



INNOLUX DISPLAY CORPORATION

MT230DW01 V.A LCD MODULE SPECIFICATION

() Preliminary Specification

(●) Final Specification

<i>Approved by</i>	<i>Checked by</i>	<i>Prepared by</i>

Innolux Display Corporation,

No.160 Kesyue Rd., Chu-Nan Site, Hsinchu Science Park,

Chu-Nan 350, Miao-Li County, Taiwan

Tel: 886-37-586000

Fax: 886-37-586060

Document Number: MT230DW01 V.A



InnoLux copyright

All rights reserved,

Copying forbidden.

Record of Revision

Version	Revise Date	Page	Content																																																											
1.0	2008/10/15		Initial Release																																																											
2.0	2009/01/08		Final Specification																																																											
		4	Add TCO'03 compliance																																																											
		7	Update CCFL Current: 3.0 mA (Min), 8.0 mA (Max)																																																											
		12	Support Input Timing Table																																																											
			<table border="1"> <thead> <tr> <th>Item</th> <th>Description</th> <th>Min.</th> <th>Typ.</th> <th>Max.</th> <th>Unit</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Dclk</td> <td>period</td> <td>11.43</td> <td>13.89</td> <td>16.7</td> <td>nS</td> </tr> <tr> <td>frequency</td> <td>60</td> <td>72</td> <td>87.5</td> <td>MHz</td> </tr> <tr> <td>T_{V_TOTAL}</td> <td>V total line number</td> <td>1090</td> <td>1100</td> <td>1160</td> <td>T_{H_TOTAL}</td> </tr> <tr> <td>T_{V_DATA}</td> <td>Data duration</td> <td>1080</td> <td>1080</td> <td>1080</td> <td>T_{H_TOTAL}</td> </tr> <tr> <td>T_{VB}</td> <td>V-blank</td> <td>10</td> <td>20</td> <td>80</td> <td>T_{H_TOTAL}</td> </tr> <tr> <td>f_v</td> <td>frequency</td> <td>50</td> <td>60</td> <td>75</td> <td>Hz</td> </tr> <tr> <td>T_{H_TOTAL}</td> <td>H total pixel number</td> <td>1000</td> <td>1088</td> <td>1120</td> <td>DClk</td> </tr> <tr> <td>T_{H_DATA}</td> <td>Data duration</td> <td>960</td> <td>960</td> <td>960</td> <td>DClk</td> </tr> <tr> <td>T_{HB}</td> <td>H-blank</td> <td>40</td> <td>128</td> <td>160</td> <td>DClk</td> </tr> </tbody> </table>	Item	Description	Min.	Typ.	Max.	Unit	Dclk	period	11.43	13.89	16.7	nS	frequency	60	72	87.5	MHz	T _{V_TOTAL}	V total line number	1090	1100	1160	T _{H_TOTAL}	T _{V_DATA}	Data duration	1080	1080	1080	T _{H_TOTAL}	T _{VB}	V-blank	10	20	80	T _{H_TOTAL}	f _v	frequency	50	60	75	Hz	T _{H_TOTAL}	H total pixel number	1000	1088	1120	DClk	T _{H_DATA}	Data duration	960	960	960	DClk	T _{HB}	H-blank	40	128	160	DClk
Item	Description		Min.	Typ.	Max.	Unit																																																								
Dclk	period		11.43	13.89	16.7	nS																																																								
	frequency		60	72	87.5	MHz																																																								
T _{V_TOTAL}	V total line number		1090	1100	1160	T _{H_TOTAL}																																																								
T _{V_DATA}	Data duration		1080	1080	1080	T _{H_TOTAL}																																																								
T _{VB}	V-blank	10	20	80	T _{H_TOTAL}																																																									
f _v	frequency	50	60	75	Hz																																																									
T _{H_TOTAL}	H total pixel number	1000	1088	1120	DClk																																																									
T _{H_DATA}	Data duration	960	960	960	DClk																																																									
T _{HB}	H-blank	40	128	160	DClk																																																									
		13	Backlight driving conditions																																																											
			<table border="1"> <thead> <tr> <th>Parameter</th> <th>Symbol</th> <th>Min.</th> <th>Typ.</th> <th>Max.</th> <th>Unit</th> </tr> </thead> <tbody> <tr> <td>Lamp voltage</td> <td>VL</td> <td>810(8mA)</td> <td>900(7.5mA)</td> <td>990(3mA)</td> <td>Vrms</td> </tr> <tr> <td>Lamp operation current</td> <td>IL</td> <td>3.0</td> <td>7.5</td> <td>8.0</td> <td>mArms</td> </tr> <tr> <td rowspan="2">Lamp starting voltage</td> <td rowspan="2">VLstart</td> <td>-</td> <td>-</td> <td>1500</td> <td rowspan="2">Vrms</td> </tr> <tr> <td>-</td> <td>-</td> <td>1800</td> </tr> <tr> <td>Frequency</td> <td>F</td> <td>40</td> <td>-</td> <td>60</td> <td>KHZ</td> </tr> <tr> <td>Lamp lifetime</td> <td></td> <td>50,000</td> <td>-</td> <td>-</td> <td>Hr</td> </tr> </tbody> </table>	Parameter	Symbol	Min.	Typ.	Max.	Unit	Lamp voltage	VL	810(8mA)	900(7.5mA)	990(3mA)	Vrms	Lamp operation current	IL	3.0	7.5	8.0	mArms	Lamp starting voltage	VLstart	-	-	1500	Vrms	-	-	1800	Frequency	F	40	-	60	KHZ	Lamp lifetime		50,000	-	-	Hr																				
Parameter	Symbol		Min.	Typ.	Max.	Unit																																																								
Lamp voltage	VL		810(8mA)	900(7.5mA)	990(3mA)	Vrms																																																								
Lamp operation current	IL		3.0	7.5	8.0	mArms																																																								
Lamp starting voltage	VLstart		-	-	1500	Vrms																																																								
			-	-	1800																																																									
Frequency	F	40	-	60	KHZ																																																									
Lamp lifetime		50,000	-	-	Hr																																																									
		15	Color Chromaticity (CIE)																																																											
			<table border="1"> <tbody> <tr> <td>Wx</td> <td></td> <td>0.313</td> </tr> <tr> <td>Wy</td> <td></td> <td>0.329</td> </tr> <tr> <td>Rx</td> <td></td> <td>0.64</td> </tr> <tr> <td>Ry</td> <td rowspan="5">θ= 0° -0.03</td> <td>0.349</td> </tr> <tr> <td>Gx</td> <td>0.284</td> </tr> <tr> <td>Gy</td> <td>0.617</td> </tr> <tr> <td>Bx</td> <td>0.142</td> </tr> <tr> <td>By</td> <td>0.067</td> </tr> </tbody> </table>	Wx		0.313	Wy		0.329	Rx		0.64	Ry	θ= 0° -0.03	0.349	Gx	0.284	Gy	0.617	Bx	0.142	By	0.067																																							
Wx			0.313																																																											
Wy			0.329																																																											
Rx			0.64																																																											
Ry	θ= 0° -0.03		0.349																																																											
Gx			0.284																																																											
Gy		0.617																																																												
Bx		0.142																																																												
By		0.067																																																												
		22~23	ME Drawing Update																																																											



SPEC NO. MT230DW01 V.0

PAGE 3/21

Contents:	
A. General Specification	
B. Electrical Specifications	
1. Pin assignment	
2. Absolute maximum ratings	
3. Electrical characteristics	
a. Typical operating conditions	
b. Display color vs. input data signals	
c. Input signal timing	
d. Display position	
e. Backlight driving conditions	
C. Optical specifications	
D. Reliability test items	
E. Safety	
F. Display quality	
G. Handling precaution	
H. Label	
I. Mechanical drawings	
Appendix	



SPEC NO. MT230DW01 V.0

PAGE 4/21

A. General specification

NO.	Item	Specification	Remark
1	Display resolution (pixel)	1,920(H) X 1,080(V), Full HD	
2	Active area (mm)	509.184(H) x 286.416(V)	
3	Screen size (inch)	23 inches diagonal	
4	Pixel pitch (mm)	0.2652(H) X 0.2652(V)	
5	Color configuration	R, G, B vertical stripe	
6	Overall dimension (mm)	533.2(H) x 312.0 (V) x 16.5(D) (Typ.)	
7	Weight (g)	3050 (Max)	
8	Surface treatment	Anti-Glare, Haze=25%, Hard coating (3H)	Note1
9	Input color signal	8 bit LVDS	
10	Display colors	16.7M (6 bit with Hi-FRC)	
11	Color Saturation	72% NTSC	
12	Optimum viewing direction	6 o'clock	
13	Backlight	4 CCFL	
14	RoHS & Halogen Free	RoHS & Halogen Free compliance	
15	TCO'03	TCO'03 compliance	Note2

Note1: Glare Option Available

Note2: Only Anti-Glare can meet TCO'03 compliance.

B. Electrical specifications

1. Pin assignment

Connector

FOXCONN GS23302-0311S-7F or mechanical interface equivalent connector.

No	Symbol	Description
1	RxO0-	LVDS Differential data input Channel 0(-)
2	RxO0+	LVDS Differential data input Channel 0(+)
3	RxO1-	LVDS Differential data input Channel 1(-)
4	RxO1+	LVDS Differential data input Channel 1(+)
5	RxO2-	LVDS Differential data input Channel 2(-)
6	RxO2+	LVDS Differential data input Channel 2(+)
7	GND	Ground
8	RxOC-	LVDS Differential Clock input (-)
9	RxOC+	LVDS Differential Clock input (+)
10	RxO3-	LVDS Differential data input Channel 3(-)
11	RxO3+	LVDS Differential data input Channel 3(+)
12	RxE0-	LVDS Differential data input Channel 0(-)
13	RxE0+	LVDS Differential data input Channel 0(+)
14	GND	Ground
15	RxE1-	LVDS Differential data input Channel 1(-)
16	RxE1+	LVDS Differential data input Channel 1(+)
17	GND	Ground
18	RxE2-	LVDS Differential data input Channel 2(-)
19	RxE2+	LVDS Differential data input Channel 2(+)
20	RxEC-	LVDS Differential Clock input (-)
21	RxEC+	LVDS Differential Clock input (+)
22	RxE3-	LVDS Differential data input Channel 3(-)
23	RxE3+	LVDS Differential data input Channel 3(+)
24	GND	Ground
25	NC	No Connection
26	NC	No Connection
27	NC	No Connection
28	VCC	Power supply (+5.0V)
29	VCC	Power supply (+5.0V)
30	VCC	Power supply (+5.0V)

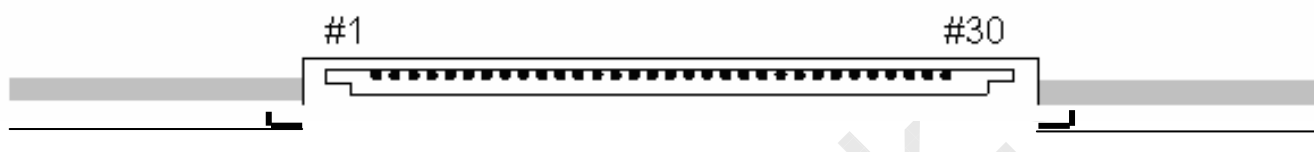


SPEC NO. MT230DW01 V.0

PAGE 6/21



Top view of LVDS connector



Rear view of LCM

www.panelook.com

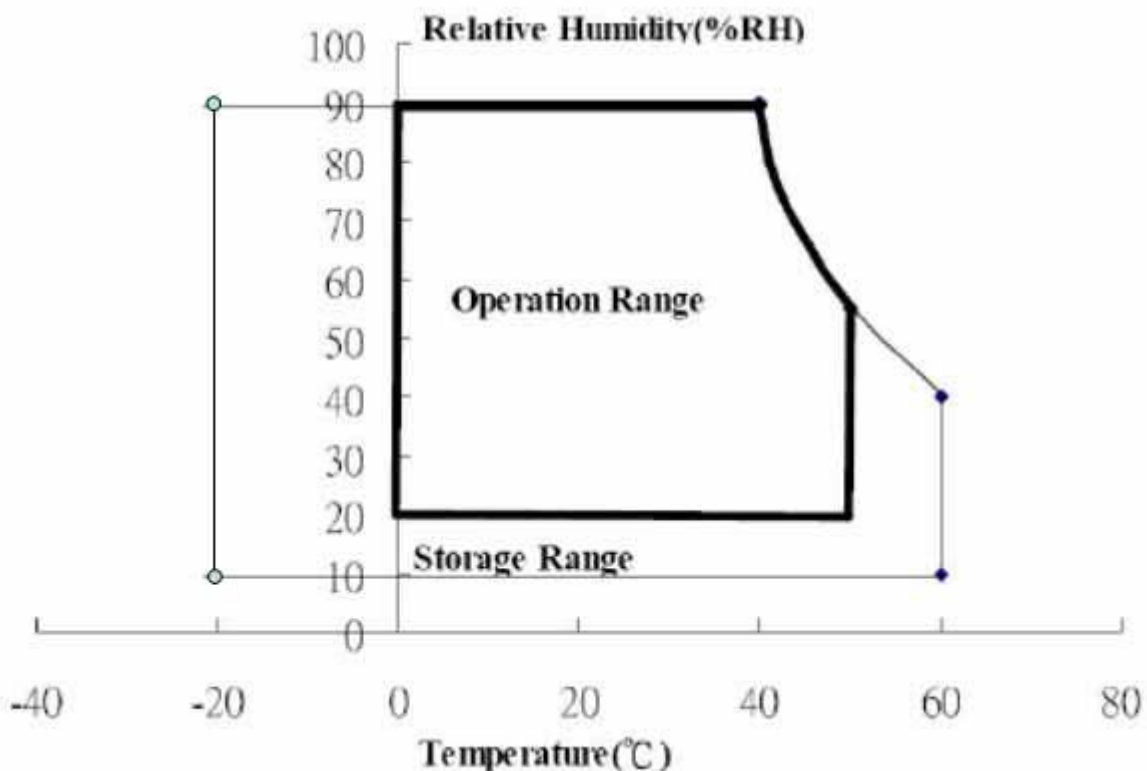
2. Absolute maximum ratings

Parameter	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Power voltage	V_{CC}	-0.3	-	6.0	V	At 25°C
Input signal voltage	V_{LH}	-0.3	-	4.3	V	At 25°C
Operating temperature	T_{op}	0	-	50	°C	Note 1
Storage temperature	T_{ST}	-20	-	60	°C	Note 2
CCFL Current	ICFL	3.0	7.5	8.0	[mA]rms	

Note 1: The relative humidity must not exceed 90% non-condensing at temperatures of 40°C or less.

At temperatures greater than 40°C, the wet bulb temperature must not exceed 39°C.

Note 2: The unit should not be exposed to corrosive chemicals.



SPEC NO. MT230DW01 V.0

PAGE 8/21

3. Electrical characteristics

a. Typical operating conditions

Item		Symbol	Min.	Typ.	Max.	Unit	Remark
Input Voltage		V_{CC}	4.5	5	5.5	V	
Permissive Power Input Ripple		V_{RF}	-	-	400	mVp-p	
Input Current	Black	I_{CC}	-	1000	-	mA	Note 1
	White	I_{CC}	-	800	-		Note 2
	Mosaic	I_{CC}	-	950	-		Note 3
Rush Current		I_{Rush}	-	1.6	3	A	Note 4
Logic Input Voltage LVDS: IN+, IN-	Common Mode Voltage	VCM	-	1.2	-	V	
	Differential Input Voltage	VID	100	-	100	mV	
	Threshold Voltage (High)	VTH	-	-	600	mV	Note 5, 6
	Threshold Voltage (Low)	VTL	-100	-	-	mV	Note 5, 6

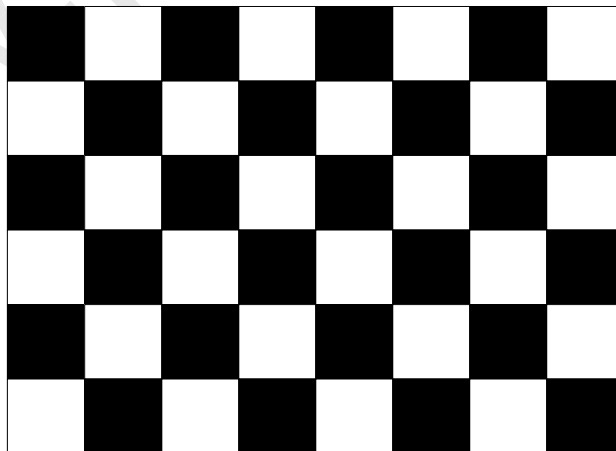
Note 1: The specified current is under the $V_{CC} = 5V$, $25^{\circ}C$, $f_v = 60Hz$ (frame frequency) condition whereas black pattern is displayed.

Note 2: The specified current is under the $V_{CC} = 5V$, $25^{\circ}C$, $f_v = 60Hz$ (frame frequency) condition whereas white pattern is displayed.

Note 3: The specified current is under the $V_{CC} = 5V$, $25^{\circ}C$, $f_v = 60Hz$ (frame frequency) condition whereas mosaic pattern (black & white [8*6]) is displayed.

White: 255 Gray

Black: 0 Gray

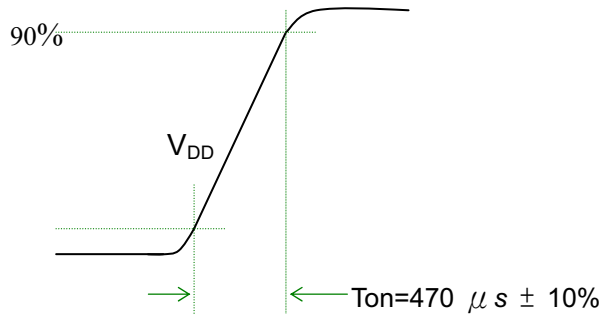


SPEC NO. MT230DW01 V.0

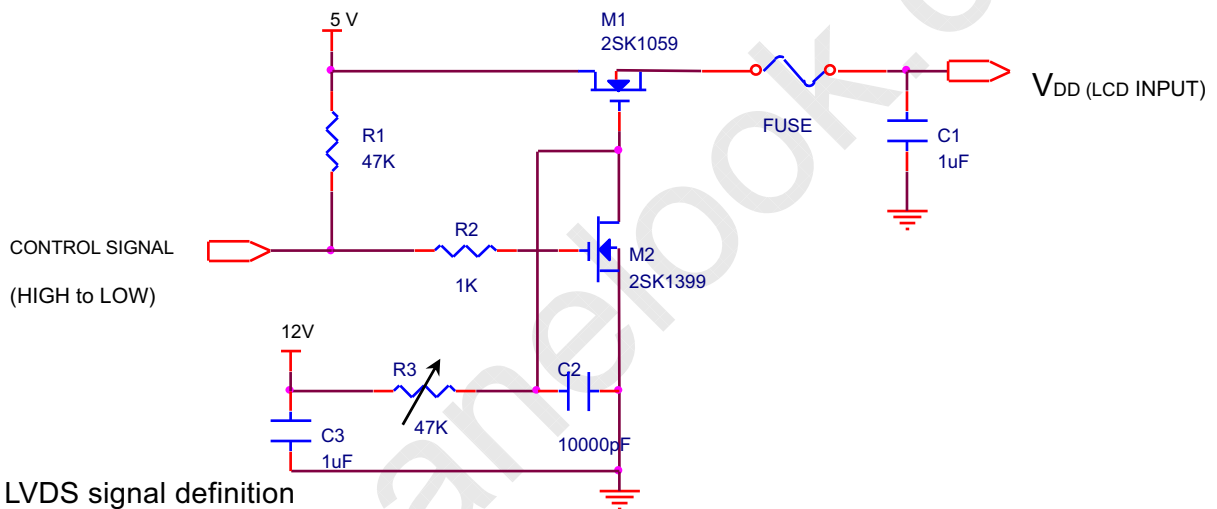
PAGE 9/21

Note 4: Test condition:

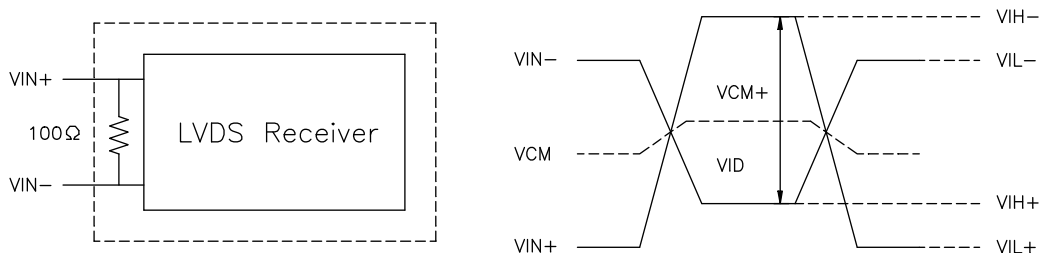
- (1). $V_{DD} = 5\text{ V}$, V_{DD} rising time = $470\ \mu\text{s} \pm 10\%$
- (2). Pattern: Mosaic pattern



(3) Test circuit

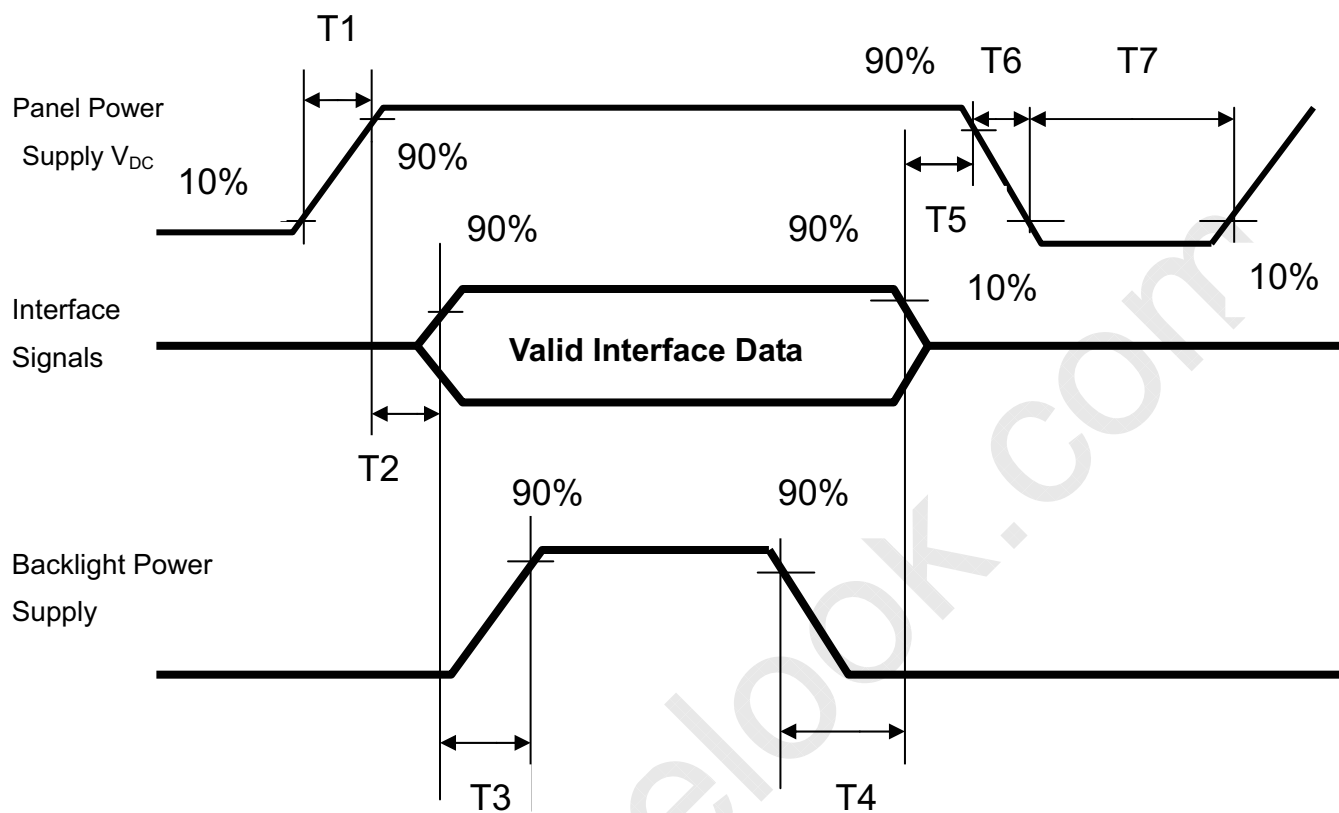


Note 5: LVDS signal definition

 VIN_+ = Positive differential DATA & CLK Input VIN_- = Negative differential DATA & CLK Input $VID = VIN_+ - VIN_-$, $\Delta V_{CM} = |V_{CM_+} - V_{CM_-}|$, $\Delta VID = |VID_+ - VID_-|$, $VID_+ = |VIH_- - VIH_-|$, $VID_- = |VIL_+ - VIL_-|$, $V_{CM} = (VIN_+ + VIN_-)/2$, $V_{CM_+} = (VIH_+ + VIH_-)/2$, $V_{CM_-} = (VIL_+ + VIL_-)/2$,

SPEC NO. MT230DW01 V.0

PAGE 10/21

Note 6: Power on sequence for LCD V_{DD}

Parameter	Value			Unit
	Min	Typ.	Max	
T1	0.1	-	10	ms
T2	0	30	50	ms
T3	200	250	-	ms
T4	100	250	-	ms
T5	0	20	50	ms
T6	0.1	-	-	ms
T7	1000	-	-	ms

b. Display color vs. input data signals

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 a reference for color versus data input.

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
	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
	Green(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	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	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
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	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
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
	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
	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
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	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
	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
	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
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
	Green(001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Green(002)	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(253)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0
	Green(254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Green(255)bright	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	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
	Blue(001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue(002)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	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
	Blue(254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	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

SPEC NO. MT230DW01 V.0

PAGE 12/21

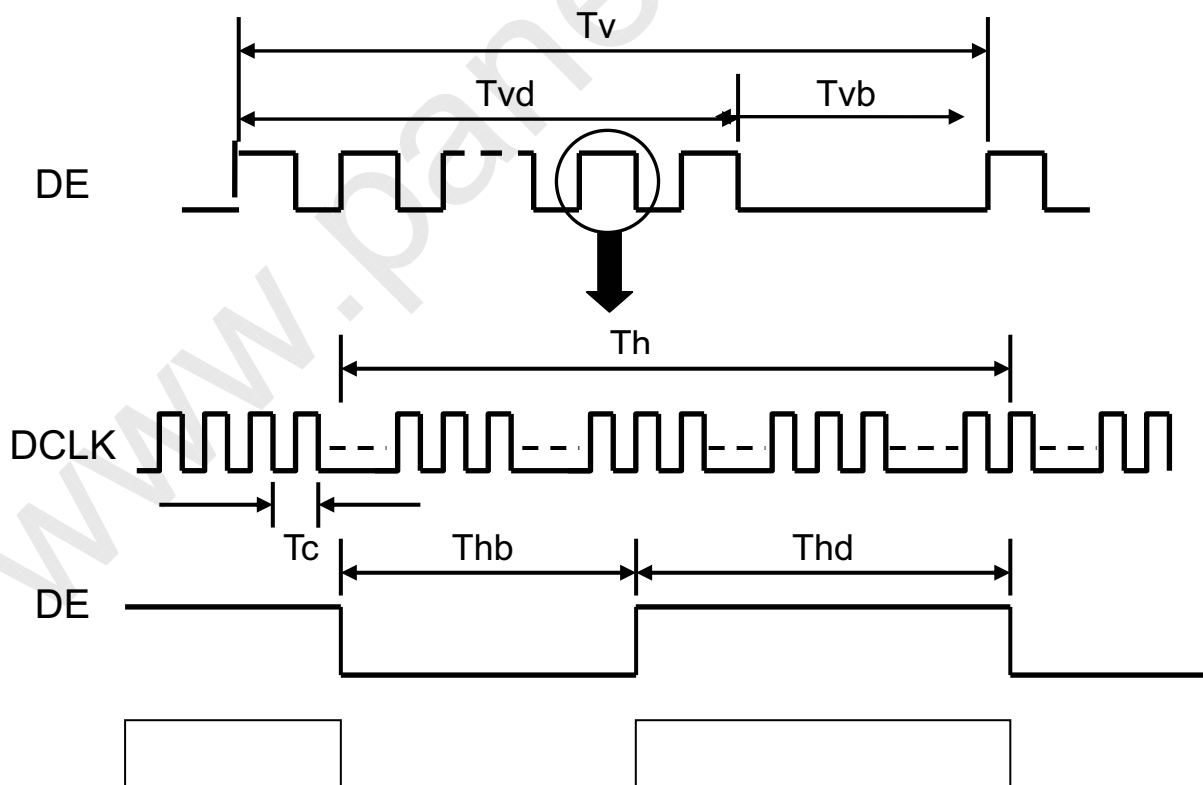
c. Input signal timing

Support Input Timing Table

	Item	Description	Min.	Typ.	Max.	Unit
Clock	Dclk	period	11.43	13.89	16.7	nS
		frequency	60	72	87.5	MHz
Vertical	T_{V_TOTAL}	V total line number	1090	1100	1160	T_{H_TOTAL}
	T_{V_DATA}	Data duration	1080	1080	1080	T_{H_TOTAL}
	T_{VB}	V-blank	10	20	80	T_{H_TOTAL}
	f_V	frequency	50	60	75	Hz
Horizontal	T_{H_TOTAL}	H total pixel number	1000	1088	1120	DClk
	T_{H_DATA}	Data duration	960	960	960	DClk
	T_{HB}	H-blank	40	128	160	DClk

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

INPUT SIGNAL TIMING DIAGRAM



SPEC NO. MT230DW01 V.0

PAGE 13/21

d. Display Position

D(1,1)	D(2,1)	D(960,1)	D(1919,1)	D(1920,1)
D(1,2)	D(2,2)	D(960,2)	D(1919,2)	D(1920,2)
⋮	⋮	⋮	⋮	⋮
D(1,540)	D(2,540)	D(960,540)	D(1919,540)	D(1920,540)
⋮	⋮	⋮	⋮	⋮
D(1,1079)	D(2,1079)	D(960,1079)	D(1919,1079)	D(1920,1079)
D(1,1080)	D(2,1080)	D(960,1080)	D(1919,1080)	D(1920,1080)

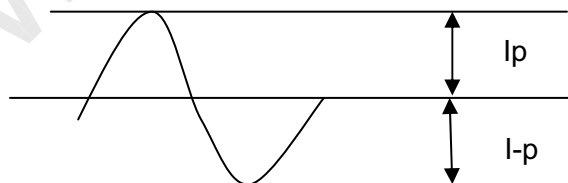
e. Backlight driving conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark	Remark
Lamp voltage	VL	810(8mA)	900(7.5mA)	990(3mA)	Vrms		
Lamp operation current	IL	3.0	7.5	8.0	mArms		Note 1
Lamp starting voltage	VLstart	-	-	1500	Vrms	T = 25°C	Note 2,3,4,5
		-	-	1800		T = 0°C	Note 2,3,4,5
Frequency	F	40	-	60	KHZ		Note 5
Lamp lifetime		50,000	-	-	Hrs		Note 6

Note: The waveform of the voltage output of inverter must be area-symmetric and the design of the inverter must have specifications for the modularized lamp. The performance of the Backlight, such as lifetime or brightness, is greatly influenced by the characteristics of the DC-AC inverter for the lamp. All the parameters of an inverter should be carefully designed to avoid producing too much current leakage from high voltage output of the inverter. When designing or ordering the inverter please make sure that a poor lighting caused by the mismatch of the Backlight and the inverter (miss-lighting, flicker, etc.) never occurs. If the above situation is confirmed, the module should be operated in the same manners when it is installed in your instrument.

Note 1: The degree of unbalance: less than 10%

The ratio of wave height: less than $\sqrt{2} \pm 10\%$



Ip: high side peak

I-p: low side peak

The degree of unbalance = $|Ip - I-p| / Irms * 100(\%)$

The ratio of wave height = $Ip \text{ (or } I-p) / Irms$

Lamp should be completely turned on.

SPEC NO. MT230DW01 V.0

PAGE 14/21

Note 2: Test equipment: AS-114B

Note 3: The voltage shown above should be applied to the lamp for more than 1 second after startup. Otherwise, the lamp may not be turned on normally.

Note 4: Inverter should provide more than max. value, and then lamp could be completely turned on.

Note 5: Lamp frequency may produce interference with horizontal synchronous frequency and this may cause line flow on the display. Therefore lamp frequency shall be detached from the horizontal synchronous frequency and its harmonics as far as possible in order to avoid interference.

Note 6: Life time (Hr) is defined as the time when brightness of a lamp unit itself becomes 50% or less than its original value at the condition of $T_a = 25 \pm 2^\circ\text{C}$ and $I_L = 7.5\text{mA}$.

Backlight connector: 3500IHS-02L

Pin no.	Symbol	Function	Remark
1	VIH	Lamp high voltage input	Cable color: Pink
2	VIL	Lamp low voltage input	Cable color: White
3	VIH	Lamp high voltage input	Cable color: Blue
4	VIL	Lamp low voltage input	Cable color: Black

C. Optical specifications

Item	Symbol	Condition	Specification			Unit	Remark
			Min.	Typ.	Max.		
Response time	Tr	$\theta = 0^\circ$	-	1.5	3	ms	Note 2
	Tf		-	3.5	7		
	Tr+Tf		-	5	10		
Contrast ratio	CR	$\theta = 0^\circ$	700	1000	-		Note 1,3
Viewing angle	Top	$CR \geq 10$	70	80	-	deg.	Note 1,3,5
		$CR \geq 5$	75	85	-		
	Bottom	$CR \geq 10$	70	80	-		
		$CR \geq 5$	75	85	-		
	Left	$CR \geq 10$	75	85	-		
		$CR \geq 5$	80	89	-		
	Right	$CR \geq 10$	75	85	-		
		$CR \geq 5$	80	89	-		
Brightness (Center)	Y_L		200	250	-	nit	Note 1,4
Color chromaticity(CIE)	Wx	$\theta = 0^\circ$	-0.03	0.313	+0.03		Note 1
	Wy			0.329			
	Rx			0.64			
	Ry			0.349			
	Gx			0.284			
	Gy			0.617			
	Bx			0.142			
	By			0.067			
White uniformity (9 points)	δW		0.75	0.80	-		Note 1,6
Cross talk	Ct		-	-	2%		Note 7

Note: Ambient temperature = 25°C.

To be measured in dark room after backlight warm up 30 minutes.

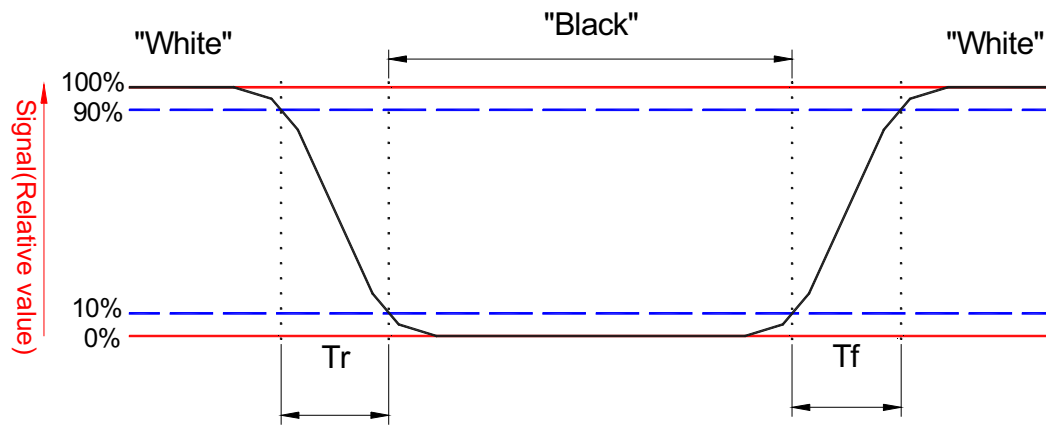
Note 1: To be measured with a viewing cone of 2° by Topcon luminance meter BM-5A.

Note 2: Definition of response time:

The output signals of BM-7 are measured when the input signals are changed from "Black" to "White" (falling time) and from "White" to "Black" (rising time), respectively. The response time interval is between the 10% and 90% of amplitudes. Refer to figure as below.

SPEC NO. MT230DW01 V.0

PAGE 16/21



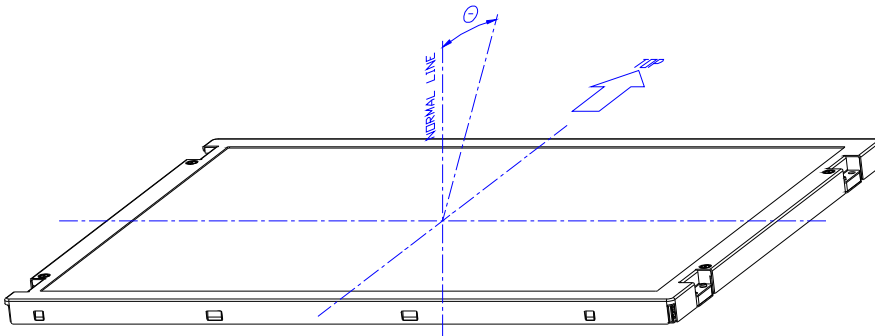
Note 3: Definition of contrast ratio:

Contrast ratio is calculated by the following formula.

$$\text{Contrast ratio (CR)} = \frac{\text{Brightness on the "white" state}}{\text{Brightness on the "black" state}}$$

Note 4: Driving conditions for CCFL: $I_L = 7.5 \text{ mA}$, 50 KHz Frequency.

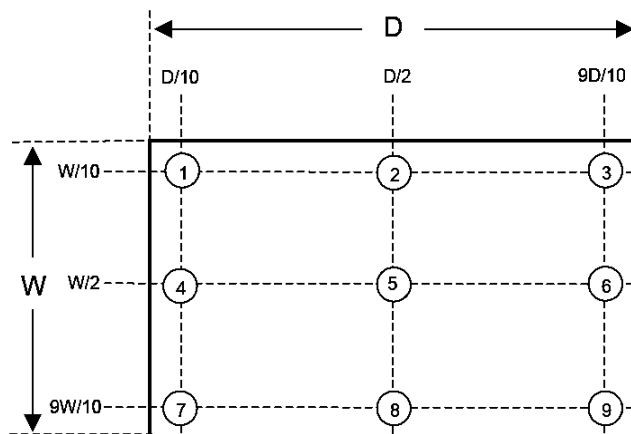
Note 5: Definition of viewing angle



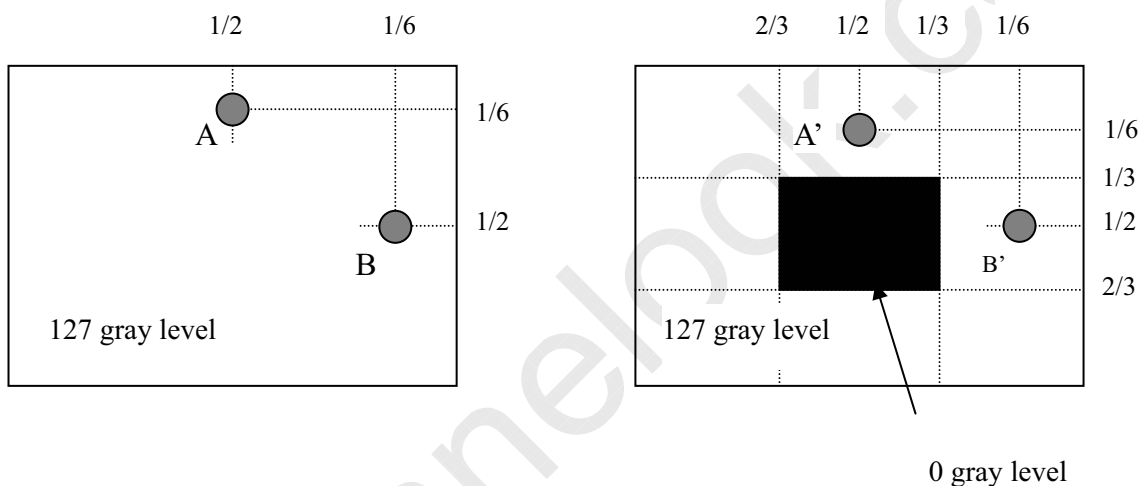
Note 6: Definition white uniformity:

Luminance are measured at the following nine points (P1~P9).

$$\delta_w = \frac{\text{Minimum Brightness of nine points (P1~P9)}}{\text{Maximum Brightness of nine points (P1~P9)}}$$



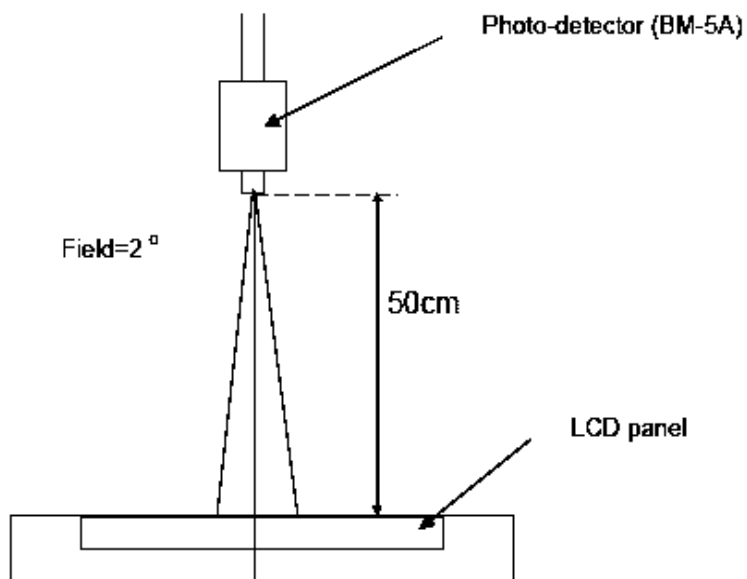
Note 7:



$|L_A - L_{A'}| / L_A \times 100\% = 2\% \text{ max.}$, L_A and $L_{A'}$ are brightness at location A and A'

$|L_B - L_{B'}| / L_B \times 100\% = 2\% \text{ max.}$, L_B and $L_{B'}$ are brightness at location B and B'

Note 10: Optical characteristic measurement setup.



D. Reliability test items

Test Item	Test Condition	Judgment	Remark
High temperature storage	60°C, 240Hrs	Note 1	Note 2
Low temperature storage	-20°C, 240Hrs	Note 1	Note 2
High temperature & high humidity operation	40°C, 90%RH, 240Hrs (No condensation)	Note 1	Note 2
High temperature operation	50°C, 240Hrs	Note 1	Note 2
Low temperature operation	0°C, 240Hrs	Note 1	Note 2
Thermal Shock (non-operation)	-20°C~60°C, 1hrs, 3mins, 1hrs, 100Cycles	Note 1	Note 2
Electrostatic discharge (ESD) (non-operation)	Contact: +/-8kV, 150pF(330ohms), 25 times/1 point, 1 time/1 sec Air discharge: +/-15kV, 150pF(330ohms), 25 times/1 point, 1 time/1 sec	Note 1	Note 2
Vibration (non-operation)	Vibration level : 1.5G Bandwidth : 10-300Hz Waveform : sine wave, sweep rate : 10min 30 min for each direction X, Y, Z (1.5 Hrs in total)	Note 1	Note 2
Mechanical Shock (non-operation)	Shock level : 50G, 11ms Waveform : Half sine wave Direction : ±X, ±Y, ±Z One time each direction	Note 1	Note 2
MTBF Demonstration	50,000 hours with confidence level 90%	Note 1	Note 3

Note1: 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.

Note2: Evaluation should be tested after storage at room temperature for two hours.

Note 3: The MTBF calculation is based on the assumption that the failure rate distribution meets the Exponential Model (CCFL excluded)

E. Safety

(1). Sharp Edge Requirements



SPEC NO. MT230DW01 V.0

PAGE 19/21

There will be no sharp edges or corners on the display assembly that could cause injury.

(2). Materials**a. Toxicity**

There will be no carcinogenic materials used anywhere in the display module. If toxic materials are used, they will be reviewed and approved by the responsible InnoLux Toxicologist.

b. Flammability

All components including electrical components that do not meet the flammability grade UL94-V1 in the module will complete the flammability rating exception approval process. The printed circuit board will be made from material rated 94-V1 or better. The actual UL flammability rating will be printed on the printed circuit board.

c. Capacitors

If any polarized capacitors are used in the display assembly, provisions will be made to keep them from being inserted backwards.

F. Display quality

The display quality of the color TFT-LCD module should be in compliance with the Innolux's Incoming inspection standard.

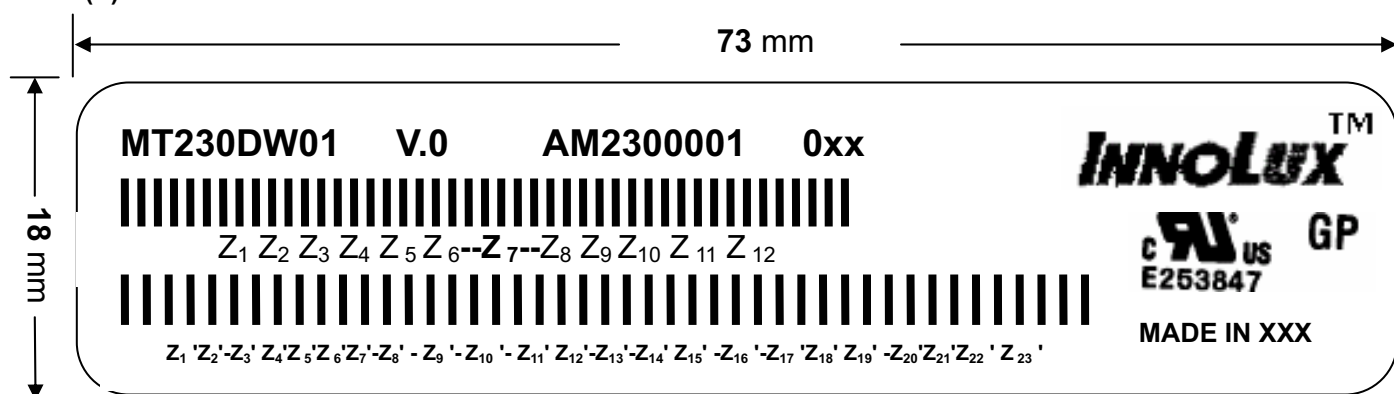
G. Handling precaution

The Handling of the TFT-LCD should be in compliance with the Innolux's handling principle standard.

www.panelook.com

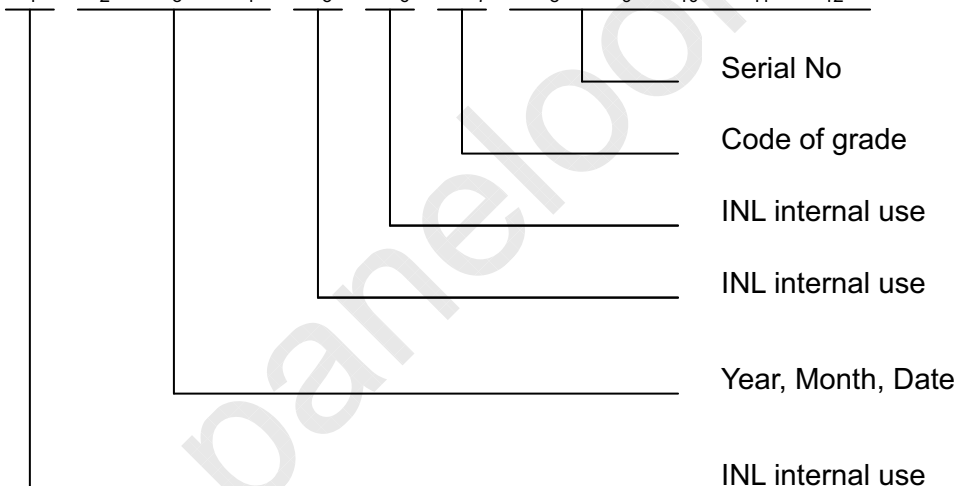
SPEC NO. MT230DW01 V.0

PAGE 20/21

H. Label**(1). Module Label**

(a). Model Number: MT230DW01

(b). Version: V.0

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

Serial ID includes the information as below:

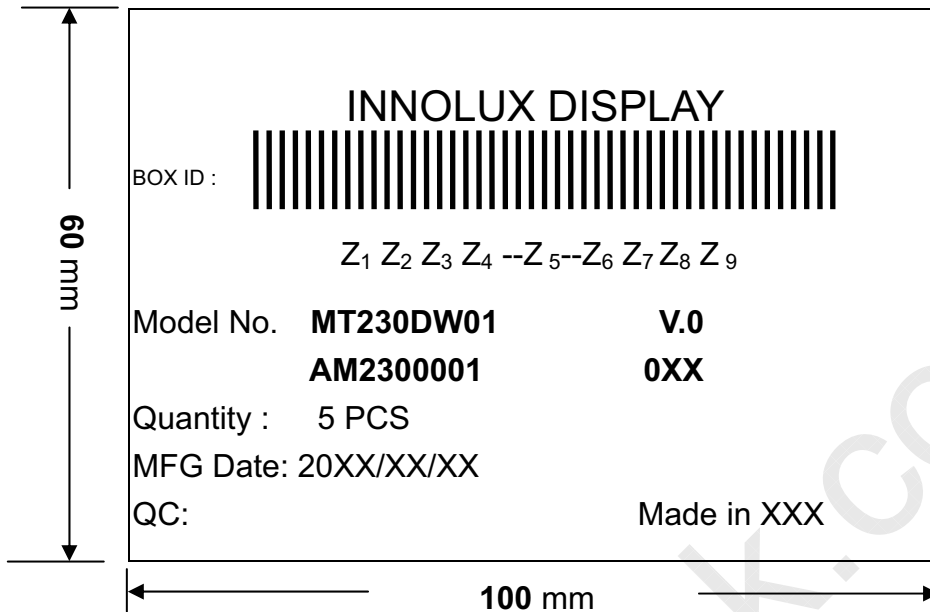
1. Manufactured Date: Year: 0~9, for 2000~2009
2. Month: 1~9 & A~C for Jan. ~ Dec.
3. Date: 1~9 & A~Z (exclude I, O, Q, U) for 1st~31th
4. Code of grade: 1, 2, 3, 5, E
5. Serial No: Module manufacture sequence no

(d). Serial ID II (INL internal use)

SPEC NO. MT230DW01 V.0

PAGE 21/21

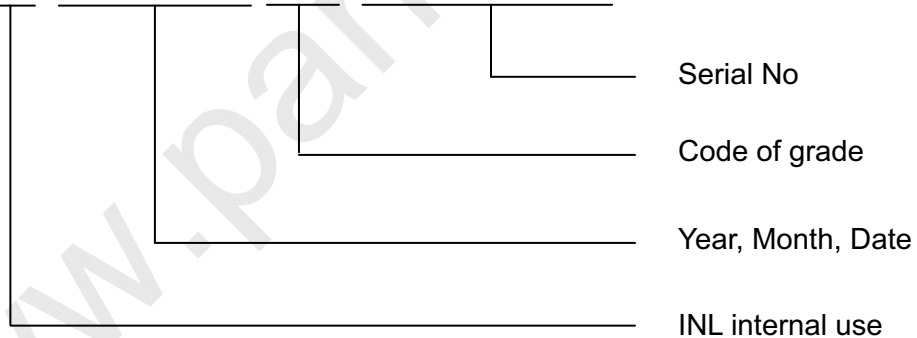
(2) Carton Label



(a). Model Number: MT230DW01

(b). Version: V.0

(c). Packing quantity: 5 pcs

(d). Serial ID: Z₁ Z₂ Z₃ Z₄ Z₅ Z₆ Z₇ Z₈ Z₉

Serial ID includes the information as below:

(a). Manufactured Date: Year: 0~9, for 2000 ~2009

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.