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Custom Display

Production Custom designs Installation

Mechanical design



To :

Date : July 8, 2021

Rev.0.4

Data Sheet	
Product Name	LPM021M528C

Approval Signature

Approved by	Date	Date
		July 8, 2021

Specifications are subject to change without notice.

Japan Display Inc.

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2 RECORD OF REVISIONS

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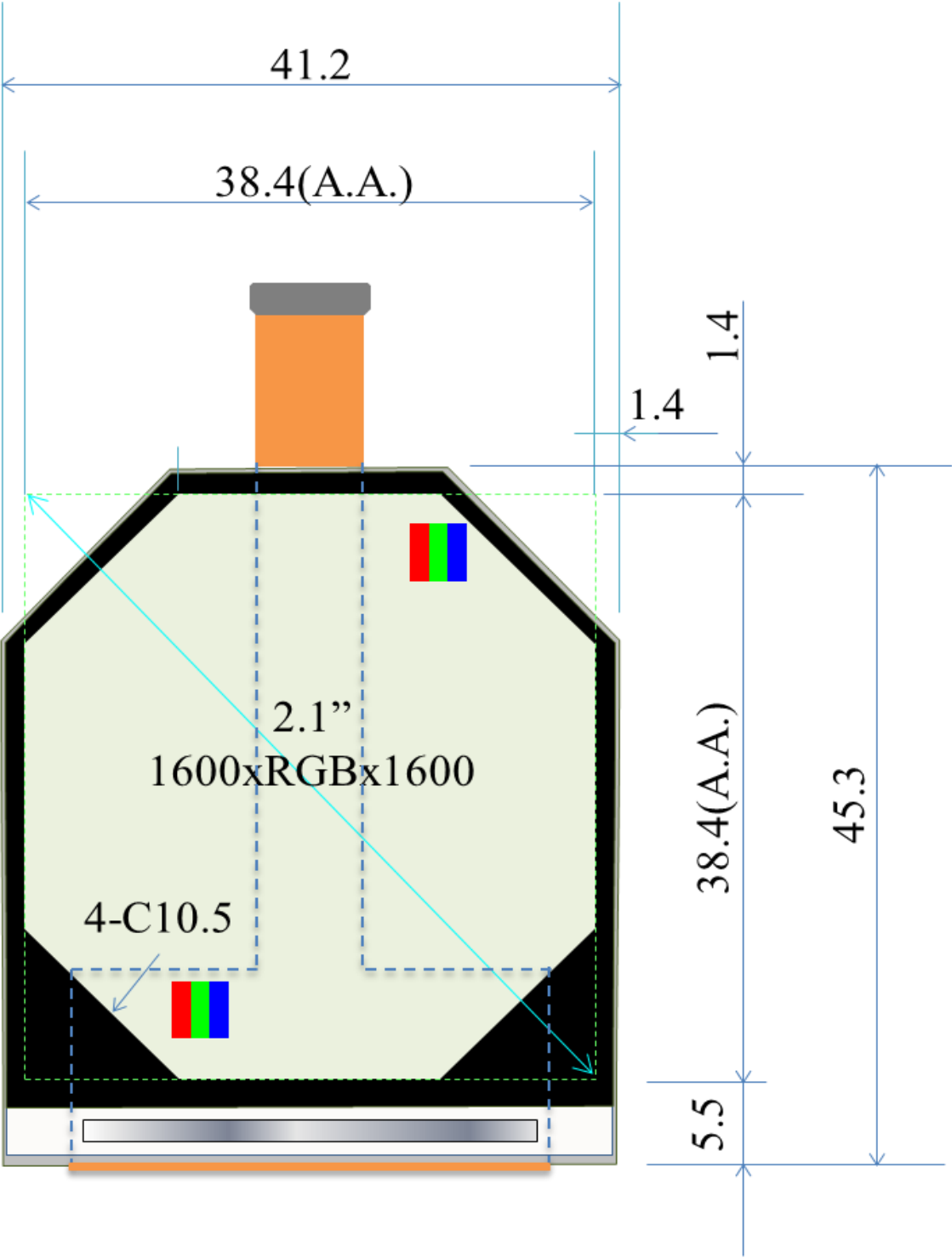
Date	Sheet No.	Summary
2020/3/11	-	New release
2021/3/22	16-21	Change of Initial sequence
	32	Modify of Packing specification
2020/5/13	22	Change of DIMENSIONAL OUTLINE
	24, 26	Modify of note
2020/7/8	22	Change of DIMENSIONAL OUTLINE

3. GENERAL DATA

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(1) Part Name	LPM021M528C
(2) Module Dimensions	41.2 (W) mm × 45.3 (H) mm × 1.65 (t) mm (Excluding FPC and Protective Film)
(3) Active Area Dimensions	38.4 (W) mm × 38.4 (H) mm with C cut
(4) Pixel Pitch	0.024 (W) mm × 0.024 (H) mm (1058ppi)
(5) Resolution	1600 × 3 (R,G,B) (W) × 1600 (H) dots
(6) Color Pixel Arrangement	RGB Vertical Stripe
(7) Display Mode	Transmissive Type, Normally Black Mode, In-Plane Switching Mode
(8) Number of Colors	16,777,216 Colors
(9) Viewing Direction	All direction
(10) Backlight	Light Emitting Diode (LED), 8 LEDs (2in1) ; 4 series 2 strings
(11) Weight	5.9g (typ)
(12) Power Supply Voltage	VSP = 5.7+/- 0.1V VSN=-5.7+/- 0.1V
(13) Interface I/O power supply Note (1)	IOVCC= 1.8V +/-0.1 V The same voltage as "H" level of a customer's interface signal must be supplied to VDDI.
(14) IC	R63455
(15) Interface	MIPI-DSI Video mode w/o data compression (4-Lane x 2-Port) MIPI-DSI Video mode 1/3 data compression (4-Lane x 1-Port)
(16) Methode of Inversion	Column Inversion
(17) Surface Treatment	HC (Hard coat)

Note (1) IOVCC is the reference voltage for adjusting the I/O signal level of R63455
IOVCC voltage must be determined according to a customer's system.



5. ABSOLUTE MAXIMUM RATINGS

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5.1 ELECTRICAL ABSOLUTE MAXIMUM RATINGS OF LCD

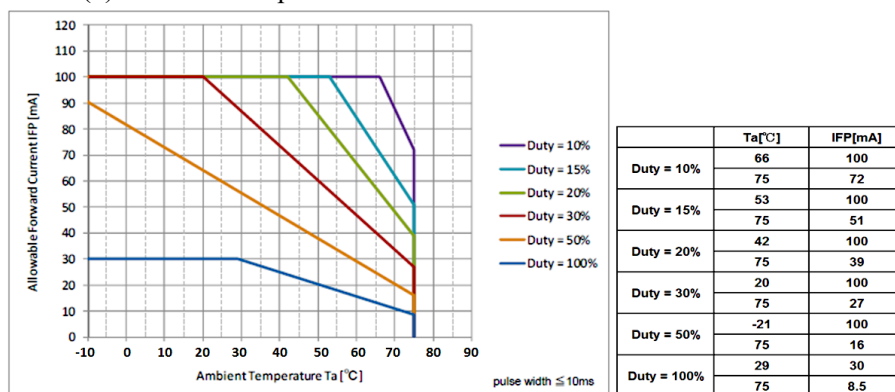
Ta=25°C

Item	Symbol	Min	Max	Unit	Note
Supply voltage	VSP	-0.3	6.5	V	(1)
Supply Voltage	VSN	-6.5	0.3	V	(2)
Logic Input voltage range	IOVCC	-0.3	2.3	V	(1)
MIPI line voltage range	Vt	-0.3	1.80	V	(1)
RESX voltage range	Vt	-0.3	IOVCC+0.3	V	(1)
LED Reverse Voltage	V _R	-	5	V	
LED Forward Current	I _{LED}	-	Note (3)	mA	per LED

Notes (1) Keep VSP, IOVCC, MIPI line and RESX Voltages no lower than GND.

(2) Keep VSN Voltages no Higher than GND.

(3) Ambient Temperatures vs. Allow able Forward Current.

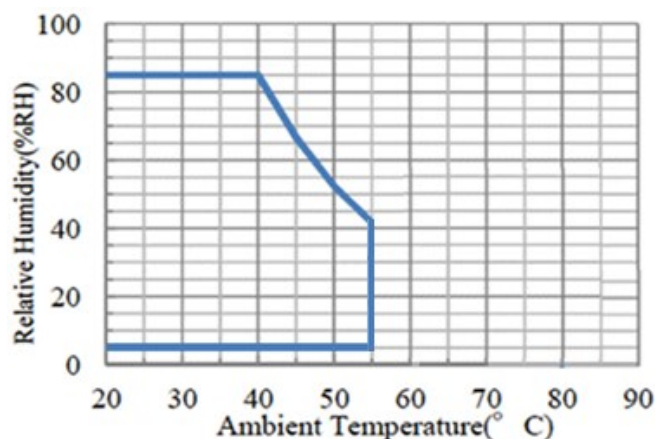


5.2 ENVIRONMENTAL ABSOLUTE MAXIMUM RATINGS

Item	Operating		Non-Operating (Note4)		Remarks
	Min	Max	Min	Max	
Ambient Temperature	0°C	55°C (2)	-20°C	70°C (2)	Note (3)
Humidity	Note (1)		Note (1)		No condensation
Corrosive Gas	Not Acceptable		Not Acceptable		

Notes (1) Ta ≤ 40°C 85%RH max.

Ta > 40°C Absolute humidity must be lower than the humidity of 85%RH at 40°C.



(2) The temperature of LCD surface shall be equal or less than 70°C.

(3) Background color slightly changes depending on ambient temperature and viewing angle. The temperature for operating in the table above apply to operation only. Visual qualities, such as brightness, color, contrast ratio and response time, to be evaluated at Ta=25°C Operating.

(4) This is not for storing condition. When storing LCM for long term, please follow the condition mentioned in "12.5 STORAGE".

6. ELECTRICAL CHARACTERISTICS

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LCD Module

Ta=25°C

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Power Supply Voltage for LCD	IOVCC	-	1.7	1.8	1.9	V	-
Power Supply Voltage for	VSP	-	5.6	5.7	5.8	V	-
Power Supply Voltage for	VSN	-	-5.8	-5.7	-5.6	V	-
Input Voltage for Logic Circuits	VIH		0.7×IOVCC	-	IOVCC	V	(1),(2)
	VIL		0	-	0.3×IOVCC		
Output Voltage for Logic Circuits	VOH1	IOH=-0.1mA	0.8×IOVCC	-	-	V	(1),(3)
	VOL1	IOL=0.1mA	-	-	0.2×IOVCC		
Power Supply Current	I_VDDI	All White	-	88	125	mA	(4)
	I_VSP	All White	-	5.8	9.5	mA	(4)
	I_VSN	All White	-7.5	-4.6	-	mA	(4)
LED Forward Voltage	VLED	-	-	6.04		V	(5)
LED Forward Current	ILED	-	-	45		mA	(5)(6)
LED Reverse Current	IR	-	-	-	-	μA	
Frame Frequency	fFLM	-			90	Hz	(7)

Notes (1) IOVCC = 1.7V to 1.9V

(2) Input : RESX

(3) Output : BCKLIGHT, TE

(4) IOVCC=1.8V, VSP=5.7V, VSN=-5.7V, fFLM=90Hz

The current is time averaged value even for Maximum criteria.

(5) Each value is the characteristics of one LED. @If=45mA Duty=20%

(6) The operating current of LED and the duty ratio should be determined within the maximum rating of the temperature environmental condition.

(7) The frame frequency shall be 90Hz.

7. OPTICAL CHARACTERISTICS

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LCD (BACKLIGHT ON)

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Brightness	B	$\phi=0^\circ, \theta=0^\circ$	344	430	-	cd/m ²	(1),(2)
Brightness Uniformity 1	-	$\phi=0^\circ, \theta=0^\circ$	70	85	-	%	(2),(3),(5)
Viewing Angle	CR	$\phi=0^\circ, \theta=30^\circ$	100	150	-	-	(4),(6),(7)
		$\phi=90^\circ, \theta=30^\circ$	100	150	-		
		$\phi=45^\circ, \theta=30^\circ$	30	50	-		
Contrast Ratio	CR	$\phi=0^\circ, \theta=0^\circ$	500	700	-	-	(6)
Response Time	G2G	$\phi=0^\circ, \theta=0^\circ$	-	4.5	5.5	ms	(8)
Color Tone (Primary Color)	Red	x	0.610	0.640	0.670	-	
		y	0.300	0.330	0.360		
	Green	x	0.27	0.300	0.33		
		y	0.570	0.600	0.630		
	Blue	x	0.120	0.150	0.180		
		y	0.030	0.060	0.090		
	White	x	0.255	0.280	0.305		
		y	0.265	0.290	0.315		
NTSC Ratio	-		-	70.8	-	%	-
Crosstalk	-	$\phi=0^\circ, \theta=0^\circ$	-	-	1.5	%	(9)
Flicker	-	$\phi=0^\circ, \theta=0^\circ$	-	-	-30	dB	(10)
Gamma	-	$\phi=0^\circ, \theta=0^\circ$	1.9	2.2	2.5	-	(11)

All the criteria shall be applied for initial(delivered) state. (Not for whole the product life.)

Measurement Conditions

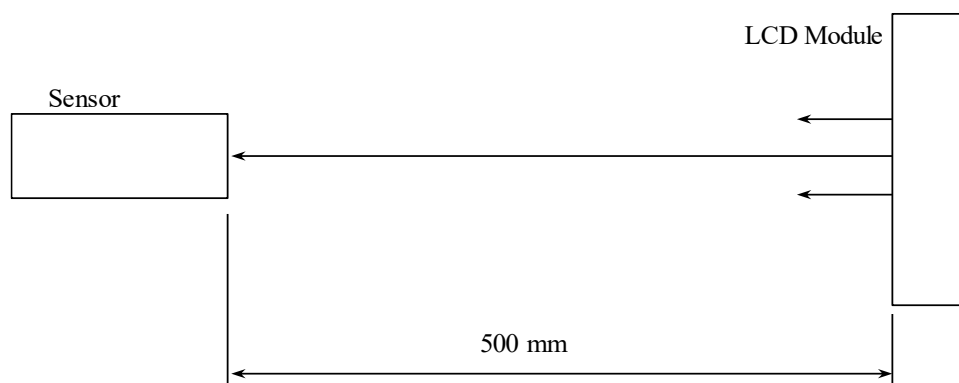
Measurement environment : Dark room
 Ambient temperature : Ta=25°C
 Sequence : Refer to Item 9.4
 Power supply voltage : IOVCC=1.8V, VSP=5.7V, VSN=-5.7V
 Backlight current : ILED=45mA x 2 Strings Duty20%

Notes (1) Display image for measurement : All White

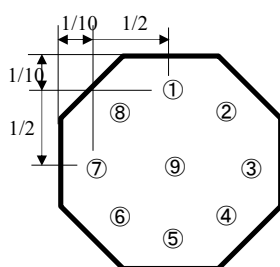
(2) Measurement system;

Sensor : CS-1000 or equivalent

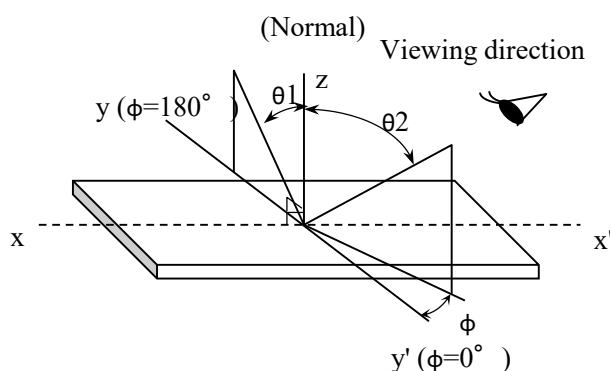
Measurement point : Center of LCD's active area



Notes (3) Measurement point



(4) Definition of θ and ϕ



(5) Definition of brightness uniformity

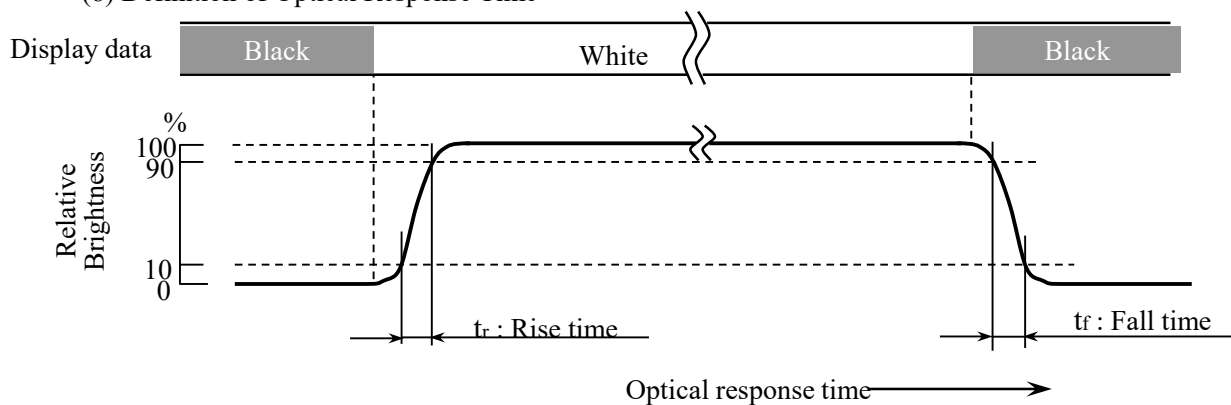
$$\text{Brightness uniformity} = \frac{\text{Brightness (min)}}{\text{Brightness (max)}} \times 100 (\%)$$

(6) Definition of Contrast "CR"

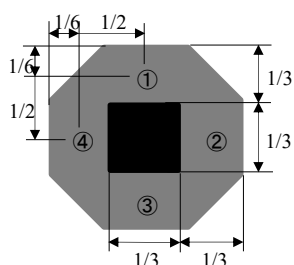
$$\text{CR} = \frac{\text{Brightness when displaying White raster}}{\text{Brightness when displaying Black raster}}$$

(7) Equipment : EZcontrast XL88RC or equivalent

(8) Definition of Optical Response Time



(9) Cross talk measurement patterns

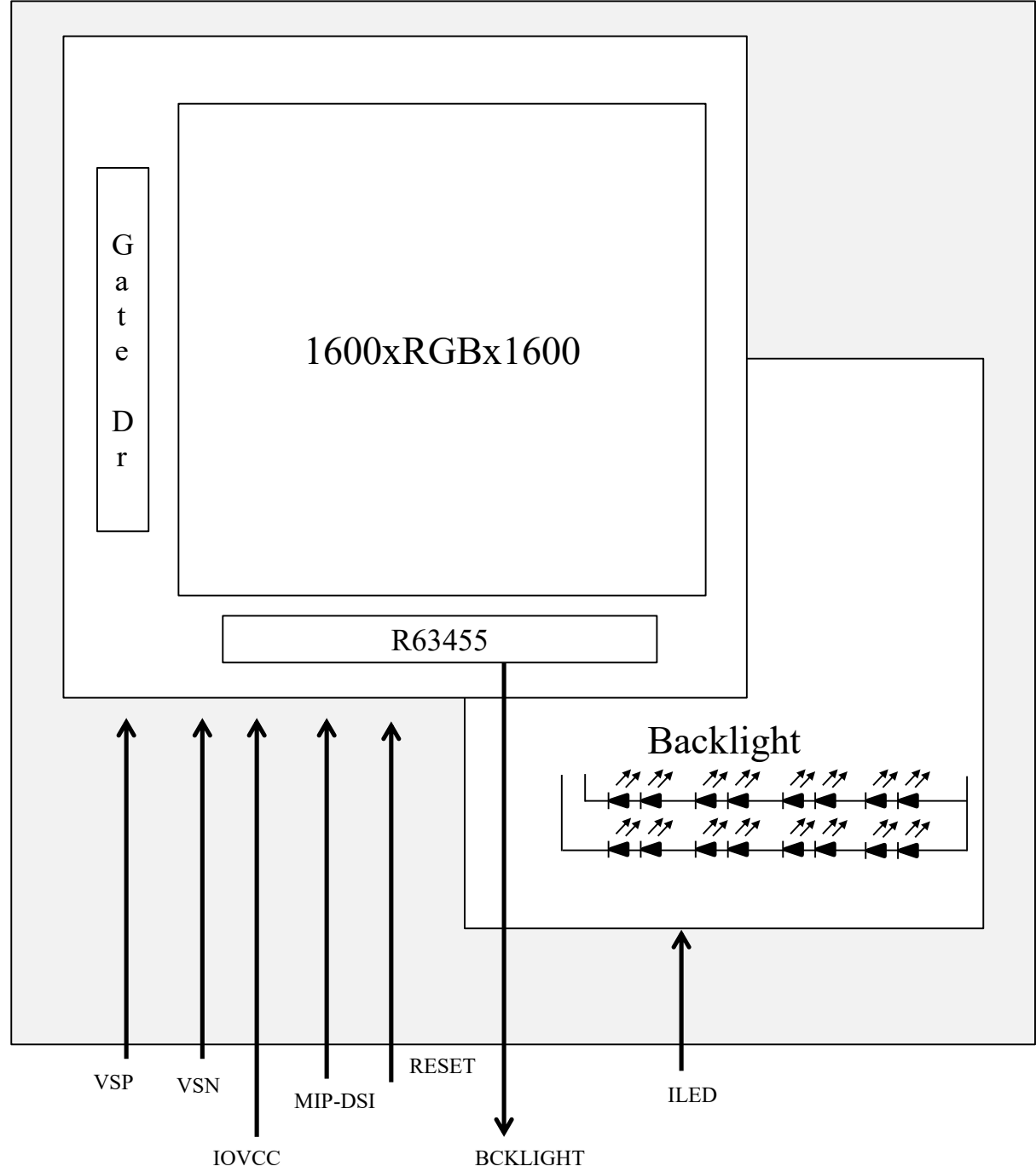


(10) Equipment : CA-310 or equivalent

(11) Gray scale is from 30 to 240

8. BLOCK DIAGRAM

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9. INTERFACE

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9.1 INTERNAL PIN CONNECTION

Pin No	Signal	Function	I/O
1	GND	Ground	P
2	NC	-	-
3	PN2PTX	DSI port number select (H:1port, L:2port)	I
4	VSP	Analog Power Supply (5.7V)	P
5	BLUPWM	LEDPWM (to LED driver)	O
6	NC	-	-
7	TE	TE	O
8	VSN	Analog Power Supply (-5.7V)	P
9	RESET	Reset for LCD	I
10	GND	Ground	P
11	GND	Ground	P
12	DSIB_D3_P	MIPI data lane	I
13	DSIB_D0_P	MIPI data lane	I
14	DSIB_D3_N	MIPI data lane	I
15	DSIB_D0_N	MIPI data lane	I
16	GND	Ground	P
17	GND	Ground	P
18	DSIB_CLK_P	MIPI clock lane	I
19	DSIB_D1_P	MIPI data lane	I
20	DSIB_CLK_N	MIPI clock lane	I
21	DSIB_D1_N	MIPI data lane	I
22	GND	Ground	P
23	GND	Ground	P
24	DSIB_D2_P	MIPI data lane	I
25	DSIA_D2_N	MIPI data lane	I
26	DSIB_D2_N	MIPI data lane	I
27	DSIA_D2_P	MIPI data lane	I
28	GND	Ground	P
29	GND	Ground	P
30	DSIA_D1_N	MIPI data lane	I
31	DSIA_CLK_N	MIPI clock lane	I
32	DSIA_D1_P	MIPI data lane	I
33	DSIA_CLK_P	MIPI clock lane	I
34	GND	Ground	P
35	GND	Ground	P
36	DSIA_D0_N	MIPI data lane	I/O
37	DSIA_D3_N	MIPI data lane	I
38	DSIA_D0_P	MIPI data lane	I/O
39	DSIA_D3_P	MIPI data lane	I
40	GND	Ground	P
41	GND	Ground	P
42	NC	-	-
43	ID0(HIGH=1.8V)	ID0(HIGH=1.8V)	O
44	LED+	Backlight Anode	P
45	ID1(LOW=0V)	ID1(LOW=0V)	O
46	NC	-	-
47	IOVCC	Logic and IF Power Supply (1.8V)	P
48	LED1-	Backlight Cathode	P
49	IOVCC	Logic and IF Power Supply (1.8V)	P
50	LED2-	Backlight Cathode	P

Connector:14 5863 050 024 829+ kyocera

9.2 TIMING CHARACTERISTICS

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(1)MIPI DSI Characteristics

Item		Symbol	Unit	Condition	Min	Typ	Max	Note
HS-RX	Differential input high threshold	VIDTH	mV	IOVCC = 1.7~1.9V	-	-	70	
	Differential input low threshold	VIDTL	mV	IOVCC = 1.7~1.9V	-70	-	-	
	Single-ended input low voltage	VILHS	mV	IOVCC = 1.7~1.9V	-40	-	-	
	Single-ended input high voltage	VIHHS	mV	IOVCC = 1.7~1.9V	-	-	460	
	Common-mode voltage HS receive mode	VCMRX(DC)	mV	IOVCC = 1.7~1.9V	70	-	330	
	Differential input impedance	ZID	Ω	IOVCC = 1.7~1.9V	-	100	-	
LP-RX	Logic 0 input voltage not in ULP State	VIL	mV	IOVCC = 1.7~1.9V	-	-	550	
	Logic 1 input voltage	VIH	mV	IOVCC = 1.7~1.9V	880	-	1350	
	I/O leakage current	ILEAK	μA	IOVCC = 1.7~1.9V	-10	-	10	
LP-TX	Thevenin output low level	VOL	mV	IOVCC = 1.7~1.9V	-50	-	50	
	Thevenin output high level	VOH	V	IOVCC = 1.7~1.9V	1.1	1.2	1.3	
	Output impedance of LP transmitter	ZOLP	Ω	IOVCC = 1.7~1.9V	110	-	-	
CD-RX	Logic 0 contention threshold	VILCD	mV	IOVCC = 1.7~1.9V	-	-	200	
	Logic 1 contention threshold	VIHCD	mV	IOVCC = 1.7~1.9V	450	-	-	

Notes 1. VCMRX (DC) = (VDP+VDN)/2

2. Excluding COG resistance (contact resistance and indium tin oxide (ITO) wiring resistance)

(2)MIPI D-PHY host characteristics

Item		Symbol	Unit	Condition	Min	Typ	Max	Note
HS-TX	Differential output voltage	VOD	mV	IOVCC = 1.7~1.9V	140	200	270	

Notes This SPEC is the HS-TX SPEC. Use the Host in conformity with this specification.

MIPI DSI High-Speed-Receiver Clock and Data-Clock Specifications

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Item	Symbol	Unit	Condition	Min	Typ	Max	Note
DSICLK frequency	fDSICLK	MHz	IOVCC = 1.7~1.9V	250	-	650	1
DSICLK cycle time	tCLKP	ns	IOVCC = 1.7~1.9V	1.54	-	4	1
DSI data transfer rate	tDSIR	Mbps	IOVCC = 1.7~1.9V	500	-	1300	1
Data to clock setup time	tSETUP	UI	IOVCC = 1.7~1.9V	0.15	-	-	1, 3
		ns	DSI transfer rate $\leq$ 1000 Mbps	0.15	-	-	1, 2, 3
		UI	IOVCC = 1.7~1.9V	0.2	-	-	1, 3
		ns	DSI transfer rate > 1000 Mbps	0.13	-	-	1, 2, 3
Clock to data hold time	tHOLD	UI	IOVCC = 1.7~1.9V	0.15	-	-	1, 3
		ns	DSI transfer rate $\leq$ 1000 Mbps	0.15	-	-	1, 2, 3
		UI	IOVCC = 1.7~1.9V	0.2	-	-	1, 3
		ns	DSI transfer rate > 1000 Mbps	0.13	-	-	1, 2, 3

Notes 1. Minimum 110 mV/-110 mV HS differential swing is required for display data transfer.

2. tSETUP/tHOLD times are measured without HS-TX jitter.

3. Minimum tSETUP/tHOLD Time is 0.15 UI or 0.20 UI. This value may change according to the DSI transfer rate.

MIPI DSI Low Power-Receiver/Transmitter Clock and Data-Clock Specifications

Item	Symbol	Unit	Condition	Min	Typ	Max	Note
Time to drive LP-00 to prepare for HS transmission	T _{HS-PREPARE}	-	IOVCC = 1.7~1.9V	40ns +4*UI	-	85ns +6*UI	
T _{HS-PREPARE} + time to drive HS-0 before the sync sequence	T _{HS-PREPARE} + T _{HS-ZERO}	-	IOVCC = 1.7~1.9V	145ns + 10 • UI	-	-	
Time to drive flipped differential state after last payload data bit of a HS transmission burst ^{1,2}	T _{HS-TRAIL}	-	IOVCC = 1.7~1.9V	max (n • 8 • UI, 60 ns + n • 4 •	-	-	
Time to drive LP-11 after HS burst	T _{HS-EXIT}	ns	IOVCC = 1.7~1.9V	100	-	-	
Time to drive LP-00 after Turnaround Request	T _{TA-GO}	-	IOVCC = 1.7~1.9V	4*T _{LTX}			
Time that the new TX waits after the LP-10 state before transmitting the bridge state (LP-00) during a link turnaround	T _{TA-SURE}	-	IOVCC = 1.7~1.9V	1*T _{LPTX}	-	2*T _{LPTX}	
Time that the new TX drives the bridge state (LP-00) after accepting control during a link turnaround	T _{TA-GET}	-	IOVCC = 1.7~1.9V	5*T _{LTX}			
Length of any Low-Power state period	T _{LTX}	ns	IOVCC = 1.7~1.9V	50	-	-	
Ratio of T _{LTX(MASTER)} /T _{LTX(SLAVE)} between Master and Slave side	Ratio T _{LTX}	-	IOVCC = 1.7~1.9V	2/3	-	3/2	
Time that the transmitter shall continue sending HS clock after the last associated Data Lane has transitioned to LP mode ³	T _{CLK-POST}	-	IOVCC = 1.7~1.9V	60ns +52UI	-	-	
T _{CLK-PREPARE} + Time for lead HS-0 drive period before starting Clock	T _{CLK-PREPARE} + T _{CLK-ZERO}	ns	IOVCC = 1.7~1.9V	300	-	-	

Item	Symbol	Unit	Condition	Min	Typ	Max	Note
Time that the HS clock shall be driven prior to any associated Data Lane beginning the transition from LP to HS mode	$T_{CLK-PRE}$	UI	IOVCC = 1.7~1.9V	8	-	-	
Time to drive LP-00 to prepare for HS clock transmission	$T_{CLK-PREPARE}$	ns	IOVCC = 1.7~1.9V	38	-	95	
Time to drive HS differential state after last payload clock bit of an HS transmission burst	$T_{CLK-TRAIL}$	ns	IOVCC = 1.7~1.9V	60	-	-	
Time from start of THS-TRAIL period to start of LP-11 state ²	T_{EOT}		IOVCC = 1.7~1.9V	-	-	105 ns + $n \cdot 12 \cdot$ UI	
Length of the low-power TX period when using the DSI-2 clock ^{4, 5}	T_{LPTX1}	UI	IOVCC = 1.7~1.9V	-	1/CTXCLK	-	
Length of the low-power TX period when using the internal OSC clock ^{4, 5}	T_{LPTX2}	ns	IOVCC = 1.7~1.9V	-	8/fosc	-	

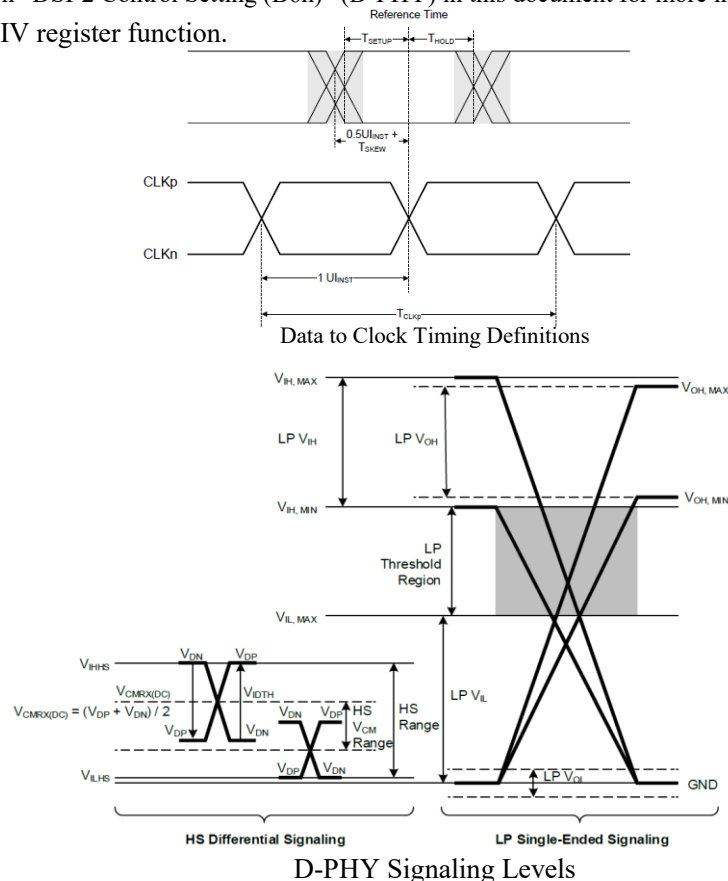
Notes 1. If $a > b$ then $\max(a, b) = a$, otherwise $\max(a, b) = b$

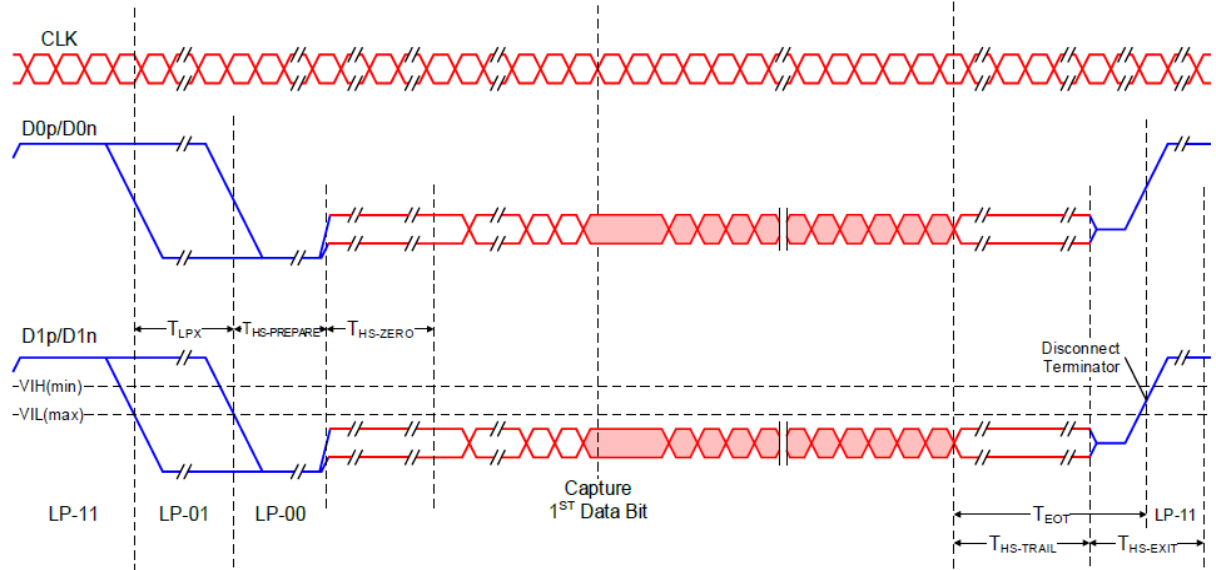
2. Where $n = 1$ for forward direction HS mode.

3. R63455 works with this specification, although the last part of the internal process remains when the clock lane enters LP-11 and R63455 works without the remaining process if tCLK-POST is more than 512 UI.

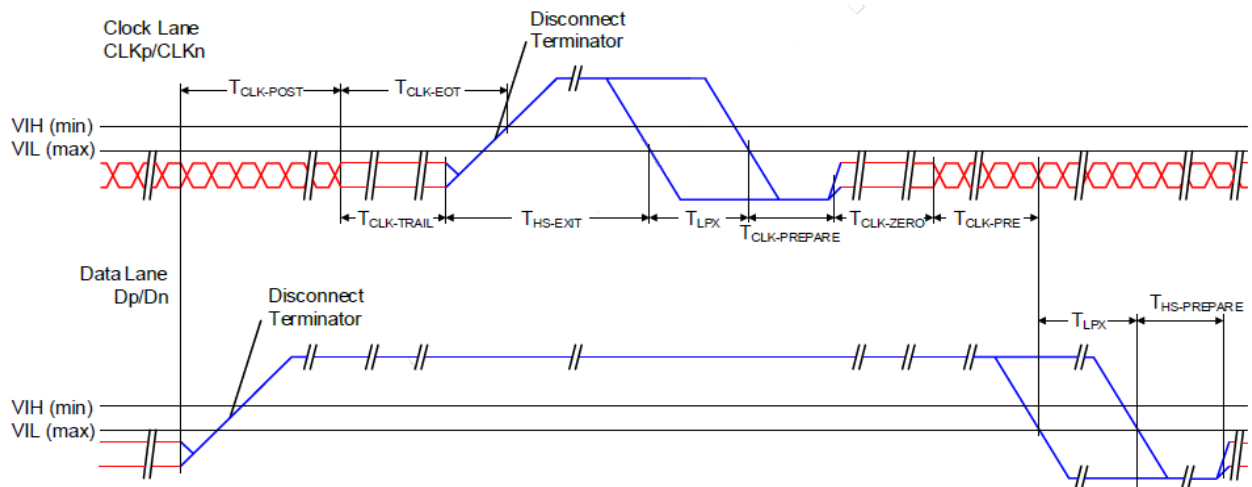
4. R63455 uses the DSI clock from the host processor if the DSI-2 clock lane is active, and uses the internal oscillator clock if the DSI-2 clock lane is stopped.

5. See section “DSI-2 Control Setting (B6h)” (D-PHY) in this document for more information about the DSITXDIV register function.

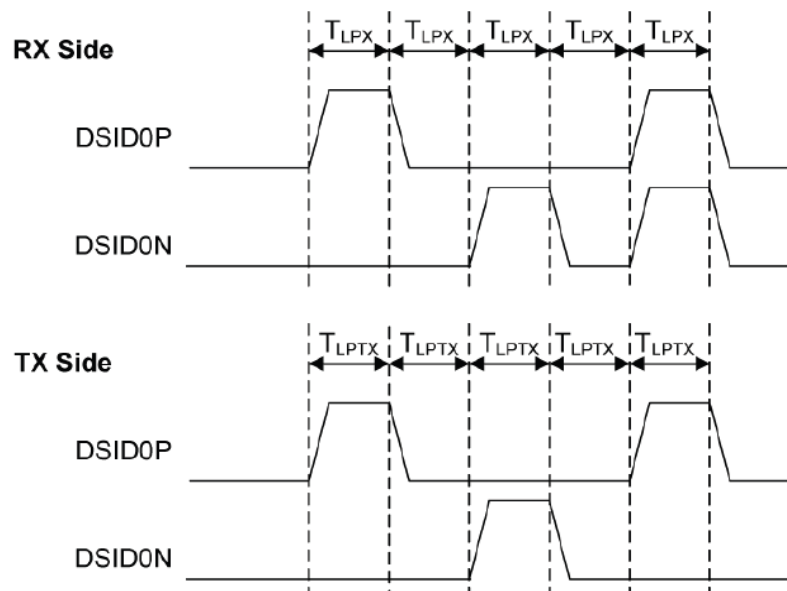




HS Data Transmission in Bursts



Switching the clock lane between clock Transmission and LP mode



MIPI D-phy VideoMode with FIFO 2port nocomp

Item		Specification	unit	Note
PHY	D/CPHY	DPHY	-	
	Lane/Trio	8Lane	-	
Comp.	VesaDSC	-	-	
	Slice width	-	pxl	
	Slice height	-	line	
Resol.	H resolution	1600	pxl	
	H res + Hdmy	1600	pxl	
	V resolution	1600	pxl	
V	Frame rate	90	Hz	
	V total	1779	line	
	V back porch	150	line	
	V front porch	29	line	
H	1line time	6.24	us	
	H active	(800)	pxl	per port
	H active + Hdmy	(800)	pxl	per port
	H back porch	min. 20	byteclock	
	H front porch	min. 20	byteclock	
	MIPI rate	1000	Mbps	

$f_{ByteClock} = (1/4) * f_{DSICLK}$. $f_{ByteClock}$ = frequency of ByteClock.

9.3 POWER ON/OFF SEQUENCE

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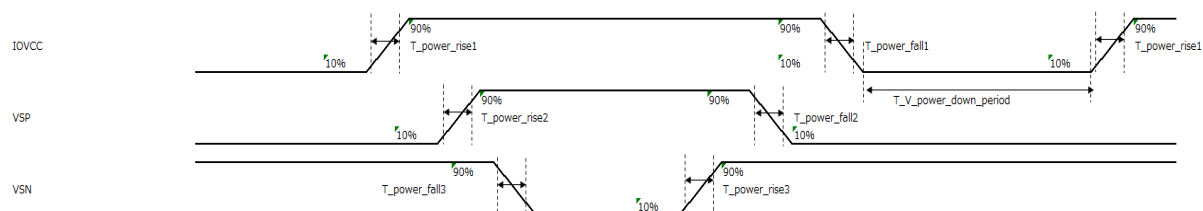
Power supply AC/DC specification and ON/OFF sequence

1. Supply Power Voltage

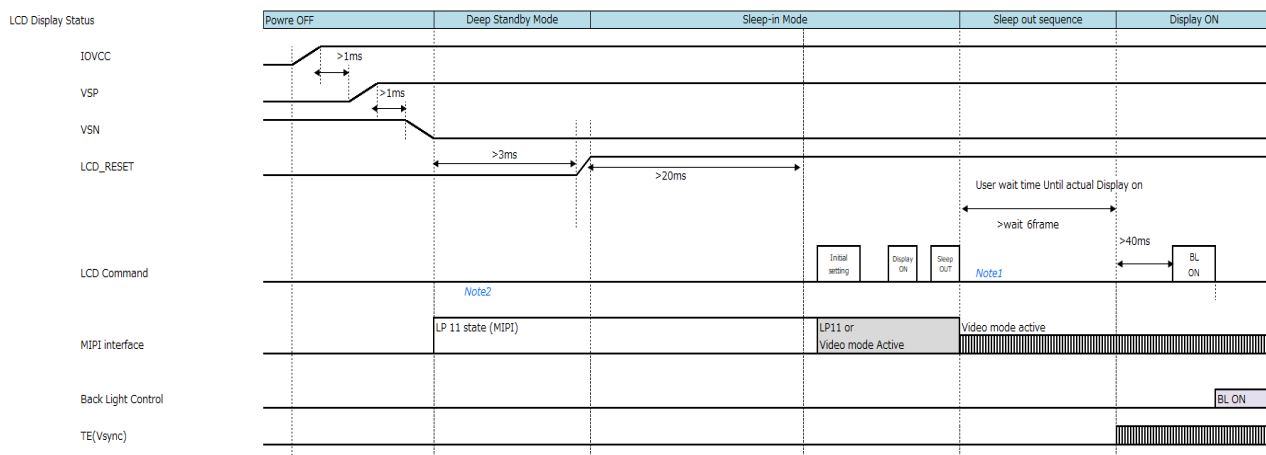
	Min	Typ	Max	Description
VSP	5.6	5.7	5.8	Analog power supply for LCD.
VSN	-5.8	-5.7	-5.6	Analog power supply for LCD.
IOVCC	1.7	1.8	1.9	Digital power supply for LCD

2. Supply Power Slew rate

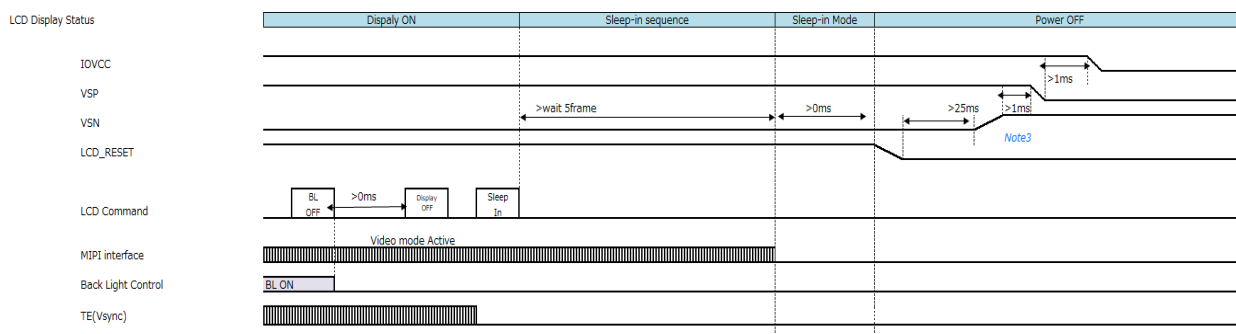
	Min	Typ	Max	Description
T _{power_rise1}	0.2ms	-	5ms	IOVCC from 10% to 90% target voltage
T _{power_fall1}	0.2ms	-	5ms	IOVCC from 90% to 10% target voltage
T _{power_rise2}	0.2ms	-	5ms	VSP from 10% to 90% target voltage
T _{power_fall2}	0.2ms	-	5ms	VSP from 90% to 10% target voltage
T _{power_rise3}	0.2ms	-	5ms	VSN from 10% to 90% target voltage
T _{power_fall3}	0.2ms	-	5ms	VSN from 90% to 10% target voltage
T _{V_power_down_period}	10ms	-	-	IOVCC < 100mV



3. Power On sequence



4. Power Off sequence



Note 1: After Sleep-out command, Driver IC will reload MTP registers and do internal power on action.
Therefore, any initial setting by MIPI should be set after Sleep-out command with minimum delay time 6frame.

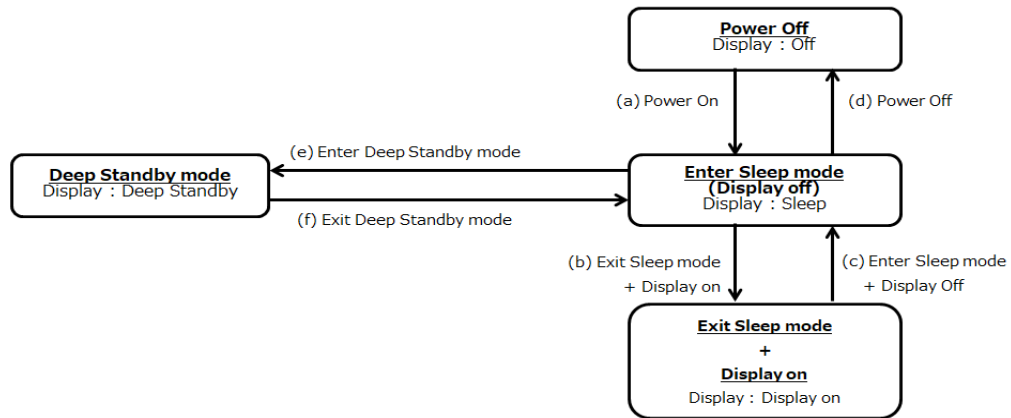
Note 2: When use MIPI I/F, MIPI lanes must go to LP11 state during power-on and RESET sequence.

Note 3: After Sleep In sequence is completed, turn off power supply (at least VSN,VSP) to avoid flicker and sticking image issue.

9.4 SEQUENCE

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State transition diagram



(a) Power On Sequence

Step	Action/Command	DSI Data Type (DDIC)	Address	Data	Note
1	RESET="L"				
2	IOVCC On				
3	Wait 1ms (min.)				Over 1ms from IOVCC=90% (depends on External Power Supply Circuit)
4	VSP On				
5	Wait 1ms (min.)				Over 0us from VSP=10%/50% to VSN=10%/50% (depends on External Power Supply Circuit)
6	VSN On				
7	Wait 3ms (min.)				Over 3ms from IOVCC=90% (depends on External Power Supply Circuit)
8	RESET="H"				
9	Wait 20ms (min.)				Wait Min. 20ms

9.4 SEQUENCE

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Initial setting & exit sleep mode sequence for MIPI D-phy VideoMode with FIFO 2port nocomp

(b) Exit Sleep mode + Display On Sequence (Initial setting & Exit Sleep mode & Display On)

Step	Action/Command	DSI Data Type (DDIC)		Address	Data (Left)	Data (Right)	Note
1	Manufacture Command access protect	MCS	0x29	0xB0	0x04	0x04	Manufacture Command access protect off
2	Sequence control	MCS	0x29	0xD6	0x00	0x00	
3	DSI Control	MCS	0x29	0xB6	0x30	0x30	
					0x6B	0x6B	
					0x00	0x00	2port
					0x06	0x06	
					0x33	0x33	
					0x8A	0x8A	
					0x00	0x00	
					0x1A	0x1A	
					0x7A	0x7A	
					0x54	0x54	FIFO
4	Display Mode	MCS	0x29	0xB7	0x00	0x00	
3	Generic Outpin setting	MCS	0x29	0xB9	0x00	0x00	
					0x00	0x00	
					0x00	0x00	
					0x00	0x00	
6	Display setting1	MCS	0x29	0xC0	0x54	0x54	Generic pin start setting
					0x00	0x00	
					0x00	0x00	
					0x00	0x00	
					0x04	0x04	Generic pin pulse width setting
					0x26	0x26	
					0x44	0x44	
					0x86	0x86	
					0x0A	0x0A	
					0x00	0x00	
7	Display setting2	MCS	0x29	0xF1	0x06	0x06	
					0x40	0x40	
					0x0C	0x0C	
					0x91	0x91	
					0x1E	0x1E	

8	Display setting3	MCS	0x29	0xC6	0x40	0x40	
					0x06	0x06	
					0x40	0x40	
					0x06	0x06	
					0x25	0x25	
					0x3F	0x3F	
					0x06	0x06	
					0x43	0x43	
					0x00	0x00	
					0x00	0x00	
					0x00	0x00	
					0x00	0x00	
					0x00	0x00	
					0x00	0x00	
					0x00	0x00	
9	Display setting3	MCS	0x29	0xCD	0x00	0x00	
10	Display setting4	MCS	0x29	0xCF	0x00	0x00	
					0x00	0x00	
					0x80	0x80	
					0x46	0x46	
					0x61	0x61	
					0x00	0x00	
11	Display setting5	MCS	0x29	0xEC	0x82	0x82	
					0x04	0x05	
					0xD3	0xA0	
					0x00	0x00	
					0x00	0x00	
12	get_compression_mode	DCS	0x39	0x03	0x00	0x00	Compression mode = Disable
13	set_tear_scanline	DCS	0x39	0x44	0x00	0x00	
					0x00	0x00	
7	set_tear_on	DCS	0x39	0x35	0x00	0x00	
14	set_address_mode	DCS	0x39	0x36	0x00	0x00	
15	set_pixel_format	DCS	0x39	0x3A	0x77	0x77	
16	Video stream Packect Start						
17	Wait 0 frames (min.)						
18	set_display_on	DCS	0x05	0x29	-	-	
19	exit_sleep_mode	DCS	0x05	0x11	-	-	
20	Wait 6frame (min.)						Do NOT input any command during ON sequence.
21	Sequence control	MCS	0x29	0xD6	0x80	0x80	
22	Manufacture Command access protect	MCS	0x29	0xB0	0x03	0x03	Manufacture Command access protect on

(c) Display off & Enter Sleep mode Sequence

Step	Action/Command	DSI Data Type (DDIC)		Address	Data		Note
1	set_display_off	DCS	0x05	0x28	-		
2	set_tear_off	DCS	0x05	0x34	-		
3	enter_sleep_mode	DCS	0x05	0x10	-		
4	Wait 5frame (min.)						

(d) Power Off Sequence

Step	Action/Command	DSI Data Type (DDIC)		Address	Data		Note
1	RESET="L"						
2	Wait 25ms(min.)						Wait Min. 25ms
3	VSN Off						
4	Wait 1ms						
5	VSP Off						
6	Wait 10ms						
7	IOVCC Off						

(g) Enter Deep Standby mode Sequence

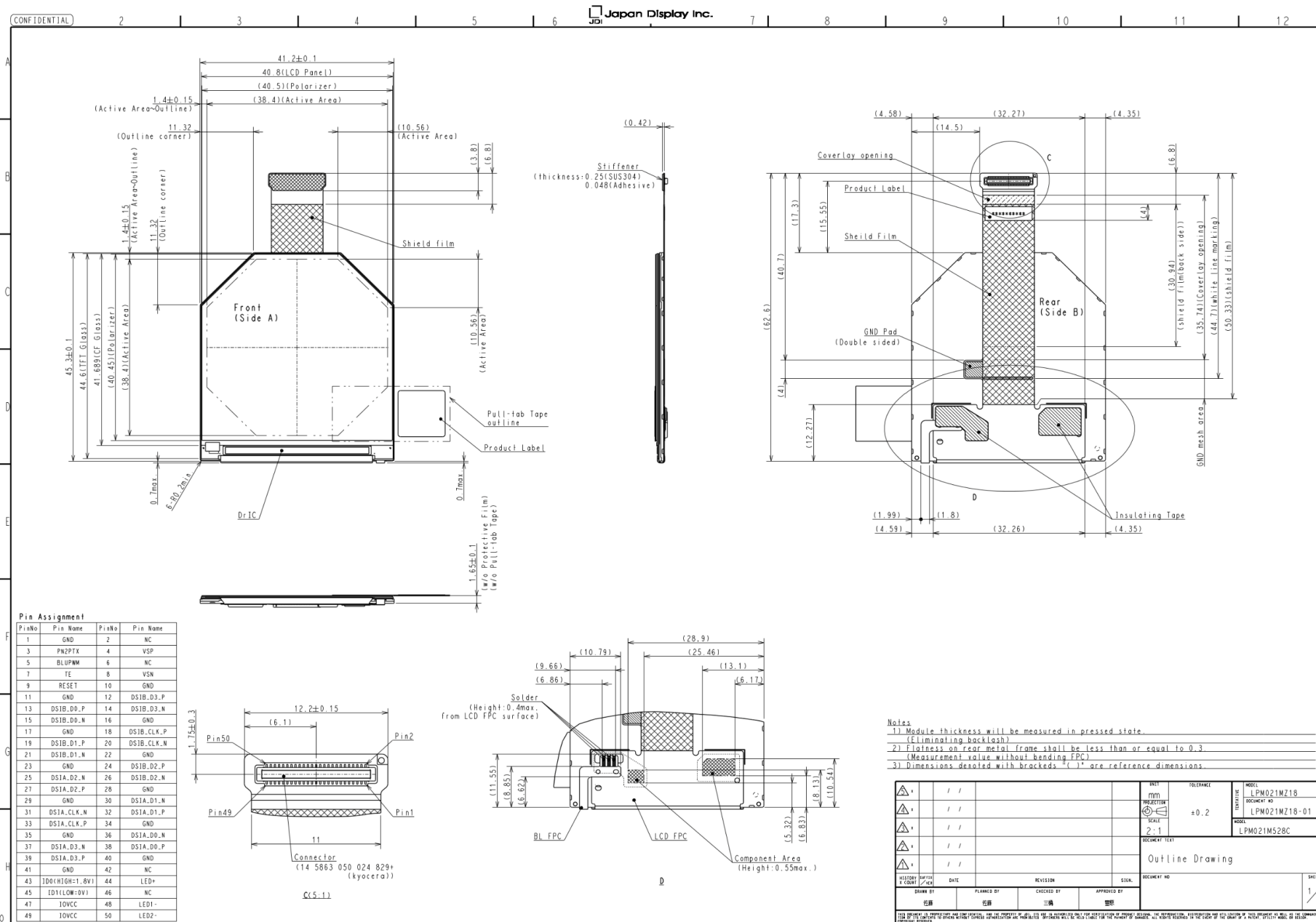
Step	Action/Command	DSI Data Type (DDIC)		Address	Data		Note
1	RESET="L"						
2	Wait 25ms(min.)						Wait Min. 25ms

(h) Exit Deep Standby mode Sequence

Step	Action/Command	DSI Data Type (DDIC)		Address	Data		Note
1	RESET="H"						
2	Wait 20ms (min.)						

10. DIMENSIONAL OUTLINE (LCD)

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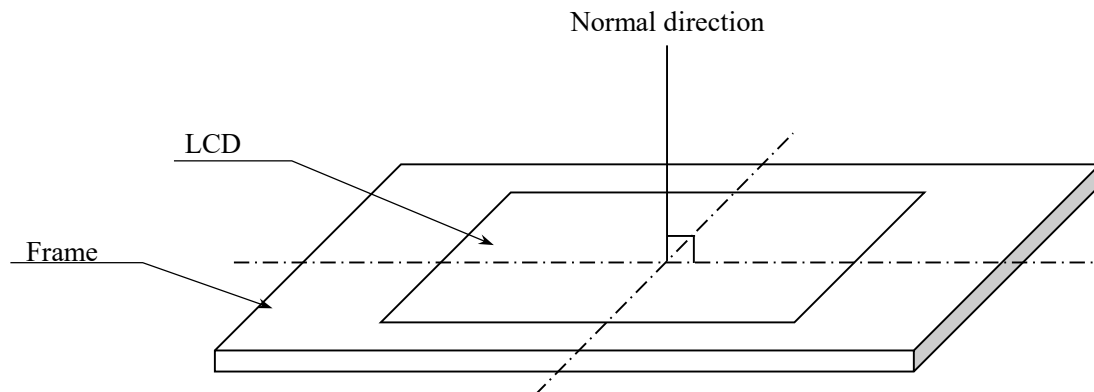
11. VISUAL INSPECTION

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11.1 INSPECTION CONDITION

- | | |
|--|-------------------------------------|
| (1) Ambient illumination 1 | : 0 - 100[lx] for B/L ON item |
| (2) Ambient illumination 2 | : 1000 - 1200 [lx] for B/L OFF item |
| (3) Distance between inspector's eyes and LCD Module | : Approximately 30 [cm] |
| (4) Viewing angle | : 0° (Normal direction) |
| (5) Ambient Temperature | : 25°C |

Refer to the Measurement Conditions described
in Item 6 for the conditions other than specified here.



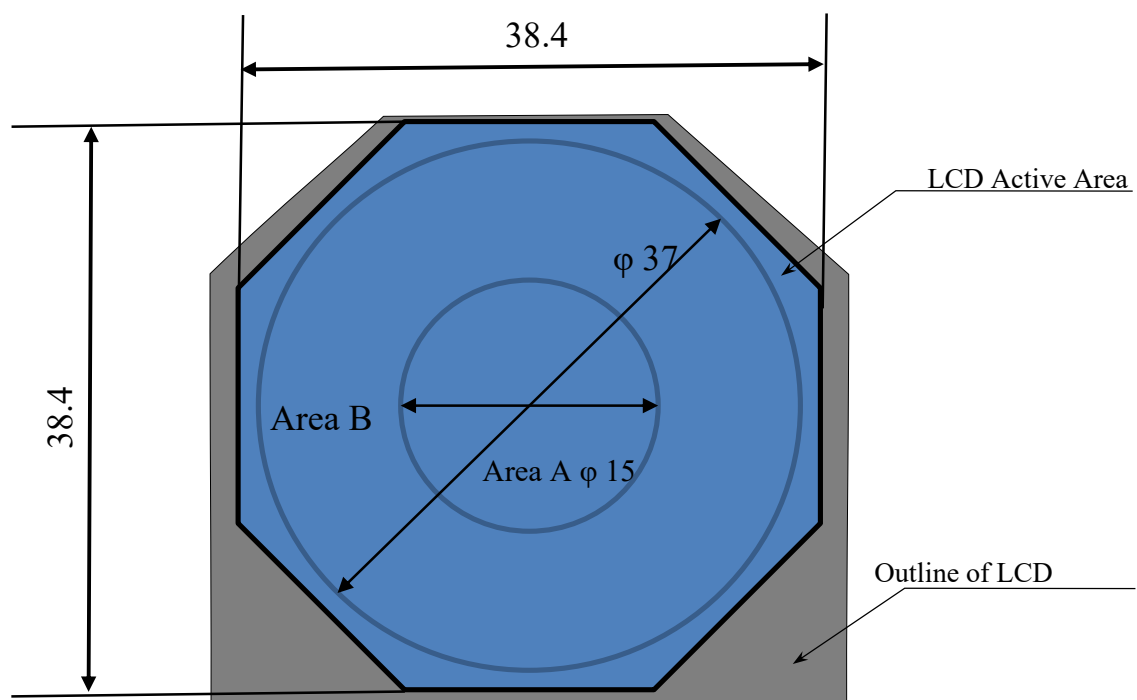
11.2 DEFINITION OF ZONE

The visual inspection zones of LCD Module is divided into two as follows.

A zone : Inspection area for VR Active Area A

B zone : Inspection area for VR Active Area B

C zone : Whole LCD module except A and B zone (Including FPC and frame)



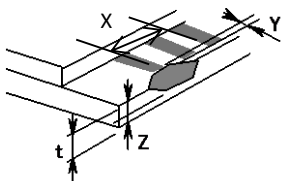
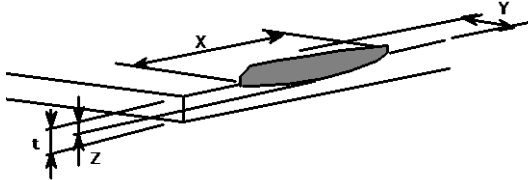
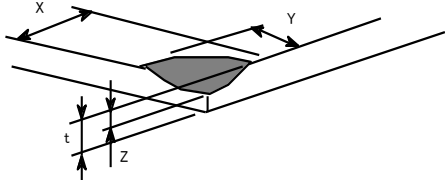
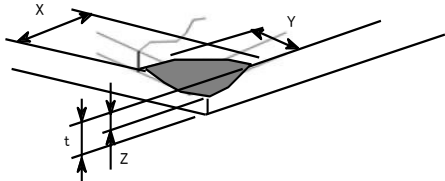
10.3 COSMETIC SPECIFICATION

10.3.1 Screen Defects Specification for LCD Module

No.	Item			Maximum Acceptable Number	Unit	Applied zone	LCD module	Back light	Note
1	Bright Defect (Bright Dot, Bright Foreign Particles, Stain, Scratch, Air Bubble)			Ignored	PC	C	On		(1), (2)
			Defect size > D (W175)	0	PC	A, B			
			Defect size ≤ D (175), check the brightness	-	-	-			
			Brightness is equal to or darker than Bright Defect Limit Pattern (R100,G55,B128,W55)	Ignored	PC	A,B			
			Brightness brighter than Bright Defect Limit Pattern (R100,G55,B128,W55)	0	PC	A			
				2		B			
2	Pixel dark dot, not including the bright particle) D:Average diameter [mm]			Ignored	PC	C	On		(1), (2)
			D≤0.024	Ignored	PC	A, B			
			0.024<D≤0.048	N≤3, DS ≥5;	PC	A, B			
			D<0.048	Not allowed	PC	A, B			
3	Total number = Bright defect + Dark defect			N<=4, DS>=5mm	PC	A, B	On	-	
4	Line Defect			0	PC	A, B	On	(2)	
5	Uneven Brightness (Linear)			Serious one is not allowed	-	A, B	On	(2)	
6	Uneven Brightness (Circular)								
7	Scratch of Polarizer (Liner)[mm] W:Width, L:Length	W≤0.05	L≤5	Ignored	PC	A, B	ON		(2), (3)
			5<L	0					
		0.05<W	-	0					
8	Foreign particles, stain, Scratch of Polarizer (Circular)[mm] D:Average diameter	D≤0.1		Ignored	PC	A, B	ON		(2), (3)
		0.1<D		0					
		D≤0.25		Ignored		A, B	Off	(3)	
		0.25<D		0					
9	Air Bubble [mm] D:Average diameter	D≤0.25		Ignored	PC	A, B	ON		(3), (4)
		0.25<D		0					
		-		-					
10	Scratch of FPC			Serious one is not allowed	-	C	Off		

11.3.2 Panel chipping Specification: It is internal standard, and this is not guaranteed SPEC.

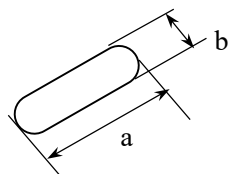
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Item	Criterion for Defects	Note
Glass Chipping [Pad Area]	 Size (mm) $X \leq 3.0$ $Y \leq 0.5$ $Z \leq t$	
Glass Chipping [Except Pad Area]	 Size (mm) $X \leq 3.0$ $Y \leq 1.0$ $Z \leq t$	
Glass Chipping [Corner PAD Area]	 Size (mm) $X(\text{or } Y) \leq 2.5$ $Y(\text{or } X) \leq 2.5$ $Z \leq t$	
Glass Chipping [Corner No Pad Area]	 Size (mm) $X(\text{or } Y) \leq 1.0$ $Y(\text{or } X) \leq 2.0$ $Z \leq t$	
Progressive crack is NG		

- Notes
- (1) Defective dots which are not adjacent are taken as a single Dot Defect each.

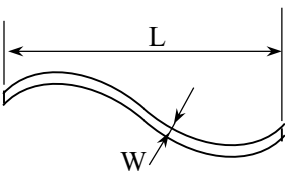
Two adjacent defective dots are considered as a single Dot Defect.
- (2) Defect is judged with the Lupe (10x) (or other equivalent method) and it is disregarded if it can not be recognized through the lens.
- (3) Something which can be easily wiped off is disregarded as a defect.
- (4) Definitions for D, W and L are as follows.

Definition of D



$$D = \frac{a + b}{2}(\text{mm})$$

Definition of W and L



The cosmetic specifications which are not shown on this document are judged by JDI criteria based on JDI past experience.

In case of any specific change from a customer, additional charge may be necessary.

11.4 RELIABILITY TEST

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No.	Test Items	Test Conditions	Note
1	High temperature, operating	70°C, 240 h	(1), (2), (3)
2	Low temperature, operating	-20°C, 240 h	(1), (2), (3)
3	High temperature, Storage Non-operation	80°C, 240 h	(3)
4	Low temperature, Storage Non-operation	-30°C, 240 h	(3)
5	High temperature & high humidity, Operating	60°C, 90%RH, 240 h	(1), (2), (3)
6	Thermal shock, Non-operation	-30°C (30min) / +70°C (30min), 50 cycles	(3)
7	ESD (HBM) x 5 each	1kV 150pF, 1.5KOhm	
8	ESD Contact discharge x 5 each	Center+4 corner, +/-8kV 150pF, 330Ohm	
9	Box vibration and drop	Random vibration frequency: 5-500Hz, PSD: 0.04-0.000006G ² /Hz Time: X(18min), Y(18min), Z(101min) Condition on the stage: Fixed	(4)
10	Drop test	Drop height : 80 cm, Dropping the package on 1 corner, 3 edges, 6 surfaces, once each.	(4)

Notes

- (1) Operation conditions : VDDI=1.8V, VSP=5.7V, VSN=-5.7V, fFLM=90Hz.
- (2) No loss of function during the test.
- (3) All the measurement shall be done @25°C
- (4) One set includes 4 inner boxes and each inner box has 10 trays which contain 3 pieces of LCD modules each and an empty tray as the cover.

12. PRECAUTIONS IN DESIGN

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12.1 GENERAL ATTENTION

- (1) The LCD module covered by this specification has been designed specifically for a head mount display (HMD) when used for other applications, we do not warrant any of the content of these specifications including quality and safety sections. Furthermore, this module has not been explicitly developed for medical equipment critically related to human life such as life support apparatus.
- (2) Never attempt to disassemble this LCD module. There is a danger of burns, electric shock, and injury. If the module is disassembled, we do not warrant any of these specifications including quality and safety sections.

12.2 PRECAUTIONS AGAINST ELECTROSTATIC DISCHARGE

This module includes C-MOS LSI(s), which are sensitive and vulnerable to electrostatic discharge. Any operator should be grounded with suitable anti-ESD equipment such as a wrist band when handling the module. Avoid touching terminal pins directly.

12.3 HANDLING PRECAUTIONS

- (1) Do not subject the LCD module to a humid environment for any extended period. If the ambient storage temperature is over 35°C, steps should be taken to avoid high humidity. The polarizer can deteriorate under high temperatures and high humidity. Additionally, this can also cause the polarizer to bubble and peel. Please store/operate the LCD module within the specified temperatures and humidity ranges.
- (2) As polarizer material tends to be easily scratched, the LCD module must be handled with due care to avoid touching, pressure or rubbing by any material which is harder than 3H pencil lead (e.g. metal fixings, tweezers, glass, etc.)
- (3) No pressure more than 19.6 kPa must be applied to the LCD module surface. If pressure is exerted over an area of less than 1 cm², the maximum pressure must not exceed 1.96 N.
- (4) As adhesives containing organic materials are used for securing upper and lower polarizers, these can be deteriorated by chemical reaction with chemicals such as acetone, toluene, ethanol and isopropyl alcohol (IPA). The following solvent is recommended for use : Normal hexane. Please contact us if it is necessary to use chemicals other than these mentioned above.
- (5) Lightly wipe the surface with a clean, soft material such as a cotton swab or cleaning cloth for glasses, dampened with the recommended chemical. Always wipe the surface horizontally or vertically. Never wipe using a circular motion and avoid excess pressure or scrubbing. To prevent the display surface from damage and to maintain in a good state, it is generally sufficient, to wipe the surface with a cotton swab.
- (6) If spittle or a water drop comes in contact with the display area, immediately wipe it off. Liquids can damage the LCD module resulting in deformation and faded color.

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- (7) Condensation on the LCD module may cause staining, dirtying or damage to the polarizer. If it is necessary to move the LCD module from an area of lower ambient temperature to a higher one, it is required to let it normalize to the new ambient temperature before unpacking or use.
- (8) Touching the display area or the terminal pins with bare hands or contaminating them should be avoided. In our experience, staining on the display area and poor insulation between terminals are often caused by being touched with bare hands. (Some cosmetics are detrimental to polarizers.)
- (9) As the display is made of glass, it is possible to break under shock loads, especially the periphery can be easily cracked or chipped in handling. Please handle the module with care and prevent it from being dropped.
- (10) Never bend nor scratch the interface part. These actions can cause poor electrical contact.
- (11) Since the top and bottom areas of bent FPC tend to be easily damaged, be very careful not to push or hold in those areas.
- (12) Be careful not to apply local stress to the back of the LCD module. This will potentially cause scratching to the backlight guide, or result in a non-uniformity issue. Pay extra attention to the interface connector portion at the time of connector insertion.
- (13) Never hold the LCD module by the FPC when handling.
- (14) Please insert the FPC into the connector first, keeping the FPC parallel to the connector's opening. Be sure to lock the connector before securing the module.

12.4 OPERATION PRECAUTION

- (1) Noise spikes can cause a malfunction of the circuit. Recommended condition of spike noise level is: $V_{cc} = \pm 200 \text{ mV}$ (over and under shoot voltage).
- (2) Response time depends on temperature (at a lower temperature, it becomes longer). Brightness and color are also temperature dependant.
- (3) Be aware of the possibility of condensation under a sudden temperature change. Formation of dewdrops can cause damage to polarizer or electrical contacts and result inferior displaying or malfunction. And even after the condensation has dispersed, smears or spots may occur on the display surface.
- (4) When a fixed pattern is displayed for a long period, afterimage is likely to occur.
- (5) As the LCD module provides a high frequency circuit, sufficient countermeasures against electromagnetic noise, such as shielding, may be required.
- (6) Do not connect nor disconnect the module to or from main system with power applied.
- (7) Provide light shielding so that the driver is not exposed to light. Exposure to strong light may cause malfunction of the driver.

12.5 STORAGE

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When storing the LCD modules as spare parts, the following precautions are necessary.

- (1) Store the LCD modules in a dark place; do not expose them to sunlight or fluorescent light. Keep the temperature between 10 and 30°C, and the humidity between 55% and 75%RH.
- (2) The polarizer surface should not come in contact with any other object. It is recommended that the LCD modules are stored in the container in which they were shipped.

12.6 SAFETY

This LCD module is a glass product. In case of damage, ensure operators wear a pair of protective gloves whilst handling it. Additionally, if any liquid (liquid crystal) accidentally comes into contact with skin, immediately wash it off with soap and water.

12.7 MECHANICAL DESIGN

- (1) The design of the HMD case and other components for this LCD module should be well studied so that any shock will not be transferred to the LCD module. When the HMD is dropped and the case provides insufficient shock absorption, the LCD module may become damaged.
- (2) Providing a cushion material (e.g. PORON) in the case will help to reduce shock load transfer to the LCD driver.
- (3) To prevent foreign substances from entering the display area, please apply a polyurethane foam cushion (e.g. PORON) around the LCD.

12.8 ENVIRONMENTAL PROTECTION

- (1) Abide by national laws, legislation and local regulations when disposing of this LCD module.
- (2) This LCD module complies with RoHS Directive.

12.9 Caution for sunlight and /or high intensity light

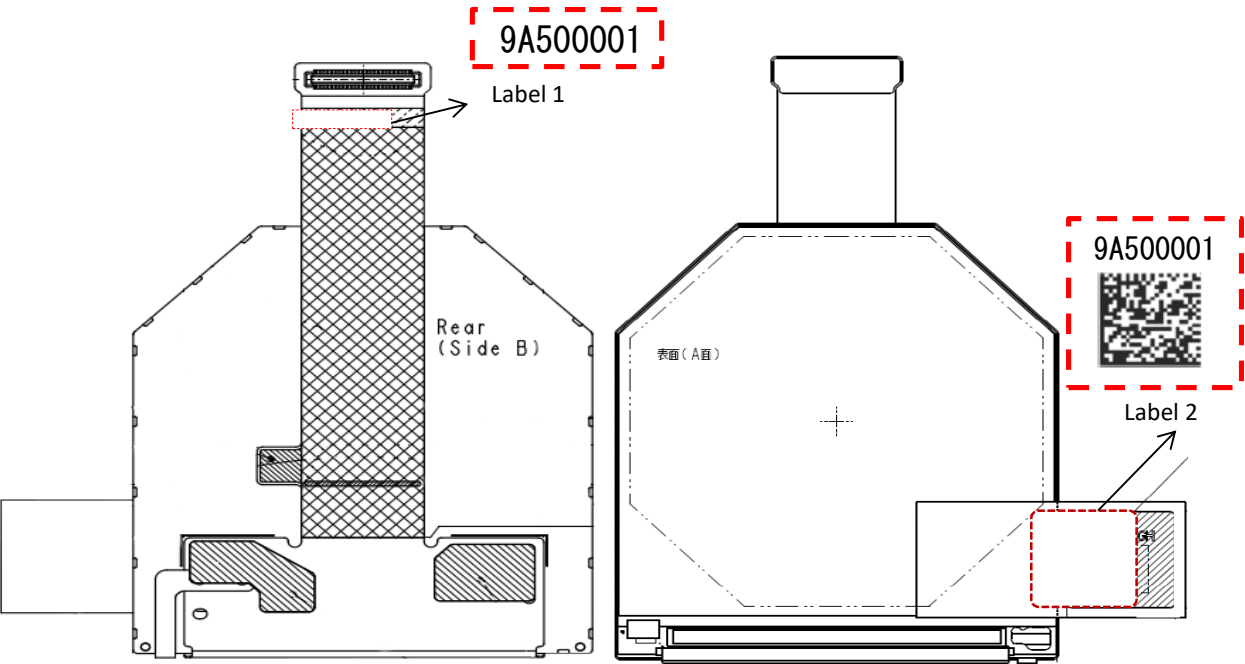
For the product that use lens such as VR head set, the lens portion should not be exposed under sunlight and /or high intensity light.

It may cause damage for LCD surface by focused light.

13. LOT MARK

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Lot mark is printed on the LCD module.



9 A 500001
① ② ③

- ① : Manufacturing date (Year)
- ② : Manufacturing date (Month)
- ③ : JDI Serial No.

① : Manufacturing date (Year)

Year	Figure in lot mark
2019	9
2020	0
2021	1
2022	2

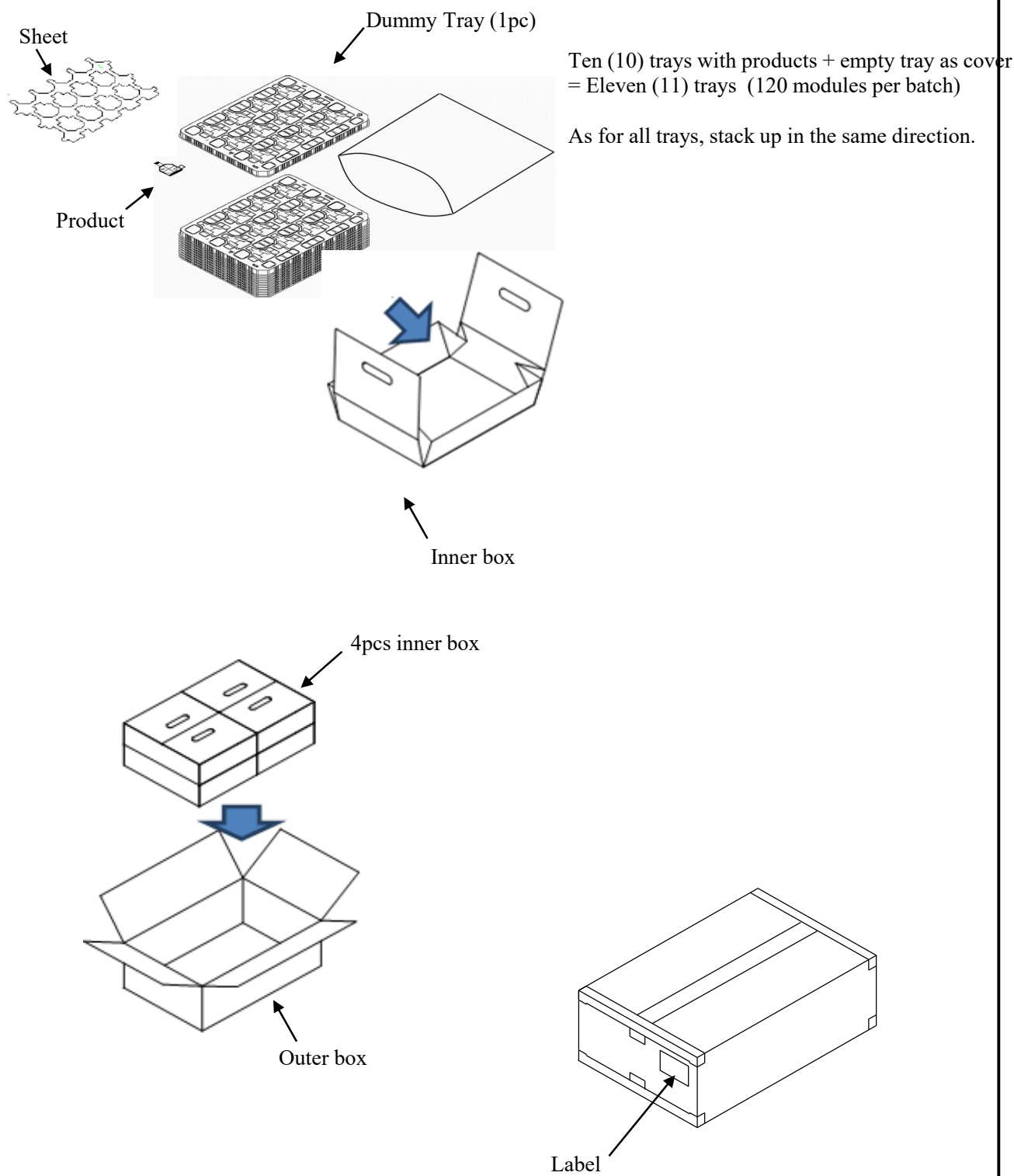
② : Manufacturing date (Month)

Month	Figure in lot mark	Month	Figure in lot mark
Jan.	1	Jul.	7
Feb.	2	Aug.	8
Mar.	3	Sep.	9
Apr.	4	Oct.	A
May	5	Nov.	B
Jun.	6	Dec.	C

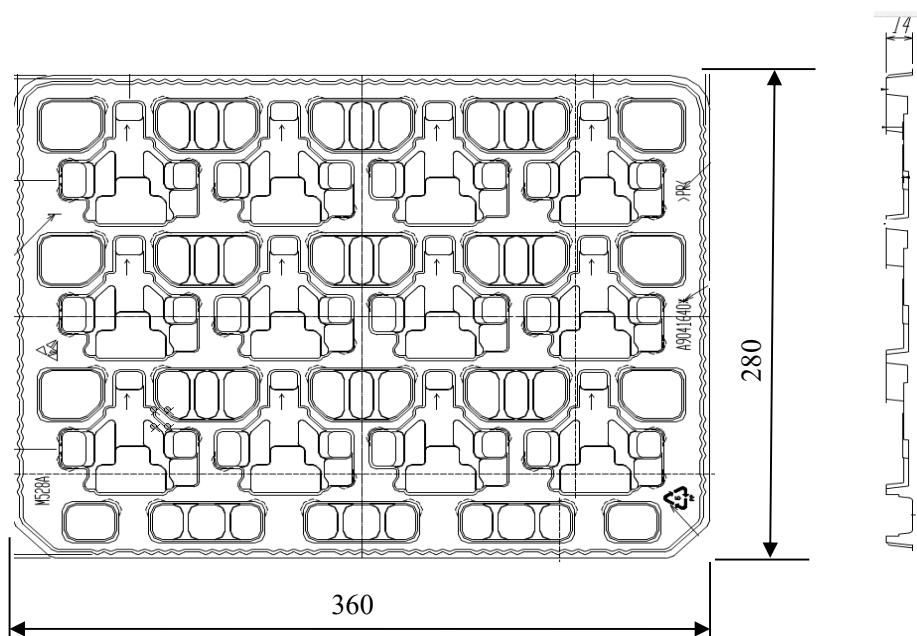
③ : JDI Serial No.

14. PACKING SPECIFICATIONS

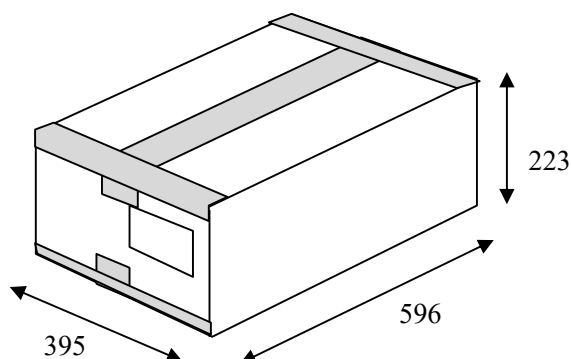
14.1 NANOX INNER BOX SPECIFICATIONS



Size of Tray

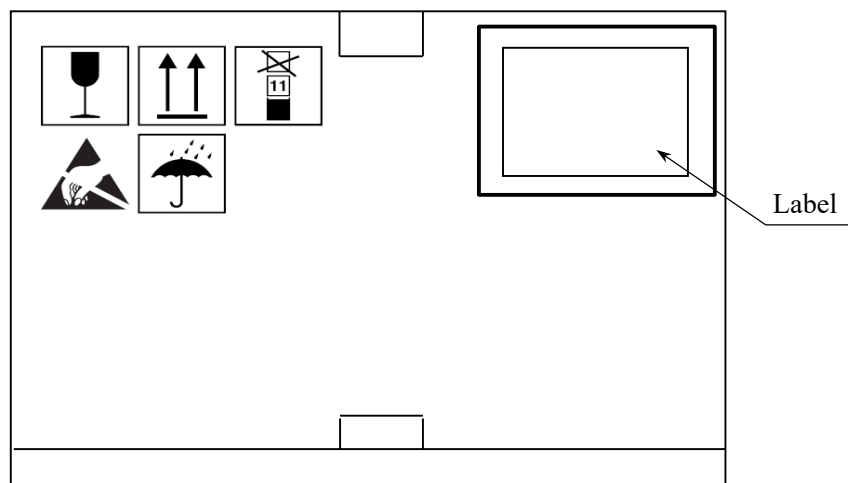


Size (L, W, H)	360 × 280 × 14 mm
Quantity	Max 12 pcs



Size (L, W, H)	395 × 596 × 223 mm
Quantity	1 to 480 pcs

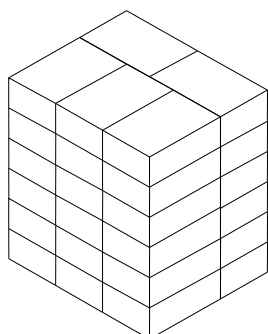
Marking on Outer Box (Example)



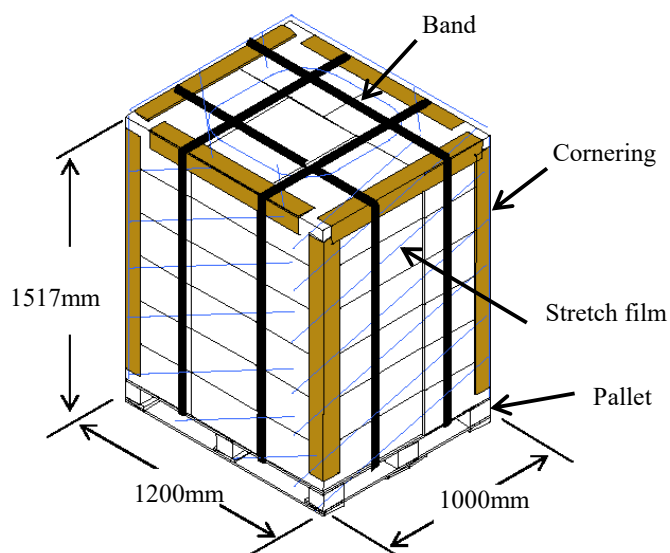
14.2 PALLET SPECIFICATIONS

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Stacking pattern of outer box



5 boxes × 6 stacking



Weight (gross)	TBD kg when the quantity is 9600 pcs
BOX quantity	30boxes (5 x 6)
Size (L, W, H)	1200×1000×1517mm
Quantity	Max 9600 pcs

14.3 LABEL DETAILED EXAMPLE



1	Product code
2	Product name
3	Date code (yy-mm-dd-0000)
4	Quantity
5	Country of production

13. PRECAUTIONS FOR USE

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- (1) A limit sample shall be provided by both parties when both parties agree to its necessity.
Judgment by limit sample shall take effect after the limit sample has been established and confirmed by both parties.
- (2) Under the following situations, handling of the problem should be decided through immediate discussion and agreement between responsible people of both parties.
 - a) When a question arises concerning the specifications.
 - b) When a new item which is not mentioned in the specification occurs.
 - c) When the customer changes any item of inspection specification or operating condition and reports it to Japan Display, and an issue with the specification arises because of this change.
 - d) When a new issue is found with the customer's operating set for sample evaluation.
- (3) All the specifications in this document become effective immediately after approval signatures of both parties are in place.

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