

# **AZ DISPLAYS, INC.**

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*COMPLETE LCD SOLUTIONS*

## **SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY**

**PART NUMBER:**  
**DATE:**

**ACM1601C Series**  
**December 3, 2009**

# ACM1601C SERIES LCD MODULE

## 1.0 MECHANICAL SPECS

1.	Overall Module Size	80.0mm(W) x 36.0mm(H) x max 13.5mm(D) for LED backlight version 80.0mm(W) x 36.0mm(H) x max 9.5mm(D) for reflective version
2.	Dot Size	0.55mm(W) x 0.75mm(H)
3.	Dot Pitch	0.63mm(W) x 0.83mm(H)
4.	Duty	1/16
5.	Controller IC	ST7066U or compatible
6.	LC Fluid Options	TN,STN,FSTN
7.	Polarizer Options	Reflective,Transflective,Transmissive
8.	Backlight Options	LED
9.	Temperature Range Options	Standard ( 0°C ~ 50°C),Wide(-20°C ~ 70°C)

## 2.0 ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Min	Typ	Max	Unit
Operating temperature (Standard)	Top	0	-	50	°C
Storage temperature (Standard)	Tst	-10	-	60	°C
Operating temperature (Wide temperature)	Top	-20	-	70	°C
Storage temperature (Wide temperature)	Tst	-30	-	80	°C
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	-	8.0	V

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## 3.0 ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Input voltage (high)	Vih	H level	2.2	-	Vdd	V
Input voltage (low)	Vil	L level	0	-	0.6	V
Recommended LC Driving Voltage (Standard Temp)	Vdd - Vo	0°C	-	4.7	5.3	V
		25°C	4.2	4.5	-	
		50°C	3.8	4.2	-	
Recommended LC Driving Voltage (Wide Temp)	Vdd -Vo	-20°C	-	6.4	7.2	V
		0°C	-	4.8	-	
		50°C	-	4.3	-	
		70°C	3.6	4.1	-	
Power Supply Current	Idd	Vdd=5.0V, fosc=270kHz	-	1.5	2.5	mA
LED Power Supply Current	I <sub>fl</sub> ed	--	-	110(YG) 30(W)	165(YG) 40(W)	mA

## 4.0 OPTICAL CHARACTERISTICS (Ta=25°C, Vdd= 5.0V±0.25V, TN LC fluid)

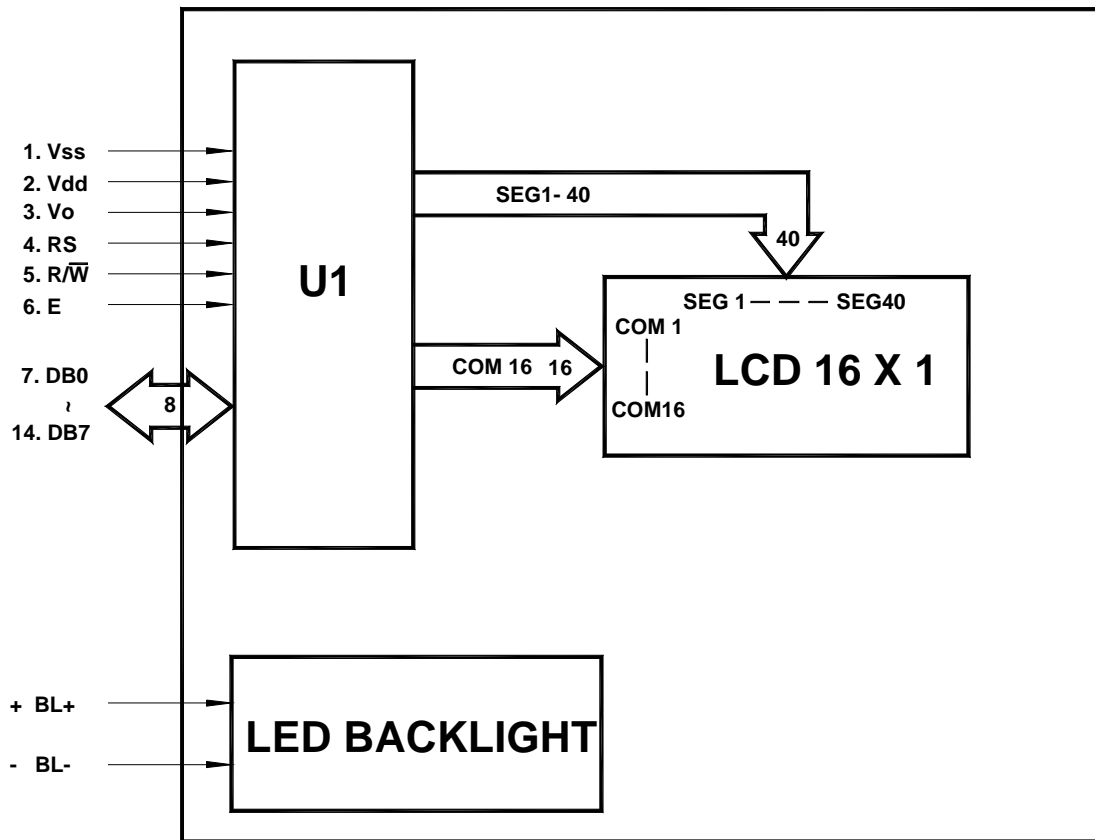
Item	Symbol	Condition	Min	Typ	Max	Unit
Viewing angle (vertical)		Cr 4.0	-25	-	-	deg
Viewing angle (horizontal)		Cr 4.0	-30	-	30	deg
Contrast Ratio	Cr	=0°, =0°	-	2	-	
Response time (rise)	Tr	=0°, =0°	-	120	150	ms
Response time (fall)	Tf	=0°, =0°	-	120	150	ms

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## 4.1 OPTICAL CHARACTERISTICS (Ta=25°C, Vdd= 5.0V±0.25V, STN LC fluid)

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

## 5.0 BLOCK DIAGRAM

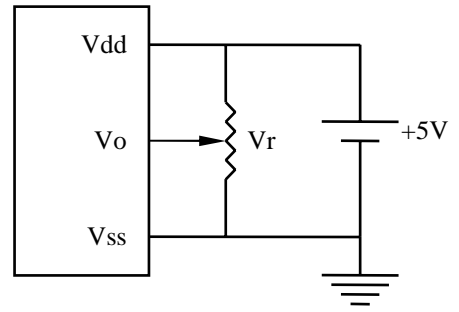


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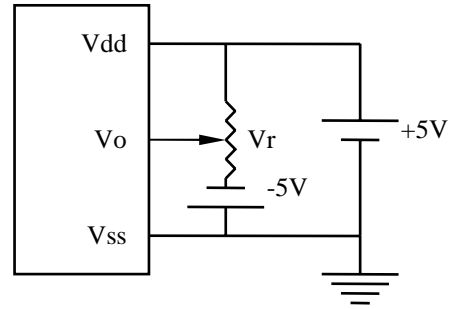
## 6.0 PIN ASSIGNMENT

Pin No.	Symbol	Function
1	Vss	Ground
2	Vdd	+5V
3	Vo	LCD contrast adjust
4	RS	Register select
5	R/W	Read / write
6	E	Enable
7	DB0	Data bit 0
8	DB1	Data bit 1
9	DB2	Data bit 2
10	DB3	Data bit 3
11	DB4	Data bit 4
12	DB5	Data bit 5
13	DB6	Data bit 6
14	DB7	Data bit 7
+	BL+	Power Supply for BL+
-	BL-	Power Supply for BL-

## 7.0 POWER SUPPLY



STANDARD TEMP RANGE



WIDE TEMP RANGE

$V_r = 10K \sim 20K$

## 8.0 TIMING CHARACTERISTICS

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Enable cycle time	$t_c$	Fig. a, Fig. b	1200	-	-	ns
Enable pulse width	$t_w$	Fig. a, Fig. b	460	-	-	ns
Enable rise/fall time	$t_r, t_f$	Fig. a, Fig. b	-	-	25	ns
RS, R/W set up time	$t_{su}$	Fig. a, Fig. b	0	-	-	ns
RS, R/W hold time	$t_h$	Fig. a, Fig. b	10	-	-	ns
Data delay time	$t_d$	Fig. b	-	-	100	ns
Data set up time	$t_{dsu}$	Fig. a	40	-	-	ns
Data hold time	$t_{dh}$	Fig. a, Fig. b	10	-	-	ns

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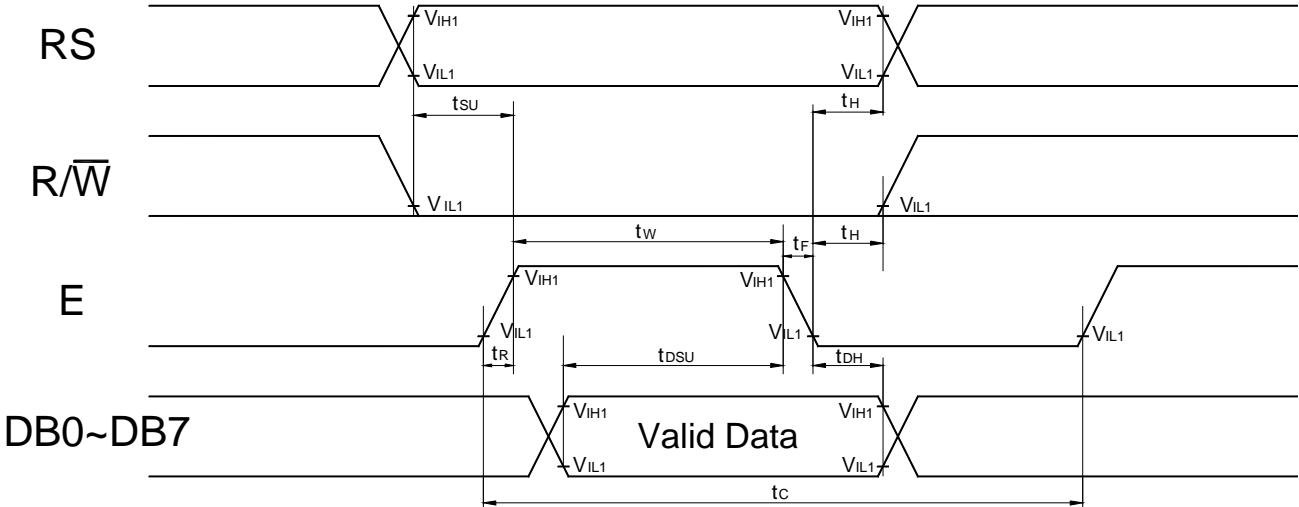


Fig. a Interface timing (data write)

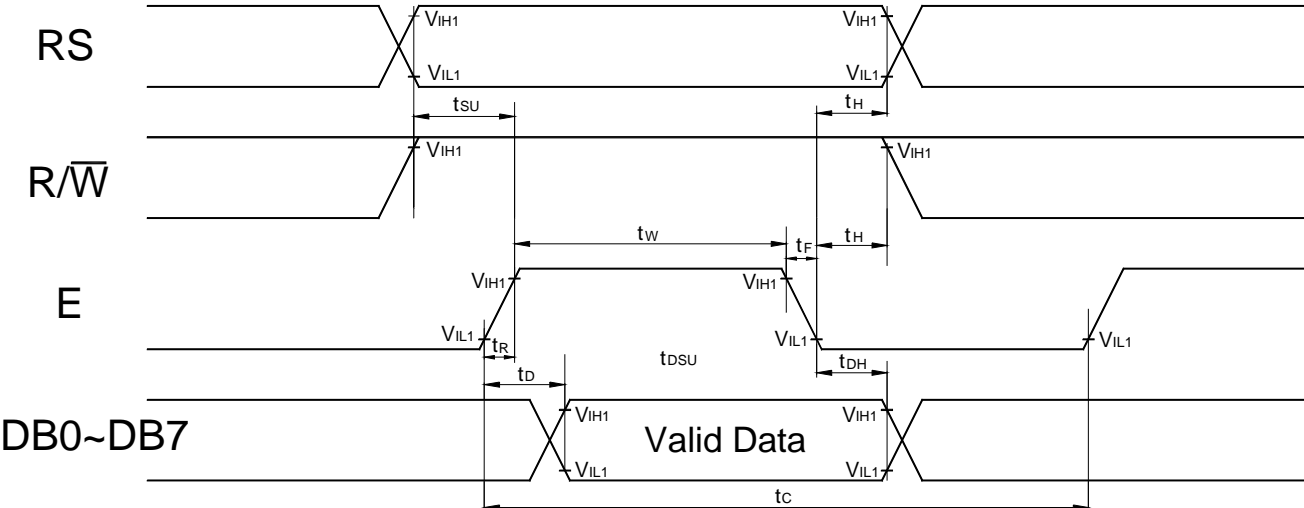
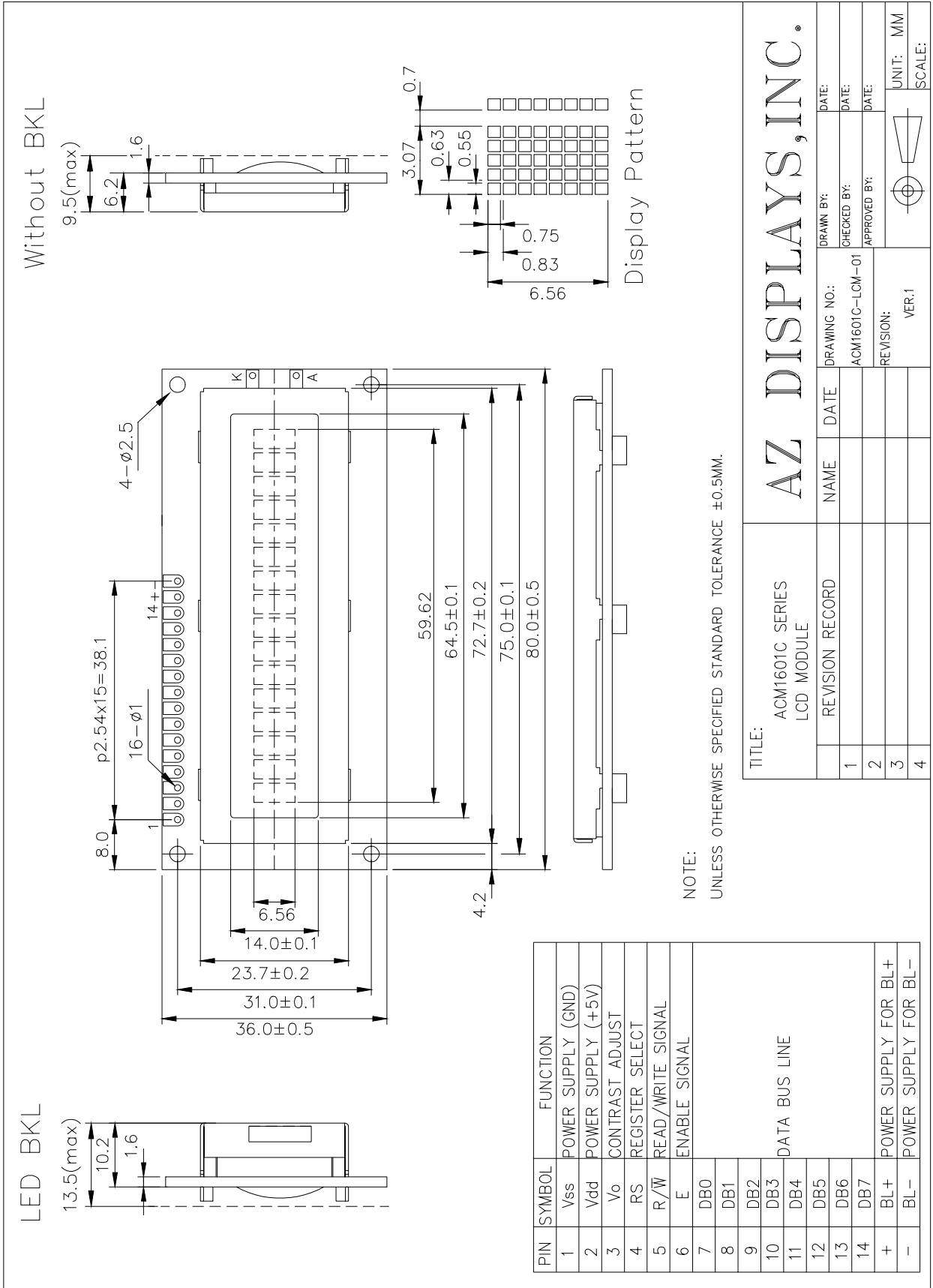


Fig. b Interface timing (data read)

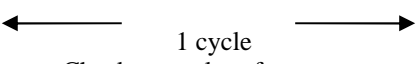
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## 9.0 MECHANICAL DIAGRAM



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## 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	60°C(80 °C) 96hrs	Note3											
2		Low temperature storage	Applying the low storage temperature Under normal humidity for a long time Check normal performance	-10°C(-30°C) 96hrs	Note3											
3		High temperature Operation	Apply the electric stress(Voltage and current) Under high temperature for a long time	50°C(70 °C) 96hrs	Note1 Note3											
4		Low temperature Operation	Apply the electric stress Under low temperature for a long time	0°C(-20°C) 96hrs	Note1 Note2 Note3											
5		High temperature/High Humidity Storage	Apply high temperature and high humidity storage for a long time	90% RH 40°C 96hrs	Note2 Note3											
6		Temperature Cycle	Apply the low and high temperature cycle <table style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <tr> <td style="padding: 0 10px;">-10°C</td> <td style="padding: 0 10px;">25°C</td> <td style="padding: 0 10px;">70°C</td> <td style="padding: 0 10px;">25°C</td> </tr> <tr> <td style="padding: 0 10px;">(-30°C</td> <td style="padding: 0 10px;">25°C</td> <td style="padding: 0 10px;">80°C</td> <td style="padding: 0 10px;">25°C</td> </tr> <tr> <td style="padding: 0 10px;">30min</td> <td style="padding: 0 10px;">10min</td> <td style="padding: 0 10px;">30min</td> <td style="padding: 0 10px;">10min</td> </tr> </table> <div style="text-align: center; margin-top: 5px;">  <p>1 cycle</p> </div> <p>Check normal performance</p>	-10°C	25°C	70°C	25°C	(-30°C	25°C	80°C	25°C	30min	10min	30min	10min	-10°C/60°C (-30°C/80°C) 10 cycle
-10°C	25°C	70°C	25°C													
(-30°C	25°C	80°C	25°C													
30min	10min	30min	10min													
7	Mechanical Test	Vibration test(Package state)	Applying vibration to product check normal performance	Freq:10~55~10Hz Amplitude:0.75mm 1 cycle time:1min X.Y.Z every direction for 15 cycles												
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 (25°C±5°C).

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

Note3:"()" means wide temp type, otherwise normal temp type.



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## 11.0 DISPLAY INSTRUCTION TABLE

COMMAND	R S	R/ W	DB 7	DB 6	DB 5	DB 4	DB 3	DB 2	DB 1	DB 0	DESCRIPTION	Executing time fosc=250khz
Clear Display	0	0	0	0	0	0	0	0	0	1	Clears Display & Returns to Address 0.	1.64ms
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.	1.64ms
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	40µs
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	40µs
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	40µs
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	40µs
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.		40µs
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.		40µs	
Busy Flag / Address Read	0	1	B F	Address counter used for both DD & CG RAM address					Reads Busy Flag (BF) and address counter contents.		40µs	
Write Data	1	0	Write Data								Writes data into DDRAM or CGRAM.	46µs
Read Data	1	1	Read Data								Reads data from DDRAM or CGRAM.	46µs

x: Don't Care

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## 12.0 STANDARD CHARACTER PATTERNS

Lower 4 Bits \ Upper 4 Bits	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
xxxx0000	CG RAM (1)		0	@	P	`	P				-	夕	三	α	ρ	
xxxx0001	(2)		!	1	A	Q	a	q			。	ア	チ	△	△	q
xxxx0010	(3)		"	2	B	R	b	r			「	イ	ツ	×	β	θ
xxxx0011	(4)		#	3	C	S	c	s			」	ウ	テ	ε	ε	∞
xxxx0100	(5)		\$	4	D	T	d	t			、	エ	ト	⊥	μ	Ω
xxxx0101	(6)		%	5	E	U	e	u			・	オ	ナ	⊥	ε	ü
xxxx0110	(7)		&	6	F	V	f	v			ヲ	カ	ニ	ヨ	ρ	Σ
xxxx0111	(8)		'	7	G	W	g	w			ヲ	キ	ヌ	ラ	g	π
xxxx1000	(1)		(	8	H	X	h	x			イ	ウ	ネ	リ	μ	∞
xxxx1001	(2)		)	9	I	Y	i	y			ウ	ケ	ル	ル	'	γ
xxxx1010	(3)		*	:	J	Z	j	z			エ	コ	ハ	レ	j	〒
xxxx1011	(4)		+	:	K	[	k	{			オ	サ	ヒ	ロ	°	〒
xxxx1100	(5)		,	<	L	¥	l	l			カ	シ	フ	ワ	φ	円
xxxx1101	(6)		-	=	M	]	m	}			ユ	ヌ	ハ	ン	ε	÷
xxxx1110	(7)		.	>	N	^	n	‡			ヨ	セ	ホ	°	円	
xxxx1111	(8)		/	?	O	_	o	€			ウ	ソ	マ	°	ö	■

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

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## 13.0 PRECAUTION FOR USING LCM

1. When design the product with this LCD Module, make sure you select the correct viewing angle for your design.
2. Because the LCD panel is made of glass substrate, dropping the module or hitting it against hard objects may cause cracking or fragmentation, especially on the corners and edges.
3. The polarizer on 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 to peel off or bubble. Therefore, the LCD module should always be stored within specified temperature range.
5. Water droplets must be wiped off immediately as those may leave stains or cause color changes if they remain on the LCD 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 stains remain, the user may blow a breath on the surface (causing light condensation) and wipe again.
7. The module should be driven according to the specified ratings to avoid malfunction and permanent damage. Applying DC voltage can cause a rapid deterioration of LC material. Make sure to apply alternating wavefrom by continuous application of the M signal. 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.
  - 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 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.
  - 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

**Wear electrostatic shielded clothes, gloves and/or bracelets. The human body may be statically charged, if you are not wearing such items, 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.**

#### 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:  $1 \times 10^9$  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:  $1 \times 10^8$  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.

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Soldering temperature :  $280^{\circ} \text{ C} \pm 10^{\circ} \text{ C}$

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.