

DATA IMAGE CORPORATION

TFT Module Specification

PRELIMINARY

ITEM NO.: FG090040DSSWBG01

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|--------------------|-----------|--------------|-------------|--------------|
| Customer Companies | R&D Dept. | Q.C. Dept. | Eng. Dept. | Prod. Dept. |
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| Approved by | Version: | Issued Date: | Sheet Code: | Total Pages: |
| | 1 | 2008/7/11 | | 17 |

3. APPLICATION

DVD player, Car TV, Notebook PC

4. GENERAL SPECIFICATIONS

| Parameter | Specifications | Unit |
|----------------------|------------------------------|------|
| Screen Size | 9 (diagonal) | inch |
| Display Format | 800(H) x (R,G,B) x 480(V) | dot |
| Active Area | 198(H) x 112.08(V) | mm |
| Dot Pitch | 0.0825 (H) x 0.2335 (V) | mm |
| Pixel Configuration | Stripe | |
| Outline Dimension | 210.7(W) x 139.4(H) x 10 (D) | mm |
| Surface treatment | Anti-glare and hard coating | |
| Back-light | LED | |
| Display mode | Normally white | |
| Weight | TBD | g |
| View Angle direction | 6 o'clock | |

5. ABSOLUTE MAXIMUM RATINGS

| Parameter | Symbol | MIN. | MAX. | Unit | Remark |
|-----------------------|-----------------|---------------------------|----------------------|------|-----------------|
| Power supply voltage | V _{CC} | -0.3 | 5.0 | V | Ta=25°C |
| Logic input voltage | V _I | -0.3 | V _{CC} +0.3 | V | |
| Operating temperature | T _{OP} | -20 | 70 | °C | Module surface* |
| Storage temperature | T _{ST} | -30 | 80 | °C | - |
| Humidity | Operation | 20%~90% relative humidity | | | Ta<=38°C |
| | Non Operation | 5%~90% relative humidity | | | Ta<=38°C |

6. ELECTRICAL CHARACTERISTICS

f_H=30KHz, F_v=60Hz, f_{CLK}=27MHz, Ta=25°C

| Parameter | Symbol | MIN. | Typ. | MAX. | Unit | Remark |
|---------------------------------|-----------------|--------------------|------|--------------------|-------------------|-----------------------|
| Power Supply voltage for LCD | V _{CC} | +3.0 | +3.3 | +3.6 | V | |
| Power Supply Current for LCD | I _{CC} | | 200 | -- | mA | V _{CC} =3.3V |
| Power Supply voltage for LED | V _{DD} | 4.5 | 5.0 | 5.5 | V | |
| Power Supply Current for LED | I _{DD} | | -- | 800 | mA | V _{DD} =5.0V |
| Ripple voltage | V _{RF} | - | - | 100 | mV _{P-P} | |
| "H" level logical input voltage | V _{IH} | 0.7V _{CC} | -- | V _{CC} | V | |
| "L" level logical input voltage | V _{IL} | 0 | -- | 0.3V _{CC} | V | |
| ADJ frequency | | 19K | 20K | 21K | Hz | |
| ADJ Duty | | 10 | | | % | Note 2 |
| ADJ input voltage | V _{IH} | 3.0 | - | 3.3 | V | |
| LED life time | V _{IL} | 0 | - | 0.3 | V | |
| | | 20,000 | | | Hr | Note 1 |

Note 1: The "LED life time" is defined as the module brightness decrease to 50% original brightness that the ambient temperature is 25 and ADJ = 3.3V.

Note 2: The ADJ turn on time must be less than 0.5 sec at PWM duty less than 10% to avoid user observe backlight uniformity problem.

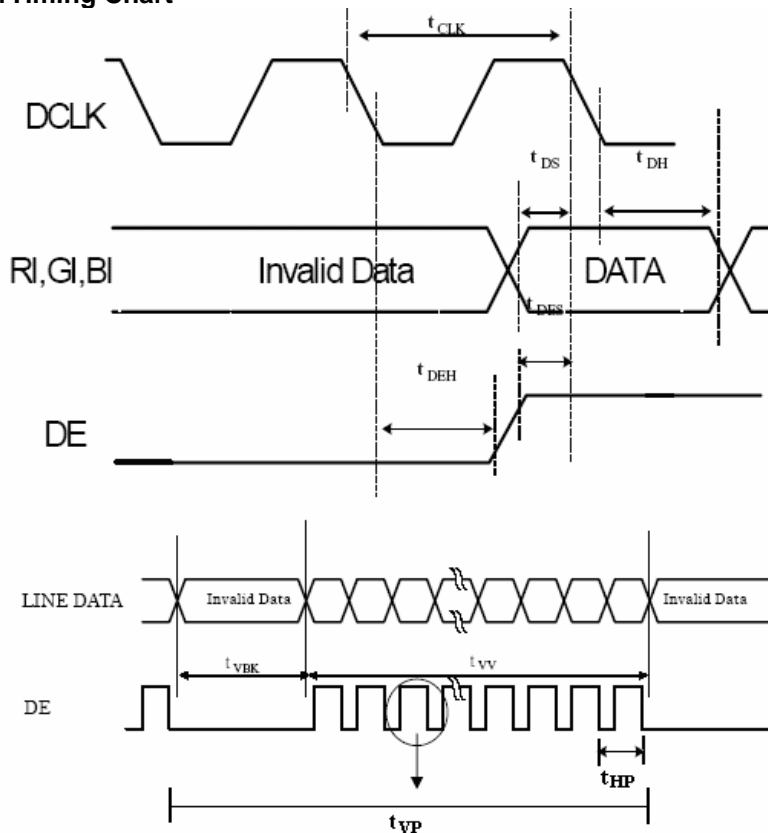
7. TIMING SPECIFICATIONS

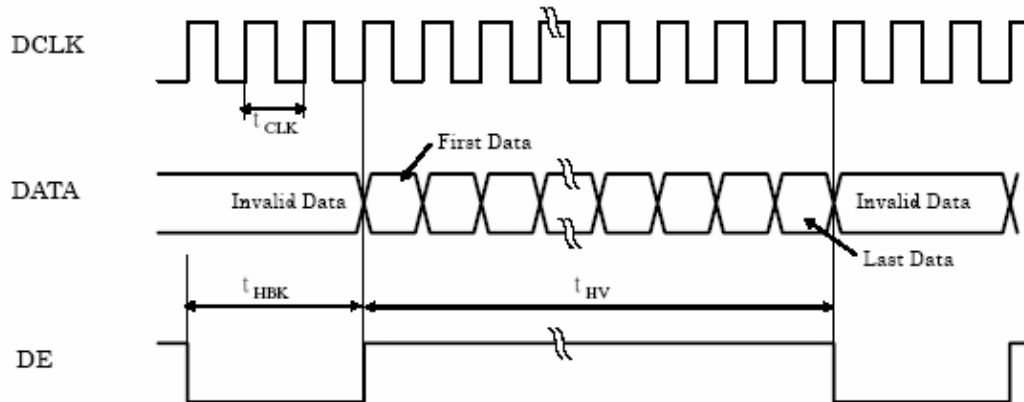
| ITEM | | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|------|-------------------|------------------|------|------|-------|------------------|
| DCLK | Period | t _{CLK} | 31 | 37.0 | 40.0 | ns |
| | Dot Clock | f _{CLK} | 25 | 27 | 32.11 | MHz |
| | Low Level Width | t _{WCL} | 8 | - | - | ns |
| | High Level Width | t _{WCH} | 8 | - | - | ns |
| DE | Setup Time | t _{DES} | 5 | - | - | ns |
| | Hold time | t _{DEH} | 10 | - | - | ns |
| | Horizontal Period | t _{HP} | 850 | 900 | 950 | t _{CLK} |
| | Horizontal Valid | t _{HV} | 800 | | | t _{CLK} |
| | Horizontal Blank | t _{HBK} | 50 | 100 | 150 | t _{CLK} |
| | Vertical Period | t _{VP} | 490 | 500 | 520 | t _{HP} |
| | Vertical Valid | t _{VV} | 480 | | | t _{HP} |
| | Vertical Blank | t _{VBK} | 10 | 20 | 40 | t _{HP} |
| DATA | Setup Time | t _{DS} | 5 | - | - | ns |
| | Hold Time | t _{DH} | 10 | - | - | ns |

Note: High level of T-CON logic signal is 80%
 Low level of T-CON logic signal is 20%

7.1 Timing Characteristic:

7.1.1 Timing Chart





7.2 Color Data Input Assignment

| | | Data Signal | | | | | | | | | | | | | | | | | |
|---------------------|-----------------|-------------|----|----|----|----|-------|----|----|----|----|------|----|----|----|----|----|----|----|
| | | Red | | | | | Green | | | | | Blue | | | | | | | |
| Color | | R5 | R4 | R3 | R2 | R1 | R0 | G5 | G4 | G3 | G2 | G1 | G0 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Colors | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Gray Scale of Red | Red(0) / Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(1) | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(2) | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Red(61) | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(62) | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(63) | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray Scale of Green | Green(0) / Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Green(61) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(62) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(63) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray Scale of Blue | Blue(0) / Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue (1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Blue (2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Blue (61) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 |
| | Blue (62) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Blue (63) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |

Correspondence between Data and Display Position

| | | | | | | | | | | | |
|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | S0001 | S0002 | S0003 | S0004 | S0005 | S0006 | S0007 | S0008 | ----- | S2399 | S2400 |
| C001 | R001 | G001 | B001 | R002 | G002 | B002 | R003 | G003 | | G800 | B800 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| C480 | R001 | G001 | B001 | R002 | G002 | B002 | R003 | G003 | | G800 | B800 |

8. OPTICAL CHARACTERISTIC

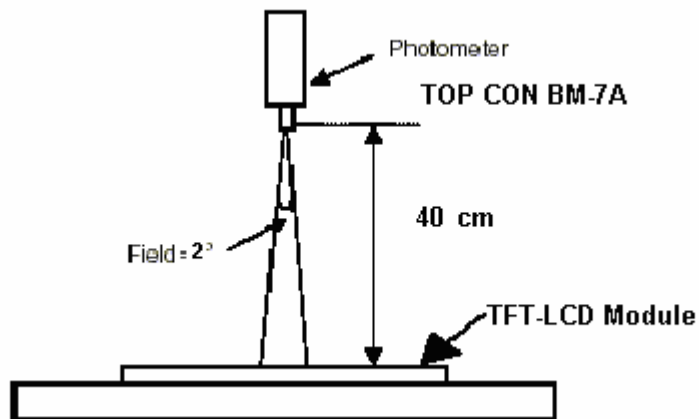
| Parameter | Symbol | Condition | MIN. | TYP. | MAX. | Unit | Remarks |
|----------------|------------|---|------|------|------|-------------------|------------|
| Viewing Angle | Horizontal | θ_{x+} | 60 | 70 | -- | deg | Note 1,4 |
| | Vertical | θ_{x-} | 60 | 70 | -- | | |
| | | θ_{y+} | 40 | 50 | -- | | |
| | | θ_{y-} | 50 | 60 | -- | | |
| Contrast Ratio | CR | at optimized viewing angle | 300 | 350 | | | Note 1,3 |
| Response time | Rise | Tr | - | TBD | -- | ms | Note 1,6 |
| | Fall | Tf | - | TBD | -- | ms | |
| Uniformity | B-uni | $\theta_x=\theta_y=0^\circ$ | 70 | 80 | -- | % | Note1,5 |
| Brightness | L | $\theta_x=\theta_y=0^\circ$ ADJ=3.3V | 320 | 400 | -- | cd/m ² | Note 1,2,4 |
| Chromaticity | x_W | Center $\theta_x=\theta_y=0^\circ$ | | TBD | | | Note 1,7 |
| | y_W | | | TBD | | | |
| | x_R | | | TBD | | | |
| | y_R | | | TBD | | | |
| | x_G | | | TBD | | | |
| | y_G | | | TBD | | | |
| | x_B | | | TBD | | | |
| | y_B | | | TBD | | | |
| Image sticking | tis | 2 hours | | | 2 | Sec | Note 8 |

The following optical specifications shall be measured in a darkroom or equivalent state (ambient luminance ≤ 1 lux, and at room temperature).

The operation temperature is $25^\circ\text{C} \pm 2^\circ\text{C}$.

The measurement method is shown in Note1.

Note1: The method of optical measurement:

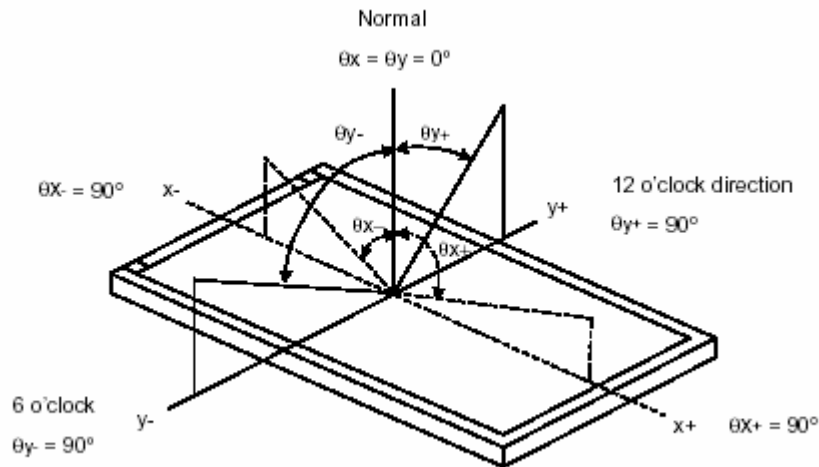


Note2: Measured at the center area of the panel and at the viewing angle of the $\theta_x = \theta_y = 0^\circ$ (Note4) When all the input terminal of LCD Panel are electrically opened.

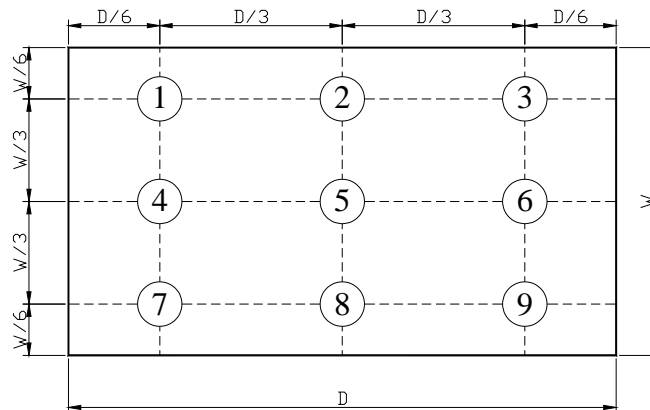
Note3: Definition of Contrast Ratio (CR):

$$CR = \frac{\text{Luminance with all pixels in white state}}{\text{Luminance with all pixels in Black state}}$$

Note4: Definition of Viewing Angle



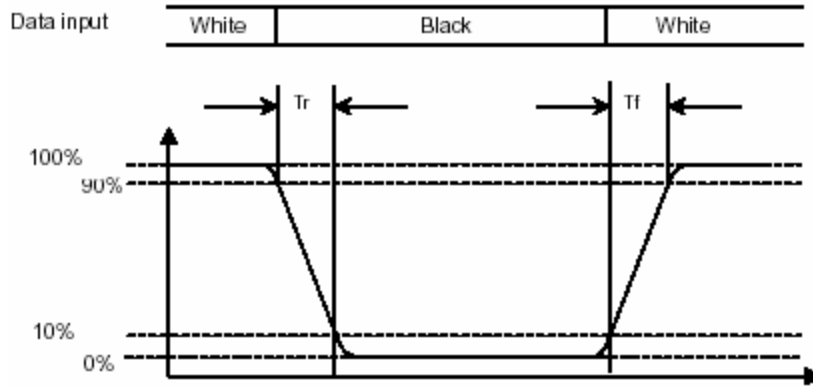
Note 5: Definition of Brightness Uniformity (B-uni):



$$B\text{-uni} = \frac{\text{Minimum luminance of 9 points}}{\text{Maximum luminance of 9 points}} \quad (\text{Note 5}).$$

Note6: Definition of Response Time:

The Response Time is set initially by defining the “Rising Time (Tr)” and the “Falling Time (Tf)” respectively. Tr and Tf are defined as following figure.



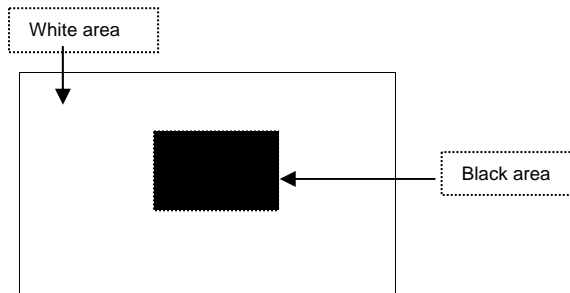
Note 7: Definition of Chromaticity:

The color coordinates $(x_W, y_W), (x_R, y_R), (x_G, y_G),$ and (x_B, y_B) are obtained with all pixels in the viewing field at white, red, green, and blue states, respectively.

Note 8: Definition of Image sticking (tis):

Continuously display the test pattern shown in the figure below for 2 hours. Then display a completely white screen. The previous image shall not persist more than 2 sec at 25 °C

Image sticking pattern



9. PIN CONNECTIONS

| Pin NO. | SYMBOL | DESCRIPTION |
|---------|--------|--|
| 1 | Vss | Power Ground |
| 2 | Vss | Power Ground |
| 3 | ADJ | Brightness control for LED B/L |
| 4 | VDD | Power Supply for LED Driver circuit |
| 5 | VDD | Power Supply for LED Driver circuit |
| 6 | VDD | Power Supply for LED Driver circuit |
| 7 | Vcc | Power Supply for Digital Circuit |
| 8 | Vcc | Power Supply for Digital Circuit |
| 9 | DE | Data Enable |
| 10 | Vss | Power Ground |
| 11 | Vss | Power Ground |
| 12 | Vss | Power Ground |
| 13 | B5 | Blue Data 5 (MSB) |
| 14 | B4 | Blue Data 4 |
| 15 | B3 | Blue Data 3 |
| 16 | Vss | Power Ground |
| 17 | B2 | Blue Data 2 |
| 18 | B1 | Blue Data 1 |
| 19 | B0 | Blue Data 0 (LSB) |
| 20 | Vss | Power Ground |
| 21 | G5 | Green Data 5 (MSB) |
| 22 | G4 | Green Data 4 |
| 23 | G3 | Green Data 3 |
| 24 | Vss | Power Ground |
| 25 | G2 | Green Data 2 |
| 26 | G1 | Green Data 1 |
| 27 | G0 | Green Data 0 (LSB) |
| 28 | Vss | Power Ground |
| 29 | R5 | Red Data 5 (MSB) |
| 30 | R4 | Red Data 4 |
| 31 | R3 | Red Data 3 |
| 32 | Vss | Power Ground |
| 33 | R2 | Red Data 2 |
| 34 | R1 | Red Data 1 |
| 35 | R0 | Red Data 0 |
| 36 | Vss | Power Ground |
| 37 | Vss | Power Ground |
| 38 | DCLK | Clock Signals ; Latch Data at the Falling Edge |
| 39 | Vss | Power Ground |
| 40 | Vss | Power Ground |

Remarks:

- 1) ADJ is brightness control Pin. The larger of the pulse duty is, the higher of the brightness.
- 2) ADJ signal is 0~3.3V. Operation frequency is 20KHz
- 3) VSS PIN must be grounding, can not be floating.
- 4) The ADJ turn on time must be less than 0.5 sec at PWM duty less than 10% to avoid user observe backlight uniformity problem.

9.1 Power Signal Sequence

Remarks:

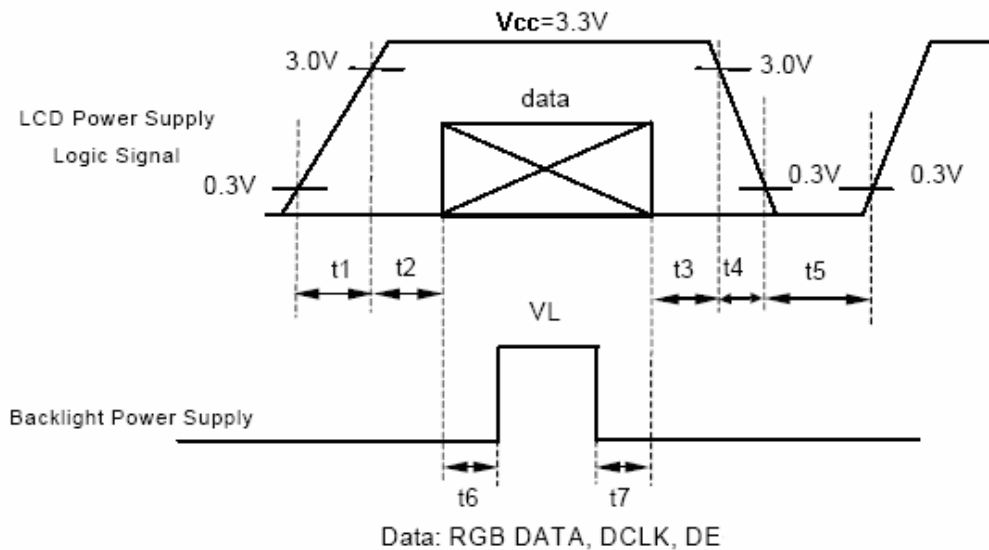
*1) Power Signal sequence:

$t1 \leq 10\text{ms}$; $1 \text{ sec} \leq t5$

$50\text{ms} \leq t2$; $200\text{ms} \leq t6$

$0 < t3 \leq 50\text{ms}$; $200\text{ms} \leq t7$

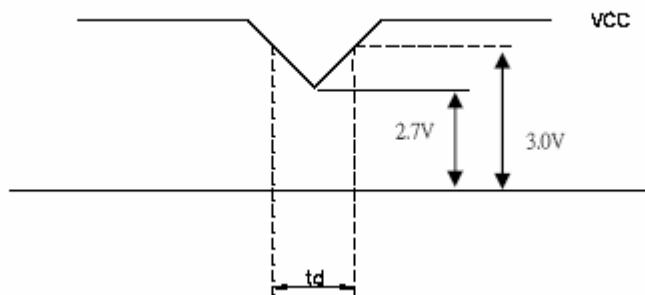
$0 < t4 \leq 10\text{ms}$



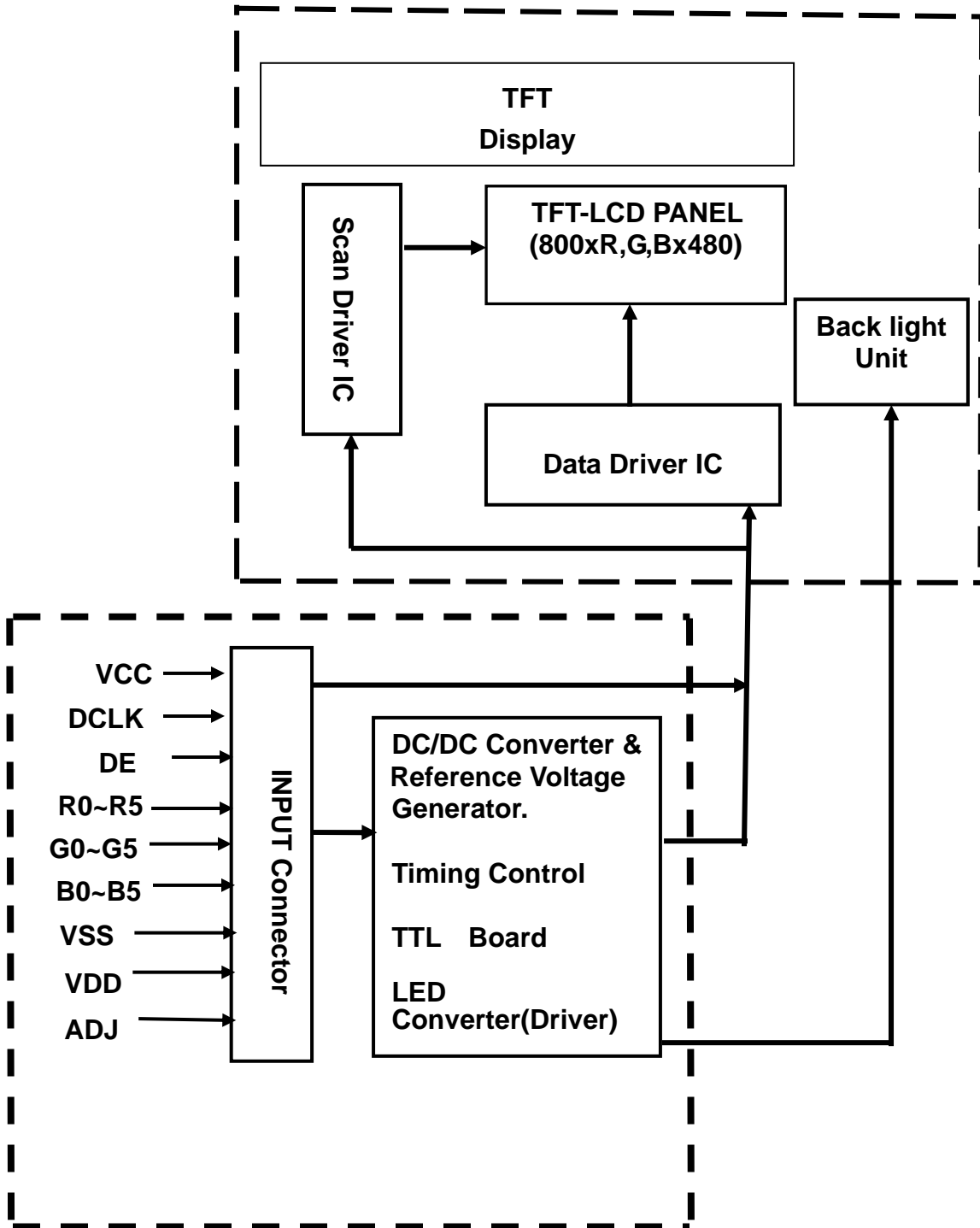
*2) VCC-dip condition:

(1) $2.7 \text{ V} \leq V_{CC} < 3.0\text{V}$, $t_d \leq 10 \text{ ms}$

(2) $V_{CC} > 3.0\text{V}$, VCC-dip condition should be the same with VCC-turn-on condition.



10. BLOCK DIAGRAM



11. QUALITY ASSURANCE

11.1 Test Condition

11.1.1 Temperature and Humidity(Ambient Temperature)

Temperature : $25 \pm 5^{\circ}\text{C}$

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.

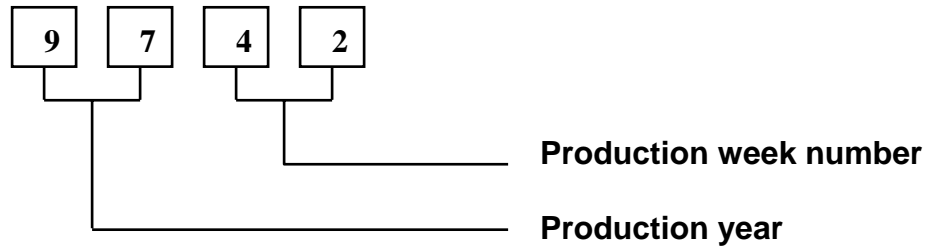
11.1.4 Test Frequency

In case of related to deterioration such as shock test. It will be conducted only once.

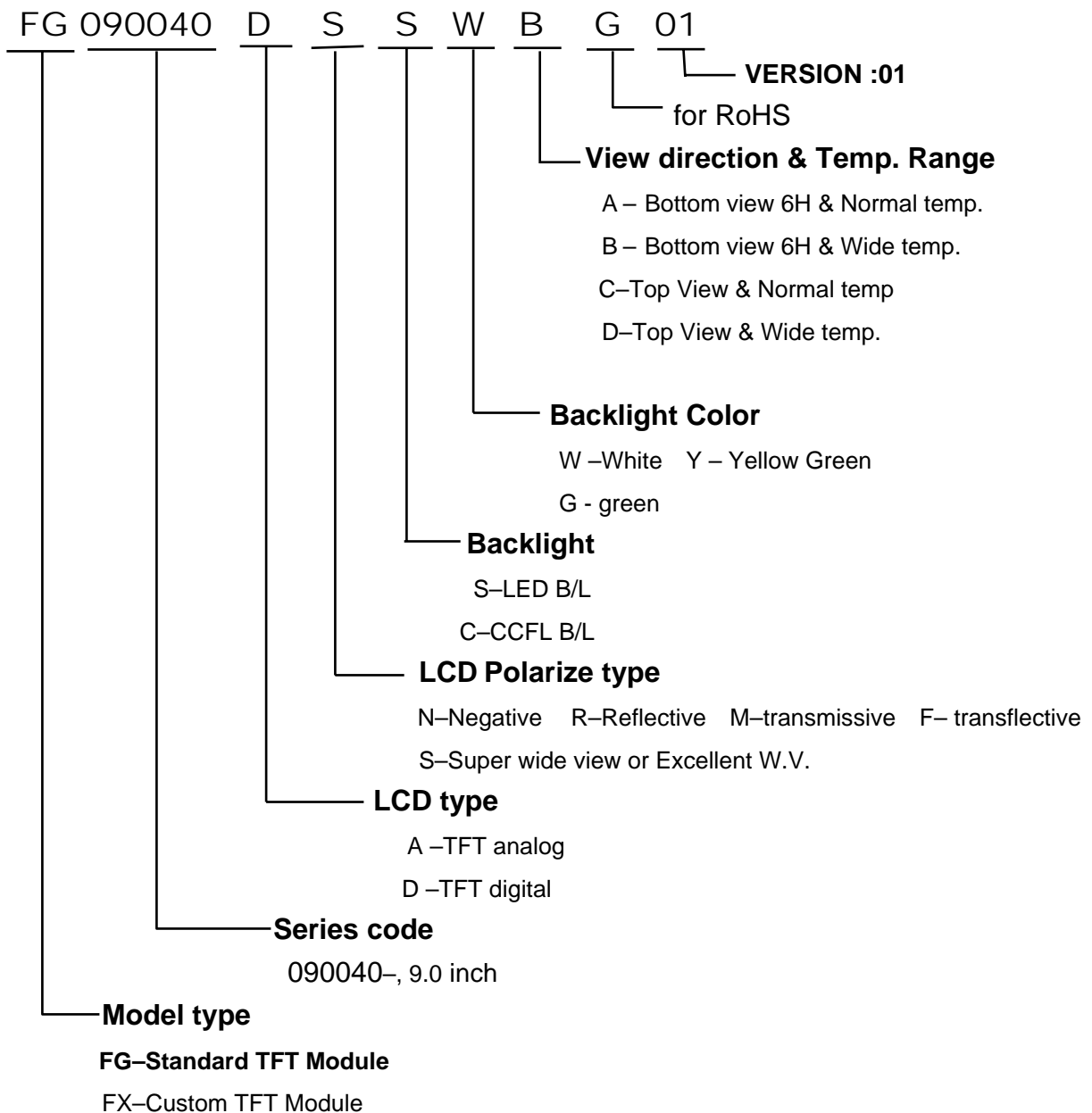
11.1.5 Test Method

| Reliability Test Item & Level | | Test Level |
|-------------------------------|---|---|
| No. | Test Item | |
| 1 | High Temperature Storage Test | T=80°C,240hrs |
| 2 | Low Temperature Storage Test | T=-30°C,240hrs |
| 3 | High Temperature Operation Test | T=70°C,240hrs |
| 4 | Low Temperature Operation Test | T=-20°C,240hrs |
| 5 | High Temperature and High Humidity Operation Test | T=60°C,90%RH,240hrs |
| 6 | Thermal Cycling Test (No operation) | -30°C +25°C + 80°C , 50 Cycles 60 min 30 min 60 min |
| 7 | Vibration Test (No operation) | Frequency:10 ~ 57 Hz Amplitude:1.0 mm 58 ~ 500 Hz, 1G Sweep Time:11min Test Period:3hrs (1hrs for each Direction of X,Y,Z) |
| 8 | Shock Test (No operation) | 80G, 6ms Direction:± X,± Y,± Z Cycle:1 times |

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 statics, 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 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".

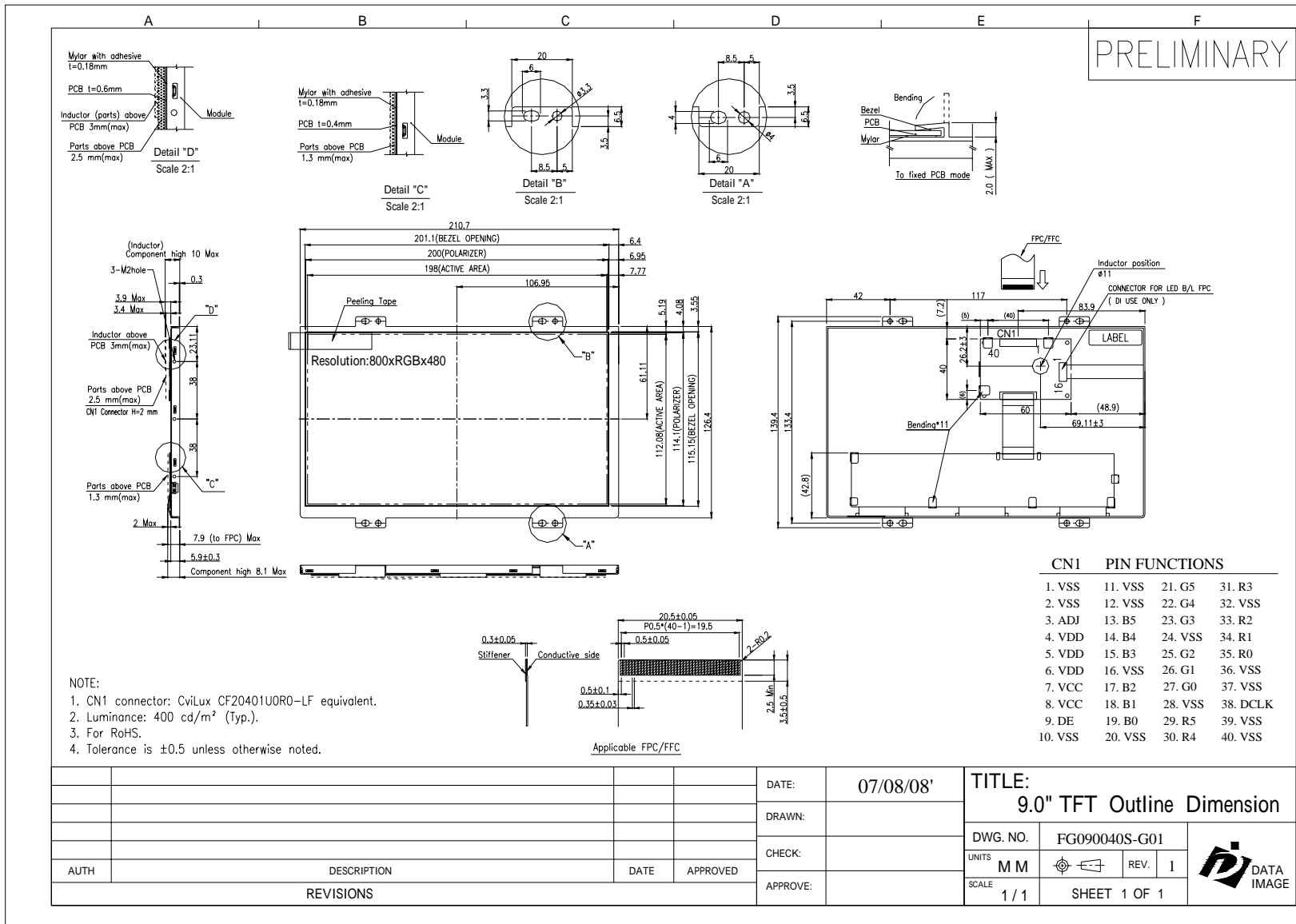
2.5 Storage

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.

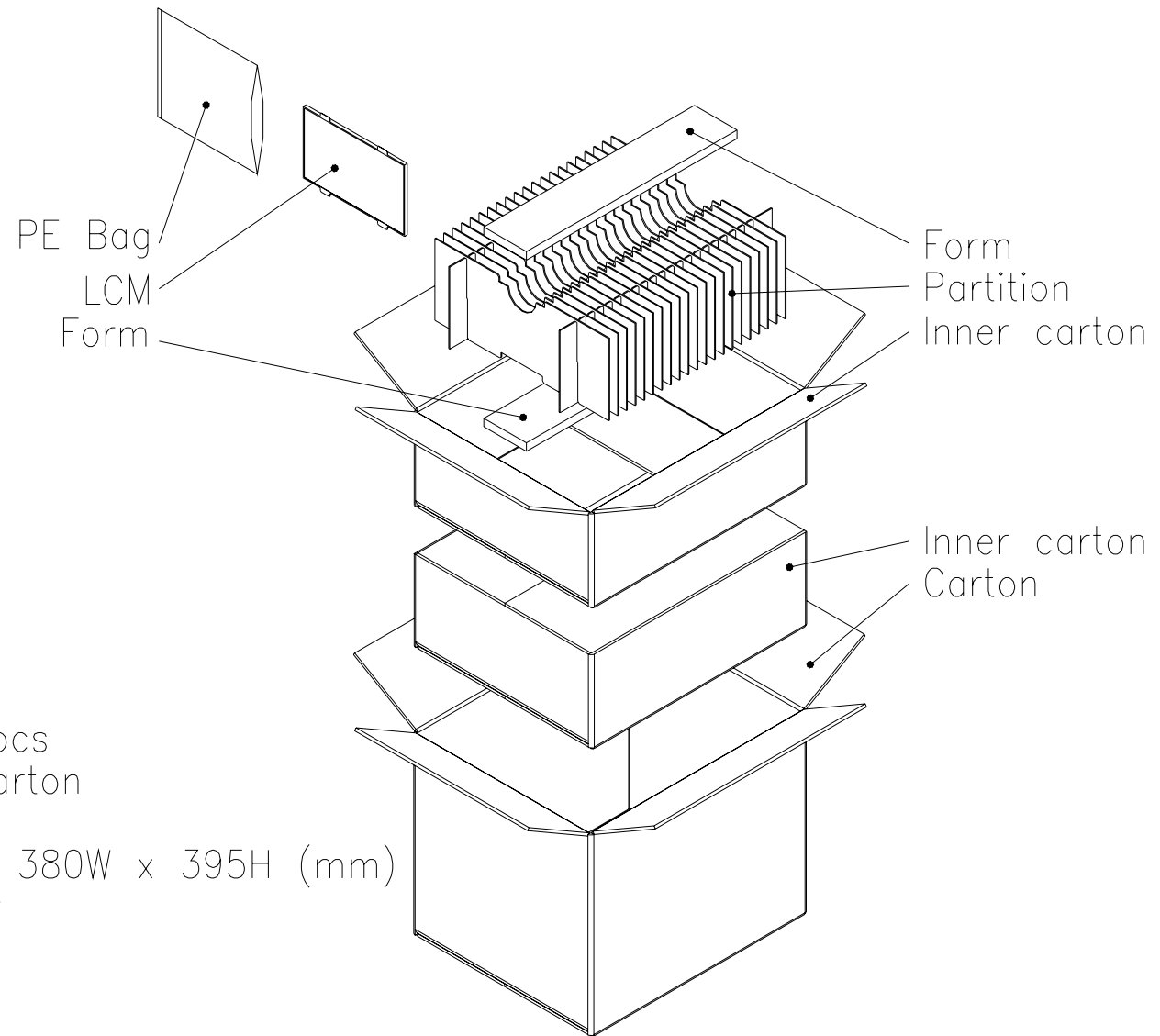
2.6 Limited Warranty

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.

Confidential Document
15. OUTLINE DRAWING



16. PACKAGE INFORMATION



1 Inner carton= 20 pcs
1 Carton= 2 Inner carton
= 20 pcs*2= 40 pcs
Carton size : 465L x 380W x 395H (mm)
Total Weight ÷20 kgw