TIANMA

Time:	
Customer:	
Sign	

TFT COLOR LCD MODULE

MODEL NO :TM185VDSG05

MODEL VERSION :00

47cm (18.5 Type)
FHD
LVDS interface (2port)

■ **Preliminary Data Sheet**

□ **Final Data Sheet**

PDB-工业 1-19-C-116 (1st edition)

Prepared by	Checked by	Approved by
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1. OUTLINE

1.1 STRUCTURE AND PRINCIPLE

Color LCD module TM185VDSG05 is composed of the amorphous silicon thin film transistor liquid crystal display (a-Si TFT LCD) panel structure with driver LSIs for driving the TFT (Thin Film Transistor) array and a backlight.

The a-Si TFT LCD panel structure is injected liquid crystal material into a narrow gap between the TFT array glass substrate and a color-filter glass substrate.

Color (Red, Green, Blue) data signals from a host system (e.g. signal generator, etc.) are modulated into best form for active matrix system by a signal processing board, and sent to the driver LSIs which drive the individual TFT arrays.

The TFT array as an electro-optical switch regulates the amount of transmitted light from the backlight assembly, when it is controlled by data signals. Color images are created by regulating the amount of transmitted light through the TFT array of red, green and blue dots.

1.2 APPLICATION

- For HMI use

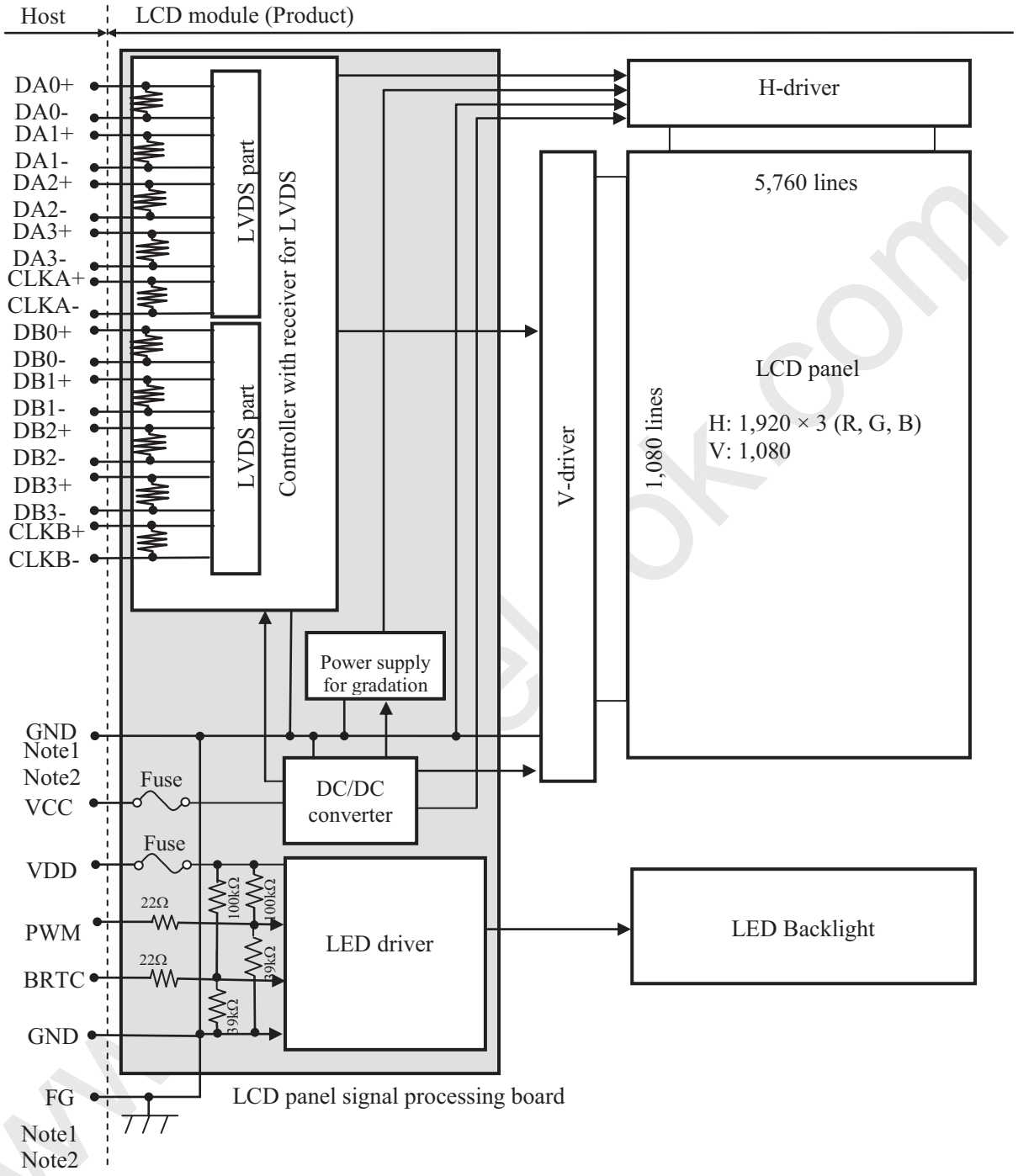
1.3 FEATURES

- Ultra Wide viewing angle (Super Fine TFT (SFT))
- High contrast
- Wide color gamut
- Wide temperature range
- LVDS interface
- 8-bit digital signals for data of RGB
- Narrow frame
- LED backlight built in LED driver
- This product will comply with the European RoHS directive (2011/65/EU) when starting mass production.

2. GENERAL SPECIFICATIONS

Display area	408.96 (H) × 230.04 (V) mm
Diagonal size of display	47cm (18.5 inches)
Drive system	a-Si TFT active matrix
Display color	16,777,216 colors
Pixel	1,920 (H) × 1,080 (V) pixels
Pixel arrangement	RGB (Red dot, Green dot, Blue dot) vertical stripe
Dot pitch	0.071(H) × 0.213 (V) mm
Pixel pitch	0.213 (H) × 0.213 (V) mm
Module size	430.4 (W) × 254.6 (H) × 13.5 (D) mm (typ.)s
Weight	1550g (typ.)
Contrast ratio	1000:1 (typ.)
Viewing angle	*At the contrast ratio ≥10:1* • Horizontal: Right side 88° (typ.), Left side 88° (typ.) • Vertical: Up side 88° (typ.), Down side 88° (typ.)
Designed viewing direction	Viewing angle with optimum grayscale (γ≒ 2.2): Normal axis (perpendicular)
Polarizer surface	Antiglare
Polarizer pencil-hardness	3H (min.) [by JIS K5600]
Color gamut	*At LCD panel center* 72% (typ.) [against NTSC color space]
Response time	*Ton+Toff (10%←→ 90%)* 25 ms (typ.)
Luminance	*At the maximum luminance control* (300) cd/m^2 (typ.)
Signal system	LVDS interface (2 port) [8-bit digital signals for data of RGB colors, Dot clock (CLK), Data enable (DE)]
Power supply voltage	LCD panel signal processing board: 5.0V LED driver: 12.0V
Backlight	LED backlight built in LED driver
Power consumption	*At the maximum luminance control, Checkered flag pattern* (13)W (max)

3. BLOCK DIAGRAM



Note1: Relation between GND (Signal ground and LED driver ground) and FG (Frame ground) in the LCD module is as follows.

GND- FG	Connected

Note2: GND and FG 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 has a 100Ω terminating resistance.

4. DETAILED SPECIFICATIONS

4.1 MECHANICAL SPECIFICATIONS

Parameter	Specification		Unit
Module size	430.4 ± 0.5 (W) × 254.6 ± 0.5 (H) × 13.5 ± 0.5 (D)	Note1	mm
Display area	408.96 (H) × 230.04	Note1	mm
Weight	1550(typ.), 1700 (max.)		g

Note1: See "**11. OUTLINE DRAWINGS**".

4.2 ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Rating	Unit	Remarks
Power supply voltage	LCD panel signal processing board	VCC	-0.3to +6.5	V	Ta= 25°C
	LED driver	VDD	-0.3to +15		
Input voltage for signals	Display signals Note1	VD	-0.3to +3.2	V	
	Function signal for LED driver	PWM	-0.3to +5.5		
		BRTC	-0.3to +5.5		
Storage temperature		Tst	-30 to +80	°C	-
Operating temperature	Front surface	TopF	-20 to +70	°C	Note2
	Rear surface	TopR	-20 to +70	°C	Note3
Relative humidity Note4		RH	≤ 95	%	Ta ≤ 40°C
			≤ 85	%	40°C < Ta ≤ 50°C
			≤ 55	%	50°C < Ta ≤ 60°C
			≤ 36	%	60°C < Ta ≤ 70°C
Absolute humidity Note4		AH	≤ 70 Note5	g/m^3	Ta > 70°C

Note1: DA0+/-, DA1+/-, DA2+/-, DA3+/- ,CLKA+/-, DB0+/-, DB1+/-, DB2+/-, DB3+/-, CLKB+/-
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= 70°C and RH= 36%

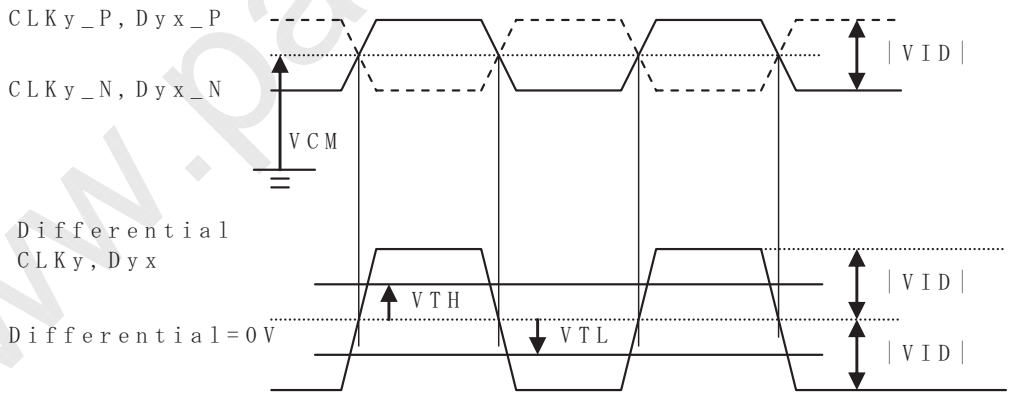
4.3 ELECTRICAL CHARACTERISTICS

4.3.1 LCD panel signal processing board

(Ta= 25°C)

Parameter		Symbol	min.	typ.	max.	Unit	Remarks
Power supply voltage		VCC	4.5	5.0	5.5	V	-
Power supply current		ICC	-	(400) Note1	(680) Note2	mA	at VCC= 5.0V
Permissible ripple voltage		VRPC	-	-	100	mVp-p	for VCC Note3, Note4, Note5
Differential input threshold voltage	High	VTH	-	-	+100	mV	at VCM= 1.2V Note6, Note7
	Low	VTL	-100	-	-	mV	
Input Differential Voltage		|VID|	100	400	600	mV	-
Differential Input Common Mode Voltage		VCM	0.7	1.2	1.6	V	-
Terminating resistance		RT	-	100	-	Ω	-

Note1: Checkered flag pattern [by IEC 61747-6]
Note2: Pattern for maximum current
Note3: This product works 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 receiver
Note7: DC characteristics (LVDS receiver part)



CLKy_P, CLKy_N: y = A,B
Dyx_P, Dyx_N: y = A,B x = 0,1,2,3
|VID| = |**_P-**_N|
VCM = (**_P+**_N)/2
P: +, N: -
**: CLKy or Dxy

4.3.2 LED driver

(Ta= 25°C, Note1)

Parameter		Symbol	min.	typ.	max.	Unit	Remarks
Power supply voltage		VDD	10.8	12.0	13.2	V	-
Power supply current		IDD	-	(680)	(780) Note2	mA	at VDD= 12.0V Note3
Permissible ripple voltage		VRPD	-	-	200	mVp-p	for VDD Note4, Note5, Note6
Input voltage for PWM signal	High	VDFH1	2.0	-	5.0	V	Note7
	Low	VDFL1	0	-	0.4	V	
Input voltage for BRTC signal	High	VDFH2	2.0	-	5.0	V	
	Low	VDFL2	0	-	(0.5)	V	
Input current for PWM signal	High	IDFH1	-	-	300	μA	
	Low	IDFL1	-300	-	-	μA	
Input current for BRTC signal	High	IDFH2	-	-	300	μA	
	Low	IDFL2	-300	-	-	μA	
PWM frequency		f_{PWM}	200	-	1k	Hz	Note8, Note9
PWM duty ratio		DR_{PWM}	1	-	100	%	Note10, Note11
PWM pulse width		tPWH	(10)	-	-	μs	

Note1: When designing of the power supply, take the measures for the prevention of surge voltage.
Note2: This value excludes peak current such as overshoot current.
Note3: At the maximum luminance control
Note4: The power supply lines (VDD and GND) 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.
Note5: This product works even if the ripple voltage levels are over the permissible values, but there might be noise on the display image.
Note6: The permissible ripple voltage includes spike noise.
Note7: See "**3. BLOCK DIAGRAM**".
Note8: A recommended f_{PWM} value is as follows.

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

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

Note9: Depending on the frequency used, some noise may appear on the screen, please conduct a thorough evaluation.
Note10: While the BRTC signal is high, do not set the tPWH (PWM pulse width) is less than minimum value. It may cause abnormal working of the backlight. In this case, turn the backlight off and then on again by BRTC signal.
Note11: Regardless of the PWM frequency, both PWM duty ratio and PWM pulse width must be always more than the minimum values.

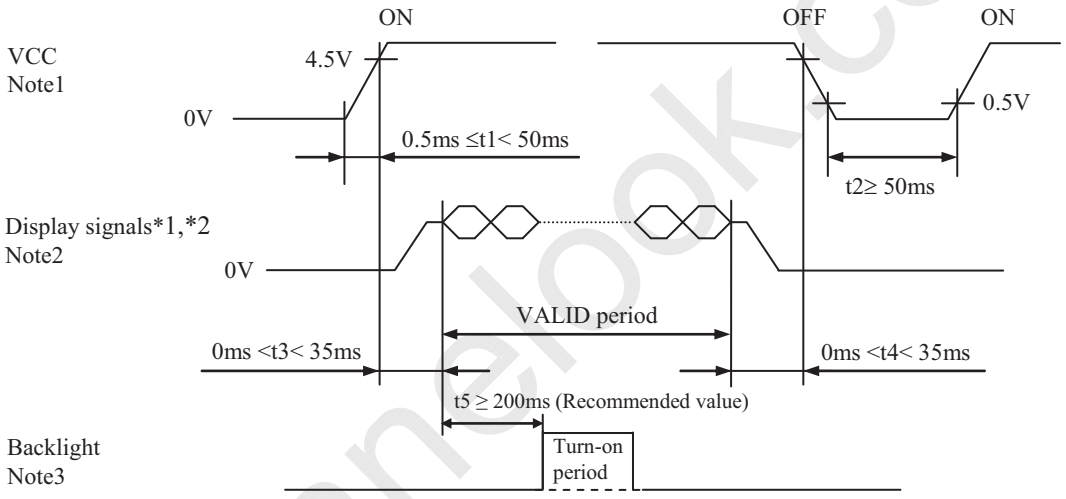
4.3.3 Fuse

Parameter	Fuse		Rating	Fusing current	Remarks
	Type	Supplier			
VCC	FCC16202AB	KAMAYA ELECTRIC CO., LTD	2.0A 36.0V	4.0A 5 seconds	Note1
VDD	(FCC16202AB)	(KAMAYA ELECTRIC CO., LTD)	(2.0A) (36.0V)	(4.0A 5 seconds)	

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.

4.4 POWER SUPPLY VOLTAGE SEQUENCE

4.4.1 LCD panel signal processing board



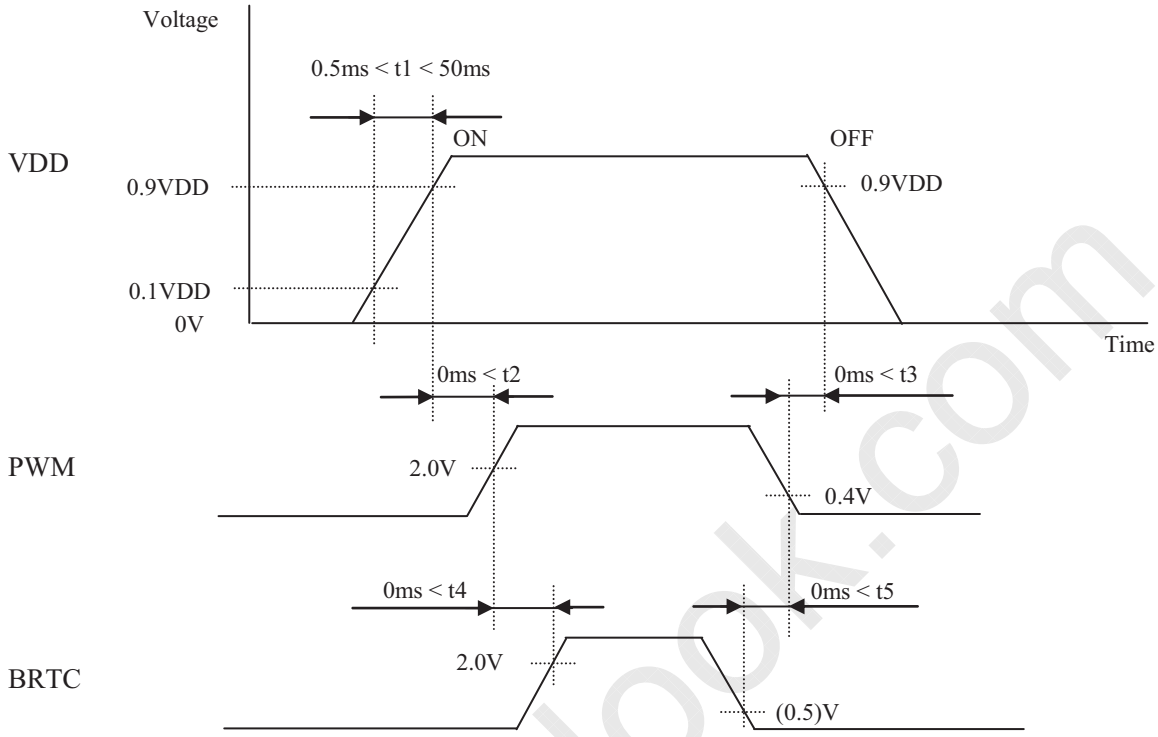
*1 DA0+/-, DA1+/-, DA2+/-, DA3+/-, CLKA+/-, DB0+/-, DB1+/-, DB2+/-, DB3+/-, CLKB+/-
*2 These signals should be measured at the terminal of 100Ω resistance.

Note1: If there is a voltage variation (voltage drop) at the rising edge of VCC below 4.5V, there is a possibility that a product does not work due to a protection circuit.

Note2: Display signals (DA0+/-, DA1+/-, DA2+/-, DA3+/-,CLKA+/-,DB0+/-, DB1+/-, DB2+/-, DB3+/- and CLKB+/-) 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 display signals of this product 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 signals, VCC also must be shut down.

Note3: In order to avoid unstable data display, the backlight is recommended to turn on within the VALID period of display and function signals.
Recommended value: t5 ≥ 200ms

4.4.2 LED driver



4.5 CONNECTIONS AND FUNCTIONS FOR INTERFACE PINS

4.5.1 LCD panel signal processing board

CN1 socket (LCD module side): MDF76KBW-30S-1H(55) (HIROSE ELECTRIC Co., Ltd.)
Adaptable plug: MDF76-30P-1C (HIROSE ELECTRIC Co., Ltd.)

Pin No.	Symbol	Signal	Remarks
1	DA0-	Odd pixel data 0	Note1
2	DA0+		
3	DA1-	Odd pixel data 1	Note1
4	DA1+		
5	DA2-	Odd pixel data 2	Note1
6	DA2+		
7	GND	Ground	Note2
8	CLKA-	Odd pixel clock	Note1
9	CLKA+		
10	DA3-	Odd pixel data 3	Note1
11	DA3+		
12	DB0-	Even pixel data 0	Note1
13	DB0+		
14	GND	Ground	Note2
15	DB1-	Even pixel data 1	Note1
16	DB1+		
17	GND	Ground	Note2
18	DB2-	Even pixel data 2	Note1
19	DB2+		
20	CLKB-	Even pixel clock	Note1
21	CLKB+		
22	DB3-	Even pixel data 3	Note1
23	DB3+		
24	GND	Ground	Note2
25	GND	Ground	Note2
26	GND	Ground	Note2
27	GND	Ground	Note2
28	VCC	Power supply	Note2
29			
30			

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

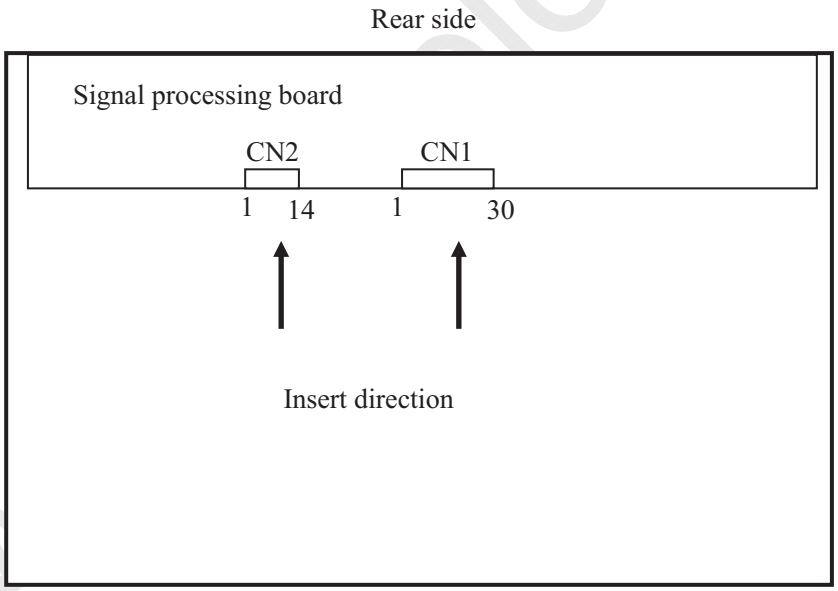
4.5.2 LED driver

CN2 socket (LCD module side): DF19L-14P-1H(54) (HIROSE ELECTRIC Co., Ltd.)
Adaptable plug: DF19-14S-1C (HIROSE ELECTRIC Co., Ltd.)

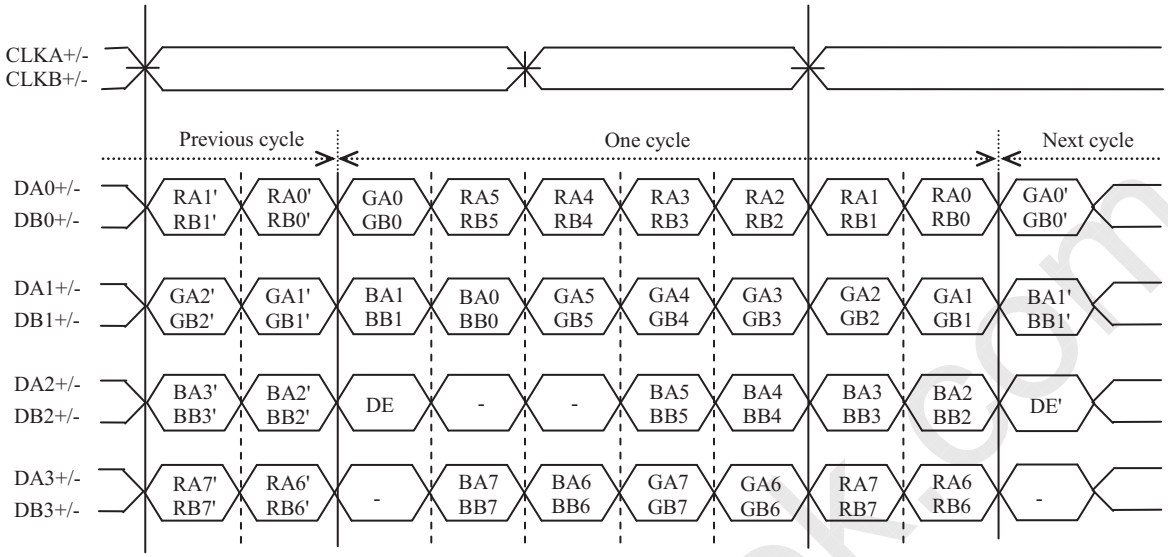
Pin No.	Symbol	Function	Description
1	VDD	Power supply	Note1
2	VDD		
3	VDD		
4	VDD		
5	VDD		
6	GND	LED driver ground	Note1
7	GND		
8	GND		
9	GND		
10	GND		
11	RSVD	Keep this pin open.	-
12	BRTC	Backlight ON/OFF control	High or Open: Backlight ON Low: Backlight OFF
13	PWM	Luminance control	PWM dimming
14	GND	LED driver ground	Note1

Note1: All VDD and GND terminals should be used without any non-connected lines.

4.5.3 Positions of socket



4.5.4 Input data mapping



Note1: LSB (Least Significant Bit) – R0, G0, B0 MSB (Most Significant Bit) – R7, G7, B7

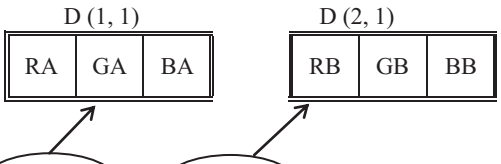
Note2: Twist pair wires with 100Ω (Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.

4.6 DISPLAY COLORS AND INPUT DATA SIGNALS

This product can display equivalent of 16,777,216 colors with 256 gray scales. Also the relation between display colors and input data signals is as follows.

Display colors		Data signal (0: Low level, 1: High level)																							
		RA7	RA6	RA5	RA4	RA3	RA2	RA1	RA0	GA7	GA6	GA5	GA4	GA3	GA2	GA1	GA0	BA7	BA6	BA5	BA4	BA3	BA2	BA1	BA0
		RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0	GB7	GB6	GB5	GB4	GB3	GB2	GB1	GB0	BB7	BB6	BB5	BB4	BB3	BB2	BB1	BB0
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

4.7 INPUT DATA SIGNALS AND DISPLAY POSITIONS



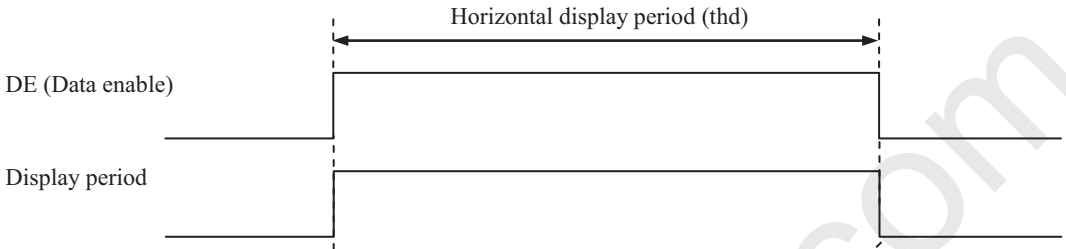
D(1, 1)	D(2, 1)	• • •	D(959, 1)	D(960, 1)	• • •	D(1919, 1)	D(1920, 1)
D(1, 2)	D(2, 2)	• • •	D(959, 2)	D(960, 2)	• • •	D(1919, 2)	D(1920, 2)
• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •
D(1, Y)	D(2, Y)	• • •	D(959, Y)	D(960, Y)	• • •	D(1919, Y)	D(1920, Y)
• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •
D(1, 1079)	D(2, 1079)	• • •	D(959, 1079)	D(960, 1079)	• • •	D(1919, 1079)	D(1920, 1079)
D(1, 1080)	D(2, 1080)	• • •	D(959, 1080)	D(960, 1080)	• • •	D(1919, 1080)	D(1920, 1080)

4.8 INPUT SIGNAL TIMINGS

4.8.1 Outline of input signal timings

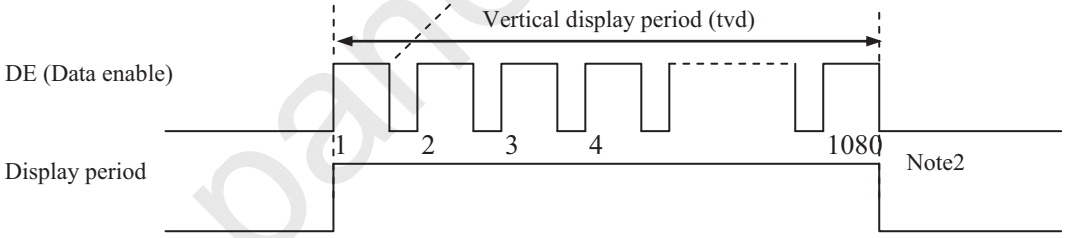
- Horizontal signal

Note1



- Vertical signal

Note1



Note1: This diagram indicates virtual signal for set up to timing.
Note2: See "**4.8.3 Input signal timing chart**" for the pulse number.

4.8.2 Timing characteristics

(Note1, Note2, Note3)

Parameter			Symbol	min.	typ.	max.	Unit	Remarks
CLK	Frequency		1/tc	65.0	74.175	81.5	MHz	13.48ns (typ.)
	Duty ratio		-	-			-	-
	Rise time, Fall time		-				ns	
DATA	CLK-DATA	Setup time	-	-			ns	-
		Hold time	-				ns	
	Rise time, Fall time		-				ns	
DE	Horizontal	Cycle	th	13.19	14.83	16.53	μs	67.43kHz (typ.)
				1,075	1,100	-	CLK	
		Display period	thd	960			CLK	-
	Vertical (One frame)	Cycle	tv	15.39	16.68	18.18	ms	59.94Hz (typ.)
				1,100	1,125	-	H	
		Display period	tvd	1,080			H	-
	CLK-DE	Setup time	-	-			ns	-
		Hold time	-				ns	
	Rise time, Fall time		-				ns	

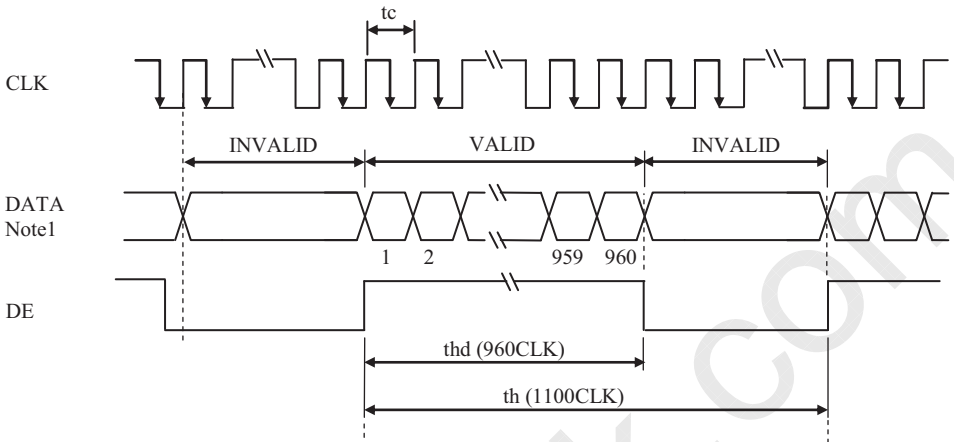
Note1: Definition of parameters is as follows.
tc= 1CLK, th= 1H

Note2: See the data sheet of LVDS transmitter.

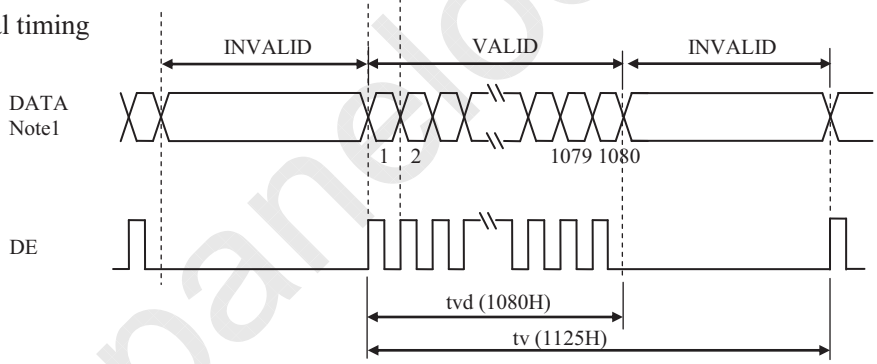
Note3: Vertical cycle (tv) should be specified in integral multiple of Horizontal cycle (th).

4.8.3 Input signal timing chart

Horizontal timing



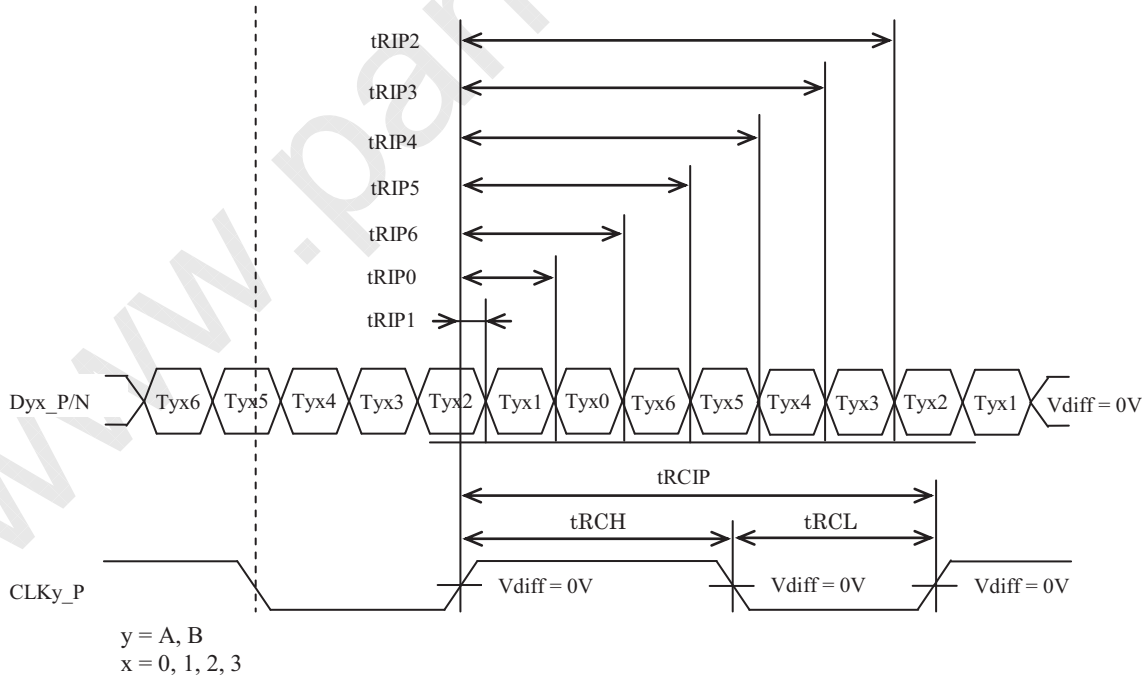
Vertical timing



Note1: DATA (A) = RA0-RA7, GA0-GA7, BA0-BA7
DATA (B) = RB0-RB7, GB0-GB7, BB0-BB7

4.9 LVDS Rx AC SPEC

Symbol	Parameter	min.	typ.	max.	Unit
t_{RCIP}	CKy_+ Period	12.27	-	15.38	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	-0.4	-	0.4	ns
t_{RIP1}	Input Data Position0	$-\lvert t_{RMG}\rvert$	0.0	$+\lvert t_{RMG}\rvert$	ns
t_{RIP0}	Input Data Position1	$\frac{t_{RCIP}}{7}-\lvert t_{RMG}\rvert$	$\frac{t_{RCIP}}{7}$	$\frac{t_{RCIP}}{7}+\lvert t_{RMG}\rvert$	ns
t_{RIP6}	Input Data Position2	$2\frac{t_{RCIP}}{7}-\lvert t_{RMG}\rvert$	$2\frac{t_{RCIP}}{7}$	$2\frac{t_{RCIP}}{7}+\lvert t_{RMG}\rvert$	ns
t_{RIP5}	Input Data Position3	$3\frac{t_{RCIP}}{7}-\lvert t_{RMG}\rvert$	$3\frac{t_{RCIP}}{7}$	$3\frac{t_{RCIP}}{7}+\lvert t_{RMG}\rvert$	ns
t_{RIP4}	Input Data Position4	$4\frac{t_{RCIP}}{7}-\lvert t_{RMG}\rvert$	$4\frac{t_{RCIP}}{7}$	$4\frac{t_{RCIP}}{7}+\lvert t_{RMG}\rvert$	ns
t_{RIP3}	Input Data Position5	$5\frac{t_{RCIP}}{7}-\lvert t_{RMG}\rvert$	$5\frac{t_{RCIP}}{7}$	$5\frac{t_{RCIP}}{7}+\lvert t_{RMG}\rvert$	ns
t_{RIP2}	Input Data Position6	$6\frac{t_{RCIP}}{7}-\lvert t_{RMG}\rvert$	$6\frac{t_{RCIP}}{7}$	$6\frac{t_{RCIP}}{7}+\lvert t_{RMG}\rvert$	ns



4.10 OPTICS

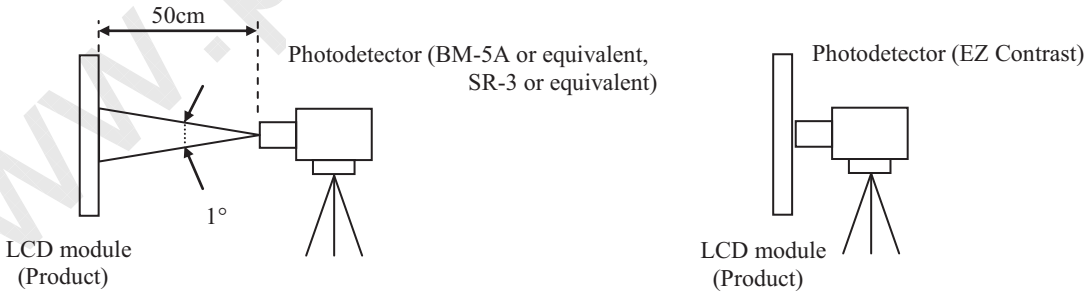
4.10.1 Optical characteristics

(Note1, Note2)

Parameter		Condition	Symbol	min.	typ.	max.	Unit	Measuring instrument	Remarks
Luminance		White at center θR= 0°, θL= 0°, θU= 0°, θD= 0°	L	(240)	(300)	-	cd/m^2	BM-5A or equivalent	-
Contrast ratio		White/Black at center θR= 0°, θL= 0°, θU= 0°, θD= 0°	CR	600	1000	-	-	BM-5A or equivalent	Note3
Luminance uniformity		White θR= 0°, θL= 0°, θU= 0°, θD= 0°	LU	-	(1.25)	(1.33)	-	BM-5A or equivalent	Note4
Chromaticity	White	**x** coordinate	Wx	(0.252)	(0.302)	(0.352)	-	SR-3 or equivalent	Note5
		y coordinate	Wy	(0.284)	(0.334)	(0.384)	-		
	Red	**x** coordinate	Rx	-	(0.640)	-	-		
		y coordinate	Ry	-	(0.341)	-	-		
	Green	**x** coordinate	Gx	-	(0.287)	-	-		
		y coordinate	Gy	-	(0.626)	-	-		
	Blue	**x** coordinate	Bx	-	(0.147)	-	-		
		y coordinate	By	-	(0.076)	-	-		
Color gamut		θR= 0°, θL= 0°, θU= 0°, θD= 0° at center, against NTSC color space	C	65	72	-	%		
Response time		Black to White	Ton	-	12	20	ms	BM-5A or equivalent	Note6 Note7
		White to Black	Toff	-	13	20	ms		
Viewing angle	Right	θU= 0°, θD= 0°, CR≥ 10	θR	70	88	-	°	EZ Contrast	Note8
	Left	θU= 0°, θD= 0°, CR≥ 10	θL	70	88	-	°		
	Up	θR= 0°, θL= 0°, CR≥ 10	θU	70	88	-	°		
	Down	θR= 0°, θL= 0°, CR≥ 10	θD	70	88	-	°		

Note1: These are initial characteristics.
Note2: Measurement conditions are as follows.
Ta= 25°C, VCC= 5.0V, VDD=12.0V, PWM duty ratio: 100%,
Display mode: FHD, Horizontal cycle= 1/67.43kHz, Vertical cycle= 1/59.94Hz

Optical characteristics are measured at luminance saturation 20minutes after the product works, in the dark room. Also measurement methods are as follows.



Note3: See "**4.10.2 Definition of contrast ratio**".
Note4: See "**4.10.3 Definition of luminance uniformity**".
Note5: These coordinates are found on CIE 1931 chromaticity diagram.
Note6: Product surface temperature: TopF= TBD°C
Note7: See "**4.10.4 Definition of response times**".
Note8: See "**4.10.5 Definition of viewing angles**".

4.10.2 Definition of contrast ratio

The contrast ratio is calculated by using the following formula.

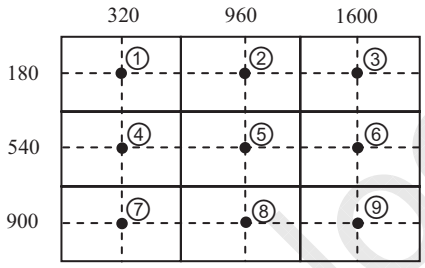
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

4.10.3 Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

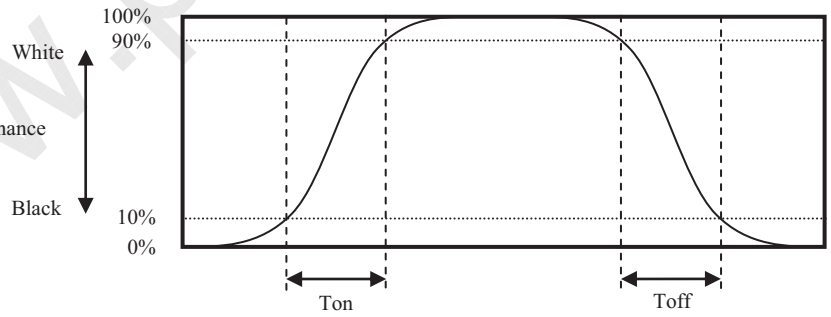
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑨}}{\text{Minimum luminance from ① to ⑨}}$$

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

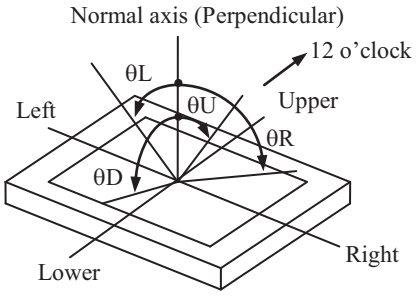


4.10.4 Definition of response times

Response time is measured at the time when the luminance changes from "black" to "white ", or "white" to "black " on the same screen point, by photo-detector. Ton is the time when the luminance changes from 10% up to 90%. Also Toff is the time when the luminance changes from 90% down to 10% (See the following diagram.).



4.10.5 Definition of viewing angles



5. ESTIMATED LUMINANCE LIFETIME

The luminance lifetime is the time from initial luminance to half-luminance.

This lifetime is the estimated value, and is not guarantee value.

Condition		Estimated luminance lifetime (Life time expectancy) Note1, Note2, Note3	Unit
LED elementary substance	25°C (Ambient temperature of the product) Continuous operation, PWM duty ratio:100%	(30,000)	h

Note1: Life time expectancy is mean time to half-luminance.
Note2: Estimated luminance lifetime is not the value for an LCD module but the value for LED elementary substance.
Note3: By ambient temperature, the lifetime changes particularly. Especially, in case the product works under high temperature environment, the lifetime becomes short.

6. PRODUCT INSPECTIONS

The following inspections are carried out for products, before shipment

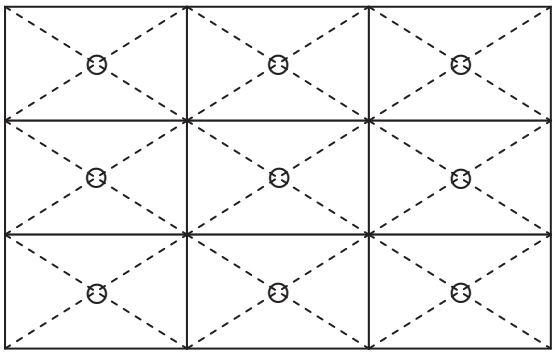
(1) 100% inspection
- Display
- Appearance

(2) Sampling inspection
- Power supply current
- White luminance
- Contrast ratio
- Luminance uniformity

7. RELIABILITY TESTS

Test item	Condition	Judgment Note1
High temperature and humidity Operation	① +50 ± 2°C, RH= 80%, 240hours ② Display data is white.	No display malfunctions
High temperature Operation	① +70 ± 3°C, 240hours Note2 ② Display data is white.	
High temperature Storage	① +80 ± 3°C, 240hours	
Low temperature Operation	① -20 ± 3°C, 240hours ② Display data is white.	
Low temperature Storage	① -30 ± 3°C, 240hours	
Thermal shock (Non operation)	① -20 ± 3°C…30minutes +60 ± 3°C…30minutes ② 50cycles, 1hour/cycle ③ Temperature transition time is within 5 minutes.	
ESD (Operation)	Contact Discharge ① 150pF, 330Ω, ±8kV ② 9 places on a panel surface Note3 ③ 10 times each place at 1 sec interval Air Discharge ① 150pF, 330Ω, ±15kV ② 9 places on a panel surface Note3 ③ 10 times each place at 1 sec interval	
Vibration (Non operation)	① 5 to 100Hz, 11.76m/s^2 ② 1 minute/cycle ③ X, Y, Z directions ④ 50 times each directions	No display malfunctions No physical damages
Mechanical shock (Non operation)	① 294m/ s2, 11ms ② ±X, ±Y, ±Z directions ③ 3 times each directions	

Note1: Display and appearance are checked under environmental conditions equivalent to the inspection conditions of defect criteria.
Note2: The maximum temperature front and rear surface of LCD module.
Note3: See the following figure for discharge points.



8. MARKINGS

The various markings are attached to this product. **See "11. OUTLINE DRAWINGS"** for attachment positions.

8.1PRODUCT LABEL

Product label

Note1: The meaning of OEM number

•Example: TM5XG10A55SA1SA19CF0001

TM5XG10A55SA1SA1	9CF	0001
TIANMA internal code	**Date code**	**S/N**

Date code:

1st Character Year Codes

Month	2019	2020	2021	2022	2023	2024	2025	2026	2027	So on
Code	9	0	1	2	3	4	5	6	7	

2nd Character Month Codes

Month	January	February	March	April	May	June	July	August	September	October	November	December
Code	1	2	3	4	5	6	7	8	9	A	B	C

3rd Character Day Codes

Day	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11st
Code	1	2	3	4	5	6	7	8	9	A	B
Day	12nd	13rd	14th	15th	16th	17th	18th	19th	20th	21st	22nd
Code	C	D	E	F	G	H	I	J	K	L	M
Day	23rd	24nd	25st	26nd	27rd	28th	29th	30th	31st		
Code	N	O	P	Q	R	S	T	U	V		

Note2: **Do not attach anything like another label on the nameplate label!** In case of repairing the product, TM needs the contents of nameplate such as the lot number, inspection date and so on, to identify the warranty period with individual product. If TM cannot decipher the contents of nameplate, repairing shall be charged. TM also may give a new lot number to repaired products.

8.2 BARCODE LABEL

Barcode label (for panel number)

Note1: The same panel number is given to barcode label and nameplate label.

9. PACKING, TRANSPORTATION AND DELIVERY

TBD

10. PRECAUTIONS

10.1 MEANING OF CAUTION SIGNS

The following caution signs have very important meaning. **Be sure to read "10.2 CAUTIONS" and "10.3 ATTENTIONS"!**

⚠	This sign has the meaning that a customer will be injured or the product will sustain damage if the customer practices wrong operations.
✋	This sign has the meaning that a customer will be injured if the customer practices wrong operations.

10.2 CAUTIONS

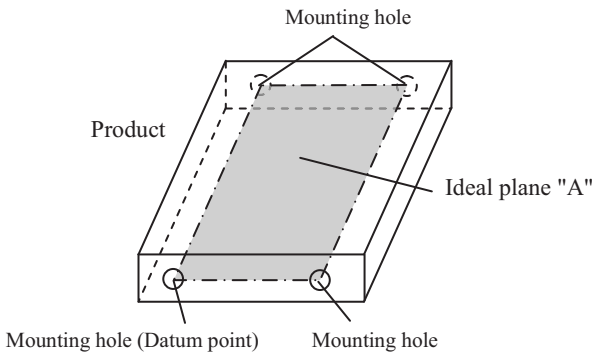
✋

* **Do not shock and press the LCD panel and the backlight! There is a danger of breaking, because they are made of glass. (Shock: Equal to or no greater than 294m/s^2 and equal to or no greater than 11ms, Pressure: Equal to or no greater than 19.6 N (ϕ16mm jig))**

10.3 ATTENTIONS ⚠

10.3.1 Handling of the product

① Take hold of both ends without touching the circuit board when the product (LCD module) is picked up from inner packing box to avoid broken down or misadjustment, because of stress to mounting parts on the circuit board.
② When the product is put on the table temporarily, display surface must be placed downward.
③ When handling the product, take the measures of electrostatic discharge with such as earth band, ionic shower and so on, because the product may be damaged by electrostatic.
④ The torque for product mounting screws must never exceed 0.735N·m. Higher torque might result in distortion of the bezel. And the length of product mounting screws must be ≤ 4.5mm.
⑤ The product must be installed using mounting holes without undue stress such as bends or twist (See outline drawings). And do not add undue stress to any portion (such as bezel flat area). Bends or twist described above and undue stress to any portion may cause display mura.
Recommended installing method: Ideal plane "A" is defined by one mounting hole (datum point) and other mounting holes. The ideal plane "A" should be the same plane within ±0.3 mm.



⑥ Do not press or rub on the sensitive product surface. When cleaning the panel surface, wipe it with a soft dry cloth.
⑦ Do not push or pull the interface connectors while the product is working. When handling the product, use of an original protection sheet on the product surface (polarizer) is recommended for protection of product surface. Adhesive type protection sheet may change color or characteristics of the polarizer.
⑧ Usually liquid crystals don't leak through the breakage of glasses because of the surface tension of thin layer and the construction of LCD panel. But, if you contact with liquid crystal by any chance, please wash it away with soap and water.

10.3.2 Environment

① Do not operate or store in high temperature, high humidity, dewdrop atmosphere or corrosive gases. Keep the product in packing box with antistatic pouch in room temperature to avoid dusts and sunlight, when storing the product.
② In order to prevent dew condensation occurred by temperature difference, the product packing box must be opened after enough time being left under the environment of an unpacking room. Evaluate the storage time sufficiently because dew condensation is affected by the environmental temperature and humidity. (Recommended leaving time: 6 hours or more with the original packing state after a customer receives the package)
③ Do not operate in high magnetic field. If not, circuit boards may be broken.
④ This product is not designed as radiation hardened.

10.3.3 Characteristics

The following items are neither defects nor failures.

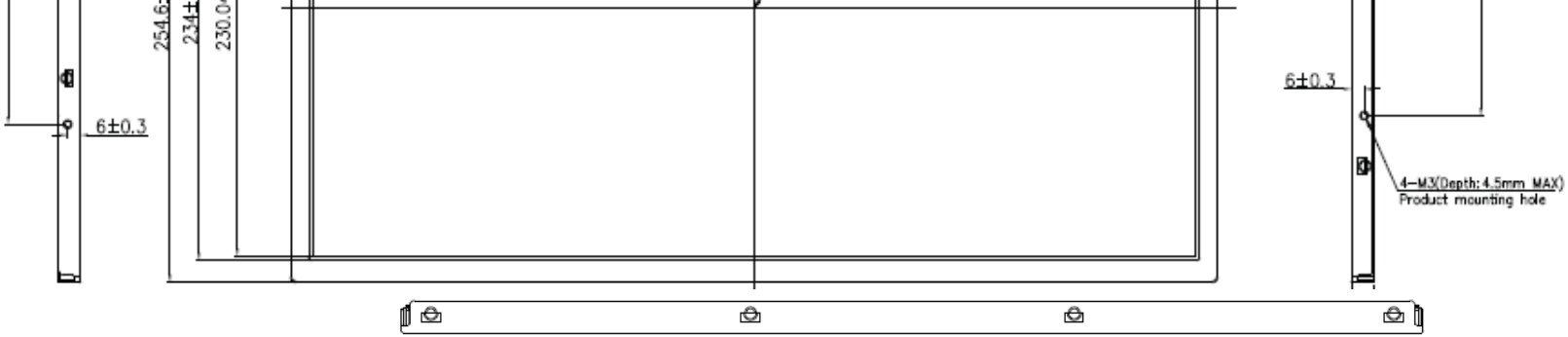
① Characteristics of the LCD (such as response time, luminance, color uniformity and so on) may be changed depending on ambient temperature. If the product is stored under condition of low temperature for a long time, it may cause display mura. In this case, the product should be operated after enough time being left under condition of operating temperature.
② Display mura, flickering, vertical streams or tiny spots may be observed depending on display patterns.
③ Do not display the fixed pattern for a long time because it may cause image sticking. Use a screen saver, if the fixed pattern is displayed on the screen.
④ The display color may be changed depending on viewing angle because of the use of condenser sheet in the backlight.
⑤ Optical characteristics may be changed depending on input signal timings.

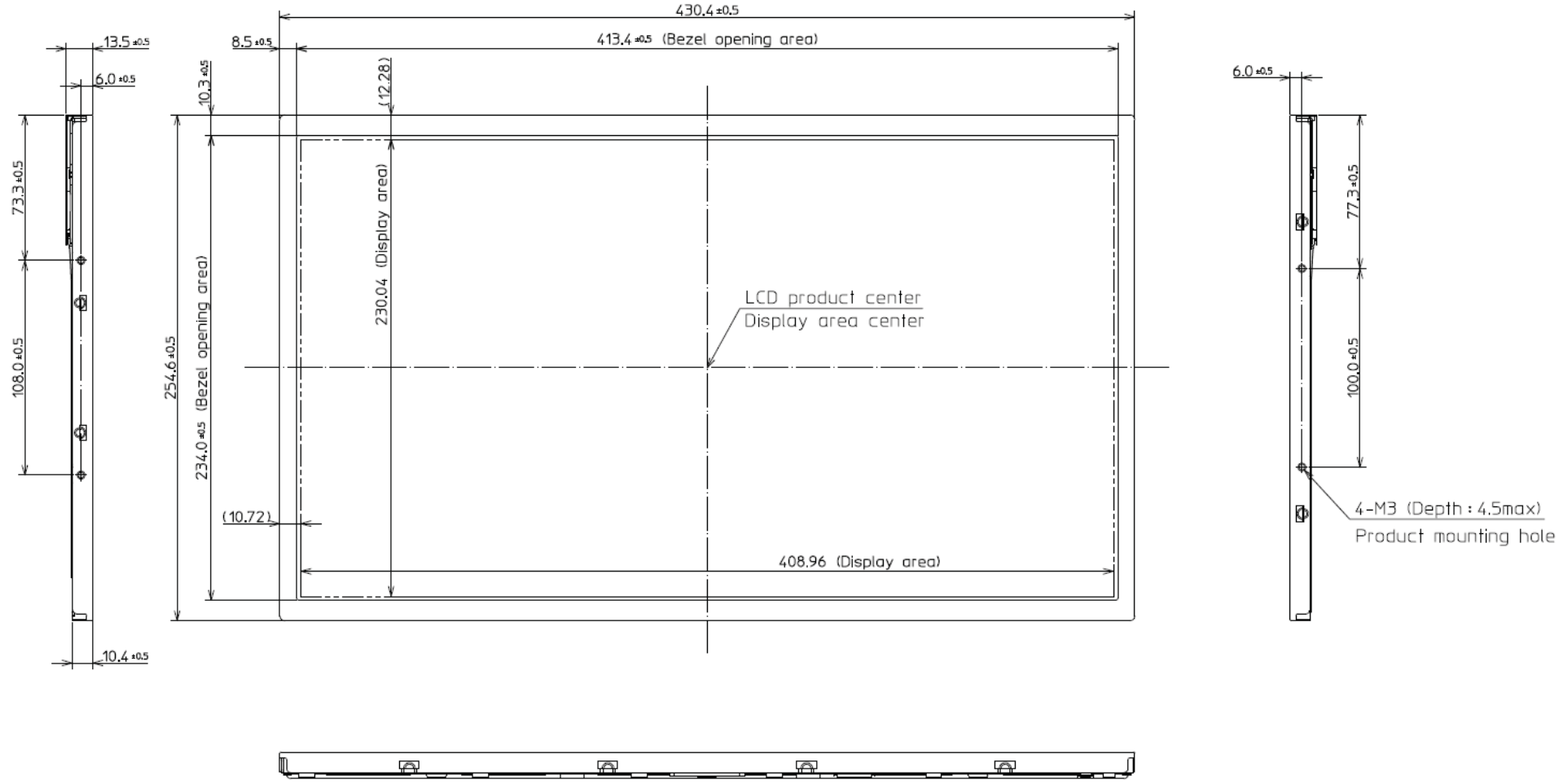
10.3.4 Others

① All GND, VCC and VDD terminals should be used without any non-connected lines.
② Do not disassemble a product or adjust variable resistors.
③ Pack the product with the original shipping package, in order to avoid any damages during transportation, when returning the product to Tianma for repairing and so on.
④ The information of China RoHS (Ⅱ) six hazardous substances or elements in this product is as follows.

China RoHS (Ⅱ) six hazardous substances or elements					
Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr VI)	Polybrominated Biphenys (PBB)	Polybrominated Biphenyl Ethers (PBDE)
TBD	TBD	TBD	TBD	TBD	TBD

Note1: ○: This indicates that the poisonous or harmful material in all the homogeneous materials for this part is equal or below the limitation level of GB/T26572-2011 standard regulation.
×: This indicates that the poisonous or harmful material in all the homogeneous materials for this part is above the limitation level of GB/T26572-2011 standard regulation.

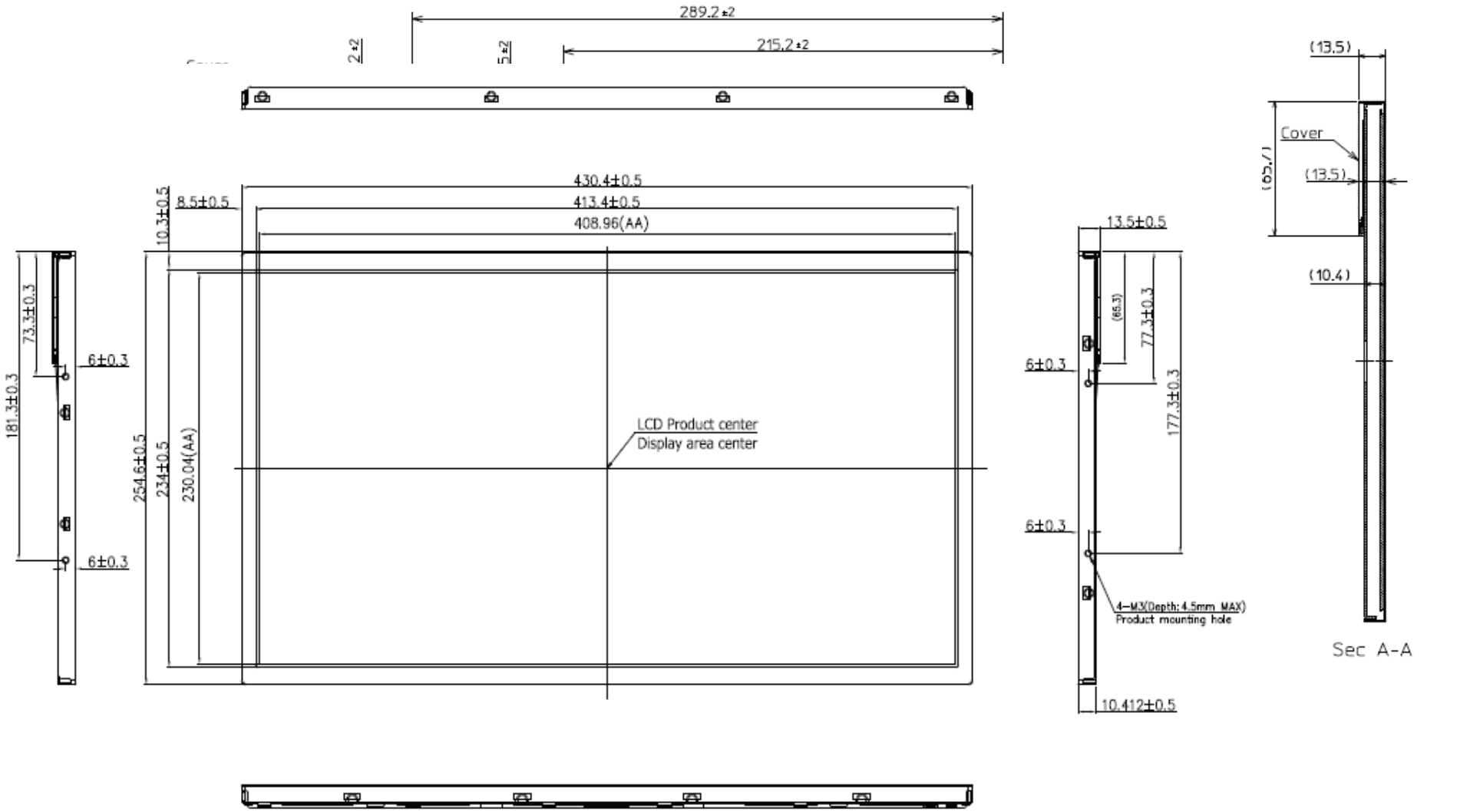




Unit: mm

Note1: The values in parentheses are for reference.
Note2: The torque for product mounting screws must never exceed 0.735N·m. And the length of product mounting screws must be ≤ 4.5mm.

11.2 REAR VIEW



Unit: mm

Note1: The values in parentheses are for reference.

REVISION HISTORY

The inside of latest specifications is revised to the clerical error and the major improvement of previous edition. Only a changed part such as functions, characteristic value and so on that may affect a design of customers, are described especially below.

Edition	Document number	Prepared date	Revision contents and signature
1st edition	PDB-工业 1-19-C-116	Sep. 17, 2019	**Revision contents** First issue