DATA IMAGE CORPORATION

LCD Module Specification

ITEM NO.: **TG161600FFEBB-P4**

Table of Contents

R&D Dept.	Q.C. Dept.	Eng. Dept.	Prod. Dept.
Mep	*Eric*	*Ken*	*helen*
Version:	Issued Date:	Sheet Code:	Total Pages:
D	2003/8/14		20

2. RECORD OF REVISION

Rev	Date	Item	Page	Comment
B	07/MAY/03	5,7.1, 15	5,9,19	1.Modify DRAWING NO. from TG161610E-P to TG161600E-P4 2.Modify IDD test condition. 3.Add M signal timing chart.
C	17/JUN/03	5	5	1.Change IDD from 30mA to 40mA.
D	14/AUG/03	5,9-10,15	5,10-11,19	1.Change CONNECTOR 2.Add IEE from 0.9 Ma 3.Modify POWER SUPPLY 4.Modify BLOCK DIAGRAM 5.Modify DRAWING

3. GENERAL SPECIFICATION

Display Format :   160 (W) × 160 (H)   dots

Dots Size :   0.335 (W) × 0.335 (H)   mm

View Area :   63.4 (W) × 63.3 (H)   mm

General Dimensions :   69.0 (W) × 69.5 (H) × 5.6 (T) mm Max.

Weight :   30 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   ☑ Green

        ☐ White   ☐ Others

Controller / Driver :   NT7701 COM & SEG

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

    Remark:

4. ABSOLUTE MAXIMUM RATINGS

4.1 ELECTRICAL ABSOLUTE MAXIMUM RATINGS

$V_{SS}= 0V,$ $Ta = 25°C$

Item	Symbol	Min.	Max.	Unit
Supply Voltage (Logic)	V_{DD}-V_{SS}	-0.3	6.5	V
Supply Voltage (LCD Driver)	V_{EE}-V_{SS}	0	30	V
Input Voltage	V_I	V_{SS}	V_{DD}	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}		2.5	3.3	5.5	V
Supply Voltage (LCD)	V_{EE}-V_{SS}	-20°C	19.3	20	21	V
		25°C	18.6	19	20	
		70°C	17.6	18	18.6	
Input Voltage	V_{IH}	--	0.8*VDD	--	V_{DD}	V
	V_{IL}		VSS	--	0.2*VDD	
Logic Supply Current	I_{DD}	EL=ON	--	40	--	mA
	I_{EE}	VEE-VSS=19	--	0.9	--	

6. ELECTRO-OPTICAL CHARACTERISTICS

| ITEM	Symbol	Condition	Min.	Typ.	Max.	Unit	Ref.
Rise Time	Tr	0°C	450	560	800	ms	Note (1)
		25°C	266	280	302		
Fall Time	Tf	0°C	400	500	750	ms	
		25°C	87	94	98		
Contrast	K	25°C	7.1	7.25	7.38		Note (3)
View Angle	$\theta1$~$\theta2$ $\varnothing1, \varnothing2$	25°C & CR≥3	--	30	--		Note (2)
			--	30	--		
Frame Frequency	Ff	25°C	--	64	--	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 ---- 64Hz
(c).   Viewing angle -------- θ= 0°, $\varnothing$ = 0°
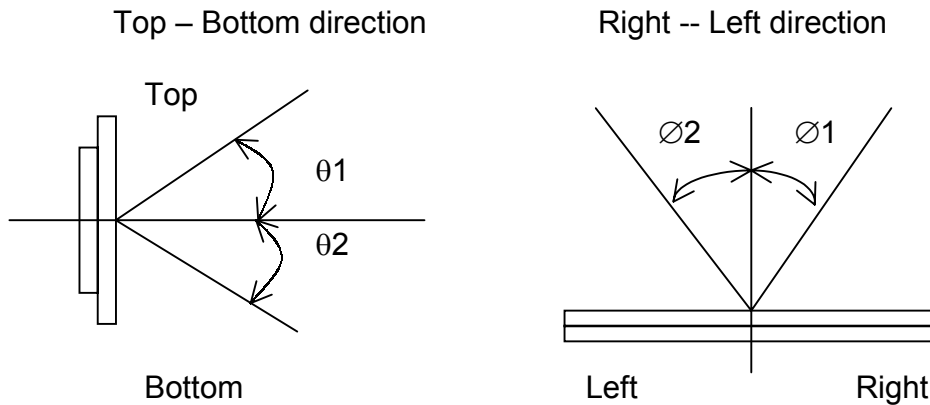(d).   Operating voltage --- 19V

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
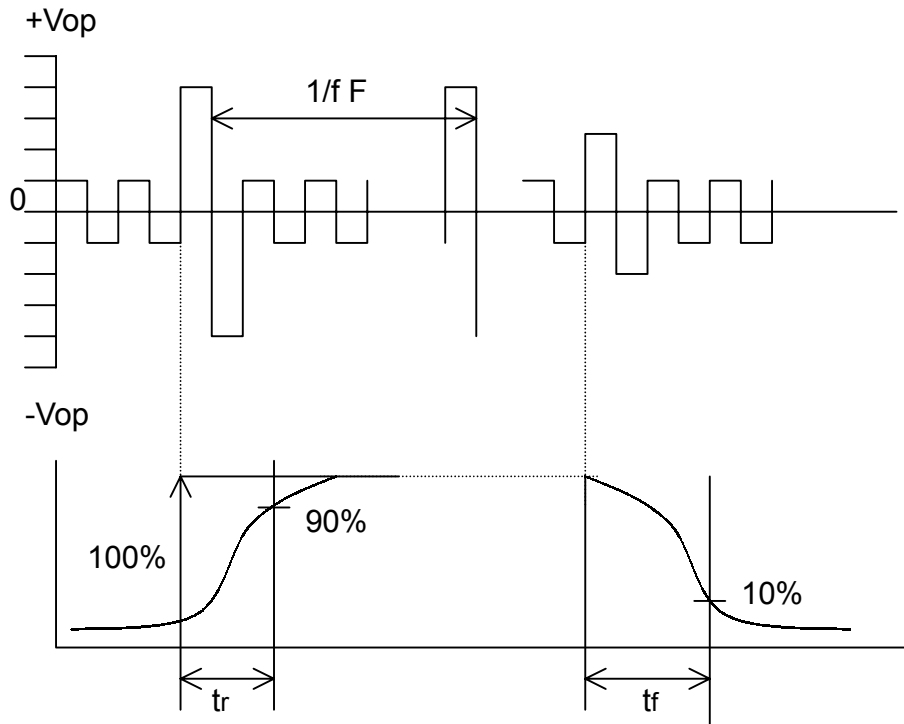
Condition:
(a) .   Temperature ---------------25°C
(b) .   Frame frequency --------- 64Hz
(c) .   View Angle ----------------- $\theta = 0°$, $\varnothing = 0°$
(d) .   Operating voltage -------- 19V

Note (2)   Definition of View Angle

Top – Bottom direction

Right -- Left direction

Top

$\theta1$

$\theta2$

Bottom

$\varnothing2$ $\varnothing1$

Left   Right

6.2 ELECTRIC - OPTICAL CHARACTERISTIC

(TEMP : 20°C)

ITEM	CONDITION	DIMENION		STANDARD		
				MIN	TYP	MAX
BRIGHTNESS	400H$_Z$,100Vrms SINE WAVE	cd/m^2		45	56	--
UNIFORMITY	400H$_Z$,100Vrms SINE WAVE	%		85	90	--
CURRENT CONSUMPTION	400H$_Z$,100Vrms SINE WAVE	mA/cm^2		--	0.12	0.17
CHROMATICITY	400H$_Z$,100Vrms SINE WAVE	GREEN	X	0.15	0.17	0.19
			Y	0.33	0.35	0.37
		White	X	0.30	0.32	0.34
			Y	0.34	0.36	0.38

Note: Measured at the EL panel unit.

7. TIMING CHARACTERISTICS

common & Segment interface timing:

| Item	Symbol	Test Condition	Min.	Typ.	Max.	Units
Clock Cycle	**tC**	**Fig.1**	**500**			**ns**
SCP Pulse Width	**tSWH, tSWL**	**Fig.1**	**240**			**ns**
Data Set Up Time	**tDSU**	**Fig.1& 2**	**240**			**ns**
Data Hold Time	**tDHD**	**Fig.1& 2**	**240**			**ns**
SCP Rise/Fall Time	**tr,tf**	**Fig.1& 2**			**50**	**ns**
LP Rise Time	**tLRP**	**Fig.1**	**240**			**ns**
LP Fall Time	**tlw**	**Fig.1**	**240**			**ns**
LP Pulse Width	**tlw**	**Fig.1**	**240**			**ns**
SCP To LP Delay Time	**tSL**	**Fig.1**	**50**			**ns**
LP To SCP Delay Time	**tLS**	**Fig.1**	**100**			**ns**
LP "H" Pulse Width	**tCWH**	**Fig.2**	**40**			**ns**
LP "L" Pulse Width	**tCWL**	**Fig.2**	**170**			**ns**
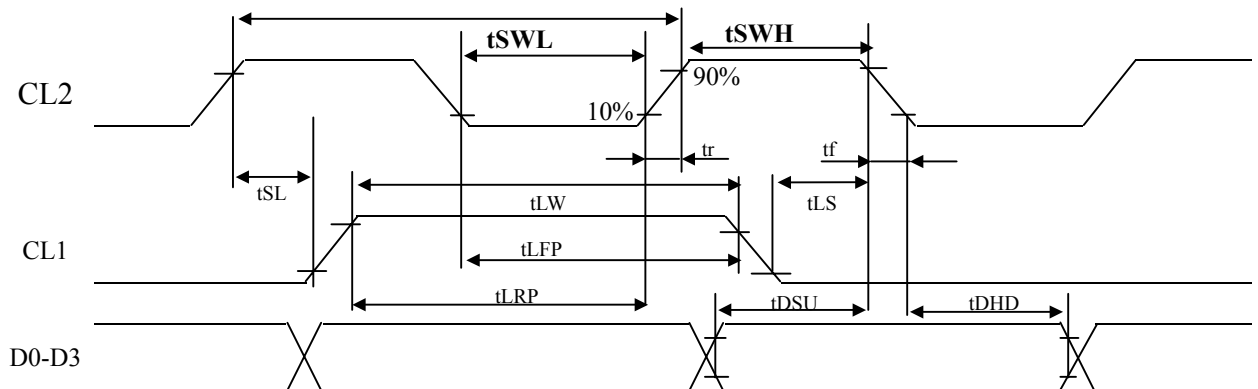
Fig1. SEGMENT TIMING
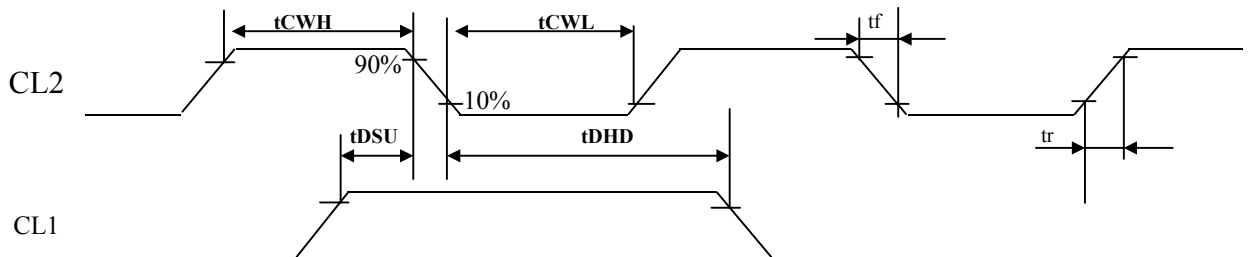
Fig2. COMMON TIMING

7.1 TIMING CHART
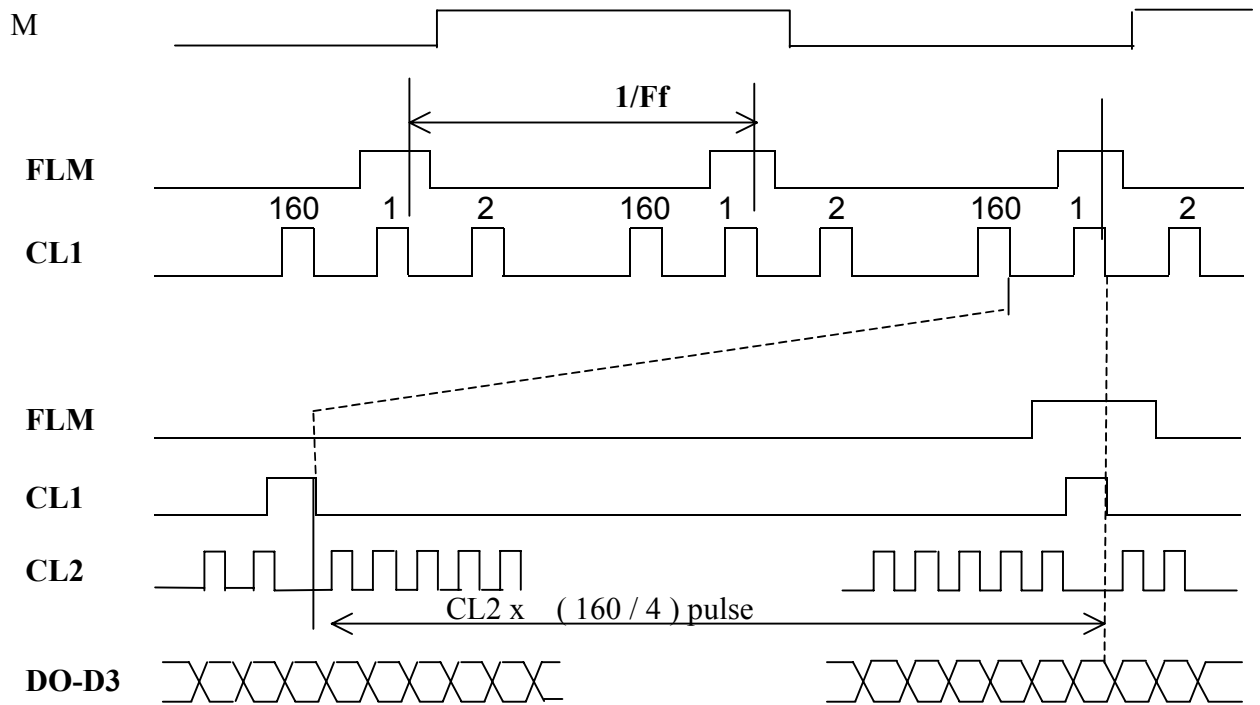
7.2 POWER ON/OFF TIMING
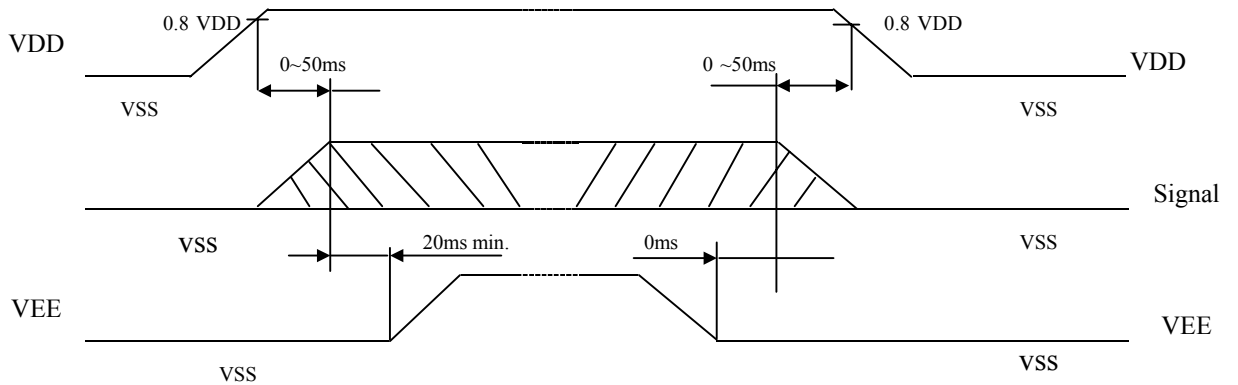
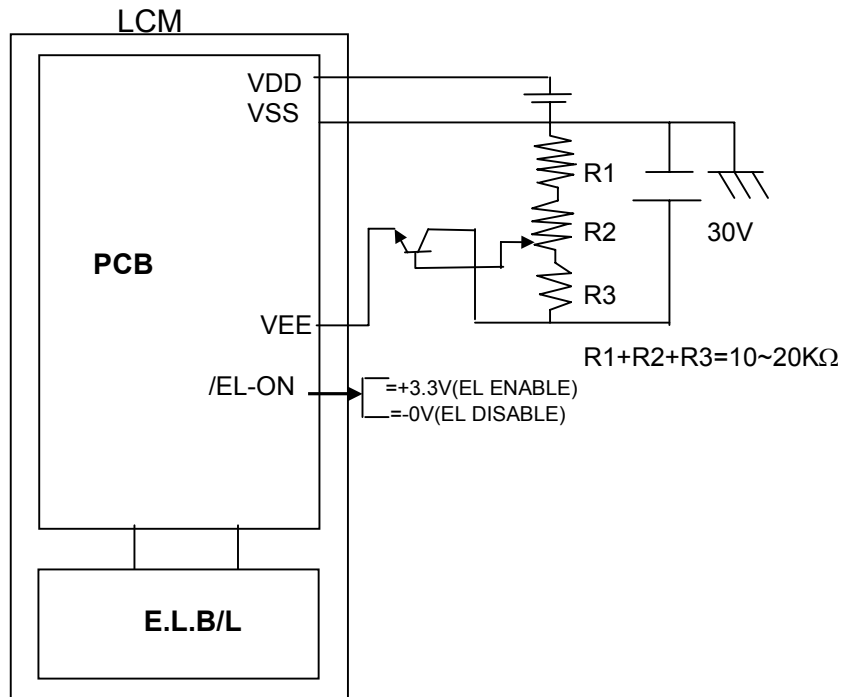POWER ON   POWER ON

The missing pixels may occur when the LCM is driven beyond above power interface timing sequence.
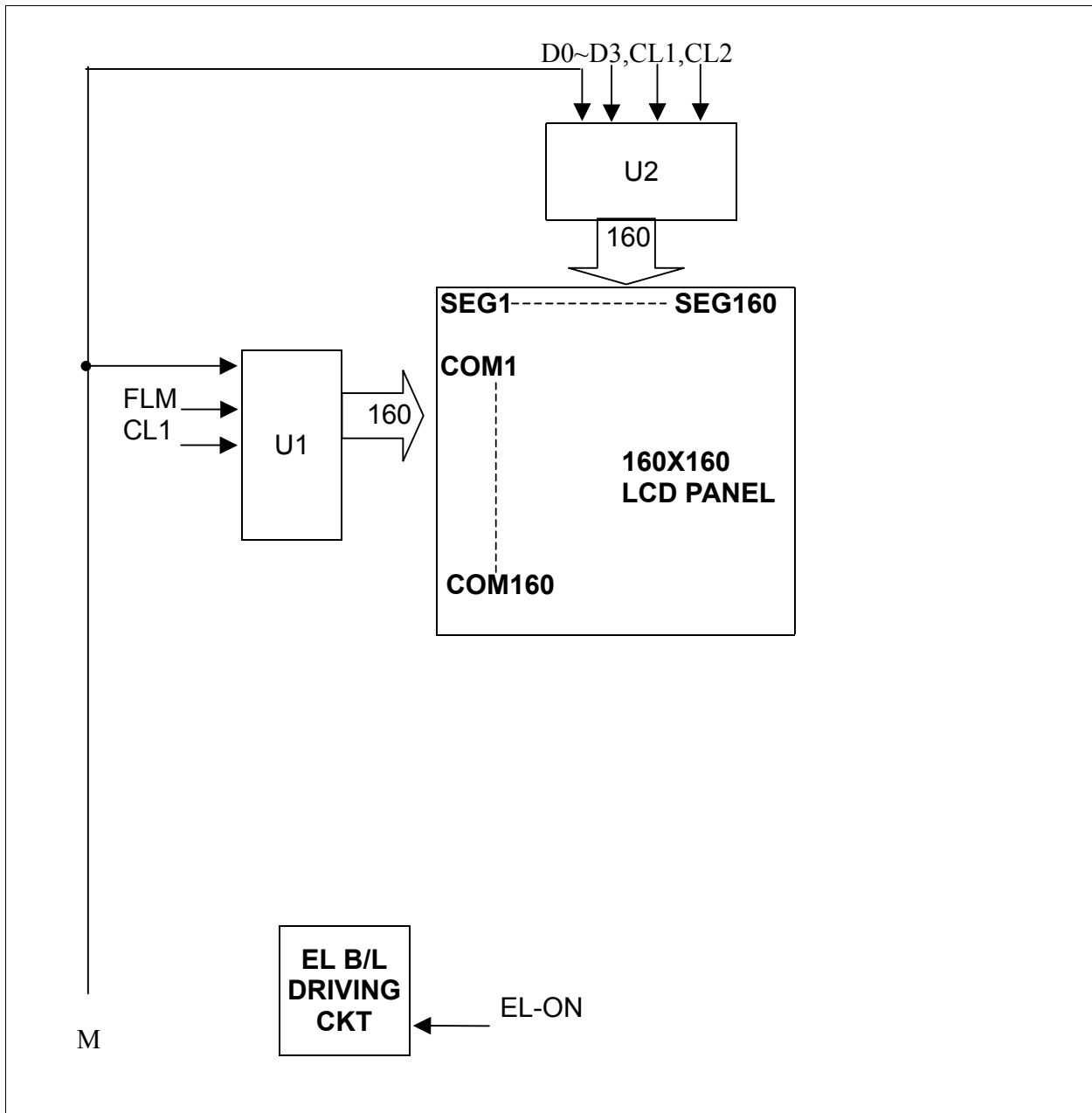
8. PIN CONNECTIONS

NO	Symbol	Function
1	VSS	Power Supply (0V)
2	FLM	First Line Mark for Common Scan
3	CL1(LP)	H→L Data Latch Pulse
4	CL2(SCP)	H→L Data Shift Pulse
5	M(N.C)	H/L Frame Reverse Signal (Alternate Signal)
6	VDD	Power Supply for Logic
7	EL__ON	EL. Back light ON /OFF ("H"=ON,"L"=OFF)
8	VEE	Power Supply for LCD (+V)
9	D3	
10	D2	H/L Display data(Upper Half)
11	D1	
12	D0	
13	NC	NO Connection.
14	NC	NO Connection.
15	NC	NO Connection.
16	NC	NO Connection.
17	VSS	Power Supply (0V)
18	VSS	Power Supply (0V)

9. POWER SUPPLY

10. BLOCK DIAGRAM

D0~D3,CL1,CL2

U2

160

SEG1-------------- SEG160

COM1

**160X160
LCD PANEL**

COM160

FLM
CL1

U1

160

M

**EL B/L
DRIVING
CKT**

EL-ON

*M SIGNAL CAN BE SUPPLIED BY USER'S INTERFACE OR GENERATED BY MODULE'S CKT
(FOR THIS SPEC.,M SIGNAL MUST BE SUPPLIED BY USER'S INTEREACE)

10.1 DISPLAY PATTERN

FIRST DATA

COM001	D3	D2	D1	D0	....	D3	D2	D1	D0
COM002	D3	D2	D1	D0	....	D3	D2	D1	D0
COM159	D3	D2	D1	D0	....	D3	D2	D1	D0
COM160	D3	D2	D1	D0	....	D3	D2	D1	D0

SEG001 SEG002 .... SEG159 SEG160
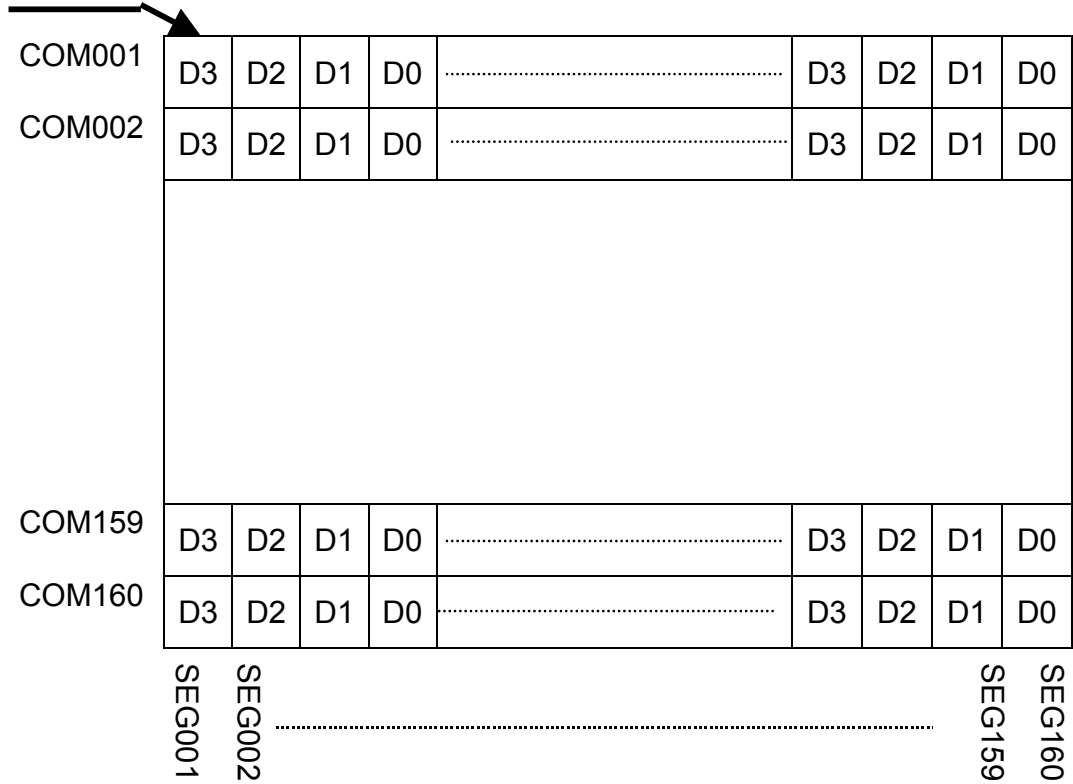
160*160 Dots Matrix

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

No.	Parameter	Conditions	Regulations
1	High Temperature Operating	$70 \pm 2 °C$	Note 3
2	Low Temperature Operating	$-20 \pm 2 °C$	Note 3
3	High Temperature Storage	$80 \pm 2 °C$	Note 3
4	Low Temperature Storage	$-30 \pm 2 °C$	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.
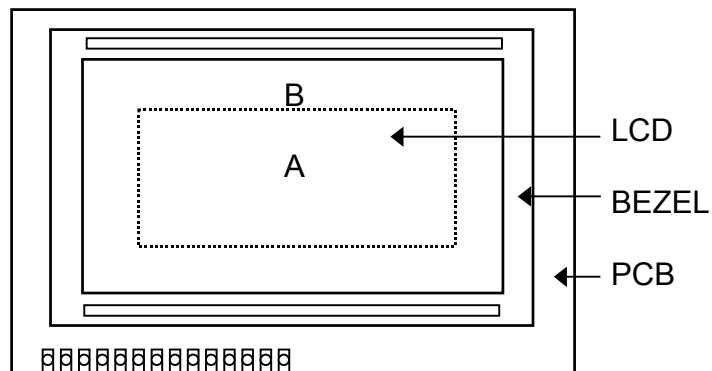Note 3: No change on display and in operation under the test condition

11.2   Inspection condition

11.2.1 Inspection conditions

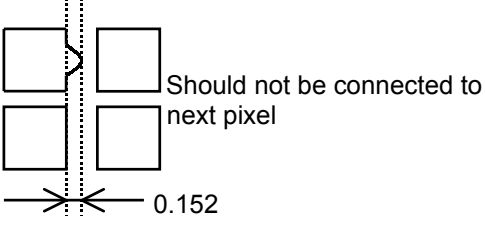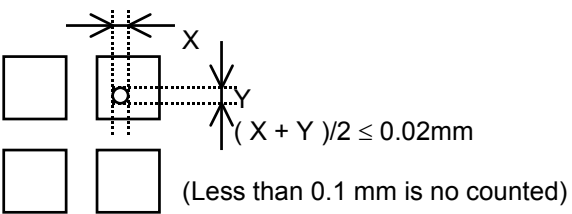The LCD shall be inspected under 40W white fluorescent light.
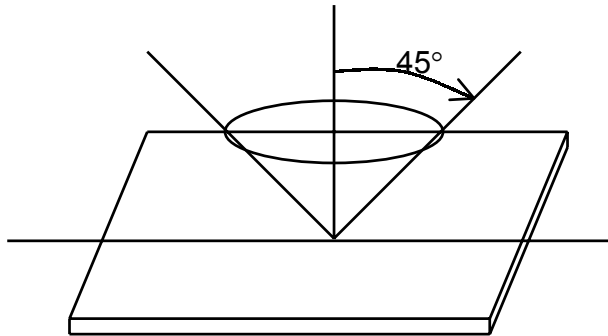
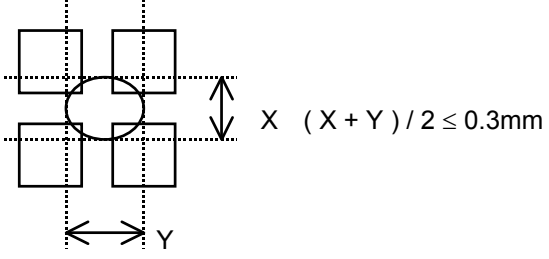### 11.2.2   Definition of applicable Zones

A : Display Area
B : Non-Display Area

11.2.3   Inspection Parameters

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

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		
0.2 ≤ D ≤ 0.25	2	2	Minor	2.5
D ≤ 0.3	0	1		

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

No. 2 — Scratch, Substances

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		
2.0 ≥ L	0.08 ≥ W	2	3	Minor	2.5
—	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 ≤ 0.02mm (Less than 0.1 mm is no counted) (4) Deformation X (X + Y) / 2 ≤ 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
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 161600 F F E B B – P4

VERSION :P4

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
Y –Yellow

Backlight
N –No Back light
E –EL

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

LCD type
P – FSTN Paper white
F – FSTN
N – TN

Series code
161600– Dot number =160 x 160 dots, 00 Type

Model type
CM – Character Module
GM – Graphic Module
TG –Slim TAB/COG Module
TGX–Custom Slim TAB/COG 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 ± 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
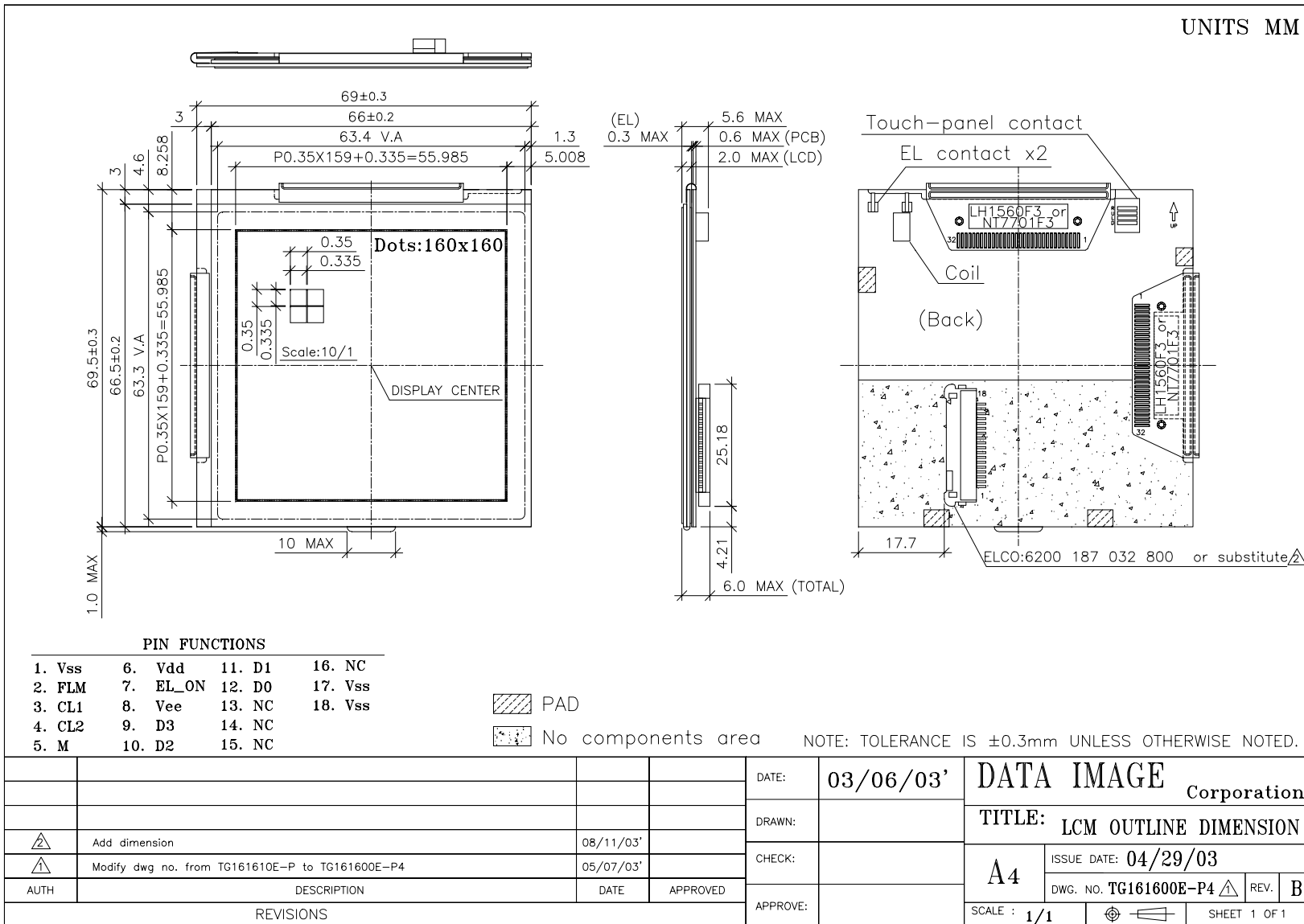
PIN FUNCTIONS

1. Vss	6. Vdd	11. D1	16. NC
2. FLM	7. EL_ON	12. D0	17. Vss
3. CL1	8. Vee	13. NC	18. Vss
4. CL2	9. D3	14. NC	
5. M	10. D2	15. NC	

▨ PAD

▨ No components area

NOTE: TOLERANCE IS ±0.3mm UNLESS OTHERWISE NOTED.

			DATE:	03/06/03'	**DATA IMAGE** Corporation		
			DRAWN:		TITLE: LCM OUTLINE DIMENSION		
△2	Add dimension	08/11/03'	CHECK:		A4	ISSUE DATE: 04/29/03	
△1	Modify dwg no. from TG161610E-P to TG161600E-P4	05/07/03'				DWG. NO. TG161600E-P4 △	REV. B
AUTH	DESCRIPTION	DATE	APPROVED	APPROVE:		SCALE : 1/1	SHEET 1 OF 1
	REVISIONS						

16. PACKAGE INFORMATION

Anti-static bag

LCM

Carton