INNOLUX DISPLAY CORPORATION

MT230DW01 V.0 LCD MODULE SPECIFICATION

( ) Preliminary Specification

(●) Final Specification

Approved by	Checked by	Prepared by
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Record of Revision

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Contents:

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.

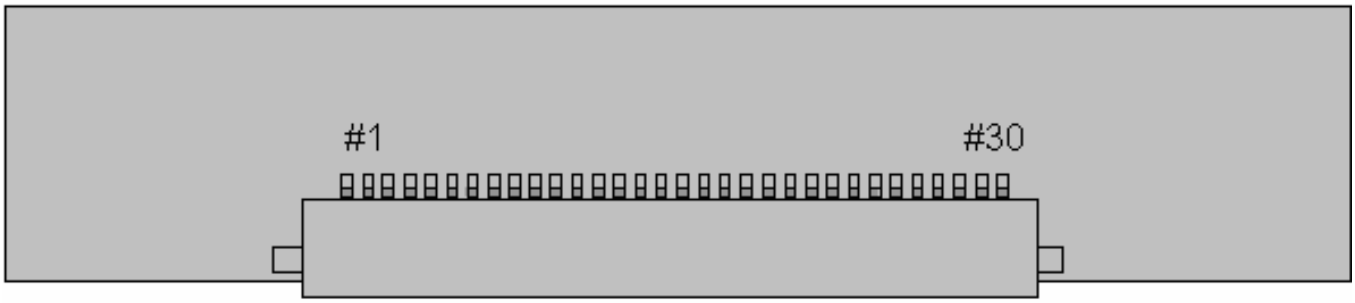
B. Electrical specifications

1. Pin assignment

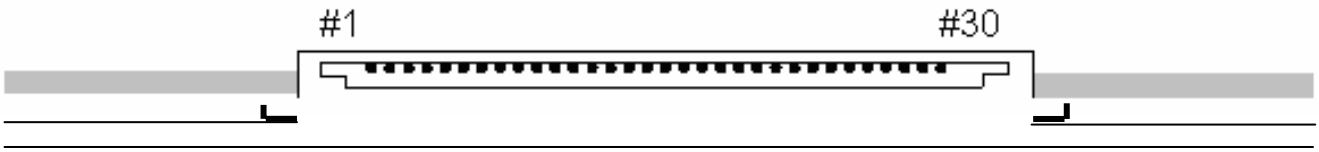
Connector

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)



Top view of LVDS connector



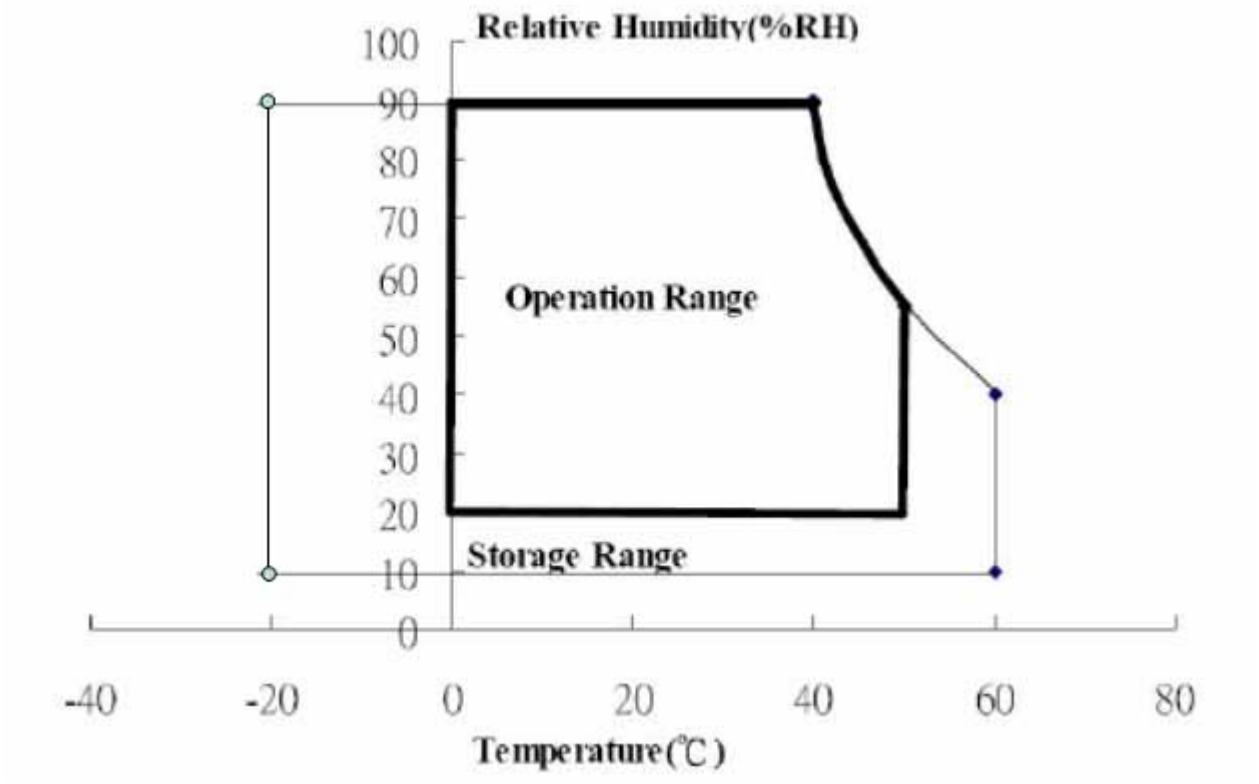
Rear view of LCM

2. Absolute maximum ratings

Parameter	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Power voltage	V_{cc}	-0.3	-	6.0	V	At 25℃
Input signal voltage	V_{LH}	-0.3	-	4.3	V	At 25℃
Operating temperature	Top	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.



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	-	600	mV	
	Threshold Voltage (High)	VTH	-	-	100	mV	Note 5, 6
	Threshold Voltage (Low)	VTL	-100	-	-	mV	Note 5, 6

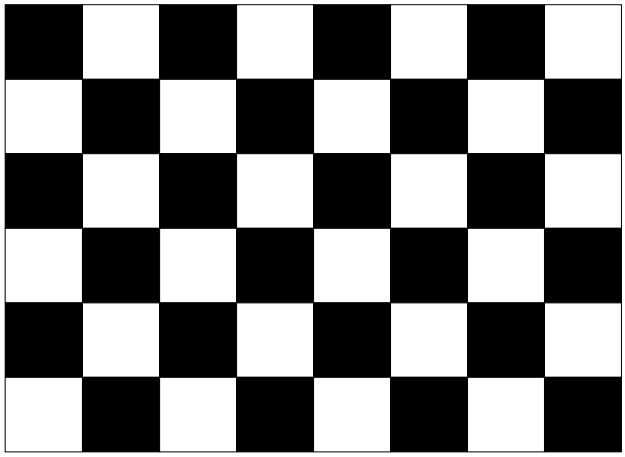
Note 1: The specified current is under the Vcc =5V, 25 °C, fv=60Hz (frame frequency) condition whereas black pattern is displayed.

Note 2: The specified current is under the Vcc =5V, 25 °C, fv=60Hz (frame frequency) condition whereas white pattern is displayed.

Note 3: The specified current is under the Vcc =5V, 25 °C, fv=60Hz (frame frequency) condition whereas mosaic pattern (black & white [8*6]) is displayed.

White: 255 Gray

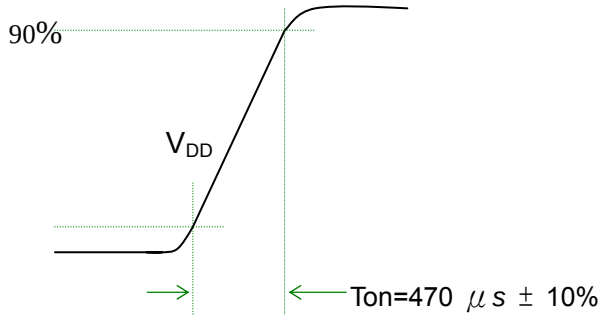
Black: 0 Gray



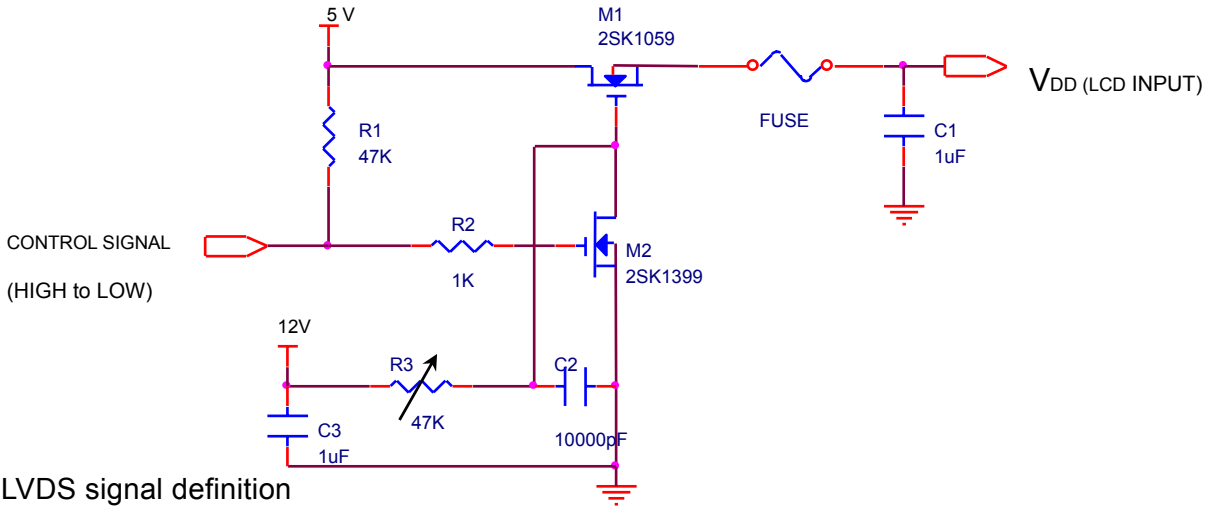
Note 4: Test condition:

(1). V_{DD} = 5 V, V_{DD} rising time = 470 μs ± 10%

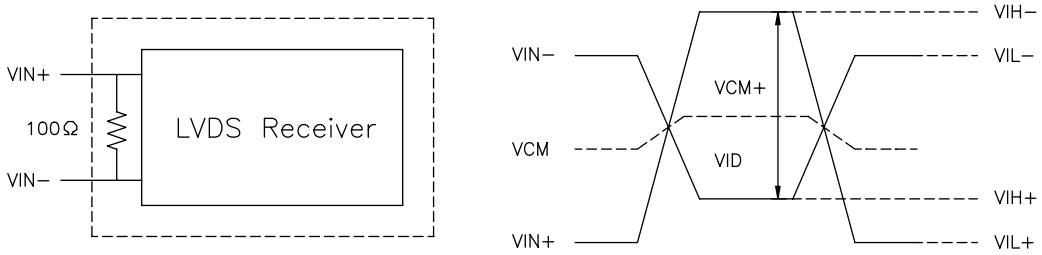
(2). Pattern: Mosaic pattern



(3) Test circuit



Note 5: LVDS signal definition



VIN_+ = Positive differential DATA & CLK Input

VIN- = Negative differential DATA & CLK Input

VID = VIN_+ – VIN- ,

ΔVCM = | VCM_+–VCM- | ,

ΔVID = | VID_+–VID- | ,

VID+ = | VIH_+–VIH- | ,

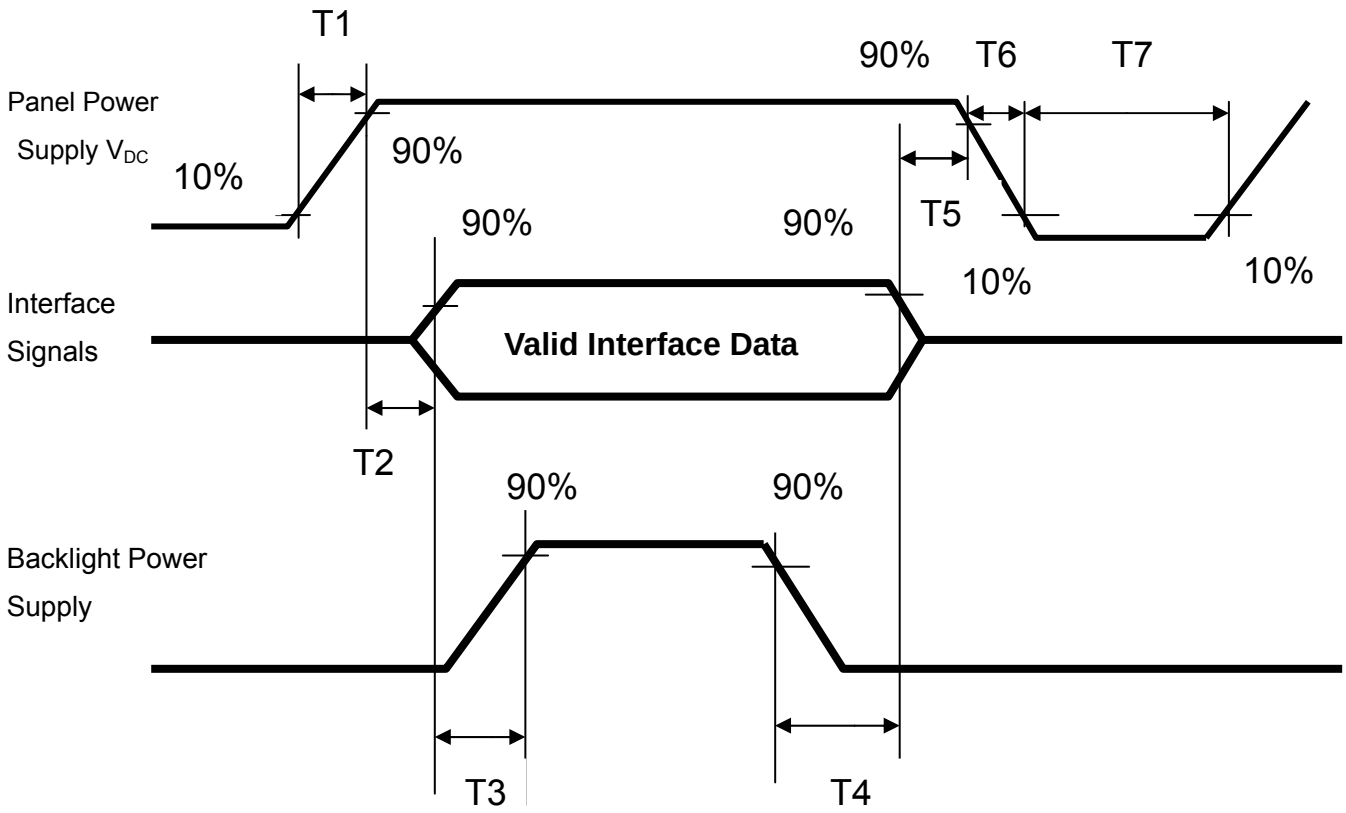
VID- = | VIL_+–VIL- | ,

VCM = (VIN_+ +VIN-)/2,

VCM+ = (VIH_+ +VIH-)/2,

VCM- = (VIL_+ +VIL-)/2,

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



Parameter	Value			Unit
	Min	Typ.	Max	ms
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	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
	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
	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
	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
	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
	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	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
	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
	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
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	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
	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
	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
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
	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
	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
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	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	0
	Green(254)	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(255)bright	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	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
	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	1
	Blue(002)	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(253)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
	Blue(254)	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(255) bright	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

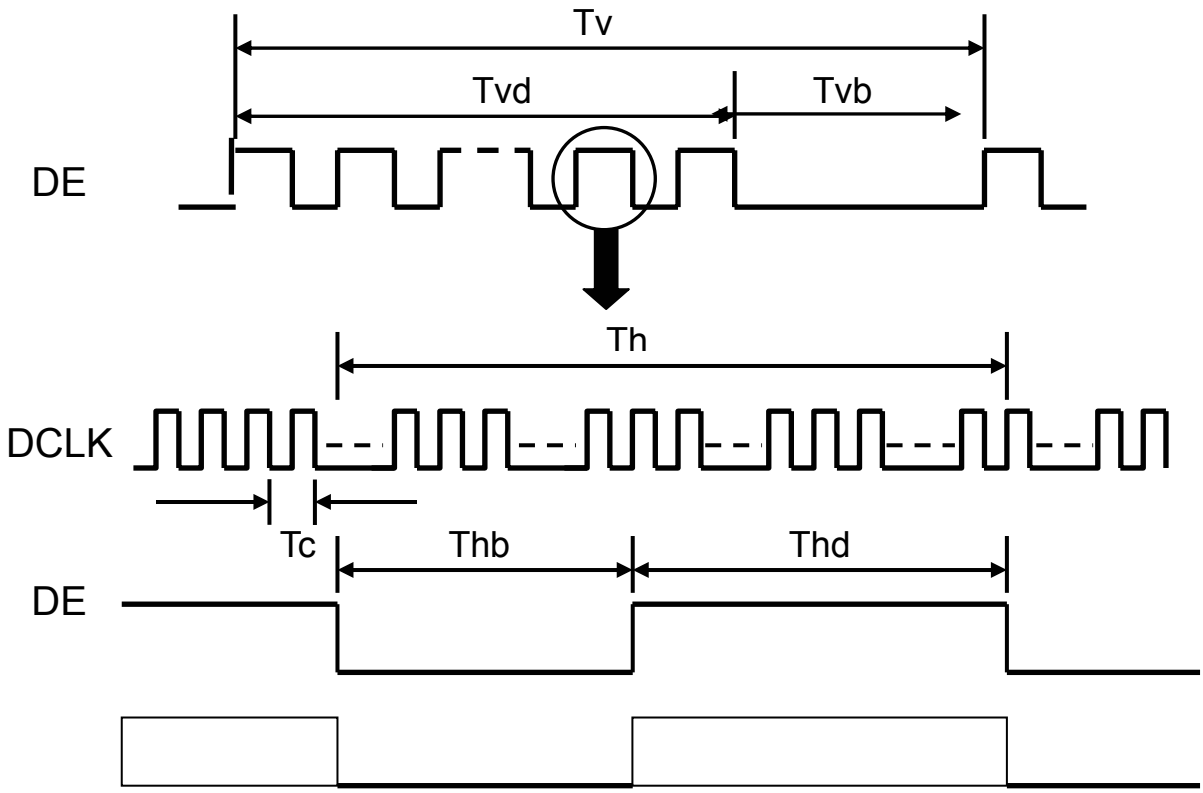
c. Input signal timing

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



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(1920,1979)
D(1,1080)	D(2,1080)	… …	D(960,1080)	… …	D(1919,1080)	D(1920,1080)

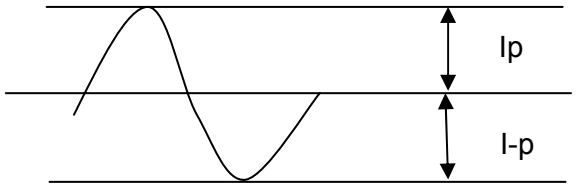
e. Backlight driving conditions

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 (or I-p)/Irms

Lamp should be completely turned on.

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 Ta = 25±2°C and IL = 7.5mArms.

Backlight connecter: 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

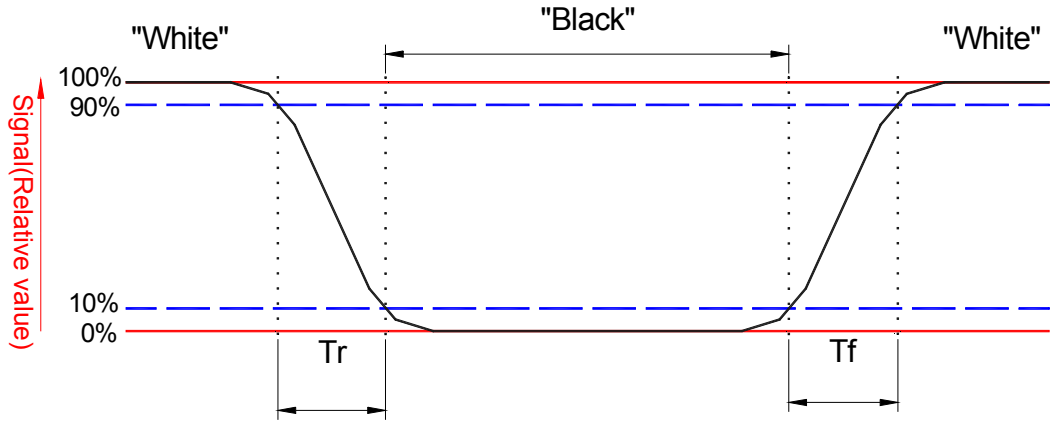
Item	Symbol	Condition	Specification			Unit	Remark
			Min.	Typ.	Max.		
Response time	Tr	θ= 0°	-	1.5	3	ms	Note 2
	Tf		-	3.5	7		
	Tr+Tf		-	5	10		
Contrast ratio	CR	θ= 0°	700	1000	-		Note 1,3
Viewing angle	Top	CR≧10	70	80	-	deg.	Note 1,3,5
		CR≧5	75	85			
	Bottom	CR≧10	70	80	-		
		CR≧5	75	85			
	Left	CR≧10	75	85	-		
		CR≧5	80	89			
	Right	CR≧10	75	85	-		
		CR≧5	80	89			
Brightness (Center)	Y_L		250	300	-	nit	Note 1,4
Color chromaticity(CIE)	Wx	θ= 0°	-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.



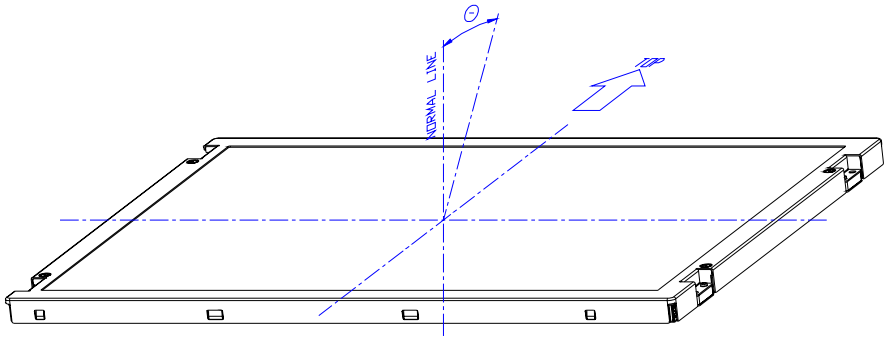
Note 3: Definition of contrast ratio:

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 mA, 50 KHz Frequency.

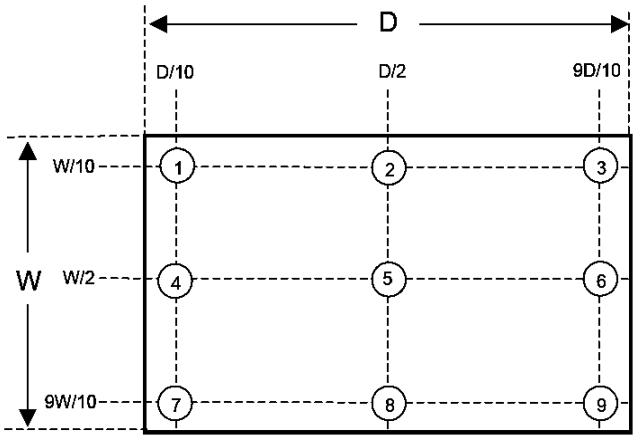
Note 5: Definition of viewing angle



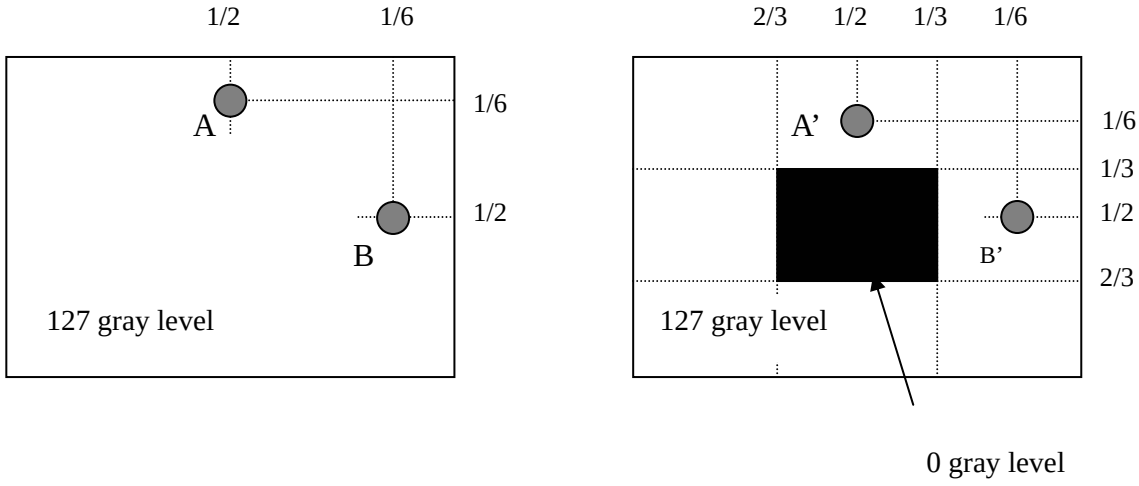
Note 6: Definition white uniformity:

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

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



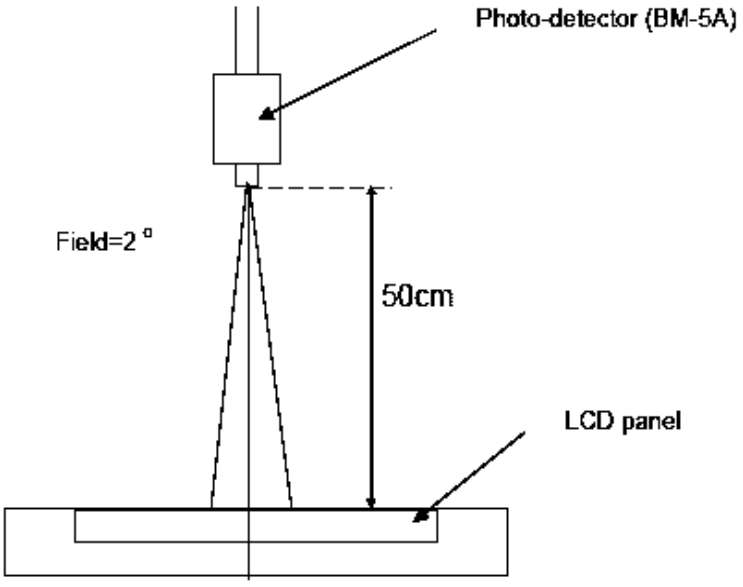
Note 7:



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

$I\ L_B-L_{B'}\ I\ /\ L_B \times 100\% = 2\%$ 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

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

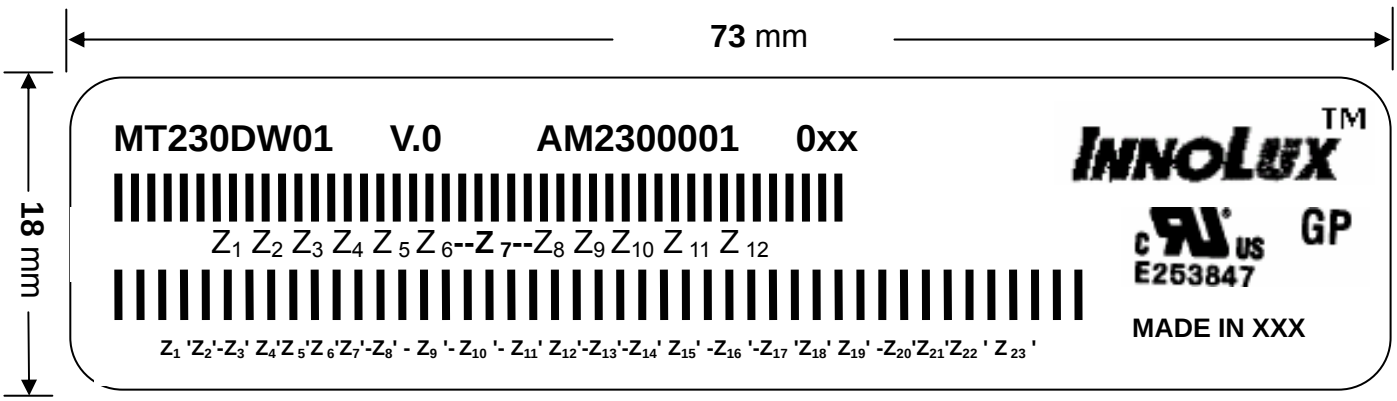
The display quality of the color TFT-LCD module should be in compliance with the Innolux's Incoming inspection standard.

G. Handling precaution

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

H. Label

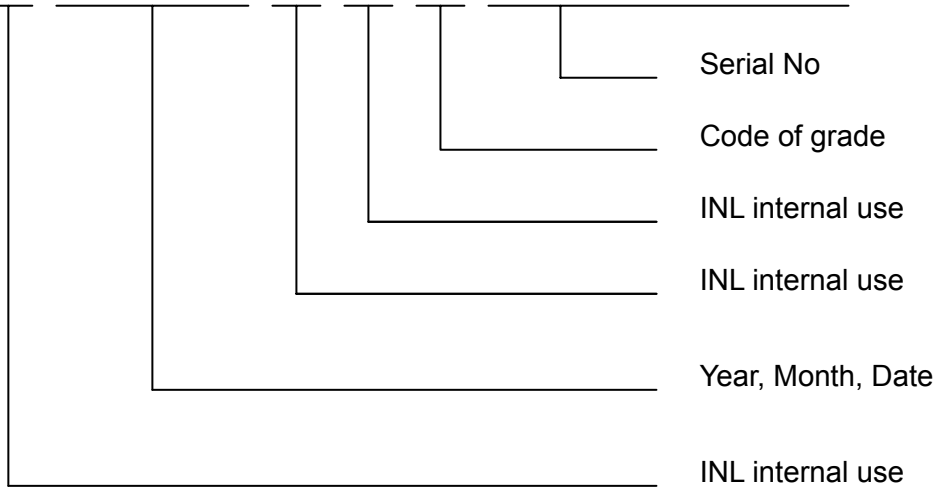
(1). Module Label



(a). Model Number: MT230DW01

(b). Version: V.0

(c). Serial ID I: Z_1 Z_2 Z_3 Z_4 Z_5 Z_6 Z_7 Z_8 Z_9 Z_{10} Z_{11} Z_{12}

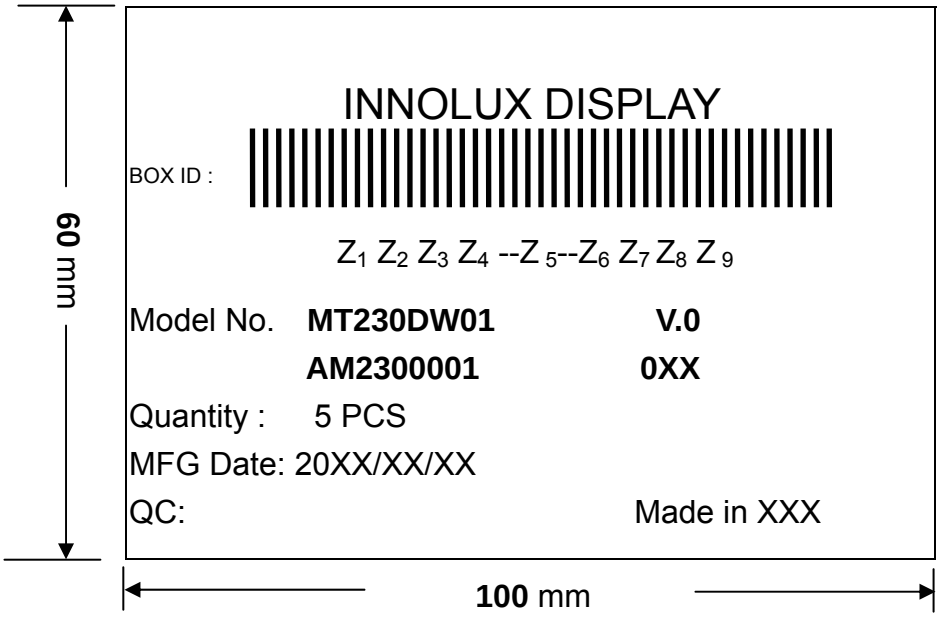


Serial ID includes the information as below:

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)

(2) Carton Label

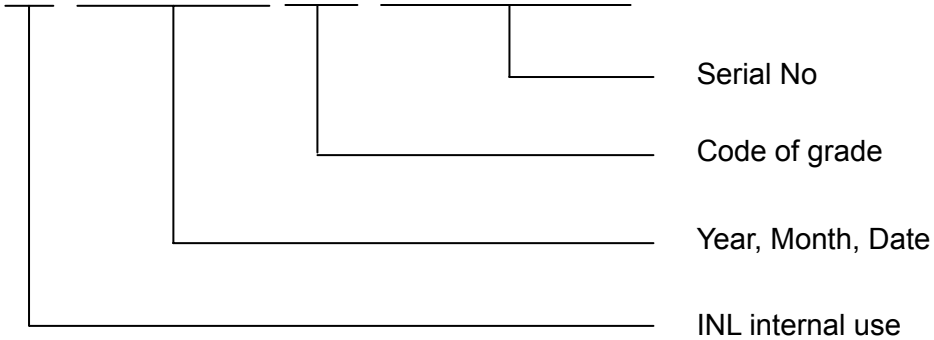


(a). Model Number: MT230DW01

(b). Version: V.0

(c). Packing quantity: 5 pcs

(d). Serial ID: Z_1 Z_2 Z_3 Z_4 Z_5 Z_6 Z_7 Z_8 Z_9



Serial ID includes the information as below:

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

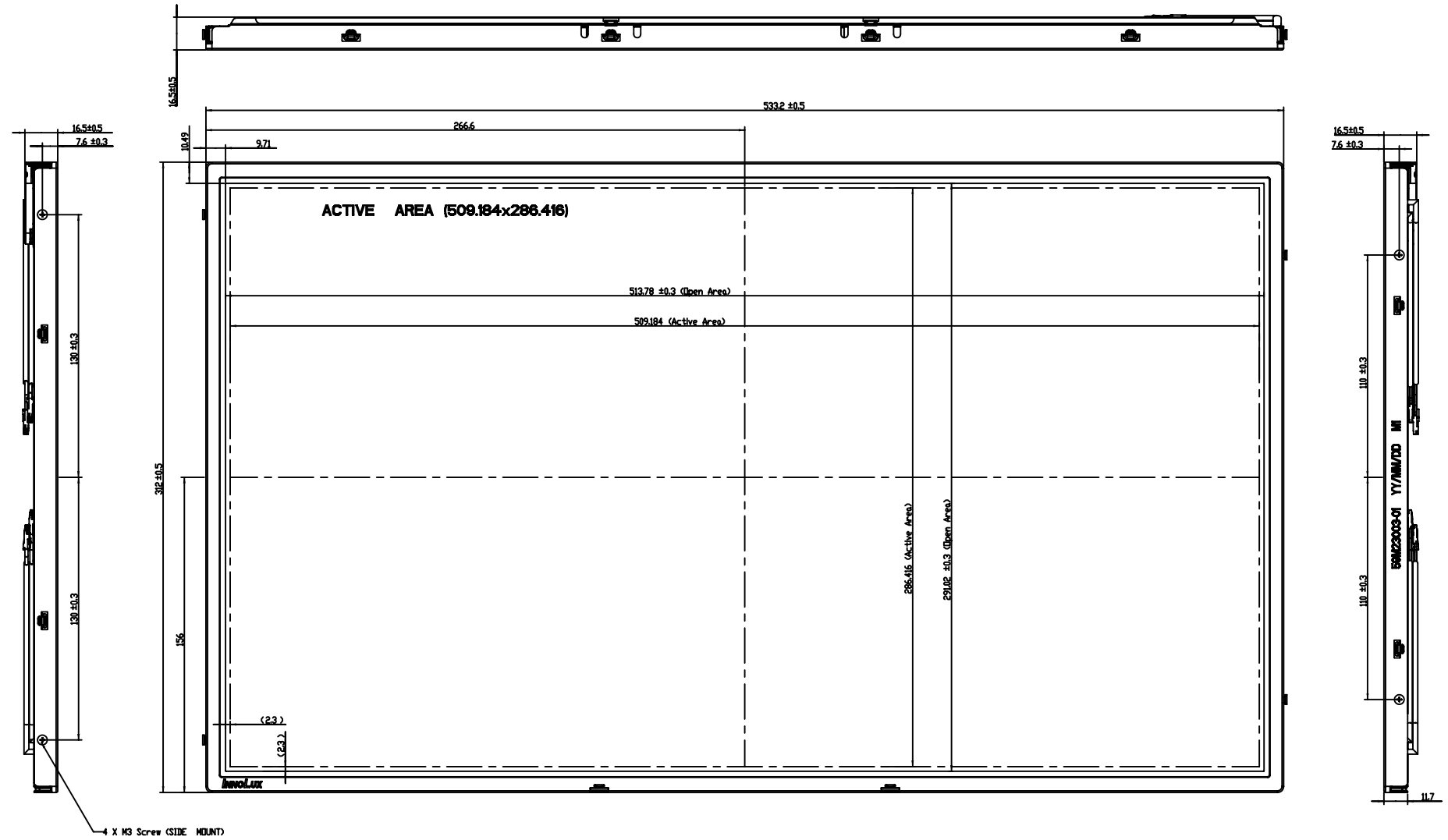
Month: 1~9 & A~C for Jan. ~ Dec.

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.

I. ME Drawing



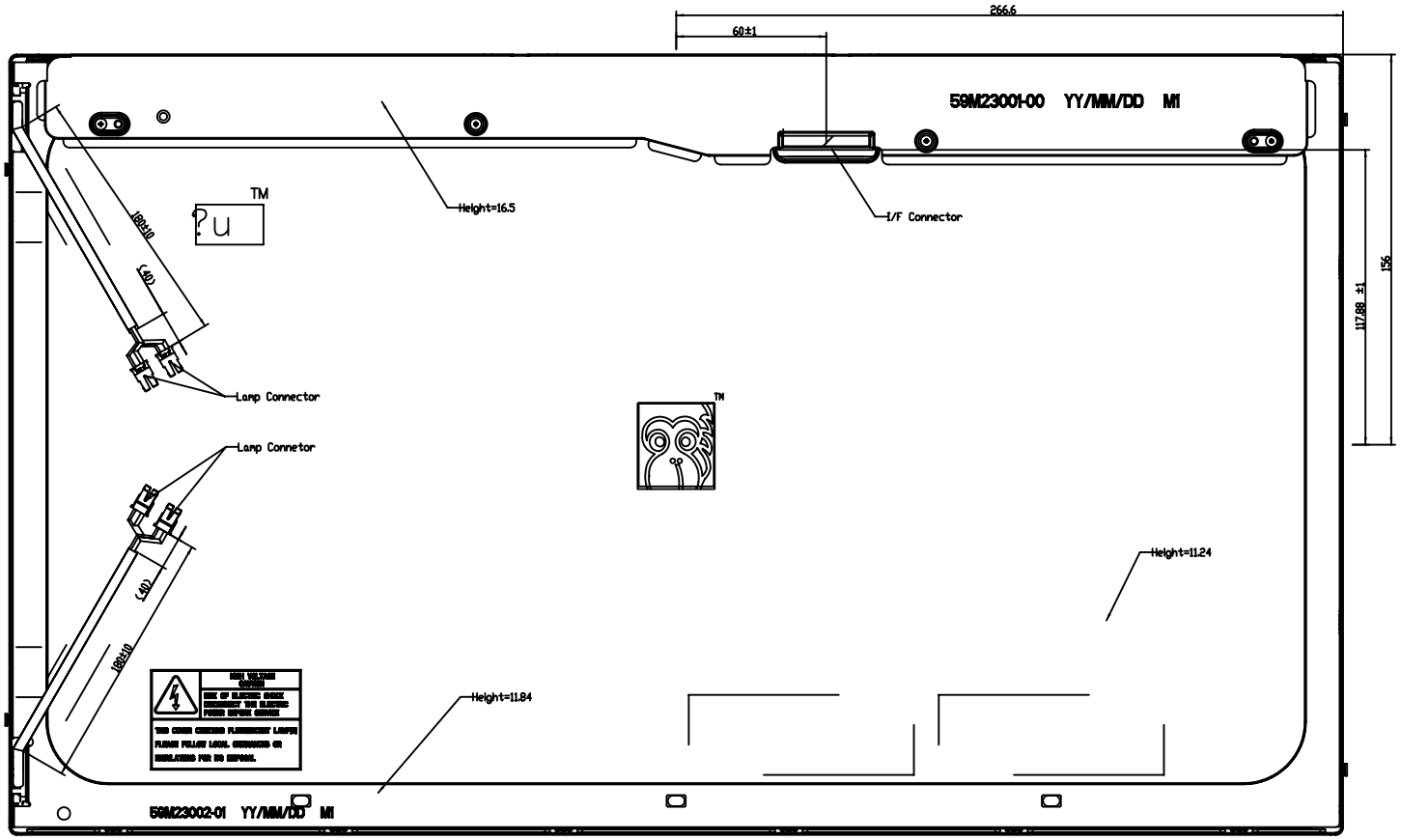
NOTES:
1.SIDE MOUNT HOLES ROTATIONAL TORQUE MUST BE MAX. 6Kgf-cm.

REV	ECO NUMBER	DESCRIPTION	DATE
V	XXXXXXXX	XXXXXXXX	xxxx/xx/xx

APPROVED	Jack Chen	2010/8/18	
CHECKED	Alex Pan	2010/8/18	
DESIGNED	Sam Yu	2010/8/18	

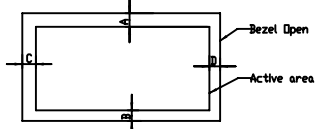
UNIT	mm
SCALE	1
3rd ANGLE	
PART NUMBER	AM230000100
PART DESCRIPTION	LCM
MODEL NAME	HTE230WB1_V0
REVISION	A
SHEET NUMBER	1of2
SIZE	A3

INNOLUX



Note:

1. Backlight:4 Cold Cathode Fluorescent Lamps.
2. I/F Connector Specification:GS23302-0311S-7F.
3. Torque of user hole(M2 threaded holes):3.0 kgf-cm.
4. Tilit and partial dispasition tole rance of display area as following
   (1) Y-Direction:[A-B] <=2.3
   (2) X-Direction:[C-D] <=2.3



5. LAMP CONNECTER: 35001HS-02L.
6. Do not wind conductive tape araund the backlight wires.
7. Gap between Bezel and Panel:Max0.8mm.
8. Unspecified tolerances to be ±0.5mm

APPROVED	Jack Chen	2009/8/18	AM230000100
CHECKED	Alex Pan	2009/8/18	LCM
DESIGNED	Sam Yu	2009/8/18	INNOLUX