



# Microtips Technology Inc.

台北縣汐止鎮康寧街169巷31號12樓  
12F, No 31, Lane 169, Kang Ning St.  
Hsi-Chih, Taipei Hsien, Taiwan, R.O.C.

WEB : <http://www.microtips.com.tw>  
E-mail : [Macros@microtips.com.tw](mailto:Macros@microtips.com.tw)  
TEL: 886-2-2695-3133 FAX :886-2-2695-8625

## LCD MODULE SPECIFICATION FOR CUSTOMER'S APPROVAL

CUSTOMER : Standard Part

MODULE TYPE : MTG-S12232CFYHSGY

APPROVED BY: (FOR CUSTOMER USE ONLY)

Approved By	Checked By	Prepared By	MT File No	Date Issued

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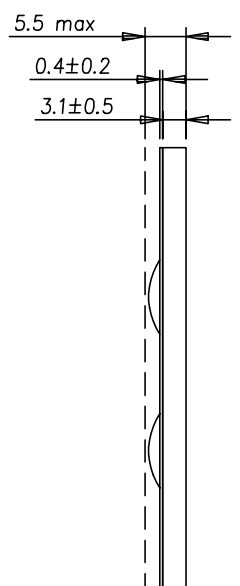
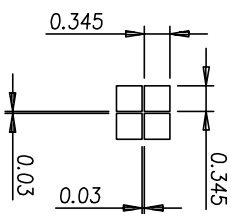
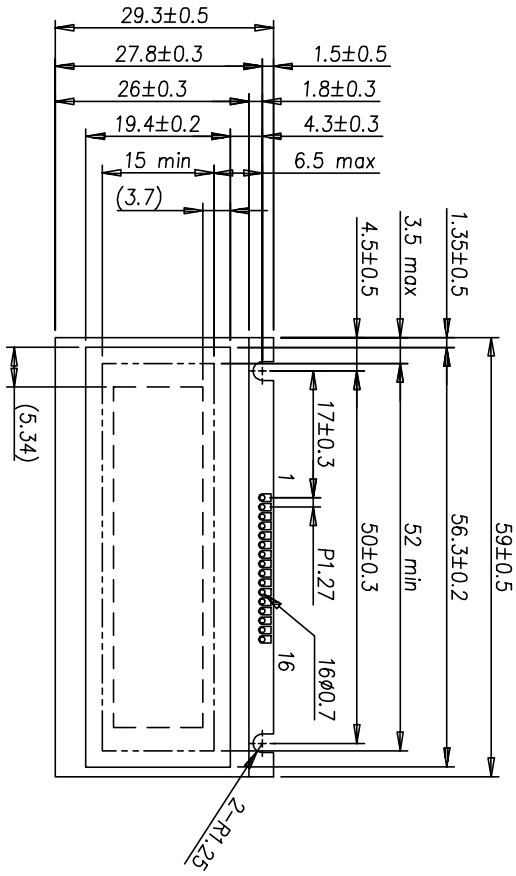
**SPECIFICATION FOR**  
**LIQUID CRYSTAL DISPLAY MODULE**  
**MODEL NO. : MTG-S12232CFYHSGY**

View Direction	<input checked="" type="checkbox"/> 6 O'clock		<input type="checkbox"/> 12 O'clock		
LCD Type	<input type="checkbox"/> FSTN Positive		<input type="checkbox"/> FSTN Negative		
	<input type="checkbox"/> STN Gray	<input checked="" type="checkbox"/> STN Yellow Green	<input type="checkbox"/> STN Blue		
Rear Polarizer	<input type="checkbox"/> Reflective	<input checked="" type="checkbox"/> Transflective	<input type="checkbox"/> Transmissive		
Backlight Type	<input checked="" type="checkbox"/> LED	<input checked="" type="checkbox"/> Internal Power	<input type="checkbox"/> EL	<input type="checkbox"/> 5V input	
		<input type="checkbox"/> External Power	<input type="checkbox"/> CCFL	<input type="checkbox"/> 24V input	
Backlight Color	<input type="checkbox"/> White	<input type="checkbox"/> Amber	<input type="checkbox"/> Blue Green	<input checked="" type="checkbox"/> Yellow Green	<input type="checkbox"/> Other
Temperature Range	<input type="checkbox"/> Normal		<input checked="" type="checkbox"/> Wide	<input type="checkbox"/> Super Wide	
EL Driver IC	<input type="checkbox"/> Build-in		<input checked="" type="checkbox"/> Not Build-in		
DC-to-DC	<input type="checkbox"/> With		<input checked="" type="checkbox"/> Without		

**TO BE VERY CAREFUL !**

The LCD driver ICs are made by CMOS process, which are very easy to be damaged by static charge, make sure the user is grounded when handling the LCM.

REV.	DESCRIPTION	DRAWN	CHECK	APP'D	DATE



PIN ASSIGNMENT							
1	VLED	5	A0	9	DB1	13	DB5
2	VSS	6	E1	10	DB2	14	DB6
3	VDD	7	E2	11	DB3	15	DB7
4	VO	8	DB0	12	DB4	16	R/W

NO.	M-12232C		Q'TY	DATE:	05/27/99	MATERIAL	FINISH
PART NAME		CHECK	APP'D	UNIT: MM	SCALE: 1/1	PRODUCT: MTG-12232C	
DRAWN		CHECK		UNLESS OTHERWISE SPECIFIED TOLERANCE ON FRACTIONS DECIMALS ANGLES 0.10 0.5°		DWG NO.: G12232C.0	
Microtips Technology		SHEET 1 / 1		FILE: \MTG122\G12232C		Rev:	

## GENERAL SPECIFICATION

Item	Content
Display Resolution	122(W)× 32(H)
Dimensional Outline(mm)	56.3(W)× 29.0(H)× 5.5 max(D)
Display mode	Transflective Type/Positive
Circuit	Common-Driver IC, Segment-driver IC with build-in SRAM
Interface	Data (D0~D7), Ao, R/W, E1, E2, V <sub>EE</sub>

## ABSOLUTE MAXIMUM RATING

### (1) Electrical Absolute Ratings

Item	Symbol	Min.	Max.	Unit	Note
Power Supply for Logic	V <sub>DD</sub> -V <sub>SS</sub>	-0.3	8.0	Volt	-
Power Supply for LCD	V <sub>DD</sub> -V <sub>O</sub>	-0.3	-16.5	Volt	-
Input Voltage	V <sub>I</sub>	-0.3	V <sub>DD</sub>	Volt	-
Supply current for LED backlight	-	-	90	Ma	-

Note 1 : Operator should be grounded during handling LCM.

### (2) Environmental Absolute Maximum Ratings

Item	Normal Temperature				Wide Temperature			
	Operating		Storage		Operating		Storage	
	Max,	Min.	Max,	Min.	Max,	Min.	Max,	Min.
Ambient Temperature	0°C	+50°C	-20°C	+70°C	-20°C	+70°C	-30°C	+80°C
Humidity(without condensation)	Note 2,4		Note 3,5		Note 4,5		Note 4,6	

Note 2 Ta ≤ 50°C : 80% RH max

Ta > 50°C : Absolute humidity must be lower than the humidity of 85%RH at 50°C

Note 3 Ta at -20°C will be < 48hrs at 70°C will be < 120hrs when humidity is higher than 70%.

Note 4 Background color changes slightly depending on ambient temperature. This phenomenon is reversible.

Note 5 Ta ≤ 70°C : 75RH max

Ta > 70°C : absolute humidity must be lower than the humidity of 75%RH at 70°C

Note 6 Ta at -30°C will be < 48hrs, at 80 °C will be < 120hrs when humidity is higher than 70%.

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min.	Typ	Max.	Unit	note
Power Supply for Logic	$V_{DD}-V_{SS}$	-	2.4	5.0	7.0	Volt	
Input Voltage	$V_{IL}$	L level	$V_{SS}$	$0.2 V_{DD}$	-	Volt	
	$V_{IH}$	H level	$0.8 V_{DD}$	$V_{DD}$	-	Volt	
LCM Recommend LCD Module Driving Voltage	$V_{DD}-V_O$	Ta=-20°C	-	-	-	Volt	
		Ta=0°C	-	-	-		
		Ta=25°C	4.0	4.3	4.6		
		Ta=50°C	-	-	-		
Power Supply Current for LCM	$I_{DD}$ (LED B/L OFF)	$V_{DD}=5.0V$ $V_{DD}-V_O=4.3V$ FLM=64Hz	-	0.6	1.1	mA	
	$I_{LED}$ (LED B/L ON)		-	45	60		

## OPTICAL CHARACTERISTICS

Item	Symbol	Condition	Min.	Typ	Max.	Unit	note
Viewing angle range	$\Phi f$ (12 o'clock)	When Cr $\geq 2$	-	20	-	Degree	9,10
	$\Phi b$ (6 o'clock)		-	40	-		
	$\Phi l$ (9 o'clock)		-	30	-		
	$\Phi r$ (3 o'clock)		-	30	-		
Rise Time	Tr	$V_{DD}-V_O=4.3V$ Ta=25°C		150		mS	
Fall Time	Tf			200			
Frame frequency	Frm		-	64	-	Hz	8,10
Contrast	Cr		-	4.0	-		7

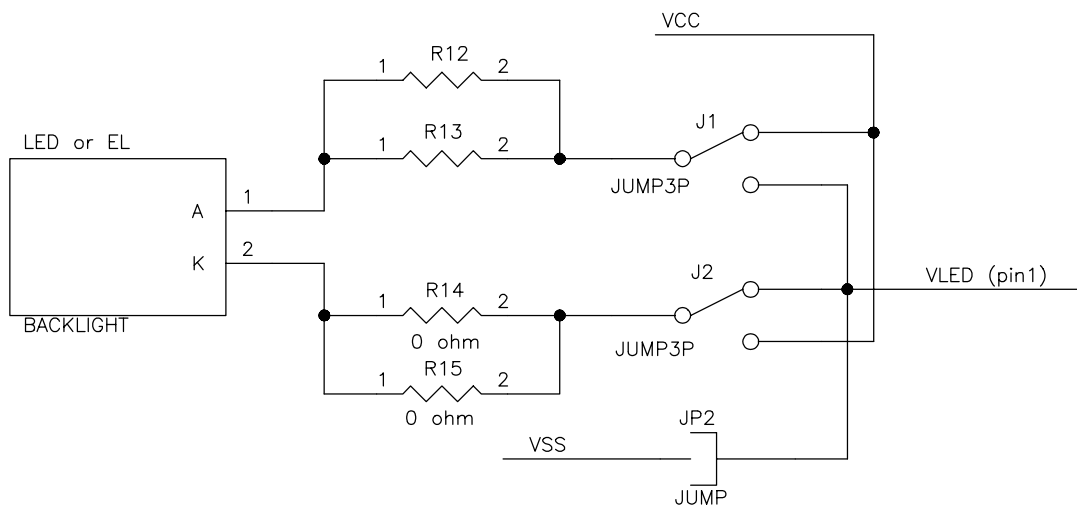
## MECHANICAL SPECIFICATION

Product No.		MTG-S12232CFYHSGY
Module Size		59.0(W)× 29.3(H)× 5.5 max(D)
Dot Size		0.345(W)mm× 0.345(H)mm
Dot Pitch		0.375(W)mm× 0.375(H)mm
Resolution		122(W)× 32(H) Dots Matrix
Duty Ratio		1/32 Duty
LCD Display Mode	STN	<input type="checkbox"/> Gray Mode <input checked="" type="checkbox"/> Yellow Mode <input type="checkbox"/> Blue Mode
	FSTN	<input type="checkbox"/> Black & White(Normally White/Positive Image) <input type="checkbox"/> Black & White(Normally White/Negative Image)
	Rear Polarizer:	<input type="checkbox"/> Reflective <input checked="" type="checkbox"/> Transflective <input type="checkbox"/> Transmissive <input type="checkbox"/> Transflective(High Transmissive)
Viewing Direction		<input checked="" type="checkbox"/> 6 O'clock <input type="checkbox"/> 12 O'clock <input type="checkbox"/> 3 O'clock <input type="checkbox"/> 9 O'clock
Backlight		<input type="checkbox"/> W/O <input type="checkbox"/> CCFL <input type="checkbox"/> EL <input checked="" type="checkbox"/> LED
Controller		Epson SED1520 or compatible
DC/DC Converter		Without
EL Driver		Without

## INTERFACE PIN ASSIGNMENT

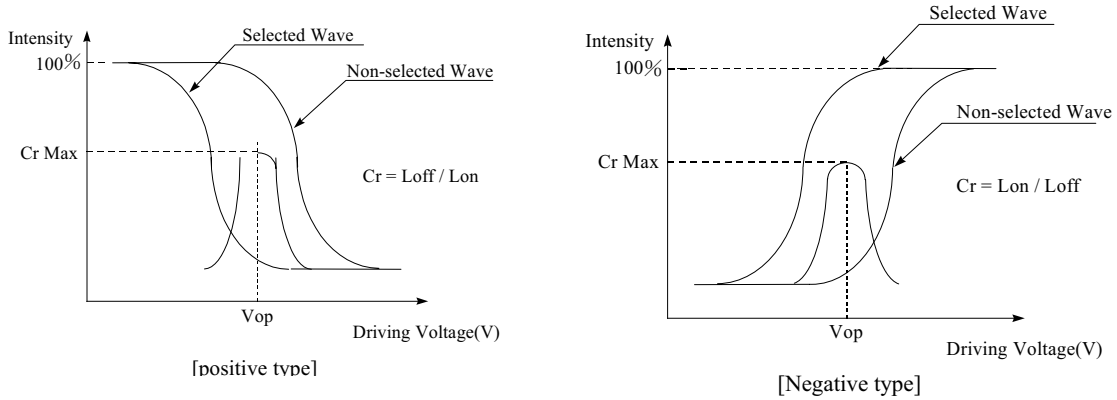
Pin No.	Pin Out	Description
1	V <sub>LED</sub>	Cathode of LED backlight, which is common Anode with logic circuit.
2	V <sub>SS</sub>	GND
3	V <sub>DD</sub>	Logic supply voltage
4	V <sub>o</sub>	LCD driver supply voltage
5	A <sub>o</sub>	Display Data/Display commands switching input. A <sub>o</sub> =0: DB0~DB7 are command input and status output. A <sub>o</sub> =1: DB0~DB7 are Display Data input/output.
6	E1	Enable signal for the left half of the screen. Active LOW
7	E2	Enable signal for the right half of the screen. Active LOW
8	DB0	3-state I/O Data Bus.
9	DB1	
10	DB2	
11	DB3	
12	DB4	
13	DB5	
14	DB6	
15	DB7	
16	R/W	High for READ, Low for WRITE.

### Jumper Explanation:

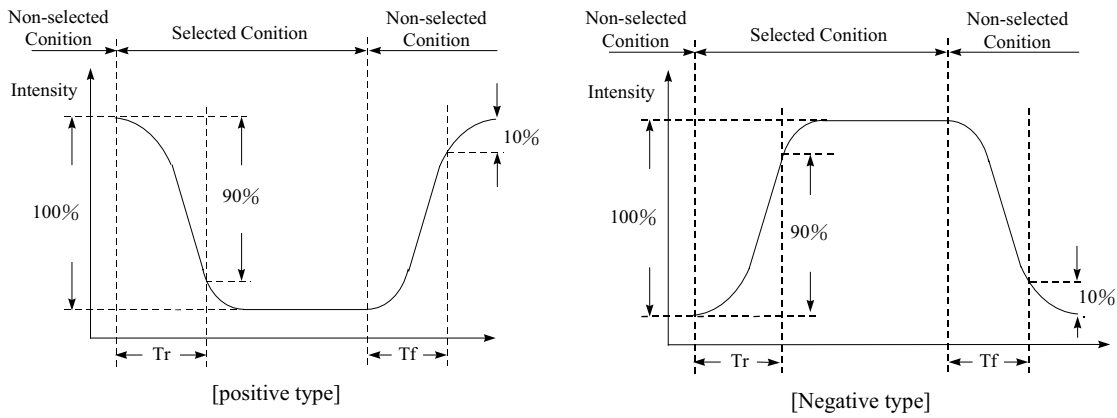




**[Note 7] Definition of Operation Voltage (Vop)**



**[Note 8] Definition of Response Time (Tr, Tf)**



**Conditions:**

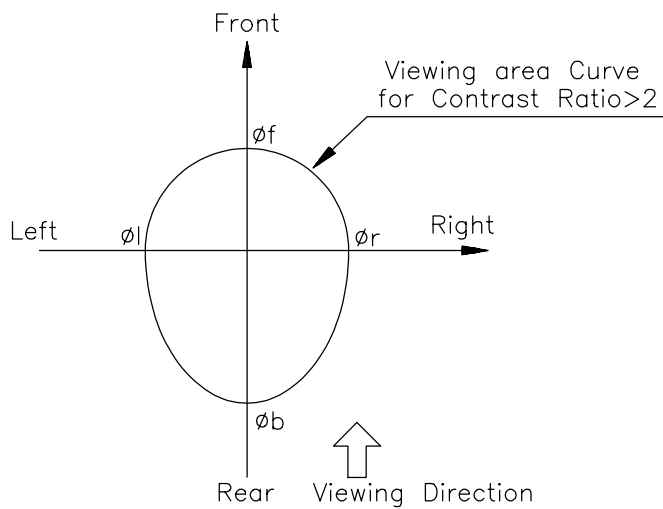
**Operating Voltage : Vop**

**Frame Frequency : 64 Hz**

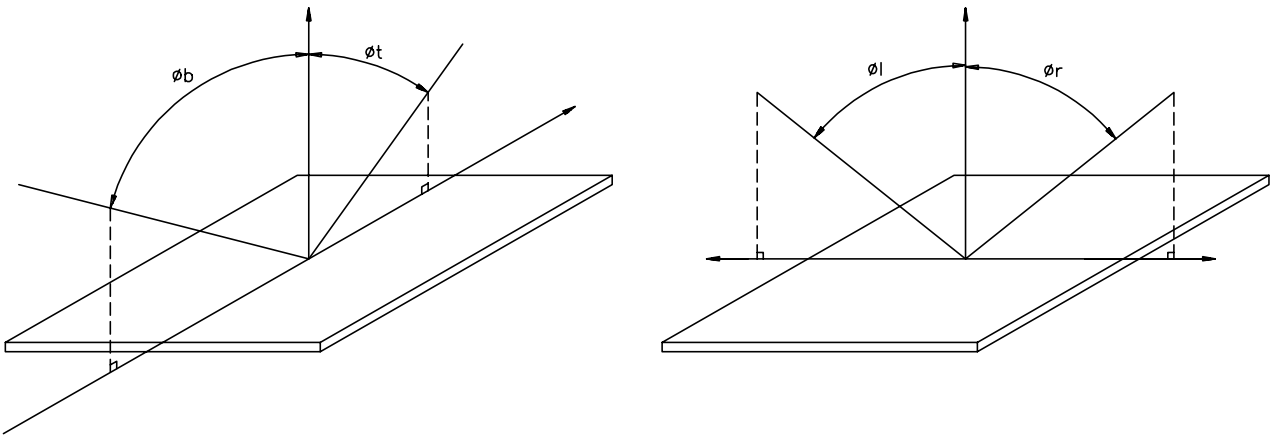
**Viewing Angle( $\theta, \varphi$ ):  $0^\circ, 0^\circ$**

**Driving Wave form : 1/N duty, 1/a bias**

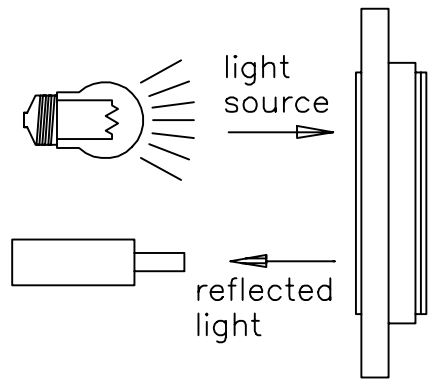
**[Note 9] Definition of Viewing Direction**



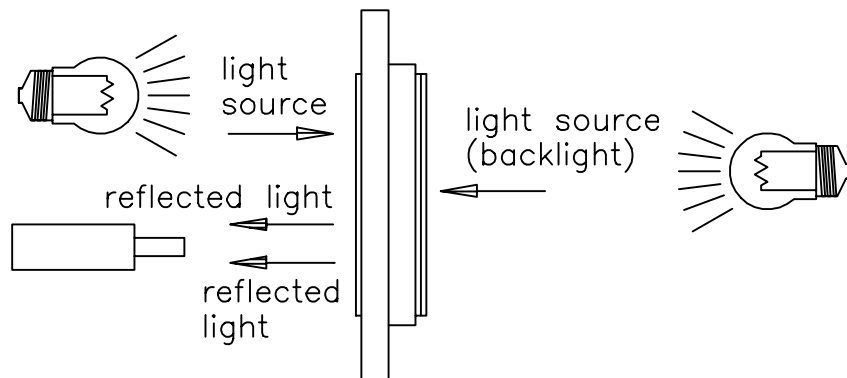
**[Note 10] Definition of viewing angle**



**[Note 11] Description of Measuring Equipment**

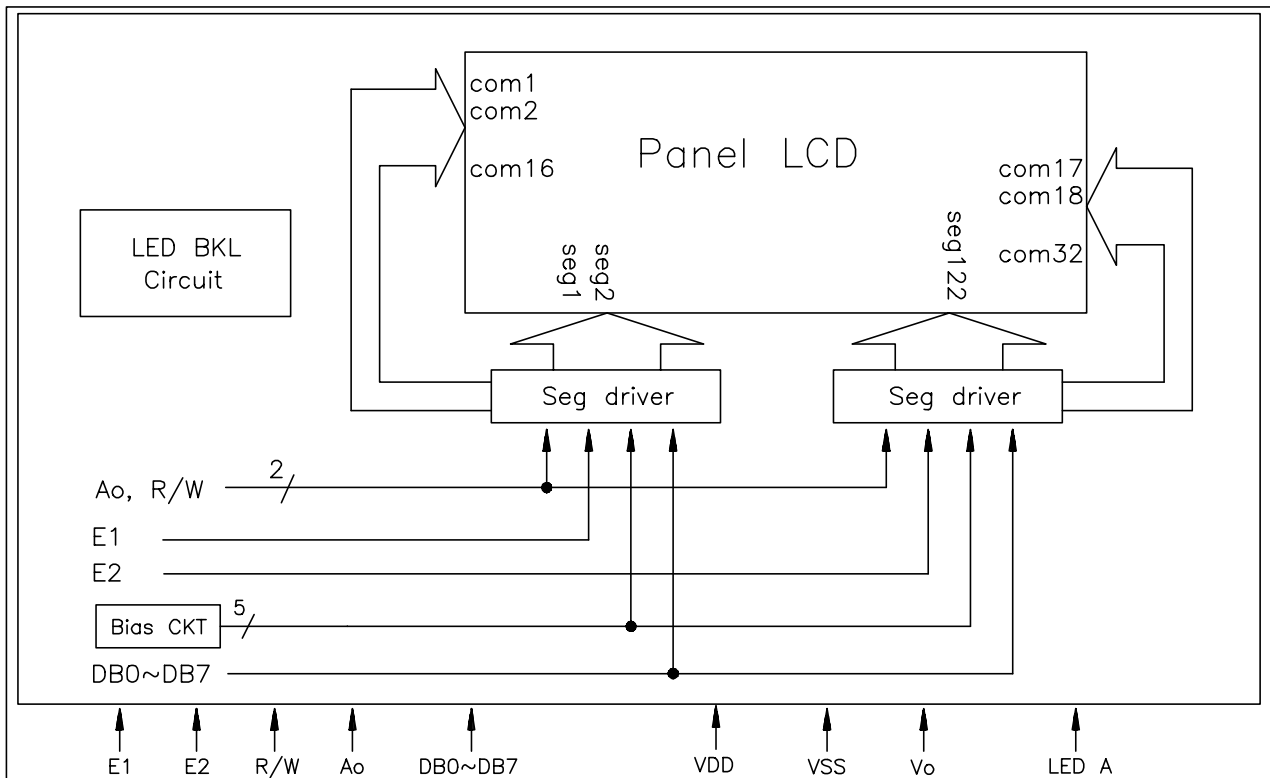


Reflective type

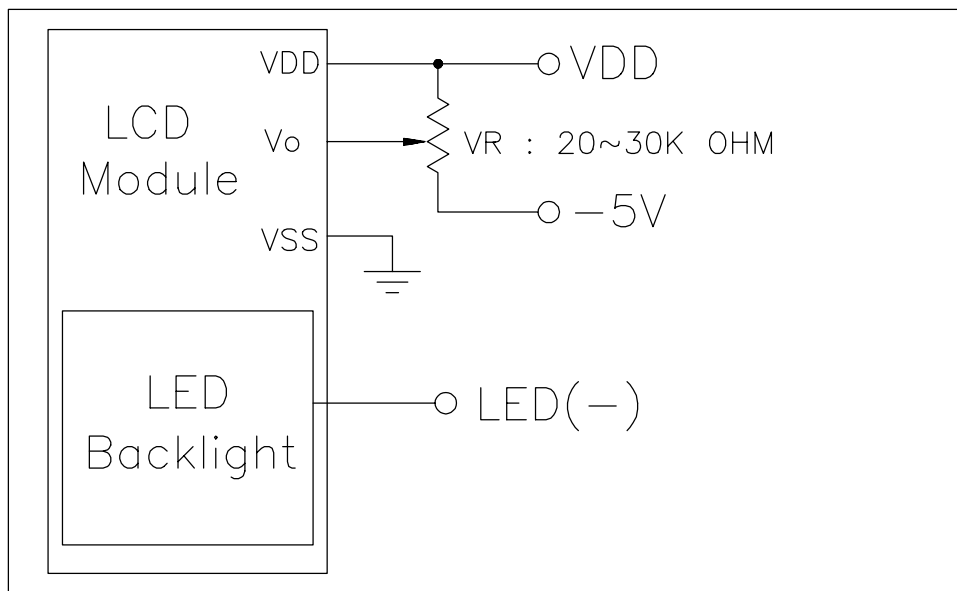


Transflective type

## BLOCK DIAGRAM

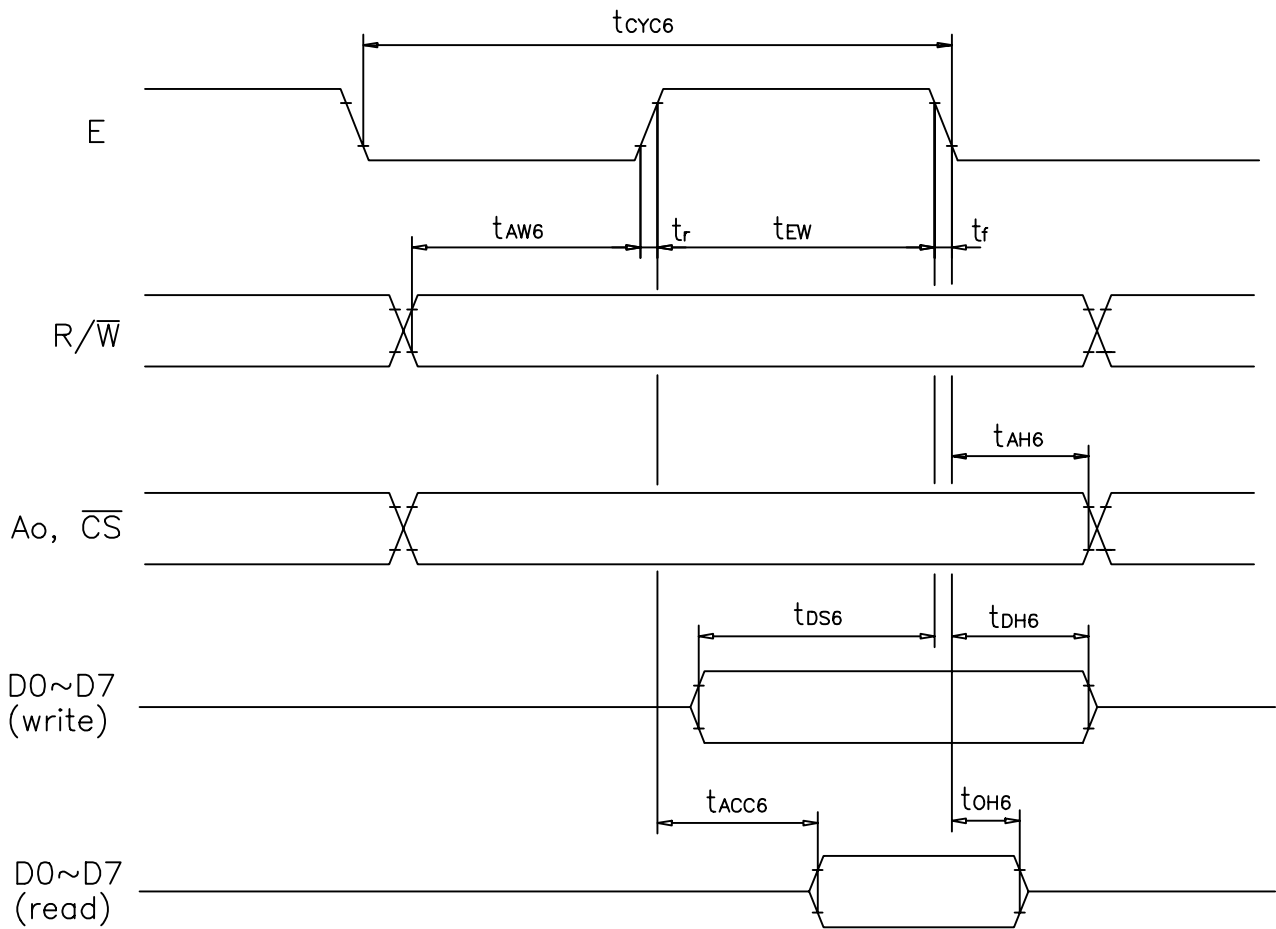


## POWER SUPPLY



# TIMING CHARACTERISTICS

AC Characteristic—68-series MPU Bus Read/Write



Ta=0~50°C, V<sub>DD</sub>=5.0V± 10%, unless state otherwise

Parameter	Symbol	Condition	Rating		Unit	Signal
			Min.	Max.		
System cycle time	t <sub>CYC6</sub>		1000	-	ns	Ao, CS, R/W
Address setup time	t <sub>AW6</sub>		20	-	ns	
Address hold time	t <sub>AH6</sub>		10	-	ns	
Data setup time	t <sub>DS6</sub>		80	-	ns	D0 to D7
Data hold time	t <sub>DH6</sub>		10	-	ns	
Output disable time	t <sub>OH6</sub>	C <sub>L</sub> =100pF	10	60	ns	
Access time	t <sub>ACC6</sub>		-	90	ns	
Enable pulse-width	Read	t <sub>EW</sub>	100	-	ns	E
	Write		80	-	ns	
Rise and fall time	t <sub>r</sub> , t <sub>f</sub>	-	-	15	Ns	-

Ta=0~50°C, V<sub>DD</sub>=2.7 to 4.5V,

Parameter	Symbol	Condition	Rating		Unit	Signal
			Min.	Max.		
System cycle time	t <sub>CYC6</sub>		2000	-	ns	Ao, CS, R/W
Address setup time	t <sub>AW6</sub>		40	-	ns	
Address hold time	t <sub>AH6</sub>		20	-	ns	
Data setup time	t <sub>DS6</sub>		160	-	ns	D0 to D7
Data hold time	t <sub>DH6</sub>		20	-	ns	
Output disable time	t <sub>OH6</sub>	C <sub>L</sub> =100pF	20	120	ns	
Access time	t <sub>ACC6</sub>		-	180	ns	
Enable pulse-width	Read	t <sub>EW</sub>	200	-	ns	E
	Write		160	-	ns	
Rise and fall time	t <sub>r</sub> , t <sub>f</sub>	-	-	15	Ns	-



## DISPLAY COMMANDS

Instruction	Ao	E	R/W	D7	D6	D5	D4	D3	D2	D1	D0	Function
Display ON/OFF	0	1	0	1	0	1	0	1	1	1	1/0	To control the display ON or OFF. The internal status and display RAM data are not affected. 0:OFF, 1:ON
Display start line	0	1	0	1	1	0	Display start address (0~31)					Specifies RAM line corresponding to top line of display.
Set page address	0	1	0	1	0	1	1	1	0	Page (0 to 3)		To set the display RAM page in page address register.
Set column (segment) address	0	1	0	0	Column address (0 to 79)							To set display RAM column address in column address register.
Status Read	0	0	1	Busy	ADC	ON/OFF	Reset	0	0	0	0	Read the following status: Busy 1: Busy 0: Ready ADC 1: CW output 0: CCW output ON/OFF 1: Display OFF 0: Display ON Reset 1: Being reset 0: Normal
Write display data	1	1	0	Write Data							To write data from data bus to display RAM.	
Read display data	1	0	1	Read Data							To read data from display RAM to data bus	
Select ADC	0	1	0	1	0	1	0	0	0	0	0/1	0: CW output, 1: CCW output
Status drive ON/OFF	0	1	0	1	0	1	0	0	1	0	0/1	To select static driving operation 1: Static drive, 0: Normal driving
Select Duty	0	1	0	1	0	1	0	1	0	0	0/1	To select duty cycle 1: 1/32 duty, 0: 1/16 duty
Read-modify-write	0	1	0	1	1	1	0	0	0	0	0	Read-modify-write ON
End	0	1	0	1	1	1	0	1	1	1	0	Read-modify-write OFF
Reset	0	1	0	1	1	1	0	0	0	1	0	To reset by software

## COMMAND DESCRIPTION

### Display ON/OFF

Ao	E	W/R	D7	D6	D5	D4	D3	D2	D1	D0	
0	1	0	1	0	1	0	1	1	1	D	AEH, AFH

This command turns the display ON or OFF.

D=1 : Display ON

D=0 : Display OFF

### Display Start Line

This command specifies the line address shown in page 13 and indicates the display line that corresponding to COM 0. The display area begins at the specified line address and continues in the line address increment direction. This area having the number of line of specified display duty is displayed. If the line address is changed dynamically by this command, the vertical smooth scrolling and paging can be used.

Ao	E	W/R	D7	D6	D5	D4	D3	D2	D1	D0	
0	1	0	1	1	0	A4	A3	A2	A1	A0	C0H to DFH

This command loads the display start line register.

A4	A3	A2	A1	A0	Line Address
0	0	0	0	0	0
0	0	0	0	1	1
		⋮			⋮
1	1	1	1	1	31

See the figure in page 13.

### Set Page address

This command specifies the page address that corresponds to the low address of the display data RAM when it is accessed by the MPU. Any bit of the display data RAM can be accessed when its page address and column address are specified. The display status is not changed even when the page address is changed.

Ao	E	W/R	D7	D6	D5	D4	D3	D2	D1	D0	
0	1	0	11	0	1	1	1	0	A1	A0	B8H to BBH

This command loads the page address register.

A1	A0	Page
0	0	0
0	1	1
1	0	2
1	1	3

See the figure in page 13.



### Set Column Address

This command specifies a column address of the display data RAM. When the display data RAM is accessed by the MPU continuously, the column address is increased by 1 every time. Therefore the MPU can access to data continuously. The column address stops to be incremented at address 80, and the page address is not changed continuously.

Ao	E	W/R	D7	D6	D5	D4	D3	D2	D1	D0	
0	1	0	0	A6	A5	A4	A3	A2	A1	A0	00H to 4FH

This command loads the column address register.

A6	A5	A4	A3	A2	A1	A0	Line Address
0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	1
			⋮				⋮
1	1	1	1	1	1	1	79

### Read Status

Ao	E	W/R	D7	D6	D5	D4	D3	D2	D1	D0	
0	0	1	BUSY	ADC	ON/OFF	RESET	0	0	0	0	00H to 4FH

Reading the command I/O register (Ao=0) yields system status information.

- The busy bit indicates whether the driver will accept a command or not.
  - Busy=1: The driver is currently executing a command or is resetting. No new command will be accepted.
  - Busy=0: The driver will accept a new command.
- The ADC bit indicates the way column addresses are assigned to a segment drivers
  - ADC=1: Normal. Column address n → segment address n.
  - ADC=0: Inverted. Column address 79-u → segment driver u.
- The ON/OFF bit indicates the current status of the display.
  - It is the inverse of the polarity of the display ON/OFF command.
  - ON/OFF=1: Display OFF.
  - ON/OFF=0: Display ON.
- The RESET bit indicates whether the driver is executing a hardware or a software reset or it is in a normal operating mode.
  - RESET=1: Currently executing the reset command.
  - RESET=0: Normal operating.

### Write Display Data

Ao	E	W/R	D7	D6	D5	D4	D3	D2	D1	D0
1	1	0	Write Data							

To write an 8-bit data into the display RAM, at a location specified by the contents of the column address and page address register by one.

## Read Display Data

Ao	E	W/R	D7	D6	D5	D4	D3	D2	D1	D0
1	0	1	Read Data							

To read an 8-bit data from the data I/O latch, updates the contents of the I/O latch with display data from the display data RAM location specified by the contents of the column address and page address registers and then increments the column address register.

After loading a new address into the column address register one dummy read is required before valid data is obtained.

## Select ADC

Ao	E	W/R	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	0	1	0	0	0	0	D

A0H, A1H

This command selects the relationship between display data RAM column address and segment driver.

D=0: SEG0 ← column address 00H, ...(normal)

This command is provided to reduce restrictions on the placement of the driver ICs and routing of tracing during printed circuit board layout. In this LCD module the D should be cleared to 0.

## Static Driver ON/OFF

Ao	E	W/R	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	0	1	0	0	1	0	D

A4H, A5H

To force the display on and all common outputs to be selected.

D=1: Static driver ON.

D=0: Static driver OFF.

## Select Duty

Ao	E	W/R	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	0	1	0	1	0	0	D

A8H, A9H

To set the D-bit to 1 because the LCD module is 1/32 duty.

## End

Ao	E	W/R	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	0	1	1	1	0

EEH

This command cancels the **Read-Modify-Write** mode and restores the contents of the column address register to their value prior to the receipt of the **Read-Modify-Write** command.

## Reset

Ao	E	W/R	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	0	0	0	1	0

E2H

This command clears:

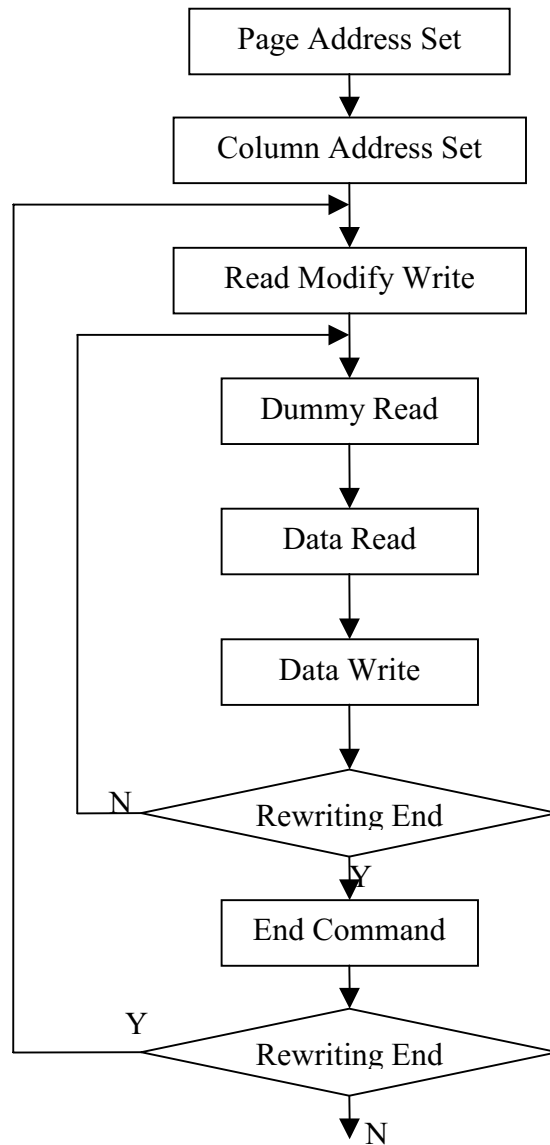
The display start line register and to set page address register to 3 page.

It does not affect the contents of the display data RAM. When the power supply is turned on, the user must sent a Reset signal into the RES pin. The Reset command cannot be used instead of this Reset signal.

## Read-Modify-Write

Ao	E	W/R	D7	D6	D5	D4	D3	D2	D1	D0	
0	1	0	1	1	1	0	0	0	0	0	E0H

This command defeats column address register auto-increment after reading data. The current contents of the column address register are saved. This mode remains active until an **END** command is received.



# INITIALIZATION PROCEDURE

Initialization status:

1. Display is OFF
2. Display start line register is set to line 1
3. Static drive is turn off
4. Column address counter is set to address 0.
5. Page address register is set to page 3.
6. 1/32 duty is selected.
7. Forward ADC is selected(ADC command D0 is 1 and ADC status flag is 1)
8. Read-modify-write is OFF.

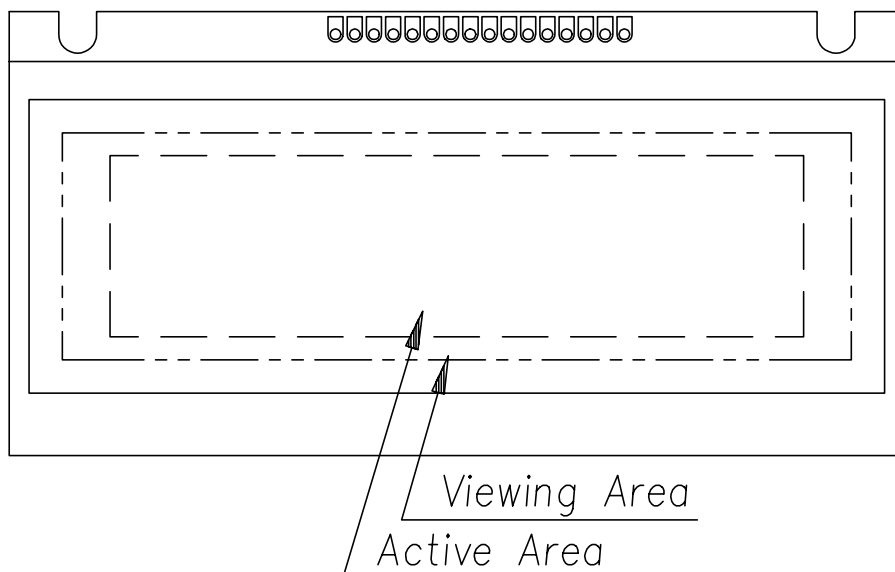
## RELIABILITY TEST

No	Item	Conditions		Note
1	High Temp. Operation	70°C	240 Hr	
2	High Temp. Storage	80°C	240 Hr	
3	Low Temp. Operation	-20°C	240 Hr	
4	Low Temp. Storage	-30°C	240 Hr	
5	High Temp./Humid Storage	60°C 90%RH	240 Hr	
6	Thermal Shock	-20°C ,30min +60°C ,30min	10 cycles	
7	Vibration Test ( IEC-68-2-6 )	Frequency : 10~55 Hz Duration : 20 times, 6 min/time Amplitude : 0.75 mm	-	
8	Shock ( IEC 68-2-27)	Duration : 11 mS Acceleration : 100g	-	X, Y, Z direction

## APPEARANCE CHECK

CONDIITON OF APPEARANCE CHECK:

- (1) Specimen shall be checked by eyes in distance of 30cm under 40w-fluorescence lamp.
- (2) Checking direction shall be in 45 degree from perpendicular line op specimen surface.



## HANDLING PRECAUTIONS

- (1) Treat polarizer very carefully since it is easy to be damaged.
- (2) When cleaning the display surface, use soft cloth (e.g. gauss) with a solvent (recommended below) and wipe lightly.

- ◆ ethyl alcohol
- ◆ iso-procolol

Do not wipe the display surface with dry or hard materials that will damage the polarizer surface.

Do not use the following solvents:

- ◆ water
- ◆ ketone
- ◆ aromatics

- (3) Direct current causes electro-chemical reaction with remarkable degradation of the display quality. Give careful consideration to prevent direct current at ON/OFF timing and during operation.
- (4) Avoid strong shock and drop from the height.
- (5) To prevent LCD panels from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity.
- (6) Give careful consideration to avoid electrical static discharge with causes uneven contrast.
- (7) Even a small condensation on the contact pads (terminals) causes electro-chemical reaction which makes missing row and column. Give careful attention to avoid condensation. When assembling with zebra connector, clean the surface of the pads with alcohol and keep the air very clean.



