

PRODUCT SPECIFICATION **FOR LCD MODULE**

Revision: 1.0

Model No: LSC060I02-MP-V1

Module Type: COG+FPC+B/L+CTP

APPROVED SIGNATURE

- ☒ Approved Product Specification only
- ☐ Approved Product Specification and Samples

<u>Prepared By</u>	<u>Checked By</u>	<u>Approved By</u>

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- 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.
- 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 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 thin 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-oxy) emits gas to which polarizer reacts (color change). Check carefully that gas from materials used in system housing or packaging do not hurt 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 (COF) 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: $1 \times 10^8 \Omega$) should be made.

④ Humidity

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

⑤ Transportation/storage

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

⑥ Others

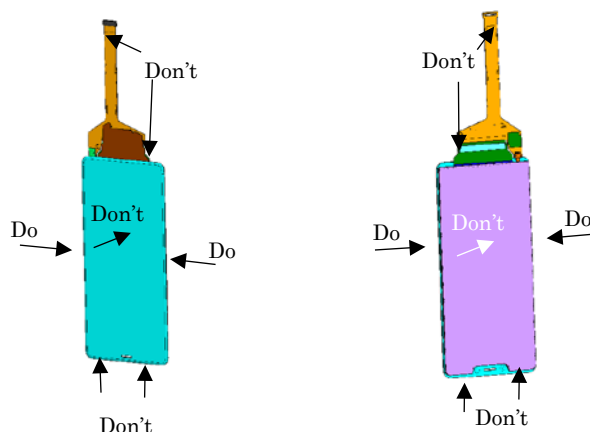
Protective film is attached on the surface of LCD panel to prevent scratches or other damages. When removing this protective film, remove it slowly under proper anti-ESD control such as ion blower.

(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, COF and other electric parts are not damaged.



(15)Do not touch the COF'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.

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- (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.
- (22) When bending FPC, please maintain R more than 0.6. And don't give any stress which tears a joint of Glass and FPC away. Please do not bend over to the opposite side either.
- (23).When removing the protection film of Cover Glass from BL's ESR film, please don't give the stress Which damages the BL surface.

[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.

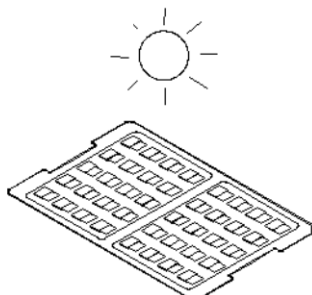
[Precautions for Storage]

- (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.
 - *Under the condition of long time high temperature storage, module's warpage may happen, so the module should be stored at normal temperature (20±5°C).
 - *Under the condition of high humidity, module's warpage also may happen, so the module should be immediately stuck with Touch panel after being opened from the degas package. Otherwise don't store the module at the high humidity condition.

(3) Keeping Method

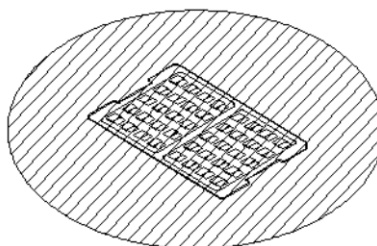
a. Don't keeping under the direct sunlight.

DON'T



b. Keeping in the tray under the dark place.

DO



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

(5) 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/VSP/VS_N) 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) 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.

(9) 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.

(10) U/V glue (Liquid OCA) should not be attached on upper polarizer edge, when customer laminate the phone set, cover glass, touch panel on LCD.

[Precautions for Discarding Liquid Crystal Modules]

COF: After removing the LSI from the COF, 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 mutagenic (Aims test: negative) material is employed.

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

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1. Application

This data sheet is to introduce the specification of LSC060I02-MP-V1 active matrix 16,777,216-color LCD module. Main color LCD module is controlled by Driver IC (FocalTech FT8716U).

If any problem occurs concerning the items not stated in this temporary 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

This module is a color transmissive, high contrast, wide viewing angle and active matrix LCD module incorporating CG-Silicon TFT (Continuous Grain-Silicon Thin Film Transistor).

Construction: LCD panel, Polarizer, Driver(COF), FPC with electric components, OCA, cover glass, 21-white LED lump, prism sheet, diffuser, light guide and reflector, plastic frame to fix them mechanically.

Outline: See page 32

Connection: 40pin Board to Board Connector

HIROSE, LCD Side: BM20B(0.8)-40DP-0.4V(51); User Side: BM20B(0.8)-40DS-0.4V(51).

There shall be no scratches, stains, chips, distortions and other external drawbacks that may affect the display function.

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	Remark
LCM Outline dimension(typ)		69.64(W) x 140.33(H) x 1.19(D) w/o CG 71.34(W) x 145.34(H) x 2.04(D) w/ CG	mm	Note1
Main LCD Panel	Display mode	New mode2	-	
	LCD mode	Transmissive	-	
	Active area	68.04(H)mm x 136.08(V)mm	mm	Note2
	Display format	1080(H)×RGB×2160(V)	-	
	Dot pitch	0.021(W)×0.063 (H)	mm	
	Base color	Normally Black	-	Note3
Mass		37.7	g	

(Note 1) The above-mentioned table indicates module size without some projections and FPC.

For detail measurements and tolerances, please refer to Fig.31 outline dimension.

(Note 2) The above-mentioned table indicates Active area size and display format without corner cut and notch area.

(Note 3) Due to the characteristics of the LC material, the colors vary with environmental temperature.

4. Pixel configuration

If the power on sequence table is issued, an initial direction of the LCD scanning is shown by following figure.

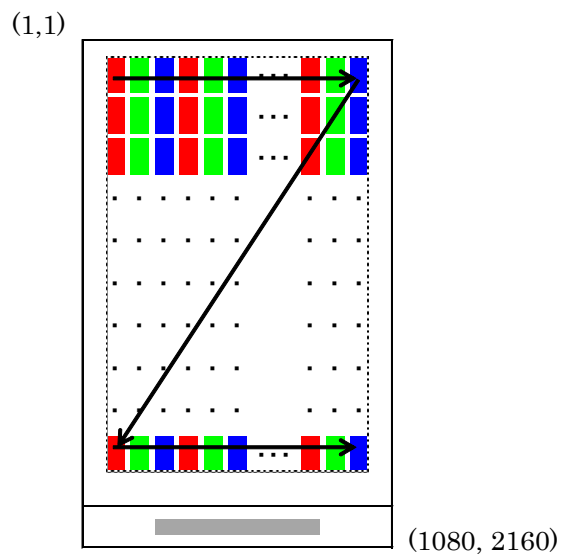


Fig.1

The Host possessing shall be 1080 x RGB x 2160 with the black dummy pattern for unnecessary area (Black area) for panel display. Black dummy size shall be unchangeable, 2 corners and center notch for camera module.

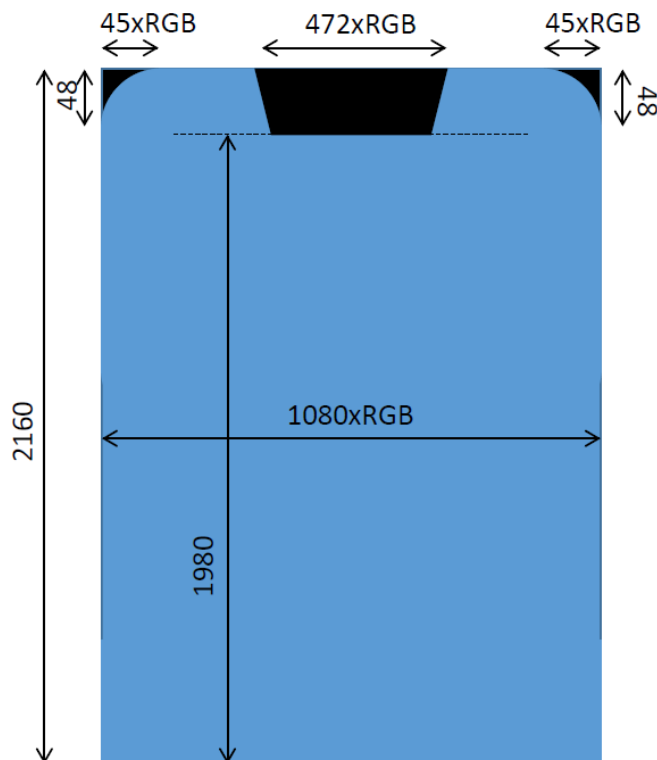


Fig.2

5. Absolute Maximum Ratings

(5-1) Electrical absolute maximum ratings

Table 2

Item	Symbol	Rating	Unit	Remark
Power Supply voltage(1)	VDDIO~GND	-0.3 to +5.5	V	Note 1,2
Power Supply voltage(2)	VSP~GND	-0.3 to +6.5	V	Note 1,3
Power Supply voltage(3)	GND~VSN	-0.3 to +6.5	V	Note 1,3
LED input current	I _{LED}	Max 25	mA	Note 4

(Note 1) The absolute maximum rating is the limit value. When the IC is exposed to the operating environment beyond this range, the IC does not assure normal operations and may be damaged permanently, not be able to be recovered.

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.

(Note 2) To make sure(High) VDDIO ≥ GND(Low).

(Note 3) To make sure(High) VSP ≥ GND(Low), (High) GND ≥ VSN(Low)

(Note 4) Ambient temperature and the maximum input are fulfilling the following operating conditions.

(5-2) Environment Conditions

Table 3

Item	Top		Tstg		Remark
	Min	Max	Min	Max	
Ambient temperature	-20℃	+70℃	-30℃	+75℃	Note 5
Humidity	Note 4		Note 4		No condensation

(Note 4) Ta ≤ 40 °C.....95 % RH Max

(Note 5) Ta > 40 °C.....Absolute humidity shall be less than Ta=40 °C /95 % RH.

(Note 6) 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.

6. Electrical Specifications

(6-1) Power Supply Voltage Range

Table 4

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Supply voltage	VSP	5.7	5.8	5.9	V	
Supply voltage	VSN	-5.9	-5.8	-5.7	V	
Supply voltage	VDDIO	1.71	1.8	1.89	V	

(6-2) DC characteristics

Table 5

Item		Symbol	Conditions	Min.	Typ.	Max.	Unit	Remark
Input high voltage		V _{IH}	VDDIO=1.65V~1.95V	0.7VDDIO	-	VDDIO	V	note 6-1
Input low voltage		V _{IL}		0	-	0.3VDDIO	V	
Output high voltage (CABC_PWM_OUT)		V _{OH1}	VDDIO=1.65V~1.95V	0.8VDDIO	-	VDDIO	V	note 6-1
Output high voltage (CABC_PWM_OUT)		V _{OL1}	VDDIO=1.65V~1.95V	0	-	0.2VDDIO	V	
Logic High level input current		I _{IH}	-	-	-	1	uA	
Logic Low level input current		I _{IL}	-	-1	-	-	uA	
Current consumption (video mode)	Normal Mode	I _{VDDIO}	All white	-	31.8	47.6	mA	note 6-2
		I _{VSP}		-	11.3	16.9	mA	
		I _{VSN}		-	10.3	15.5	mA	
		I _{VDDIO}	Color Bar	-	34.7	-	mA	note 6-3
		I _{VSP}		-	18.1	-	mA	
		I _{VSN}		-	17.0	-	mA	
		I _{VDDIO}	Analog Worst pattern	-	-	57.1	mA	note 6-4
		I _{VSP}		-	-	28.6	mA	
		I _{VSN}		-	-	34.3	mA	
		I _{VDDIO}	Logic Worst pattern	-	-	67.2	mA	note 6-5
		I _{VSP}		-	-	16.5	mA	
		I _{VSN}		-	-	14.8	mA	

(Note 6-1) The DC/AC electrical characteristics of Module are guaranteed at $-20^{\circ}\text{C} \sim +70^{\circ}\text{C}$.

(Note 6-2) Conditions: Full screen all white pattern, $T_a=25^{\circ}\text{C}$, $VSP=5.8\text{V}$, $VSN=-5.8\text{V}$, $VDDIO=1.8\text{V}$, MIPI-DSI Video Mode, 4 lane, Refresh rate=60Hz, CABC/CE OFF, Touch panel is monitor mode

(Note 6-3) Conditions: Color Bar pattern $T_a=25^{\circ}\text{C}$, $VSP=5.8\text{V}$, $VSN=-5.8\text{V}$, $VDDIO=1.8\text{V}$, MIPI-DSI Video Mode, 4 lane, Refresh rate=60Hz, CABC/CE OFF, Touch panel is monitor mode



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(Note 6-4) Conditions: 1x1 checker pattern(Analog power worst) Ta=25℃, VSP=5.8V, VSN=-5.8V, VDDIO=1.8V, MIPI-DSI Video Mode, 4 lane, Refresh rate=60Hz, CABC/CE OFF, Touch panel is monitor mode



(Note 6-5) Conditions: Gaussian pattern(Logic power worst) Ta=25℃, VSP=5.8V, VSN=-5.8V, VDDIO=1.8V, MIPI-DSI Video Mode, 4 lane, Refresh rate=60Hz, CABC/CE OFF, Touch panel is monitor mode



(6-3) MIPI DSI characteristics

(6-3-1) HS and LP signal timing

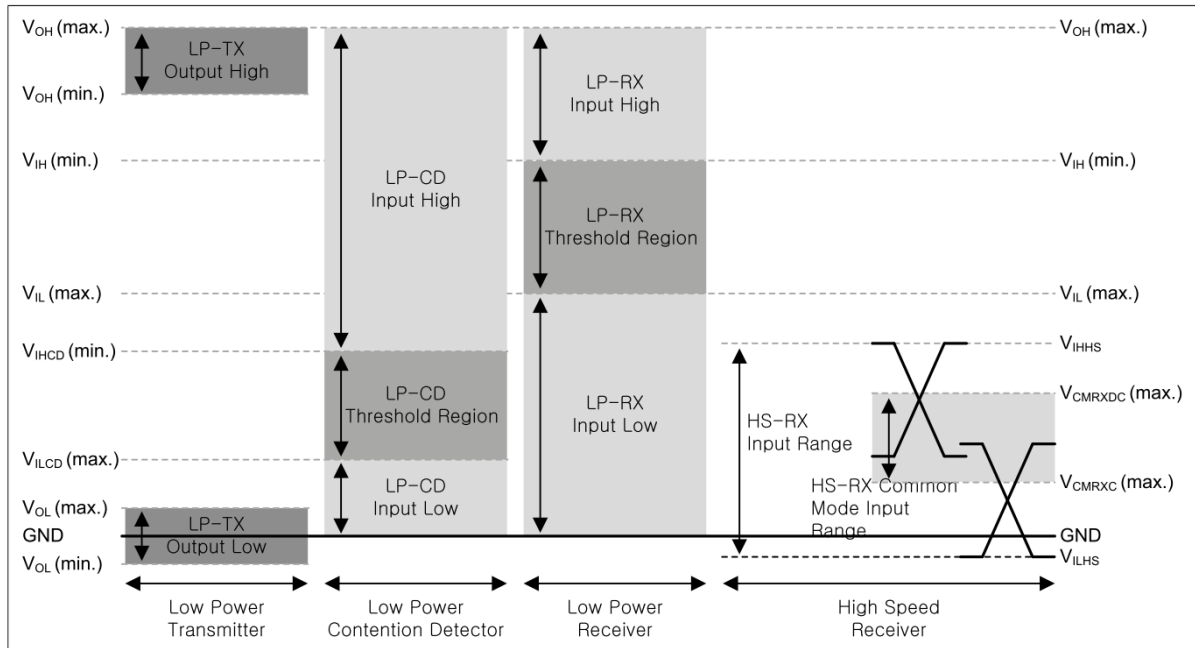


Fig.3 HS and LP signal levels

Table 6 Characteristics for MIPI DC

Parameter	Symbol	Conditions	Specification			Unit
			MIN	TYP	MAX	
Power supply voltage for MIPI Interface						
Power supply voltage for MIPI interface	VDDAM	-	1.65	1.8	1.95	V
	LVDSVDD	-	1.125	1.3	1.5	V
LPDT Input Characteristics						
Pad signal voltage range	VI	-	-50	-	1350	mV
Ground Shift	VGND SH	-	-50	-	50	mV
Logic 0 input threshold	VIL	-	0	-	550	mV
Logic 1 input threshold	VIH	-	880	-	LVDSVDD	mV
Input hysteresis	VHYST	-	25	-	-	mV
LPDT Output Characteristics						
Output low level	VOL	-	-50	-	50	mV
Output high level	VOH	-	1.1	1.2	1.3	V
Logic 1 contention threshold	VILCD,MIN	-	450	-	LVDSVDD	mV
Logic 0 contention threshold	VIHCD,MAX	-	0	-	200	mV
Output impedance of LPDT	ZOLP	-	80	100	125	ohm
Hi-speed Input/Output Characteristics						
Single-end input low voltage	VILHS	-	-40	-	-	mV
Single-end input high voltage	VIHHS	-	-	-	460	mV
Common mode voltage	VCMRXDC	-	70		330	mV
Hi-speed transmit voltage	VOD	-	140	200	250	mV
Differential input impedance	ZID	-	80	100	125	ohm

(6-3-2)High Speed Mode

Table 7

Parameter	Symbol	Parameter	Specification			Unit
			MIN	TYP	MAX	
High Speed Mode						
DSI-CLK+/-	2xUI _{INST}	Double UI instantaneous	2	-	25	ns
DSI-CLK+/-	UI _{INSTA} , UI _{INSTB}	UI instantaneous Halfs	1	-	12.5	ns
DSI-Dn+/-	t _{DS}	Data to clock setup time	0.15	-	-	UI
DSI-Dn+/-	t _{DH}	Data to clock hold time	0.15	-	-	UI
DSI-CLK+/-	t _{DRTCLK}	Differential rise time for clock	150	-	0.3UI	ps
DSI-Dn+/-	t _{DRTDATA}	Differential rise time for data	150	-	0.3UI	ps
DSI-CLK+/-	t _{DFTCLK}	Differential fall time for clock	150	-	0.3UI	ps
DSI-Dn+/-	t _{DFTDATA}	Differential fall time for data	150	-	0.3UI	ps

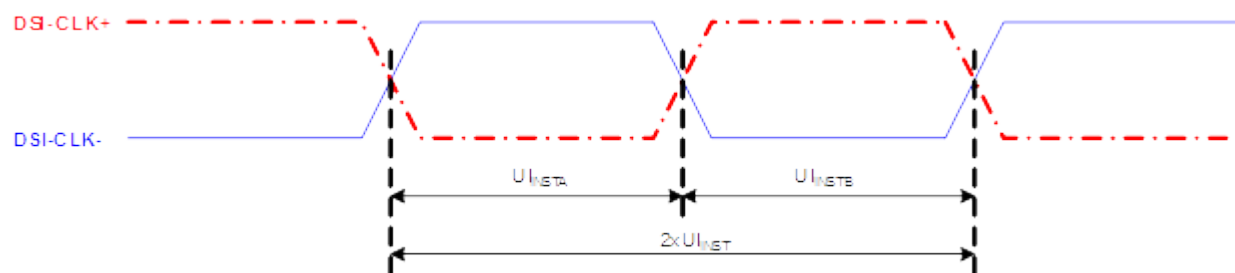


Fig. 4

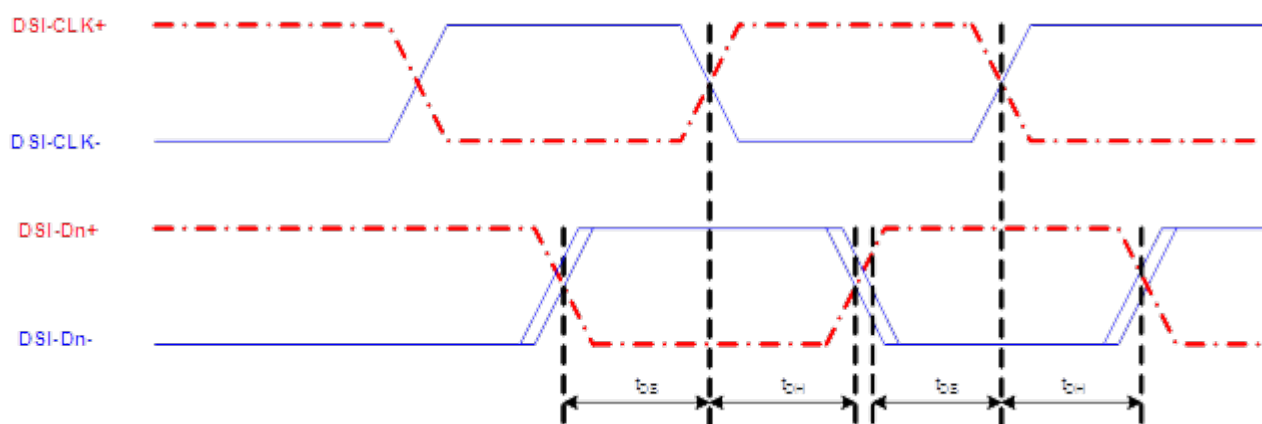


Fig. 5

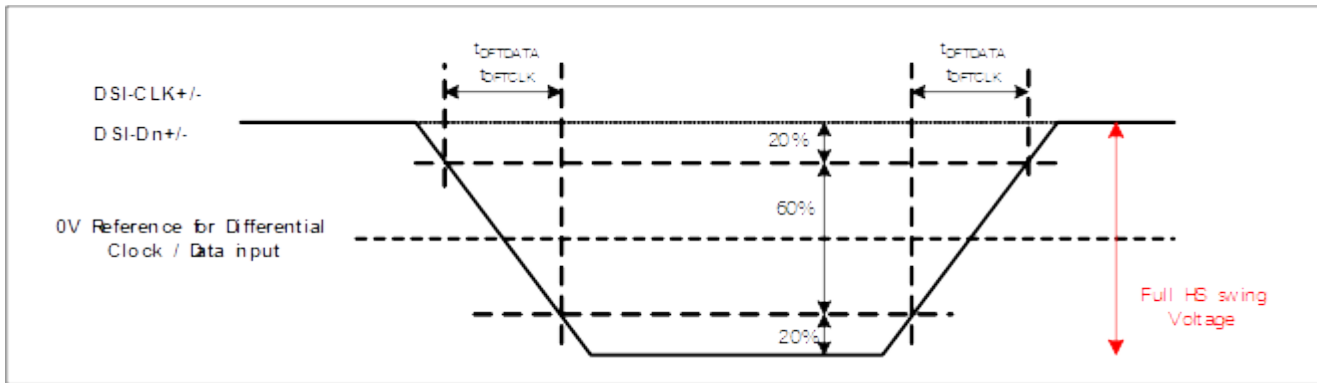


Fig. 6 AC characteristics for MIPI-DSI High speed mode

(6-3-3)Low Power Mode

Table 8

Parameter	Symbol	Parameter	Specification			Unit
			MIN	TYP	MAX	
Low Power mode						
DSI-D0+/-	T _{LPXM}	Length of LP-00, LP-01, LP-10 or LP-11 periods MPU Display Module	50	-	-	ns
DSI-D0+/-	T _{LPXD}	Length of LP-00, LP-01, LP-10 or LP-11 periods Display Module MPU	58	-	-	ns
DSI-D0+/-	T _{TA-SURED}	Time-out before the MPU start driving	T _{LPXD}	-	2XT _{LPXD}	ns
DSI-D0+/-	T _{TA-GETD}	Time to drive LP-00 by display module	5XT _{LPXD}	-	-	ns
DSI-D0+/-	T _{TA-GOD}	Time to drive LP-00 after turnaround request - MPU	4XT _{LPXD}	-	-	ns
DSI-D0+/-	Ratio T _{LPX}	Ratio of T _{LPXM} / T _{LPXD} between MCU and display module	2/3	-	3/2	-

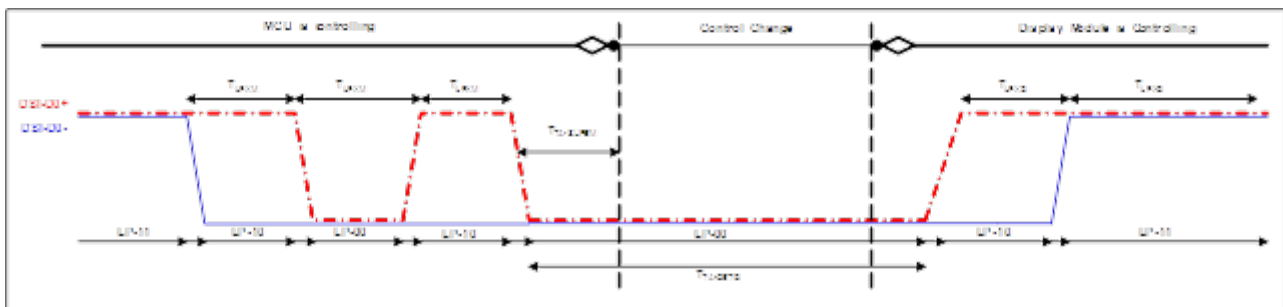


Fig. 7 BTA from the MCU to the Display Module

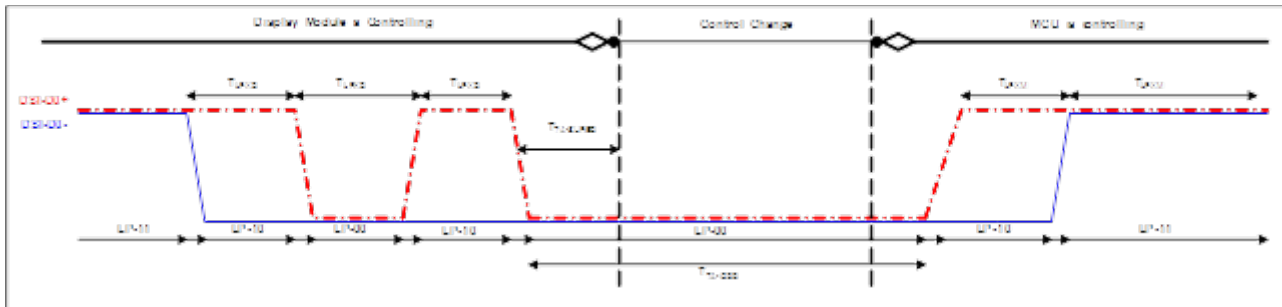


Fig. 8 BTA from the Display Module to the MCU

(6-3-4)Burst Mode

Table 9

Parameter	Symbol	Parameter	Specification			Unit
			MIN	TYP	MAX	
High Speed Data Transmission Bursts						
DSI-Dn+/-	T _{LPX}	Length of any low-power state period	50	-	-	ns
DSI-Dn+/-	T _{HS-PREPARE}	Time to drive LP-00 to prepare for HS transmission	40ns + 4UI	-	85ns + 6UI	ns
DSI-Dn+/-	T _{HS-PREPARE} + T _{HS-ZERO}	T _{HS-PREPARE} + time to drive HS-0 before the sync sequence	145ns + 10UI	-	-	ns
DSI-Dn+/-	T _{D-TERM-EN}	Time to enable Data Lane receiver line termination measured from when Dn crosses V _{IL(max)}	Time for Dn to reach V _{TERM-EN}	-	35ns + 4UI	ns
DSI-Dn+/-	T _{HS-SKIP}	Time-out at RX to ignore transition period of EoT	40	-	55ns + 4UI	ns
DSI-Dn+/-	T _{HS-TRAIL}	Time to drive flipped differential state after last payload data bit of a HS transmission burst	max(8UI, 60ns+4UI)	-	-	ns
DSI-Dn+/-	T _{HS-EXIT}	Time to drive LP-11 after HS burst	100	-	-	ns
DSI-Dn+/-	T _{EoT}	Time from start of T _{HS-TRAIL} period to start of LP-11 state	-	-	105ns + 12UI	ns

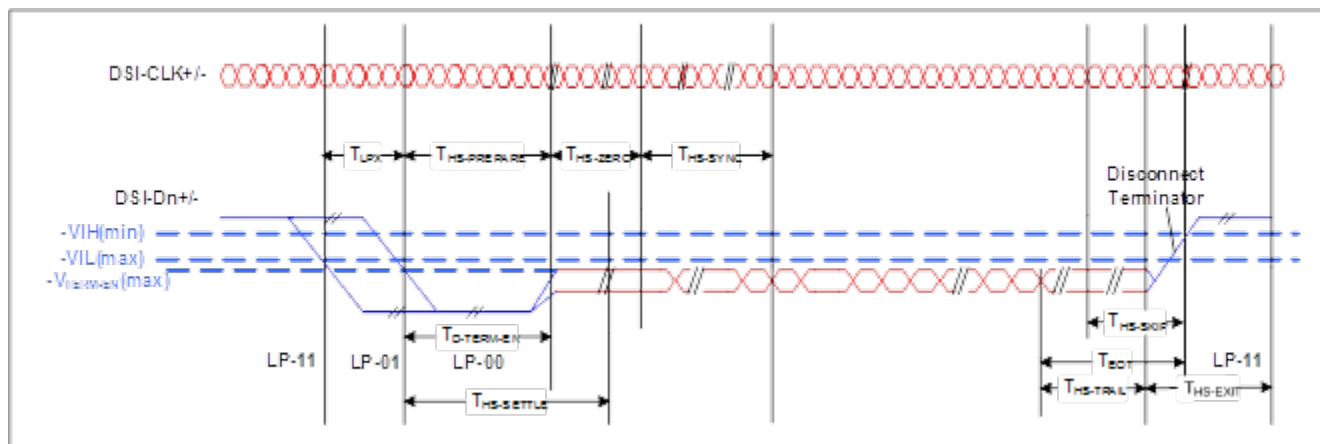


Fig. 9 High Speed Data Transmission Bursts

Table 10

Table 20

Parameter	Symbol	Parameter	Specification			Unit
			MIN	TYP	MAX	
Switching the clock Lane between clock Transmission and Low Power Mode						
DSI-CLK+/-	T _{CLK-POST}	Time that the transmitter shall continue sending HS clock after the last associated Data Lane has transitioned to LP mode	60ns + 52UI	-	-	ns
DSI-CLK+/-	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
DSI-CLK+/-	T _{CLK-PREPARE}	Time to drive LP-00 to prepare for HS clock transmission	38	-	95	ns
DSI-CLK+/-	T _{CLK-TERM-EN}	Time to enable Clock Lane receiver line termination measured from when Dn crosses V _{IL(max)}	Time for Dn to reach V _{TERM-EN}	-	38	ns
DSI-CLK+/-	T _{CLK-PREPARE} + T _{CLK-ZERO}	T _{CLK-PREPARE} + time for lead HS-0 drive period before starting Clock	300	-	-	ns
DSI-CLK+/-	T _{CLK-TRAIL}	Time to drive HS differential state after last payload clock bit of a HS transmission burst	60	-	-	ns
DSI-CLK+/-	T _{EoT}	Time from start of T _{CLK-TRAIL} period to start of LP-11 state	-	-	105ns + 12UI	ns

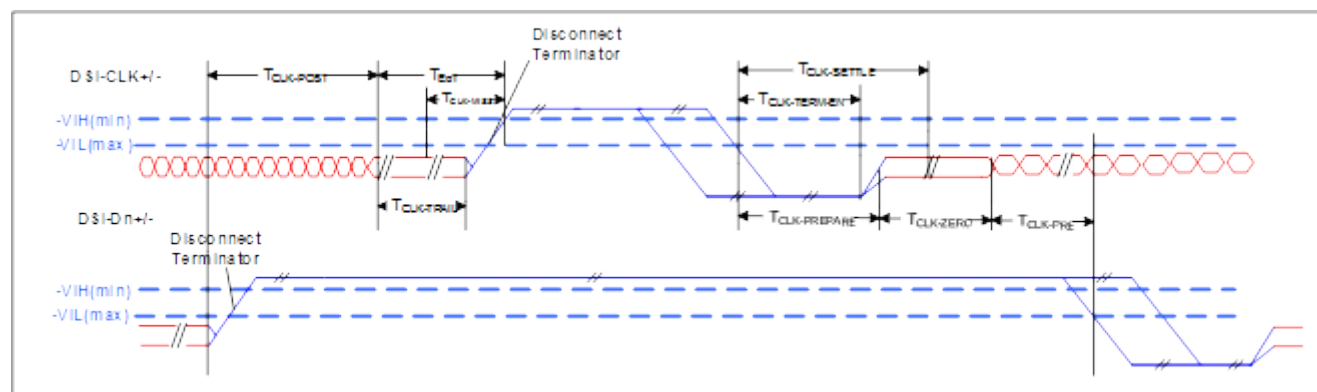


Fig. 10 Switching the clock Lane between clock Transmission and Low Power Mode

(6-3-5) LP-11 between High Speed and Low Power Modes

DSI-D0 High Speed or Low Power modes are starting or finishing from/to Stop State (SS, LP-11) when 4 different combinations, what are listed below, are possible:

1. High Speed Mode => Stop State (SS, LP-11) => High Speed Mode
2. High Speed Mode => Stop State (SS, LP-11) => Low Power Mode
3. Low Power Mode => Stop State (SS, LP-11) => High Speed Mode
4. Low Power Mode => Stop State (SS, LP-11) => Low Power Mode

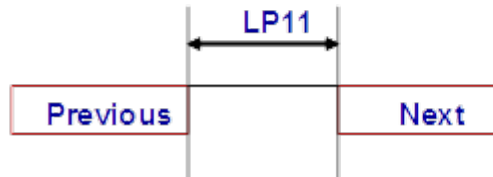
The Low Power Mode is also including 2 different functions:

1. Escape
2. Bus Turnaround (BTA)

Stop State (SS, LP-11) Timings from Previous mode to Next mode

Table 11

Previous \ Next	Escape mode		HSDT		BTA	
	Min	Max	Min	Max	Min	Max
Escape mode	100 ns	-	100 ns	-	100 ns	-
HSDT	60ns + 52UI	-	60ns + 52UI	-	60ns + 52UI	-
BTA	100 ns	-	100 ns	-	100 ns	-



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(6-4) LED backlight
At main panel the back light uses 21pcs edge light type white LED.

Table 12

Item	Value(1 parallel)			Unit
	Min	Nominal	Max	
Forward current	-	20	-	mA
Forward Voltage	-	19.6 x 3	-	V
Power consumption	-	(1176)	-	mW
Number of LED components	21pcs LED(7pcs*3parallel)			

LED lamp: Nichia (NSSW703BT-HG)
Please consider Allowable Forward Current on used temperature

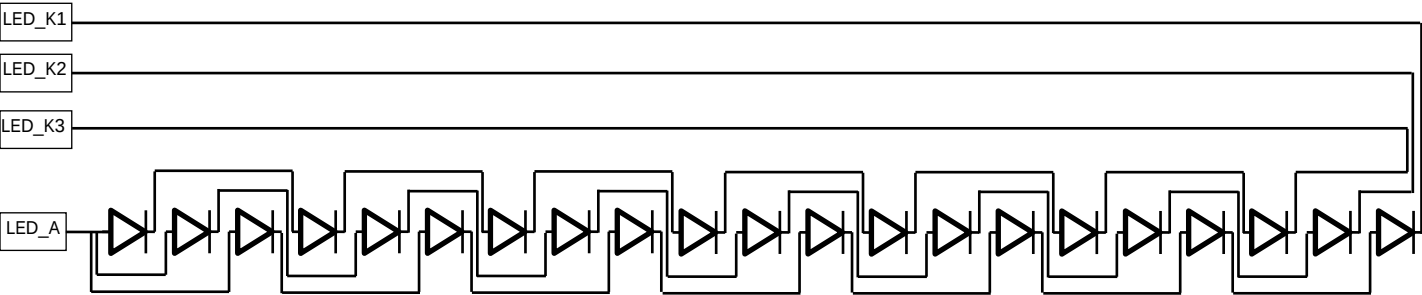


Fig. 11 Schematics drawing of lighting

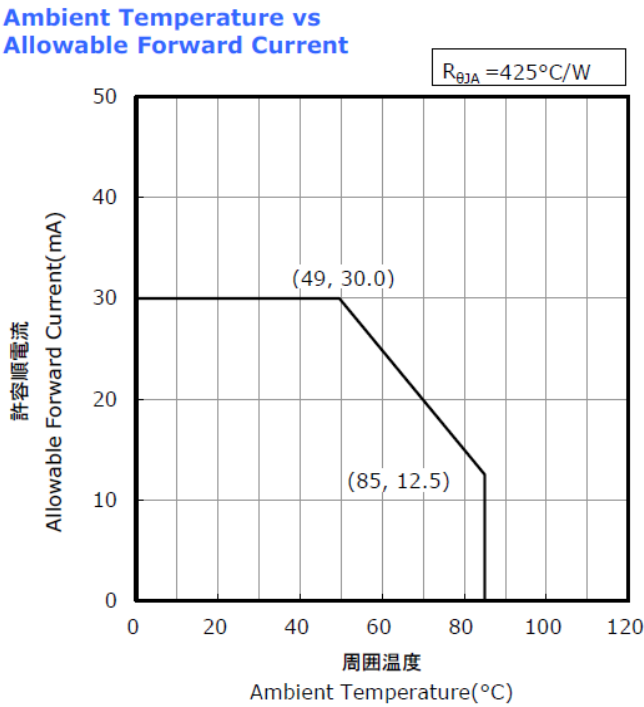


Fig. 12 Ambient Temperature VS. Allowable Forward Current

(6-5) Interface signals

Table 13

Pin No.	Symbol	Description	I/O	Remarks
1	GND	Ground level	-	
2	GND	Ground level	-	
3	D3N	MIPI data3 negative signal line	I	
4	TP_INT	INT for touch panel	I	
5	D3P	MIPI data3 positive signal line	I	
6	NC	No Connect	-	
7	GND	Ground level	-	
8	TP_SDA	I2C SDA for touch panel	I/O	
9	D0N	MIPI data0 negative signal line	I/O	
10	TP_SCL	I2C SCL for touch panel	I	
11	D0P	MIPI data0 positive signal line	I/O	
12	TP_RST	Reset for touch panel	I	
13	GND	Ground level	-	
14	GND	Ground level	-	
15	CLKN	MIPI clock negative signal line	I	
16	VDDIO	Digital Power Supply	-	IOVCC=typ.1.8V
17	CLKP	MIPI clock positive signal line	I	
18	ID1(GND)	Supplier information terminal (GND level)	-	Connected to GND on FPC
19	GND	Ground level	-	
20	ID2(GND)	Supplier information terminal (GND level)	-	Connected to GND on FPC
21	D1N	MIPI data1 negative signal line	I	
22	LED-PWM	Backlight LED driver PWM	O	
23	D1P	MIPI data1 positive signal line	I	
24	TE	TE signal output from driver IC	O	
25	GND	Ground level	-	
26	RESET	Reset Pin	I	
27	D2N	MIPI data2 negative signal line	I	
28	NC(OTP-PWR)	No connect	-	
29	D2P	MIPI data2 positive signal line	I	
30	GND	Ground level	-	
31	GND	Ground level	-	
32	LED_A1	LED Anode	-	
33	GND	Ground level	-	
34	LED_A2	LED Anode	-	
35	VSN	Analog Power Supply	-	VSN=typ.-5.8V
36	LED_K1	LED Cathode	-	
37	VSP	Analog Power Supply	-	VSP=typ.5.8V
38	LED_K2	LED Cathode	-	
39	GND	Ground level	-	
40	LED_K3	LED Cathode	-	

(Note 1) The direction is named with respect to the display module, I = from host to module, O = from module to host.

Table 14 Connector description

Assembled on	Item	Description
Phone PWB	Connector type	Board to Board
	Pin amount	40
	Manufacturer	HIROSE
	Part number	BM20B(0.8)-40DP-0.4V(51)

(6-6) Reset input timing for LCM

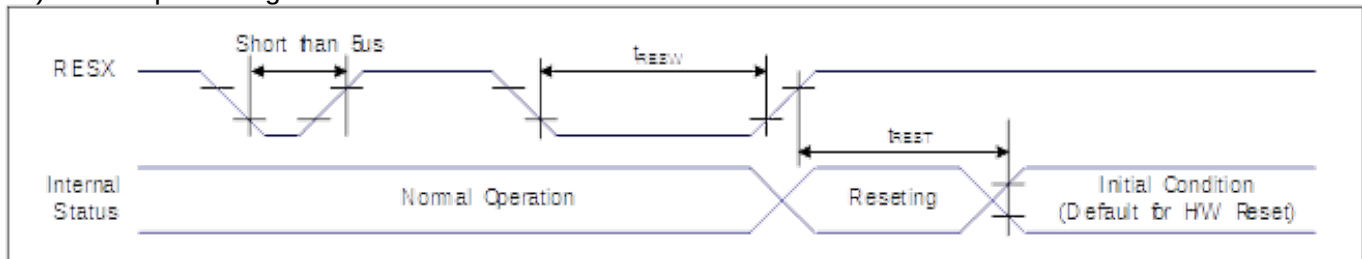


Fig. 13 Reset input timing

Table 15

Symbol	Parameter	Related Pin	MIN	TYP	MAX	Note	Unit
t_{RESW}	*1) Reset low pulse width	RESX	10	-	-	Reset applied during Sleep in mode	us
			70	-	-	Reset applied during Sleep out mode	ms
t_{REST}	*2) Reset complete time	-	-	-	6	Reset applied during Sleep in mode	ms
		-	-	-	120	Reset applied during Sleep out mode	ms

(Note 2) Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below.

Table 16

RESX Pulse	Action
Shorter than 5us	Reset Rejected
Longer than 10us	Reset
Between 5us and 10us	Reset starts (It depends on voltage and temperature condition.)

(Note 3) During the resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts in Sleep-out mode. The display remains the blank state in Sleep-in mode) and then return to Default condition for H/W reset.

(Note 4) During Reset Complete Time, ID1/ID2/ID3 and VCOM value in OTP will be latched to internal register during this period. This loading is done every time when there is H/W reset complete time (t_{REST}) within 5ms after a rising edge of RESX.

(Note 5) Spike Rejection also applies during a valid reset pulse as shown below:

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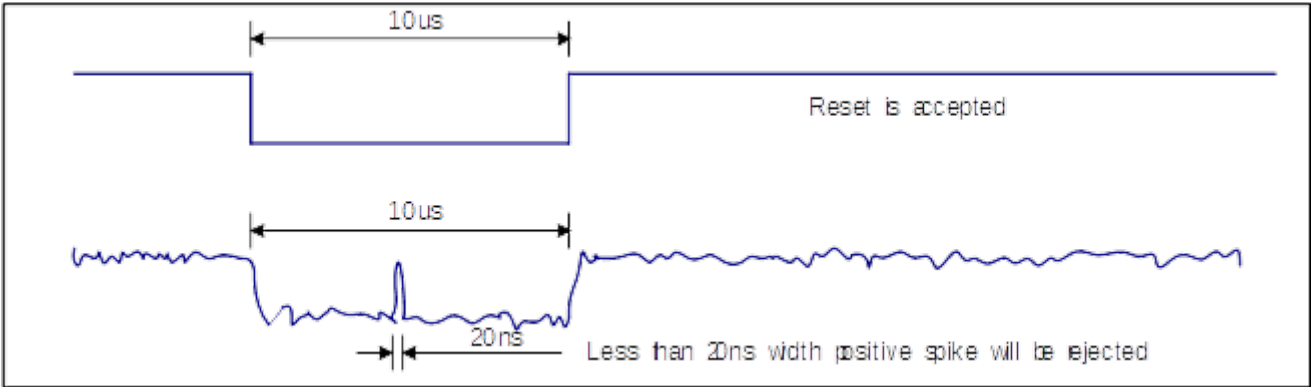


Fig. 14 Reset input timing

(Note 6) It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120 ms.

(6-7) Reset input timing for Touch panel

DSI-D0 High Speed or Low Power modes are starting or finishing from/to Stop State (SS, LP-11) when 4 different combinations, what are listed below, are possible:

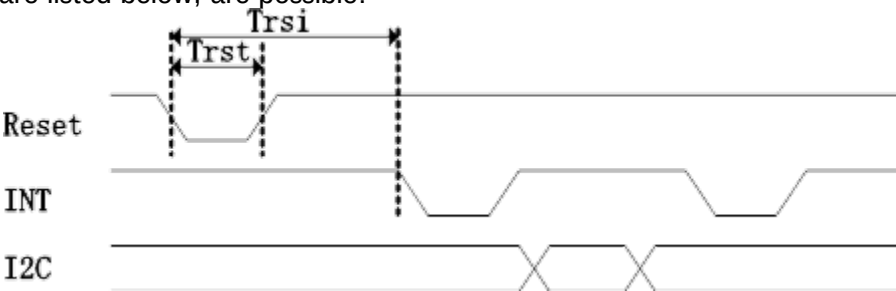


Table 17

Parameter	Description	Min	Max	Units
Trsi	Time of starting to report point after resetting	300	--	ms
Trst	Reset time	5	--	ms

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(6-8) Schematic of LCD module system

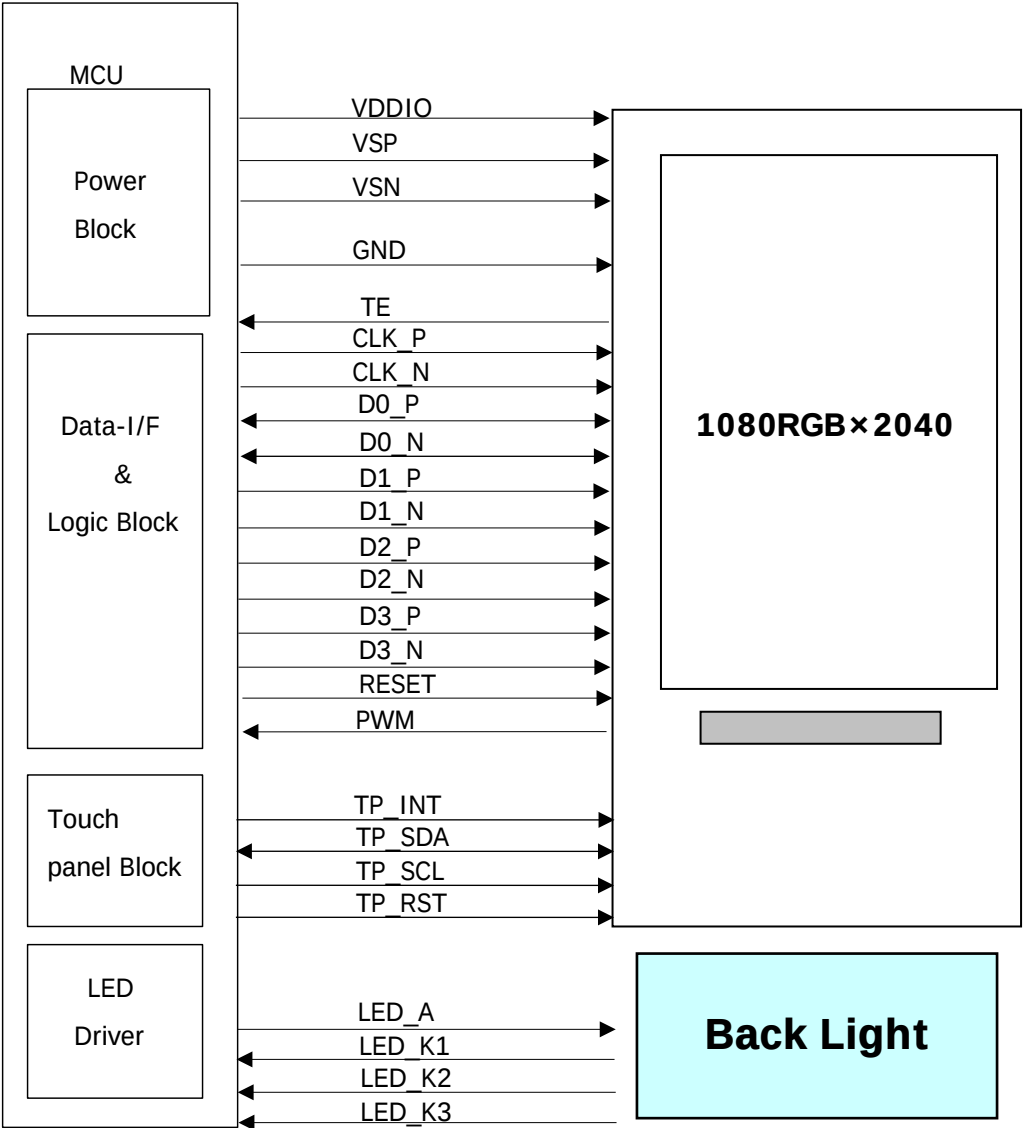


Fig. 15 Schematic of LCD module system

(6-9) General Timing Diagram

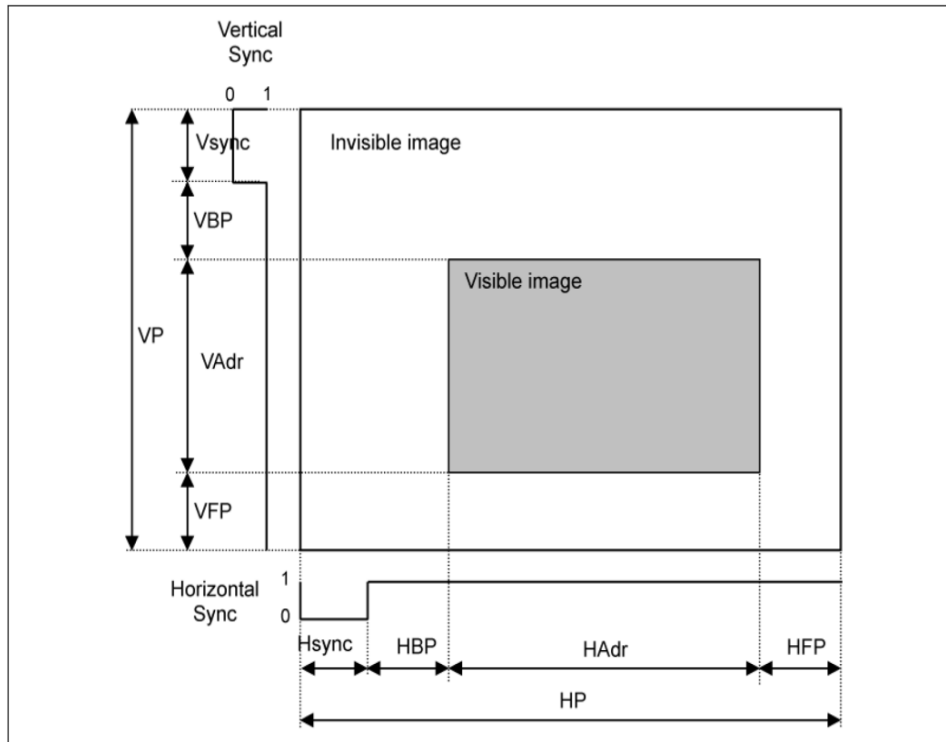


Fig. 16 MIPI Interface

(6-10) Video Timing

Table 18

Item	Min.	Typ.	Max.	Unit
Horizontal low pulse width(HS)	-	4	-	Line
Horizontal back porch(HBP)	-	32	-	Line
Horizontal active area (HAdr)	-	1080	-	Pixel
Horizontal front porch (HFP)	-	32	-	Line
Vertical low pulse width(VS)	-	2	-	H
Vertical front porch(VFP)	-	16	-	H
Vertical back porch(VBP)	-	16	-	H
Vertical active area (VAdr)	-	2160	-	Pixel
Frame Frequency	-	60	-	Hz
DSI DATA rate	-	907	-	Mbps/Lane

Ta = -20 ~ +70°C, VDDIO = 1.8 V, VSP=5.8V, VSN= -5.8V, GND = 0 V

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7. Initial Sequence

Table 19 Power ON Sequence

Item	Register Address	Register Data.	Remark
RESET="L"			
VDDIO=1.8V			VDDIO power on
Wait 5ms			
RESET="H"			
Wait 5ms			
VSP=5.8V			VSP power on
Wait 5ms			
VSN=-5.8V			VSN power on
Wait 5ms			
RESET="L"			
Wait 1ms			
RESET="H"			
Wait 15ms			
Sleep Out	11h		LP
Wait 120ms			LP
TE On	35h	00h	LP
Wait 10ms			
Image transfer			HS
Display On	29h		HS

Table 20 Power OFF Sequence

Item	Register Address	Register Data.	Remark
Display Off	28h		HS
Wait 20ms			HS
Sleep In	10h		HS
Wait 120ms			HS
VSN OFF			LP
Wait 5ms			
VSP OFF			
Wait 5ms			
VDDIO OFF			
RESET="L"			

8. Optical Characteristics

(8-1) Optical Characteristics (All with cover glass)

Table 21

VDDIO=1.8 V, VSP=5.8V, VSN=-5.8V, ILED=20mA, Ta = 25℃

Parameter	Symbol	Condition	Min	Typ	Max	Unit	Remark
Contrast	CR	$\theta=0^{\circ}$	1050	1500	-	-	Note 1,2
		$\theta=80^{\circ}$ $\Phi=0/90/180/270$	100	-	-		
Brightness	L	$\theta=0^{\circ}$	440	550	-	cd/m ²	Note 1
NTSC ratio	S	$\theta=0^{\circ}$	-	95	-	%	Note 1
Response Time	Tr+Td	$\theta=0^{\circ}$	-	30	35	ms	Note 1,3
White Chromaticity	x	$\theta=0^{\circ}$	0.270	0.300	0.330	-	Note 1
	y		0.290	0.320	0.350		
Red Chromaticity	x	$\theta=0^{\circ}$	0.650	0.680	0.710	-	Note 1
	y		0.286	0.316	0.346	-	
Green Chromaticity	x	$\theta=0^{\circ}$	0.237	0.267	0.297	-	Note 1
	y		0.662	0.692	0.722	-	
Blue Chromaticity	x	$\theta=0^{\circ}$	0.120	0.150	0.180	-	Note 1
	y		0.026	0.056	0.086	-	
Brightness Uniformity	-	$\theta=0^{\circ}$	80	85	-	%	Note 1,4
Crosstalk	-	$\theta=0^{\circ}$	-	-	3	%	Note 1,5
Flicker	-	$\theta=0^{\circ}$	-	-	-25	dB	Note 1,4,6
Gamma	-	$\theta=0^{\circ}$	2.0	2.2	2.4	-	Note 1, (Gray scale112-143)

*1: Measuring condition

- Temperature = 25℃(±3℃), Frame Frequency =60Hz, LED back-light: ON, CABC/CE OFF, Environment brightness < 150 lx
- Measured sample : New sample before a long term aging.
- Specification data is defined by the liquid crystal input voltage of chromaticity center shift adjustment for all LCD modules. A measurement device is TOPCON luminance meter SR-3. (Measurement angle1°)

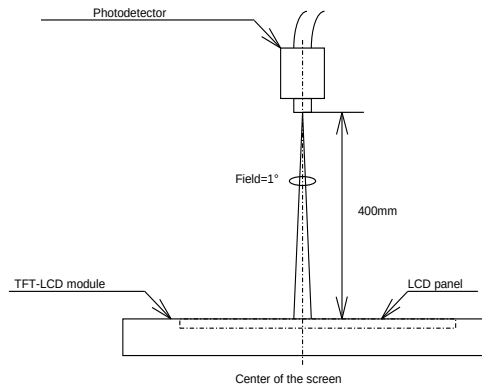


Fig. 17 Optical characteristics Test Method

(Note 1) Definition of range of visual angle

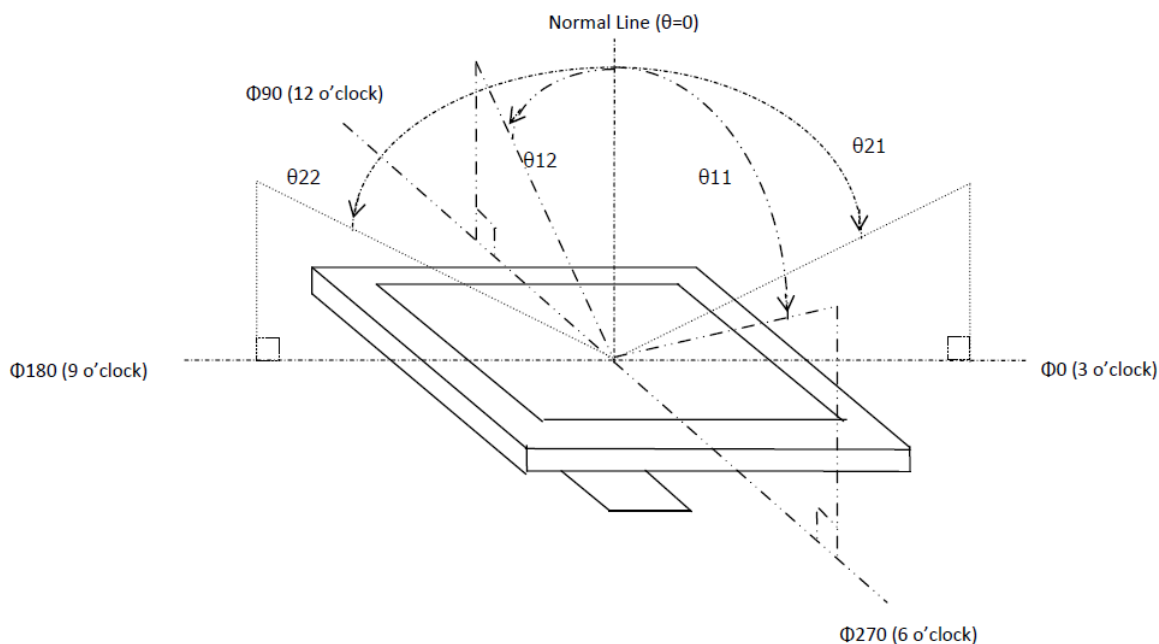


Fig. 18 Definition of viewing angle

(Note 2) Contrast ratio is defined as follows:

$$C_o = \frac{\text{Luminance(brightness) all pixels "White"}}{\text{Luminance(brightness) all pixels "Black"}}$$

(Note 3) Response time is defined as follows:

Define response time 1:

The response time 1 is defined as the following figure and shall be measured by Switching the input signal for "black" and "white".

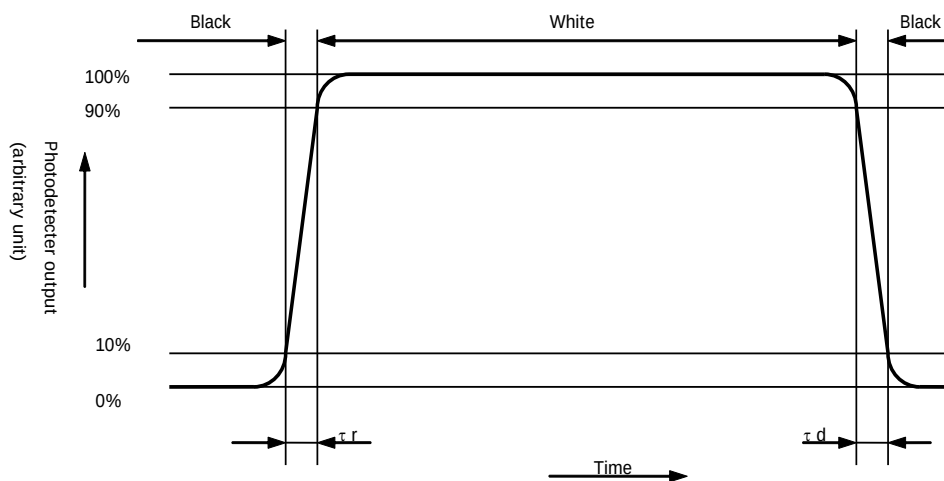


Fig. 19 Response time

(Note 4) Uniformity is defined as follows:

$$\text{Uniformity} = \frac{\text{Minimum Brightness}}{\text{Maximum Brightness}} \times 100 [\%]$$

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

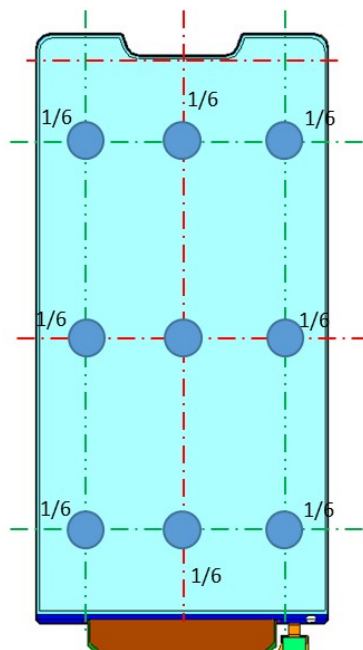


Fig. 20 Definition of measurement points

(Note 5) Definition of Crosstalk

$$CT_w = \frac{|Y_w(x) - Y_G(x)|}{Y_G(x)} \times 100 (\%)$$

x=U, D, L or R

Gray level=V128

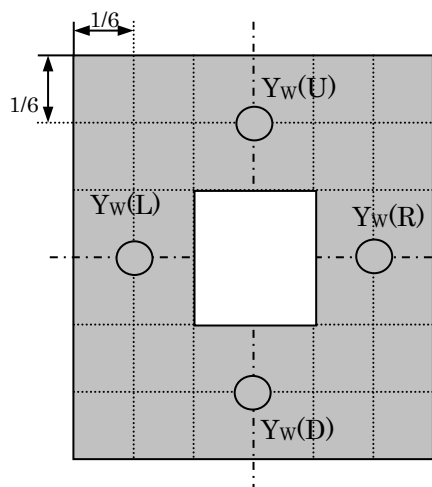


Fig. 21 Definition of Crosstalk

(Note 6) Measuring systems: YOKOGAWA 3298_01 + 3298_11

- Temperature = 25°C(±3°C), Frame Frequency = 60Hz, 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.
- Measurement point is panel center.
- Conversion of Flicker ratio : Flicker[dB] = 20log(ACrms/DC)
- Worst pattern:

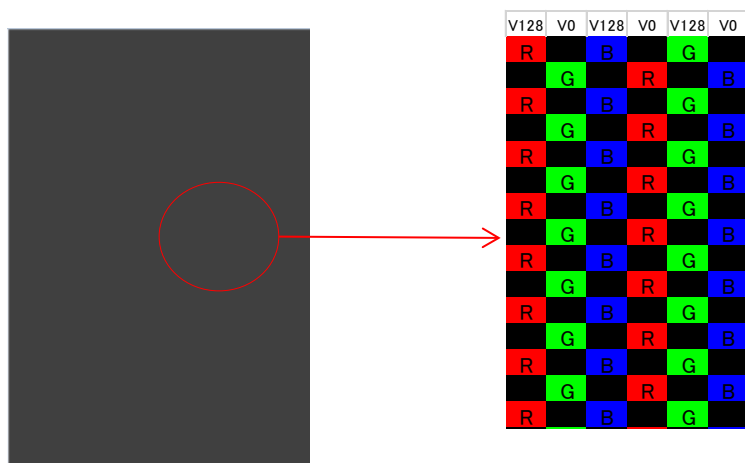


Fig. 22 Flicker pattern

9. Touch panel characteristics

Table 22

Item	Specification
Accuracy	(Zone1 : Max ± 1 mm, Zone2:Max ± 2.0 mm($\phi 7$ mm))
Linearity	(Zone1 : Max ± 0.5 mm, Zone2:Max ± 2.0 mm($\phi 7$ mm))
Jitter	(Zone1 : Max ± 0.5 mm, Zone2:Max ± 2.0 mm($\phi 7$ mm))
Report rate	120Hz
Sensor system	Capacitance
Host I/F	I2C
Detection number	Up to 10 finger
Maximum coordinate value	1080,2160
Response	Active state: 2 x report period Idle state: 1 x idle scan period + 1 x report period

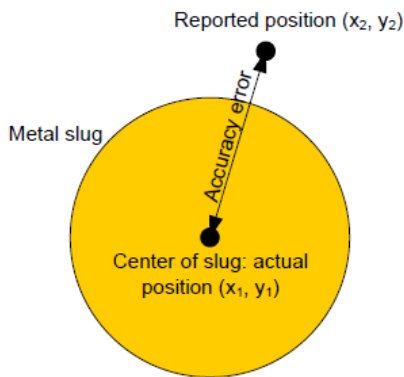


Fig. 23 Accuracy methodology

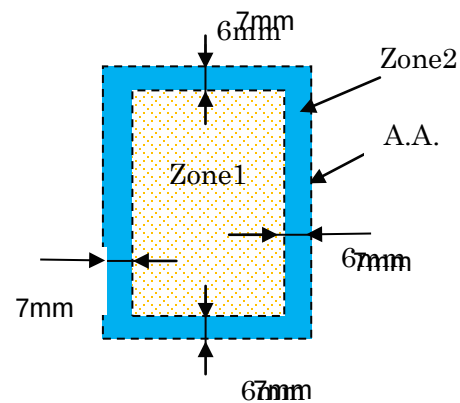


Fig. 24 Zone

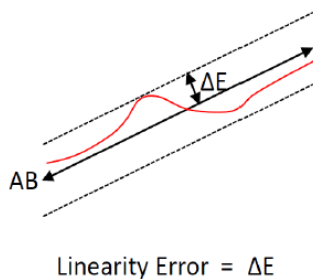


Fig. 25 Linearity Error calculation

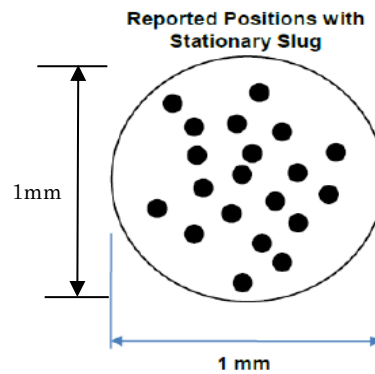


Fig. 26 Jitter

10. Reliability test items

(10-1) For Full LCD Module

Table 23

No.	Test item	Conditions
1	High temperature storage test	Ta = +75°C, 240h
2	Low temperature storage test	Ta = -30°C, 240h
3	High temperature operation test	Ta = +70°C, 240h
4	Low temperature operation test	Ta = -20°C, 240h
5	High temperature and high humidity operation test	Ta = +60°C, 90%RH, 240h (No condensation)
6	Heat shock test	Ta = -30°C(45min) ~ +75°C(45min), 50cycle, Non operation
7	Electro static discharge test	HBM : 330ohm/150pF Contact : +/- 4kV Normally display in the Re-power on Air : +/- 8kV Normally display in the Re-power on Point : A.A.center , 3 time for point , Operation
8	Packing Vibration test	Frequency range : 10~55Hz Stroke : 1.5mm Sweep: 10Hz~55Hz~10Hz 2hrs for each direction of X,Y,Z (Total 6hrs)
9	Packing Drop test	Height : 90cm Base material: Concrete floor Direction : 1 corner, 3 edge, 6 face Times of test : Once for point
10	FPC Bending Resistance	Bending radius : R2.0mm Bending times : 20times Bending degree : 180 degree No detects in appearance, electrical, optical, mechanical, functionality

Note 10-1) As for the Reliability test item of No.1-No.6, LCD modules are checked by two hours later.

Note 10-2) Check items for other Test

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

(10-2) For only Cover Glass

Following test spec are only provisional.

We will put final conditions after fixing specifications between and CG vender. (Nov. begin)

Table 24

No.	Test item	Conditions
1	High temperature storage test	Ta = +85°C, 240h
2	Low temperature storage test	Ta = -40°C, 240h
3	High temperature and high humidity storage test	Ta = +60°C, 90%RH, 240h (No condensation)
4	Heat shock test	Ta = -40°C(1h) ~ +85°C(1h), 30cycle, Non operation
5	Corrosion test	Ta = +35°C, 85%RH, Spray 5% NaCl@PH6.5~7.2, 24h
6	Ball drop test	Test hight: 20cm Jig: Ø31.75mm steel ball, 130g weight Measurement point: 9point (Drop times : Once per each height) Direction : Ink Face Down
7	Pencil hardness	Jig : Mitsubishi UNI pencil Measurement point: 5 test straight lines of 20mm length Method of measurement: Pressure is 750g. Pencil angle is 45° SPEC : Pencil Hardness 9H, No visible scratch
8	AF coating test	Jig : MXD-02 Loading 200+/-20gf, 3stroke / each sample SPEC : Coefficient of kinetic friction under 0.03
9	Contact angle test	Test speed : 50cycles/min Jig : steel wool(0000#) Loading : 2500cycle with 1kg load SPEC : water... > 110° before test, >100° after test Oleic Acid... > 65° before test, >60° after test
10	Surface energy test	Jig : Arcotest Dynes Pencil Loading : 5strokes line of 10mm length / each sample SPEC : Back surface (Ink area) Dyne > 32
11	Cross cut test	Cut the printing surface into a 1mm*1mm pattern with 11-cuts cross cutter in 2 mutual perpendicular directions. Apply a band of 3M 610 adhesive tape over the latticed pattern and remove it by peeling back rapidly. SPEC : Pass 4B classification. (4B=the detached area should be smaller than 5% of the lattice.)

Note 10-3) As for the Reliability test item of No.1-No.5, Cover Glass are checked by two hours later.

Note 10-4) Check items for other Test

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

Note 10-5) Reliability test item of No.6-No.9 apply only to flat area of CG surface.

11. Forwarding Form

(11-1) Packing description

- (a) Piling number of cartons: 8 deeps
- (b) Package quality in one cartons: 80 pcs
- (c) Carton size: 530 mm × 365 mm × 235 mm
- (d) Total mass of 1 carton filled with full modules: approximately 8.1 kg

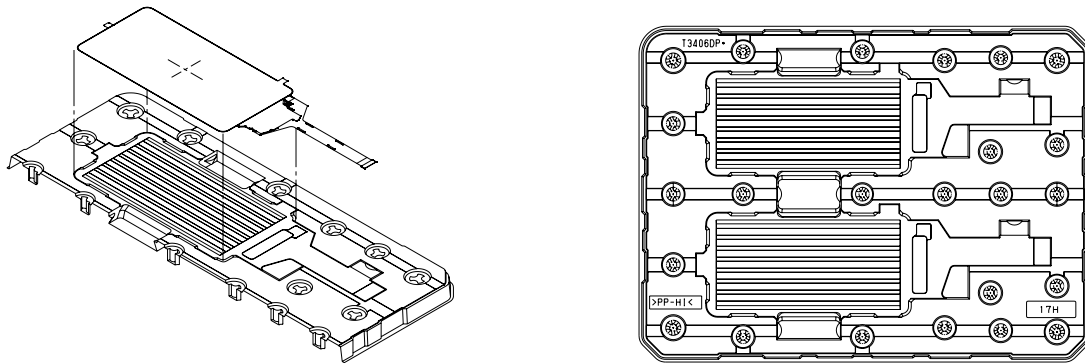


Fig.27 tray

Condition for storage Environment

- (1) Temperature: 0 to 40°C
- (2) Humidity: 60%RH or less (at 40°C)
- (3) Atmosphere: Harmful gas, such as acid or alkali which erodes electronic components and/or wires, must not be detected.
- (4) Period: about 3 months
- (5) Opening of the package: In order to prevent the LCD module from breakdown by electrostatic charges, please control the room humidity over 50%RH and open the package taking sufficient countermeasures against electrostatic charges, such as earth, etc.

(11-2) Description of packing material

No.	1	2	3	4	5	6
Description	LCD module	Tray	Aluminum packing	Inner sleeve	Outer sleeve	Master carton
Quantity	80	44	4	4	2	1

(11-3) Description of packing procedure

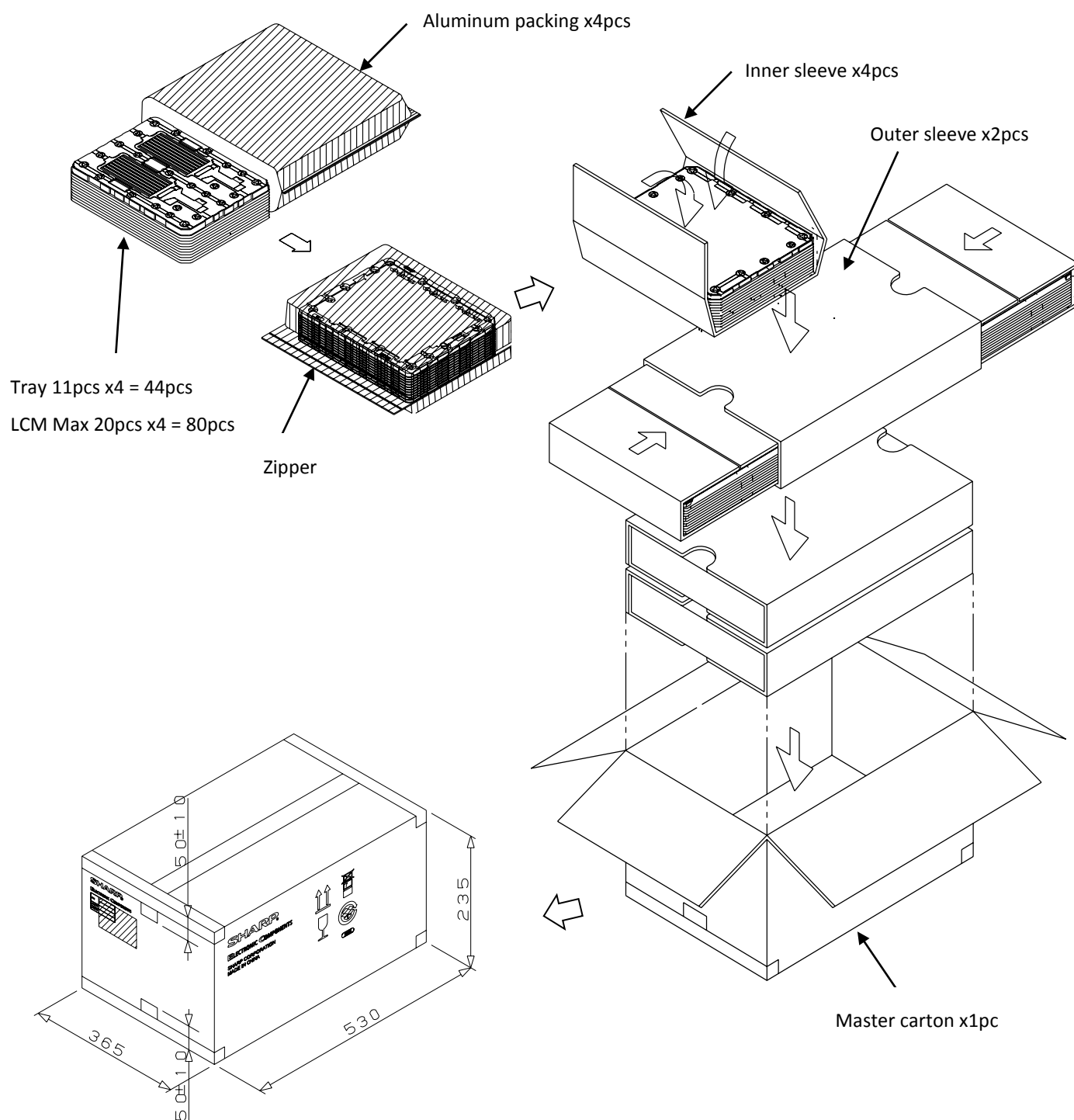


Fig.28 packing case

Fig.29

13. FPC schematic

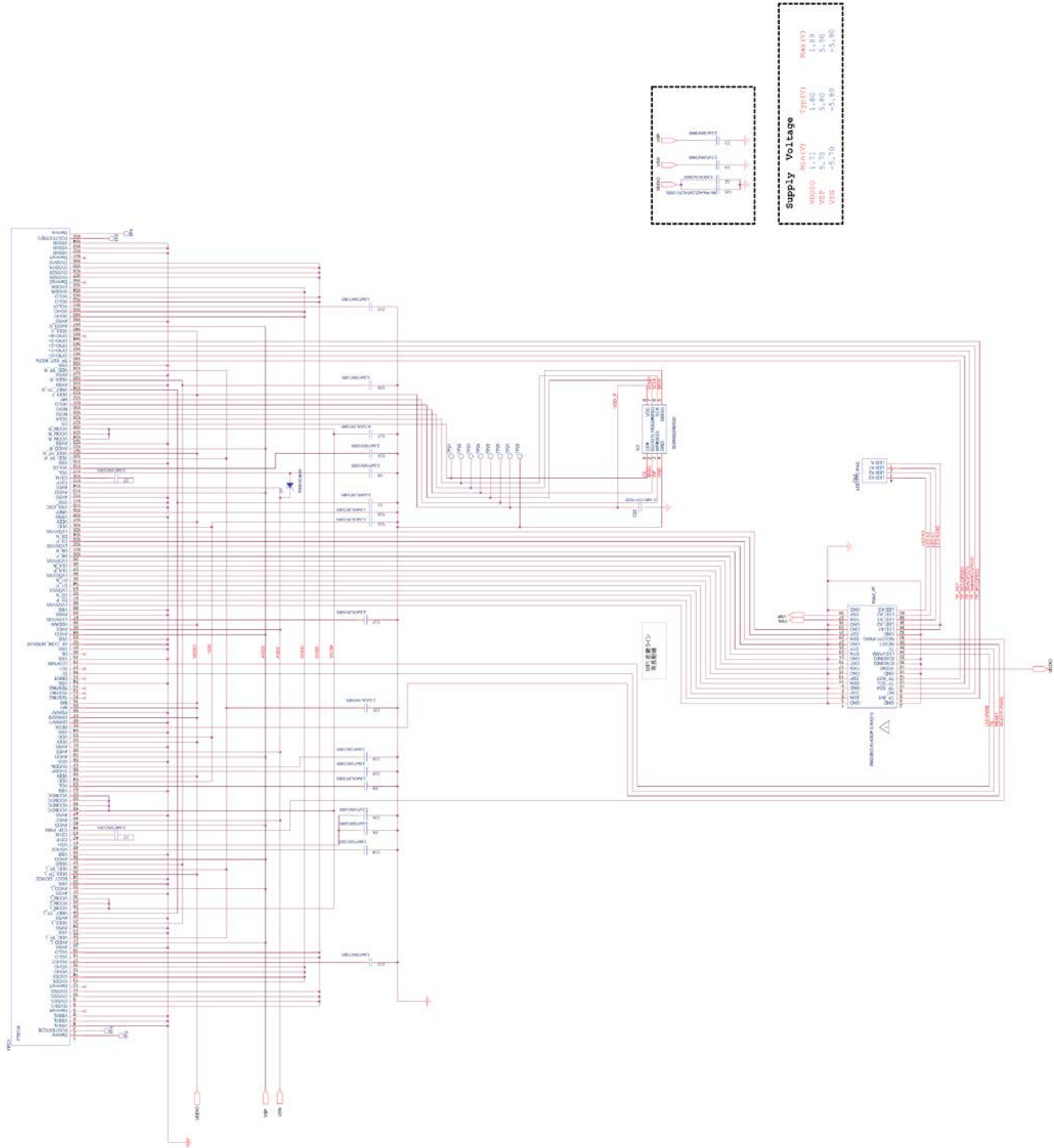


Fig.30