20 characters × 2 lines transflective character module with LED backlight

RCM2011M

The RCM2011M is a transflective TN type liquid crystal module with a yellow-green LED backlight, a built-in controller/driver LSI, and a display capacity of 20 characters × 2 lines.

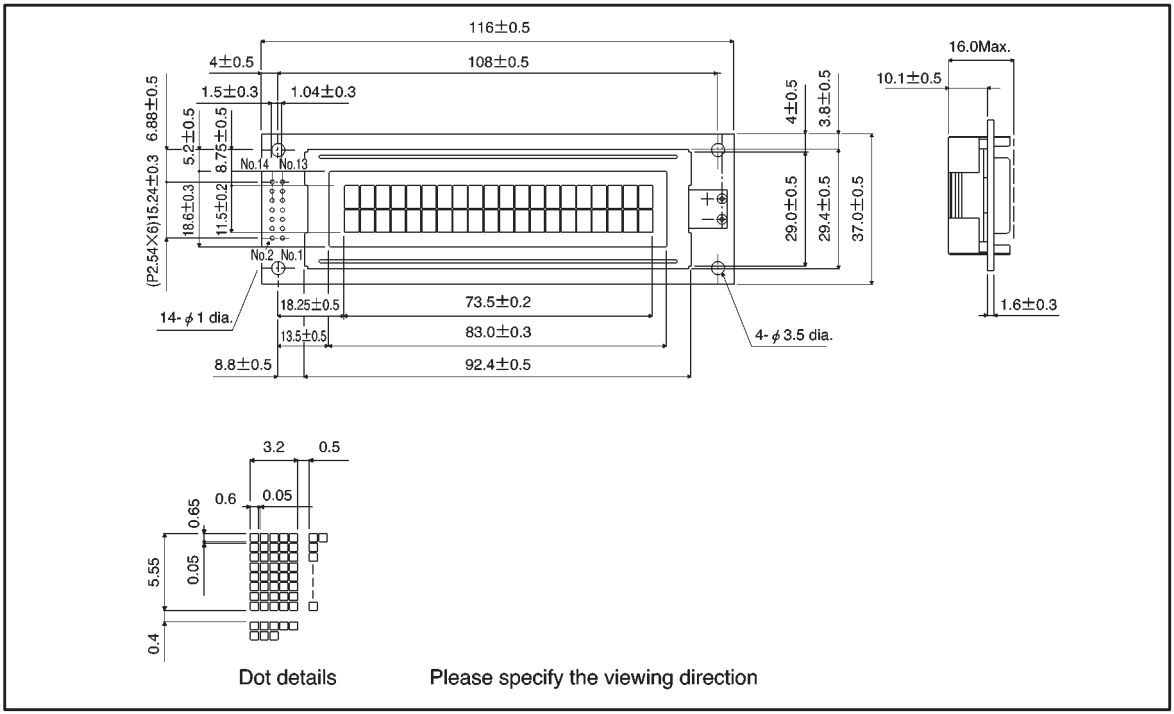
●Applications

Personal computers, word processors, facsimiles, telephones, etc.

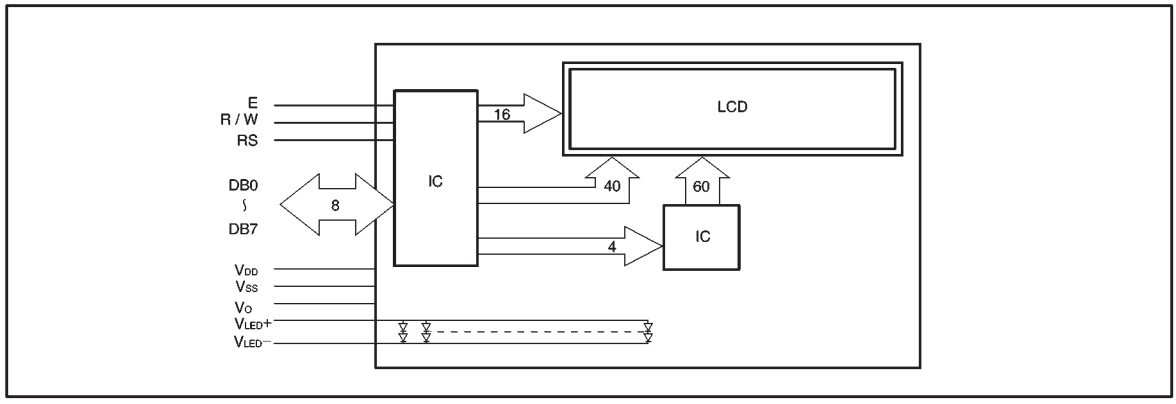
●Features

1) Wide viewing angle and high contrast.
2) 5 × 7 dot character matrix with cursor.
3) Interfaces with 4-bit or 8-bit MPUs.
4) Displays up to 226 characters and special symbols.
5) Custom character patterns are displayed with the character RAM.
6) Abundant instruction set including clear display, cursor on/off, and character blinking.
7) Compact and light weight for easy assembly to the host instrument.
8) Operable on single 5 V power supply.
9) Low power consumption.
10) Built-in LED backlight with minimal power consumption.

●External dimensions (Units: mm)



●Block diagram



●Pin assignments

Pin no.	Signal	Pin no.	Signal
1	V_{SS}	8	DB1
2	V_{DD}	9	DB2
3	V_O	10	DB3
4	RS	11	DB4
5	R / W	12	DB5
6	E	13	DB6
7	DB0	14	DB7

●Power supply example

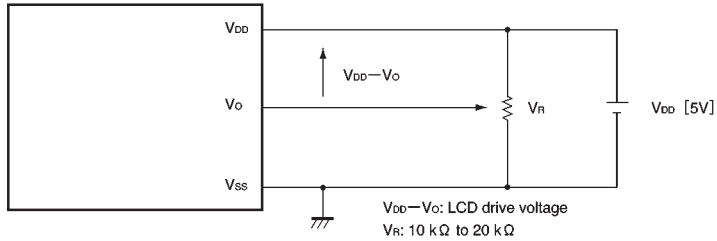


Fig.1

●Absolute maximum ratings (Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Logic power supply voltage	V_{DD}-V_{SS}	0	—	6.5	V
LCD drive voltage	V_{DD}-V_O	0	—	6.5	V
Input voltage	V_{IN}	V_{SS}	—	V_{DD}	V
Operating temperature	Topr	0	—	50	℃
Storage temperature	Tstg	−20	—	70	℃

●Electrical characteristics (V_{DD} = 5.0 V ± 0.25 V, Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Input high level voltage	V_{IH}	2.0	—	V_{DD}	V	
Input low level voltage	V_{IL}	—	—	0.8	V	
Output high level voltage	V_{OH}	2.4	—	—	V	$-I_{OH}$=1.2mA
Output low level voltage	V_{OL}	—	—	0.4	V	I_{OL}=2mA
Power supply current	I_{DD}	—	1.5	3	mA	V_{DD}=5V
LED forward current	I_R	—	—	1.2	mA	V_{LED}=8V
LED forward voltage	V_F	3.8	4.1	4.4	V	I_{LED}=120mA

●Optical characteristics (Ta = 25°C) Viewing direction 6 o'clock

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Rise time	t_r	—	100	250	ms	θ=10°, ϕ=0°
Fall time	t_d	—	150	250	ms	θ=10°, ϕ=0°
Contrast ratio	K	—	3	—	—	θ=10°, ϕ=0°
Viewing angle	θ_1	—	—	10	deg	ϕ=0°, K≧1.4
	θ_2	40	—	—	deg	ϕ=0°, K≧1.4
	ϕ	±30	—	—	deg	θ_1=20°, K≧1.4

(1) Definition of θ and ϕ

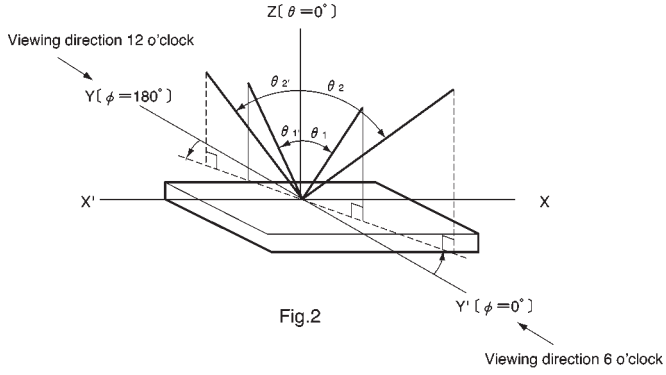


Fig.2

(2) Definition of viewing angles θ_1 and θ_2

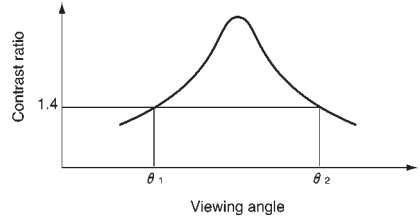


Fig.3

(3) Definition of contrast ratio"K"

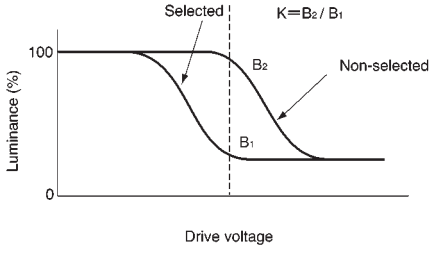


Fig.4

(4) Definition of optical response

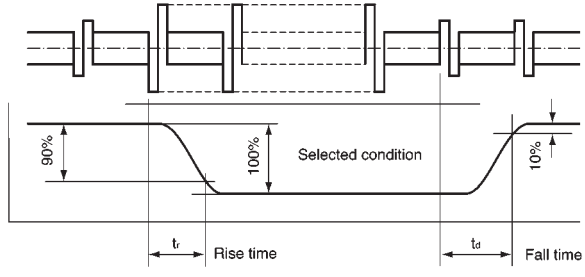


Fig.5

●Timing chart

(1) Writing

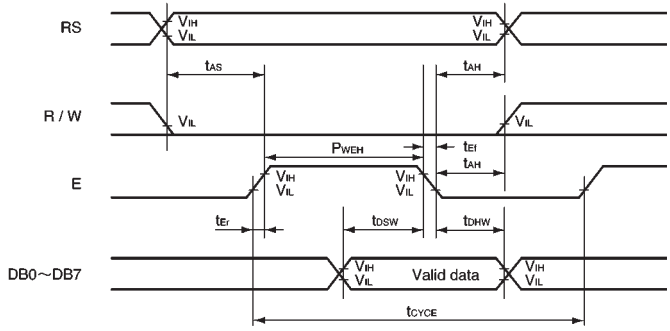


Fig. 6

Parameter	Symbol	Min.	Typ.	Max.	Unit	
Enable cycle time	t_{CYCE}	500	—	—	ns	Fig.6
Enable pulse time	P_{WEH}	220	—	—	ns	Fig.6
Enable rise and fall time	t_{Er}, t_{Ef}	—	—	20	ns	Fig.6
Address setup time	t_{AS}	40	—	—	ns	Fig.6
Address hold time	t_{AH}	10	—	—	ns	Fig.6
Data setup time	t_{DSW}	60	—	—	ns	Fig.6
Data hold time	t_{DHW}	10	—	—	ns	Fig.6

(2) Reading

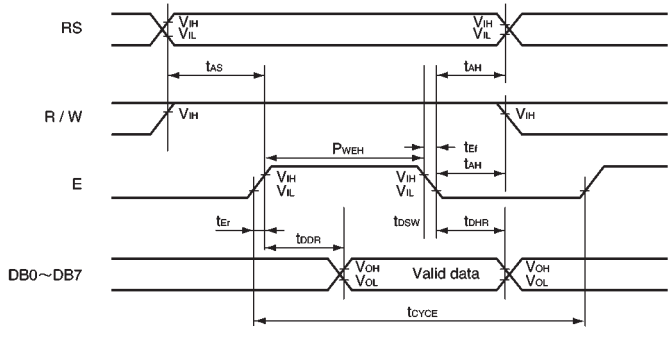


Fig. 7

Parameter	Symbol	Min.	Typ.	Max.	Unit	
Enable cycle time	t_{CYCE}	500	—	—	ns	Fig.7
Enable pulse time	P_{WEH}	220	—	—	ns	Fig.7
Enable rise and fall time	t_{Er},t_{Ef}	—	—	20	ns	Fig.7
Address setup time	t_{AS}	40	—	—	ns	Fig.7
Address hold time	t_{AH}	10	—	—	ns	Fig.7
Data delay time	t_{DDR}	—	—	120	ns	Fig.7
Data hold time	t_{DHR}	10	—	—	ns	Fig.7

●Pin functions

Symbol	Level	Input / output	Function	
V_{SS}	—	—	GND : 0V	Power supply voltage
V_{DD}	—	—	5V	
V_O	—	—		
RS	H / L	Input	Register selection signal. 0: Instruction register (writing) Busy flag, address counter (reading) 1: Data register (reading / writing)	
R / W	H / L	Input	Reading (R) and writing (W) selection signal. "0": Writing MPU → LCD module "1": Reading MPU ← LCD module	
E	H,H→L	Input	Data reading and writing start signal.	
DB0 ≀ DB3	H / L	Input / output	The lower 4 line data buses are bi-directional and used for data transfer between the MPU and the module. They are not used during 4-bit operation.	
DB4 ≀ DB7	H / L	Input / output	The upper 4 line data buses are bi-directional and used for data transfer between the MPU and the module. DB7 can also be used as a busy flag.	

Note: In order to be able to interface with 4-bit or 8-bit MPUs, the module supports data transfer with two transmissions of 4 bits at a time or one transmission of 8 bits at once.

(1) When the interface data length is 4 bits, data is transferred along DB4 through DB7 buses and DB0 through DB3 buses are not used. Data transferal is completed after two transfers of 4 bit data. First the upper nibble (contents of DB4 through DB7 during 8-bit interfacing) is transferred and then the lower nibble (contents of DB0 through DB3 during 8-bit interfacing) is transferred.

(2) When the interface data length is 8 bits, the data DB0 through DB7 is transferred along the eight data buses.

●Instructions

Instruction	Code										Description	Execution time
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		fCP=250kHz
Clear display	0	0	0	0	0	0	0	0	0	1	Clears display and sets address 0 of DD RAM to address counter.	1.64ms
Home cursor	0	0	0	0	0	0	0	0	1	*	Sets address 0 of DD RAM to address counter and returns a shifted display to original position. The contents of DD RAM are unchanged.	1.64ms
Entry mode set	0	0	0	0	0	0	0	1	I/D	S	Sets the cursor move direction and specifies whether or not to shift display. This operation occurs when reading or writing data.	40 μs
Display on / off control	0	0	0	0	0	0	1	D	C	B	Turns display on or off [D], turns cursor on or off [C], or blinks the character at the cursor position [B].	40 μs
Cursor / display shift	0	0	0	0	0	1	S/C	R/L	*	*	Moves cursor or shifts display without changing the DD RAM.	40 μs
Function set	0	0	0	0	1	DL	N	F	*	*	Sets the interface data length [DL], number of lines displayed [N], and character font [F].	40 μs
CG RAM address set	0	0	0	1	ACG						Sets the CG RAM address. Data received after this is CG RAM data.	40 μs
DD RAM address set	0	0	1	ADD							Sets the DD RAM address. Data received after this is DD RAM data.	40 μs
Read busy flag address	0	1	BF	AC							Reads the busy flag signifying internal operations in progress and reads the contents of the address counter.	0 μs
Write data to CG or DD RAM	1	0	Write Data								Data is written from the DD RAM or CG RAM.	46 μs
Read data from CG or DD RAM	1	1	Read Data								Data is read to DD RAM or CG RAM.	46 μs
	I / D = 1: Increment I / D = 0: Decrement S = 1: Accompanies display shift S / C = 1: Display shift S / C = 0: Cursor movement R / L = 1: Right shift R / L = 0: Left shift DL = 1: 8 bit DL = 0: 4 bit N = 1: 2 lines N = 0: 1 line F = 1: 5 × 10 dots F = 0: 5 × 7 dots BF = 1: Internal operation in progress BF = 0: Instructions can be received										DD RAM: Display data RAM CG RAM: Character generator RAM ACG: CG RAM address ADD: DD RAM address (corresponds to cursor address) AC: Address counter used for both DD and CG RAM.	Execution times will vary with frequency.

(Note) * = Invalid

●Character code and corresponding character pattern

Higher 4 bit / Lower 4 bit	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
XXXX0000	CGRAM (0)															
XXXX0001	(1)															
XXXX0010	(2)															
XXXX0011	(3)															
XXXX0100	(4)															
XXXX0101	(5)															
XXXX0110	(6)															
XXXX0111	(7)															
XXXX1000	(0)															
XXXX1001	(1)															
XXXX1010	(2)															
XXXX1011	(3)															
XXXX1100	(4)															
XXXX1101	(5)															
XXXX1110	(6)															
XXXX1111	(7)															

●Reset function

When you turn the power supply on using the internal reset circuit, the module automatically returns to its initial (reset) settings. At the initial settings, the following instructions are carried out.

(1) Clear display

The busy flag remains in the busy condition (BF = 1) until initialization is completed. This takes 15 ms.

(2) Function set

DL = 1: 8-bit interface data length

N = 1

F = 0: 5 × 7 dot matrix

(3) Display on/off control

D = 0: Display off

C = 0: Cursor off

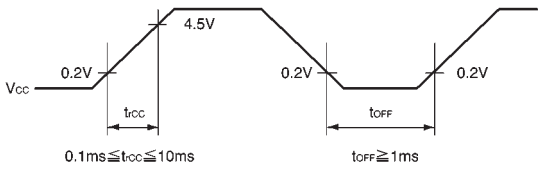
B = 0: Blinking off

(4) Entry mode set

I/D = 1: +1 (increment)

S = 0: No shift

Depending on the power supply's rise and fall times when it is turned on, there may be times when the initialization cannot be completed. Therefore, be aware of the following timing relationship.



t_{OFF} regulates the power supply breaks, or on and off times.

Note) When the above power supply conditions are not met, the internal reset circuit will not operate properly.