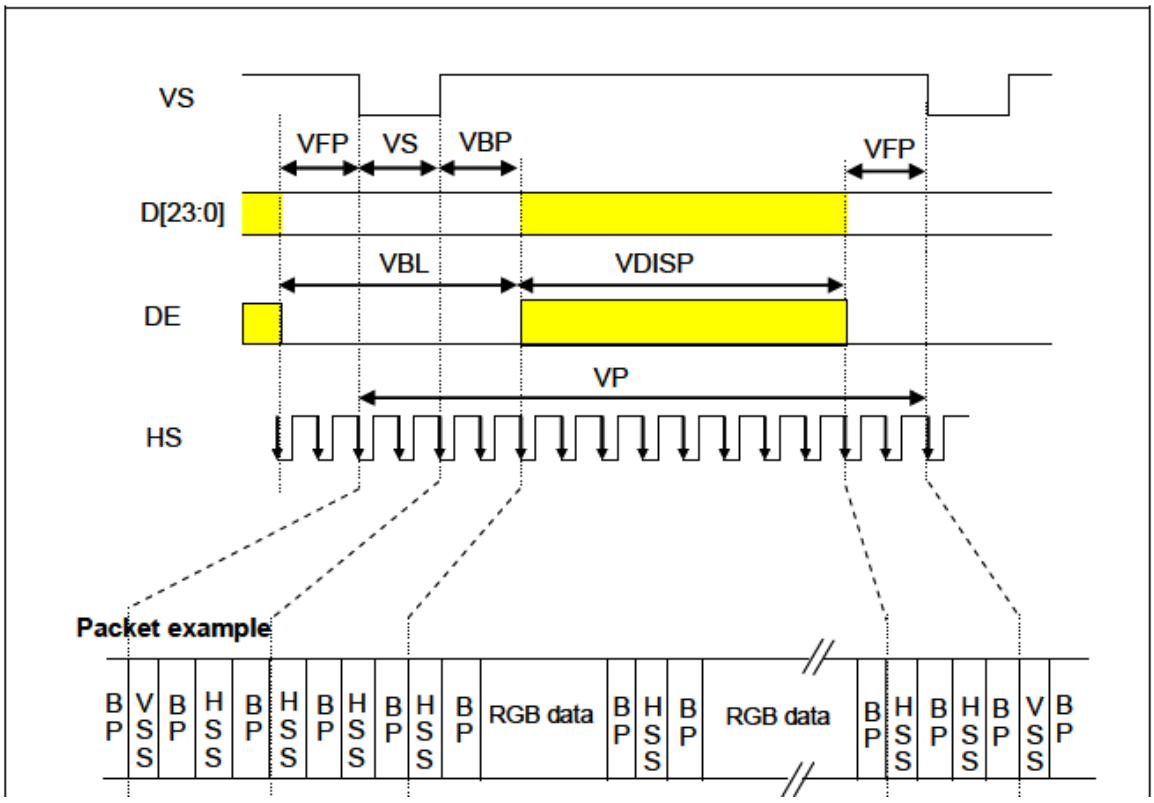


Fig.3 Circuit diagram(FPC)

6. MIPI Interface Characteristics for Video mode

(6-1) Vertical Input Timing(MIPI-DSI)

Vertical Input Timing (MIPI-DSI)



#Figure 4

GND=0V, DVDD=1.36±0.02V, VDDI =1.85±0.1V, , VSP=5.8±0.2V, VSN=-5.6+/-0.2V,T_{AMB}=+25C

UHD(FBC&VESA MODE)

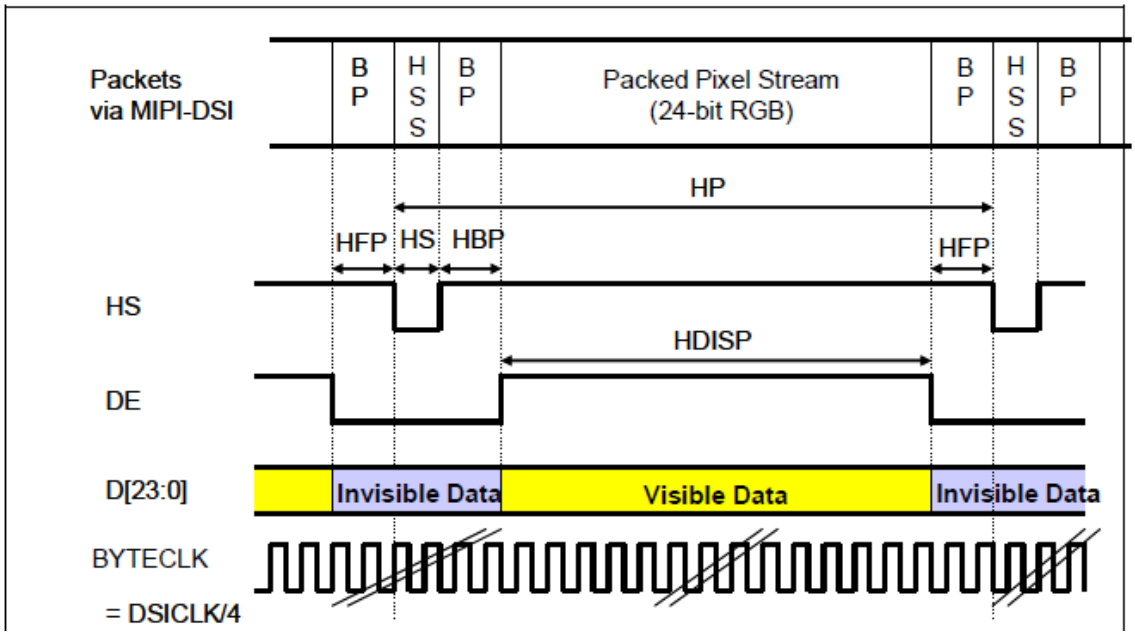
Parameter	Symbol	MIN.	Typ.	MAX.	Unit
Vertical cycle	VP	-	2	-	Line
Vertical data start point	VS+VBP	-	12	-	Line
Vertical Front Porch	VFP	-	12	-	Line
Vertical active area	VDISP	-	3840	-	Line
Vertical Refresh Rate	VRR	59	60	61	Hz

FHD(SCALING UP MODE)

Parameter	Symbol	MIN.	Typ.	MAX.	Unit
Vertical cycle	VP	-	2	-	Line
Vertical data start point	VS+VBP	-	10	-	Line
Vertical Front Porch	VFP	-	12	-	Line
Vertical active area	VDISP	-	1920	-	Line
Vertical Refresh Rate	VRR	59	60	61	Hz

※Please refer to specification of "Novatek NT35950" for detail.

Horizontal Input Timing (MIPI-DSI)



#Figure 5

GND=0V, DVDD=1.36±0.02V, VDDI =1.85±0.1V, , VSP=5.8±0.2V, VSN=-5.6+/-0.2V,T_{AMB}=+25C

UHD(FBC&VESA MODE)

Parameter	Symbol	MIN.	Typ.	MAX.	Unit
Horizontal front porch	HFP	-	105	-	BYTECLK (*1)
Horizontal data start point	HS+HBP	-	108	-	BYTECLK (*1)
Horizontal active area	HDISP	-	270	-	BYTECLK (*1)
Horizontal cycle	Hcyc	4.243	4.313	4.386	us (*2)

FHD(SCALING UP MODE)

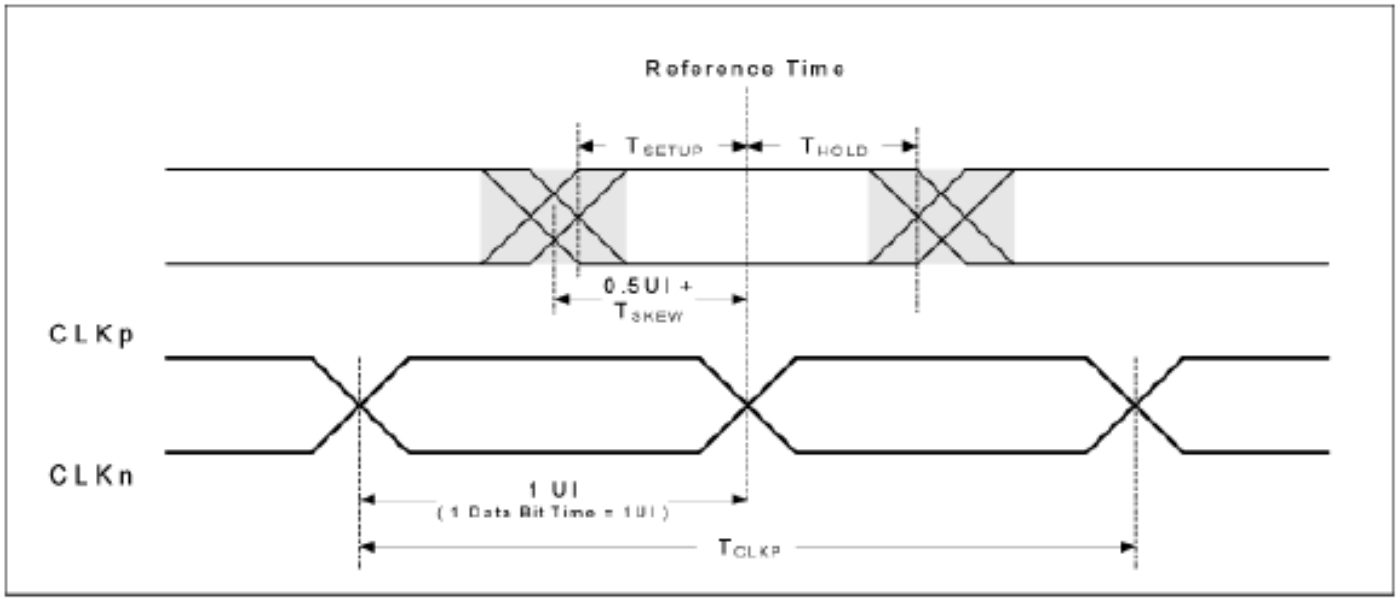
Parameter	Symbol	MIN.	Typ.	MAX.	Unit
Horizontal front porch	HFP	-	168	-	BYTECLK (*1)
Horizontal data start point	HS+HBP	-	123	-	BYTECLK (*1)
Horizontal active area	HDISP	-	135	-	BYTECLK (*1)
Horizontal cycle	Hcyc	8.16	8.57	9.02	us (*2)

(*1) BYTECLK is generated by dividing DSICLK by 8, or pclk x 3/8

(*2) Horizontal cycle of MIPI DSI input is related to the frame rate. (1H=4.308us /8.57us→ Frm=60Hz)

The tolerance all over the operating temperature shall be within the spec.

7. MIPI DSI CLK & Data Timing



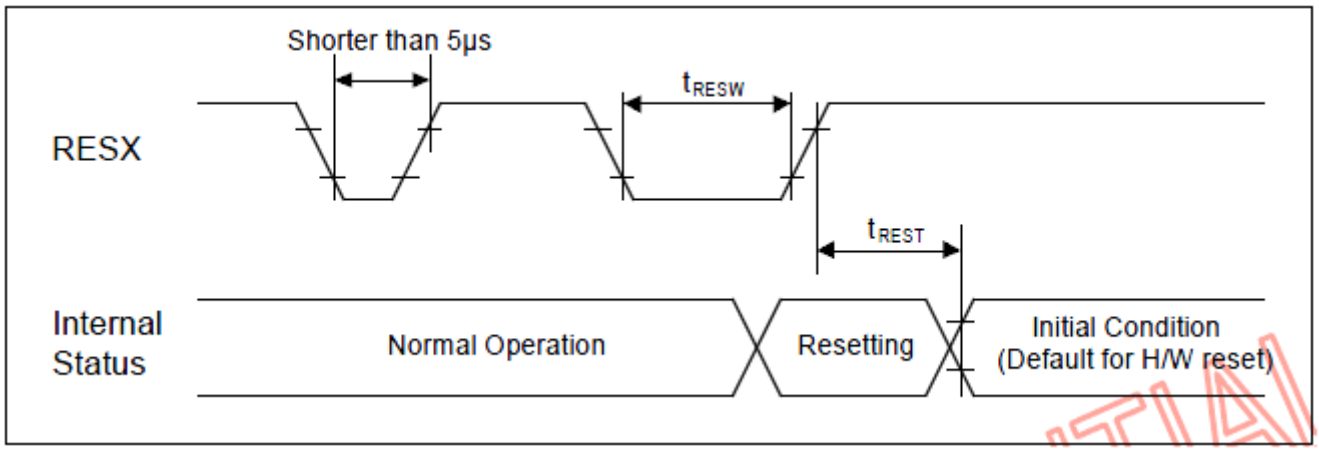
#Figure 6

GND=0V, DVDD=1.36±0.02V, VDDI =1.85±0.1V, , VSP=5.8±0.2V, VSN=-5.6+/-0.2V,T_{AMB}=+25C

Parameter	Symbol	MIN.	Typ.	MAX.	Unit
DSICLK Frequency*1	fDSICLK	100	-	500	MHz
Data Transfer Rate (HS mode)	tDSIR	200	-	1000	Mbps
DSICLK Cycle time	tCLKP	2.0	-	8	ns
Data to Clock Setup Time	tSETUP	0.15	-	-	UI
		0.15	-	-	ns
Clock to Data Hold time	tHOLD	0.15	-	-	UI
		0.15	-	-	ns

*1: The frequency which a SOMC mobile VR glass sets = 897.04Mbps is recommended.

Reset Timing Characteristics



#Figure 7

(DVSS=DVSS1=DVSS2=AVSS=VSSAM1=VSSAM2=0V, VDDI=1.65V to 1.95V, Ta=-30 to 70°C)

Signal	Symbol	Parameter	MIN	TYP	MAX	Unit	Description
RESX	tRESW	Reset "L" pulse width (Note 1)	10	-	-	µs	
	tREST	Reset complete time (Note 2)	-	-	10	ms	When reset applied during Sleep In Mode
			-	-	120	ms	When reset applied during Sleep Out Mode and Note 4

Note 1) Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below.

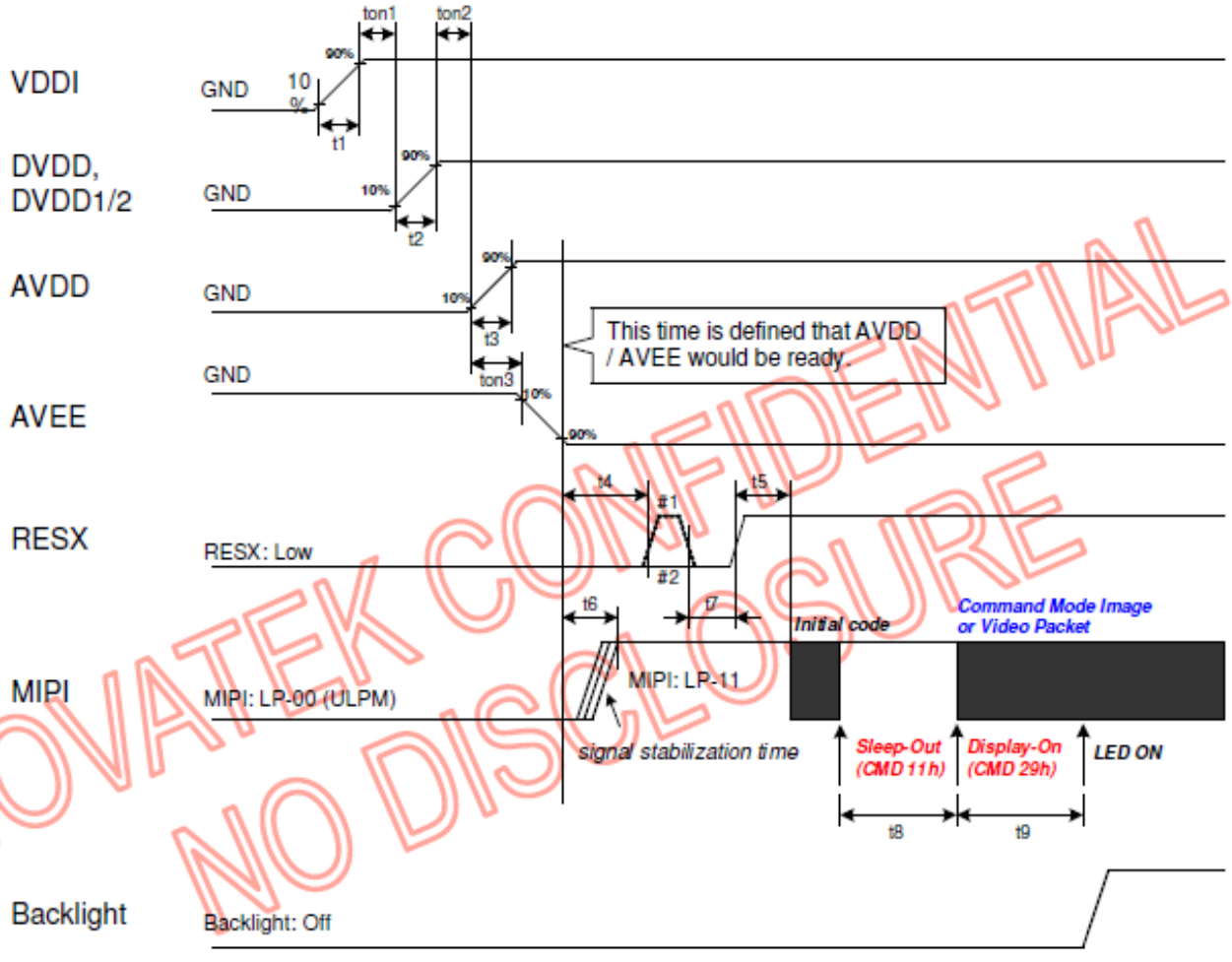
RESX Pulse	*Action*
Shorter than 5µs	*Reset Rejected*
Longer than 10µs	*Reset*
Between 5µs and 10µs	*Reset Start*

#Figure 8

8. Initial Sequence

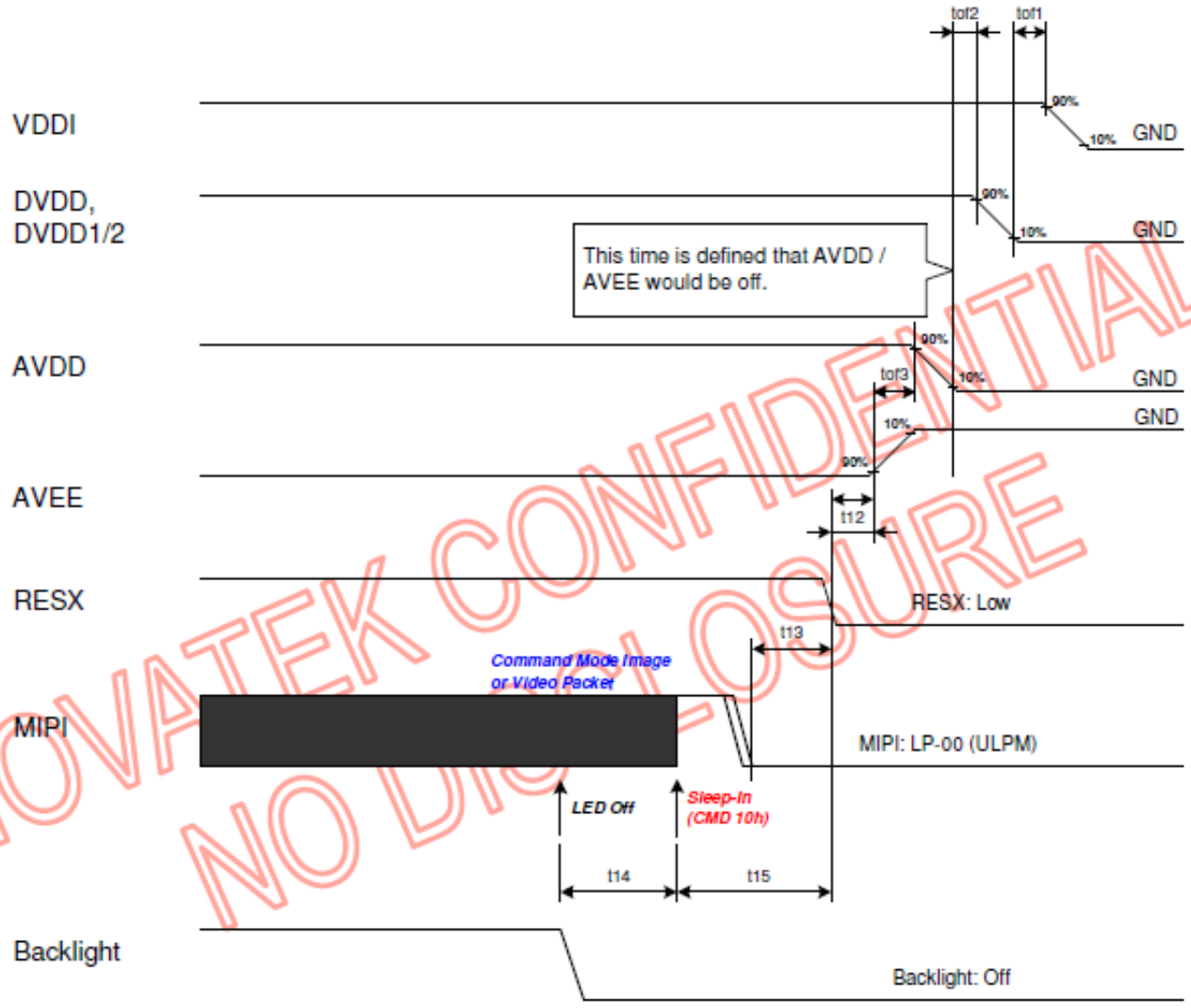
(8-1) Power On Sequence

Symbol	Value			Unit	Remark
	Min.	Typ.	Max.		
ton1	0	-	-	ms	
~~ton2~~	~~5~~	~~-~~	~~-~~	~~ms~~	~~EXT_DVDD_EN=0~~
ton2	0	-	-	ms	EXT_DVDD_EN=1
ton3	0	-	-	ms	BTM=0: |AVDD| ≥ |AVEE| during power rising BTM=1: |VGH| ≥ |AVDD| during power rising
ton4	0	-	-	ms	|VGH| ≥ |VGLX| during power rising
ton5	0	-	-	ms	|VGLX| ≥ |AVEE| during power rising
t1	0.2	-	5	ms	
t2	0.2	-	2	ms	
t3	0.2	-	5	ms	
t4	10	-	-	ms	
t5	10	-	-	ms	
t6	0	-	t4	ms	
t7	10	-	-	us	
t8	120	-	-	ms	
t9	0	-	-	ms	



(8-2) Power Off sequence

Symbol	Value			Unit	Remark
	Min.	Typ.	Max.		
tof1	0	-	-	µs	
tof2	0	-	-	ms	
tof3	0	-	-	ms	
tof4	0	-	-	ms	
t12	0	-	-	ms	
t13	0	-	-	ms	
t14	0	-	-	ms	
t15	100			ms	



(8-3) LCD Initialization Sequence table

Power ON Sequence(NT35950-Command FBC MODE)

Display off ->display on				Mipi sate		DATE TYPE
NO,		Addr	Date	date	clk	
power on						
1	initial conditon					
2	power supply vddio(TYP 1.85v)					
3	wait 10ms					
4	power supply Dvdd(TYP 1.36v)					
5	wait 10ms					
6	power supply AVDD(TYP5.8V)					
7	WATI 0ms (MIN 0ms)					
8	power supply AVEE(TYP -5.6)					
9	wait 10ms(min 10ms)			LP11	LP11	
10	Enter LP_11 sate			LP11	LP11	
11	wait 10ms			LP11	LP11	
12	RESX go high			LP11	LP11	
13	wait 10ms(min 10ms)			LP11	LP11	
14	RESX go low			LP11	LP11	
15	wait 15ms(min 10ms)			LP11	LP11	
16	RESX go high			LP11	LP11	
17	wait 20ms(min 10ms)			LP11	LP11	
18	sleep mode on			LP11	LP11	
A) Initialization						
1	date compression methon seletion	90h	02h	LP	LP	15h
2	page select page7	F0h	55(1st_para)	LP	LP	39h
			AA(2st_para)	LP	LP	
			52(3st_para)	LP	LP	
			08(4st_para)	LP	LP	
			07(5st_para)	LP	LP	
3	display mode select(YYG Rainbow RGB)	EFh	01h	LP	LP	15h
4	page select page0	F0h	55(1st_para)	LP	LP	39h
			AA(2st_para)	LP	LP	
			52(3st_para)	LP	LP	
			08(4st_para)	LP	LP	
			00(5st_para)	LP	LP	
5	Set to "Display date path control"(command mode)	B4h	01h	LP	LP	15h
6	Tearing Effect Line on	35h	00h	LP	LP	15h
7 (*1)	set Tearing effect scan line	44h	**(1st_para)	LP	LP	39h
			**(2st_para)	LP	LP	
8	Page Select page1	F0h	55(1st_para)	LP	LP	39h
			AA(2st_para)	LP	LP	
			52(3st_para)	LP	LP	
			08(4st_para)	LP	LP	
			01(5st_para)	LP	LP	
9	OSC Setting	D4h	88(1st_para)	LP	LP	39h
			88(2st_para)	LP	LP	
C)SET Dislay on						
1)	display on	29h		LP/HS	LP/HS	05h
B)Exit Sleep						
1	Exit sleep mode(sleep out)	11h		LP/HS	LP/HS	05h
2	wait 4frame(67ms in 60HZ case)					
3	Dipalay date tranfer			HS	HS	
4	Backlight on					

Power ON Sequence(NT35950-Video FBC MODE)

Display off ->display on				Mipi sate		DATE TYPE
NO,		Addr	Date	date	clk	
power on						
1	initial conditon					
2	power supply vddio(TYP 1.85v)					
3	wait 10ms					
4	power supply Dvdd(TYP 1.36v)					
5	wait 10ms					
6	power supply AVDD(TYP5.8V)					
7	WATI 0ms (MIN 0ms)					
8	power supply AVEE(TYP -5.6)					
9	wait 10ms(min 10ms)			LP11	LP11	
10	Enter LP_11 sate			LP11	LP11	
11	wait 10ms			LP11	LP11	
12	RESX go high			LP11	LP11	
13	wait 10ms(min 10ms)			LP11	LP11	
14	RESX go low			LP11	LP11	
15	wait 15ms(min 10ms)			LP11	LP11	
16	RESX go high			LP11	LP11	
17	wait 20ms(min 10ms)			LP11	LP11	
18	sleep mode on			LP11	LP11	
A) Initialization						
1	page select page3	F0h	55(1st_para)	LP	LP	39h
			AA(2st_para)	LP	LP	
			52(3st_para)	LP	LP	
			08(4st_para)	LP	LP	
			03(5st_para)	LP	LP	
		B2h	00(1st_para)	LP	LP	39h
			00(2st_para)	LP	LP	
			12(3st_para)	LP	LP	
			00(4st_para)	LP	LP	
			A0(5st_para)	LP	LP	
			03(6st_para)	LP	LP	
			02(7st_para)	LP	LP	
2	date compression methon seletion	90h	02h	LP	LP	15h
3	page select page7	F0h	55(1st_para)	LP	LP	39h
			AA(2st_para)	LP	LP	
			52(3st_para)	LP	LP	
			08(4st_para)	LP	LP	
			07(5st_para)	LP	LP	
4	display mode select(YYG Rainbow RGB)	EFh	01h	LP	LP	15h
5	page select page0	F0h	55(1st_para)	LP	LP	39h
			AA(2st_para)	LP	LP	
			52(3st_para)	LP	LP	
			08(4st_para)	LP	LP	
			00(5st_para)	LP	LP	
6	Set to "Display date path control"(command mode)	B4h	10h	LP	LP	15h
7	Tearing Effect Line on	35h	00h	LP	LP	15h
8 (*1)	set Tearing effect scan line	44h	**(1st_para)	LP	LP	39h
			**(2st_para)	LP	LP	
9	Page Select page1	F0h	55(1st_para)	LP	LP	39h
			AA(2st_para)	LP	LP	
			52(3st_para)	LP	LP	
			08(4st_para)	LP	LP	
			01(5st_para)	LP	LP	
10	OSC Setting	D4h	88(1st_para)	LP	LP	39h
			88(2st_para)	LP	LP	
C)SET Dislay on						
1)	display on	29h		LP/HS	LP/HS	05h
B)Exit Sleep						
1	Exit sleep mode(sleep out)	11h		LP/HS	LP/HS	05h
2	wait 4frame(67ms in 60HZ case)					
3	Dipalay date tranfer			HS	HS	
4	Backlight on					

Power ON Sequence(NT35950-Command SCALING UP MODE)

Display off ->display on				Mipi sate		DATA TYPE
NO,		Addr	Date	date	clk	
power on						
1	initial conditon					
2	power supply vddio(TYP 1.85v)					
3	wait 10ms					
4	power supply Dvdd(TYP 1.36v)					
5	wait 10ms					
6	power supply AVDD(TYP5.8V)					
7	WATI 0ms (MIN 0ms)					
8	power supply AVEE(TYP -5.6)					
9	wait 10ms(min 10ms)			LP11	LP11	
10	Enter LP_11 sate			LP11	LP11	
11	wait 10ms			LP11	LP11	
12	RESX go high			LP11	LP11	
13	wait 10ms(min 10ms)			LP11	LP11	
14	RESX go low			LP11	LP11	
15	wait 15ms(min 10ms)			LP11	LP11	
16	RESX go high			LP11	LP11	
17	wait 20ms(min 10ms)			LP11	LP11	
18	sleep mode on			LP11	LP11	
A) Initialization						
1	page select page0	F0h	55(1st_para)	LP	LP	
			AA(2st_para)	LP	LP	
			52(3st_para)	LP	LP	
			08(4st_para)	LP	LP	
			00(5st_para)	LP	LP	
2	Scalling up fuction on	58h	01h	LP	LP	
3	FHD Selet	C9h	01h	LP	LP	
4	date compression methon seletion	90h	00h	LP	LP	
5	page select page7	F0h	55(1st_para)	LP	LP	39h
			AA(2st_para)	LP	LP	
			52(3st_para)	LP	LP	
			08(4st_para)	LP	LP	
			07(5st_para)	LP	LP	
6	display mode select(YYG Rainbow RGB)	EFh	01h	LP	LP	15h
7	page select page0	F0h	55(1st_para)	LP	LP	39h
			AA(2st_para)	LP	LP	
			52(3st_para)	LP	LP	
			08(4st_para)	LP	LP	
			00(5st_para)	LP	LP	
8	Set to "Display date path control"(command mode)	B4h	01h	LP	LP	15h
9	Tearing Effect Line on	35h	00h	LP	LP	15h
10	set Tearing effect scan line	44h	**(1st_para)	LP	LP	39h
			**(2st_para)	LP	LP	
11	Page Select page1	F0h	55(1st_para)	LP	LP	39h
			AA(2st_para)	LP	LP	
			52(3st_para)	LP	LP	
			08(4st_para)	LP	LP	
			01(5st_para)	LP	LP	
12	OSC Setting	D4h	88(1st_para)	LP	LP	39h
			88(2st_para)	LP	LP	
C)SET Dislay on						
1)	display on	29h		LP/HS	LP/HS	05h
B)Exit Sleep						
1	Exit sleep mode(sleep out)	11h		LP/HS	LP/HS	05h
2	wait 4frame(67ms in 60HZ case)					
3	Dipalay date tranfer			HS	HS	
4	Backlight on					

Power ON Sequence(NT35950-Video SCALING UP MODE)

Display off –>display on				Mipi sate		DATA TYPE
NO.		Addr	Date	date	clk	
power on						
1	initial conditon					
2	power supply vddio(TYP 1.85v)					
3	wait 10ms					
4	power supply Dvdd(TYP 1.36v)					
5	wait 10ms					
6	power supply AVDD(TYP5.8V)					
7	WATI 0ms (MIN 0ms)					
8	power supply AVEE(TYP -5.6)					
9	wait 10ms(min 10ms)			LP11	LP11	
10	Enter LP_11 sate			LP11	LP11	
11	wait 10ms			LP11	LP11	
12	RESX go high			LP11	LP11	
13	wait 10ms(min 10ms)			LP11	LP11	
14	RESX go low			LP11	LP11	
15	wait 15ms(min 10ms)			LP11	LP11	
16	RESX go high			LP11	LP11	
17	wait 20ms(min 10ms)			LP11	LP11	
18	sleep mode on			LP11	LP11	
A) Initialization						
1	page select page3	F0h	55(1st para)	LP	LP	39h
			AA(2st para)	LP	LP	
			52(3st para)	LP	LP	
			08(4st para)	LP	LP	
			03(5st para)	LP	LP	
		B2h	00(1st para)	LP	LP	39h
			00(2st para)	LP	LP	
			12(3st para)	LP	LP	
			00(4st para)	LP	LP	
			A0(5st para)	LP	LP	
			03(6st para)	LP	LP	
			02(7st para)	LP	LP	
2	page select page0	F0h	55(1st para)	LP	LP	
			AA(2st para)	LP	LP	
			52(3st para)	LP	LP	
			08(4st para)	LP	LP	
			00(5st para)	LP	LP	
3	Scalling up fuction on	58h	01h	LP	LP	
4	FHD Selet	C9h	01h	LP	LP	
5	date compression methon seletion	90h	00h	LP	LP	
6	page select page7	F0h	55(1st para)	LP	LP	39h
			AA(2st para)	LP	LP	
			52(3st para)	LP	LP	
			08(4st para)	LP	LP	
			07(5st para)	LP	LP	
7	display mode select(YYG Rainbow RGB)	EFh	01h	LP	LP	15h
8	page select page0	F0h	55(1st para)	LP	LP	39h
			AA(2st para)	LP	LP	
			52(3st para)	LP	LP	
			08(4st para)	LP	LP	
			00(5st para)	LP	LP	
9	Set to "Display date path control"(command mode)	B4h	10h	LP	LP	15h
10	Tearing Effect Line on	35h	00h	LP	LP	15h
11	set Tearing effect scan line	44h	**(1st para)	LP	LP	39h
			**(2st para)	LP	LP	
12	Page Select page1	F0h	55(1st para)	LP	LP	39h
			AA(2st para)	LP	LP	
			52(3st para)	LP	LP	
			08(4st para)	LP	LP	
			01(5st para)	LP	LP	
13	OSC Setting	D4h	88(1st para)	LP	LP	39h
			88(2st para)	LP	LP	
C)SET Dislay on						
1)	display on	29h		LP/HS	LP/HS	05h
B)Exit Sleep						
1	Exit sleep mode(sleep out)	11h		LP/HS	LP/HS	05h
2	wait 4frame(67ms in 60HZ case)					
3	Dipalay date tranfer			HS	HS	
4	Backlight on					

*1 Setting by user side

Power OFF Sequence (NT35950)

Display on ->display off				Mipi sate		DATE TYPE
NO		Addr	Date	date	clk	
D) set display off						
1	display off	28h	-	LP/HS	LP/HS	05h
2	backlinght off			LP11	LP11	
3	wait 10ms			LP11	LP11	
E) Sleep set						
1	Enter sleep mode	10H	-	LP/HS	LP/HS	05h
2	wait 150ms(wati more than 100ms)			LP11	LP11	
3	date transfer stop			LP11	LP11	
4	mipi drive to LP-00			LP10	LP10	
Power off						
1	XRES-Low					
2	wait 5ms(Min>0ms)					
3	Power off VSN(TYP -5.6V)					
4	wait 5ms(Min>0ms)					
5	Power off VSP(TYP 5.8V)					
6	wait 5ms(Min>0ms)					
7	Power off DVDD(TYP 1.36V)					
8	wait 5ms(Min>0ms)					
9	Power off VDDIO(TYP 1.85V)					
RE-POWER ON						
1	(wait more than 100ms)					
2	power supply vddio (TYP 1.85v)					
	see display on sheet for further sequnence					

9. Optical Characteristics

VDDI=1.85V, DVDD=1.36,VSP=5.8V, VSN=-5.6V, ILED=(20)mA/pcs, Ta = 25℃

Optical Characteristics

Parameter	symbol	condition	MIN	TYP	MAX	unit	Remark
Brightness	Br	θ=0°	425	530	-	cd/㎡	Note1,2
Response Time	(τr+td)	θ=0°	-	30	-	ms	Note1,7
Contrast	Co	θ=0°	800	1200	-		Note1,3
Viewing Angle	θ11	CR > 10	80	-	-	deg	Note1
	θ12		80	-	-		
	θ21		80	-	-		
	θ22		80	-	-		
White chromaticity	x	θ=0°	0.255	0.285	0.315		Note.1,3
	y		0.285	0.315	0.345		
Red chromaticity	x	θ=0°	-	0.675	-		
	y		-	0.313	-		
Green chromaticity	x	θ=0°	-	0.281	-		
	y		-	0.663	-		
Blue chromaticity	x	θ=0°	-	0.156	-		
	y		-	0.050	-		
Uniformity	-	θ=0°	70	80	-	%	Note.5
NTSC ratio	-	θ=0°	-	90	-	%	Note.1,3
Flicker ratio	-	θ=0°	-	-	10.0	%	Note.4
Crosstalk	CT	θ=0°	-	-	4	%	Note.6

Note 1) Definition of range of visual angle

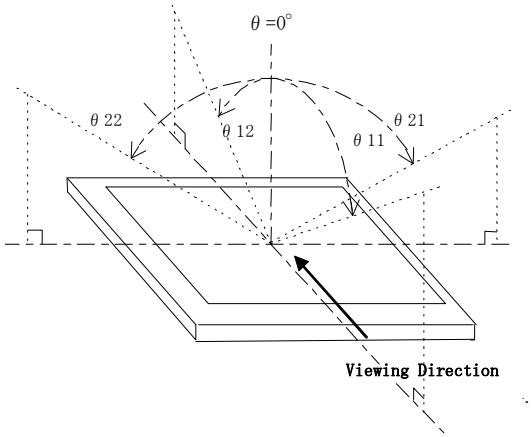


Fig .9 Definition of viewing angle

Note 2) Brightness is measured as shown in Fig.10, and is defined as the brightness of all pixels "White" at the center of display area on optimum contrast.

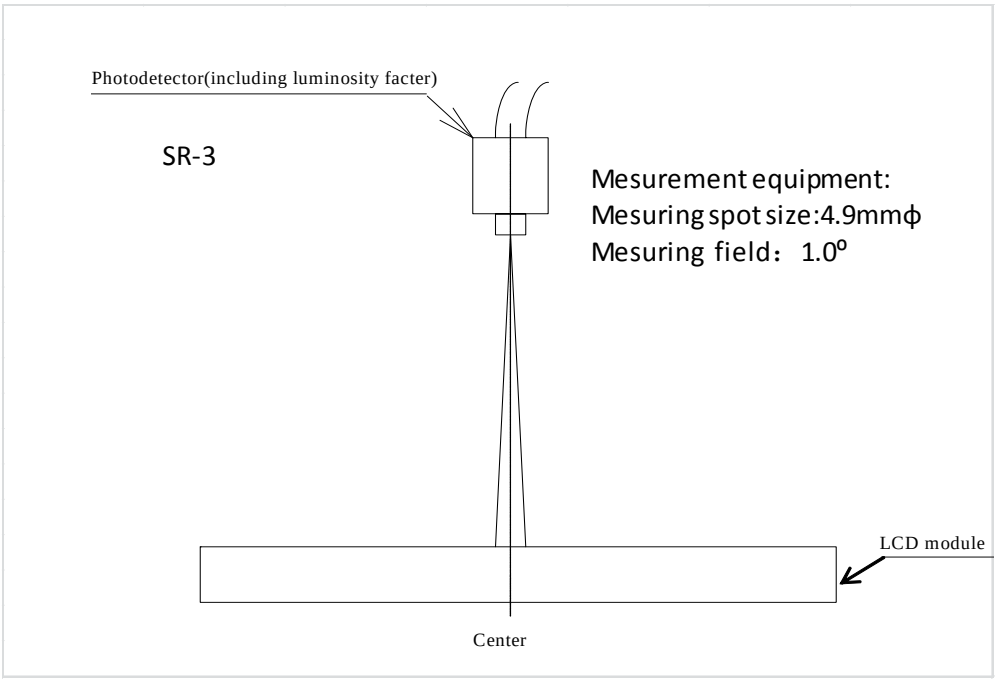


Fig. 10 Optical characteristics Test Method (Brightness)

Note 3) Contrast ratio is defined as follows:

$$Co = \frac{\text{Luminance(brightness) all pixcels "White"}}{\text{Luminance(brightness) all pixcels "Black"}}$$

Note 4) Measuring systems: YOKOGAWA 3298_01 + 3298_11

- ·Temperature = 25℃(±3℃), Frame Frequency = 57Hz~63Hz, LED back-light: ON, Environment brightness < 150 lx
- ·Measured sample : New sample before a long term aging.
- ·Flicker ratio is very sensitive to measuring condition.
- ·Measuring pattern Please refer to figure below.

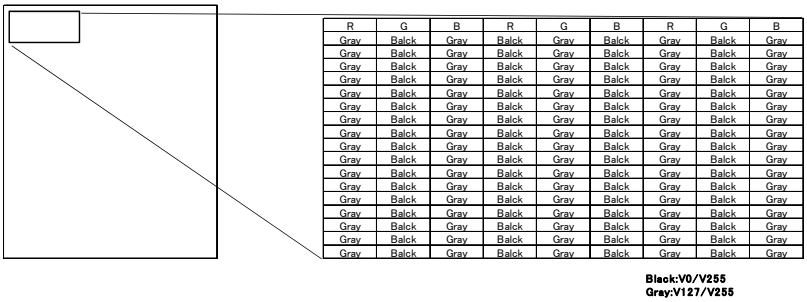


Fig. 11 Flicker Measuring pattern

Note 5) Uniformity is defined as follows:

$$\text{Uniformity} = \frac{\text{Minimum Luminance(brightness) in 9 points}}{\text{Maximum Luminance(brightness) in 9 points}}$$

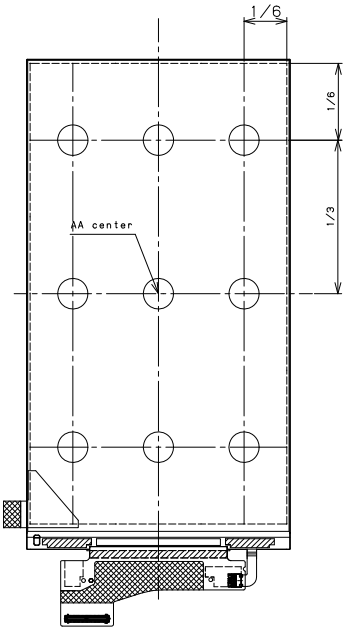


Fig. 12 Measuring Point

Note 6) Crosstalk is defined as follows:

CT=|Yw(Xi)-YG(Xi)|×100(%)/YG(Xi) X=U,D,L,R i=gray 127

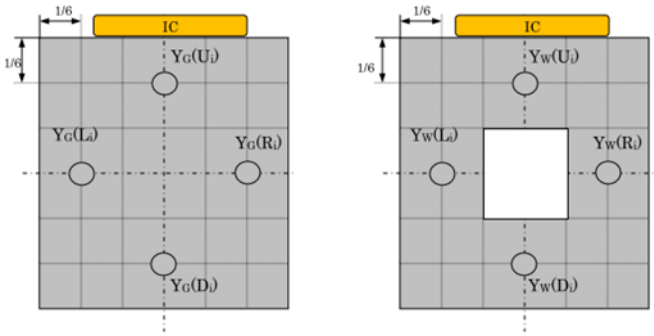


Fig.13 Measuring Point

Note 7) Response time is defined as follows:

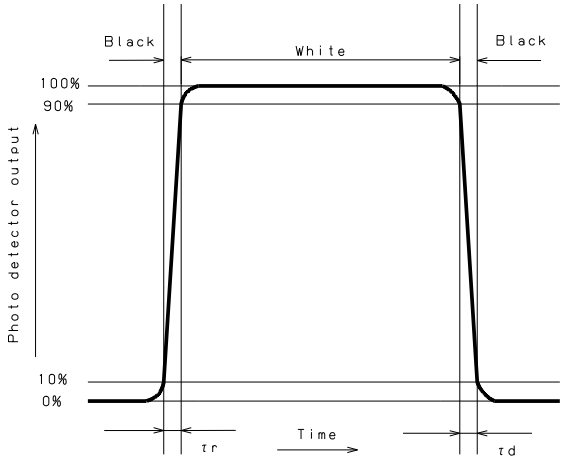


Fig.14 Response time

10. Reliability

Table.21

No.	Test	Condition	Judgment criteria
1	Temperature Cycling	Ta = -20℃(60min) to 70℃(60min), 20cycle	Per table in below
2	High Temp. Storage	Ta=70℃ 240h	Per table in below
3	Low Temp. Storage	Ta=-30℃ 240h	Per table in below
4	Humidity Operation	Ta=40℃ 90%RH 240h	Per table in below (polarizer discoloration is excluded)
5	High Temp. Operation	Ta=60℃ 240h	Per table in below
6	Low Temp. Operation	Ta=-20℃ 240h	Per table in below
7	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

INSPECTION	CRITERION(after test)
Appearance	No Crack on the FPC, on the LCD Panel
Alignment of LCD Panel	No Bubbles in the LCD Panel No other Defects of Alignment in Active area
Electrical current	Within device specifications
Function / Display	No Broken Circuit, No Short Circuit or No Black line No Other Defects of Display

11. Packaging specifications

(11-1) Details of packaging

Packaging style : Fig. 15, 16

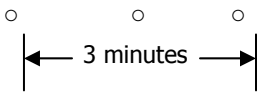
(11-2) Reliability

1) Vibration test

Table.22

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))

(11-3) Packaging quantities

120 modules per master carton

(11-4) Packaging weight

TBD

(11-5) Packaging outline dimensions

530 mm × 365 mm ×235 mm (H)

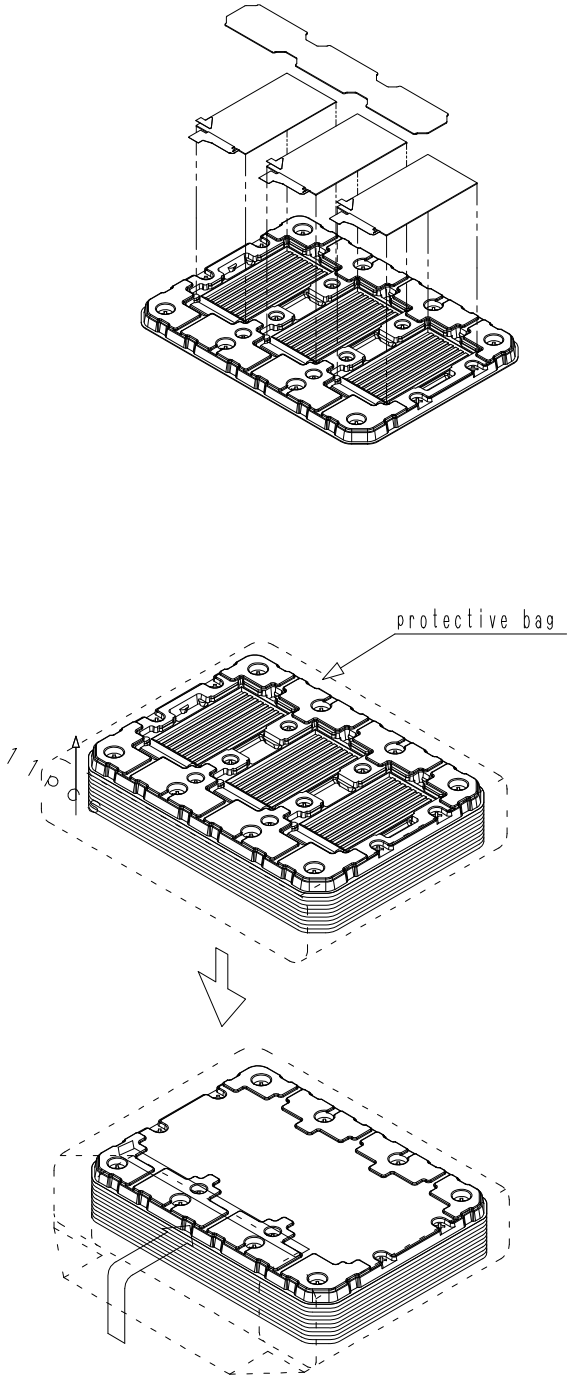


Figure 15. Packaging style (tray for packaging)

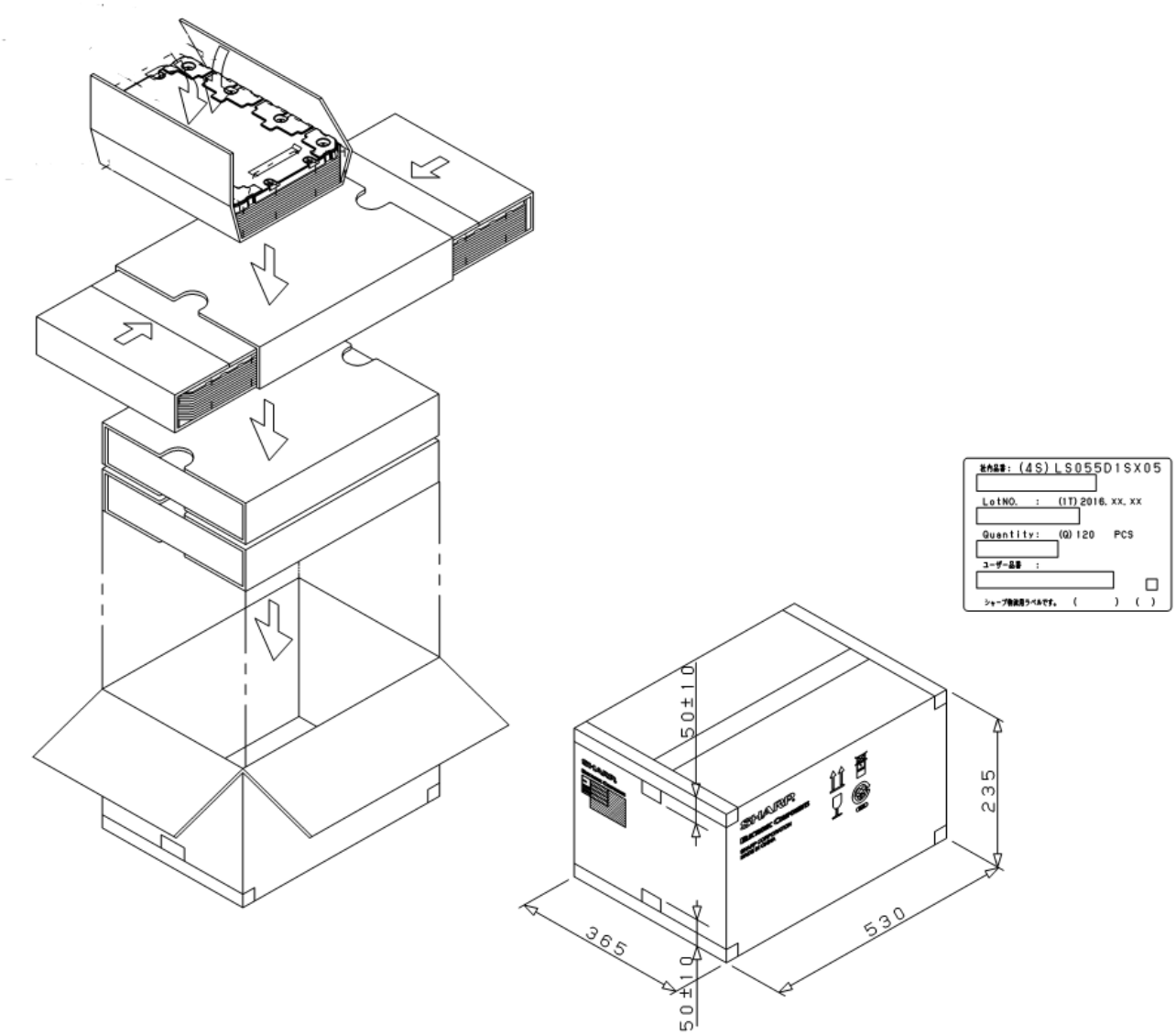


Figure 16. Packaging style (Master carton packaging)

12. Serial Number Label identification

Numbering is specified as follows.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	L	S	0	5	5	D	1	S	X	0	1		S
2	6	7	*	*	*	*	*	1		M	0	1	

First line

1~11: LCM's name

12:blank

13:Sharp's factory code

Q: The head office plant

S : STECH plant

Second line

1~2: Date of production

Year (lower 1 digits)

6: 2016

7:2017

Month: 1～9 =Jan~Sep

X: October

Y: November

Z: December

3~8: Serial number

9: Blank

10~12: Version

M01=MP1

13:blank

13. Outline dimensions

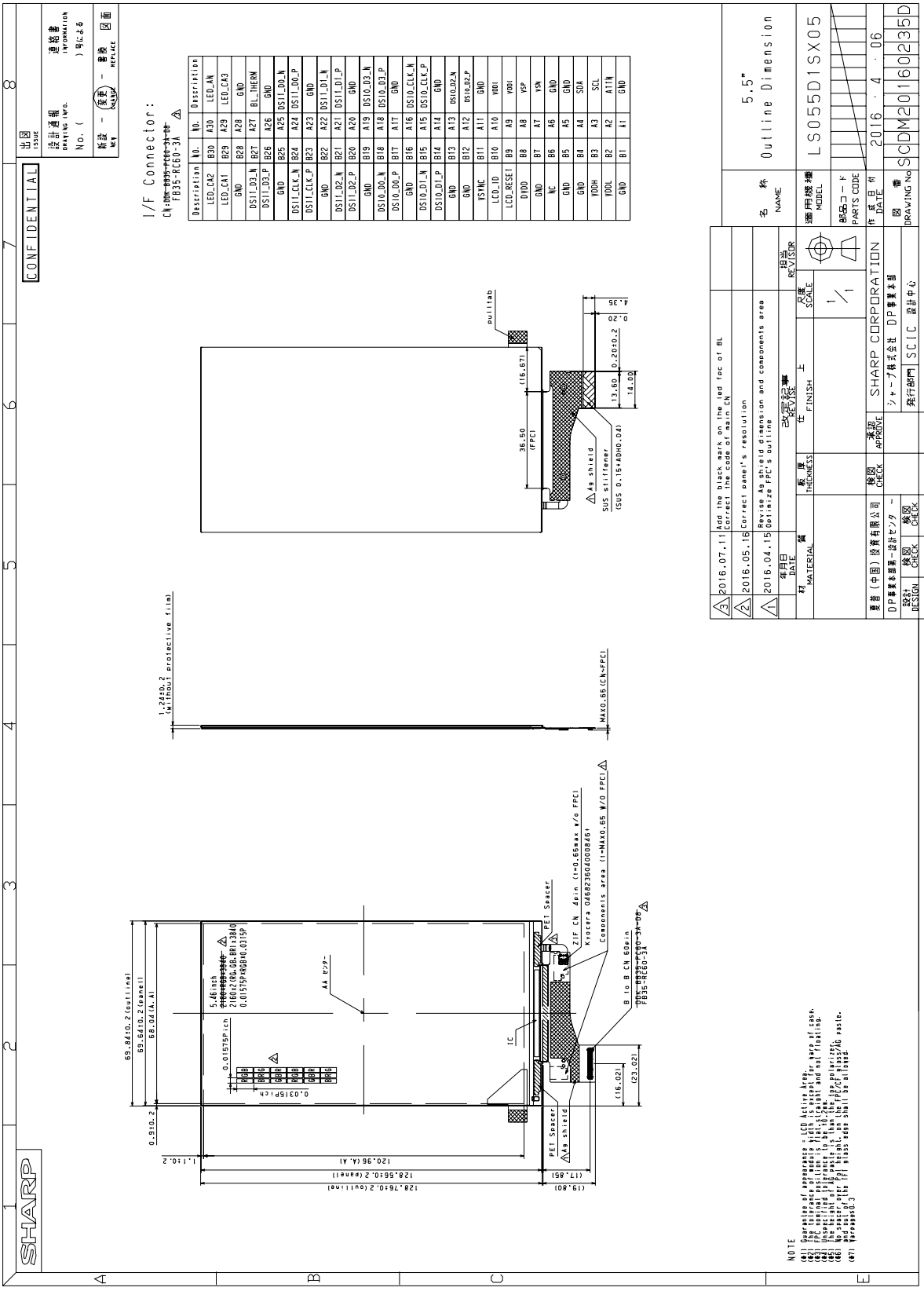


Fig. 16 Outline dimensions