SPECIFICATION
FOR
LCM MODULE

MODULE NO.: GGG240128A05-A01
DOC.REVISION：01

Customer Approval:

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	SIGNATURE	DATE
PREPARED BY (RD ENGINEER)		
PREPARED BY (QA ENGINEER)		
CHECKED BY		
APPROVED BY		

DOCUMENT REVISION HISTORY

Version	DATE	DESCRIPTION	CHANGED BY
00	Nov-04-2009	First issue	Chen
01	Nov-20-2009	Update backlight characteristics(Page 13)	Chen

CONTENTS

1. FUNCTIONS & FEATURES

1.1. Format	: 240*128 Dots
1.2. LCD mode	: FSTN /Positive Mode /Transflective
1.3. Viewing direction	: 6 o'clock
1.4. Driving scheme	: 1/128 Duty cycle, 1/12 Bias
1.5. Power supply voltage (V_{DD})	: 3.3V
1.6. LCD driving voltage (VLCD)	: 14.5V(Reference voltage)
1.7. Operation temp	: -20~70℃
1.8. Storage temp	: -30~80℃
1.9. Back light	: Edge White
1.10. RoHS compliant.	

2. MECHANICAL SPECIFICATIONS

2.1. Module size	: 101.30mm(L)*76.3mm+30.0mm(FPC length)(W)*4.50mm(H)
2.2. Viewing area	: 92.0mm(L)*60.50mm(W)
2.3. Dot pitch	: 0.36mm(L)*0.40mm(W)
2.4. Dot size	: 0.33mm(L)*0.37mm(W)
2.5. Weight	: Approx.

3. BLOCK DIAGRAM

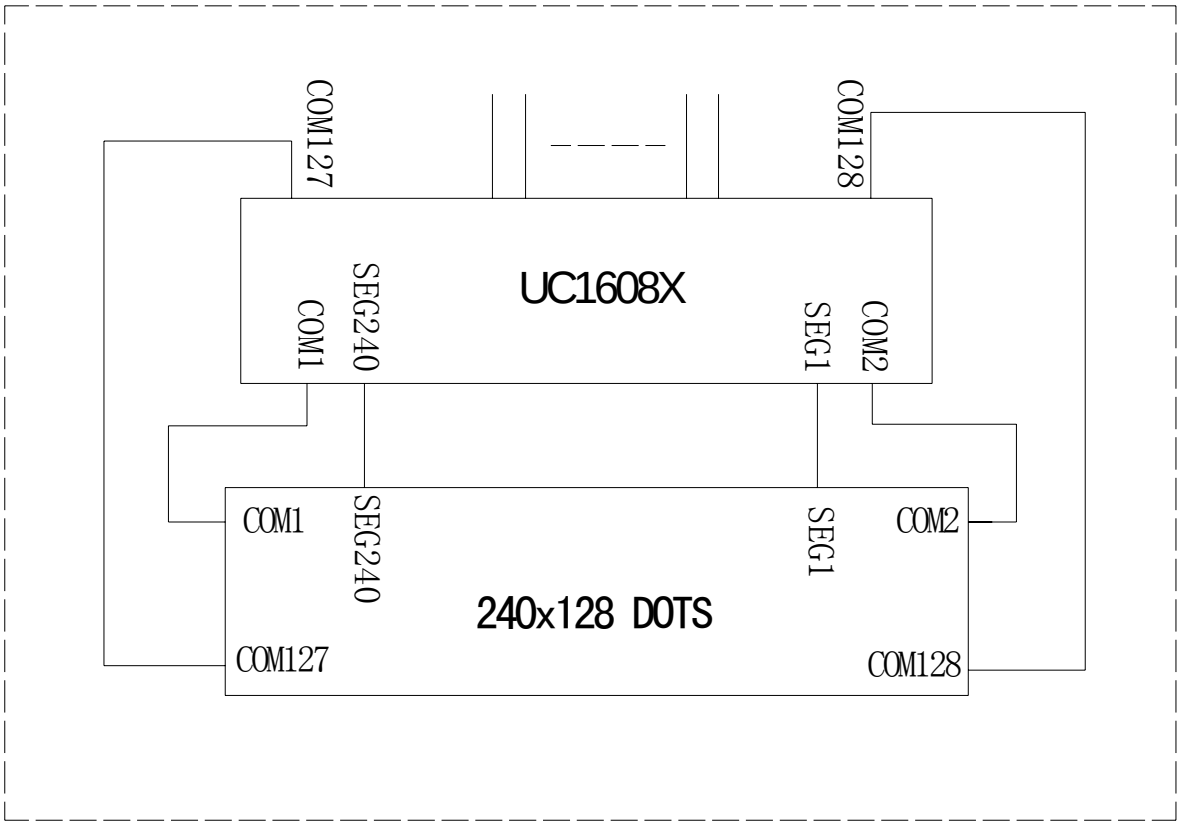


Figure 1.Block diagram

4. DIMENSIONAL OUTLINE

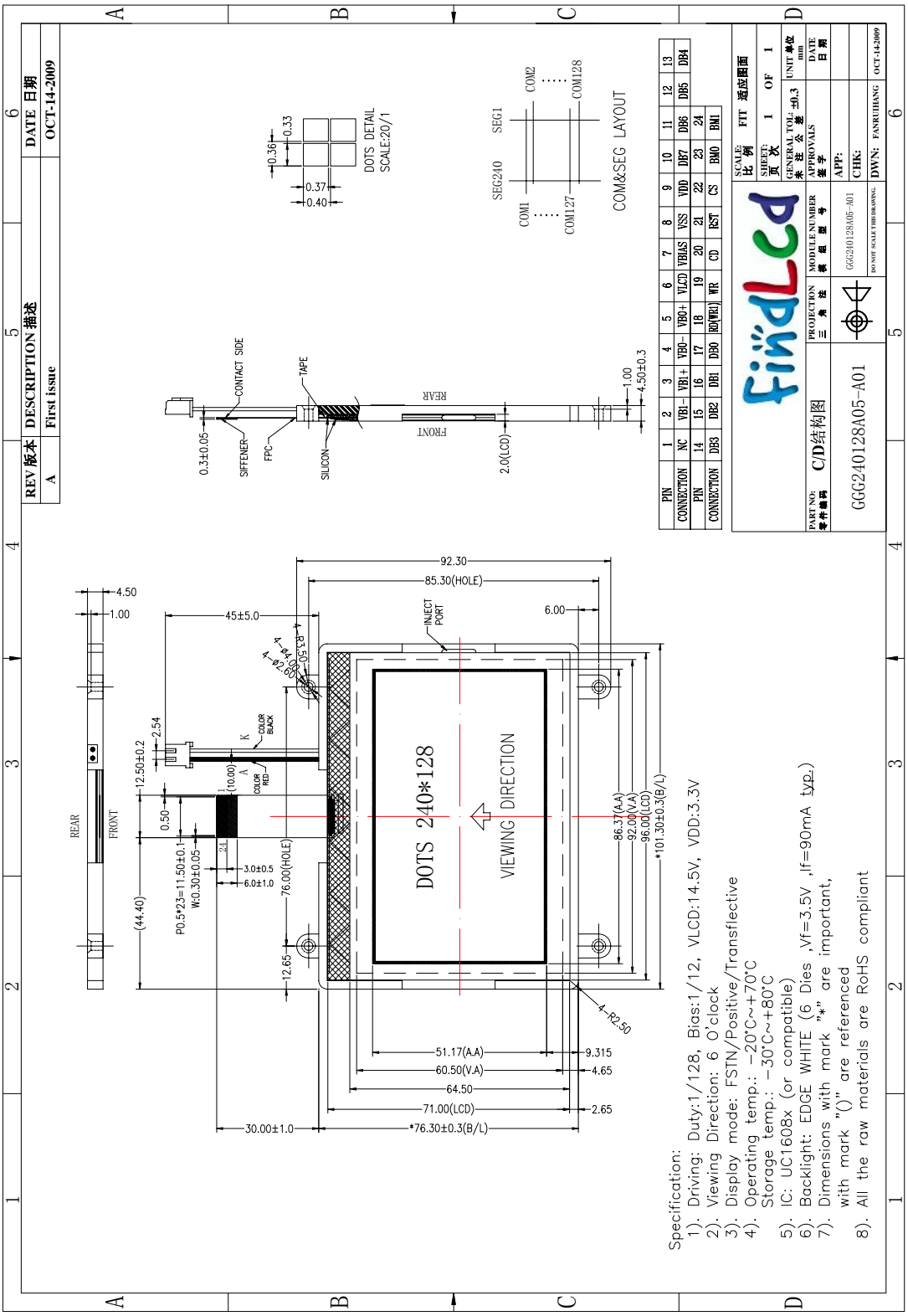


Figure2. Dimensional outline

5. LCD DRIVING VOLTAGE GENERATOR AND BIAS REFERENCE CIRCUIT

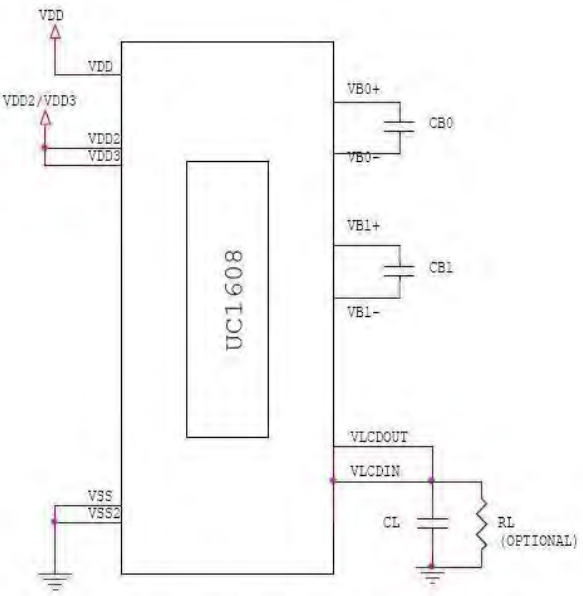


FIGURE 1: Reference circuit using internal Hi-V generator circuit

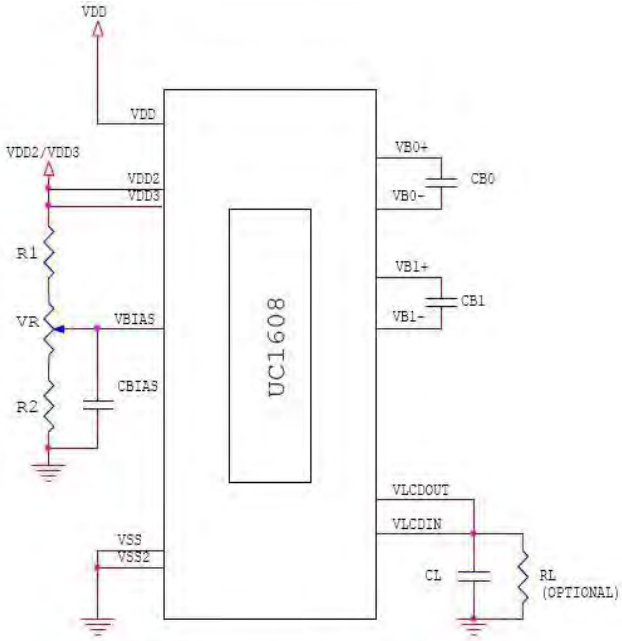


Figure 2: Reference circuit using external Bias source

NOTE: Recommended component values.
CB: 150~250xLCD load capacitance or 4.7 uF (2V). whichever is higher.
CL: 50Nf~0.1uF(25V)is appropriate for most applications..
Rl: 10MΩ Acts as a draining circuit when the power is abnormally shut down.
VR: 1MΩ.
R1,R2: See instructions below.
CBIAS: 10nF~0.1Nf.

- The above component values are for reference only. Please optimize the values for individual requirements of each specific application.
- To ensure consistency of LCM contrast. VLCD fine tuning is highly recommended.

Since the value of R1/R2 depends strongly on the GN,PM,BR settings, and vary slightly depends on the value of VDD2,each LCM design will need to be optimized individually.
The following is the recommended procedures for selecting R1, R2 and VR values.

Step 1: adjust LCM for best contrast which CBIAS. But without R1, R2, VR.
Step 2: measure VBIAS voltage.
Step 3: select VR and R2 (recommend to start with VR=1MΩ, R2=200K)
Step 4: calculate R1 by: R1 = R2 x (VDD2/VBIAS-1)
Step 5: install R1, R2, VR . The “neutral position” of VR is at VBIAS/VDD2 .
Step 6: Test the fine tuning range by adjusting VR over the full range.
Step7 : if adjustment fang is too narrow, reduce R2,… and vise versa.
Step 8: repeat from Sept 4.

6. PIN DESCRIPTION

<table>
<tr><th>No.</th><th>Symbol</th><th>Function</th></tr>
<tr><td>1</td><td>NC</td><td>No connection</td></tr>
<tr><td>2~5</td><td>VB1-,VB1+
VB0-,VB0+</td><td>LCD Bias voltage. These are the voltage source to provide SEG driving currents. These voltages are generated internally. Connect capacitors of CBX between VBX- and VBX+</td></tr>
<tr><td>6</td><td>VLCD</td><td>Main LCD power supply, capacitor CL should be connected between VLCD and VSS.</td></tr>
<tr><td>7</td><td>VBIAS</td><td>This is the reference voltage to generate the actual SEG driving voltage.</td></tr>
<tr><td>8</td><td>VSS</td><td>Power GND.</td></tr>
<tr><td>9</td><td>VDD</td><td>Power Supply (+3.3V).</td></tr>
<tr><td>10~17</td><td>DB7~DB0</td><td>Bi-directional bus for both serial and parallel host interfaces.
<table>
<tr><th></th><th>BM=1X</th><th>BM=0X</th><th>BM=01</th><th>BM=00</th></tr>
<tr><td>D0</td><td>D0</td><td>D0/D4</td><td>SCK</td><td>SCK</td></tr>
<tr><td>D1</td><td>D1</td><td>D1/D5</td><td>-</td><td>-</td></tr>
<tr><td>D2</td><td>D2</td><td>D2/D6</td><td>-</td><td>-</td></tr>
<tr><td>D3</td><td>D3</td><td>D3/D7</td><td>SDA</td><td>SDA</td></tr>
<tr><td>D4</td><td>D4</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>D5</td><td>D5</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>D6</td><td>D6</td><td>-</td><td>S9</td><td>S8/s8uc</td></tr>
<tr><td>D7</td><td>D7</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td colspan="5">Connect the unused pins to VDD OR VSS</td></tr>
</table></td></tr>
<tr><td>18</td><td>RD(WR1)</td><td rowspan="2">These terminals controls the read/write operation of host interface.
<table>
<tr><th></th><th>8080</th><th>6800</th><th>Serial</th></tr>
<tr><td>WR</td><td>/RW</td><td>R/W</td><td>0</td></tr>
<tr><td>RD(WR1)</td><td>/RD</td><td>EN</td><td>0</td></tr>
</table></td></tr>
<tr><td>19</td><td>WR</td></tr>
<tr><td>20</td><td>CD</td><td>Select control data or display data for read/write operation. In S9 mode, CD pin is no used, connect CD to VSS when not use, “L”: control data; “H”: display data</td></tr>
<tr><td>21</td><td>RST</td><td>Reset signal.</td></tr>
<tr><td>22</td><td>CS</td><td>Chip select signal</td></tr>
<tr><td>23</td><td>BM0</td><td rowspan="2">The interface bus mode is determined by MB[1:0] and D[7:6] by the following relationship.
<table>
<tr><th>BM[1:0]</th><th>D[7:6]</th><th>MODE</th></tr>
<tr><td>11</td><td>Data</td><td>6800/8bit</td></tr>
<tr><td>10</td><td>Data</td><td>8080/8bit</td></tr>
<tr><td>01</td><td>0x</td><td>6800/4bit</td></tr>
<tr><td>00</td><td>0x</td><td>8080/4bit</td></tr>
<tr><td>01</td><td>10</td><td>3-wire SPI w/9-bit token.(s9:conventional)</td></tr>
<tr><td>00</td><td>10</td><td>4-wire SPI w/8-bit token.(s8:conventional)</td></tr>
</table></td></tr>
<tr><td>24</td><td>BM1</td></tr>
</table>

		00	11	3-or 4-wire SPI w/8-bit token.(s8ul)	

7. MAXIMUM ABSOUTE LIMIT

(Voltage Reference to VSS)(for IC)

Symbol	Parameter	Min.	Max.	Unit
V_{DD}	Logic Supply voltage	-0.3	+4.0	V
V_{DD2}	LCD Generator Supply voltage	-0.3	+4.0	V
V_{DD3}	Analog Circuit Supply voltage	-0.3	+4.0	V
$V_{DD2/3}$-V_{DD}	Voltage difference between V_{DD} and $V_{DD2/3}$	--	1.6	V
V_{LCD}	LCD Generated voltage (-30°C ~ +80°C)	-0.3	+17.0	V
V_{IN}	Any input voltage	-0.4	V_{DD} + 0.5	V
T_{OPR}	Operating temperature range	-30	+85	°C
T_{STR}	Storage temperature	-55	+125	°C

Note:

1. V_{DD} is based on V_{SS} = 0V
2. Stress values listed above may cause permanent damages to the device.

8. ELECTRICAL CHARACTERISTICS

DC CHARACTERISTICS

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{DD}	Supply for digital circuit		2.7	2.8~3.3	3.6	V
$V_{DD2/3}$	Supply for bias & pump		2.7	2.8~3.3	3.6	V
V_{LCD}	Charge pump output	$V_{DD2/3} \geq 2.7V$, 25°C		12.5	16	V
V_D	LCD data voltage	$V_{DD2/3} \geq 2.7V$, 25°C			1.53	V
V_{IL}	Input logic LOW				$0.2V_{DD}$	V
V_{IH}	Input logic HIGH		$0.8V_{DD}$			V
V_{OL}	Output logic LOW				$0.2V_{DD}$	V
V_{OH}	Output logic HIGH		$0.8V_{DD}$			V
I_{IL}	Input leakage current				1.5	µA
C_{IN}	Input capacitance			5	10	PF
C_{OUT}	Output capacitance			5	10	PF
$R_{0(SEG)}$	SEG output impedance	V_{LCD} = 12.5V		1.5	3	k Ω
$R_{0(COM)}$	COM output impedance	V_{LCD} = 9		1.5	3	k Ω
f_{LINE}	Average frame rate		69	75	--	Hz

POWER CONSUMPTION

V_{DD} = 2.7V, $V_{DD2/3}$ = 2.7V, Bias Ratio (BR) = 10b, GN = 11b, PM = 000000b,
Panel Loading (PL): 26~43nF, MR = 128, Bus mode = 6800, C_L = 0.1µF, C_B = 4.7µF.
All outputs are open circuit.

Display Pattern	Conditions	Typ. (µA)	Max. (µA)
All-OFF	Bus = idle	580	870
2-pixel checker	Bus = idle	730	1095
--	Bus = idle (standby current)	--	5

9. TIMING CHARACTERISTICS

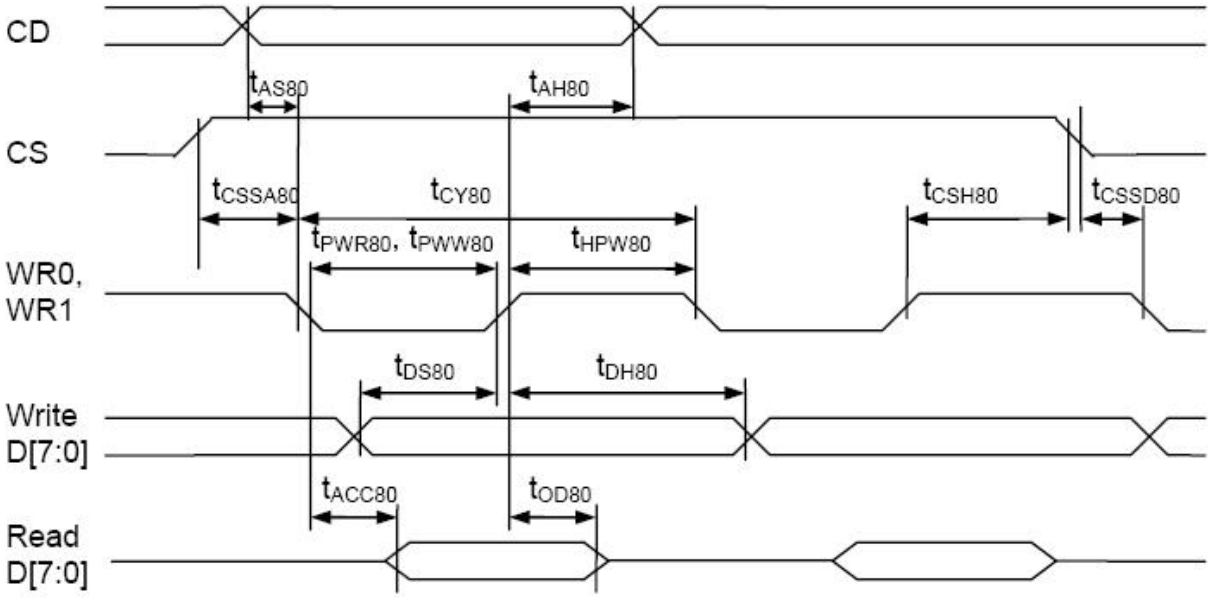


FIGURE 15: Parallel Bus Timing Characteristics (for 8080 MCU)

($2.7V \leq V_{DD} < 3.6V$, Ta= –30 to +85°C)

Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{AS80} t_{AH80}	CD	Address setup time Address hold time		0 20	–	nS
t_{CY80}		System cycle time 8-bit bus (read) 8-bit bus (write) 4-bit bus (read) 4-bit bus (write)		 140 140 140 140	–	nS
t_{PWR80}	WR1	Pulse width 8-bit bus (read) 4-bit bus (read)		 65 65	–	nS
t_{PWW80}	WR0	Pulse width 8-bit bus (write) 4-bit bus (write)		 35 35	–	nS
t_{HPW80}	WR0, WR1	High pulse width 8-bit bus (read) (write) 4-bit bus (read) (write)		 65 35 65 35	–	nS
t_{DS80} t_{DH80}	D0~D7	Data setup time Data hold time		30 20	–	nS
t_{ACC80} t_{OD80}		Read access time Output disable time	C_L = 100pF	– 12	60 20	nS
t_{SSA80} t_{CSSD80} t_{CSH80}	CS1/CS0	Chip select setup time		10 10 20		nS

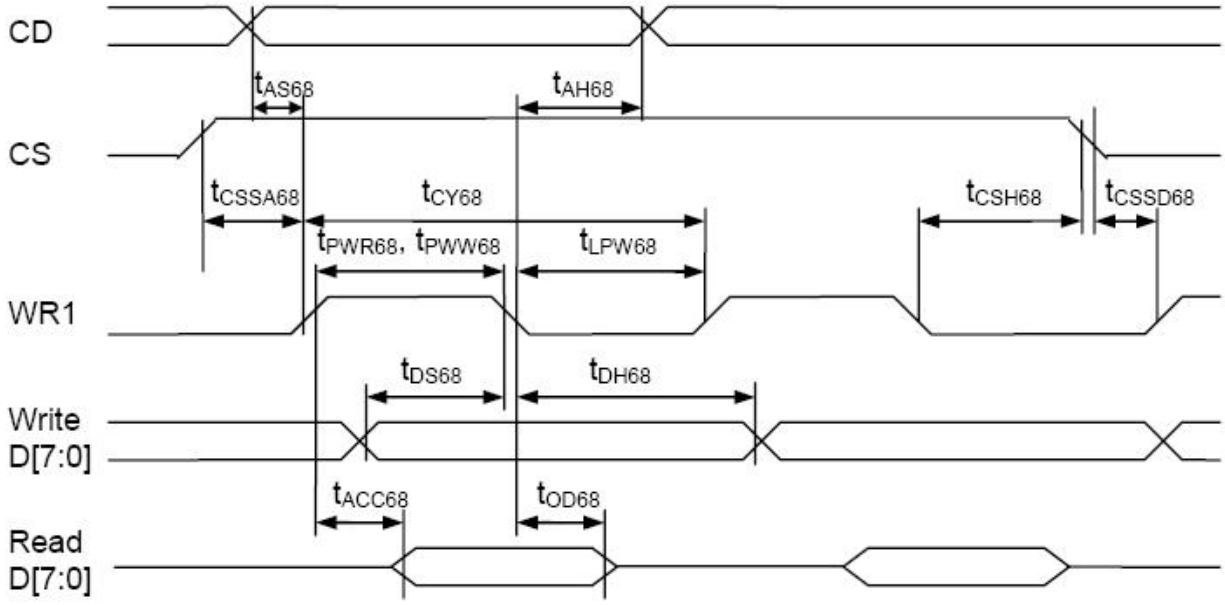


FIGURE 16: Parallel Bus Timing Characteristics (for 6800 MCU)

($2.7V \leqslant V_{DD} < 3.6V$, Ta= –30 to +85°C)

Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{AS68} t_{AH68}	CD	Address setup time Address hold time		0 20	–	nS
T_{CY68}		System cycle time 8-bit bus (read) 8-bit bus (write) 4-bit bus (read) 4-bit bus (write)		 140 140 140 140	–	nS
t_{PWR68}	WR1	Pulse width 8-bit bus (read) 4-bit bus (read)		 65 65	–	nS
t_{PWW68}	WR0	Pulse width 8-bit bus (write) 4-bit bus (write)		 35 35	–	nS
t_{LPW68}	WR0, WR1	Low pulse width 8-bit bus (read) 8-bit bus (write) 4-bit bus (read) 4-bit bus (write)		 65 35 65 35	–	nS
t_{DS68} t_{DH68}	D0~D7	Data setup time Data hold time		30 20	–	nS
t_{ACC68} t_{OD68}		Read access time Output disable time	C_L = 100pF	– 12	60 20	nS
t_{CSSA68} t_{CSSD68} t_{CSH68}	CS1/CS0	Chip select setup time		10 10 20		nS

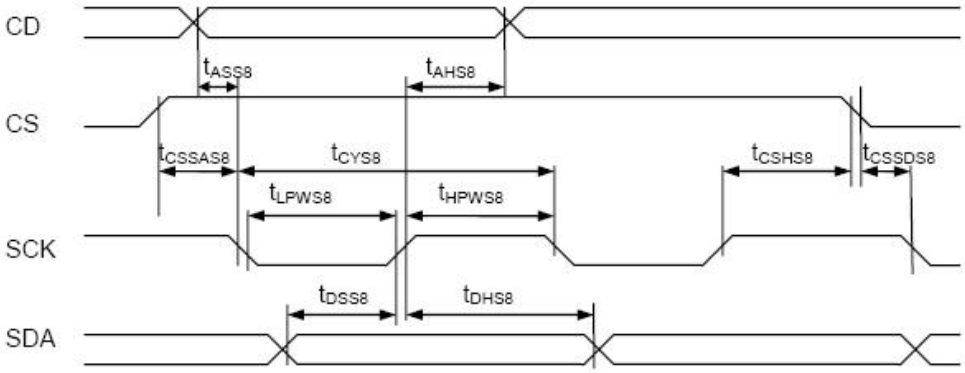


FIGURE 17: Serial Bus Timing Characteristics (for S8 / S8uc)

(2.7V ≤ V_{DD} < 3.6V, Ta= –30 to +85°C)

Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{ASS8}	CD	Address setup time		0	–	nS
t_{AHS8}		Address hold time		20	–	nS
t_{CYS8}	SCK	System cycle time		140	–	nS
t_{LPWS8}		Low pulse width		65	–	nS
t_{HPWS8}		High pulse width		65	–	nS
t_{DSS8} t_{DHS8}	SDA	Data setup time Data hold time		30 20	–	nS
t_{CSSAS8} t_{CSSDS8} t_{CSHS8}	CS	Chip select setup time		10 20 10		nS

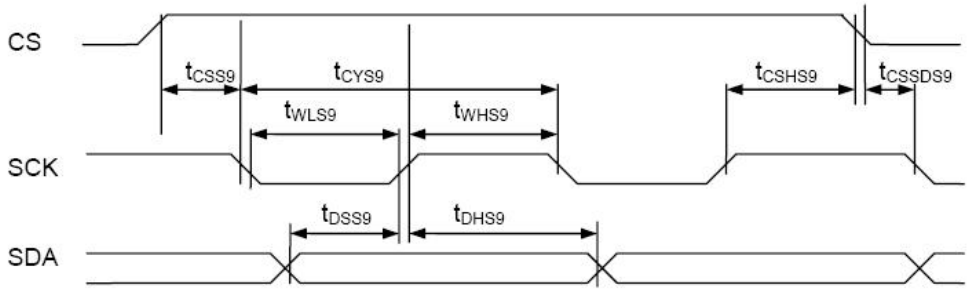


FIGURE 18: Serial Bus Timing Characteristics (for S9)

(2.7V ≤ V_{DD} < 3.6V, Ta= –30 to +85°C)

Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{CYS9}	SCK	System cycle time		140	–	nS
t_{LPWS9}		Low pulse width		65	–	nS
t_{HPWS9}		High pulse width		65	–	nS
t_{DSS9} t_{DHS9}	SDA	Data setup time Data hold time		30 20	–	nS
t_{CSSAS9} t_{CSSDS9} t_{CSHS9}	CS	Chip select setup time		10 20 10		nS

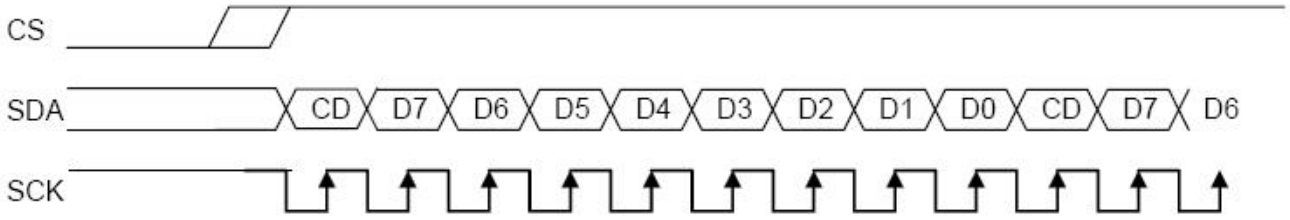


FIGURE 4.C: 3-wire Serial Interface (S9)

RESET TIMING

Reset Characteristics

(2.7V ≤ V_{DD} < 3.6V, Ta= –30 to +85°C)

Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{RW}	RST	Reset low pulse width		1000	–	nS

10. CONTROL AND DISPLAY INSTRUCTION

\# Useful Data bits
– Don't Care

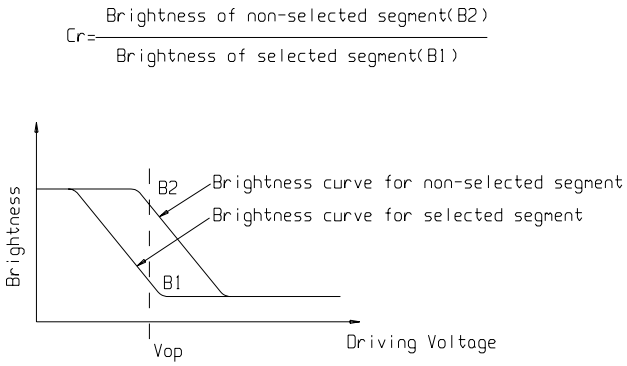
	Command	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0	Action	Default
1	Write Data Byte	1	0	#	#	#	#	#	#	#	#	Write 1 byte	N/A
2	Read Data Byte	1	1	#	#	#	#	#	#	#	#	Read 1 byte	N/A
3	Get Status	0	1	BZ	MX	DE	RS	WA	GN1	GN0	1	Get Status	N/A
4	Set Column Address LSB	0	0	0	0	0	0	#	#	#	#	Set CA[3:0]	0
	Set Column Address MSB	0	0	0	0	0	1	#	#	#	#	Set CA[7:4]	0
5	Set Mux Rate and temperature compensation.	0	0	0	0	1	0	0	#	#	#	Set {MR, TC[1:0]}	MR: 1b TC: 00b
6	Set Power Control	0	0	0	0	1	0	1	#	#	#	Set PC[2:0]	101b
7	Set Adv. Program Control. (double byte command)	0	0	0	0	1	1	0	0	0	R	For UltraChip only. Do not use.	N/A
		0	0	#	#	#	#	#	#	#	#		
8	Set Start Line	0	0	0	1	#	#	#	#	#	#	Set SL[5:0]	0
9	Set Gain and Potentiometer (double-byte command)	0 0	0 0	1 #	0 #	0 #	0 #	0 #	0 #	0 #	1 #	Set {GN[1:0], PM[5:0]}	GN=3 PM=0
10	Set RAM Address Control	0	0	1	0	0	0	1	#	#	#	Set AC[2:0]	001b
11	Set All-Pixel-ON	0	0	1	0	1	0	0	1	0	#	Set DC[1]	0=disable
12	Set Inverse Display	0	0	1	0	1	0	0	1	1	#	Set DC[0]	0=disable
13	Set Display Enable	0	0	1	0	1	0	1	1	1	#	Set DC[2]	0=disable
14	Set Fixed Lines	0	0	1	0	0	1	#	#	#	#	Set FL[3:0]	0
15	Set Page Address	0	0	1	0	1	1	#	#	#	#	Set PA[3:0]	0
16	Set LCD Mapping Control	0	0	1	1	0	0	#	#	#	#	Set LC[3:0]	0
17	System Reset	0	0	1	1	1	0	0	0	1	0	System Reset	N/A
18	NOP	0	0	1	1	1	0	0	0	1	1	No operation	N/A
19	Set LCD Bias Ratio	0	0	1	1	1	0	1	0	#	#	Set BR[1:0]	10b=12
20	Reset Cursor Mode	0	0	1	1	1	0	1	1	1	0	AC[3]=0, CA=CR	N/A
21	Set Cursor Mode	0	0	1	1	1	0	1	1	1	1	AC[3]=1, CR=CA	N/A
22	Set Test Control (double byte command)	0	0	1	1	1	0	0	1	TT		For UltraChip only. Do not use.	N/A
		0	0	#	#	#	#	#	#	#	#		

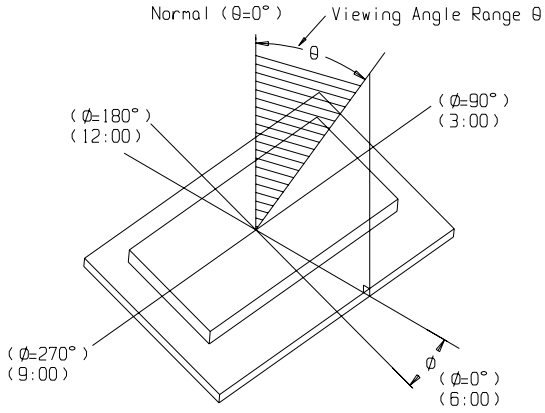
* Other than commands listed above, all other bit patterns may result in undefined behavior.

11. ELECTRO-OPTICAL CHARACTERISTICS

(V_{DD} = 3.3V, Ta = 25°C)

Item	Symbol	Condition	Min	Typ	Max	Unit
Operating Voltage for LCD	Vop	Ta =-20°C	14.7	15.0	15.3	V
		Ta = 25°C	14.2	14.5	14.8	
		Ta = 70°C	13.7	14.0	14.3	
Response time	Tr	Ta = 25°C	---	250	500	ms
	Tf		---	300	600	ms
Contrast	Cr	Ta = 25°C	2	10	---	---
Viewing angle range	θ	Cr≧2	-35	---	+35	deg
	Φ		-35	---	+40	deg





12. BACK LIGHT CHARACTERISTICS

LCD Module with Edge white LED Backlight

ELECTRICAL RATINGS. Ta = 25°C

Item	Symbol	Condition	Min	Typ	Max	Unit
Forward Curret	IF	VF=3.5V	---	90	110	mA
Reverse Current	IR	VR=0.8V	---	30	---	mA
Luminous Intensity(Without LCD)	Lv	VF=3.5V	300	380	---	cd/m2
Color coordinates(without LCD)	X Y	VF=3.5V	0.27 0.26	---	0.31 0.30	
Color	white					

Note:

During high temperature operation, please refer to the LED spec(current vs temperature) to decide the current of single LED.

13. PRECAUTION FOR USING LCD/LCM

After reliability test, recovery time should be 24 hours minimum. Moreover, functions, performance and appearance shall be free from remarkable deterioration within 50,000 hours(average) under ordinary operating and storage conditions room temperature (20±8°C), normal humidity (below 65% RH), and in the area not exposed to direct sun light. Using LCM beyond these conditions will shorten the life time.

Precaution for using LCD/LCM

LCD/LCM is assembled and adjusted with a high degree of precision. Do not attempt to make any alteration or modification. The followings should be noted.

General Precautions:

1. LCD panel is made of glass. Avoid excessive mechanical shock or applying strong pressure onto the surface of display area.
2. The polarizer used on the display surface is easily scratched and damaged. Extreme care should be taken when handling. To clean dust or dirt off the display surface, wipe gently with cotton, or other soft material soaked with isoproply alcohol, ethyl alcohol or trichlorotriflorothane, do not use water, ketone or aromatics and never scrub hard.
3. Do not tamper in any way with the tabs on the metal frame.
4. Do not made any modification on the PCB without consulting Gemini.
5. 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.
6. Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels and also cause rainbow on the display.
7. Be careful not to touch or swallow liquid crystal that might leak from a damaged cell. Any liquid crystal adheres to skin or clothes, wash it off immediately with soap and water.

Static Electricity Precautions:

1. CMOS-LSI is used for the module circuit; therefore operators should be grounded whenever he/she comes into contact with the module.
2. Do not 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.
3. Do not touch the connection terminals of the display with bare hand; it will cause disconnection or defective insulation of terminals.
4. The modules should be kept in anti-static bags or other containers resistant to static for storage.

5. Only properly grounded soldering irons should be used.
6. If an electric screwdriver is used, it should be grounded and shielded to prevent sparks.
7. The normal static prevention measures should be observed for work clothes and working benches.
8. Since dry air is inductive to static, a relative humidity of 50-60% is recommended.

Soldering Precautions:

1. Soldering should be performed only on the I/O terminals.
2. Use soldering irons with proper grounding and no leakage.
3. Soldering temperature: 350°C±10°C
4. Soldering time: 3 to 4 second.
5. Use eutectic solder with resin flux filling.
6. If flux is used, the LCD surface should be protected to avoid spattering flux.
7. Flux residue should be removed.

Operation Precautions:

1. The viewing angle can be adjusted by varying the LCD driving voltage Vo.
2. Since applied DC voltage causes electro-chemical reactions, which deteriorate the display, the applied pulse waveform should be a symmetric waveform such that no DC component remains. Be sure to use the specified operating voltage.
3. Driving voltage should be kept within specified range; excess voltage will shorten display life.
4. Response time increases with decrease in temperature.
5. Display color may be affected at temperatures above its operational range.
6. Keep the temperature within the specified range usage and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel-off or generate bubbles.
7. For long-term storage over 40°C is required, the relative humidity should be kept below 60%, and avoid direct sunlight.

Limited Warranty

Gemini LCDs and modules are not consumer products, but may be incorporated by Gemini's customers into consumer products or components thereof, Gemini does not warrant that its LCDs and components are fit for any such particular purpose.

1. The liability of Gemini is limited to repair or replacement on the terms set forth below. Gemini will not be responsible for any subsequent or consequential events or injury or damage to any personnel or user including third party personnel and/or user. Unless otherwise agreed in writing between Gemini and the customer, Gemini will only replace or repair any of its LCD which is found defective electrically or visually when inspected in accordance with Gemini general LCD inspection standard . (Copies available on request)
2. No warranty can be granted if any of the precautions state in handling liquid crystal display above has been disregarded. Broken glass, scratches on polarizer mechanical damages as well as defects that are caused accelerated environment tests are excluded from warranty.
3. In returning the LCD/LCM, they must be properly packaged; there should be detailed description of the failures or defect.

14. LCM TEST CRITERIA

1. Objective

The criteria is applied for consolidating the LCM quality standard between Gemini and customer in finished products acceptance inspection and shipment, to guarantee the products quality to meet with customer's demand.

2. Scope

2.1 This criteria is applicable to all the LCM products produced by Gemini.

3. Inspection equipment

Function Tester、Vernier Calipers、Microscope、Magnifier、ESD Wrist Strap、Finger Cover、Labels、 High-Low Temperature Oven、 Refrigerator、Constant Voltage Power Supply（DC），Desk Lamp, etc.

4. Sampling Plan and Reference Standard

4.1.1 According to GB/T 2828.1---2003/ISO2859-1:1999，single sampling under normal inspection, general inspection level II.

Item of Inspection	Times of Sampling	AQL Judgment
Cosmetic	II Single Sampling	MA=0.4 MI=1.5
Mechanical	N=3	C=0
Functional	II Single Sampling	MA=0.4 MI=1.5

4.1.2 GB/T 2828.1---2003/ISO2859-1:1999 Counting and sampling procedures and sampling table for Batch-to-Batch Inspection.

4.1.3 GB/T 1619.96 Test method for TN LCD.

4.1.4 GB/T 12848.91 General Specification for STN LCD.

4.1.5 GB2421-89 Basic Environmental Test Procedures for Electrical and Electronic Products

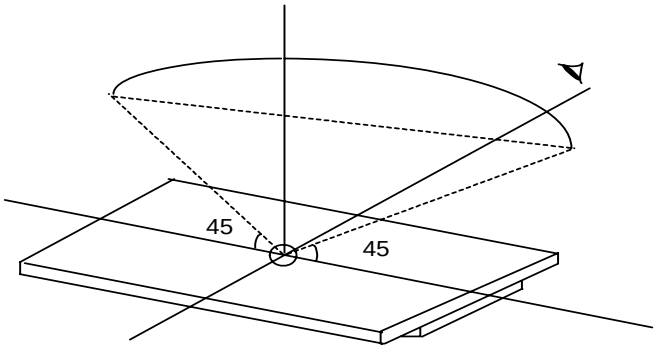
4.1.6 IPC-A-610C Acceptance Condition for Electrical Assemblies.

5. Inspection Condition and Inspection Reference

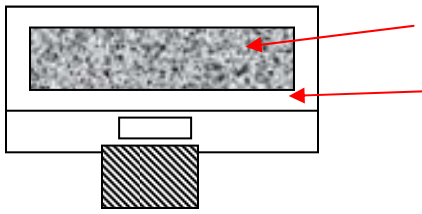
5.1 The ambient temperature and humidity are 25±5℃ and 45±20%RH respectively, and the ambient luminance should be more than 300cd/cm^2. The distance between inspector's eyes and the LCD panel should be 30cm away. Normally we inspect products with reflected light, when we inspect the LCD produces with backlight turned on, the ambient luminance should be less than 100cd/cm^2.

5.2 The LCD should be test with 45° both left and right side, 0-45° both upside

and downside （if for STN product, -20-55° is needed）.



5.3 Definition of VA



VA：effective viewing area

Non-VA：Ineffective viewing area

5.4 Inspection with viewed eyes（not including defect size measure by magnifiers）.

5.5 Electrical property

Inspect with the test jig to meet with the requirement indicated in the approved documents, including the pattern design and the display performance.

5.5.1 Testing voltage（V）

5.5.1.1 According to the inspection of test jig and production specification the test voltage setting is Vop±0.3V when the Vop is under 9.0V, and Vop ±3%Vop when the Vop is above 9.0V.

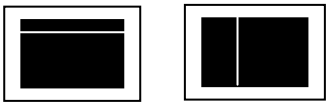
5.5.1.2 As per the product with the fixed voltage the test voltage setting is same as Vop and keeps the constant voltage through the internal circuit. And the limited sample on the voltage range is needed if necessary.

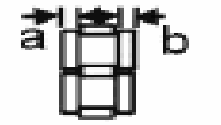
5.5.2 Current Consumption（I）： refer to product document and approval drawing to confirm it.

6. Inspection Item and Acceptance Standard

6.1 Outer dimension：For the outer dimension and the sizes which could influence the assembly at the customer's side, it should be in accordance to the approval drawing, and it belongs to the major defect.

6.2 Functional Test:

No.	Item	Description	MAJ	MIN	Accept standard
6.2.1	Missing Segment	Any missing segment caused by an open circuit; Any missing COM, pattern, dot or segment caused by an open circuit or poor crossover contact 	√		Rejected
6.2.3	No display/no action	No segment is displayed when the product is connected correctly.	√		Rejected
6.2.4	Display error/abnormal	The display pattern and display order is not as required under the normal scanning procedure.	√		Rejected
6.2.5	Viewing angle wrong	The direction with the best display of patterns should be as customer required (or refer to the approval samples)	√		Rejected
6.2.6	Display dim/dark	The contrast of LCD is too dark or too dim under normal operation	√		Beyond the voltage tolerance, Rejected
6.2.7	Slow response	Response of some segments is different with others when turned on or off the LCD	√		Rejected
6.2.8	Extra segment	Display of wiring, or extra pattern, caused by wrong alignment or insufficient corrosion..		√	refer to spot/line standard
6.2.9	Dim segment	Under the normal voltage, the contrast of segment are uneven		√	Reject or refer to samples
6.2.10	PI black/white spot	Partial black and white spot are visible while changing display content due to the PI layer defective		√	refer to the spot/line criteria for the visible spots when display image stopped, others O
6.2.11	pinhole/white spot	The phenomena of missing patterns when turned on caused by missing of ITO fragment.  d = (X+Y)/2		√	refer to spot/line standard

6.2.12	Pattern distortion	Width of pattern displayed is wider , narrower or deformed from the specifications caused by wrong alignment, i.e. extra heave or missing: |Ia-Ib|≤ 1/4W(W is the normal width) 		√	Acceptable |Ia-Ib|>1/4W, rejected
6.2.13	High current	the current is bigger than regulated value.		√	Rejected

6.3 LCD Visual Defect

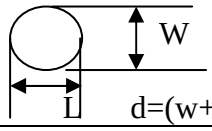
6.3.1 Dot defect(defined within VA, out of VA spots not accounted)

Defect item	Average diameter（d）	Accept numbers	MAJ	MIN
Spot defect （black spot, foreign material, nick, scratches, LC defect）	d≤0.2	3		√
	0.2<d≤0.25	2		
	0.25<d≤0.30	1		

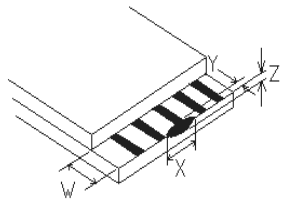
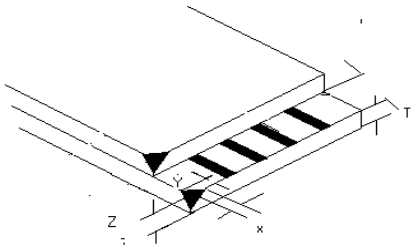
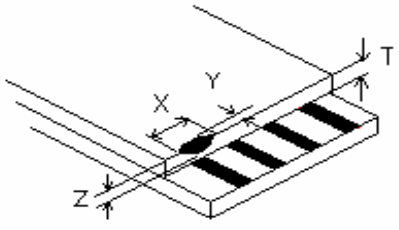
6.3.2 Line defect(defined within VA, out of VA spots not accounted)

Defective item	length(L)	width(W)	Accept numbers	MAJ	MIN
line defect (scratch, liner foreign material) 	≤5.0	≤0.02	3		√
	≤3.0	≤0.03	3		
	≤3.0	≤0.05	1		
note： 1. If the width is bigger than 0.1mm, it can be treated as spot defect.					

6.3.3 Polarizer Air Bubble (defined within VA, out of VA spots not accounted)

Defective item	Average diameter（d）	Accept numbers	MAJ	MIN
polarizer Air Bubble、Concave-Convex Dot  d=(w+l)/2	d≤0.3	3		√
	0.3<d≤0.5	2		
	0.5<d≤0.8	1		

6.3.4 Damaged(For the products with LCD edge expose to outside without mental frame, including products in COG, with H/S or assembled with backlight)

No.	Item	Acceptance Standard		MAJ	MIN
6.3.4.1	Chip on lead 		（mm）		√
		X	≤1/8L		
		Y	≤1/3W		
		Z	≤1/2t		
		Accept number	2		
		When Y≤0.2mm, neglect the length of X, chip on the side without lead, and not perforated, when X≤1/10L，Y≤1/2W max, accept.			
6.3.4.2	chip on corner(ITO lead) 		（mm）	MAJ	MIN
		X	Not enter into frame epoxy and touch the lead		√
		Y			
		Z	≤t		
		Accept numbers	2		
		Chips on corner refer to 6.3.4.3 and must be out of the frame epoxy. If chips on lead, refer to 6.3.4.1			
6.3.4.3	Chip on sealed area (outer chip) 		（mm）	MAJ	MIN
		X	≤1/8 L		√
		Y	≤1/2H		
		z	≤ 1/2t		
		Accept numbers	2		
		The standard for inner chip on sealed area is same as the standard for outer. If chip on the opposite side of ITO lead, the value Y refer to 6.3.4.1 for the chip on the side without lead.			
note: t---glass thickness, L---length, H---The distance between the LCD edge to the inner of LCD frame epoxy. W—The width of ITO lead					

6.3.5 Others

No.	Item	Description	MAJ	MIN	Accept standard
6.3.5.1	Newton/ B/G color uniformity	There exists more than one color on one product or same batch.		√	Reject or refer to limited sample

	not good				
6.3.5.2	Leakage(LC)	/	√		Rejected
6.3.5.3	No protective film	/		√	Rejected

6.4 Backlight components

No.	Item	Description	MAJ	MIN	Accept standard
6.4.1	Backlight not work, wrong color	/	√		Rejected
6.4.2	Color deviation	Turn backlight, the color differ from the sample, do not match the drawing after testing		√	Refer to sample and drawing
6.4.3	Brightness deviation	Turn on backlight, the brightness is differ from the sample, or do not match the drawing after testing, or over±30% compare with sample if drawing not specified.		√	Refer to sample and drawing
6.4.4	Uneven brightness	Turn on the backlight, the brightness is uneven on the same LED and beyond the specification of drawing.		√	Refer to sample and drawing
6.4.5	Spot/line scratch	There is stain, scratches on backlight when turn on.		√	Refer to 6.3.1/6.3.2

6.5 Mental frame

No.	Item	Description	MAJ	MIN	Accept standard
6.5.1	material/surface	Mental frame/surface approach inconsistent with specification.	√		Rejected
6.5.2	Twist not qualified/without twisting	Twist method/direction wrong, not twist as required	√		Rejected
6.5.3	Oxidized steak, paint stripped, color changed, dented mark, scratches	1.Oxidized steak on the surface of the metal frame;2. front surface paint scratch to substrate, the stripped spot ≤0.8mm and exceed 3 areas;3.line defect in length≤5.0mm and width ≤0.05mm exceed 2 areas, front dent, bubble and side surface have paint stripping to substrate≤1.0mm exceed 3 areas, line defect in width ≤0.05mm exceed 3 areas.		√	Rejected

6.5.4	Burred	Burr is too long, enter into viewing area		√	Rejected

6.6 PCB/COB

No.	Item	Description	MAJ	MIN	Accept standard
6.6.1	Epoxy Cover Improper	1. The Pad within the round white mark is exposed to outside. 2. The height of epoxy covers beyond document /drawing specification. 3. The epoxy should be covered within the white round mark and the maximum overage is 2mm more than the radius of white mark. 4. Clear liner mark on COB surface or pinhole that it is possible to penetrate through the epoxy to chip. 5. The pinhole diameter over 0.25mm or other material on COB surface.		√	Rejected
6.6.2	PCB cosmetic defect	1. PCB pad surface can not be oxidized or contaminated. 2. PCB can not appear bubbles after through the reflow oven. 3. Copper lead due to the PCB green oil drop or scratches. If repaired by adding the green oil, circuit diameter Φ can not over 1.3mm, other diameter Φ can not over 2.6mm, total less than 10 areas. Otherwise reject.		√	Rejected
6.6.3	Components error	1. PCB components inconsistent with drawing. Wrong components, more or less pa, polar reverse（The bias circuit of LCD voltage or BL limit current value adjustment is not controlled if not special specified.） 2. The JUMP short of PCB should be consistent of the mechanical drawing. 3. The components is specially required by the customers and specified in mechanical drawing / technical documents, the components specification should be conformed to technique demand. Otherwise rejected	√		Rejected

6.7 SMT part (Refer to IPC-A-610C if not specified)

No.	Item	Description	MAJ	MIN	Accept standard
6.7.1	Soldering defect	Cold soldering, false solder, missing solder, tin crack, tin un-dissolved happened with soldering.		√	Rejected
6.7.2	Solder ball/splash	Solder ball/tin dross drop lead to solder short.		√	Rejected
6.7.3	DIP parts	DIP parts, keypad, connection appear floating and tilted.		√	Rejected
6.7.4	Spot weld shape	The spot weld should be inner dent, can not form to cover solder or less solder or icicle, otherwise reject		√	Rejected
6.7.5	Component foot exposed	For the DIP type components, after soldered, 0.5~2mm component foot must be remained, and should not damage the solder surface nor fully covered the component foot. Otherwise rejected.		√	Rejected
6.7.6	Appearance poor	After soldering, the solder residues appear brown or black. PCB solder spot remained white mist residues after clean.		√	Rejected

6.8 Heating pressure part (including H/S， FPC, etc.）

No.	Item	Description	MAJ	MIN	Accept standard
6.8.1	Out of specification		√		Rejected
6.8.2	Size/position	The size of heating material should be within the specification of the drawing, the contact area of conducted material should be attached more than 1/2 of the body (ITO, PDA, etc)		√	Acceptable
6.8.3	Heat pressure dirty	The obstacle existed in non-conductive heating area and not lead to short, or existed in conductive area but the obstacle is less than 50% of pressure area, it is acceptable.		√	Acceptable
6.8.4	Folding defect			√	Refer to limited sample

6.9 Connector and other parts

No.	Item	Description	MAJ	MIN	Accept standard
6.9.1	Specification improper	The specification of connector and other components do not conform to the drawing	√		Rejected

		as required.			
6.9.2	Position and order	Solder position and Pin 1 should be consistent with the drawing.		√	Rejected
6.9.3	Cosmetic	1. The body of outer component and the PIN has flux. 2. The deformation bigger of PIN connector is bigger than 1/2 of PIN width.		√	Rejected

6.10 General cosmetic

No.	Item	Description	MAJ	MIN	Accept standard
6.10.1	Connection material	Copper lead on FPC pad or the pin terminal of H/S, FFC and damaged. FPC,FFC, COF,H/S connected material curved （except for original ）. FPC、PCB pad is bigger than 1PIN width. FPC/FFC material segment, crease exceed the specification.		√	Rejected
6.10.2	Stiffing type defect	Stiffening tape is not covered or fully covered the product's circuit needs to be protected. （Like H/S，FFC，FPC） or cover to the output pin.		√	Rejected
6.10.3	Visual dirty	Dirty on surface of finished products, residual glue, solder spatter or solder ball remain on non-soldered area of PCB/COB. The defective mark or label on product does not remove.		√	Rejected
6.10.4	Assembly black spot	The spot or black dots found after assembly the products with backlight or diffuser.		√	Refer to 6.3.1
6.10.5	Product mark	Part number and batch mark is not conformed with the technical requirement and position, not clear or without mark.		√	Rejected
6.10.6	Inner packing	Packing is inconsistent with requirement，short or over load, Packing is inconsistent with shipment mark/ order demand.		√	Rejected

7. Reality test

Test item	Condition	Time(hrs)	Accept standard
High Temp Storage	80°C	120	No abnormalities in functions and appearance
High Temp Operating	70°C	120	
Low Temp Storage	-30°C	120	
Low Temp Operating	-20°C	120	
Temp& Humidity Test	40°C/90%RH	120	
Temp Shock	-20°C ← 25°C → +70°C (30 min ← 5 min → 30min)	10 cycles	

Note: ①The customer should inform the special requirements on the reliability test to Gemini when starting the project.

②For high/low temperature test under both storage and operating condition, the temperature is referrer to the product specification.

③For temperature test ±5℃ deviation could be accepted.

8. Packing

8.1. Product packing must meet the requirement of packing design. The label should be qualified by QA department and it includes the Item No., specification sheet, quantity and production date. Incomplete or mistake is regarded as not qualified.

8.2. When the safety of the packing exist the problems, including shock resistance, moisture resistance, anti-ESD and press resistance, it is regarded as not qualified.

8.3. When customer has special requirement on packing, which is confirmed and accepted by Gemini, inspect and release the products as customer required.

8.4. For RoHS or non-RoHS products it should be distinguished with obvious label. Currently we adopt the “RoHS” label for all the products meet the RoHS compliance, or using the labels / marks as the customer required.

9. Others

9.1 For unregulated and compromised items, reference shall be taken to mutual agreements and limit samples.