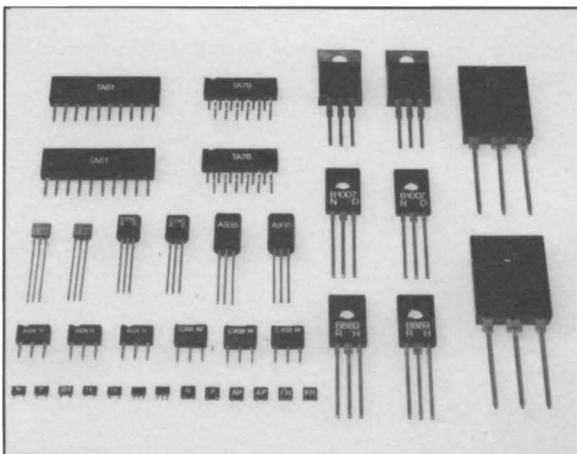
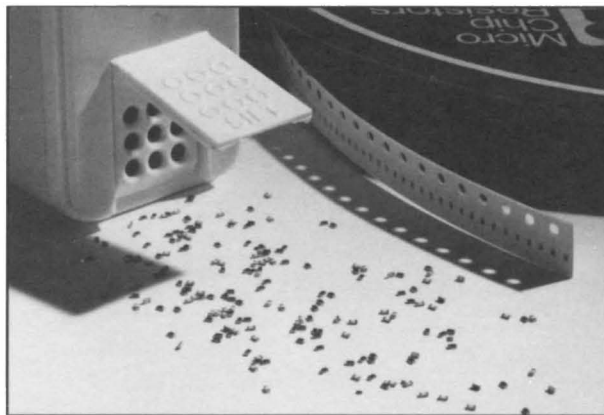
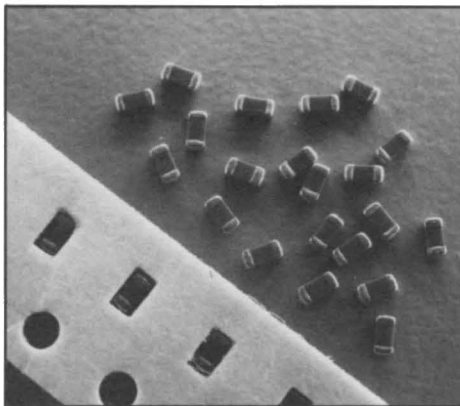
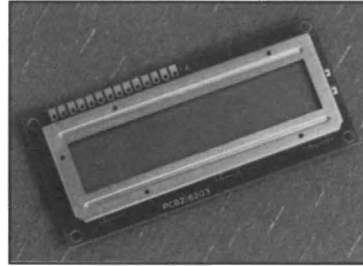
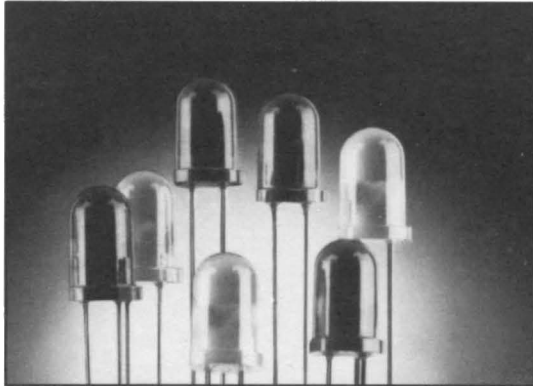




LCD DATA BOOK

STANDARD DOT MATRIX MODULES

ROHM



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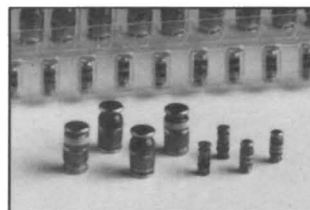


TABLE OF CONTENTS

LIQUID CRYSTAL DISPLAYS

RCM SERIES	1
RCM2003R	2
RCM2034R	13
RCM2037R	25
RCM2033M	37
RCM2013R	49
RCM2025R	61
RCM2019R	73
RCM2010R	85
RCM2011M	97
RCM2029M	109
RCM2030R	121
RCM2035R-A	133
RCM7033M	145
Custom LCD Check Sheet (Module Type)	157
Custom LCD Check Sheet (Panel Type)	158
ROHM REPS AND DISTRIBUTORS	159

ROHM

**LIQUID
CRYSTAL
DISPLAYS

RCM SERIES**

BLOCK DIAGRAM

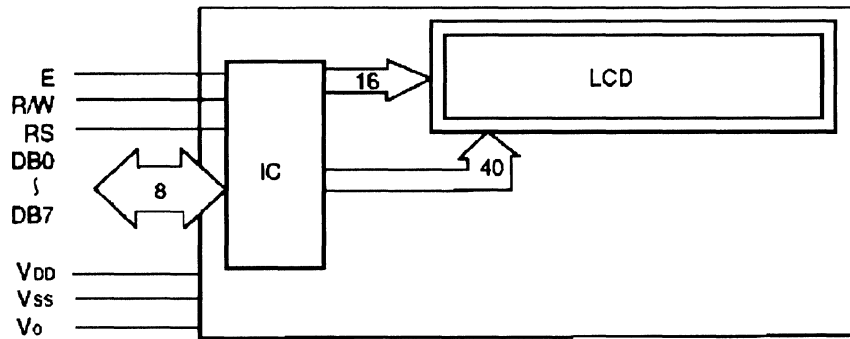


Fig. # 3, Block Diagram

INTERFACE PIN CONNECTION

Pin NO.	Symbol	Pin No.	Symbol
1	V_{SS}	8	DB 1
2	V_{DD}	9	DB 2
3	V_o	10	DB 3
4	RS	11	DB 4
5	R/W	12	DB 5
6	E	13	DB 6
7	DB _o	14	DB 7

DD RAM ADDRESS

	1	2		7	8	9	10		15	16
1	00H	01H	—	06H	07H	40H	41H	—	46H	47H

POWER SUPPLY SAMPLE CONNECTION

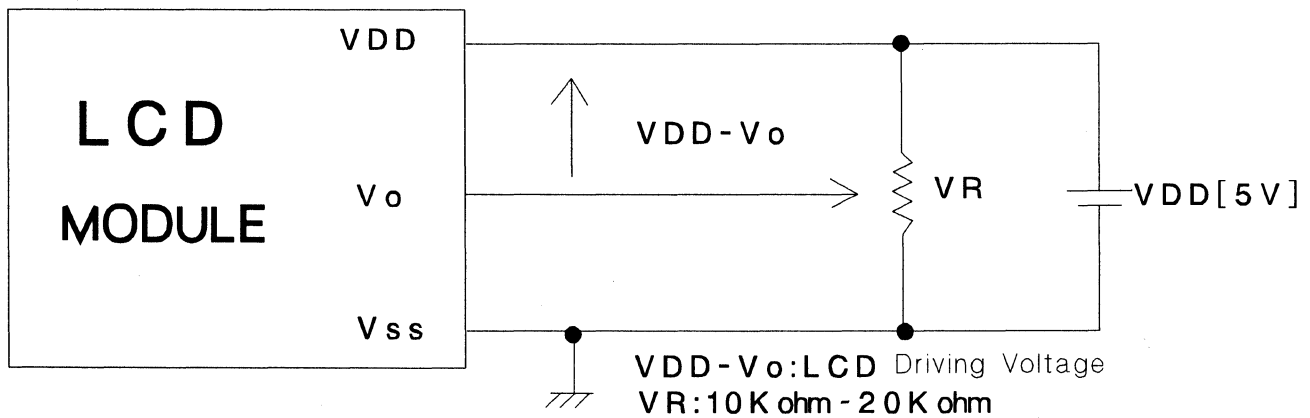


Fig. 4 Power Supply Sample Connection

ABSOLUTE MAXIMUM RATINGS

Items	Symbol	Min.	Max.	Unit
Supply Voltage for Logics	VDD-VSS	0	6.5	V
Supply Voltage for Driving LCD	VDD-V0	0	6.5	V
Input Voltage	VIN	-0.3	VDD+0.3	V
Operating Temperature	T0P	0	50	°C
Storage Temperature Range	Tstg	-20	70	°C

ELECTRICAL CHARACTERISTICS - VDD = 5.0 ± 5% Ta = 25°C

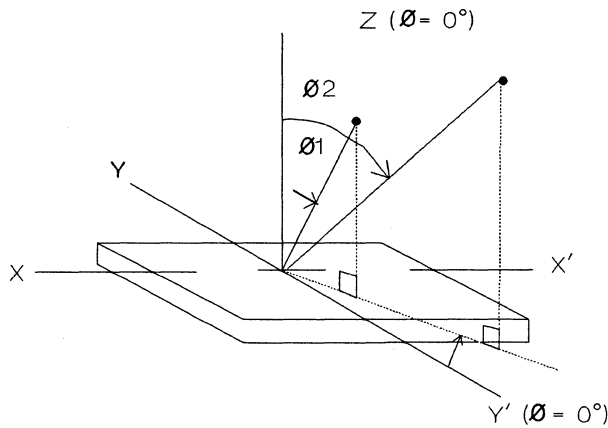
Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input High Level Voltage	VIH		2.2	-	VDD	V
Input Low Level Voltage	VIL		-	-	0.6	V
Output High Level Voltage	V0H	-I 0H = -0.205mA	2.4	-	-	V
Output Low Level Voltage	V0L	I 0L = 1.2mA	-	-	0.4	V
Power Supply Current	IDD	VDD=5V	-	1.5	3	mA

OPTICAL CHARACTERISTICS Ta=25°C

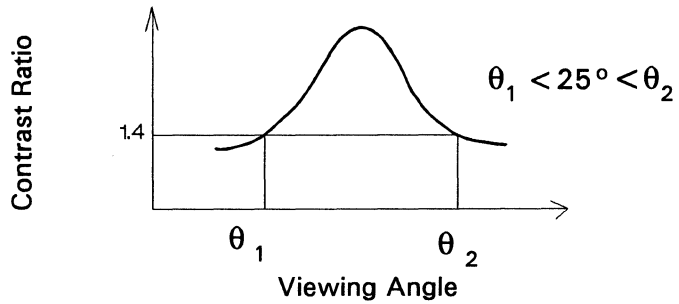
Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
t rise time	tr	$\theta = 10^\circ \phi = 0^\circ$	-	100	250	ms
t fall time	td	$\theta = 10^\circ \phi = 0^\circ$	-	150	250	ms
Contrast Ratio	K	$\theta = 10^\circ \phi = 0^\circ$	-	3		
Viewing Angle	$\theta 1$	$K \geq 1.4 -$ $\phi = 0^\circ$			20	degree
	$\theta 2$		40		-	degree
	ϕ	$K \geq 1.4$ $\theta = 20^\circ$	±30	-	-	degree

OPTICAL CHARACTERISTICS

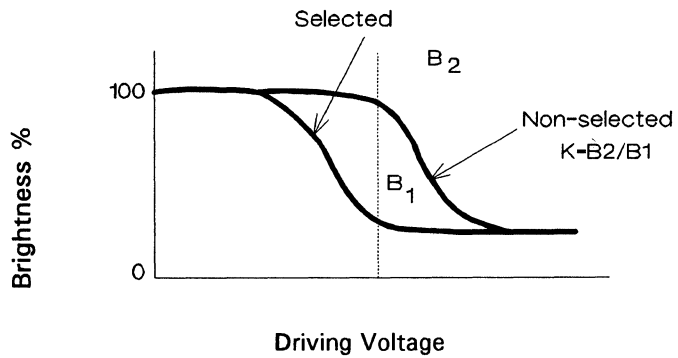
1) Definition of θ and ϕ



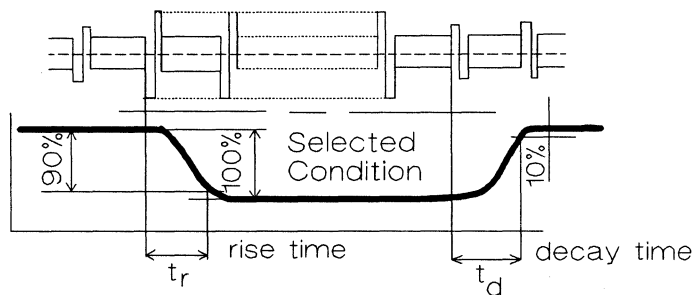
2) Definition of viewing angle θ_1 and θ_2



3) Definition of contrast ratio "K"



4) Definition of optical response time



OPERATION

(1) Writing

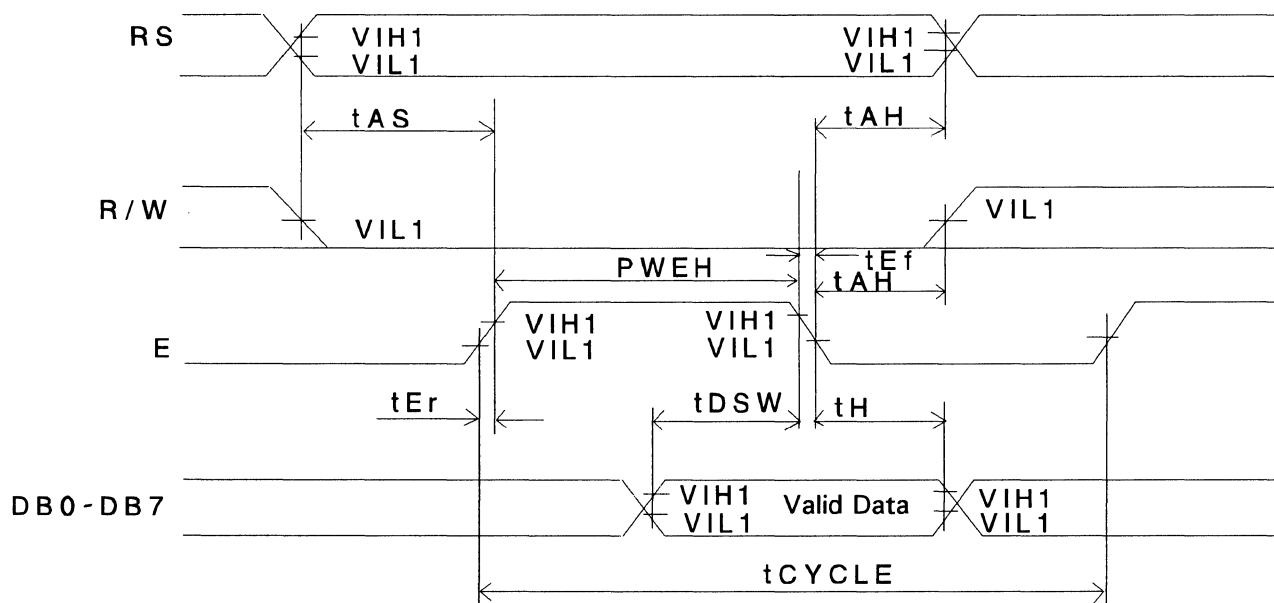


Fig. 5 Writing

Item	Symbol	Test Condition	Min.	Max.	Unit
Enable Cycle Time	tCYCE	Fig. 5	1.0	-	μ sec
Enable Pulse Time	PWE	Fig. 5	450	-	n sec
Enable Rise Time	tEr, tEf	Fig. 5	-	25	n sec
Enable Decay Time					
Address Set-Up Time	tAS	Fig. 5	10	-	n sec
Address Hold Time	tAH	Fig. 5	195	-	n sec
Data Hold Time	tH	Fig. 5	10	-	n sec

(2) Reading

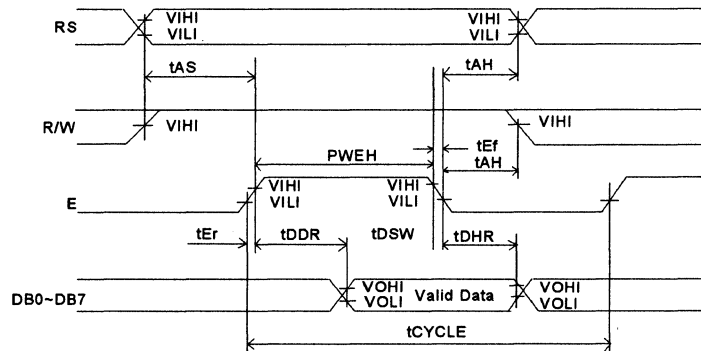


Fig. 6 Reading

Item	Symbol	Test Conditions	Min.	Max.	Unit
Enable Cycle Time	tCYCE	Fig. 6	1.0	-	μ sec
Enable Pulse Time	P WEH	Fig. 6	450	-	n sec
Enable Rise Time					
Enable Decay Time	tEr, tEf	Fig. 6	-	25	n sec
Address Set-Up Time	tAS	Fig. 6	140	-	n sec
Address Hold Time	tAH	Fig. 6	10	-	n sec
Data Delay Time	tDDR	Fig. 6	-	320	n sec
Data Hold Time	tDHR	Fig. 6	20	-	n sec

PIN FUNCTION

Symbol	Level	Input/Output	Function
VSS	----	----	GND : 0V +5V Power Voltage
VDD	----	----	
VO	----	----	
RS	H/L	Input	Register select signal 0: Instruction register (write) Busy flag address counter (read) 1: Data register (read/write)
R/W	H/L	Input	Read (R) Write (W) Select signal "0": Write MPU → LCD module "1": Read MPU ← LCD module
E	H, H → L	Input	Signal to start read or write data.
DB0	H/L	Input output power	Lower level 4 lines data bus are used to transfer data between MPU and module. When operated with 4bits, this function does not work.
DB3			
DB4	H/L	Input output power	
DB7			

REMARK:

This module can be interfaced with both 4 or 8bit MPU. Data transmission can either be sent in 2 parts at 4bits or once at 8bits.

- (1) If interface data is 4bits, data transmission is DB4~DB7, using 4bus, and the DB0~DB3 bus is not used. Data transmission between module and MPU will end after two transmissions.

Upper 4bits of data (Interface data length is at 8bits when contents are DB4~DB7) is transmitted, then lower 4bit is sent (interface data length is at 8bits contents are DB0~DB3).

- (2) When interface data is 8bits, data DB0~DB7, data is transmitted by using data bus.

Character Type LCD Module

RCM2003R

INSTRUCTION		Code										Description	Execution Time (f=250kHz)
Instruction	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 0) after entire display is cleared.	1.64 ms
Cursor at Home	0	0	0	0	0	0	0	0	0	1	*	Cursor is returned to home position (address 0). Shifted display is also returned to the original position. Contents of DDRAM are not changed.	1.64 ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S		Cursor advance direction and display shift are set. These operations are performed during data write and read modes.	40 μs
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.	40 μs
Cursor/Display Shift	0	0	0	0	0	1	S/CR/L	*	*			Cursor and display are shifted without changing the contents of DDRAM.	40 μs
Function Set	0	0	0	0	1	DL	N	F	*	*		Interface data length (DL), number of display lines (N), and character font (F) are set.	40 μs
CGRAM Address Set	0	0	0	1	ACG							CGRAM address is set. Transmitted and received after this is the data of CGRAM.	40 μs
DDRAM Address Set	0	0	0	ADD							DDRAM address is set. Transmitted and received after this is the data of DDRAM.	40 μs	
Busy Flag/address read	0	1	BF	AC							Busy flag (BF) showing internal operation and contents of address counter are read.	0 μs	
CGRAM/DDRAM Data Write	1	0	Write Data									Data is written in DDRAM or CGRAM.	46 μs
CGRAM/DDRAM Data Read	1	1	Read Data									Data is read out of DDRAM or CGRAM.	46 μs
	I/D = 1: Increment (+1) I/D = 0: Decrement (-1) 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 N = 1: 2 lines N = 0: 1 line F = 1: 5x10 dots F = 0: 5x7 dots BF = 1: Internal operation is being performed BF = 0: Instruction acceptable										DDRAM: Display Data RAM CGRAM: Character Generator RAM ACG: Address of CGRAM ADD: Address of DDRAM These correspond to cursor addresses AC: Address counter used for both DDRAM and CGRAM	Execution time changes with change in internal oscillation frequency (fosc).	

CHARACTER CODE AND PATTERN TABLE

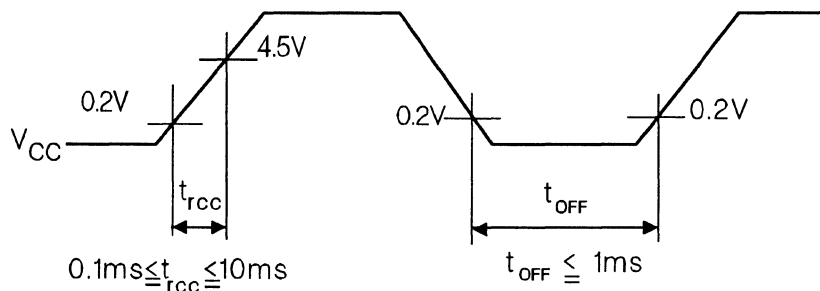
Higher 4 bit / Lower 4 bit	0000	0010	0011	0100	0101	0110	0111	1010	1011	1100	1101	1110	1111
xxxx0000	CG RAM (1)		0	1	2	3	4	5	6	7	8	9	0
	(2)	!	"	#	\$	%	&	'	()	*	+	,
xxxx0001	(3)	;	:	?	@	A	B	C	D	E	F	G	H
	(4)	I	J	K	L	M	N	O	P	Q	R	S	T
xxxx0010	(5)	U	V	W	X	Y	Z	[\]	^	_	`
	(6)	{	|	}	~	`	a	b	c	d	e	f	g
xxxx0011	(7)	h	i	j	k	l	m	n	o	p	q	r	s
	(8)	t	u	v	w	x	y	z	[\]	^	_
xxxx0100	(1)	`	a	b	c	d	e	f	g	h	i	j	k
	(2)	l	m	n	o	p	q	r	s	t	u	v	w
xxxx0101	(3)	x	y	z	[	\	\]	^	_	`	a	b	c
	(4)	d	e	f	g	h	i	j	k	l	m	n	o
xxxx0110	(5)	p	q	r	s	t	u	v	w	x	y	z	[
	(6)	\	\]	^	_	`	a	b	c	d	e	f	g
xxxx0111	(7)	h	i	j	k	l	m	n	o	p	q	r	s
	(8)	t	u	v	w	x	y	z	[\]	^	_
xxxx1000	(1)	`	a	b	c	d	e	f	g	h	i	j	k
	(2)	l	m	n	o	p	q	r	s	t	u	v	w
xxxx1001	(3)	x	y	z	[	\	\]	^	_	`	a	b	c
	(4)	d	e	f	g	h	i	j	k	l	m	n	o
xxxx1010	(5)	p	q	r	s	t	u	v	w	x	y	z	[
	(6)	\	\]	^	_	`	a	b	c	d	e	f	g
xxxx1011	(7)	h	i	j	k	l	m	n	o	p	q	r	s
	(8)	t	u	v	w	x	y	z	[\]	^	_
xxxx1100	(1)	`	a	b	c	d	e	f	g	h	i	j	k
	(2)	l	m	n	o	p	q	r	s	t	u	v	w
xxxx1101	(3)	x	y	z	[	\	\]	^	_	`	a	b	c
	(4)	d	e	f	g	h	i	j	k	l	m	n	o
xxxx1110	(5)	p	q	r	s	t	u	v	w	x	y	z	[
	(6)	\	\]	^	_	`	a	b	c	d	e	f	g
xxxx1111	(7)	h	i	j	k	l	m	n	o	p	q	r	s
	(8)	t	u	v	w	x	y	z	[\]	^	_

RESET FUNCTION

Upon reset, the module will automatically reset to its initial function.

At initial function, please start by using the following instructions.

- 1) Clear Display
(Note: Busy flag (BF) is active high - BF=1)
- 2) Function set up
 DL = 1: Interface data length 8bits.
 N = 0: 1 line display
 F = 0: 5 x 7 dot
- 3) Display ON/OFF Control
 D: = 0: Display OFF
 C: = 0: Cursor OFF
 B = 0: Intermittent OFF
- 4) Input Set Up Mode
 I/D = 1: + 1 (inclement)
 S = 0: Does Not Shift



t_{OFF} present instant or ON.OFF time.
 (Remark) Unless above electrical condition are satisfied internal circuit will not operate properly.

APPLICATIONS

Personal computer, word processor, facsimile, telephone, etc., medical and other instrumentations.

- 1) Handling Instructions
 - a) Attention must be paid to avoid external shock, which will cause operations failure.
 - b) Polarizer on the surface is fragile and can easily be scratched and damaged. Therefore, please take extra care when handling. To clean surface of termination, please wipe off with alcohol.
 - c) The liquid used in the LCD panel is a harmful substance and must not be ingested. Avoid contact on exposed skin. If liquid is touched, wash thoroughly.
 - d) Do not expose to direct sunlight or fluorescent light for long periods of time. If it will be in direct sunlight, please use UV filter.
 - e) For storage please avoid high temperature/high humidity.
When long term storage is required, keep panels in low temperature (5°C ~ 25°C) and low humidity.
- 2) Operational Instructions
 - a) Do not connect or disconnect module while power is on.
 - b) Turn on module power before input of signal. Turn off input signal before turning off power to module. It can be damaged by "latch-up" phenomenon.
- 3) Mounting Instructions
 - a) Ground solder before using.
 - b) CMOS-IC requires caution in cases of potential ESD.
 - c) Do not remove panel from board.
- 4) Module Assembly Instructions
 - a) For mounting, use 4 holes on each corner and do not stress circuit.
 - b) To prevent contamination, scratches, or cuts on the polarizer, please use the protective cover on the front panel.

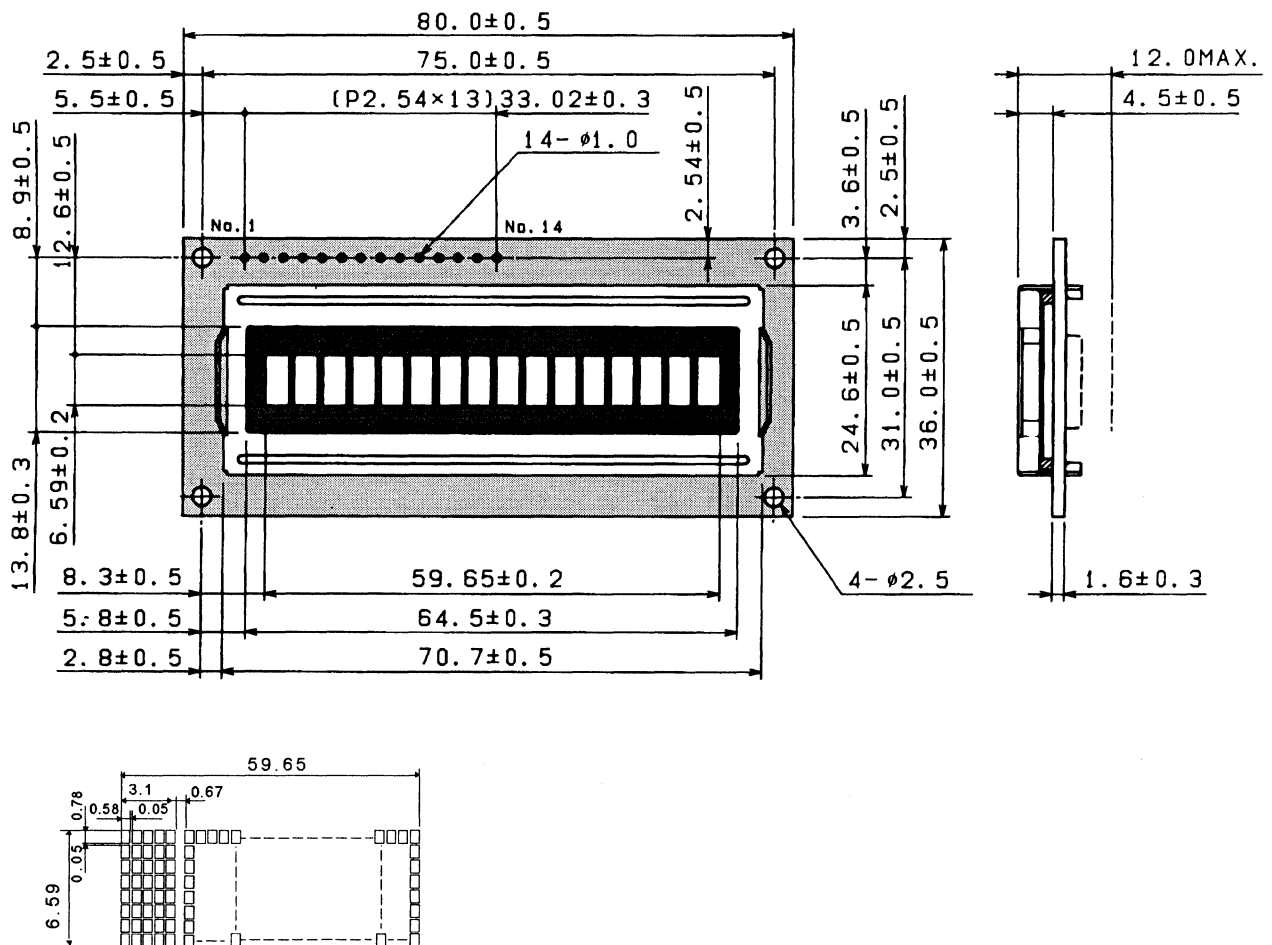
Character Type LCD Module

DESCRIPTION

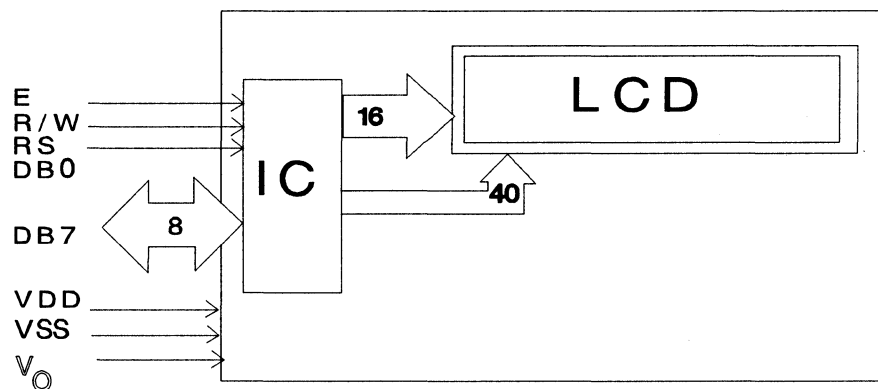
RCM2034R is an LCD module with LSI controller/driver built in.

FEATURES

- 1) 16 Character x 1 Row
- 2) Wide viewing angle, high contrast ratio.
- 3) 5 x 7 dot construction in each character.
- 4) Can be interfaced with 4bit or 8bit MPU.
- 5) Displays 208 different types of international characters and symbols plus 32 different types of special characters and symbols.
- 6) User designed display pattern with built in character generator RAM.
- 7) Clear, easy to read display, with cursor on/off, and character blink. Simple instructions for various functions.
- 8) Compact and light weight, for easy assembly.
- 9) Can be driven by a 5V circuit.
- 10) Low power consumption.
- 11) Optional transmissive, transreflective type with back light.



BLOCK DIAGRAM



INTERFACE PIN CONNECTION

Pin No.	Symbol	Pin No.	Symbol
1	V_{SS}	8	DB 1
2	V_{DD}	9	DB 2
3	V_o	10	DB 3
4	RS	11	DB 4
5	R/W	12	DB 5
6	E	13	DB 6
7	DB0	14	DB 7

DD RAM ADDRESS

	1	2	7	8	9	10	15	16		
1 Line	00H	01H	—	06H	07H	40H	41H	—	46H	47H

POWER SUPPLY SAMPLE CONNECT

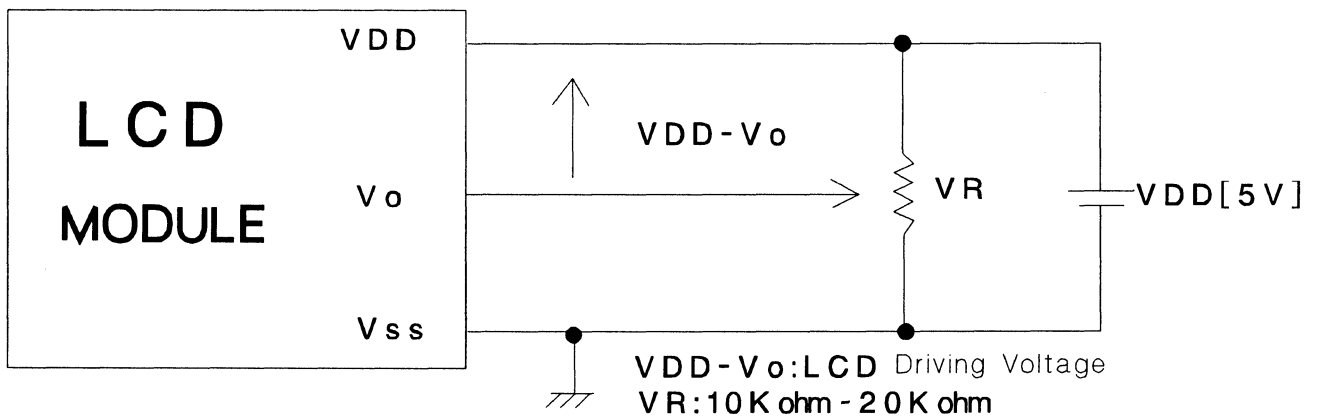


Fig. 4 Power Supply Sample Connect

ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

Items	Symbol	Min.	Max.	Unit
Supply Voltage for Logics	VDD-VSS	-0.3	6.5	V
Supply Voltage for Driving LCD	VDD-VO	0	6.5	V
Input Voltage	VIN	-0.3	VDD+0.3	V
Operating Temperature	TOP	0	50	°C
Storage Temperature	Tstg	-20	70	°C

ELECTRICAL CHARACTERISTICS (VDD = 5.0 ± 5% Ta = 25°C)

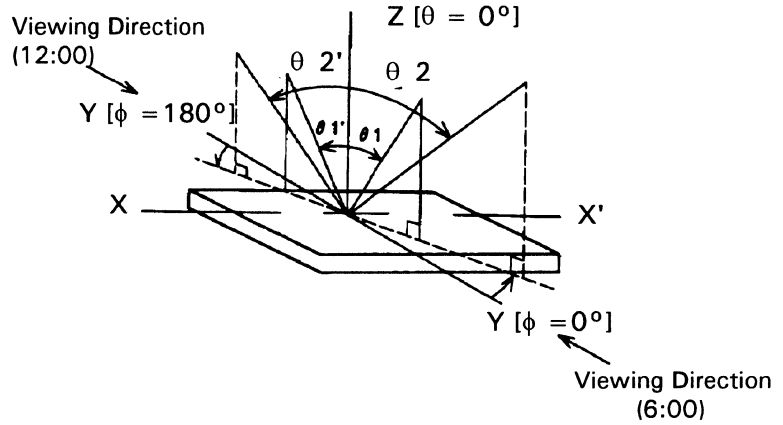
Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input High Level Voltage	VIH		2.0	-	-	V
Input Low Level Voltage	VIL		-	-	0.8	V
Output High Level Voltage	VOH	I OH=1.2mA	2.4	-	-	V
Output Low Level Voltage	VOL	I OL=2.0mA	-	-	0.4	V
Power Supply Current	IDD	VDD=5V	-	0.5	2	mA

OPTICAL CHARACTERISTICS (Ta = 25°C)

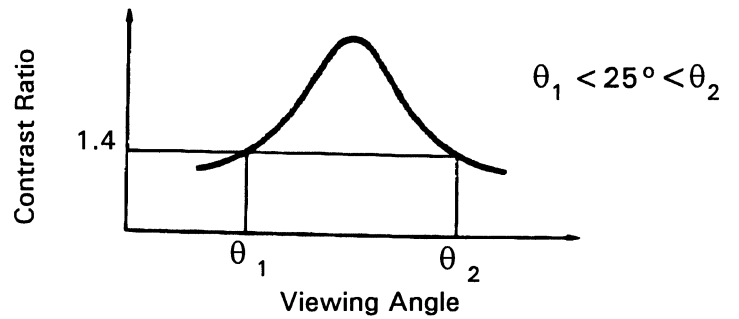
Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
t rise time	tr	$\theta = 10^\circ$ $\phi = 0^\circ$	-	100	250	ms
t fall time	td	$\theta = 10^\circ$ $\phi = 0^\circ$	-	150	250	ms
Contrast Ratio	K	$\theta = 10^\circ$ $\phi = 0^\circ$	-	3		
Viewing Angle	$\theta 1$	$K \geq 1.4$	-	-	20	degree
	$\theta 2$	$\phi = 0^\circ$	40	-	-	degree
	ϕ	$K \geq 1.4$ $\theta = 20^\circ$	± 30	-	-	degree

OPTICAL CHARACTERISTICS

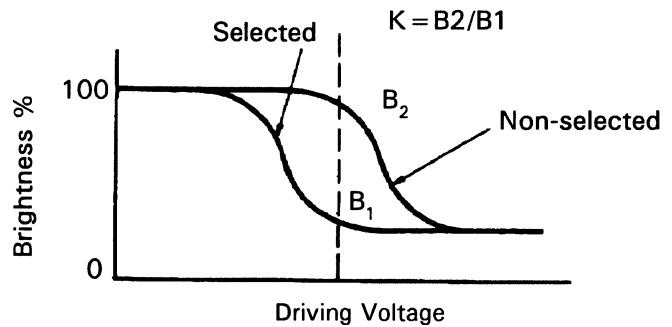
1) Definition of θ and ϕ



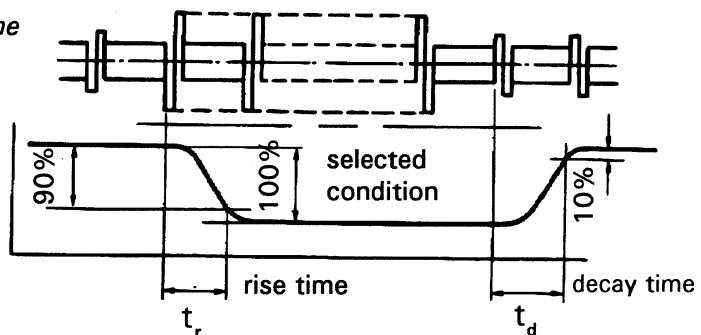
2) Definition of viewing angle $\theta 1$ and $\theta 2$



3) Definition of contrast ratio "K"



4) Definition of optical response time



OPERATION

(1) Writing

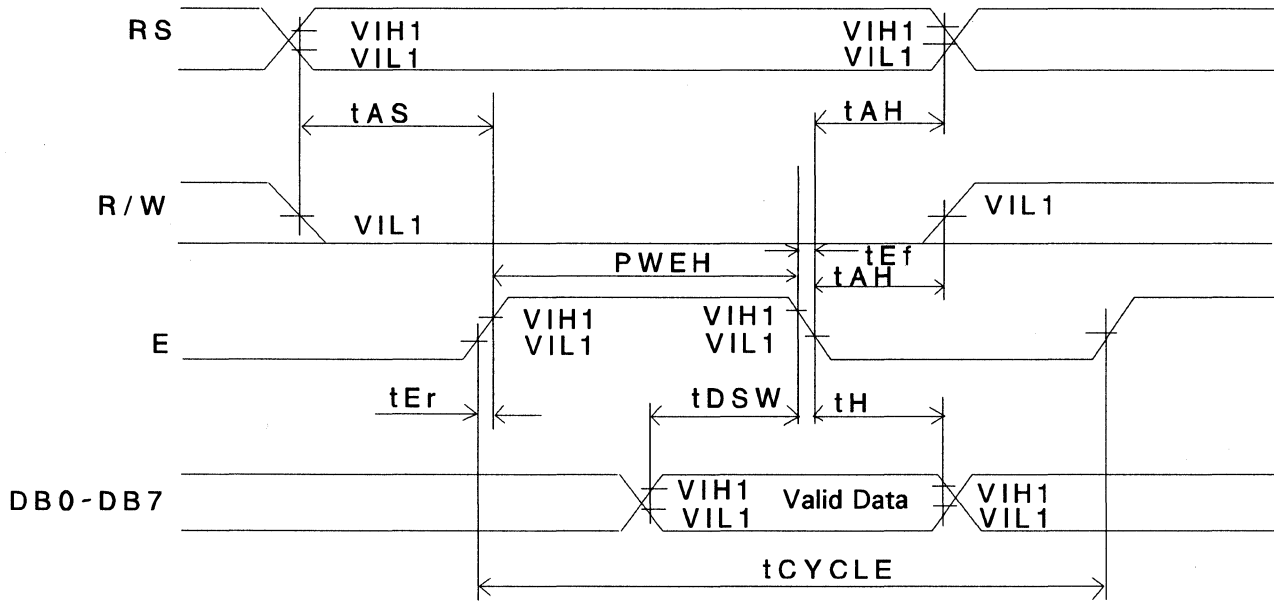


Fig. 5 Writing

Item	Symbol	Test Condition	Min.	Max.	Unit
Enable Cycle Time	tCYCE	Fig. 5	500	-	n sec
Enable Pulse Time	PWE	Fig. 5	220	-	n sec
Enable Rise Time	tEr, tEf	Fig. 5	-	20	n sec
Enable Decay Time					
Address Set-Up Time	tAS	Fig. 5	40	-	n sec
Address Hold Time	tAH	Fig. 5	10	-	n sec
Data Set-Up Time	tDSW	Fig. 5	60	-	n sec
Data Hold Time	tH	Fig. 5	10	-	n sec

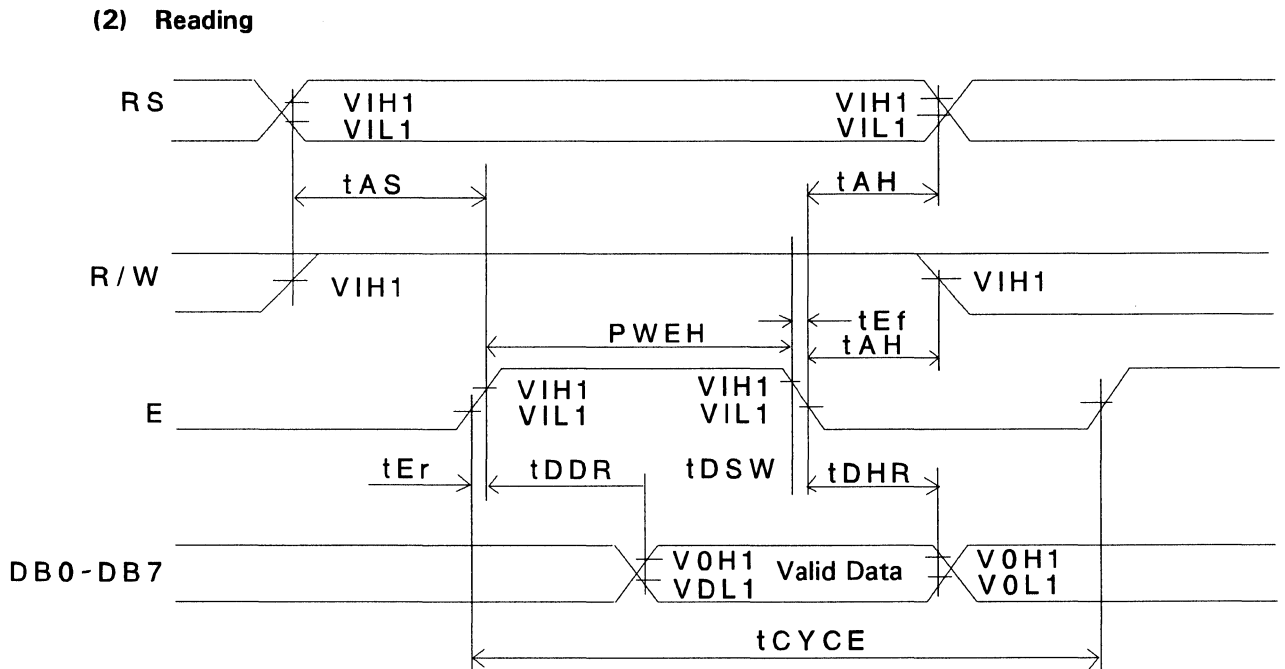


Fig. 6 Reading

Item	Symbol	Test Conditions	Min.	Max.	Unit
Enable Cycle Time	tCYCE	Fig. 6	500	-	n sec
Enable Pulse Time	PWEH	Fig. 6	220	-	n sec
Enable Rise Time	tEr, rEf	Fig. 6	-	20	n sec
Enable Decay Time					
Address Set-Up Time	tAS	Fig. 6	40	-	n sec
Address Hold Time	tAH	Fig. 6	10	-	n sec
Data Delay Time	tDDR	Fig. 6	-	120	n sec
Data Hold Time	tDHR	Fig. 6	20	-	n sec

PIN FUNCTION

Symbol	Level	Input/ Output Power	Function	
VSS	_____	_____	GND : 0V	Power
VDD	_____	_____	+ 5V	
Voltage	_____	_____		
VO	_____	_____		
RS	H/L	Input	Register select signal 0: Instruction register (write) Busy flag address counter (read) 1: Data register (read/write)	
R/W	H/L	Input	Read (R) Write (W) Select signal "0": Write MPU → LCD module "1": Read MPU ← LCD module	
E	H, H → L	Input	Signal to start read or write data.	
DB0 DB3	H/L	Input output power	Lower level 4 lines data bus are used to transfer data between MPU and module. When operated with 4bits, this function does not work.	
DB4 DB7	H/L	Input output power	Upper level 4 lines data bus are used to transfer data between MPU and module.	

REMARK:

This module can be interfaced with both 4 or 8 bit MPU.
Data transmission can either be sent in 2 parts at 4bits or once at 8bits.

- (1) If interface data is 4bits, data transmission is DB4~DB7, using 4bus, and the DB0~DB3 bus is not used.

Data transmission between module and MPU will end after two transmissions.

Upper 4bits of data (Interface data length is at 8bits when contents are DB4~DB7) is transmitted, then lower 4bit is sent (interface data length is at 8bits contents are DB0~DB3).

- (2) When interface data is 8bits, data DB0~DB7, data is transmitted by using data bus.

Character Type LCD Module

RCM2034R

INSTRUCTION											Description	Execution Time (f = 250kHz)	
Instruction	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 0) after entire display is cleared	1.64 ms	
Cursor at Home	0	0	0	0	0	0	0	0	1	*	Cursor is returned to home position (address 0). Shifted display is also returned to the original position. Contents of DDRAM are not changed.	1.64 ms	
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Cursor advance direction and display shift are set. These operations are performed during data write and read modes.	40 μs	
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.	40 μs	
Cursor/Display Shift	0	0	0	0	0	1	S/C	R/L	*	*	Cursor and display are shifted without changing the contents of DDRAM	40 μs	
Function Set	0	0	0	0	1	DL	N	F	*	*	Interface data length (DL), number of display lines (N), and character font (F) are set.	40 μs	
CGRAM Address Set	0	0	0	1	ACG					CGRAM address is set. Transmitted and received after this are the data of CGRAM.		40 μs	
DDRAM Address Set	0	0	1	ADD					DDRAM address is set. Transmitted and received after this are the data of DDRAM.		40 μs		
Busy Flag/address read	0	1	BF	AC					Busy flag (BF) showing internal operation and contents of address counter are read.		0 μs		
CGRAM/DDRAM Data Write	1	0	Write Data					Data are written in DDRAM or CGRAM.		46 μs			
CGRAM/DDRAM Data Read	1	1	Read Data					Data are read out of DDRAM or CGRAM.		46 μs			
<p>I/D = 1: Increment (+1) I/D = D: Decrement (-1) 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 N = 1: 2 lines N = 0: 1 line F = 1: 5x10 dots</p>											<p>F = 0: 5x7 dots BF = 1: Internal operation is being performed BF = 0: Instruction acceptable DDRAM: Display Data RAM CGRAM: Character Generator RAM ACG: Address of CGRAM ADD: Address of DDRAM. These correspond to cursor addresses AC: Address counter used for both DDRAM and CGRAM</p>		Execution time changes with change in internal oscillation frequency (fosc).

CHARACTER CODE AND PATTERN TABLE

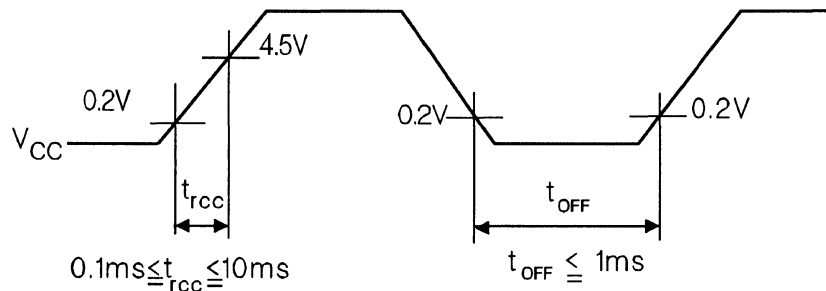
Higher 4bit \ Lower 4bit	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
XXXX0000	CGRAM (0)															
XXXX0001	(1)															
XXXX0010	(2)															
XXXX0011	(3)															
XXXX0100	(4)															
XXXX0101	(5)															
XXXX0110	(6)									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

RESET FUNCTION

Upon reset, the module will automatically reset to its initial function.

At initial function, please start by using the following instructions.

- 1) Clear Display
(Note: Busy flag (BF) is active high - BF = 1)
- 2) Function set up
DL = 1: Interface data length 8bits.
N = 0: 1 line display
F = 0: 5 x 7 dot
- 3) Display ON/OFF Control
D: = 0: Display OFF
C: = 0: Cursor OFF
B = 0: Intermittent OFF
- 4) Input Set Up Mode
I/D = 1: + 1 (inclement)
S = 0: Does Not Shift



t_{OFF} present instant or ON.OFF time.

(Remark) Unless above electrical condition are satisfied internal circuit will not operate properly.

APPLICATIONS

Personal computer, word processor, facsimile, telephone, etc., medical and other instrumentations.

1) Handling Instructions

- a) Attention must be paid to avoid external shock, which will cause operational failure.
- b) Polarizer on the surface is fragile and can easily be scratched and damaged. Therefore, please take extra care when handling. To clean surface of termination, please wipe off with alcohol.
- c) The liquid used in the LCD panel is a harmful substance and must not be ingested. Avoid contact on exposed skin. If liquid is touched, wash thoroughly.
- d) Do not expose to direct sunlight or fluorescent light for long periods of time. If it will be in direct sunlight, please use UV filter.
- e) For storage please avoid high temperature/high humidity. When long term storage is required, keep panels in low temperature (5°C ~ 25°C) and low humidity.

2) Operational Instructions

- a) Do not connect or disconnect module while power is on.
- b) Turn on module power before input of signal. Turn off input signal before turning off power to module. It can be damaged by "latch-up" phenomenon.

3) Mounting Instructions

- a) Ground solder before using.
- b) CMOS-IC requires caution in cases of potential ESD.
- c) Do not remove panel from board.

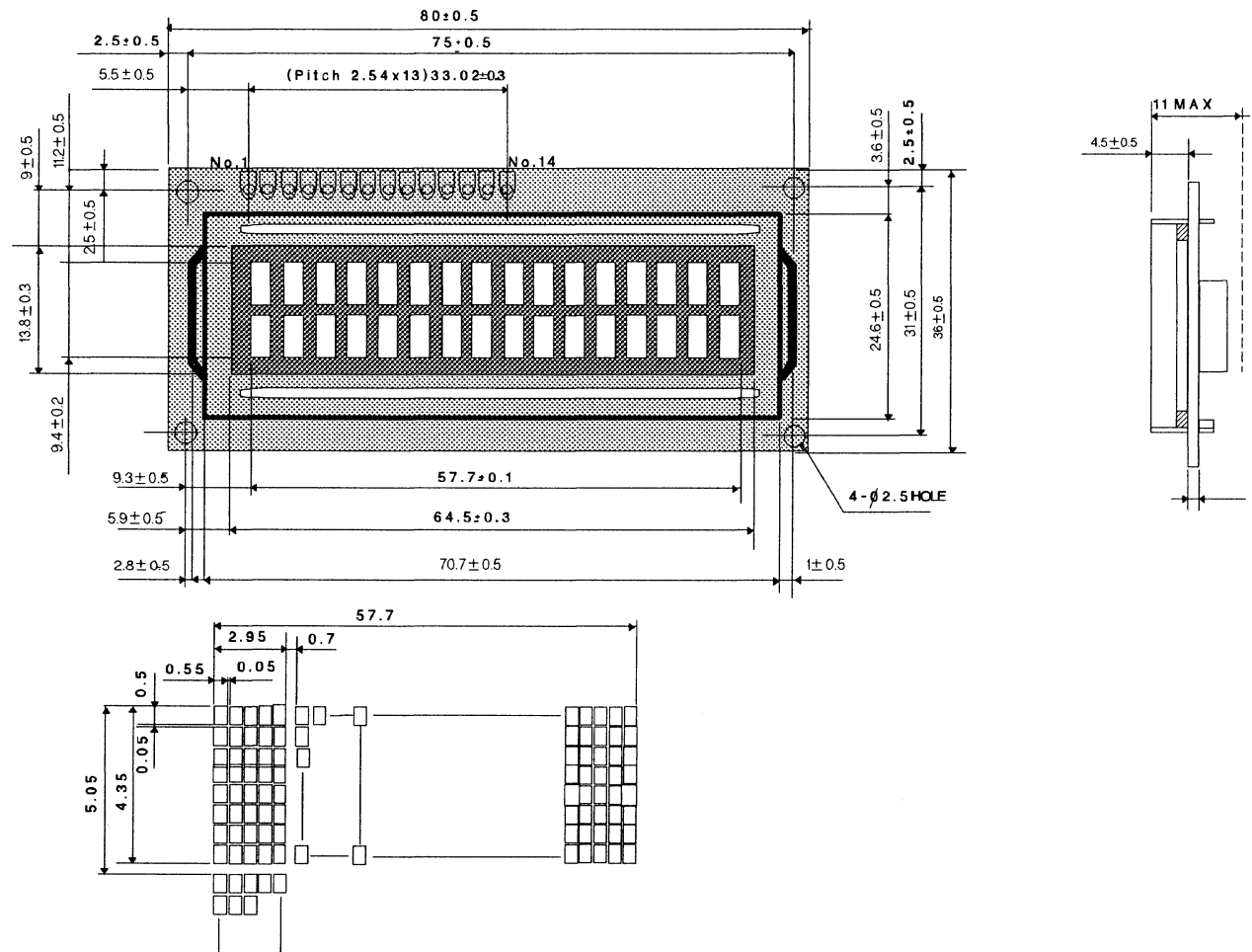
4) Module Assembly Instructions

- a) For mounting, use 4 holes on each corner and do not stress circuit.
- b) To prevent contamination, scratches, or cuts on the polarizer, please use the protective cover on the front panel.

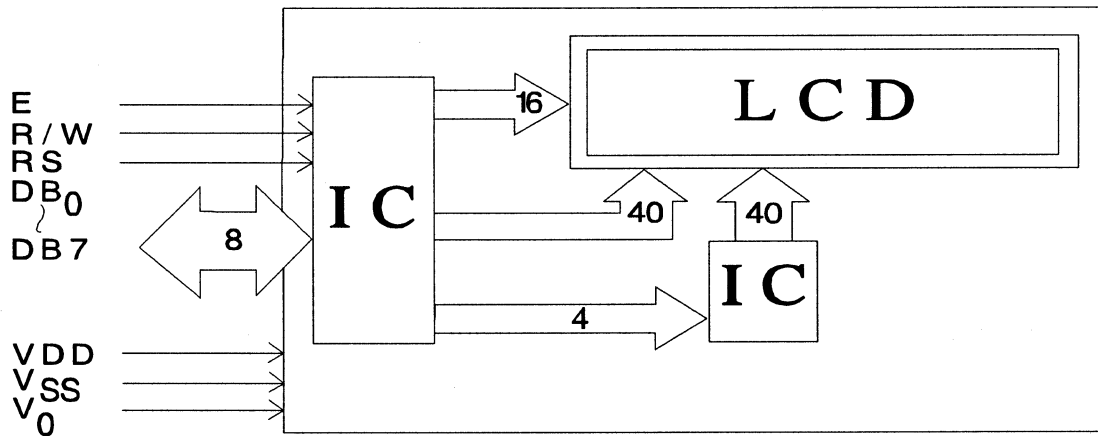
Character Type LCD Module

FEATURES

- 1) 16 Character x 2 Row
- 2) Wide viewing angle, high contrast ratio.
- 3) The dot construction is 5x7 dot plus 1 line.
- 4) Can be interfaced with 4bit or 8bit MPU.
- 5) Displays 160 different types of US characters and symbols plus 32 different types of special characters and symbols.
- 6) With built-in character generator RAM, any user-design pattern can be displayed.
- 7) Display clear, cursor on/off, displayed character blink, etc., various function instruction can be accomplished simply.
- 8) Compact light weight type, which can easily be assembled to a machine.
- 9) Can be driven by a 5V circuit.
- 10) Low power consumption.
- 11) With option, it is possible to build transmissive, trans-reflective type with back light.



BLOCK DIAGRAM



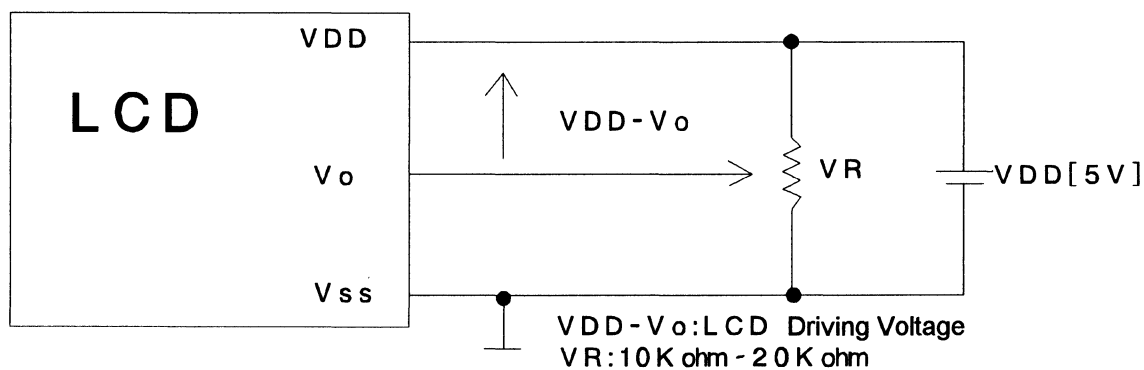
INTERFACE PIN CONNECTION

Pin NO.	Symbol	Pin No.	Symbol
1	V_{SS}	8	DB 1
2	VDD	9	DB 2
3	V_o	10	DB 3
4	RS	11	DB 4
5	R/W	12	DB 5
6	E	13	DB 6
7	DB_o	14	DB 7

DD RAM ADDRESS

	1	2	3	4	14	15	16	
1 Line	00H	01H	02H	03H	————	0DH	0EH	0FH
2 Line	40H	41H	42H	43H	————	4DH	4EH	4FH

POWER SUPPLY SAMPLE CONNECT



ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

Items	Symbol	Min.	Max.	Unit
Supply Voltage for Logics	VDD-VSS	-0.3	6.5	V
Supply Voltage for Driving LCD	VDD-VO	0	6.5	V
Input Voltage	VIN	-0.3	VDD+0.3	V
Operating Temperature	TOP	0	50	°C
Storage Temperature	Tstg	-20	70	°C

ELECTRICAL CHARACTERISTICS (VDD=5.0 ± 5% Ta=25°C)

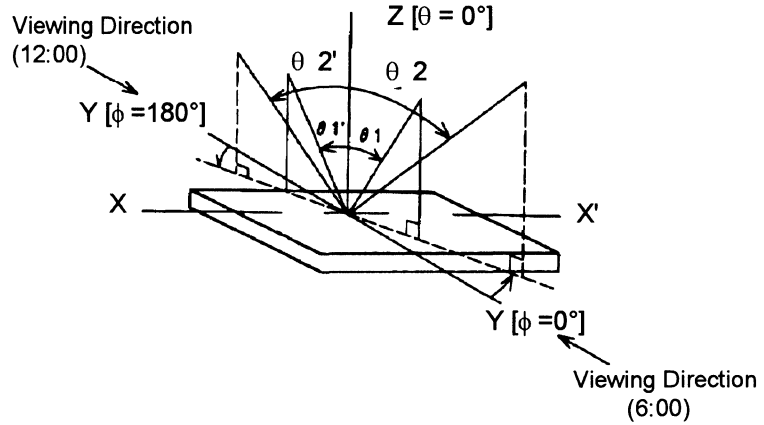
Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input High Level Voltage	VIH		2.2	-	VDD	V
Input Low Level Voltage	VIL		-	-	0.5	V
Output High Level Voltage	VOH	-IGH=0.205mA	2.4	-	-	V
Output Low Level Voltage	VOL	IOL=1.2mA	-	-	0.4	V
Power Supply Current	IDO	VDD=5V	-	1	3	mA

OPTICAL CHARACTERISTICS (Ta=25°C)

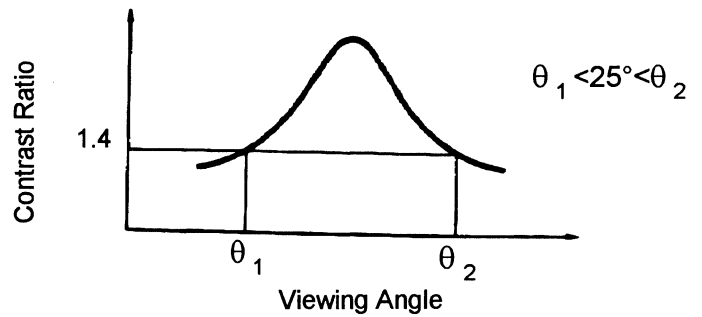
Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
t rise time	tr	$\theta = 10^\circ$ $\phi = 0^\circ$	-	100	250	ns
t fall time	td	$\theta = 10^\circ$ $\phi = 0^\circ$	-	150	250	ns
Contrast Ratio	K	$\theta = 10^\circ$ $\phi = 0^\circ$	-	3		
Viewing Angle	$\theta 1$	$K \geq 1.4$	-	-	20	degree
	$\theta 2$	$\phi = 0^\circ$	40	-	-	degree
	ϕ	$K \geq 1.4$ $\phi = 20^\circ$	± 30	-	-	degree

OPTICAL CHARACTERISTICS

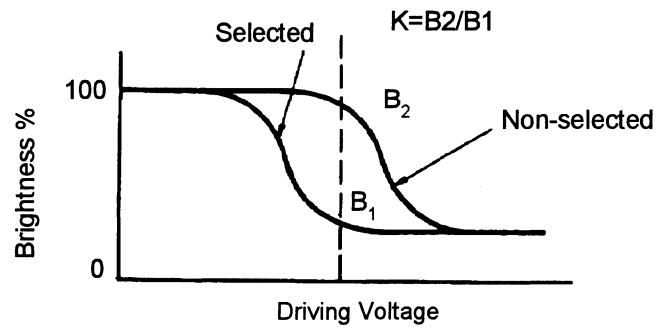
1) Definition of θ and ϕ



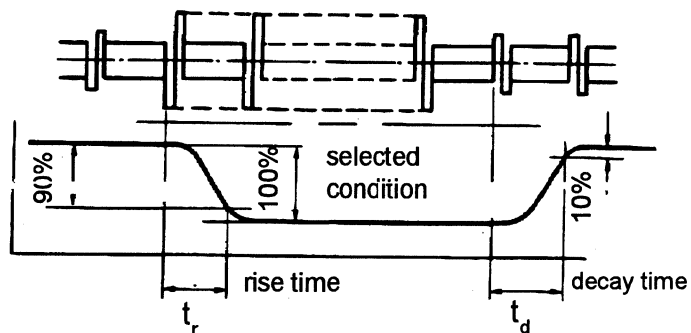
2) Definition of viewing angle $\theta 1$ and $\theta 2$



3) Definition of contrast ratio "K"



4) Definition of optical response time



OPERATION

(1) Writing

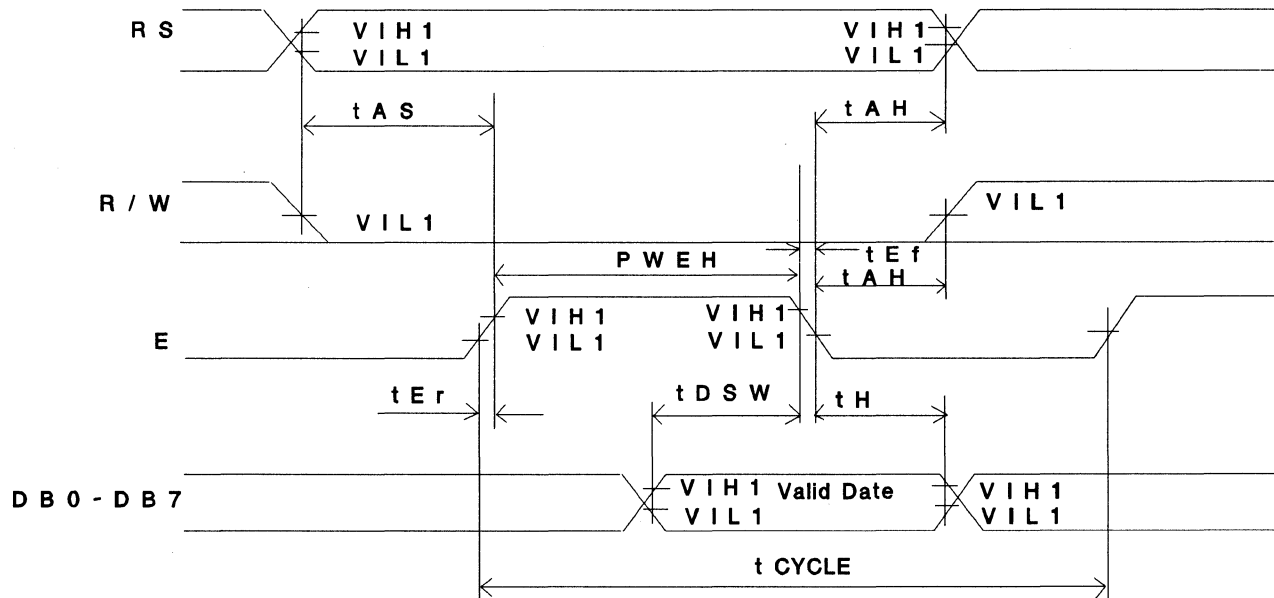


Fig. 5 Writing

Item	Symbol	Test Condition	Min.	Max.	Unit
Enable Cycle Time	tCYCE	Fig. 5	1.0	-	μ sec
Enable Pulse Time	PWEH	Fig. 5	450	-	n sec
Enable Rise Time	tEr, tEf	Fig. 5	-	25	n sec
Enable Decay Time					
Address Set-Up Time	tAS	Fig. 5	140	-	n sec
Address Hold Time	tAH	Fig. 5	10	-	n sec
Data Set-Up Time	tDSW	Fig. 5	195	-	n sec
Data Hold Time	tH	Fig. 5	10	-	n sec

(2) Reading

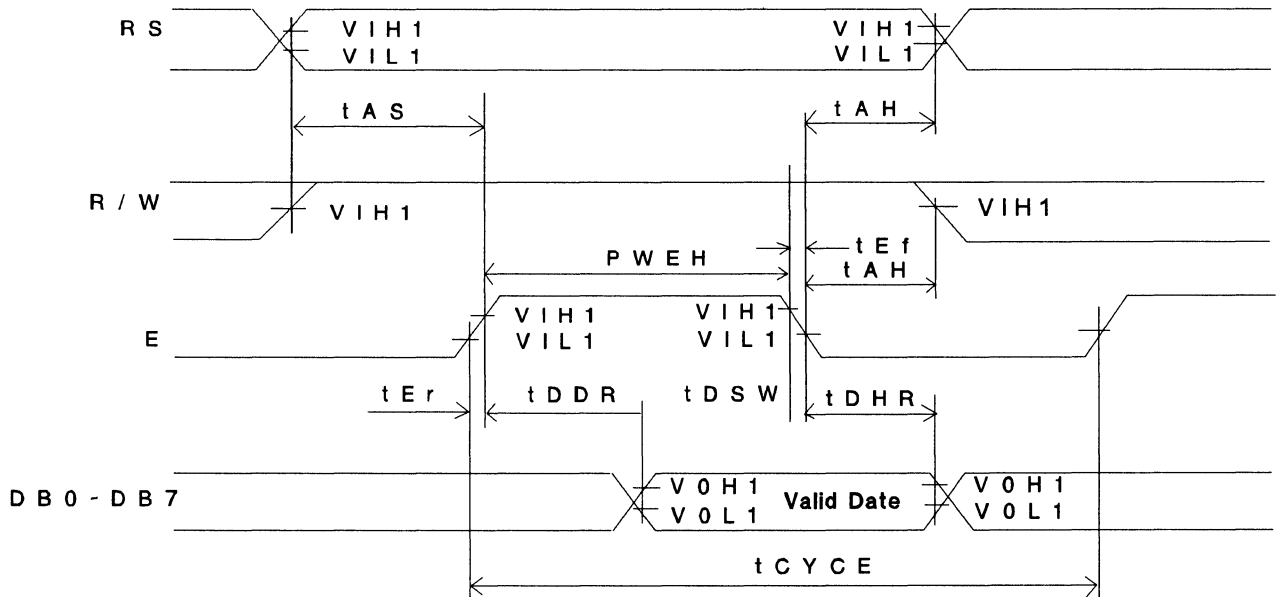


Fig. 6 Reading

Item	Symbol	Test Conditions	Min.	Max.	Unit
Enable Cycle Time	tCYCE	Fig. 6	1.0	-	μ sec
Enable Pulse Time	PWEH	Fig. 6	450	-	n sec
Enable Rise Time	tEr, rEf	Fig. 6	-	25	n sec
Enable Decay Time					
Address Set-Up Time	tAS	Fig. 6	140	-	n sec
Address Hold Time	tAH	Fig. 6	10	-	n sec
Data Delay Time	tDDR	Fig. 6	-	320	n sec
Data Hold Time	tDHR	Fig. 6	20	-	n sec

Symbol	Level	Input/ Output Power	Function
VSS	———	———	Power Voltage
VDD	———	———	
VO	———	———	
RS	H/L	input	Register select signal 0: Instruction register (write) Busy flag address counter (read) 1: Data register (read/write)
R/W	R/L	Input	Read (R) Write (W) Select signal "0": Write MPU → LCD module "1": Read MPU ← LCD module
E	HH → L	Input	Signal to start read or write data.
DB0 DB3	F/L	Input out put power	Lower level 4 lines data bus are used to transfer data between MPU and module. When operated with 4bits, this function does not work.
DB4 DB7	H/L	Input output power	Upper level 4 lines data bus are used to transfer data between MPU and module DB7 can be used as busy flag.

REMARK:

This module can be interfaced with both 4 or 8 bit MPU.
 Data transmission can either be sent in 2 parts at 4bits or once at 8bits.

- (1) If interface data is 4bits, data transmission is DB4~DB7, using 4bus, and the DB0~DB3 bus is not used.

Data transmission between module and MPU will end after two transmissions.

Upper 4bits of data (Interface data length is at 8bits when contents are DB4~DB7) is transmitted, then lower 4bit is sent (interface data length is at 8bits contents are DB0~DB3).

- (2) When interface data is 8bits, data DB0~DB7, data is transmitted by using data bus.

Character Type LCD Module

RCM2037R

INSTRUCTION											Description	Execution Time (f=250kHz)
Instruction	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 0) after entire display is cleared	1.64 ms
Cursor at Home	0	0	0	0	0	0	0	0	0	*	Cursor is returned to home position (address 0). Shifted display is also returned to the original position. Contents of DDRAM are not changed.	1.64 ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Cursor advance direction and display shift are set. These operations are performed during data write and read modes.	40 μs
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.	40 μs
Cursor/Display Shift	0	0	0	0	0	1	S/C	R/L	*	*	Cursor and display are shifted without changing the contents of DDRAM	40 μs
Function Set	0	0	0	0	1	DL	N	F	*	*	Interface data length (DL), number of display lines (N), and character font (F) are set.	40 μs
CGRAM Address Set	0	0	0	1	AGG						CGRAM address is set. Transmitted and received after this are the data of CGRAM.	40 μs
DDRAM Address Set	0	0	1	ADD						DDRAM address is sent. Transmitted and received after this are the data of DDRAM.	40 μs	
Busy Flag/address read	0	1	BF	AC						Busy flag (BF) showing internal operation and contents of address counter are read.	0 μs	
CGRAM/DDRAM Data Write	1	0									Data are written in DDRAM or CGRAM.	46 μs
CGRAM/DDGRAM Data Write	1	1	Read Data								Data are read out of DDRAM or CGRAM.	46 μs
<p>I/D = 1: Increment (+1) I/D = D: Decrement (-1) 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 N = 1: 2 lines N = 0: 1 line F = 1: 5x10 dots</p>											<p>F = 0: 5x7 dots BF = 1: Internal operation is being performed BF = 0: Instruction acceptable DDRAM: Display Data RAM CGRAM: Character Generator RAM ACG: Address of CGRAM ADD: Address of DDRAM. These correspond to cursor addresses AC: Address counter used for both DDRAM and CGRAM</p>	Execution time changes with change in internal oscillation frequency (fosc).

CHARACTER CODE AND PATTERN TABLE

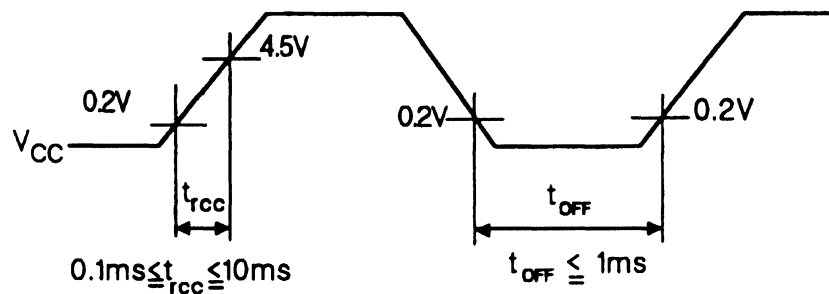
上位ビット Higher 4 bit 下位ビット Lower 4 bit	0000	0010	0011	0100	0101	0110	0111	1010	1011	1100	1101	1110	1111
××××0000	CG RAM (1)		0	1	2	3	4	5	6	7	8	9	0
	(2)	!	~	^	^	^	^	^	^	^	^	^	^
××××0010	(3)	!	2	3	4	5	6	7	8	9	0	1	2
	(4)	!	3	5	6	7	8	9	0	1	2	3	4
××××0100	(5)	!	4	0	1	2	3	4	5	6	7	8	9
	(6)	!	5	6	7	8	9	0	1	2	3	4	5
××××0110	(7)	!	6	7	8	9	0	1	2	3	4	5	6
	(8)	!	7	8	9	0	1	2	3	4	5	6	7
××××1000	(1)	!	8	9	0	1	2	3	4	5	6	7	8
	(2)	!	9	0	1	2	3	4	5	6	7	8	9
××××1010	(3)	!	0	1	2	3	4	5	6	7	8	9	0
	(4)	!	1	2	3	4	5	6	7	8	9	0	1
××××1100	(5)	!	2	3	4	5	6	7	8	9	0	1	2
	(6)	!	3	4	5	6	7	8	9	0	1	2	3
××××1110	(7)	!	4	5	6	7	8	9	0	1	2	3	4
	(8)	!	5	6	7	8	9	0	1	2	3	4	5
××××1111	(8)	!	6	7	8	9	0	1	2	3	4	5	6

RESET FUNCTION

Upon reset, the module will automatically reset to its initial function.

At initial function, please start by using the following instructions.

- 1) Clear Display
(Note: Busy flag (BF) is active high - BF=1)
- 2) Function Set Up
DL = 1: Interface data length 8bits.
N = 0: 1 line display
F = 0: 5 x 7 dot
- 3) Display ON/OFF Control
D = 0: Display OFF
C = 0: Curser OFF
B = 0: Intermittent OFF
- 4) Input Set Up Mode
I/D = 1: + 1 (inclement)
S = 0: Does Not Shift



t_{OFF} present instant or ON.OFF time.

(Remark) Unless above electrical condition are satisfied internal circuit will not operate properly.

APPLICATIONS

Personal computer, word processor, facsimile, telephone, etc., medical and other instrumentations.

- 1) Handling Instruction
 - a) Attention must be paid to avoid external shock, which will cause operations failure.
 - b) Polarizer on the surface is fragile and can easily be scratched and damaged. Therefore, please take extra care when handling. To clean surface of termination, please wipe off with alcohol.
 - c) The liquid used in the LCD panel is a harmful substance and must not be ingested. Avoid contact on exposed skin. If liquid is touched, wash thoroughly.
 - d) Do not expose to direct sunlight or fluorescent light for long periods of time. If it will be in direct sunlight, please use UV filter.
 - e) For storage please avoid high temperature/high humidity.
When long term storage is required, keep panels in low temperature (5°C ~ 25°C) and low humidity.
- 2) Operational Instructions
 - a) Do not connect or disconnect module while power is on.
 - b) Turn on module power before input of signal. Turn off input signal before turning off power to module. It can be damaged by "latch-up" phenomenon.
- 3) Mounting Instructions
 - a) Ground solder before using.
 - b) CMOS-IC requires caution in cases of potential ESD.
 - c) Do not remove panel from board.
- 4) Module Assembly Instructions
 - a) For mounting, use 4 holes on each corner and do not stress circuit.
 - b) To prevent contamination, scratches, or cuts on the polarizer, please use the protective cover on the front panel.

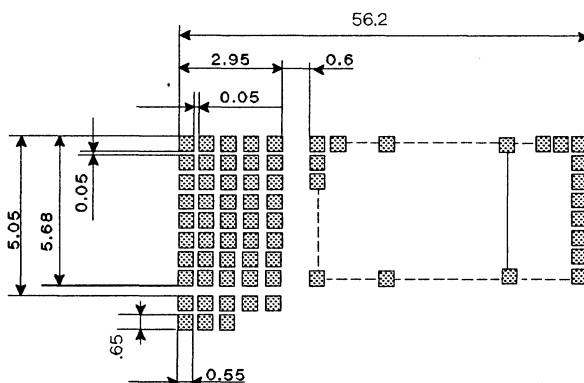
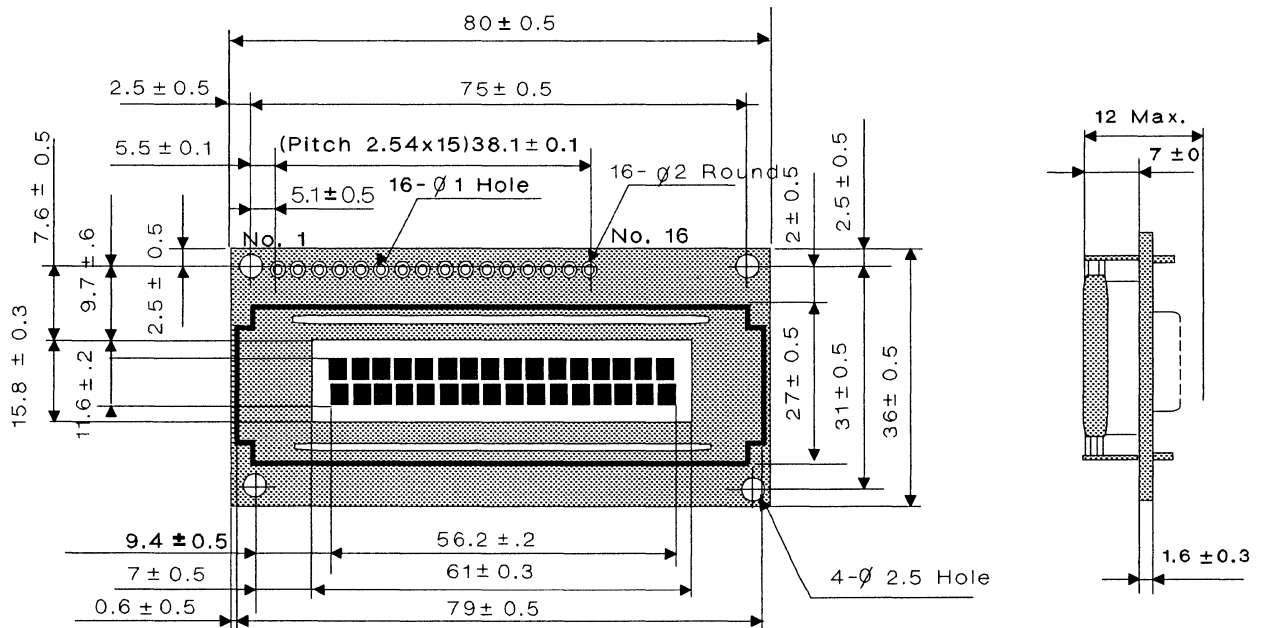
Character Type LCD Module

DESCRIPTION

RCM2033M is an LCD module with LSI controller/driver built in.

FEATURES

- 1) 16 Characters x 2 Rows with LED backlight.
- 2) Wide viewing angle, high contrast ratio.
- 3) 5 x 7 dot construction in each character, plus one line.
- 4) Can be interfaced with 4bit or 8bit MPU.
- 5) Displays 160 different types of international characters and symbols plus 32 different types of special characters and symbols.
- 6) With built in character generator RAM, any user-design pattern can be displayed.
- 7) Clear, easy to read display, with cursor on/off, and character blink. Simple instructions for various functions.
- 8) Compact and light weight, for easy assembly.
- 9) Can be driven by a 5V circuit.
- 10) Low power consumption.
- 11) Optional transmissive, transreflective type with back light.



BLOCK DIAGRAM

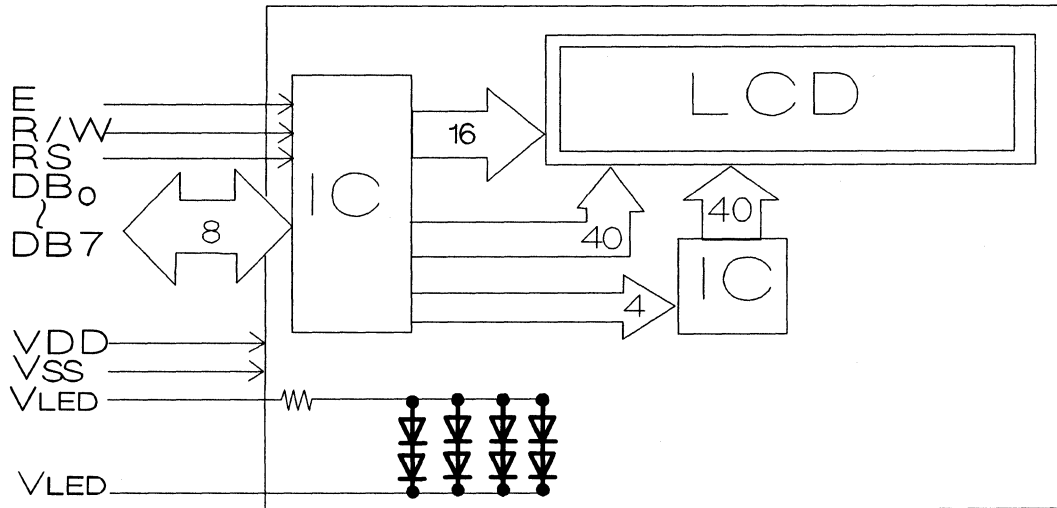


Fig. # 3, Block Diagram

INTERFACE PIN CONNECTION

Pin No.	Symbol	Pin No.	Symbol
1	V _{SS}	9	DB 2
2	V _{DD}	10	DB 3
3	V	11	DB 4
4	RS	12	DB 5
5	R/W	13	DB 6
6	E	14	DB 7
7	DB ₀	15	VLED
8	DBI	16	VLED+

DD RAM ADDRESS

	1	2	3	4	-	14	15	16
1 Line	00H	01H	02H	03H	—	0DH	0EH	0FH
2 Line	40H	41H	42H	43H	—	4DH	4EH	4FH

POWER SUPPLY SAMPLE CONNECTION

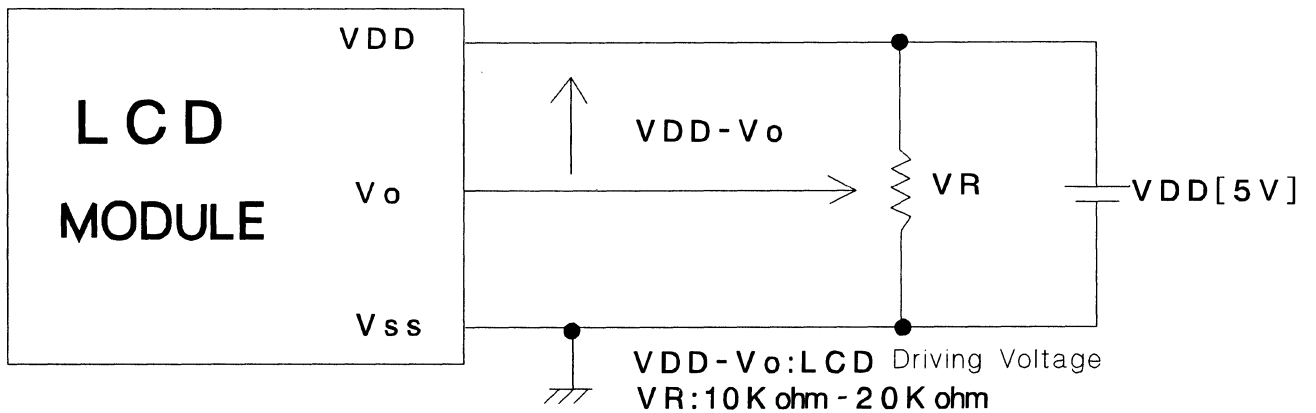


Fig. 4 Power Supply Sample Connection

ABSOLUTE MAXIMUM RATINGS

Items	Symbol	Min.	Max.	Unit
Supply Voltage for Logics	VDD-VSS	- 0.3	6.5	V
Supply Voltage for Driving LCD	VDD-V0	0	6.5	V
Input Voltage	VIN	- 0.3	VDD+0.3	V
Operating Temperature	T0P	0	50	°C
Storage Temperature	Tstg	- 20	70	°C

ELECTRICAL CHARACTERISTICS

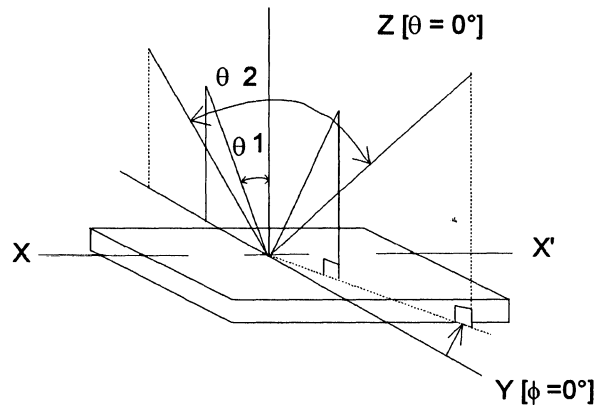
Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input High Level Voltage	VIH		2.2	-	VDD	V
Input Low Level Voltage	VIL		-	-	0.6	V
Output High Level Voltage	V0H	- I 0H = - 0.205mA	2.4	-	-	V
Output Low Level Voltage	V0L	I 0L = 1.2mA	-	-	0.4	V
Power Supply Current	IDD	VDD=5V	-	1	3	mA
LED Forward Current	ILED	VLED = 5V	-	60	80	mA

OPTICAL CHARACTERISTICS

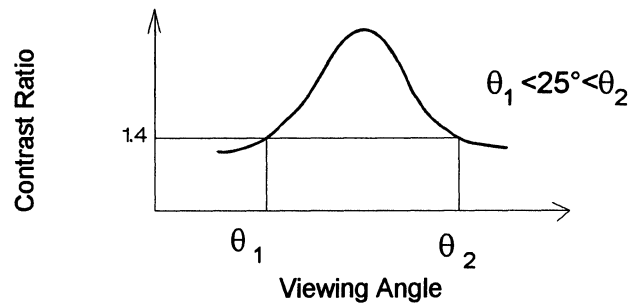
Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
t rise time	tr	$\theta = 10^\circ$ $\phi = 0^\circ$	-	100	250	ms
t fall time	td	$\theta = 10^\circ$ $\phi = 0^\circ$	-	150	250	ms
Contrast Ratio	K	$\theta = 10^\circ$ $\phi = 0^\circ$	-	3		
Viewing Angle	$\theta 1$	$K \geq 1.4$ -	-	20	degree	
	$\theta 2$	$\phi = 0^\circ$	40	-	-	degree
	ϕ	$K \geq 1.4$ 30 $\theta = 20^\circ$	\pm -	-	degree	

OPTICAL CHARACTERISTICS

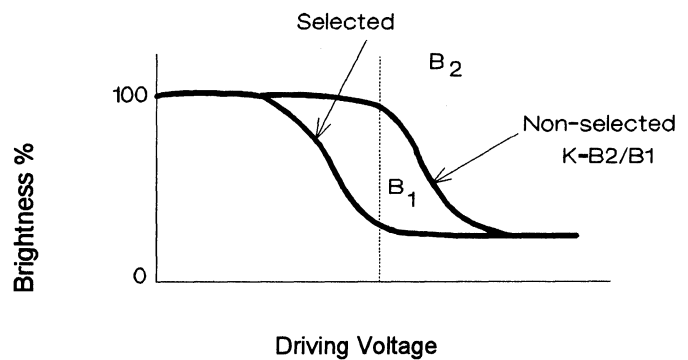
1) Definition of θ and ϕ



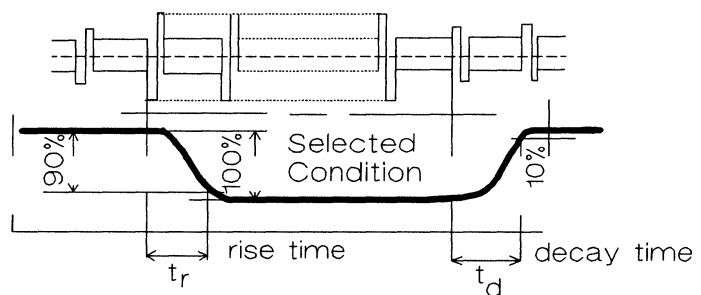
2) Definition of viewing angle $\theta 1$ and $\theta 2$



3) Definition of contrast ratio "K"



4) Definition of optical response time



OPERATION

(1) Writing

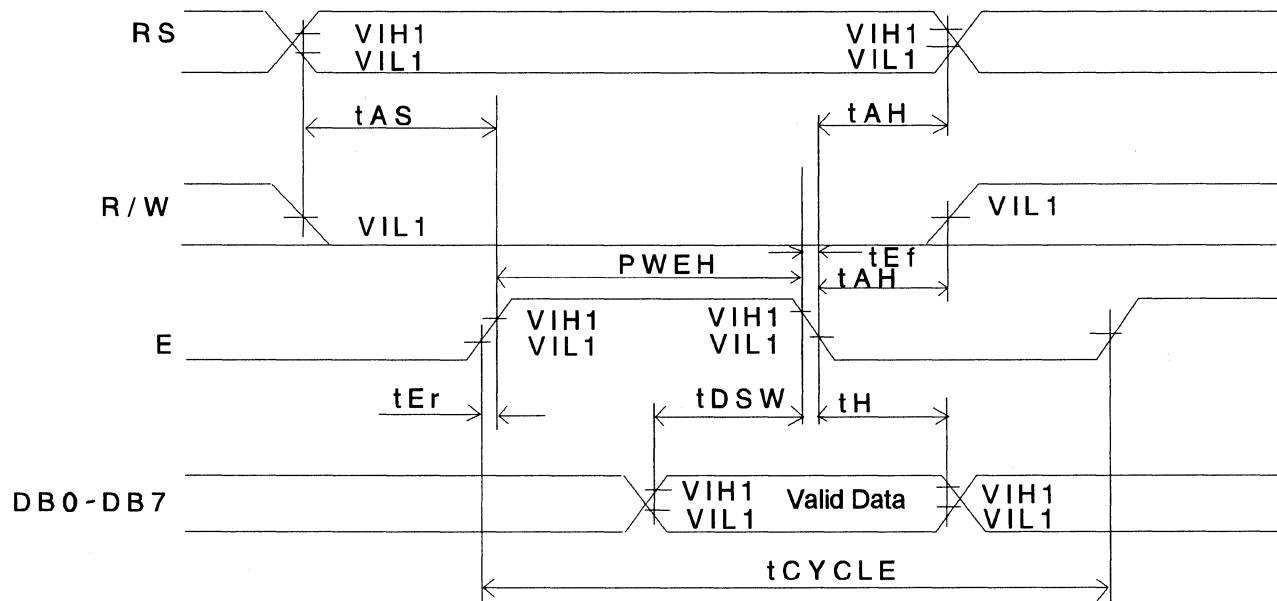


Fig. 5 Writing

Item	Symbol	Test Condition	Min.	Max.	Unit
Enable Cycle Time	t_{CYCE}	Fig. 5	1.0	-	μ sec
Enable Pulse Time	PWE	Fig. 5	450	-	n sec
Enable Rise Time	t_{Er}, t_{Ef}	Fig. 5	-	25	n sec
Enable Decay Time					
Address Set-Up Time	t_{AS}	Fig. 5	140	-	n sec
Address Hold Time	t_{AH}	Fig. 5	10	-	n sec
Data Set-Up Time	t_{DSW}	Fig. 5	195	-	n sec
Data Hold Time	t_H	Fig. 5	10	-	n sec

PIN FUNCTION

Symbol	Level	Input/ Output Power	Function
VSS	----	----	GND : OV + 5V Power Voltage
VDD	----	----	
VO	----	----	
RS	H/L	input	Register select signal 0: Instruction register (write) Busy flag address counter (read) 1: Data register (read/write)
R/W	H/L	Input	Read (R) Write (W) Select signal "0": Write MPU → LCD module "1": Read MPU ← LCD module
E	H, H → L	Input	Signal to start read or write data.
DB0 DB3	H/L	Input out put power	Lower level 4 lines data bus are used to transfer data between MPU and module. When operated with 4bits, this function does not work.
DB4 DB7	H/L	Input output power	Upper level 4 lines data bus are used to transfer data between MPU and module. DB7 can be used as busy flag.

REMARK:

This module can be interfaced with both 4 or 8bit MPU.
Data transmission can either be sent in 2 parts at 4bits or once at 8bits.

- (1) If interface data is 4bits, data transmission is DB4~DB7, using 4bus, and the DB0~DB3 bus is not used.

Data transmission between module and MPU will end after two transmissions.

Upper 4bits of data (Interface data length is at 8bits when contents are DB4~DB7) is transmitted, then lower 4bit is sent (interface data length is at 8bits contents are DB0~DB3).

- (2) When interface data is 8bits, data DB0~DB7, data is transmitted by using data bus.

Character Type LCD Module

RCM2033M

INSTRUCTION											Description	Execution Time (f=250kHz)	
Instruction	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 0) after entire display is cleared	1.64 ms	
Cursor at Home	0	0	0	0	0	0	0	0	1	*	Cursor is returned to home position (address 0). Shifted display is also returned to the original position. Contents of DDRAM are not changed.	1.64 ms	
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Cursor advance direction and display shift are set. These operations are performed during data write and read modes.	40 μs	
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.	40 μs	
Cursor/Display Shift	0	0	0	0	0	1	S/C	R/L	*	*	Cursor and display are shifted without changing the contents of DDRAM	40 μs	
Function Set	0	0	0	0	1	DL	N	F	*	*	Interface data length (DL), number of display lines (N), and character font (F) are set.	40 μs	
CGRAM Address Set	0	0	0	1	ACG							CGRAM address is set. Transmitted and received after this is the data of CGRAM.	40 μs
DDRAM Address Set	0	0	0	ADD							DDRAM address is set. Transmitted and received after this is the data of DDRAM.	40 μs	
Busy Flag/address read	0	1	BF	AC							Busy flag (BF) showing internal operation and contents of address counter are read.	0 μs	
CGRAM/DDRAM Data Write	1	0	Write Data							Data is written in DDRAM or CGRAM.	46 μs		
CGRAM/DDRAM Data Read	1	1	Read Data							Data is read out of DDRAM or CGRAM.	46 μs		
	I/D = 1: Increment (+ 1) I/D = 0: Decrement (-1) 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 N = 1: 2 lines N = 0: 1 line F = 1: 5x10 dots F = 0: 5x7 dots BF = 1: Internal operation is being performed BF = 0: Instruction acceptable										DDRAM: Display Data RAM CGRAM: Character Generator RAM ACG: Address of CGRAM ADD: Address of DDRAM. These correspond to cursor addresses AC: Address counter used for both DDRAM and CGRAM	Execution time changes with change in internal oscillation frequency (fosc).	

CHARACTER CODE AND PATTERN TABLE

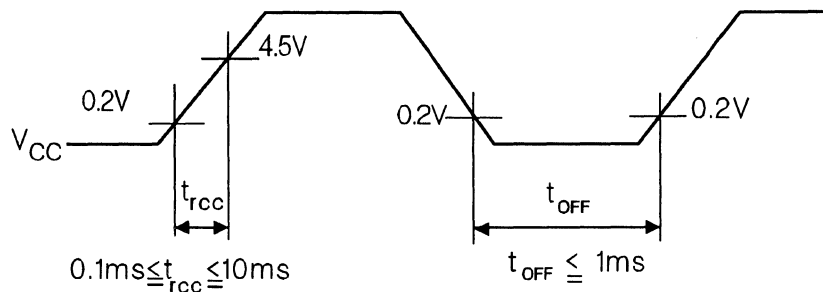
上位ビット Higher 4 bit 下位ビット Lower 4 bit	0000	0010	0011	0100	0101	0110	0111	1010	1011	1100	1101	1110	1111
××××0000	CG RAM (1)		0	1	2	3	4	5	6	7	8	9	0
	(2)	!	@	#	\$	%	&	'	()	*	+	,
××××0001	(3)	."	3	4	5	6	7	8	9	:	;	<	=
	(4)	#	\$	%	&	'	()	*	+	,	-	.
××××0010	(5)	@	1	2	3	4	5	6	7	8	9	:	;
	(6)	7	8	9	:	;	<	=	>	?	0	1	2
××××0100	(7)	8	9	:	;	<	=	>	?	0	1	2	3
	(8)	7	8	9	:	;	<	=	>	?	0	1	2
××××0101	(1)	C	B	A	X	Y	Z	0	1	2	3	4	5
	(2)	>	8	9	:	;	<	=	>	?	0	1	2
××××1000	(3)	*	#	\$	%	&	'	()	*	+	,	-
	(4)	+	#	\$	%	&	'	()	*	+	,	-
××××1001	(5)	.	<	=	>	?	0	1	2	3	4	5	6
	(6)	-	+	+	+	+	+	+	+	+	+	+	+
××××1010	(7)	.	<	=	>	?	0	1	2	3	4	5	6
	(8)	/	?	0	1	2	3	4	5	6	7	8	9
××××1011	(1)	.	<	=	>	?	0	1	2	3	4	5	6
	(2)	.	<	=	>	?	0	1	2	3	4	5	6
××××1100	(3)	.	<	=	>	?	0	1	2	3	4	5	6
	(4)	.	<	=	>	?	0	1	2	3	4	5	6
××××1101	(5)	.	<	=	>	?	0	1	2	3	4	5	6
	(6)	.	<	=	>	?	0	1	2	3	4	5	6
××××1110	(7)	.	<	=	>	?	0	1	2	3	4	5	6
	(8)	.	<	=	>	?	0	1	2	3	4	5	6
××××1111	(1)	.	<	=	>	?	0	1	2	3	4	5	6
	(2)	.	<	=	>	?	0	1	2	3	4	5	6

RESET FUNCTION

Upon reset, the module will automatically reset to its initial function.

At initial function, please start by using the following instructions.

- 1) Clear Display
(Note: Busy flag (BF) is active high - BF=1)
- 2) Function set up
DL = 1: Interface data length 8bits.
N = 0: 1 line display
F = 0: 5 x 7 dot
- 3) Display ON/OFF Control
D: = 0: Display OFF
C: = 0: Cursor OFF
B = 0: Intermittent OFF
- 4) Input Set Up Mode
I/D = 1: + 1 (inclement)
S = 0: Does Not Shift



t_{OFF} present instant or ON.OFF time.
(Remark) Unless above electrical condition are satisfied internal circuit will not operate properly.

APPLICATIONS

Personal computer, word processor, facsimile, telephone, etc., medical and other instrumentations.

1) Handling Instructions

- a) Attention must be paid to avoid external shock, which will cause operational failure.
- b) Polarizer on the surface is fragile and can easily be scratched and damaged. Therefore, please take extra care when handling. To clean surface of termination, please wipe off with alcohol.
- c) The liquid used in the LCD panel is a harmful substance and must not be ingested. Avoid contact on exposed skin. If liquid is touched, wash thoroughly.
- d) Do not expose to direct sunlight or fluorescent light for long periods of time. If it will be in direct sunlight, please use UV filter.
- e) For storage please avoid high temperature/high humidity.
When long term storage is required, keep panels in low temperature (5°C ~ 25°C) and low humidity.

2) Operational Instructions

- a) Do not connect or disconnect module while power is on.
- b) Turn on module power before input of signal. Turn off input signal before turning off power to module. It can be damaged by "latch-up" phenomenon.

3) Mounting Instructions

- a) Ground solder before using.
- b) CMOS-IC requires caution in cases of potential ESD.
- c) Do not remove panel from board.

4) Module Assembly Instructions

- a) For mounting, use 4 holes on each corner and do not stress circuit.
- b) To prevent contamination, scratches, or cuts on the polarizer, please use the protective cover on the front panel.

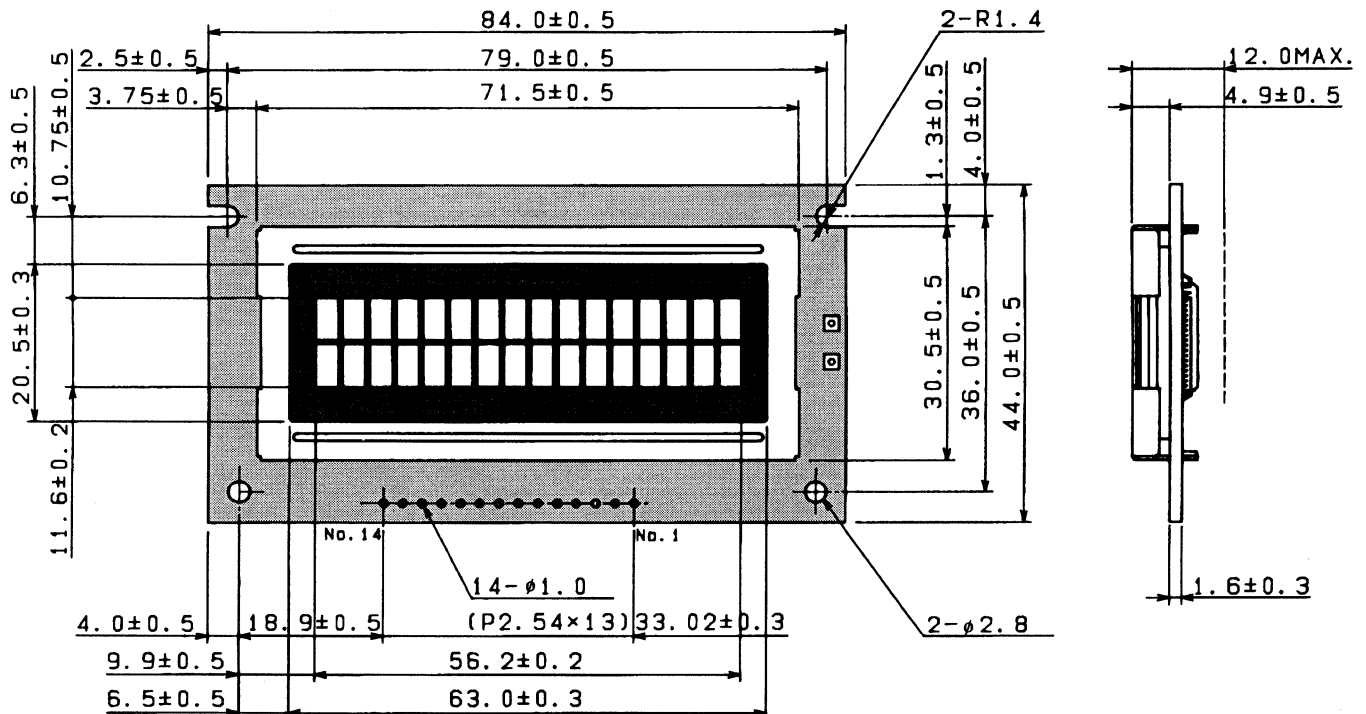
Character Type LCD Module

DESCRIPTION

RCM2013R is an LCD module with LSI controller/driver built in.

FEATURES

- 1) 16 Character x 2 Rows.
- 2) Wide viewing angle, high contrast ratio.
- 3) 5 x 7 dot construction in each character.
- 4) Can be interfaced with 4bit or 8bit MPU.
- 5) Displays 208 different types of international characters and symbols plus 32 different types of special characters and symbols.
- 6) User designed display pattern with built in character generator RAM.
- 7) Clear, easy to read display, with cursor on/off, and character blink. Simple instructions for various functions.
- 8) Compact and light weight , for easy assembly.
- 9) Can be driven by a 5V circuit.
- 10) Low power consumption.



USAGE

Personal Computer, Word Processor, Facsimile, Telephone, etc.

BLOCK DIAGRAM

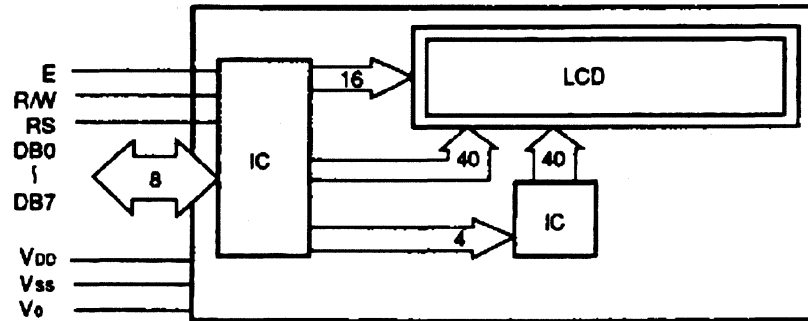


Fig. # 3, Block Diagram

INTERFACE PIN CONNECTION

Pin NO.	Symbol	Pin No.	Symbol
1	V_{SS}	8	DB 1
2	V_{DD}	9	DB 2
3	V_O	10	DB 3
4	RS	11	DB 4
5	R/W	12	DB 5
6	E	13	DB 6
7	DB _O	14	DB 7

ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

Items	Symbol	Min.	Max.	Unit
Supply Voltage for Logics	VDD-VSS	0	6.5	V
Supply Voltage for Driving LCD	VDD-V0	0	6.5	V
Input Voltage	VIN	-0.3	VDD+0.3	V
Operating Temperature	T0P	0	50	°C
Storage Temperature	Tstg	-20	70	°C

ELECTRICAL CHARACTERISTICS (VDD=5.0 ± 5% Ta=25°C)

Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input High Level Voltage	VIH		2.2	-	VDD	V
Input Low Level Voltage	VIL		-	-	0.6	V
Output High Level Voltage	V0H	-I 0H=0.205mA	2.4	-	-	V
Output Low Level Voltage	V0L	I 0L=1.2mA	-	-	0.4	V
Power Supply Current	IDD	VDD=5V	-	1.5	3	mA

OPTICAL CHARACTERISTICS (Ta=25°C)

Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
t rise time	tr	$\theta = 10^\circ$ $\phi = 0^\circ$	-	100	250	ms
t fall time	td	$\theta = 10^\circ$ $\phi = 0^\circ$	-	150	250	ms
Contrast Ratio	K	$\theta = 10^\circ$ $\phi = 0^\circ$	-	3		
Viewing Angle	$\theta 1$	$K \geq 1.4$	-	-	20	degree
	$\theta 2$	$\phi = 0^\circ$	40	-	-	degree
	ϕ	$K \geq 1.4$ $\theta = 20^\circ$	±30	-	-	degree

DD RAM ADDRESS

	1	2	3	4		14	15	16
1 Line	00H	01H	02H	03H	——	0DH	0EH	0FH
2 Line	40H	41H	42H	43H	——	4DH	4EH	4FH

POWER SUPPLY SAMPLE CONNECTION

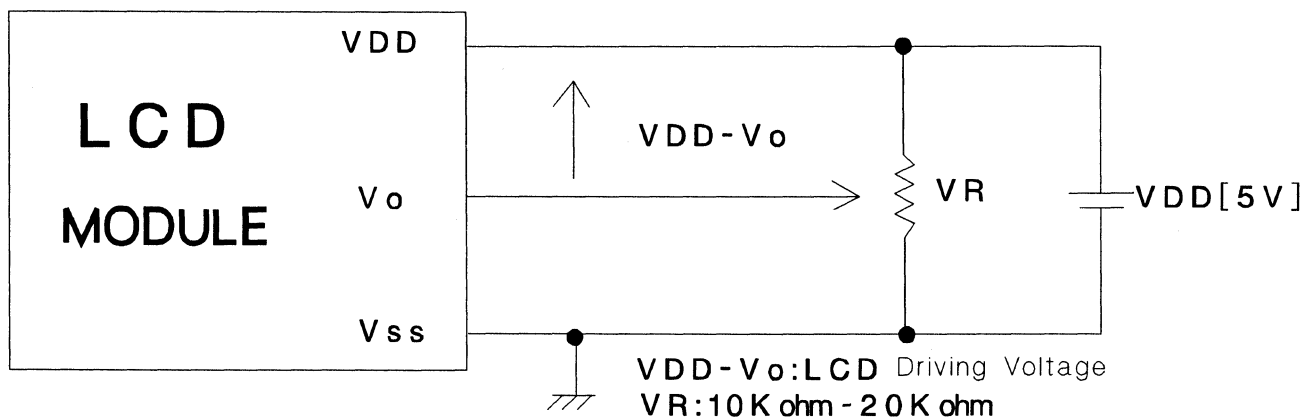
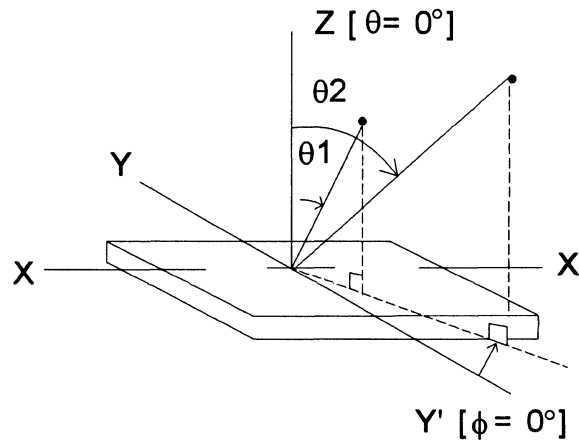


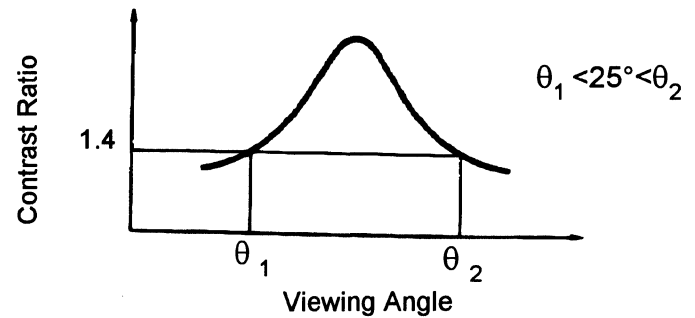
Fig. 4 Power Supply Sample Connection

OPTICAL CHARACTERISTICS

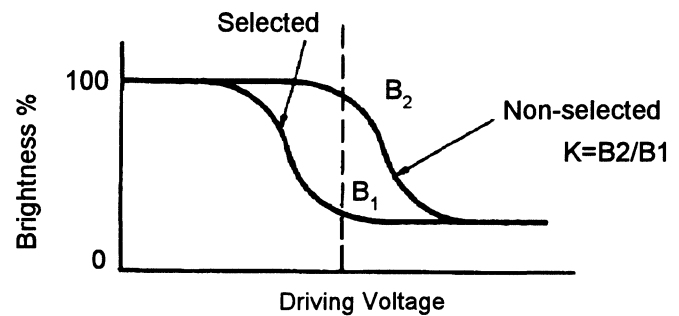
1) Definition of θ and ϕ



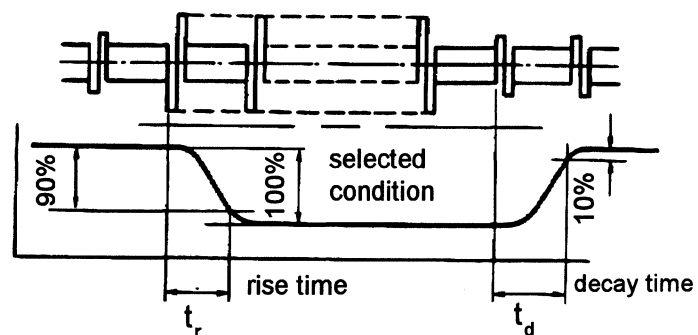
2) Definition of viewing angle θ_1 and θ_2



3) Definition of contrast ratio "K"



4) Definition of optical response time



OPERATION

(1) Writing

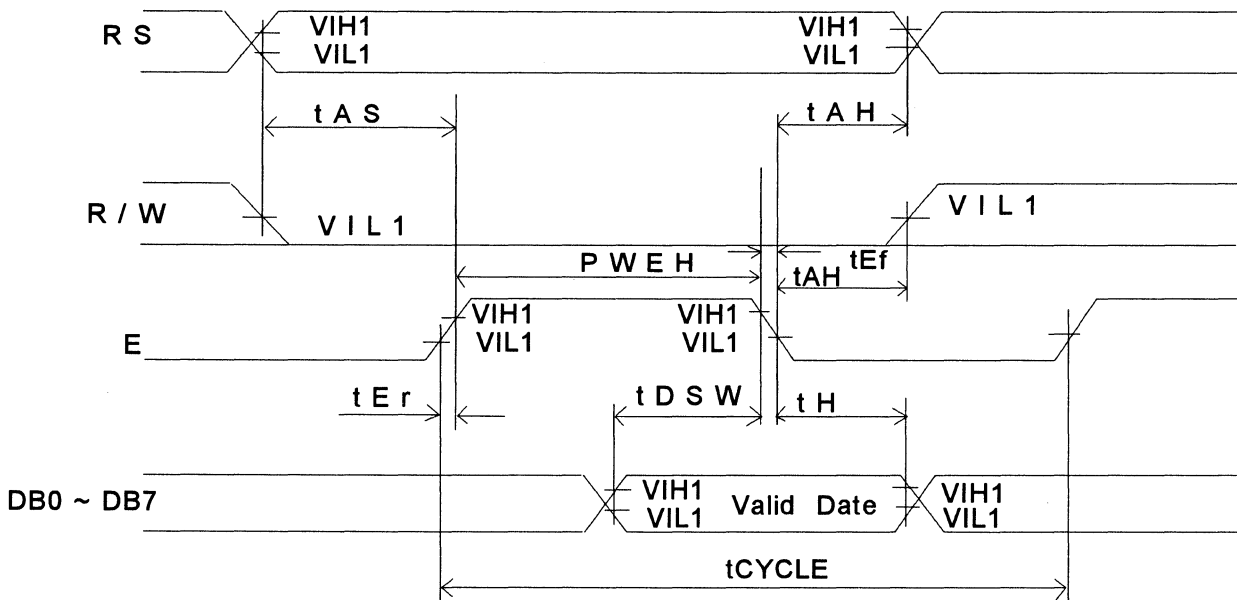


Fig. 5 Writing

Item	Symbol	Test Condition	Min.	Max.	Unit
Enable Cycle Time	tCYCE	Fig. 5	1.0	-	μ sec
Enable Pulse Time	PWE	Fig. 5	450	-	n sec
Enable Rise Time	tEr, tEf	Fig. 5	-	25	n sec
Enable Decay Time					
Address Set-Up Time	tAS	Fig. 5	10	-	n sec
Address Hold Time	tAH	Fig. 5	195	-	n sec
Data Hold Time	tH	Fig. 5	10	-	n sec

(2) Reading

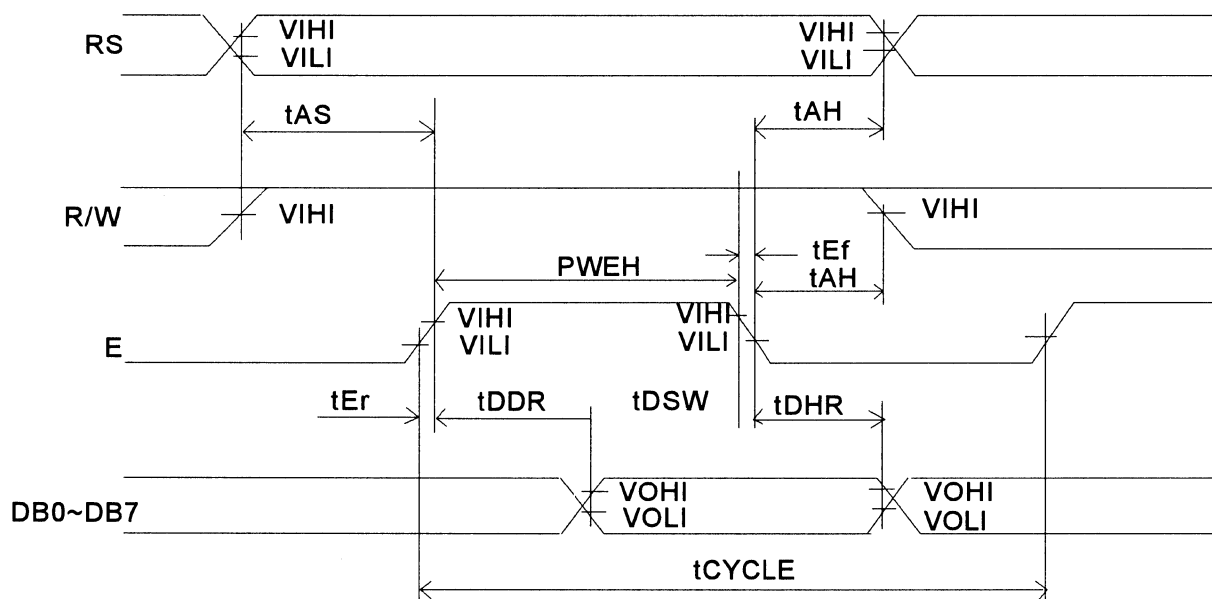


Fig. 6 Reading

Item	Symbol	Test Conditions	Min.	Max.	Unit
Enable Cycle Time	tCYCE	Fig. 6	500	-	n sec
Enable Pulse Time	PWEH	Fig. 6	220	-	n sec
Enable Rise Time	tEr, rEf	Fig. 6	-	20	n sec
Enable Decay Time					
Address Set-Up Time	tAS	Fig. 6	40	-	n sec
Address Hold Time	tAH	Fig. 6	10	-	n sec
Data Delay Time	tDDR	Fig. 6	-	120	n sec
Data Hold Time	tDHR	Fig. 6	20	-	n sec

PIN FUNCTION

Symbol	Level	Input/ Output Power	Function
VSS	———	———	GND : 0V +5V Power Voltage
VDD	———	———	
VO	———	———	
RS	H/L	Input	Register select signal 0: Instruction register (write) Busy flag address counter (read) 1: Data register (read/write)
R/W	H/L	Input	Read (R) Write (W) Select signal "0": Write MPU → LCD module "1": Read MPU ← LCD module
E	H, H → L	Input	Signal to start read or write data.
DB0	H/L	Input output power	Lower level 4 lines data bus are used to transfer data between MPU and module. When operated with 4bits, this function does not work.
DB3			
DB4	H/L	Input output power	Upper level 4 lines data bus are used to transfer data between MPU and module.
DB7			

REMARK:

This module can be interfaced with both 4 or 8bit MPU.
Data transmission can either be sent in 2 parts at 4bits or once at 8bits.

- (1) If interface data is 4bits, data transmission is DB4~DB7, using 4bus, and the DB0~DB3 bus is not used.

Data transmission between module and MPU will end after two transmissions.

Upper 4bits of data (Interface data length is at 8bits when contents are DB4~DB7) is transmitted, then lower 4bit is sent (interface data length is at 8bits contents are DB0~DB3).

- (2) When interface data is 8bits, data DB0~DB7, data is transmitted by using data bus.

Character Type LCD Module

RCM2013R

INSTRUCTION											Description	Execution Time (f=250kHz)	
Instruction	RS	RW	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 0) after entire display is cleared	1.64 ms
Cursor at Home	0	0	0	0	0	0	0	0	0	1	*	Cursor is returned to home position (address 0). Shifted display is also returned to the original position. Contents of DDRAM are not changed.	1.64 ms
Entry Mode Set	0	0	0	0	0	0	0	0	1	I/D	S	Cursor advance direction and display shift are set. These operations are performed during data write and read modes.	40 μs
Display ON/OFF Control	0	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.	40 μs
Cursor/Display Shift	0	0	0	0	0	0	1	S/C	R/L	*	*	Cursor and display are shifted without changing the contents of DDRAM	40 μs
Function Set	0	0	0	0	1	DL	N	F	*	*		Interface data length (DL), number of display lines (N), and character font (F) are set.	40 μs
CGRAM Address Set	0	0	0	1	ACG							CGRAM address is set. Transmitted and received after this is the data of CGRAM.	40 μs
DDRAM Address Set	0	0	0	ADD							DDRAM address is set. Transmitted and received after this is the data of DDRAM.	40 μs	
Busy Flag/address read	0	1	BF	AC							Busy flag (BF) showing internal operation and contents of address counter are read.	0 μs	
CGRAM/DDRAM Data Write	1	0	Write Data							Data is written in DDRAM or CGRAM.	46 μs		
CGRAM/DDRAM Data Read	1	1	Read Data							Data is read out of DDRAM or CGRAM.	46 μs		
	I/D=1: Increment (+1) I/D=0: Decrement (-1) 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 N=1: 2 lines N=0: 1 line F=1: 5x10 dots F=0: 5x7 dots BF=1: Internal operation is being performed BF=0: Instruction acceptable										DDRAM: Display Data RAM CGRAM: Character Generator RAM ACG: Address of CGRAM ADD: Address of DDRAM. These correspond to cursor addresses AC: Address counter used for both DDRAM and CGRAM	Execution time changes with change in internal oscillation frequency (fosc).	

CHARACTER CODE AND PATTERN TABLE

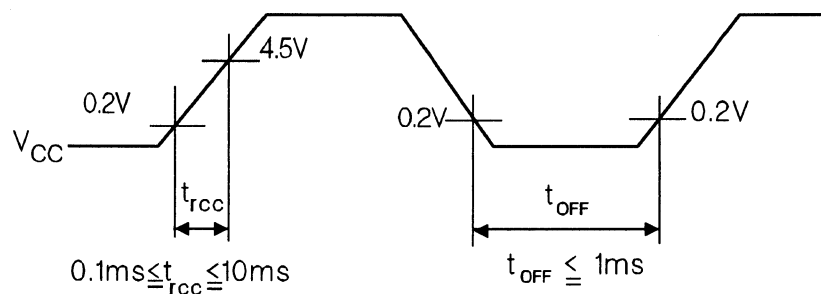
上位ビット Higher 4 bit 下位ビット Lower 4 bit	0000	0010	0011	0100	0101	0110	0111	1010	1011	1100	1101	1110	1111
××××0000	CG RAM (1)		0	1	2	3	4	5	6	7	8	9	0
	(2)	!	2	3	4	5	6	7	8	9	*	+	=
××××0010	(3)	["]	{	}	~	^	&	%	@	#	\$	%
	(4)	&	7	8	9	:	;	'	"	~	^	&	%
××××0100	(5)	0	1	2	3	4	5	6	7	8	9	*	+
	(6)	0	1	2	3	4	5	6	7	8	9	*	+
××××0110	(7)	0	1	2	3	4	5	6	7	8	9	*	+
	(8)	0	1	2	3	4	5	6	7	8	9	*	+
××××1000	(1)	0	1	2	3	4	5	6	7	8	9	*	+
	(2)	0	1	2	3	4	5	6	7	8	9	*	+
××××1010	(3)	0	1	2	3	4	5	6	7	8	9	*	+
	(4)	0	1	2	3	4	5	6	7	8	9	*	+
××××1100	(5)	0	1	2	3	4	5	6	7	8	9	*	+
	(6)	0	1	2	3	4	5	6	7	8	9	*	+
××××1110	(7)	0	1	2	3	4	5	6	7	8	9	*	+
	(8)	0	1	2	3	4	5	6	7	8	9	*	+
××××1111	(8)	0	1	2	3	4	5	6	7	8	9	*	+

RESET FUNCTION

Upon reset, the module will automatically reset to its initial function.

At initial function, please start by using the following instructions.

- 1) Clear Display
(Note: Busy flag (BF) is active high - BF=1)
- 2) Function set up
 DL = 1: Interface data length 8bits.
 N = 0: 1 line display
 F = 0: 5 x 7 dot
- 3) Display ON/OFF Control
 D = 0: Display OFF
 C = 0: Cursor OFF
 B = 0: Intermittent OFF
- 4) Input Set Up Mode
 I/D = 1: + 1 (inclement)
 S = 0: Does Not Shift



t_{OFF} present instant or ON.OFF time.
 (Remark) Unless above electrical condition are satisfied internal circuit will not operate properly.

APPLICATIONS

Personal computer, word processor, facsimile, telephone, etc., medical and other instrumentations.

- 1) Handling Instruction
 - a) Attention must be paid to avoid external shock, which will cause operations failure.
 - b) Polarizer on the surface is fragile and can easily be scratched and damaged. Therefore, please take extra care when handling. To clean surface of termination, please wipe off with alcohol.
 - c) The liquid used in the LCD panel is a harmful substance and must not be ingested. Avoid contact on exposed skin. If liquid is touched, wash thoroughly.
 - d) Do not expose to direct sunlight or fluorescent light for long periods of time. If it will be in direct sunlight, please use UV filter.
 - e) For storage please avoid high temperature/high humidity. When long term storage is required, keep panels in low temperature (5°C ~ 25°C) and low humidity.
- 2) Operational Instructions
 - a) Do not connect or disconnect module while power is on.
 - b) Turn on module power before input of signal. Turn off input signal before turning off power to module. It can be damaged by "latch-up" phenomenon.
- 3) Mounting Instructions
 - a) Ground solder before using.
 - b) CMOS-IC requires caution in cases of potential ESD.
 - c) Do not remove panel from board.
- 4) Module Assembly Instructions
 - a) For mounting, use 4 holes on each corner and do not stress circuit.
 - b) To prevent contamination, scratches, or cuts on the polarizer, please use the protective cover on the front panel.

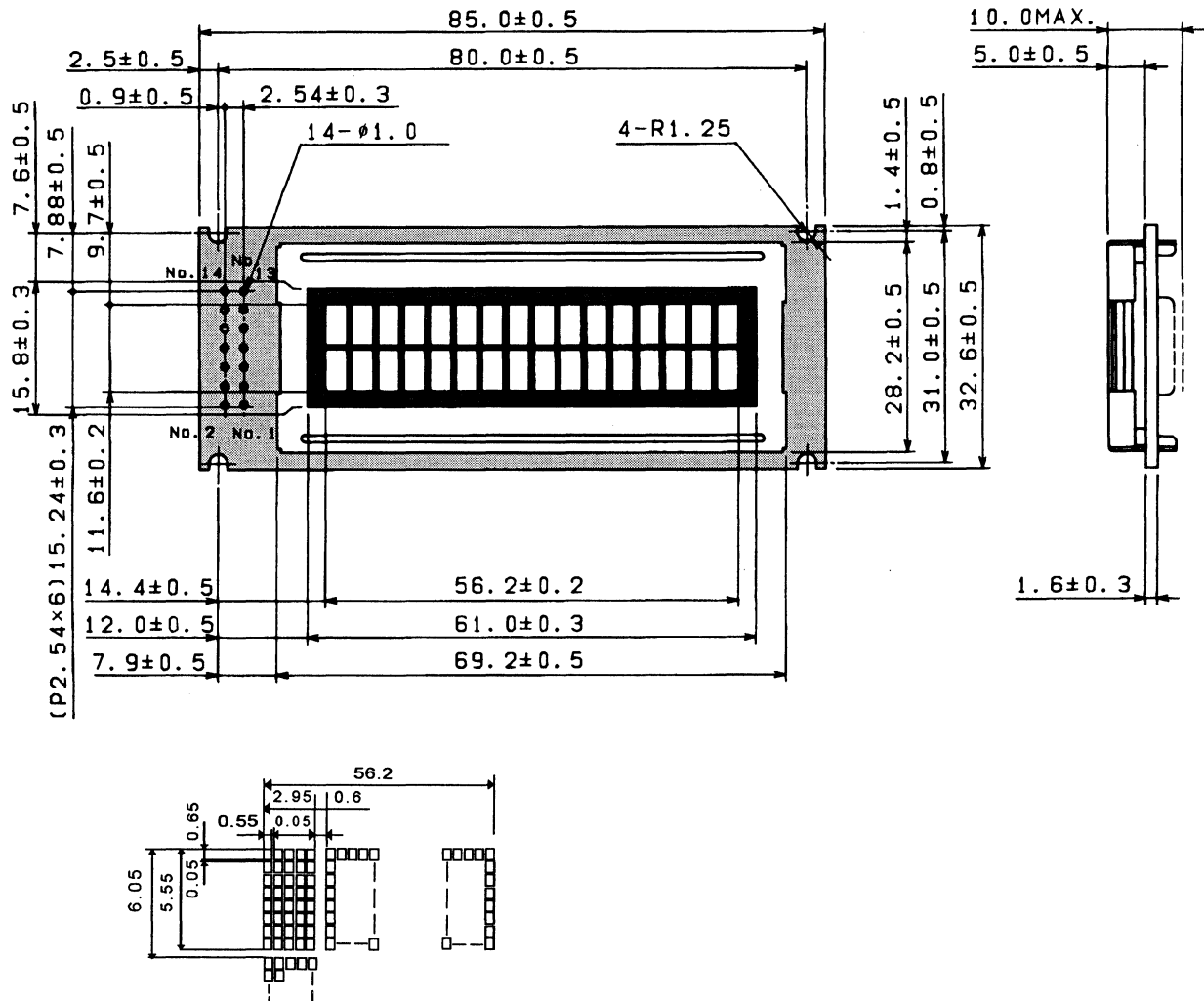
Character Type LCD Module

DESCRIPTION

RCM2025 R is an LCD module with LSI controller/driver built in.

FEATURES

- 1) 16 Character x 2 Rows
- 2) Wide viewing angle, high contrast ratio.
- 3) 5 x 7 dot construction in each character, plus one line.
- 4) Can be interfaced with 4bit or 8bit MPU.
- 5) Displays 160 different types of international characters and symbols plus 32 different types of special characters and symbols.
- 6) User designed display pattern with built in character generator RAM.
- 7) Clear, easy to read display, with cursor on/off, and character blink. Simple instructions for various functions.
- 8) Compact and light weight, for easy assembly.
- 9) Can be driven by a 5V circuit.
- 10) Low power consumption.



BLOCK DIAGRAM

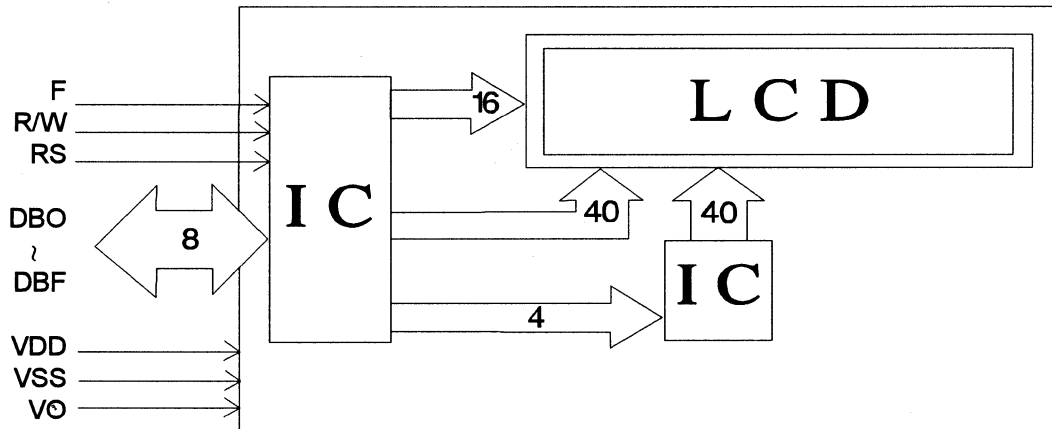


Fig. # 3, Block Diagram

INTERFACE PIN CONNECTION

Pin NO.	Symbol	Pin No.	Symbol
1	V_{SS}	8	DB 1
2	V_{DD}	9	DB 2
3	V_o	10	DB 3
4	RS	11	DB 4
5	R/W	12	DB 5
6	E	13	DB 6
7	DB_o	14	DB 7

DD RAM ADDRESS

	1	2	3	4		14	15	16
1 Line	00H	01H	02H	03H	—	0DH	0EH	0FH
2 Line	40H	41H	42H	43H	—	4DH	4EH	4FH

POWER SUPPLY SAMPLE CONNECTION

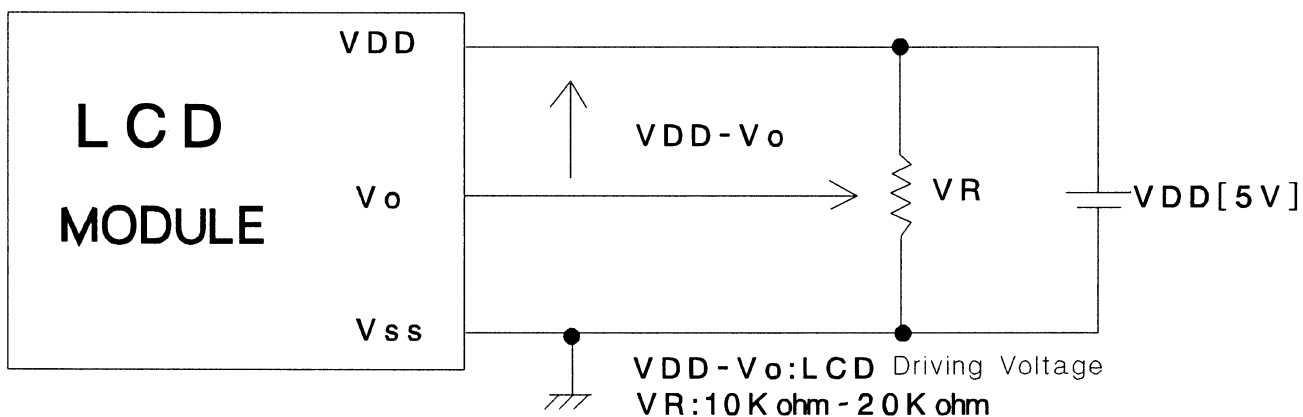


Fig. 4 Power Supply Sample Connection

ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

Items	Symbol	Min.	Max.	Unit
Supply Voltage for Logics	VDD-VSS	0	6.5	V
Supply Voltage for Driving LCD	VDD-V0	0	6.5	V
Input Voltage	VIN	- 0.3	VDD+0.3	V
Operating Temperature	T0P	0	50	°C
Storage Temperature	Tstg	- 20	70	°C

ELECTRICAL CHARACTERISTICS (VDD=5.0 ± 5% Ta=25°C)

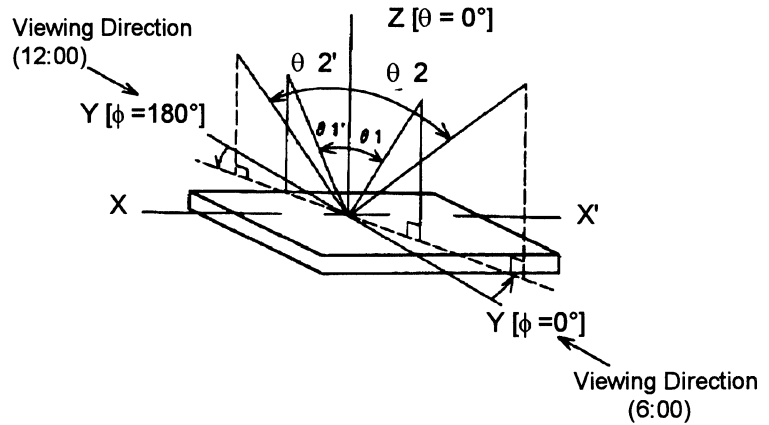
Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input High Level Voltage	VIH		2.2	-	VDD-	V
Input Low Level Voltage	VIL		-	-	0.6	V
Output High Level Voltage	V0H	- I 0H=0.205mA	2.4	-	-	V
Output Low Level Voltage	V0L	I 0L=1.2mA	-	-	0.4	V
Power Supply Current	IDD	VDD=5V	-	1.5	3	mA

OPTICAL CHARACTERISTICS (Ta=25°C)

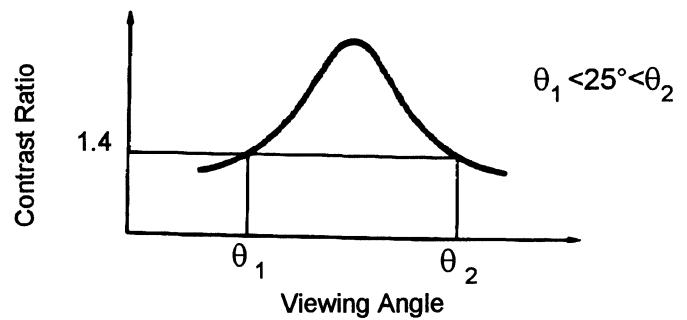
Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
t rise time	tr	$\theta = 10^\circ$ $\phi = 0^\circ$	-	100	250	ms
t fall time	td	$\theta = 10^\circ$ $\phi = 0^\circ$	-	150	250	ms
Contrast Ratio	K	$\theta = 10^\circ$ $\phi = 0^\circ$	-	3		
Viewing Angle	$\theta 1$	$K \geq 1.4$	-	-	20	degree
	$\theta 2$	$\phi = 0^\circ$	40	-	-	degree
	ϕ	$K \geq 1.4$ $\theta = 20^\circ$	± 30	-	-	degree

OPTICAL CHARACTERISTICS

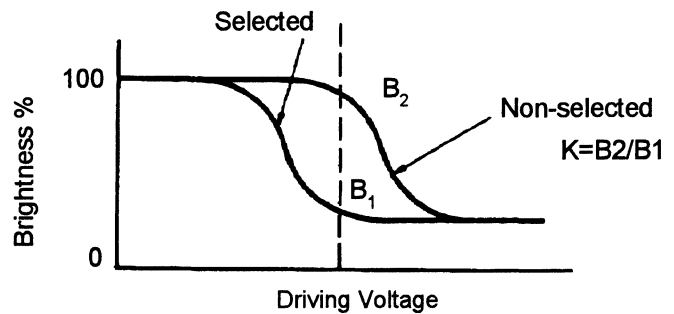
1) Definition of θ and ϕ



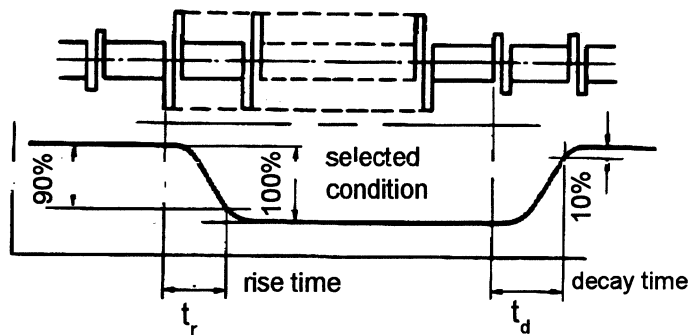
2) Definition of viewing angle θ_1 and θ_2



3) Definition of contrast ratio "K"



4) Definition of optical response time



OPERATION

(1) Writing

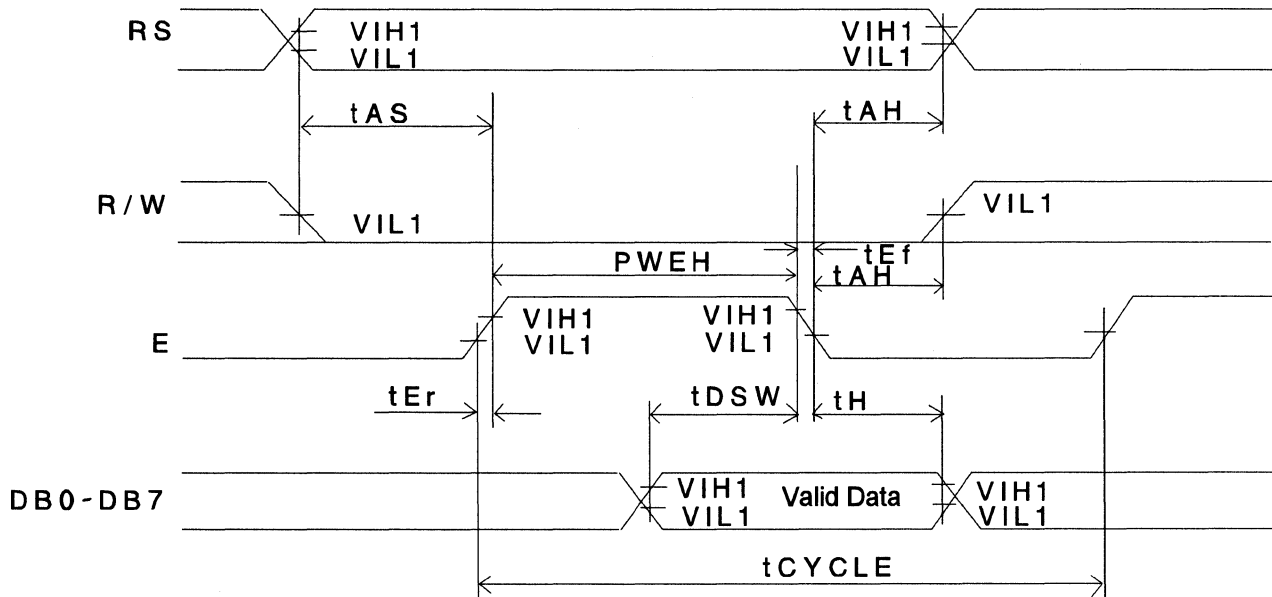


Fig. 5 Writing

Item	Symbol	Test Condition	Min.	Max.	Unit
Enable Cycle Time	t_{CYCE}	Fig. 5	500	-	n sec
Enable Pulse Time	PWE	Fig. 5	220	-	n sec
Enable Rise Time	t_{Er}, t_{Ef}	Fig. 5	-	20	n sec
Enable Decay Time					
Address Set-Up Time	t_{AS}	Fig. 5	40	-	n sec
Address Hold Time	t_{AH}	Fig. 5	10	-	n sec
Data Hold Time	t_H	Fig. 5	10	-	n sec

(2) Reading

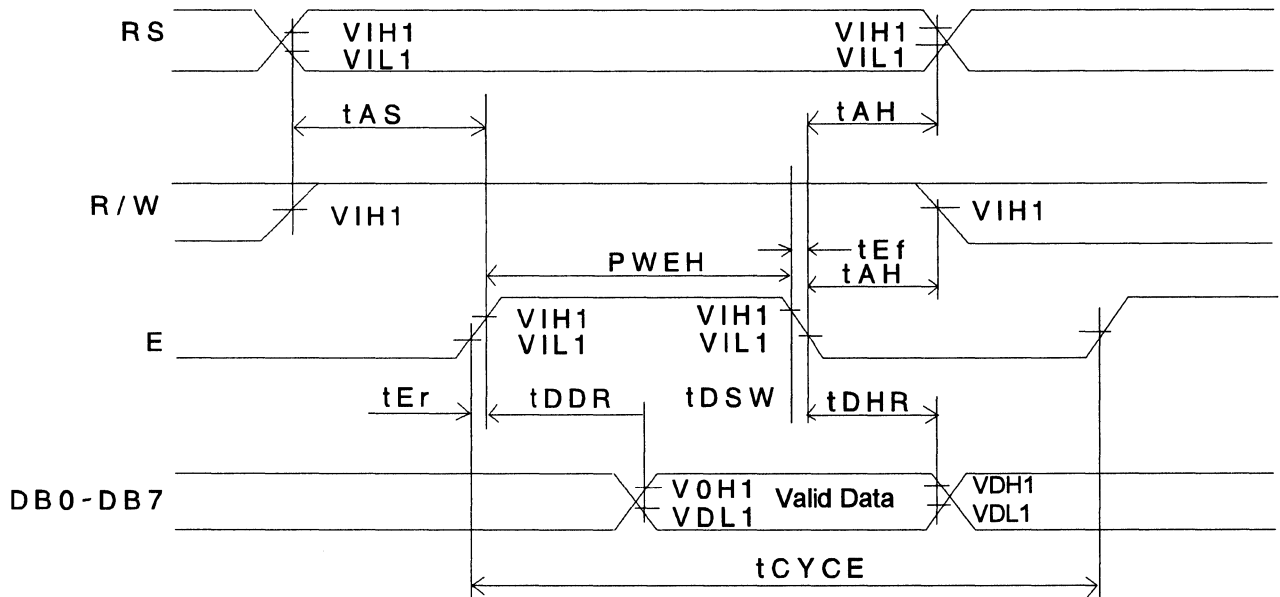


Fig. 6 Reading

Item	Symbol	Test Conditions	Min.	Max.	Unit
Enable Cycle Time	tCYCE	Fig. 6	1000	-	n sec
Enable Pulse Time	PWEH	Fig. 6	450	-	n sec
Enable Rise Time	tEr, rEf	Fig. 6	-	25	n sec
Enable Decay Time					
Address Set-Up Time	tAS	Fig. 6	140	-	n sec
Address Hold Time	tAH	Fig. 6	10	-	n sec
Data Delay Time	tDDR	Fig. 6	-	320	n sec
Data Hold Time	tDHR	Fig. 6	20	-	n sec

PIN FUNCTION

Symbol	Level	Input/ Output Power	Function
VSS	——	——	GND : 0V +5V Power Voltage
VDD	——	——	
VO	——	——	
RS	H/L	Input	Register select signal 0: Instruction register (write) Busy flag address counter (read) 1: Data register (read/write)
R/W	H/L	Input	Read (R) Write (W) Select signal "0": Write MPU → LCD module "1": Read MPU ← LCD module
E	H, H → L	Input	Signal to start read or write data.
DB0 DB3	H/L	Input output power	Lower level 4 lines data bus are used to transfer data between MPU and module. When operated with 4bits, this function does not work.
DB4 DB7	H/L	Input output power	Upper level 4 lines data bus are used to transfer data between MPU and module.

REMARK:

This module can be interfaced with both 4 or 8bit MPU.
Data transmission can either be sent in 2 parts at 4bits or once at 8bits.

- (1) If interface data is 4bits, data transmission is DB4~DB7, using 4bus, and the DB0~DB3 bus is not used.

Data transmission between module and MPU will end after two transmissions.

Upper 4bits of data (Interface data length is at 8bits when contents are DB4~DB7) is transmitted, then lower 4bit is sent (interface data length is at 8bits contents are DB0~DB3).

- (2) When interface data is 8bits, data DB0~DB7, data is transmitted by using data bus.

Character Type LCD Module

RCM2025R

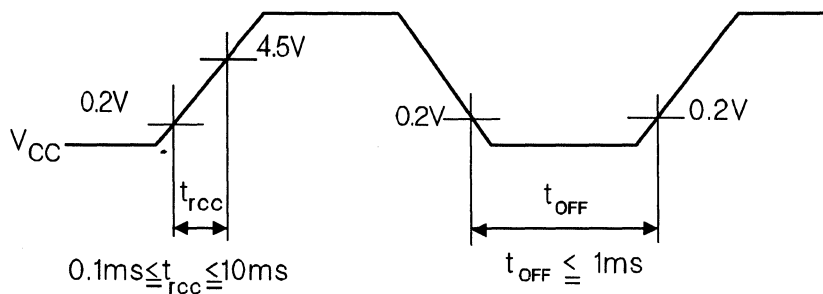
INSTRUCTION											Description	Execution Time (f=250kHz)
Instruction	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Cursor is returned to home position (address 0) after entire display is cleared	1.64 ms
Cursor at Home	0	0	0	0	0	0	0	0	1	*	Cursor is returned to home position (address 0). Shifted display is also returned to the original position. Contents of DDRAM are not changed.	1.64 ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Cursor advance direction and display shift are set. These operations are performed during data write and read modes.	40 μs
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.	40 μs
Cursor/Display Shift	0	0	0	0	0	1	S/C	R/L	*	*	Cursor and display are shifted without changing the contents of DDRAM	40 μs
Function Set	0	0	0	0	1	DL	N	F	*	*	Interface data length (DL), number of display lines (N), and character font (F) are set.	40 μs
CGRAM Address Set	0	0	0	1	ACG					CGRAM address is set. Transmitted and received after this is the data of CGRAM.		40 μs
DDRAM Address Set	0	0	0	ADD					DDRAM address is set. Transmitted and received after this is the data of DDRAM.		40 μs	
Busy Flag/address read	0	1	BF	AC					Busy flag (BF) showing internal operation and contents of address counter are read.		0 μs	
CGRAM/DDRAM Data Write	1	0	Write Data					Data is written in DDRAM or CGRAM.		46 μs		
CGRAM/DDRAM Data Read	1	1	Read Data					Data is read out of DDRAM or CGRAM.		46 μs		
	I/D = 1: Increment (+1) I/D = 0: Decrement (-1) 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 N = 1: 2 lines N = 0: 1 line F = 1: 5x10 dots F = 0: 5x7 dots BF = 1: Internal operation is being performed BF = 0: Instruction acceptable										DDRAM: Display Data RAM CGRAM: Character Generator RAM ACG: Address of CGRAM ADD: Address of DDRAM. These correspond to cursor addresses AC: Address counter used for both DDRAM and CGRAM	Execution time changes with change in internal oscillation frequency (fosc).

RESET FUNCTION

Upon reset, the module will automatically reset to its initial function.

At initial function, please start by using the following instructions.

- 1) Clear Display
(Note: Busy flag (BF) is active high - BF=1)
- 2) Function set up
DL = 1: Interface data length 8bits.
N = 0: 1 line display
F = 0: 5 x 7 dot
- 3) Display ON/OFF Control
D: = 0: Display OFF
C: = 0: Cursor OFF
B = 0: Intermittent OFF
- 4) Input Set Up Mode
I/D = 1: + 1 (inclement)
S = 0: Does Not Shift



t_{OFF} present instant or ON.OFF time.
(Remark) Unless above electrical condition are satisfied internal circuit will not operate properly.

CHARACTER CODE AND PATTERN TABLE

Lower 4bit	Higher 4bit	0000	0010	0011	0100	0101	0110	0111	1010	1011	1100	1101	1110	1111
	XXXX0000	CG RAM (1)		0	1	2	3	4	5	6	7	8	9	A	B
XXXX0001	(2)	!	@	#	\$	%	&	'	()	*	+	=	~
XXXX0010	(3)	"	#	\$	%	&	'	()	*	+	=	~	^
XXXX0011	(4)	~	^	&	'	()	*	+	=	~	^	&	'
XXXX0100	(5)	^	&	'	()	*	+	=	~	^	&	'	(
XXXX0101	(6)	&	'	()	*	+	=	~	^	&	'	()
XXXX0110	(7)	'	()	*	+	=	~	^	&	'	()	*
XXXX0111	(8)	()	*	+	=	~	^	&	'	()	*	+
XXXX1000	(1))	*	+	=	~	^	&	'	()	*	+	=
XXXX1001	(2)	*	+	=	~	^	&	'	()	*	+	=	~
XXXX1010	(3)	+	=	~	^	&	'	()	*	+	=	~	^
XXXX1011	(4)	=	~	^	&	'	()	*	+	=	~	^	&
XXXX1100	(5)	~	^	&	'	()	*	+	=	~	^	&	'
XXXX1101	(6)	^	&	'	()	*	+	=	~	^	&	'	(
XXXX1110	(7)	&	'	()	*	+	=	~	^	&	'	()
XXXX1111	(8)	'	()	*	+	=	~	^	&	'	()	*

APPLICATIONS

Personal computer, word processor, facsimile, telephone, etc., medical and other instrumentations.

1) Handling Instructions

- a) Attention must be paid to avoid external shock, which will cause operations failure.
- b) Polarizer on the surface is fragile and can easily be scratched and damaged. Therefore, please take extra care when handling. To clean surface of termination, please wipe off with alcohol.
- c) The liquid used in the LCD panel is a harmful substance and must not be ingested. Avoid contact on exposed skin. If liquid is touched, wash thoroughly.
- d) Do not expose to direct sunlight or fluorescent light for long periods of time. If it will be in direct sunlight, please use UV filter.
- e) For storage please avoid high temperature/high humidity. When long term storage is required, keep panels in low temperature (5°C ~ 25°C) and low humidity.

2) Operational Instructions

- a) Do not connect or disconnect module while power is on.
- b) Turn on module power before input of signal. Turn off input signal before turning off power to module. It can be damaged by "latch-up" phenomenon.

3) Mounting Instructions

- a) Ground solder before using.
- b) CMOS-IC requires caution in cases of potential ESD.
- c) Do not remove panel from board.

4) Module Assembly Instructions

- a) For mounting, use 4 holes on each corner and do not stress circuit.
- b) To prevent contamination, scratches, or cuts on the polarizer, please use the protective cover on the front panel.

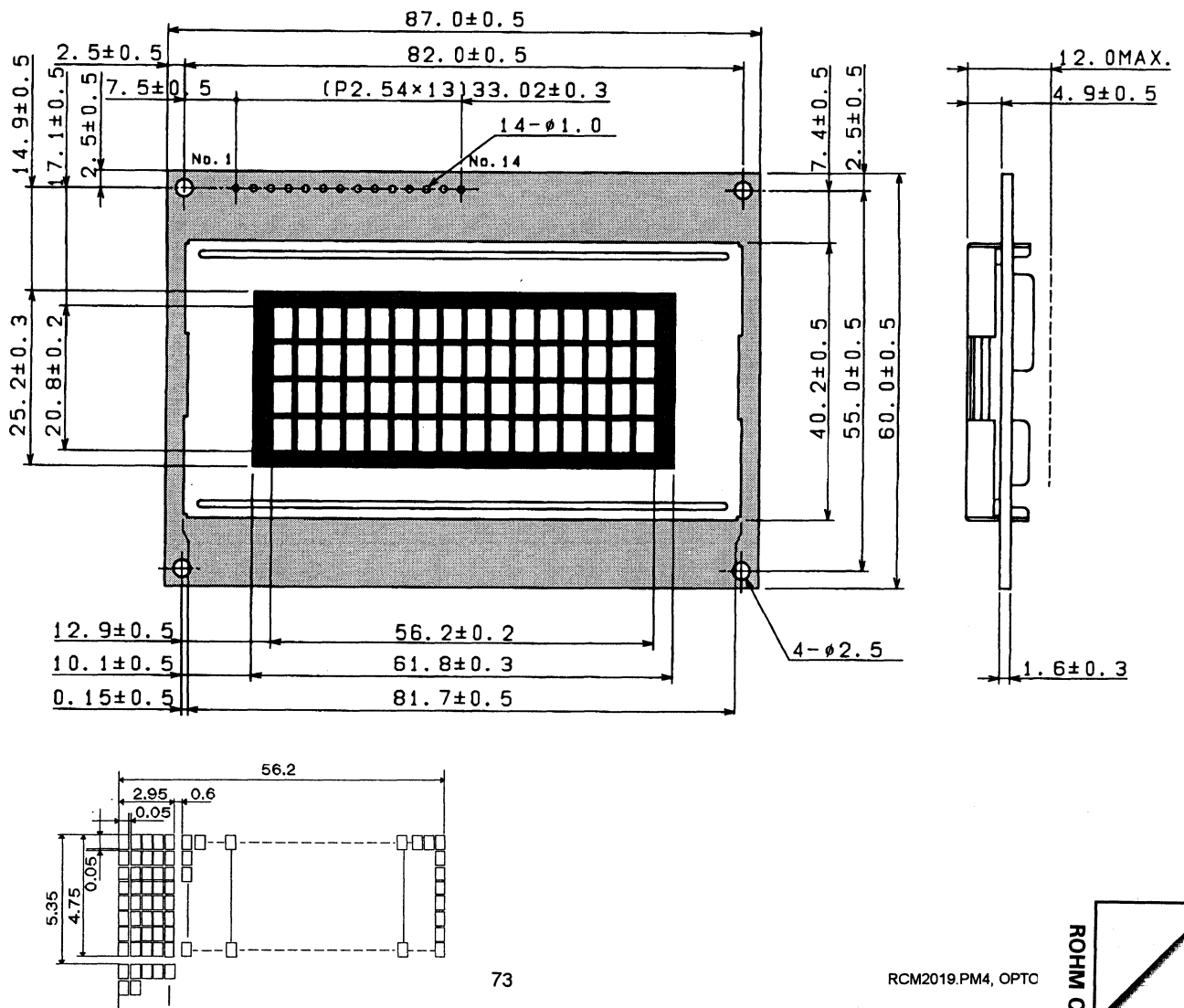
Character Type LCD Module

DESCRIPTION

RCM2019 R is an LCD module with LSI controller/driver built in.

FEATURES

- 1) 16 Character x 4 Rows
- 2) Wide viewing angle, high contrast ratio.
- 3) 5 x 7 dot construction in each character.
- 4) Can be interfaced with 4bit or 8bit MPU.
- 5) Displays 208 different types of international characters and symbols plus 32 different types of special characters and symbols.
- 6) User designed display pattern with built in character generator RAM.
- 7) Clear, easy to read display, with cursor on/off, and character blink. Simple instructions for various functions.
- 8) Compact and light weight, for easy assembly.
- 9) Can be driven by a 5V circuit.
- 10) Low power consumption.
- 11) Optional transmissive, transreflective type with back light.



BLOCK DIAGRAM

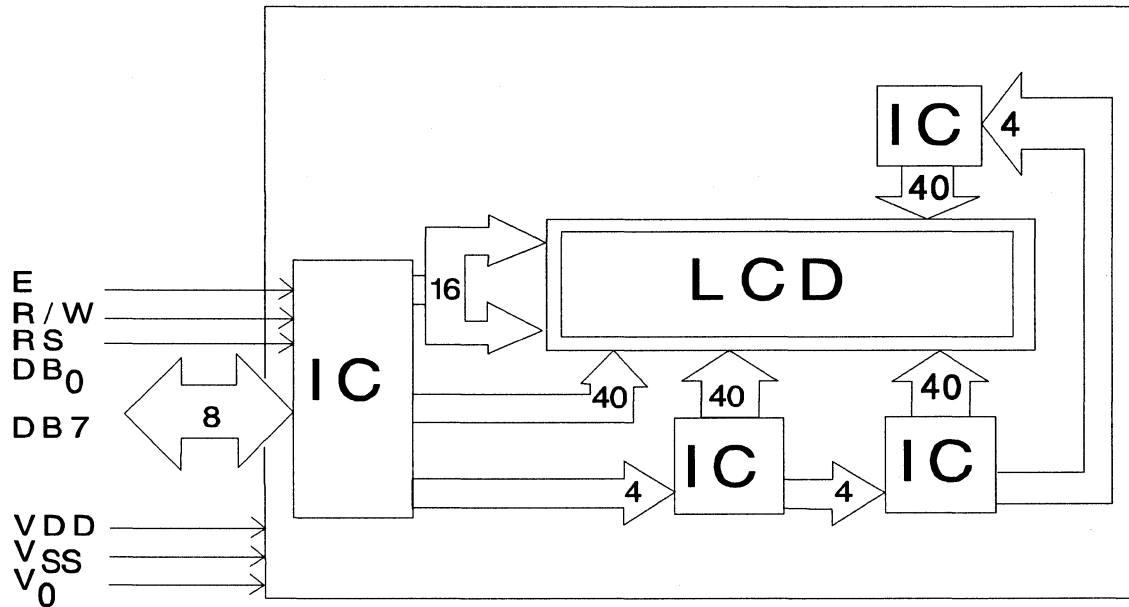


Fig. # 3, Block Diagram

INTERFACE PIN CONNECTION

Pin NO.	Symbol	Pin No.	Symbol
1	V_{SS}	8	DB 1
2	VDD	9	DB 2
3	V_o	10	DB 3
4	RS	11	DB 4
5	R/W	12	DB 5
6	E	13	DB 6
7	DB_o	14	DB 7

DD RAM ADDRESS

	1	2	3	4		14	15	16
1 Line	00H	01H	02H	03H	——	0DH	0EH	0FH
2 Line	40H	41H	42H	43H	——	4DH	4EH	4FH
3 Line	10H	11H	12H	13H		1DH	1EH	1FH
4 Line	50H	51H	52H	53H		5DH	5EH	5FH

POWER SUPPLY SAMPLE CONNECTION

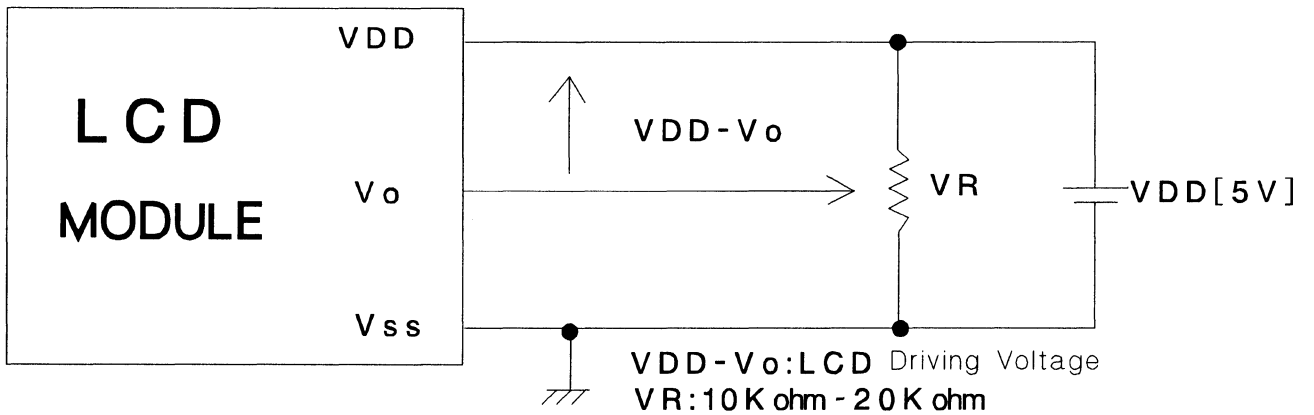


Fig. 4 Power Supply Sample Connection

ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

Items	Symbol	Min.	Max.	Unit
Supply Voltage for Logics	VDD-VSS	-0.3	6.5	V
Supply Voltage for Driving LCD	VDD-V0	0	6.5	V
Input Voltage	VIN	-0.3	VDD+0.3	V
Operating Temperature	T0P	0	50	°C
Storage Temperature	Tstg	-20	70	°C

ELECTRICAL CHARACTERISTICS (VDD=5.0 ± 5% Ta=25°C)

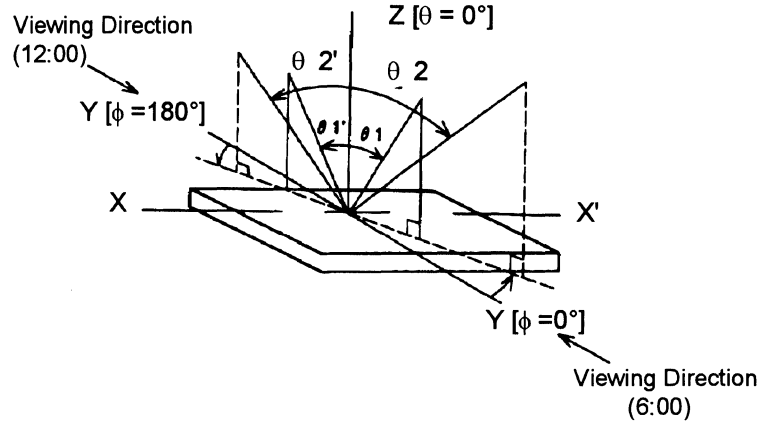
Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input High Level Voltage	VIH		2.0	-	-	V
Input Low Level Voltage	VIL		-	-	0.8	V
Output High Level Voltage	V0H	I0H=1.2mA	2.4	-	-	V
Output Low Level Voltage	V0L	I0L=2.0mA	-	-	0.4	V
Power Supply Current	IDD	VDD=5V	-	2	3	mA

OPTICAL CHARACTERISTICS (Ta=25°C)

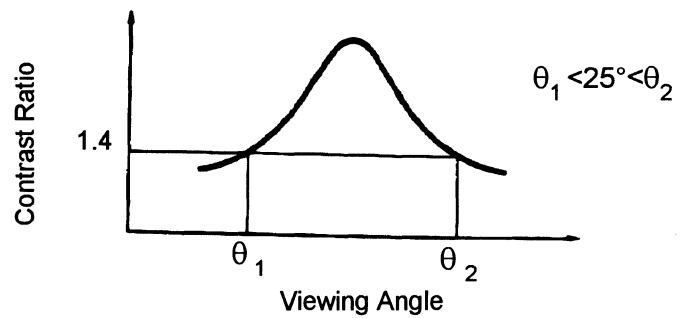
Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
t rise time	tr	$\theta = 10^\circ$ $\phi = 0^\circ$	-	100	250	ms
t fall time	td	$\theta = 10^\circ$ $\phi = 0^\circ$	-	150	250	ms
Contrast Ratio	K	$\theta = 10^\circ$ $\phi = 0^\circ$	-	3		
Viewing Angle	$\theta 1$	$K \geq 1.4$	-	-	20	degree
	$\theta 2$	$\phi = 0^\circ$	40	-	-	degree
	ϕ	$K \geq 1.4$ $\theta = 20^\circ$	± 30	-	-	degree

OPTICAL CHARACTERISTICS

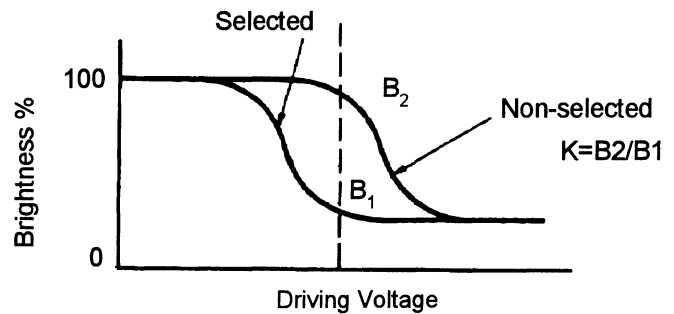
1) Definition of θ and ϕ



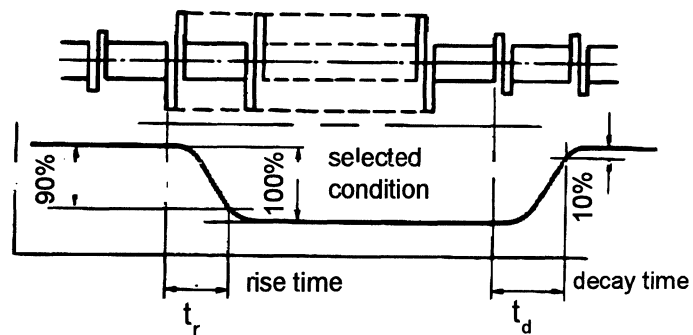
2) Definition of viewing angle θ_1 and θ_2



3) Definition of contrast ratio "K"



4) Definition of optical response time



OPERATION

(1) Writing

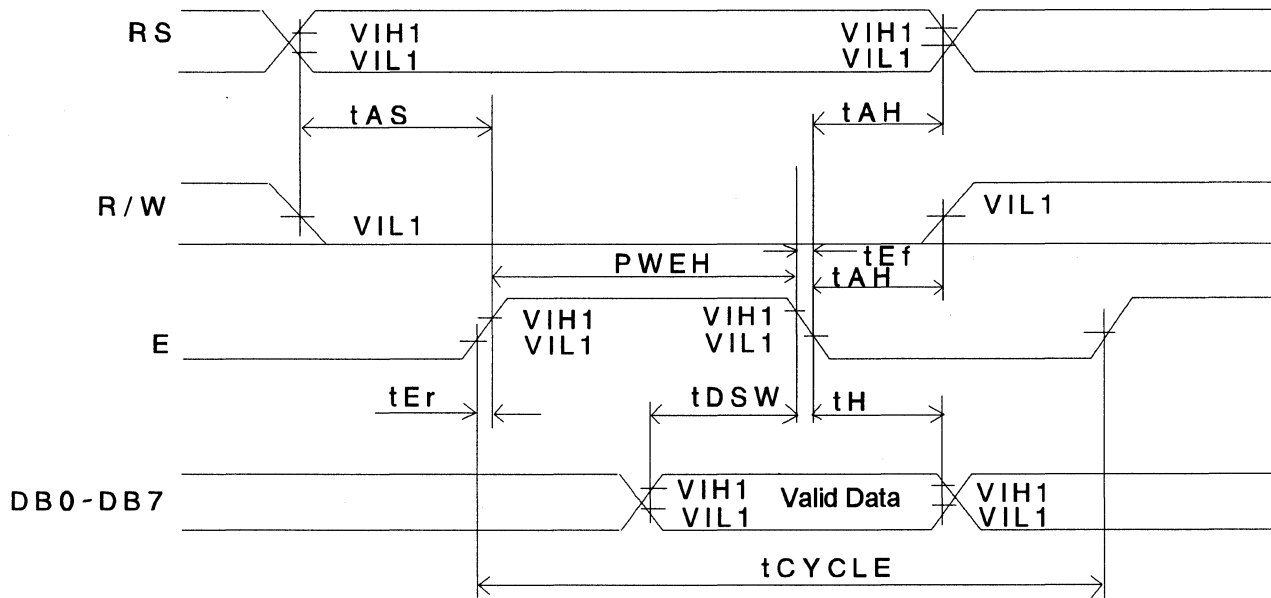


Fig. 5 Writing

Item	Symbol	Test Condition	Min.	Max.	Unit
Enable Cycle Time	t_{CYCE}	Fig. 5	500	-	n sec
Enable Pulse Time	PWE	Fig. 5	220	-	n sec
Enable Rise Time	t_{Er}, t_{Ef}	Fig. 5	-	20	n sec
Enable Decay Time					
Address Set-Up Time	t_{AS}	Fig. 5	40	-	n sec
Address Hold Time	t_{AH}	Fig. 5	10	-	n sec
Data Set-Up Time	t_{DSW}	Fig. 5	60	-	n sec
Data Hold Time	t_H	Fig. 5	10	-	n sec

(2) Reading

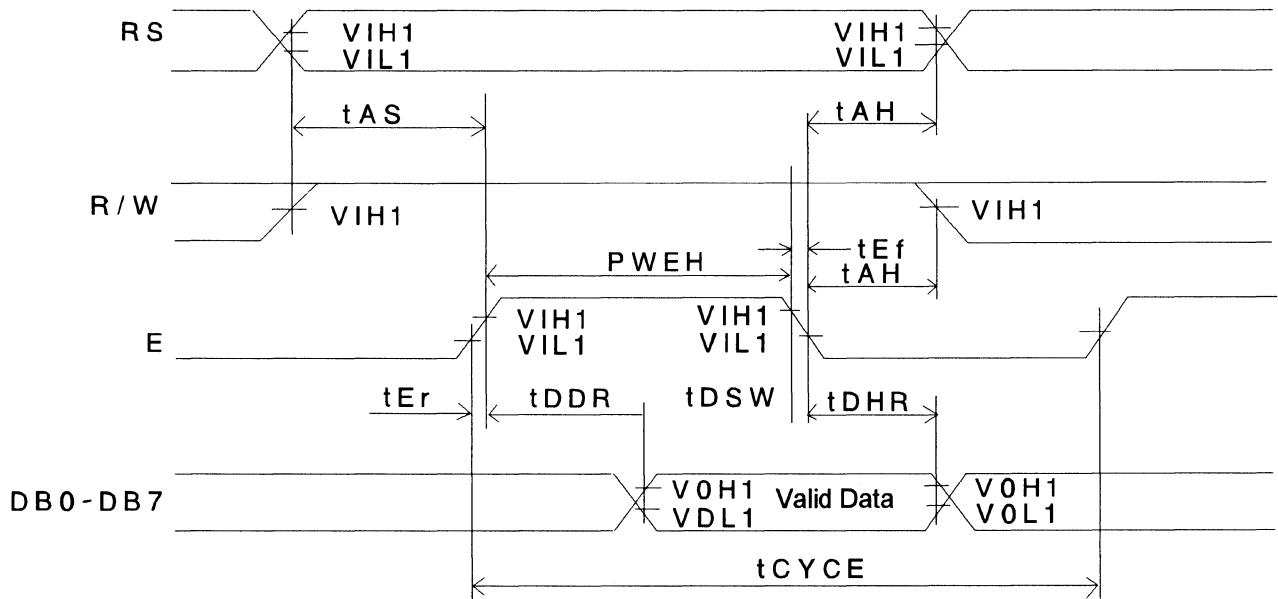


Fig. 6 Reading

Item	Symbol	Test Conditions	Min.	Max.	Unit
Enable Cycle Time	tCYCE	Fig. 6	500	-	n sec
Enable Pulse Time	PWEH	Fig. 6	220	-	n sec
Enable Rise Time	tEr, rEf	Fig. 6	-	20	n sec
Enable Decay Time					
Address Set-Up Time	tAS	Fig. 6	40	-	n sec
Address Hold Time	tAH	Fig. 6	10	-	n sec
Data Delay Time	tDDR	Fig. 6	-	120	n sec
Data Hold Time	tDHR	Fig. 6	20	-	n sec

PIN FUNCTION

Symbol	Level	Input/ Output Power	Function
VSS	——	——	Power Voltage
VDD	——	——	
VO	——	——	
RS	H/L	Input	Register select signal 0: Instruction register (write) Busy flag address counter (read) 1: Data register (read/write)
R/W	H/L	Input	Read (R) Write (W) Select signal "0": Write MPU → LCD module "1": Read MPU ← LCD module
E	H, H → L	Input	Signal to start read or write data.
DB0 DB3	H/L	Input output power	Lower level 4 lines data bus are used to transfer data between MPU and module. When operated with 4bits, this function does not work.
DB4 DB7	H/L	Input output power	Upper level 4 lines data bus are used to transfer data between MPU and module.

REMARK:

This module can be interfaced with both 4 or 8bit MPU.
 Data transmission can either be sent in 2 parts at 4bits or once at 8bits.

- (1) If interface data is 4bits, data transmission is DB4~DB7, using 4bus, and the DB0~DB3 bus is not used.

Data transmission between module and MPU will end after two transmissions.

Upper 4bits of data (Interface data length is at 8bits when contents are DB4~DB7) is transmitted, then lower 4bit is sent (interface data length is at 8bits contents are DB0~DB3).

- (2) When interface data is 8bits, data DB0~DB7, data is transmitted by using data bus.

Character Type LCD Module

RCM2019R

INSTRUCTION											Description	Execution Time (f=250kHz)
Instruction	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 0) after entire display is cleared	1.64 ms
Cursor at Home	0	0	0	0	0	0	0	0	1	*	Cursor is returned to home position (address 0). Shifted display is also returned to the original position. Contents of DDRAM are not changed.	1.64 ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Cursor advance direction and display shift are set. These operations are performed during data write and read modes.	40 μs
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.	40 μs
Cursor/Display Shift	0	0	0	0	0	1	S/C	R/L	*	*	Cursor and display are shifted without changing the contents of DDRAM	40 μs
Function Set	0	0	0	0	1	DL	N	F	*	*	Interface data length (DL), number of display lines (N), and character font (F) are set.	40 μs
CGRAM Address Set	0	0	0	1	ACG					CGRAM address is set. Transmitted and received after this is the data of CGRAM.		40 μs
DDRAM Address Set	0	0	0	ADD					DDRAM address is set. Transmitted and received after this is the data of DDRAM.		40 μs	
Busy Flag/address read	0	1	BF	AC					Busy flag (BF) showing internal operation and contents of address counter are read.		0 μs	
CGRAM/DDRAM Data Write	1	0	Write Data					Data is written in DDRAM or CGRAM.		46 μs		
CGRAM/DDRAM Data Read	1	1	Read Data					Data is read out of DDRAM or CGRAM.		46 μs		
	I/D = 1: Increment (+1) I/D = 0: Decrement (-1) 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 N = 1: 2 lines N = 0: 1 line F = 1: 5x10 dots F = 0: 5x7 dots BF = 1: Internal operation is being performed BF = 0: Instruction acceptable										DDRAM: Display Data RAM CGRAM: Character Generator RAM ACG: Address of CGRAM ADD: Address of DDRAM. These correspond to cursor addresses AC: Address counter used for both DDRAM and CGRAM	Execution time changes with change in internal oscillation frequency (fosc).

CHARACTER CODE AND PATTERN TABLE

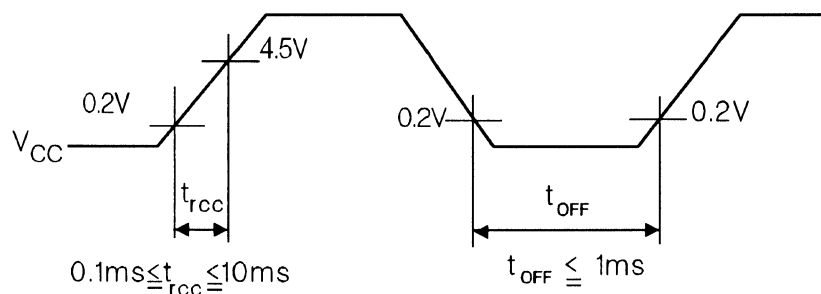
Higher 4bit \ Lower 4bit	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
XXXX0000	CGRAM (0)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
XXXX0001	(1)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
XXXX0010	(2)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
XXXX0011	(3)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
XXXX0100	(4)	☐	☐	☐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

RESET FUNCTION

Upon reset, the module will automatically reset to its initial function.

At initial function, please start by using the following instructions.

- 1) Clear Display
(Note: Busy flag (BF) is active high - BF=1)
- 2) Function set up
DL = 1: Interface data length 8bits.
N = 0: 1 line display
F = 0: 5 x 7 dot
- 3) Display ON/OFF Control
D: = 0: Display OFF
C: = 0: Cursor OFF
B = 0: Intermittent OFF
- 4) Input Set Up Mode
I/D = 1: + 1 (inclement)
S = 0: Does Not Shift



t_{OFF} present instant or ON.OFF time.

(Remark) Unless above electrical condition are satisfied internal circuit will not operate properly.

APPLICATIONS

Personal computer, word processor, facsimile, telephone, etc., medical and other instrumentations.

1) Handling Instruction

- a) Attention must be paid to avoid external shock, which will cause operations failure.
- b) Polarizer on the surface is fragile and can easily be scratched and damaged. Therefore, please take extra care when handling. To clean surface of termination, please wipe off with alcohol.
- c) The liquid used in the LCD panel is a harmful substance and must not be ingested. Avoid contact on exposed skin. If liquid is touched, wash thoroughly.
- d) Do not expose to direct sunlight or fluorescent light for long periods of time. If it will be in direct sunlight, please use UV filter.
- e) For storage please avoid high temperature/high humidity. When long term storage is required, keep panels in low temperature (5°C ~ 25°C) and low humidity.

2) Operational Instructions

- a) Do not connect or disconnect module while power is on.
- b) Turn on module power before input of signal. Turn off input signal before turning off power to module. It can be damaged by "latch-up" phenomenon.

3) Mounting Instructions

- a) Ground solder before using.
- b) CMOS-IC requires caution in cases of potential ESD.
- c) Do not remove panel from board.

4) Module Assembly Instructions

- a) For mounting, use 4 holes on each corner and do not stress circuit.
- b) To prevent contamination, scratches, or cuts on the polarizer, please use the protective cover on the front panel.

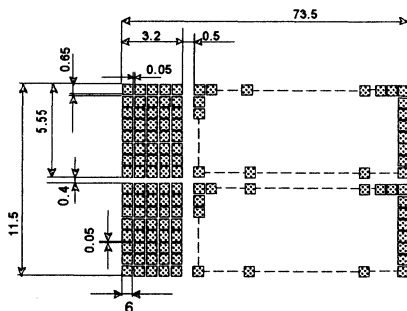
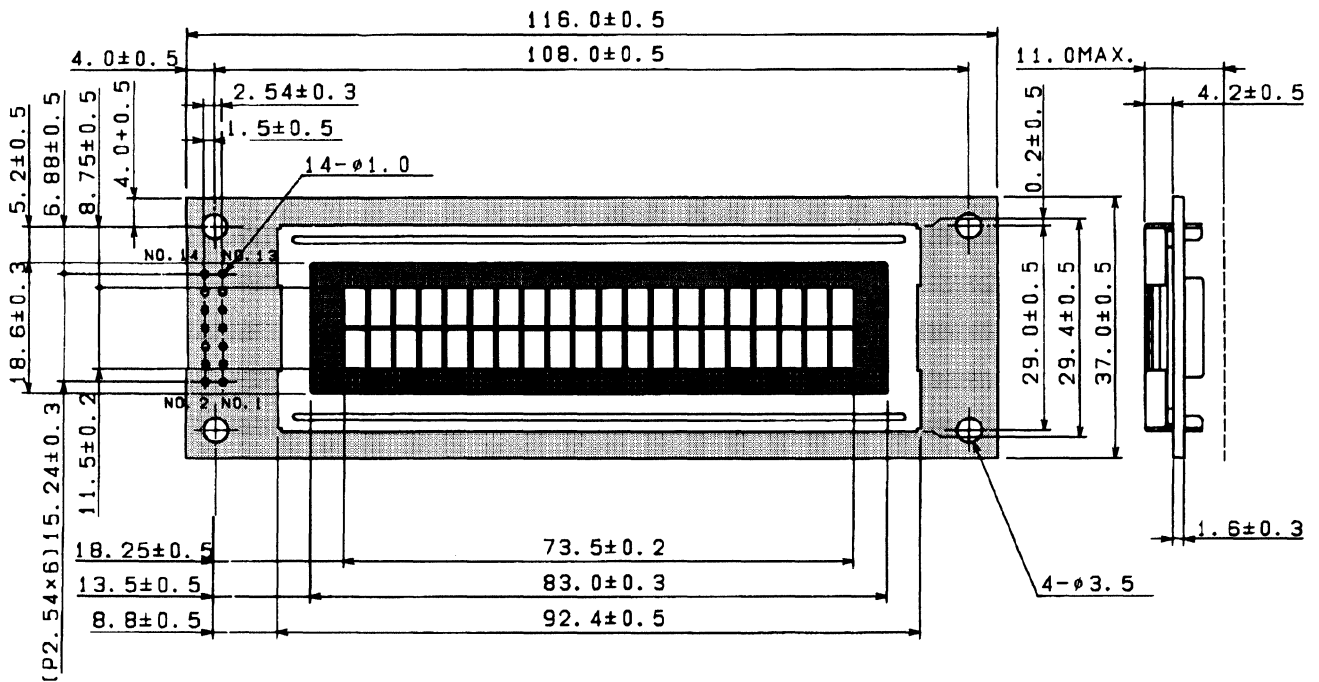
Character Type LCD Module

DESCRIPTION

RCM2010 R is an LCD module with LSI controller/driver built in.

FEATURES

- 1) 20 Characters x 2 Rows
- 2) Wide viewing angle, high contrast ratio.
- 3) 5 x 7 dot construction in each character, plus one line.
- 4) Can be interfaced with 4bit or 8bit MPU.
- 5) Displays 208 different types of international characters and symbols plus 32 different types of special characters and symbols.
- 6) With built in character generator RAM any user design pattern can be displayed.
- 7) Clear, easy to read display, with cursor on/off, and character blink. Simple instructions for various functions.
- 8) Compact and light weight, for easy assembly.
- 9) Can be driven by a 5V circuit.
- 10) Low power consumption.
- 11) Optional transmissive, transreflective type with back light.



BLOCK DIAGRAM

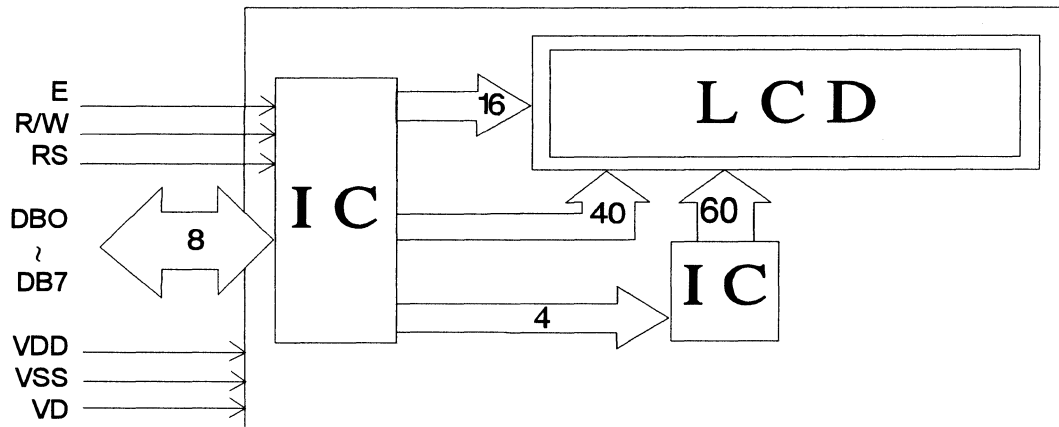


Fig. # 3, Block Diagram

INTERFACE PIN CONNECTION

Pin NO.	Symbol	Pin No.	Symbol
1	V_{SS}	8	DB 1
2	V_{DD}	9	DB 2
3	V_o	10	DB 3
4	RS	11	DB 4
5	R/W	12	DB 5
6	E	13	DB 6
7	DB_o	14	DB 7

DD RAM ADDRESS

	1	2	3	4		18	19	20
1 Line	00H	01H	02H	03H	——	11H	12H	13H
2 Line	40H	41H	42H	43H	——	51H	52H	53H

POWER SUPPLY SAMPLE CONNECTION

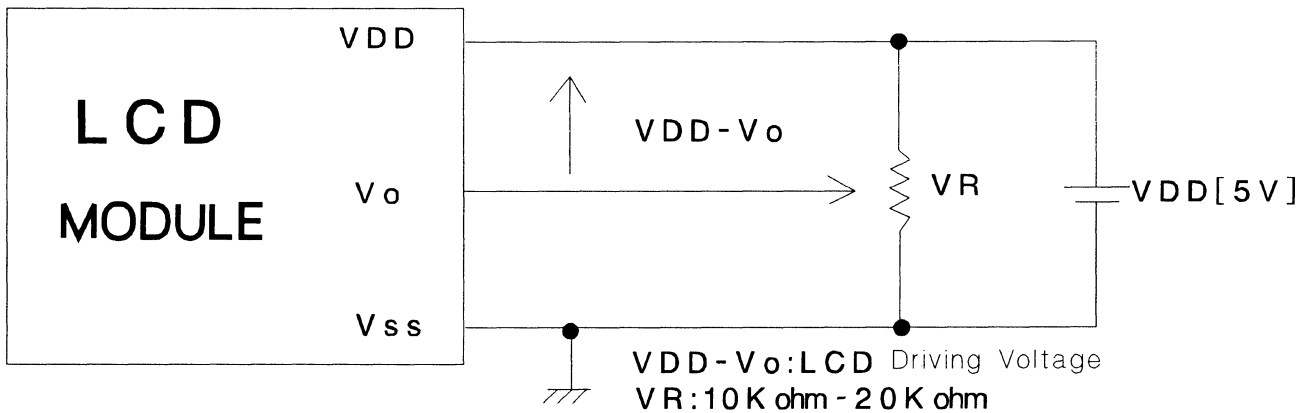


Fig. 4 Power Supply Sample Connection

ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

Items	Symbol	Min.	Max.	Unit
Supply Voltage for Logics	VDD-VSS	- 0.3	6.5	V
Supply Voltage for Driving LCD	VDD-V0	0	6.5	V
Input Voltage	VIN	- 0.3	VDD+0.3	V
Operating Temperature	T0P	0	50	°C
Storage Temperature	Tstg	- 20	70	°C

ELECTRICAL CHARACTERISTICS (VDD=5.0 ± 5% Ta=25°C)

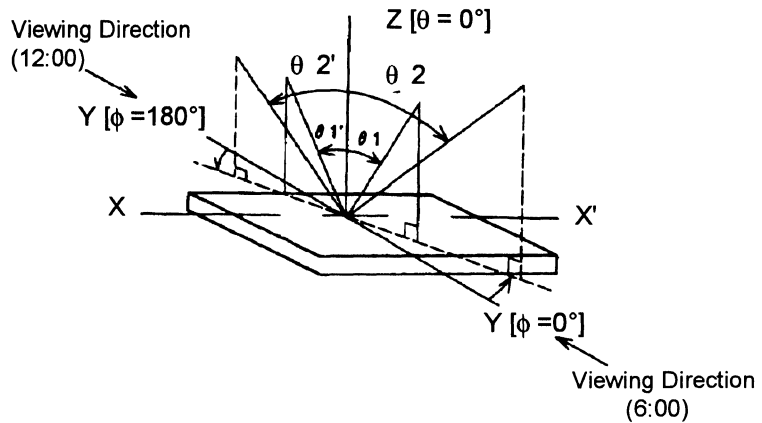
Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input High Level Voltage	VIH		2.0	-	-	V
Input Low Level Voltage	VIL		-	-	0.8	V
Output High Level Voltage	V0H	I 0H= - 1.2mA	2.4	-	-	V
Output Low Level Voltage	V0L	I 0L=2.0mA	-	-	0.4	V
Power Supply Current	IDD	VDD=5V	-	2	3	mA

OPTICAL CHARACTERISTICS (Ta=25°C)

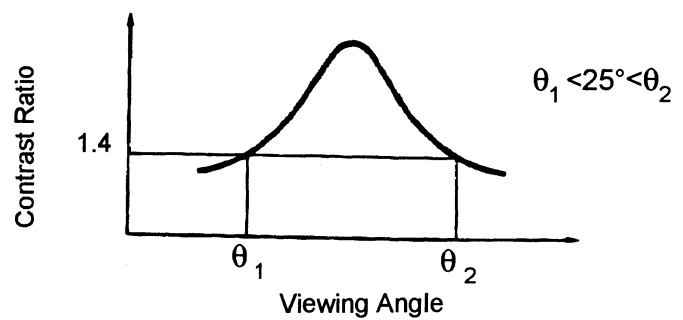
Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
t rise time	tr	$\theta = 10^\circ$ $\phi = 0^\circ$	-	100	250	ms
t fall time	td	$\theta = 10^\circ$ $\phi = 0^\circ$	-	150	250	ms
Contrast Ratio	K	$\theta = 10^\circ$ $\phi = 0^\circ$	-	3		
Viewing Angle	$\theta 1$	$K \geq 1.4$	-	-	20	degree
	$\theta 2$	$\phi = 0^\circ$	40	-	-	degree
	ϕ	$K \geq 1.4$ $\theta = 20^\circ$	± 30	-	-	degree

OPTICAL CHARACTERISTICS

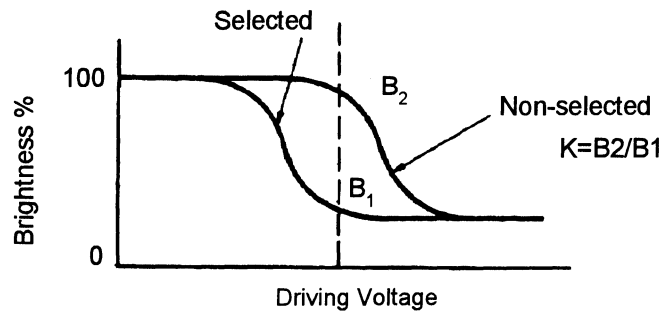
1) Definition of θ and ϕ



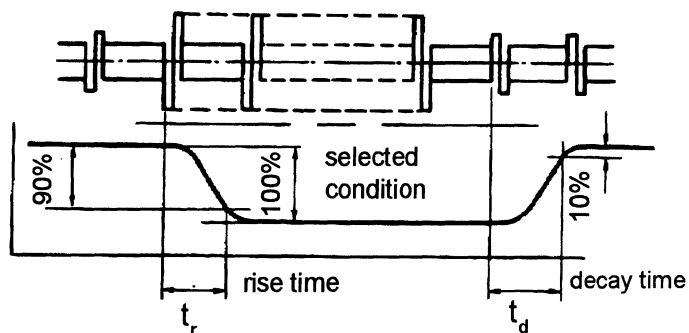
2) Definition of viewing angle θ_1 and θ_2



3) Definition of contrast ratio "K"



4) Definition of optical response time



OPERATION

(1) Writing

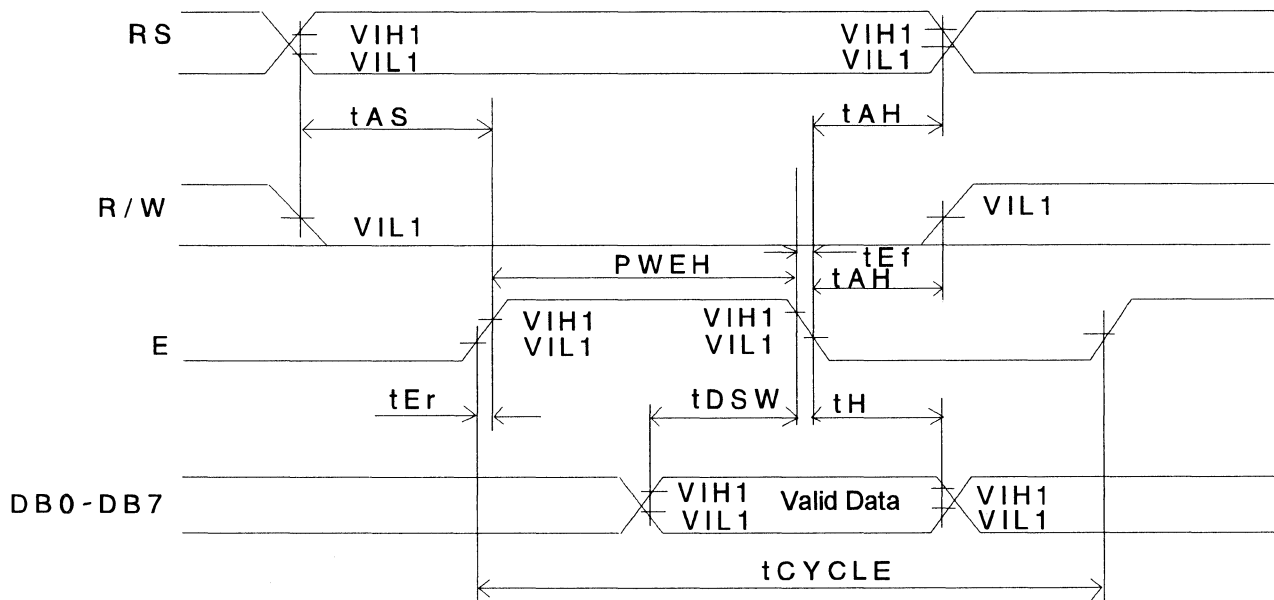


Fig. 5 Writing

Item	Symbol	Test Condition	Min.	Max.	Unit
Enable Cycle Time	t_{CYCE}	Fig. 5	500	-	n sec
Enable Pulse Time	PWE	Fig. 5	220	-	n sec
Enable Rise Time	t_{Er}, t_{Ef}	Fig. 5	-	20	n sec
Enable Decay Time					
Address Set-Up Time	t_{AS}	Fig. 5	40	-	n sec
Address Hold Time	t_{AH}	Fig. 5	10	-	n sec
Data Set-Up Time	t_{DSW}	Fig. 5	60	-	n sec
Data Hold Time	t_H	Fig. 5	10	-	n sec

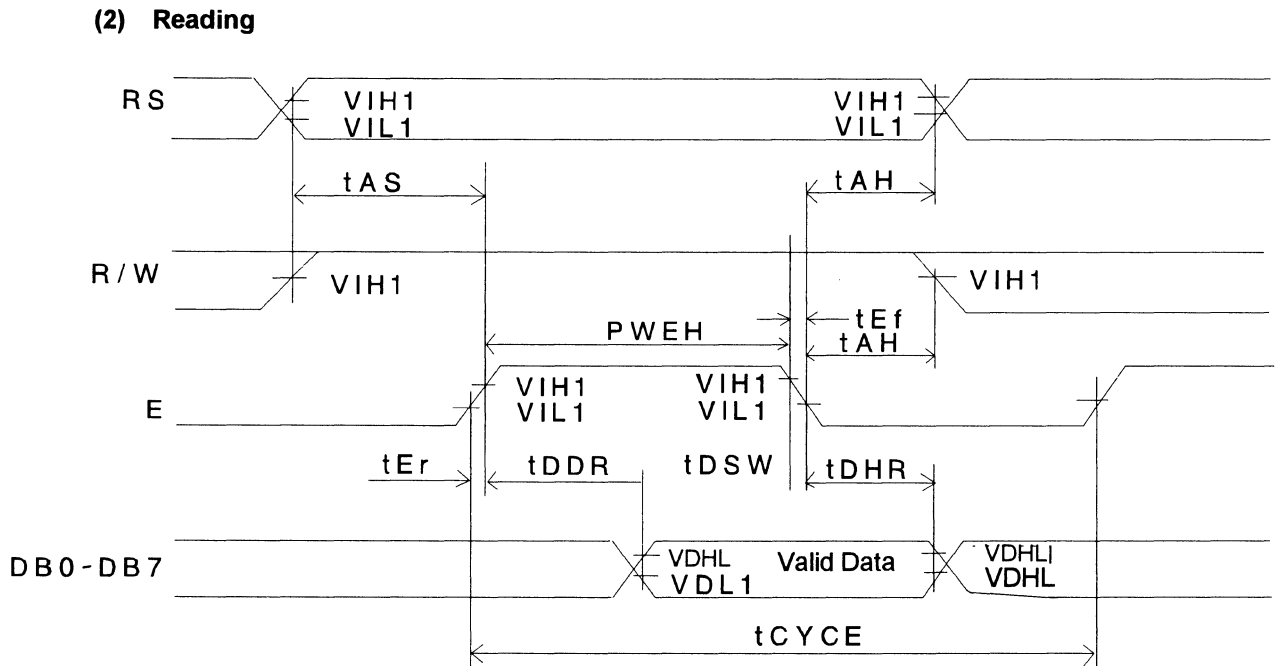


Fig. 6 Reading

Item	Symbol	Test Conditions	Min.	Max.	Unit
Enable Cycle Time	tCYCE	Fig. 6	500	-	n sec
Enable Pulse Time	PWEH	Fig. 6	220	-	n sec
Enable Rise Time	tEr, tEf	Fig. 6	-	20	n sec
Enable Decay Time					
Address Set-Up Time	tAS	Fig. 6	40	-	n sec
Address Hold Time	tAH	Fig. 6	10	-	n sec
Data Delay Time	tDDR	Fig. 6	-	120	n sec
Data Hold Time	tDHR	Fig. 6	20	-	n sec

PIN FUNCTION

Symbol	Level	Input/ Output Power	Function
VSS	———	———	GND : 0V +5V Power Voltage
VDD	———	———	
VO	———	———	
RS	H/L	input	Register select signal 0: Instruction register (write) Busy flag address counter (read) 1: Data register (read/write)
R/W	H/L	Input	Read (R) Write (W) Select signal "0": Write MPU → LCD module "1": Read MPU ← LCD module
E	H, H → L	Input	Signal to start read or write data.
DB0 DB3	H/L	Input out put power	Lower level 4 lines data bus are used to transfer data between MPU and module. When operated with 4bits, this function does not work.
DB4 DB7	H/L	Input output power	Upper level 4 lines data bus are used to transfer data between MPU and module.

REMARK:

This module can be interfaced with both 4 or 8bit MPU.
Data transmission can either be sent in 2 parts at 4bits or once at 8bits.

- (1) If interface data is 4bits, data transmission is DB4~DB7, using 4bus, and the DB0~DB3 bus is not used.

Data transmission between module and MPU will end after two transmissions.

Upper 4bits of data (Interface data length is at 8bits when contents are DB4~DB7) is transmitted, then lower 4bit is sent (interface data length is at 8bits contents are DB0~DB3).

- (2) When interface data is 8bits, data DB0~DB7, data is transmitted by using data bus.

Character Type LCD Module

RCM2010R

INSTRUCTION		Code										Description	Execution Time (f=250kHz)
Instruction	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0			
Clear Display	0	0	0	0	0	0	0	0	0	0	1	Cursor is returned to home position (address 0) after entire display is cleared	1.64 ms
Cursor at Home	0	0	0	0	0	0	0	0	0	1	*	Cursor is returned to home position (address 0). Shifted display is also returned to the original position. Contents of DDRAM are not changed.	1.64 ms
Entry Mode Set	0	0	0	0	0	0	0	0	1	I/D	S	Cursor advance direction and display shift are set. These operations are performed during data write and read modes.	40 μs
Display ON/OFF Control	0	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.	40 μs
Cursor/Display Shift	0	0	0	0	0	1	S/C	R/L	*	*	*	Cursor and display are shifted without changing the contents of DDRAM	40 μs
Function Set	0	0	0	0	1	DL	N	F	*	*	*	Interface data length (DL), number of display lines (N), and character font (F) are set.	40 μs
CGRAM Address Set	0	0	0	1	ACG						CGRAM address is set. Transmitted and received after this is the data of CGRAM.	40 μs	
DDRAM Address Set	0	0	0	ADD						DDRAM address is set. Transmitted and received after this is the data of DDRAM.	40 μs		
Busy Flag/address read	0	1	BF	AC						Busy flag (BF) showing internal operation and contents of address counter are read.	0 μs		
CGRAM/DDRAM Data Write	1	0	Write Data						Data is written in DDRAM or CGRAM.	46 μs			
CGRAM/DDRAM Data Read	1	1	Read Data						Data is read out of DDRAM or CGRAM.	46 μs			
	I/D = 1: Increment (+1) I/D = 0: Decrement (-1) 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 N = 1: 2 lines N = 0: 1 line F = 1: 5x10 dots F = 0: 5x7 dots BF = 1: Internal operation is being performed BF = 0: Instruction acceptable										DDRAM: Display Data RAM CGRAM: Character Generator RAM ACG: Address of CGRAM ADD: Address of DDRAM. These correspond to cursor addresses AC: Address counter used for both DDRAM and CGRAM	Execution time changes with change in internal oscillation frequency (fosc).	

CHARACTER CODE AND PATTERN TABLE

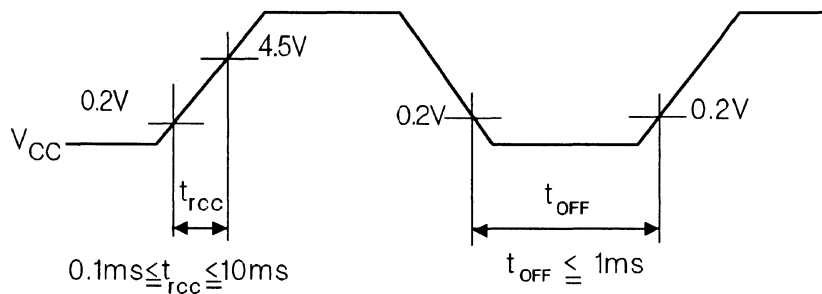
Higher 4bit / Lower 4bit	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
XXXX0000 (0)	☐		0	1	2	3	4	5	6	7	8	9	+	=	∅	∅
XXXX0001 (1)	+	!	1	A	a	9	-	∅	∅	∅	∅	∅	∅	∅	∅	∅
XXXX0010 (2)	2	#	2	B	b	r	=	T	T	∅	∅	∅	∅	∅	∅	∅
XXXX0011 (3)	3	#	3	C	c	s	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅
XXXX0100 (4)	4	#	4	D	d	t	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅
XXXX0101 (5)	5	#	5	E	e	u	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅
XXXX0110 (6)	6	#	6	F	f	v	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅
XXXX0111 (7)	7	#	7	G	g	w	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅
XXXX1000 (0)	∅	∅	∅	H	h	x	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅
XXXX1001 (1)	∅	∅	∅	I	i	v	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅
XXXX1010 (2)	∅	∅	∅	J	j	z	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅
XXXX1011 (3)	∅	∅	∅	K	k	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅
XXXX1100 (4)	∅	∅	∅	L	l	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅
XXXX1101 (5)	∅	∅	∅	M	m	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅
XXXX1110 (6)	∅	∅	∅	N	n	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅
XXXX1111 (7)	∅	∅	∅	O	o	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅

RESET FUNCTION

Upon reset, the module will automatically reset to its initial function.

At initial function, please start by using the following instructions.

- 1) Clear Display
(Note: Busy flag (BF) is active high - BF=1)
- 2) Function set up
DL = 1: Interface data length 8bits.
N = 0: 1 line display
F = 0: 5 x 7 dot
- 3) Display ON/OFF Control
D: = 0: Display OFF
C: = 0: Cursor OFF
B = 0: Intermittent OFF
- 4) Input Set Up Mode
I/D = 1: + 1 (inclement)
S = 0: Does Not Shift



t_{OFF} present instant or ON.OFF time.

(Remark) Unless above electrical condition are satisfied internal circuit will not operate properly.

APPLICATIONS

Personal computer, word processor, facsimile, telephone, etc., medical and other instrumentations.

- 1) Handling Instruction
 - a) Attention must be paid to avoid external shock, which will cause operations failure.
 - b) Polarizer on the surface is fragile and can easily be scratched and damaged. Therefore, please take extra care when handling. To clean surface of termination, please wipe off with alcohol.
 - c) The liquid used in the LCD panel is a harmful substance and must not be ingested. Avoid contact on exposed skin. If liquid is touched, wash thoroughly.
 - d) Do not expose to direct sunlight or fluorescent light for long periods of time. If it will be in direct sunlight, please use UV filter.
 - e) For storage please avoid high temperature/high humidity.
When long term storage is required, keep panels in low temperature (5°C ~ 25°C) and low humidity.
- 2) Operational Instructions
 - a) Do not connect or disconnect module while power is on.
 - b) Turn on module power before input of signal. Turn off input signal before turning off power to module. It can be damaged by "latch-up" phenomenon.
- 3) Mounting Instructions
 - a) Ground solder before using.
 - b) CMOS-IC requires caution in cases of potential ESD.
 - c) Do not remove panel from board.
- 4) Module Assembly Instructions
 - a) For mounting, use 4 holes on each corner and do not stress circuit.
 - b) To prevent contamination, scratches, or cuts on the polarizer, please use the protective cover on the front panel.

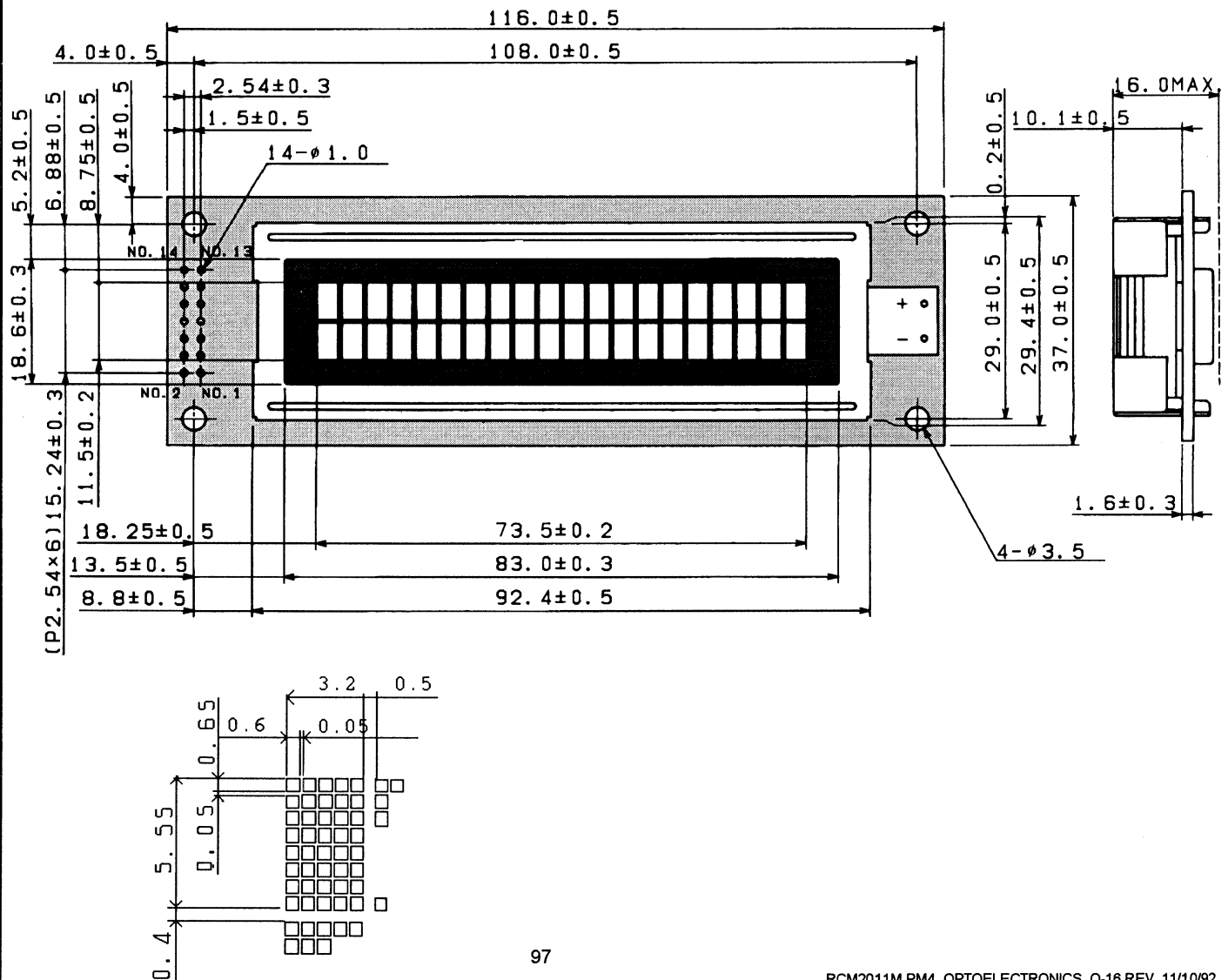
Character Type LCD Module

DESCRIPTION

RCM2011M is an LCD module with LSI controller/driver built in.

FEATURES

- 1) 20 Characters x 2 Rows with LED backlight.
- 2) Wide viewing angle, high contrast ratio.
- 3) 5 x 7 dot construction in each character, plus one line.
- 4) Can be interfaced with 4bit or 8bit MPU.
- 5) Displays 208 different types of international characters and symbols plus 32 different types of special characters and symbols.
- 6) With built in character generator RAM, any user-design pattern can be displayed.
- 7) Clear, easy to read display, with cursor on/off, and character blink. Simple instructions for various functions.
- 8) Compact and light weight, for easy assembly.
- 9) Can be driven by a 5V circuit.
- 10) Low power consumption.
- 11) Optional transmissive, transfective type with back light.



BLOCK DIAGRAM

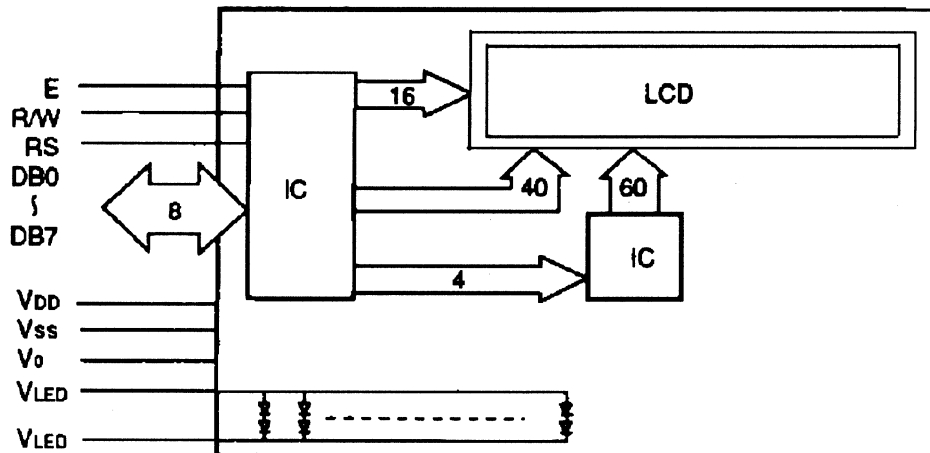


Fig. # 3, Block Diagram

INTERFACE PIN CONNECTION

Pin NO.	Symbol	Pin No.	Symbol
1	V_{SS}	8	DB 1
2	V_{DD}	9	DB 2
3	V_o	10	DB 3
4	RS	11	DB 4
5	R/W	12	DB 5
6	E	13	DB 6
7	DB_o	14	DB 7

DD RAM ADDRESS

	1	2	3	4	-	18	19	20
1 Line	00H	01H	02H	03H	—	11H	12H	13H
2 Line	40H	41H	42H	43H	—	51H	52H	53H

POWER SUPPLY SAMPLE CONNECTION

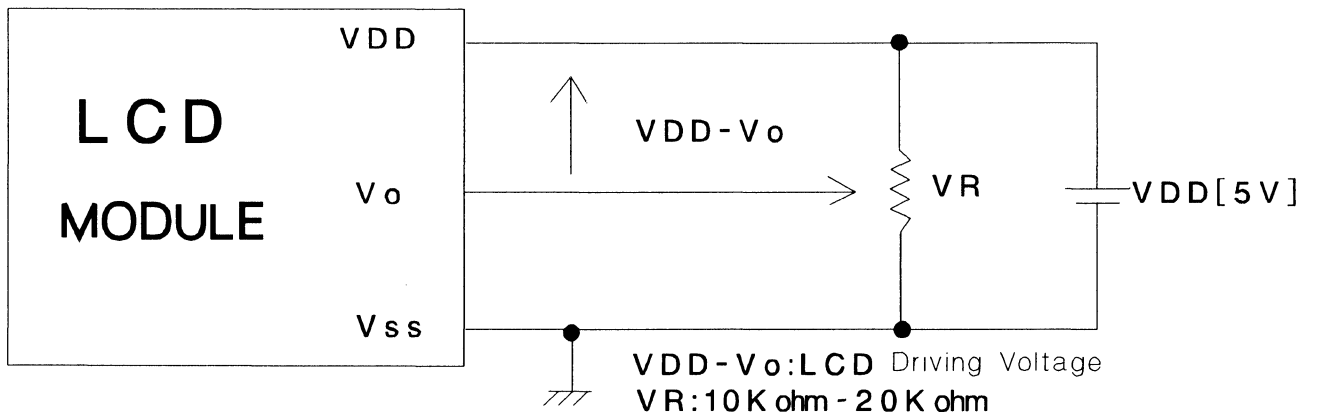
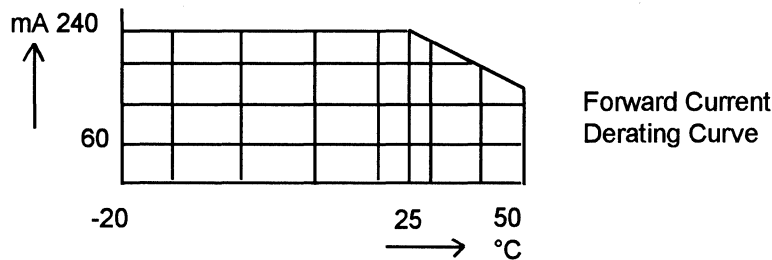


Fig. 4 Power Supply Sample Connection

ABSOLUTE MAXIMUM RATINGS

Items	Symbol	Min.	Max.	Unit
Supply Voltage for Logics	VDD-VSS	- 0.3	6.5	V
Supply Voltage for Driving LCD	VDD-V0	0	6.5	V
Input Voltage	VIN	- 0.3	VDD+0.3	V
Operating Temperature	T0Pr	0	50	°C
Storage Temperature	Tstg	- 20	70	°C
LED backlight DC forward current	IF		240	mA
LED backlight DC reverse voltage	VR		8	V



ELECTRICAL CHARACTERISTICS - VDD=5.0±5% Ta=25°C

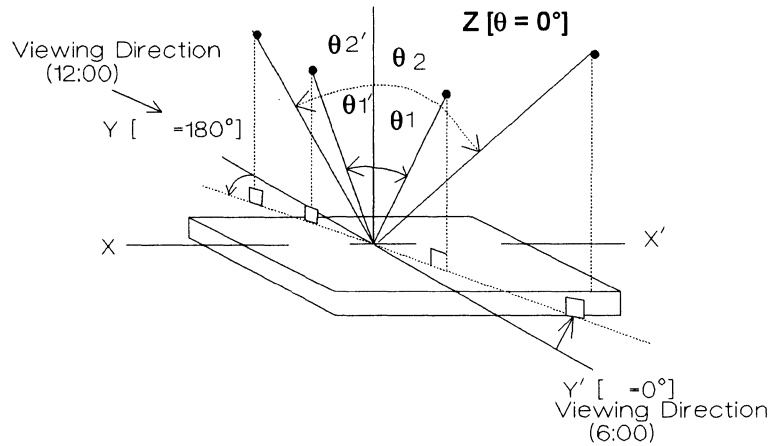
Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input High Level Voltage	VIH		2.0	-	-	V
Input Low Level Voltage	VIL		-	-	0.8	V
Output High Level Voltage	V0H	I0H = - 1.2 mA	2.4	-	-	V
Output Low Level Voltage	V0L	I0L = 2.0 mA	-	-	0.4	V
Power Supply Current	IDD	VDD=5V	-	2	3	mA
LED backlight forward voltage	VF	IF=120 mA	3.8	4.1	4.4	V
LED backlight reverse current	IR	VR=8V			1.2	mA

OPTICAL CHARACTERISTICS Ta=25°C

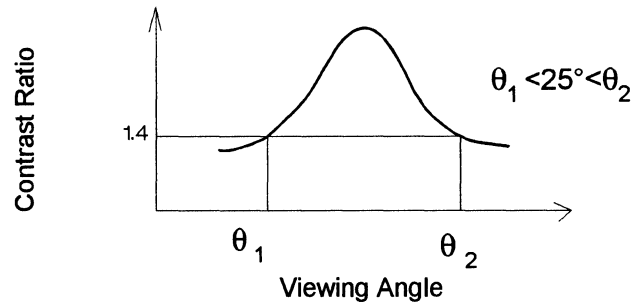
Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
t rise time	tr	$\theta = 10^\circ \phi = 0^\circ$	-	100	250	ms
t fall time	td	$\theta = 10^\circ \phi = 0^\circ$	-	150	250	ms
Contrast Ratio	K	$\theta = 10^\circ \phi = 0^\circ$	-	3		
Viewing Angle	$\theta 1$	$K \geq 1.4 -$			20	degree
	$\theta 2$	$\phi = 0^\circ$	40		-	degree
	ϕ	$K \geq 1.4$ $\theta = 20^\circ$	± 30	-	-	degree
LED backlight peak wave length	λp	IF=120		567		nm
LED backlight spectral half width	$\Delta\lambda$	IF=120		30		nm

OPTICAL CHARACTERISTICS

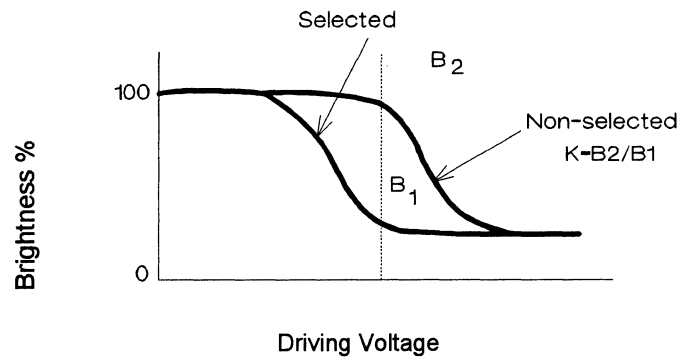
1) Definition of θ and ϕ



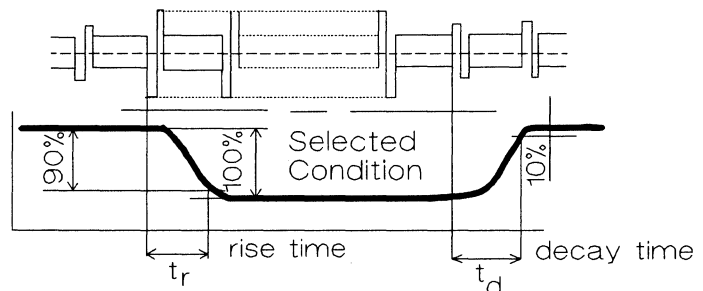
2) Definition of viewing angle θ_1 and θ_2



3) Definition of contrast ratio "K"



4) Definition of optical response time



OPERATION

(1) Writing

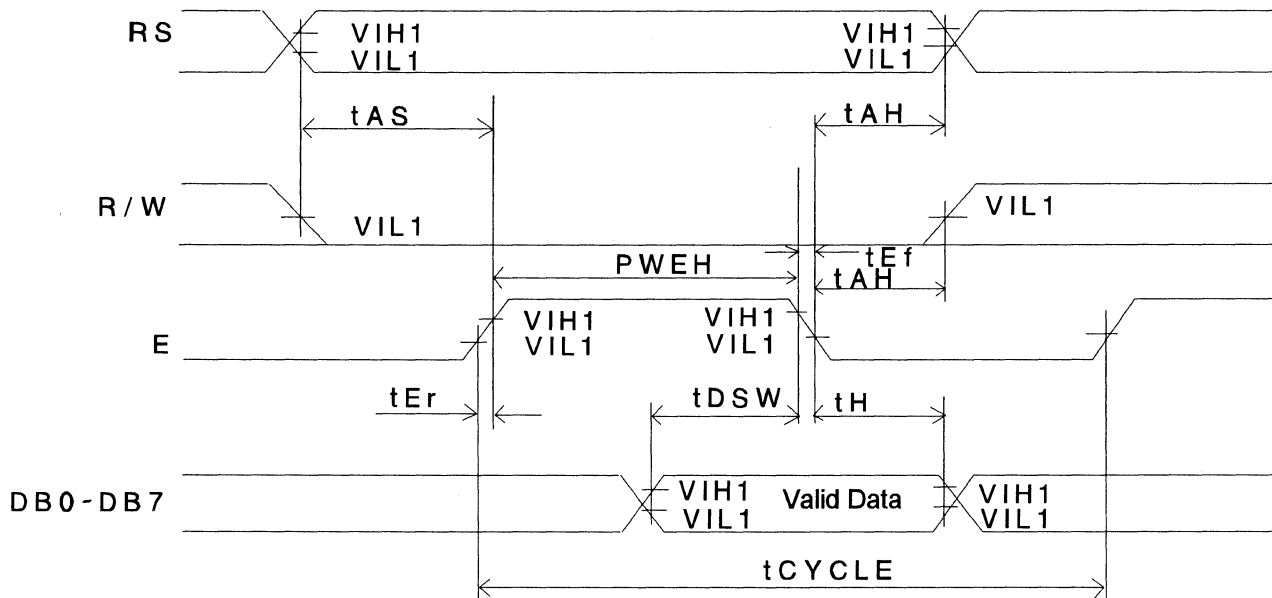


Fig. 5 Writing

Item	Symbol	Test Condition	Min.	Max.	Unit
Enable Cycle Time	tCYCE	Fig. 5	500	-	μ sec
Enable Pulse Time	PWE	Fig. 5	220	-	n sec
Enable Rise Time	tEr, tEf	Fig. 5	-	20	n sec
Enable Decay Time					
Address Set-Up Time	tAS	Fig. 5	40	-	n sec
Address Hold Time	tAH	Fig. 5	10	-	n sec
Data Set-Up Time	tDSW	Fig. 5	60	-	n sec
Data Hold Time	tH	Fig. 5	10	-	n sec

(2) Reading

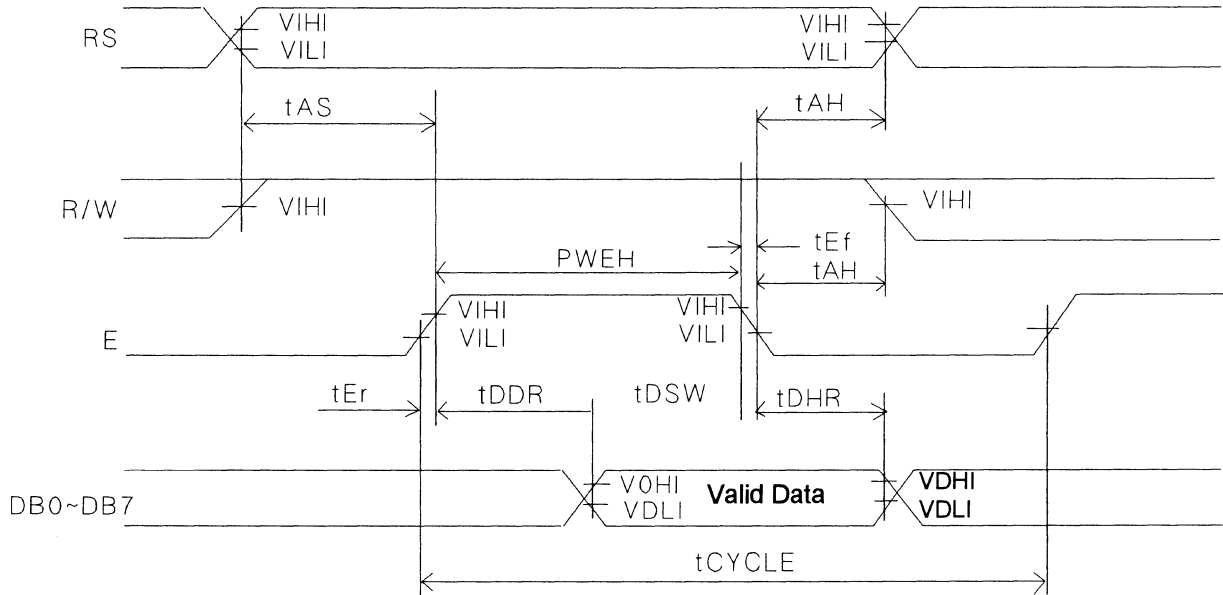


Fig. 6 Reading

Item	Symbol	Test Conditions	Min.	Max.	Unit
Enable Cycle Time	tCYCE	Fig. 6	1.0	-	μ sec
Enable Pulse Time	PWEH	Fig. 6	450	-	n sec
Enable Rise Time	tEr, tEf	Fig. 6	-	25	n sec
Enable Decay Time					
Address Set-Up Time	tAS	Fig. 6	140	-	n sec
Address Hold Time	tAH	Fig. 6	10	-	n sec
Data Delay Time	tDDR	Fig. 6	-	320	n sec
Data Hold Time	tDHR	Fig. 6	20	-	n sec

PIN FUNCTION

Symbol	Level	Input/ Output Power	Function
VSS	——	——	Power Voltage
VDD	——	——	
VO	——	——	
RS	H/L	Input	Register select signal 0: Instruction register (write) Busy flag address counter (read) 1: Data register (read/write)
R/W	H/L	Input	Read (R) Write (W) Select signal "0": Write MPU → LCD module "1": Read MPU ← LCD module
E	H, H → L	Input	Signal to start read or write data.
DB0 DB3	H/L	Input output power	Lower level 4 lines data bus are used to transfer data between MPU and module. When operated with 4bits, this function does not work.
DB4 DB7	H/L	Input output power	Upper level 4 lines data bus are used to transfer data between MPU and module.

REMARK:

This module can be interfaced with both 4 or 8bit MPU.
 Data transmission can either be sent in 2 parts at 4bits or once at 8bits.

- (1) If interface data is 4bits, data transmission is DB4~DB7, using 4bus, and the DB0~DB3 bus is not used.

Data transmission between module and MPU will end after two transmissions.

Upper 4bits of data (Interface data length is at 8bits when contents are DB4~DB7) is transmitted, then lower 4bit is sent (interface data length is at 8bits contents are DB0~DB3).

- (2) When interface data is 8bits, data DB0~DB7, data is transmitted by using data bus.

Character Type LCD Module

RCM2011M

INSTRUCTION		Code										Description	Execution Time (f=250kHz)
Instruction	RS	RW	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 0) after entire display is cleared	1.64 ms
Cursor at Home	0	0	0	0	0	0	0	0	1	*		Cursor is returned to home position (address 0). Shifted display is also returned to the original position. Contents of DDRAM are not changed.	1.64 ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S		Cursor advance direction and display shift are set. These operations are performed during data write and read modes.	40 μs
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.	40 μs
Cursor/Display Shift	0	0	0	0	0	1	S/C	R/L	*	*		Cursor and display are shifted without changing the contents of DDRAM	40 μs
Function Set	0	0	0	0	1	DL	N	F	*	*		Interface data length (DL), number of display lines (N), and character font (F) are set.	40 μs
CGRAM Address Set	0	0	0	1	ACG							CGRAM address is set. Transmitted and received after this is the data of CGRAM.	40 μs
DDRAM Address Set	0	0	0	ADD							DDRAM address is set. Transmitted and received after this is the data of DDRAM.	40 μs	
Busy Flag/address read	0	1	BF	AC							Busy flag (BF) showing internal operation and contents of address counter are read.	0 μs	
CGRAM/DDRAM Data Write	1	0	Write Data							Data is written in DDRAM or CGRAM.	46 μs		
CGRAM/DDRAM Data Read	1	1	Read Data							Data is read out of DDRAM or CGRAM.	46 μs		
	I/D = 1: Increment (+1) I/D = 0: Decrement (-1) 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 N = 1: 2 lines N = 0: 1 line F = 1: 5x10 dots F = 0: 5x7 dots BF = 1: Internal operation is being performed BF = 0: Instruction acceptable										DDRAM: Display Data RAM CGRAM: Character Generator RAM ACG: Address of CGRAM ADD: Address of DDRAM. These correspond to cursor addresses AC: Address counter used for both DDRAM and CGRAM	Execution time changes with change in internal oscillation frequency (fosc).	

CHARACTER CODE AND PATTERN TABLE

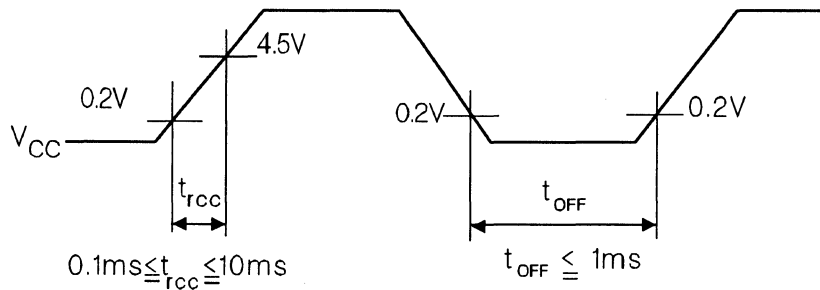
Higher 4bit \ Lower 4bit	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
XXXX0000	CGRAM (0)															
XXXX0001	(1)															
XXXX0010	(2)															
XXXX0011	(3)															
XXXX0100	(4)															
XXXX0101	(5)															
XXXX0110	(6)									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

RESET FUNCTION

Upon reset, the module will automatically reset to its initial function.

At initial function, please start by using the following instructions.

- 1) Clear Display
(Note: Busy flag (BF) is active high - BF=1)
- 2) Function set up
DL = 1: Interface data length 8bits.
N = 0: 1 line display
F = 0: 5 x 7 dot
- 3) Display ON/OFF Control
D: = 0: Display OFF
C: = 0: Cursor OFF
B = 0: Intermittent OFF
- 4) Input Set Up Mode
I/D = 1: + 1 (inclement)
S = 0: Does Not Shift



t_{OFF} present instant or ON.OFF time.
(Remark) Unless above electrical condition are satisfied internal circuit will not operate properly.

APPLICATIONS

Personal computer, word processor, facsimile, telephone, etc., medical and other instrumentations.

- 1) Handling Instruction
 - a) Attention must be paid to avoid external shock, which will cause operations failure.
 - b) Polarizer on the surface is fragile and can easily be scratched and damaged. Therefore, please take extra care when handling. To clean surface of termination, please wipe off with alcohol.
 - c) The liquid used in the LCD panel is a harmful substance and must not be ingested. Avoid contact on exposed skin. If liquid is touched, wash thoroughly.
 - d) Do not expose to direct sunlight or fluorescent light for long periods of time. If it will be in direct sunlight, please use UV filter.
 - e) For storage please avoid high temperature/high humidity.
When long term storage is required, keep panels in low temperature (5°C ~ 25°C) and low humidity.
- 2) Operational Instructions
 - a) Do not connect or disconnect module while power is on.
 - b) Turn on module power before input of signal. Turn off input signal before turning off power to module. It can be damaged by "latch-up" phenomenon.
- 3) Mounting Instructions
 - a) Ground solder before using.
 - b) CMOS-IC requires caution in cases of potential ESD.
 - c) Do not remove panel from board.
- 4) Module Assembly Instructions
 - a) For mounting, use 4 holes on each corner and do not stress circuit.
 - b) To prevent contamination, scratches, or cuts on the polarizer, please use the protective cover on the front panel.

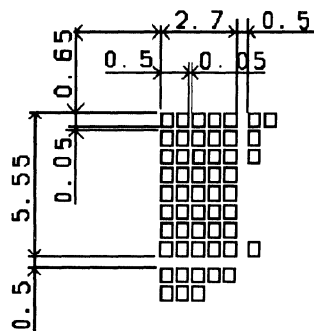
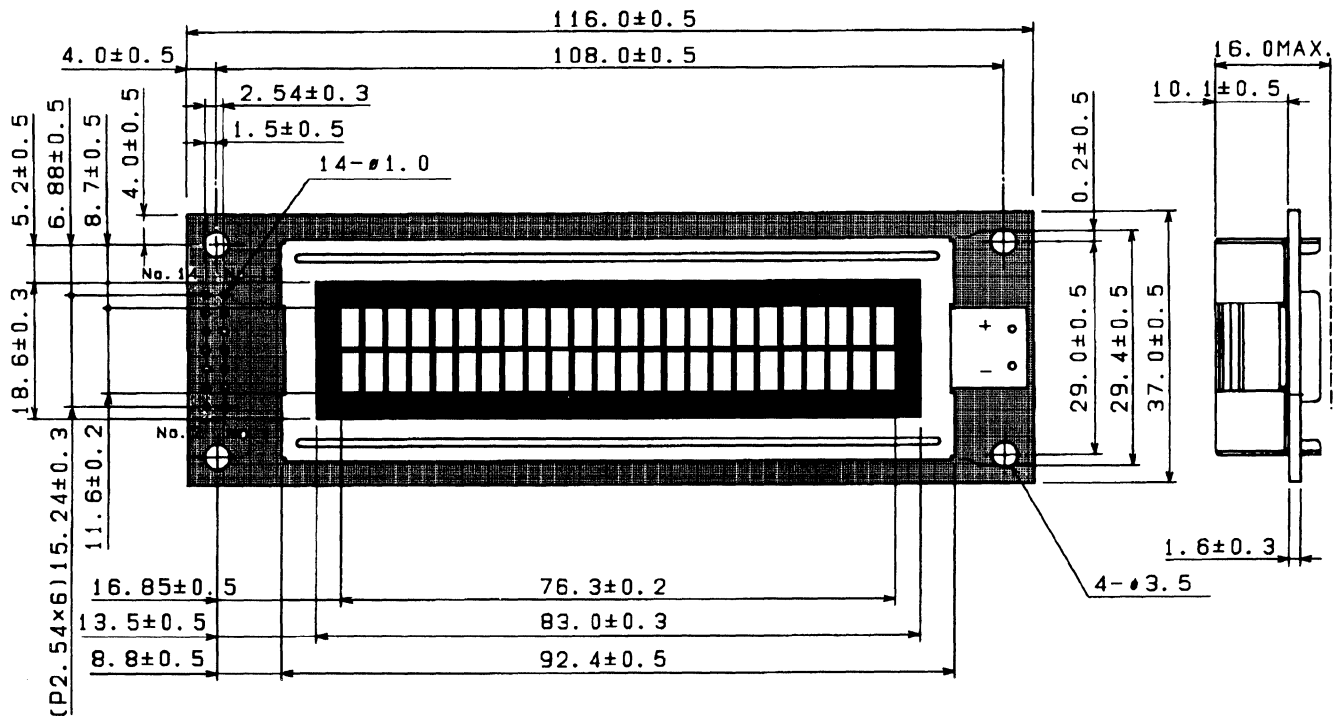
Character Type LCD Module

DESCRIPTION

RCM2029M is an LCD module with LSI controller/driver built in.

FEATURES

- 1) 24 Characters x 2 Rows, with LED back light.
- 2) Wide viewing angle, high contrast ratio.
- 3) 5 x 7 dot construction in each character, plus one line.
- 4) Can be interfaced with 4bit or 8bit MPU.
- 5) Displays 208 different types of international characters and symbols plus 32 different types of special characters and symbols.
- 6) With built in character generator RAM, any user-design pattern can be displayed.
- 7) Clear, easy to read display, with cursor on/off, and character blink. Simple instructions for various functions.
- 8) Compact and light weight, for easy assembly.
- 9) Can be driven by a 5V circuit.
- 10) Low power consumption LED backlight is built in.



BLOCK DIAGRAM

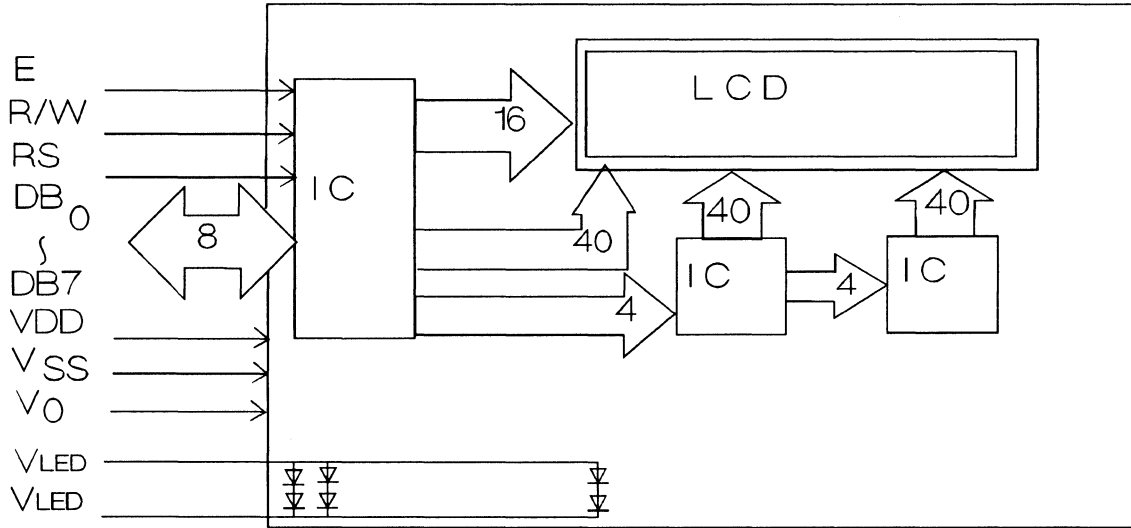


Fig. # 3, Block Diagram

INTERFACE PIN CONNECTION

Pin NO.	Symbol	Pin No.	Symbol
1	V _{SS}	8	DB 1
2	V _{DD}	9	DB 2
3	V _O	10	DB 3
4	RS	11	DB 4
5	R/W	12	DB 5
6	E	13	DB 6
7	DB ₀	14	DB 7

DD RAM ADDRESS

	1	2	3	4	-	22	23	24
1 Line	00H	01H	02H	03H	---	15H	16H	17H
2 Line	40H	41H	42H	43H	---	55H	56H	57H

POWER SUPPLY SAMPLE CONNECTION

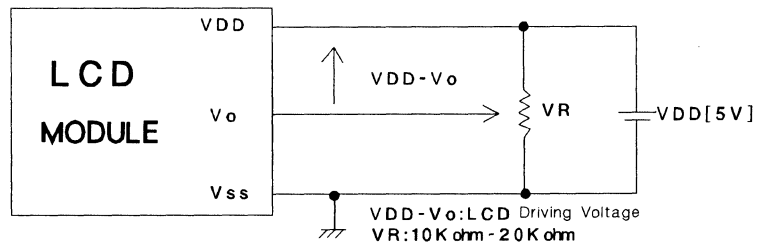
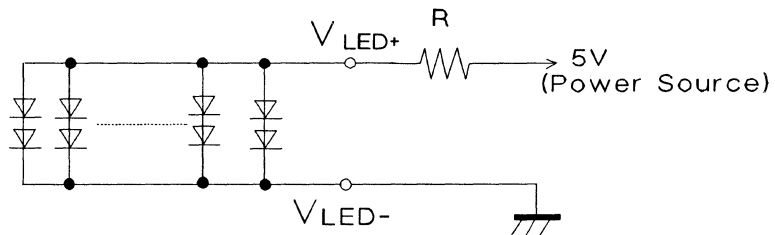


Fig. 4 Power Supply Sample Connection

BACKLIGHT POWER SOURCE CONNECTING SAMPLE



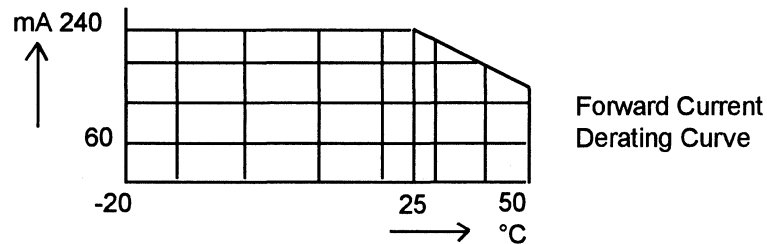
Current control resistor R for backlight should be built in between 5V (Power Source) and backlight electrode VLED+.

Character Type LCD Module

RCM2029M

ABSOLUTE MAXIMUM RATINGS

Items	Symbol	Min.	Max.	Unit
Supply Voltage for Logics	VDD-VSS	- 0.3	6.5	V
Supply Voltage for Driving LCD	VDD-V0	0	6.5	V
Input Voltage	VIN	- 0.3	VDD+0.3	V
Operating Temperature	T0Pr	0	50	°C
Storage Temperature	Tstg	- 20	70	°C
LED backlight DC forward current	IF		240	mA
LED backlight DC reverse voltage	VR		8	V



ELECTRICAL CHARACTERISTICS - VDD=5.0 ± 5% Ta=25°C

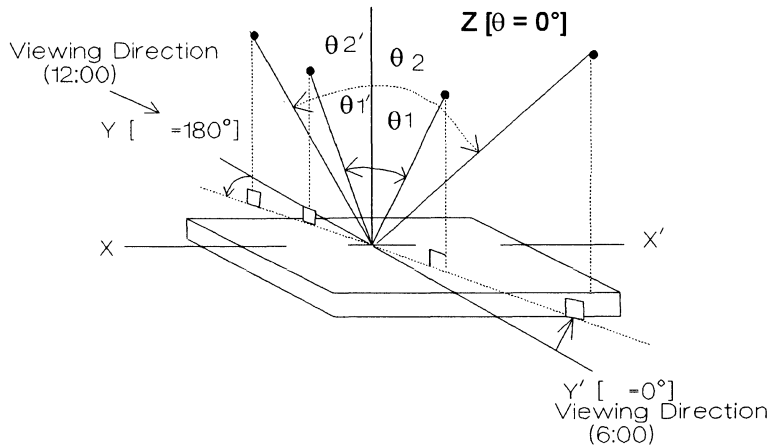
Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input High Level Voltage	VIH		2.0	-	-	V
Input Low Level Voltage	VIL		-	-	0.8	V
Output High Level Voltage	V0H	I 0H = - 1.2 mA	2.4	-	-	V
Output Low Level Voltage	V0L	I 0L = 2.0 mA	-	-	0.4	V
Power Supply Current	IDD	VDD=5V	-	2	3	mA
LED backlight forward voltage	VF	IF=120 mA	3.8	4.1	4.4	V
LED backlight reverse current	IR	VR=8V			1.2	mA

OPTICAL CHARACTERISTICS Ta=25°C

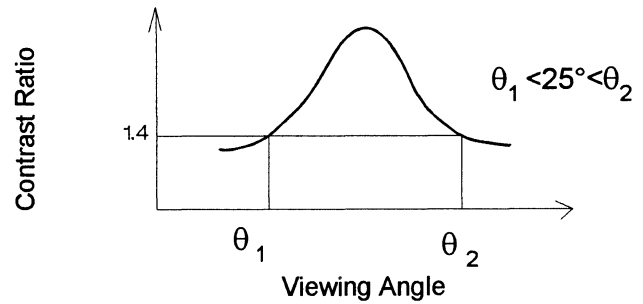
Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
t rise time	tr	$\theta = 10^\circ \phi = 0^\circ$	-	100	250	ms
t fall time	td	$\theta = 10^\circ \phi = 0^\circ$	-	150	250	ms
Contrast Ratio	K	$\theta = 10^\circ \phi = 0^\circ$	-	3		
Viewing Angle	$\theta 1$	K ≥ 1.4 $\phi = 0^\circ$	-		20	degree
	$\theta 2$			40	-	degree
	ϕ	K ≥ 1.4 $\theta = 20^\circ$	± 30	-	-	degree
LED backlight peak wave length	λp	IF=120		567		nm
LED backlight spectral half width	$\Delta\lambda$	IF=120		30		nm

OPTICAL CHARACTERISTICS

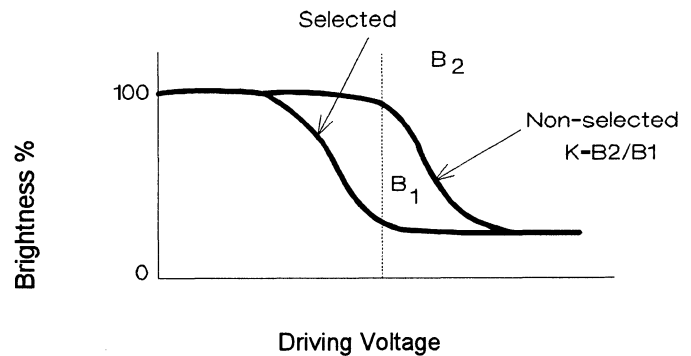
1) Definition of θ and ϕ



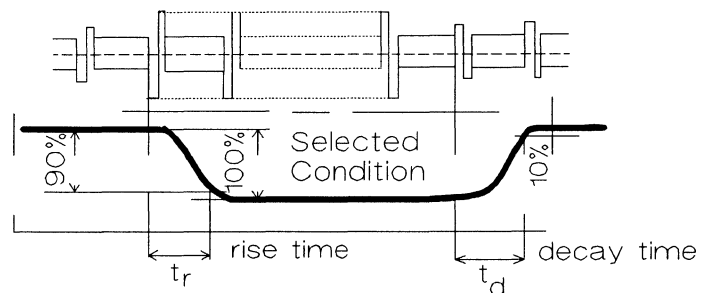
2) Definition of viewing angle θ_1 and θ_2



3) Definition of contrast ratio "K"



4) Definition of optical response time



OPERATION

(1) Writing

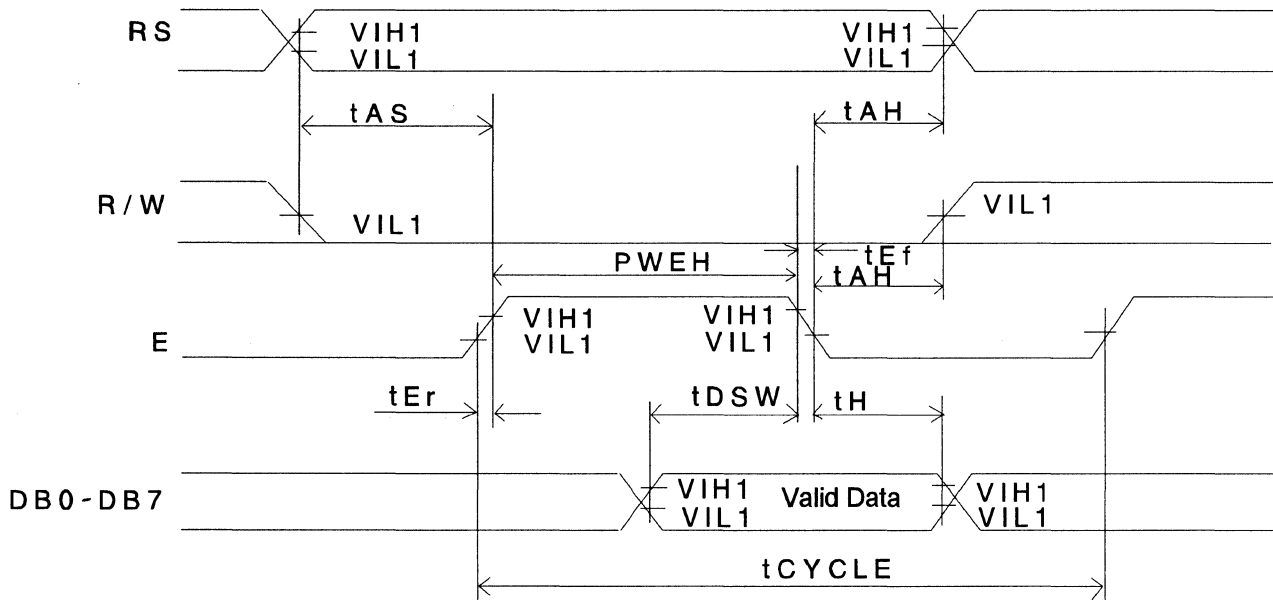


Fig. 5 Writing

Item	Symbol	Test Condition	Min.	Max.	Unit
Enable Cycle Time	t_{CYCE}	Fig. 5	500	-	n sec
Enable Pulse Time	PWE	Fig. 5	220	-	n sec
Enable Rise Time	t_{Er}, t_{Ef}	Fig. 5	-	20	n sec
Enable Decay Time					
Address Set-Up Time	t_{AS}	Fig. 5	40	-	n sec
Address Hold Time	t_{AH}	Fig. 5	10	-	n sec
Data Set-Up Time	t_{DSW}	Fig. 5	60	-	n sec
Data Hold Time	t_H	Fig. 5	10	-	n sec

(2) Reading

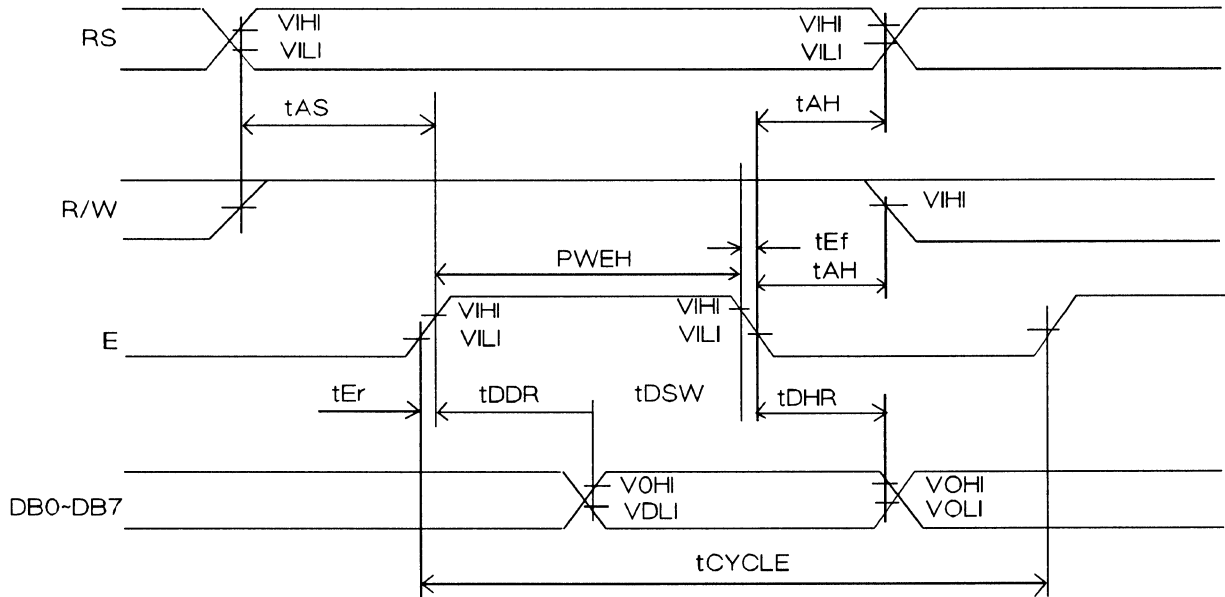


Fig. 6 Reading

Item	Symbol	Test Conditions	Min.	Max.	Unit
Enable Cycle Time	tCYCE	Fig. 6	500	-	n sec
Enable Pulse Time	PWEH	Fig. 6	220	-	n sec
Enable Rise Time	tEr, tEf	Fig. 6	-	20	n sec
Enable Decay Time					
Address Set-Up Time	tAS	Fig. 6	40	-	n sec
Address Hold Time	tAH	Fig. 6	10	-	n sec
Data Delay Time	tDDR	Fig. 6	-	120	n sec
Data Hold Time	tDHR	Fig. 6	20	-	n sec

PIN FUNCTION

Symbol	Level	Input/ Output Power	Function
VSS	———	———	GND : OV +5V Power Voltage
VDD	———	———	
VO	———	———	
RS	H/L	Input	Register select signal 0: Instruction register (write) Busy flag address counter (read) 1: Data register (read/write)
R/W	H/L	Input	Read (R) Write (W) Select signal "0": Write MPU → LCD module "1": Read MPU ← LCD module
E	H, H → L	Input	Signal to start read or write data.
DB0 DB3	H/L	Input output power	Lower level 4 lines data bus are used to transfer data between MPU and module. When operated with 4bits, this function does not work.
DB4 DB7	H/L	Input output power	Upper level 4 lines data bus are used to transfer data between MPU and module.

REMARK:

This module can be interfaced with both 4 or 8bit MPU.
Data transmission can either be sent in 2 parts at 4bits or once at 8bits.

- (1) If interface data is 4bits, data transmission is DB4~DB7, using 4bus, and the DB0~DB3 bus is not used.

Data transmission between module and MPU will end after two transmissions.

Upper 4bits of data (Interface data length is at 8bits when contents are DB4~DB7) is transmitted, then lower 4bit is sent (interface data length is at 8bits contents are DB0~DB3).

- (2) When interface data is 8bits, data DB0~DB7, data is transmitted by using data bus.

Character Type LCD Module

RCM2029M

INSTRUCTION											Description	Execution Time (f=250kHz)
Instruction	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 0) after entire display is cleared	1.64 ms
Cursor at Home	0	0	0	0	0	0	0	0	1	*	Cursor is returned to home position (address 0). Shifted display is also returned to the original position. Contents of DDRAM are not changed.	1.64 ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Cursor advance direction and display shift are set. These operations are performed during data write and read modes.	40 μs
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.	40 μs
Cursor/Display Shift	0	0	0	0	0	1	S/C	R/L	*	*	Cursor and display are shifted without changing the contents of DDRAM	40 μs
Function Set	0	0	0	0	1	DL	N	F	*	*	Interface data length (DL), number of display lines (N), and character font (F) are set.	40 μs
CGRAM Address Set	0	0	0	1	ACG					CGRAM address is set. Transmitted and received after this is the data of CGRAM.		40 μs
DDRAM Address Set	0	0	0	ADD					DDRAM address is set. Transmitted and received after this is the data of DDRAM.		40 μs	
Busy Flag/address read	0	1	BF	AC					Busy flag (BF) showing internal operation and contents of address counter are read.		0 μs	
CGRAM/DDRAM Data Write	1	0	Write Data					Data is written in DDRAM or CGRAM.		46 μs		
CGRAM/DDRAM Data Read	1	1	Read Data					Data is read out of DDRAM or CGRAM.		46 μs		
	I/D = 1: Increment (+1) I/D = 0: Decrement (-1) 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 N = 1: 2 lines N = 0: 1 line F = 1: 5x10 dots F = 0: 5x7 dots BF = 1: Internal operation is being performed BF = 0: Instruction acceptable										DDRAM: Display Data RAM CGRAM: Character Generator RAM ACG: Address of CGRAM ADD: Address of DDRAM. These correspond to cursor addresses AC: Address counter used for both DDRAM and CGRAM	Execution time changes with change in internal oscillation frequency (fosc).

CHARACTER CODE AND PATTERN TABLE

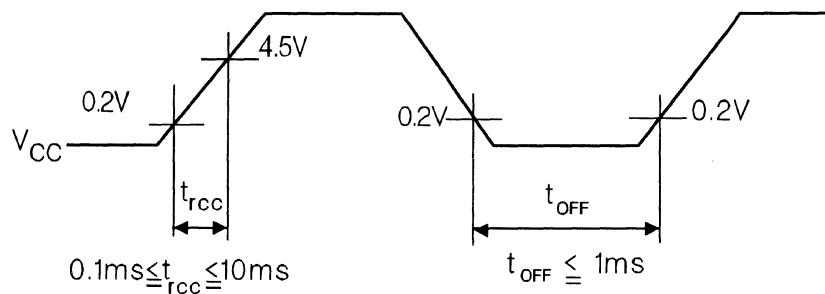
Higher 4bit / Lower 4bit	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
XXXX0000	CGRAM (0)															
XXXX0001	(1)															
XXXX0010	(2)															
XXXX0011	(3)															
XXXX0100	(4)															
XXXX0101	(5)															
XXXX0110	(6)									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

RESET FUNCTION

Upon reset, the module will automatically reset to its initial function.

At initial function, please start by using the following instructions.

- 1) Clear Display
(Note: Busy flag (BF) is active high - BF=1)
- 2) Function set up
DL = 1: Interface data length 8bits.
N = 0: 1 line display
F = 0: 5 x 7 dot
- 3) Display ON/OFF Control
D: = 0: Display OFF
C: = 0: Cursor OFF
B = 0: Intermittent OFF
- 4) Input Set Up Mode
I/D = 1: + 1 (inclement)
S = 0: Does Not Shift



t_{OFF} present instant or ON.OFF time.

(Remark) Unless above electrical condition are satisfied internal circuit will not operate properly.

APPLICATIONS

Personal computer, word processor, facsimile, telephone, etc., medical and other instrumentations.

1) Handling Instructions

- a) Attention must be paid to avoid external shock, which will cause operational failure.
- b) Polarizer on the surface is fragile and can easily be scratched and damaged. Therefore, please take extra care when handling. To clean surface of termination, please wipe off with alcohol.
- c) The liquid used in the LCD panel is a harmful substance and must not be ingested. Avoid contact on exposed skin. If liquid is touched, wash thoroughly.
- d) Do not expose to direct sunlight or fluorescent light for long periods of time. If it will be in direct sunlight, please use UV filter.
- e) For storage please avoid high temperature/high humidity. When long term storage is required, keep panels in low temperature (5°C ~ 25°C) and low humidity.

2) Operational Instructions

- a) Do not connect or disconnect module while power is on.
- b) Turn on module power before input of signal. Turn off input signal before turning off power to module. It can be damaged by "latch-up" phenomenon.

3) Mounting Instructions

- a) Ground solder before using.
- b) CMOS-IC requires caution in cases of potential ESD.
- c) Do not remove panel from board.

4) Module Assembly Instructions

- a) For mounting, use 4 holes on each corner and do not stress circuit.
- b) To prevent contamination, scratches, or cuts on the polarizer, please use the protective cover on the front panel.

BLOCK DIAGRAM

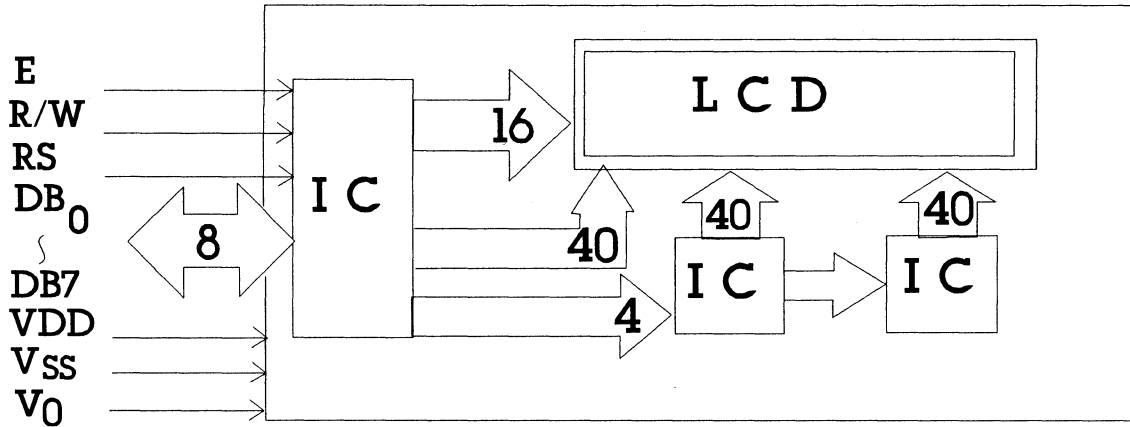


Fig. # 3, Block Diagram

INTERFACE PIN CONNECTION

Pin NO.	Symbol	Pin No.	Symbol
1	V_{SS}	8	DB 1
2	V_{DD}	9	DB 2
3	V_o	10	DB 3
4	RS	11	DB 4
5	R/W	12	DB 5
6	E	13	DB 6
7	DB _o	14	DB 7

DD RAM ADDRESS

	1	2	3	4	-	23	24	
1 Line	00H	01H	02H	03H	---	15H	16H	17H
2 Line	40H	41H	42H	43H	---	55H	56H	57H

POWER SUPPLY SAMPLE CONNECTION

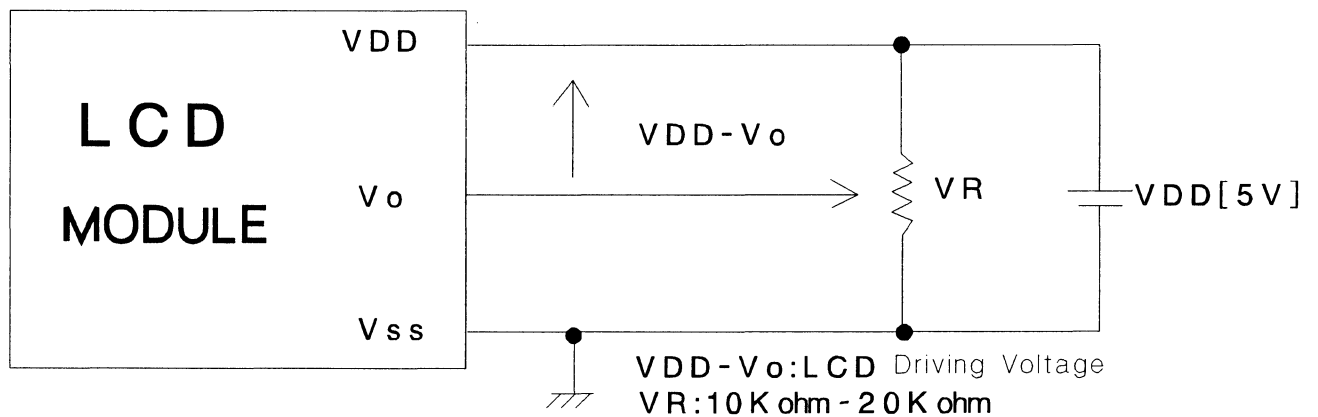


Fig. 4 Power Supply Sample Connection

ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

Items	Symbol	Min.	Max.	Unit
Supply Voltage for Logics	VDD-VSS	- 0.3	6.5	V
Supply Voltage for Driving LCD	VDD-V0	0	6.5	V
Input Voltage	VIN	- 0.3	VDD+0.3	V
Operating Temperature	T0P	0	50	°C
Storage Temperature	Tstg	- 20	70	°C

ELECTRICAL CHARACTERISTICS (VDD=5.0 ± 5% Ta=25°C)

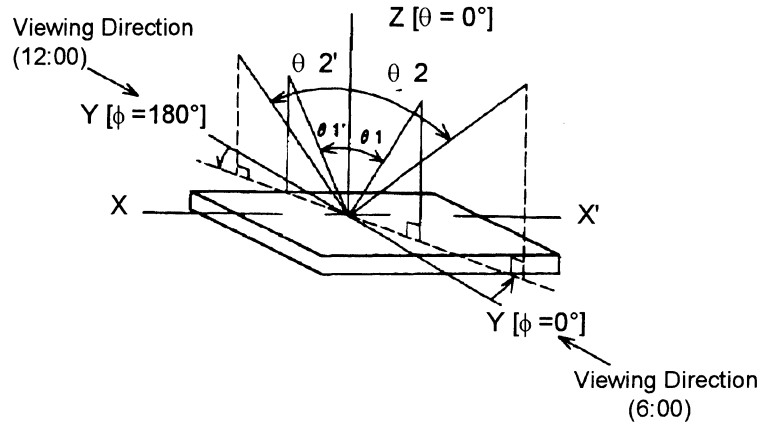
Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input High Level Voltage	VIH		2.0	-	-	V
Input Low Level Voltage	VIL		-	-	0.8	V
Output High Level Voltage	V0H	I 0H= - 1.2mA	2.4	-	-	V
Output Low Level Voltage	V0L	I 0L=2.0mA	-	-	0.4	V
Power Supply Current	IDD	VDD=5V	-	2	3	mA

OPTICAL CHARACTERISTICS (Ta=25°C)

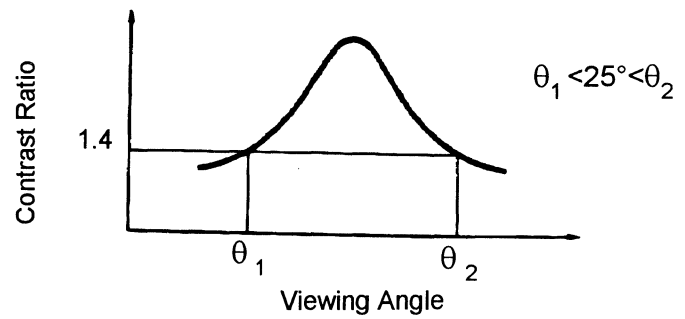
Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
t rise time	tr	$\theta = 10^\circ$ $\phi = 0^\circ$	-	100	250	ms
t fall time	td	$\theta = 10^\circ$ $\phi = 0^\circ$	-	150	250	ms
Contrast Ratio	K	$\theta = 10^\circ$ $\phi = 0^\circ$	-	3		
Viewing Angle	$\theta 1$	$K \geq 1.4$	-	-	20	degree
	$\theta 2$	$\phi = 0^\circ$	40	-	-	degree
	ϕ	$K \geq 1.4$ $\theta = 20^\circ$	± 30	-	-	degree

OPTICAL CHARACTERISTICS

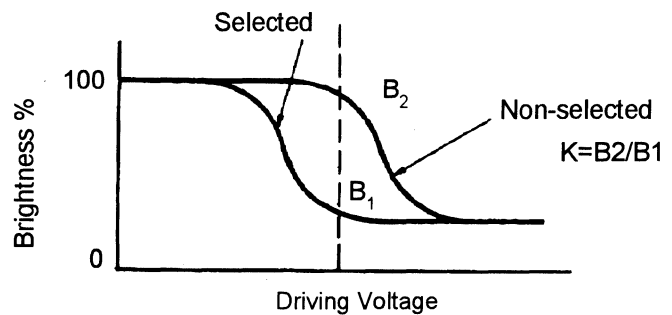
1) Definition of θ and ϕ



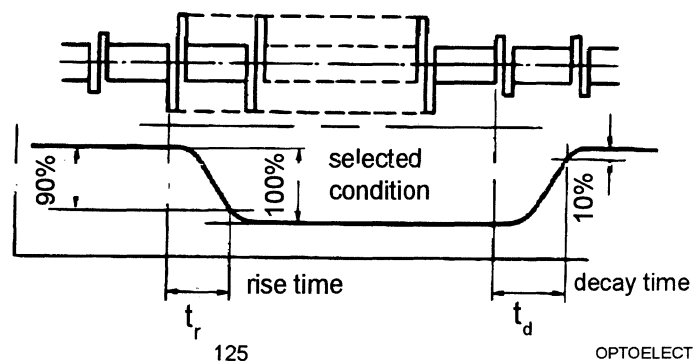
2) Definition of viewing angle $\theta 1$ and $\theta 2$



3) Definition of contrast ratio "K"



4) Definition of optical response time



OPERATION

(1) Writing

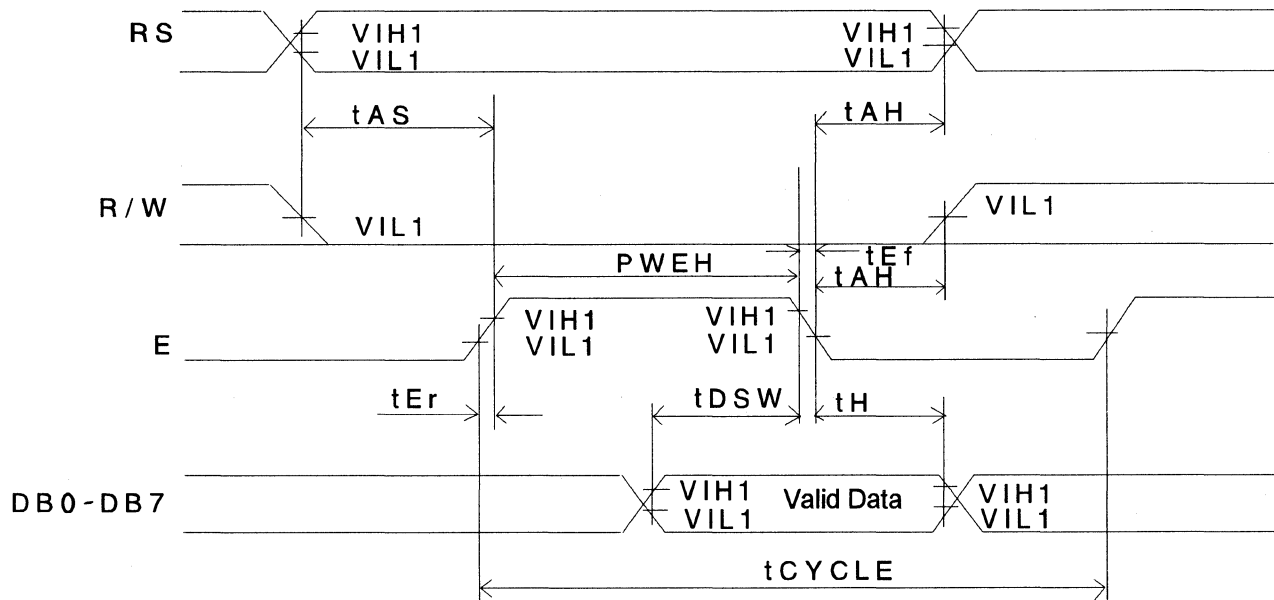


Fig. 5 Writing

Item	Symbol	Test Condition	Min.	Max.	Unit
Enable Cycle Time	tCYCE	Fig. 5	500	-	n sec
Enable Pulse Time	PWE	Fig. 5	220	-	n sec
Enable Rise Time	tEr, tEf	Fig. 5	-	20	n sec
Enable Decay Time					
Address Set-Up Time	tAS	Fig. 5	40	-	n sec
Address Hold Time	tAH	Fig. 5	10	-	n sec
Data Set-Up Time	tDSW	Fig. 5	60	-	n sec
Data Hold Time	tH	Fig. 5	10	-	n sec

(2) Reading

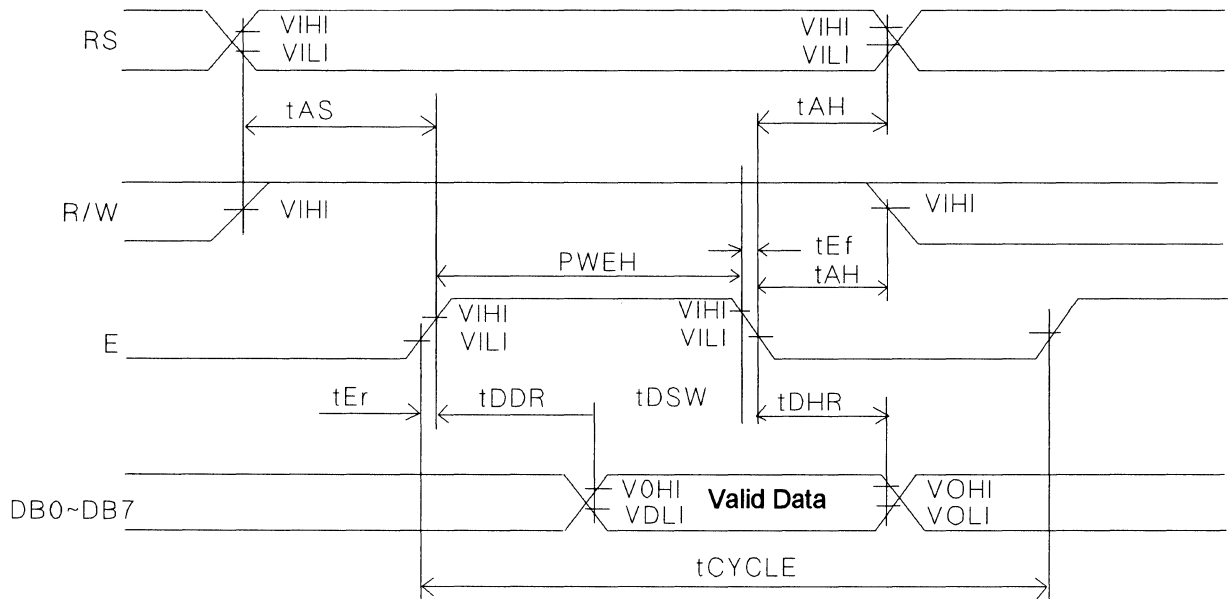


Fig. 6 Reading

Item	Symbol	Test Conditions	Min.	Max.	Unit
Enable Cycle Time	tCYCE	Fig. 6	500	-	n sec
Enable Pulse Time	PWEH	Fig. 6	220	-	n sec
Enable Rise Time	tEr, tEf	Fig. 6	-	20	n sec
Enable Decay Time					
Address Set-Up Time	tAS	Fig. 6	40	-	n sec
Address Hold Time	tAH	Fig. 6	10	-	n sec
Data Delay Time	tDDR	Fig. 6	-	120	n sec
Data Hold Time	tDHR	Fig. 6	20	-	n sec

PIN FUNCTION

Symbol	Level	Input/ Output Power	Function
VSS	———	———	GND : 0V +5V Power Voltage
VDD	———	———	
VO	———	———	
RS	H/L	Input	Register select signal 0: Instruction register (write) Busy flag address counter (read) 1: Data register (read/write)
R/W	H/L	Input	Read (R) Write (W) Select signal "0": Write MPU → LCD module "1": Read MPU ← LCD module
E	H, H → L	Input	Signal to start read or write data.
DB0 DB3	H/L	Input output power	Lower level 4 lines data bus are used to transfer data between MPU and module. When operated with 4bits, this function does not work.
DB4 DB7	H/L	Input output power	Upper level 4 lines data bus are used to transfer data between MPU and module.

REMARK:

This module can be interfaced with both 4 or 8bit MPU.
Data transmission can either be sent in 2 parts at 4bits or once at 8bits.

- (1) If interface data is 4bits, data transmission is DB4~DB7, using 4bus, and the DB0~DB3 bus is not used.

Data transmission between module and MPU will end after two transmissions.

Upper 4bits of data (Interface data length is at 8bits when contents are DB4~DB7) is transmitted, then lower 4bit is sent (interface data length is at 8bits contents are DB0~DB3).

- (2) When interface data is 8bits, data DB0~DB7, data is transmitted by using data bus.

Character Type LCD Module

RCM2030R

INSTRUCTION		Code										Description	Execution Time (f=250kHz)
Instruction	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0			
Clear Display	0	0	0	0	0	0	0	0	0	0	1	Cursor is returned to home position (address 0) after entire display is cleared	1.64 ms
Cursor at Home	0	0	0	0	0	0	0	0	0	1	*	Cursor is returned to home position (address 0). Shifted display is also returned to the original position. Contents of DDRAM are not changed.	1.64 ms
Entry Mode Set	0	0	0	0	0	0	0	0	1	I/D	S	Cursor advance direction and display shift are set. These operations are performed during data write and read modes.	40 μs
Display ON/OFF Control	0	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.	40 μs
Cursor/Display Shift	0	0	0	0	0	0	1	S/C	R/L	*	*	Cursor and display are shifted without changing the contents of DDRAM	40 μs
Function Set	0	0	0	0	1	DL	N	F	*	*		Interface data length (DL), number of display lines (N), and character font (F) are set.	40 μs
CGRAM Address Set	0	0	0	1	ACG							CGRAM address is set. Transmitted and received after this is the data of CGRAM.	40 μs
DDRAM Address Set	0	0	1	ADD							DDRAM address is set. Transmitted and received after this is the data of DDRAM.	40 μs	
Busy Flag/address read	0	1	BF	AC							Busy flag (BF) showing internal operation and contents of address counter are read.	0 μs	
CGRAM/DDRAM Data Write	1	0	Write Data							Data is written in DDRAM or CGRAM.	46 μs		
CGRAM/DDRAM Data Read	1	1	Read Data							Data is read out of DDRAM or CGRAM.	46 μs		
	I/D = 1: Increment (+1) I/D = 0: Decrement (-1) 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 N = 1: 2 lines N = 0: 1 line F = 1: 5x10 dots F = 0: 5x7 dots BF = 1: Internal operation is being performed BF = 0: Instruction acceptable										DDRAM: Display Data RAM CGRAM: Character Generator RAM ACG: Address of CGRAM ADD: Address of DDRAM. AC: Address counter used for both DDRAM and CGRAM	Execution time changes with change in internal oscillation frequency (fosc).	

CHARACTER CODE AND PATTERN TABLE

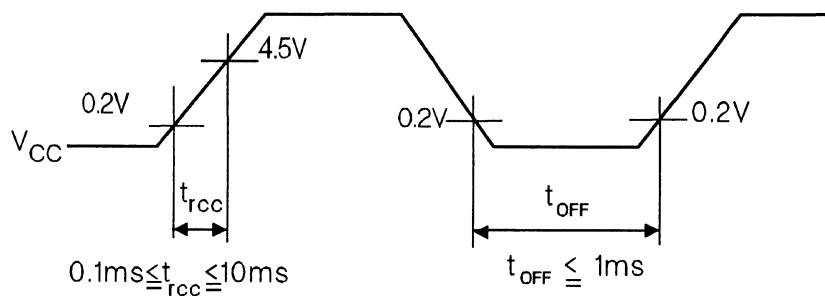
Higher 4bit \ Lower 4bit	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
XXXX0000	CGRAM (0)															
XXXX0001	(1)															
XXXX0010	(2)															
XXXX0011	(3)															
XXXX0100	(4)															
XXXX0101	(5)															
XXXX0110	(6)									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

RESET FUNCTION

Upon reset, the module will automatically reset to its initial function.

At initial function, please start by using the following instructions.

- 1) Clear Display
(Note: Busy flag (BF) is active high - BF=1)
- 2) Function set up
 - DL = 1: Interface data length 8bits.
 - N = 0: 1 line display
 - F = 0: 5 x 7 dot
- 3) Display ON/OFF Control
 - D: = 0: Display OFF
 - C: = 0: Cursor OFF
 - B = 0: Intermittent OFF
- 4) Input Set Up Mode
 - I/D=1: + 1 (inclement)
 - S =0: Does Not Shift



t_{OFF} present instant or ON.OFF time.

(Remark) Unless above electrical condition are satisfied internal circuit will not operate properly.

APPLICATIONS

Personal computer, word processor, facsimile, telephone, etc., medical and other instrumentations.

1) Handling Instructions

- a) Attention must be paid to avoid external shock, which will cause operational failure.
- b) Polarizer on the surface is fragile and can easily be scratched and damaged. Therefore, please take extra care when handling. To clean surface of termination, please wipe off with alcohol.
- c) The liquid used in the LCD panel is a harmful substance and must not be ingested. Avoid contact on exposed skin. If liquid is touched, wash thoroughly.
- d) Do not expose to direct sunlight or fluorescent light for long periods of time. If it will be in direct sunlight, please use UV filter.
- e) For storage please avoid high temperature/high humidity.
When long term storage is required, keep panels in low temperature (5°C ~ 25°C) and low humidity.

2) Operational Instructions

- a) Do not connect or disconnect module while power is on.
- b) Turn on module power before input of signal. Turn off input signal before turning off power to module. It can be damaged by "latch-up" phenomenon.

3) Mounting Instructions

- a) Ground solder before using.
- b) CMOS-IC requires caution in cases of potential ESD.
- c) Do not remove panel from board.

4) Module Assembly Instructions

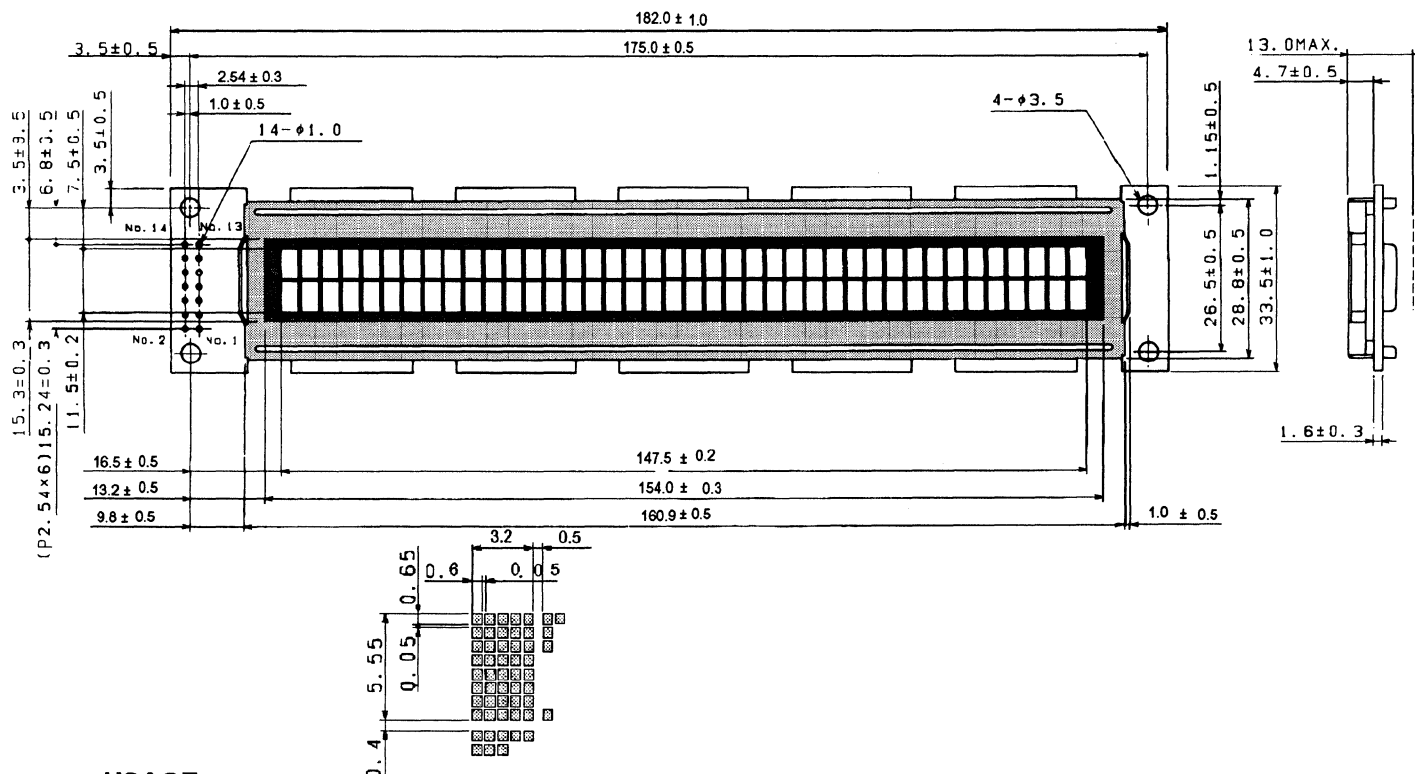
- a) For mounting, use 4 holes on each corner and do not stress circuit.
- b) To prevent contamination, scratches, or cuts on the polarizer, please use the protective cover on the front panel.

Character Type LCD Module**DESCRIPTION**

RCM2035R-A is an LCD module with LSI controller/driver built in.

FEATURES

- 1) 40 Characters x 2 Rows.
- 2) Wide viewing angle, high contrast ratio.
- 3) Dot construction is 5 x 7 dot, plus 1 line.
- 4) Can be interfaced with 4bit or 8bit MPU.
- 5) Displays 160 different types of international characters and symbols plus 32 different types of special characters and symbols.
- 6) User designed display pattern with built in character generator RAM.
- 7) Clear, easy to read display, with cursor on/off, and character blink. Simple instructions for various functions.
- 8) Compact and light weight, for easy assembly.
- 9) Can be driven by a 5V circuit.
- 10) Low power consumption.

**USAGE**

Personal Computer, Word Processor, Facsimile, Telephone, etc.

BLOCK DIAGRAM

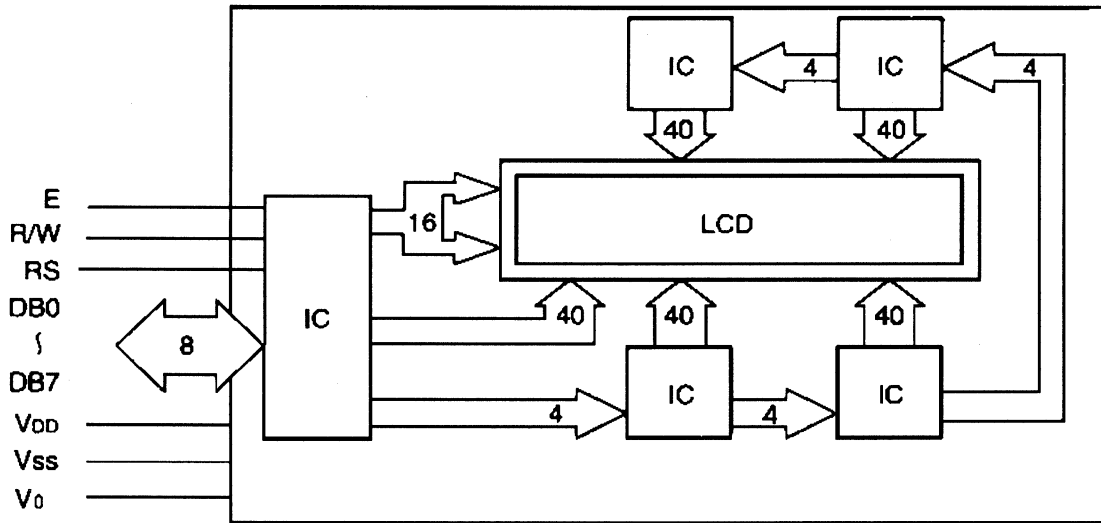


Fig. # 3, Block Diagram

INTERFACE PIN CONNECTION

Pin No.	Symbol	Pin No.	Symbol
1	V_{SS}	8	DB 1
2	V_{DD}	9	DB 2
3	V_O	10	DB 3
4	RS	11	DB 4
5	R/W	12	DB 5
6	E	13	DB 6
7	DB ₀	14	DB 7

DD RAM ADDRESS

	1	2	3	4		38	39	40
1 Line	00H	01H	02H	03H	—	25H	26H	27H
2 Line	40H	41H	42H	43H	—	65H	66H	67H

POWER SUPPLY SAMPLE CONNECTION

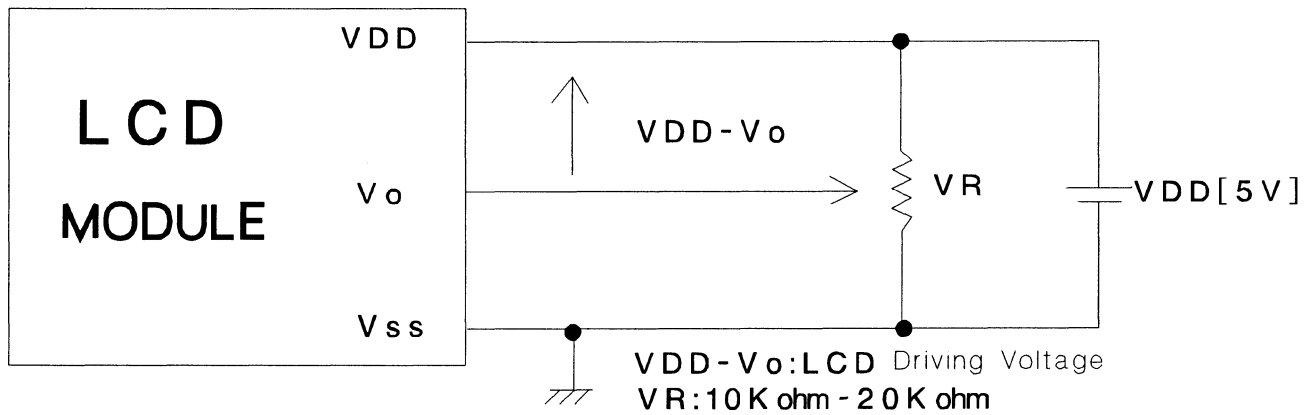


Fig. 4 Power Supply Sample Connection

ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

Items	Symbol	Min.	Max.	Unit
Supply Voltage for Logics	VDD-VSS	- 0.3	6.5	V
Supply Voltage for Driving LCD	VDD-V0	0	6.5	V
Input Voltage	VIN	- 0.3	VDD + 0.3	V
Operating Temperature	T0P	0	50	°C
Storage Temperature	Tstg	- 20	70	°C

ELECTRICAL CHARACTERISTICS (VDD=5.0 ± 5% Ta=25°C)

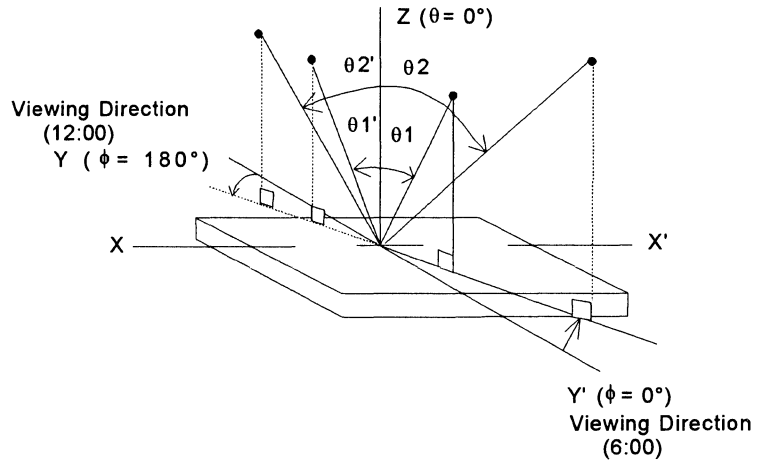
Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input High Level Voltage	VIH		2.2	-	VDD	V
Input Low Level Voltage	VIL		-	-	0.6	V
Output High Level Voltage	V0H	-I 0H=0.205mA	2.4	-	-	V
Output Low Level Voltage	V0L	I 0L=1.2mA	-	-	0.4	V
Power Supply Current	IDD	VDD=5V	-	2.0	5.0	mA

OPTICAL CHARACTERISTICS (Ta=25°C)

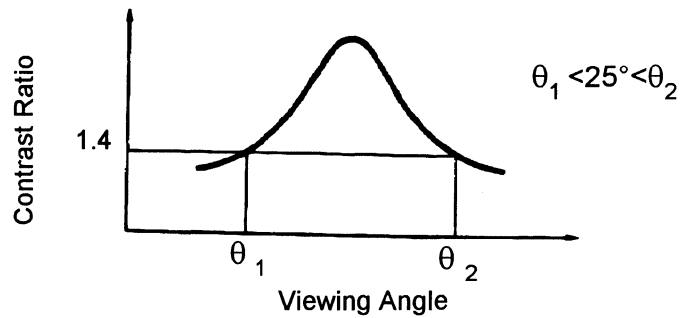
Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
t rise time	tr	$\theta = 10^\circ$ $\phi = 0^\circ$	-	100	250	ms
t fall time	td	$\theta = 10^\circ$ $\phi = 0^\circ$	-	150	250	ms
Contrast Ratio	K	$\theta = 10^\circ$ $\phi = 0^\circ$	-	3		
Viewing Angle	$\theta 1$	$K \geq 1.4$	-	-	20	degree
	$\theta 2$	$\phi = 0^\circ$	40	-	-	degree
	ϕ	$K \geq 1.4$ $\theta = 20^\circ$	± 30	-	-	degree

OPTICAL CHARACTERISTICS

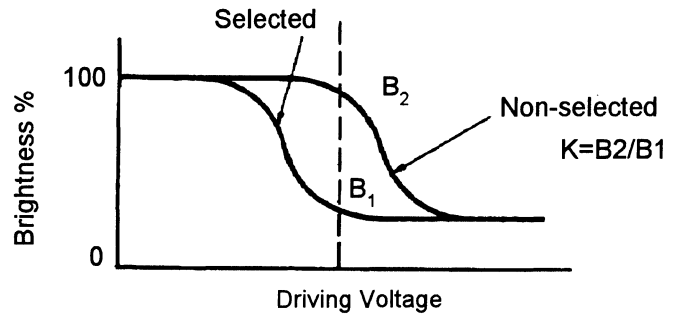
1) Definition of θ and ϕ



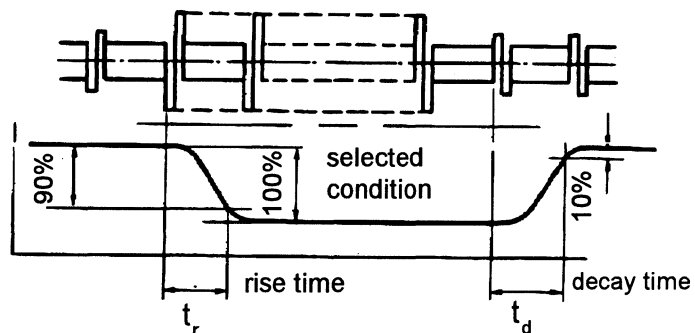
2) Definition of viewing angle θ_1 and θ_2



3) Definition of contrast ratio "K"



4) Definition of optical response time



OPERATION

(1) Writing

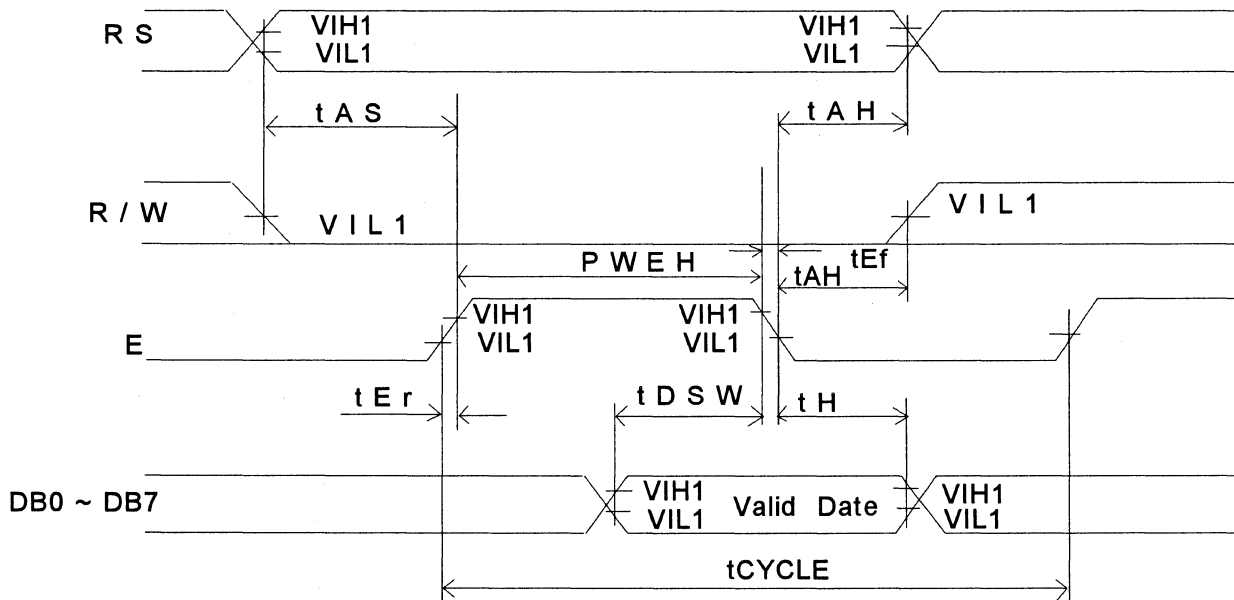


Fig. 5 Writing

Item	Symbol	Test Condition	Min.	Max.	Unit
Enable Cycle Time	tCYCE	Fig. 5	1.0	-	μ sec
Enable Pulse Time	PWEH	Fig. 5	450	-	n sec
Enable Rise Time	tEr, tEf	Fig. 5	-	25	n sec
Enable Decay Time					
Address Set-Up Time	tAS	Fig. 5	140	-	n sec
Address Hold Time	tAH	Fig. 5	10	-	n sec
Data Set Up Time	tDSW	Fig. 3	105		
Data Hold Time	tH	Fig. 3	10	-	n sec

(2) Reading

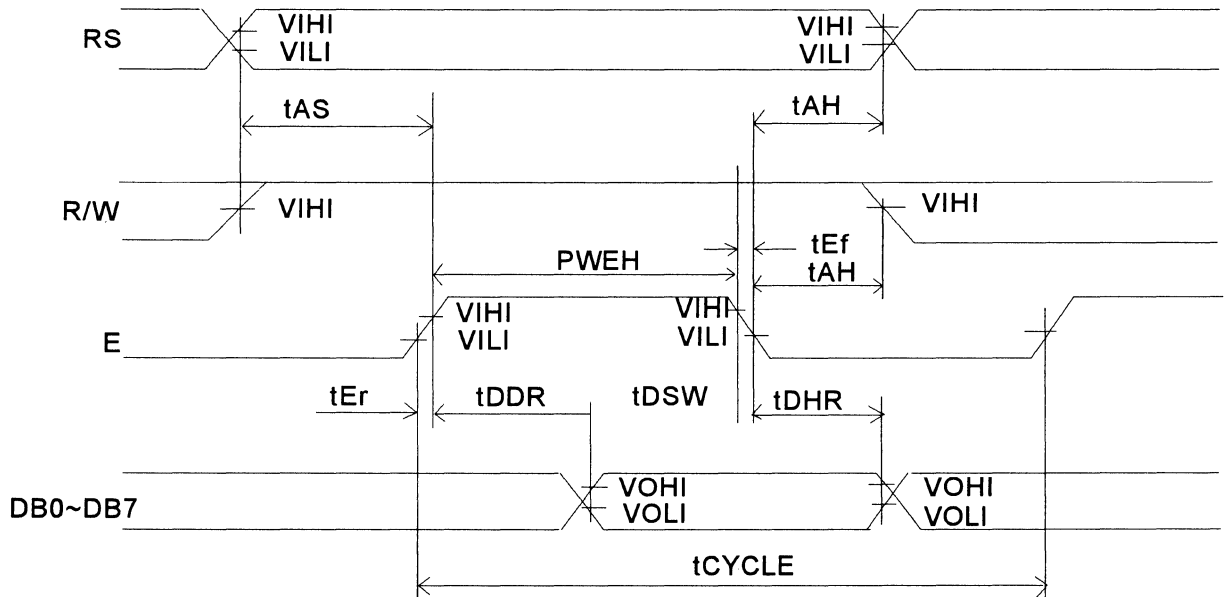


Fig. 6 Reading

Item	Symbol	Test Conditions	Min.	Max.	Unit
Enable Cycle Time	t_{CYCE}	Fig. 4	1.0	-	n sec
Enable Pulse Time	$PWEH$	Fig. 4	450	-	n sec
Enable Rise Time	t_{Er}, rEf	Fig. 4	-	25	n sec
Enable Decay Time					
Address Set-Up Time	t_{AS}	Fig. 4	140	-	n sec
Address Hold Time	t_{AH}	Fig. 4	10	-	n sec
Data Delay Time	t_{DDR}	Fig. 4	-	320	n sec
Data Hold Time	t_{DHR}	Fig. 4	20	-	n sec

PIN FUNCTION

Symbol	Level	Input/ Output Power	Function	
VSS	———	———	GND : OV	Power Voltage
VDD	———	———	+5V	
VO	———	———		
RS	H/L	input	Register select signal 0: Instruction register (write) Busy flag address counter (read) 1: Data register (read/write)	
R/W	H/L	Input	Read (R) Write (W) Select signal "0": Write MPU → LCD module "1": Read MPU ← LCD module	
E	H, H → L	Input	Signal to start read or write data.	
DB0	H/L	Input	Lower level 4 lines data bus are used to transfer data between MPU and module. When operated with 4bits, this function does not work.	
DB3		out put power		
DB4	H/L	Input		
DB7		output power	Upper level 4 lines data bus are used to transfer data between MPU and module.	

REMARK:

This module can be interfaced with both 4 or 8 bit MPU.
 Data transmission can either be sent in 2 parts at 4 bits or once at 8 bits.

- (1) If interface data is 4 bits, data transmission is DB4~DB7, using 4 bus, and the DB0~DB3 bus is not used.

Data transmission between module and MPU will end after two transmissions.

Upper 4 bits of data (Interface data length is at 8 bits when contents are DB4~DB7) is transmitted, then lower 4 bit is sent (interface data length is at 8 bits contents are DBO~DB3).

- (2) When interface data is 8 bits, data DB0~DB7, data is transmitted by using data bus.

Character Type LCD Module

RCM2035R-A

INSTRUCTION		Code										Description	Execution Time (f=250kHz)
Instruction	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0			
Clear Display	0	0	0	0	0	0	0	0	0	0	1	Cursor is returned to home position (address 0) after entire display is cleared	1.64 ms
Cursor at Home	0	0	0	0	0	0	0	0	0	1	*	Cursor is returned to home position (address 0). Shifted display is also returned to the original position. Contents of DDRAM are not changed.	1.64 ms
Entry Mode Set	0	0	0	0	0	0	0	0	1	I/D	S	Cursor advance direction and display shift are set. These operations are performed during data write and read modes.	40 μs
Display ON/OFF Control	0	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.	40 μs
Cursor/Display Shift	0	0	0	0	0	0	1	S/C	R/L	*	*	Cursor and display are shifted without changing the contents of DDRAM	40 μs
Function Set	0	0	0	0	0	1	DL	N	F	*	*	Interface data length (DL), number of display lines (N), and character font (F) are set.	40 μs
CGRAM Address Set	0	0	0	0	1	ACG					CGRAM address is set. Transmitted and received after this is the data of CGRAM.	40 μs	
DDRAM Address Set	0	0	0	ADD							DDRAM address is set. Transmitted and received after this is the data of DDRAM.	40 μs	
Busy Flag/address read	0	1	BF	AC							Busy flag (BF) showing internal operation and contents of address counter are read.	0 μs	
CGRAM/DDRAM Data Write	1	0	Write Data								Data is written in DDRAM or CGRAM.	46 μs	
CGRAM/DDRAM Data Read	1	1	Read Data								Data is read out of DDRAM or CGRAM.	46 μs	
	I/D=1: Increment (+1) I/D=0: Decrement (-1) 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: 8 bits DL=0: 4 bits N=1: 2 lines N=0: 1 line F=1: 5x10 dots F=0: 5x7 dots BF=1: Internal operation is being performed BF=0: Instruction acceptable										DDRAM: Display Data RAM CGRAM: Character Generator RAM ACG: Address of CGRAM ADD: Address of DDRAM. These correspond to cursor addresses AC: Address counter used for both DDRAM and CGRAM	Execution time changes with change in internal oscillation frequency (fosc).	

CHARACTER CODE AND PATTERN TABLE

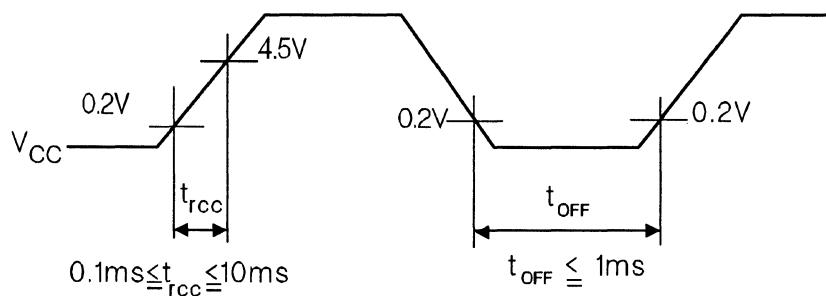
Higher 4 bit Lower 4 bit	0000	0010	0011	0100	0101	0110	0111	1010	1011	1100	1101	1110	1111
xxxx0000	CG RAM (1)		0	1	2	3	4	5	6	7	8	9	0
	(2)	!	@	A	B	C	D	E	F	G	H	I	J
xxxx0010	(3)	"	#	\$	%	&	'	()	*	+	,	-
	(4)	.	:	;	<	=	>	?	@	[\]	^
xxxx0100	(5)	~	0	1	2	3	4	5	6	7	8	9	0
	(6)	!	@	A	B	C	D	E	F	G	H	I	J
xxxx0110	(7)	K	L	M	N	O	P	Q	R	S	T	U	V
	(8)	W	X	Y	Z	[	\	\]	^	_	0	1	2
xxxx1000	(1)	3	4	5	6	7	8	9	0	1	2	3	4
	(2)	5	6	7	8	9	0	1	2	3	4	5	6
xxxx1010	(3)	7	8	9	0	1	2	3	4	5	6	7	8
	(4)	9	0	1	2	3	4	5	6	7	8	9	0
xxxx1100	(5)	!	@	A	B	C	D	E	F	G	H	I	J
	(6)	K	L	M	N	O	P	Q	R	S	T	U	V
xxxx1110	(7)	W	X	Y	Z	[	\	\]	^	_	0	1	2
	(8)	3	4	5	6	7	8	9	0	1	2	3	4
xxxx1111	(8)	5	6	7	8	9	0	1	2	3	4	5	6

RESET FUNCTION

Upon reset, the module will automatically reset to its initial function.

At initial function, please start by using the following instructions.

- 1) Clear Display
(Note: Busy flag (BF) is active high - BF=1)
- 2) Function set up
DL = 1: Interface data length 8bits.
N = 0: 1 line display
F = 0: 5 x 7 dot
- 3) Display ON/OFF Control
D = 0: Display OFF
C = 0: Cursor OFF
B = 0: Intermittent OFF
- 4) Input Set Up Mode
I/D = 1: + 1 (inclement)
S = 0: Does Not Shift



t_{OFF} present instant or ON.OFF time.

(Remark) Unless above electrical condition are satisfied internal circuit will not operate properly.

APPLICATIONS

Personal computer, word processor, facsimile, telephone, etc., medical and other instrumentations.

1) *Handling Instructions*

- a) Attention must be paid to avoid external shock, which will cause operational failure.
- b) Polarizer on the surface is fragile and can easily be scratched and damaged. Therefore, please take extra care when handling. To clean surface of termination, please wipe off with alcohol.
- c) The liquid used in the LCD panel is a harmful substance and must not be ingested. Avoid contact on exposed skin. If liquid is touched, wash thoroughly.
- d) Do not expose to direct sunlight or fluorescent light for long periods of time. If it will be in direct sunlight, please use UV filter.
- e) For storage please avoid high temperature/high humidity. When long term storage is required, keep panels in low temperature (5°C ~ 25°C) and low humidity.

2) *Operational Instructions*

- a) Do not connect or disconnect module while power is on.
- b) Turn on module power before input of signal. Turn off input signal before turning off power to module. It can be damaged by "latch-up" phenomenon.

3) *Mounting Instructions*

- a) Ground solder before using.
- b) CMOS-IC requires caution in cases of potential ESD.
- c) Do not remove panel from board.

4) *Module Assembly Instructions*

- a) For mounting, use 4 holes on each corner and do not stress circuit.
- b) To prevent contamination, scratches, or cuts on the polarizer, please use the protective cover on the front panel.

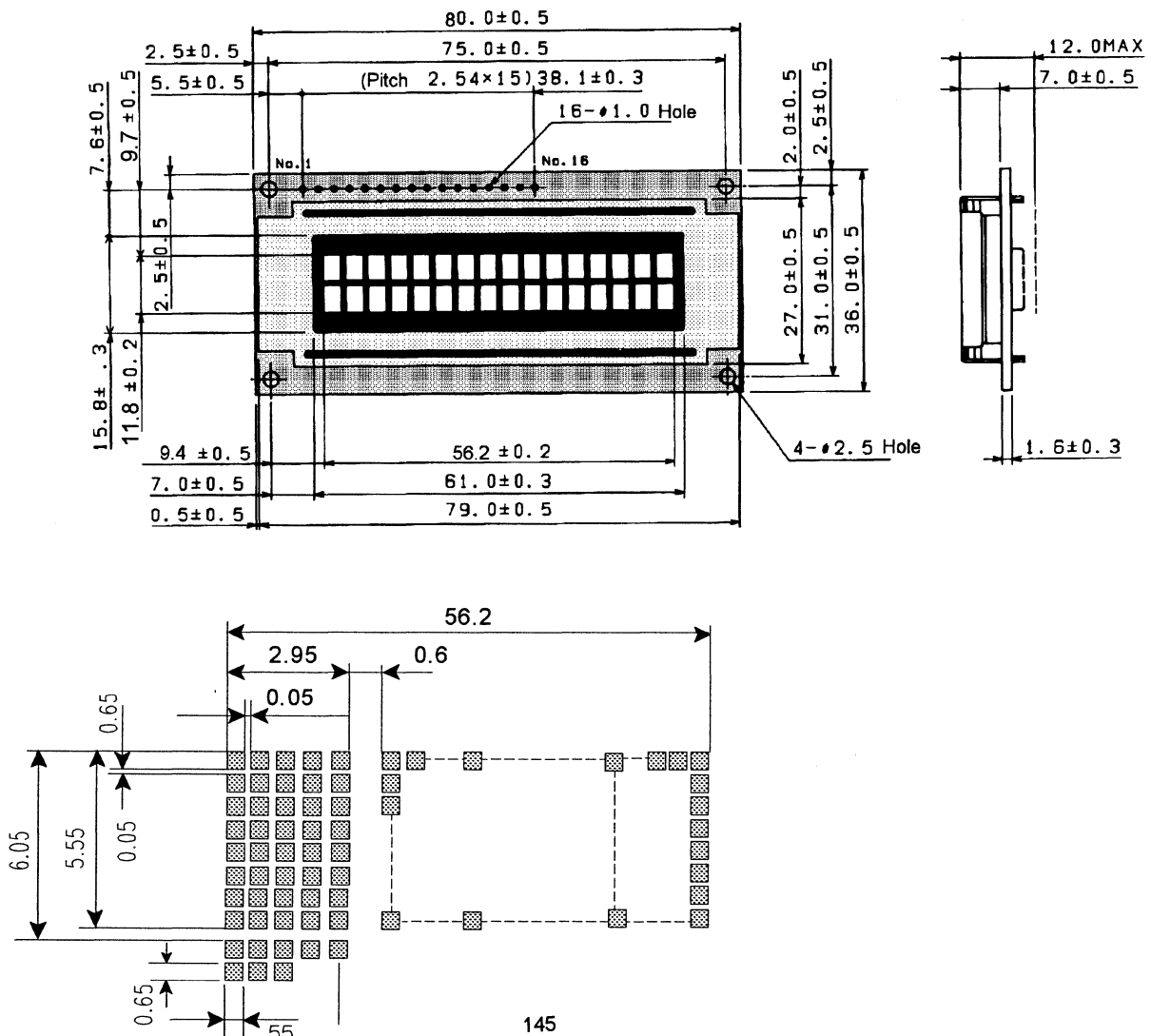
Character Type LCD Module

DESCRIPTION

RCM7033M is an STN (Super Twist) LCD module with LSI controller/driver built in.

FEATURES

- 1) 16 Characters x 2 Rows, with LED backlight.
- 2) Wide viewing angle, high contrast ratio.
- 3) 5 x 7 dot construction in each character, plus one line.
- 4) Can be interfaced with 4bit or 8bit MPU.
- 5) Displays 208 different types of international characters and symbols plus 32 different types of special characters and symbols.
- 6) With built in character generator RAM, any user-design pattern can be displayed.
- 7) Clear, easy to read display, with cursor on/off, and character blink. Simple instructions for various functions.
- 8) Compact and light weight, for easy assembly.
- 9) Can be driven by a 5V circuit.
- 10) Low power consumption.



BLOCK DIAGRAM

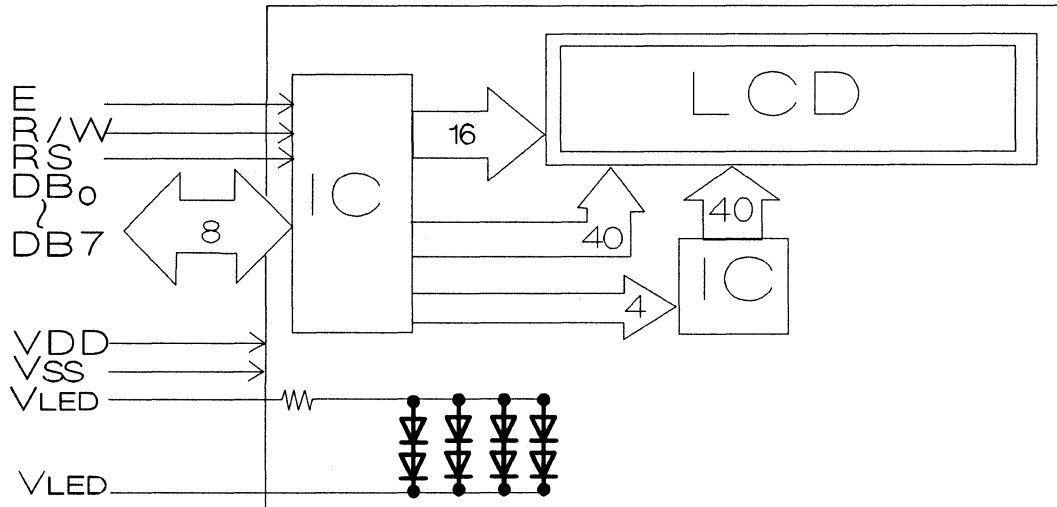


Fig. # 3, Block Diagram

INTERFACE PIN CONNECTION

Pin No.	Symbol	Pin No.	Symbol
1	V_{SS}	9	DB 2
2	V_{DD}	10	DB 3
3	V_O	11	DB 4
4	RS	12	DB 5
5	R/W	13	DB 6
6	E	14	DB 7
7	DB0	15	VLED
8	DBI	16	VLED+

DD RAM ADDRESS

	1	2	3	4	-	14	15	16
1 Line	00H	01H	02H	03H	—	0DH	0EH	0FH
2 Line	40H	41H	42H	43H	—	4DH	4EH	4FH

POWER SUPPLY SAMPLE CONNECTION

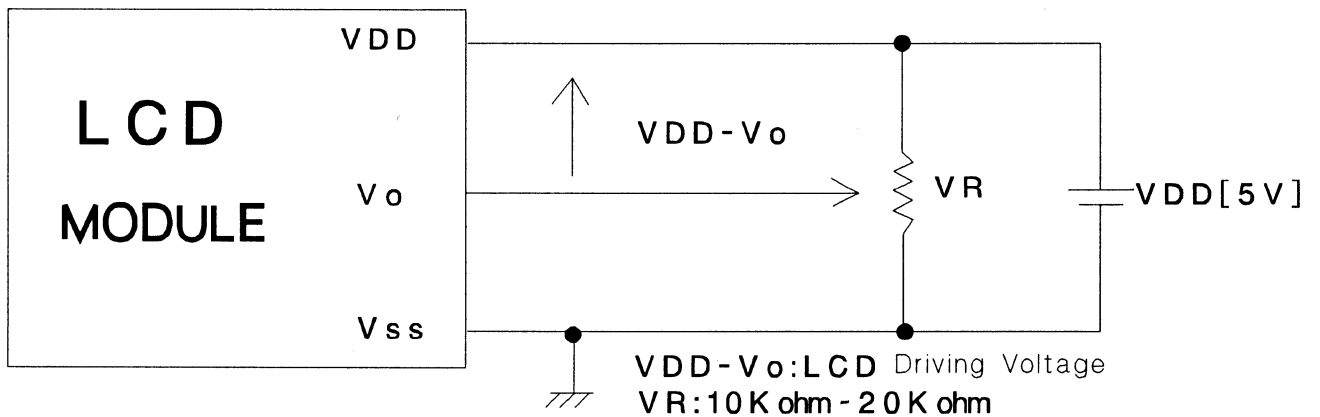


Fig. 4 Power Supply Sample Connection

ABSOLUTE MAXIMUM RATINGS

Items	Symbol	Min.	Max.	Unit
Supply Voltage for Logics	VDD-VSS	- 0.3	6.5	V
Supply Voltage for Driving LCD	VDD-V0	0	6.5	V
Input Voltage	VIN	- 0.3	VDD+0.3	V
Operating Temperature	T0P	0	50	°C
Storage Temperature	Tstg	- 20	70	°C

ELECTRICAL CHARACTERISTICS

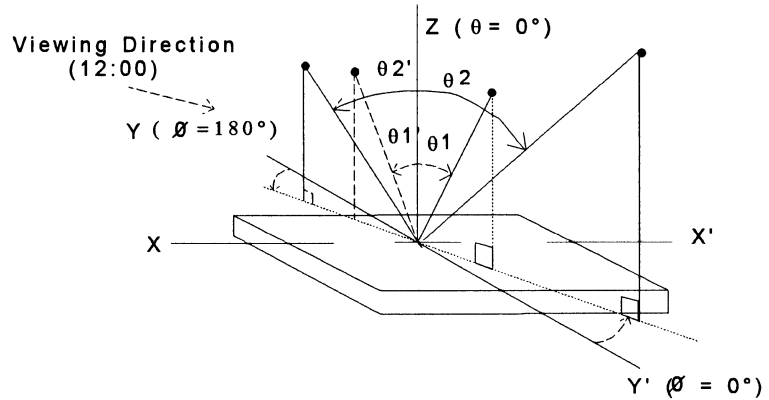
Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input High Level Voltage	VIH		2.0	-		V
Input Low Level Voltage	VIL		-	-	0.8	V
Output High Level Voltage	V0H	- I 0H = -1.2 mA	2.4	-	-	V
Output Low Level Voltage	V0L	I 0L = 2mA	-	-	0.4	V
Power Supply Current	IDD	VDD=5V	-	1	3	mA
LED Forward Current	ILED	VLED = 15W	-	60	-	mA

OPTICAL CHARACTERISTICS

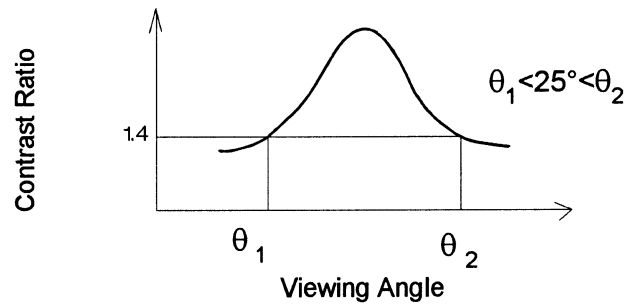
Items	Symbol	Conditions	Min.	Typ.	Max.	Unit
t rise time	tr	$\theta = 10^\circ \quad \theta = 0^\circ$	-	150	250	ms
r fall time	td	$\theta = 10^\circ \quad \theta = 0^\circ$	-	150	250	ms
Contrast Ratio	K	$\theta = 10^\circ \quad \theta = 0^\circ$	-	5		
Viewing Angle	$\theta 1$	$K \geq 1.4$	-	-	10	degree
	$\theta 2$	$\phi = 0^\circ$	40	-	-	degree
	ϕ	$K \geq 1.4$ $\theta = 20^\circ$	± 40	-	-	degree

OPTICAL CHARACTERISTICS

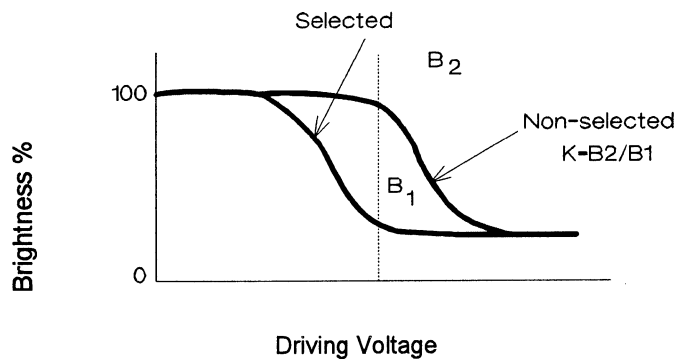
1) Definition of θ and ϕ



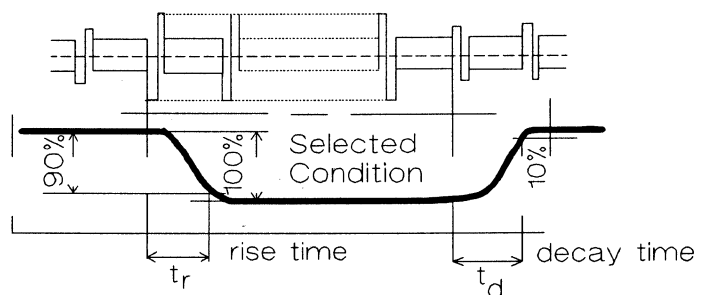
2) Definition of viewing angle θ_1 and θ_2



3) Definition of contrast ratio "K"



4) Definition of optical response time



OPERATION

(1) Writing

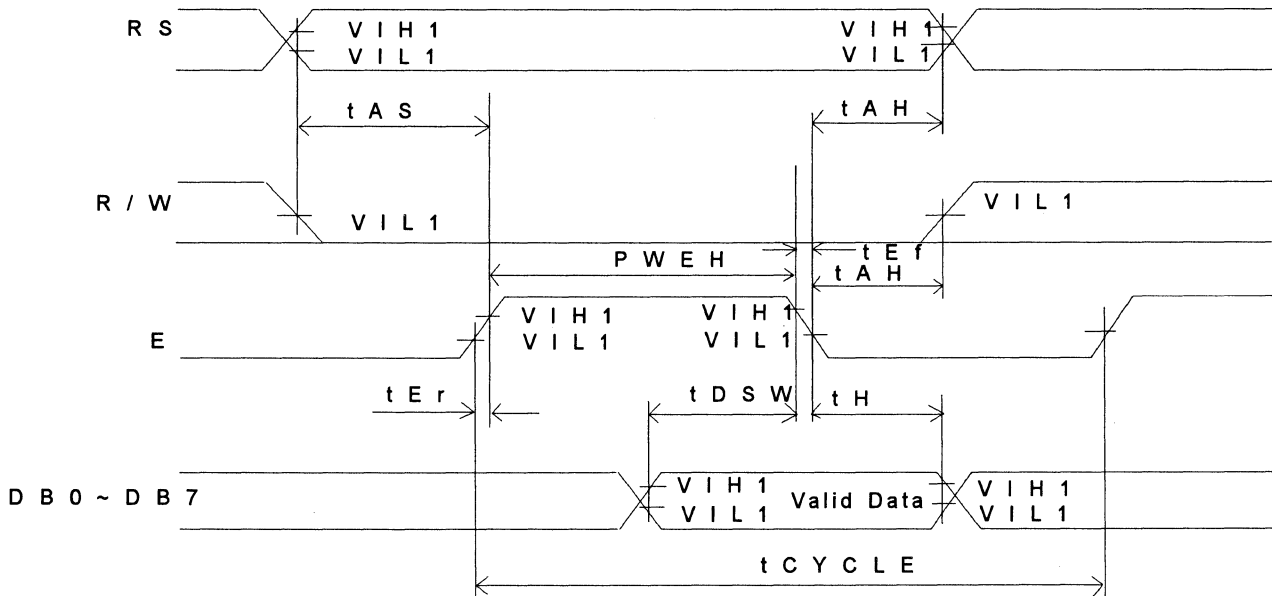


Fig. 5 Writing

Item	Symbol	Test Condition	Min.	Max.	Unit
Enable Cycle Time	tCYCE	Fig. 3	500	-	μ sec
Enable Pulse Time	PWEH	Fig. 3	220	-	n sec
Enable Rise Time	tEr, tEf	Fig. 3	-	20	n sec
Enable Decay Time					
Address Set-Up Time	tAS	Fig. 3	40	-	n sec
Address Hold Time	tAH	Fig. 3	10	-	n sec
Data Set-Up Time	tDSW	Fig. 3	60	-	n sec
Data Hold Time	tH	Fig. 3	10	-	n sec

(2) Reading

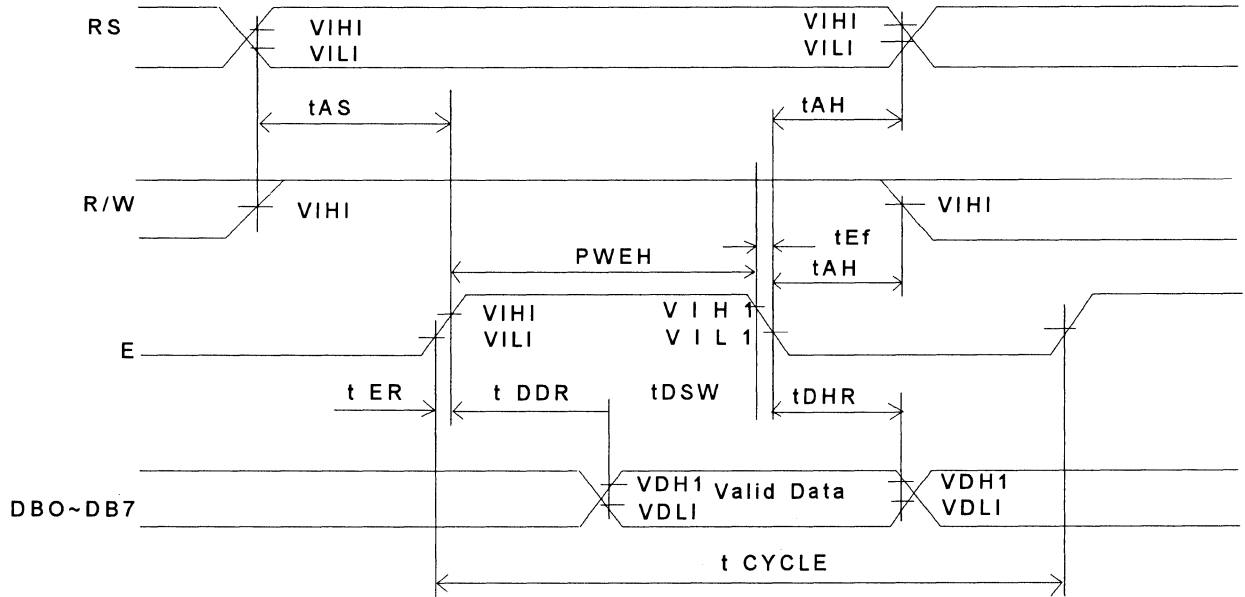


Fig. 6 Reading

Item	Symbol	Test Conditions	Min.	Max.	Unit
Enable Cycle Time	t_{CYCE}	Fig. 4	500	-	μ sec
Enable Pulse Time	PWEH	Fig. 4	220	-	n sec
Enable Rise Time	t_{Er}, t_{Ef}	Fig. 4	-	20	n sec
Enable Decay Time					
Address Set-Up Time	t_{AS}	Fig. 4	40	-	n sec
Address Hold Time	t_{AH}	Fig. 4	10	-	n sec
Data Delay Time	t_{DDR}	Fig. 4	-	120	n sec
Data Hold Time	t_{DHR}	Fig. 4	20	-	n sec

PIN FUNCTION

Symbol	Level	Input/ Output Power	Function
VSS	--	--	GND : OV
VDD	--	--	+ 5V
VO	--	--	
			Power Voltage
RS	H/L	Input	Register select signal 0: Instruction register (write) Busy flag address counter (read) 1: Data register (read/write)
R/W	H/L	Input	Read (R) Write (W) Select signal "0": Write MPU → LCD module "1": Read MPU ← LCD module
E	H, H → L	Input	Signal to start read or write data.
DB0 DB3	F/L	Input output power	Lower level 4 lines data bus are used to transfer data between MPU and module. When operated with 4bits, this function does not work.
DB4 DB7	H/L	Input output power	Upper level 4 lines data bus are used to transfer data between MPU and module. DB7 can be used as busy flag.

REMARK:

This module can be interfaced with both 4 or 8bit MPU.
Data transmission can either be sent in 2 parts at 4bits or once at 8bits.

- (1) If interface data is 4bits, data transmission is DB4~DB7, using 4bus, and the DB0~DB3 bus is not used.

Data transmission between module and MPU will end after two transmissions.

Upper 4bits of data (Interface data length is at 8bits when contents are DB4~DB7) is transmitted, then lower 4bit is sent (interface data length is at 8bits contents are DB0~DB3).

- (2) When interface data is 8bits, data DB0~DB7, data is transmitted by using data bus.

Character Type LCD Module

RCM7033M

INSTRUCTION											Description	Execution Time (f=250kHz)
Instruction	RS	RW	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 0) after entire display is cleared	1.64 ms
Cursor at Home	0	0	0	0	0	0	0	0	1	*	Cursor is returned to home position (address 0). Shifted display is also returned to the original position. Contents of DDRAM are not changed.	1.64 ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Cursor advance direction and display shift are set. These operations are performed during data write and read modes.	40 μs
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.	40 μs
Cursor/Display Shift	0	0	0	0	0	1	S/C	R/L	*	*	Cursor and display are shifted without changing the contents of DDRAM	40 μs
Function Set	0	0	0	0	1	DL	N	F	*	*	Interface data length (DL), number of display lines (N), and character font (F) are set.	40 μs
CGRAM Address Set	0	0	0	1	ACG					CGRAM address is set. Transmitted and received. This is the data of CGRAM.		40 μs
DDRAM Address Set	0	0	0	ADD					DDRAM address is set. Transmitted and received. This is the data of DDRAM.		40 μs	
Busy Flag/address read	0	1	BF	AC					Busy flag (BF) showing internal operation and contents of address counter are read.		0 μs	
CGRAM/DDRAM Data Write	1	0	Write Data					Data is written in DDRAM or CGRAM.		46 μs		
CGRAM/DDRAM Data Read	1	1	Read Data					Data is read out of DDRAM or CGRAM.		46 μs		
	I/D = 1: Increment (+1) I/D = 0: Decrement (-1) 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 N = 1: 2 lines N = 0: 1 line F = 1: 5x10 dots F = 0: 5x7 dots BF = 1: Internal operation is being performed BF = 0: Instruction acceptable										DDRAM: Display Data RAM CGRAM: Character Generator RAM ACG: Address of CGRAM ADD: Address of DDRAM. These correspond to cursor addresses AC: Address counter used for both DDRAM and CGRAM	Execution time changes with change in internal oscillation frequency (fosc).

CHARACTER CODE AND PATTERN TABLE

Higher 4bit / Lower 4bit	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

Upon reset, the module will automatically reset to its initial function.

At initial function, please start by using the following instructions.

- 1) Clear Display
(Note: Busy flag (BF) is active high - BF=1)
- 2) Function set up
DL = 1: Interface data length 8bits.
N = 0: 1 line display
F = 0: 5 x 7 dot
- 3) Display ON/OFF Control
D: = 0: Display OFF
C: = 0: Cursor OFF
B = 0: Intermittent OFF
- 4) Input Set Up Mode
I/D = 1: + 1 (inclement)
S = 0: Does Not Shift

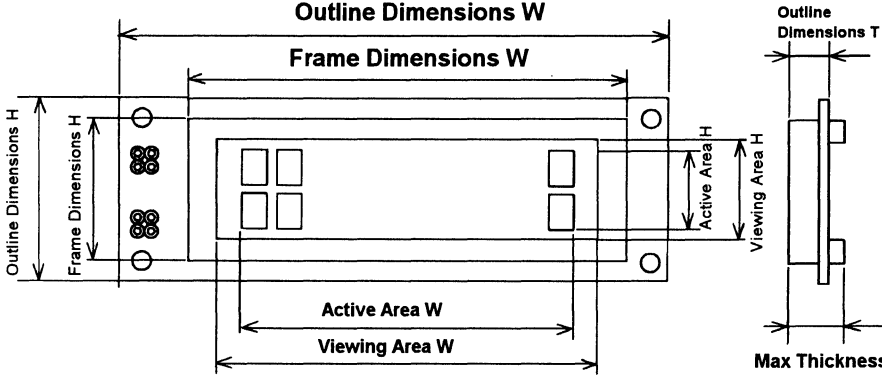
APPLICATIONS

Personal computer, word processor, facsimile, telephone, etc., medical and other instrumentations.

- 1) Handling Instruction
 - a) Attention must be paid to avoid external shock, which will cause operations failure.
 - b) Polarizer on the surface is fragile and can easily be scratched and damaged. Therefore, please take extra care when handling. To clean surface of termination, please wipe off with alcohol.
 - c) The liquid used in the LCD panel is a harmful substance and must not be ingested. Avoid contact on exposed skin. If liquid is touched, wash thoroughly.
 - d) Do not expose to direct sunlight or fluorescent light for long periods of time. If it will be in direct sunlight, please use UV filter.
 - e) For storage please avoid high temperature/high humidity.
When long term storage is required, keep panels in low temperature (5°C ~ 25°C) and low humidity.
- 2) Operational Instructions
 - a) Do not connect or disconnect module while power is on.
 - b) Turn on module power before input of signal. Turn off input signal before turning off power to module. It can be damaged by "latch-up" phenomenon.
- 3) Mounting Instructions
 - a) Ground solder before using.
 - b) CMOS-IC requires caution in cases of potential ESD.
 - c) Do not remove panel from board.
- 4) Module Assembly Instructions
 - a) For mounting, use 4 holes on each corner and do not stress circuit.
 - b) To prevent contamination, scratches, or cuts on the polarizer, please use the protective cover on the front panel.

Custom LCD Check Sheet (Module Type)

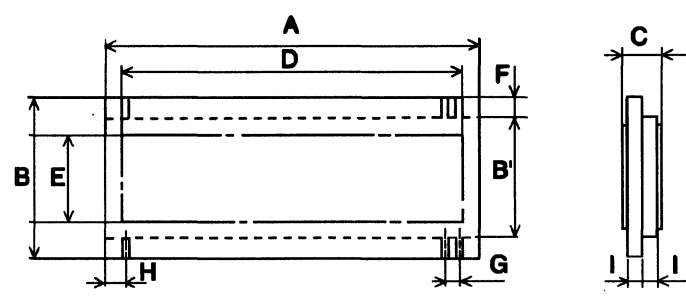
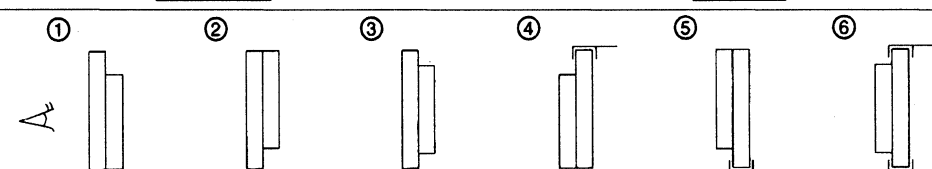
ROHM develops and manufactures custom LCD modules at customer's request. Customers are requested to fill in this check sheet and provide to ROHM. Detailed specifications may be discussed later.

1. Applications	<ul style="list-style-type: none"> ● Applications. _____
2. Character	<ul style="list-style-type: none"> ● <input type="checkbox"/> SegmentType. (Please provide Artwork.) <input type="checkbox"/> Character Type _____ dotsX _____ dots. column. row. <input type="checkbox"/> Other. (Please provide Artwork.)
3. Construction	<ul style="list-style-type: none"> ● <input type="checkbox"/> TN (negative, positive) <input type="checkbox"/> STN (Yellow Mode, Gray Mode, Blue Mode, B/W Mode) <input type="checkbox"/> Reflective <input type="checkbox"/> Transmissive <input type="checkbox"/> Transflective ● Viewing angle. <input type="checkbox"/> 12:00 <input type="checkbox"/> 6:00
4. Dimensions	<div style="text-align: center;">  </div> <p>Outline Dimensions (WXHT) _____ mm MAX. Thickness _____ mm Frame Dimensions (WXH) _____ mm Pin Position _____ mm Active Are (WXH) _____ mm Dot Size _____ X _____ mm Viewing Area (WXH) _____ mm Dot Pitch _____ X _____ mm</p>
5. Connector	<ul style="list-style-type: none"> ● <input type="checkbox"/> No <input type="checkbox"/> Yes (Connector Parts No. _____) (Wire Harness Parts No., Length _____ , _____ , _____ mm)
6. Absolute Max. Ratings	<ul style="list-style-type: none"> ● Operating Temperature _____ °C~ _____ °C ● Storage Temperature _____ °C~ _____ °C
7. Drive Condition	<ul style="list-style-type: none"> ● Drive Voltage _____ V ● Duty _____ duty ● Bias _____ bias ● Controller IC _____ ● Driver IC _____
8. Schedule	<ul style="list-style-type: none"> ● Specification _____ ● Prototype Sample _____ ● Quantity _____ pcsM ● Production _____ ● Total Quantity _____ pcs

Custom LCD Check Sheet (Panel Type)



ROHM develops and manufactures custom LCD modules at customer's request.
 Customers are requested to fill in this check sheet and provide to ROHM.
 Detailed specifications may be discussed later.

1. Applications	● Applications. _____
2. Character	● <input type="checkbox"/> Segment Type. (Please provide Artwork.) <input type="checkbox"/> Character Type _____ dots X _____ dots. column. row. <input type="checkbox"/> Other. (Please provide Artwork.)
3. Construction	● <input type="checkbox"/> TN (negative, positive) <input type="checkbox"/> Black Mask <input type="checkbox"/> STN (Yellow Mode, Gray Mode, Blue Mode, B/W Mode) ● <input type="checkbox"/> Reflective <input type="checkbox"/> Transmissive <input type="checkbox"/> Transflective ● Viewing angle. <input type="checkbox"/> 12:00 <input type="checkbox"/> 6:00
4. Dimensions	 <p>A: Glass Width _____ mm F: Pin Height _____ mm B: SEG Width _____ mm G: Pin Pitch _____ mm B': COM Width _____ mm H: Pin Position _____ mm D: Active Area H _____ mm C: Panel Thickness _____ mm E: Active Area W _____ mm I: Glass Thickness _____ 1.1 mm, 0.7 mm</p>
5. Panel Design	
6. Viewing Angle	● <input type="checkbox"/> 12:00 <input type="checkbox"/> 6:00 <input type="checkbox"/> Other
7. Connector	● <input type="checkbox"/> Rubber Connector <input type="checkbox"/> Pin _____ pins Pin Forming <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Heat Seal <input type="checkbox"/> FPC <input type="checkbox"/> Other _____
8. Polarizer	● Color <input type="checkbox"/> Standard <input type="checkbox"/> Other _____ <input type="checkbox"/> Other
9. Printing	● <input type="checkbox"/> No <input type="checkbox"/> Yes _____ Colors
10. Absolute Max. Ratings	● Operating Temperature _____ °C ~ _____ °C ● Storage Temperature _____ °C ~ _____ °C
11. Drive Condition	● <input type="checkbox"/> Static <input type="checkbox"/> Dynamic _____ duty. _____ bias. ● Drive Voltage _____ V ● Drive Freq. _____ Hz ● Controller IC _____ ● Driver IC _____
12. Schedule	● Specification _____ ● Prototype Sample _____ ● Quantity _____ pcsM ● Production _____ ● Total Quantity _____ pcs

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408-737-1333

QUALITY COMPONENT

Buffalo, NY 716-837-5430
Manlius, NY 315-682-8885
Rochester, NY 716-324-7229

R.J. MARKETING

Tuscon, AZ 602-770-1782

R.M. ELECTRONICS CO., INC.

Grand Rapids, MI 616-531-9300
Indianapolis, IN
Longwood, FL 800-878-7622

RADIX, INC.

Springfield, NJ 201-467-4970

REPCO ELECTRONICS

Solon, OH 216-248-8900

ROME ELECTRONICS

E. Rochester, NY 716-248-0160
Rome, NY 315-337-5400
Williamsville, NY 800-366-0118
716-626-1602

SAGE MARKETING

Austin, TX 512-335-0300
Dallas, TX 214-526-3257
Spring, TX 713-320-9206

SALES ENGINEERING CONCEPT

Altamonte Springs, FL 407-830-8444
Deerfield Beach, FL 305-426-4601
Puerto Rico 809-841-4220

SCHILLINGER ASSOCIATES

Kokomo, IN 317-457-7241

S.M.D., INC.

Nashville, TN 615-331-6045

SOLID STATE, INC.

Bloomfield, NJ 201-429-8700

STERLING ELECTRONICS

Albuquerque, NM 505-884-1900
Austin, TX 512-836-1341
Carrollton, TX 214-243-1600
Chatsworth, CA 818-407-8850
Clayton, NC 919-553-3259
Columbia, MD 410-290-3800
Edison, NJ 908-417-1000
Englewood, CO 303-792-3939
Houston, TX 713-627-9800
Lenexa, KS 913-492-5406
Minneapolis, MN 612-831-2666
Phoenix, AZ 602-437-5565
Richmond, VA 804-323-5510
Salt Lake City, UT 801-972-5444
San Diego, CA 619-560-8097
San Jose, CA 408-435-5566
Schaumburg, IL 708-303-9900
Solon, OH 216-248-1122
Tulsa, OK 918-663-2410
Tustin, CA 714-259-0900
Wallingford, CT 203-265-9535
Westwego, LA 504-436-1418
Woburn, MA 617-938-6200

STRATEGIC MARKETING

Duluth, GA 404-381-7430
Huntsville, AL 205-464-0490
Jonesborough, TN 615-753-5518
Nashville, TN 615-883-7882
Raleigh, NC 919-847-7972

BOB MAURO

Raleigh, NC 919-387-7101

TANDY NATIONAL PARTS

Fort Worth, TX 817-870-5649

TONAR INDUSTRIES, INC.

Pointe Claire, Quebec
Rockaway, NJ 201-586-9000

UTECH ELECTRONICS, INC.

Ontario, CN 416-609-2900

ROHM

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