Confidential Document

# DATA IMAGE   CORPORATION

## LCD Module Specification

### ITEM NO.:   TG322440GNCWA-01

### Table of Contents

| R&D Dept. | Q.C. Dept. | Eng. Dept. | Prod. Dept. |
|---|---|---|---|
| *(signature)* | *(signature)* | *(signature)* | helen |
| Version: | Issued Date: | Sheet Code: | Total Pages: |
|  | 2003/8/1 |  | 19 |

## 2.　RECORD OF REVISION

| Rev | Date | Item | Page | Comment |
|-----|------|------|------|---------|
|     |      |      |      |         |

# 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 :                          166 (W) $\times$       109 (H) $\times$   7.5 (T) mm Max.

Weight :                      180 g max.

LCD Type :            ☑ STN              ☐ 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

$V_{SS}= 0V, \quad Ta = 25°C$

| 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 | $T_{OP}$ | 0 | 50 | °C |
| Storage Temperature | $T_{STG}$ | -20 | 70 | °C |

## 4.2 ENVIRONMENTAL ABSOLUTE MAXIMUM RATINGS

| Item | Operating | | Storage | | Comment |
|---|---|---|---|---|---|
| | (Min.) | Max.) | (Min.) | (Max.) | |
| Ambient Temp | 0 | 50 | -20 | 70 | 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) | $V_{DD}$-$V_{EE}$ | 0°C | 19.9 | 21.6 | 22.3 | V |
| | | 25°C | 19.6 | 20.3 | 21.0 | |
| | | 50°C | 18.3 | 19.0 | 19.7 | |
| 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 | -- | 2.7 | 4 | mA |
| | $I_{EE}$ | VDD-VEE=20.3V | -- | 3.0 | 5 | |

# 6. ELECTRO-OPTICAL CHARACTERISTICS

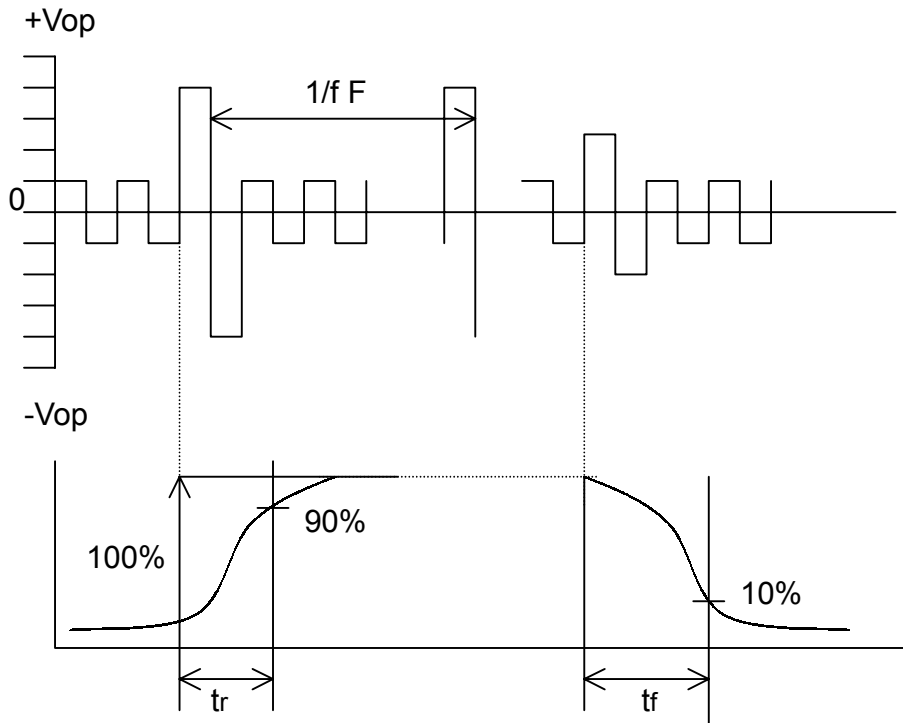| ITEM | Symbol | Condition | Min. | Typ. | Max. | Unit | Ref. |
|------|--------|-----------|------|------|------|------|------|
| Rise Time | Tr | 0°C | | 790 | 1300 | ms | Note (1) |
| | | 25°C | | 200 | 400 | | |
| Fall Time | Tf | 0°C | | 670 | 1100 | ms | |
| | | 25°C | | 250 | 450 | | |
| Contrast | CR | 25°C | 4.0 | 6.0 | -- | | Note (3) |
| View Angle | $\theta1\sim\theta2$ $\varnothing1, \varnothing2$ | 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= <u>Brightness of non-selected condition</u>
Brightness of selected condition

( a ).    Temperature ---------- 25°C
( b ).    Frame frequency ---- 78Hz
( c ).    Viewing angle -------- θ= 0°,   ∅ = 0°
( d ).    Operating voltage ---20.3V

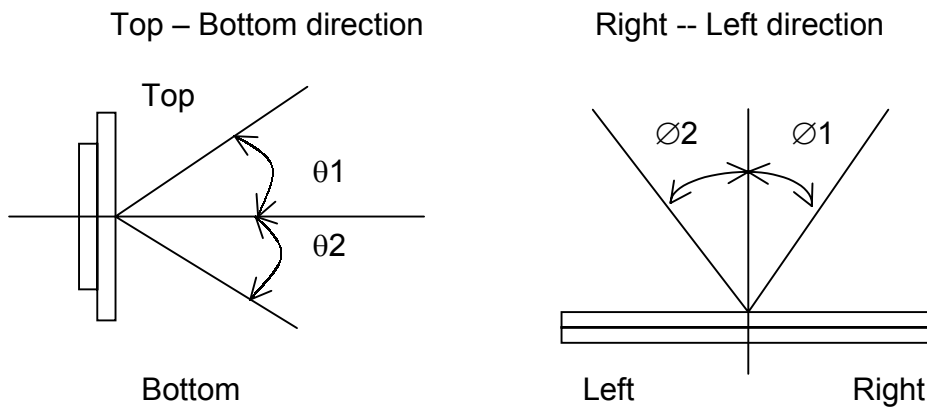Note (1)   Response time is measured as the shortest period of time possible between the change in state of an LCD segment as demonstrated below:

+Vop

1/f F

0

-Vop

100%

90%

10%

tr

tf

Condition:
( a ) .   Temperature ---------------25℃
( b ) .   Frame frequency --------- 78Hz
( c ) .   View Angle ----------------- $\theta = 0°$, $\varnothing=0°$
( d ) .   Operating voltage -------- 20.3V

Note (2)   Definition of View Angle

Top – Bottom direction

Right -- Left direction

Top

$\theta1$

$\theta2$

$\varnothing2$   $\varnothing1$

Bottom

Left

Right

## 6.1  CCFL ELECTRICAL CHARACTERISTIC

| Item | Condition |
|---|---|
| Start Voltage | 500 Vrms min,at Ta=25°C |
| Tube Voltage | 300Vrms typ,at Ta=25°C |
| Tube Current | 5m Arms typ ,at Ta=25°C |
| Drive Frequency | 30 KHz , typ at Ta=25°C |
| Life time | Min=15KHrs TYP=20 KHrs |

## 6.1.2  Initial Optical Characteristics

| Item | Condition | |
|---|---|---|
| Brightness Uniformity | 75% min. | |
| Average Brightness | 500 cd/m$^2$ min. | |
| | 550 cd/m$^2$ mean | |
| Chromaticity | X | 0.322±0.015 |
| | Y | 0.327±0.015 |

## 6.1.3 Environmental Conditions

| Item | Temperature | Humidity | Unit |
|---|---|---|---|
| Operating | -10 to 60°C | 20 to 90% | RH |
| Storage | -20 to 70°C | 5 to 90% | RH |

## Recommend CCFL inverter:

TDK L10L    operation voltage +12V , 300mA

TDK L10A    operation voltage +5V   , 600mA
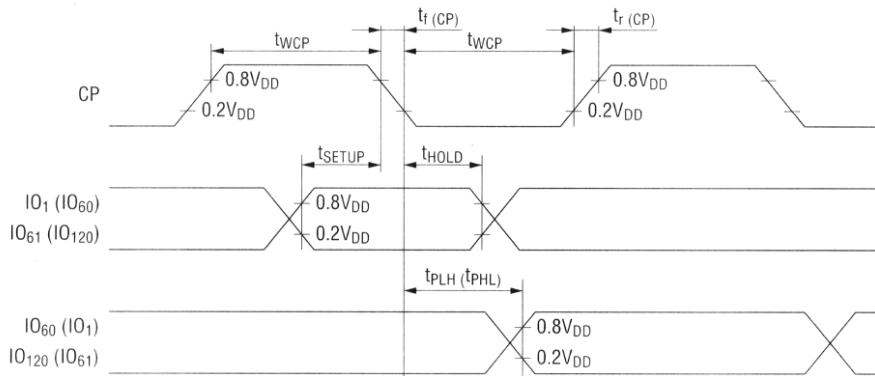
# 7. TIMING CHARACTERISTIC

## 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 |
|---|---|---|---|---|---|---|
| $IO_1$, $IO_{61}$ ($IO_{60}$, $IO_{120}$)<br>"H", "L" Propagation Delay Time | $t_{PLH}$<br>$t_{PHL}$ | — | *1 | — | 3 | µs |
| Clock Frequency | $f_{CP}$ | — | — | — | 1 | MHz |
| CP Pulse Width | $t_{WCP}$ | — | 63 | — | — | ns |
| Data Setup Time<br>$IO_1$, $IO_{61} \rightarrow$ CP<br>($IO_{60}$, $IO_{120} \rightarrow$ CP) | $t_{SETUP}$ | — | 100 | — | — | ns |
| Data Hold Time<br>CP $\rightarrow IO_1$, $IO_{61}$<br>(CP $\rightarrow IO_{60}$, $IO_{120}$) | $t_{HOLD}$ | — | 100 | — | — | ns |
| CP Rise, Fall Time | $t_{r (CP)}$<br>$t_{f (CP)}$ | — | — | — | 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 $\overline{DISPOFF}$ pin, CP rise and fall time must be ≦ 1 µs.

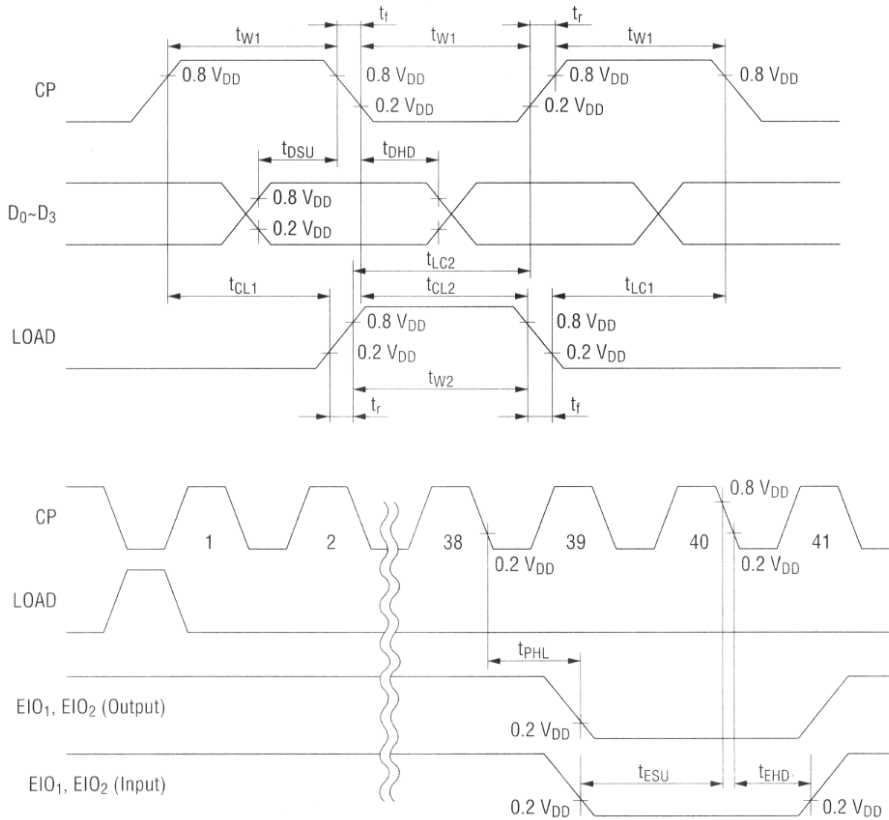Note 2: The above values are guaranteed when TCP is protected from light.

## 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 | S | First line mark of common signal |
| 2 | CP1 | Data latch pulse.(Load) |
| 3 | CP2 | Data shift pulse.(CP) |
| 4 | NC | No connection |
| 5 | DISP OFF | Display ON/OFF control input (H=ON, L=OFF) |
| 6 | D0 | Data bus line |
| 7 | D1 | |
| 8 | D2 | |
| 9 | D3 | |
| 10 | VDD | Logic power input |
| 11 | VSS | Ground (0V) |
| 12 | VEE | Voltage input for LCD contrast |

# 9. POWER SUPPLY



VDD

$V_{DD}$

GND

VR

$V_{EE}$

-24V
VR=10K

# 10. BLOCK DIAGRAM

```
CP2 ─────────────────────────────────▶ ┌──────────────────────────┐
D0-D3 ───────────────────────────────▶ │                          │
CP1,DISP OFF ────────────────────────▶ │      SEG DRIVER X 2      │
                         │             │                          │
                         │    │        └──────────────────────────┘
S ───────────────────┐   │    │                    320 │
                     ▼   ▼    │                         ▼
              ┌──────────┐    │   ┌─────────────────────────────────┐
              │          │    │   │ D3 D2 D1 D0 D3                   │
              │   COM    │    │   │                                 │
              │  DRIVER  │ 240│   │                                 │
              │   X 2    │────┼──▶│       LCD320 x 240 DOTS         │
              │          │    │   │                                 │
              └──────────┘    │   └─────────────────────────────────┘
                              │
                              │
VDD ──────────▶ ┌──────────────────┐
VSS ──────────▶ │   BIAS CIRCUIT   │      CCFL HOT ──── ┌───────────┐
                │                  │                    │ CCFL B/L  │
VEE ──────────▶ └──────────────────┘      CCFL GND ──── └───────────┘
```
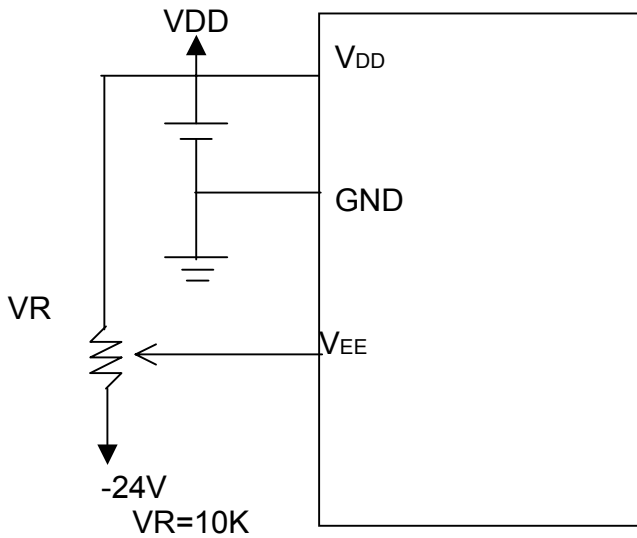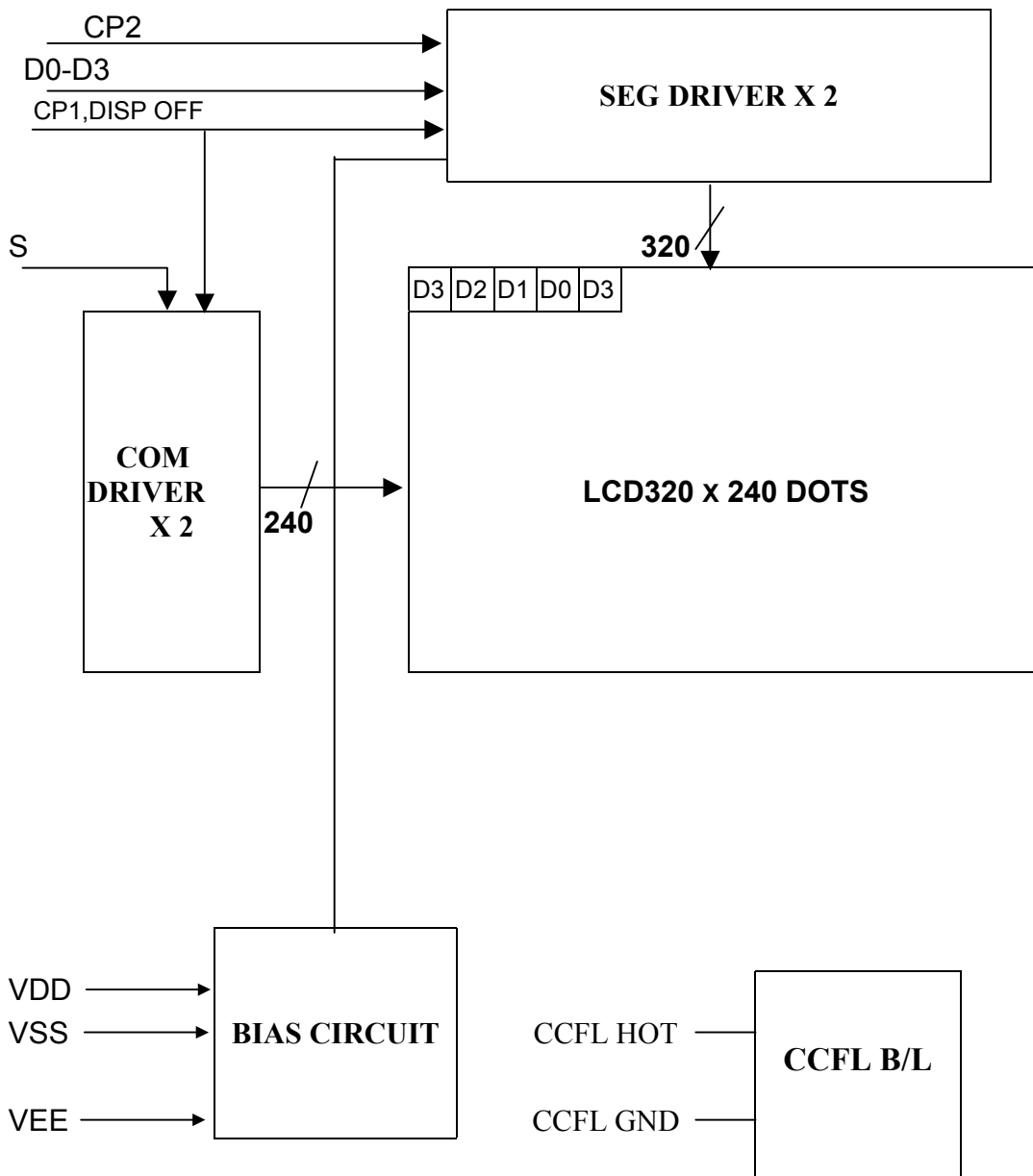
# 11. QUALITY ASSURANCE

## 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 under function state.

### 11.1.3 Container
Unless specified otherwise, vibration test will be conducted to the product itself without putting it in a container.

### 11.1.4 Test Frequency
Single cycle.

### 11.1.5 Test Method

| No. | Parameter | Conditions | Regulations |
|---|---|---|---|
| 1 | High Temperature Operating | $50 \pm 2$ °C | Note 3 |
| 2 | Low Temperature Operating | $0 \pm 2$ °C | Note 3 |
| 3 | High Temperature Storage | $70 \pm 2$ °C | Note 3 |
| 4 | Low Temperature Storage | $-20 \pm 2$ °C | Note 3 |
| 5 | Vibration Test (Non-operation state) | Total fixed amplitude : 1.5mm Vibration Frequency : 10 ~ 55Hz One cycle 60 seconds to 3 directions of X.Y.Z. for each 15 minutes | Note 3 |
| 6 | Damp Proof Test (Non-operation state) | $40°C \pm 2°C$, 90~95%RH, 96h | Note 1,2 |
| 7 | Shock Test (Non-operation state) | To be measured after dropping from 60cm high once concrete surface in packing state | Note 3 |

Note 1: Returned under normal temperature and humidity for 4 hrs.
Note 2: No dew condensation to be observed.
Note 3: No change on display and in operation under the test condition

## 11.2 Inspection condition

### 11.2.1 Inspection conditions

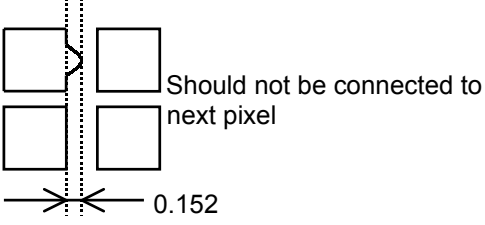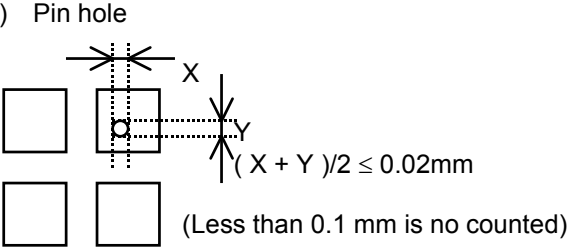The LCD shall be inspected under 40W white fluorescent light.
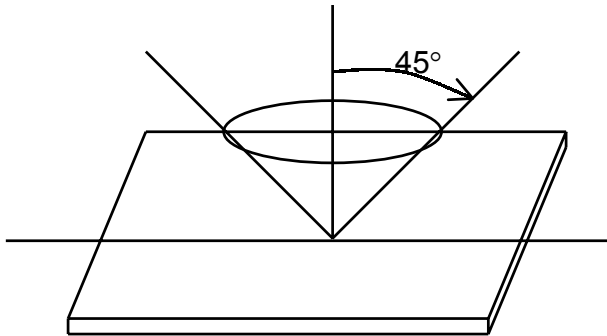


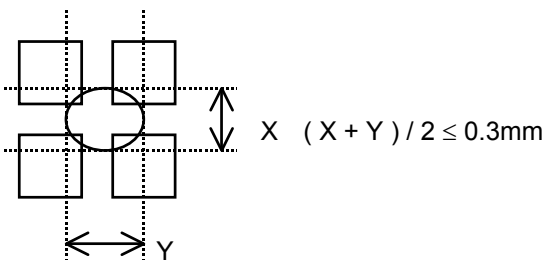### 11.2.2 Definition of applicable Zones
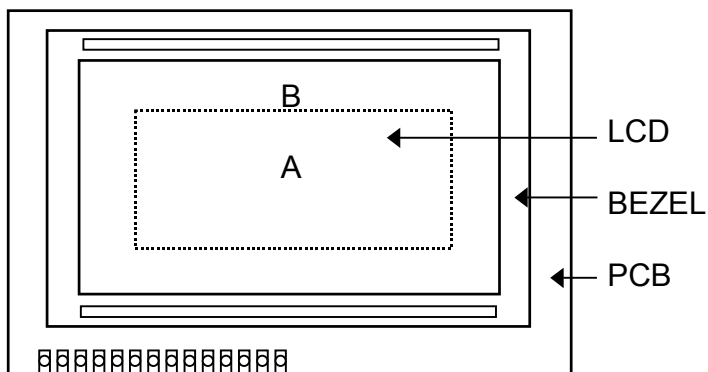


A : Display Area
B : Non-Display Area

## 11.2.3　Inspection Parameters

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

**Parameter 1 – Black or White spots:**

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

D = (Long + Short) / 2　　* : Disregard

**Parameter 2 – Scratch, Substances:**

| Zone X (mm) | Y (mm) | 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

**Parameter 3 – Air Bubbles (between glass & polarizer):**

| Zone / Dimension | 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.

**Parameter 4 – Uniformity of Pixel:**

(1)　Pixel shape (with Dent)

0.152

| 4 | Uniformity of Pixel | (2)   Pixel shape ( with Projection)<br><br>Should not be connected to next pixel<br><br>0.152<br><br>(3)   Pin hole<br><br>X<br>Y<br>$( X + Y )/2 \le 0.02mm$<br>(Less than 0.1 mm is no counted)<br><br>(4)   Deformation<br><br>X   $( X + Y ) / 2 \le 0.3mm$<br><br>Y<br>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
Sampling table: MIL-STD-105E
Inspection level: Level II

# 12. LOT NUMBERING SYSTEM

| 9 | 7 | 4 | 2 |
|---|---|---|---|

└─────────── **Production week number**

└─────────── **Production year**

# 13. LCM NUMBERING SYSTEM

**TG  322440  G  N  C  W  A – 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
C –CCFL B/L
N –No Back light

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

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

**Series code**
3224**40** –320 Dots X 240 Dot, **4** LCD type, **0** PCB type

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

320 x 240 Dots

CN2

pin 1

∅2.8 HOLE

45±5
166±0.5
160±0.5
151.7±0.3
121±0.2 (V.A.)
115.17 (A.A.)
7.5
3±0.3
20
22.915
3.8
8

2−∅3 HLOES

109±0.5
101.5±0.3
91.6±0.2 (V.A.)
86.37 (A.A.)
86.45±1
100±0.3

0.36
0.34
0.36
0.34
Detail of dots
Scale:10/1

4−R1

3.75
12.45
15.065
∅3
7.5

pin 1
CN1
pin 12
45.7±5
13
P1.0x11=11
43.25±2
4−R1
8
4.55

7.5MAX
3
3
0.3±0.05
1.5
∅7.5
4
1.5
CONTACT SIDE

~ CN1 ~
INTERFACE CABLE

1. S        7. D1
2. CP1      8. D2
3. CP2      9. D3
4. NC       10. VDD
5. DISP OFF 11. VSS
6. D0       12. VEE

~ CN2 ~
CCFL CONNECTOR

1.HOT       3. GND
2. NC

[ NOTE ]
1. UNSPECIFIED TOL TO BE ±0.5
2. CCFL CONNECTOR : BHR−03VS−1(JST)
3. CCFL CABLE : UL3579.AWG26
4. FFC CABLE : UL2896  P=1.0

| AUTH | DESCRIPTION | DATE | APPROVED |
|---|---|---|---|
| | | | |
| | | | |
| | REVISIONS | | |

| DATE: | 06/13/03' |
|---|---|
| DRAWN: | Jim |
| CHECK: | |
| APPROVE: | |

DATA IMAGE Corporation

TITLE: LCM OUTLINE DIMENSION

A4

ISSUE DATE:

PART. NO.  TG322440-01   REV.  1

SCALE : 2/3    SHEET 1 OF 1

# 16. PACKAGE INFORMATION

Module

Anti-static PET tray

Carton