

64K Commercial Industrial X2864B X2864BI 8192 x 8 Bit

## Electrically Erasable PROM

### TYPICAL FEATURES

- 120 ns Access Time
- High Performance Scaled NMOS Technology
- Fast Write Cycle Times
  - 32-Byte Page Write Operation
  - Byte or Page Write Cycle: 3 ms Typical
  - Complete Memory Rewrite: 750 ms Typical
  - Effective Byte Write Cycle Time of 95  $\mu$ s Typical
- DATA Polling
  - Allows User to Minimize Write Cycle Time
- Simple Byte and Page Write
  - Single TTL Level WE Signal
  - Internally Latched Address and Data
  - Automatic Write Timing
- JEDEC Approved Byte-Wide Pinout
- High Reliability
  - Endurance: 10,000 Cycles
  - Data Retention: 100 Years

### DESCRIPTION

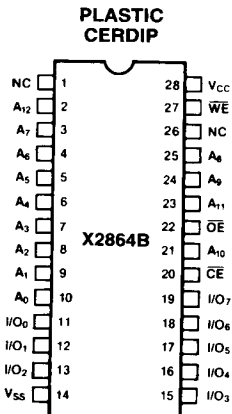
The Xicor X2864B is a 8K x 8 E<sup>2</sup>PROM, fabricated with an advanced, high performance N-channel floating gate MOS technology. Like all Xicor programmable nonvolatile memories it is a 5V only device. The X2864B features the JEDEC approved pinout for byte-wide memories, compatible with industry standard RAMs, ROMs and EPROMs.

The X2864B supports a 32-byte page write operation, effectively providing a 95  $\mu$ s/byte write cycle and enabling the entire memory to be written in less than 750 ms. The X2864B also features DATA Polling, a system software support scheme used to indicate the early completion of a write cycle.

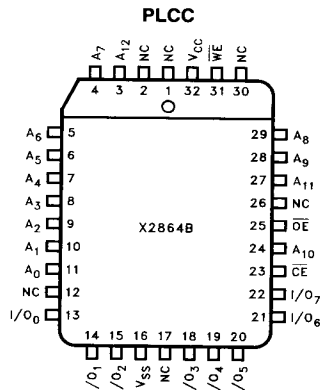
Xicor E<sup>2</sup>PROMs are designed and tested for applications requiring extended endurance. Inherent data retention is greater than 100 years. Refer to RR-515 for details of data retention characteristics for Xicor non-volatile memories.

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### PIN CONFIGURATIONS



0031-1



0031-2

### PIN NAMES

A <sub>0</sub> -A <sub>12</sub>	Address Inputs
I/O <sub>0</sub> -I/O <sub>7</sub>	Data Input/Output
WE	Write Enable
CE	Chip Enable
OE	Output Enable
V <sub>CC</sub>	+ 5V
V <sub>SS</sub>	Ground
NC	No Connect

# X2864B, X2864BI

## ABSOLUTE MAXIMUM RATINGS\*

Temperature Under Bias	
X2864B	-10°C to +85°C
X2864BI	-65°C to +135°C
Storage Temperature	-65°C to +150°C
Voltage on any Pin with Respect to Ground	-1.0V to +7V
D.C. Output Current	5 mA
Lead Temperature (Soldering, 10 Seconds)	300°C

## \*COMMENT

Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and the functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## D.C. OPERATING CHARACTERISTICS

X2864B  $T_A = 0^\circ\text{C}$  to  $+70^\circ\text{C}$ ,  $V_{CC} = +5V \pm 5\%$ , unless otherwise specified.

X2864BI  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ ,  $V_{CC} = +5V \pm 10\%$ , unless otherwise specified.

Symbol	Parameter	Limits			Units	Test Conditions
		Min.	Typ.(1)	Max.		
$I_{CC}$	$V_{CC}$ Current (Active)		80	140	mA	$\overline{CE} = \overline{OE} = V_{IL}$ All I/O's = Open Other Inputs = $V_{CC}$
$I_{SB}$	$V_{CC}$ Current (Standby)		50	70	mA	$\overline{CE} = V_{IH}$ , $\overline{OE} = V_{IL}$ All I/O's = Open Other Inputs = $V_{CC}$
$I_{LI}$	Input Leakage Current			10	$\mu\text{A}$	$V_{IN} = \text{GND to } V_{CC}$
$I_{LO}$	Output Leakage Current			10	$\mu\text{A}$	$V_{OUT} = \text{GND to } V_{CC}$ , $\overline{CE} = V_{IH}$
$V_{IL}^{(2)}$	Input Low Voltage	-1.0		0.8	V	
$V_{IH}^{(2)}$	Input High Voltage	2.0		$V_{CC} + 1.0$	V	
$V_{OL}$	Output Low Voltage			0.4	V	$I_{OL} = 2.1 \text{ mA}$
$V_{OH}$	Output High Voltage	2.4			V	$I_{OH} = -400 \mu\text{A}$

## ENDURANCE AND DATA RETENTION

Parameter	Min.	Max.	Unit	Condition
Minimum Endurance	10,000		Cycles/Byte	Reliability Report-520
Data Retention	100		Years	Reliability Report-515

## TYPICAL POWER-UP TIMING

Symbol	Parameter	Typ.(1)	Units
$t_{PUR}^{(3)}$	Power-Up to Read Operation	1	ms
$t_{PUW}^{(3)}$	Power-Up to Write Operation	5	ms

**CAPACITANCE**  $T_A = 25^\circ\text{C}$ ,  $f = 1.0 \text{ MHz}$ ,  $V_{CC} = 5V$

Symbol	Test	Max.	Units	Conditions
$C_{I/O}^{(3)}$	Input/Output Capacitance	10	pF	$V_{I/O} = 0V$
$C_{IN}^{(3)}$	Input Capacitance	6	pF	$V_{IN} = 0V$

- Notes:** (1) Typical values are for  $T_A = 25^\circ\text{C}$  and nominal supply voltage.  
 (2)  $V_{IL}$  min. and  $V_{IH}$  max. are for reference only and are not tested.  
 (3) This parameter is periodically sampled and not 100% tested.

# X2864B, X2864BI

## A.C. CONDITIONS OF TEST

Input Pulse Levels	0.4V to 2.4V
Input Rise and Fall Times	10 ns
Input and Output Timing Levels	0.8V and 2.0V
Output Load	1 TTL Gate and $C_L = 100$ pF

## MODE SELECTION

CE	OE	WE	Mode	I/O	Power
L	L	H	Read	D <sub>OUT</sub>	Active
L	H	L	Write	D <sub>IN</sub>	Active
H	X	X	Standby and Write Inhibit	High Z	Standby
X	L	X	Write Inhibit	—	—
X	X	H	Write Inhibit	—	—

## A.C. CHARACTERISTICS

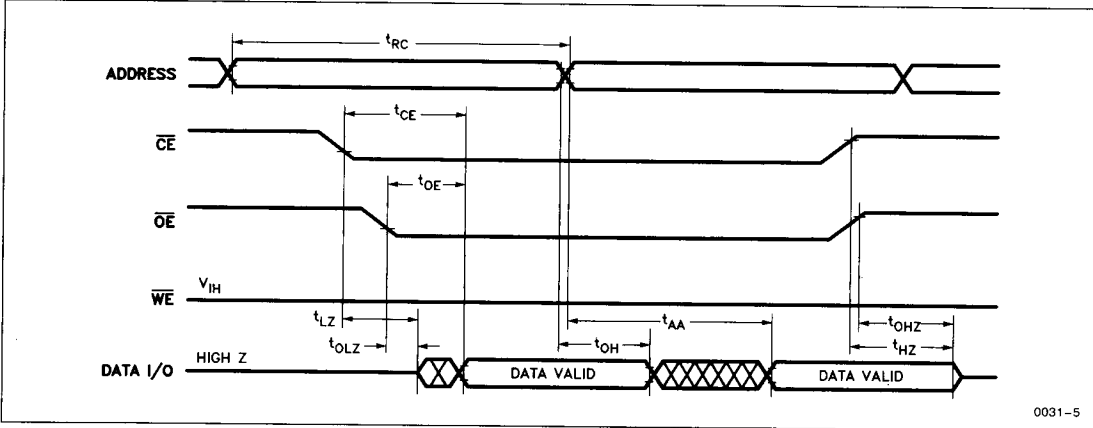
X2864B  $T_A = 0^\circ\text{C}$  to  $+70^\circ\text{C}$ ,  $V_{CC} = +5\text{V} \pm 5\%$ , unless otherwise specified.

X2864BI  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ ,  $V_{CC} = +5\text{V} \pm 10\%$ , unless otherwise specified.

## Read Cycle Limits

Symbol	Parameter	X2864B-12 X2864BI-12		X2864B-15 X2864BI-15		X2864B-20 X2864BI-20		X2864B-25 X2864BI-25		Units
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
$t_{RC}$	Read Cycle Time	120		150		200		250		ns
$t_{CE}$	Chip Enable Access Time		120		150		200		250	ns
$t_{AA}$	Address Access Time		120		150		200		250	ns
$t_{OE}$	Output Enable Access Time		50		70		100		100	ns
$t_{LZ}^{(4)}$	CE Low to Active Output	0		0		0		0		ns
$t_{OLZ}^{(4)}$	OE Low to Active Output	0		0		0		0		ns
$t_{HZ}^{(5)}$	CE High to High Z Output	0	50	0	50	0	50	0	50	ns
$t_{OHZ}^{(5)}$	OE High to High Z Output	0	50	0	50	0	50	0	50	ns
$t_{OH}$	Output Hold from Address Change	0		0		0		0		ns

## Read Cycle



Notes: (4)  $t_{LZ}$  min. and  $t_{OLZ}$  min. are shown for reference only, they are periodically characterized and are not tested.

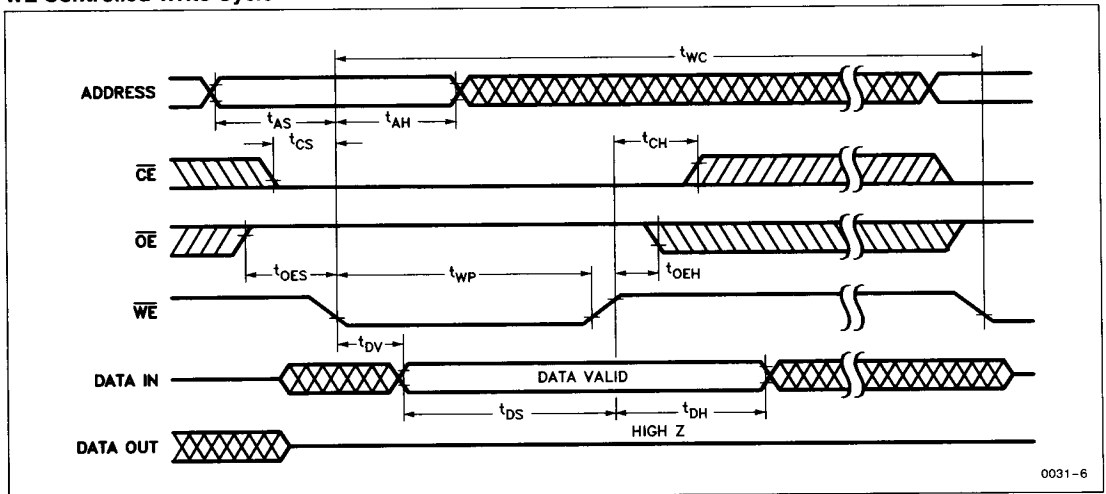
(5)  $t_{HZ}$  max. and  $t_{OHZ}$  max. are measured from the point when CE or OE return high (whichever occurs first) to the time when the outputs are no longer driven.  $t_{HZ}$  min. and  $t_{OHZ}$  min. are shown for reference only, they are periodically characterized and are not tested.

# X2864B, X2864BI

## Write Cycle Limits

Symbol	Parameter	Min.	Typ. <sup>(6)</sup>	Max.	Units
$t_{WC}^{(7)}$	Write Cycle Time		3	5	ms
$t_{AS}$	Address Setup Time	5			ns
$t_{AH}$	Address Hold Time	50			ns
$t_{CS}$	Write Setup Time	0			ns
$t_{CH}$	Write Hold Time	0			ns
$t_{CW}$	$\overline{CE}$ Pulse Width	100			ns
$t_{OES}$	$\overline{OE}$ High Setup Time	10			ns
$t_{OEH}$	$\overline{OE}$ High Hold Time	10			ns
$t_{WP}$	$\overline{WE}$ Pulse Width	100			ns
$t_{WPH}$	$\overline{WE}$ High Recovery	50			ns
$t_{DV}$	Data Valid			100	$\mu$ s
$t_{DS}$	Data Setup	50			ns
$t_{DH}$	Data Hold	5			ns
$t_{DW}$	Delay to Next Write	10			$\mu$ s
$t_{BLC}$	Byte Load Cycle	1		100	$\mu$ s

## WE Controlled Write Cycle

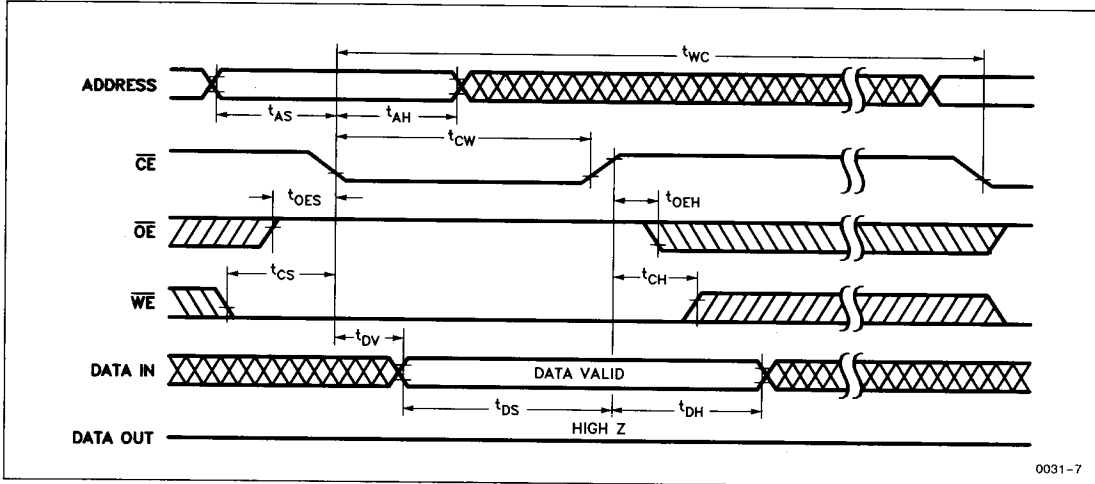


Notes: (6) Typical values are for  $T_A = 25^\circ\text{C}$  and nominal supply voltage.

(7)  $t_{WC}$  is the minimum cycle time from the system perspective; it is the maximum time the device requires to perform the internal write operation.

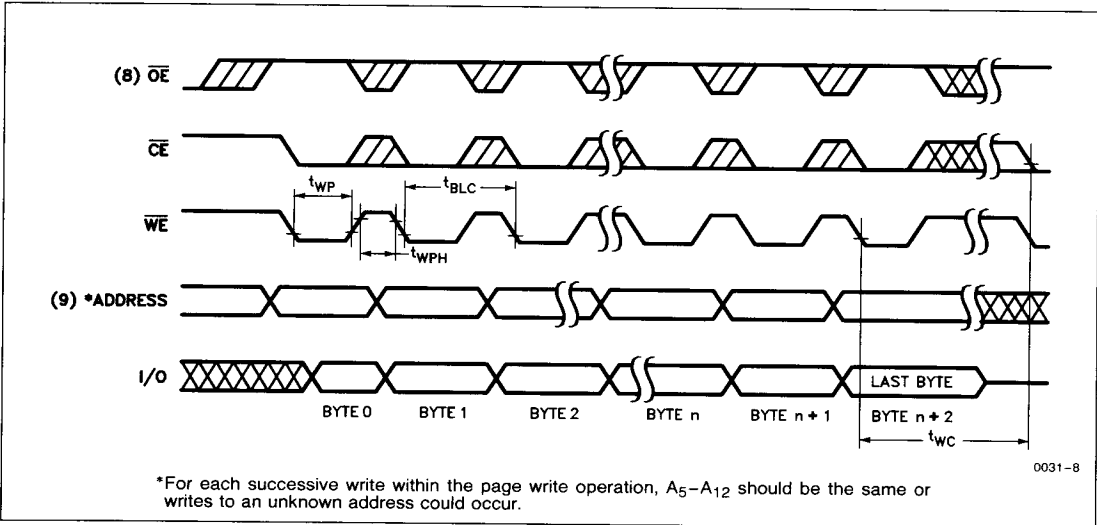
# X2864B, X2864BI

## $\overline{CE}$ Controlled Write Cycle



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## Page Write Cycle

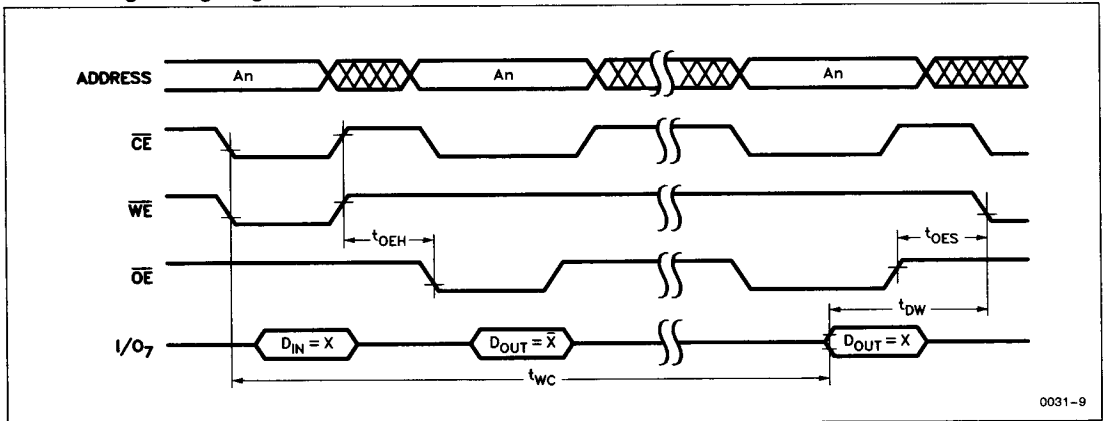


**Notes:** (8) Between successive byte writes within a page write operation,  $\overline{OE}$  can be strobed LOW; e.g., this can be done with  $\overline{CE}$  and WE HIGH to fetch data from another memory device within the system for the next write; or with WE HIGH and  $\overline{CE}$  LOW effectively performing a polling operation.

(9) The timings shown above are unique to page write operations. Individual byte load operations within the page write must conform to either the  $\overline{CE}$  or WE controlled write cycle timing.

# X2864B, X2864BI

**DATA Polling Timing Diagram<sup>(10)</sup>**



**Note:** (10) Polling operations are by definition read cycles and are therefore subject to read cycle timings.

## SYMBOL TABLE

WAVEFORM	INPUTS	OUTPUTS
	Must be steady	Will be steady
	May change from Low to High	Will change from Low to High
	May change from High to Low	Will change from High to Low
	Don't Care : Changes Allowed	Changing : State Not Known
	N/A	Center Line is High Impedance

## X2864B, X2864BI

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### PIN DESCRIPTIONS

#### Addresses ( $A_0$ – $A_{12}$ )

The Address inputs select an 8-bit memory location during a read or write operation.

#### Chip Enable ( $\overline{CE}$ )

The Chip Enable input must be LOW to enable all read/write operations. When  $\overline{CE}$  is HIGH, power consumption is reduced.

#### Output Enable ( $\overline{OE}$ )

The Output Enable input controls the data output buffers and is used to initiate read operations.

#### Data In/Data Out ( $I/O_0$ – $I/O_7$ )

Data is written to or read from the X2864B through the I/O pins.

#### Write Enable ( $\overline{WE}$ )

The Write Enable input controls the writing of data to the X2864B.

### DEVICE OPERATION

#### Read

Read operations are initiated by both  $\overline{OE}$  and  $\overline{CE}$  LOW. The read operation is terminated by either  $\overline{CE}$  or  $\overline{OE}$  returning HIGH. This 2-line control architecture eliminates bus contention in a system environment. The data bus will be in a high impedance state when either  $\overline{OE}$  or  $\overline{CE}$  is HIGH.

#### Write

Write operations are initiated when both  $\overline{CE}$  and  $\overline{WE}$  are LOW and  $\overline{OE}$  is HIGH. The X2864B supports both a  $\overline{CE}$  and  $\overline{WE}$  controlled write cycle. That is, the address is latched by the falling edge of either  $\overline{CE}$  or  $\overline{WE}$ , whichever occurs last. Similarly, the data is latched internally by the rising edge of either  $\overline{CE}$  or  $\overline{WE}$ , whichever occurs first. A byte write operation, once initiated, will automatically continue to completion, typically within 3 ms.

#### Page Write Operation

The page write feature of the X2864B allows the entire memory to be written in 750 ms. Page write allows two

to thirty-two bytes of data to be consecutively written to the X2864B prior to the commencement of the internal programming cycle. The destination addresses for a page write operation must reside on the same page; that is,  $A_5$  through  $A_{12}$  must not change.

The page write mode can be entered during any write operation. Following the initial byte write cycle, the host can write an additional one to thirty-one bytes in the same manner as the first byte was written. Each successive byte load cycle, started by the  $\overline{WE}$  HIGH to LOW transition, must begin within 100  $\mu$ s of the falling edge of the preceding  $\overline{WE}$ . If a subsequent  $\overline{WE}$  HIGH to LOW transition is not detected within 100  $\mu$ s the internal automatic programming cycle will commence. There is no page write window limitation. The page write window is infinitely wide so long as the host continues to access the device within the byte load cycle time of 100  $\mu$ s.

#### $\overline{DATA}$ Polling

The X2864B features  $\overline{DATA}$  Polling as a method to indicate to the host system that the byte write or page write cycle has completed.  $\overline{DATA}$  Polling allows a simple bit test operation to determine the status of the X2864B, eliminating additional interrupt inputs or external hardware. During the internal programming cycle, any attempt to read the last byte written will produce the complement of that data on  $I/O_7$  (i.e., write data = 0xxx xxxx, read data = 1xxx xxxx). Once the programming cycle is complete,  $I/O_7$  will reflect true data.

#### WRITE PROTECTION

There are two features that protect the nonvolatile data from inadvertent writes.

- $V_{CC}$  Sense—All functions are inhibited when  $V_{CC}$  is  $\leq 3.5V$ .
- Write Inhibit—Holding either  $\overline{OE}$  LOW,  $\overline{WE}$  HIGH or  $\overline{CE}$  HIGH during power-on and power-off, will inhibit inadvertent writes.

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## X2864B, X2864BI

### SYSTEM CONSIDERATIONS

Because the X2864B is frequently used in large memory arrays it is provided with a two line control architecture for both read and write operations. Proper usage can provide the lowest possible power dissipation and eliminate the possibility of contention where multiple I/O pins share the same bus.

To gain the most benefit it is recommended that  $\overline{CE}$  be decoded from the address bus and be used as the primary device selection input. Both  $\overline{OE}$  and  $\overline{WE}$  would then be common among all devices in the array. For a read operation this assures that all deselected devices are in their standby mode and that only the selected device(s) is outputting data on the bus.

Because the X2864B has two power modes, standby and active, proper decoupling of the memory array is of prime concern. Enabling  $\overline{CE}$  will cause transient current spikes. The magnitude of these spikes is dependent on the output capacitive loading of the I/Os. Therefore, the larger the array sharing a common bus, the larger the transient spikes. The voltage peaks associated with the current transients can be suppressed by the proper selection and placement of decoupling capacitors. As a minimum, it is recommended that a 0.1  $\mu\text{F}$  high frequency ceramic capacitor be used between  $V_{CC}$  and

GND at each device. Depending on the size of the array, the value of the capacitor may have to be larger.

In addition, it is recommended that a 4.7  $\mu\text{F}$  electrolytic bulk capacitor be placed between  $V_{CC}$  and GND for each eight devices employed in the array. This bulk capacitor is employed to overcome the voltage droop caused by the inductive effects of the PC board traces.

### FUNCTIONAL DIAGRAM

