DATA IMAGE CORPORATION

LCD Module Specification

ITEM NO.: **TG322400FFNNB-01**

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R&D Dept.	Q.C. Dept.	Eng. Dept.	Prod. Dept.
(signature)	*(signature)*	*(signature)*	*(signature)*
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2. RECORD OF REVISION

Rev	Date	Item	Page	Comment
B	MAR/14/03	13 11.2.3, 11.3,15	16 14-15,	New model numbering system updated from old P/N# TG32242FH 1.Change: 11.2.3 Inspection Parameters. 2.Add:11.3 Sampling Condition. 3. Modify: OUTLINE DRAWING.

3. GENERAL SPECIFICATION

Display Format :   320 (W) $\times$ 240 (H)   dots

Dots Pitch :   0.36 (W) $\times$ 0.36 (H)   mm

Dots Size :   0.34 (W) $\times$ 0.34 (H)   mm

View Area :   121 (W) $\times$ 91.6 (H)   mm

General Dimensions :   150 (W) $\times$ 106 (H) $\times$ 2.7 (T) mm Max.

Weight :   g max.

LCD Type :   ☐STN Blue   ☐STN Yellow ☑FSTN

Polarizer mode :   ☐Reflective   ☑Transflective

                     ☐Transmissive ☐Negative

View Angle :   ☑6 O'clock   ☐12 O'clock   ☐Others ____

Backlight :   ☐LED   ☐EL   ☐CCFL

Backlight Color :   ☐Yellow green ☐Amber   ☐Blue Green

                     ☐White   ☐Others

Controller / Driver :   Msm6778/Msm6779

Temperature Range :   ☐Normal   ☑Wide Temperature
                     Operating 0 to 50°C   Operating -20 to 70°C
                     Storage   -20 to 70°C   Storage   -30 to 80°C

4. ABSOLUTE MAXIMUM RATINGS

4.1 ELECTRICAL ABSOLUTE MAXIMUM RATINGS

$V_{SS}= 0V, \quad T_a = 25°C$

Item	Symbol	Min.	Max.	Unit
Supply Voltage (Logic)	V_{DD}-V_{SS}	-0.3	6.5	V
Supply Voltage (LCD Driver)	V_{DD}-V_{EE}	0	30	V
Input Voltage	V_I	-0.3	V_{DD} +0.3	V
Operating Temperature	T_{OP}	-20	70	°C
Storage Temperature	T_{STG}	-30	80	°C

4.2 ENVIRONMENTAL ABSOLUTE MAXIMUM RATINGS

Item	Operating		Storage		Comment
	(Min.)	Max.)	(Min.)	(Max.)	
Ambient Temp	-20	70	-30	80	Note (1)
Humidity	Note (2)		Note(2)		Without Condensation
Vibration	--	$4.9M/S^2$	--	$19.6M/S^2$	XYZ Direction
Shock	--	$29.4M/S^2$	--	$490M/S^2$	XYZ Direction

Note(1) Ta =   0°C :   50Hr Max.
Note(2) Ta $\leq 40°C$:   90% RH Max.
      Ta $\geq 40°C$:   Absolute humidity must be lower than the humidity
                  of 90% RH at 40°C.

5. ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage (Logic)	V_{DD}-V_{SS}		4.5	5	5.5	V
Supply Voltage (LCD)	V_{DD}-V_O	-20°C	26.2	26.7	27.2	V
		-10°C	23	23.5	24	
		0°C	21.9	22.4	22.9	
		10°C	21.2	21.7	22.2	
		25°C	20.5	21.0	21.5	
		50°C	18.9	19.4	19.9	
		70°C	17.8	18.3	18.8	
Input Voltage	V_{IH}	--	0.8*VDD	--	V_{DD}	V
	V_{IL}		VSS	--	0.2*VDD	
Logic Supply Current	I_{DD}	V_{DD}-V_{SS}=5V	--	3.6	--	mA
	I_{EE}	V_{EE}-V_{SS}=-24V	--	3.0	--	

6. ELECTRO-OPTICAL CHARACTERISTICS

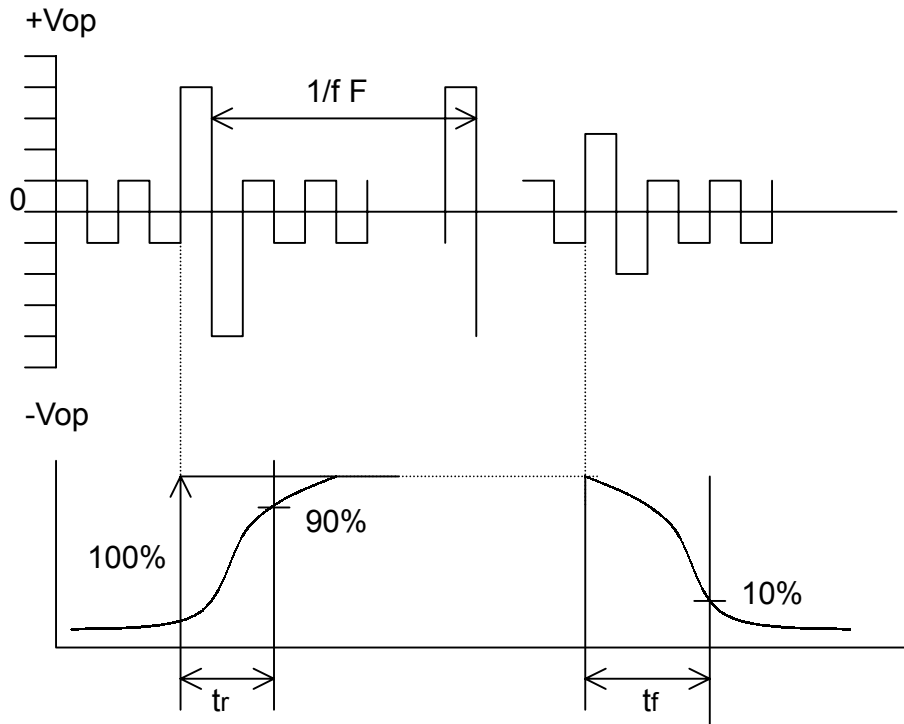| ITEM	Symbol	Condition	Min.	Typ.	Max.	Unit	Ref.
Rise Time	Tr	-20°C	--	2000	3500	ms	Note (1)
		0°C		790	1300		
		25°C		200	400		
Fall Time	Tf	-20°C	--	1500	3000	ms	
		0°C		670	1100		
		25°C		250	450		
Contrast	CR	25°C	4.0	6.0	--		Note (3)
View Angle	θ1~θ2 ∅1, ∅2	25°C & CR≥2	--	60	--		Note (2)
			--	50	--		
Frame Frequency	Ff	25°C	--	78	--	Hz	

Note (1) & (2) : See next page
Note (3) : Contrast ratio is defined under the following condition:

CR= $\dfrac{\text{Brightness of non-selected condition}}{\text{Brightness of selected condition}}$

(a). Temperature ---------- 25°C
(b). Frame frequency ---- 78Hz
(c). Viewing angle -------- θ= 0°, ∅ = 0°
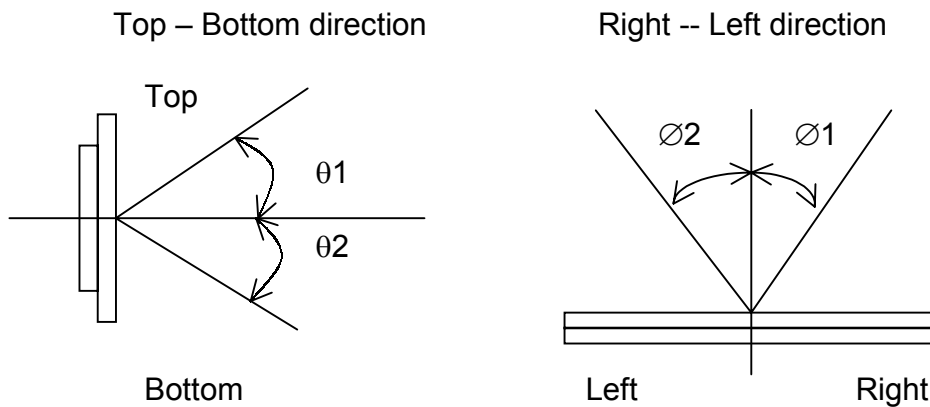(d). Operating voltage --- 21.0V

Note (1)   Response time is measured as the shortest period of time possible between the change in state of an LCD segment as demonstrated below:

Condition:
(a) .   Temperature ---------------25℃
(b) .   Frame frequency --------- 78Hz
(c) .   View Angle ----------------- $\theta = 0°$, $\varnothing = 0°$
(d) .   Operating voltage -------- 21.0V

Note (2)   Definition of View Angle

Top – Bottom direction   Right -- Left direction

7. TIMING CHARACTERISTIC

Switching Characteristics

(V_{DD}=2.7 to 5.5 V, Ta= −20 to +75°C, C_L=15 pF)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
IO_1, IO_{61} (IO_{60}, IO_{120}) "H", "L" Propagation Delay Time	t_{PLH} t_{PHL}	—	*1	—	3	µs
Clock Frequency	f_{CP}	—	—	—	1	MHz
CP Pulse Width	t_{WCP}	—	63	—	—	ns
Data Setup Time IO_1, $IO_{61} \rightarrow$ CP (IO_{60}, $IO_{120} \rightarrow$ CP)	t_{SETUP}	—	100	—	—	ns
Data Hold Time CP $\rightarrow IO_1$, IO_{61} (CP $\rightarrow IO_{60}$, IO_{120})	t_{HOLD}	—	100	—	—	ns
CP Rise, Fall Time	$t_{r (CP)}$ $t_{f (CP)}$	—	—	—	20	ns

*1 The relationship between t_{PLH} (t_{PLH}) Min. and t_{HOLD} Min. satisfies the operation in a cascade connection state.

Note 1: When display is controlled by $\overline{\text{DISPOFF}}$ pin, CP rise and fall time must be ≦ 1 µs.

Note 2: The above values are guaranteed when TCP is protected from light.
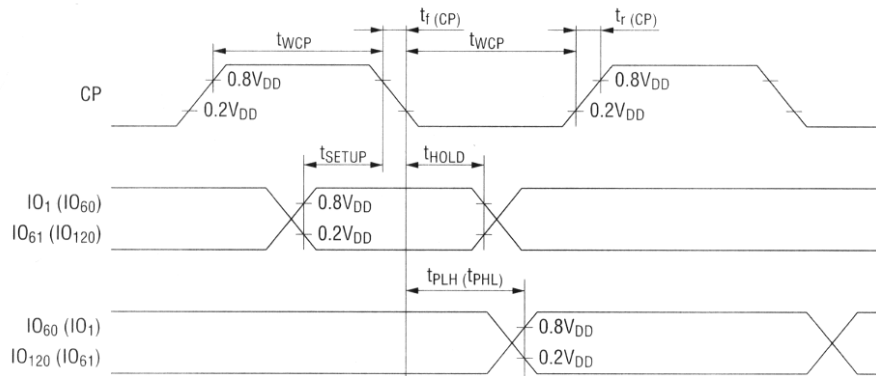
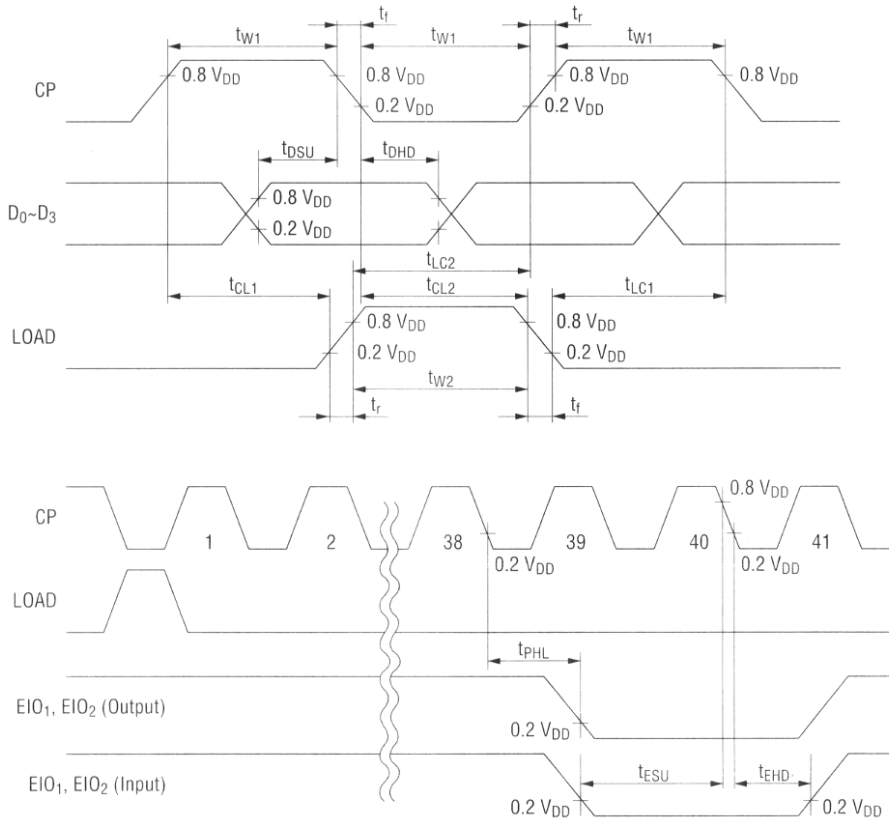## Switching Characteristics

(4.5≤V_{DD}≤5.5 V, Ta=−20 to +75°C)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Clock Frequency	f_{CP}	DUTY=50%, V_{DD}=4.5 V	—	—	6.5	MHz
Clock Pulse Width	t_{W1}	—	56	—	—	ns
Load Pulse Width	t_{W2}	—	70	—	—	ns
Clock Pulse Rise/Fall Time	t_r, t_f	—	—	—	20	ns
Data Set-up Time	t_{DSU}	—	50	—	—	ns
Data Hold Time	t_{DHD}	—	40	—	—	ns
Clock Load Time 1	t_{CL1}	—	0	—	—	ns
Clock Load Time 2	t_{CL2}	—	65	—	—	ns
Load Clock Time 1	t_{LC1}	—	65	—	—	ns
Load Clock Time 2	t_{LC2}	—	65	—	—	ns
Propagation Delay Time	t_{PHL}	C_L=15 pF	—	—	236	ns
EIO_1, EIO_2 Set-up Time	t_{ESU}	—	50	—	—	ns
EIO_1, EIO_2 Hold Time	t_{EHD}	—	50	—	—	ns

Note: The above values are quaranteed when TCP is protected from light.

8. PIN CONNECTIONS

NO	Symbol	Function
1	VO	Voltage input for LCD contrast
2	VEE	Negative Voltage input
3	D3	
4	D2	Data bus line
5	D1	
6	D0	
7	NC	No connection
8	VSS	Ground (0V)
9	VDD	Logic power input
10	CP2	Data shift pulse.(CP)
11	CP1	Data latch pulse.(Load)
12	S	First line mark of common signal

9. POWER SUPPLY

10. BLOCK DIAGRAM

CP2 →	
D0-D3 →	**SEG DRIVER X 2**
CP1 →	

320

D3 D2 D1 D0 D3

S →

COM DRIVER X 2

240 →

LCD320 x 240 DOTS

VDD →
VSS →
VO →
VEE →

BIAS CIRCUIT
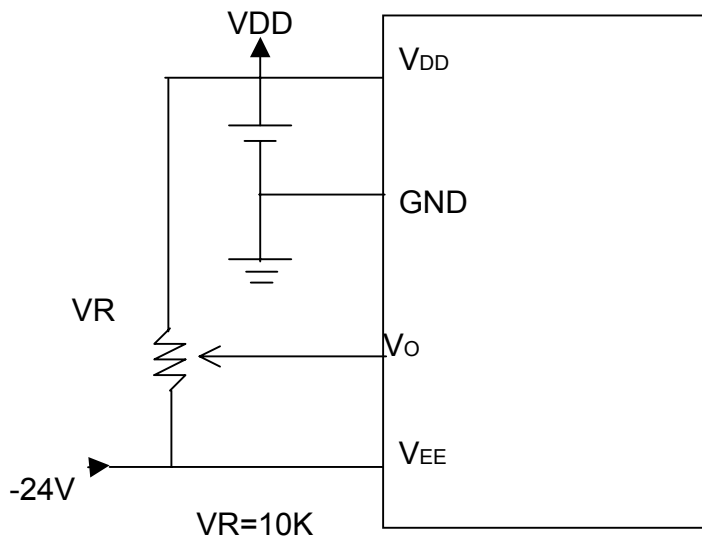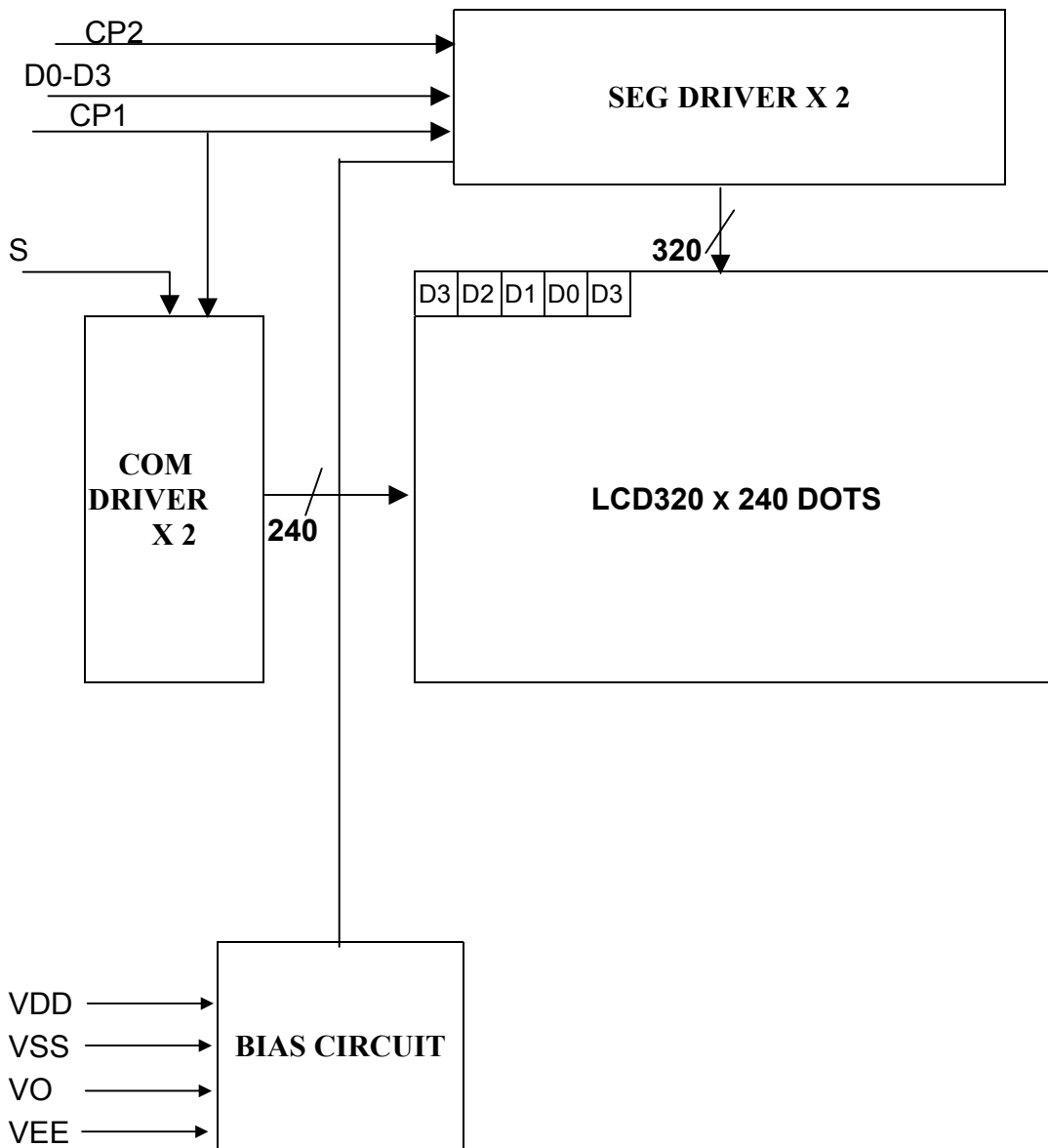
11. QUALITY ASSURANCE

11.1 Test Condition

11.1.1 Temperature and Humidity(Ambient Temperature)
Temperature : 20 $\pm$ 5°C
Humidity : 65 $\pm$ 5%

11.1.2 Operation
Unless specified otherwise, test will be conducted with LCM in operation.

11.1.3 Container
Unless specified otherwise, vibration test will be conducted on module only.

11.1.4 Test Frequency
Single cycle.

11.1.5 Test Method

A. Thermal Cycle (Humid) Requirements

Samples functionally tested at low humidity dwell in following profile:			
Ramp	31 deg C	88% RH	7 hours
Dwell	31 deg C	88% RH	5 hours
Ramp	41 deg C	59% RH	7 hours
Dwell	41 deg C	59% RH	4 hours
Loop 14 cycles			

B. Thermal Cycling (Non-Operating) Requirements

Functional test after entire test complete and 4 hours of stabilization.							
#1	Ramp	-25 deg C	15 min	#2	Ramp	-40 deg C	15 min
	Dwell	-25 deg C	80 min		Dwell	-40 deg C	80 min
	Ramp	70 deg C	30 min		Ramp	85 deg C	30 min
	Dwell	70 deg C	85 min		Dwell	85 deg C	85 min
	Ramp	25 deg C	15 min		Ramp	25 deg C	15 min
Loop 84 times - For First 3 days run profile #1.							
For remainder of test run profile #2							

C. Thermal Cycle (Operating) Requirements

Verify functionality every 3 days of 4 units.											
#1	Ramp	-10 deg C	12 min	#2	Ramp	12 min	#3	Ramp	-30 deg C	12 min
	Dwell	-10 deg C	85 min		Dwell	85 min		Dwell	-30 deg C	85 min
	Ramp	60 deg C	25 min		Ramp	25 min		Ramp	70 deg C	25 min
	Dwell	60 deg C	91 min		Dwell	91 min		Dwell	70 deg C	91 min
	Ramp	25 deg C	15 min		Ramp	15 min		Ramp	25 deg C	15 min
Note: LCDs not required to work at -30 deg C.											

D. Electrical Life Requirements

Functional test done daily inside dwell of following profile:		
Ramp	70 deg C	30 min
Dwell	70 deg C	324 hours
Ramp	25 deg C	30 min

E. Drop Requirements

| 48" to 1/2" steel plate all faces and corners in the following order:	
Sample 1 order of drop:	Sample 2 order of drop:
Corner - top right	Back (LCD up)
Corner - top left	Front (LCD down)
Corner - bottom right	**Right face**
Corner - bottom left	Left face
Top face	Bottom face
Bottom face	**Top face**
Left face	Corner - bottom left
Right face	Corner - bottom right
Front (LCD down)	Corner - top left
Back (LCD up)	Corner - top right
* Red is non-functional failure, **bold** is functional failure - data is from all four samples tested	

F. Vibration Requirements

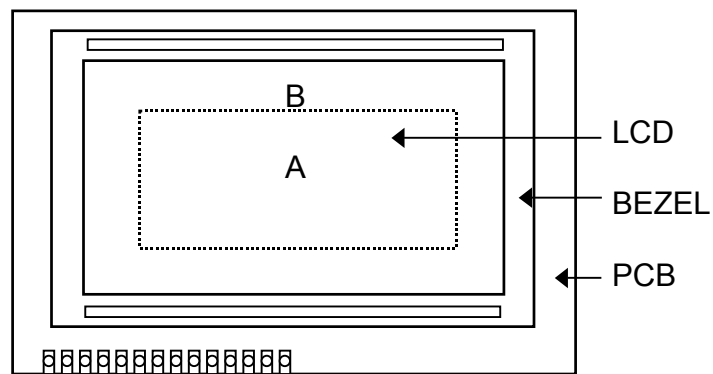|	
FREQUENCY	10 TO 57 Hz
AMPLITUDE	0.075 mm
FREQUENCY	57 TO 500 Hz
ACCELERATION	$9.8 m/S^2$
INTERVAL	10Hz-500Hz-10Hz/11min per cycle
DURATION	12 CYCLES IN EACH DIRECTION(X/Y/Z)

11.2 Inspection condition

11.2.1 Inspection conditions
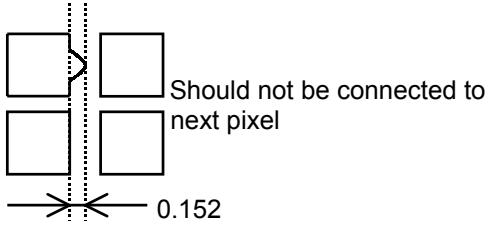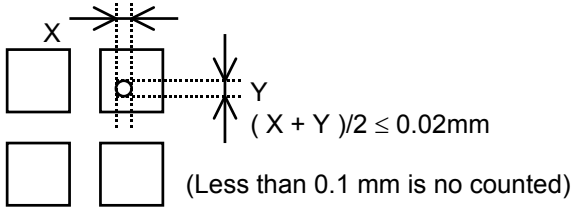
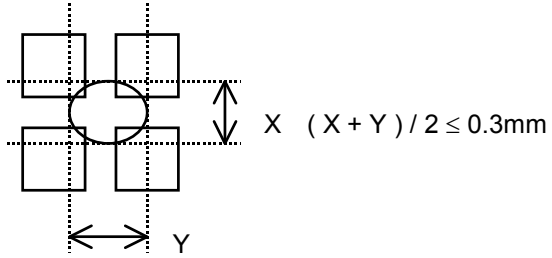The LCD shall be inspected under 40W white fluorescent light.
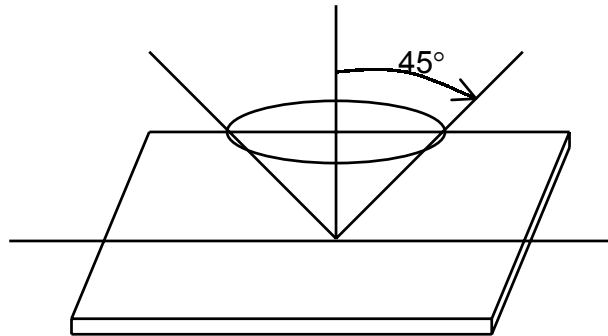
11.2.2 Definition of applicable Zones

A : Display Area
B : Non-Display Area

11.2.3 Inspection Parameters

No.	Parameter	Criteria
1	Black or White spots	<table see below>
2	Scratch, Substances	<table see below>
3	Air Bubbles (between glass & polarizer)	<table see below>
4	Uniformity of Pixel	(1) Pixel shape (with Dent)

No. 1 — Black or White spots

Dimension / Zone	Acceptable number A	Acceptable number B	Class Of Defects	AQL Level
D < 0.15	∗	∗		
0.15 ≤ D < 0.2	4	4	Minor	2.5
0.2 ≤ D ≤ 0.25	2	2		
D ≤ 0.3	0	1		

D = (Long + Short) / 2   ∗ : Disregard

No. 2 — Scratch, Substances

X (mm)	Y (mm) / Zone	Acceptable number A	Acceptable number B	Class Of Defects	AQL Level
∗	0.04 ≥ W	∗	∗		
3.0 ≥ L	0.06 ≥ W	4	4	Minor	2.5
2.0 ≥ L	0.08 ≥ W	2	3		
—	0.1 < W	0	1		

X : Length   Y : Width   ∗ : Disregard
Total defects should not exceed 4/module

No. 3 — Air Bubbles (between glass & polarizer)

Dimension / Zone	Acceptable number A	Acceptable number B	Class of Defects	AQL Level
D ≤ 0.15	∗	∗		
0.15 < D ≤ 0.25	2	∗	Minor	2.5
0.25 < D	0	1		

∗ : Disregard
Total defects shall not excess 3/module.

No. 4 — Uniformity of Pixel

(1) Pixel shape (with Dent)

0.152

4	Uniformity of Pixel	(2) Pixel shape (with Projection) Should not be connected to next pixel 0.152 (3) Pin hole X Y $(X + Y)/2 \leq 0.02mm$ (Less than 0.1 mm is no counted) (4) Deformation X $(X + Y) / 2 \leq 0.3mm$ Y Total acceptable number : 1/pixel, 5/cell

Class of defects	**Major**	AQL 0.65%	**Definition**
			It is a defect that is likely to result in failure or to reduce materially the usability of the product for the intended function.
		AQL 1.00%	It is a defect that is likely to assembly size and not result in functioning problem.
	Minor	AQL 2.5%	It is a defect that will not result in functioning problem with deviation classified.

11.3 Sampling Condition

Unless otherwise agree in written, the sampling inspection shall be applied to the incoming inspection of customer.
Lot size: Quantity of shipment lot per model.
Sampling type: normal inspection, single sampling
Inspection level: Level II
Sampling table: MIL-STD-105E

12. LOT NUMBERING SYSTEM

| 9 | 7 | 4 | 2 |

Production week number

Production year

13. LCM NUMBERING SYSTEM

TG 322400 F F N N B – 01

VERSION :01

View direction & Temp. Range
A–Bottom view 6H & Normal temp.
B–Bottom view 6H & Wide temp.
C–Top View & Normal temp.
D–Top View & Wide temp.

Backlight Color
B –Blue
W –White
N –None

Backlight
S –edge light LED B/L
E –EL
N –No Back light

MODE
M – transmissive   R – Reflective
F – transflective   N - Negative

LCD type
G – STN Gray
S –STN Yellow
F – FSTN

Series code
322**400** –320 Dots X 240 Dot, **0** LCD type, **0** PCB type

Model type
CM – Character Module
GM – Graphic Module
TG–Single TAB/COG Graphic Module
TX–Custom Single TAB/COG Graphic Module

14.   PRECAUTION FOR USING LCM

1.   LIQUID CRYSTAL DISPLAY (LCD)
LCD is made up of glass, organic sealant, organic fluid, and polymer based polarizers. The following precautions should be taken when handing,
(1).   Keep the temperature within range of use and storage. Excessive temperature and humidity could cause polarization degredation, polarizer peel off or bubble.
(2).   Do not contact the exposed polarizers with anything harder than an HB pencil lead.   To clean dust off the display surface, wipe gently with cotton, chamois or other soft material soaked in petroleum benzin.
(3).   Wipe off saliva or water drops immediately. Contact with water over a long period of time may cause polarizer deformation or color fading, while an active LCD with water condensation on its surface will cause corrosion of ITO electrodes.
(4).   Glass can be easily chipped or cracked from rough handling, especially at corners and edges.
(5).   Do not drive LCD with DC voltage.

2.   Liquid Crystal Display Modules
2.1   Mechanical Considerations
LCM are assembled and adjusted with a high degree of precision. Avoid excessive shocks and do not make any alterations or modifications. The following should be noted.
(1).   Do not tamper in any way with the tabs on the metal frame.
(2).   Do not modify the PCB by drilling extra holes, changing its outline, moving its components or modifying its pattern.
(3).   Do not touch the elastomer connector, especially insert an backlight panel (for example, EL).
(4).   When mounting a LCM make sure that the PCB is not under any stress such as bending or twisting . Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
(5).   Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels.

2.2.   Static Electricity
LCM contains CMOS LSI's and the same precaution for such devices should apply, namely
(1).   The operator should be grounded whenever he/she comes into contact with the module. Never touch any of the conductive parts such as the LSI pads, the copper leads on the PCB and the interface terminals with any parts of the human body.
(2).   The modules should be kept in antistatic bags or other containers resistant to static for storage.
(3).   Only properly grounded soldering irons should be used.
(4).   If an electric screwdriver is used, it should be well grounded and shielded from commutator sparks.

(5) The normal static prevention measures should be observed for work clothes and working benches; for the latter conductive (rubber) mat is recommended.
(6).   Since dry air is inductive to static, a relative humidity of 50-60% is recommended.

2.3   Soldering
(1).   Solder only to the I/O terminals.
(2).   Use only soldering irons with proper grounding and no leakage.
(3).   Soldering temperature : $280°C \pm 10°C$
(4).   Soldering time: 3 to 4 sec.
(5).   Use eutectic solder with resin flux fill.
(6).   If flux is used, the LCD surface should be covered to avoid flux spatters. Flux residue should be removed after wards.

2.4   Operation
(1).   The viewing angle can be adjusted by varying the LCD driving voltage V0.
(2).   Driving voltage should be kept within specified range; excess voltage shortens display life.
(3).   Response time increases with decrease in temperature.
(4).   Display may turn black or dark blue at temperatures above its operational range; this is (however not pressing on the viewing area) may cause the segments to appear "fractured".
(5).   Mechanical disturbance during operation (such as pressing on the viewing area) may cause the segments to appear "fractured".
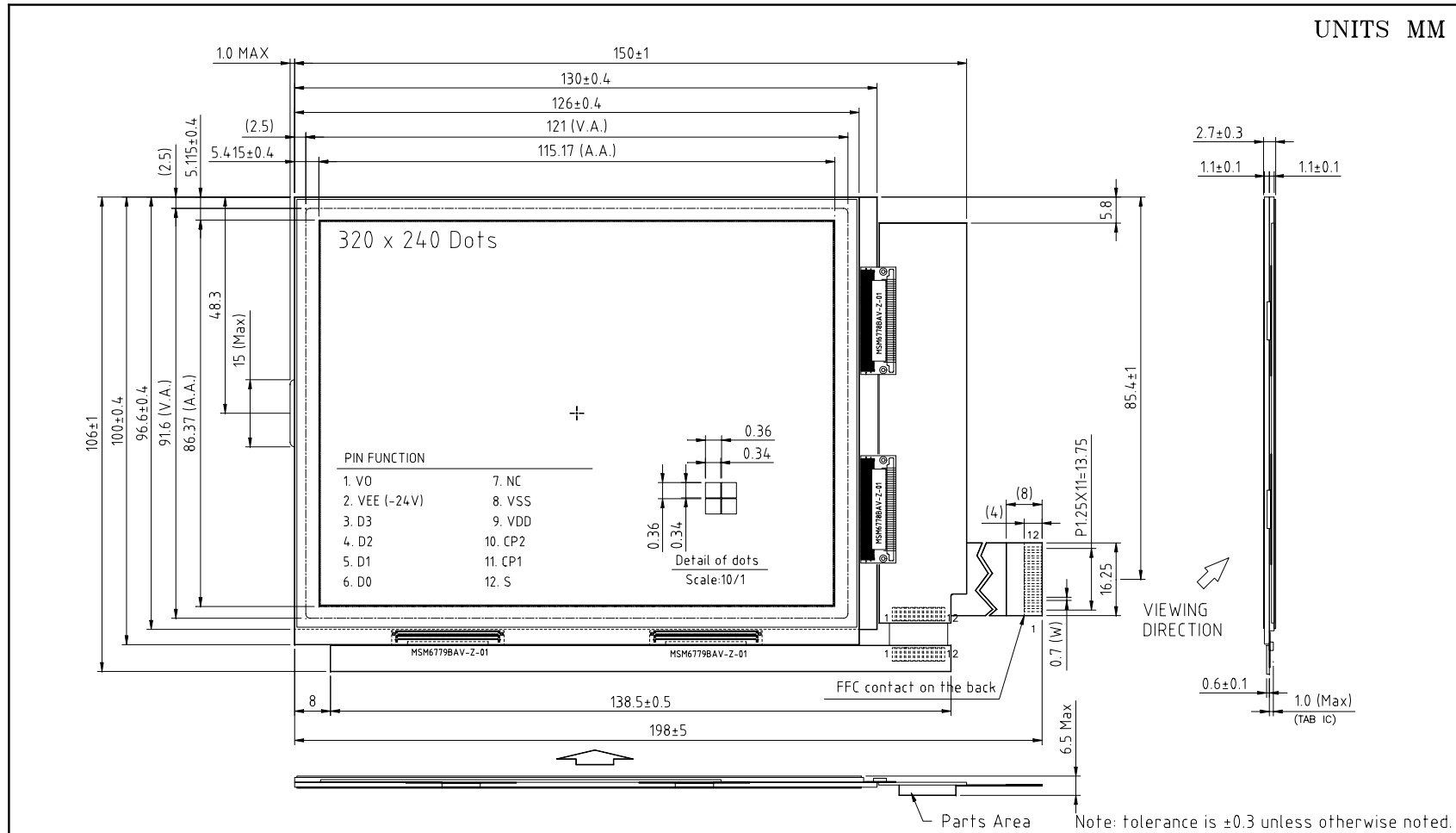
2.5   Storage
If any fluid leaks out of a damaged glass cell, wash off any human part that comes into contact with soap and water. Never swallow the fluid. The toxicity is extremely low but caution should be exercised at all the time.

2.6   Limited Warranty
Unless otherwise agreed between DATA IMAGE and customer, DATA IMAGE will replace or repair any of its LCD and LCM which is found to be defective electrically and visually when inspected in accordance with DATA IMAGE acceptance standards, for a period on one year from date of shipment. Confirmation of such date shall be based on freight documents.   The warranty liability of DATA IMAGE is limited to repair and/or replacement on the terms set forth above. DATA IMAGE will not responsible for any subsequent or consequential events.

15   OUTLINE DRAWING

UNITS MM

1.0 MAX

150±1
130±0.4
126±0.4
121 (V.A.)
115.17 (A.A.)

(2.5)
5.115±0.4
5.415±0.4

2.7±0.3
1.1±0.1   1.1±0.1

(2.5)

5.8

106±1
100±0.4
96.6±0.4
91.6 (V.A.)
86.37 (A.A.)

48.3
15 (Max)

85.4±1

320 x 240 Dots

0.36
0.34

PIN FUNCTION

1. VO   7. NC
2. VEE (−24V)   8. VSS
3. D3   9. VDD
4. D2   10. CP2
5. D1   11. CP1
6. D0   12. S

0.36
0.34

Detail of dots
Scale:10/1

P1.25X11=13.75

(8)
(4)
12

16.25

MSM6778BAV-Z-01

MSM6779BAV-Z-01   MSM6779BAV-Z-01

0.7 (W)

FFC contact on the back

VIEWING
DIRECTION

0.6±0.1   1.0 (Max)
                 (TAB IC)

8   138.5±0.5
198±5

6.5 Max

Parts Area   Note: tolerance is ±0.3 unless otherwise noted.

				DATE:	11/30/00	**DATA IMAGE** Corporation
				DRAWN:		**TITLE:** LCM OUTLINE DIMENSION
⚠	Cgange part NO. TG32242 to dwg NO. TG322400			CHECK:		A4 · ISSUE DATE: 2/18/03'
AUTH	DESCRIPTION	DATE	APPROVED	APPROVE:		DWG. NO. TG322400 ⚠ REV. B
	REVISIONS					SCALE : 5/6 SHEET 1 OF 1

16. PACKAGE INFORMATION

Anti-static bag

LCM

Carton