





DATA IMAGE CORPORATION

LCD Module Specification

ITEM NO.: TG322420GNCWC-01

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R&D Dept.	Q.C. Dept.	Eng. Dept.	Prod. Dept.
			
Version:	Issued Date:	Sheet Code:	Total Pages:
	2003/5/28		21

2. RECORD OF REVISION

Rev	Date	Item	Page	Comment

3. GENERAL SPECIFICATION

Display Format : 320 (W) × 240 (H) dots
Dots Pitch : 0.36 (W) × 0.36 (H) mm
Dots Size : 0.34 (W) × 0.34 (H) mm
View Area : 121 (W) × 91.6 (H) mm
General Dimensions : 166 (W) × 109 (H) × 7.5 (T) mm Max.
Weight : 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 : NT7701 / NT7705

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

 $V_{SS} = 0V, T_a = 25^{\circ}C$

Item	Symbol	Min.	Max.	Unit
Supply Voltage (Logic)	V _{DD-VSS}	-0.3	6.5	V
Supply Voltage (LCD Driver)	V _{EE-VSS}	-0.3	30	V
Input Voltage	V _I	V _{SS}	V _{DD}	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) $T_a = 0^{\circ}C$: 50Hr Max.

Note(2) $T_a \leq 40^{\circ}C$: 90% RH Max.

$T_a \geq 40^{\circ}C$: 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)	VDD-VSS		2.5	5	5.5	V
Supply Voltage (LCD)	VEE-VSS	0°C	21.7	22.4	23.1	V
		25°C	20.8	21.5	22.2	
		50°C	20.0	20.7	21.4	
Input Voltage	V _{IH}	--	0.8*VDD	--	VDD	V
	V _{IL}		VSS	--	0.2*VDD	
Logic Supply Current	I _{DD}	25°C	--	0.5	--	mA
	I _{EE}	VDD-VSS=5V	--	4.0	--	

6. ELECTRO-OPTICAL CHARACTERISTICS

ITEM	Symbol	Condition	Min.	Typ.	Max.	Unit	Ref.
Rise Time	Tr	0°C	--	--	--	ms	Note (1)
		25°C		200	450		
Fall Time	Tf	0°C	--	--	--	ms	
		25°C		300	700		
Contrast	K	25°C	3	4			Note (3)
View Angle	θ _{1~θ2} ∅ _{1, ∅2}	25°C & CR≥2	--	25	--		Note (2)
			--	20	--		
Frame Frequency	Ff	25°C	32	64	128	Hz	

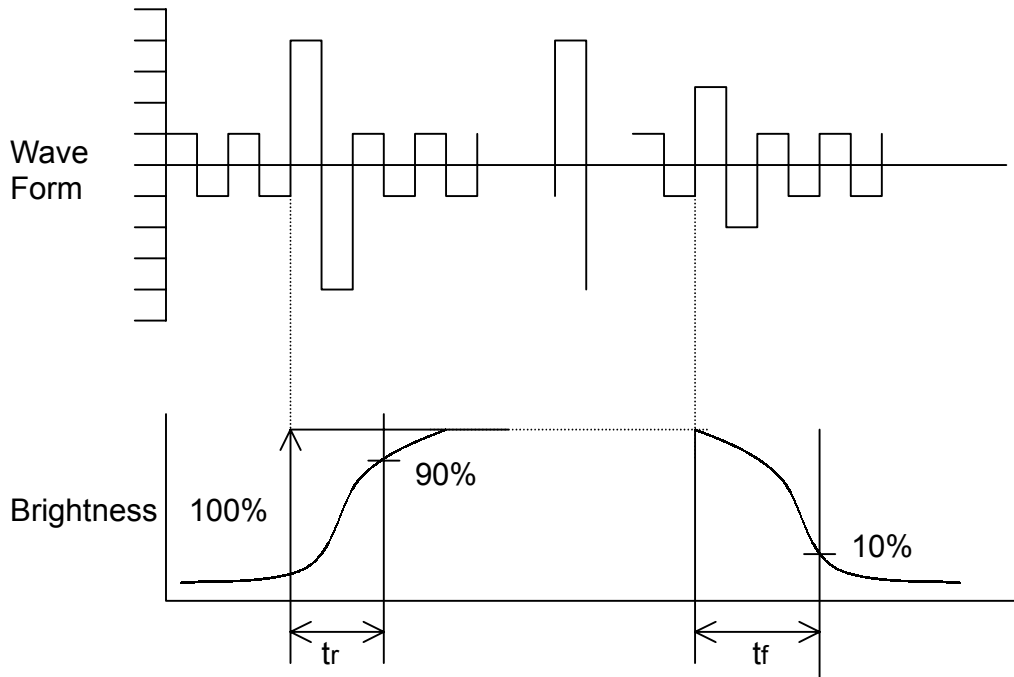
Note (1) & (2) : See next page

Note (3) : Contrast ratio is defined under the following condition:

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

- (a). Temperature ----- 25°C
- (b). Frame frequency ---- 64Hz
- (c). Viewing angle ----- θ= 0°, ∅ = 0°
- (d). Operating voltage --- 21.5V

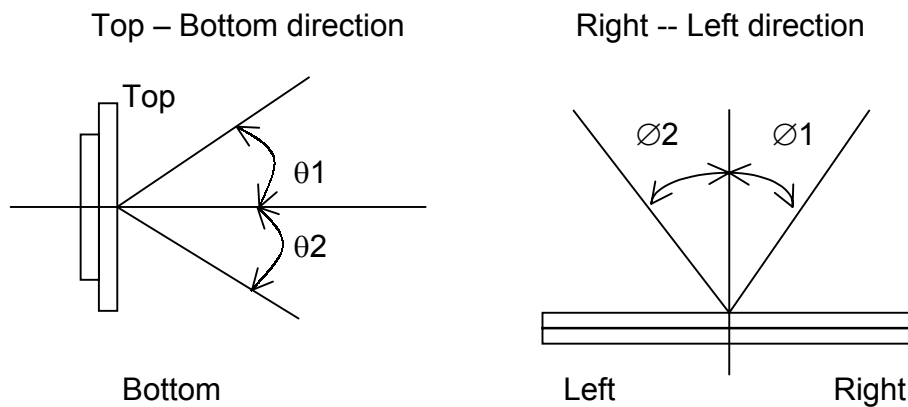
Note (1) Response time is measured as the shortest period of time possible between the change in state of an LCD segment as demonstrated below:



Condition:

- (a) . Temperature -----25°C
- (b) . Frame frequency ----- 64Hz
- (c) . View Angle ----- $\theta = 0^\circ, \varnothing=0^\circ$
- (d) . Operating voltage ----- 21.5V

Note (2) Definition of View Angle



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 Typical	
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 CHARACTERISTICS

Segment timing:

(VSS=0V,VDD=4.5-5.5V,Vo=15 to 30, and ta=-30 to 85°C, unless otherwise noted)

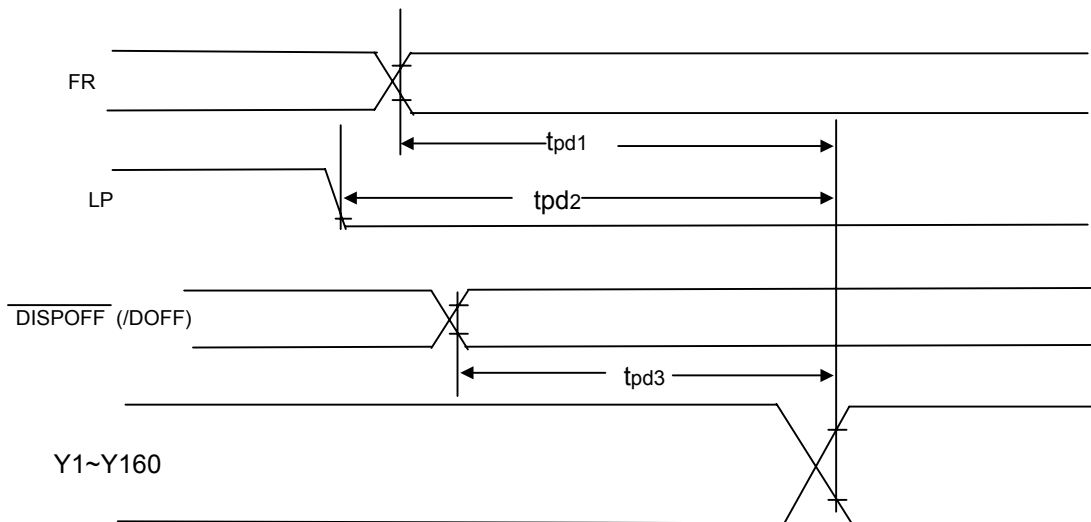
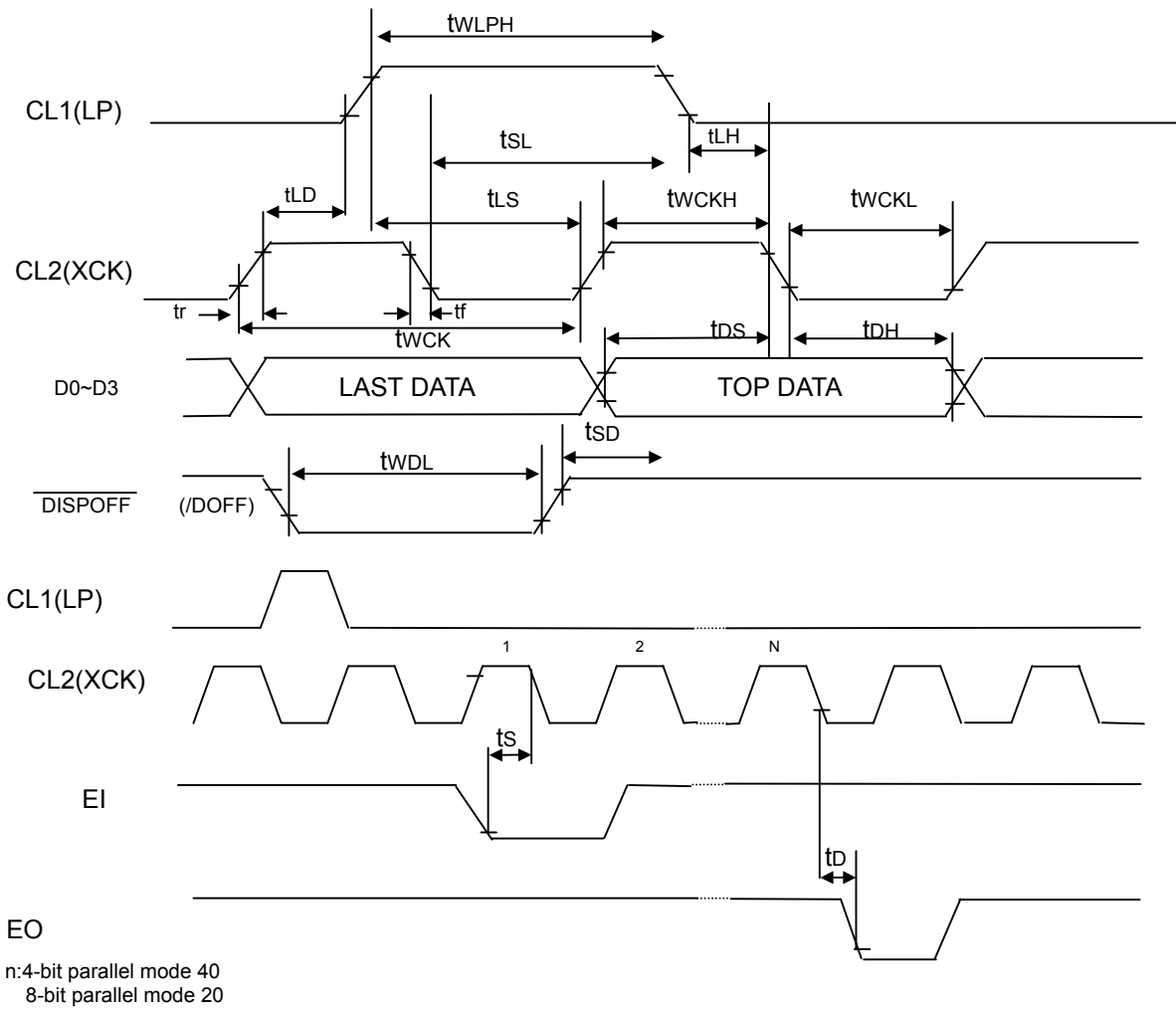
Item	Symbol	Condition	Min.	Typ.	Max.	Units
Shift clock period	tWCK	tr ,tf≤10ns,Note 1	71			ns
Shift clock "H"/ "L" pulse width	tWCKH ; tWCKL		23			ns
Data setup time	tDS		10			ns
Data hold time	tDH		20			ns
Latch pulse "H" pulse width	tWLPH		23			ns
Shift clock rise to Latch pulse rise time	tLD		0			ns
Shift clock fall to Latch pulse fall time	tSL		25			ns
Latch pulse rise to Shift clock rise time	tLS		25			ns
Latch pulse fall to Shift clock fall time	tLH		25			ns
Input signal rise/ fall time	tr, tf	Note2			50	ns
Enable setup time	tS		21			ns
$\overline{\text{DISPOFF}}$ removal time	tSD		100			ns
$\overline{\text{DISPOFF}}$ enable pulse width	tWDL		1.2			μs
Output delay time (1)	tD	CL=15pF			40	ns
Output delay time (2) (3)	t _{pd1} , t _{pd2} , t _{pd3}	CL=15pF			1.2	μs

(VSS=0V,VDD=2.5-4.5V,Vo=15 to 30, and ta=-30 to 85°C, unless otherwise noted)

Item	Symbol	Condition	Min.	Typ.	Max.	Units
Shift clock period	tWCK	tr,tf≤11ns,Note 1	125			ns
Shift clock "H"/ "L" pulse width	tWCKH ; tWCKL		51			ns
Data setup time	tDS		30			ns
Data hold time	tDH		40			ns
Latch pulse "H" pulse width	tWLPH		51			ns
Shift clock rise to Latch pulse rise time	tLD		0			ns
Shift clock fall to Latch pulse fall time	tSL		51			ns
Latch pulse rise to Shift clock rise time	tLS		51			ns
Latch pulse fall to Shift clock fall time	tLH		51			ns
Input signal rise/ fall time	tr, tf	Note2			50	ns
Enable setup time	tS		36			ns
$\overline{\text{DISPOFF}}$ removal time	tSD		100			ns
$\overline{\text{DISPOFF}}$ enable pulse width	tWDL		1.2			μs
Output delay time (1)	tD	CL=15pF			78	ns
Output delay time (2) (3)	t _{pd1} , t _{pd2} , t _{pd3}	CL=15pF			1.2	μs

Note1: Take the cascade connection into consideration.

Note2: (tck-tWCKH-tWCKL)/2 is the maximum in the case of high speed operation.

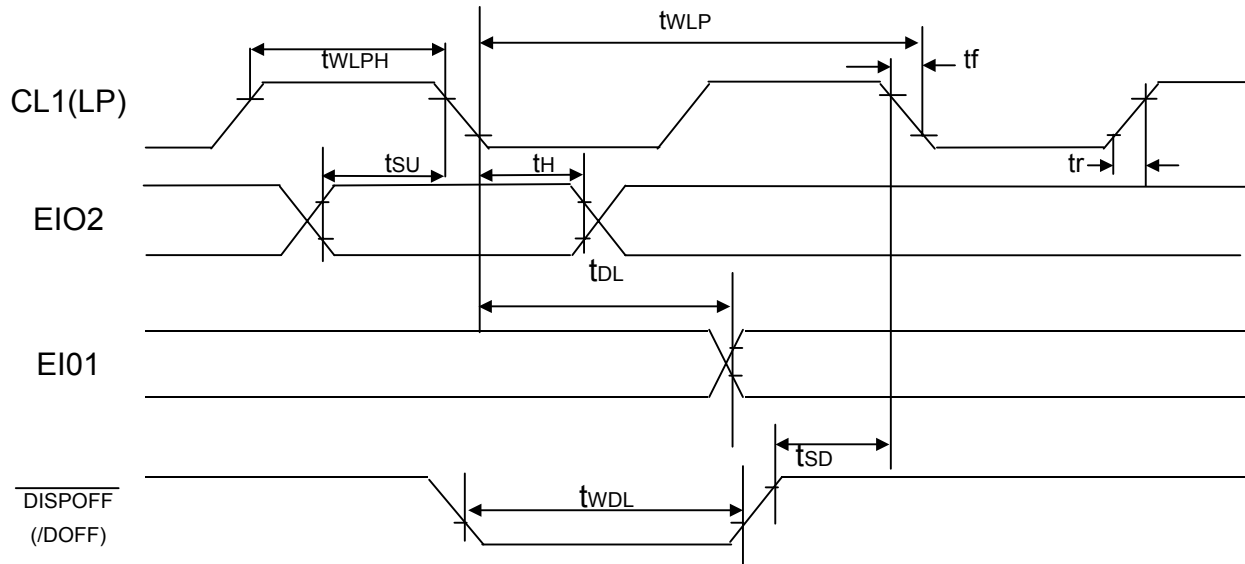


Common timing:

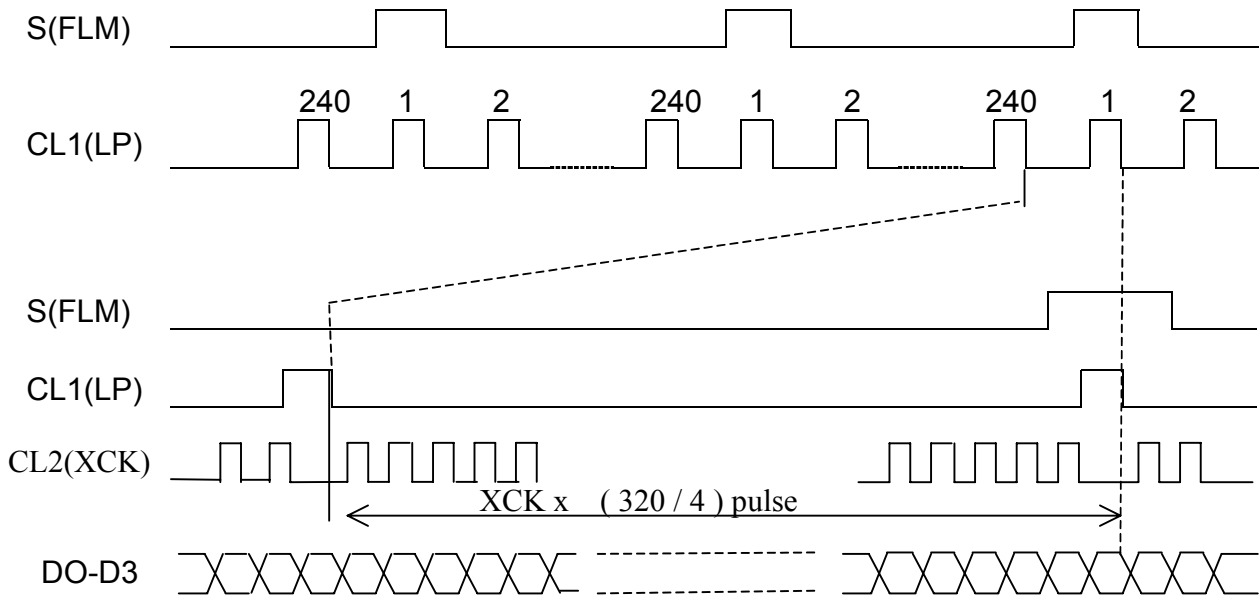
(VSS=0V, VDD=2.5-5.5V, Vo=15 to 30v, and ta=-30 to 85°C, unless otherwise noted)

Item	Symbol	Condition	Min.	Typ.	Max.	Units
Shift clock period	tWLP	tr,tf≤20ns	250			ns
Shift clock "H" pulse width	tWLPH	VDD=+5.0V±10%	15			ns
		VDD=+2.5-+4.5V	30			ns
Data setup time	tSU		30			ns
Data hold time	tH		50			ns
Input signal rise/ fall time	tr, tf				50	ns
$\overline{\text{DISPOFF}}$ removal time	tSD		100			ns
$\overline{\text{DISPOFF}}$ Enable pulse width	tWDL		1.2			μs
Output delay time (1)	tDL	CL=15pF			200	ns

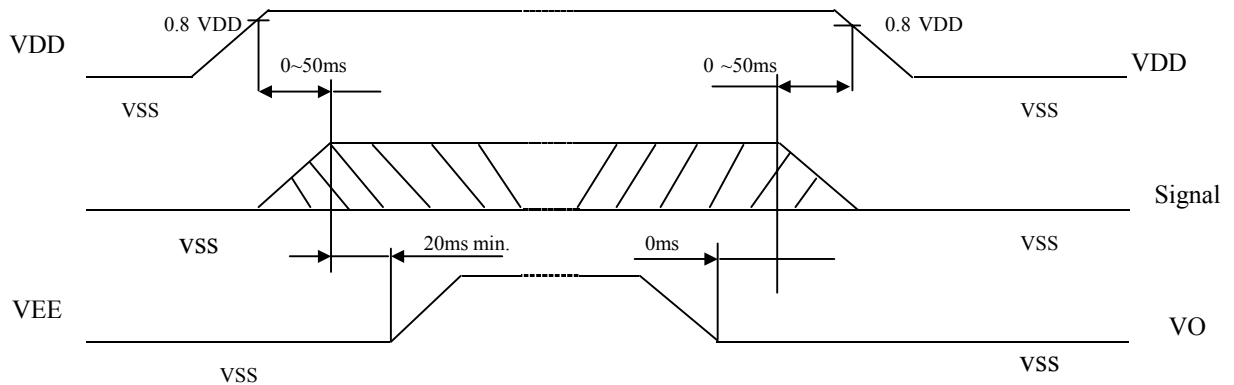
COMMON TIMING



7.1 TIMING CHART



7.2 POWER ON/OFF TIMING



POWER ON

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

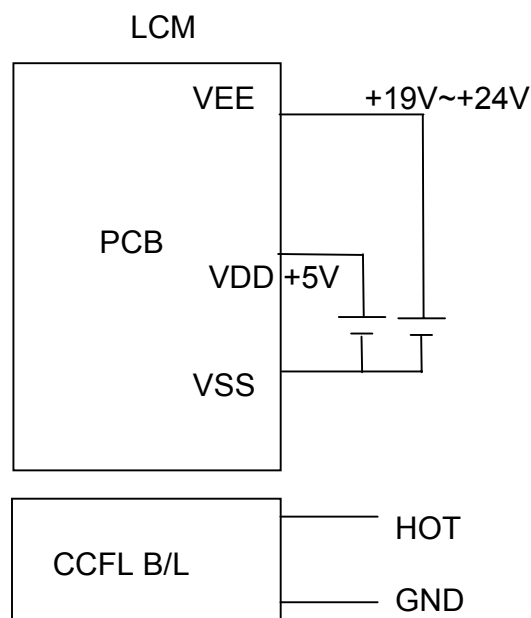
8. PIN CONNECTIONS

NO	Symbol	Function
1	S(FLM)	First Line Mark for Common Scan
2	CL1(LP)	Data Latch Pulse
3	CL2(XCK)	Data Shift Clock
4	N.C	No connection
5	DISP OFF(/DOFF)	Display ON/ OFF control input ("H"=ON, "L"=OFF)
6	D0	H/L Display data
7	D1	
8	D2	
9	D3	
10	VDD	Power Supply for Logic
11	VSS	Power Supply (0V)
12	VEE(VO)	LCD Contrast Voltage(+)

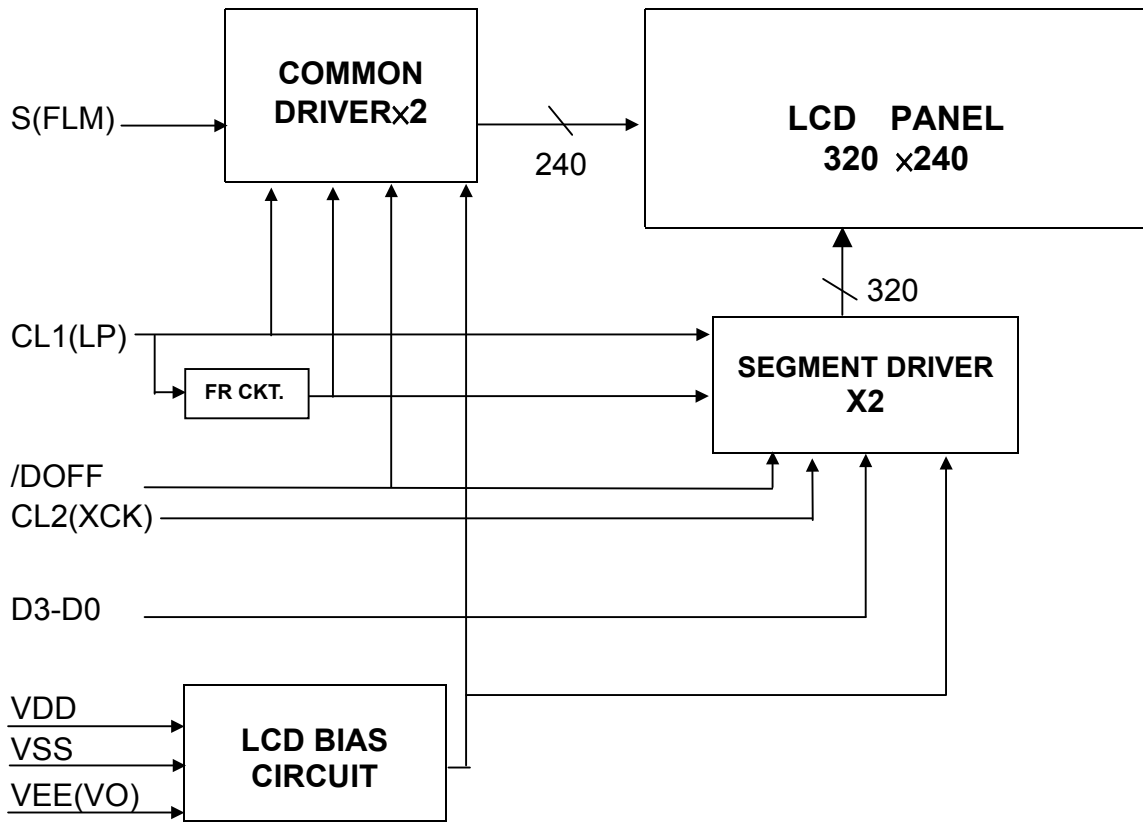
CCFL

NO	Symbol	Function
1	HOT	CCFL HOT +
2	NC	--
3	GND	CCFL GND -

9. POWER SUPPLY



10. BLOCK DIAGRAM



10.1 DISPLAY PATTERN

FIRST DATA

COM001	D3	D2	D1	D0	.....	D3	D2	D1	D0
COM002	D3	D2	D1	D0	.....	D3	D2	D1	D0
.....									
COM239	D3	D2	D1	D0	.....	D3	D2	D1	D0
COM240	D3	D2	D1	D0	.....	D3	D2	D1	D0
	SEG001	SEG002				SEG319	SEG320		

320*240 Dots Matrix

11. QUALITY ASSURANCE

11.1 Test Condition

11.1.1 Temperature and Humidity(Ambient Temperature)

Temperature : $20 \pm 5^{\circ}\text{C}$

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	$50 \pm 2^{\circ}\text{C}$	Note 3
2	Low Temperature Operating	$0 \pm 2^{\circ}\text{C}$	Note 3
3	High Temperature Storage	$70 \pm 2^{\circ}\text{C}$	Note 3
4	Low Temperature Storage	$-20 \pm 2^{\circ}\text{C}$	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)	$40^{\circ}\text{C} \pm 2^{\circ}\text{C}$, 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.

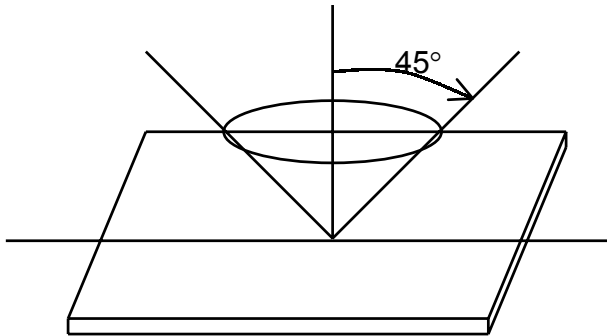
Note 2: No dew condensation to be observed.

Note 3: No change on display and in operation under the test condition

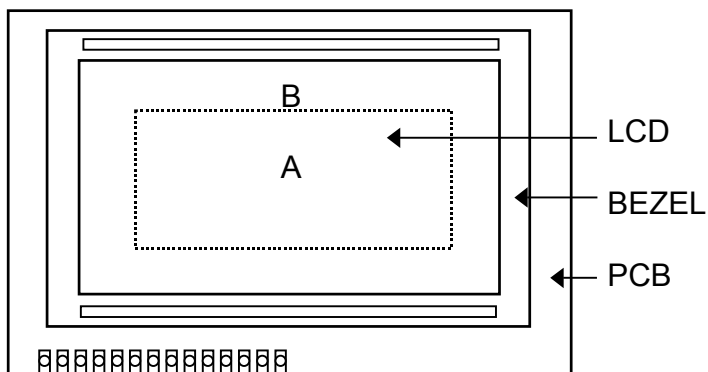
11.2 Inspection condition

11.2.1 Inspection conditions

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

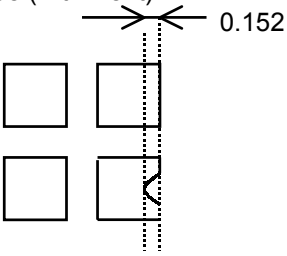


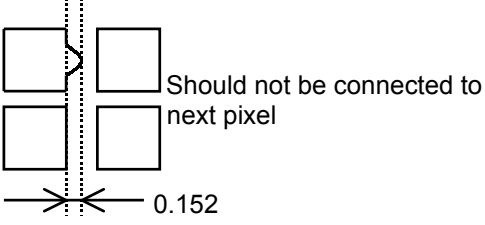
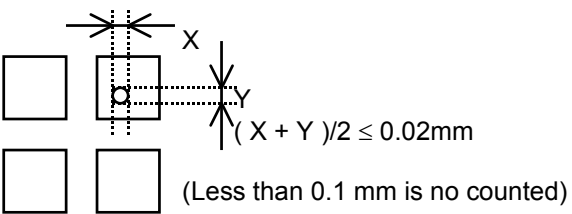
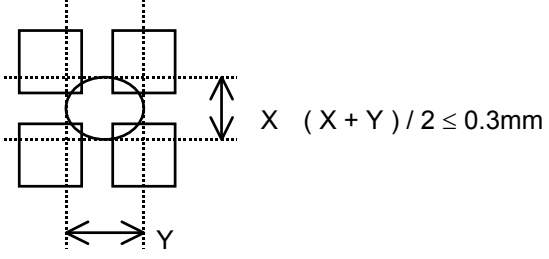
11.2.2 Definition of applicable Zones



A : Display Area
B : Non-Display Area

11.2.3 Inspection Parameters

No.	Parameter	Criteria																												
1	Black or White spots	<table border="1"> <thead> <tr> <th rowspan="2">Zone Dimension</th> <th colspan="2">Acceptable number</th> <th rowspan="2">Class Of Defects</th> <th rowspan="2">AQL Level</th> </tr> <tr> <th>A</th> <th>B</th> </tr> </thead> <tbody> <tr> <td>D < 0.15</td> <td>*</td> <td>*</td> <td rowspan="4">Minor</td> <td rowspan="4">2.5</td> </tr> <tr> <td>0.15 ≤ D < 0.2</td> <td>4</td> <td>4</td> </tr> <tr> <td>0.2 ≤ D ≤ 0.25</td> <td>2</td> <td>2</td> </tr> <tr> <td>D ≤ 0.3</td> <td>0</td> <td>1</td> </tr> </tbody> </table> <p style="text-align: center;">D = (Long + Short) / 2 * : Disregard</p>	Zone Dimension	Acceptable number		Class Of Defects	AQL Level	A	B	D < 0.15	*	*	Minor	2.5	0.15 ≤ D < 0.2	4	4	0.2 ≤ D ≤ 0.25	2	2	D ≤ 0.3	0	1							
Zone Dimension	Acceptable number			Class Of Defects	AQL Level																									
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D ≤ 0.3	0	1																												
2	Scratch, Substances	<table border="1"> <thead> <tr> <th colspan="2">Zone</th> <th colspan="2">Acceptable number</th> <th rowspan="2">Class Of Defects</th> <th rowspan="2">AQL Level</th> </tr> <tr> <th>X (mm)</th> <th>Y (mm)</th> <th>A</th> <th>B</th> </tr> </thead> <tbody> <tr> <td>*</td> <td>0.04 ≥ W</td> <td>*</td> <td>*</td> <td rowspan="4">Minor</td> <td rowspan="4">2.5</td> </tr> <tr> <td>3.0 ≥ L</td> <td>0.06 ≥ W</td> <td>4</td> <td>4</td> </tr> <tr> <td>2.0 ≥ L</td> <td>0.08 ≥ W</td> <td>2</td> <td>3</td> </tr> <tr> <td>—</td> <td>0.1 < W</td> <td>0</td> <td>1</td> </tr> </tbody> </table> <p style="text-align: center;">X : Length Y : Width * : Disregard Total defects should not exceed 4/module</p>	Zone		Acceptable number		Class Of Defects	AQL Level	X (mm)	Y (mm)	A	B	*	0.04 ≥ W	*	*	Minor	2.5	3.0 ≥ L	0.06 ≥ W	4	4	2.0 ≥ L	0.08 ≥ W	2	3	—	0.1 < W	0	1
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3.0 ≥ L	0.06 ≥ W	4	4																											
2.0 ≥ L	0.08 ≥ W	2	3																											
—	0.1 < W	0	1																											
3	Air Bubbles (between glass & polarizer)	<table border="1"> <thead> <tr> <th rowspan="2">Zone Dimension</th> <th colspan="2">Acceptable number</th> <th rowspan="2">Class of Defects</th> <th rowspan="2">AQL Level</th> </tr> <tr> <th>A</th> <th>B</th> </tr> </thead> <tbody> <tr> <td>D ≤ 0.15</td> <td>*</td> <td>*</td> <td rowspan="3">Minor</td> <td rowspan="3">2.5</td> </tr> <tr> <td>0.15 < D ≤ 0.25</td> <td>2</td> <td>*</td> </tr> <tr> <td>0.25 < D</td> <td>0</td> <td>1</td> </tr> </tbody> </table> <p style="text-align: center;">* : Disregard Total defects shall not excess 3/module.</p>	Zone Dimension	Acceptable number		Class of Defects	AQL Level	A	B	D ≤ 0.15	*	*	Minor	2.5	0.15 < D ≤ 0.25	2	*	0.25 < D	0	1										
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0.15 < D ≤ 0.25	2	*																												
0.25 < D	0	1																												
4	Uniformity of Pixel	<p>(1) Pixel shape (with Dent)</p> 																												

4	Uniformity of Pixel	<p>(2) Pixel shape (with Projection)</p> 	
		<p>(3) Pin hole</p> 	
		<p>(4) Deformation</p> 	
		<p>Total acceptable number : 1/pixel, 5/cell</p>	
Class of defects	Major	AQL 0.65%	<p>Definition</p> <p>It is a defect that is likely to result in failure or to reduce materially the usability of the product for the intended function.</p>
		AQL 1.00%	<p>It is a defect that is likely to assembly size and not result in functioning problem.</p>
	Minor	AQL 2.5%	<p>It is a defect that will not result in functioning problem with deviation classified.</p>

11.3 Sampling Condition

Unless otherwise agree in written, the sampling inspection shall be applied to the incoming inspection of customer.

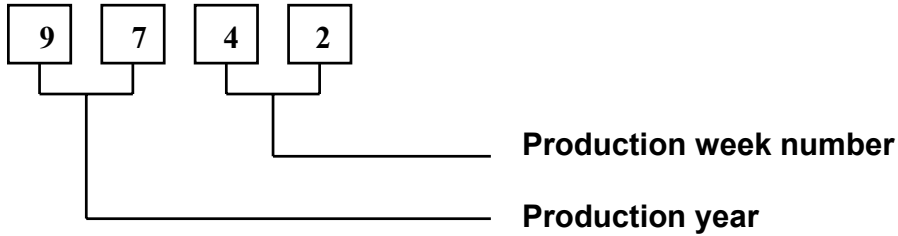
Lot size: Quantity of shipment lot per model.

Sampling type: normal inspection, single sampling

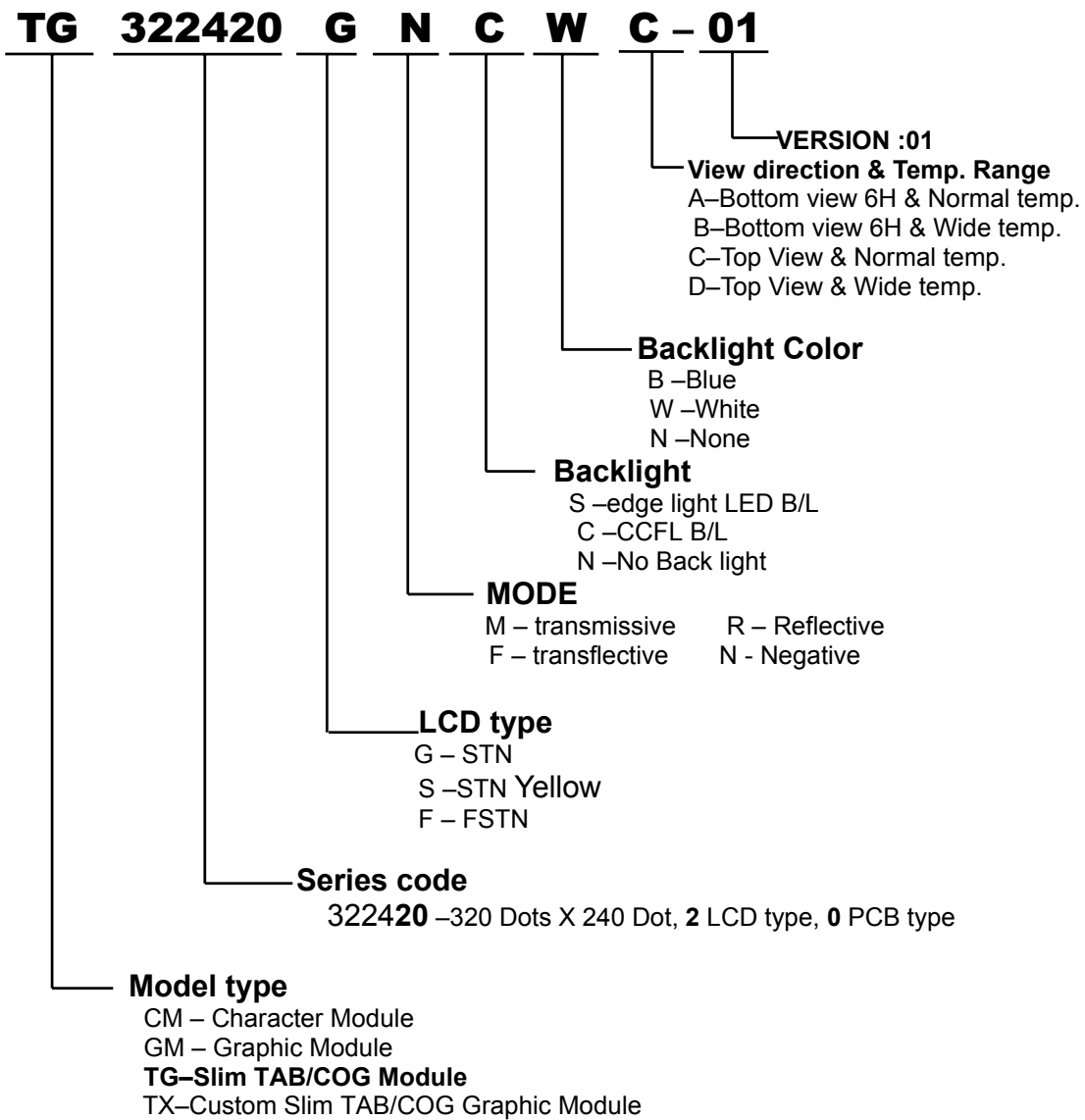
Sampling table: MIL-STD-105E

Inspection level: Level II

12. LOT NUMBERING SYSTEM



13. LCM NUMBERING SYSTEM



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 handling,

- (1). Keep the temperature within range of use and storage. Excessive temperature and humidity could cause polarization degradation, 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 : $280^{\circ}\text{C} \pm 10^{\circ}\text{C}$
- (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 V_0 .
- (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".

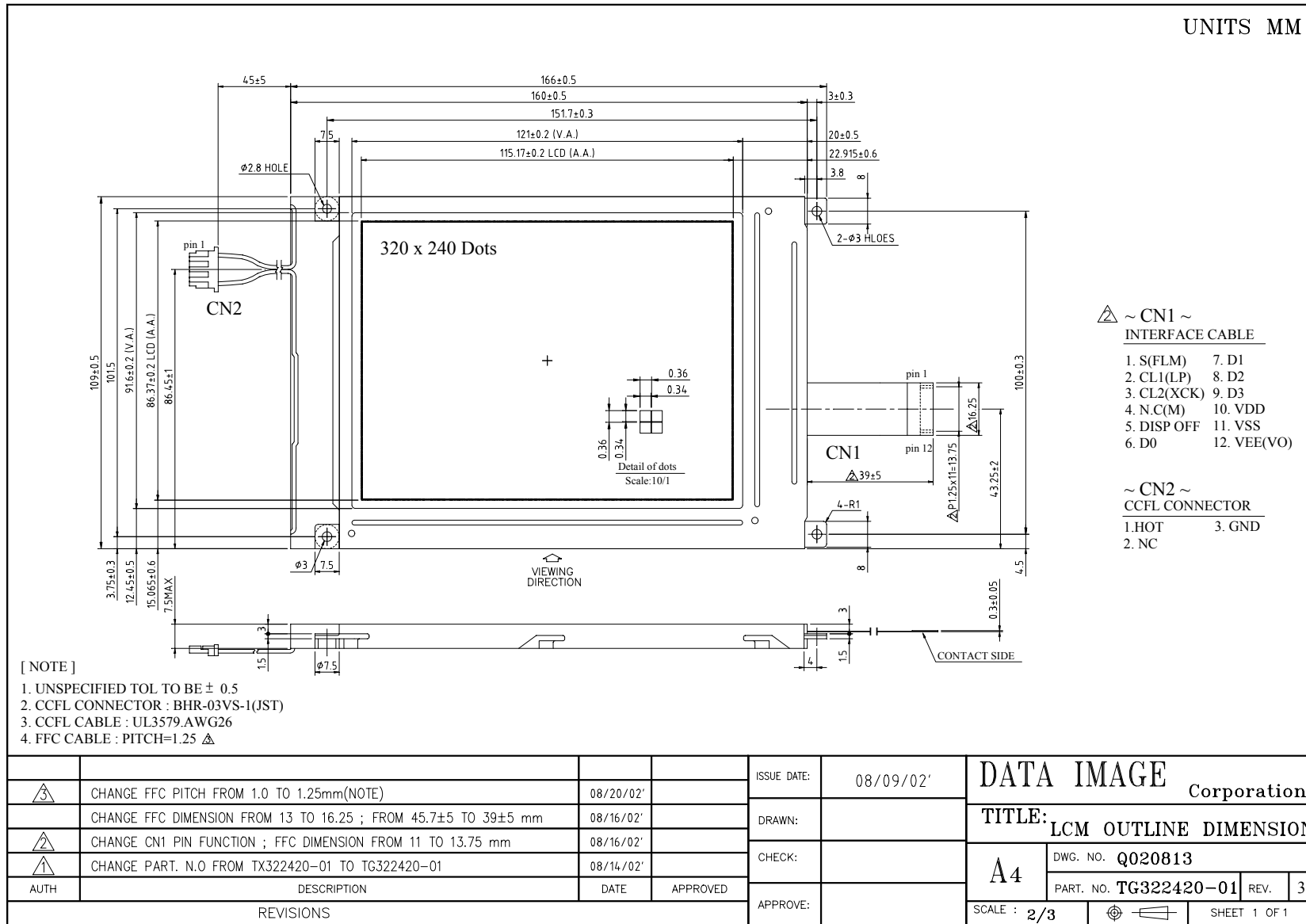
2.5 Storage

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



16. PACKAGE INFORM

