



64K  
32K  
16K

X25648/49,  
X25328/29,  
X25168/69

8K x 8 Bit  
4K x 8 Bit  
2K x 8 Bit

## V<sub>CC</sub> Supervisory Circuit w/Serial E<sup>2</sup>PROM

### FEATURES

- **Low V<sub>CC</sub> Detection and Reset Assertion**
  - Reset Signal Valid to V<sub>CC</sub>=1V
- **Save Critical Data With Block Lock™ Protection**
  - Block Lock™ Protect 0, 1/4, 1/2 or all of Serial E<sup>2</sup>PROM Memory Array
- **In Circuit Programmable ROM Mode**
- **Long Battery Life With Low Power Consumption**
  - <1μA Max Standby Current
  - <5mA Max Active Current during Write
  - <400μA Max Active Current during Read
- **1.8V to 3.6V, 2.7V to 5.5V and 4.5V to 5.5V Power Supply Operation**
- **2MHz Clock Rate**
- **Minimize Programming Time**
  - 32 Byte Page Write Mode
  - Self-Timed Write Cycle
  - 5ms Write Cycle Time (Typical)
- **SPI Modes (0,0 & 1,1)**
- **Built-in Inadvertent Write Protection**
  - Power-Up/Power-Down Protection Circuitry
  - Write Enable Latch
  - Write Protect Pin
- **High Reliability**
- **Available Packages**
  - 14-Lead SOIC (X2564X)
  - 14-Lead TSSOP (X2532X, X2516X)
  - 8-Lead SOIC (X2532X, X2516X)

### DESCRIPTION

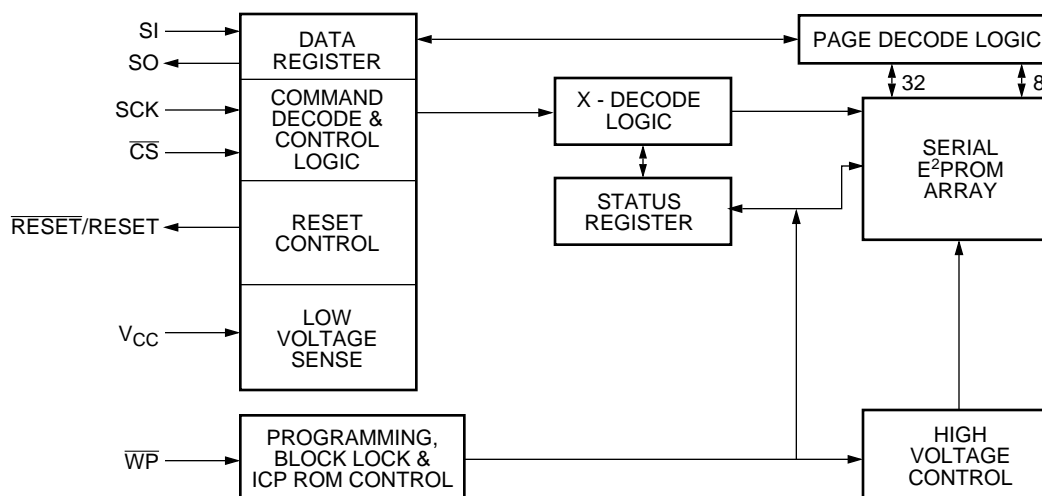
These devices combines two popular functions, Supply Voltage Supervision and Serial E<sup>2</sup>PROM Memory in one package. This combination lowers system cost, reduces board space requirements, and increases reliability.

The user's system is protected from low voltage conditions by the devices low V<sub>CC</sub> detection circuitry. When V<sub>CC</sub> falls below the minimum V<sub>CC</sub> trip point, the system is reset.  $\overline{\text{RESET}}$ /RESET is asserted until V<sub>CC</sub> returns to proper operating levels and stabilizes.

The memory portion of the device is a CMOS Serial E<sup>2</sup>PROM array with Xicor's Block Lock™ Protection. The array is internally organized as x 8. The device features a Serial Peripheral Interface (SPI) and software protocol allowing operation on a simple four-wire bus.

The device utilizes Xicor's proprietary Direct Write™ cell, providing a minimum endurance of 100,000 cycles per sector and a minimum data retention of 100 years.

### BLOCK DIAGRAM



7036 FRM 01

# X25648/49, X25328/29, X25168/69

## PIN DESCRIPTIONS

### Serial Output (SO)

SO is a push/pull serial data output pin. During a read cycle, data is shifted out on this pin. Data is clocked out by the falling edge of the serial clock.

### Serial Input (SI)

SI is a serial data input pin. All opcodes, byte addresses, and data to be written to the memory are input on this pin. Data is latched by the rising edge of the serial clock.

### Serial Clock (SCK)

The Serial Clock controls the serial bus timing for data input and output. Opcodes, addresses, or data present on the SI pin are latched on the rising edge of the clock input, while data on the SO pin change after the falling edge of the clock input.

### Chip Select ( $\overline{CS}$ )

When  $\overline{CS}$  is HIGH, the device is deselected and the SO output pin is at high impedance and unless a nonvolatile write cycle is underway, the device will be in the standby power mode.  $\overline{CS}$  LOW enables the device, placing it in the active power mode. It should be noted that after power-up, a HIGH to LOW transition on  $\overline{CS}$  is required prior to the start of any operation.

### Write Protect ( $\overline{WP}$ )

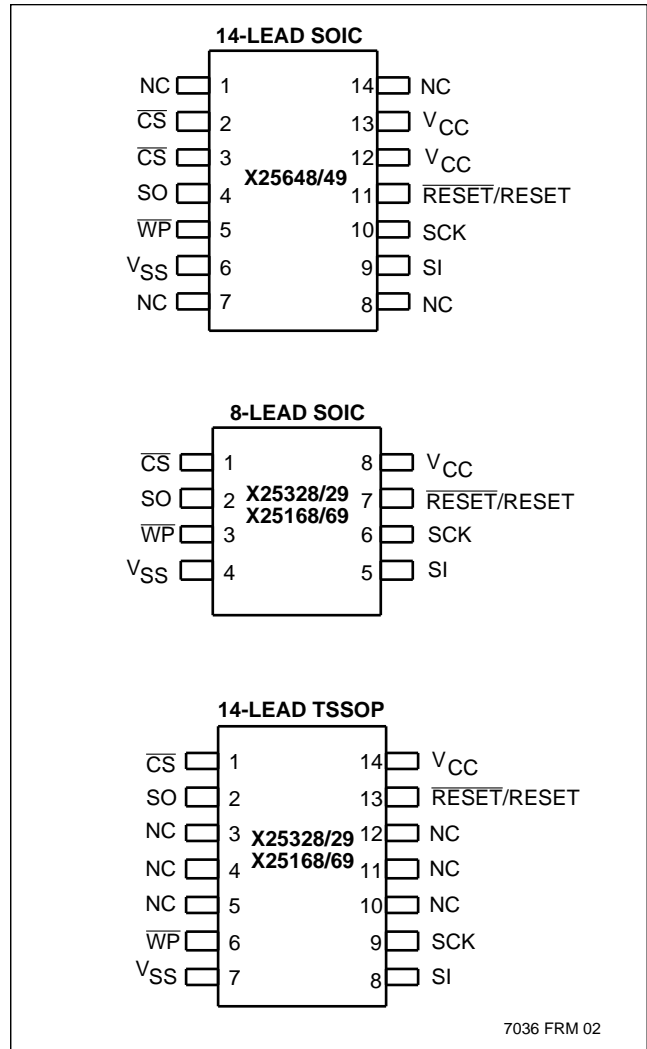
When  $\overline{WP}$  is low and the nonvolatile bit WPEN is "1", nonvolatile writes to the device Status Register are disabled, but the part otherwise functions normally. When  $\overline{WP}$  is held high, all functions, including nonvolatile writes to the Status Register operate normally. If an internal Status Register Write Cycle has already been initiated,  $\overline{WP}$  going low while WPEN is a "1" will have no effect on this write. Subsequent write attempts to the Status Register under these conditions will be disabled.

The  $\overline{WP}$  pin function is blocked when the WPEN bit in the Status Register is "0". This allows the user to install the device in a system with  $\overline{WP}$  pin grounded and still be able to program the Status Register. The  $\overline{WP}$  pin functions will be enabled when the WPEN bit is set to a "1".

### Reset (RESET/RESET)

RESET/RESET is an active LOW/HIGH, open drain output which goes active whenever Vcc falls below the minimum Vcc sense level. It will remain active until Vcc rises above the minimum Vcc sense level for 200ms.

## PIN CONFIGURATION



## PIN NAMES

Symbol	Description
$\overline{CS}$	Chip Select Input
SO	Serial Output
SI	Serial Input
SCK	Serial Clock Input
$\overline{WP}$	Program Protect Input
VSS	Ground
VCC	Supply Voltage
RESET/RESET	Reset Output

7036 FRM T01

# X25648/49, X25328/29, X25168/69

## PRINCIPLES OF OPERATION

The device is designed to interface directly with the synchronous Serial Peripheral Interface (SPI) of many popular microcontroller families.

The device monitors  $V_{CC}$  and asserts  $\overline{RESET}/RESET$  output if the supply voltage falls below a preset minimum  $V_{trip}$ . The device contains an 8-bit instruction register. It is accessed via the SI input, with data being clocked in on the rising edge of SCK.  $\overline{CS}$  must be LOW during the entire operation.

All instructions (Table 1), addresses and data are transferred MSB first. Data input on the SI line is latched on the first rising edge of SCK after  $\overline{CS}$  goes LOW. Data is output on the SO line by the falling edge of SCK. SCK is static, allowing the user to stop the clock and then start it again to resume operations where left off.

### Write Enable Latch

The device contains a Write Enable Latch. This latch must be SET before a Write Operation is initiated. The WREN instruction will set the latch and the WRDI instruction will reset the latch (Figure 3). This latch is automatically reset upon a power-up condition and after the completion of a valid Write Cycle.

### Status Register

The RDSR instruction provides access to the Status Register. The Status Register may be read at any time, even during a Write Cycle. The Status Register is formatted as follows:

7	6	5	4	3	2	1	0
WPEN	FLB	1	1	BL1	BL0	WEL	WIP

7036 FRM T02

The Write-In-Progress (WIP) bit is a volatile, read only bit and indicates whether the device is busy with an internal nonvolatile write operation. The WIP bit is read using the RDSR instruction. When set to a "1", a nonvolatile write operation is in progress. When set to a "0", no write is in progress.

The Write Enable Latch (WEL) bit indicates the Status of the Write Enable Latch. When WEL=1, the latch is set HIGH and when WEL=0 the latch is reset LOW. The WEL bit is a volatile, read only bit. It can be set by the WREN instruction and can be reset by the WRDS instruction.

The Block Lock bits, BL0 and BL1, set the level of Block Lock™ Protection. These nonvolatile bits are programmed using the WRSR instruction and allow the user to protect one quarter, one half, all or none of the E<sup>2</sup>PROM array. Any portion of the array that is Block Lock Protected can be read but not written. It will remain protected until the BL bits are altered to disable Block Lock Protection of that portion of memory.

Status Register Bits		Array Addresses Protected		
BL1	BL0	X2564X	X2532X	X2516X
0	0	None	None	None
0	1	\$1800-\$1FFF	\$0C00-\$0FFF	\$0600-\$07FF
1	0	\$1000-\$1FFF	\$0800-\$0FFF	\$0400-\$07FF
1	1	\$0000-\$1FFF	\$0000-\$0FFF	\$0000-\$07FF

7036 FRM T03

Bits 4 and 5 of the Status Register will be read as "1's" and must be written as "1's" on all Status Register writes.

Table 1. Instruction Set

Instruction Name	Instruction Format*	Operation
WREN	0000 0110	Set the Write Enable Latch (Enable Write Operations)
SFLB	0000 0000	Set Flag Bit
WRDI/RFLB	0000 0100	Reset the Write Enable Latch/Reset Flag Bit
RSDR	0000 0101	Read Status Register
WRSR	0000 0001	Write Status Register (BlockLock, WPEN & Flag Bits)
READ	0000 0011	Read Data from Memory Array Beginning at Selected Address
WRITE	0000 0010	Write Data to Memory Array Beginning at Selected Address

\*Instructions are shown MSB in leftmost position. Instructions are transferred MSB first.

7036 FRM T04

## X25648/49, X25328/29, X25168/69

The read only FLAG bit shows the status of a volatile latch that can be set and reset by the system using the SFLB and RFLB instructions. The Flag bit is automatically reset upon power up.

The nonvolatile WPEN bit is programmed using the WRSR instruction. This bit works in conjunction with the WP pin to provide Programmable Hardware Write Protection (Table 2). When WP is LOW and the WPEN bit is programmed HIGH, all Status Register Write Operations are disabled.

### In Circuit Programmable ROM Mode

This mechanism protects the Block Lock and Watchdog bits from inadvertent corruption. It may be used to perform an In Circuit Programmable ROM function by hard-wiring the WP pin to ground, writing and Block Locking the desired portion of the array to be ROM, and then programming the WPEN bit HIGH.

### Read Sequence

When reading from the E<sup>2</sup>PROM memory array, CS is first pulled low to select the device. The 8-bit READ instruction is transmitted to the device, followed by the 16-bit address. After the READ opcode and address are sent, the data stored in the memory at the selected address is shifted out on the SO line. The data stored in memory at the next address can be read sequentially by continuing to provide clock pulses. The address is automatically incremented to the next higher address after each byte of data is shifted out. When the highest address is reached, the address counter rolls over to address \$0000 allowing the read cycle to be continued indefinitely. The read operation is terminated by taking CS high. Refer to the Read E<sup>2</sup>PROM Array Sequence (Figure 1).

To read the Status Register, the CS line is first pulled low to select the device followed by the 8-bit RDSR instruction. After the RDSR opcode is sent, the contents of the Status Register are shifted out on the SO line. Refer to the Read Status Register Sequence (Figure 2).

### Write Sequence

Prior to any attempt to write data into the device, the "Write Enable" Latch (WEL) must first be set by issuing the WREN instruction (Figure 3). CS is first taken LOW, then the WREN instruction is clocked into the device. After all eight bits of the instruction are transmitted, CS must then be taken HIGH. If the user continues the Write Operation without taking CS HIGH after issuing the WREN instruction, the Write Operation will be ignored.

To write data to the E<sup>2</sup>PROM memory array, the user then issues the WRITE instruction followed by the 16 bit address and then the data to be written. Any unused bits are specified to be "0's". The WRITE operation minimally takes 32 clocks. CS must go low and remain low for the duration of the operation. If the address counter reaches the end of a page and the clock continues, the counter will roll back to the first address of the page and overwrite any data that may have been previously written.

For the Page Write Operation (byte or page write) to be completed, CS can only be brought HIGH after bit 0 of the last data byte to be written is clocked in. If it is brought HIGH at any other time, the write operation will not be completed (Figure 4).

To write to the Status Register, the WRSR instruction is followed by the data to be written (Figure 5). Data bits 0 and 1 must be "0". Data bits 4 and 5 must be "1".

Table 2.

STATUS REGISTER	STATUS REGISTER	DEVICE PIN	BLOCK	BLOCK	STATUS REGISTER
WEL	WPEN	WP#	PROTECTED BLOCK	UNPROTECTED BLOCK	WPEN, BL0, BL1 BITS
0	X	X	Protected	Protected	Protected
1	1	0	Protected	Writable	Protected
1	0	X	Protected	Writable	Writable
1	X	1	Protected	Writable	Writable

7036 FRM T06

## X25648/49, X25328/29, X25168/69

While the write is in progress following a Status Register or E<sup>2</sup>PROM Sequence, the Status Register may be read to check the WIP bit. During this time the WIP bit will be high.

### **RESET/RESET Operation**

The  $\overline{\text{RESET}}$  (X25XX3) output is designed to go LOW whenever  $V_{\text{CC}}$  has dropped below the minimum trip point,  $V_{\text{trip}}$ .

The RESET (X25XX5) output is designed to go HIGH whenever  $V_{\text{CC}}$  has dropped below the minimum trip point,  $V_{\text{trip}}$ .

The  $\overline{\text{RESET}}$ /RESET output is an open drain output and requires a pull up resistor.

### **Operational Notes**

The device powers-up in the following state:

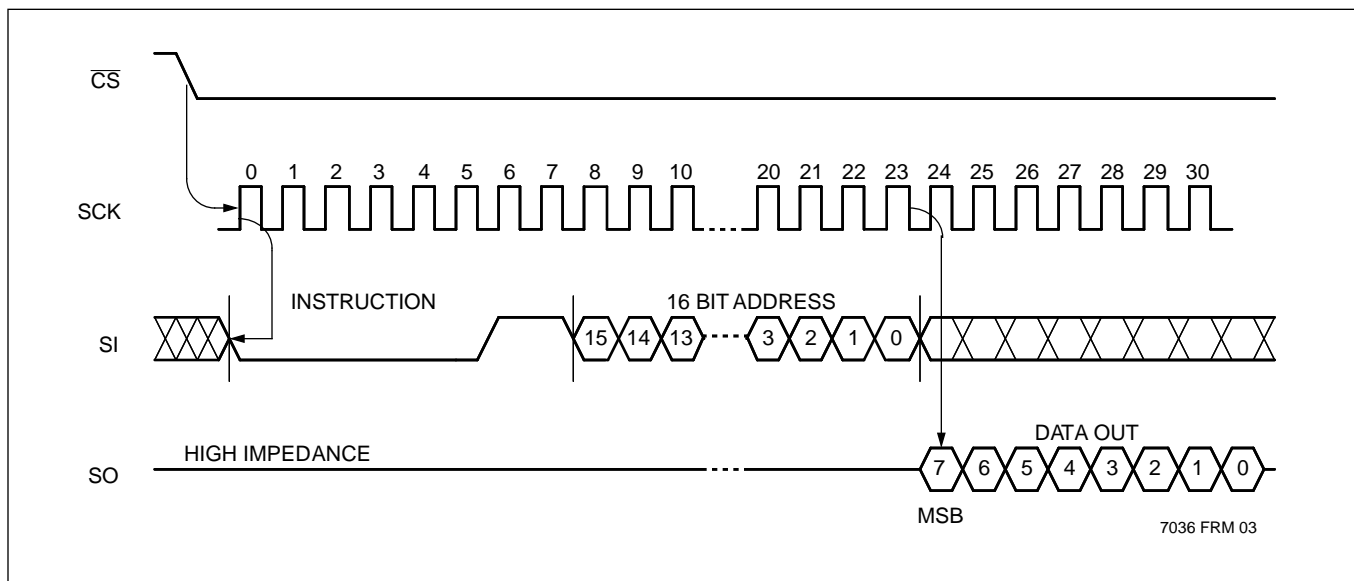
- The device is in the low power standby state.
- A HIGH to LOW transition on  $\overline{\text{CS}}$  is required to enter an active state and receive an instruction.
- SO pin is high impedance.
- The Write Enable Latch is reset.
- The Flag Bit is reset.
- Reset Signal is active for  $t_{\text{PURST}}$ .

### **Data Protection**

The following circuitry has been included to prevent inadvertent writes:

- A WREN instruction must be issued to set the Write Enable Latch.
- $\overline{\text{CS}}$  must come HIGH at the proper clock count in order to start a nonvolatile write cycle.

**Figure 1. Read E<sup>2</sup>PROM Array Sequence**



# X25648/49, X25328/29, X25168/69

Figure 2. Read Status Register Sequence

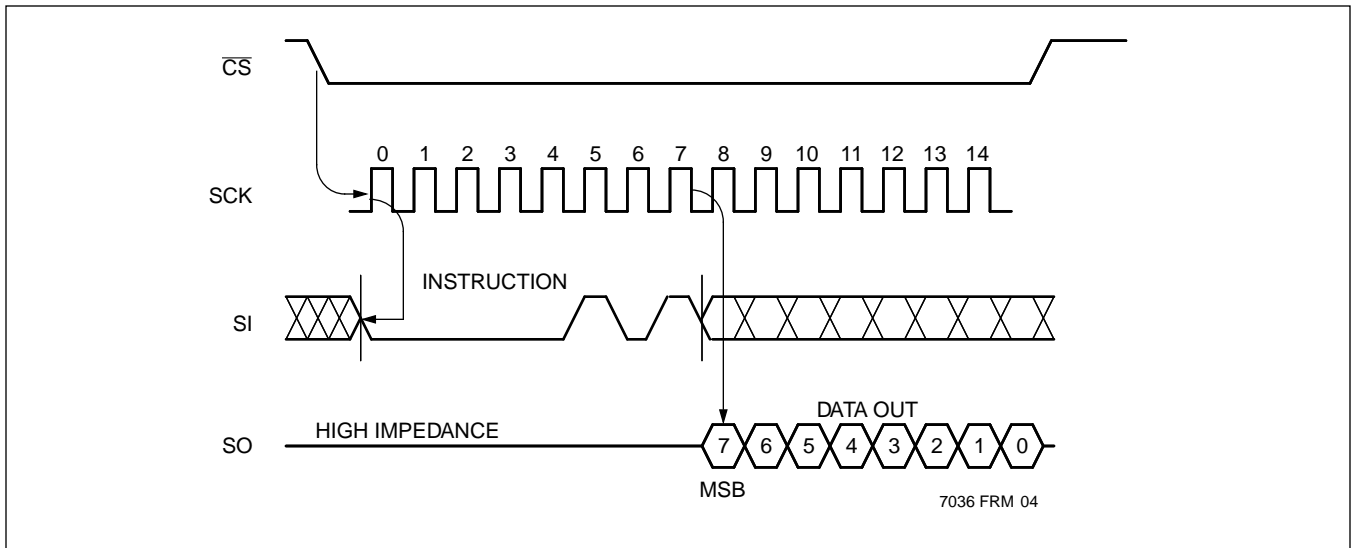
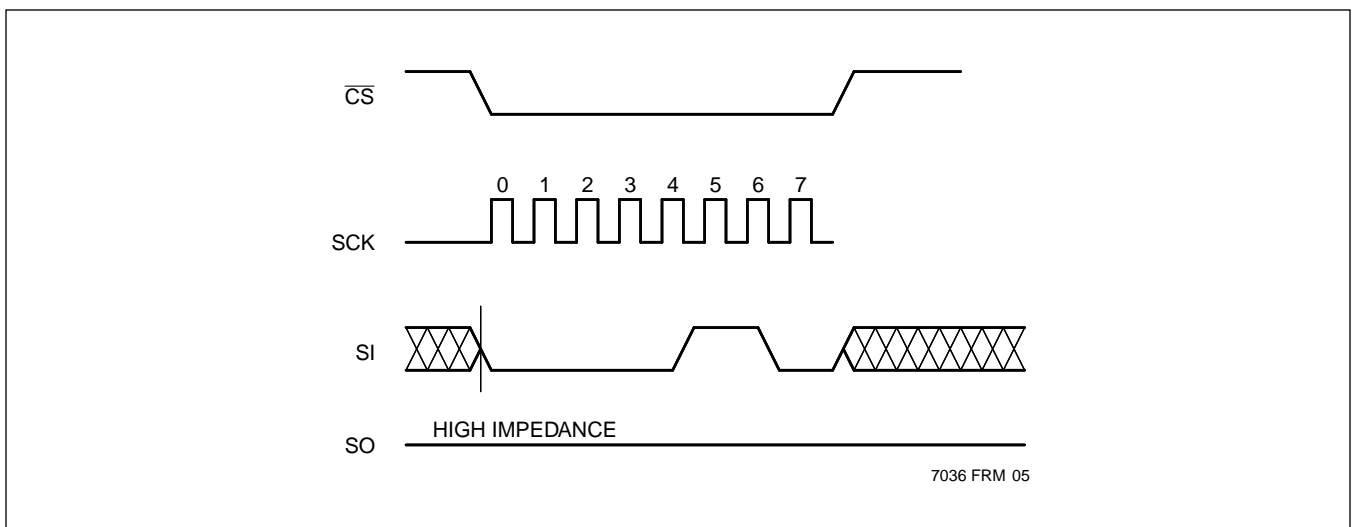
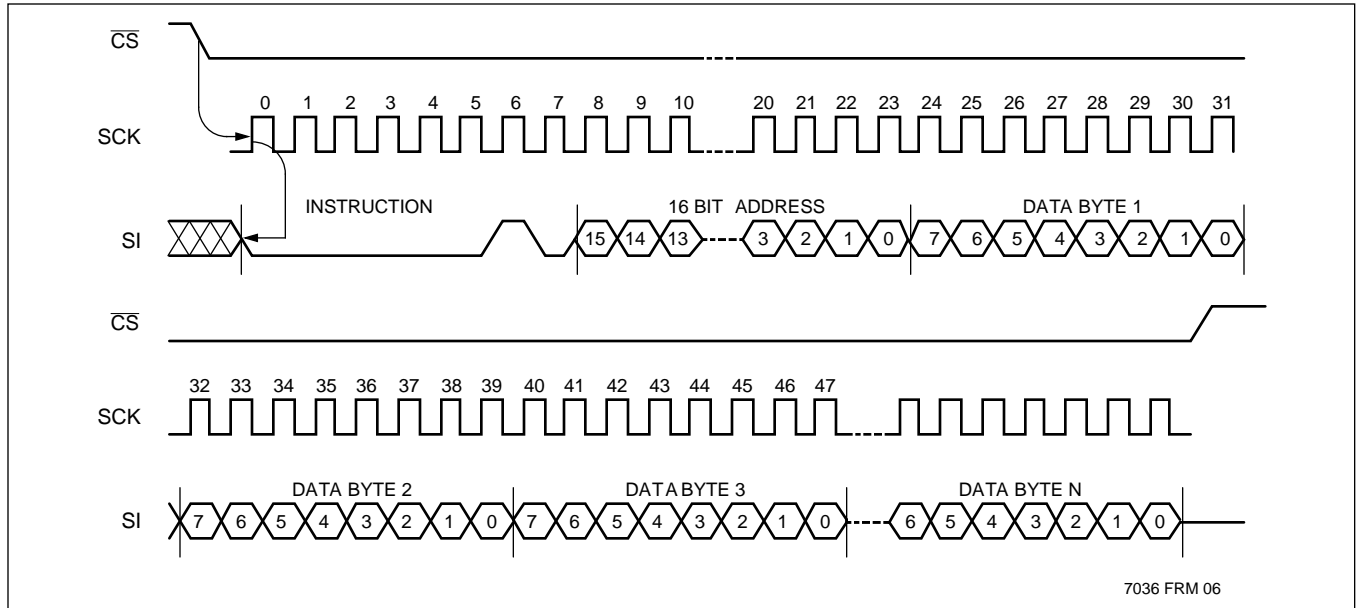


Figure 3. Write Enable Latch Sequence

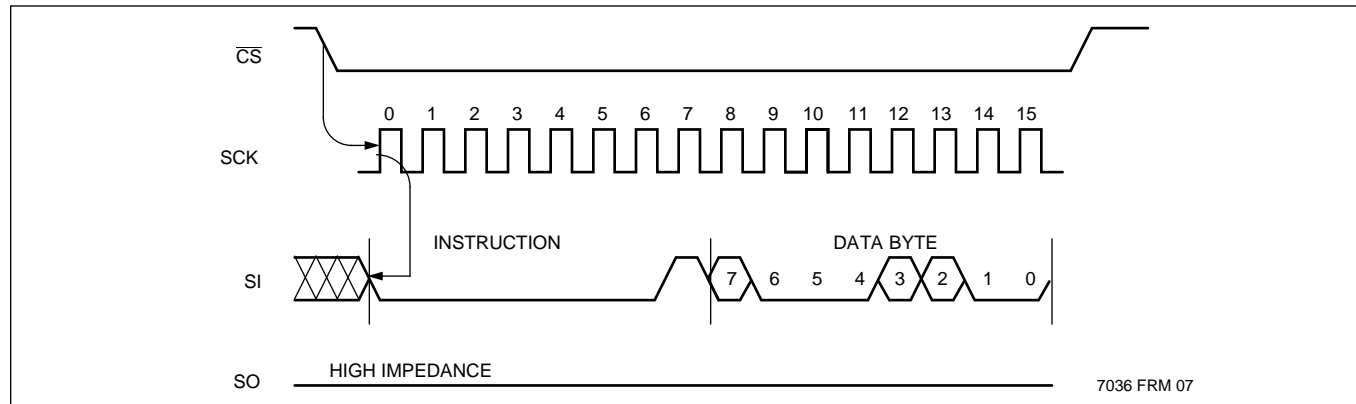


# X25648/49, X25328/29, X25168/69

**Figure 4. Write Sequence**



**Figure 5. Status Register Write Sequence**



## 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

# X25648/49, X25328/29, X25168/69

## ABSOLUTE MAXIMUM RATINGS\*

Temperature under Bias .....-65°C to +135°C  
 Storage Temperature .....-65°C to +150°C  
 Voltage on any Pin with Respect to V<sub>SS</sub>..... -1.0V to +7V  
 D.C. Output Current .....5mA  
 Lead Temperature (Soldering, 10 seconds)..... 300°C

## RECOMMENDED OPERATING CONDITIONS

Temp	Min.	Max.
Commercial	0°C	70°C
Industrial	-40°C	+85°C

7036 FRM T07

## \*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 listed in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Supply Voltage	Limits
X25XXX-1.8	1.8V-3.6V
X25XXX-2.7	2.7V to 5.5V
X25XXX	4.5V-5.5V

7036 FRM T08

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

Symbol	Parameter	Limits			Units	Test Conditions
		Min.	Typ.	Max.		
I <sub>CC1</sub>	V <sub>CC</sub> Write Current (Active)			5	mA	SCK = V <sub>CC</sub> x 0.1/V <sub>CC</sub> x 0.9 @ 2MHz, SO = Open
I <sub>CC2</sub>	V <sub>CC</sub> Read Current (Active)			0.4	mA	SCK = V <sub>CC</sub> x 0.1/V <sub>CC</sub> x 0.9 @ 2MHz, SO = Open
I <sub>SB1</sub>	V <sub>CC</sub> Standby Current WDT=OFF			1	µA	$\overline{CS} = V_{CC}$ , V <sub>IN</sub> = V <sub>SS</sub> or V <sub>CC</sub> , V <sub>CC</sub> = 5.5V
I <sub>SB2</sub>	V <sub>CC</sub> Standby Current WDT=ON			50	µA	$\overline{CS} = V_{CC}$ , V <sub>IN</sub> = V <sub>SS</sub> or V <sub>CC</sub> , V <sub>CC</sub> = 5.5V
I <sub>SB3</sub>	V <sub>CC</sub> Standby Current WDT=ON			20	µA	$\overline{CS} = V_{CC}$ , V <sub>IN</sub> = V <sub>SS</sub> or V <sub>CC</sub> , V <sub>CC</sub> = 3.6V
I <sub>LI</sub>	Input Leakage Current		0.1	10	µA	V <sub>IN</sub> = V <sub>SS</sub> to V <sub>CC</sub>
I <sub>LO</sub>	Output Leakage Current		0.1	10	µA	V <sub>OUT</sub> = V <sub>SS</sub> to V <sub>CC</sub>
V <sub>IL</sub> <sup>(1)</sup>	Input LOW Voltage	-0.5		V <sub>CC</sub> x0.3	V	
V <sub>IH</sub> <sup>(1)</sup>	Input HIGH Voltage	V <sub>CC</sub> x0.7		V <sub>CC</sub> +0.5	V	
V <sub>OL1</sub>	Output LOW Voltage			0.4	V	V <sub>CC</sub> > 3.3V, I <sub>OL</sub> = 2.1mA
V <sub>OL2</sub>	Output LOW Voltage			0.4	V	2V < V <sub>CC</sub> ≤ 3.3V, I <sub>OL</sub> = 1mA
V <sub>OL3</sub>	Output LOW Voltage			0.4	V	V <sub>CC</sub> ≤ 2V, I <sub>OL</sub> = 0.5mA
V <sub>OH1</sub>	Output HIGH Voltage	V <sub>CC</sub> -0.8			V	V <sub>CC</sub> > 3.3V, I <sub>OH</sub> = -1.0mA
V <sub>OH2</sub>	Output HIGH Voltage	V <sub>CC</sub> -0.4			V	2V < V <sub>CC</sub> ≤ 3.3V, I <sub>OH</sub> = -0.4mA
V <sub>OH3</sub>	Output HIGH Voltage	V <sub>CC</sub> -0.2			V	V <sub>CC</sub> ≤ 2V, I <sub>OH</sub> = -0.25mA
V <sub>OLRS</sub>	Reset Output LOW Voltage			0.4	V	I <sub>OL</sub> = 1mA

7036 FRM T09

## POWER-UP TIMING

Symbol	Parameter	Min.	Max.	Units
t <sub>PUR</sub> <sup>(2)</sup>	Power-up to Read Operation		1	ms
t <sub>PUW</sub> <sup>(2)</sup>	Power-up to Write Operation		5	ms

7036 FRM T10

## CAPACITANCE T<sub>A</sub> = +25°C, f = 1MHz, V<sub>CC</sub> = 5V.

Symbol	Test	Max.	Units	Conditions
C <sub>OUT</sub> <sup>(2)</sup>	Output Capacitance (SO, RESET, RESET)	8	pF	V <sub>OUT</sub> = 0V
C <sub>IN</sub> <sup>(2)</sup>	Input Capacitance (SCK, SI, CS, WP)	6	pF	V <sub>IN</sub> = 0V

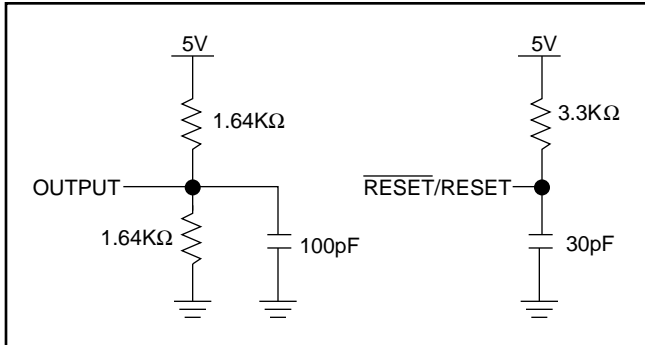
Notes: (1) V<sub>IL</sub> min. and V<sub>IH</sub> max. are for reference only and are not tested.  
 (2) This parameter is periodically sampled and not 100% tested.

7036 FRM T11



# X25648/49, X25328/29, X25168/69

## EQUIVALENT A.C. LOAD CIRCUIT AT 5V V<sub>CC</sub>



## A.C. TEST CONDITIONS

Input Pulse Levels	V <sub>CC</sub> x 0.1 to V <sub>CC</sub> x 0.9
Input Rise and Fall Times	10ns
Input and Output Timing Level	V <sub>CC</sub> x 0.5

7036 FRM T12

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

### Data Input Timing

Symbol	Parameter	Voltage Range	Min.	Max.	Units
f <sub>SCK</sub>	Clock Frequency	2.7V–5.5V 1.8V–3.6V	0	2 1	MHz
t <sub>CYC</sub>	Cycle Time	2.7V–5.5V 1.8V–3.6V	500 1000		ns
t <sub>LEAD</sub>	$\overline{CS}$ Lead Time	2.7V–5.5V 1.8V–3.6V	250 500		ns
t <sub>LAG</sub>	$\overline{CS}$ Lag Time	2.7V–5.5V 1.8V–3.6V	250 500		ns
t <sub>WH</sub>	Clock HIGH Time	2.7V–5.5V 1.8V–3.6V	200 400		ns
t <sub>WL</sub>	Clock LOW Time	2.7V–5.5V 1.8V–3.6V	200 400		ns
t <sub>SU</sub>	Data Setup Time	2.7V–5.5V 1.8V–3.6V	50		ns
t <sub>H</sub>	Data Hold Time	2.7V–5.5V 1.8V–3.6V	50		ns
t <sub>RI</sub> <sup>(3)</sup>	Input Rise Time	2.7V–5.5V 1.8V–3.6V		100	ns
t <sub>FI</sub> <sup>(3)</sup>	Input Fall Time	2.7V–5.5V 1.8V–3.6V		100	ns
t <sub>CS</sub>	$\overline{CS}$ Deselect Time	2.7V–5.5V 1.8V–3.6V	500		ns
t <sub>WC</sub> <sup>(4)</sup>	Write Cycle Time	2.7V–5.5V 1.8V–3.6V		10	ms

7036 FRM T13

## X25648/49, X25328/29, X25168/69

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### Data Output Timing

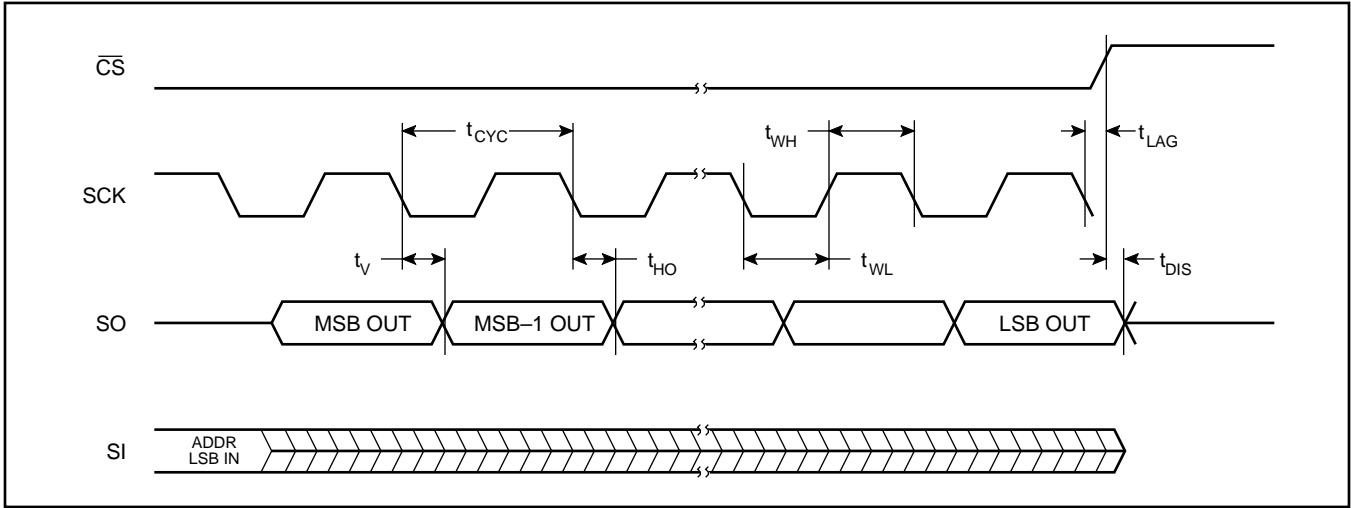
Symbol	Parameter	Part Number	Min.	Max.	Units
$f_{SCK}$	Clock Frequency	2.7V–5.5V 1.8V–3.6V	0	2 1	MHz
$t_{DIS}$	Output Disable Time	2.7V–5.5V 1.8V–3.6V		250	ns
$t_V$	Output Valid from Clock Low	2.7V–5.5V 1.8V–3.6V		200 400	ns
$t_{HO}$	Output Hold Time	2.7V–5.5V 1.8V–3.6V	0		ns
$t_{RO}^{(3)}$	Output Rise Time	2.7V–5.5V 1.8V–3.6V		100	ns
$t_{FO}^{(3)}$	Output Fall Time	2.7V–5.5V 1.8V–3.6V		100	ns

7036 FRM T14

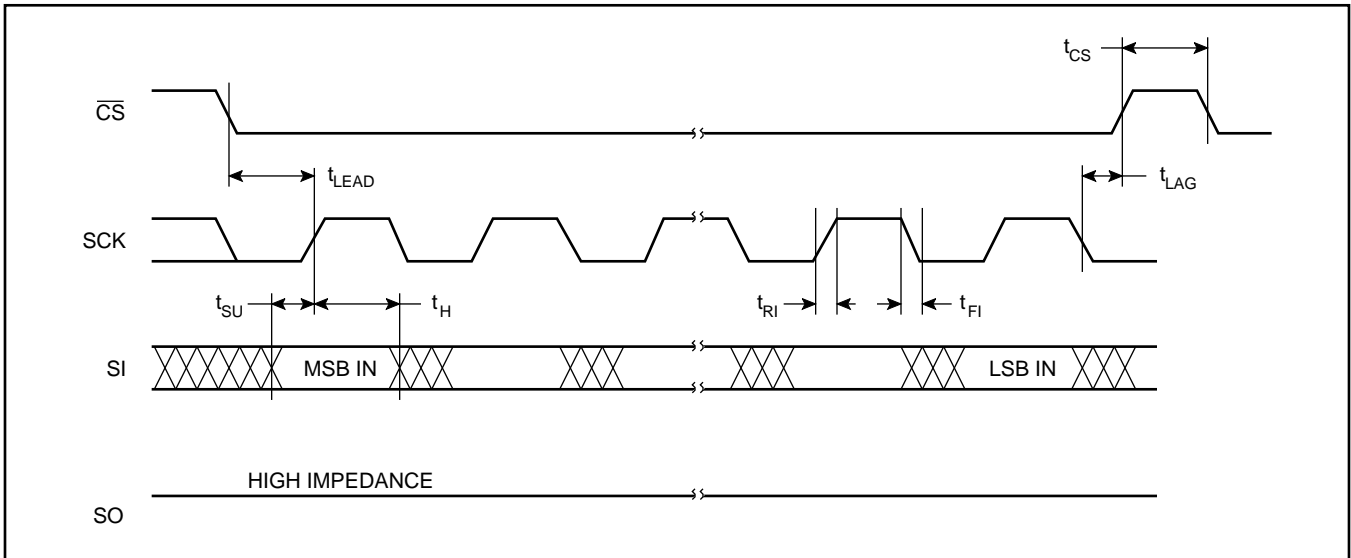
- Notes:** (3) This parameter is periodically sampled and not 100% tested.  
(4)  $t_{WC}$  is the time from the rising edge of  $\overline{CS}$  after a valid write sequence has been sent to the end of the self-timed internal nonvolatile write cycle.

# X25648/49, X25328/29, X25168/69

## Serial Output Timing

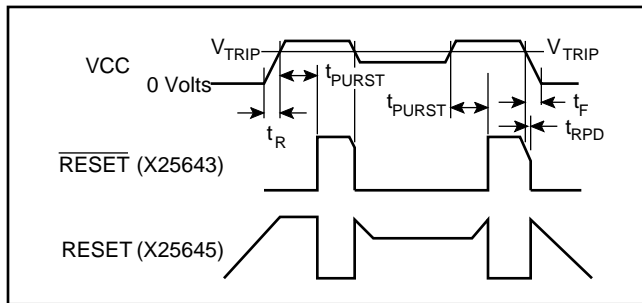


## Serial Input Timing



## X25648/49, X25328/29, X25168/69

### Power-Up and Power-Down Timing



### RESET Output Timing

Symbol	Parameter	Min.	Typ.	Max.	Units
$V_{TRIP}$	Reset Trip Point Voltage, 5V Device	4.25		4.5	V
	Reset Trip Point Voltage, 2.7V Device	2.55		2.7	V
	Reset Trip Point Voltage, 1.8V Device	1.7		1.8	V
$t_{PURST}$	Power-up Reset Timeout	100	200	280	ms
$t_{RPD}^{(5)}$	$V_{CC}$ Detect to Reset/Output			500	ns
$t_F^{(5)}$	$V_{CC}$ Fall Time	0.1			ns
$t_R^{(5)}$	$V_{CC}$ Rise Time	0.1			ns
$V_{RVALID}$	Reset Valid $V_{CC}$	1			V

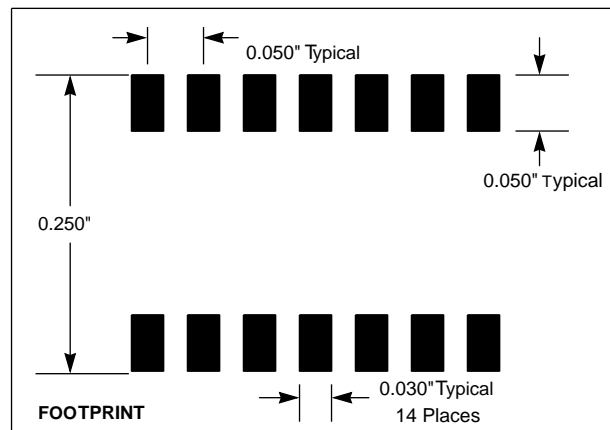
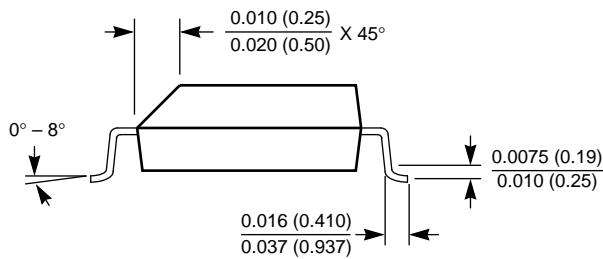
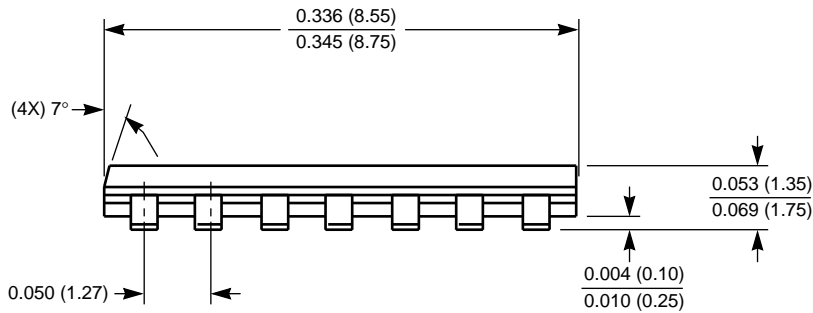
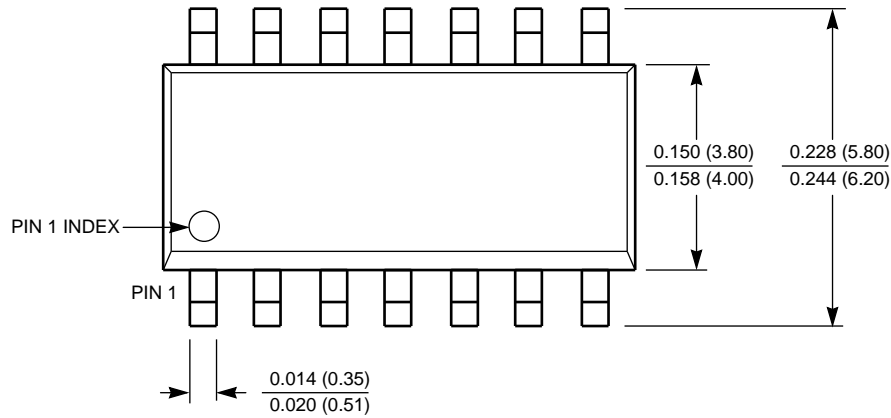
7036 FRMT15

**Notes:** (5) This parameter is periodically sampled and not 100% tested.

# X25648/49, X25328/29, X25168/69

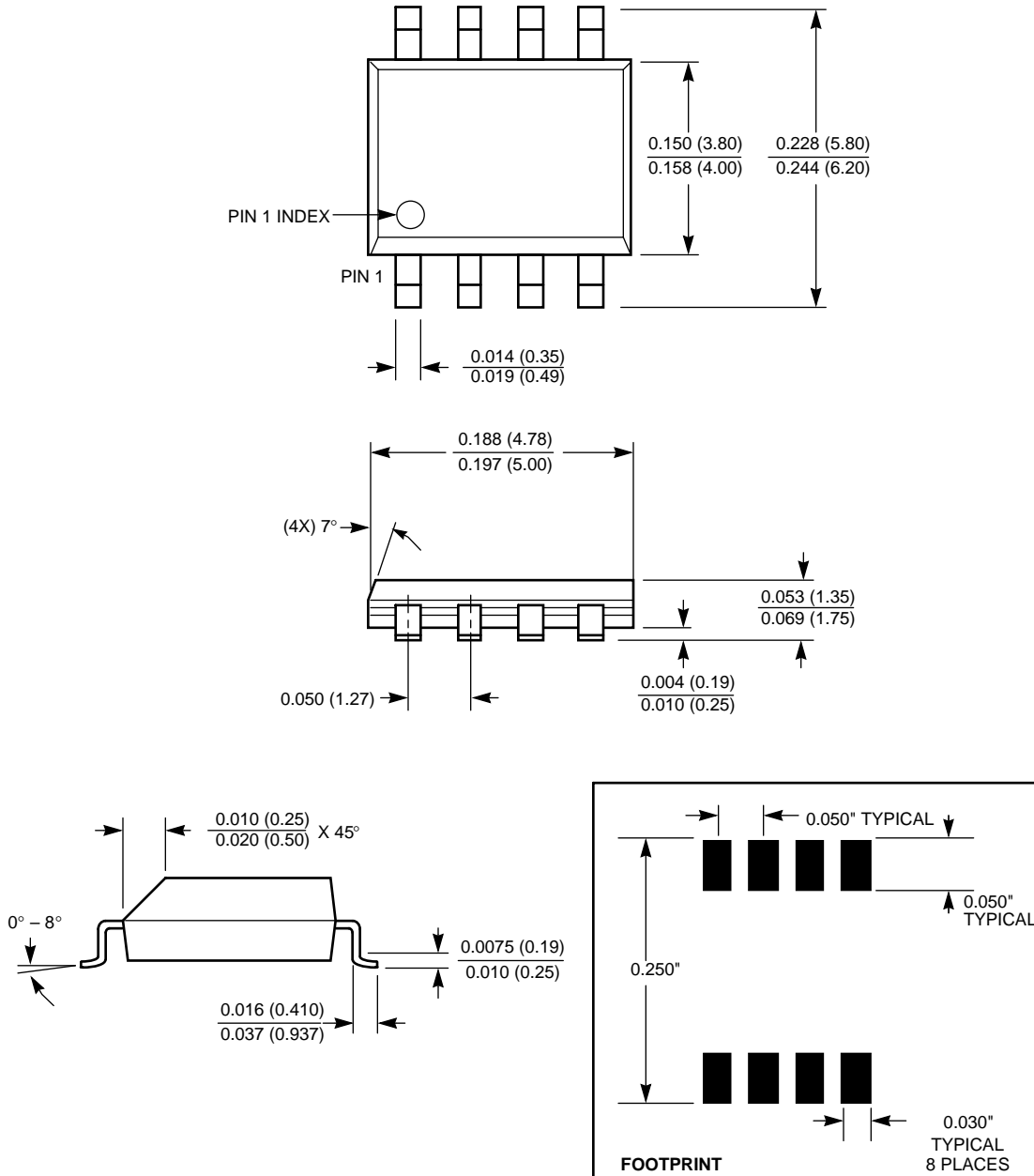
## PACKAGING INFORMATION

### 14-LEAD PLASTIC SMALL OUTLINE GULL WING PACKAGE TYPE S



NOTE: ALL DIMENSIONS IN INCHES (IN PARENTHESES IN MILLIMETERS)

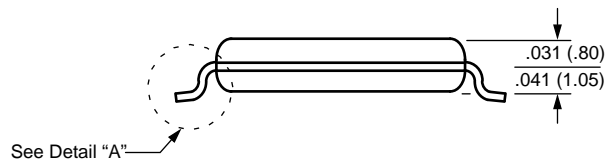
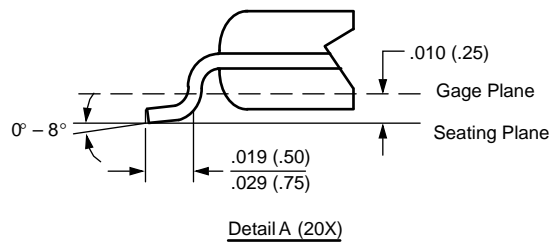
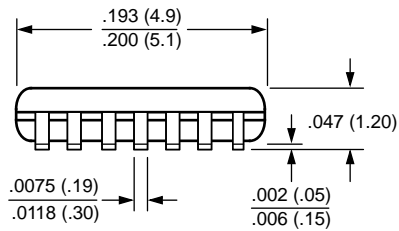
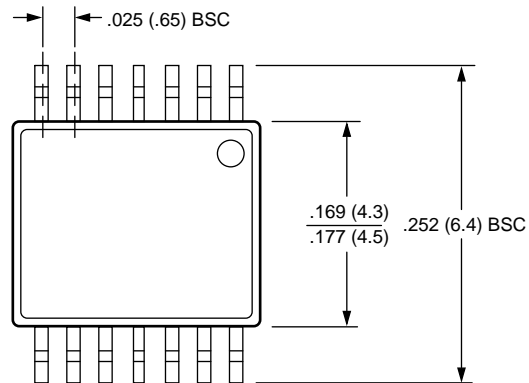
8-LEAD PLASTIC SMALL OUTLINE GULL WING PACKAGE TYPE S



NOTE: ALL DIMENSIONS IN INCHES (IN PARENTHESES IN MILLIMETERS)

# X25648/49, X25328/29, X25168/69

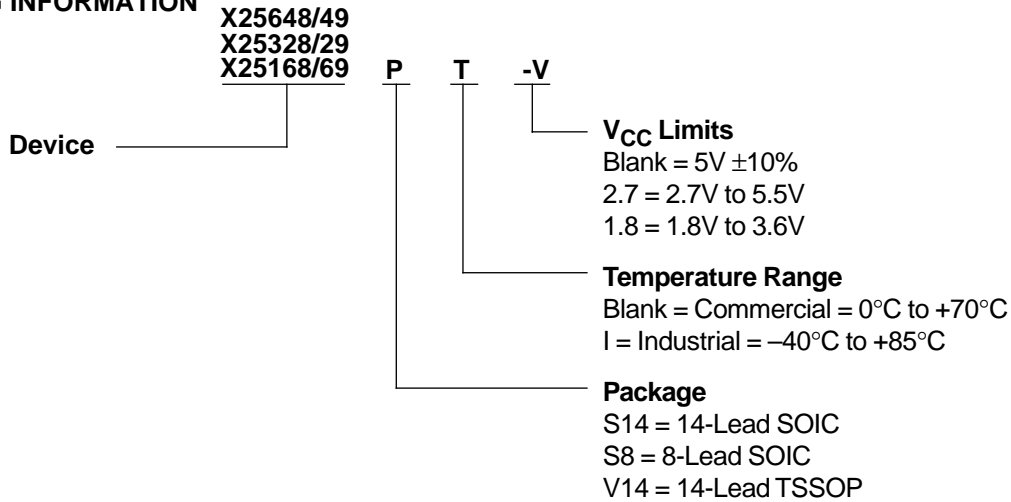
## 14-LEAD PLASTIC, TSSOP, PACKAGE TYPE V



NOTE: ALL DIMENSIONS IN INCHES (IN PARENTHESES IN MILLIMETERS)

# X25648/49, X25328/29, X25168/69

## ORDERING INFORMATION



## Part Mark Convention

**X25648/49** X — Blank = 14-Lead SOIC

**X25328/29** X — Blank = 8-Lead SOIC  
**X25168/69** V = 14 Lead TSSOP

**X**  
Blank = 5V ±10%, 0°C to +70°C  
I = 5V ±10%, -40°C to +85°C  
F = 2.7V to 5.5V, 0°C to +70°C  
G = 2.7V to 5.5V, -40°C to +85°C  
AG = 1.8V to 3.6V, 0°C to +70°C

**X**  
Blank = 5V ±10%, 0°C to +70°C  
I = 5V ±10%, -40°C to +85°C  
F = 2.7V to 5.5V, 0°C to +70°C  
G = 2.7V to 5.5V, -40°C to +85°C  
AG = 1.8V to 3.6V, 0°C to +70°C

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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.