

128 Bit

X24001

16 x 8 Bit

Identi™ PROM

FEATURES

- 2.7V to 5.5V Power Supply
- 128 Bit Serial E²PROM
- Low Power CMOS
 - Active Current Less Than 1mA
 - Standby Current Less Than 50µA
- Internally Organized 16 x 8
- 2 Wire Serial Interface
- High Voltage Programmable Only
 - V_{PGM}, 12V to 15V
- Push/Pull Output
- High Reliability
 - Data Retention: 100 Years
- 8-Pin Mini-DIP, 8-Lead TSSOP and 8-Lead SOIC Packages

DESCRIPTION

The X24001 is a CMOS 128 bit serial E²PROM, internally organized as 16 x 8. The X24001 features a serial interface and software protocol allowing operation on a simple two wire bus.

The X24001 is ideally suited for identification applications such as serial numbers or device revision numbers which need to be stored and retrieved electronically.

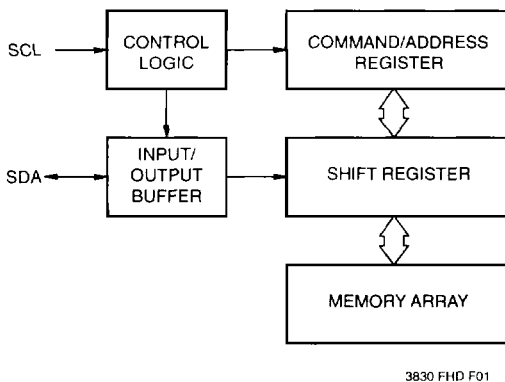
V_{PGM} is used to enable writes to the device. This provides full protection of the data in the user's environment where V_{PGM} is not available.

Xicor E²PROMs are designed and tested for applications requiring extended endurance. Inherent data retention is greater than 100 years.

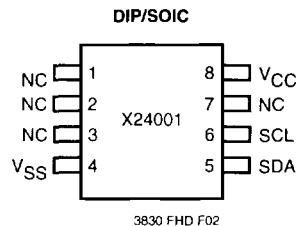
The X24001 is fabricated with Xicor's Advanced CMOS Floating Gate technology.

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FUNCTIONAL DIAGRAM



PIN CONFIGURATION



X24001

PIN DESCRIPTIONS

Serial Clock (SCL)

The SCL input is used to clock all data into and out of the device.

Serial Data (SDA)

SDA is a bidirectional pin used to transfer data into and out of the device. It is a push/pull output and does not require the use of a pull-up resistor. During the programming operation, SDA is an input.

PIN NAMES

Symbol	Description
NC	No Connect
V _{SS}	Ground
V _{CC}	Supply Voltage
SDA	Serial Data
SCL	Serial Clock

3830 PGM T01

DEVICE OPERATION

The X24001 supports a bidirectional bus oriented protocol. The protocol defines any device that sends data onto the bus as a transmitter and the receiving device as the receiver. The device controlling the transfer is a master and the device being controlled is the slave. The master will always initiate data transfers and provide the clock for both transmit and receive operations. Therefore, the X24001 will be considered a slave in all applications.

Clock and Data Conventions

Data states on the SDA line can change only during SCL LOW. SDA state changes during SCL HIGH are reserved for indicating start and stop conditions. Refer to Figures 1 and 2.

Start Condition

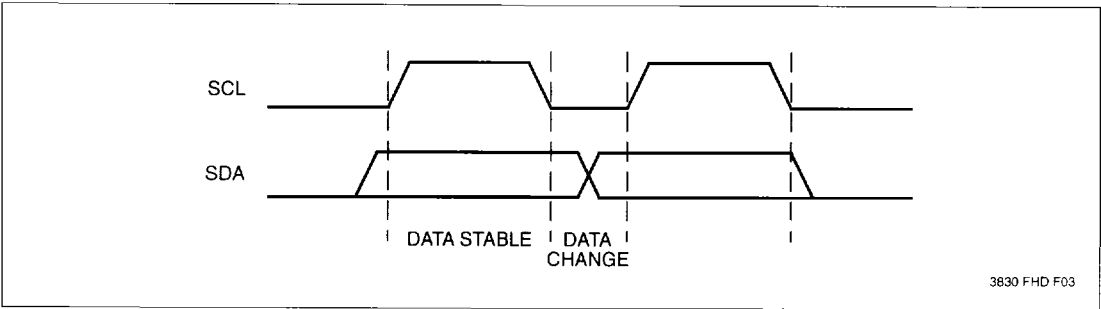
All commands are preceded by the start condition, which is a HIGH to LOW transition of SDA when SCL is HIGH. The X24001 continuously monitors the SDA and SCL lines for the start condition and will not respond to any command until this condition has been met.

A start may be issued to terminate the input of a control word or the input of data to be written. This will reset the device and leave it ready to begin a new read or write command. Because of the push/pull output, a start cannot be generated while the part is outputting data. Starts are also inhibited while a write is in progress.

Stop Condition

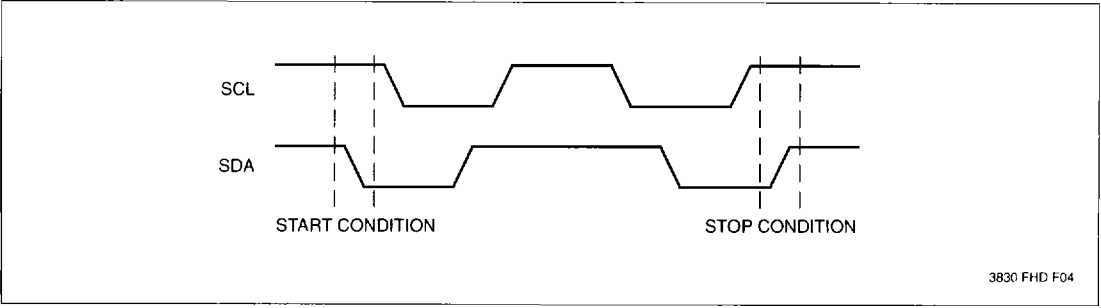
The stop condition is a LOW to HIGH transition of SDA when SCL is HIGH. The stop condition is used to reset the device during a command or data input sequence and will leave the device in the standby mode. As with starts, stops are inhibited when outputting data and while a write is in progress.

Figure 1. Data Validity



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Figure 2. Definition of Start and Stop Conditions



X24001

Programming Operation

Programming of the X24001 is performed one byte at a time. After each byte is written, a delay equal to the write cycle time of 5ms must be observed before initiating the next write cycle.

The sequence of operations is: first raise the SCL pin to V_{PGM} and generate a HIGH to LOW transition of SDA (programming mode start). This is followed by eight bits of data containing the program command bits, four address bits and two don't care bits, immediately followed by the 8-bit data byte.

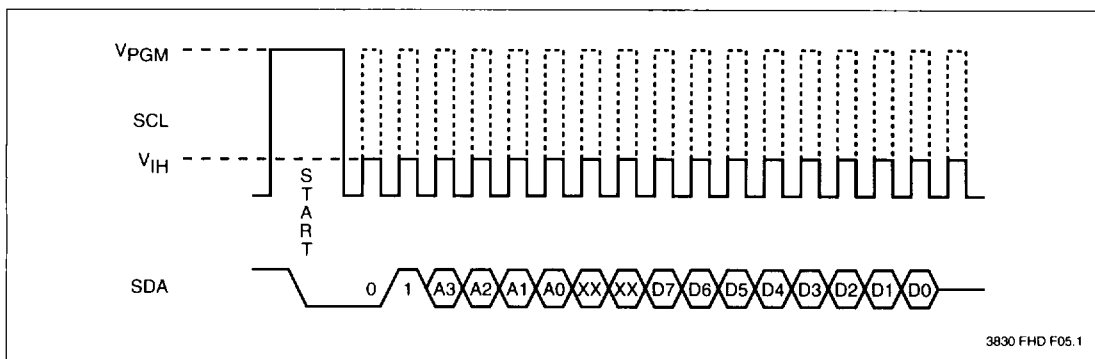
The timing of the operation conforms to the standard A.C. timing requirements and follows the sequence shown below. After generating the Programming Mode start condition the SCL HIGH level can be either V_{IH} or V_{PGM} .

Factory Programming Service

The X24001 can be programmed with customer specific data prior to shipment. The data programmed can be in two forms: static data pattern where there is no change in the data in a group of devices or sequential data, such as a base number incremented by one for each device tested and shipped.

Customers requiring one of these services should contact their local sales office for ordering procedures and service charges.

Figure 3. Programming Sequence



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Read Operation

The byte read operation is initiated with a start condition. The start condition is followed by an eight-bit control byte which consists of a two-bit read command (1,0), four address bits, and two "don't care" bits. After receipt of the control byte, the X24001 will enter the read mode and transfer data into the shift register from the array. This data is shifted out of the device on the next eight SCL clocks. At the end of the read, all counters are reset

and the X24001 will enter the standby mode. As with a write, the read operation can be interrupted by a start or stop condition while the command or address is being clocked in. While clocking data out, starts or stops cannot be generated.

During the second don't care clock cycle, starts and stops are ignored. The master must free the bus prior to the end of this clock cycle to allow the X24001 to begin outputting data (Figures 4 and 5).

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Figure 4. Read Sequence

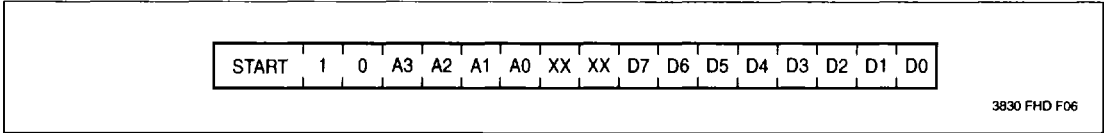
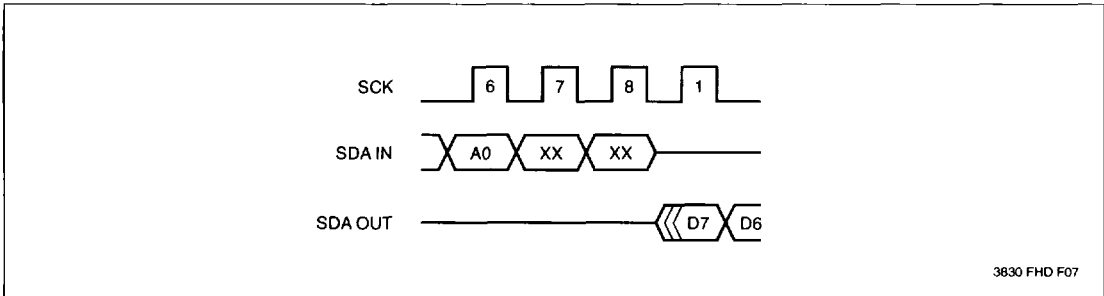


Figure 5. Read Cycle Timing



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

X24001

ABSOLUTE MAXIMUM RATINGS*

Temperature under Bias

X24001 -65°C to +135°C

Storage Temperature -65°C to +150°C

Voltage on any Pin with

Respect to V_{SS} -1V to +7V

Voltage on SCL with

Respect to V_{SS} -1V to +17V

D.C. Output Current 5mA

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.

RECOMMENDED OPERATING CONDITIONS

Temperature	Min.	Max.
Commercial	0°C	+70°C
Industrial	-40°C	+85°C
Military	-55°C	+125°C

3830 PGM T02.1

Supply Voltage	Limits
X24001	5V $\pm$ 10%
X24001-3	3V to 5.5V
X24001-2.7	2.7V to 5.5V

3830 PGM T03.1

D.C. OPERATING CHARACTERISTICS (Over recommended operating conditions unless otherwise specified.)

Symbol	Parameter	Limits		Units	Test Conditions
		Min.	Max.		
I_{CC1}	V_{CC} Supply Current Read		1	mA	SCL = $V_{CC} \times 0.1/V_{CC} \times 0.9$ Levels @ 1MHz, SDA = Open
I_{SB1}	V_{CC} Standby Current		100	μ A	SCL = SDA = V_{CC} $V_{CC} = 5V \pm 10\%$
I_{SB2}	V_{CC} Standby Current		50	μ A	SCL = SDA = V_{CC} $V_{CC} = 3V$
I_{LI}	Input Leakage Current		10	μ A	$V_{IN} = V_{SS}$ to V_{CC}
I_{LO}	Output Leakage Current		10	μ A	$V_{OUT} = V_{SS}$ to V_{CC}
$V_{IL}^{(1)}$	Input LOW Voltage	-1.0	$V_{CC} \times 0.3$	V	
$V_{IH}^{(1)}$	Input HIGH Voltage	$V_{CC} \times 0.7$	$V_{CC} + 0.5$	V	
V_{OL}	Output LOW Voltage		0.4	V	$I_{OL} = 2.1mA$
V_{OH}	Output HIGH Voltage	$V_{CC} - 0.8$		V	$I_{OH} = 1mA$
V_{PGM}	Program Enable Voltage	12	15	V	

3830 PGM T04.3

CAPACITANCE $T_A = +25^\circ C$, $f = 1MHz$, $V_{CC} = 5V$

Symbol	Parameter	Max.	Units	Test Conditions
$C_{I/O}^{(2)}$	Input/Output Capacitance (SDA)	8	pF	$V_{I/O} = 0V$
$C_{IN}^{(2)}$	Input Capacitance (SCL)	6	pF	$V_{IN} = 0V$

3830 PGM T05.1

Notes: (1) V_{IL} min. and V_{IH} max. are for reference only and are not tested.

(2) This parameter is periodically sampled and not 100% tested.

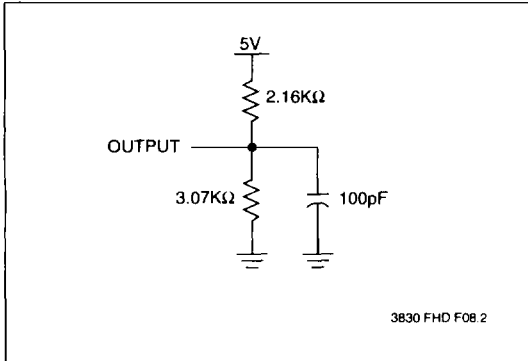
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POWER-UP TIMING

Symbol	Parameter	Max.	Units
$t_{PUR}^{(3)}$	Power-up to Read Operation	2	ms
$t_{PUW}^{(3)}$	Power-up to Write Operation	5	ms

3830 PGM T06

EQUIVALENT A.C. LOAD CIRCUIT



A.C. CONDITIONS OF TEST

Input Pulse Levels	$V_{CC} \times 0.1$ to $V_{CC} \times 0.9$
Input Rise and Fall Times	10ns
Input and Output Timing Levels	$V_{CC} \times 0.5$

3830 PGM T07.1

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A.C. CHARACTERISTICS (Over the recommended operating conditions unless otherwise specified.)

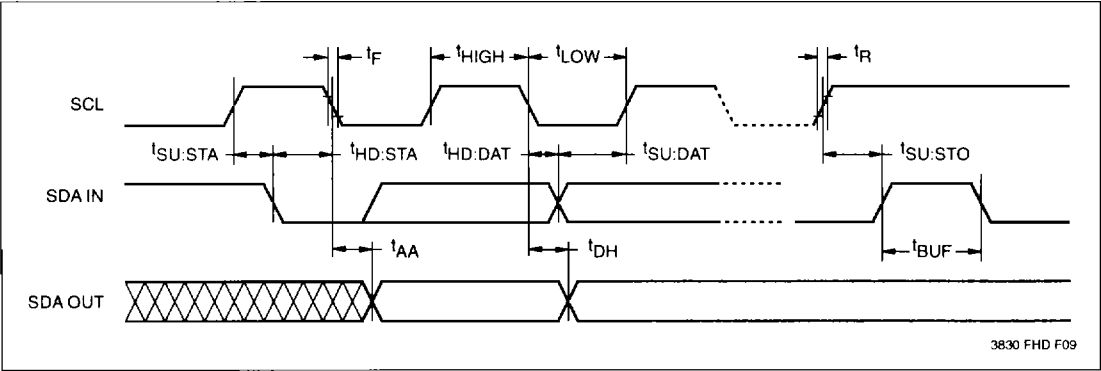
Read & Write Cycle Limits

Symbol	Parameter	Min.	Max.	Units
f_{SCL}	SCL Clock Frequency	0	1	MHz
t_{AA}	SCL LOW to SDA Data Out Valid		350	ns
t_{BUF}	Time the Bus Must Be Free Before a New Transmission Can Start	500		ns
$t_{HD:STA}$	Start Condition Hold Time	250		ns
t_{LOW}	Clock LOW Period	500		ns
t_{HIGH}	Clock HIGH Period	500		ns
$t_{SU:STA}$	Start Condition Setup Time	250		ns
$t_{HD:DAT}$	Data In Hold Time	0		μs
$t_{SU:DAT}$	Data in Setup Time	250		ns
t_R	SDA and SCL Rise Time		1	μs
t_F	SDA and SCL Fall Time		300	ns
$t_{SU:STO}$	Stop Condition Setup Time	250		ns
t_{DH}	Data Out Hold Time	50		ns

3830 PGM T08.1

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Bus Timing

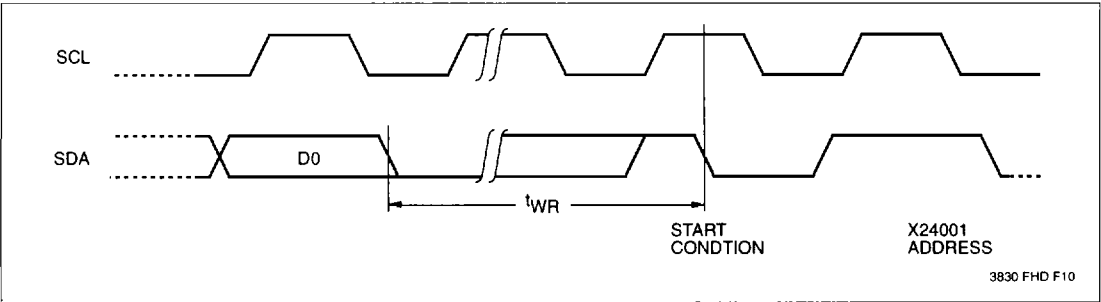


WRITE CYCLE LIMITS

Symbol	Parameter	Min.	Max.	Units
$t_{WR}^{(4)}$	Write Cycle Time		5	ms

3830 PGM T09

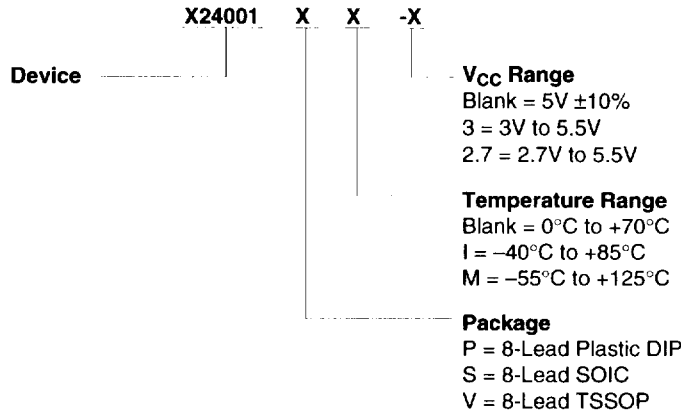
Write Cycle Timing



- Note:** (3) t_{PUR} and t_{PUW} are the delays required from the time V_{CC} is stable until the specified operation can be initiated. These parameters are periodically sampled and not 100% tested.
- (4) The write cycle time is the time from the initiation of a write sequence to the end of the internal erase/program cycle. During the write cycle, the X24001 bus interface circuits are disabled, SDA is high impedance, and the device does not respond to start conditions.

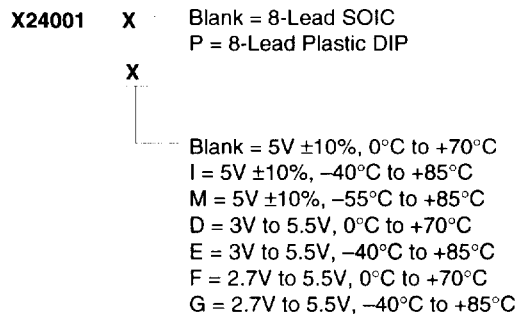
X24001

ORDERING INFORMATION



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Part Mark Convention



LIMITED WARRANTY

Devices sold by Xicor, Inc. are covered by the warranty and patent indemnification provisions appearing in its Terms of Sale only. Xicor, Inc. makes no warranty, express, statutory, implied, or by description regarding the information set forth herein or regarding the freedom of the described devices from patent infringement. Xicor, Inc. makes no warranty of merchantability or fitness for any purpose. Xicor, Inc. reserves the right to discontinue production and change specifications and prices at any time and without notice.

Xicor, Inc. assumes no responsibility for the use of any circuitry other than circuitry embodied in a Xicor, Inc. product. No other circuits, patents, licenses are implied.

US. PATENTS

Xicor products are covered by one or more of the following U.S. Patents: 4,263,664; 4,274,012; 4,300,212; 4,314,265; 4,326,134; 4,393,481; 4,404,475; 4,450,402; 4,486,769; 4,488,060; 4,520,461; 4,533,846; 4,599,706; 4,617,652; 4,668,932; 4,752,912; 4,829,482; 4,874,967; 4,883,976. Foreign patents and additional patents pending.

LIFE RELATED POLICY

In situations where semiconductor component failure may endanger life, system designers using this product should design the system with appropriate error detection and correction, redundancy and back-up features to prevent such an occurrence.

Xicor's products are not authorized for use as critical components in life support devices or systems.

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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X24001 PROGRAMMING ORDER INFORMATION

Customer Name:

Address:

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Complete Device Part Number:

- ☐ Static Pattern
Fill in matrix A below
- ☐ Incrementing Pattern
Indicate in Matix A any static pattern and
indicate in Matrix B beginning sequence value
to be incremented.
- ☐ Totally Random Pattern

AUTHORIZATION

Programming Information Supplied By

Print or Type Clearly Full Name

Title

Signature

Date

Matrix A

Address	Data Pattern MSB First							
	7	6	5	4	3	2	1	0
0								
1								
2								
3								
4								
5								
6								
7								
8								
9								
A								
B								
C								
D								
E								
F								

Matrix B

Address	Data Pattern MSB First							
	7	6	5	4	3	2	1	0
0								
1								
2								
3								
4								
5								
6								
7								
8								
9								
A								
B								
C								
D								
E								
F								