AZ DISPLAYS

SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY

CUSTOMER APPROVAL			
※ **PART NO. :** AQM2412E-FLW-FBH (AZ DISPLAYS) VER1.0			
APPROVAL		**COMPANY CHOP**	
CUSTOMER COMMENTS			

AZ DISPLAYS ENGINEERING APPROVAL		
DESIGN BY	**CHECKED BY**	**APPROVED BY**

REVISION RECORD

REVISION	REVISION DATE	PAGE	CONTENTS
VER1.0	**20/01-2010**		**FIRST ISSUE**

※ CONTENTS

1.0 GENERAL SPECS

1. Display Format	240x128 dots
2. Power Supply	3.3V
3. Overall Module Size	78.0mm(W) x 50.0mm(H) x 6.5mm(D)
4. Viewing Aera(W*H)	60.0mm(W) x 32.0mm(H)
5. Dot Size (W*H)	0.22mm(W) x0.21mm(H)
6. Dot Pitch (W*H)	0.24mm(W) x 0.23mm(H)
7. Viewing Direction	6:00 O'Clock
8. Driving Method	1/128Duty,1/12Bias
9. Controller IC	UC1608xGBE
10. LCD Fluid Options	FSTN/Positive
11. Polarizer Options	Transflective
12. Backlight Options	LED-SIDE（WHITE）
13. Operating temperature	-20ºC ~ 70ºC
14. Storage temperature	-30ºC ~ 80ºC
15. ROHS	ROHS compliant

2.0 ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Min	Typ	Max	Unit
Operating temperature	Top	-25	-	70	ºC
Storage temperature	Tst	-30	-	85	ºC
Input voltage	Vin	Vss		Vdd	V
Supply voltage for logic	Vdd- Vss	-	3.3	-	V
Supply voltage for LCD drive	Vdd- Vo	-	16.5	-	V

3.0 ELECTRICAL CHARACTERISTICS

3.1 Electrical Characteristics Of LCM

Item	Symbol	Condition	Min	Typ	Max	Unit
Power Supply Voltage	VDD	Ta=25ºC	-	3.3	-	V
Power Supply Current	Idd	Vdd=3.3V	-	-	3.0	mA
Input voltage (high)	Vih	H level	0.8Vdd	-	Vdd	V
Input voltage (low)	Vil	L level	0	-	0.2Vdd	V
Recommended LC Driving Voltage	Vdd -Vo	-20ºC	-	-	-	V
		25ºC	-	16.5	-	
		70ºC	-	-	-	
LED Power Supply Voltage	V_F	Ta=25ºC	4.8	5.0	5.2	V
LED Power Supply Current	I_F	V_F=5.0V	-	60	-	mA

3.2 The Characteristics Of LED Backlight

Item	Symbol	Condition	Min	Typ	Max	Unit
Forward Current	If	VF=5.0±0.2V	--	60	--	mA
Reverse Voltage	Vr		--	--	5.0	V
Luminance	Lv	If=60mA	--	800	--	cd/㎡
Uniformity	Δ	(Lvmin/Lvmax)%	75%	--	--	
Lifetime		If=140mA	18000	20000	---	Hours

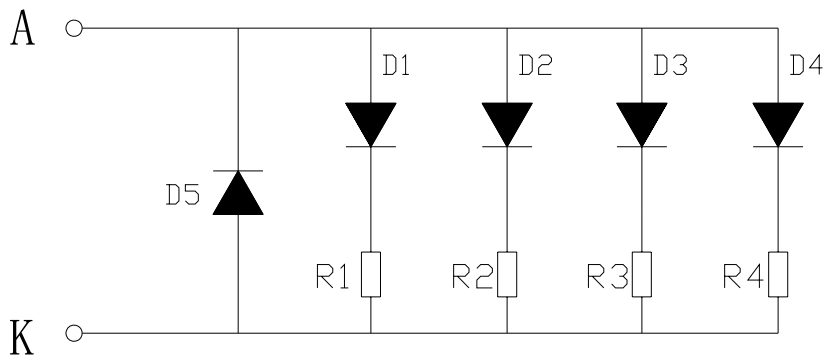
NOTE:

(1)The luminance is the average value of 5 points,The measurement instrument is BM-7 luminance colorimeter.The diameter of aperture is Φ5mm

(2) Luminance means the backlight brightness without glass.

(3) Backlight lifetime means luminance value larger than half the original after 20000 hours' continuous work.

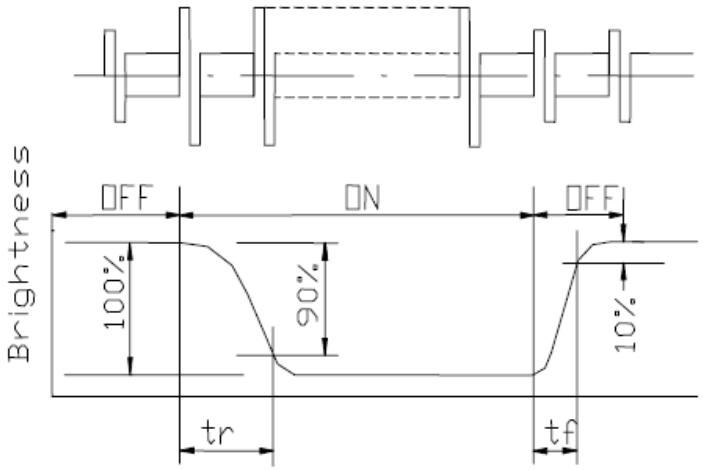
3.2.2 Backlight Control Circuit For LCM（1x4=4 pcs LED）



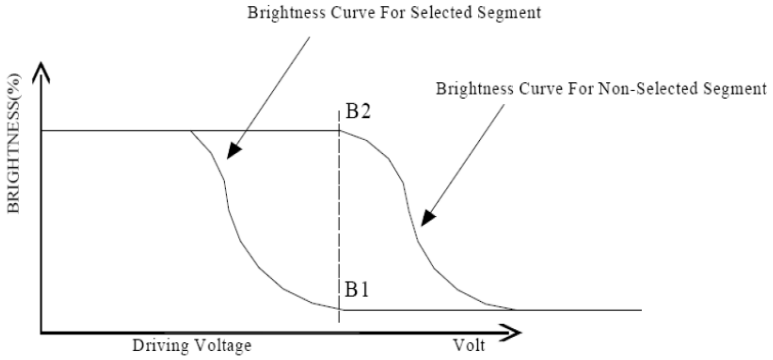
4.0 OPTICAL CHARACTERISTICS (Ta=25ºC, Vdd= 3.3V±0.2V)

Item	Symbol	Condition	Min	Typ	Max	Unit
Viewing angle (horizontal)	θ	Cr ≥ 5.0	-35	-	35	deg
Viewing angle (vertical)	ϕ	Cr ≥ 5.0	-25	-	45	deg
Contrast Ratio	Cr	ϕ=0°, θ=0°	5.0		-	
Response time (rise)	Tr	ϕ=0°, θ=0°	-	150	250	ms
Response time (fall)	Tf	ϕ=0°, θ=0°	-	160	280	ms

(1). Definition of Optical Response Time

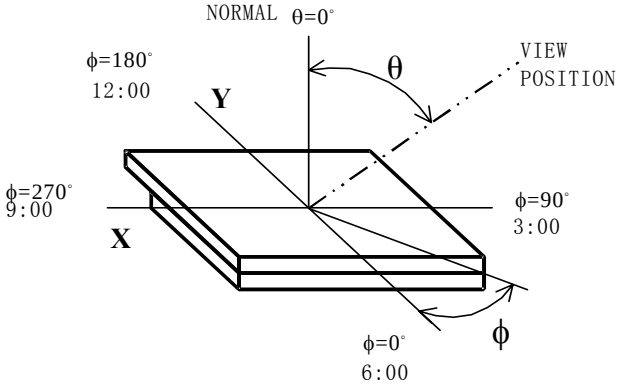


(2). Definition of Contrast Ratio

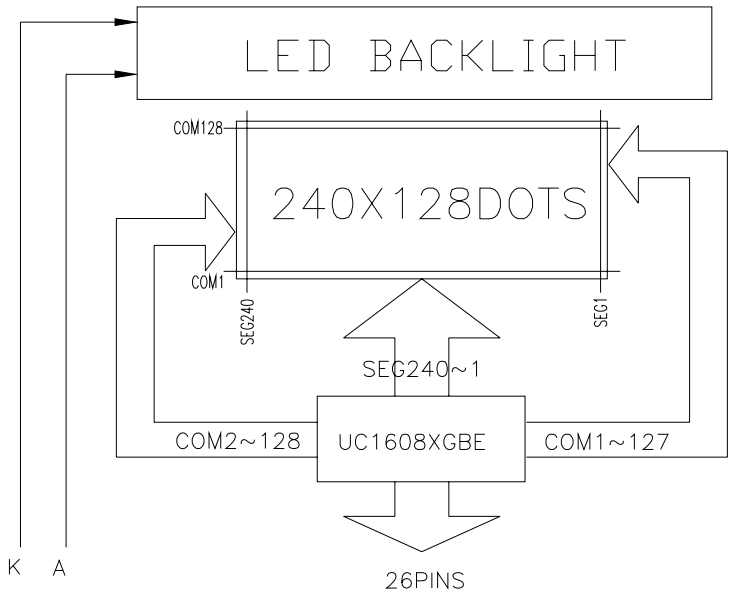


$$Cr = \frac{\text{Brightness of Non-selected Segment(B2)}}{\text{Brightness of selected Segment(B1)}}$$

(3). Definition of Viewing Angle θ and Φ



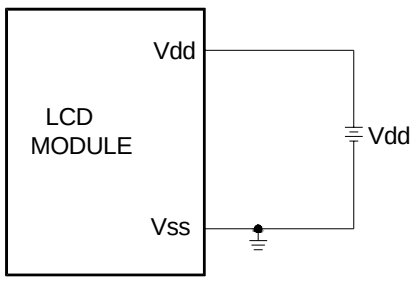
5.0 BLOCK DIAGRAM



6.0 PIN ASSIGNMENT

PIN ASSIGNMENT					
PIN	**SYMBOL**	**PIN**	**SYMBOL**	**PIN**	**SYMBOL**
1	VB1-	11	D7	21	CD
2	VB1+	12	D6	22	RST
3	VB0-	13	D5	23	NC
4	VB0+	14	D4	24	CS
5	VLCD	15	D3	25	BM0
6	VBIAS	16	D2	26	BM1
7	VSS	17	D1		
8	VDD2,3	18	D0		
9	VDD	19	WR1		
10	NC	20	WR0		

7.0 POWER SUPPLY



8.0 TIMING CHARACTERISTICS (Please refer to the datasheet of UC1608xGBE)

($2.7V \leq V_{DD} < 3.3V$, 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 bits bus (read) (write) 4 bits bus (read) (write)		 140 140 140 140	–	nS
t_{PWR80}	WR1	Pulse width 8 bits (read) 4 bits		65 65	–	nS
t_{PWW80}	WR0	Pulse width 8 bits (write) 4 bits		35 35	–	nS
t_{HPW80}	WR0, WR1	High pulse width 8 bits bus (read) (write) 4 bits 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

AC CHARACTERISTICS

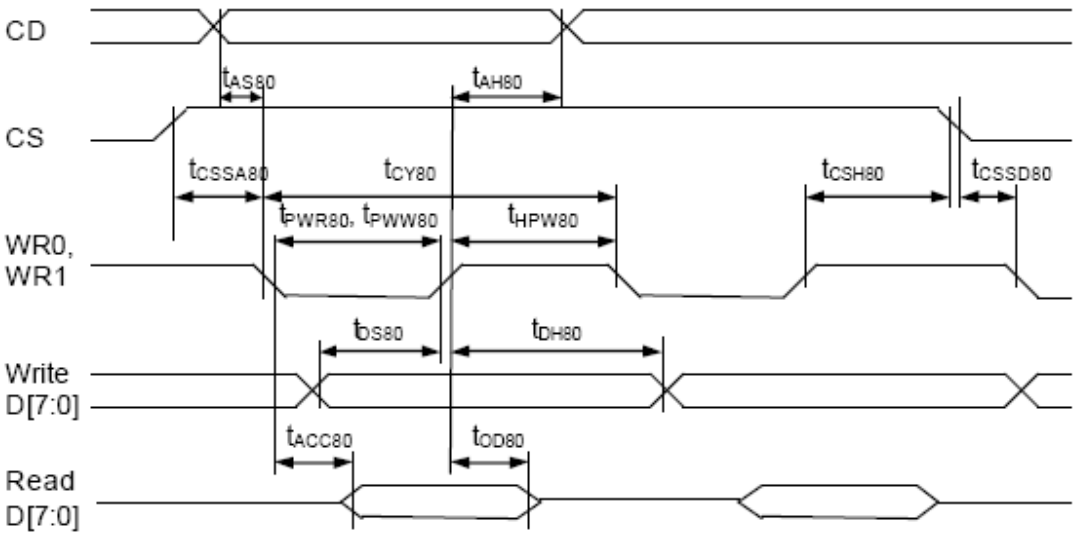
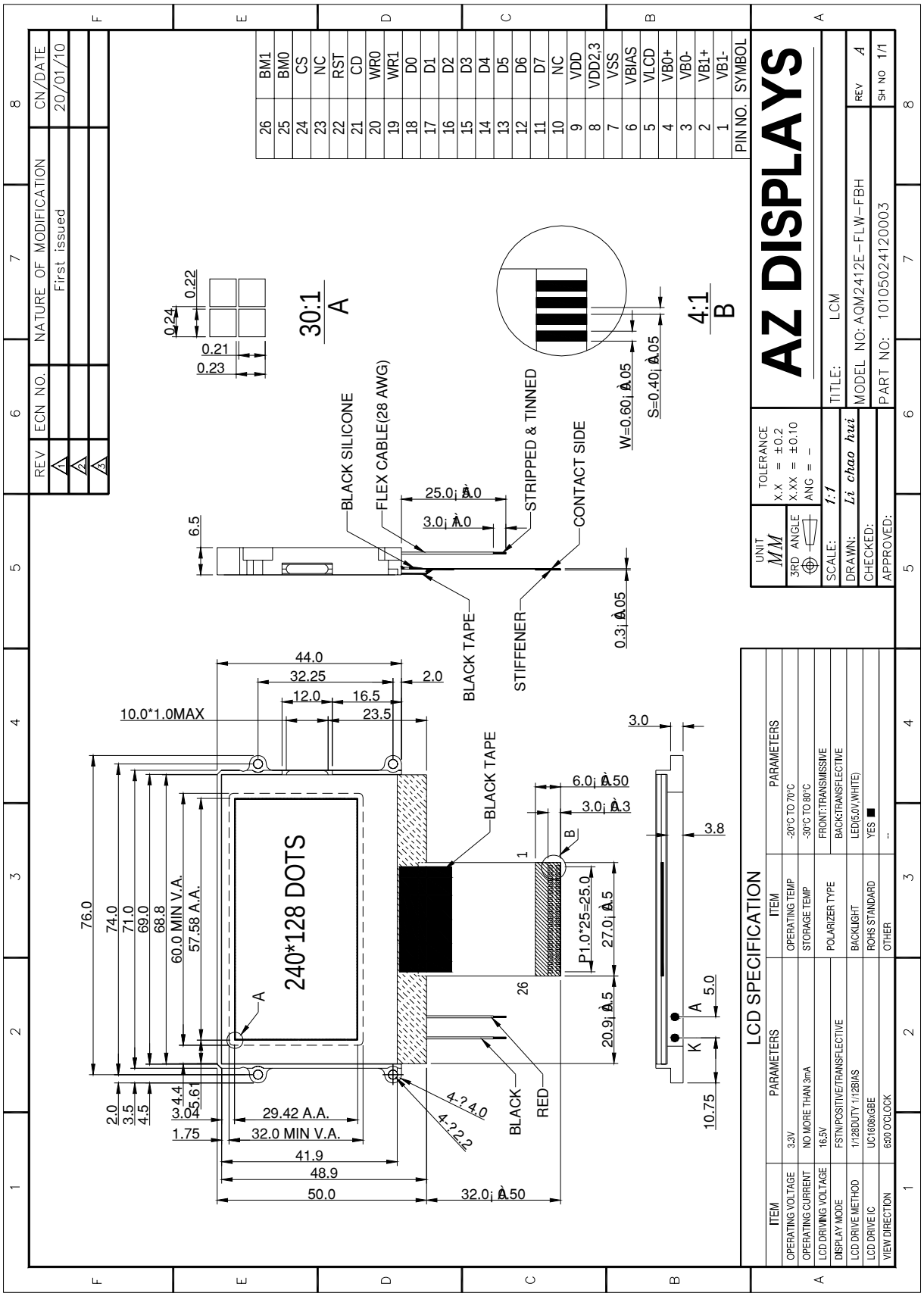


FIGURE 15: Parallel Bus Timing Characteristics (for 8080 MCU)

9.0 MECHANICAL DRAWING



10.0 RELIABILITY TEST

NO	Test Item		Description	Test Condition	Remark
1	Environmental Test	High temperature storage	Applying the high storage temperature Under normal humidity for a long time Check normal performance	80 ºC 96hrs	
2		Low temperature storage	Applying the low storage temperature Under normal humidity for a long time Check normal performance	-30ºC 96hrs	
3		High temperature Operation	Apply the electric stress(Volatge and current) Under high temperature for a long time	70 ºC 96hrs	Note1
4		Low temperature Operation	Apply the electric stress Under low temperature for a long time	-20ºC 96hrs	Note1 Note2
5		High temperature/High Humidity Storage	Apply high temperature and high humidity storage for a long time	90% RH 40ºC 96hrs	Note2
6		Temperature Cycle	Apply the low and high temperature cycle -30ºC＜＞25ºC＜＞80ºC ＜＞25ºC 30min 10min 30min 10min ←——— 1 cycle ———→ Check normal performance	-30ºC/80ºC 10 cycle	
7	Mechanical Test	Vibration test(Package state)	Applying vibration to product check normal performance	Freq:10-55Hz Max Acceleration 5G 1cycle time:1min time X.Y.Z direction for 15 mines	
8		Shock test(package state)	Applying shock to product check normal performance	Drop them through 70cm height to strike horizontal plane	
9	Other				

Remark

Note1:Normal operations condition (25ºC±5ºC).

Note2:Pay attention to keep dewdrops from the module during this test.

11.0 DISPLAY CONTROL INSTRUCTION

COMMAND TABLE

The following is a list of host commands supported by UC1608

C/D: 0: Control, 1: Data
W/R: 0: Write Cycle, 1: Read Cycle
\# 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	1	0	0	0	0	0	0	1	Set {GN[1:0], PM[5:0]}	GN=3 PM=0
		0	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.

12.0 RECOMMENDED INITIAL CODE

```
VOID UC1608_240128_8080_MONI_INILCD(VOID)

{

 UC1608_240128_8080_MONI_RST=0;

 UC1608_240128_8080_MONI_DELAY(1);

 UC1608_240128_8080_MONI_RST=1;

 UC1608_240128_8080_MONI_DELAY(1);

 UC1608_240128_8080_MONI_CS=1;

 UC1608_240128_8080_MONI_WRITECOMMAND(0XE2);

 UC1608_240128_8080_MONI_DELAY(1);

 UC1608_240128_8080_MONI_WRITECOMMAND(0X25);

 UC1608_240128_8080_MONI_WRITECOMMAND(0X2F);

 UC1608_240128_8080_MONI_WRITECOMMAND(0X40);

 UC1608_240128_8080_MONI_WRITECOMMAND(0X81);

 UC1608_240128_8080_MONI_WRITECOMMAND(0XB0);

 UC1608_240128_8080_MONI_WRITECOMMAND(0X89);

 UC1608_240128_8080_MONI_WRITECOMMAND(0XAF);

 UC1608_240128_8080_MONI_WRITECOMMAND(0XEA);

 UC1608_240128_8080_MONI_WRITECOMMAND(0X00);

 UC1608_240128_8080_MONI_WRITECOMMAND(0X10);

 UC1608_240128_8080_MONI_WRITECOMMAND(0XB0);

}
```

13.0 PRECAUTION FOR USING LCM

1. When design the product with this LCD Module, make sure the viewing angle matches to its purpose of usage.
2. As LCD panel is made of glass substrate, Dropping the LCD module or banging it against hard objects may cause cracking or fragmentation. Especially at corners and edges.
3. Although the polarizer of this LCD Module has the anti-glare coating, always be careful not to scratch its surface. Use of a plastic cover is recommended to protect the surface of polarizer.
4. If the LCD module is stored at below specified temperature, the LC material may freeze and be deteriorated. If it is stored at above specified temperature, the molecular orientation of the LC material may change to Liquid state and it may not revert to its original state. Excessive temperature and humidity could cause polarizer peel off or bubble. Therefore, the LCD module should always be stored within specified temperature range.
5. Saliva or water droplets must be wiped off immediately as those may leave stains or cause color changes if remained for a long time. Water vapor will cause corrosion of ITO electrodes.
6. If the surface of LCD panel needs to be cleaned, wipe it swiftly with cotton or other soft cloth. If it is not still clean enough, blow a breath on the surface and wipe again.
7. The module should be driven according to the specified ratings to avoid malfunction and permanent damage. Applying DC voltage cause a rapid deterioration of LC material. Make sure to apply alternating waveform by continuous application of the M signal. Especially the power ON/OFF sequence should be kept to avoid latch-up of driver LSIs and DC charge up to LCD panel.
8. Mechanical Considerations
    a) 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.
    b) Do not tamper in any way with the tabs on the metal frame.
    c) Do not modify the PCB by drilling extra holes, changing its outline, moving its components or modifying its pattern.
    d) Do not touch the elastomer connector; especially insert a backlight panel (for example, EL).
    e) When mounting a LCM makes 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.
    f) Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels.
9. Static Electricity
    a) Operator

Ware the electrostatics shielded clothes because human body may be statically charged if not ware shielded clothes. 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.

    b) Equipment

There is a possibility that the static electricity is charged to the equipment, which has a function of peeling or friction action (ex: conveyer, soldering iron, working table). Earth the equipment through proper resistance (electrostatic earth: $1x10^8$ ohm).
Only properly grounded soldering irons should be used.
If an electric screwdriver is used, it should be well grounded and shielded from commutator sparks.
The normal static prevention measures should be observed for work clothes and working benches; for the latter conductive (rubber) mat is recommended.

    c) Floor

Floor is the important part to drain static electricity, which is generated by operators or equipment.

There is a possibility that charged static electricity is not properly drained in case of insulating floor. Set the electrostatic earth (electrostatic earth: $1x10^8$ ohm).

    d) Humidity

Proper humidity helps in reducing the chance of generating electrostatic charges. Humidity should be kept over 50%RH.

    e) Transportation/storage

The storage materials also need to be anti-static treated because there is a possibility that the human body or storage materials such as containers may be statically charged by friction or peeling.

The modules should be kept in antistatic bags or other containers resistant to static for storage.

    f) Soldering

Solder only to the I/O terminals. Use only soldering irons with proper grounding and no leakage.

Soldering temperature : 280° C ± 10° C
Soldering time: 3 to 4 sec.
Use eutectic solder with resin flux fill.
If flux is used, the LCD surface should be covered to avoid flux spatters. Flux residue should be removed afterwards.

g) Others

The laminator (protective film) is attached on the surface of LCD panel to prevent it from scratches or stains. It should be peeled off slowly using static eliminator.

Static eliminator should also be installed to the workbench to prevent LCD module from static charge.

10. Operation
    a) Driving voltage should be kept within specified range; excess voltage shortens display life.
    b) Response time increases with decrease in temperature.
    c) 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”.
    d) Mechanical disturbance during operation (such as pressing on the viewing area) may cause the segments to appear “fractured”.
11. If any fluid leaks out of a damaged glass cell, wash off any human part that comes into contact with soap and water. The toxicity is extremely low but caution should be exercised at all the time.
12. Disassembling the LCD module can cause permanent damage and it should be strictly avoided.
13. LCD retains the display pattern when it is applied for long time (Image retention). To prevent image retention, do not apply the fixed pattern for a long time. Image retention is not a deterioration of LCD. It will be removed after display pattern is changed.
14. Do not use any materials, which emit gas from epoxy resin (hardener for amine) and silicone adhesive agent (dealcohol or deoxym) to prevent discoloration of polarizer due to gas.
15. Avoid the exposure of the module to the direct sunlight or strong ultraviolet light for a long time.

The brightness of LCD module may be affected by the routing of CCFL cables due to leakage to the chassis through coupling effect. The inverter circuit needs to be designed taking the level of leakage current into consideration. Thorough evaluation is needed for LCD module and inverter built into its host equipment to ensure specified brightness.