16 character × 1 line COG module

RCM2122R

RCM2122R is LCD module which controller / driver LSI built in.
For display of 16 character × 1 line type reflective TN type LCD module.

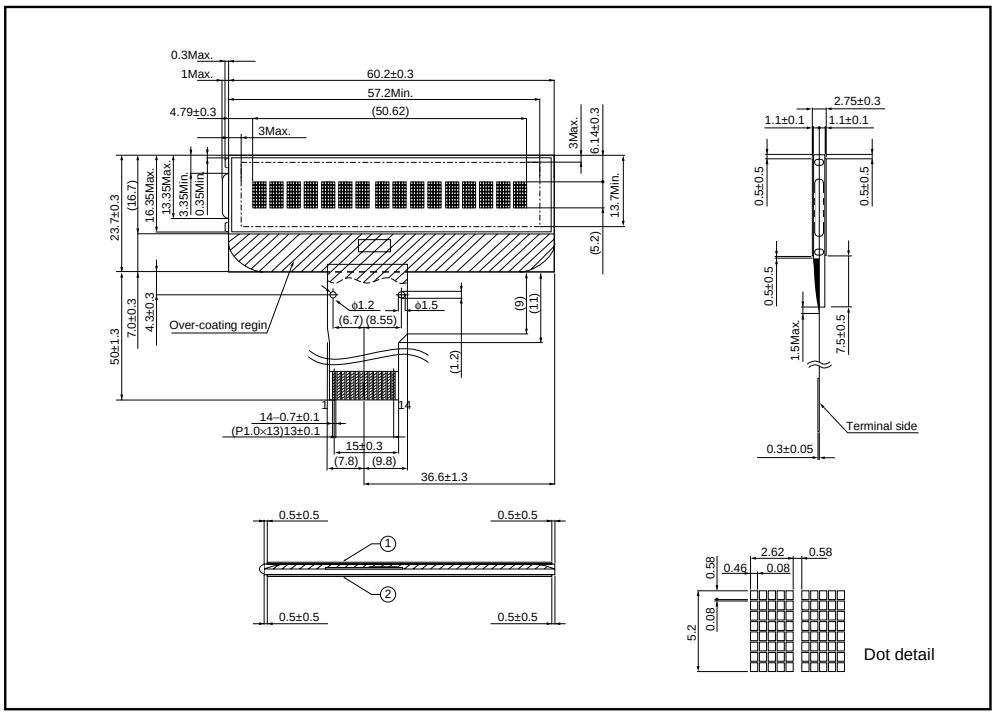
●Applications

Printer, Copy machine, Facsimile, Telephone, etc

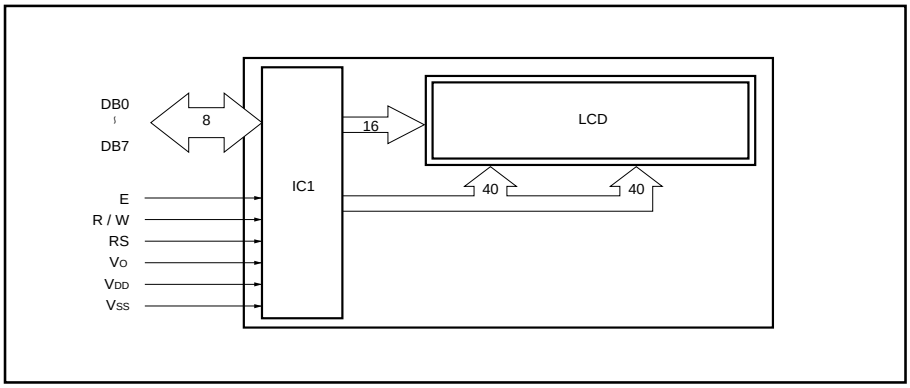
●Features

(1) Wide viewing angle, high contrast ratio.
(2) The dot construction is 5 × 7 dot plus 1 line.
(3) Can be interfaced with 4bit or 8bit MPU.
(4) Can display 190 different types of JIS character and symbols.
(5) With built-in character generator RAM, any user-design pattern can be displayed.
(6) Display clear, cursor ON / OFF, displayed character blink etc,
various function instruction can be accomplished simply.
(7) Compact light weight type, which can be assembled to a machine easily.
(8) Can drive by a 5V circuit.
(9) Low power consumption.

●External dimensions (Units : mm)



●**Block diagram**



●**Pin functions**

Pin No.	Symbol	Pin No.	Symbol
1	DB7	8	DB0
2	DB6	9	E
3	DB5	10	R / W
4	DB4	11	RS
5	DB3	12	VO
6	DB2	13	VDD
7	DB1	14	VSS

●**DD RAM Address**

(1) Addressing mode 1 (A=0)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16 (Display position)
1 Line	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F

DD RAM ADDRESS
(16H)

(2) Addressing mode 2 (A=1)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16 (Display position)
1Line	00	01	02	03	04	05	06	07	40	41	42	43	44	45	46	47

DD RAM ADDRESS
(16H)

Note) The above shows the addresses when the display off is not conducted.

●Power supply sample connect

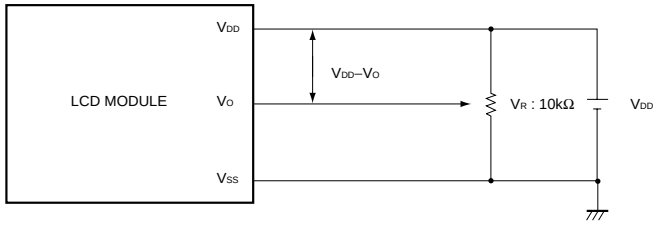


Fig.1

(Note) As operating voltage, (V_{DD}-V_O)V is charged to LCD.
Optimum operating voltage changes by viewing angle and temperature.
Contrast can be changed by adjustment of V_O, so please use LCD module at most suitable condition by each operating situation.
When you fix the V_O, please check using by actual set.

●Absolute maximum ratings (Ta=25°C)

Parameter	Symbol	Min.	Max.	Unit
Supply voltage for logics	V_{DD}-V_{SS}	–0.3	6.0	V
Supply voltage for driving LCD	V_{DD}-V_O	–0.3	6.0	V
Input voltage	V_{IN}	–0.3	V_{DD}+0.3	V
Operating temperature rang	Topr	0	50	˚C
Storage temperature rang	Tstg	–20	70	˚C

●Electrical characteristics (V_{DD}=5.0±5%, Ta=25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Supply voltage for logics	V_{DD}	4.75	5.0	5.25	V	
Operating voltage	V_{DD}–V_O	3.0	–	V_{DD}	V	
Input "H" level voltage (1)	V_{IH1}	2.3	–	V_{DD}	V	All terminals except E terminal
Input "L" level voltage (1)	V_{IL1}	0	–	0.8	V	
Input "H" level voltage (2)	V_{IH2}	0.8V_{DD}	–	V_{DD}	V	E
Input "L" level voltage (2)	V_{IL2}	0	–	0.2V_{DD}	V	
Output "H" level voltage	V_{OH}	2.4	–	–	V	IOH=–0.205mA
Output "L" level voltage	V_{OL}	–	–	0.4	V	IOL=1.6mA
Power supply current	I_{DD}	–	1.4	3.6	mA	V_{DD}=5.0V, fosc=270kHz

●Optical characteristics (Ta=25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Rise time	t_r	–	100	200	ms	θ=10˚, ϕ=0˚
Decay time	t_d	–	150	250	ms	θ=10˚, ϕ=0˚
Contrast ratio	K	1.4	2.0	–	–	θ=10˚, ϕ=0˚
Viewing angle	θ_1	–	–	10	deg	ϕ=0˚, K≥1.4
	θ_2	40	–	–	deg	
	ϕ	±30	–	–	deg	θ=20˚, K≥1.4

(1) Difinition of θ and ϕ

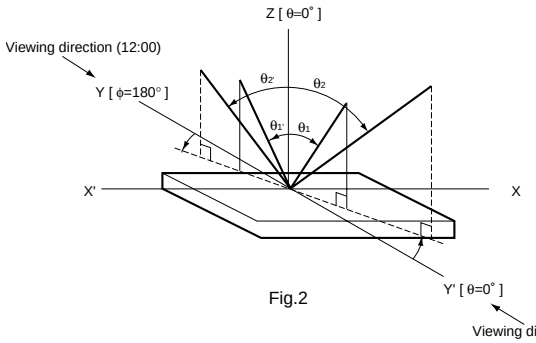


Fig.2

(2) Difinition of viewing angle θ1 and θ2

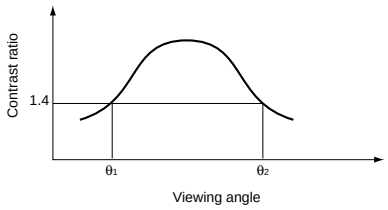


Fig.3

(3) Difinition of contrast ratio K

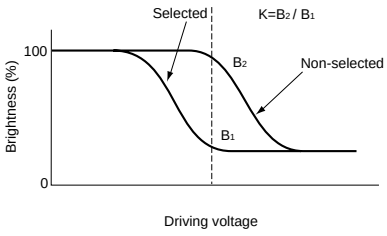


Fig.4

(4) Difinition of optical response time

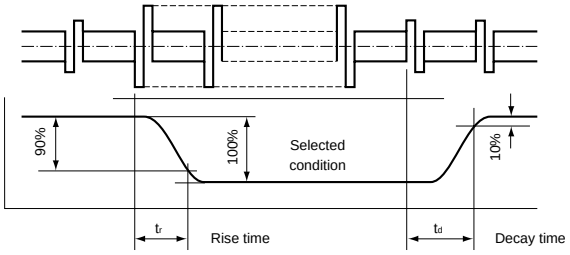


Fig.5

●Timing characteristics

(1) Writing (V_{DD}=5V±5%, V_{SS}=0V, Ta=0~+50°C)

Parameter		Symbol	Min.	Max.	Unit	
Enable cycle time		t_{CYCE}	500	–	ns	Fig.6
Enable pulse time	"H" level	PW_{EH}	220	–	ns	Fig.6
	"L" level	PW_{EL}	280	–	ns	Fig.6
Enable rise time / decay time		t_{Er},t_{Ef}	–	20	ns	Fig.6
Set-up time	RS, R / W, E	t_{AS}	40	–	ns	Fig.6
Address hold time		t_{AH}	10	–	ns	Fig.6
Data set-up time		t_{DSW}	60	–	ns	Fig.6
Data hold time		t_H	10	–	ns	Fig.6

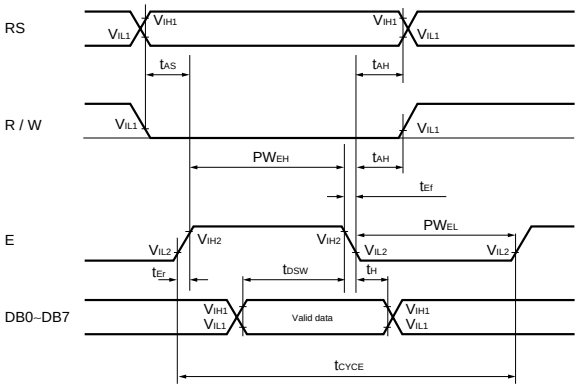


Fig.6

(2) Reading (V_{DD}=5V±5%, V_{SS}=0V, Ta=0~+50°C)

Parameter		Symbol	Min.	Max.	Unit	
Enable cycle time		t_{CYCE}	500	–	ns	Fig.7
Enable pulse time	"H" leve	PW_{EH}	220	–	ns	Fig.7
	"L" level	PW_{EL}	280	–	ns	Fig.7
Enable rise time / decay time		t_{Er},t_{Ef}	–	20	ns	Fig.7
Set-up time	RS, R / W, E	t_{AS}	40	–	ns	Fig.7
Address hold time		t_{AH}	10	–	ns	Fig.7
Data set-up time		t_{DDR}	–	240	ns	Fig.7
Data hold time		t_{DHR}	20	–	ns	Fig.7

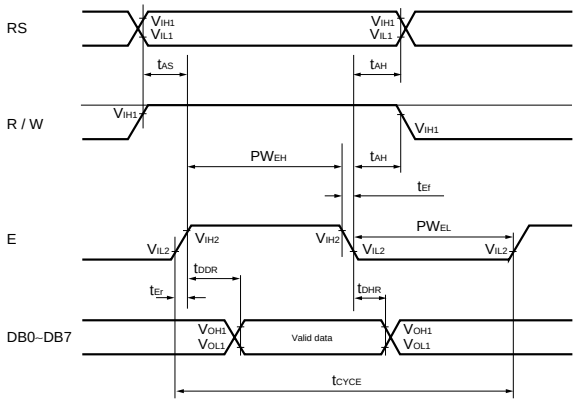


Fig.7

●Pin function

Symbol	Level	I / O	Function	
V_{SS}	–	–	0V	Ground electrical potential
V_{DD}	–	–	5.0V	Power voltage
V_O	–	–	3.0~5.0V (V_{DD}~V_O)	LCD drive voltage set termination $V_{DD} \geq V_O \geq V_{SS}$
R_S	H / L	I	Resistor select signal 0 : Instruction resistor (Write) Busy flag address counter (Read) 1 : Data resistor (Read / Write)	
R / W	H / L	I	Read (R) Write (W) Select signal 0 : Write MPU → LCD module 1 : Read MPU ← LCD module	
E	H, H / L	I	Signal to start read or write data	
DB4 ~ DB7	H / L	I / O	Upper level 4 line data bus Also DB7 is enable to use as busy flag	
DB0 ~ DB3	H / L	I / O	Lower level 4 line data bus These pins are not used during 4-bits operation	

●Instruction

There are two resistors of instruction resistor and data resistor inside the driver IC.
And perform the internal operation at recorded the control information temporary here for enabling interface the various CPU or control IC which have different speed than internal operation.
Internal operation is controlled by resistor select signal, read and write signal, and data bus signal.
List of instruction and operation time are mentioned below.

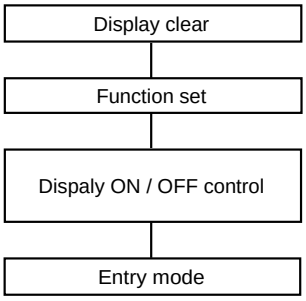
Instruction	Code										Description	Execution time(Max.) (f_{CP} or fosc=270kHz)
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear display	0	0	0	0	0	0	0	0	0	1	Cursor is returned to home position (address o) after entire display clear.	2.2ms
Cursor at home	0	0	0	0	0	0	0	0	1	*	Cursor is returned to home position (address o). Shifted display is also returned to the original position. Contens of DDRAM are not changed.	2.2ms
Entry mode	0	0	0	0	0	0	0	1	I / D	S	Cursor advance direction and display shift are set. These operation are performed during data write and read modes.	53µs
Display ON / OFF control	0	0	0	0	0	0	1	D	C	B	Entire display ON / OFF (D), cursor ON / OFF (C), and character blink (B) at cursor position are set.	53µs
Cursor / Display shift	0	0	0	0	0	1	S/C	R/L	*	*	Cursor and dispaly are shifted without changing the contents of DDRAM.	80µs
Function set	0	0	0	0	1	DL	A	*	*	*	Interface data length (DL), Addressing mode of DDRAM (A) are set.	53µs
CG RAM address set	0	0	0	1	*	A_{CG}					CGRAM address is set. After this what is transmitted and received is the data of CGRAM.	53µs
DD RAM address set	0	0	1	A_{DD}							DDRAM address is set. After this what is transmitted and received is the data of DDRAM.	53µs
Busy flag / Address read	0	1	BF	AC_{DD}							Busy flag (BF) showing internal operation and contents of address counter are read.	0µs
				*	*	AC_{CG}						
CG RAM / DD RAM data read	1	0	Write Data (DD RAM)								Data are written in DDRAM or CGRAM	53µs
			*	*	*	Write Data (CG RAM)						
CG RAM / DD RAM data read	1	1	Read Data (DD RAM)								Data are read out of DDRAM or CGRAM	80µs
			*	*	*	Read Data (CG RAM)						
I / D=1 : Increment I / D=0 : Decrement S=1 : With display shift S / C=1 : With display shift S / C=0 : Cursor movement R / L=1 : Shift to the right R / L=0 : Shift to the left DL=1 : 8bits DL=0 : 4bits A=0 : Addressing mode 1 A=1 : Addressing mode 2 BF=1 : Internal operation is being performed BF=0 : Instruction acceptable * Don't care											DD RAM : Display data RAM CG RAM : Character generator RAM A_{CG} : Address of CGRAM A_{DD} : Address of DDRAM These correspond to cursor address. AC :Address counter used for both DDRAM and CGRAM.	Exchange time changes with change in internal oscillation frequency (fosc)

●**Character code and pattern table**

Upper 4bits (HEX) / Lower 4bits (HEX)	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
XXXX0000	CGRAM (1)															
XXXX0001	(2)															
XXXX0010	(3)															
XXXX0011	(4)															
XXXX0100	(1)															
XXXX0101	(2)															
XXXX0110	(3)															
XXXX0111	(4)															
XXXX1000	(1)															
XXXX1001	(2)															
XXXX1010	(3)															
XXXX1011	(4)															
XXXX1100	(1)															
XXXX1101	(2)															
XXXX1110	(3)															
XXXX1111	(4)															

●Reset function

When the power is supplied, the setting are automatically reset to the initial / default values.
The following is concluded during the initial / default setting.
Until the initial / default settings are completed, the busy flag remains busy condition.
The tivace length when busy flag is a busy condition is 10ms after V_{DD} reaches 4.5Volt.
The flow of initial / default setting is snow on below diagram.



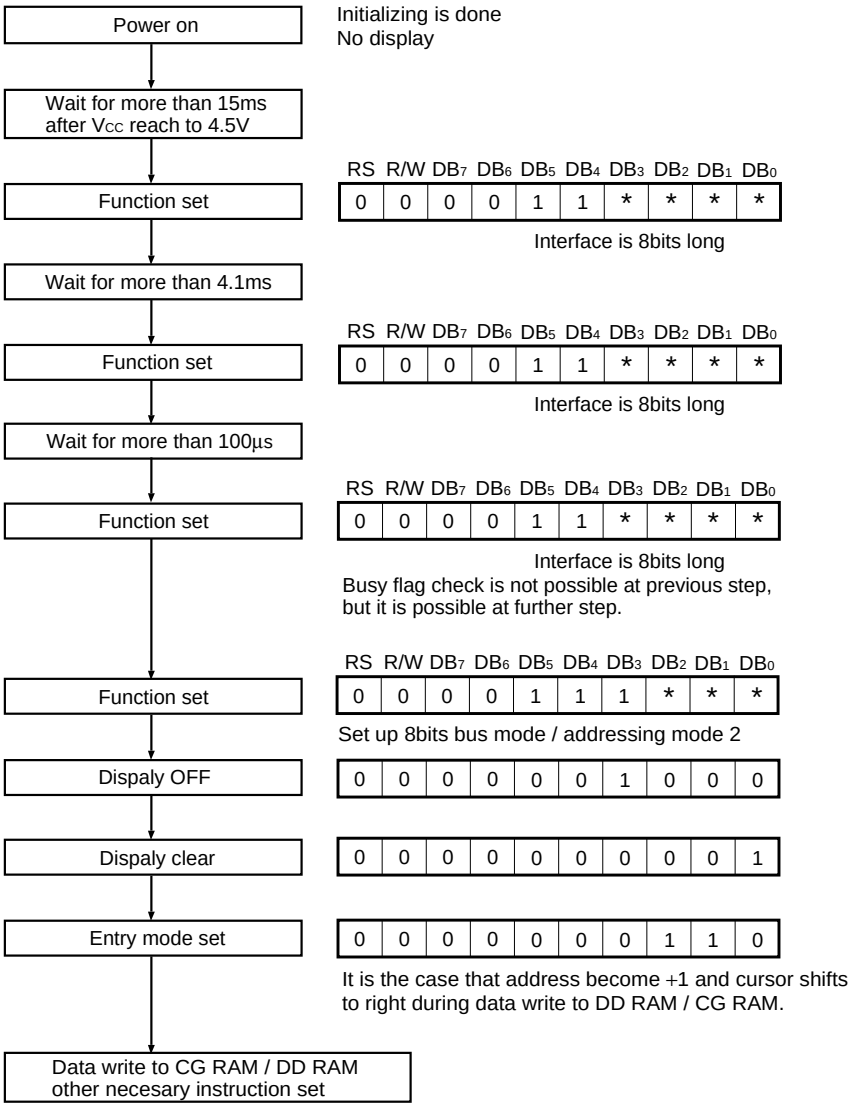
DL=1 : 8bits interface data
A=0 : Addressing mode 1

D=0 : Dispaly OFF
C=0 : Cursor OFF
B=0 : Blink OFF

I / D=1 : +1 (Increment)
S=0 : No shift

(Note) In case the condition mentioned and by「Power supply condition when built in reset circuitb is used」 can not be satisfied, please make Initializing by CPU based on「Initializing by instruction」.

●Initializing by instruction



●Operation note

(1) Handling precautions

- Protect LCDs from strong shocks as these can cause damage of defective operation.
- The polarization plate on the surface of the LCD is soft and can be easily scratched. Wipe away dirt dust lightly with a soft cloth soaked in an alcohol-based cleanser.
- If the liquid crystal panel is damaged and the liquid crystal contacts your hands or clothing wash with soap and copious
  quantities of water immediately.
- If the unit is to be use for long periods under direct sunlight, use a filter to cut ultraviolet.
- Do not store in areas of high temperature or high humidity. Do not store the unit where it will be exposed to strong sunlight or fluorescent light.
- Using under high temperature or high humidity may cause damages on the polarization plate.

(2) Operating precautions

- Do not connect or disconnect the module while the module is in a powered up state.
- Send the input signal only after the module has been powered up.
  Removing or connecting the LCD driver power supply, when the unit is in the ON state, can cause damage to the LCD.

(3) Work precautions

- Use an grounded soldering iron.
- Complete soldering within 3 sec per 1 pin with 280°C±10°C soldering heat.
- Do not apply any physical stress on leads.
- Protect the polarization plate and the side of grass from flux or melted solders in soldering work.
- Do not apply more than 100g weight on the surface and at the corners of LCD.

(4)Installation precautions

- Placing protection covers on the panel surface is strongly recommended for protection of the polarization plate.
- Do not apply strong shocks on over-coating resin over the IC when installed to the set.

(5)Precautions for COG module

- Do not let light in the IC. The light many cause malfunction.
  The light protection film attached on LCD can not prevent malfunction perfectly.
  Light shielding is also necessary on your application.
- A protective film is pasted over the front and back of the module to protect the panel surfaces during shipping and installation.
  When this film is peeled off, if may hold static electricity.
  Peel the film off very slowly using an iron blower or other deionizing tool.
- Special protections from static electricity are not applied to the module. Protect static electricity by your application.