To:	SHARP SHARP DISPLAY TECHNOLOGY CORPORATION	SPEC No. LCP-0623029A FILE No. ISSUE Nov.17.2022 PAGE Pages 35
	SPECIFICATION	DEVEROPMENT DIVISION MOBILE/IA BUSINESS UNIT SHARP DISPLAY TECHNOLOGY CORPORATION (SDTC)

DEVICE SPECIFICATION for

LCD Module

Model No.

LS050K7SX03

*If you have any problems to this standard, please let us know before placing an order.

☐ CUSTOMER'S APPROVALDATE

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[Handling Instructions]

Handling Precautions

(1) Treat LCD module in dustless surroundings.

(2) Be sure to turn off the power supply when remove the plugged FPC.

(3) Be careful not to give any physical stress onto the circuit of LCD module when you plug a FPC. Physical stress will cause a break or worse connection.

(4) Do not touch or scratch the polarizer with items harder than the surface rating or permanent damage can result.

(5) Since the LCD panel is made of glass, it may break or crack if dropped or bumped on hard surface. Always handle with care.

(6) Be careful to handle this LCD panel in order to avoid injury yourself as this panel is made of glass and have sharp edge. When the panel is broken, do not touch the glass. Although the panel is difficult to be scattered, touching the broken part may hurt your hands.

(7) Since a long contact with water may cause discoloration or spots, wipe it with absorbent cotton or other soft cloth immediately.

(8) This module contains TFT. Please use appropriate anti-static protection methods for all contact with the LCD panel and its electrical circuits.

(9) Do not expose to strong ultraviolet rays such as direct sunlight for a long time.

(10) Liquid crystal contained in the panel may leak if the LCD is broken. If LC material should accidently come in contact with the mouth or eyes rinse with water as soon as possible, following the instructions of the appropriate MSDS.

(11) Use N2-blower such as ionized nitrogen has anti-electrostatic when you blow dusts on Polarizer. To clean LCD panel surface, wipe clean with absorbent cotton or soft cloth. If further cleaning is needed, use IPA (isopropyl alcohol) and wipe clean lightly on surface only. Do not use organic solvents as it may damage the LCD panel terminal area which uses organic material. Also, do not directly touch with finger. When the terminals cleaning is needed, those should be wiped by a soft cloth or a cotton swab without directly touching by hand.

Set-Design Precautions

(1) Disassembly of the LCD panel in any way voids the warranty and may permanently damage the LCD panel.

(2) Do not expose the side of LCD panel and gate driver, etc. on the panel (circuit area outside panel display area) to light as it may not operate properly. Design that shields the side of LCD panel and gate driver, etc. from light is required when mounting the LCD module.

(3) Support for the LCD panel should be carefully designed to avoid the outside of stress specification on glass surface. Be sure to design the cabinet so that the module can be assembled without any extra stress such as warp or twist.

(4) It causes an irregular display and the defective indication, etc., when always put constant pressure on the back of the module. Please do not make the structure to press the back of the module.

(5) In case of attaching a cover glass or touch panel to the front surface, use appropriate measures to avoid degrading optical performance.

(6) To prevent loss of uniformity and prevent the introduction of contamination to the optical path of the LCD panel, please use fine-pitch filters in the air flow of forced ventilation.

(7) Be sure to follow the absolute maximum rating in the specification. The design should consider the surrounding temperature, the fluctuating input signal, and tolerance of the electronic parts. Exceeding values is possible to cause worse characteristic such as burn and/or broken of the parts on LCD module.

(8) Be sure to use LCD module within the recommended Electrical Characteristics and Timing Characteristics of Input Signals conditions. Operating module out of the recommended range is not guaranteed even if it is in the absolute maximum rating.

(9) Follow the power, signal, and supply voltage sequence which the specification indicates, regarding on-off input signal after power on of LCD module.

(10) According to the using application, power circuit protection is recommended at module failure.

(11) When handling LCD modules and assembling them into the cabinet, please avoid long-term storage in the environment of oxidization or deoxidization gas. The use of materials such as reagent, solvent, adhesive, resin, etc. which generate these gasses, may cause corrosion and discoloration of the modules.
Do not use the LCD module under such environment.

(12) Protection film is attached to the module surface to prevent it from being scratched. Peel the film off slowly, just before the use, with strict attention to electrostatic charges. Blow off 'dust' on the polarizer by using an ionized nitrogen. After peeling the protection film off, please do not reattach to the front polarizer. If you reattach and store it long time, surface of the front polarizer changes in quality and it may cause display non-uniformity issue.

(13) Panel is susceptible to mechanical stress and such stress may affect the display. Place the LCD panel on flat surface to avoid stress caused by twist, bend, etc.

(14) To prevent reduction in optical quality and abnormal display, avoid exposure and contamination of the LCD panel from epoxy resin (mine system curing agent) that comes out from the material and the packaging material used for the set side, the silicon adhesive (dealcoholization system and oxime system), and the tray blowing agents (azo compound), etc. Please confirm LCD panel compatibility with materials employed in your manufacturing and shipping processes.

(15) Since the LCD panel is made of glass, it may break or crack if dropped or bumped on hard surface. Always handle with care.

(16) Please design part arrangement to consider the heat dissipation not to change the local temperature for module.

(17) This product is not waterproof and dust-proof structure.

(18) As this LCD module is composed electronic circuits, it is sensitive to electrostatic discharge of 200V or more. Handle with care using cautions for the followings:

・Operators

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

・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.

・Floor

Floor plays an important role in leaking static electricity generated in human body or equipment. If the floor is made of insulated material (such as polymer or rubber material), such static electricity may charge. Proper measure should be taken to avoid static electricity charge (electrostatic earth: 100Mohms). There is a possibility that the static electricity is charged to them without leakage in case of insulating floor, so the electrostatic earth: 100Mohms should be made.

・Humidity

Humidity in work area relates to surface resistance of the persons or objects that generate electrostatics, and it can be manipulated to prevent electrostatic charge. Humidity of 40% or lower increases electrostatic earth resistance and promotes electrostatic charging. Therefore, the humidity in the work area should be kept above 40%. Specifically for film peeling process or processes that require human hands, humidity should be kept above 50% and use electricity removal blower.

・Transportation/Storage

Containers and styroform used in transporation and storage may charge electrostatic (from friction and peeling) or electrostatic charge from human body, etc. may cause containers and styroform to have induced charge. Proper electrostatic measure should be taken for containers and storage material.

【Operation Precautions】

(1) Do not use polychloroprene (CR) with LCD module. It will generate chlorine gas, which will damage the reliability of the connection part on LCD panel.

(2) Be sure to use LCD module within the recommended operating conditions. Operating module out of the recommended range is not guaranteed even if it is in the absolute maximum rating.

(3) When handling LCD modules and assembling them into cabinets, please avoid long-term storage in the environment of oxidization or deoxidization gas. The use of materials such as reagent, solvent, adhesive, resin, etc. which generate these gasses, may cause corrosion and discoloration of the modules. Do not use the LCD module under such environment.

(4) To prevent reduction in optical quality and abnormal display, avoid exposure and contamination of the LCD panel from epoxy resin (amine system curing agent) that comes out from the material and the packaging material used for the set side, the silicon adhesive (dealcoholization system and oxime system), and the tray blowing agents (azo-compound), etc. Please confirm LCD panel compatibility with materials employed in your manufacturing and shipping processes.

(5) If stored at the temperatures lower than the rated storage temperature, the LC may freeze, and it may cause LCD panel damage. And if stored at the temperatures higher than the rated storage temperature, the LC will lose its characteristics, and it cannot recover. Please keep it at near room temperature.

(6) Do not operate the LCD panel under outside of electrical specification. Otherwise LCD panel may be damaged.

(7) Do not use the LCD panel under outside of specified driving timing chart. Otherwise LCD panel may not have proper picture quality.

(8) A still image should be displayed less than two hours, if it is necessary to display still image longer than two hours, display image data must be refreshed in order to avoid sticking image on LCD panel.

(9) If LCD module takes a static electricity, as the display image which is written into pixel memory might not be displayed, Data update should be executed frequently.

(10) It is neither a breakdown nor a defective indication though very slight change in black level might be periodically seen in a black part on the black display image according to the source of light (angle of the luminance and the source of light).

(11) Be sure to follow the absolute maximum rating in the specification. The design should consider the surrounding temperature, the fluctuating input signal, and tolerance of the electronic parts. Exceeding values is possible to cause worse characteristic such as burn and/or broken of the parts on LCD module.

(12) Follow the power, signal, and supply voltage sequence which the specification indicates, regarding on-off input signal after power on of LCD module.

(13) According to the using application, power circuit protection is recommended at module failure.

(14) Nature of dew consideration prevention is necessary when LCD is used for long time under high-temperature and high-humidity

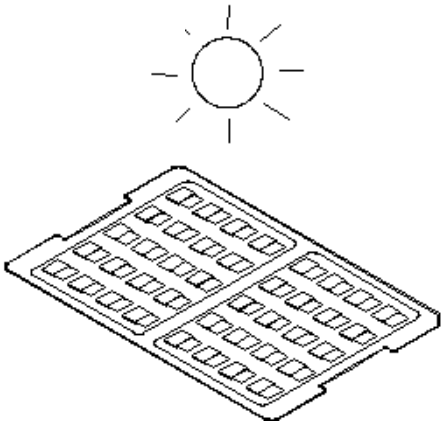
[Precautions for Storage]

(1) After opening the package, do not leave the LCD panel in direct sun or under strong ultraviolet ray. Store in the dark place.

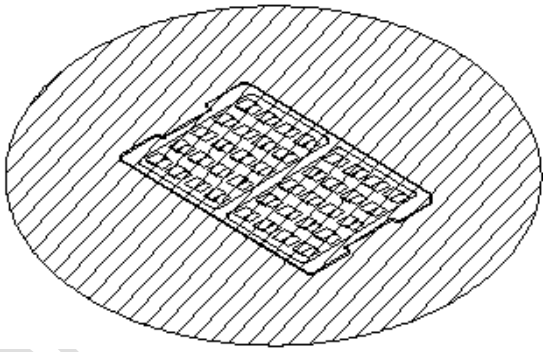
(2) In temperature lower than specified rating, liquid crystal material will coagulate. In temperature higher than specified rating, it will liquefy. In either condition, the liquid crystal may not recover its original condition. Store the LCD panel in at or around room temperature as much as possible. Also, storing the LCD panel in high humidity will damage the polarizer. Store in normal room temperature as much as possible.

(3) Keeping Method

a. Don't keeping under the direct sunlight.



b. Keeping in the tray under the dark place.



[Other Notice]

(1) Operation outside specified environmental conditions cannot be guaranteed.

(2) As power supply impedance is lowered during use, bus controller should be inserted near LCD module as much as possible.

(3) Polarizer is applied over LCD panel surface. Liquid crystal inside LCD panel deteriorates with ultraviolet ray. The panel should not be left in direct sun or under strong ultraviolet ray for prolonged period of time even with the polarizer.

(4) Disassembling the LCD module will cause permanent damage to the module. Do not disassemble the module.

(5) If LCD panel is broken, do not ingest the liquid crystal from the broken panel. If hand, leg or clothes come in contact with liquid crystal, wash off immediately with soap. If mouth or eyes come in contact with liquid crystal, rinse with water as soon as possible, following the instructions of the appropriate MSDS.

(6) ODS (specific chlorofuorocarbon, specific halon, 1-1-1 trichloroethane, carbon tetrachloride) are not used or contained in material or all production processes of this product.

(7) Observe all other precautionary requirements in handling general electronic components.

***Discarding liquid crystal modules**

Follow the regulations when LCD module is scrapped. The government you stay may have some regulations about it.

LCD Panel : Dispose of as glass waste. This LCD module contains no harmful substances. The liquid crystal panel contains no dangerous or harmful substances. This liquid crystal panel contains only an extremely small amount of liquid crystal (approximately 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 used.

1. Application

This specification is applied to color TFT-LCD module LS050K7SX03.

2. Outline

This module is a color reflective and active-matrix LCD module incorporating Oxide semiconductor (IGZO) TFT (Thin Film Transistor).

This TFT-LCD module can indicate a figure and the character with 720RGB×1280 and 16,777,216 colors.

LCD module is controlled by Driver IC (NT36523: Novatek.).

As to basic specification of driver IC refer to the IC specification and handbook.

3. Construction

- Reflective active matrix with slightly transmissive panel of Color.
- 4.99inch, vertical stripes, HD720 (720×RGB×1280 pixel)
- Low power consumption IGZO panel
- Display control by MIPI DSI Interface (3lane)
- Front polarizer surface is HC

4. Mechanical (Physical) Specifications

Table 4-1.

Item	Specifications	Unit
Screen size（Diagonal）	12.667 [4.99inch]	cm
Active area	62.10 (H)×110.40 (V)	mm
Pixel format	720(H)×RGB×1280(V)	Pixel
Pixel pitch	0.02875(H)×0.08625(V)	mm
Pixel configuration	RGB vertical stripes	—
Outline dimensions (Except protrusion)	67.0(W) × 120.57(H) × 2.205(D) (*)	mm
Mass	32	g
Surface hardness（HC）	>2H (Initial）	Pencil hardness

(*) For detailed measurements and tolerances, please refer to Fig.5-1 Outline Dimensions.

5. Structure

5-1. Component

This LCD module is Construction of LCD panel, POL (front and rear), LCD-FPC, COG-Driver (IC) and Back light unit.

Outline: Fig.5-1 Outline Dimensions

5-2. LCD-FPC performance

FPC Flexing properties:

Flexing test in wind radius =R0.6mm and the wind angle = 90 ° of condition, and don't be broken in less than 30 times.

* Please don't bend FPC on the front side in a connection part with a LCD panel.

5-3. LED-FPC performance

FPC Flexing properties:

Flexing test in wind radius =R0.6mm and the wind angle = 90 ° of condition, and don't be broken in less than 30 times.

* Please don't bend FPC on the front side in a connection part with a LCD panel.

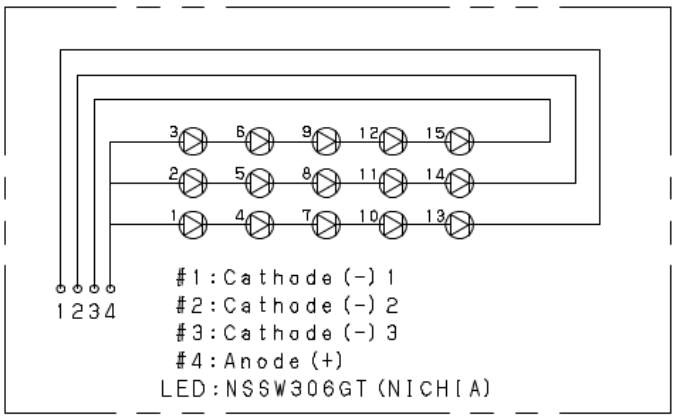


Fig.5-3 LED-FPC circuit

5-4. LED performance

LED : NSSW306GT : NICHIA Corporation 0.6t

Table 5-1

luminous flux,rank (Ta=25℃、I_F=20mA)

rank	luminous flux,		
	Min	Max	Unit
NW1025	10.25	10.50	lm
NW1000	10.00	10.25	
NW975	9.75	10.00	
NW950	9.50	9.75	

About a rank division, there is ±5% of common difference.

.

Table 5-2

CIE	x	y	CIE	x	y
Bv54	0.3325	0.3332	Bv55	0.3275	0.3240
	0.3325	0.3432		0.3275	0.3340
	0.3375	0.3524		0.3325	0.3432
	0.3375	0.3424		0.3325	0.3332
Bv56	0.3225	0.3148	Bv74	0.3325	0.3232
	0.3225	0.3248		0.3325	0.3332
	0.3275	0.3340		0.3375	0.3424
	0.3275	0.3240		0.3375	0.3324
Bv75	0.3275	0.3140	Bv76	0.3225	0.3048
	0.3275	0.3240		0.3225	0.3148
	0.3325	0.3332		0.3275	0.3240
	0.3325	0.3232		0.3275	0.3140

About a rank division, there is ±0.003 of common difference.

6. Interface Signals Pin assignment

Table6-1. LCD pin assignment

No.	Symbol	I/O	Description
1	AGND	−	Analog GND
2	RESX	I	LCD Reset Signal
3	LEDPWM	O	LEDPWM signal output. If not used, please open this pin.
4	FTE1	O	FTE1 signal output. If not used, please open this pin.
5	FTE	O	FTE signal output. If not used, please open this pin.
6	GND	-	Digital GND
7	NC	-	No connection
8	NC	-	No connection
9	GND	-	Digital GND
10	HSSI_D0_N	I	DSI date (lane0_N)
11	HSSI_D0_P	I	DSI date (lane0_P)
12	GND	-	Digital GND
13	HSSI_CLK_N	I	DSI clock_N
14	HSSI_CLK_P	I	DSI clock_P
15	GND	-	Digital GND
16	HSSI_D1_N	I	DSI date (lane1_N)
17	HSSI_D1_P	I	DSI date (lane1_P)
18	GND	-	Digital GND
19	HSSI_D2_N	I	DSI date (lane2_N)
20	HSSI_D2_P	I	DSI date (lane2_P)
21	GND	-	Digital GND
22	AVEE	-	Power supply (-) for analog circuit
23	AGND	-	Analog GND
24	VDDI	-	Degital Power supply
25	AVDD	-	Power supply (+) for analog circuit
26	AGND	-	Analog GND

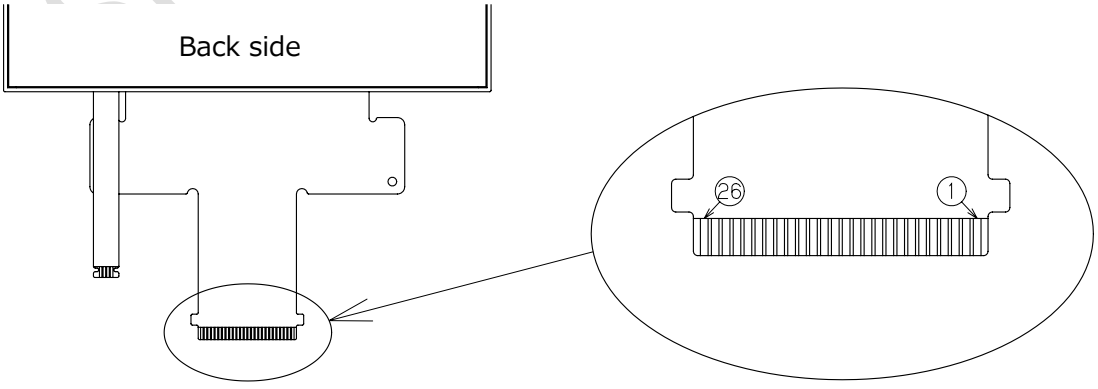


Fig. 6-1

Table6-2. LED pin assignment

No.	Symbol	I/O	Description
1	LED-	–	LED Cathode1
2	LED-	-	LED Cathode2
3	LED-	-	LED Cathode3
4	LED+	-	LED Anode

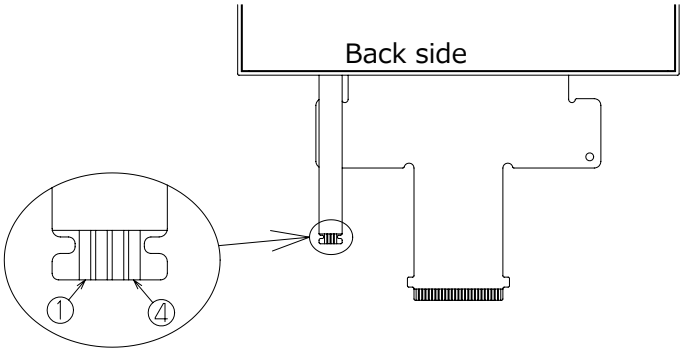


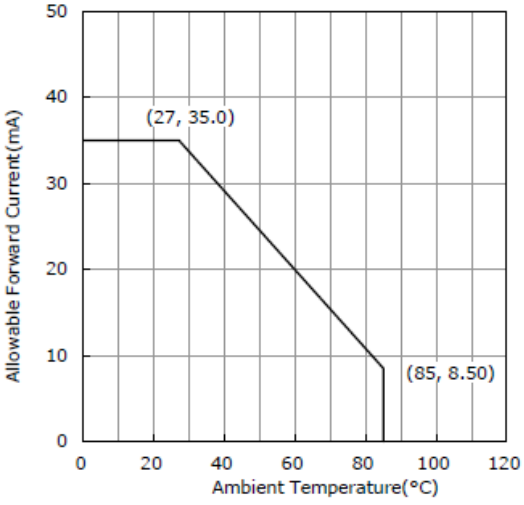
Fig. 6-2

7. Absolute Maximum Ratings

Table7-1. Absolute maximum ratings

Parameter	Symbol	Rated value	Unit	Remarks
Power Suply Voltge	VDDI	-0.3 ~ +2.0	V	Degital voltage
	AVDD	-0.3 ~ +6.5	V	Positive Voltage
	AVEE	-6.5 ~ +0.3	V	Negative Voltage
Differential Input Voltage (MIPI)	-	-0.05 ~ +1.3	V	Digital (*2)
LEDReverse electric current	VR(LED)	+5.0	Vmax	(*3)
LED Input electric current	I(LED)	35	mAmax	(*3), (*4)
LED Power Dissipation	PD(LED)	106	mWmax	Per 1LED.(*3)
Operating Temperature	T_{OPR}	-20 ~ +70	℃	(*1)
Storage Temperature	T_{STG}	-30 ~ +80	℃	(*1)

(*) As far as there is no designation in particular, GND＝0V
(*1) Don't make them condense into dew.
(*2) D0_N, D0_P, D1_N, D1_P, D2_N, D2_P, CLK_N, CLK_P
(*3) TA=25°C
(*4) Ambient temperature and the maximum input are fulfilling the following operating conditions.



8. Electrical Characteristics

8-1. Recommended operating condition

Table 8-1. Recommended operating condition

(Ta＝-20 ~ 70℃, GND＝0V)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Power supply for digital circuit	VDDI		1.71	1.80	1.89	V	
Power supply (+) for analog circuit	AVDD		5.3	5.4	5.5	V	
Power supply (-) for analog circuit	AVEE		-5.5	-5.4	-5.3	V	

8-2. DC characteristics

Table8-2-1. DC characteristics1

(Ta=-20 ~ 70℃, VDDI =1.71 ~ 1.89 V, GND=0V)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Input voltage (Low)	VIL		0	—	0.2*VDDI	V	
Input voltage (High)	VIH		0.8*VDDI	—	VDDI	V	
Output voltage (Low)	VOL	IOL = +0.1mA	0	-	0.2*VDDI	V	(*1)
Output voltage (High)	VOH	IOH = -0.1mA	0.8*VDDI	-	VDDI	V	(*1)
Logic Low level leakage (Except MIPI)	ILIL1	Vin = 0 to VDDI	-1			uA	
Logic High level leakage (Except MIPI)	ILIH1	Vin = 0 to VDDI			1	uA	
Logic Low level leakage (MIPI)	ILIL2	Vin = 0 to 1.3V	-10			uA	
Logic High level leakage (MIPI)	ILIH2	Vin = 0 to 1.3V			10	uA	

(*1) FTE, FTE1, LEDPWM

Table8-2-2. DC characteristics2

(Ta=-25℃, GND=0V)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Current consumption (1)	I_{OPE1}	60Hz (*4)		19.0	26.0	mA	(*1)
	I_{OPE2}	60Hz (*4)		5.8	10.5	mA	(*2)
	I_{OPE3}	60Hz (*4)	-11.5	6.2		mA	(*3)
Power Consumption	W_{OPE}	60Hz (*4)		99	174.4	mW	

(*1) VDDI, (*2) AVDD, (*3) AVEE

(*4) setting based on 9-2sequence (Video Mode, Full screen White pattern), VSP = 5.4V, VSN = -5.4V, VDDI = 1.8V

Table8-2-3. Back light characteristics

(Ta=-20 ~ 70℃, GND=0V)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
LED Voltage	V_{LED}	-	-	2.85	-	V	
LED Current	I_{LED}	-	-	20	-	mA	
Power Consumption	W_{LED}	-	-	855	-	mW	
LED Quantity	-	-	15			pcs	

8-3. MIPI DSI interface

Table 8-3-1. DC characteristics

Parameter	Symbol	Min.	Typ	Max.	Unit	Note
MIPI Characteristics for High Speed Receiver						
Single-ended input low voltage	VILHS	-40			mV	
Single-ended input high voltage	VIHHS			460	mV	
Common-mode voltage	VCMRXDC	70		330	mV	
Differential input impedance	ZID	80	100	125	ohm	
HS transmit differential voltage (VOD=VDP-VDN)	|VOD|	140	200	250	mV	
Different input high threshold	V_{IDTH}			70	mV	
Different input low threshold	V_{IDTL}	-70			mV	
Single-ended threshold for HS termination enable	$V_{TERM-EN}$			450	mV	
MIPI Characteristics for Low Power Mode						
Logic 0 input threshold, not in ULP state	VIL	-		550	mV	
Logic 1 input threshold	VIH	880		-	mV	
Thevenin output low level	VOL	-50		50	mV	
Thevenin output high level	VOH	1.1	1.2	1.3	V	
Output impedance of Low Power Transmitter	ZOLP	80	100	125	ohm	
Logic 0 contention threshold	VIHCD	-		200	mV	
Logic 1 contention threshold	VILCD	450		-	mV	

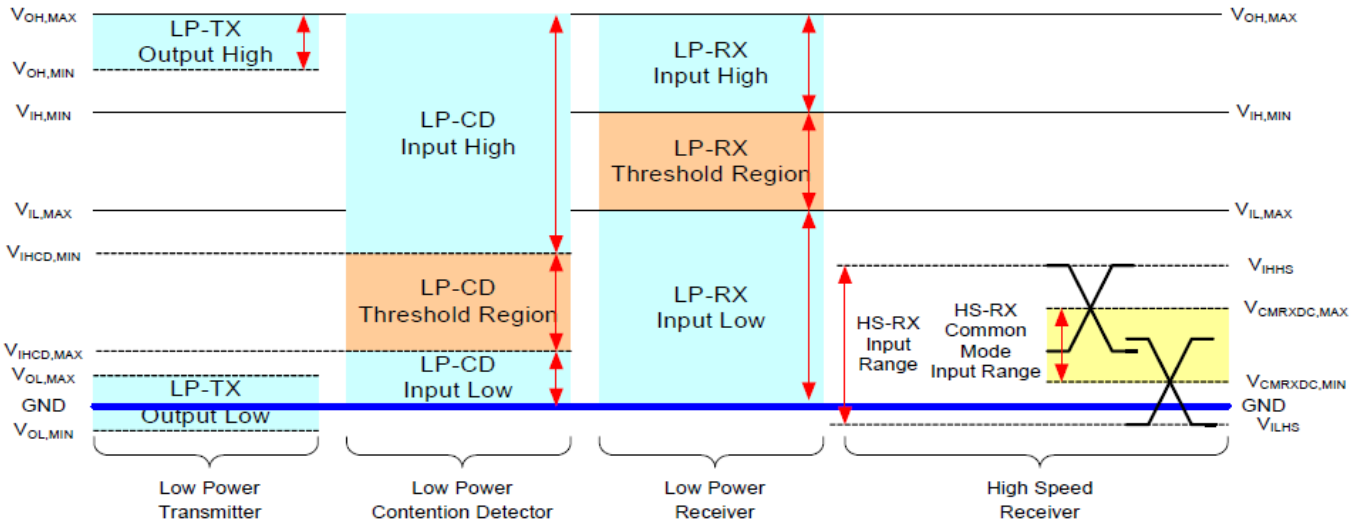


Fig.8-3-1

Table8-3-2. AC characteristics

High Speed Data Transmission: Data-Clock Timing

Parameter	Symbol	Min.	Typ	Max.	Unit	Note
UI instantaneous	UI_{INST}	-		4	ns	1,2,3
Data to Clock Skew [measured at tansmitter]	T_{SKEW}[TX]	-0.15	-		UI_{INST}	4
Data to Clock Setup Time [measured at receiver]	T_{SETUP}[RX]	0.15	-		UI_{INST}	5
Data to Clock Hold Time [measured at reciever]	T_{HOLD}[RX]	0.15	-		UI_{INST}	5

Note 1: This value corresponds to a minimum 80 Mbps data rate.
Note 2: The minimum UI shall not be violated for any single bit period, i.e., any DDR half cycle within a data burst.
Note 3: For MIPI speed limitation: [1] Per lane bandwidth is 1Gbps, [2] Total Bit Rate: 4Gbps for 24bit format.
Note 4: Total silicon and package delay budget of 0.3* UIINST when D-PHY is supporting maximum data rate = 1Gbps.
Note 5: Total setup and hole window for receiver of 0.3* UIINST when D-PHY is supporting maximum data rate = 1Gbps.

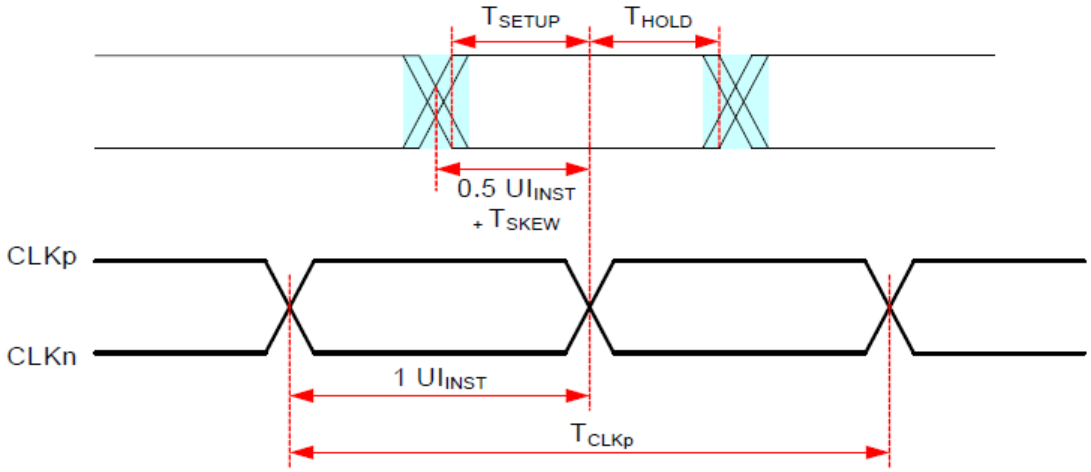


Fig.8-3-2

Table8-3-3. AC Characteristics

LP Transmission AC Specification

Parameter		Symbol	Min.	Typ	Max.	Unit	Note
15%-85% rise time and fall time		T_{RLP} / T_{FLP}			25	ns	1
30%-85% rise time and fall time		T_{REOT}			35	ns	1,5,6
Pulse width of the LP exclusive-OR clock	First pulse after STOP state or last pulse before stop state	$T_{LP-PULSE-TX}$	40			Ns	4
	All other pulses		20			ns	4
Period of the LP exclusive-OR clock		$T_{LP-PER-TX}$	90			ns	
Slew rate@ CLOAD = 0pF		oV/otSR	30		500	mV/ns	1,2,3,7
Slew rate@ CLOAD = 5pF			30		200	mV/ns	1,2,3,7
Slew rate@ CLOAD = 20pF			30		150	mV/ns	1,2,3,7
Slew rate@ CLOAD = 70pF			30		100	mV/ns	1,2,3,7
Load Capacitance		C_{LOAD}			70	pF	1

Note 1: CLOAD includes the low-frequency equivalent transmission line capacitance. The capacitance of TX and RX are assumed to always be<10pF. The distributed line capacitance can be up to 50pF for a transmission line with 2ns delay.

Note 2: When the output voltage is between 15% and below 85% of the fully settled LP signal levels.

Note 3: Measured as average across any 50 mV segment of the output signal transition.

Note 4: This parameter value can be lower then TLPX due to differences in rise vs. fall signal slopes and trip levels and mismatches between Dp and Dn LP transmitters. Any LP exclusive-OR pulse observed during HS EoT (transition from HS level to LP-11) is glitch behavior.

Note 5: The rise-time of TREOT starts from the HS common-level at the moment the differential amplitude drops below 70mV, due to stopping the differential drive.

Note 6: With an additional load capacitance CCM between 0-60pF on the termination center tap at RX side of the Lane.

Note 7: This value represents a corner point in a piecewise linear curve as bellowed.

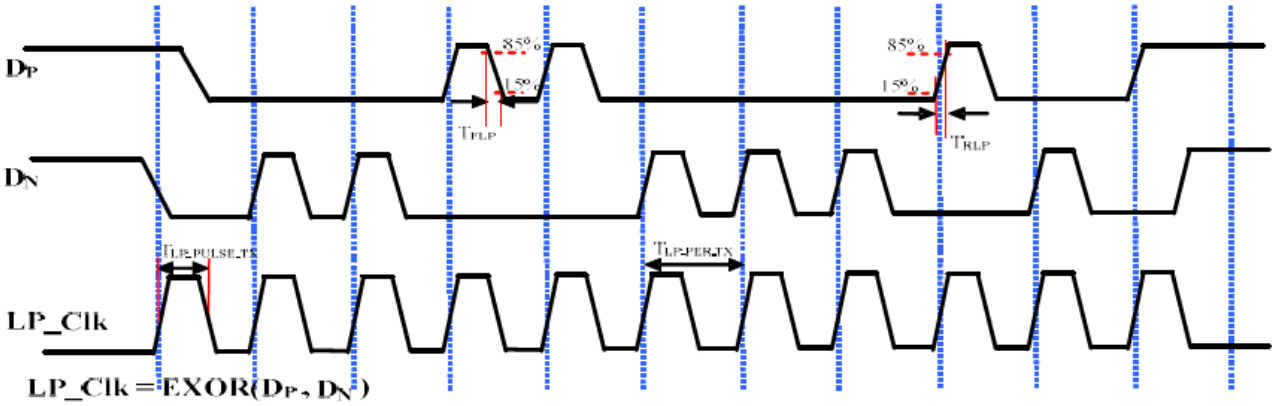


Fig.8-3-3a

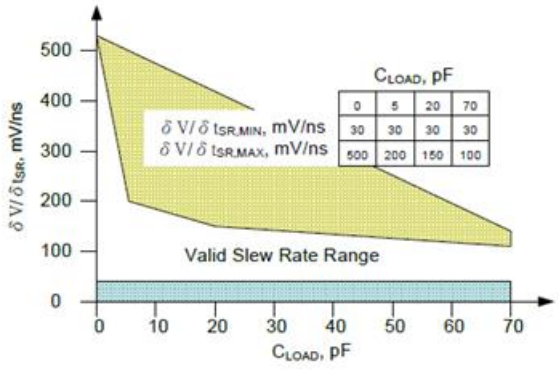


Fig.8-3-3b

Table8-3-4. AC Characteristics

High-Speed Data Transmission in Bursts

Parameter	Symbol	Min.	Typ	Max.	Unit	Note
Time to drive LP-00 to prepare for HS transmission	$T_{HS-PREPARE}$	40+4UI		85+6UI	ns	
Time from start of tHS-TRAIL or tCLK-TRAIL period to start of LP-11 state	T_{EOT}			105+12UI		
Time to enable Data Lane receiver line termination measured from when Dn cross VIL, MAX	$T_{D-TERM-EN}$			35+4UI	ns	
Time to drive flipped differential state after last payload data bit of a HS transmission burst	$T_{HS-TRAIL}$	60+4UI			ns	
Time-out at RX to ignore transition period of EoT	$T_{HS-SKIP}$	40		55+4UI	ns	
Time to drive LP-11 after HS burst	$T_{HS-EXIT}$	100			ns	
Length of any Low-Power state period	T_{LPX}	50			ns	
Sync sequence period	$T_{HS-SYNC}$		8UI		ns	
Minimum lead HS-0 drive period before the Sync sequence	$T_{HS-ZERO}$	105+6UI			ns	

Note 1: The minimum value depends on the bit rate. Implementations should ensure proper operation for all the supported bit rates.

Note 2: UI means Unit Interval, equal to one half HS the clock period on the Clock Lane.

Note 3: TLPX is an internal state machine timing reference. Externally measured values may differ slightly from the specified values due to asymmetrical rise and fall times.

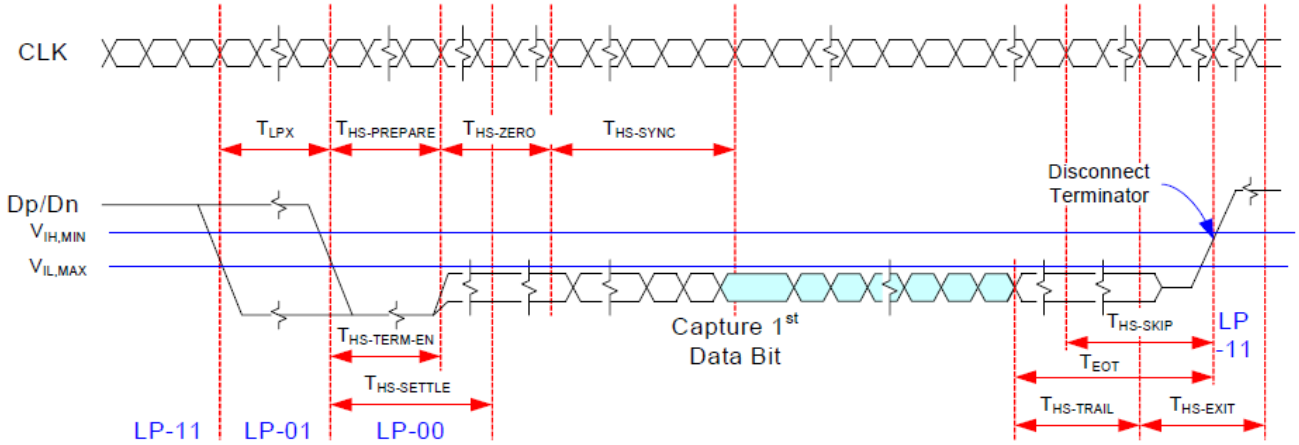


Fig.8-3-4

Table 8-3-5. AC Characteristics

Switching the Clock Lane between Clock Transmission and Low-Power Mode

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Time that the transmitter shall continue sending HS clock after the last associated Data Lane has transitioned to LP mode.	$T_{CLK-POST}$	60+52UI			ns	1
Detection time that the clock has stopped toggling	$T_{CLK-MISS}$			60		
Time to drive LP-00 to prepare for HS clock transmission	$T_{CLK-PREPARE}$	38		95	ns	
Minimum lead HS-0 drive period before starting Clock	$T_{CLK-PREPARE}$ + $T_{CLK-ZERO}$	300			ns	
Time to enable Clock Lane receiver line termination measured from when Dn cross VIL, MAX	$T_{HS-TERM-EN}$			38	ns	
Minimum time that the HS clock must be set prior to any associated date lane beginning the transmission from LP to HS mode	$T_{CLK-PRE}$	8UI			UI	
Time to drive HS differential state after last payload clock bit of a HS transmission burst	$T_{CLK-TRAIL}$	100			ns	

Note 1: Due to this value need to correspond with a minimum 500 Mbps data rate

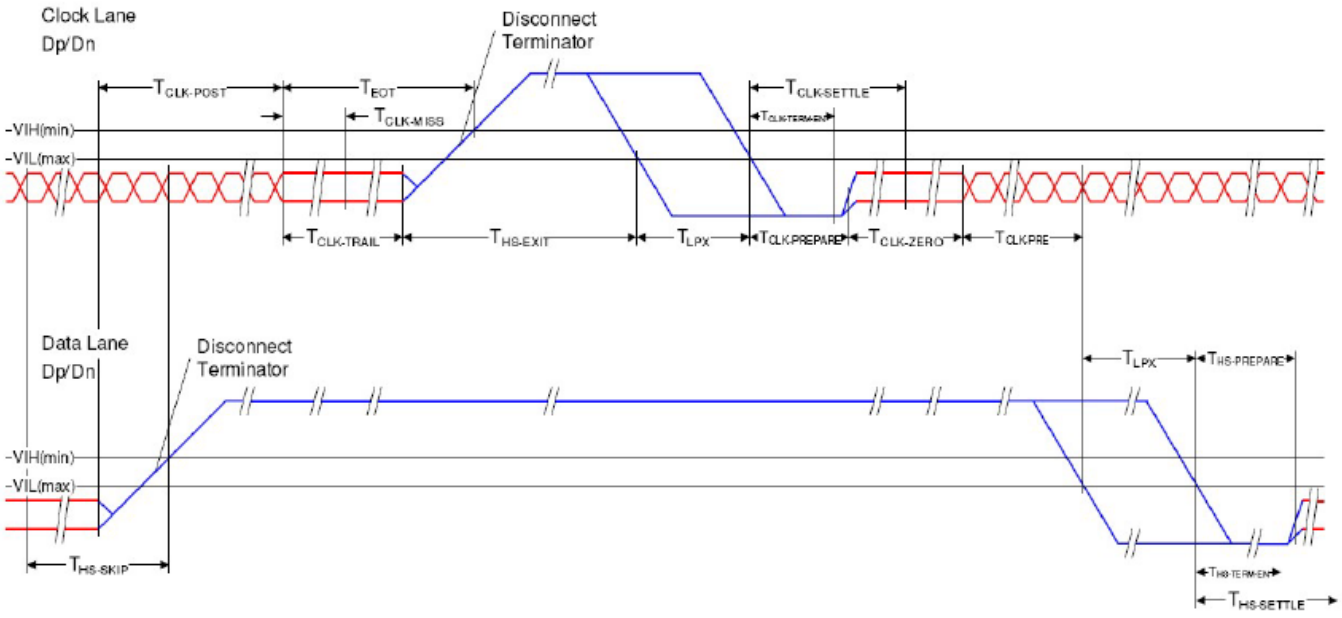


Fig.8-3-5

8-4. Control signal

Table 8-4. Reset Timing Characteristics

(Ta=-20 ~ 70°C, IOVCC =1.71 ~ 1.89V, GND = 0V)

Signal	Symbol	Parameter	Min.	Max.	Unit	Note
RESX	t_{RW}	Reset pulse width	10		us	1
	tRT	Reset cancel		10	ms	1
				120	ms	1
	tDSTB	Reset pulse duration	3		ms	

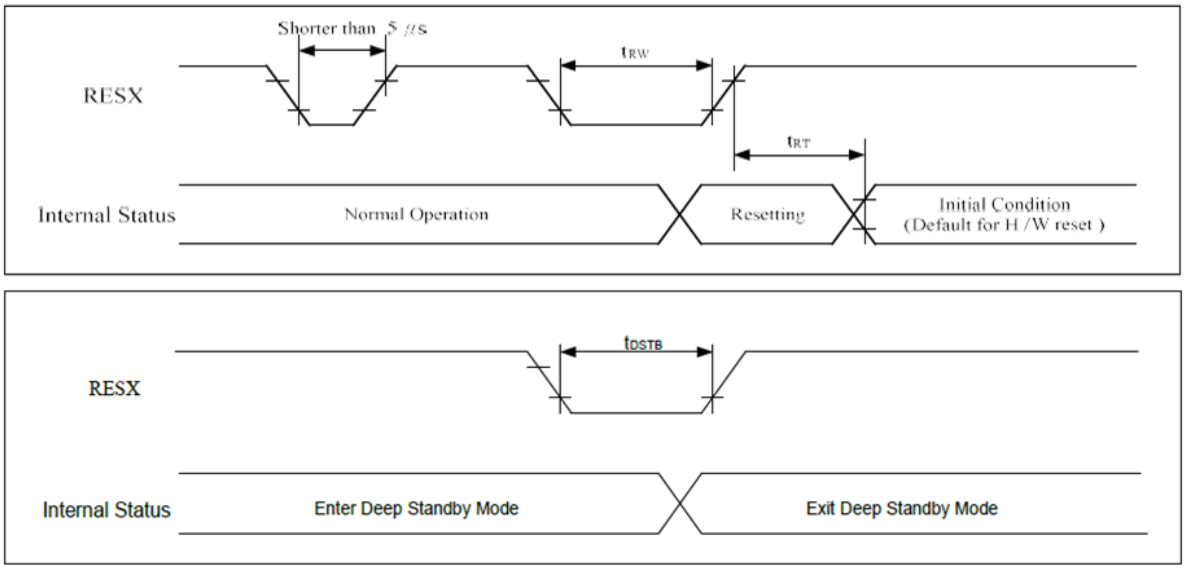
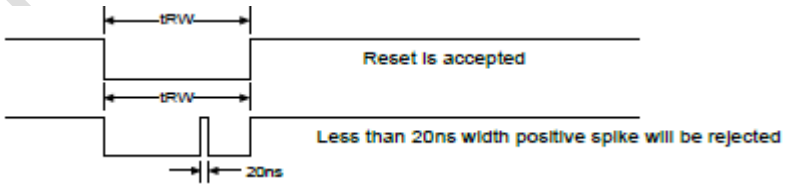


Fig.8-4

Note 1:

- The reset cancel also includes required time for loading ID bytes, VCOM setting and other settings from EEPROM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 10 ms after a rising edge of RESX.
- Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the figure below
- During the Resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts at Sleep-Out status. The display remains the blank state in Sleep-In mode). Then return to Default condition for Hardware Reset
- Spike Rejection also applies during a valid reset pulse as shown below



- When RESET applied during Sleep-In Mode. (RESET active during Sleep-in mode)
- When RESET applied during Sleep-Out Mode.
- It is necessary to wait 10ms after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120 ms.

9. Recommended Power On/Off Sequence

9-1. Timing (MIPI interface characteristics)

	SYMBOL	MIN	TYP	MAX	UNIT
Hsync Pulse Width	HS		10		pixels
Horizontal back porch	HBP		56		pixels
Horizontal active area	HDISP		720		pixels
Horizontal front porch	HFP		40		pixels
Vsync Pulse Width	VS		2		Line
Vertical back porch	VBP		6		Line
Vertical active area	VDISP		1280		Line
Vertical Front Porch	VFP		26		Line
Vertical Refresh Rate	VRR	(59.4)	60	(60.6)	Hz
Horizontal cycle	Hcyc	(12.56)	12.68	(12.81)	us
MIPI DSI Bit Rate	-		521.0		Mbps/Lane

9-2. Display ON (common) sequence

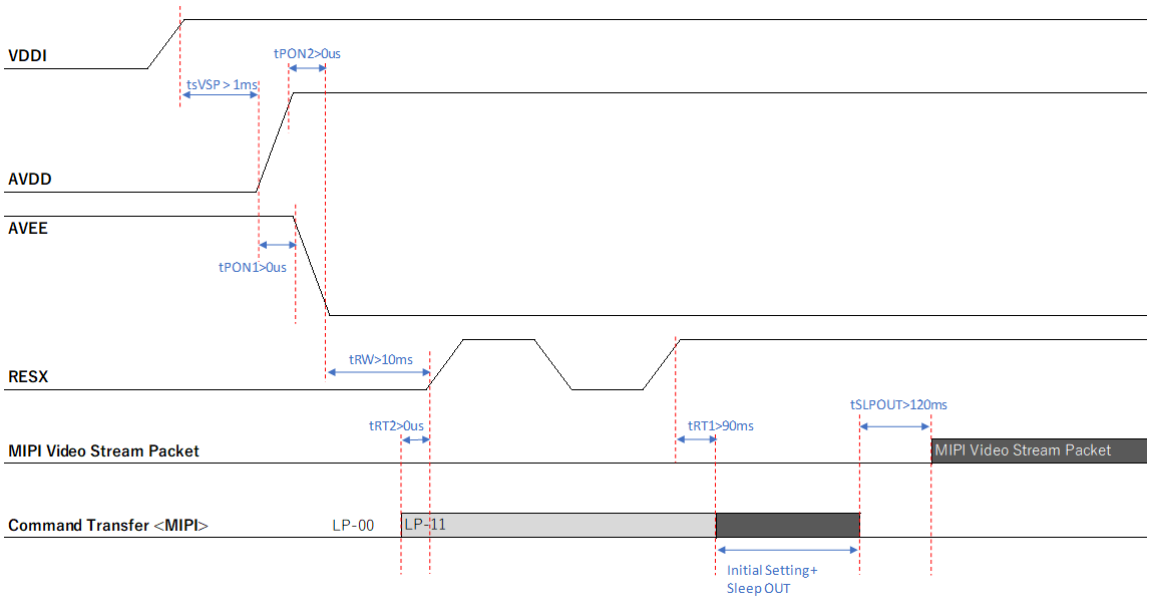


Fig.9-2 Power ON Sequence

Table 9-2. COG driver power ON

Step	Address	Value	Delay	Note
1	Initial condition			Reset = L
2	Power supply VDDI (Typ. 1.8V)			VDDI ON
3	Wait		Min. 1 ms	
4	Power supply AVDD (Typ. 5.4V)			AVDD ON
5	Wait		Min. 0 ms	
6	Power supply AVEE (Typ. -5.4V)			AVEE ON
7	Wait		Min. 10 ms	
8	RESET (L→H)			Reset = H
9	Wait		Min. 10 us	
10	RESET (H→L)			Reset = L
11	Wait		Min. 10 us	
12	RESET (L→H)			Reset = H
13	Wait		Min. 90 ms	[Automatic] MTP Auto load [Automatic] Sleep mode ON
14	0xFF	0x20		Initial Setting
15	0xFB	0x01		
16	0x18	0x04		
17	0x19	0x02		
18	0xFF	0x10		
19	0xFB	0x01		
20	0x35	0x00		
21	0x11	-		Sleep out
22	Wait		Min. 120 ms	
23	0x29	-		Display ON

* If this Power ON sequence is to be changed, we request to announce it to us.

9-3. Display OFF sequence

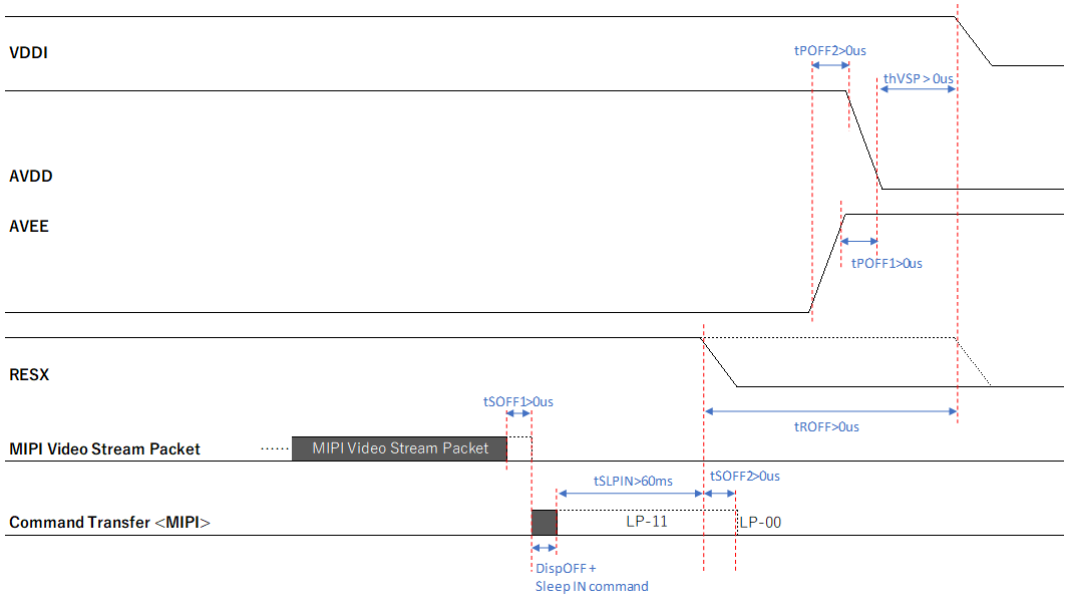


Fig.9-3 Power OFF Sequence

Table9-3. COG driver power OFF

Step	Address	Value	Delay	Note
1	0xFF	0x10		Command page select CMD1
2	0x28	-		Display OFF
3	0x10	-		Sleep in
4	Wait		Min. 60 ms	
5	Power OFF AVEE (Typ. -5.4V)			AVEE OFF
6	Wait		Min. 0 ms	
7	Power OFF AVDD (Typ. 5.4V)			AVDD OFF
8	Wait		Min. 0 ms	
9	Power OFF VDDI (Typ. 1.8V)			VDDI OFF
10	Wait			
11	RESET (H→L)			Reset = L

* If this Power OFF sequence is to be changed, we request to announce it to us.

9-4. Power ramp-up/down SPEC

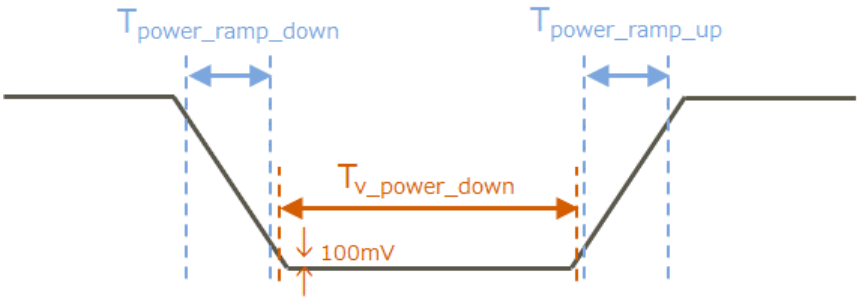


Fig.9-4 Power OFF Sequence

Table9-4. COG driver power OFF

	Min.	Typ.	Max.
$T_{power\_ramp\_up}$ (10% - 90%) for VDDI			2ms
$T_{power\_ramp\_up}$ (10% - 90%) for AVDD	0.2ms		5ms
$T_{power\_ramp\_down}$ (10% - 90%) for AVEE	0.2ms		5ms
$T_{power\_ramp\_down}$ (10% - 90%) for VDDI			2ms
$T_{power\_ramp\_down}$ (10% - 90%) for AVDD	0.2ms		5ms
$T_{power\_ramp\_up}$ (10% - 90%) for AVEE	0.2ms		5ms
$T_{v\_power\_down}$ (<100mV)	10ms		

10. Recommended Design

10-1. Recommended peripheral circuit

●MIPI-DSI Lanes: 3

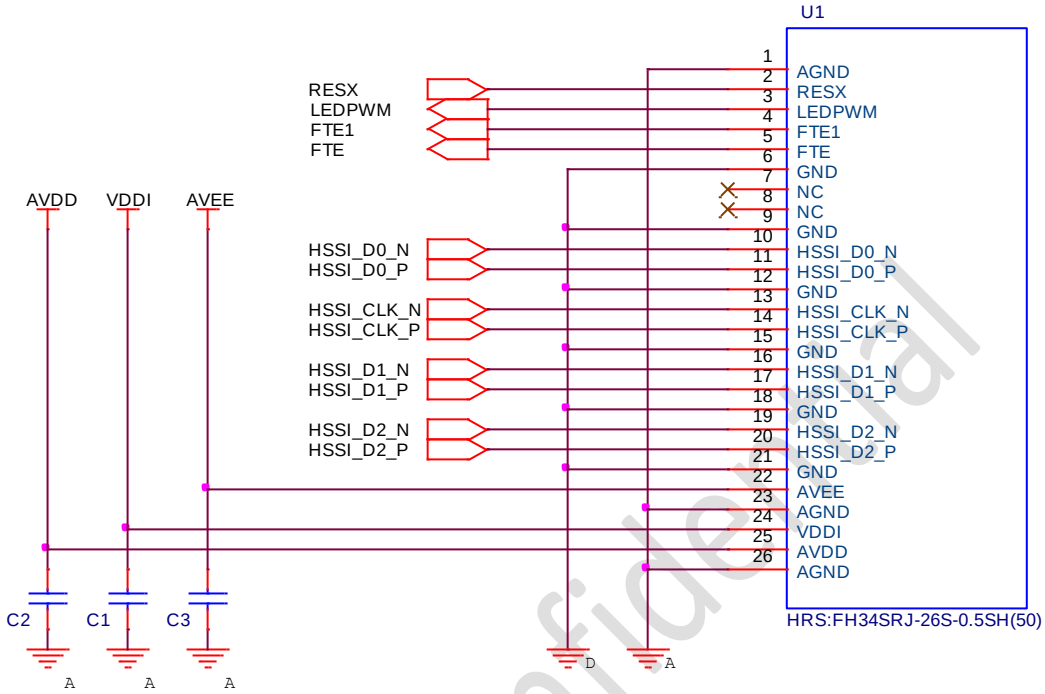


Fig.10-1 Recommended peripheral circuit

C1: VDDI – GND: 1.0μF Ceramic capacitor

C2: AVDD – GND: 1.0μF Ceramic capacitor

C3: AVEE – GND: 1.0μF Ceramic capacitor

* It's a recommendation example about the above circuit and parts. After estimating the consistency with the system when using, please design.

10-2. Recommended structure diagram

To prevent pooling, please consider the following mechanical design.

Pooling can not be seen with adopting below structure because the pressure on the LCD is reduced.

1: Space-1 Making space between BL(Back Light) unit and electrical components.

2: CG Fixing LCD module and set with using CG (cover glass) as below.

In case of soft materials, such as acrylic, the LCD may warp and reduce uniformity.

In design the housing, please fully consider that no distortion is caused by the external force.

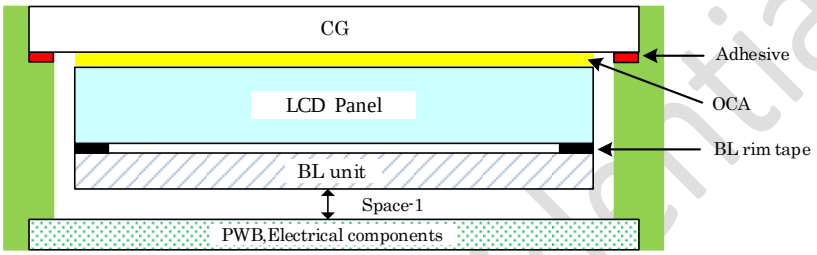


Figure 10-2-1 Precautions for SET design

11. Optical Characteristics

11-1. Optical characteristics

Table11-1. Optical characteristics (Reflective mode)

(Ta=25°C, BL=0mA)

Parameter		Symbol	Min.	Typ.	Max.	Unit	Note
Reflectivity ratio		R	6.0	8.8		%	3
Contrast Ratio		CR	21	30		-	2, 3
Viewing Angle (CR≧2)	Vertical	θ11	40	60		°	1, 3
		θ12	40	60		°	
	Horizontal	θ21	40	60		°	
		θ22	40	60		°	
Response Time	rise time	τr		6	15	ms	3, 4(*Black→White), θ=0°
	fall time	τd		5	13	ms	3, 4(*White→Black), θ=0°
Chromaticity	White	Wx	Typ-0.05	0.314	Typ+0.05	-	3, 5
		Wy		0.345		-	
	Red	Bx		0.457		-	
		By		0.311		-	
	Green	Gx		0.315		-	
		Gy		0.422		-	
	Blue	Bx		0.152		-	
		By		0.215		-	
NTSC Ratio (x, y)				15		%	

Table11-2. Optical characteristics (Transmissive mode)

(Ta=25°C, BL=20mA)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Brightness	Lv		150		cd/m^2	6

Note 1: Defintion of Viewing Angle

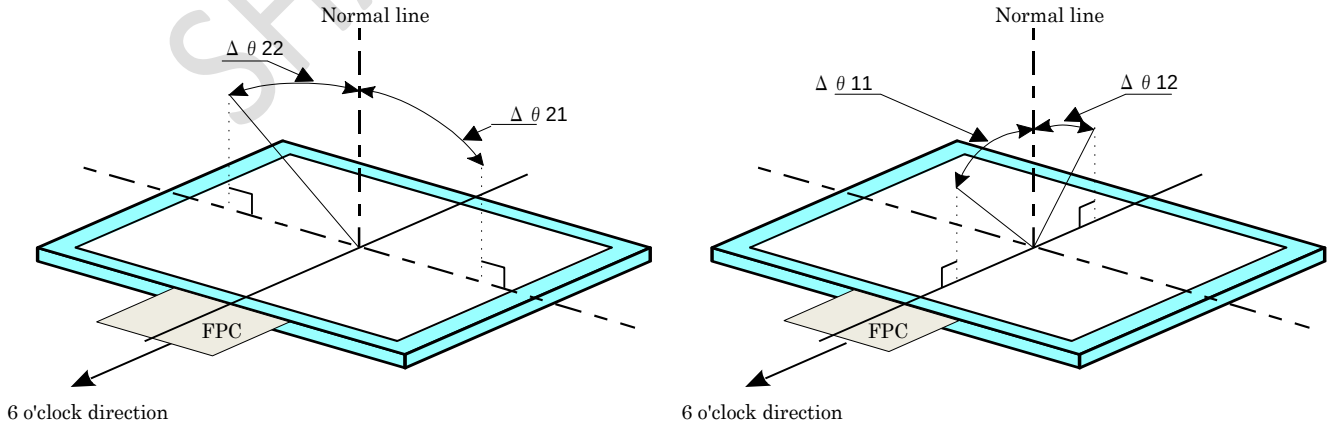


Figure 11-1 Defintion of Viewing Angle

Note 2: Defintion of Contrast Ratio

The contrast ratio is defined as the following.

$$Contrast\ ratio\ (CR) = \frac{Reflection\ intensity\ in\ white\ display}{Reflection\ intensity\ in\ black\ display}$$

Note 3: Optical characteristics measurement equipment.

Figure 7-2 is for contrast ratio, reflectivity ratio, and panel chromaticity measurement, and

Figure 7-3 is for response time measurement.

Both are to be conducted in a dark or room equipment to a dark room.

Measurement equipment (CM-700D)

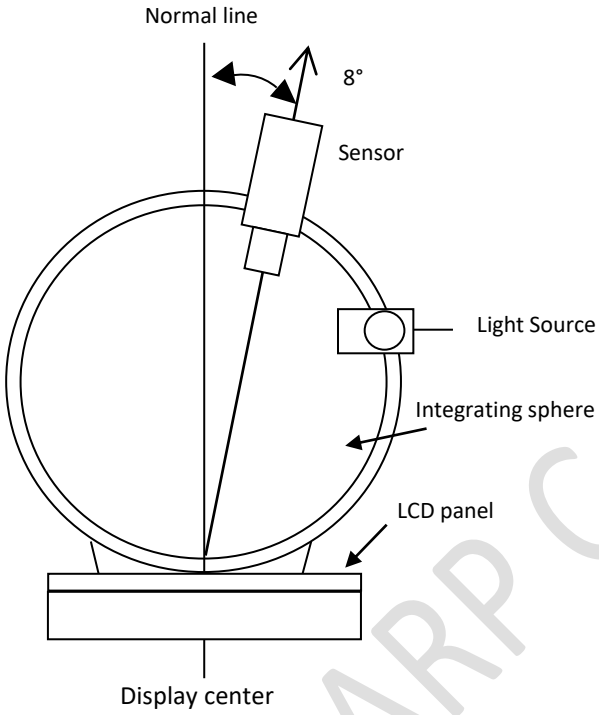


Figure 11-2 Contrast ratio, Reflectivity ratio

Measurement equipment (DMS-803)

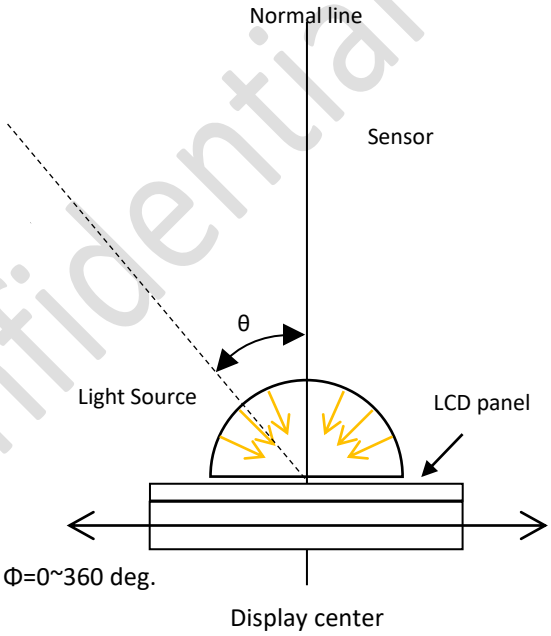


Figure 11-3 Viewing Angle, Response time

Note 4: It's difined by the time change of optical receiver output when signal is input to display white or black.

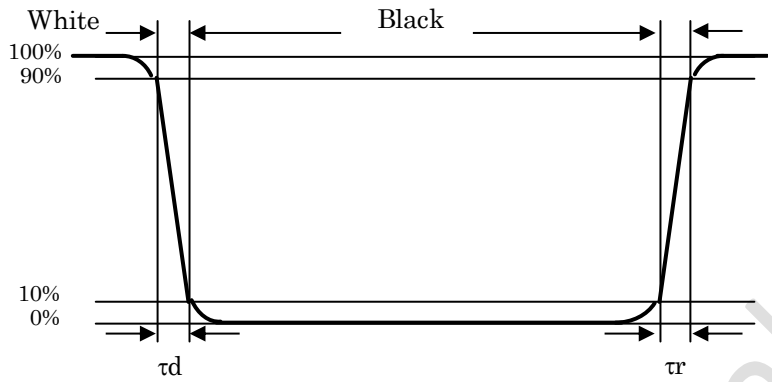


Figure 11-4 Response time

Note 5: Panel Chromaticity is not a guaranteed value. (Reference value)

Note 6: The measuring method of the transmissive brightness is shown by the following figure.

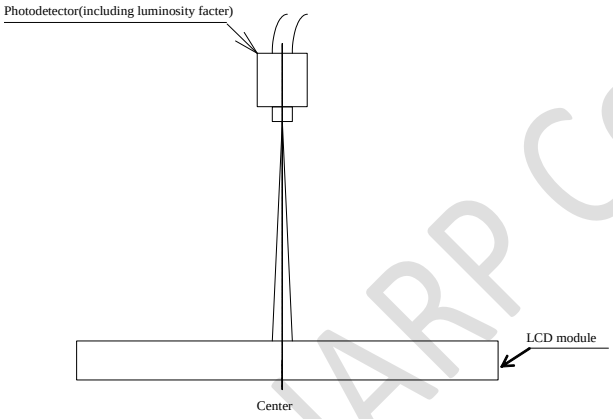


Figure 11-5 Transmissive brightness

Measurement angle: 1 degree.

Distance between SR-3 and the surface of LCD module :350mm

Measurement diameter: 0.5mm.

A measurement device is TOPCON luminance meter SR-3/SR-UL1.

12. Display Quality

The standard about the color liquid crystal display module quality is based on shipment inspection standards.

13. Shipment Form

13-1. Lot number

It's indicated by printout. The indication location is indicated in a lot number printing position on fig 13-1.

YMDDP
01234A

Table 13-1. Lot number definition

Line	Marking	Description	
1	YMDDP	Y	Single-digit year (Last digit of the year) (0,1,- - 8,9)
		M	Single-digit Months (1,2,--,9,X,Y,Z)
		DD	Digit of the day (01,--,31)
		P	Code of manufacture
2	01234A	01234	Consecutive number (Traceabillity number)
		A	Product revision

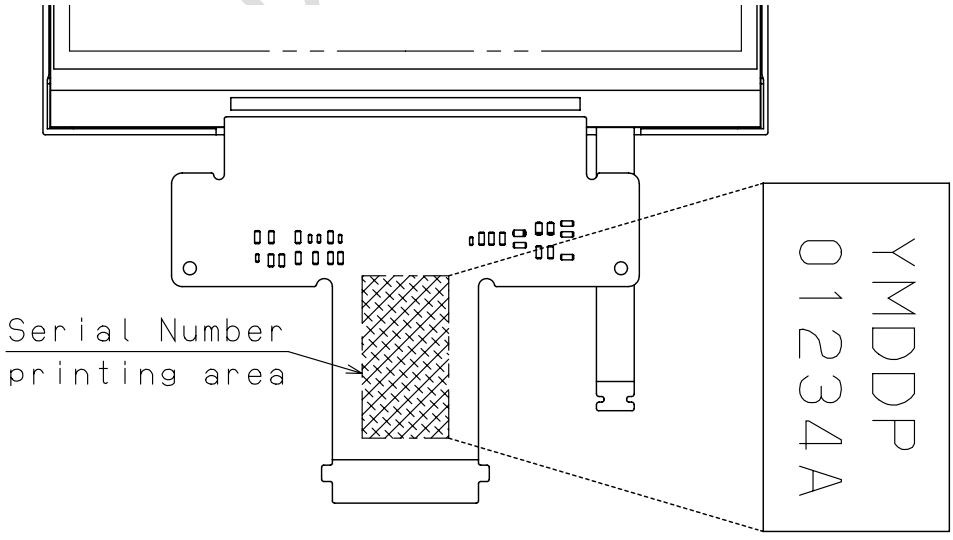


Fig. 13-1

13-2. Condition for strage

1) Piling number of cartons : 8 (max)
2) Pakage quantity in one carton : 120 pcs
3) Carton size (Typ.) : 365 mm x 530 mm x 235 mm
4) Total mass : 6.4 kg (One carton filled with 120 modules)
5) Carton store environment

・Temperature

0~40°C

・Humidity

60%RH or lower (at 40°C)

There should be no condensation at low temperature and high humidity.

・Atmosphere

No harmful gas, such as acid or alkali, which causes severe corrosion on electronic parts and wiring, are to be detected.

・Opening the package

In order to prevent electrostatic damage to TFT modules, room humidity should be made over 50%RH and take effective measure such as use of earth when opening the package.

・Direct sunlight

Please keep the product in a dark room or cover the product to protect from direct sunlight.

・Atmospheric condition

Please refrain from keeping the product with possible corrosive gas or volatile flux.

・Prevention of dew

Do not place directly on the floor, and please store the product carton either on a wooden pallet or a stand to avoid dew condensation. In order to obtain moderate ventilation in the pallet's bottom surfaces, arrange correctly in the fixed direction. Please place the product cartons away from the storage wall. Be careful of the inside of a warehouse to ventilate well and please consider installation of a ventilator. Manage to rapid temperature change under natural environment.

・Vibration

Please refrain from keeping the product in the place which always has vibration.

・Storage Period

Within above mentioned conditions, maximum storage period should be about 3 months.

13-3. Packing from

Refer to Fig 13-3 Packing Form

When transporting it about packing, a module is the design which isn't damaged.

14. Reliability

14-1. Reliability test

Table 14-1. <The following items are currently being evaluated for reliability test. It will be updated at next issue. >

	Test item	Conditions			Note
1	High temperature storage test	Ta=80°C	240h	(Storage test)	
2	Low temperature storage test	Ta=-30°C	240h	(Storage test)	
3	High temperature and high humidity storage test	Ta=40°C /95%RH	240h	(Storage test)	
4	High temperature operation test	Tp=70°C	240h		
5	Low temperature operation test	Tp=-20°C	240h		
6	High temperature and high humidity operation test	Tp=40°C /95%RH	240h		
7	Heat shock test	Ta=-20°C (1h) to +70°C (1h)	5cycle	(Storage test)	
8	Electrostatic discharge test	±200V, 200pF(0Ω) to Terminals (Contact) (Once for each terminal)			

*Ta = Ambient temperature, Tp= panel temperature

(Result Evaluation Criteria)

Under normal operating conditions, there shall be no change in the display function that would affect practical use.

* Normal operating conditions: temperature 15 to 35°C, humidity 45 to 75%, and air pressure 86 to 106 kpa.

15. Other

If any problem occurs concerning the items not stated in this specification, it must be solved sincerely by both parties after deliberation.

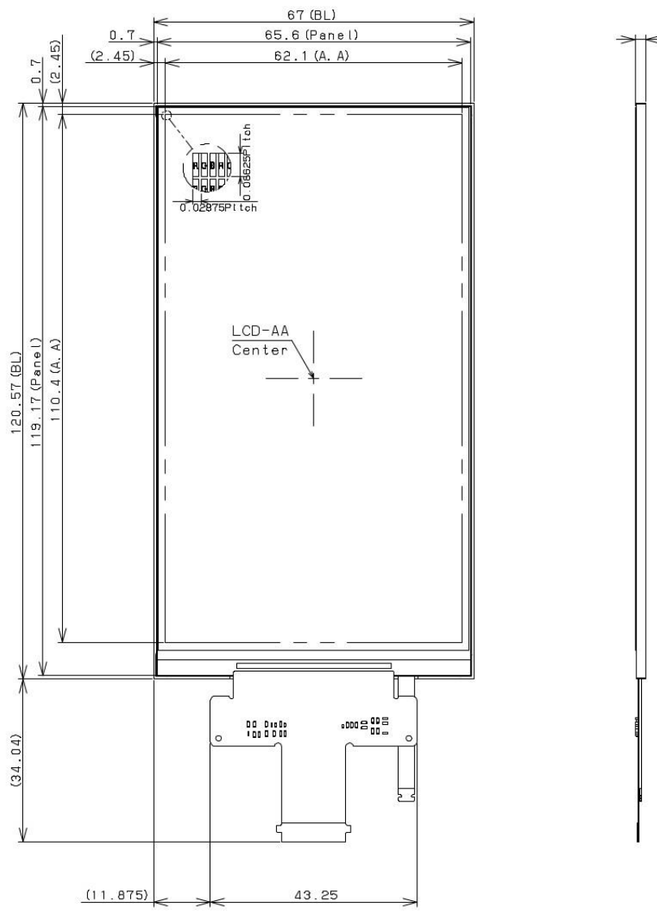
When doing change with a possibility that I have an influence important to the quality and the reliability, we assume that I make a contact and get agreement beforehand.

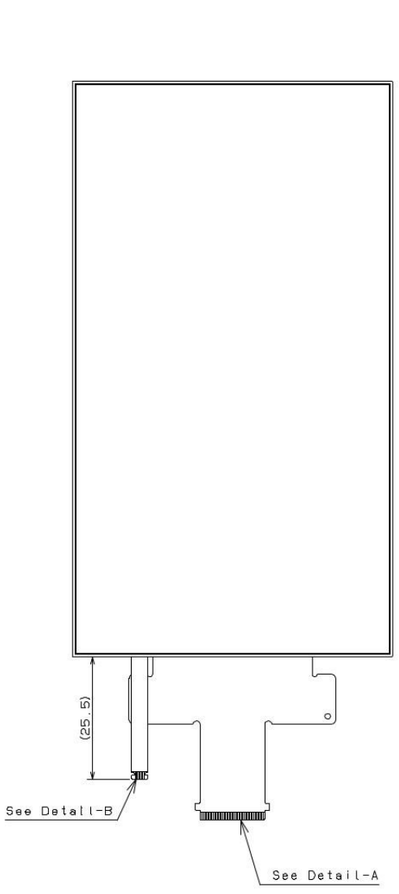
SHARP

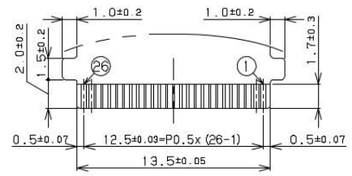
CONFIDENTIAL

TENTATIVE

The drawings are tentative as the some parts are currently being under review, which may be changed in future.

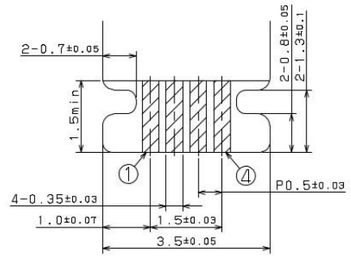






Fitting Connecter
HRS:FH34SRJ-26S-0.5SH(50)

Detail-A
Scale=3:1



Fitting Connecter
Panasonic:AYF530465T

Detail-B
Scale=10:1

Fitting Connecter	
HRS: FH34SRJ-26S-0.5SH(50)	
No.	Pin name
1	AGND
2	RESX
3	LEDPWM
4	FTE1
5	FTE
6	GND
7	NC
8	NC
9	GND
10	HSSI_D0_N
11	HSSI_D0_P
12	GND
13	HSSI_CLK_N
14	HSSI_CLK_P
15	GND
16	HSSI_D1_N
17	HSSI_D1_P
18	GND
19	HSSI_D2_N
20	HSSI_D2_P
21	GND
22	AVEE
23	AGND
24	VDDI
25	AVDD
26	AGND

Fitting Connecter	
Panasonic:AYF530465T	
No.	Pin name
1	CATHODE1
2	CATHODE2
3	CATHODE3
4	ANODE

Tablel General Tolerance

Dimension L	TOL
More than 10	±0.2
Less than 10	±0.1

UNIT:mm

(1) LCM-FPC bend larger than 0.45 in radius.
(2) The tolerances of the module width doesn't include warp of the case.
(3) Module flatness is under study. Need to evaluate "flatness" with Optical Measurement Method via 9pt measurement locations.
(4) Any foreign materials and contamination outside the Active area are to be treated as "NO-Count" at our Inspections.
(5) Guarantee of appearance=LCD Active area.
(6) Unless otherwise specified, tolerance should be shown in the Table1.

No.	改訂日	改訂記事	担当
5	-	-	-
4	-	-	-
3	-	-	-
2	-	-	-
1	-	-	-

REVISIONS

設計 DESIGNER	製図 DRAFTER	検図 DSN CK	検図 DSN CK	承認 ENG APPD
〃	〃	〃	〃	〃

8/シャープ㈱鴻海集団
DEVELOPMENT DIVISION
BUSINESS UNIT VI / BU I]
DISPLAY DEVICE COMPANY
SHARP CORPORATION

ORIGINAL MODEL	4.99"
画面サイズ ACTIVE AREA SIZE	62.10x110.40
	720xRGBx1280
尺度 SCALE	1:1
First edition DATE	Feb.16, 2022
Revised edition DATE	*
単位 Unit	mm
名称 NAME	LCD panel Module Outline Dimensions
原紙サイズ	A3
図番 DRAWING NO	LDS-210394*
Sheet	1/1

Fig. 5-1 LCD-module Outline dimensions

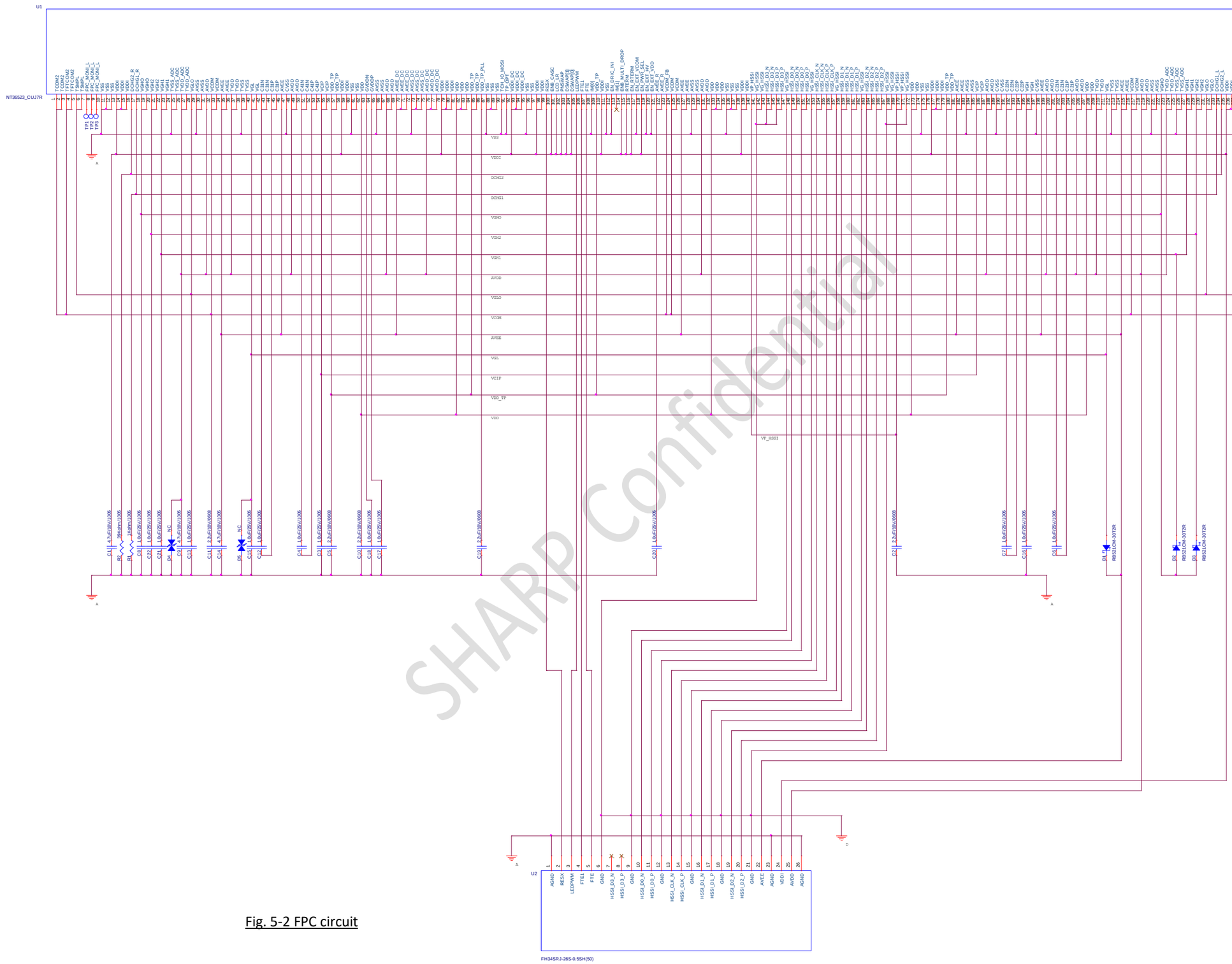


Fig. 5-2 FPC circuit

2pcs/pocket, 6pcs/Tray, 6pcs×5Tray＝30pcs／Inner sleeve, 30pcs×2sleeve×2outer sleeve = 120pcs/Curton

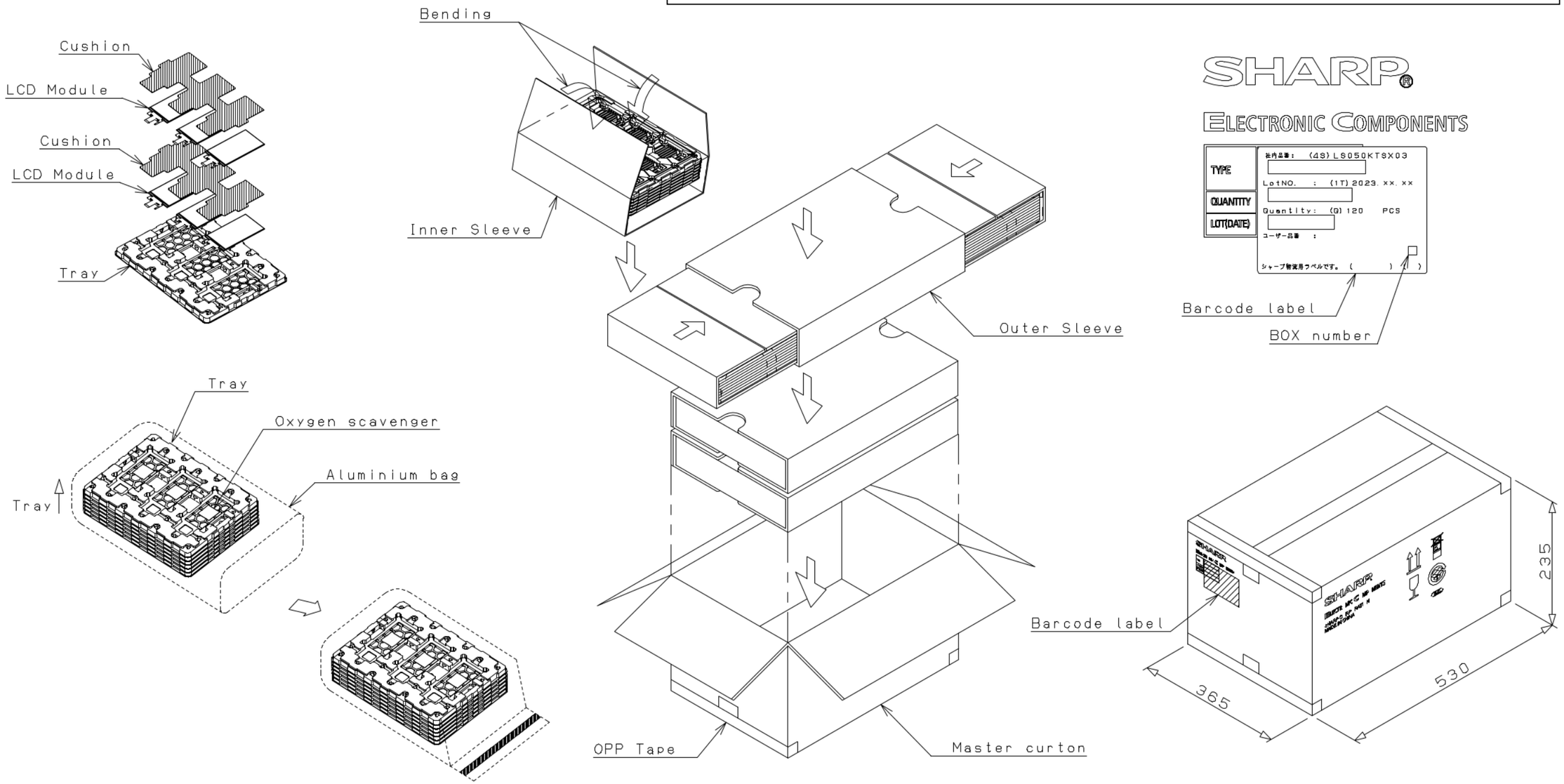


Fig. 13-3 Packaging form figure