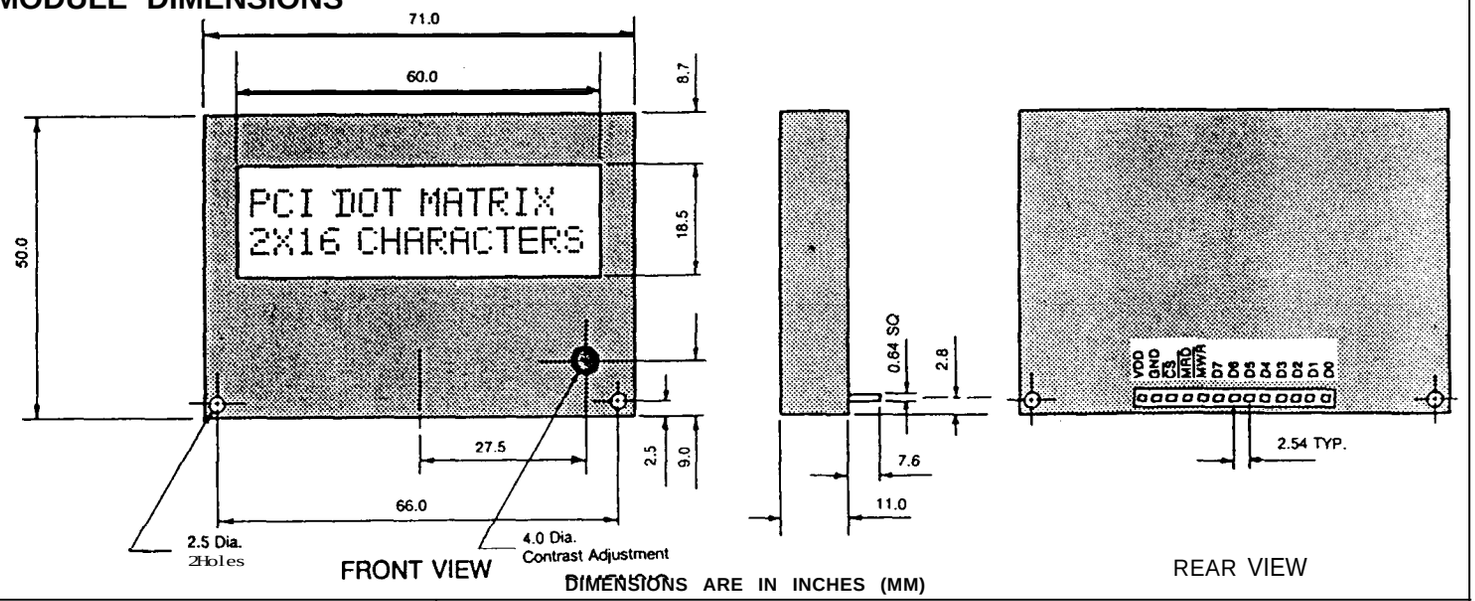
MODEL PCIM 201

HIGH CONTRAST 1 X 16 DOT MATRIX LCD MODULE

MODULE DIMENSIONS



DIMENSIONS ARE IN INCHES (MM)

DESCRIPTION

The PCIM 201 is designed to achieve a high standard of optical quality for any apptiition 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 in&or/ outdoor usage without excessive power drain.

FEATURES

- 2linex16Characters5x7PlusCursor 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
- Slectable Top View or Bottom Viiw 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

KEY:
BV = Bottom View
H = Wide Temperature
TV = Top View

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

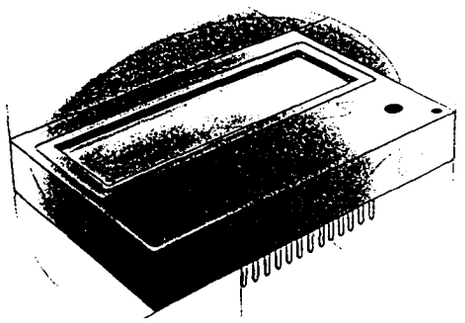
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage	V_{DD}	—	4.5	5.0	5.5	V
Supply Current	I_{DD}	V_{DD} = 5V	—	7.7	14	mA
Quiescent Current	I_Q	Power Down Mode Inputs at either supply	—	—	5	mA
Input "High" Voltage	V_{IH}	V_{DD} = 4.5 to 5.5V	$0.8V_{DD}$	—	V_{DD}	V
Input "Low" Voltage	V_{IL}	V_{DD} = 5.0V	0	—	$0.5V_{DD}$	V
Input Leakage Current	I_L	V_{IN} = 0V, V_{DD} = 5V	—	—	5	µA
Input Capacitance	C_{IN}	—	—	—	6.5	pF
Bus Output "High" Voltage	V_{OH}	V_{DD} = 5V I = 1.6mA Source	4.0	—	—	V
Bus Output "Low" Voltage	V_{OL}	V_{DD} = 5V I = 1.6mA Sink	—	—	0.4	V
CS, MWR & MRD Pulse	t_{pw}	—	700 800*	—	—	nS
Data Set-up Time	t_{DS}	—	26	—	—	nS
Data Hold Time	t_{DH}	—	75	—	—	nS
MRD Fall to Valid Data Time	t_{PD}		— 600	400	700	nS

Note: Operating Voltage Referenced to GND

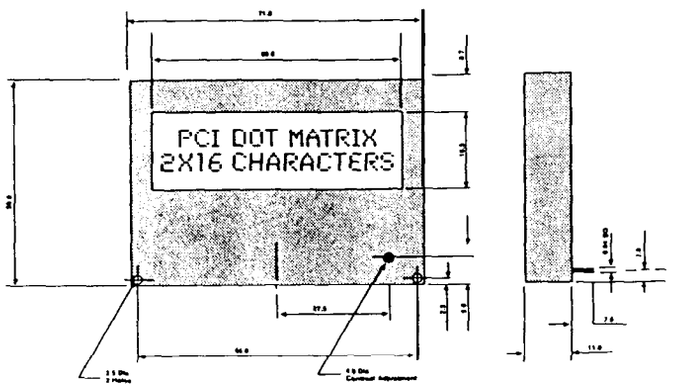
*Wide Temp Version

High Contrast 2 x 16 Dot Matrix LCD Module

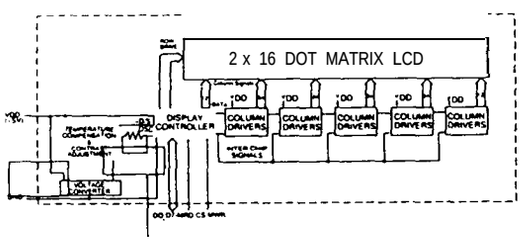
The PCIM 201 is designed to achieve a high standard of optical quality for any application by selectable viewing, top view or bottom view. The display's highest contrast viewing range is tailored to your exact application. Optional wide temperature operation is available for indoor/outdoor usage without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



Module Dimensions



FRONT VIEW



Pin Functions

VDD	Positive terminal for module power supply.
GND	Negative terminal for module power supply.
$\overline{CS}$	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-DO	8 bit directional 1/0 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.	9296 RH Max @ 40%	909% RH Max @ 70°C

Electrical Characteristics Ta = 25°C

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage	V_{DD}	—	4.5	5.0	5.5	V
Supply Current	I_{DD}	V_{DD} = 5V		7.7	14	mA
Quiescent Current	I_Q	Power Down Mode — Inputs al either supply	—	—	5	mA
Input "High" Voltage	V_{IH}	V_{DD} = 4.5 to 5.5V	0.8V_{DD}	—	V_{DD}	V
Input "Low" Voltage	V_{IL}	V_{DD} = 5.0V	0	—	0.5V_{DD}	V
Input Leakage Current	I_L	V_{IN} = 0V, V_{DD} = 5V	—	—	5	µA
Input Capacitance	C_{IN}	—	—	—	6.5	pF
Bus Output "High" Voltage	V_{OH}	V_{DD} = 5V I = 1.6mA Source	4.0	—	—	V
Bus Output "Low" Voltage	V_{OL}	V_{DD} = 5V I = 1.6mA Sink	—	—	0.4	V
CS, MWR & MRD Pulse	t_{pw}	—	700 800*	—	—	nS
Data Set-up Time	t_{DS}	—	20	—	—	nS
Data Hold Time	t_{DH}	—	75	—	—	nS
MRD Fall to Valid Data Time	t_{PD}	—	— 600	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
- 1/8 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 conditions as high transients may cause permanent damage.*

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 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	84		0	✓	—	—	✓ (see note 3)	✓ (see note 3)
Get Cursor Location	10000010	82		0	✓	—	—		—
Get Display Control Flags	10000001	81		0	✓		—		—
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)	1000101 1	8B		I	✓		—		—

NOTE: (I) Associated Bus Line for display control flags. Status appears on Bus Line on MRD input following a get control gags 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 lo 10 periods of master oscillator, or 125μsec al 82 KHz.
Long Busy is up to 100 periods of master oscillator or 2 msec al 82 KHz.
Input instructions are accomplished when MWR and CS are held low.
Output instructions are accomplished when MRD and CS are held tow. (An output instruction must have been previously written.)

Instruction Set

DESCRIPTION	OP CODE 7654321Ø (SEE NOTE 1)	HEX CODE	BUS (SEE NOTE 1)	INPUT OR OUTPUT	IMMED. EXEC.	CREATES SHORT BUSY	CREATES LONG BUSY	CAN'T DURING PD	CAN'T 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 68	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	84		0	—	—	—	✓ (see note 3)	✓ (see note 3)
Get Cursor Location	10000010	82		0	✓	—	—	—	—
Get Display Control Flags	10000001	81		0	—	—	—	—	—
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	88		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 $\overline{MWR}$ and $\overline{CS}$ are held low.
Output instructions are accomplished when MRD and $\overline{CS}$ are held low. (An output instruction must have been previously written.)

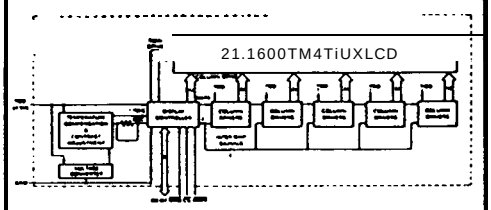
MODEL PCIM 2

PIN FUNCTIONS

V_{DD}	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.
$\overline{MRD}$	Terminal to place module in 'READ' mode. This mode is obtained when $\overline{MRD}$ is 'LOW.'
$\overline{MWR}$	Terminal to place module in 'WRITE' mode. This mode is obtained when $\overline{MWR}$ 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	CREATES SHORT BUSY	CREATES LONG BUSY	NOT DURING POWER DOWN	NOT DURING BUSY
Load Character	001XXXXX or 010XXXXX	I			•	•	•
Load Cursor Location	000XXXXX	I	•				*1
Set Display Control Flag	011XXXXY	I	•				
Get Character	10000100	O	•			*2	*2
Get Cursor Location	10000010	O	•				
Get Display Control Flags	10000001	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 (Abort)	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 $\overline{MWR}$ and $\overline{CS}$ are held 'LOW.'

Output instructions are executed when $\overline{MRD}$ 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 :

1. 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.
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 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 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.

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.

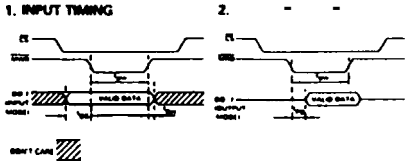
Vldbfe Cursor
A '1' in this flag causes the cursor to be visible. The cursor cannot be blinked unless it is visible.

ASCII CHARACTER SET

(2,1,0) LO 3 BITS \ HI 3 BITS (5,4,3)	000	001	010	011	100	101	110	111
000	@	H	P	X		(	0	8
001	A	I	Q	Y	'	)	1	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	?

TIMING DIAGRAM

1. INPUT TIMING 2. - -



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.

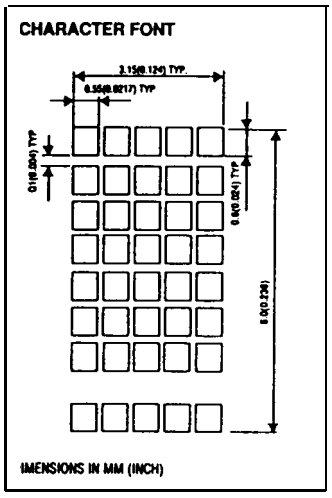
WRITE 6B	Reset Busy
WRITE 70	Reset Power Down Mode Flag
WRITE 6E	Reset Rapid Load Flag
WRITE 6D	Enable Underline Cursor
WRITE 6A	Reset Visible Cursor Flag
WRITE 68	Reset Blank Display Flag
WRITE 67	Set Up/Down Flag to Up
WRITE 65	Enable Auto Dec/Inc Flag
WRITE 62	Reset Blink Display Flag
WRITE 61	Set Blink Cursor Flag
WRITE 00	Set Cursor to leftmost position
WRITE 8A	Clear Display

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
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	—



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 DecIInc
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 gag causes the cursor to be visible. The cursor cannot be blinked unless it is visible.

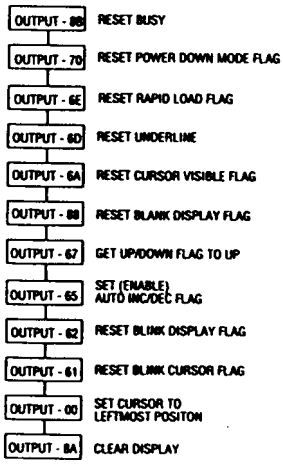
Initialization

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.

WRITE 8B	Reset Busy
WRITE 70	Reset Power Down Mode Flag
WRITE 6E	Reset Rapid Load flag
WRITE 60	Enable Underline Cursor
WRITE 6A	Reset Visible Cursor Flag
WRITE 66	Reset Blank Display Flag
WRITE 67	Set Up/Down Flag to up
WRITE 65	Enable Auto DecIInc Flag
WRITE 62	Reset Blink Display Flag
WRITE 61	Set Blink Cursor Flag
WRITE 00	Set Cursor to kftmost Position
WRITE 8A	Clear Display

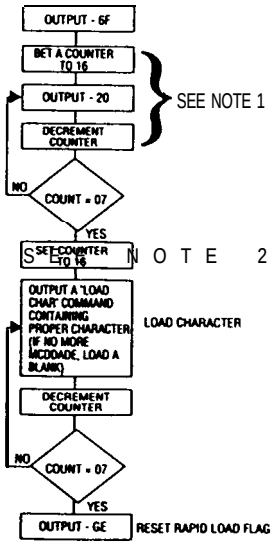
Initialize: This sequence, performed after system power up, will initialize everything, blank the cursor and set it at the left most position, and be ready for character badii from left to right.

Sample Program 1



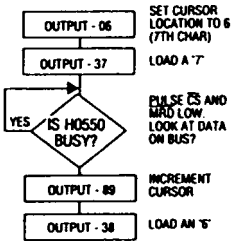
Rapid Load Display: This sequence will display a 10 character message using the rapid load feature. Assume initialization was done as in example.

Sample Program 2



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

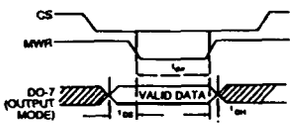
Sample Program 3



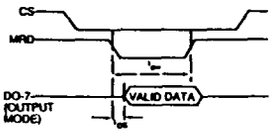
Note 1 Only necessary fur single line display (Delete section for 2 line display.)
Note2 Set to 32 for 2 line display.

TIMING DIAGRAM

1 INPUT TIMING



2. OUPUT TIMING



DON'T CARE

ASCII Character Set

HI 3 BITS (2,1,0) / LO 3 BITS	000	001	010	011	100	101	110	111
000	@	H	P	X		(	0	8
001	A	I	Q	Y	!	)	1	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 1/0 bus. The LSB appears on bus 0 and MS6 appears on bus 4.

Get Display Control Flags
Thii instruction enables the contents of the display control flags register onto the 1/0 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. Thii 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 = I(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
Thii 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 OOOXXXXX 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 1/0 bus on which the flag contents appear after the 'Get Display Control Flag' instruction.