

SPECIFICATION

ECM-A1010

(Omaha/Amps)

**SEIKO EPSON CORPORATION
LCD DIVISION**

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1. BASIC SPECIFICATIONS

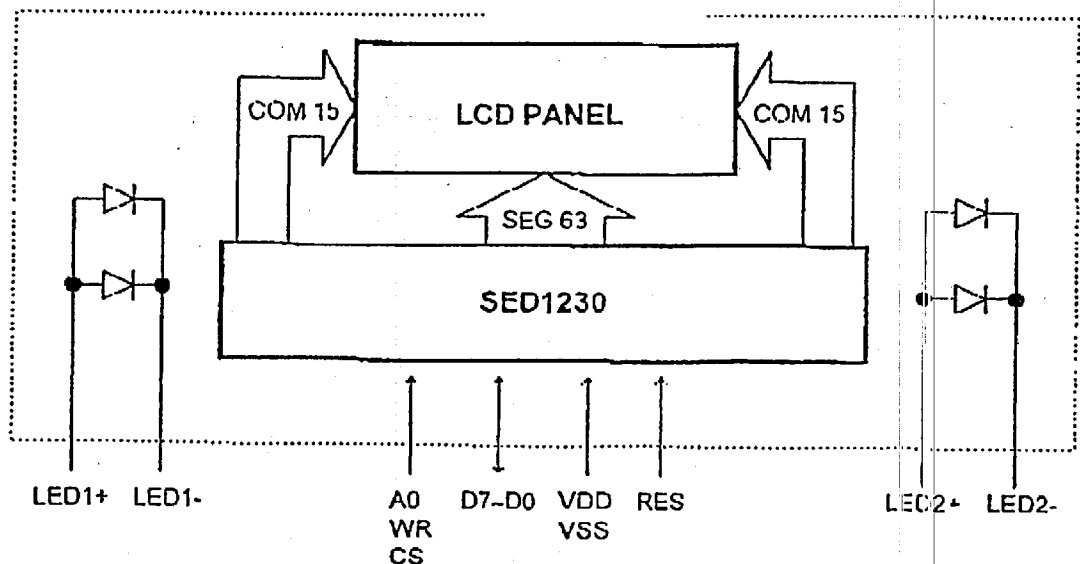
1.1. Display Specifications

- 1) LCD Mode : FTN : Positive : Transflective
 - 2) Display Color *1
 - Display Color : Display Data "1" : Black
 - Background Color : Display Data "0" : White
 - 3) Viewing Angle : 6 O'clock Direction
 - 4) Driving Duty and Bias : 1/30 Duty, 1/5 Bias
 - 5) Backlight : LED Backlight (Yellow Green)
- *1 Color tone is slightly changed by temperature and driving voltage.

1.2. Mechanical Specifications

- 1) Outline Dimension : Refer to attached outline dimensions figure TD-270231
- 2) Design Dimension : Refer to attached design dimensions figure M10255B1
- 3) Wiring Drawing : Refer to attached wiring drawing figure M10255C1
M10255D1
- 4) Display Format : 12 x 4 + Icons (Characters)
- 5) Character Structure : 5 x 7 (Pixels)
- 6) Pixel Size : 0.36 x 0.49 (mm)
- 7) Pixel Pitch : 0.4 x 0.53 (mm)
- 8) Weight : Approx. 7.4 (g)

1.3. Block Diagram



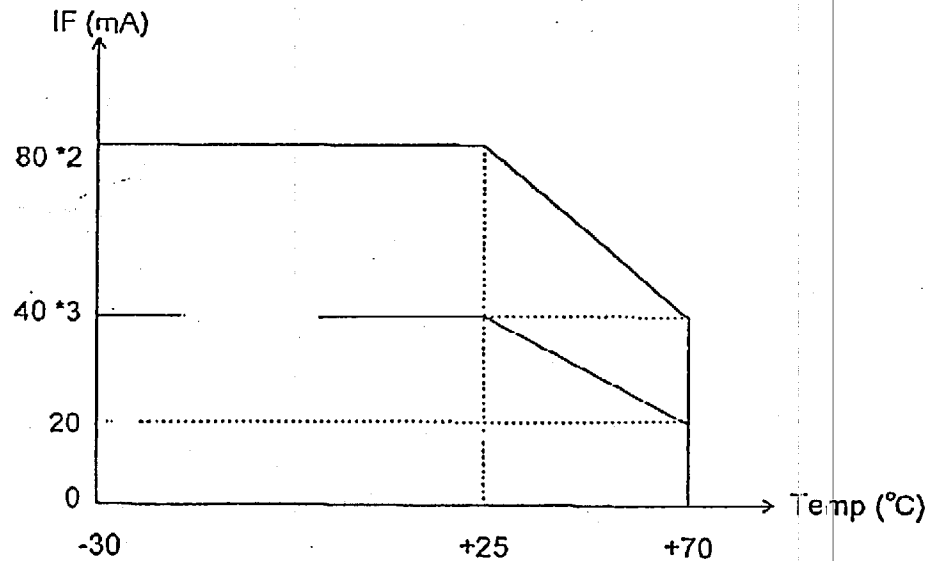
1.4. Terminal Functions

Pin No.	Symbol	Type	Function
1	LED1+	I	LED1 Anode
2	LED1-	I	LED1- Cathode
3	A0	I	Selects Register (“L” = Command, “H” = Data)
4	WR	I	Write Enable Input (“L” = Active)
5	CS	I	Chip Selects (“L” = Enable)
6 - 13	D7 - D0	I	Data Bus
14	VDD	I	Power Supply for Logic(2.8V±1%)
15	VSS	I	Ground
16	RES	I	Reset
17	LED2+	I	LED2 Anode
18	LED2-	I	LED2 Cathode

2.ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Standard Value		Unit	Condition
		Min	Max		
Power Supply Voltage	VDD-VSS	-0.3	6.0	V	
LCD Driving Voltage	VDD-V5	-0.3	16.0	V	
Input Voltage	VIN	0.3	VDD+0.3	V	
Operating Temperature	TOP	-30	70	°C	No Condensation
Storage Temperature	TST	-40	80	°C	No vibration and shock within 18 hours. No Condensation
LED Backlight Forward Current *1	4 parallel	IF	80 *2	mA	Ta = 25°C
	2 series 2 parallel		40 *3		
LED Backlight Reverse Voltage	4 parallel	VR	4	V	Ta = 25°C
	2 series 2 parallel		8		
LED Backlight Power Dissipation	PD		200	mW	Ta = 25°C

*1 : Allowable Forward Current Derating.



3.ELECTRICAL CHARACTERISTICS

3.1.DC Characteristics

3.1.1.Module DC Characteristics

Ta = -30-70°C, VDD = 2.8V±1%

Item	Symbol	Standard Value			Unit	Applicable Terminal	Condition
		Min.	Typ.	Max.			
Power Supply Voltage	VDD	2.11	2.8	2.83	V	VDD	
Adjustment range of LCD driving Voltage (Triple Boost)	[VDD-V5]	4.5	-	3VDD	V	VDD, V5	
		Depending on Optical Characteristics					
"0" Input Voltage	VIL	0	-	0.2VDD	V	*1	
"1" Input Voltage	VIH	0.8VDD	-	VDD	V		
I/O Leak Current	IIL	-1.0		1.0	μA	*1	VIN = VDD or VSS
Power Supply Current	IDD	-	0.21	0.25	mA	VDD	Normal Mode
		-	-	5.0	μA	VDD	Sleep Mode
Frame Frequency	fFR	70	-	130	Hz	VDD	Ta=25°C

*1 A0, RES, CS, WR, D0 - D7

3.2.AC Characteristics

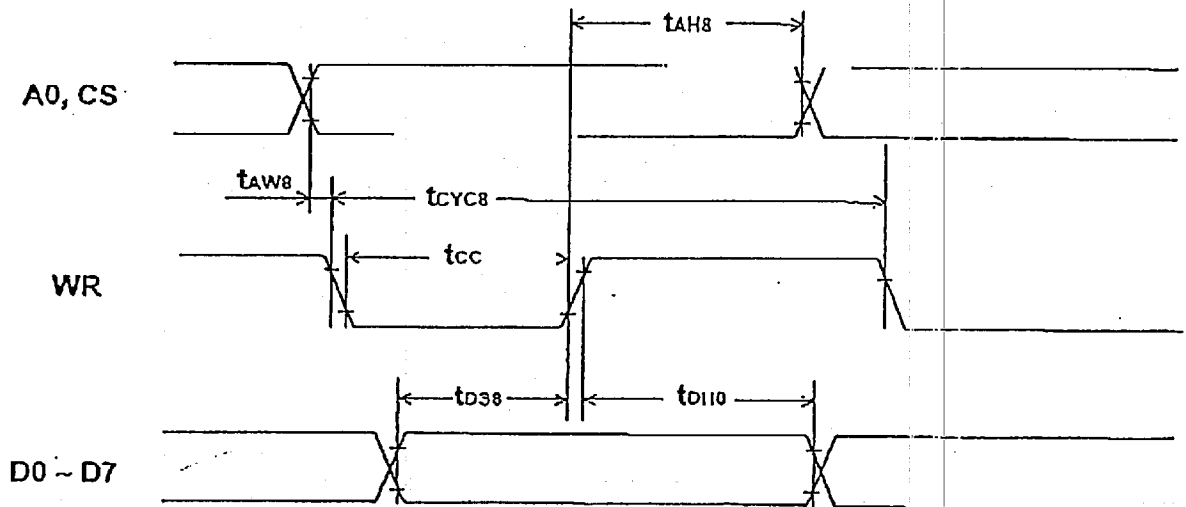
$T_a = -30 \sim 70^\circ\text{C}$, $V_{DD} = 2.8\text{V} \pm 1\%$

Parameter	Symbol	Min	Max	Unit	Applicable
Address Hold Time	t_{AH8}	30	-	ns	A0, CS
Address Setup Time	t_{AW8}	60	-	ns	
System Cycle Time	t_{CYC8}	500	-	ns	WR
Control Pulse Width	t_{CC}	100	-	ns	
Data Setup Time	t_{DS8}	100	-	ns	D0 ~ D7
Data Hold Time	t_{DH8}	50	-	ns	

*1 The input signal rise time and fall time shall both be 15ns or less.

*2 Each timing is based on 20% and 80% of V_{DD} .

3.3.Timing Chart



4. OPERATING SPECIFICATIONS

4.1. Function Specifications

4.1.1. Instruction Table

* Invalid Data

Command	Code									Function
	D7	D6	D5	D4	D3	D2	D1	D0		
Cursor Home	0	0	0	0	1	*	*	*	*	Moves cursor to Home position.
Static Display Control	0	0	0	1	0	*	*	SD1	SD0	Sets display mode of symbol by static display terminal (SEGS1, COMS1). SD1, SD0 = 0, 0 : Display OFF SD1, SD0 = 0, 1 : 1 ~ 2Hz Blink SD1, SD0 = 1, 0 : 3 ~ 4Hz Blink SD1, SD0 = 1, 1 : Display ON
Display ON/OFF Control	0	0	0	1	1	C	B	DC	D	Sets cursor ON/OFF, cursor blink ON/OFF, double cursor ON/OFF and display ON/OFF by dynamic display terminal. (SEGXX, COMXX, SEGS2-6, COMS2,3) C = 1 : Cursor ON C = 0 : Cursor OFF B = 1 : Blink ON B = 0 : Blink OFF DC = 1 : Double Cursor ON DC = 0 : Double Cursor OFF D = 1 : Display ON D = 0 : Display OFF
Power Save	0	0	1	0	0	*	*	O	PS	Sets power save ON/OFF and oscillator circuit ON/OFF. PS = 1 : Power Save ON PS = 0 : Power Save OFF O = 1 : Oscillator Circuit ON O = 0 : Oscillator Circuit OFF

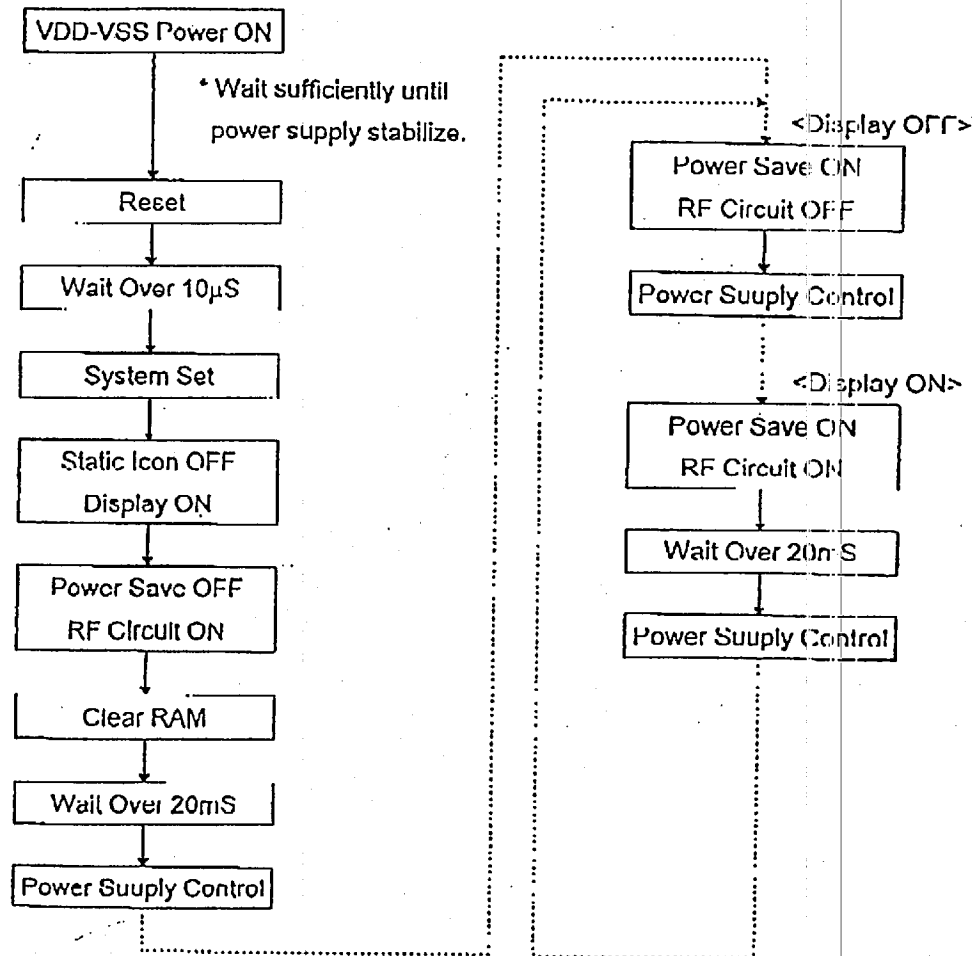
*1

* Invalid Data

Command	Code								Data	Description	
	A0	D7	D6	D5	D4	D3	D2	D1			D0
Power Supply Control	0	0	1	0	1	0	VC	VF	P	Sets internal voltage regulator ON/OFF, voltage booster ON/OFF and voltage follower ON/OFF. VC = 1 : Voltage Regulator ON VC = 0 : Voltage Regulator OFF P = 1 : Voltage Booster ON P = 0 : Voltage Booster OFF VF = 1 : Voltage Follower ON VF = 0 : Voltage Follower OFF	
System Set	0	0	1	1	0	N2	N1	*	CG	Sets CGRAM to USE/NO USE and the number of display lines. CC = 1 : CGRAM Use CC = 0 : CGRAM Not Use N2, N1 = 0, 0 : 2 Lines N2, N1 = 0, 1 : 3 Lines N2, N1 = 1, 0 : 4 Lines	
Electronic Vol. Register	0	0	1	1	1	MSB		LSB		Sets the data to electronic volume register. *2	
RAM Address Set	0	1	ADDRESS								Sets the address to DDRAM, CGRAM or symbol register. *3
RAM Writing	1	DATA								Sets the data to DDRAM, CGRAM or symbol register. *3	

*1 Display ON/OFF (Voltage Booster ON)

To turn ON and OFF the display, please follow the flow chart shown below. because an unintended display for a moment may occur if display is ON/OFF by "Display ON" command. With this flow, power consumption, while display is OFF, can be reduced.



* Make the following command after "System Set" and before "Power Supply Control"

- Static Display Control
- Electronic Volume Register Set
- RAM Data Set (Set "Non-Display" area as "Blank" or "0")

<In case not using on-chip power supply>

Turn ON/OFF the external power supply to V1 to V5 at the same timing as Power Supply Control command.

2 Set Electronic Vol. Register

Hex code : 70H~7FH

D3	D2	D1	D0	MODEV5
MSB			LSB	
0	0	0	0	Small
				↓
1	1	1	1	Large

Note; When not use the electronic volume control function, set to (D3, D2, D1, D0) = (0, 0, 0, 0).

3 RAM Address Set

- 1) The address length that can be setted is "00H ~ 7FH".
- 2) When write the data to RAM, this command set the address; that should be write the data at, and the address is incremented automatically by writing the data continuously.

RAM Address Lower 4 Bit

RAM Address Higher 4 Bit	00H	01H	02H	03H	04H	05H	06H	07H	08H	09H	0AH	0BH	0CH	0DH	0EH	0FH
00H	CG RAM (00H)	*3-1	-	CG RAM (01H)	*3-1	-	-	-	-	-	-	-	-	-	-	-
01H	CG RAM (02H)	*3-1	-	CG RAM (03H)	*3-1	-	-	-	-	-	-	-	-	-	-	-
02H																
03H			DD RAM 1 Line	*3-2												
04H			DD RAM 2 Line	*3-2												
05H			DD RAM 3 Line	*3-2												
06H			DD RAM 4 Line	*3-2												
07H			Symbol Register	*3-3												

- : No Use

*3-1 CG RAM

By System Set Command, select use of CG RAM when use CG RAM.

There is the volume of CG RAM 140 bit, and it is possible for registering 4 kinds arbitrary patterns by constitution of 5 x 7 dots.

Relationship of between Character Pattern, CG RAM Address and Character Code.

Character Code	CG RAM Address	CG RAM Data (Character Pattern)	CG RAM Data (Character Pattern)							Display		
			D7	D6	D5	D4	D3	D2	D1	D0	D7	D0
00H ← 02H ←	00H ~ 06H	x0H	*	*	*	0	1	1	1	1		
	10H ~ 16H	x1H	*	*	*	1	0	0	0	0		
		x2H	*	*	*	1	0	0	0	0		
		x3H	*	*	*	0	1	1	1	1		
		x4H	*	*	*	0	0	0	0	1		
		x5H	*	*	*	0	0	0	0	1		
		x6H	*	*	*	1	1	1	1	1		
		x7H	*	*	*	*	*	*	*	*		
01H ← 03H ←	08H ~ 0EH	x8H	*	*	*	0	0	1	0	0		
	18H ~ 1CH	x9H	*	*	*	0	0	1	0	0		
		xAH	*	*	*	0	1	1	1	0		
		xBH	*	*	*	0	1	1	1	0		
		xCH	*	*	*	0	1	1	1	0		
		xDH	*	*	*	1	1	1	1	1		
		xEH	*	*	*	1	1	1	1	1		
		xFH	*	*	*	*	*	*	*	*		



Note ; It is completed to indicate arbitrary Character Pattern when writes in Character Code 00H to 03H at DD RAM.

***3-2 DD RAM**

Character Pattern is indicated on LCD when in Character Code at DD RAM.

Relationship of between DD RAM and Display on LCD.

30H	31H	32H	33H	34H	35H	36H	37H	38H	39H	3AH	3BH
40H	41H	42H	43H	44H	45H	46H	47H	48H	49H	4AH	4BH
50H	51H	52H	53H	54H	55H	56H	57H	58H	59H	5AH	5BH
60H	61H	62H	63H	64H	65H	66H	67H	68H	69H	6AH	6BH

***3-3 Symbol Register**

It is completed to indicate a Symbol by writing in data at Symbol Register.
(RAM Address = 70H ~ 7CH)

RAM Address	Symbol Register							
	D7	D6	D5	D4	D3	D2	D1	D0
70 H	*	*	*	SY 11	SY 1	SY 12	SY 2	*
71 H	*	*	*	SY 13	SY 3	SY 14	SY 4	*
72 H	*	*	*	SY 15	SY 5	SY 16	SY 6	*
73 H	*	*	*	*	*	*	*	*
74 H	*	*	*	SY 17	SY 7	SY 18	SY 8	*
75 H	*	*	*	SY 19	SY 9	SY 20	SY 10	*
76 H	*	*	*	SY 21	*	SY 22	*	*
77 H	*	*	*	SY 23	*	SY 25	*	*
78 H	*	*	*	SY 26	*	SY 27	*	*
79 H	*	*	*	SY 28	*	SY 30	*	*
7A H	*	*	*	SY 31	*	SY 34	*	*
7B H	*	*	*	SY 33	*	SY 32	*	*
7C H	*	*	*	*	*	SY 29	SY 24	*

Notes ; * ; Don't Care.
; Symbol ON = "1", OFF = "0"

*3-4 Signal

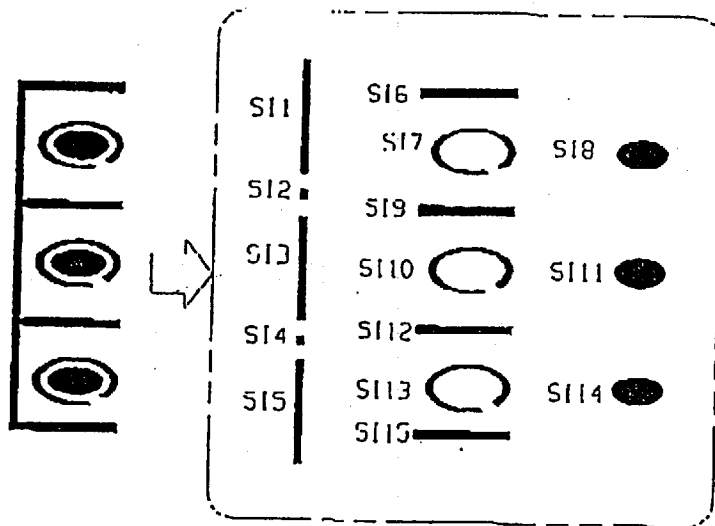
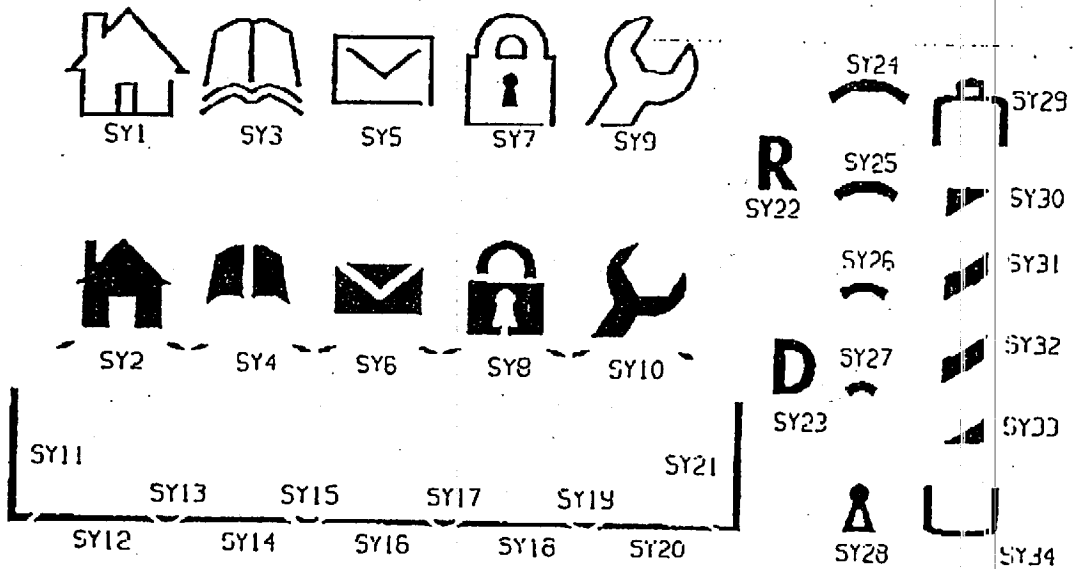
The Signal turns on by writing Character Code at RAM Address 4CH, 5CH and 6CH.

Relationship of between Character Pattern and Signal.

RAM Address	Character Code	Character Pattern (for Signal)							
		D7	D6	D5	D4	D3	D2	D1	D0
4CH	xxH	*	*	*	*	*	*	*	*
		*	*	*	*	*	*	*	*
		*	*	*	*	*	*	*	*
		*	*	*	*	*	*	*	*
		*	*	*	*	*	SI 0	*	*
		*	*	*	*	SI 1	SI 7	*	*
		*	*	*	*	*	*	*	*
5CH	xxH	*	*	*	*	*	*	*	
		*	*	*	*	*	SI 8	*	
		*	*	*	*	SI 2	SI 9	*	
		*	*	*	*	SI 3	SI 10	*	
		*	*	*	*	*	SI 11	*	
		*	*	*	*	*	*	*	
		*	*	*	*	*	*	*	
6CH	xxH	*	*	*	*	*	*	*	
		*	*	*	*	SI 4	SI 12	*	
		*	*	*	*	SI 5	SI 13	*	
		*	*	*	*	*	*	*	
		*	*	*	*	*	SI 14	*	
		*	*	*	*	*	SI 15	*	
		*	*	*	*	*	*	*	

Note ; * : No Use

*3-5 Symbol and Signal No.



4.2.Reset Circuit

When RES input becomes active, this LSI is initialized.

-Initial Settings-

1. Static Display Control
SDD, SDI = 0 ; OFF
2. Display ON/OFF Control
C = 0 ; Cursor OFF
B = 0 ; Blink OFF
DC = 0 ; Double Cursor OFF
D = 0 ; Display OFF
3. Power Save
O = 0 ; Oscillator OFF
PS = 0 ; Power save OFF
4. Power Supply Control
VC = 0 ; Voltage Regulation Circuit OFF
VF = 0 ; Voltage Follower OFF
P = 0 ; Voltage Booster OFF
5. System Set
CG = 0 ; CG RAM No Use
6. Electronic Volume Set
Register (0, 0, 0, 0)

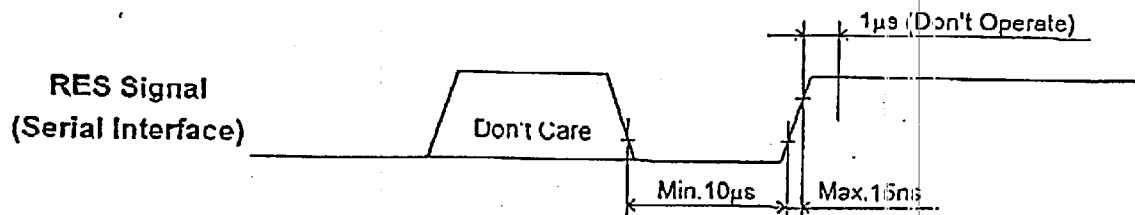
RES terminal should be connected to the MPU reset terminal so that both devices are reset at the same time.

Active level pulse width of RES signal must be kept 10 μ S.

Normal operation starts after 1 μ s from the edge on RES. *

If it is not properly initialized by RES input when power is turned ON, there is possibility to lock itself into a start that cannot be canceled.

* Reset Timing



4.3.Low Power Mode

Sleep mode

Let the power supply circuit and oscillator circuit off by command , and make sleep mode by power save command , then save the power supply current near to the static supply current.

- 1.LCD Output
VDD Level
- 2.DDRAM,CGRAM

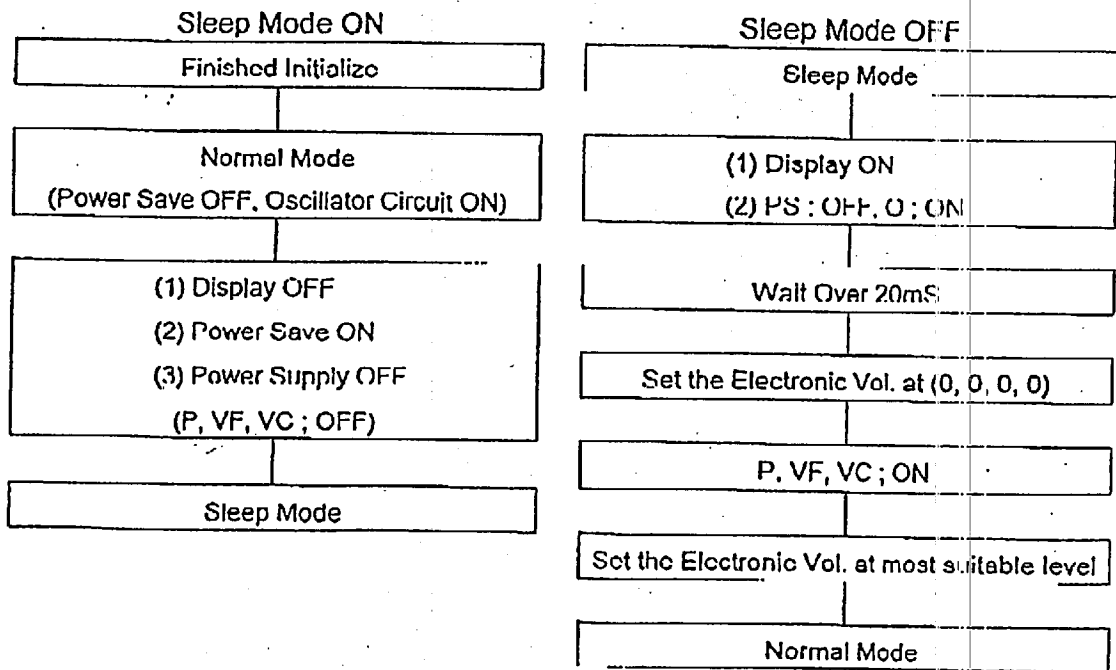
The content is saved without any changes regardless of ON/OFF of sleep mode.

- 3.Operation mode keeps the condition of pre sleep mode.
Internal circuit is all stopped.

- 4.Power Supply Circuit , Oscillator Circuit

Use power save command and power control command to let the built in power supply and oscillator circuit off.

-Instruction at Sleep Mode ON and OFF-



Note : Order of (1), (2) is Inequality. And (1) you needn't execute it.

5.OPTICAL CHARACTERISTICS

5.1.Optical Characteristics

Parameter	Symbol	Temp. (°C)	Standard Value			Unit	Condition
			Min	Typ	Max		
Driving Voltage	VOP	-30	6.78	7.14	7.5	V	*1
		25	5.99	6.31	6.63		
		70	5.72	6.02	6.32		
Response Time	tr	-30	-	6100	9150	ms	
		25	-	95	145		
	lf	-30	-	29000	43500		
		25	-	190	285		
Contrast Ratio	K	25	3	6	-	-	*2

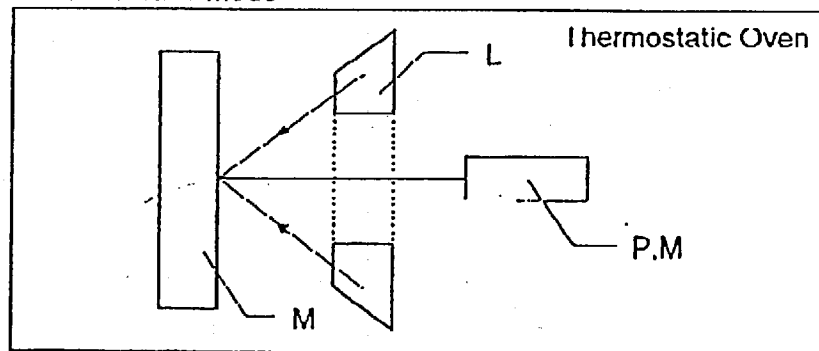
*1 VOP = LCD Driving Voltage Getting Maximum Contrast
≠ VDD-V5

*2 $\theta X, \theta Y = 0^\circ$ Measuring Point : Graphic

5.2.Definition of Optical Characteristics

5.2.1.Optical Measuring Equipment

- Reflective Mode



L : Lighting Source (Circular Halogen Lamp)

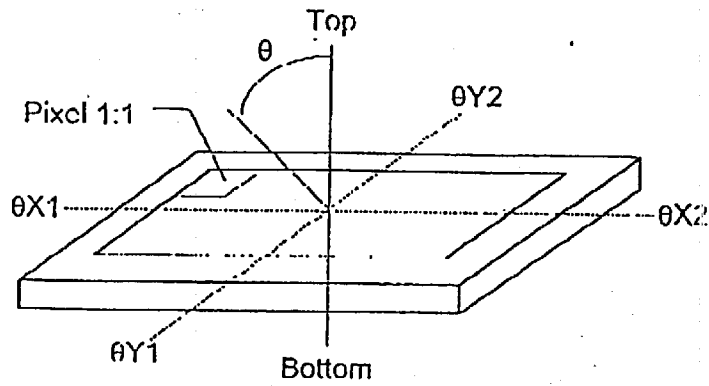
P.M : Lighting Sensor

M : Module

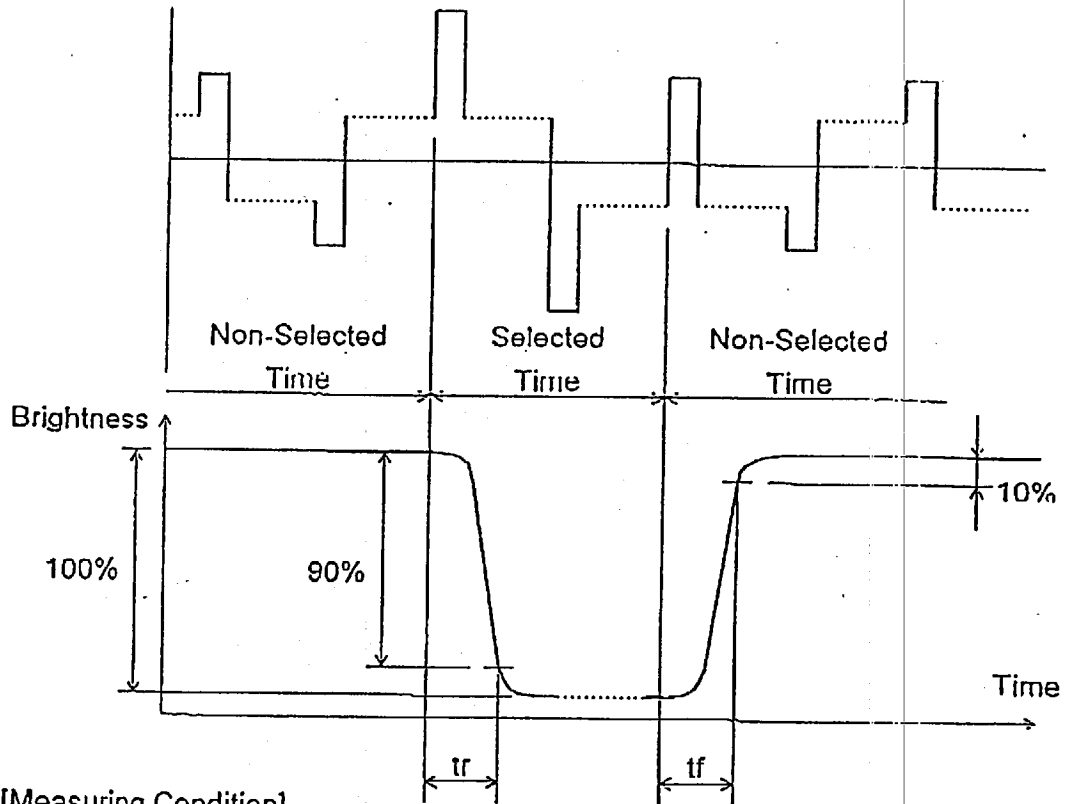
[Specification of Equipment and Measuring Condition]

- Luxmeter : Canon LC-3S
- Brightness Measurement Spot Diameter : $\phi 2.0\text{mm}$

5.2.2. Definition of Viewing Angle



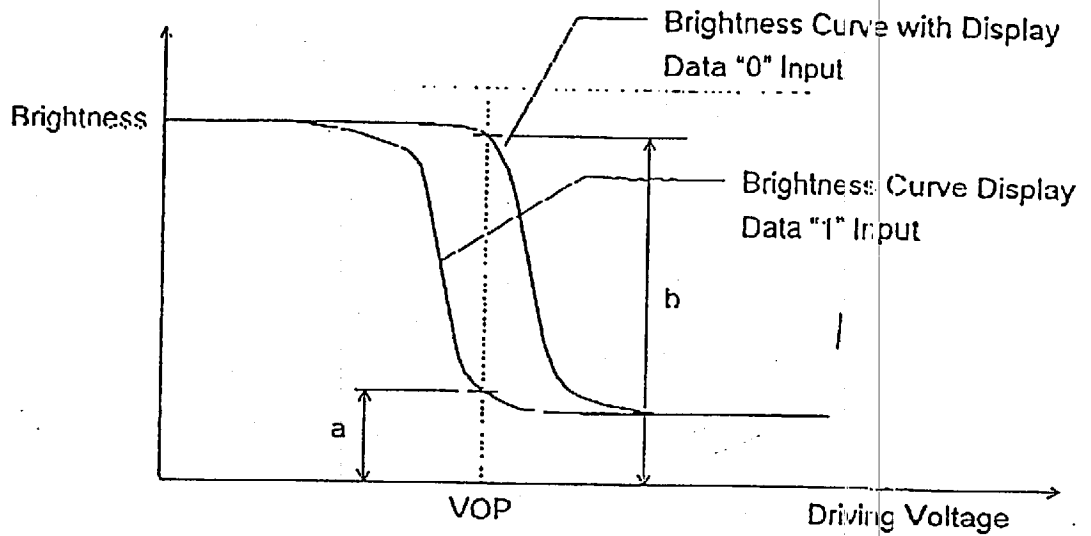
5.2.3. Definition of Response Time



[Measuring Condition]

- VOP = Typ. Value at Operating Temperature
- $\theta X = \theta Y = 0^\circ$

5.2.4. Definition of Contrast Ratio



$$\text{Contrast Ratio} = \frac{\text{Brightness Curve with Display Data "0" Input } b}{\text{Brightness Curve with Display Data "1" Input } a}$$

[Measuring Condition]

- VOP = Typ. value at 25°C
- $\theta X = \theta Y = 0^\circ$

6. RELIABILITY TEST

6.1. Content of Reliability Test

No.	Test Item	Content of Test	Test Condition
Environmental Test			
1	High Temperature Storage	Endurance test applying the high storage temperature for a long time.	80°C 200H
2	Low Temperature Storage	Endurance test applying the low storage temperature for a long time.	-30°C 200H
3	High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	70°C 200H
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	-30°C 200H
5	High Temperature / Humidity Storage	Endurance test applying the high temperature and high humidity storage for a long time.	50°C 90%RH 200H
6	High Temperature / Humidity Operation	Endurance test applying the electric stress (Voltage & Current) and temperature/humidity stress to the element for a long time.	40°C 90%RH 200H
7	Temperature Cycle	Endurance test applying the low and high temperature cycle. -30°C ← → 25°C ← → 80°C ← → 25°C 30min ← → 5min ← → 30min ← → 5min. ← → 1 cycle →	-30°C/80°C 10 cycle
Mechanical Test			
8	Vibration Test (Package State)	Endurance test applying the vibration during transportation.	10 ~ 55Hz 2.0mm-p Max. 2.0G Max. Direction of X,Y,Z total 2.0H
9	Shock Test (Package State)	Endurance test applying the shock during transportation.	80cm onto solid 1 corner 3 mountain ridge 6 surface 1 time per each direction
Others			
10	Static Electricity Test	Endurance test applying the electric stress to the terminal.	VS = 800V RS = 1.5kΩ CS = 100pF 1 time

*1 Driving condition for operating test.

Power Supply Voltage for Logic System (VDD) = 2.8V±1%

6.2.Failure Judgment Criterion

After the above-mentioned test.

- 1) There should not exist conspicuous failure of display quality and appearance.
Contrast ratio should be 50% of the initial contrast ratio.
- 2) There should not have any abnormality of functions.