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1. OVERVIEW

ATM1010D9 is 10.1" color TFT-LCD (Thin Film Transistor Liquid Crystal Display) module composed of LCD panel, driver ICs ,control circuit and LED backlight. By applying 1024x600 images are displayed on the 10.1" diagonal screen. Display 16.2M colors by R.G.B signal input.

General specifications are summarized in the following table:

ITEM	SPECIFICATION			
Display Area (mm)	222.72(W) x 125.28(H)			
Number of Pixels	1024(H) x 3 (RGB) x 600(V)			
Pixel Pitch (mm)	0.2175(W) x 0.2088(H)			
Color Pixel Arrangement	RGB vertical stripe			
Display Mode	Normally white			
Number of Colors	16.2M			
Brightness (cd/m ²)	850 (Typ)			
Response Time (ms)	25 (Typ.)			
Optimum Viewing Direction	6 O'clock(Max contrast ratio,Gray level inversion)			
Contrast Ratio	600:1 (typ)			
Viewing Angle (CR \geq 10)	140degree (Horizontal.)			
	120degree (Vertical)			
Power Consumption (W)	3.16 (Typ)			
Interface connection	TTL			
Module Size (mm)		Min.	Typ.	Max.
	Horizontal(H)	234.7	235	235.3
	Vertical(V)	142.7	143	143.3
	Depth(D)	4.7	5.0	5.3
Module Weight (g)	285 (Typ)			
Backlight Unit	LED			
Surface Treatment	Anti-Glare			

2. ABSOLUTE MAXIMUM RATINGS

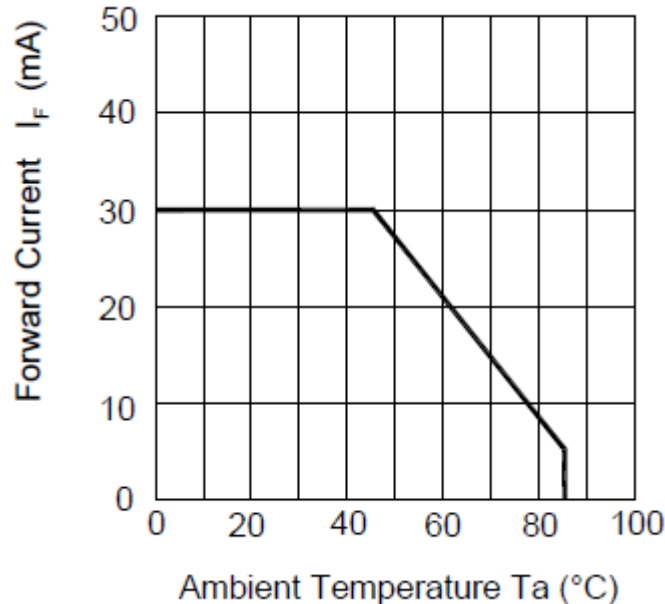
The following are maximum values which, if exceeded, may cause faulty operation or damage to the unit.

Item	Symbol	Min.	Max.	Unit	Note
Digital Supply Voltage	DVDD DVDD_LVDS	-0.3	3.96	V	
Analog Supply Voltage	AVDD	-0.5	14.85	V	
Gate On Voltage	VGH	-0.3	40	V	
Gate Off Voltage	VGL	-20	0.3	V	
Gate On-Gate Off Voltage	VGH-VGL	12	40	V	
Signal Input Voltage	NIND0 ~ NIND3 PIND0 ~ PIND3 NINC,PINC	-0.5	5	V	
Forward Current (per LED)	If	-	30	mA	
Reverse Voltage (per LED)	VR	-	5	V	
Pulse forward current (per LED)	Ifp	-	100	mA	Note 1、 2
Operating temperature	Topa	-20	70	°C	Note 3
Storage temperature	Tstg	-30	80	°C	Note 3

Note1: Ifp Conditions : Pulse Width \leq 10msec; Duty \leq 1/10

Note2: perating must under the condition as below drawing.

(Ambient Temperature /Allowable Forward Current) Each LED



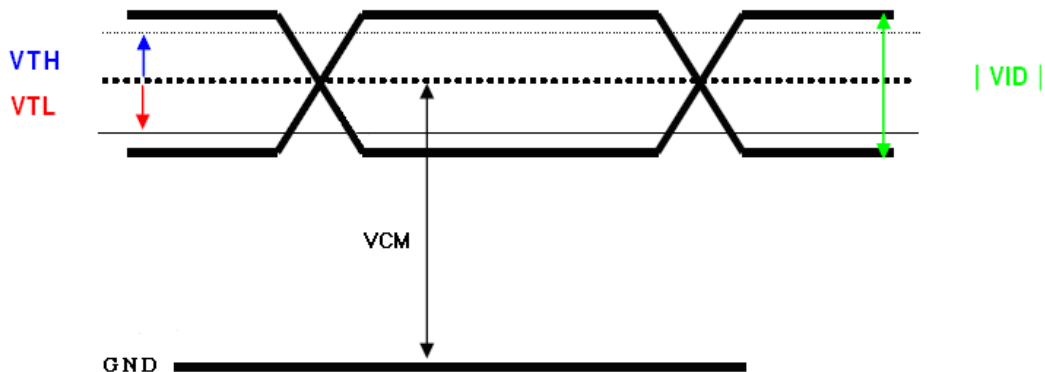
Note3: If users use the product out off the environmental operation range (temperature and humidity) , it will have visual quality concerns.

3. ELECTRICAL CHARACTERISTICS

3.1 TFT LCD

ITEM	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Digital Power Supply Voltage For LCD	DVDD VDD_LVDS	3	3.3	3.6	V	
Logic Input Voltage (LVDS:IN+,IN-)	VCM	$\frac{ VID }{2}$	-	$2.4 - \frac{ VID }{2}$	V	Note1
	VID	200	-	600	mV	Note1
	VTH	-	-	100	mV	VCM=1.2V Note1
	VTL	-100	-	-	mV	
Analog Power Supply Voltage	AVDD	9.4	9.6	9.8	V	
Gate On Power Supply Voltage	VGH	17	18	19	V	
Gate Off Power Supply Voltage	VGL	-6.6	-6	-5.4	V	
Common Power Supply Voltage	VCOM	3.8	4.0	4.2	V	Note2
Gamma Voltage	V1	-	9.450	-	V	
	V2	-	8.762	-	V	
	V3	-	7.559	-	V	
	V4	-	7.146	-	V	
	V5	-	6.859	-	V	
	V6	-	6.336	-	V	
	V7	-	5.524	-	V	
	V8	-	4.947	-	V	
	V9	-	4.045	-	V	
	V10	-	3.295	-	V	
	V11	-	2.882	-	V	
	V12	-	2.406	-	V	
	V13	-	0.983	-	V	
	V14	-	0.205	-	V	

【Note1】 LVDS signal



【Note2】 Please adjust VCOM to make the flicker level be minimum.

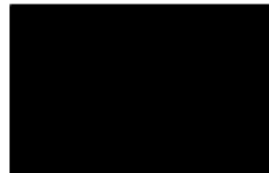
3.2 TFT-LCD Current Consumption

Item	Symbol	Condition	Min.	Typ.	Max.	Unit.	Note.
Gate on Current	IVGH	VGH = 18V	-	0.5	1	mA	【Note1】
Gate off Current	IVGL	VGL = -6V	-	0.5	1	mA	【Note1】
Digital Current	IDVDD	DVDD = 3.3V	-	40	50	mA	【Note1】
Analog Current	IAVDD	AVDD = 9.6V	-	35	45	mA	【Note1】
Total Power Consumption	PC		-	480	621	mW	【Note1】

Note1: Typical: Under 256 gray pattern
Maximum: Under black pattern



256 gray pattern

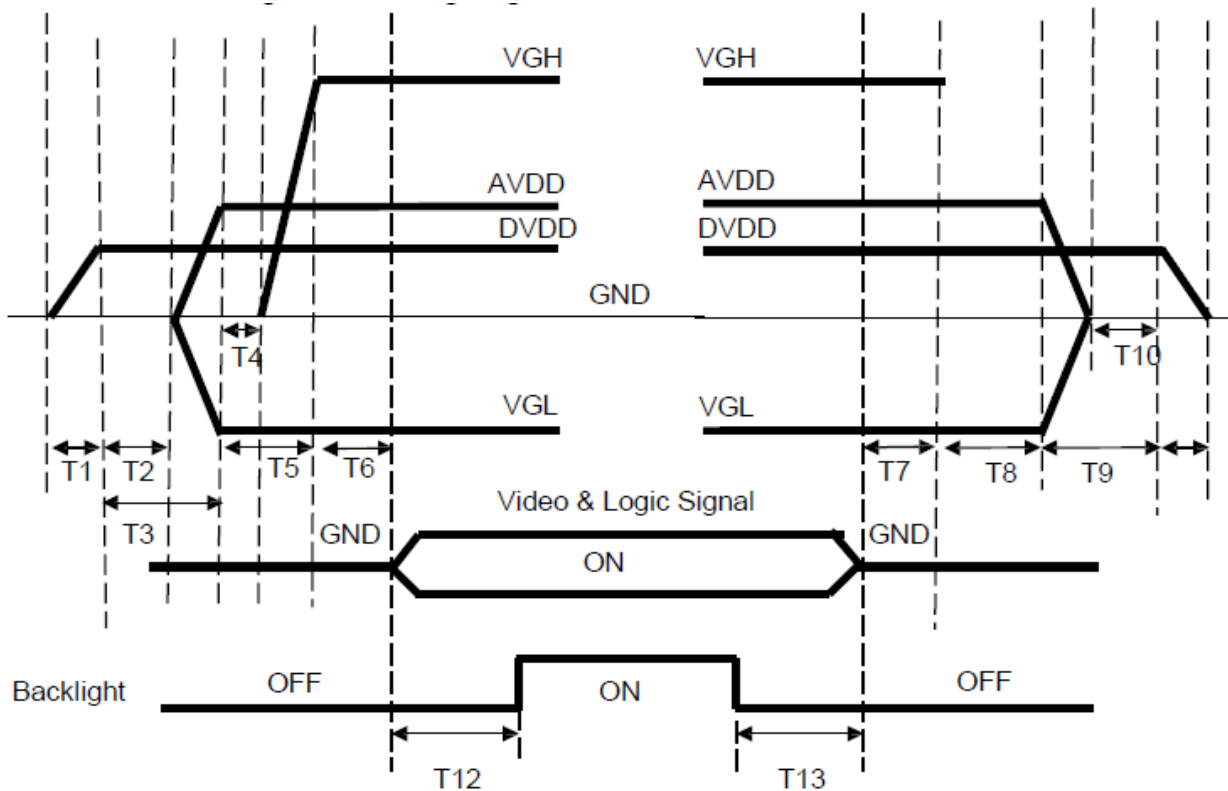


Black Pattern

3.3 Power, Signal sequence

Power On : DVDD→AVDD/VGL →VGH →Video & Logic Signal→Backlight

Power Off : Backlight→Video & Logic Signal→ VGH→AVDD/VGL→DVDD



$0 < T1 \leq 10\text{ms}$
 $T2 > 0\text{ms}$
 $T3 > 20\text{ms}$
 $T4 > 0\text{ms}$
 $T5 > 10\text{ms}$
 $0 < T6 \leq 10\text{ms}$
 $T12 \geq 200\text{ms}$

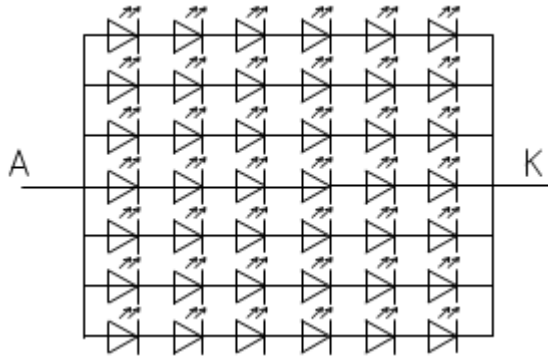
$T7 > 0\text{ms}$
 $T8 > 0\text{ms}$
 $T9 > 0\text{ms}$
 $T10 > 0\text{ms}$
 $0 < T11 \leq 10\text{ms}$
 $T13 \geq 200\text{ms}$

3.4 Backlight

ITEM	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT	NOTE
LED current	IL	Ta=25°C (60mA/serise)	--	420	--	mA	
LED voltage	VL	Ta=25°C (60mA/serise)	18.0	19.0	20.0	V	
Power consumption	WL	Ta=25°C (60mA/serise)	--	7980	--	W	
LED Lifetime	-	Ta=25°C IF=60mA	20000	--	--	Hr	

Remarks:

*1)LED Circuit Diagram



*2) A: Anode(+), K: Cathode(-)

*3) Suggestion: Using the constant current control to avoid the leakage light and brightness quality issue.

*4) Definition of Led lifetime: Luminance < Initial luminance 50%.

4. INTERFACE CONNECTION

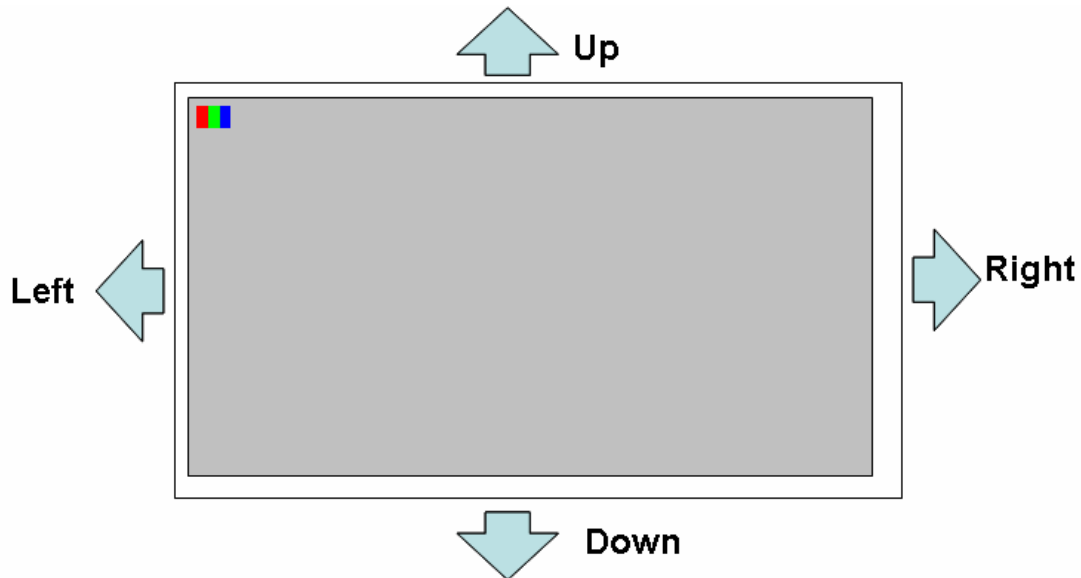
4.1 CN1 (Input Signal)

Pin NO.	Symbol	Description	Note
1	LED+	LED Anode	
2	LED+	LED Anode	
3	LED-	LED Cathode	
4	LED-	LED Cathode	
5	GND	Ground	
6	VCOM	Common Voltage	
7	DVDD	Digital Power	
8	MODE	DE/SYNC mode select. Normally pull high H: DE mode. L: HSD/VSD mode	
9	DEN	Data Enable signal	
10	VSD	Vertical sync input. Negative polarity	
11	HSD	Horizontal sync input. Negative polarity	
12	B7	Blue Data Input(MSB)	
13	B6	Blue Data Input	
14	B5	Blue Data Input	
15	B4	Blue Data Input	
16	B3	Blue Data Input	
17	B2	Blue Data Input	
18	B1	Blue Data Input	
19	B0	Blue Data Input(LSB)	
20	G7	Green Data Input(MSB)	
21	G6	Green Data Input	
22	G5	Green Data Input	
23	G4	Green Data Input	
24	G3	Green Data Input	
25	G2	Green Data Input	
26	G1	Green Data Input	
27	G0	Green Data Input(LSB)	
28	R7	Red Data Input(MSB)	
29	R6	Red Data Input	
30	R5	Red Data Input	
31	R4	Red Data Input	
32	R3	Red Data Input	
33	R2	Red Data Input	
34	R1	Red Data Input	
35	R0	Red Data Input(LSB)	
36	GND	Power ground	
37	DCLK	Clock input	
38	GND	Power ground	
39	SHLR	Left or Right Display Control	Note 1
40	UPDN	Up / Down Display Control	Note 1
41	VGH	Positive Power for TFT	
42	VGL	Negative Power for TFT	
43	AVDD	Analog Power	
44	RESET	Global reset pin. Active low to enter reset state. Suggest to connecting with an RC reset circuit for stability.	
45	NC	Not connect	
46	VCOM	Common Voltage	
47	DITH	Dithering setting DITH="H" 6bit resolution(last 2 bit of input data truncated) DITH="L" 8bit resolution(default setting)	
48	GND	Power ground	
49	NC	Not connect	
50	NC	Not connect	

Remarks : Mating connector : 089K60-000100-G2-R(STARCONN)

Note 1 : UPDN and SHLR control function

UPDN	SHLR	FUNCTION
0	1	Normal display
0	0	Inverse Left and Right
1	1	Inverse Up and Down
1	0	Inverse Left and Right Inverse Up and Down



4.2 CN2 (LED backlight)

PIN NO	SYMBOL	FUNCTION
1	A	Anode
2	K	Cathode

Note :

Maker:JST

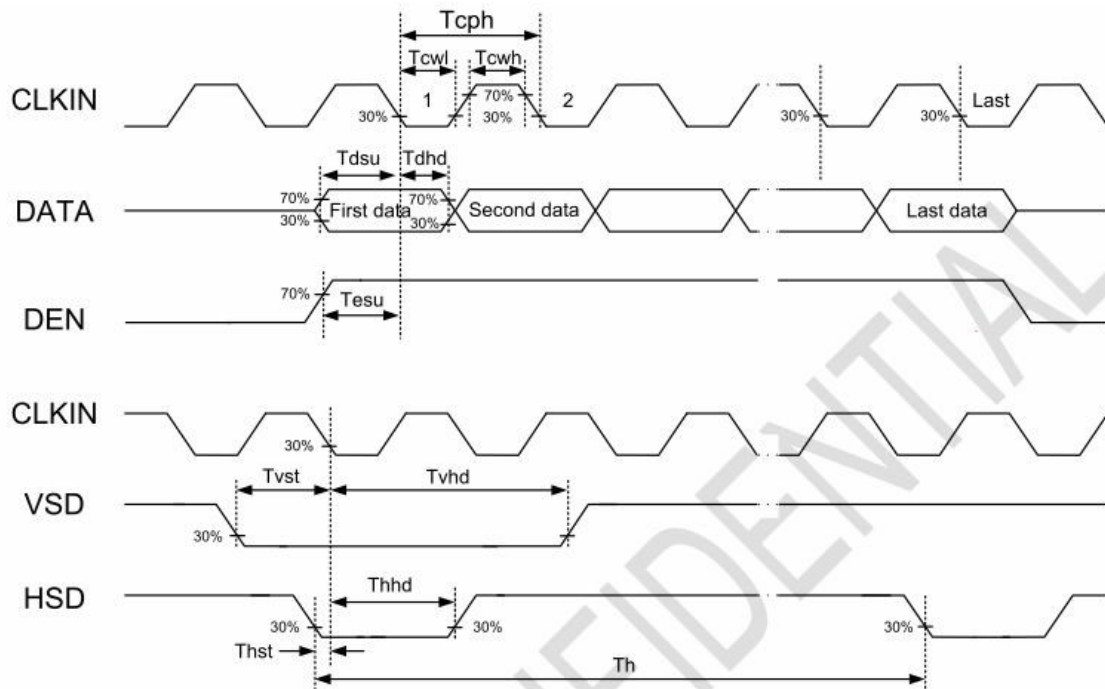
Input connector : BHSR-02VS-1(JST)

Outlet connector: SM02B-BHSS-1(JST)

5. INPUT SIGNAL(DE ONLY MODE)

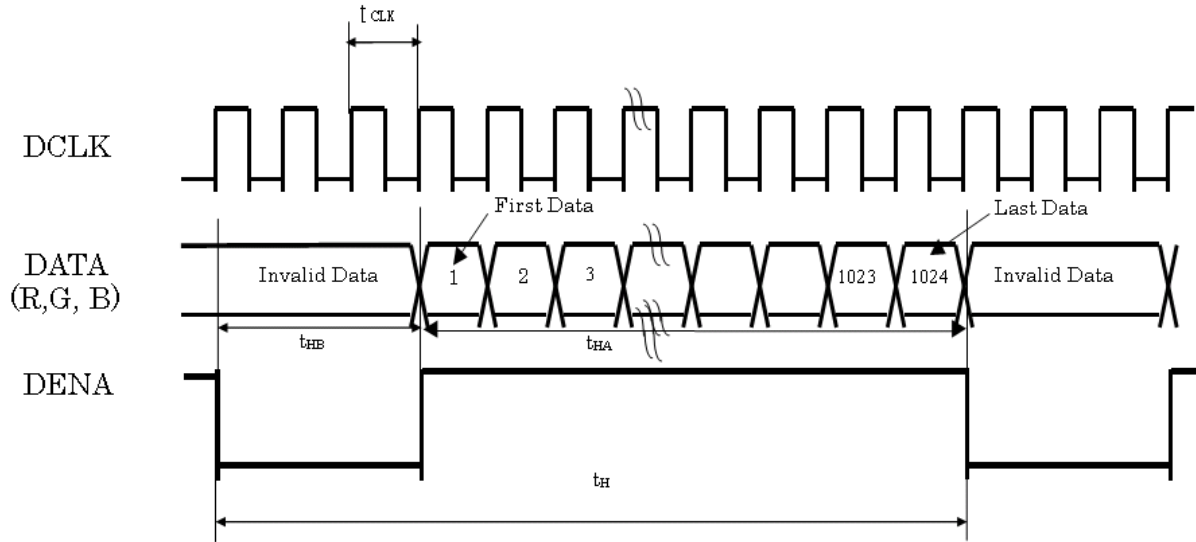
5.1 Timing characteristics of input signals

	ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	Note
DCLK	Dot Clock	$1/t_{CLK}$	45	51.2	57	MHZ	
	DCLK pulse duty	T_{cwh}	40	50	60	%	
DE	Setup Time	T_{esu}	5	-	-	ns	
	Hold time	T_{ehd}	5	-	-	ns	
	Horizontal total Time	t_H	1324	1344	1364	t_{CLK}	
	Horizontal Valid	t_{HA}	1024			t_{CLK}	
	Horizontal Blank	t_{HB}	300	320	340	t_{CLK}	
	Vertical total Time	t_V	625	635	645	t_H	
	Vertical Valid	t_{VA}	600			t_H	
	Vertical Blank	t_{VB}	25	35	45	t_H	
SYNC	HSYNC Setup Time	T_{hst}	5	-	-	ns	
	HSYNC Hold Time	T_{hhd}	5	-	-	ns	
	VSYNC Setup Time	T_{vst}	5	-	-	ns	
	VSYNC Hold Time	T_{vhd}	5	-	-	ns	
	Horizontal total Time	t_H	1324	1344	1364	t_{CLK}	
	Horizontal Pulse Width	t_{HPW}		20	-	t_{CLK}	$t_{HB} + t_{HPW} = 160DCLK$ is fixed
	Horizontal Back Porch	t_{HB}		140	-	t_{CLK}	
	Horizontal Front Porch	t_{HFP}	140	160	180	t_{CLK}	
	Horizontal Valid	t_{HV}	1024			t_{CLK}	
	Vertical total Time	t_V	625	635	645	t_H	
	Vertical Pulse Width	t_{VPW}		3	-	t_H	$t_{VPW} + t_{VB} = 23t_H$ is fixed
	Vertical Back Porch	t_{VB}	-	20	-	t_H	
	Vertical Front Porch	t_{VFP}	2	12	22	t_H	
	Vertical Valid	t_{VV}	600			t_H	
DATA	Setup Time	T_{dsu}	5	-	-	ns	
	Hold Time	T_{dhd}	5	-	-	ns	

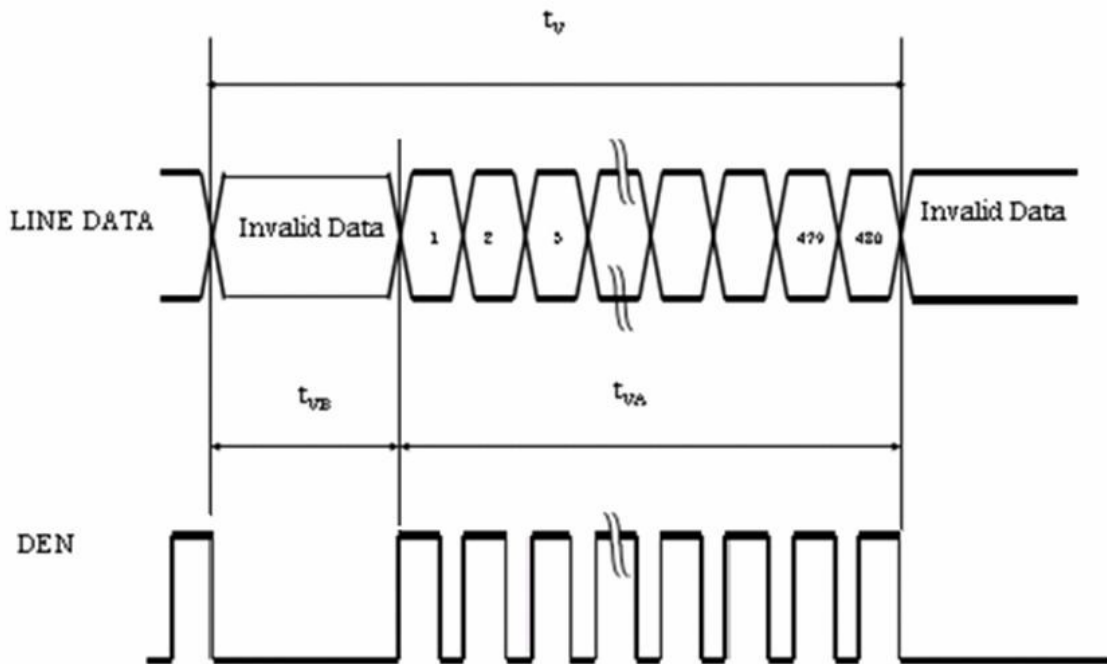


5.2 Timing Sequence(Timing Chart)

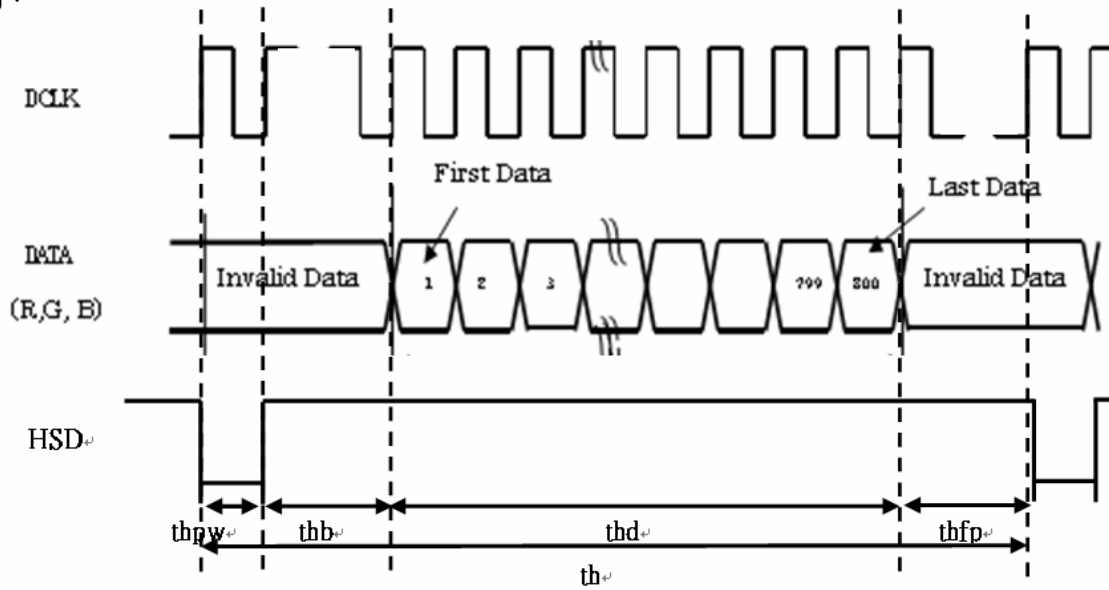
5.2.1 Horizontal Timing Sequence



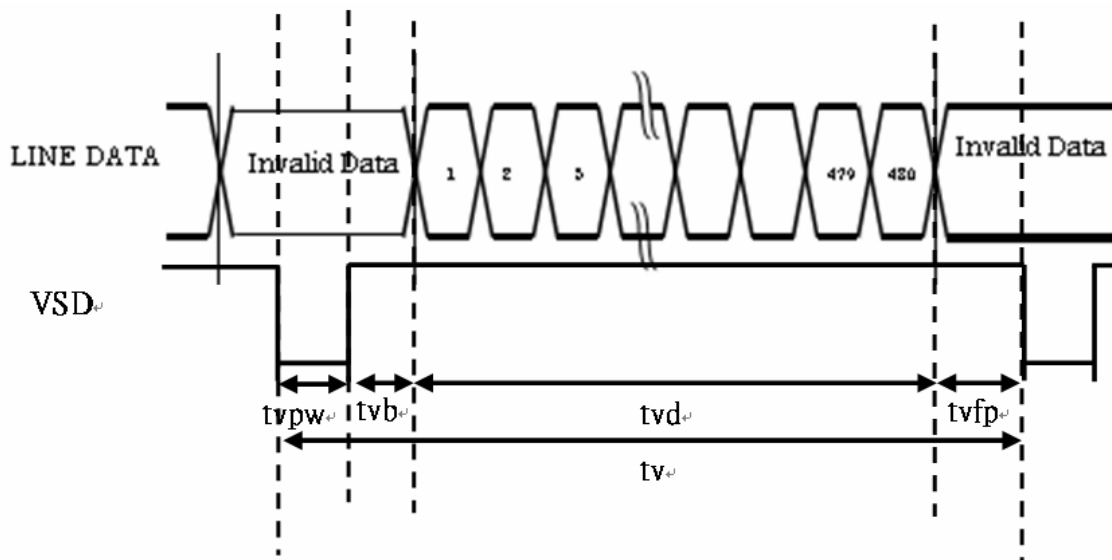
5.2.2 Vertical Timing Sequence



SYNC mode Horizontal timing :



Vertical timing:

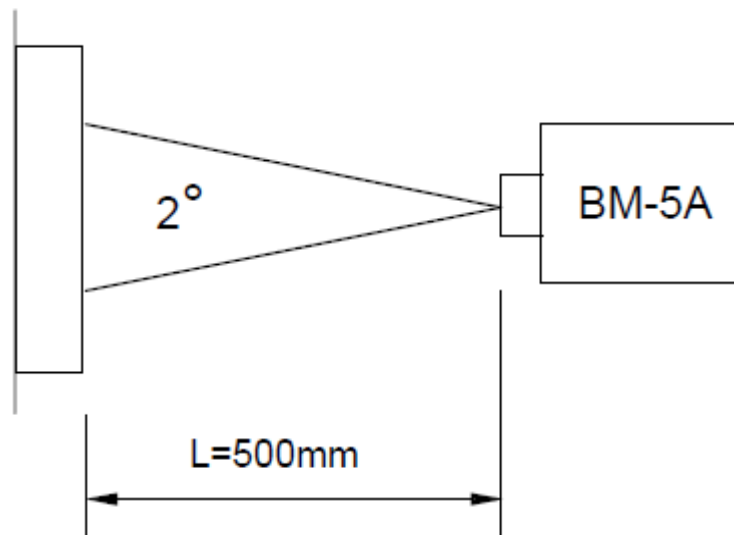


6. OPTICAL CHARACTERISTICS

Ta = 25°C, VCC=3.3V

ITEM	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT	NOTE	
Constrast Ratio	CR	Point-5	500	600	--	--	1, 2, 3	
Luminance(CEN)	Lw	Point-5	800	850	--	cd/m ²	1, 3	
Luminance Uniformity	-L		70	80	--	%	1, 3	
Response Time (White - Black)	Tr +Tf	Point-5	--	25	40	ms	1, 3, 5	
NTSC	-	Point-5	45	50	--	%	1, 4	
Viewing Angle	Vertical	Upper(θ)	CR≥10 Point-5	60	70	--	°	1, 4
		Down(θ)		40	50	--		1, 4
	Horizontal	Left(ψ)		60	70	--		1, 4
		Right(ψ)		60	70	--	°	1, 4
Color Coordinate	White	Wx	Point-5	0.273	0.313	0.353	--	1, 3
		Wy		0.289	0.329	0.369		
	Red	Rx		0.550	0.590	0.630		
		Ry		0.300	0.340	0.380		
	Green	Gx		0.301	0.341	0.381		
		Gy		0.554	0.594	0.634		
	Blue	Bx		0.117	0.157	0.197		
		By		0.075	0.115	0.155		

Note1: Measure condition: 25°C±2°C, 60±10%RH, under10 Lux in the dark room.BM-5A (TOPCON), viewing angle2°, IL=420 mA (Backlight current) , measurement after lighting on 10 mins



Note2: Definition of contrast ratio:

$$\text{Contrast Ratio (CR)} = (\text{White}) \text{ Luminance of ON} \div (\text{Black}) \text{ Luminance of OFF}$$

Note3: Definition of luminance : Measure white luminance on the point 5 as figure.6-1

Definition of Luminance Uniformity: Measure white luminance on the point1~9 as figure.6-1

$$\Delta L = [L(\text{MIN})/L(\text{MAX})] \times 100$$

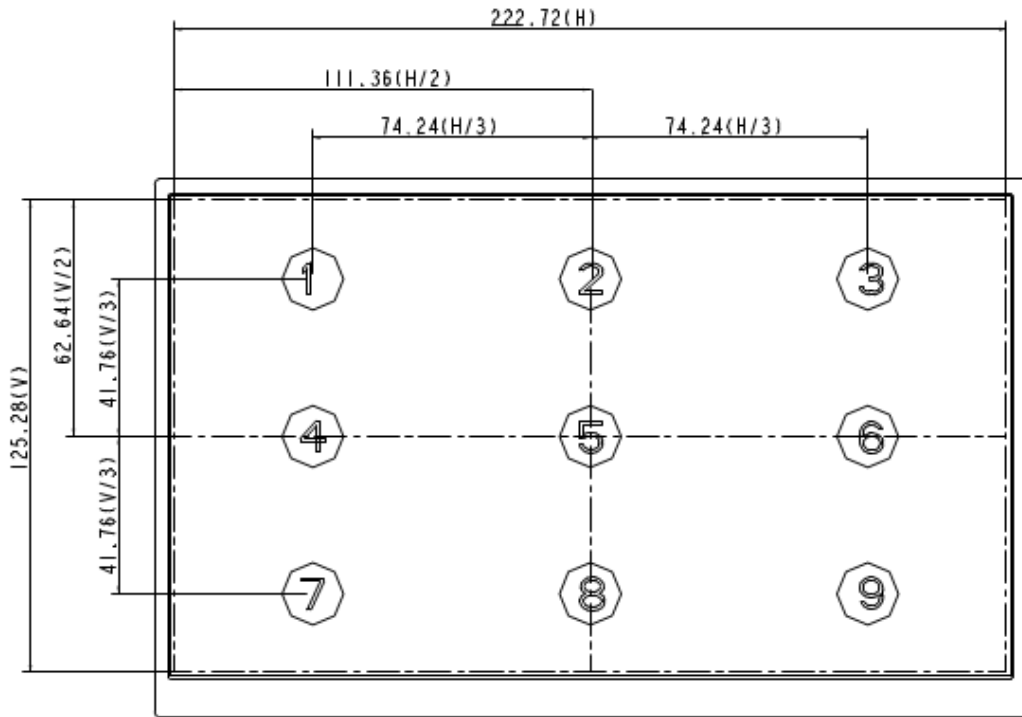


Fig.7-1 Measuring point

Note 4: Definition of Viewing Angle(θ, ψ),refer to Fig.7-2 as below

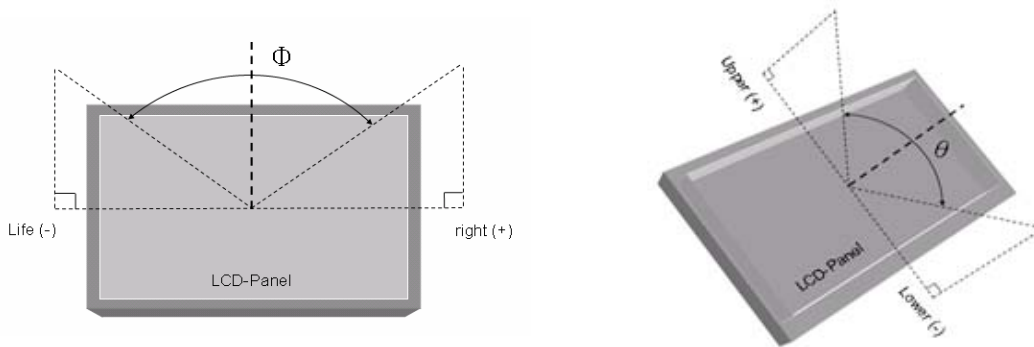


Fig.7-2 Definition of Viewing Angle

Note5: Definition of Response Time.(White-Black)

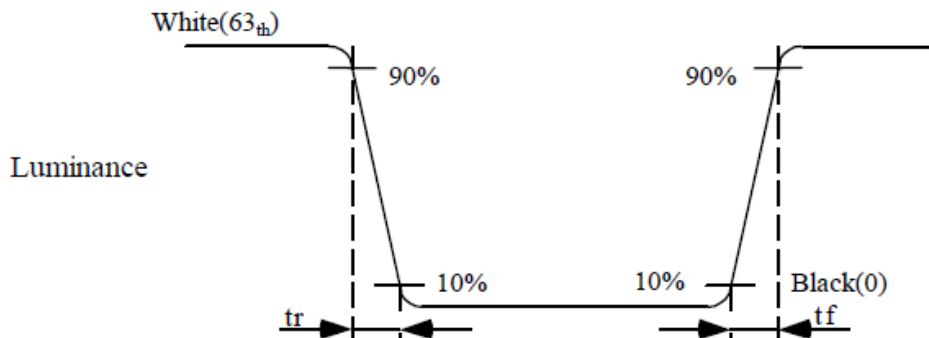


Fig.7-3 Definition of Response Time(White-Black)

7. RELIABILITY TEST

7.1 Temperature and humidity

TEST ITEMS	CONDITIONS	NOTE
High Temperature Operation	70°C ;240hrs	
High Temperature Storage	80°C ; 240hrs	
High Temperature High Humidity Operation	60°C ; 90%RH ;240hrs	No condensation
Low Temperature Operation	-20°C ; 240hrs	Backlight unit always turn on
Low Temperature Storage	-30°C ; 240hrs	
Thermal Shock	-30°C(0.5hr) ~ 80°C(0.5hr) ; 200 Cycles	
Image Sticking	25 °C± 2 °C ; 4hrs	Note 1

Note 1.:

Condition of Image Sticking test: 25 °C± 2 °C

Operation with test pattern sustained for 4hrs, then change to gray pattern immediately.

After 5 mins, the mura must be disappeared completely

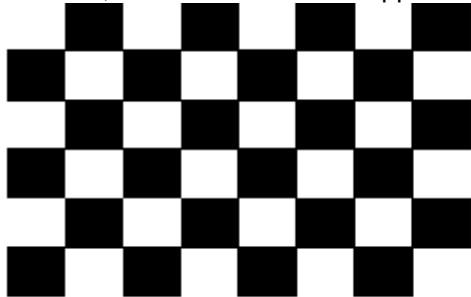


Image Sticking -pattern



Mid-Gray pattern

7.2 Shock and Vibration

TEST ITEMS	CONDITIONS
Shock (Non-operation)	<ul style="list-style-type: none"> Shock level: 980m/s²(equal to 100G). Waveform: half sinusoidal wave,6ms. Number of shocks: ±X,±Y,±Z axes for a total of six shock inputs.
Vibration (Non-operation)	<ul style="list-style-type: none"> Frequency range:8~33.3Hz Stoke : 1.3 mm Vibration: sinusoidal wave, perpendicular axis(both x, z axis: 2hrs ,y axis: 4hrs). Sweep: 2.9G,33.3 Hz-400 Hz Cycle time: 15 min

7.3 Electrostatic Discharge

TEST ITEM	CONDITIONS	Note
ESD	150pF , 330Ω , ±8kV&±15kV air& contact test	1
	200pF , 0Ω , ±200V contact test	2

Note: Measure

1: LCD glass and metal bezel

2: IF connector pins

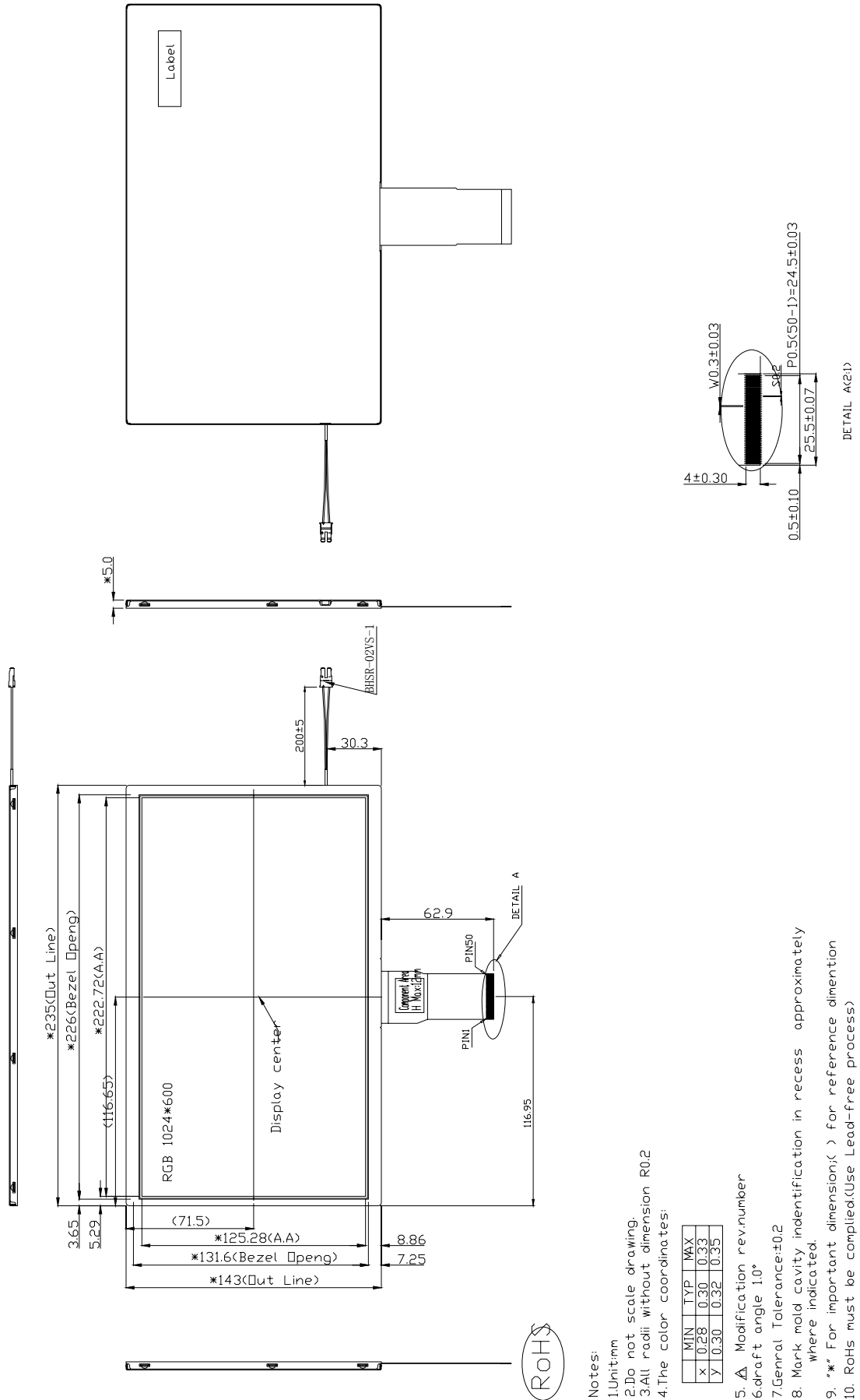
7.4 Judgment Standard

The judgment of the above test should be made as follow:

Pass: Normal display image with no obvious non-uniformity and no line defect.Partial transformation of the module parts should be ignored.

Fail: No display image, obvious non-uniformity, or line defects.

8. OUTLINE DIMENSION



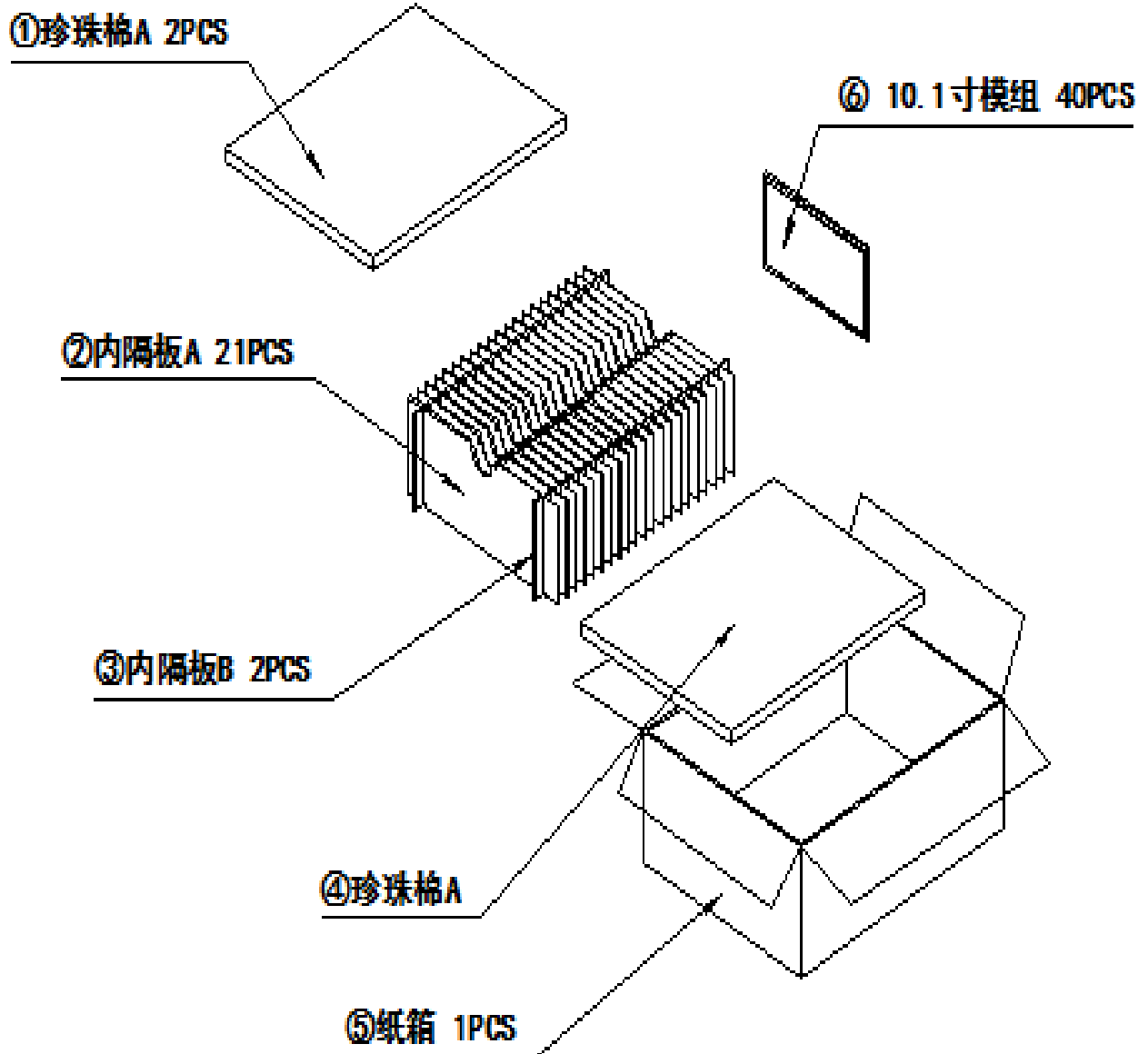
Notes:

1. Unit:mm
2. Do not scale drawing.
3. All radii without dimension R0.2
4. The color coordinates:

	MIN	TYP	MAX
X	0.28	0.30	0.33
Y	0.30	0.32	0.35

5. Δ Modification rev.number
6. draft angle 1.0°
7. Genral Tolerance:±0.2
8. Mark mold cavity indentification in recess approximately where indicated.
9. "*" For important dimension;() for reference dimension
10. RoHS must be complied.(Use Lead-free process)

9. PACKING FROM



10. WARRANTY

10.1 The period is within 12 months since the date of shipping out under normal using and storage conditions.

10.2 The warranty will be avoided in case of defect induced by customer