

**DISPLAY Elektronik GmbH**

# DATA SHEET

**2,2" TFT  
MODULE**

**DEM 240320A TMH-PW-N**

**Product specification**

**Version: 1.0**

**15.JUN 2007**

REVISION HISTORY:				
Revision	Date	Description	Written By	Approved By
1.0	15-Jun-2007	New Release.	XH	MH

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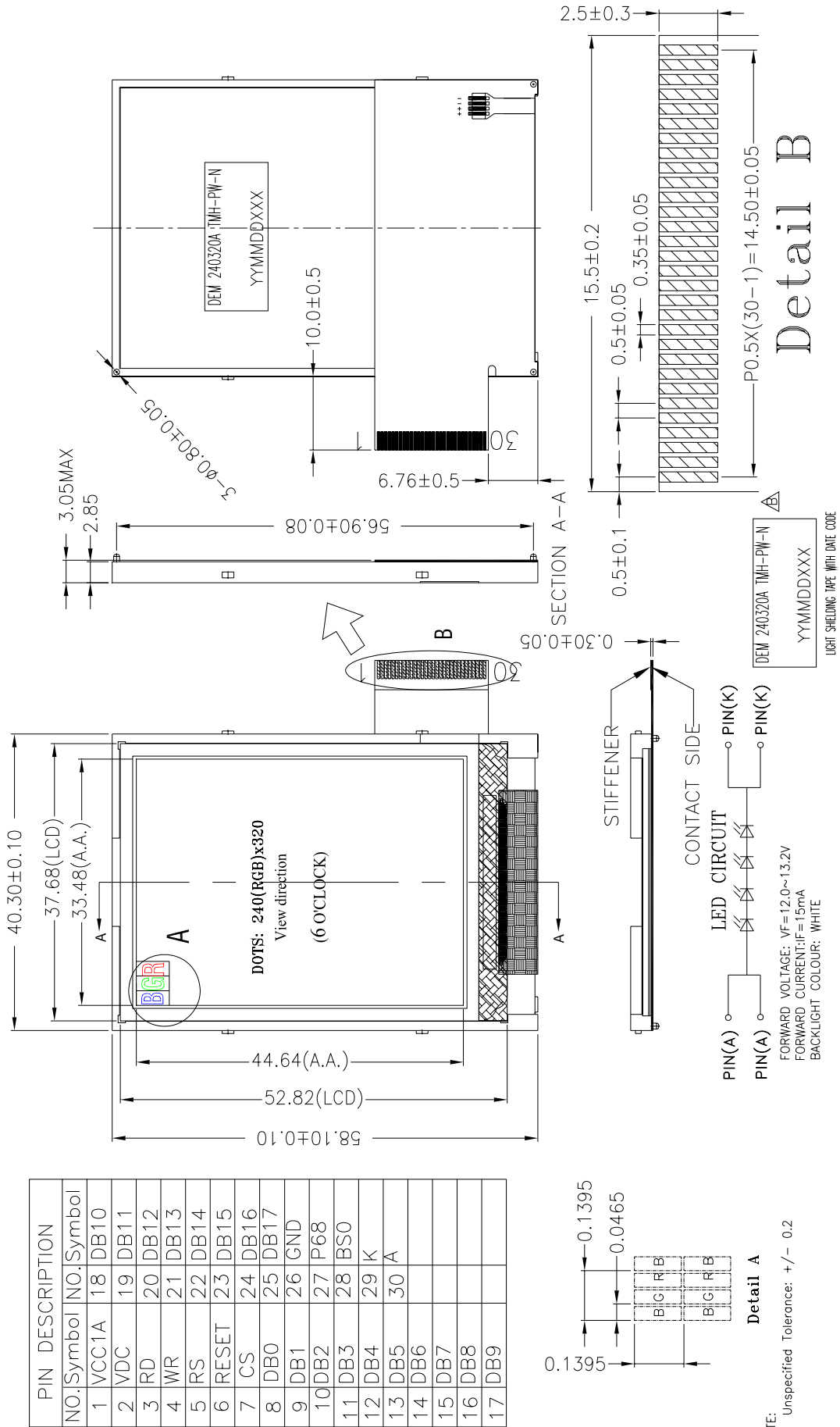
**1.0 GENERAL SPECIFICATION**

ITEM	CONTENTS	UNIT
LCD Type	2.2 inch a-Si TFT active-matrix Transmissive	-
Module outer dimension	40.30 × 58.10 × 3.05 (max.)	mm
Pixel Size	0.1395(RGB) × 0.1395	mm
Active display area	33.48 × 44.64	mm
Number of dots	240(RGB) × 320	dots
Viewing direction	6	O'clock
Color-filter-array	RGB Stripe	
Number Of Colors	262k	
Backlight	LED white backlight	-
Drive IC	HX8346-A (HIMAX)	-
Interface type	16-bit 68 mode;18-bit 68 mode;16-bit 80 mode;18-bit 80 mode, Serial, RGB, VSYNC	See Note
Operating temperature	-20 ~ 70	°C
Storage temperature	-30 ~ 80	°C
Weight	10	g

Note: Below interfaces can be custom-made according to different applications:

- 8/16 MPU (68-system and 80-system) parallel interface
- 3-wire serial data transfer interface
- 16, 18 data lines parallel video (RGB) interface.

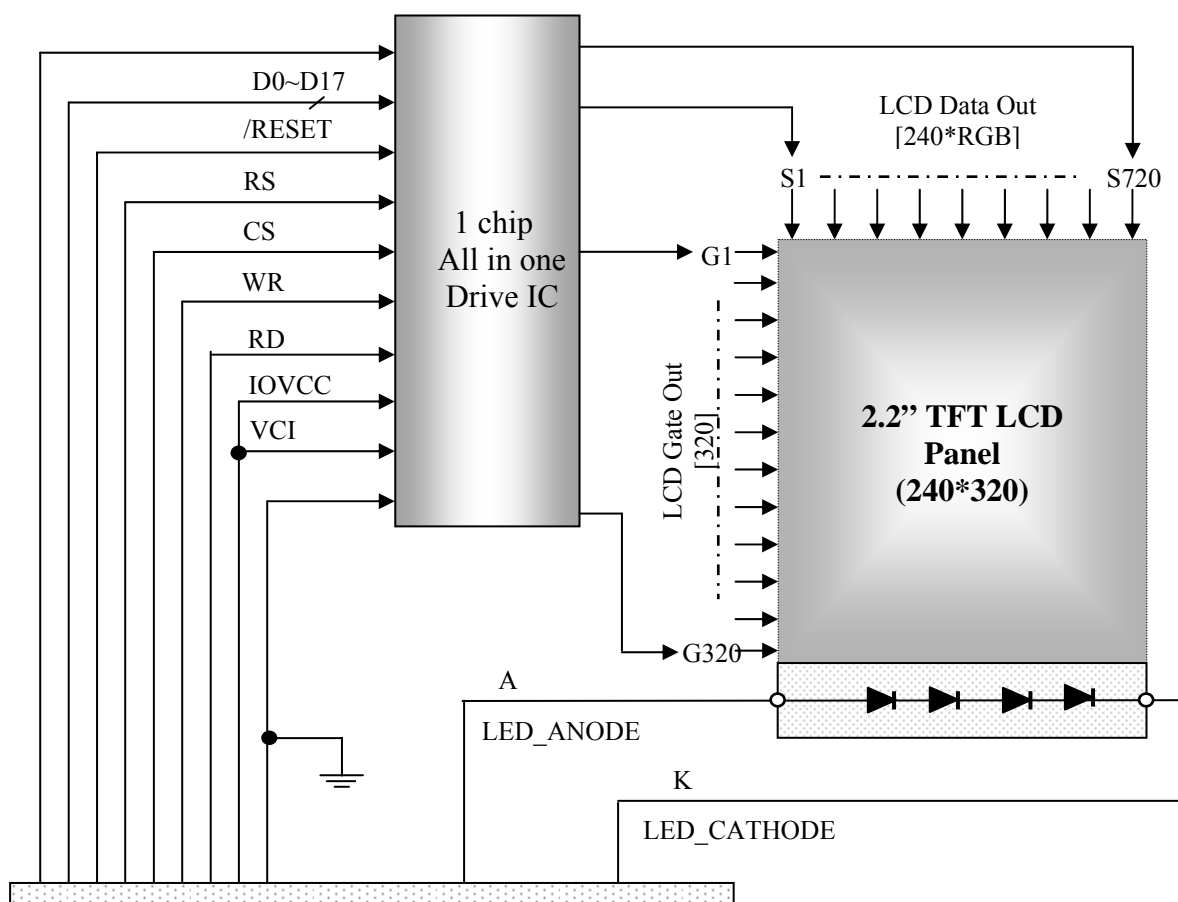
2.0 OUTLINE DRAWING



**3.0 INTERFACE PIN DESCRIPTION**

Pin No.	Symbol	Function
1	VCC1A	Logic power supply.
2	VDC	Power supply.
3	RD	Read strobe signal.
4	WR	Write strobe signal.
5	RS	Register selection input When RS = "low", instruction register . When RS = "high" . data register .
6	RESET	Reset signal.
7	CS	Chip select signal. Low active.
8 ~ 25	DB0 ~ DB17	Data Bus.
26	GND	Power ground.
27	P68	68-mode or 80-mode selection.
28	BS0	16-bit or 18-bit interface selection.
29	K	Cathode of the backlight power supply.
30	A	Anode of the backlight power supply.

**4.0 BLOCK DIAGRAM**



5.0 OPERATING PRINCIPLE & DRIVING METHOD

5.1 Please refer to HX8346-A datasheet for more details.

5.2 HX8346-A Instruction Description.

(Hex)	Operation Code	DNC	NWR	NRD	D15-8	D7	D6	D5	D4	D3	D2	D1	D0	Function
00	NOP	0	↑	1	-	0	0	0	0	0	0	0	0	No Operation
01	SWRESET	0	↑	1	-	0	0	0	0	0	0	0	1	Software reset
04	RDDIDIF	0	↑	1	-	0	0	0	0	0	1	0	0	Read Display Identification Information
		1	1	↑	-	-	-	-	-	-	-	-	-	Dummy read
		1	1	↑	-	ID1[7:0]				ID1 read				
		1	1	↑	-	ID2[7:0]				ID2 read				
		1	1	↑	-	ID3[7:0]				ID3 read				
06	RDREAD <small>(Notes: Active only under REG_EN=1, otherwise always return 0)</small>	0	↑	1	-	0	0	0	0	0	1	1	0	Read Red Color
		1	1	↑	-	-				Dummy Read				
		1	1	↑	-	R[7:0]								
07	RDGREN <small>(Notes: Active only under REG_EN=1, otherwise always return 0)</small>	0	↑	1	-	0	0	0	0	0	1	1	1	Read Green Color
		1	1	↑	-	-				Dummy read				
		1	1	↑	-	G[7:0]								
08	RDBLUE <small>(Notes: Active only under REG_EN=1, otherwise always return 0)</small>	0	↑	1	-	0	0	0	0	1	0	0	0	Read Blue Color
		1	1	↑	-	-				Dummy read				
		1	1	↑	-	B[7:0]								
09	RDDST	0	↑	1	-	0	0	0	0	1	0	0	1	Read Display Status
		1	1	↑	-	-	-	-	-	-	-	-	-	Dummy read
		1	1	↑	-	D[31:24]								
		1	1	↑	-	D[23:16]								
		1	1	↑	-	D[15:8]								
0A	RDDPM	0	↑	1	-	0	0	0	0	1	0	1	0	Read Display Power Mode
		1	1	↑	-	-	-	-	-	-	-	-	-	Dummy read
		1	1	↑	-	D[7:0]								
0B	RDDMADCTL	0	↑	1	-	0	0	0	0	1	0	1	1	Read Display MADCTL
		1	1	↑	-	-	-	-	-	-	-	-	-	Dummy read
		1	1	↑	-	D[7:0]								
0C	RDDCOLM OD	0	↑	1	-	0	0	0	0	1	1	0	0	Read Display Pixel Format
		1	1	↑	-	-	-	-	-	-	-	-	-	Dummy read
		1	1	↑	-	D[7:0]								
0D	RDDIM	0	↑	1	-	0	0	0	0	1	1	0	1	Read Display Image Mode
		1	1	↑	-	-	-	-	-	-	-	-	-	Dummy read
		1	1	↑	-	D[7:0]								
0E	RDDSM	0	↑	1	-	0	0	0	0	1	1	1	0	Read Display Signal Mode
		1	1	↑	-	-	-	-	-	-	-	-	-	Dummy Read
		1	1	↑	-	D[7:0]								
0F	RDDSDR	0	↑	1	-	0	0	0	0	1	1	1	1	Read Display Self-Diagnostic Result
		1	1	↑	-	-	-	-	-	-	-	-	-	Dummy Read
		1	1	↑	-	D[7:0]								

**6.0 ABSOLUTE MAXIMUM RATINGS**

Item	Symbol	Unit	Value
Power Supply Voltage (1)	V <sub>DC</sub>	V	-0.3 to +4.6
Power Supply Voltage (1)	V <sub>CC1A</sub>	V	-0.3 to +4.6
Input Voltage	V <sub>I</sub>	V	-0.3 to V <sub>CC1A</sub> +0.3

**7.0 ELECTRICAL CHARACTERISTICS**

Item	Symbol	Min	Typ.	Max	Unit	Remarks
Digital Power voltage	DVDC	2.5	2.8	3.3	V	
	AVDC	2.5	2.8	3.3	V	
Gate on voltage	V <sub>GH</sub>	-	15	-	V	
Gate off voltage	V <sub>GL</sub>	-	-8	-	V	
I/O Power supply	V <sub>CC1A</sub>	1.7	-	3.3	V	
Input high voltage	V <sub>IH</sub>	0.8 x V <sub>CC1A</sub>	-	V <sub>CC1A</sub>	V	
Input low voltage	V <sub>IL1</sub>	GND	-	0.2 x V <sub>CC1A</sub>	V	

**8.0 BACKLIGHT SPECIFICATIONS**

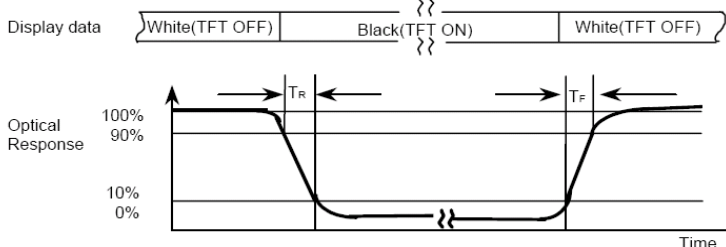
Item	Symbol	Min.	Typ.	Max.	Unit	Conditions
Forward voltage	V <sub>f</sub>	12	12.8	13.2	V	If = 15 mA
Forward Current	I <sub>f</sub>	-	15	-	mA	
Reverse Voltage	V <sub>r</sub>	-	-	5	V	
Reverse current	I <sub>r</sub>	-	-	15	□μA	V <sub>r</sub> = 3.0V
Chromaticity coordinates	X	0.283	-	0.330	-	
	Y	0.276	-	0.330	-	
Luminance (BLU only)	L <sub>v</sub>	2800	3400	3700	cd/m <sup>2</sup>	If = 15 mA
Uniformity	Δ	80	85	-	%	Min/max 100%
Half-Brightness Life Time	50000 Hours					



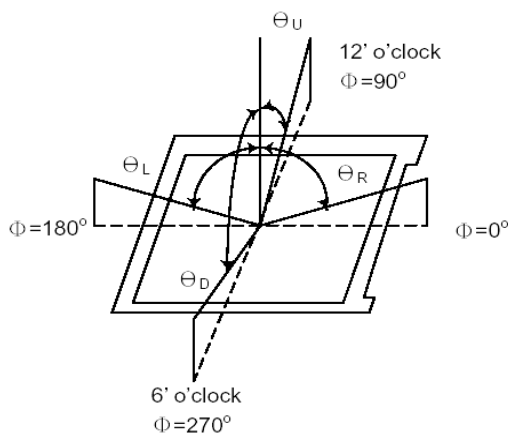
9.0 OPTICAL CHARACTERISTICS (Ta=25°C)

No	Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note	
1	Response Time	Rise	Tr	$\theta = \phi = 0^\circ$	-	15	30	ms	(1)
		Fall	Tf	$\theta = \phi = 0^\circ$	-	35	50	ms	
2	Contrast Ratio	CR	$\theta = \phi = 0^\circ$	150	250	-	-	(2)	
3	Viewing Angle (CR ≥ 10)	Right	$\phi = 0^\circ$	40	45		Deg	(3)	
		Left	$\phi = 180^\circ$	40	45		Deg		
		Upper	$\phi = 90^\circ$	10	15		Deg		
		Lower	$\phi = 270^\circ$	30	35		Deg		
4	Color Chromaticity (CIE1931)	Red	Rx	$\theta = \phi = 0^\circ$	0.610	0.640	0.670	-	(4)
			Ry		0.314	0.344	0.374	-	
		Green	Gx		0.268	0.398	0.328	-	
			Gy		0.553	0.583	0.613	-	
		Blue	Bx		0.102	0.132	0.162	-	
			By		0.107	0.137	0.167	-	
		White	Wx		0.282	0.312	0.342	-	
			Wy		0.319	0.349	0.379	-	
5	Luminance of white (Center point of LCM)	L		250	TBD	-	Cd/m <sup>2</sup>	(5)	

Note (1): Definition of Response Time



Note (3): Definition of Viewing



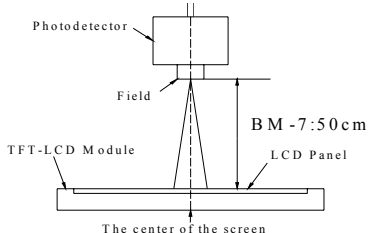
Note (2): Definition of Contrast Ratio

CR = Brightness at all pixels “White” / Brightness at all pixels “Black”

Note (4): Measured at center point vertically with backlight on.

Note(5): After stabilizing and leaving the panel alone at a given temperature for 30 min ,the measurement should be executed .Measurement should be executed in a stable, windless, and dark room. 30 min after lighting the back-light. This should be measured in the center of the screen.

Environment condition: Ta=25±2°C Back-Light On condition



**11.0 STANDARD SPECIFICATION FOR RELIABILITY**

**11.1 Standard specification of Reliability Test**

No	Test Item	Content of Test	Test Condition	Applicable Standard
1	High temperature storage	Endurance test applying the high storage temperature for a long time.	80+/-3 °C @ 240 hrs	-----
2	Low temperature storage	Endurance test applying the low storage temperature for a long time.	-30+/-3 °C @ 240 hrs	-----
3	High temperature operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	70+/-3 °C @ 240 hrs	-----
4	Low temperature operation	Endurance test applying the electric stress under low temperature for a long time.	-20+/-3 °C @ 240 hrs	-----
5	High temperature / Humidity operation	Endurance test applying the electric stress (Voltage & Current) and temperature / humidity stress to the element for a long time.	40 °C, 90 %RH @ 120 hrs	MIL-202E-103B JIS-C5023
6	Temperature cycle	Endurance test applying the low and high temperature cycle.  $\begin{array}{ccccc} -20^{\circ}\text{C} & \rightleftharpoons & 25^{\circ}\text{C} & \rightleftharpoons & 70^{\circ}\text{C} \\ 30\text{min.} & \leftarrow & 5\text{min.} & \rightarrow & 30\text{min.} \\ \leftarrow & & & & \rightarrow \\ & & \text{1 cycle} & & \end{array}$	-----	
<b>Mechanical Test</b>				
7	Drop Test	Endurance test applying the drop during transportation.	Packed, 100cm free fall (6 sides, 1 corner, 3edges)	----

Remarks:

- 1) For operation test, above specification is applicable when test pattern is changing during entire operation test.
- 2) Inspections after reliability tests are performed when the display temperature resumes back to room temperature.
- 3) It is a normal characteristic that some display abnormality can be seen during reliability test. If the display abnormality can resume back to normal condition at room temperature within 24hours, there is no permanent destruction over the display. The display still possesses its functionality after reliability tests.

**11.2 Failure Judgment Criteria**

After the reliability tests above, test sample shall be let return to room temperature and humidity for at least 4 hours before final tests are carried out.

Criterion Item	Failure Judgment Criteria
Electrical characteristic	Electrical short and open.
Mechanical characteristic	Out of mechanical specification
Optical characteristic	Out of the Appearance Standard

**12.0 QUALITY ASSURANCE**

**12.1 Acceptable Quality Level (AQL)**

Each lot should satisfy the quality level defined as follows:

- a) Inspection method: MIL-STD-105E Level II normal one time sampling
- b) AQL level

Category	AQL	Definition
Major	0.25%	Functional defective as product
Minor	1.00%	Satisfy all functions as product but not satisfy cosmetic standard

**12.2 Cosmetic Screening Criteria**

No	Defect	Judgment Criteria	Category		
1	Spots/Dust /Bubble (Round type)	Size, d (mm)	Acceptable quantity in active area	Minor	
		$d \leq 0.15$	Disregard		
		$0.15 < d \leq 0.20$	3		
		$d > 0.20$	0		
2	Dust/Scratches/ Black streak (Line type)	Width, W (mm)	Length, L (mm)	Acceptable quantity in active area	Minor
		$W \leq 0.02$	Disregard	Disregard	
		$W \leq 0.03$	$L \leq 1.0$	Disregard	
		$W \leq 0.05$	$L \leq 2.0$	3	
		$W > 0.05$	Disregard	0	
3	Allowable density	Above defects should be separated more than 5mm each other.	Minor		
4	Rainbow	Obvious unven color (rainbow) shall not be noticeable.	Minor		
5	Display condition	Dim display on the patterns, extra pattern and short circuit are not acceptable.	Major		
6	No display or missing display	The patterns of display shall light up as required. No display or missing display are not acceptable.	Major		

**13.0 PRECAUTIONS FOR USING LCD MODULE****Handling Precautions**

- The display panel is made of glass and polarizer. Do not subject it to mechanical shock by dropping or impact which may cause chipping especially on the edges.
- Do not touch, push or rub the exposed polarizers with anything harder than an HB pencil lead (glass, tweezers, etc.). The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.
- If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten cloth with Isopropyl alcohol or ethyl alcohol. Avoid using solvents like acetone (ketene), water, toluene, ethanol to clean the polarizer surface.
- Please keep the temperature within specified range for use and storage. Polarization degradation, bubble generation or polarizer peel-off may occur with high temperature and high humidity.
- Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- Install the LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion.
- Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.
- NC terminal should be open. Do not connect anything.
- If the logic circuit power is off, do not apply the input signals.
- Avoid contacting oil and fats.
- Condensation on the surface and contact with terminals due to cold will damage, stain or dirty the polarizers. After products are tested at low temperature they must be warmed up in a container before coming in contact with room temperature air.
- Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading.

**Electro-Static Discharge Control**

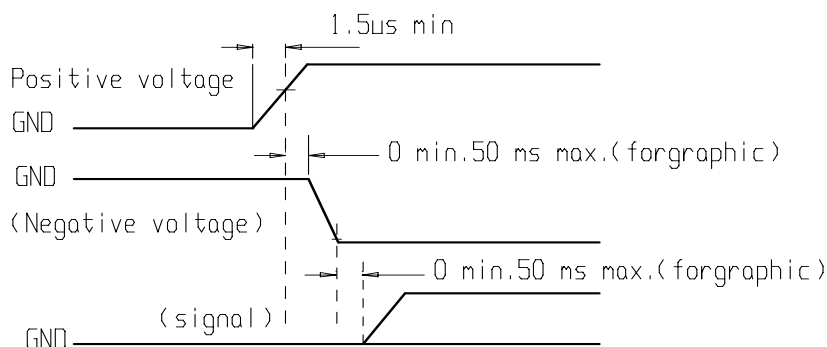
- Since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC.
- Be sure to ground the body when handling the LCD modules. Tools required for assembling, such as soldering irons, must be properly grounded.
- To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions. To reduce the generation of static electricity, be careful that the air in the work is not too dried. A relative humidity of 50%-60% is recommended.
- The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.
- When soldering the terminal of LCM, make certain the AC power source for the soldering iron does not leak.

**Precaution for soldering to the LCM**

- Observe the following when soldering lead wire, connector cable and etc. to the LCD module.
- Soldering iron temperature: 300 ~ 350°C.
- Soldering time: ≤ 3 sec.
- Solder: eutectic solder.
- Above is a recommended approach. Due to different solder composition and processing method, it is recommended that customer to study and fine tuning their soldering process parameters accordingly.
- If soldering flux is used, be sure to remove any remaining flux after finishing to soldering operation. (This does not apply in the case of a non-halogen type of flux.) It is recommended that you protect the LCD surface with a cover during soldering to prevent any damage due to flux spatters.

**Precautions for Operation**

- Viewing angle varies with the change of liquid crystal driving voltage ( $V_O$ ). Adjust  $V_O$  to show the best contrast.
- Driving the LCD in the voltage above the limit shortens its lifetime.
- Response time is greatly delayed at temperature below the operating temperature range. However, it will recover when it returns to the specified temperature range.
- If the display area is pushed hard during operation, the display will become abnormal. However, it will return to normal if it is turned off and then back on.
- When turning the power on, input each signal after the positive/negative voltage becomes stable.

**Storage**

- When storing LCDs as spares for some years, the following precautions are necessary.
- Store them in a sealed polyethylene bag. If properly sealed, there is no need for desiccant.
- Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0°C and 35°C.
- Environmental conditions:
  - Do not leave them for more than 168hrs. at 60°C.
  - Should not be left for more than 48hrs. at -20°C.

**Safety**

- It is recommended to crush damaged or unnecessary LCD into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.
- If any liquid leaks out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

**14.0 LOT NUMBERING SYSTEM**

**14.1 Definition of Lot Number**

One lot means the delivery date and times to customer at one time.

**YYMMDD XXX**

(1) (2)

(1) Manufacturing date (COG bonding) (YY: Year, MM: Month, DD: Day)

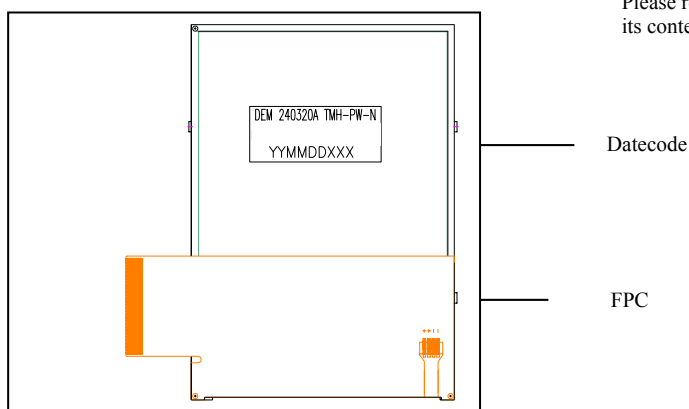
(2) Serial number starts from A01, A02.....,A99, B01, B02....

**14.2 Location of lot number**

Remarks:

This datecode is meant for traceability purpose and will not affect functionality of the display module. Thus, there is no special control on the font type and font size of the datecode as long as it is visible and readable.

Please refer to outline drawing for datecode orientation and its content.



**15.0 ROHS COMPLIANT PRODUCT**

**Standard of specific chemical substance**

1. Cadmium and Cadmium Compounds	Less than 100ppm
2. Hexavalent Chromium Compounds	Less than 1000ppm
3. Lead and Lead Compounds	Less than 1000ppm
4. Mercury and Mercury Compounds	Less than 1000ppm
5. Polybrominated Biphenyls (PBBs)	Less than 1000ppm
6. Polybrominated Diphenyl ethers (PBDEs)	Less than 1000ppm

**16.0 LIMITED WARRANTY**

Please inspect the LCD modules within one month after your receipt. Unless agreed between DISPLAY and customer, DISPLAY will replace or repair any of its LCD modules, which are found to be functionally defective when inspected in accordance with DISPLAY LCD/LCM acceptance standards (copies available upon request) for a period of one year from date of shipments. Cosmetic/visual defects must be returned to DISPLAY within 90 days of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of DISPLAY limited to repair and/or replacement on the terms set forth above. DISPLAY will not be responsible for any subsequent or consequential events.