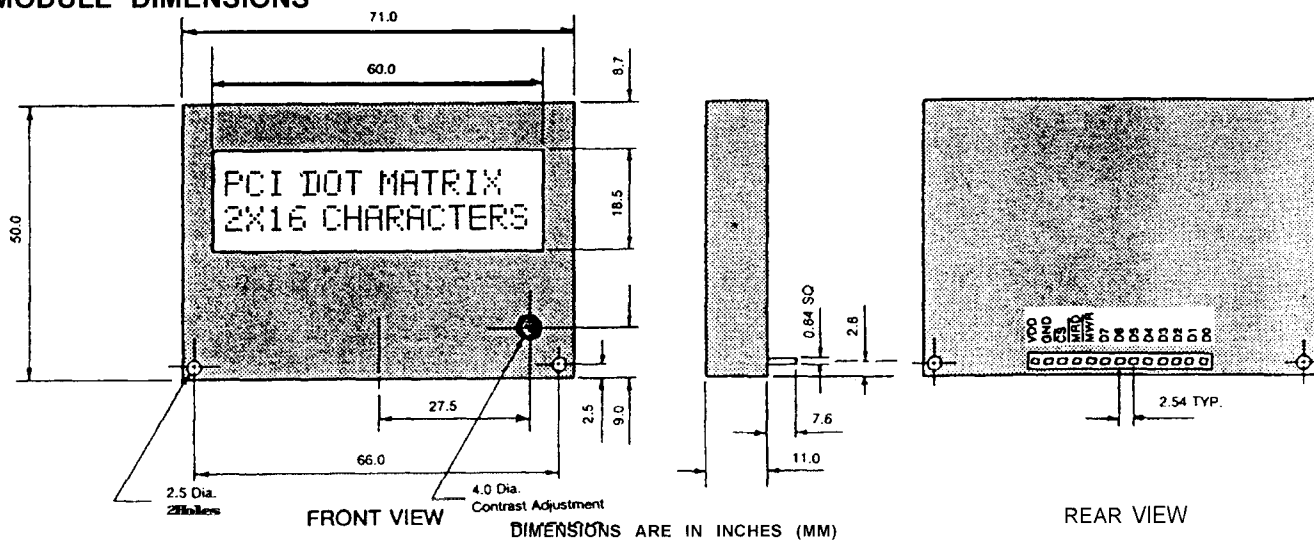


## HIGH CONTRAST 1 X 16 DOT MATRIX LCD MODULE

### MODULE DIMENSIONS



### DESCRIPTION

The PCIM 201 is designed to achieve a high standard of optical quality for any application by selectable viewing, top view or bottom view. The display's highest contrast viewing range is tailored to your exact application. Optional wide temperature operation is available for indoor/outdoor usage without excessive power drain.

### FEATURES

- 2lines16Characters5x7PlusCursor LCD Dot Matrix
- Wide Temperature Operation Option
- 16 Level Multiplex Display For Wide Viewing Angles
- Character Height of .192" (.236" including cursor)
- High Contrast Readability
- On Board Character Generator
- On Board Contrast Adjustment Potentiometer
- On Board Minus 5 Volt Generator
- Selectable Top View or Bottom View Display
- Low Power Operation
- Low Profile Packaging
- Pin Terminated

### ORDERING INFORMATION

Standard Model  
**PCIM 201 BV**

Options Available  
on Request

**PCIM 201 TV**  
**PCIM 201 TVH**  
**PCIM 201 BVH**  
TV = Top View

#### KEY:

BV = Bottom View  
H = Wide Temperature

### OPERATING SPECIFICATIONS

	Standard	Wide Temp.
Operating Temperature Range .....	0°C to +50°C	-20°C to +70°C
Storage Temperature Range .....	-20°C to +70°C	-40°C to +80°C
Humidity Resistance .....	92% RH Max @ 40°C	90% RH Max @ 70°C

### ELECTRICAL CHARACTERISTICS

TA = 25°C

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage	V <sub>DD</sub>	—	4.5	5.0	5.5	V
Supply Current	I <sub>DD</sub>	V <sub>DD</sub> = 5V	—	7.7	14	mA
Quiescent Current	I <sub>O</sub>	Power Down Mode Inputs at either supply	—	—	5	mA
Input "High" Voltage	V <sub>HI</sub>	V <sub>DD</sub> = 4.5 to 5.5V	0.8V <sub>DD</sub>	—	V <sub>DD</sub>	V
Input "Low" Voltage	V <sub>LI</sub>	V <sub>DD</sub> = 5.0V	0	—	0.5V <sub>DD</sub>	V
Input Leakage Current	I <sub>L</sub>	V <sub>HI</sub> = 0V, V <sub>DD</sub> = 5V	—	—	5	μA
Input Capacitance	C <sub>IN</sub>	—	—	—	6.5	pF
Bus Output "High" Voltage	V <sub>OH</sub>	V <sub>DD</sub> = 5V I = 1.6mA Source	4.0	—	—	V
Bus Output "Low" Voltage	V <sub>OL</sub>	V <sub>DD</sub> = 5V I = 1.6mA Sink	—	—	0.4	V
CS, MWR & MRD Pulse	t <sub>pw</sub>	—	700 800*	—	—	nS
Data Set-up Time	t <sub>DS</sub>	—	26	—	—	nS
Data Hold Time	t <sub>OH</sub>	—	75	—	—	nS
MRD Fall to Valid Data Time	t <sub>FD</sub>	—	—	400	700	nS
			600			

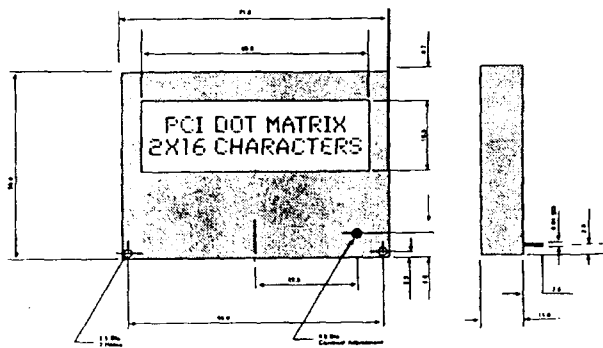
Note: Operating Voltage Referenced to GND

\*Wide Temp Version

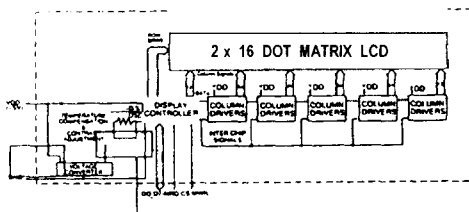
## High Contrast 2 x 16 Dot Matrix LCD Module

The PCIM 201 is designed to achieve a high standard of optical quality for any application by selectable viewing, top view or bottom view. The display's highest contrast viewing range is tailored to your exact application. Optional wide temperature operation is available for indoor/outdoor usage without excessive power drain.

### Module Dimensions



FRONT VIEW

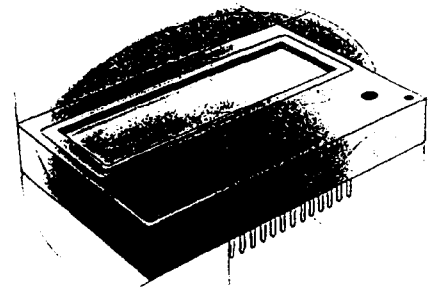


### Pin Functions

- VDD** Positive terminal for module power supply.
- GND** Negative terminal for module power supply.
- CS** Terminal to select/enable module. A 'LOW' at this terminal will enable.
- MRD** Terminal to place module in 'READ' mode. This mode is obtained when MRD is 'LOW.'
- MWR** Terminal to place module in 'WRITE' mode. This mode is obtained when MWR is 'LOW.'
- D7-D0** 8 bit directional I/O bus which allows control of the display via the various instructions.

### Ordering Information & Options

PCIM 201 BV TV, TVH, BVH Optional  
(BV = Bottom View/TV = Top View/H = Wide Temperature)



### Operating Specifications

	standard	Wide Temp.
Operating Temperature Range	0°C to +50°C	-20°C to +70°C
Storage Temperature Range	-20% to +70°C	-40°C to +80°C
Humidity Resistance.	92% RH Max @ 40%	90% RH Max @ 70°C

### Electrical Characteristics Ta = 25°C

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage	VDD	—	4.5	5.0	5.5	V
Supply Current	I <sub>DD</sub>	VDD = 5V	—	7.7	14	mA
Quiescent Current	I <sub>Q</sub>	Power Down Mode Inputs at either supply	—	—	5	mA
Input "High" Voltage	V <sub>IH</sub>	VDD = 4.5 to 5.5V	0.8VDD	—	VDD	V
Input "Low" Voltage	V <sub>IL</sub>	VDD = 5.0V	0	—	0.5VDD	V
Input Leakage Current	I <sub>L</sub>	V <sub>IH</sub> = 0V, VDD = 5V	—	—	5	μA
Input Capacitance	C <sub>IN</sub>	—	—	—	6.5	pF
Bus Output "High" Voltage	V <sub>OH</sub>	VDD = 5V I = 1.6mA Source	4.0	—	—	V
Bus Output "Low" Voltage	V <sub>OL</sub>	VDD = 5V I = 1.6mA Sink	—	—	0.4	V
CS, MWR & MRD Pulse	t <sub>pw</sub>	—	700	800*	—	nS
Data Set-up Time	t <sub>DS</sub>	—	20	—	—	nS
Data Hold Time	t <sub>DH</sub>	—	75	—	—	nS
MRD Fall to Valid Data Time	t <sub>FD</sub>	—	—	400	700	nS

Note: Operating Voltage Referenced to GND

\*Wide Temp. Ver.

### Features

- 2 Line x 16 Characters 5 x 7 Plus Cursor LCD Dot Matrix
- Wide Temperature Operation Option
- 18 Level Multiplex Display For Wide Viewing Angles
- Character Height of .192" (.236" including cursor)
- High Contrast Readability
- On Board Character Generator
- On Board Contrast Adjustment Potentiometer
- On Board Minus 5 Volt Generator
- Selectable Top View or Bottom View Display
- Low Power Operation
- Low Profile Packaging
- Pin Terminated

**HANDLING PRECAUTIONS:** The PCIM 201 contains CMOS devices and must be handled correctly to avoid damage. Input pins should be shorted with conductive foil. Do not make any circuit changes under power. Power conditions as high transients may cause permanent damage.

# Application Notes — 200/201 Series



## Instruction Set

DESCRIPTION	OP CODE 76543210 (SEE NOTE 1)	HEX CODE	BUS (SEE NOTE 1)	INPUT OR OUTPUT	IMMED EXEC.	CREATES SHORT BUSY	CREATES LONG BUSY	NOT DURING PO	NOT DURING BUSY
Load Character	001XXXXX to 010XXXXX	20 to 5F		I		—	✓	✓	✓
Load Cursor Location	000XXXXX	00 to 1F		I	✓		—	—	✓ (see note 2)
Set Display Control Flag	011XXXXY	60 to 7F		I	✓				—
Blink Cursor	01100000 - off 01100001 - on	60 61	0						
Blink Display	01100010 - off 01100011 - on	62 63	1						
Auto Inc/Dec	01100100 - off 01100101 - on	64 65	2						
Up/Down	01100110 - off 01100111 - on	66 67	3						
Blank Display	01101000 - off 01101001 - on	68 69	4						
Visible Cursor	01101010 - off 01101011 - on	6A 6B	5						
Cursor Type	01101100 - off 01101101 - on	6C 6D	6						
<b>Busy</b>	Output Only	—	7						
Rapid Load	01101110 - off 01101111 - on	6E 6F	—						
Power Down	01110000 - off 01110001 - on	70 71	—						
Get Character	10000100	84		O	✓	—	—	✓ (see note 3)	✓ (see note 3)
Get Cursor Location	10000010	82		O	✓	—	—		—
Get Display Control Flags	10000001	81		O	✓	—	—		—
Decrement Cursor Increment Cursor	10001000 10001001	88 89		I	✓	—	—		✓ (see note 2)
Shift Right	10001111	8F		I	—	—	✓	✓	✓
Shift Left	10001101	8D		I	—	—	✓	✓	✓
Rotate Right	10001110	8E		I	—	✓	—	✓	✓
Rotate Left	10001100	8C		I	—	✓	—	✓	✓
Clear	10001010	8A		I	—	—	✓	✓	✓
Reset Busy (Abort)	10001011	8B		I	✓	—	—	—	—

NOTE: (1) Associated Bus Line for display control flags. Status appears on Bus Line on MRD input following a get control flags instruction.  
 (2) Only if busy is due to Load Character.  
 (3) See Instruction Set for special precautions.

X = Variable Data Y = Flag State  
 Short Busy is 5 to 10 periods of master oscillator, or 125 $\mu$ sec at 82 KHz.  
 Long Busy is up to 100 periods of master oscillator or 2 msec at 82 KHz.  
 Input instructions are accomplished when MWR and CS are held low.  
 Output instructions are accomplished when MRD and CS are held low. (An output instruction must have been previously written.)



## Instruction Set

DESCRIPTION	OP. CODE HEX CODE (SEE NOTE 1)	HEX CODE	BUS (SEE NOTE 1)	INPUT OR OUTPUT	TIMER EXEC.	CREATES SHORT BUSY	CREATES LONG BUSY	NOT DURING MWD	NOT DURING BUSY
Load Character	001XXXXX to 010XXXXX	20 to 5F		I	-	-	✓	✓	✓
Load Cursor Location	000XXXXX	00 to 1F		I	✓	-	✓	✓	(see note 2)
Set Display Control Flag	011XXXXY	60 to 71		I	✓	-	-	-	-
Blink Cursor	01100000 - off 01100001 - on	60 61	0						
Blink Display	01100010 - off 01100011 - on	62 63	1						
Auto Inc/Dec	01100100 - off 01100101 - on	64 65	2						
Up/Down	01100110 - off 01100111 - on	66 67	3						
Blank Display	01101000 - off 01101001 - on	68 69	4						
Visible Cursor	01101010 - off 01101011 - on	6A 6B	5						
Cursor Type	01101100 - off 01101101 - on	6C 6D	6						
Busy	Output Only	-	7						
Rapid Load	01101110 - off 01101111 - on	6E 6F							
Power Down	01110000 - off 01110001 - on	70 71							
Get Character	10000100	80		O	✓	-	-	(see note 3)	✓ (see note 3)
Get Cursor Location	10000010	82		O	✓	-	-	-	-
Get Display Control Flags	10000001	81		O	✓	-	-	-	-
Decrement Cursor Increment Cursor	10001000 Low Limit	88 89		I	✓	-	-	-	✓ (see note 2)
Shift Right	10001100	87		I	-	-	✓	✓	✓
Shift Left	10001101	8D		I	-	-	✓	✓	✓
Rotate Right	10001110	8E		I	-	✓	-	✓	✓
Rotate Left	10001100	8C		I	-	✓	-	✓	✓
Clear	10000100	8A		I	-	-	✓	✓	✓
Reset Busy (Abort)	10001011	8B		I	✓	-	-	-	-

NOTE: (1) Associated Bus Line for display control flags. Status appears on Bus Line on MRD input following a get control flags instruction.  
 (2) Only if busy is due to Load Character.  
 (3) See Instruction Set for special precautions.

X = Variable Data Y = Flag State

Short Busy is 5 to 10 periods of master oscillator, or 125µsec at 82 KHz.

Long Busy is up to 100 periods of master oscillator, or 2 msec at 82 KHz.

Input instructions are accomplished when MWR and CS are held low.

Output instructions are accomplished when MRD and CS are held low. (An output instruction must have been previously written.)

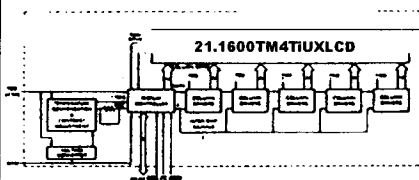
# MODEL PCIM 2

## PIN FUNCTIONS

V <sub>DD</sub>	Positive terminal for module power supply.
GND	Negative terminal for module power supply.
$\overline{CS}$	Terminal to select/enable module. A "LOW" at this terminal will enable.
MRD	Terminal to place module in "READ" mode. This mode is obtained when MRD is "LOW."
MWR	Terminal to place module in "WRITE" mode. This mode is obtained when MWR is "LOW."
D7-D0	8 bit directional I/O bus which allows control of the display via the various instructions.

## MODULE BLOCK DIAGRAM

PCIM 201



## DISPLAY CONTROL FLAGS

FLAG	ADDRESS	BUS
Blink Cursor	0000	0
Blink Display	0001	1
Auto Dec/Inc	0010	2
Up/Down	0011	3
Blank Display	0100	4
Visible Cursor	0101	5
Cursor Type	0110	6
Busy	Output Only	7
Rapid Load	0111	—
Power Down	1000	—

## INSTRUCTION SET

DESCRIPTION	OP CODE	INPUT OR OUTPUT	IMMEDIATE EXECUTION	CURSOR MOVE	CREATES LONG BUSY	NO DURING POWER DOWN	NO DURING POWER DOWN
Load Character	001XXXXX or 010XXXXX	I					
Load Cursor Location	000XXXXX	I	*				*1
Set Display Control Flag	011XXXXY	I	*				
Get Character	1000100	O	*			*2	*2
Get Cursor Location	1000010	O	*				
Get Display Control Flags	1000001	O	*				
Dec/Inc Cursor	1000100X	I	*				*1
Shift Right	10001111	I		*	*	*	*
Shift Left	10001101	I		*	*	*	*
Rotate Right	10001110	I		*	*	*	*
Rotate Left	10001100	I		*	*	*	*
Clear	10001010	I		*	*	*	*
Reset Busy (Aboard)	10001011	I	*				

(1) Only if busy is due to load character.  
 (2) Refer to instruction explanation for special precautions.  
 Short busy ranges from 0.1 to 0.2 ms.  
 Long busy last up to 3.5 ms (Typ.)  
 Input instructions are executed when MWR and  $\overline{CS}$  are held "LOW."  
 Output instructions are executed when MRD and  $\overline{CS}$  are "LOW." An output instruction must have been previously written. Output data is that of most recent output instruction.

## INSTRUCTION EXPLANATION

### Get Character

This instruction will enable the ASCII code for the character pointed by the cursor location register into the I/O bus. There are two cases to watch for:

- After a "Load Cursor Location" instruction, a time of 3.5 ms must be allowed before the "Get Character" instruction in order to guarantee that the character retrieved is the one pointed by the new cursor.
- If the cursor location has been changed during the power down, the "Get Character" instruction will output correct data only after the power down is stopped and 3.5 ms have passed.

### Get Cursor Location

This instruction will cause the number stored in the cursor location register to be enabled onto the I/O bus. The LSB appears on bus 0 and MSB appears on bus 4.

### Get Display Control Flags

This instruction enables the contents of the display control flags register onto the I/O bus. For details, refer to Display Control Flags.

### Load Character

The instruction code is 001XXXXX or 010XXXXX depending on whether bit 5 of ASCII data is a "1" or "0" respectively. Refer to ASCII character set. This instruction creates a long busy and cannot be performed during an existing busy condition or a power down. During the busy time, the ASCII data is loaded into a memory location that corresponds to the display position held in the cursor location register.

### Dec/Inc Cursor

The instruction code is 1000100X, where X = 1(0) will cause an immediate increment (decrement) of the cursor location register by one.

### Shift

The shift right (left) instruction moves every character right (left) by one position and loads a blank into the first (last) position.

### Rotate

The rotate right (left) instruction moves every character right (left) by one position and moves the last (first) character to the first (last) position. The rotation is a 32 character rotation.

### Clear

This instruction loads a blank into every display location.

### Reset Busy

This instruction aborts any instruction execution which has caused a busy signal, resets the busy flag, and allows the immediate loading of any instruction. The aborted instruction may or may not have been completed.

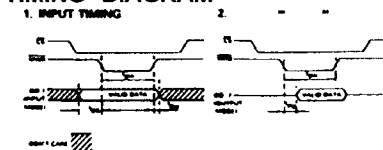
### Load Cursor Location

The instruction code is 000XXXXX, where XXXXX can be any binary number "0" through "31." "0" corresponds to the 1st location and 31 corresponds to the 32nd location. The left most position is the "0" location.

### Set Flag

The instruction code is 011XXXXY, where XXXXX is a binary number: 0-8 which corresponds to one of the 9 flag registers and Y is the flag state. Display Control Flags gives the flag address, and the I/O bus on which the flag contents appear after the "Get Display Control Flag" instruction.

## TIMING DIAGRAM



## DISPLAY CONTROL FLAG EXPLANATION

### Blink Cursor

A "1" in this flag causes the cursor to blink at approximately 1 Hz. The cursor visible flag must be set.

### Blink Display

When this flag is set, the entire display flashes on and off at approximately 1 Hz.

### Auto Dec/Inc

A "1" in this flag will cause the cursor location register to automatically change by one every time a character is read from or written to the character register.

### Up/Down

A "1" ("0") in this flag works in conjunction with the auto Dec/Inc flag to cause automatic incrementing (decrementing) of the cursor location register.

### Blank Display

A "1" in this flag will blank the display but leaves the display memory intact.

### Vldbfe Cursor

A "1" in this flag causes the cursor to be visible. The cursor cannot be blinked unless it is visible.

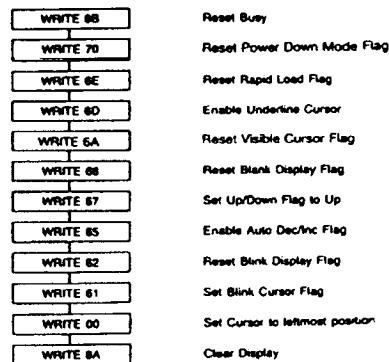
## ASCII CHARACTER SET

(2,1,0)	H(3) BITS (5,4,3)	000	001	010	011	100	101	110	111
		@	H	P	X				
		A	I	O	Y				
		B	J	R	Z	*	*	2	:
		C	K	S		#	+	3	:
		D	L	T	\	\$	.	4	<
		E	M	U		%	-	5	=
		F	N	V	'	&		6	>
		G	O	W	-		/	7	?

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## INITIALIZATION

The module does not power up into a particular state. Hence, it requires initialization on power up. The following is a typical power up sequence:

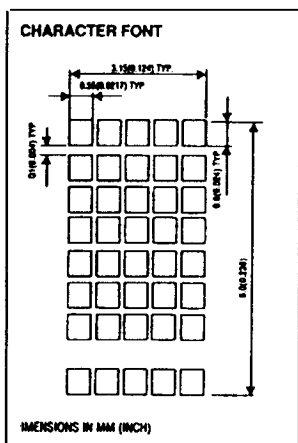


HANDLING PRECAUTIONS: The PCIM MI contains CMOS devices and must be handled correctly to prevent damage. Do not make any circuit changes under "Power On" conditions as high transients may cause permanent damage.

Authorized Distributors:

## Display Control Flags

FLAG	ADDRESS	BUS
Blink Cursor	0000	0
Blank Display	0001	1
Auto Dec/Inc	0010	2
Up/Down	0011	3
Blank Display	0100	4
Visible Cursor	0101	5
Cursor Type	0110	6
Busy	Output Only	7
Rapid Load	0111	—
Power Down	1000	—



## Display Control Flag Explanation

**Blink Cursor**  
A '1' in this flag causes the cursor to blink at approximately 1Hz. The cursor visible flag must be set.

**Blink Display**  
When this flag is set, the entire display flashes on and off at approximately 1Hz.

**Auto Dec/Inc**  
A "1" in this flag will cause the cursor location register to automatically change by one every time a character is read from or written to the character register.

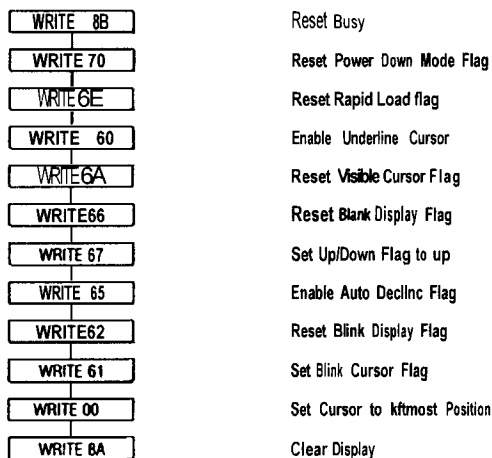
**Up/Down**  
A '1' ('0') in this flag works in conjunction with the auto Dec/Inc flag to cause automatic incrementing (decrementing) of the cursor location register.

**Blank Display**  
A '1' in this flag will blank this display but leaves the display memory intact.

**Visible Cursor**  
A '1' in this flag causes the cursor to be visible. The cursor cannot be blinked unless it is visible.

## Initialization

The moduk does not power up into a particular state. Hence, it requires initialization on power up. The following is a typical power up sequence. Instruction codes expressed in hexadecimal notation.

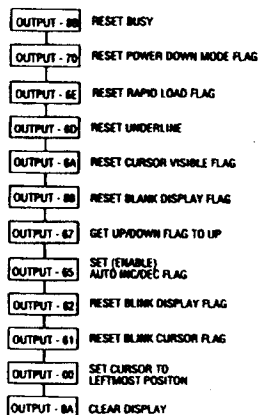


**Initialize:** This sequence, performed after system power up, will initialize everything, blank the cursor and set it at the left most position, and be ready for character load from left to right.

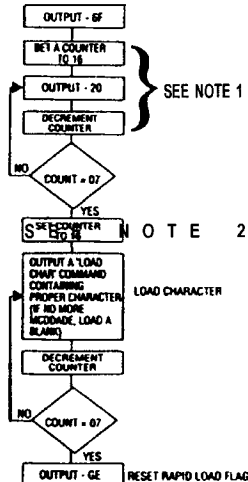
**Rapid Load Display:** This sequence will display a 10 character message using the rapid load feature. Assume initialization was done as in example.

**Character Load Display:** Suppose the display shows the message SUM = 354.2 (left justified) and if it is desired that this be change to SUM = 357.8. Assume the initialization of the example

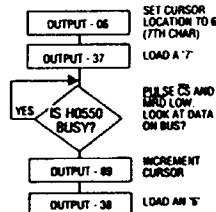
Sample Program 1



Sample Program 2



Sample Program 3

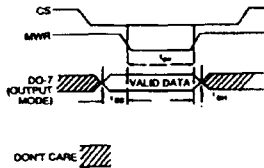


Note 1 Only necessary for single line display (Delete section for 2 line display.)  
Note 2 Set to 32 for 2 line display.

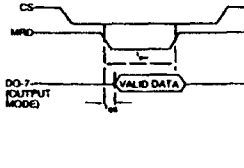


## TIMING DIAGRAM

### 1. INPUT TIMING



### 2. OUTPUT TIMING



DON'T CARE

## ASCII Character Set

DO-7 (OUTPUT MODE)	000	001	010	011	100	101	110	111
000	0	H	P	X	(	0	8	
001	1	A	C	Y	)	9		
010	B	J	R	Z	*	2	.	
011	C	K	S	[	+	3	:	
100	D	L	T	/	\$	4	<	
101	E	M	U	]	%	5	=	
110	F	N	V	^	&	6	>	
111	G	O	W	_	'	7	?	

## Instruction Explanation

### Get Character

This instruction will enable the ASCII code for the character pointed by the cursor location register into the I/O bus. There are two cases to watch for:

1. After a 'Load Cursor Location' instruction, a delay of 3.5 ms must elapse before the 'Get Character' instruction is issued in order to guarantee that the character retrieved is the one pointed by the new cursor.
2. If the cursor location has been changed during the power down, the 'Get Character' instruction will output correct data only after the power down is stopped and 3.5 ms have passed.

### Get Cursor Location

This instruction will cause the number stored in the cursor location register to be enabled onto the I/O bus. The LSB appears on bus 0 and MS6 appears on bus 4.

### Get Display Control Flags

This instruction enables the contents of the display control flags register onto the I/O bus. For details, refer to Display Control Flags.

### Load Character

The instruction code is 001XXXXX or 010XXXXX depending on whether bit 5 of ASCII data is a '1' or '0' respectively. Refer to ASCII character set. This instruction creates a long busy and cannot be performed during an existing busy condition or a power down. During the busy time, the ASCII data is loaded into a memory location that corresponds to the display position held in the cursor location register.

### Dec/Inc Cursor

The instruction code is 1000100X, where X = 1(0) will cause an immediate increment (decrement) of the cursor location register by one.

### shin

The shift right (left) instruction moves every character right (left) by one position and loads a blank into the first (last) position.

### Rotate

The rotate right (left) instruction moves every character right (left) by one position and moves the last (first) character to the first (last) position. The rotation is a 32 character rotation. Even when only 16 character display is used.

### Clear

This instruction loads a blank into every display location.

### Reset Busy

This instruction aborts any instruction execution which has caused a busy signal, resets the busy flag, and allows the immediate loading of any instruction. The aborted instruction may or may not have been completed.

### Load Cursor Location

The instruction code is 000XXXXX where XXXXX can be any binary number "0" through "31." "0" corresponds to the 1st location and 31 corresponds to the 32nd location. The left most position is the "0" location.

### Set Flag

The instruction code is 011XXXXY where XXXX is a binary number 0-8 which corresponds to one of the 9 flag registers and Y is the flag state. Display Control Flags gives the flag address, and the I/O bus on which the flag contents appear after the 'Get Display Control Flag' instruction.

