DISPLAYTRONIC

XIAMEN ZETTLER ELECTRONICS CO., LTD.

SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY

CUSTOMER APPROVAL			
※ **PART NO. :** ACM4004E SERIES			
APPROVAL		**COMPANY CHOP**	
CUSTOMER COMMENTS			

DISPLAYTRONIC ENGINEERING APPROVAL		
DESIGN BY	**CHECKED BY**	**APPROVED BY**

REVISION RECORD

REVISION	REVISION DATE	PAGE	CONTENTS
ver1.0	12/1-2006		FIRST ISSUE
ver2.0	14/10-2008		modify the cover,add content and revision record.

※ CONTENTS

1.0 MECHANICAL SPECS

1. Display Format	40*4 Character
2. Power Supply	5.0V
3. Overall Module Size	190.0mm(W) x 54.0mm(H) x max 14.5mm(D) for LED backlight version 190.0mm(W) x 54.0mm(H) x max 9.5mm(D) for reflective version
4. Viewing Aera(W*H)	147.0mm(W) x 29.5mm(H)
5. Dot Size (W*H)	0.50mm(W) x 0.55mm(H)
6. Dot Pitch (W*H)	0.57mm(W) x 0.62mm(H)
7. Character Size (W*H)	2.78mm(W) x 4.89mm(H)
8. Character Pitch (W*H)	3.53mm(W) x 6.09mm(H)
9. Viewing Direction	6:00 ;12:00 O'Clock
10. Driving Method	1/16Duty,1/5Bias
11. Controller IC	SPLC780D-001 OR EQUIV
12. LC Fluid Options	STN FSTN
13. Polarizer Options	Reflective, Transflective, Transmissive
14. Backlight Options	LED
15. ROHS	ROHS compliant

2.0 ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Min	Typ	Max	Unit
Operating temperature (Standard)	Top	0	-	50	ºC
Storage temperature (Standard)	Tst	-10	-	60	ºC
Operating temperature (Wide temperature)	Top	-20	-	70	ºC
Storage temperature (Wide temperature)	Tst	-30	-	80	ºC
Input voltage	Vin	Vss		Vdd	V
Supply voltage for logic	Vdd- Vss	2.7	-	5.5	V
Supply voltage for LCD drive	Vdd- Vo	3.0	-	13.0	V

3.0 ELECTRICAL CHARACTERISTICS

3.1 Electrical Characteristics Of LCM

Item	Symbol	Condition	Min	Typ	Max	Unit
Power Supply Voltage	Vdd	25ºC	--	5.0	--	V
Power Supply Current	Idd	Vdd=5.0V, fosc=270kHz	--	2.5	4.5	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
		0ºC				
		25ºC	4.0	4.2	4.4	
		50ºC				
		70ºC	--	--	---	

3.2 The Characteristics Of LED Backlight

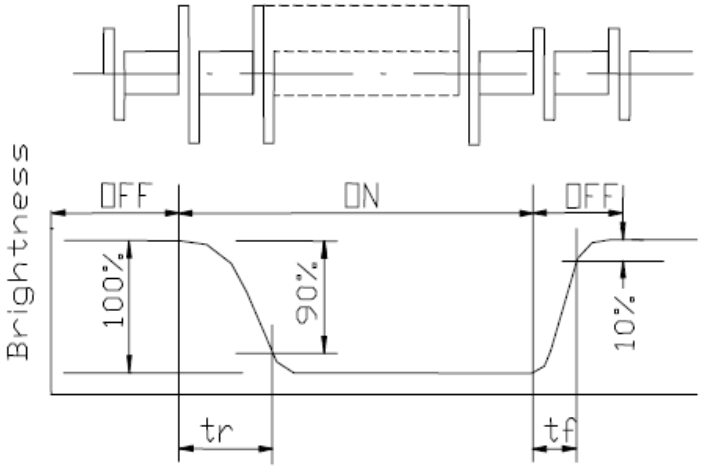
Item	Symbol	Condition	Min	Typ	Max	Unit
Operate Current	IF	VF=4.1V	--	500	--	mA
Luminance	Lv	IF= 500 mA	--	200	--	cd/m²
Peak wave length	λ p	IF= 500 mA	--	568	--	nm
Coordinate range	--	--	x = -- , y = --			

Note: i. Luminance means the backlight brightness without glass.

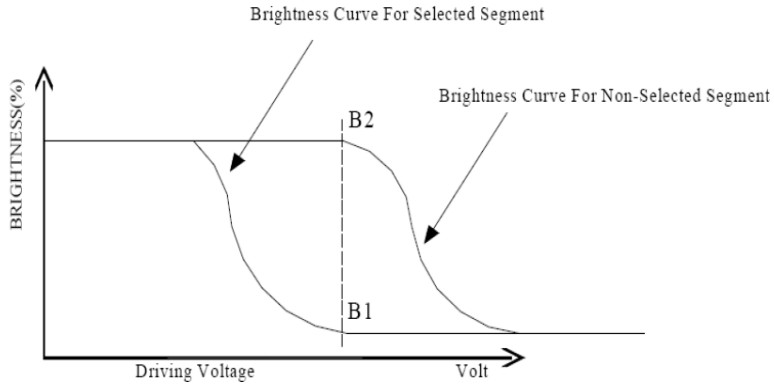
4.0 OPTICAL CHARACTERISTICS (Ta=25ºC, Vdd= 5.0V±0.25V)

Item	Symbol	Condition	Min	Typ	Max	Unit
Viewing angle (horizontal)	θ	Cr ≥ 2.0	-35	-	35	deg
Viewing angle (vertical)	ϕ	Cr ≥ 2.0	-25	-	40	deg
Contrast Ratio	Cr	ϕ=0°, θ=0°	-	6	-	
Response time (rise)	Tr	ϕ=0°, θ=0°	-	180	300	ms
Response time (fall)	Tf	ϕ=0°, θ=0°	-	150	250	ms

(1). Definition of Optical Response Time

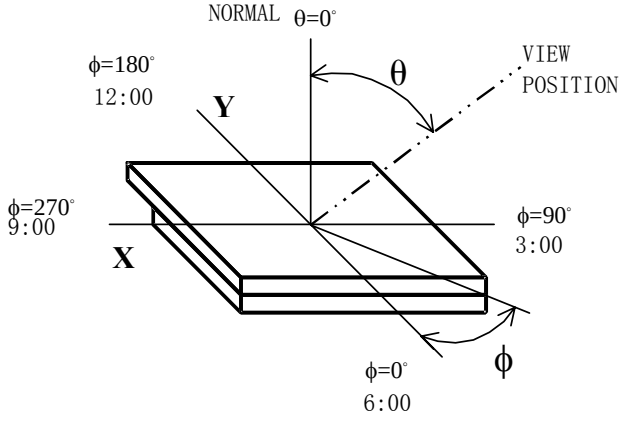


(2). Definition of Contrast Ratio

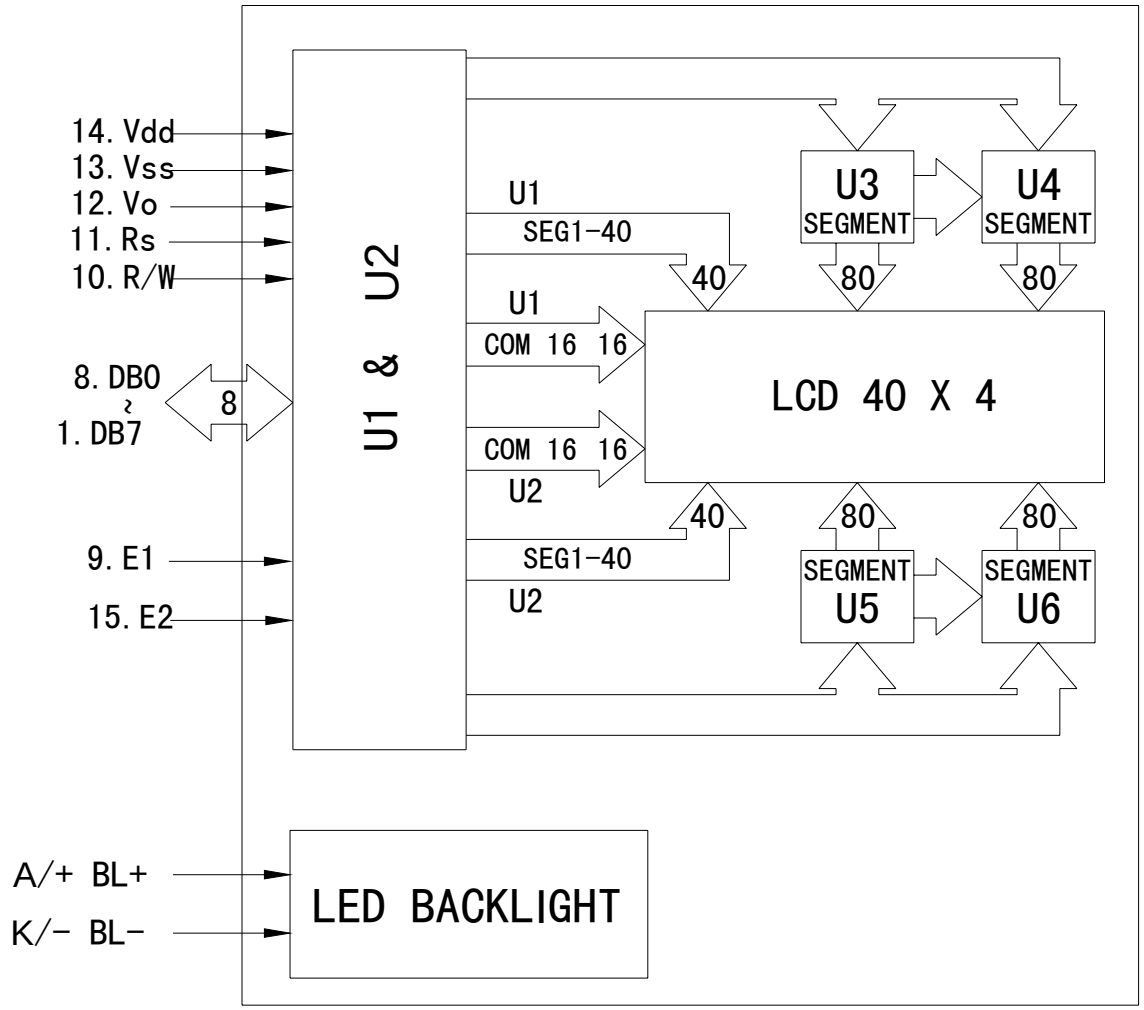


$$Cr = \frac{\text{Brightness of Non-selected Segment(B2)}}{\text{Brightness of selected Segment(B1)}}$$

(3). Definition of Viewing Angle θ and Φ



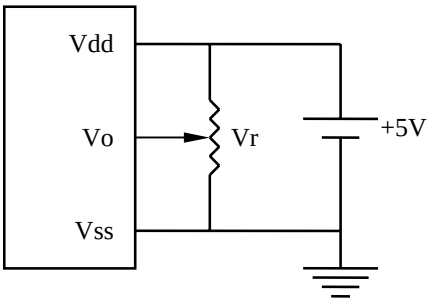
5.0 BLOCK DIAGRAM



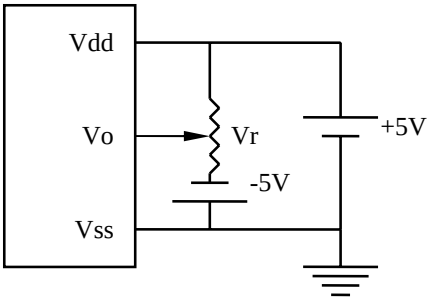
6.0 PIN ASSIGNMENT

Pin No.	Symbol	Function
1	DB7	Data bit 7
2	DB6	Data bit6
3	DB5	Data bit5
4	DB4	Data bit4
5	DB3	Data bit3
6	DB2	Data bit2
7	DB1	Data bit1
8	DB0	Data bit0
9	E1	U1 enable
10	R/W	Read / Write
11	RS	Register select
12	Vo	LCD contrast adjust
13	Vss	Ground
14	Vdd	+5V
15	E2	U2 enable
16	NC	-
A/+	BL+	Power Supply for BL+(4.1V)
K/-	BL-	Power Supply for BL-

7.0 POWER SUPPLY



STANDARD TEMP RANGE



WIDE TEMP RANGE

Vr = 10KΩ ~ 20KΩ

8.0 TIMING CHARACTERISTICS

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Enable cycle time	t_C	Fig. a, Fig. b	500	-	-	ns
Enable pulse width	t_W	Fig. a, Fig. b	230	-	-	ns
Enable rise/fall time	t_R , t_F	Fig. a, Fig. b	-	-	20	ns
RS, R/W set up time	t_{SU}	Fig. a, Fig. b	40	-	-	ns
RS, R/W hold time	t_H	Fig. a, Fig. b	10	-	-	ns
Data delay time	t_D	Fig. b	-	-	120	ns
Data set up time	t_{DSU}	Fig. a	80	-	-	ns
Data hold time	t_{DH}	Fig. a, Fig. b	10	-	-	ns

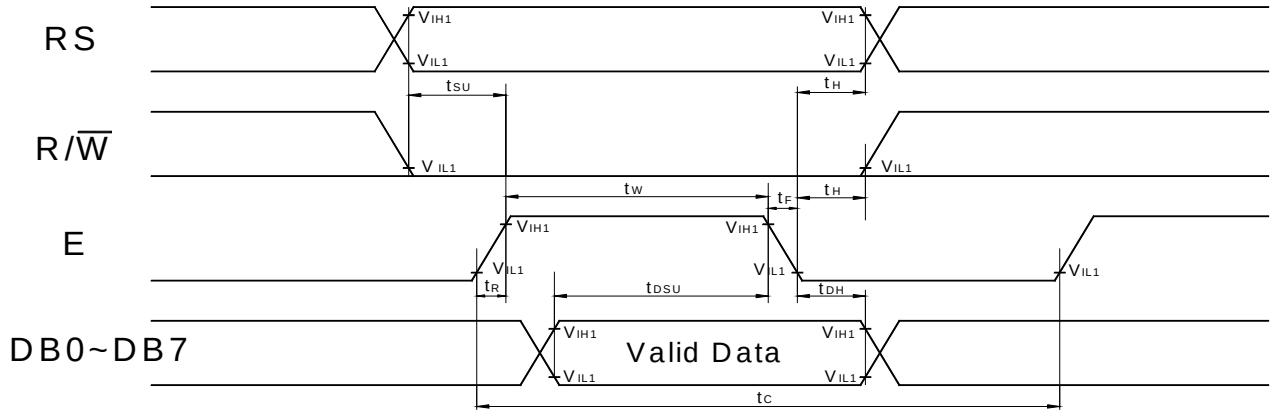


Fig. a Interface timing (data write)

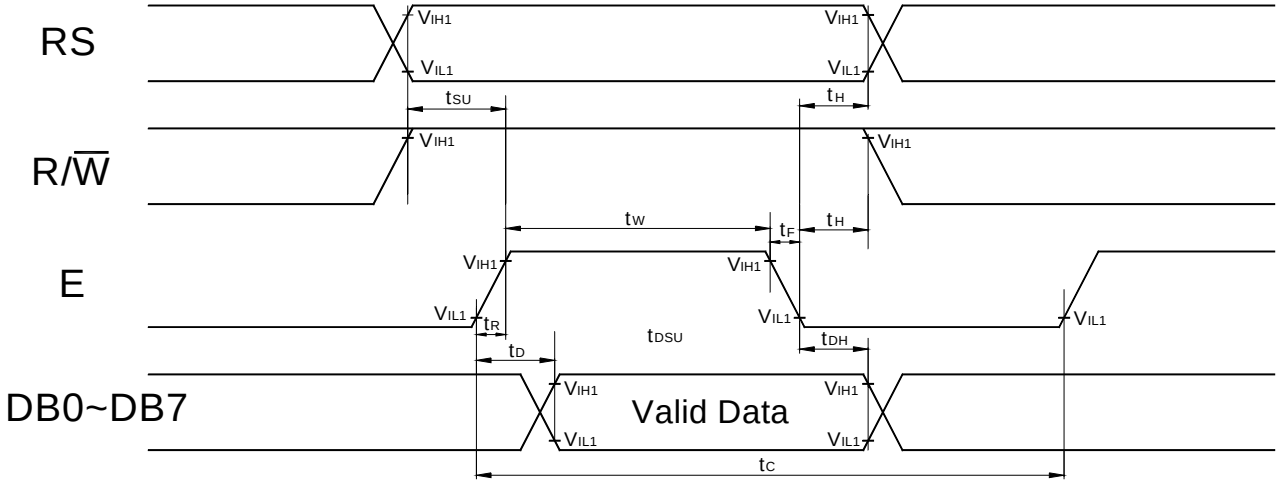
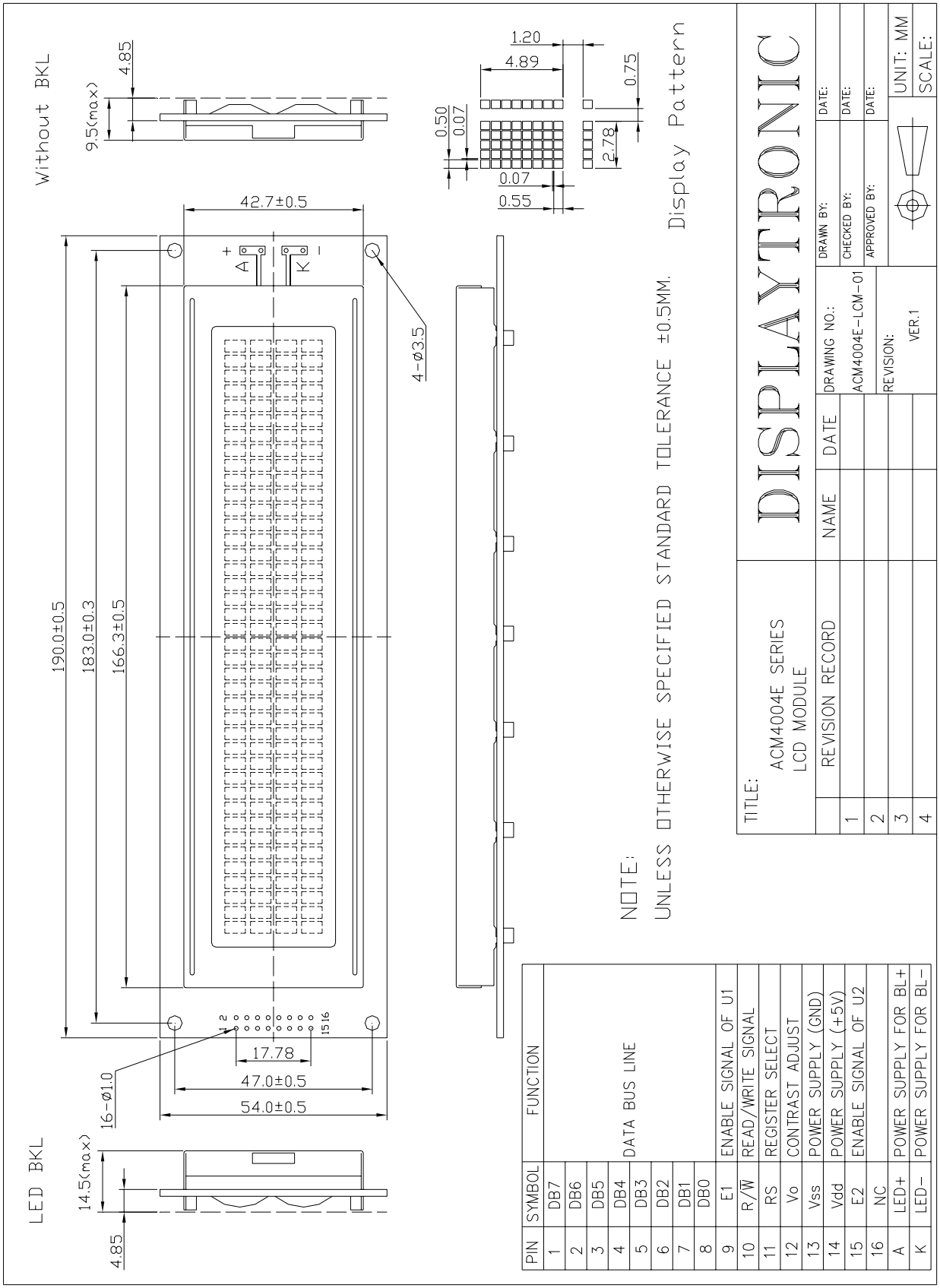


Fig. b Interface timing (data read)

9.0 MECHANICAL DIAGRAM



PIN	SYMBOL	FUNCTION
1	DB7	DATA BUS LINE
2	DB6	
3	DB5	
4	DB4	
5	DB3	
6	DB2	
7	DB1	
8	DB0	
9	E1	ENABLE SIGNAL OF U1
10	R/$\overline{W}$	READ/WRITE SIGNAL
11	RS	REGISTER SELECT
12	Vo	CONTRAST ADJUST
13	Vss	POWER SUPPLY (GND)
14	Vdd	POWER SUPPLY (+5V)
15	E2	ENABLE SIGNAL OF U2
16	NC	
A	LED+	POWER SUPPLY FOR BL+
K	LED-	POWER SUPPLY FOR BL-

10.0 RELIABILITY TEST

Standard temperature

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	60 ºC 96hrs	
2		Low temperature storage	Applying the low storage temperature Under normal humidity for a long time Check normal performance	-10ºC 96hrs	
3		High temperature Operation	Apply the electric stress(Volatge and current) Under high temperature for a long time	50 ºC 96hrs	Note1
4		Low temperature Operation	Apply the electric stress Under low temperature for a long time	0ºC 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 -10ºC＜＞25ºC＜＞60ºC ＜＞25ºC 30min 10min 30min 10min ←——— 1 cycle ———→ Check normal performance	-10ºC/60ºC 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				

(Wide temperature)

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 OR 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 INSTRUCTION TABLE

COMMAND	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	DESCRIPTION	Executing time fosc=270khz
Clear Display	0	0	0	0	0	0	0	0	0	1	Clears Display & Returns to Address 0.	1.52ms
Cursor at Home	0	0	0	0	0	0	0	0	1	x	Returns Cursor to Address 0. Also returns the display being shifted to the original position. DDRAM contents remain unchanged.	1.52ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	I/D: Set Cursor Moving Direction I/D=1: Increment I/D=0: Decrement S: Specify Shift of Display S=1: The display is shifted S=0: The display is not shifted	38µs
Display ON/OFF Control	0	0	0	0	0	0	1	D	C	B	Display D=1: Display on D=0: Display off Cursor C=1: Cursor on C=0: Cursor off Brink B=1: Brink on B=0: Brink off	38µs
Cursor / Display Shift	0	0	0	0	0	1	S/C	R/L	x	x	Moves cursor or shifts the display w/o changing DD RAM contents S/C=0: Cursor Shift (RAM unchanged) S/C=1: Display Shift (RAM unchanged) R/L=1: Shift to the Right R/L=0: Shift to the Left	38µs
Function Set	0	0	0	0	1	DL	N	F	x	x	Sets data bus length (DL), # of display lines (N), and character fonts (F). DL=1: 8 bits F=0: 5x7 dots DL=0: 4 bits F=1: 5x10 dots N=0: 1 line display N=1: 2 lines display	38µs
Set CG RAM Address	0	0	0	1	Character Generator (CG) RAM Address						Sets CG RAM address. CG RAM data is sent and received after this instruction.	38µs
Set DD RAM Address	0	0	1	Display Data (DD) RAM Address / Cursor Address							Sets DD RAM address. DD Ram data is sent and received after this instruction.	38µs
Busy Flag / Address Read	0	1	BF	Address counter used for both DD & CG RAM address							Reads Busy Flag (BF) and address counter contents.	
Write Data	1	0	Write Data								Writes data into DDRAM or CGRAM.	38µs
Read Data	1	1	Read Data								Reads data from DDRAM or CGRAM.	38µs

x: Don't Care.

12.0 STANDARD CHARACTER PATTERNS

Note: The character generator RAM is the RAM with which the user can rewrite character patterns by program.

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