

Doc. Number : **MT190EN02 V.W-DR4-26**

- ☐ Tentative Specification
☐ Preliminary Specification
☒ Approval Specification

MODEL NO.: MT190EN02
SUFFIX: V.W

Customer:**APPROVED BY****SIGNATURE****Name / Title**

Note

Please return 1 copy for your confirmation with your signature and comments.

Approved By	Checked By	Prepared By

MT190EN02 V.W LCD MODULE SPECIFICATION



Department		Prepared by	Checked by
MKT			
PD	EE		
	ME		
	POFA		
RA			
PE			

Document Number: MT190EN02 V.W-DR4-26

**CONTENTS**

1. GENERAL DESCRIPTION	7
1.1 OVERVIEW	7
1.2 GENERAL SPECIFICATIONS	7
2. MECHANICAL SPECIFICATIONS	7
3. ABSOLUTE MAXIMUM RATINGS	7
3.1 ABSOLUTE RATINGS OF ENVIRONMENT	7
3.2 ELECTRICAL ABSOLUTE RATINGS	8
3.2.1 TFT LCD MODULE	8
3.2.2 BACKLIGHT UNIT	8
4. ELECTRICAL SPECIFICATIONS	9
4.1 FUNCTION BLOCK DIAGRAM	9
4.2. INTERFACE CONNECTIONS	9
4.3 ELECTRICAL CHARACTERISTICS	11
4.3.1 LCD ELETRONICS SPECIFICATION	11
4.3.2 Vcc Power Dip Condition	13
4.3.3 BACKLIGHT UNIT (LED matrix is 10S12P)	13
4.3.4 LIGHTBAR Connector Pin Assignment	14
4.4 LVDS INPUT SIGNAL SPECIFICATIONS	15
4.4.1 LVDS DATA MAPPING TABLE	15
4.4.2 COLOR DATA INPUT ASSIGNMENT	15
4.5 DISPLAY TIMING SPECIFICATIONS	17
4.6 POWER ON/OFF SEQUENCE	19
5. OPTICAL CHARACTERISTICS	20
5.1 TEST CONDITIONS	20
5.2 OPTICAL SPECIFICATIONS	20
6. RELIABILITY TEST ITEM	23
7. PACKING	24
7.1 PACKING SPECIFICATIONS	24
7.2 PACKING METHOD	24
7.3 PALLET	25
8. CMI MODULE LABEL	26
9. PRECAUTIONS	28
9.1 ASSEMBLY AND HANDLING PRECAUTIONS	28
9.2 STORAGE PRECAUTIONS	28
9.3 OPERATION PRECAUTIONS	28



9.4 SAFETY PRECAUTIONS	28
9.5 SAFETY STANDARDS	29
9.6 OTHER	29
Appendix. OUTLINE DRAWING	29

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REVISION HISTORY

Record of Revision																																																																																							
Version	Revise	Page	Content																																																																																				
2.0	2010-8-27	All	First edition to all Spec.																																																																																				
2.1	2010-10-15	17	The Value of timing specification T1=0.1 update to 0.5																																																																																				
		21	Update altitude test operation:10000ft to 16400ft Non-operation:30000ft to 40000ft,																																																																																				
3.0	2011-5-11	12	Add a drawing about the Lightbar Connector																																																																																				
3.1	2011-12-21	7	3.2.2 <table><tr><th colspan="7">3.2.2 BACKLIGHT UNIT</th></tr><tr><th>Item</th><th>Symbol</th><th>Min.</th><th>Typ.</th><th>Max.</th><th>Unit</th><th>Note</th></tr><tr><td>LED Forward Current Per input Pin</td><td>I_f</td><td>0</td><td>50</td><td>55</td><td>mA</td><td>(1), (2)</td></tr><tr><td>LED Reverse Voltage Per input Pin</td><td>V_r</td><td>—</td><td>—</td><td>50</td><td>V</td><td>Duty=100%</td></tr><tr><td>LED Pulse Forward Current Per input Pin</td><td>I_p</td><td>—</td><td>—</td><td>350</td><td>mA</td><td>(1), (2) Pulse Width ≤ 10ms; and Duty ≤ 10%</td></tr></table> To <table><tr><th colspan="7">3.2.2 BACKLIGHT UNIT</th></tr><tr><th>Item</th><th>Symbol</th><th>Min.</th><th>Typ.</th><th>Max.</th><th>Unit</th><th>Note</th></tr><tr><td>LED Forward Current Per input Pin</td><td>I_f</td><td>0</td><td>66</td><td>68.6</td><td>mA</td><td>(1), (2)</td></tr><tr><td>LED Reverse Voltage Per input Pin</td><td>V_r</td><td>—</td><td>—</td><td>50</td><td>V</td><td>Duty=100%</td></tr><tr><td>LED Pulse Forward Current Per input Pin</td><td>I_p</td><td>—</td><td>—</td><td>350</td><td>mA</td><td>(1), (2) Pulse Width ≤ 10ms; and Duty ≤ 10%</td></tr></table>	3.2.2 BACKLIGHT UNIT							Item	Symbol	Min.	Typ.	Max.	Unit	Note	LED Forward Current Per input Pin	I _f	0	50	55	mA	(1), (2)	LED Reverse Voltage Per input Pin	V _r	—	—	50	V	Duty=100%	LED Pulse Forward Current Per input Pin	I _p	—	—	350	mA	(1), (2) Pulse Width ≤ 10ms; and Duty ≤ 10%	3.2.2 BACKLIGHT UNIT							Item	Symbol	Min.	Typ.	Max.	Unit	Note	LED Forward Current Per input Pin	I _f	0	66	68.6	mA	(1), (2)	LED Reverse Voltage Per input Pin	V _r	—	—	50	V	Duty=100%	LED Pulse Forward Current Per input Pin	I _p	—	—	350	mA	(1), (2) Pulse Width ≤ 10ms; and Duty ≤ 10%														
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		10	4.3.1 Add Vic Min=1.0, Vin Max=1.4																																																																																				
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3.2	2011-12-27	6	Add Color Gamut: 72% of NTSC(CIE1931),84% of NTSC(CIE 1976)																																																																																				
		16	4.5 Change Vtotal Max =1150 to Max=1186, Pixel clock Min = 45 to Min=40 V freq Max = 75 to Max=76																																																																																				
3.3	2012-1-5	17	4.5 Add Note(4): Note (4) The DCLK range at last line of V-blanking should be set in 0 to Hdisplay/2																																																																																				
		18	4.6 Change T6 Max=50 to T6 Max=100																																																																																				



3.4	2012-2-17	13	Update Note Ipin=44mA
		30~31	Update 2D Drawing



1. GENERAL DESCRIPTION

1.1 OVERVIEW

MT190EN02 V.W is a 19" TFT Liquid Crystal Display module with WLED Backlight unit and 30 pins 2ch-LVDS interface. This module supports 1280 x 1024 SXGA mode and can display up to 16.7M colors. The converter module for Backlight is not built in.

1.2 GENERAL SPECIFICATIONS

Item	Specification	Unit	Note
Screen Size	19 inches diagonal		
Driver Element	a-si TFT active matrix	-	-
Pixel Number	1280(H) X 1024(V), SXGA resolution	pixel	-
Pixel Pitch	0.294(H) X 0.294(V)	mm	-
Pixel Arrangement	R, G, B vertical stripe	-	-
Display Colors	16.7M (6 bit with Hi-FRC)	color	-
Transmissive Mode	Normally white	-	-
Surface Treatment	Anti-Glare, Haze=25%, Hard coating (3H)	-	-
Luminance, White	250nits(Typ.)	Cd/m2	
Color Gamut	72% of NTSC(CIE1931),84%of NTSC(CIE 1976)	-	-
ROHS,Halogen Free&TCO 5.2	ROHS, Halogen Free TCO 5.2 compliance	-	-
Power Consumption	Total 12.68 W (Max.) @ cell 3.7W (Max.), BL8.98W (Max.)		(1)

Note (1) The specified power consumption : Total= cell (reference 4.3.1)+BL (reference 4.3.3)

2. MECHANICAL SPECIFICATIONS

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	395.5	396	396.5	mm	(1)
	Vertical (V)	323.5	324	324.5	mm	
	Thickness (T)	---	10.5	11	mm	
Bezel Area	Horizontal	380	380.3	380.6	mm	
	Vertical	304.7	305	305.3	mm	
Active Area	Horizontal	---	376.32	---	mm	
	Vertical	---	301.06	---	mm	
Weight		---	1400	1500	g	

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.

3. ABSOLUTE MAXIMUM RATINGS

3.1 ABSOLUTE RATINGS OF ENVIRONMENT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	TST	-20	60	°C	(1)
Operating Ambient Temperature	TOP	0	50	°C	(1), (2)

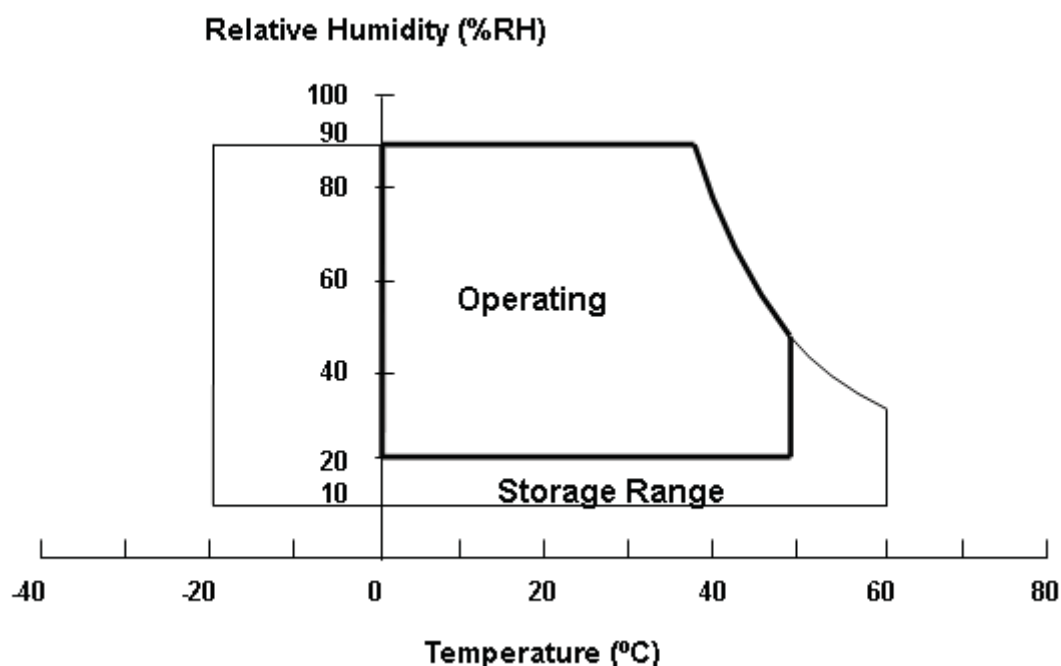
Note (1)

(a) 90 %RH Max. (Ta <= 40 °C).

(b) Wet-bulb temperature should be 39 °C Max. (Ta > 40 °C).

(c) No condensation.

Note (2) The temperature of panel surface should be 0 °C min. and 60 °C max.



3.2 ELECTRICAL ABSOLUTE RATINGS

3.2.1 TFT LCD MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	VCCS	-0.3	6.0	V	(1)
Logic Input Voltage	V _{IN}	-0.3	2.8	V	

3.2.2 BACKLIGHT UNIT

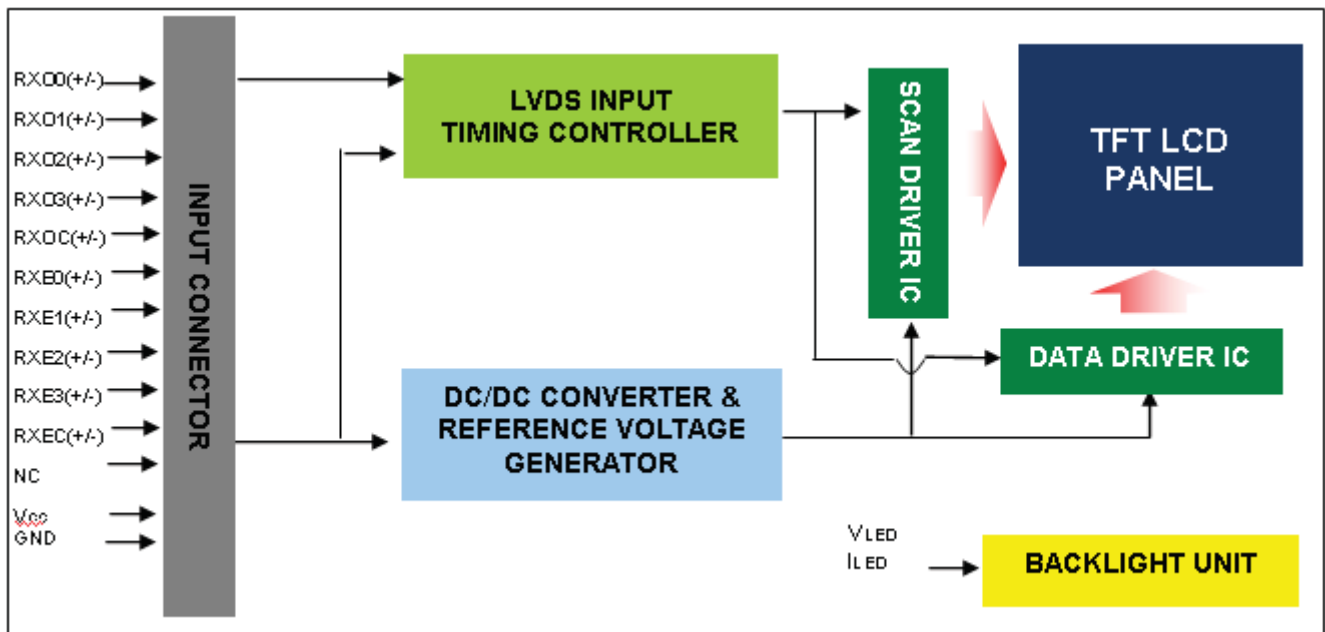
Item	Symbol	Value			Unit	Note
		Min.	Typ	Max.		
LED Forward Current Per input Pin	I _F	<u>0</u>	<u>44</u>	<u>48.4</u>	mA	(1), (2) Duty=100%
LED Reverse Voltage Per Input Pin	V _R	---	---	<u>50</u>	V	
LED Pulse Forward Current Per input Pin	I _P	---	---	<u>160</u>	mA	(1), (2) Pulse Width ≤ 10msec. and Duty ≤ 10%

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

Note (2) Specified values are for input pin of LED light bar at Ta=25±2°C (Refer to 4.3.3 and 4.3.4 for further information).

4. ELECTRICAL SPECIFICATIONS

4.1 FUNCTION BLOCK DIAGRAM



4.2. INTERFACE CONNECTIONS

PIN ASSIGNMENT

Pin No	Symbol	Description
Frame	VSS	Ground
1	RXinO0-	-LVDS differential data input, Chan 0-Odd
2	RXinO0+	+LVDS differential data input, Chan 0-Odd
3	RXinO1-	-LVDS differential data input, Chan 1-Odd
4	RXinO1+	+LVDS differential data input, Chan 1-Odd
5	RXinO2-	-LVDS differential data input, Chan 2-Odd
6	RXinO2+	+LVDS differential data input, Chan 2-Odd
7	VSS	Ground
8	RXOC-	-LVDS differential Clock input (Odd)
9	RXOC+	+LVDS differential Clock input (Odd)
10	RXinO3-	-LVDS differential data input, Chan 3-Odd
11	RXinO3+	+LVDS differential data input, Chan 3-Odd
12	RXinE0-	-LVDS differential data input, Chan 0-Even
13	RXinE0+	+LVDS differential data input, Chan 0-Even
14	VSS	Ground
15	RXinE1-	-LVDS differential data input, Chan 1-Even
16	RXinE1+	+LVDS differential data input, Chan 1-Even
17	VSS	Ground
18	RXinE2-	-LVDS differential data input, Chan 2-Even
19	RXinE2+	+LVDS differential data input, Chan 2-Even
20	RXEC-	-LVDS differential Clock input (Even)
21	RXEC+	+LVDS differential Clock input (Even)
22	RXinE3-	-LVDS differential data input, Chan 3-Even
23	RXinE3+	+LVDS differential data input, Chan 3-Even



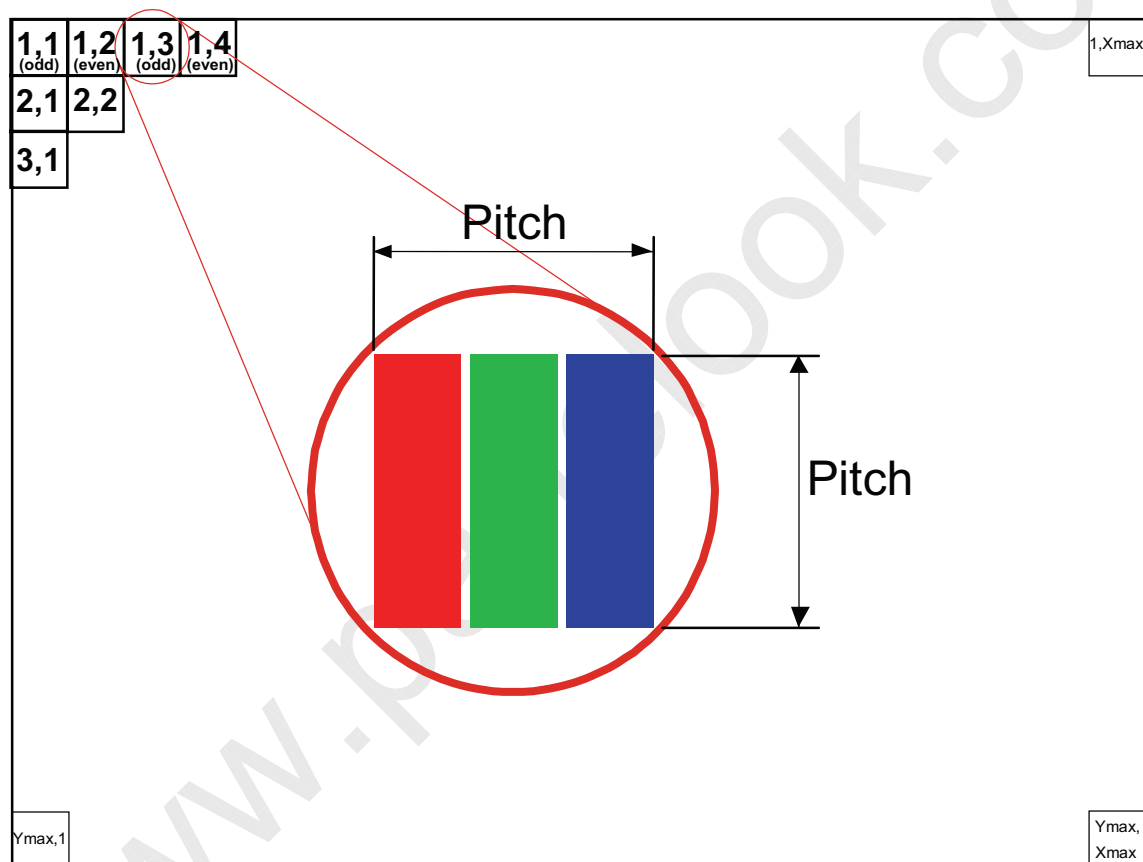
24	VSS	Ground
25	NC	No Connection
26	NC	No Connection
27	NC	No Connection
28	VCC	+5.0V power supply
29	VCC	+5.0V power supply
30	VCC	+5.0V power supply
Frame	VSS	Ground

Note (1) Connector Part No.:

GS23302-0311R-7H (Foxconn) or 187007-30091 (P-TWO) or equivalent

Note (2) The first pixel is odd.

Note (3) Input signal of even and odd clock should be the same timing.



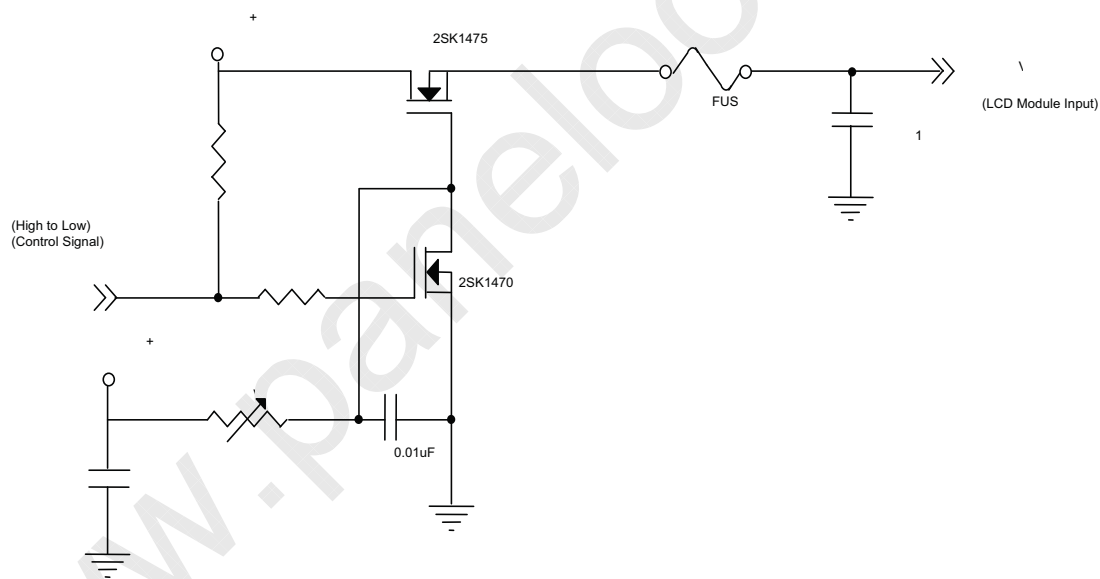
4.3 ELECTRICAL CHARACTERISTICS

4.3.1 LCD ELETRONICS SPECIFICATION

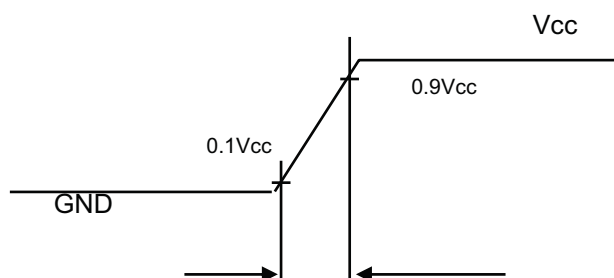
Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Power Supply Voltage	V _{CC}	4.5	5	5.5	V	-
Ripple Voltage	V _{RP}	--	--	150	mV	-
Rush Current	I _{RUSH}	--	1.6	3	A	(2)
Power Supply Current	White	--	500	700	mA	(3)a
	Black	--	700	1000	mA	(3)b
	Vertical Stripe	--	700	1000	mA	(3)c
Power Consumption	PLCD	--	--	3.7	Watt	(4)
LVDS differential input voltage	V _{id}	100	--	600	mV	
LVDS common input voltage	V _{ic}	1.0	1.2	1.4	V	
Logic High Input Voltage	V _{IH}	--	--	100	mV	
Logic Low Input Voltage	V _{IL}	-100	--	--	mV	

Note (1) The ambient temperature is Ta = 25 ± 2 °C.

Note (2) Measurement Conditions:



V_{CC} rising time is 470μs±10%



Note (3) The specified power supply current is under the conditions at $V_{CC} = 5.0\text{ V}$, $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$, $F_r = 60\text{ Hz}$, whereas a power dissipation check pattern below is displayed.

a. White Pattern



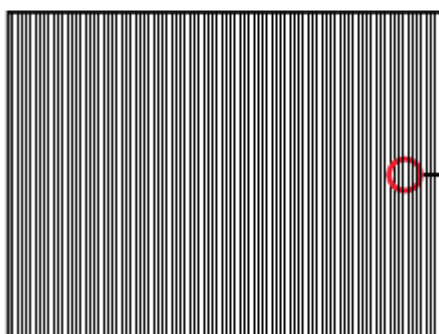
Active Area

b. Black Pattern

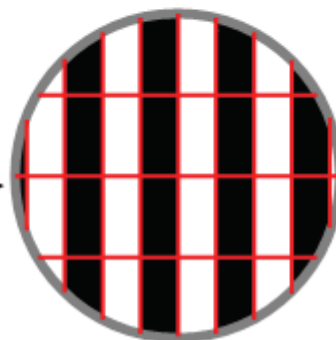


Active Area

c. Vertical Stripe Pattern



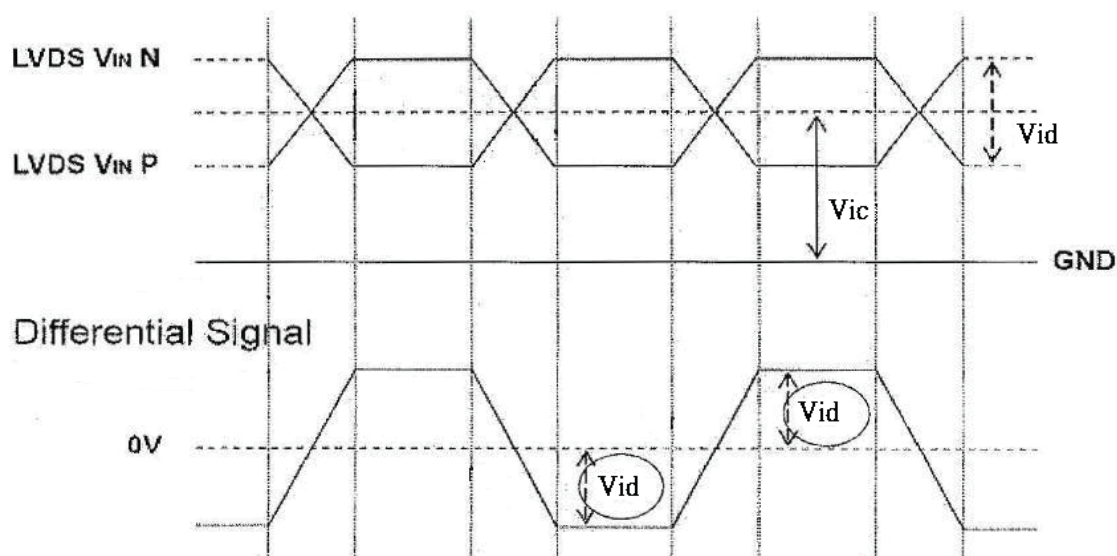
Active Area



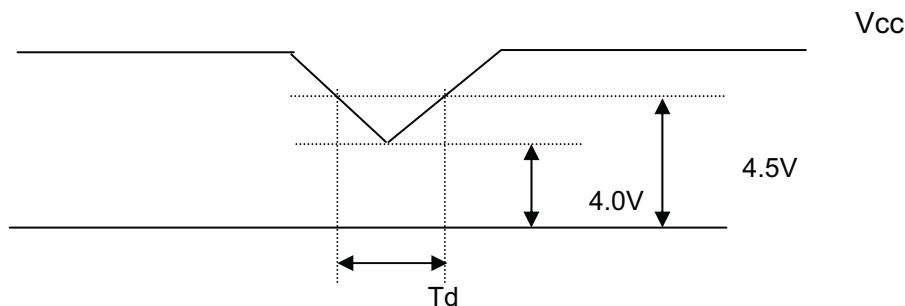
Note (4) The power consumption is specified at the pattern with the maximum current.

Note (5) VID waveform condition

Single-End



4.3.2 Vcc Power Dip Condition



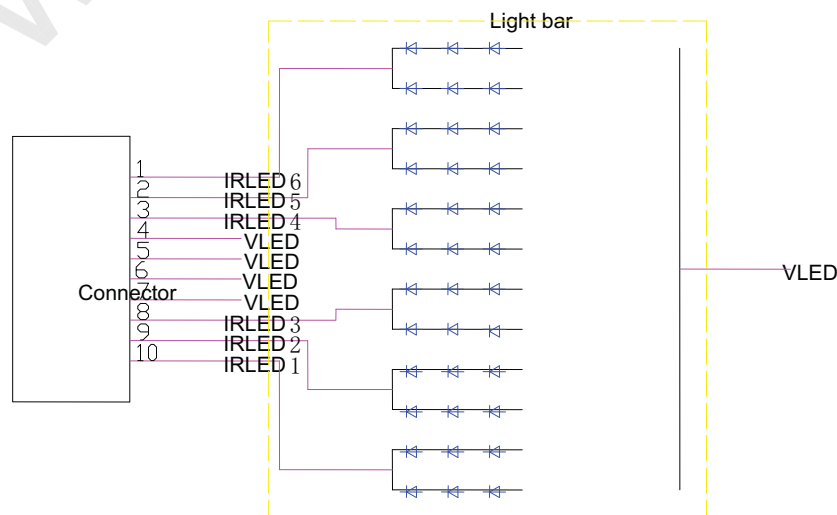
4.3.3 BACKLIGHT UNIT (LED matrix is 10S12P)

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
LED Light Bar Input Voltage Per Input Pin	V_{PIN}	---	<u>32</u>	<u>34</u>	V	(1), Duty=100%, $I_{PIN}=44mA$
LED Light Bar Current Per Input Pin	I_{PIN}	---	<u>44</u>	<u>48.4</u>	mA	(1), (2) Duty=100%
LED Life Time	L_{LED}	<u>30000</u>	---	---	Hrs	(3)
Power Consumption	P_{BL}	---	<u>8.45</u>	<u>8.98</u>	W	(1) Duty=100%, $I_{PIN}=44mA$

Note (1) LED light bar input voltage and current are measured by utilizing a true RMS multimeter as shown below:

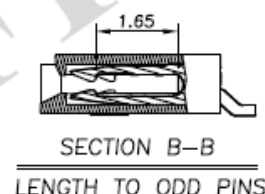
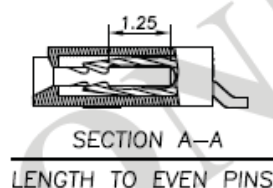
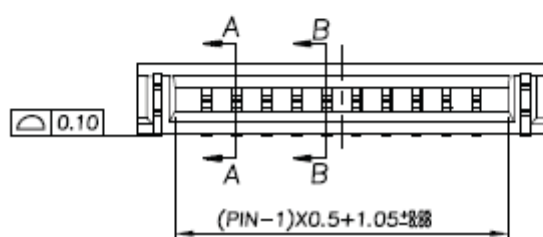
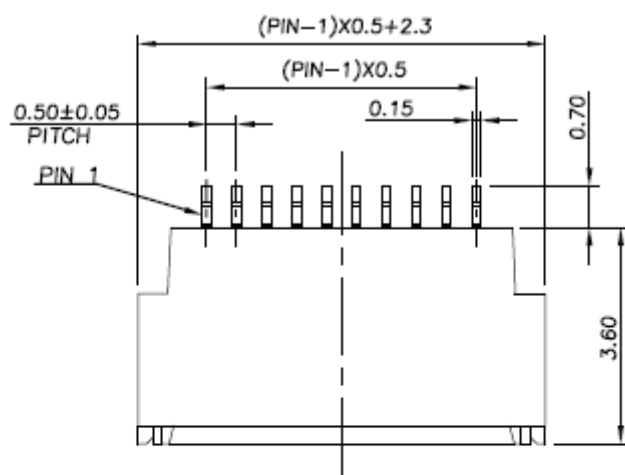
Note (2) $P_{BL} = V_{PIN} \times I_{PIN} \times (6)$ Feedback pins , LED light bar circuit is (10)Series, (12)Parallel.

Note (3) The lifetime of LED is defined as the time when LED packages continue to operate under the conditions at $T_a = 25 \pm 2^\circ C$ and $I = (22)mA$ (per chip) until the brightness becomes $\leq 50\%$ of its original value.



4.3.4 LIGHTBAR Connector Pin Assignment

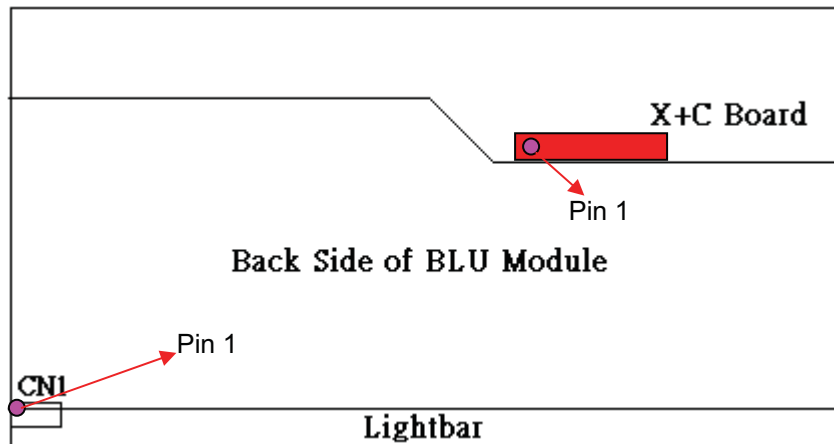
Connector: 7083K-F10N-01L (Entery) / FF04-404-103A (FCN) or Compatible



CN1

Pin number	Description
1	LED current sense for string 6
2	LED current sense for string 5
3	LED current sense for string 4
4	LED power supply
5	LED power supply
6	LED power supply
7	LED power supply
8	LED current sense for string 3
9	LED current sense for string 2
10	LED current sense for string 1

4.4 LVDS INPUT SIGNAL SPECIFICATIONS



4.4.1 LVDS DATA MAPPING TABLE

LVDS Channel O0	LVDS output	D7	D6	D4	D3	D2	D1	D0
	Data order	OG0	OR5	OR4	OR3	OR2	OR1	OR0
LVDS Channel O1	LVDS output	D18	D15	D14	D13	D12	D9	D8
	Data order	OB1	OB0	OG5	OG4	OG3	OG2	OG1
LVDS Channel O2	LVDS output	D26	D25	D24	D22	D21	D20	D19
	Data order	DE	NA	NA	OB5	OB4	OB3	OB2
LVDS Channel O3	LVDS output	D23	D17	D16	D11	D10	D5	D27
	Data order	NA	OB7	OB6	OG7	OG6	OR7	OR6
LVDS Channel E0	LVDS output	D7	D6	D4	D3	D2	D1	D0
	Data order	EG0	ER5	ER4	ER3	ER2	ER1	ER0
LVDS Channel E1	LVDS output	D18	D15	D14	D13	D12	D9	D8
	Data order	EB1	EB0	EG5	EG4	EG3	EG2	EG1
LVDS Channel E2	LVDS output	D26	D25	D24	D22	D21	D20	D19
	Data order	DE	NA	NA	EB5	EB4	EB3	EB2
LVDS Channel E3	LVDS output	D23	D17	D16	D11	D10	D5	D27
	Data order	NA	EB7	EB6	EG7	EG6	ER7	ER6

4.4.2 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 8-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of color versus data input.

Note (1) 0: Low Level Voltage, 1: High Level Voltage



Color		Input color data																											
		Red								Green								Blue											
		MSB				LSB				MSB				LSB				MSB				LSB							
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	0	0		
	Red(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Green(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0		
	Blue(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1		
	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	1	1		
	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	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	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	1	1		
Red	Red(000) dark	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		
	Red(001)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Red(002)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	Red(253)	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Red(254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Red(255) bright	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Green	Green(000)dark	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		
	Green(001)	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		
	Green(002)	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		
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	Green(253)	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0		
	Green(254)	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0		
	Green(255)bright	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0		
Blue	Blue(000) dark	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		
	Blue(001)	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		
	Blue(002)	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		
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	Blue(253)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	1	0	1		
	Blue(254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	1	0		
	Blue(255) bright	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1		

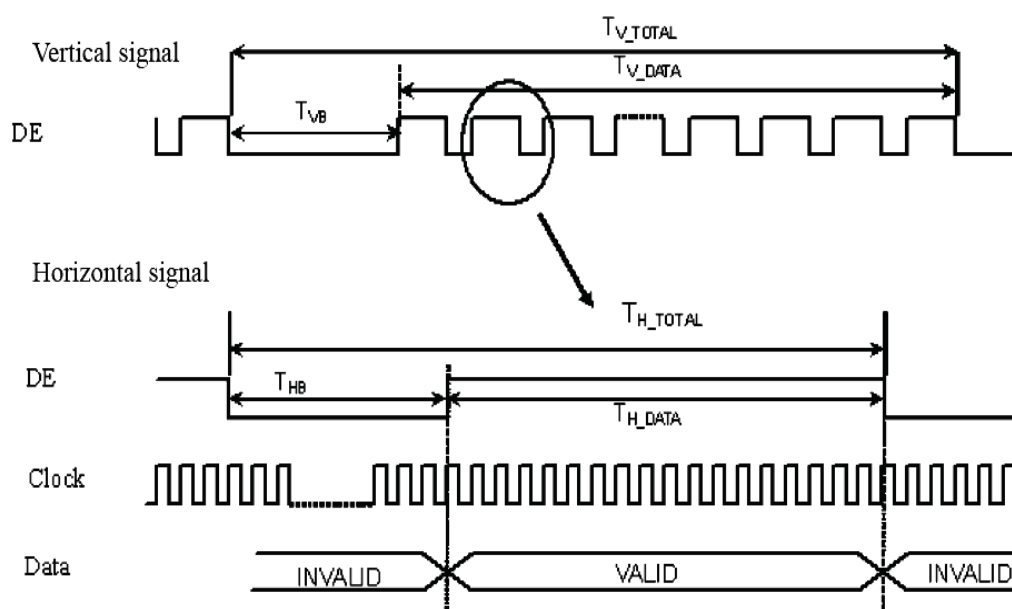
4.5 DISPLAY TIMING SPECIFICATIONS

The input signal timing specifications are shown as the following table and timing diagram.

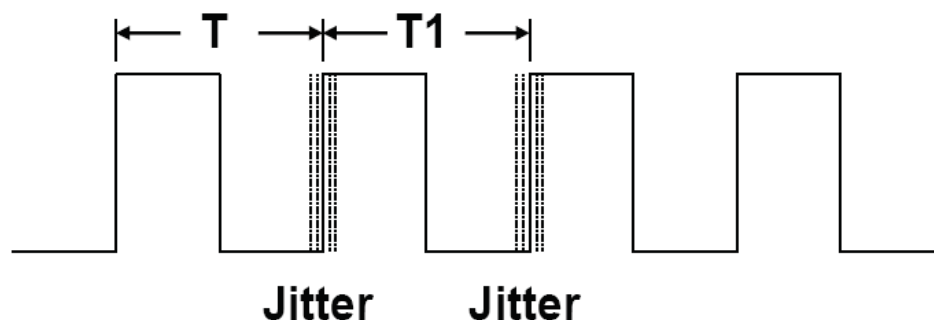
Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Clock	Frequency	F _c	40	54	68	MHz	-
	Period	T _c	14.71	18.52	22.22	ns	-
	Input cycle to cycle jitter	T _{rcl}	-0.02*T _C	--	0.02*T _C	ns	(1)
	Input Clock to data skew	TLVCCS	-0.02* T _C	--	0.02*T _C		(2)
	Spread spectrum modulation range	F _{ckin_mod}	0.97*F _C	--	1.03*F _C	MHz	(3)
	Spread spectrum modulation frequency	F _{SSM}	--	--	100	KHz	
Vertical Display Term	Frame Rate	Fr	50	60	76	Hz	Tv=Tvd+Tvb
	Total	Tv	1044	1066	1186	Th	-
	Active Display	Tvd	--	1024	--	Th	-
	Blank	Tvb	20	42	--	Th	-
Horizontal Display Term	Total	Th	790	844	880	Tc	Th=Thd+Thb
	Active Display	Thd	--	640	--	Tc	-
	Blank	Thb	150	204	--	Tc	-

Note: Because this module is operated by DE only mode, Hsync and Vsync input signals should be set to low Logic level or ground. Otherwise, this module would operate abnormally.

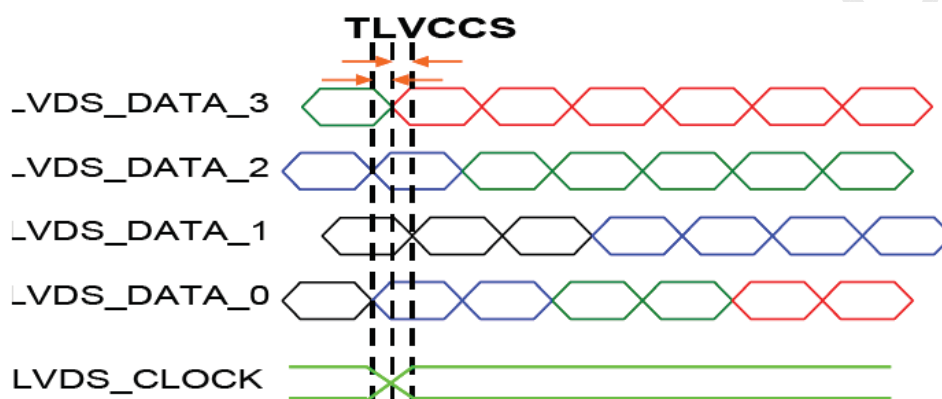
INPUT SIGNAL TIMING DIAGRAM



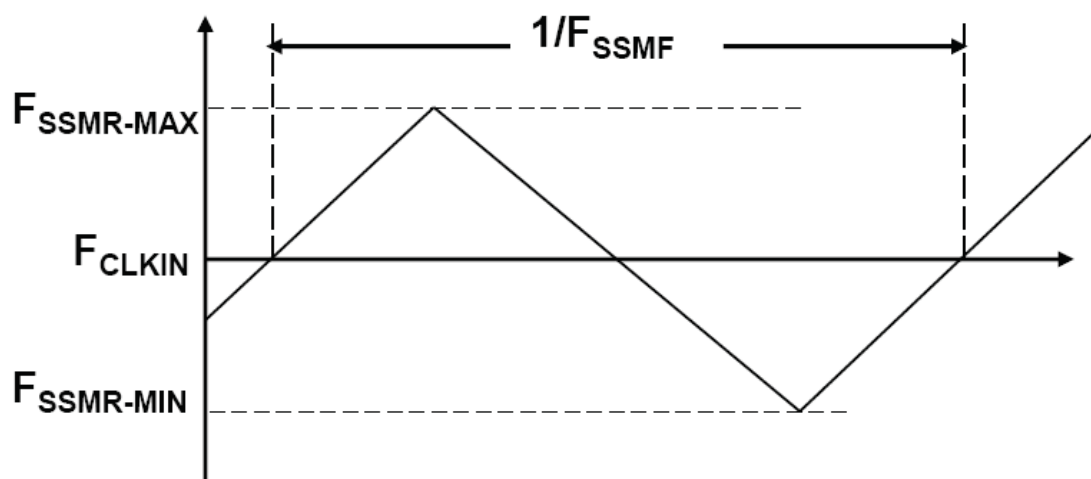
Note (1) The input clock cycle-to-cycle jitter is defined as below figures. $Trcl = |T_1 - T|$



Note (2) Input Clock to data skew is defined as below figures.



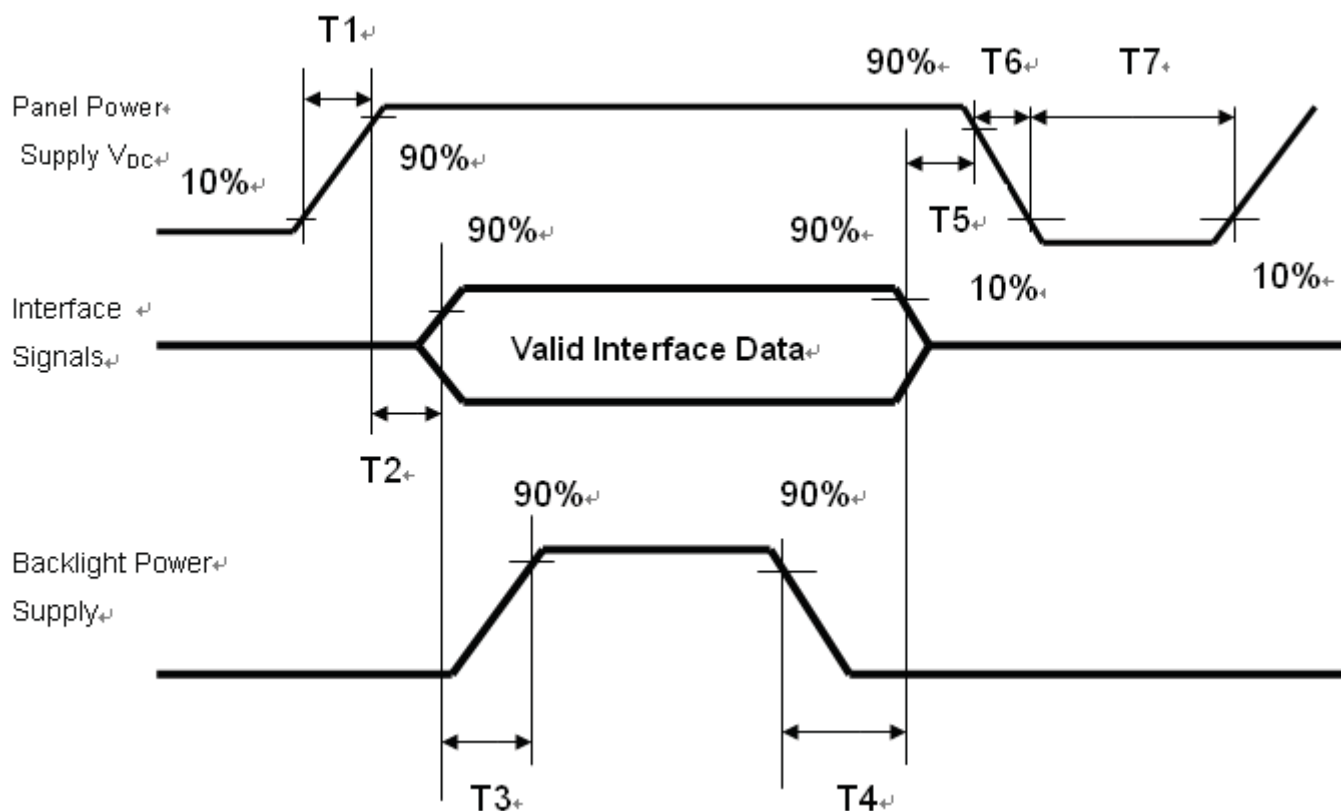
Note (3) The SSCG (Spread spectrum clock generator) is defined as below figures.



Note (4) The DCLK range at last line of V-blanking should be set in 0 to Hdisplay/2.

4.6 POWER ON/OFF SEQUENCE

The power sequence specifications are shown as the following table and diagram.



Timing Specifications:

Parameters	Values			Units
	Min	Typ.	Max	
T1	0.5	--	10	ms
T2	0	30	50	ms
T3	200	250	--	ms
T4	100	250	---	ms
T5	0	20	50	ms
T6	0.1	--	100	ms
T7	1000	--	--	ms

Note (1) The supply voltage of the external system for the module input should be the same as the definition of V_{CC}.

Note (2) When the backlight turns on before the LCD operation of the LCD turns off, the display may momentarily become abnormal screen.

Note (3) In case of V_{CC} = off level, please keep the level of input signals on the low or keep a high impedance.

Note (4) T4 should be measured after the module has been fully discharged between power off and on period.

Note (5) Interface signal shall not be kept at high impedance when the power is on.



Note (6) CMI won't take any responsibility for the products which are damaged by the customers not following the Power Sequence.

Note (7) There might be slight electronic noise when LCD is turned off (even backlight unit is also off). To avoid this symptom, we suggest "Vcc falling timing" to follow "t6 spec".

5. OPTICAL CHARACTERISTICS

5.1 TEST CONDITIONS

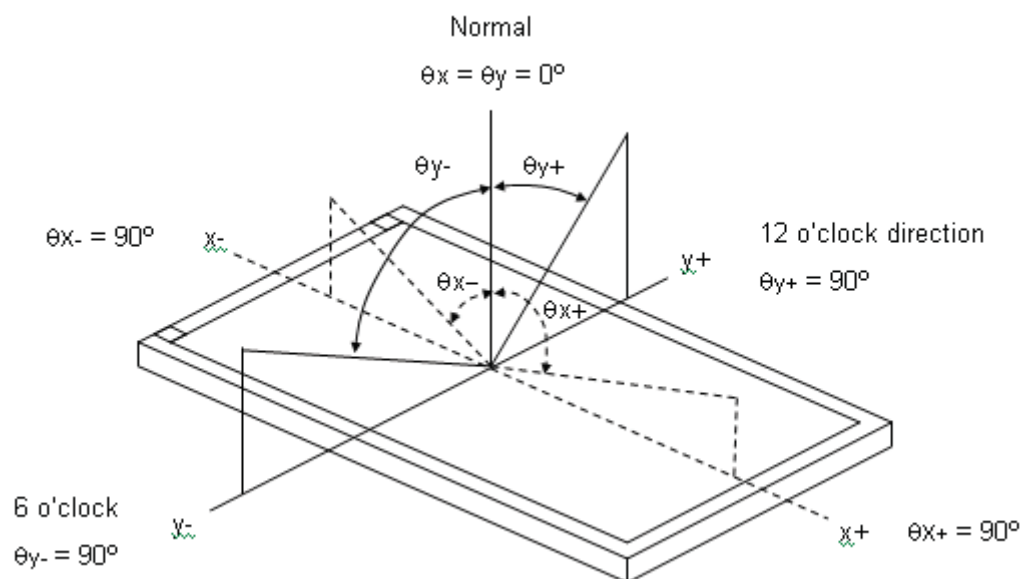
Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	°C
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	V _{CC}	5	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
LED Light Bar Input Current Per Input Pin	I _{PIN}	44 ± 1.2	mA _{DC}
PWM Duty Ratio	D	100	%
LED Light Bar Test Converter	TEST01001 T1-B1		

5.2 OPTICAL SPECIFICATIONS

The relative measurement methods of optical characteristics are shown in 5.2. The following items should be measured under the test conditions described in 5.1 and stable environment shown in Note (5).

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Color Chromaticity (CIE 1931)	Red	R _x	θ _x =0°, θ _Y =0°	Typ – 0.03	0.636	Typ + 0.03	-	(1), (5)
		R _y			0.347			
	Green	G _x			0.312			
		G _y			0.622			
	Blue	B _x			0.148			
		B _y			0.053			
	White	W _x			0.313			
		W _y			0.329			
Center Luminance of White (Center of Screen)		L _C	200	250	---	cd/m ²	(4), (5)	
Contrast Ratio		CR	700	1000	---	-	(2), (5)	
Response Time		T _R	θ _x =0°, θ _Y =0°	---	1.5	4	ms	(3)
		T _F		---	3.5	6		
White uniformity		δW	θ _x =0°, θ _Y =0°	0.75	---	---	-	(5), (6)
Viewing Angle	Horizontal	x- + x+	CR ≥ 10	150	170	----	Deg.	(1), (5)
	Vertical	y- + y+		140	160	----		
Viewing Angle	Horizontal	x- + x+	CR ≥ 5	160	178	---	Deg.	(1), (5)
	Vertical	y- + y+		150	170	---		

Note (1) Definition of Viewing Angle (θ_x , θ_y):



Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

$$\text{Contrast Ratio (CR)} = L_{255} / L_0$$

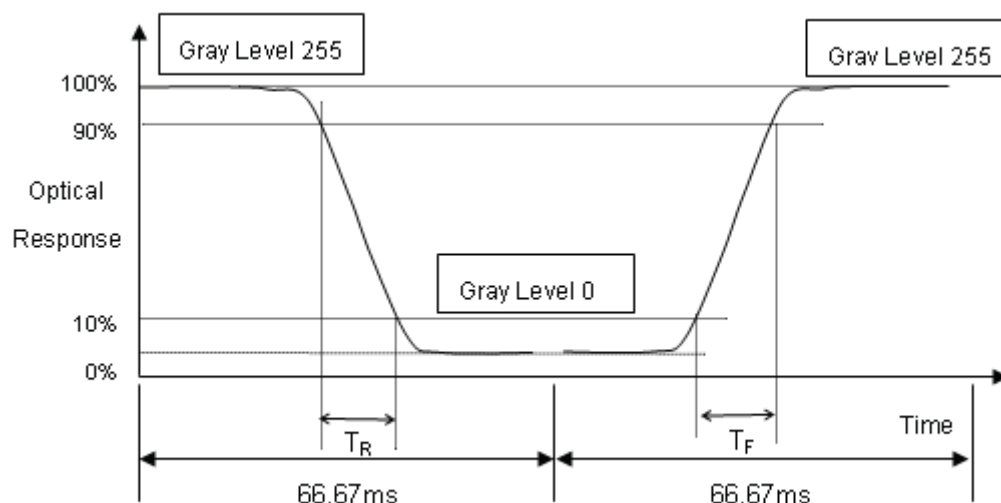
L255: Luminance of gray level 255

L 0: Luminance of gray level 0

$$\text{CR} = \text{CR} (5)$$

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (6).

Note (3) Definition of Response Time (T_R , T_F):



Note (4) Definition of Luminance of White (L_C):

Measure the luminance of gray level 255 at center point

$$L_C = L(5)$$

$L(x)$ is corresponding to the luminance of the point X at Figure in Note (6).

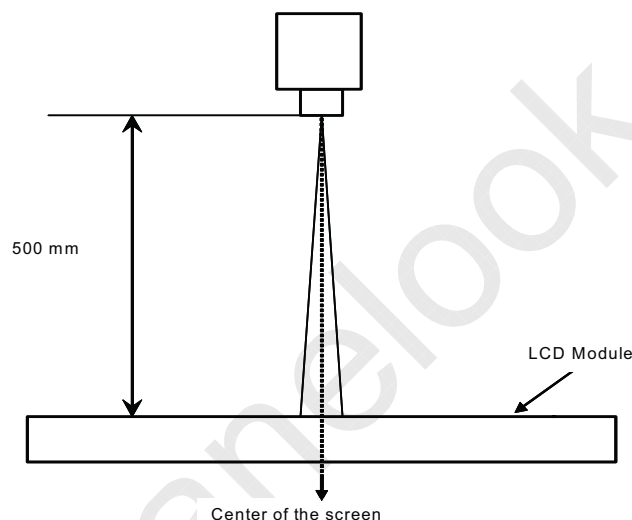
Note (5) Measurement Setup:

The LCD module should be stabilized at given temperature for 10 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 10 minutes in a windless room.

Back-Light ON Condition

Measuring Instrument: TOPCON BM-5A, SR-3A

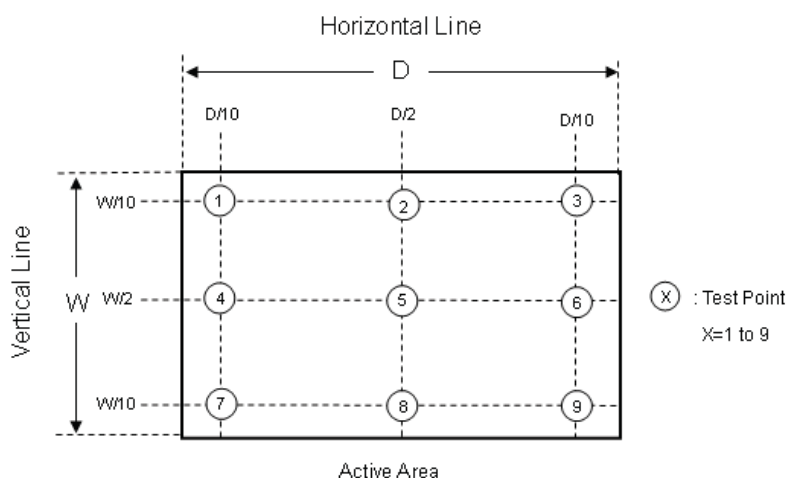
Field: 2°



Note (6) Definition of White Variation (δW):

Measure the luminance of gray level 255 at 9 points

$$\delta W = \text{Minimum } [L(1) \sim L(9)] / \text{Maximum } [L(1) \sim L(9)]$$



6. RELIABILITY TEST ITEM

Items	Required Condition	Note
Temperature Humidity Bias (THB)	50°C , 80%RH, 240hours	
High Temperature Operation (HTO)	50°C, 240Hrs	
Low Temperature Operation (LTO)	0°C, 240Hrs	
High Temperature Storage (HTS)	60°C, 240Hrs	
Low Temperature Storage (LTS)	-20°C, 240Hrs	
Vibration Test (Non-operation)	Acceleration: 1.5 Grms Wave: Half-sine Frequency: 10 - 300 Hz Sweep: 30 Minutes each Axis (X, Y, Z)	
Shock Test (Non-operation)	Acceleration: 50 G Wave: Half-sine Active Time: 11 ms Direction : $\pm X, \pm Y, \pm Z$. (one time for each Axis)	
Thermal Shock Test (TST)	-20°C~60°C 1Hr, 1Hr, 100cycles	
On/Off Test	25°C , On/10sec , Off /10sec , 30,000 cycles	
ESD (Electro Static Discharge)	Contact Discharge: $\pm 8KV$, 150pF(330 Ω)	
	Air Discharge: $\pm 15KV$, 150pF(330 Ω)	
Altitude Test	Operation:16,400 ft / 24hours Non-Operation:40,000 ft / 12 hours	

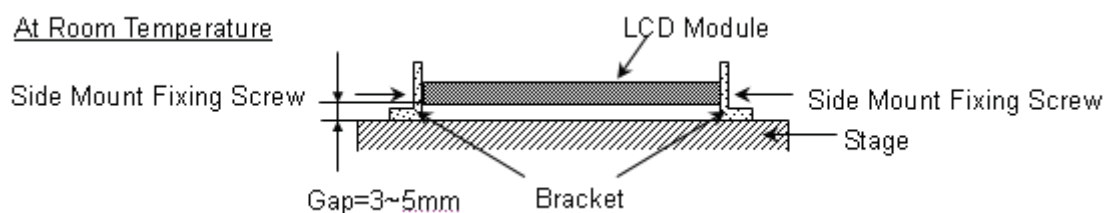
Note (1) criteria : Normal display image with no obvious non-uniformity and no line defect.

Note (2) Evaluation should be tested after storage at room temperature for more than two hour

Note (3) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.

The fixing condition is shown as below:

At Room Temperature



7. PACKING

7.1 PACKING SPECIFICATIONS

- (1) 9 LCD modules / 1 Box
- (2) Box dimensions: 470(L) X 282(W) X 442(H) mm
- (3) Weight: approximately: 15.13Kg (9 modules per box)

7.2 PACKING METHOD

- (1) Carton Packing should have no failure in the following reliability test items.

Test Item	Test Conditions	Note
Vibration	ISTA STANDARD 1 . 5G, 1 0 t o 5 0 0 Hz , r a n d o m , 30 mins for each axis X/Y/Z	Non Operation
Dropping Test	1 Corner , 3 Edge, 6 Face, 60cm	Non Operation

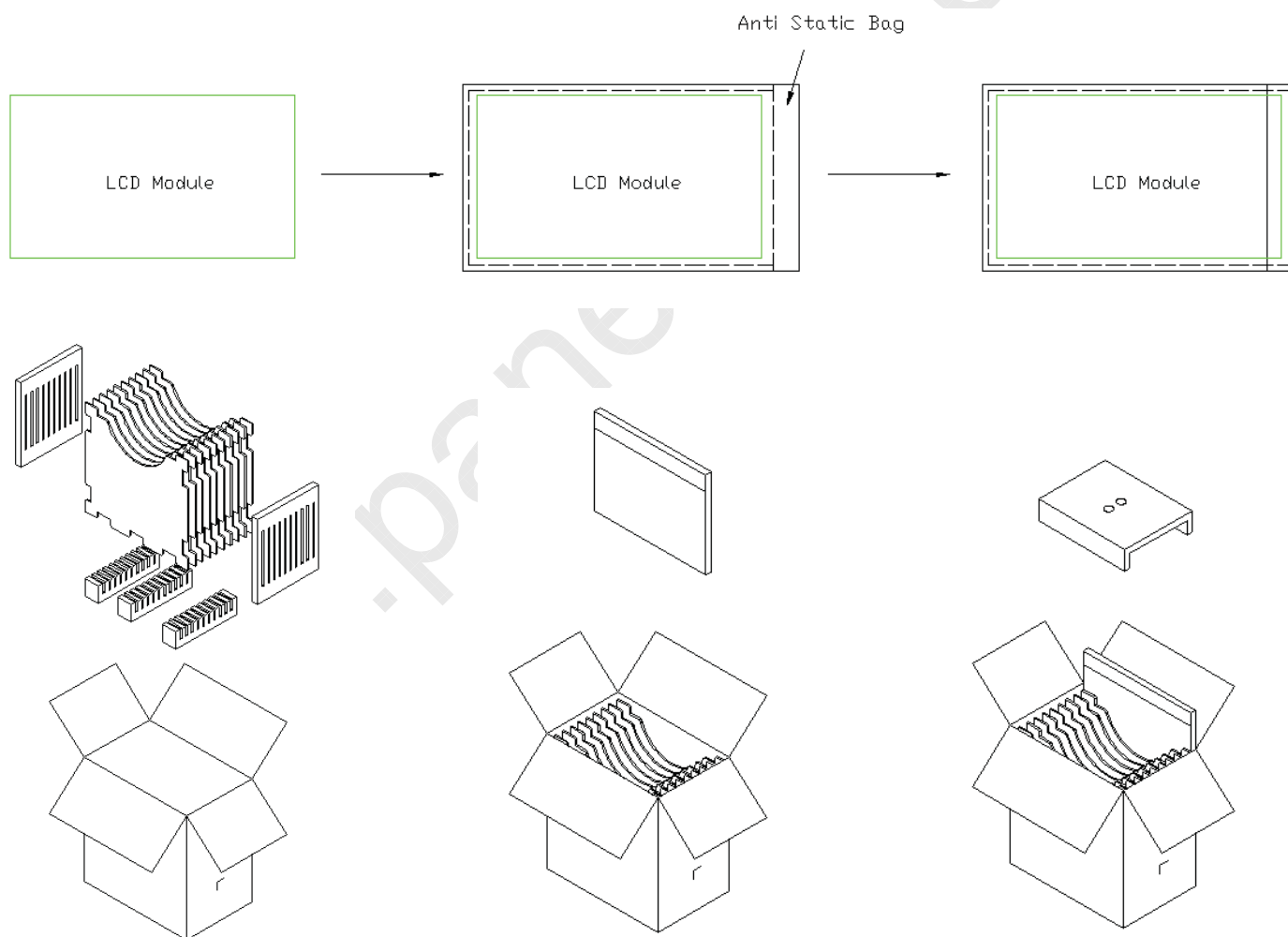


Figure. 7-1 Packing method

7.3 PALLET

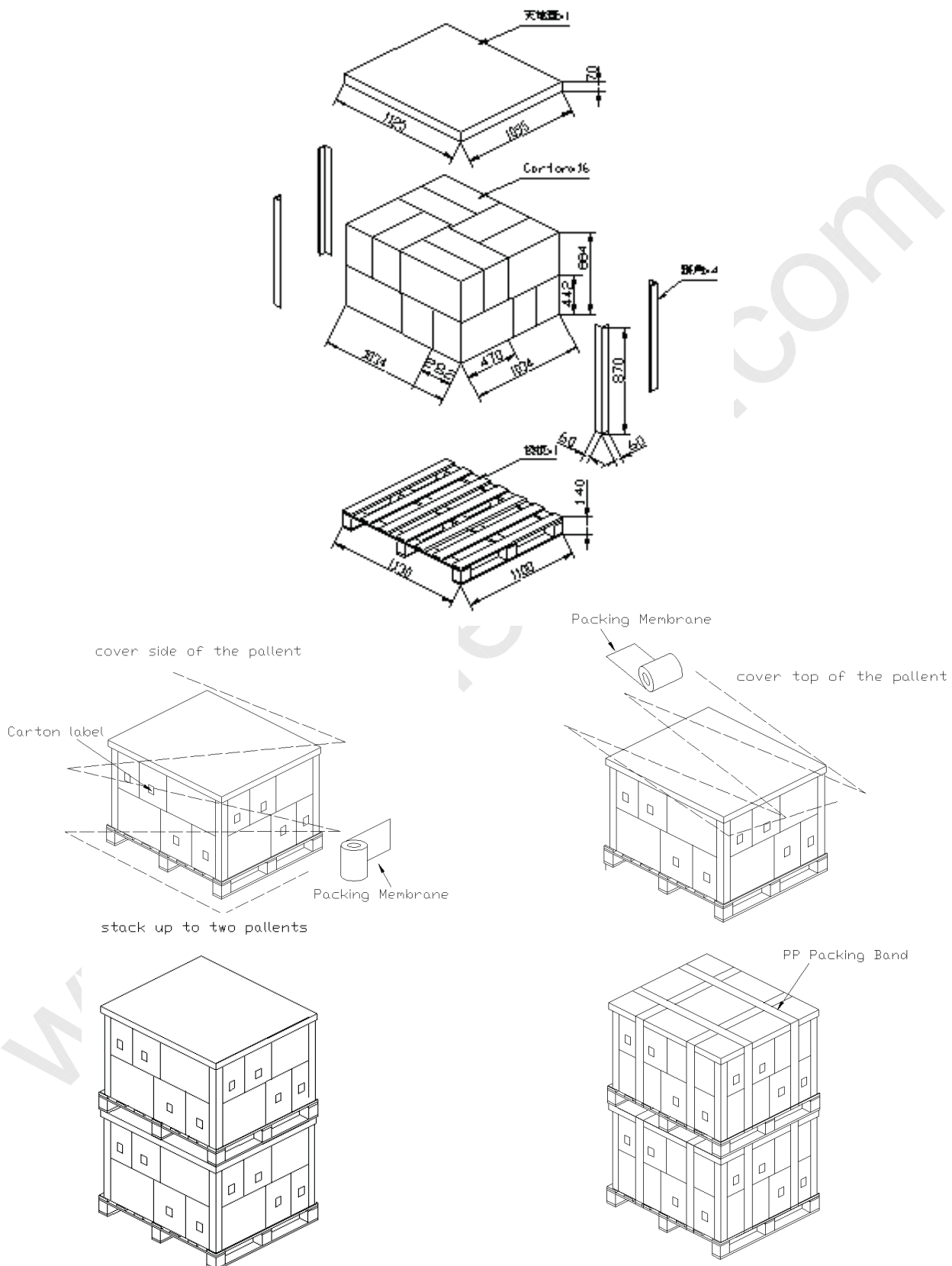
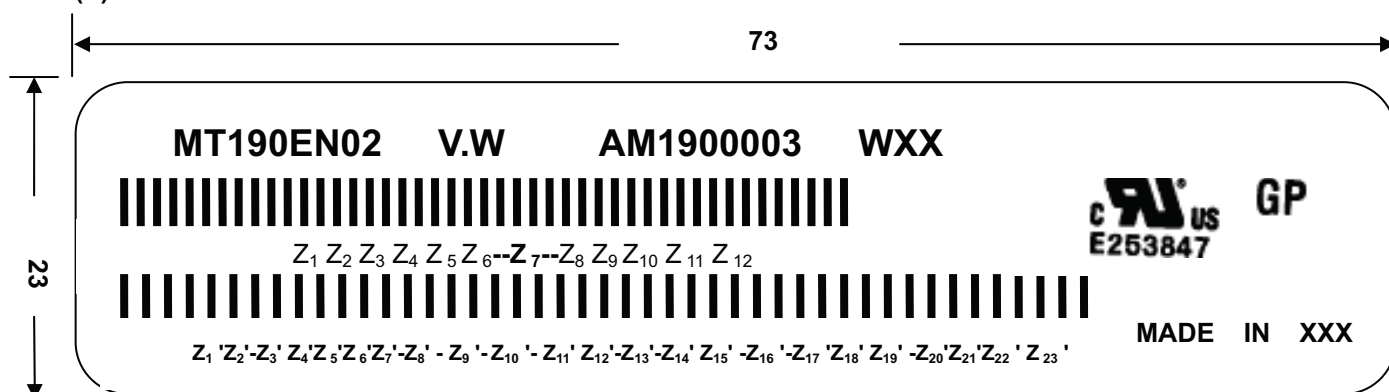


Figure. 7-2 Packing method

8. CMI MODULE LABEL

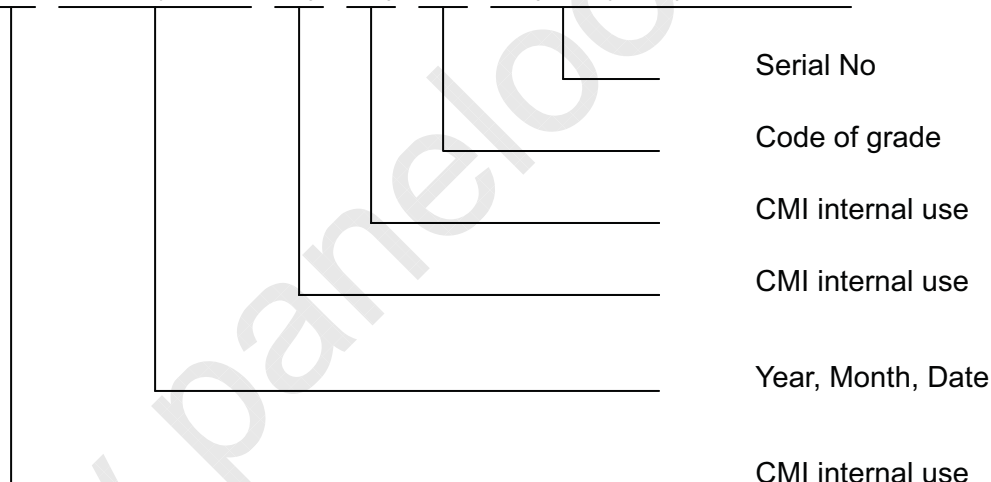
(1) Module Label



(a) Model Number: MT190EN02

(b) Version: V.W

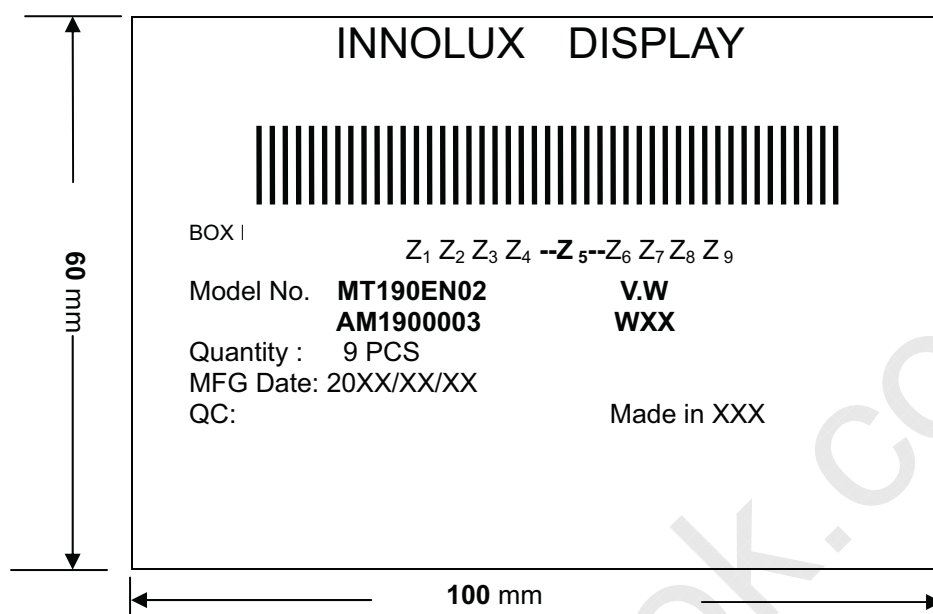
(c) Serial ID I: Z₁ Z₂ Z₃ Z₄ Z₅ Z₆ Z₇ Z₈ Z₉ Z₁₀ Z₁₁ Z₁₂



Serial ID includes the information as below:

1. Manufactured Date: Year: 0~9, for 2010~2019
 2. Month: 1~9 & A~C for Jan.~Dec.
 3. Date: 1~9 & A~Z (exclude I, O, Q, U) for 1st~31th
 4. Code of grade: 1, 2, 3, 5, E
 5. Serial No: Module manufacture sequence no
- (d) Serial ID II (CMI internal use)

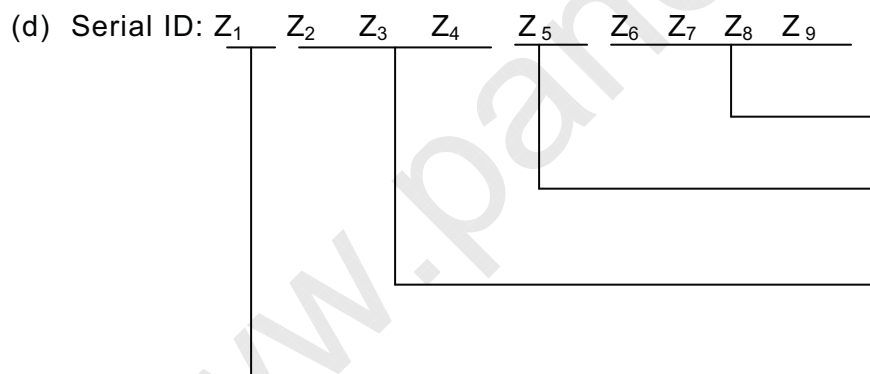
(2) Carton Label



(a) Model Number: MT190EN02

(b) Version: V.W

(c) Packing quantity: 9 pcs



Serial ID includes the information as below:

(a) Manufactured Date: Year: 0~9, for 2010~2019

Month: 1~9 & A~C for Jan.~Dec.

Date: 1~9 & A~Z (exclude I, O, Q, U) for 1st~31th

(b) Code of grade: 1, 2, 3, 5, E

(c) Serial No: Module packing sequence no

9. PRECAUTIONS

9.1 ASSEMBLY AND HANDLING PRECAUTIONS

- (1) Do not apply rough force such as bending or twisting to the module during assembly.
- (2) To assemble or install module into user's system can be only in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
- (3) It's not permitted to have pressure or impulse on the module because the LCD panel and Backlight will be damaged.
- (4) Always follow the correct power sequence when LCD module is connecting and operating. This can prevent damage to the CMOS LSI chips during latch-up.
- (5) Do not pull the I/F connector in or out while the module is operating.
- (6) Do not disassemble the module.
- (7) Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.
- (8) It is dangerous that moisture come into or contacted the LCD module, because moisture may damage LCD module when it is operating.
- (9) High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storage conditions.
- (10) When ambient temperature is lower than 10°C may reduce the display quality. For example, the response time will become slowly.

9.2 STORAGE PRECAUTIONS

- (1) Do not leave the module in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0°C to 35°C and relative humidity of less than 70%
- (2) Do not store the TFT – LCD module in direct sunlight
- (3) The module should be stored in dark place. It is prohibited to apply sunlight or fluorescent light in storing

9.3 OPERATION PRECAUTIONS

- (1) The LCD product should be operated under normal condition.
Normal condition is defined as below :
Temperature : 20±15°C
Humidity: 65±20%
Display pattern : continually changing pattern(Not stationary)
- (2) If the product will be used in extreme conditions such as high temperature, high humidity, high altitude, display pattern or operation time etc... It is strongly recommended to contact CMO for application engineering advice. Otherwise, its reliability and function may not be guaranteed.

9.4 SAFETY PRECAUTIONS

- (1) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.
- (2) After the module's end of life, it is not harmful in case of normal operation and storage.

9.5 SAFETY STANDARDS

The LCD module should be certified with safety regulations as follows:

- (1) UL60950-1 or updated standard.
- (2) IEC60950-1 or updated standard.

9.6 OTHER

When fixed patterns are displayed for a long time, remnant image is likely to occur.

Appendix. OUTLINE DRAWING

