

Liquid Crystal Displays

16 characters × 2 lines COG module

RCM2228R-A / B

The RCM2228R-A / B is a reflective TN type liquid crystal module with a built-in controller / driver LSI and a display capacity of 16 characters × 2 lines.

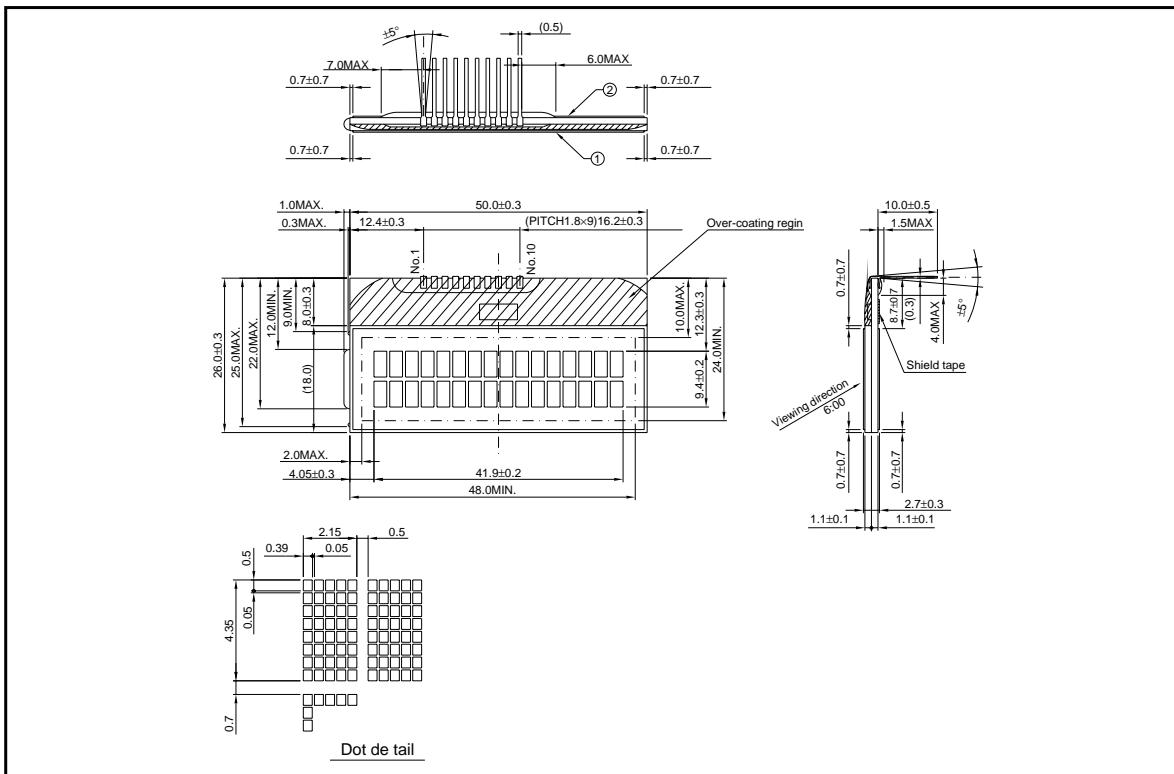
●Applications

Printers, Copiers, Facsimiles, etc

●Features

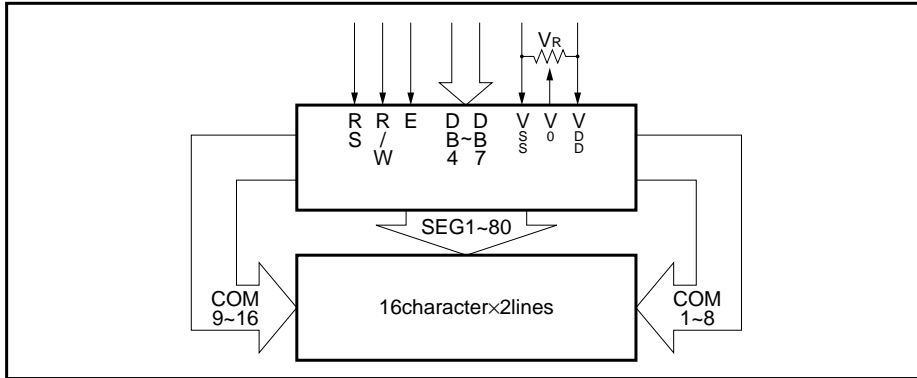
- (1) 5×7 dot character matrix with cursor.
- (2) Interfaces with 4-bit MPUs.
- (3) Displays up to 237 characters and special symbols.
- (4) Custom character patterns are displayed with the character RAM.
- (5) Abundant instruction set including clear display, cursor on/off, and character blinking.
- (6) Compact and lightweight for easy assembly to the host instrument.
- (7) Operable on single 5V power supply.
- (8) Low power consumption.

●External dimensions (Unit : mm) (Viewing direction : 6 : 00)



Liquid Crystal Displays

●Block diagram



●Pin assignments

Pin No.	Symbol	Pin No.	Symbol
1	RS	6	DB6
2	R / W	7	DB7
3	E	8	V _{SS}
4	DB4	9	V _{DD}
5	DB5	10	V ₀

●Power supply example

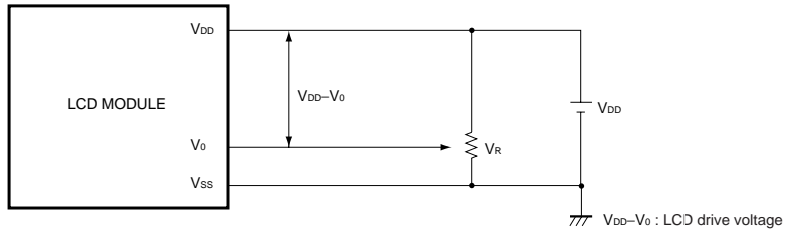


Fig.1

●Absolute maximum ratings (Ta=25°C)

Parameter	Symbol	Min.	Max.	Unit
Power voltage for logics	V _{DD}	-0.3	6.0	V
Power voltage for driving LCD	V _{LCD}	-0.3	6.0	V
Input voltage	V _{IN}	-0.3	V _{DD} +0.3	V
Operating temperature	T _{opr}	0	50	°C
Storage temperature	T _{stg}	-20	70	°C

Liquid Crystal Displays

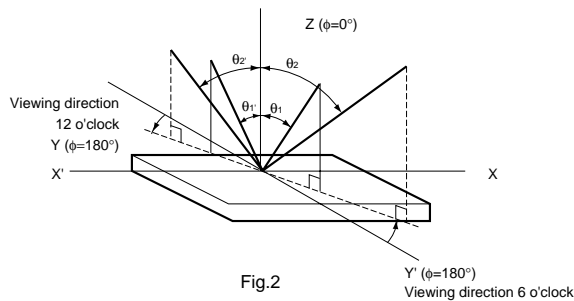
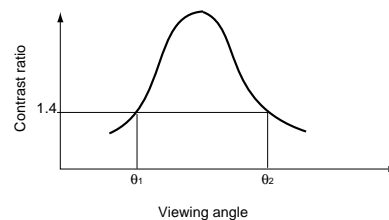
●Electrical characteristics ($V_{DD}=5.0V$, $T_a=25^\circ C$)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Logic power voltage	V_{DD}	4.75	5.0	5.25	V	
LCD driving voltage	V_{LCD}	3.0	–	5.0	V	
"H" input voltage	V_{IH}	$0.7V_{DD}$	–	V_{DD}	V	RS, R / W, CS
"L" input voltage	V_{IL}	$V_{SS}-0.3$	–	0.6	V	
"H" output voltage	V_{OH}	$0.75V_{DD}$	–	–	V	$I_{OH}=-0.1mA$
"L" output voltage	V_{OL}	V_{SS}	–	$0.2V_{DD}$	V	$I_{OL}=0.1mA$
Clock frequency	fosc	350	540	1100	kHz	
Current consumption	I_{DD}	–	0.5	1.0	mA	$V_{DD}=5.0V$, fosc=270kHz check pattern

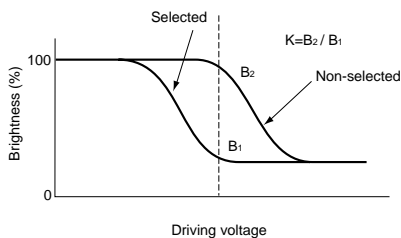
●Optical characteristics ($T_a=25^\circ C$)

When viewing from below

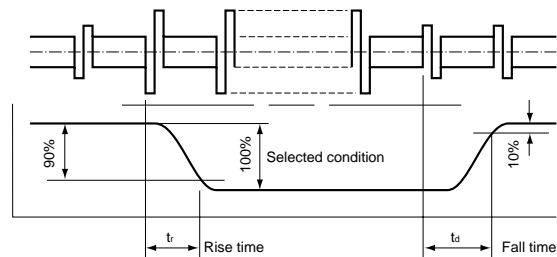
Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Response time	t_r	–	100	250	ms	$\phi=0^\circ$, $\theta=10^\circ$
Response time	t_d	–	150	250	ms	$\phi=0^\circ$, $\theta=10^\circ$
Contrast ratio	K	–	3.0	–	–	$\phi=0^\circ$, $\theta=10^\circ$
Viewing angle	θ_1	–	–	10	deg	$K \geq 1.4$, $\phi=0^\circ$
	θ_2	40	–	–	deg	
	ϕ	± 30	–	–	–	$K \geq 1.4$, $\theta=10^\circ$

(1) Definition θ and ϕ (2) Definition of viewing angles θ_1 and θ_2 

(3) Definition of contrast ratio "K"



(4) Definition of optical response



Liquid Crystal Displays

●Terminal function

Symbol	I / O Terminal	Function
V _{DD}	Input	V _{DD} =4.75~5.25V
V _{SS}	Input	V _{SS} =0V
V ₀	Input	LCD driving voltage input terminal V _{DD} ≥ V ₀ ≥ V _{SS}
DB4-DB7	Input / Output	Data bus four-state bi-directional
RS	Input	Register selected signal L: Instruction register (at write) L: Busy flag / address counter (at read) H: Data register (at write & read)
R / W	Input	Read / Write select signal L: Write H: Read
E	Input	Data Read / Write enable signal

●Timing chart

Writing

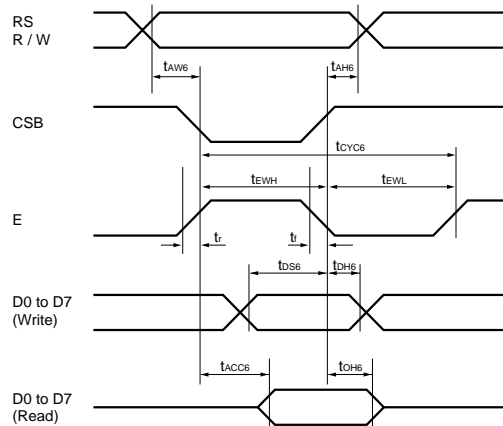


Fig.6 interface (Write Operation)

Item	Terminal	Symbol	Min.	Max.	Unit
Address hold time	RS	t _{AH6}	20	–	ns
Address set up time	RS	t _{AW6}	20	–	
System cycle time	RS	t _{CYC6}	150	–	ns
Data setup time	D0 to D7	t _{DS6}	80	–	ns
Data hold time	D0 to D7	t _{DH6}	20	–	ns
Access time	D0 to D7	t _{ACC6}	–	400	ns
Output disable time	D0 to D7	t _{OH6}	150	–	ns
"E" rise / fall time	E	t _r , t _f	–	20	ns
"E" pulse width H level	E	t _{EWH}	120	–	ns
"E" pulse width L level	E	t _{EWL}	30	–	ns

* In designing, please set the timing with sufficient margin

Liquid Crystal Displays

●Instruction

Instruction	Instruction Code											Description	Time (MAX)
	RS	RW	D7	D6	D5	D4	D3	D2	D1	D0			
Display Clear	0	0	0	0	0	0	0	0	0	0	1	Clears entire display and sets DDRAM address 0 in address counter.	1.08ms
Cursor Home	0	0	0	0	0	0	0	0	0	1	*	Sets DDRAM address 0 in the address counter Shifted display returns to the original state. DDRAM data does not change.	1.08ms
Entry Mode Set	0	0	0	0	0	0	0	0	1	I / D	S	I / D : Specifies cursor / display shift (I / D=1 : +1 I / D=0 : -1) S : Executes the shift operation (S=1: shift S=0 : no shift) These operations are performed during data write and read.	26.3μs
Display ON / OFF Control	0	0	0	0	0	0	0	1	D	C	B	D: All display ON / OFF (1: ON , 0: OFF) C: Cursor ON / OFF (1: ON , 0: OFF) B: Cursor position blink ON / OFF (1: ON , 0: OFF)	26.3μs
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	*	*	*	Shifts the cursor or display without changing DDRAM data S / C : (1: Display shift, 0: Cursor shift) R / L : Specifies the shift direction (1: Right shift 0: Left shift)	26.3μs
Function Set	0	0	0	0	1	DL	N	*	*	*	*	Sets function for the internal operation DL : (1:8bit , 0:4bit) N : (1:2line , 0:1line)	26.3μs
CGRAM Address set	0	0	0	1	A5	A4	A3	A2	A1	A0		Assigns the CGRAM address	26.3μs
DDRAM Address set	0	0	1	A6	A5	A4	A3	A2	A1	A0		Assigns the DDRAM address	26.3μs
Busy flag Address counter read	0	1	BF	A6	A5	A4	A3	A2	A1	A0		BF: Reads the internal operation state (1: In operation, 0: Completed operation) AC: Reads the address counter value.	0μs
Data write	1	0	D7	D6	D5	D4	D3	D2	D1	D0		Writes data into DD / CGRAM	26.3μs
Data read	1	1	D7	D6	D5	D4	D3	D2	D1	D0		Read data from DD / CGRAM	26.3μs

Note: Refer to Instruction table for the list of each instruction execution time.

(* : don't care)

Liquid Crystal Displays

●Character code and corresponding character pattern

		UPPER																
		0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111	
LOWER	0000	CGRAM (1)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
	0001	(2)	!	"	#	\$	%	&	'	()	*	+	,	-	.	/	:
	0010	(3)	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
	0011	(4)	+	*	#	\$	%	&	'	()	*	+	,	-	.	/	:
	0100	(5)	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
	0101	(6)	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
	0110	(7)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
	0111	(8)	Q	R	S	T	U	V	W	X	Y	Z	[\]	^	_	~
	1000	(1)	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p
	1001	(2)	q	r	s	t	u	v	w	x	y	z	[\]	^	_	~
	1010	(3)	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
	1011	(4)	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
	1100	(5)	W	X	Y	Z	[\]	^	_	~	0	1	2	3	4	5
	1101	(6)	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L
	1110	(7)	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	[\
	1111	(8)	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

Liquid Crystal Displays

●Operation note

(1) Handling precautions

- Protect the module from strong shocks as they can cause damage or defective operation.
- The polarizing plate on the surface of the module is soft and can easily be scratched. Wipe away dirt and dust using an alcohol-based cleanser.
- If the liquid crystal panel is damaged and the liquid crystal contacts your clothing or body, wash immediately with soap and water.
- If the module is to be used for long periods subjected to direct sunlight, employ a filter to block the ultraviolet rays.
- Do not use the module in areas of high temperature or high humidity. Do not use the module locations exposed to direct sunlight or fluorescent light.
- A protective film (polyethylene) is pasted over ROHM liquid crystal modules to protect the panel surfaces. When peeling this film off, be sure to peel as slow as possible in order to minimize the generation of static electricity.

(2) Precautions during operation

- Do not connect or disconnect the module while the power supply is turned on.
- Input the input signal after the module power supply is turned on. When turning it off, turn off the input signal first. Otherwise the IC may be damaged by the latch-up phenomenon.

(3) Precautions during installation

- Be sure to use a grounded soldering iron when performing any installation procedures.
- Be careful to avoid damage from static electricity. A CMOS-IC is used in the modules circuitry that can be easily damaged by static electricity.

(4) Precautions during unit assembly

- In order to protect the polarizing plate from dirt or scratches, it is recommended to use a protective cover on the front surface.

(5) Precautions for COG module

- Do not subject the front and back surface of the IC to light. Doing so may cause defective operation.
- When peeling off the protective film of the panel, use of an ion blower or other device to reduce the generation of static electricity is recommended.
- No special measures are taken to prevent the generation of static electricity on the module. Therefore, be sure to take the appropriate measures to prevent the generation of electrical charge on the LCD module by the design of the product itself.