MODEL NO : TM213XDGP04

MODEL VERSION: 00

SPEC VERSION : V1.0

ISSUED DATE: 2020-11-11

Document number: PDB-工业 1-20-C-084

■**Preliminary Specification**

□**Final Product Specification**

Customer :_____

Approved by	Notes

TIANMA Confirmed :

Prepared by	Checked by	Approved by
Zhou Wenbo 2020.11.11	Zhu Guanchen 2020.11.11	Zhu Guanchen 2020.11.11

This technical specification is subjected to change without notice

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Record of Revision

Rev	Issued Date	Description	Editor
1.0	2020-11-11	Preliminary Specification Released.	Zhou Wenbo

1 General Specifications

Feature		Spec
Display Spec.	Size (inch)	21.3
	Resolution	1200(RGB)*1600
	Technology Type	SFT
	Pixel Configuration	RGB vertical stripe
	Pixel Pitch (mm)	0.27072 x 0.27072
	Display Mode	Transmissive, Normally Black
	Polarizer pencil-hardness	3H (min.) [by JIS K5600]
	Surface Treatment (Up Polarizer)	Antiglare
Optical Characteristics	Luminance (cd/m2)	900 Typ.
	Contrast ratio	(2000:1) Typ.
	Response time Ton+Toff (ms)	(35) Typ.
	Viewing angle R/L/U/D (Degree)	89/89/89/89 Typ. At the contrast ratio ≥ 10:1
Mechanical Characteristics	LCM (W x H x D) (mm)	336x 453 x TBD Typ.
	Active Area (mm)	324.864 x 433.152
	With /Without TSP	Without TSP
	Weight (g)	TBD Typ.
	Backlight LED replacement	Not Available
Electrical Characteristics	Interface	2port LVDS, 8bit
	Power supply voltage (V)	LCD panel: 12.0V Typ.
		Backlight: 24.0V Typ.
	Color Depth	16.7M
	Backlight LED driver	Build in.
	Power consumption (W)	(48.6)W (typ.) At checkered flag pattern, the maximum luminance control

Note 1 : Requirements on Environmental Protection: Q/S0002

Note 2 : LCM weight max. tolerance : +10%

2 Input/Output Terminals

2.1 TFT LCD Panel

CN1 socket (LCD module side): FI-RE41S-HF (Japan Aviation Electronics Industry Limited (JAE))
Adaptable plug: FI-RE41HL (Japan Aviation Electronics Industry Limited (JAE))

Pin No.	Symbol	Signal	Remarks
1	GND	Ground	Note1
2	DA0-	Pixel data A0	Odd pixel data input (LVDS DIFFERENTIAL DATA) Note2
3	DA0+		
4	GND	Ground	Note1
5	DA1-	Pixel data A1	Odd pixel data input (LVDS DIFFERENTIAL DATA) Note2
6	DA1+		
7	GND	Ground	Note1
8	DA2-	Pixel data A2	Odd pixel data input (LVDS DIFFERENTIAL DATA) Note2
9	DA2+		
10	GND	Ground	Note1
11	CKA-	Pixel clock	Odd pixel clock input (LVDS DIFFERENTIAL DATA) Note2
12	CKA+		
13	GND	Ground	Note1
14	DA3-	Pixel data A3	Odd pixel data input (LVDS DIFFERENTIAL DATA) Note2
15	DA3+		
16	GND	Ground	Note1
17	DB0-	Pixel data B0	Even pixel data input (LVDS DIFFERENTIAL DATA) Note2
18	DB0+		
19	GND	Ground	Note1
20	DB1-	Pixel data B1	Even pixel data input (LVDS DIFFERENTIAL DATA) Note2
21	DB1+		
22	GND	Ground	Note1
23	DB2-	Pixel data B2	Even pixel data input (LVDS DIFFERENTIAL DATA) Note2
24	DB2+		
25	GND	Ground	Note1
26	CKB-	Pixel clock	Even pixel clock input (LVDS DIFFERENTIAL DATA) Note2
27	CKB+		
28	GND	Ground	Note1
29	DB3-	Pixel data B3	Even pixel data input (LVDS DIFFERENTIAL DATA) Note2
30	DB3+		
31	GND	Ground	Note1
32	NA	NA	NA
33	RSVD	For internal use	
34	NA	NA	NA
35	VDD	Power supply	Note1
36	VDD		
37	VDD		
38	VDD		
39	VDD		
40	GND	Ground	Note1
41	GND	Ground	Note1

Note1: All GND and VCC terminals should be used without any non-connected lines.
Note2: Twist pair wires with 100Ω (Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.

2.2 Backlight

CN201 socket (LCD module side): DF3EA-10P-2H(21) (HIROSE ELECTRIC Co., Ltd.)
Adaptable plug: DF3-10S-2C (HIROSE ELECTRIC Co., Ltd.)

Pin No.	Symbol	Function	Description
1	GNDB	LED driver ground	Note1
2	GNDB		
3	GNDB		
4	GNDB		
5	GNDB		
6	VDDB	Power supply	Note1
7	VDDB		
8	VDDB		
9	VDDB		
10	VDDB		

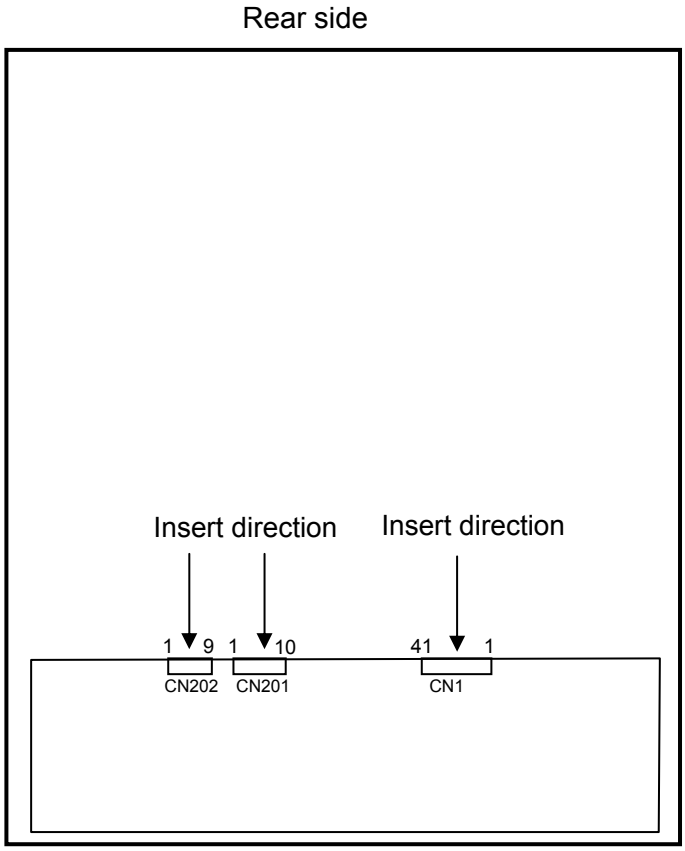
Note1: All VDDB and GNDB terminals should be used without any non-connected lines.

CN202 socket (LCD module side): 53261-0971 (MOLEX Inc.)
Adaptable plug: 51021-0900 (MOLEX Inc.)

Pin No.	Symbol	Function	Description
1	PWSEL	Selection of luminance control signal method	Note1, Note2
2	GNDB	LED driver ground	Note3
3	BRTP	BRTP signal	Note1
4	BRTI	Luminance control terminal	
5	BRTH		
6	BRTC	Backlight ON/OFF control signal	High or Open: Backlight ON Low: Backlight OFF
7	N. C.	-	Keep this pin Open.
8	GNDB	LED driver ground	Note3
9	GNDB		

Note1: See "**5.3 LUMINANCE CONTROL** ".
Note2: When VDDB is 0V or BRTC is Low, PWSEL must be set to Low or Open.
Note3: All GNDB terminals should be used without any non-connected lines.

2.3 Positions of Socket



3 Absolute Maximum Ratings

Parameter			Symbol	Rating	Unit	Remarks
Power supply voltage	LCD panel signal processing board		VDD	-0.3 to +15.0	V	Ta= 25°C
	LED driver		VDDB	-0.3 to +28.0	V	
Input voltage for signals	LCD panel signal processing board Note1		Vi	-0.3 to +2.8	V	VDD= 12.0V Ta= 25°C
	LED driver	BRTI signal	VBI	-0.3 to +1.5	V	VDDB= 24.0V Ta= 25°C
		BRTP signal	VBP	-0.3 to +5.5	V	
		BRTC signal	VBC	-0.3 to +5.5	V	
		PWSEL signal	VBS	-0.3 to +5.5	V	
Storage temperature			Tst	-20 to +60	°C	-
Operating temperature		Center of front surface	TopF	0 to +60	°C	Note2
		Edge of front surface	TopF	0 to +65	°C	Note2
		Edge of rear surface	TopR	0 to +70	°C	Note3
Relative humidity Note4, Note6			RH	≤ 95	%	Ta ≤ 40°C
				≤ 85	%	40°C < Ta ≤ 50°C
				≤ 55	%	50°C < Ta ≤ 60°C
Absolute humidity Note4, Note6			AH	≤ 70 Note5	g/m^3	Ta > 60°C
Operating altitude			-	≤ 5,100	m	0°C ≤ Ta ≤ 60°C
Storage altitude			-	≤ 13,600	m	-20°C ≤ Ta ≤ 60°C

Note1: DA0+/-, DA1+/-, DA2+/-, DA3+/-, CKA+/-, DB0+/-, DB1+/-, DB2+/-, DB4+/-, CKB+/-,
Note2: Measured at LCD panel surface (including self-heat)
Note3: Measured at LCD module's rear shield surface (including self-heat)
Note4: No condensation
Note5: Water amount at Ta= 60°C and RH= 55%
Note6: Rapid change of humidity and temperature may cause degradation of the image quality.

4 Mechanical Characteristics

Parameter	Specification	Unit
Module size	336.0 ±0.5 (W) × 453.0 ±0.5 (H) × TBD (D) Note1	mm
Weight	TBD. (typ.), TBD, (max.)	g

Note1: See " **9 Mechanical Drawing** ".

5 Electrical Characteristics

5.1 Driving TFT LCD Panel

(Ta= 25°C)

Parameter		Symbol	min.	typ.	max.	Unit	Remarks
Power supply voltage		VDD	10.8	12.0	13.2	V	-
Power supply current		IDD	-	(450) Note1	(600) Note2	mA	at VDD= 12.0V
Permissible ripple voltage		VRP	-	-	200	mVp-p	for VDD Note3,4,5
Differential input threshold voltage	High	VTH	-	-	+100	mV	at VCM= 1.2V Note6,7
	Low	VTL	-100	-	-	mV	
Input voltage swing		VI	（0）	-	（2.4）	V	Note7
Terminating resistance		RT	-	(100)	-	Ω	-

Note1: Checkered flag pattern [by IEC 61747-6]
Note2: Pattern for maximum current
Note3: This product works even if the ripple voltage levels are over the permissible values, but there might be noise on the display image.
Note4: The permissible ripple voltage includes spike noise.
Note5: The load variation influence does not include.
Note6: Common mode voltage for LVDS driver
Note7: DA0+/-, DA1+/-, DA2+/-, DA3+/-, CKA+/-, DB0+/-, DB1+/-, DB2+/-, DB3+/-, CKB+/-,

5.2 Driving Backlight

Ta= 25°C)

Parameter			Symbol	min.	typ.	max.	Unit	Remarks
Power supply voltage			VDDB	22.8	24.0	25.2	V	Note1
Power supply current			IDDB	-	(1800)	(2040) Note2	mA	VDDB= 24.0V, At the maximum luminance control
Permissible ripple voltage			VRPB	-	-	200	mVp-p	for VDDB Note3, 4, 5
Input voltage for signals	BRTI signal		VBI	0	-	1.0	V	-
	BRTP signal	High	VBPH	2.0	-	5.25	V	
		Low	VBPL	0	-	0.8	V	
	BRTC signal	High	VBCH	2.0	-	5.25	V	
		Low	VBCL	0	-	0.8	V	
	PWSEL signal	High	VBSH	2.0	-	5.25	V	
		Low	VBSL	0	-	0.8	V	
Input current for signals	BRTI signal		IBI	(-200)	-	(-50)		
	BRTP signal	High	IBPH	-	-	(1,000)		
		Low	IBPL	(-600)	-	-		
	BRTC signal	High	IBCH	-	-	(300)		
		Low	IBCL	(-300)	-	-		
	PWSEL signal	High	IPSH	-	-	(1,000)		
		Low	IPSL	(-600)	-	-		
LED life time			Hr		(50000)		hour	Note 6

Note1: When designing of the power supply, take the measures for prevention of surge voltage.
Note2: This value excludes peak current such as overshoot current.
Note3: This product works even if the ripple voltage levels are over the permissible values, but there might be noise on the display image.
Note4: The permissible ripple voltage includes spike noise.
Note5: The power supply lines (VDDB and GNDB) may have ripple voltage during luminance control of LED. There is the possibility that the ripple voltage produces acoustic noise and signal wave noise in audio circuit and so on.
Note6: Optical performance should be evaluated at Ta=25℃.Only If LED is driven by high current, high ambient temperature & humidity condition. The life time of LED will be reduced. Operating life means brightness goes down to 50% of initial brightness. Typical operating life time is an estimated data.

5.3Luminance Control

5.3.1 Luminance control methods

(Ta= 25°C)

<table>
<tr><th>Method</th><th>Adjustment and luminance ratio</th><th>PWSEL terminal</th><th>BRTP terminal</th></tr>
<tr><td>Variable resistor control

Note1</td><td>• Adjustment
The variable resistor (R) for luminance control should be 10kΩ ±5%, 1/10W. Minimum point of the resistance is the minimum luminance and maximum point of the resistance is the maximum luminance.
The resistor (R) must be connected between BRTH-BRTI terminals.
 
• Luminance ratio Note3
<table><tr><th>Resistance</th><th>Luminance ratio</th></tr><tr><td>TBDΩ</td><td>10% (typ.)</td></tr><tr><td>10kΩ</td><td>100%</td></tr></table></td><td rowspan="2">High or Open</td><td rowspan="2">Open</td></tr>
<tr><td>Voltage control

Note1</td><td>• Adjustment
Voltage control method works, when BRTH terminal is 0V and VBI voltage is input between BRTI-BRTH terminals. This control method can carry out continuation adjustment of luminance. Luminance is the maximum when BRTI terminal is Open.
• Luminance ratio Note3
<table><tr><th>BRTI Voltage (VBI)</th><th>Luminance ratio</th></tr><tr><td>TBDV</td><td>10% (typ.)</td></tr><tr><td>1.0V</td><td>100%</td></tr></table></td></tr>
<tr><td>Pulse width modulation (PWM)

Note1
Note2
Note4</td><td>• Adjustment
Pulse width modulation (PWM) method works, when PWSEL terminal is Low and PWM signal (BRTP signal) is input into BRTP terminal. The luminance is controlled by duty ratio of BRTP signal. Keep BRTI and BRTH terminals Open when using PWM method.
• Luminance ratio Note3
<table><tr><th>Duty ratio</th><th>Luminance ratio</th></tr><tr><td>0.21</td><td>21% (typ.)</td></tr><tr><td>1.0</td><td>100%</td></tr></table></td><td>Low</td><td>BRTP signal</td></tr>
</table>

Note1: In case of the variable resistor control method and the voltage control method, noises may appear on the display image depending on the input signals timing for LCD panel signal processing board.
Use Pulse width modulation (PWM) method, if interference noises appear on the display image!

Note2: The LED driver will stop working, if the Low period of BRTP signal is more than 50ms while BRTC signal is High or Open. Then the backlight will not turn on anymore, even if BRTP signal is input again. This is not out of order. The LED driver will start to work when power is supplied again.

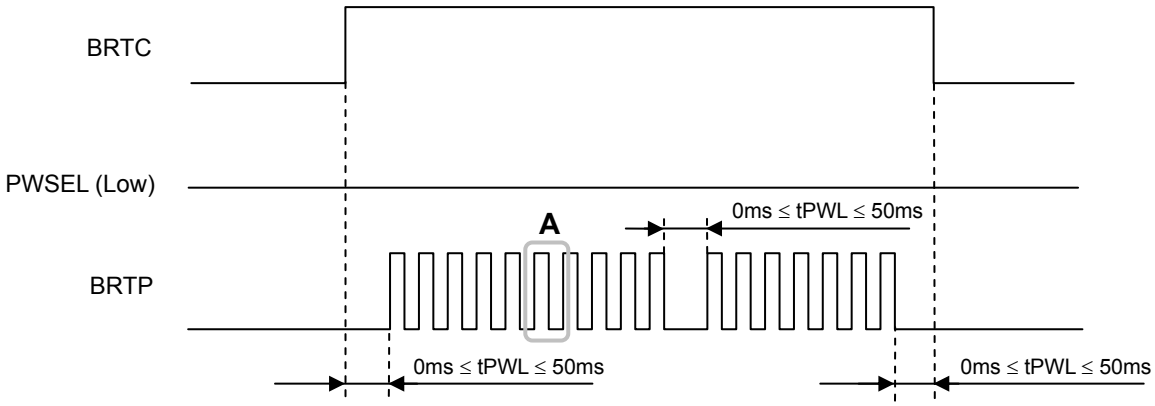
Note3: These data are the target values.

Note4: See "5**.3.2 Detail of BRTP timing**".

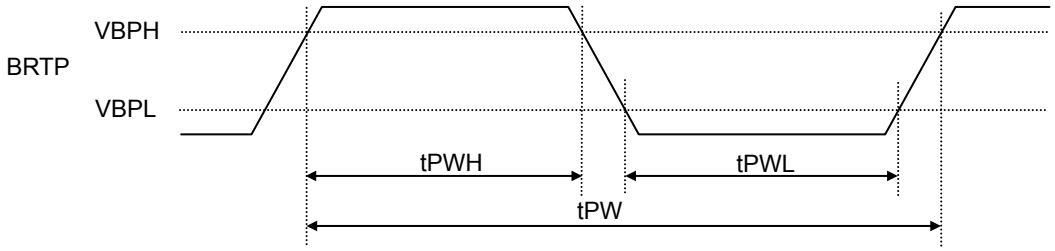
5.3.2 Detail of BRTP timing

(1) Timing diagrams

- Outline chart



- Detail of **A** part



(2) Each parameter

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
PWM frequency	f_{PWM}	(185)	-	(20k)	Hz	Note1,2,3
PWM duty ratio	DR_{PWM}	(21)	-	100	%	Note4,5
PWM pulse width	tPWH	(10)	-	-	μs	Note1,4,5

Note1: Definition of parameters is as follows.

$$f_{PWM} = \frac{1}{tPW} \quad , DR_{PWM} = \frac{tPWH}{tPW}$$

Note2: A recommended f_{PWM} value is as follows.

$$f_{PWM} = \frac{2n-1}{4} \times fv$$

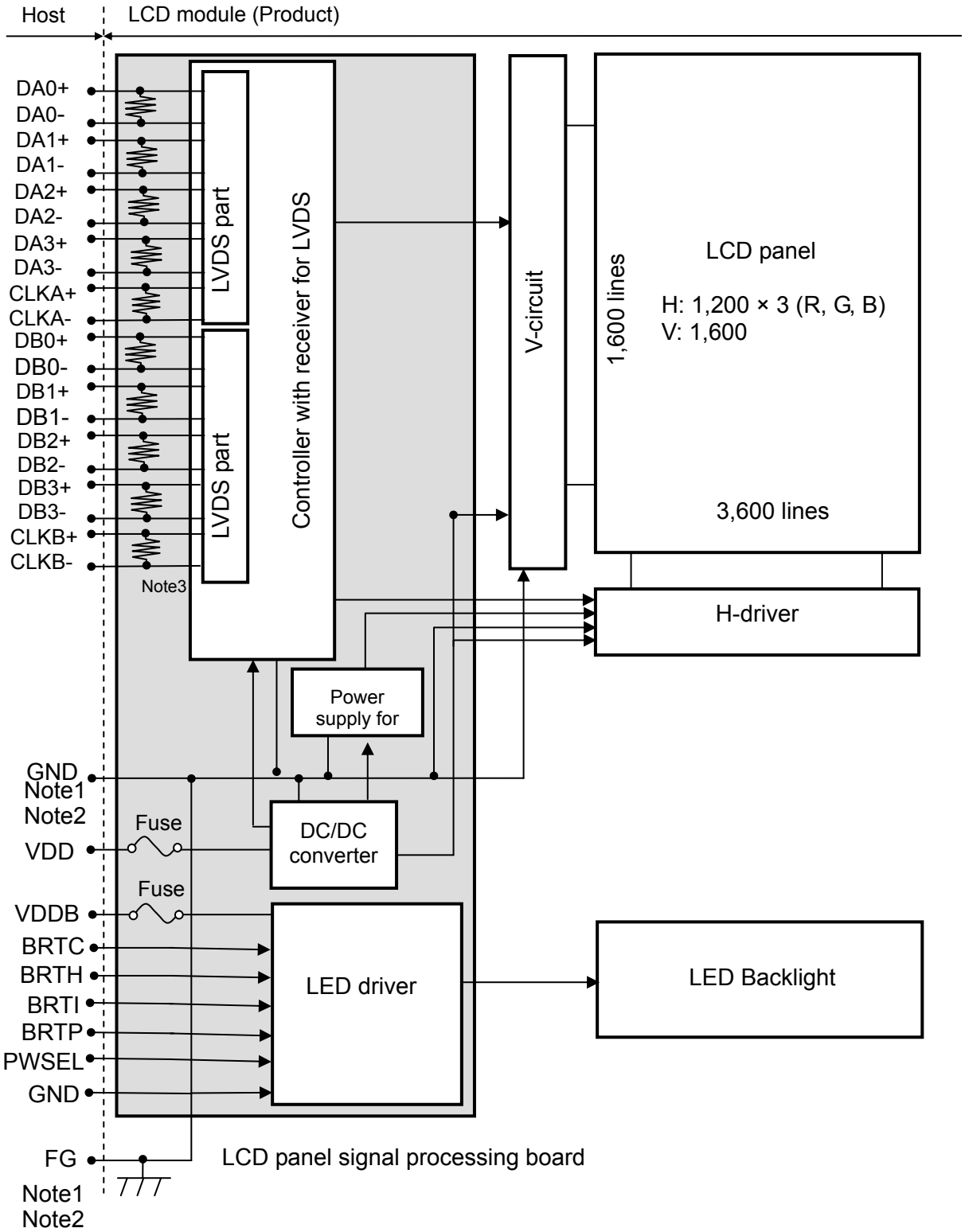
(n= integer, fv= frame frequency of LCD module)

Note3: Depending on the frequency used, a noise may appear on the screen, please conduct a thorough evaluation.

Note4: While the BRTC signal is high, do not set the tPWH (PWM pulse width) is less than the minimum values. It may cause abnormal working of the backlight. In this case, turn the backlight off and then on again by BRTC signal.

Note5: Regardless of the PWM frequency, both PWM duty ratio and PWM pulse width must be always more than the minimum values.

5.4 Block Diagram



Note1: Relations between GND (Signal ground), FG (Frame ground) and GNDB (LED driver ground) in the LCD module are as follows.

GND - FG	Connected
GND - GNDB	Not connected
FG - GNDB	Not connected

Note2: GND, FG and GNDB must be connected to customer equipment's ground, and it is recommended that these grounds to be connected together in customer equipment.

Note3: Each pair of the LVDS signal lines has 100Ω terminating resistance.

5.6 Fuse

Parameter	Fuse		Rating	Fusing current	Remarks
	Type	Supplier			
VDD	T.B.D	T.B.D	T.B.D.A	T.B.D.A	Note1
			T.B.D.V		
VDDB	T.B.D.	T.B.D.	T.B.D.A	T.B.D.A	
			T.B.D V		

Note1: The power supply's rated current must be more than the fusing current. If it is less than the fusing current, the fuse may not blow in a short time, and then nasty smell, smoke and so on may occur.

6 Timing Chart

6.1 Timing Characteristics

(Note1, Note2, Note3，Note4)

Parameter			Symbol	min.	typ.	max.	Unit	Remarks
CLK	Frequency		1/ tc	TBD	（73.5）	TBD	MHz	
	Duty ratio		-	See the data sheet of LVDS transmitter.			-	-
	Rise time, Fall time		-				ns	-
DATA	CLK-DATA	Setup time	-				ns	-
		Hold time	-				ns	-
	Rise time, Fall time		-				ns	-
DE	Horizontal	Cycle	th	-	（9.54）	-	μs	
				TBD	（700）	TBD	CLK	
		Display period	thd	600			CLK	-
	Vertical (One frame)	Cycle	tv	-	（16.7）	-	ms	60.0Hz (typ.)
				TBD	（1750）	TBD	H	
		Display period	tvd	1600			H	-
	CLK-DE	Setup time	-	See the data sheet of LVDS transmitter.			ns	-
		Hold time	-				ns	-
	Rise time, Fall time		-				ns	-

Note1: Definition of parameters is as follows.

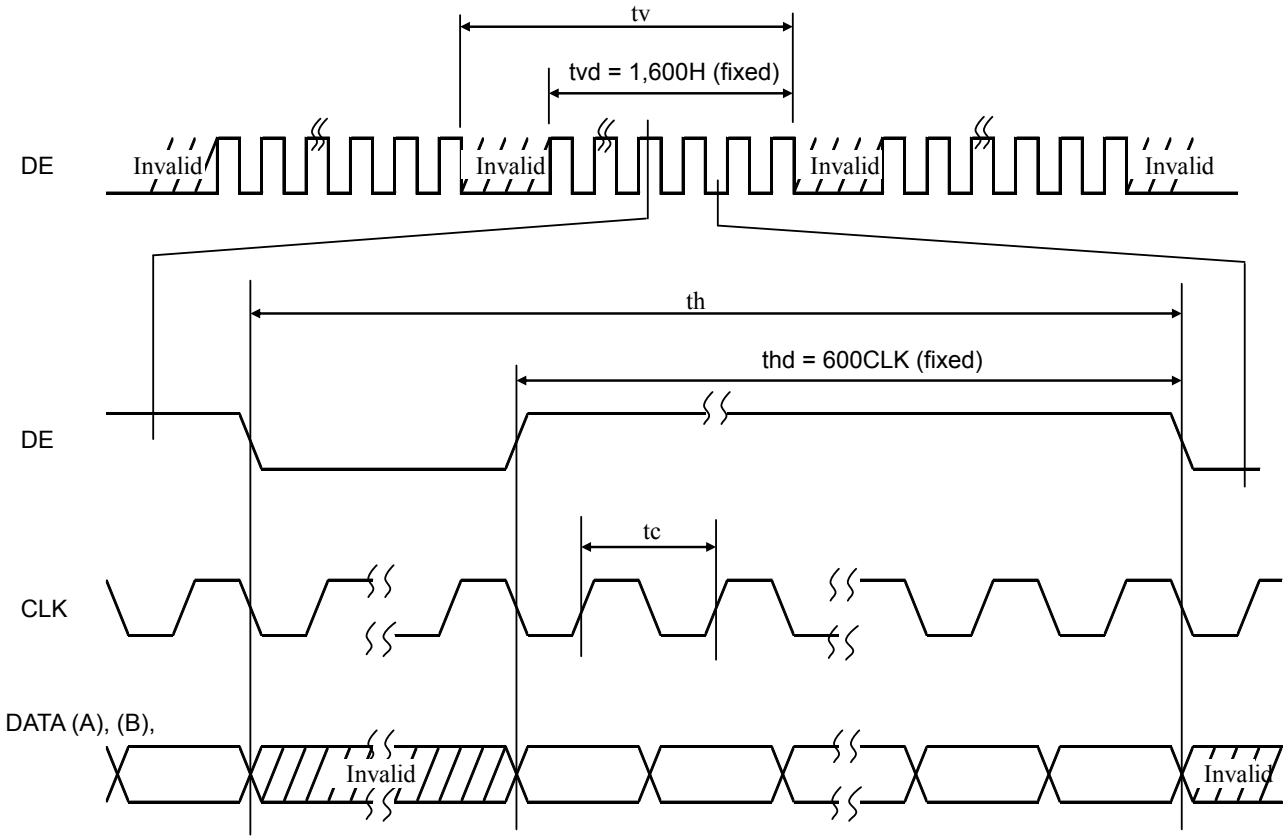
tc= 1CLK, th= 1H

Note2: See the data sheet of LVDS transmitter.

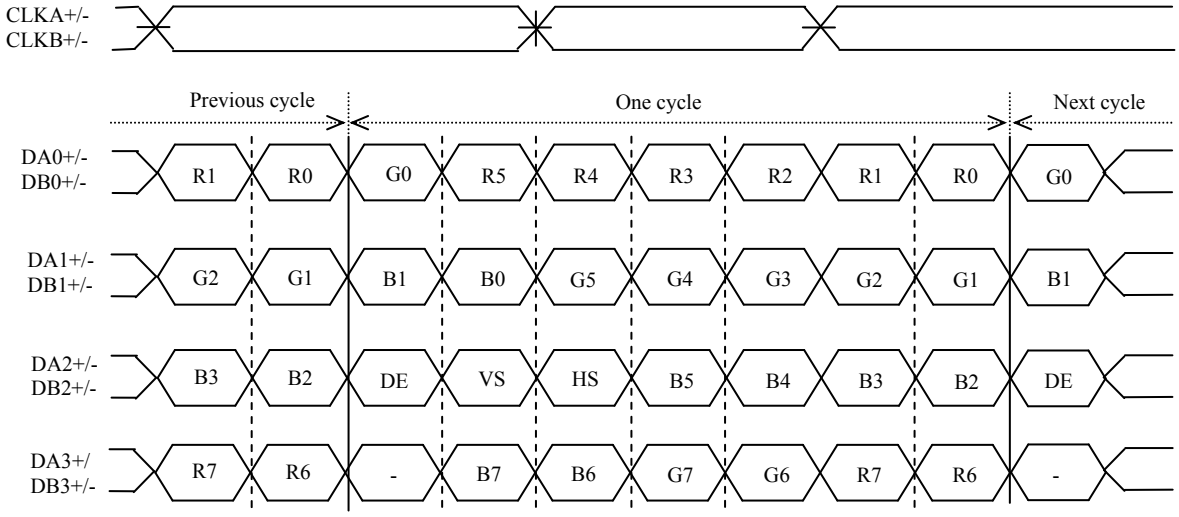
Note3: Vertical cycle (tv) should be specified in integral multiple of Horizontal cycle (th).

Note4：Definition for landscape

6.2 Input Signal Timing Chart

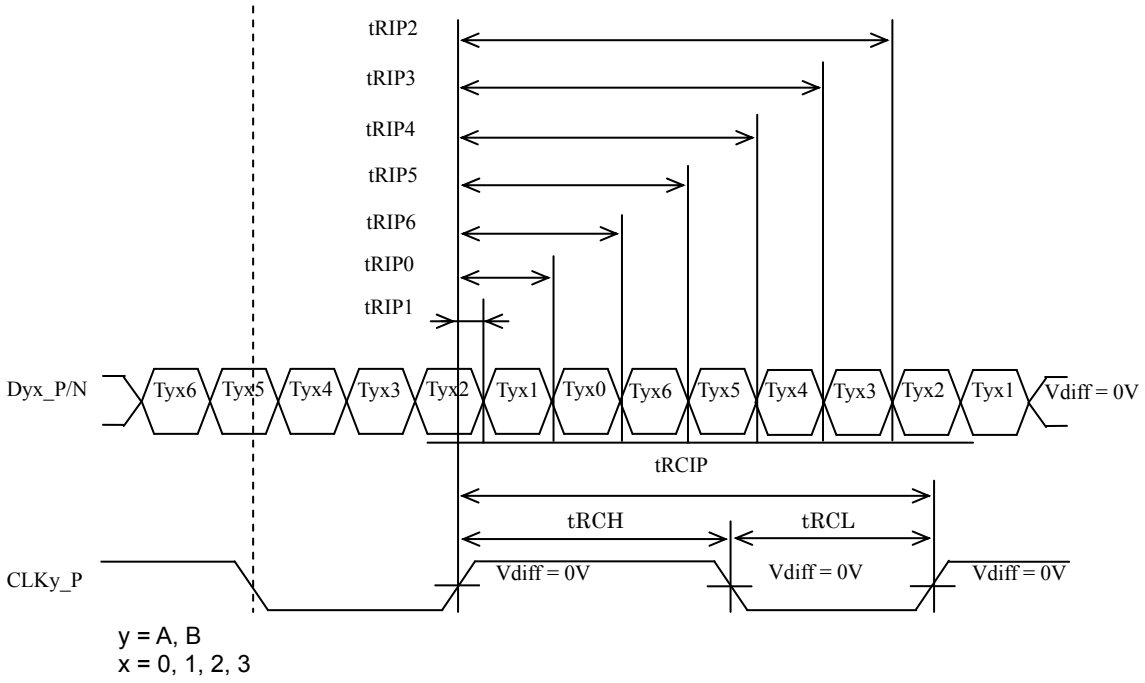


6.3 Input Data Mapping



6.4 LVDS Rx AC SPEC

Symbol	Parameter	min.	typ.	max.	Unit
t_{RCIP}	CKy_+ Period	TBD	-	TBD	ns
t_{RCIH}	CKy_+ High pulse width	-	$\frac{4}{7}t_{RCIP}$	-	ns
t_{RCIL}	CKy_+ Low pulse width	-	$\frac{3}{7}t_{RCIP}$	-	ns
t_{RMG}	Receiver Data Input Margin	TBD	-	TBD	ns
t_{RIP1}	Input Data Position 0	$-\lvert t_{RMG}\rvert$	0.0	$+\lvert t_{RMG}\rvert$	ns
t_{RIP0}	Input Data Position 1	$\frac{t_{RCIP}}{7}-\lvert t_{RMG}\rvert$	$\frac{t_{RCIP}}{7}$	$\frac{t_{RCIP}}{7}+\lvert t_{RMG}\rvert$	ns
t_{RIP6}	Input Data Position 2	$2\frac{t_{RCIP}}{7}-\lvert t_{RMG}\rvert$	$2\frac{t_{RCIP}}{7}$	$2\frac{t_{RCIP}}{7}+\lvert t_{RMG}\rvert$	ns
t_{RIP5}	Input Data Position 3	$3\frac{t_{RCIP}}{7}-\lvert t_{RMG}\rvert$	$3\frac{t_{RCIP}}{7}$	$3\frac{t_{RCIP}}{7}+\lvert t_{RMG}\rvert$	ns
t_{RIP4}	Input Data Position 4	$4\frac{t_{RCIP}}{7}-\lvert t_{RMG}\rvert$	$4\frac{t_{RCIP}}{7}$	$4\frac{t_{RCIP}}{7}+\lvert t_{RMG}\rvert$	ns
t_{RIP3}	Input Data Position 5	$5\frac{t_{RCIP}}{7}-\lvert t_{RMG}\rvert$	$5\frac{t_{RCIP}}{7}$	$5\frac{t_{RCIP}}{7}+\lvert t_{RMG}\rvert$	ns
t_{RIP2}	Input Data Position 6	$6\frac{t_{RCIP}}{7}-\lvert t_{RMG}\rvert$	$6\frac{t_{RCIP}}{7}$	$6\frac{t_{RCIP}}{7}+\lvert t_{RMG}\rvert$	ns



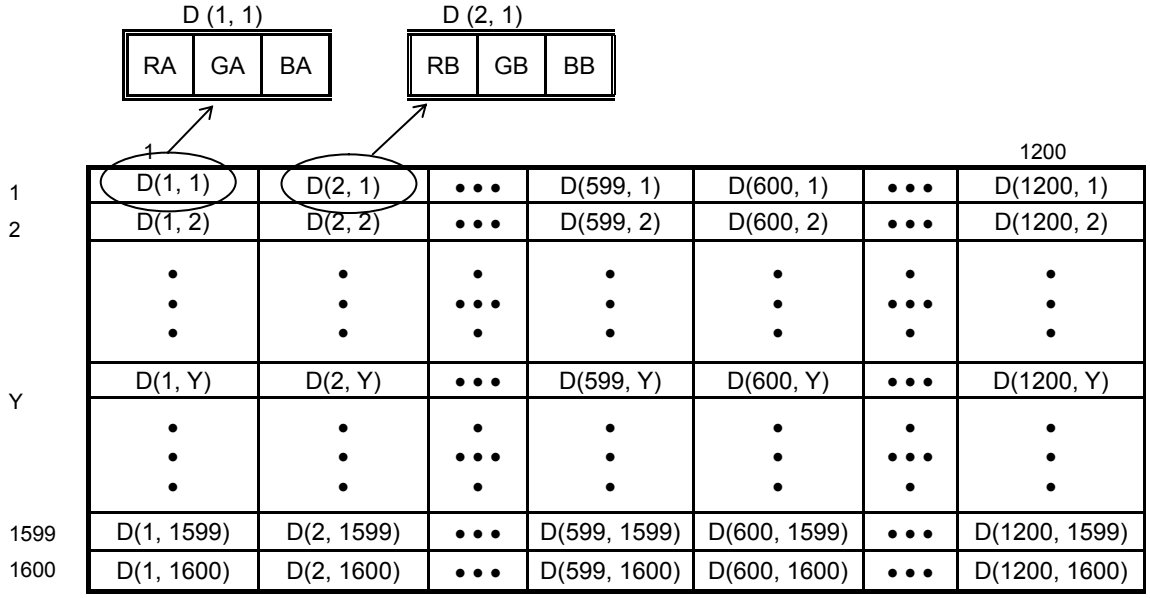
y = A, B
x = 0, 1, 2, 3

6.5 Display Colors and Input Data Signals

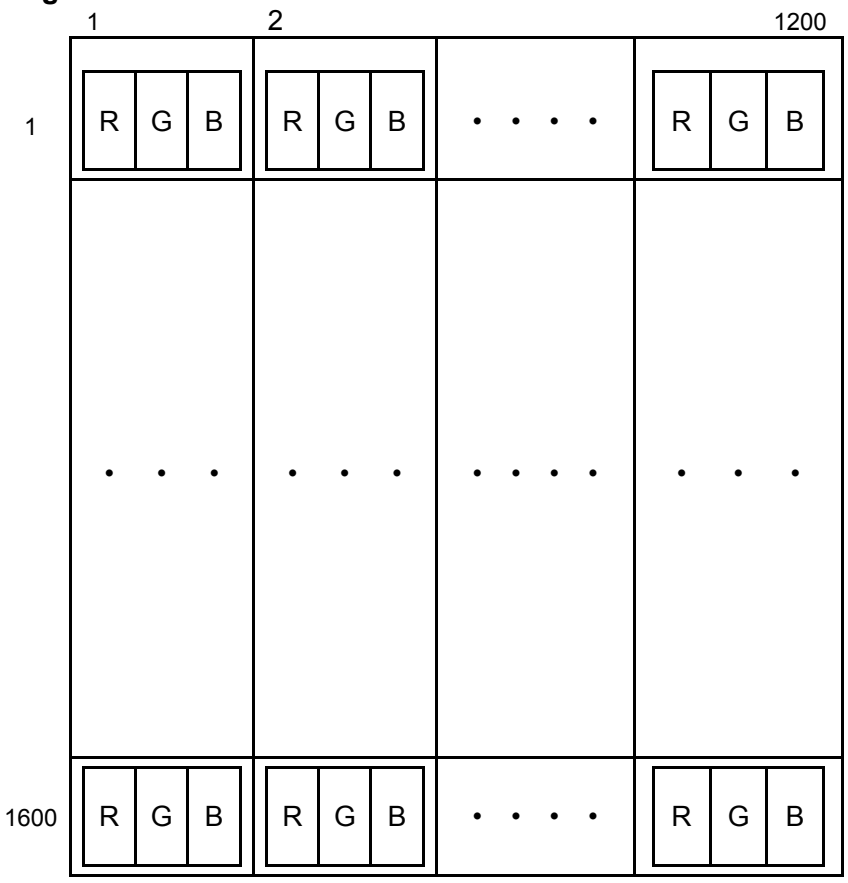
This product can display 256 gray scales in each RGB sub-pixel and 256 gray scales per 1 pixel. Also the relation between display gray scale and input data signals is as follows.

Display colors		Data signal (0: Low level, 1: High level)																									
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Red gray scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	dark	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑					:								:								:			
	↓					:								:								:			
	bright	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Green gray scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	↑					:								:								:			
	↓					:								:								:			
	bright	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Blue gray scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	↑					:								:								:			
	↓					:								:								:			
	bright	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

6.6 Display Positions



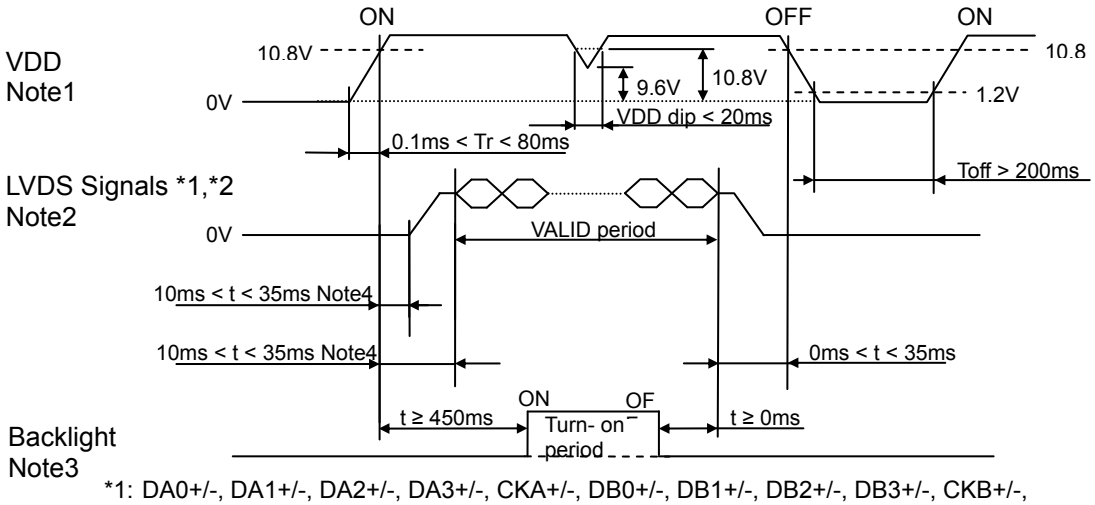
6.7 Scanning Direction



Note1：Definition for portrait

6.8 Power On/Off Sequence

6.7.1 LCD panel signal processing board



*1: DA0+/-, DA1+/-, DA2+/-, DA3+/-, CKA+/-, DB0+/-, DB1+/-, DB2+/-, DB3+/-, CKB+/-,

*2: LVDS signals should be measured at the terminal of 100 Ω resistance.

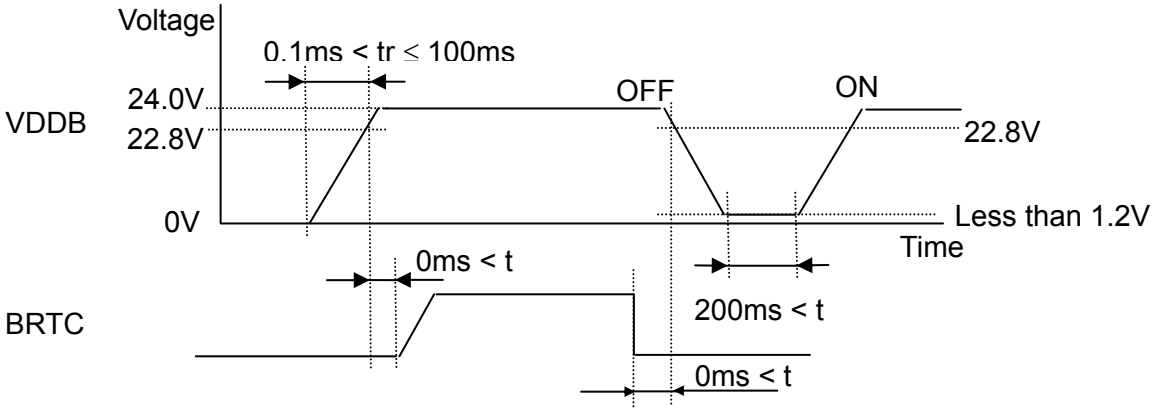
Note1: If there is a voltage variation (voltage drop) at the rising edge of VDD below 10.8V, there is a possibility that a product does not work due to a protection circuit.

Note2: LVDS signals must be set to Low or High-impedance, except the VALID period (See above sequence diagram), in order to avoid the circuitry damage. If some of signals are cut while this product is working, even if the signal input to it once again, it might not work normally. If a customer stops the display and function signals, VDD also must be shut down.

Note3: The backlight should be turned on within the turn-on period, in order to avoid unstable data display.

Note4: After turning VDD on, terminal voltages on LVDS input terminals (*1) will rise. This is caused by initial operation of the product.

6.7.2 LED Driver



Note1: If tr is more than 100ms, the backlight will be turned off by a protection circuit for LED driver.

Note2: When VDDB is 0V or BRTC is Low, PWSEL must be set to Low or Open.

7 Optical Characteristics

Ta=25℃

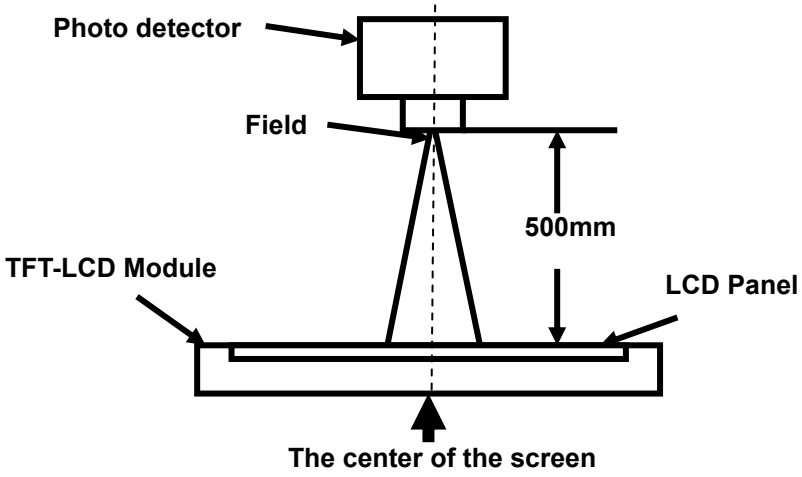
Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
View Angles		θT	CR≧10	70	89	-	Degree	Note 2
		θB		70	89	-		
		θL		70	89	-		
		θR		70	89	-		
Contrast Ratio		CR	θ=0°	(1400)	(2000)	-	-	Note1 Note3
Response Time		$T_{ON}+T_{OFF}$	25℃	-	(35)	(45)	ms	Note1 Note4
Chromaticity	White	x	Backlight is on	(0.264)	(0.314)	(0.364)	-	Note5 Note1
		y		(0.276)	(0.326)	(0.376)		
	Red	x		-	(0.680)	-		
		y		-	(0.307)	-		
	Green	x		-	(0.270)	-		
		y		-	(0.678)	-		
	Blue	x		-	(0.146)	-		
		y		-	(0.068)	-		
Uniformity		LU1	White（255/255gray）	(80)	-	-	%	Note1 Note6
		LU2	Gray（26/255gray）	-	-	20		
		LU3	Gray（204/255gray）	-	-	20		
NTSC		-	-	TBD	(93)	-	%	Note 5
Luminance		L	White（255/255gray）	TBD	(900)	-	cd/m^2	Note1 Note7

Test Conditions:

1. The ambient temperature is 25±2℃.humidity is 65±7%. PWM duty ratio is 100%.
2. The test systems refer to Note 1 and Note 2.
3. Contrast Ratio, Chromaticity, Uniformity, and Luminance is measured by SR-UL, SR-3AR or equivalent.
4. Response Time is measured by TRD-100, LCD-5200 or equivalent.

Note 1: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 20 minutes operation, the optical properties are measured at the center point of the LCD screen. All input terminals LCD panel must be ground when measuring the center area of the panel.



Note 2: Definition of viewing angle range and measurement system.

Viewing angle is measured at the center point of the LCD by LCD5200。

The 12 o'clock direction is upper side of outline in "**9 Mechanical Drawing**".

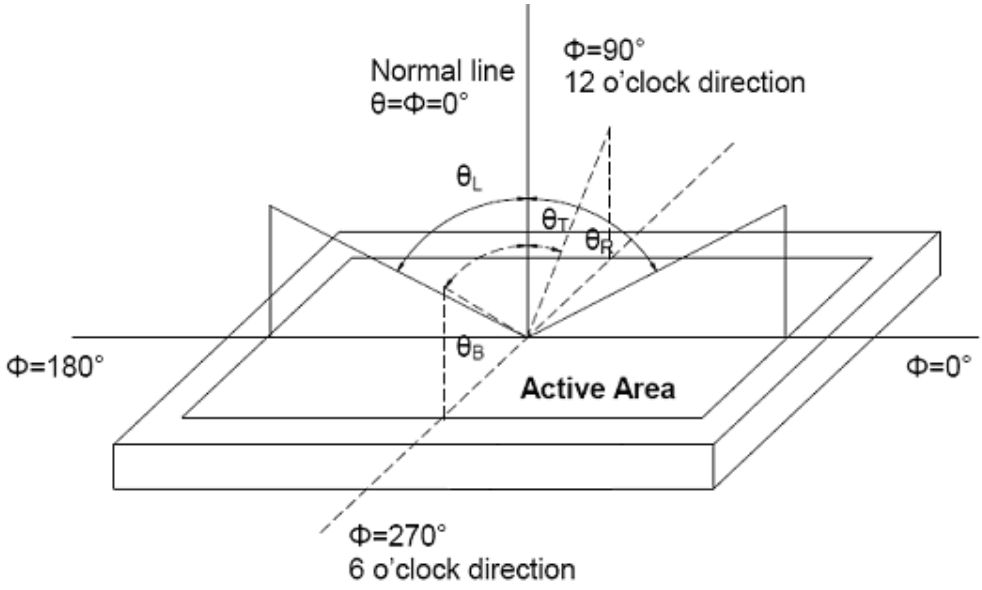


Fig. 1 Definition of viewing angle

Note 3: Definition of contrast ratio

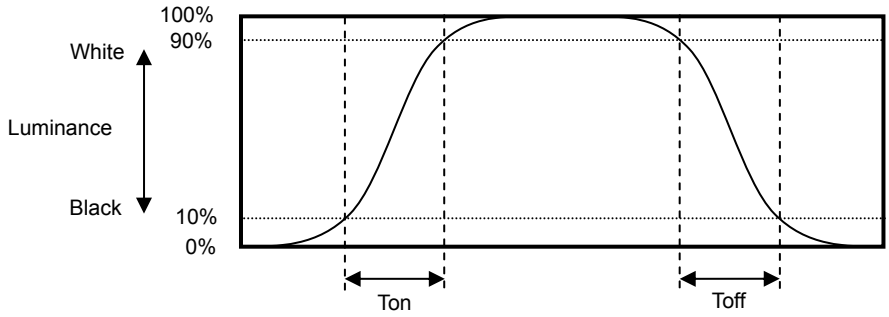
The contrast ratio is calculated by using the following formula.

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

Note 4: Definition of Response time

The response time is defined as the LCD optical switching time interval between “Black” state and “White” state. Rise time (Ton) is the time between photo detector output intensity changed from 10% to 90%. And fall time (Toff) is the time between photo detector output intensity changed from 90% to 10%.

Product surface temperature: TopF= TBD℃.



Note 5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.

Note 6: Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (Refer Fig. 2). Every measuring point is placed at the center of each measuring area.

Luminance Uniformity(U) = Lmin/ Lmax

L-------Active area length W----- Active area width

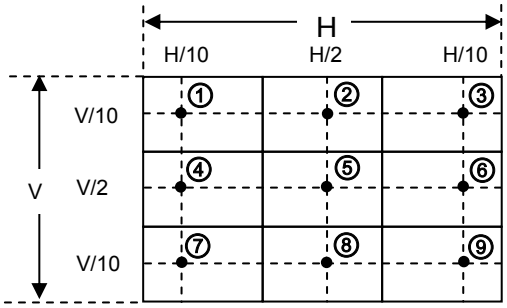


Fig. 2 Definition of uniformity

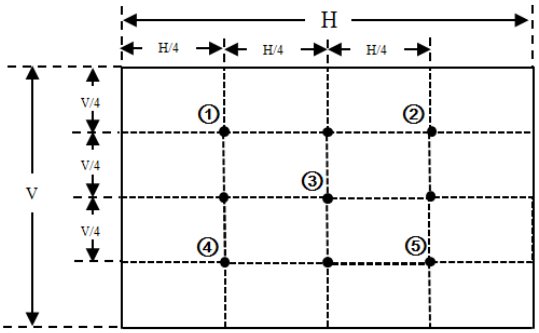
Lmax: The measured maximum luminance of all measurement position.

Lmin: The measured minimum luminance of all measurement position.

The Gray luminance uniformity is calculated by using following formula.

$$\text{LU2/ LU3} = 200^{*} \frac{\text{Maximum luminance from ① to ⑤- Minimum luminance from ① to ⑤}}{\text{Maximum luminance from ① to ⑤+ Minimum luminance from ① to ⑤}}$$

The luminance is measured at near the 5 points shown below.



Note 7: Definition of Luminance :

Measure the luminance of white state at center point.

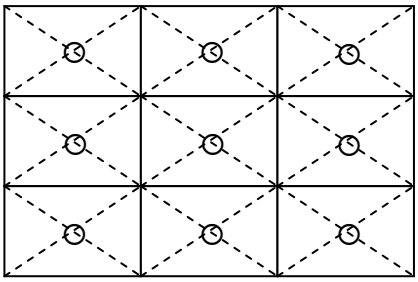
8 Environmental / Reliability Test

Test item	Condition	Judgment Note1
High temperature and humidity (Operation)	①60 ± 2°C, RH= 60%, 240hours ②Display data is white. Note2	No display malfunctions
Heat cycle (Operation)	① 0 ± 3°C 1hour 60 ± 3°C 1hour ② 50cycles, 4hours/cycle ③ Display data is white. Note2	
Thermal shock (Non operation)	① -20 ± 3°C 30minutes 60 ± 3°C 30minutes ② 100cycles, 1hour/cycle ③ Temperature transition time is within 5 minutes.	
Vibration (Non operation)	① 5 to 100Hz, 11.76m/s^2 ② 1 minute/cycle ③ X, Y, Z directions ④ 10 times each direction	No display malfunctions No physical damages
Mechanical shock (Non operation)	① 294m/s^2, 11ms ② ±X, ±Y, ±Z directions ③ 3 times each direction	
ESD (Operation)	Contact Discharge ① 150pF, 330Ω, ±8kV ② 9 places on a panel surface Note3 ③ 25 times each place at 1 sec interval Air Discharge ① 150pF, 330Ω, ±15kV ② 9 places on a panel surface Note3 ③ 25 times each place at 1 sec interval	No display malfunctions

Note1: Display and appearance are checked under environmental conditions equivalent to the inspection conditions of defect criteria.

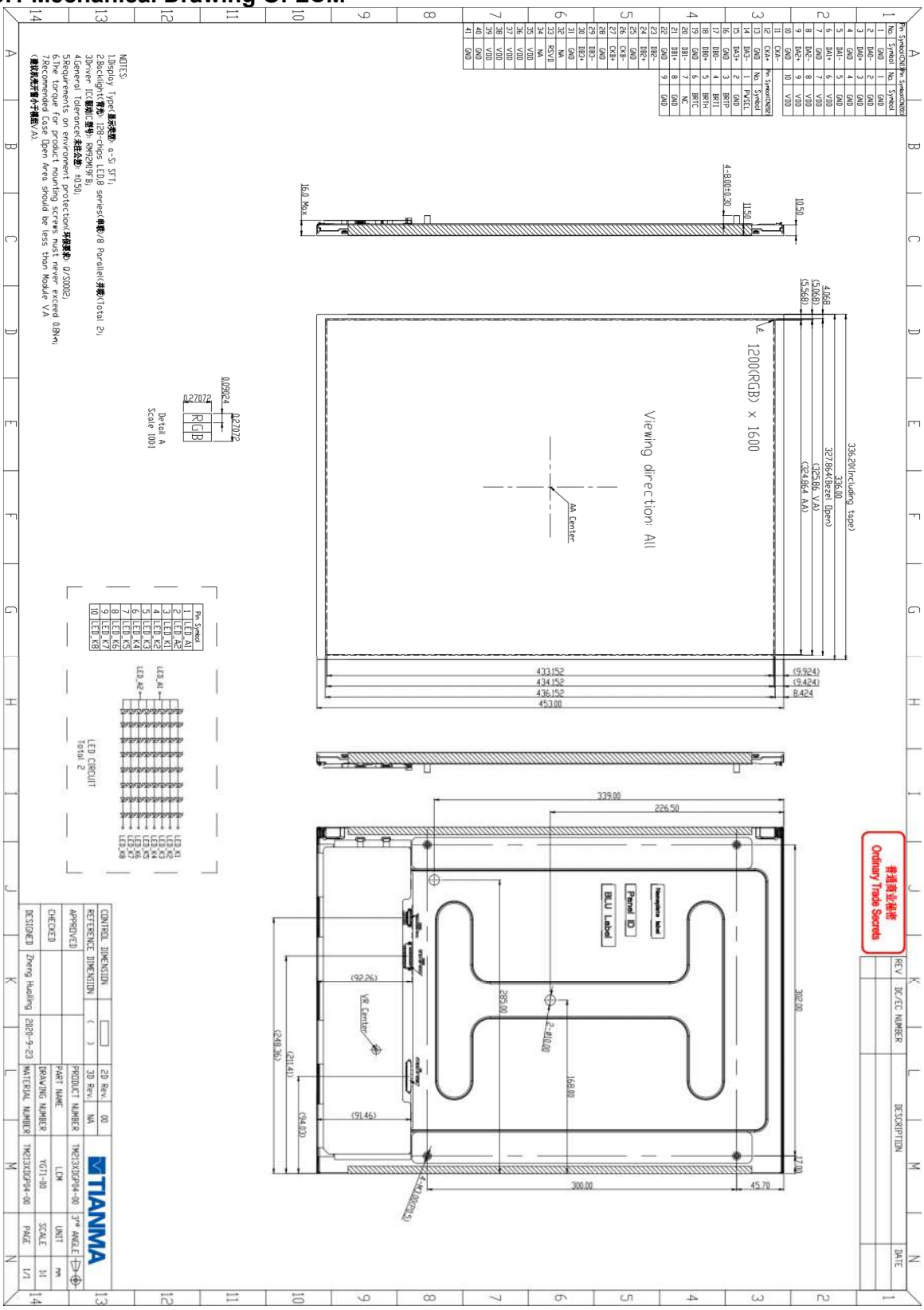
Note2: Luminance: 600cd/m2 at luminance control.

Note3: See the following figure for discharge points.



9 Mechanical Drawing

9.1 Mechanical Drawing Of LCM



9.2 Markings

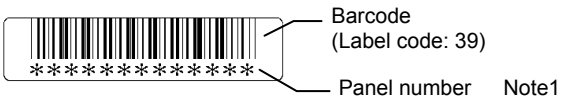
The marking is attached to this product.

9.2.1 Nameplate label

Nameplate label

9.2.2 Barcode label

Barcode label

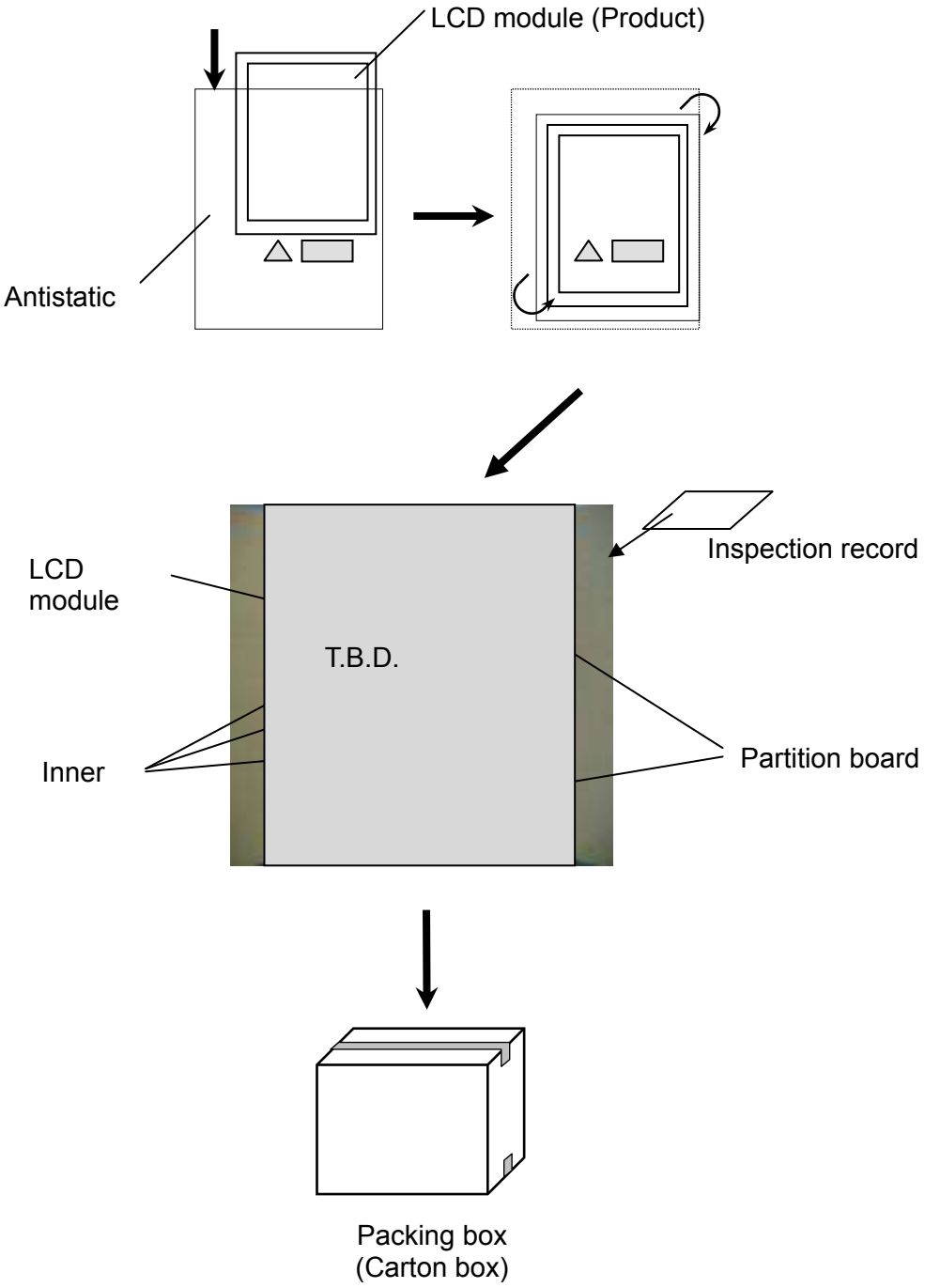


Note1: **Do not attach anything like another label on the nameplate label!**

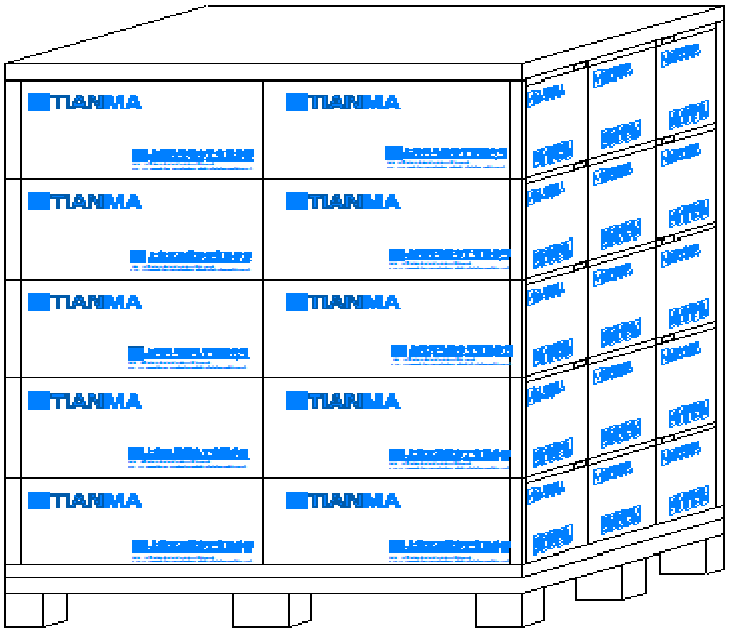
10 Packing Drawing

Parameter	Inner packing box	Unit
Size	T.B.D.(W) × T.B.D.(H) × T.B.D.(D) (typ.)	mm
Weight	T.B.D. (typ.)	kg
Total weight	T.B.D. (typ.) (with T.B.D. products)	kg

10.1 LCD Module Packing Method



10.2 Stacking method (T.B.D.×T.B.D.×T.B.D.)



11 Precautions For Use of LCD Modules

11.1 Handling Precautions

11.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

11.1.2 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.

11.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

11.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

11.1.5 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:

- Isopropyl alcohol
- Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

- Water
- Ketone
- Aromatic solvents

11.1.6 Do not attempt to disassemble the LCD Module.

11.1.7 If the logic circuit power is off, do not apply the input signals.

11.1.8 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

11.1.8.1 Be sure to ground the body when handling the LCD Modules.

11.1.8.2 Tools required for assembly, such as soldering irons, must be properly ground.

11.1.8.3 To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

11.1.8.4 The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

11.1.9 The torque for product mounting screws must never exceed (0.8) N·m. Higher torque might result in distortion of the bezel. And the length of product mounting screws must be ≤ (7) mm.

11.2 Storage Precautions

11.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

11.2.2 The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

Temperature : 0℃ ～ 40℃ Relatively humidity: ≤80%

11.2.3 The LCD modules should be stored in the room without acid, alkali and harmful gas.

11.3 Transportation Precautions

The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.