

TIEM	DESCRIPTION				
Product No	SG12232AULB-GS-K				
LCD Type	<input type="checkbox"/> STN Gray	<input checked="" type="checkbox"/> STN Yellow Green	<input type="checkbox"/> STN Blue		
	<input type="checkbox"/> TN Negative		<input type="checkbox"/> TN Positive		
	<input type="checkbox"/> FSTN Negative White & Black		<input type="checkbox"/> FSTN Positive Black & White		
Rear Polarizer	<input type="checkbox"/> Reflective		<input checked="" type="checkbox"/> Transflective	<input type="checkbox"/> Transmissive	
Backlight Type	<input checked="" type="checkbox"/> LED	<input type="checkbox"/> Internal Power	<input type="checkbox"/> CCFL	<input type="checkbox"/> EL	<input type="checkbox"/> 5V input
Backlight Color	<input type="checkbox"/> White	<input type="checkbox"/> Amber	<input type="checkbox"/> Green Blue	<input checked="" type="checkbox"/> Yellow Green	<input type="checkbox"/> Other
View Direction	<input checked="" type="checkbox"/> 6 O'clock		<input type="checkbox"/> 12 O'clock		
Temperature Range	<input checked="" type="checkbox"/> Normal		<input type="checkbox"/> Wide		
Frame	<input type="checkbox"/> Black		<input checked="" type="checkbox"/> Silver		
EL Inverter	<input type="checkbox"/> Build-in		<input checked="" type="checkbox"/> Not Build-in		

**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.



## GENERAL SPECIFICATION

Item	Content
Display Resolution	122(W)×32(H)
Dimensional Outline(mm)	84.0(W)×36.0(H)×12.7 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 , E , CS1, CS2 , RES,CL

## ABSOLUTE MAXIMUM RATING

### (1) Electrical Absolute Ratings

Item	Symbol	Min.	Max.	Unit	Note
Power Supply for Logic	$V_{DD}-V_{SS}$	-0.3	8.0	Volt	
Power Supply for LCD	$V_{DD}-V_O$	-0.3	12.0	Volt	
Input Voltage	$V_I$	-0.3	$V_{DD}$	Volt	
Static Electricity	-	-	-	-	Note 1
LED Power Dissipation	$P_{AD}$	-	0.9	W	
LED Forward current	$I_{AF}$	-	195	mA	
LED Reverse Voltage	$V_R$	-	8	V	

Note 1 : Operator should be grounded during handling LCM.

### (2) Environmental Absolute Maximum Ratings

Item	Normal Temperature				Wide Temperature			
	Operating		Storage		Operating		Storage	
	Min,	Max.	Min,	Max.	Min,	Max.	Min,	Max.
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  $T_a \leq 50^\circ\text{C}$  : 80% RH max

$T_a > 50^\circ\text{C}$  : Absolute humidity must be lower than the humidity of 85%RH at  $50^\circ\text{C}$

Note 3  $T_a$  at  $-20^\circ\text{C}$  will be <48hrs at  $70^\circ\text{C}$  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  $T_a \leq 70^\circ\text{C}$  : 75RH max

$T_a > 70^\circ\text{C}$  : absolute humidity must be lower than the humidity of 75%RH at  $70^\circ\text{C}$

Note 6  $T_a$  at  $-30^\circ\text{C}$  will be <48hrs, at  $80^\circ\text{C}$  will be <120hrs when humidity is higher than 70%.

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min.	Typ	Max.	Unit	note
Power Supply for Logic	$V_{DD}-V_{SS}$	-	4.5	5.0	5.5	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	4.4	4.8	5.2		
		Ta=50°C	-	-	-		
Power Supply Current for LCM	$I_{DD}$ (LED B/L OFF)	$V_{DD}=5.0V$ $V_{DD}-V_O=4.8V$ FLM=64Hz	-	0.6	1.1	mA	
	$I_{LED}$ (LED B/L ON)		-	90	120		
LED For Ward Doltage	$V_F$	If= 130 mA	-	4.2	4.6	Volt	
LED For Ward Current	$I_F$	-	-	130	-	mA	
LED Reverse Current	$I_R$	VR=8V	-	-	0.2	mA	

## OPTICAL CHARACTERISTICS

Item	Symbol	Condition	Min.	Typ	Max.	Unit	note
Viewing angle range	$\Phi f$ (12 o'clock)	When Cr $\geq$ 1.4	-	10	-	Degree	9,10
	$\Phi b$ (6 o'clock)		-	30	-		
	$\Phi l$ (9 o'clock)		-	30	-		
	$\Phi r$ (3 o'clock)		-	30	-		
Rise Time	Tr	$V_{DD}-V_O=4.8V$ Ta=25°C		200		mS	
Fall Time	Tf			250			
Frame frequency	Frm		-	64	-	Hz	8,10
Contrast	Cr		-	5.0	-		7
The Brightness Of Backlight	L	IF=130 mA	140	180	-	cd/m <sup>2</sup>	
Peak Emission Wavelength	$\lambda P$		-	570	576	nm	

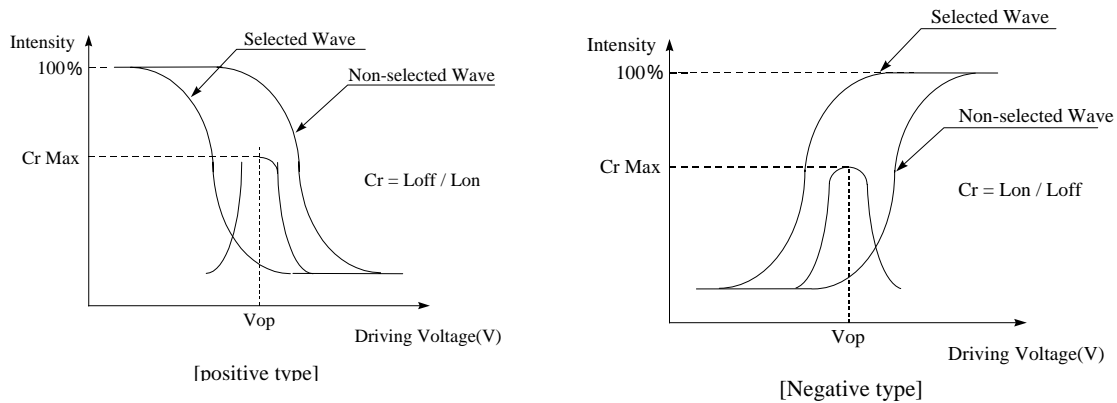
## MECHANICAL SPECIFICATION

Product No.		SG12232A
Module Size		84.0(W)×36.0(H)×12.7 max(D)
Dot Size		0.4(W)mm×0.45(H)mm
Dot Pitch		0.44(W)mm×0.49(H)mm
Resolution		122(W)×32(H) Dots Matrix
Duty Ratio		1/32 Duty
Controller		Epson SED1520 or compatible
DC/DC Converter		Without

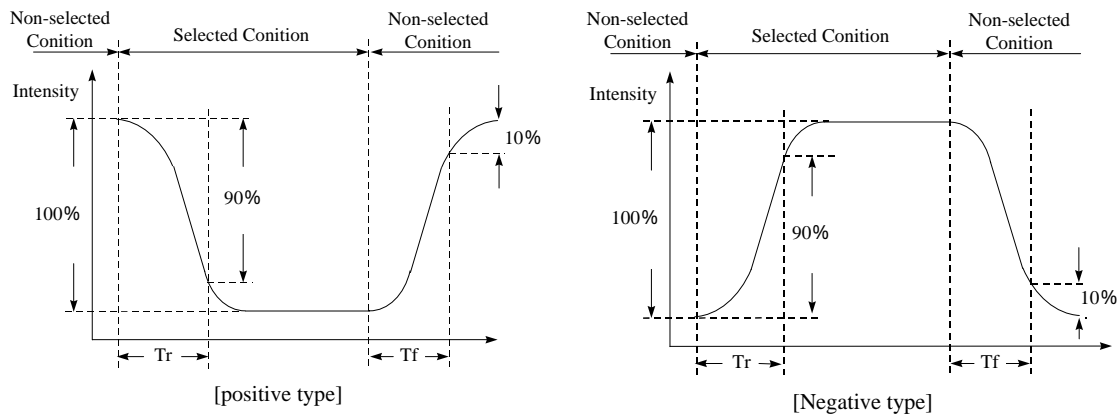
**INTERFACE PIN ASSIGNMENT**

Pin No.	Pin Out	Level	Description
1	VSS	0V	GND
2	VDD	5V	Supply Voltage for Logic and LCD
3	Vo	---	LCD driver supply voltage
4	Ao	H/L	Data Type select signal
5	/CS1	H	Chip Select Signal for IC1
6	/CS2	H	Chip Select Signal for IC2
7	CL	H/L	Clock Input (2 KHz)
8	E	H→L	Enable Signal
9	R/W	H/L	H : Read / L : WRTIE
10	DB0	H/L	Data Bit 0
11	DB1	H/L	Data Bit 1
12	DB2	H/L	Data Bit 2
13	DB3	H/L	Data Bit 3
14	DB4	H/L	Data Bit 4
15	DB5	H/L	Data Bit 5
16	DB6	H/L	Data Bit 6
17	DB7	H/L	Data Bit 7
18	/RES	L	Reset Signal
19	A	4.2V	LED Power (+)
20	K	0V	LED Power (-)

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



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



### Conditions:

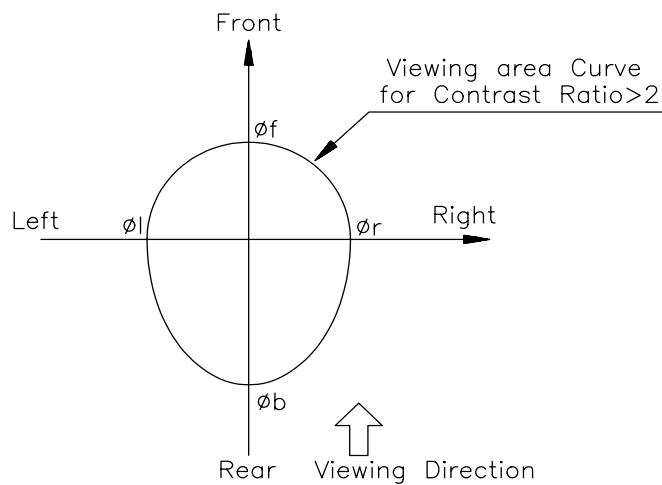
Operating Voltage : Vop

Frame Frequency : 64 Hz

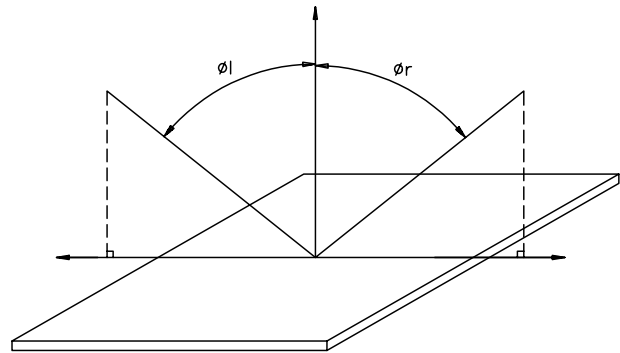
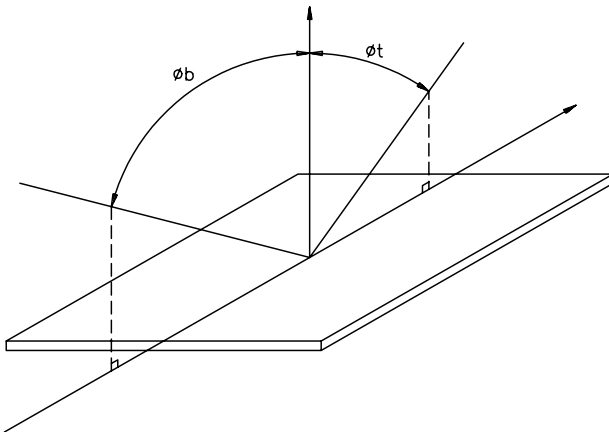
Viewing Angle( $\theta, \varphi$ ):  $0^\circ, 0^\circ$

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

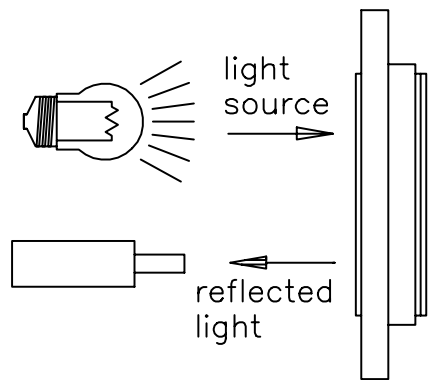
## [Note 9] Definition of Viewing Direction



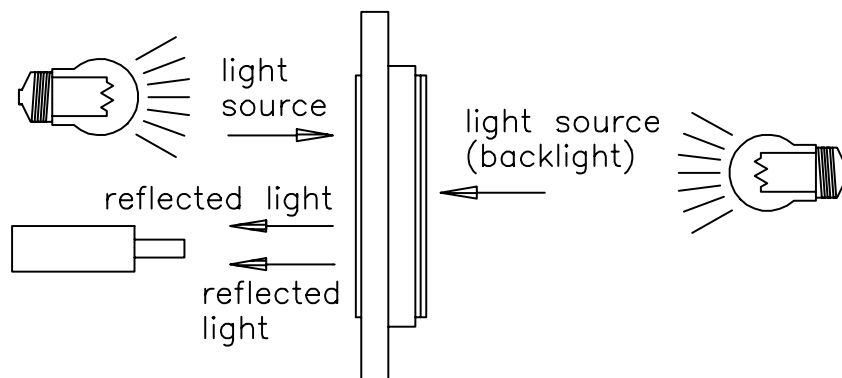
**[Note 10] Definition of viewing angle**



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



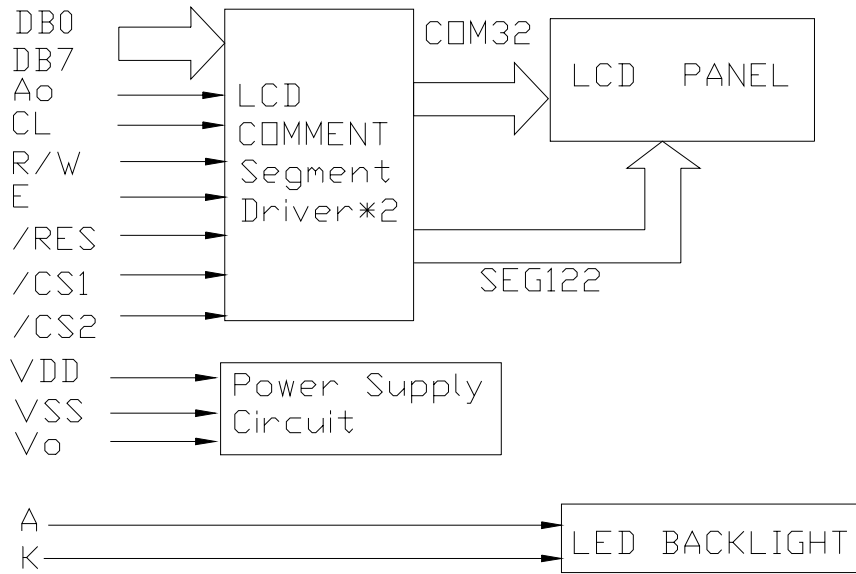
Reflective type



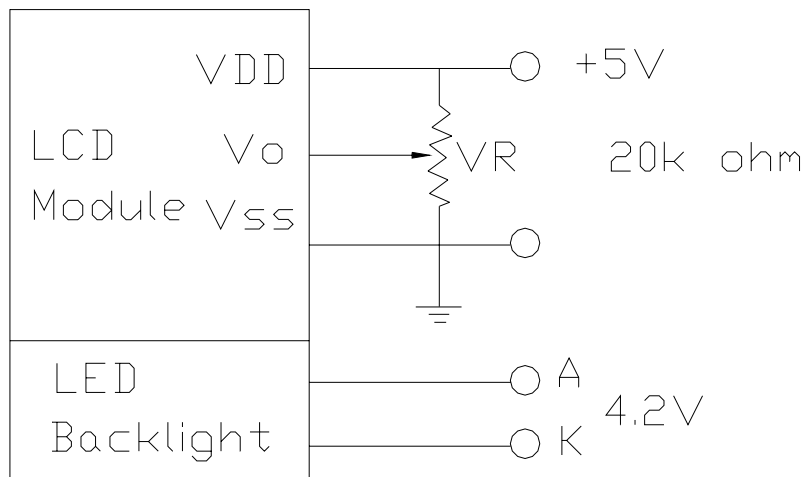
Transflective type



## BLOCK DIAGRAM

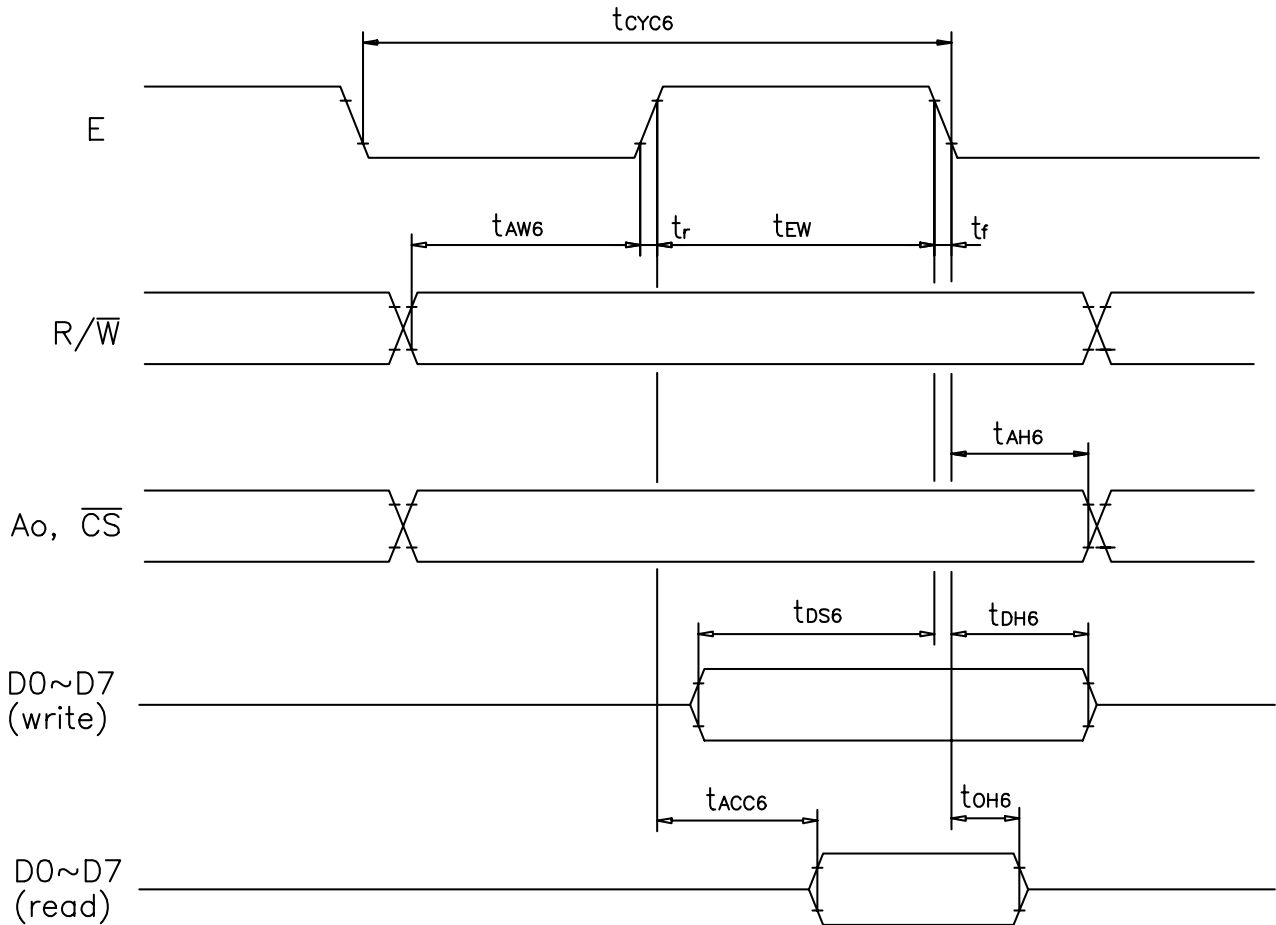


## POWER SUPPLY



## TIMING CHARACTERISTICS

AC Characteristic—68-series MPU Bus Read/Write



# SUNLIKE DISPLAY

Mode No: SG12232A

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	1	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.

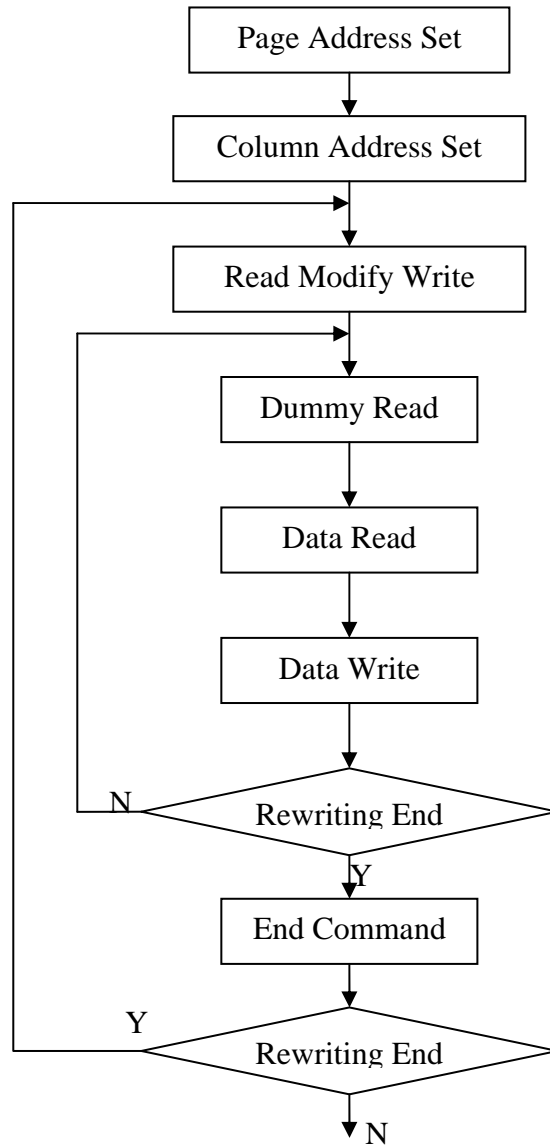
It does not affect the contents of the display data RAM. When the power supply is turned on, the user must sent a Reset signal into the RES pin. The Reset command cannot be used instead of this Reset signal.



## 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.



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## INITIALIZATION PROCEDURE

Detects a rising edge or falling edge of an RES input and initializes the MPU during power-on.  
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.