CAT93C46A/CAT93C46AI

1K-Bit SERIAL E²PROM

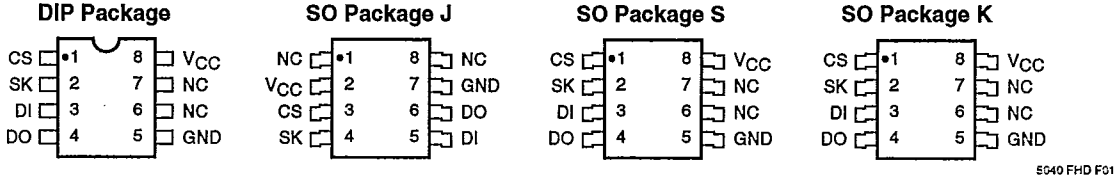
FEATURES

- High Speed Operation: 1MHz
- Low Power CMOS Technology
- Single 5V Supply
- 64 x 16 Serial Memory
- Self-Timed Write Cycle with Auto-Clear
- Hardware and Software Write Protection
- Power-Up Inadvertant Write Protection
- 100,000 Program/Erase Cycles
- 100 Year Data Retention
- Optional High Endurance Device Available

DESCRIPTION

The CAT93C46A and CAT93C46AI are 1K bit Serial E²PROM memory devices which are configured as 64 registers by 16 bits. Each register can be written (or read) serially by using the DI (or DO) pin. The CAT93C46A/CAT93C46AI is manufactured using Catalyst's advanced CMOS E²PROM floating gate technology. It is designed to endure 100,000 program/erase cycles and has a data retention of 100 years. The device is available in 8 pin DIP or SO packages.

PIN CONFIGURATION



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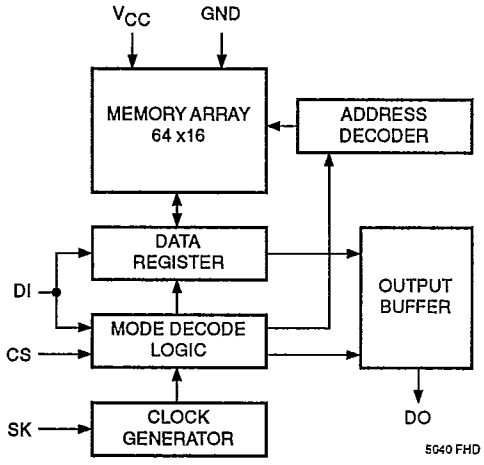
PIN FUNCTIONS

Pin Name	Function
CS	Chip Select
SK	Clock Input
DI	Serial Data Input
DO	Serial Data Output
Vcc	+5V Power Supply
GND	Ground
NC	No Connection

BLOCK DIAGRAM



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ABSOLUTE MAXIMUM RATINGS*

Temperature Under Bias .....–55°C to +125°C

Storage Temperature .....–65°C to +150°C

Voltage on any Pin with Respect to Ground(1) .....–2.0V to +V_{CC} +2.0V

V_{CC} with Respect to Ground .....–2.0V to +7.0V

Package Power Dissipation Capability (Ta = 25°C) 1.0W

Lead Soldering Temperature (10 secs) .....300°C

Output Short Circuit Current(2) .....100 mA

*COMMENT

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

RELIABILITY CHARACTERISTICS

Symbol	Parameter	Min.	Max.	Units	Reference Test Method
N_{END}(3)	Endurance	100,000		Cycles/Byte	MIL-STD-883, Test Method 1033
T_{DR}(3)	Data Retention	100		Years	MIL-STD-883, Test Method 1008
V_{ZAP}(3)	ESD Susceptibility	2000		Volts	MIL-STD-883, Test Method 3015
I_{LTH}(3)(4)	Latch-Up	100		mA	JEDEC Standard 17

D.C. OPERATING CHARACTERISTICS

CAT93C46A T_A= 0°C to +70°C, V_{CC} = +5V±10%, unless otherwise specified.
CAT93C46AI T_A= –40°C to +85°C, V_{CC} = +5V±10%, unless otherwise specified.

Symbol	Parameter	Limits			Units	Test Conditions
		Min.	Typ.	Max.		
I_{CC1}	Power Supply Current (Operating)			3	mA	DI = 0.0V, SK = 5.0V V_{CC} = 5.0V, CS = 5.0V, Output Open
I_{CC2}	Power Supply Current (Standby)			100	µA	V_{CC} = 5.5V, CS = 0V DI = 0V SK = 0V
I_{LI}	Input Leakage Current			2	µA	V_{IN} = 0V to 5.5V
I_{LO}	Output Leakage Current			10	µA	V_{OUT} = 0V to 5.5V, CS = 0V
V_{IH}	High Level Input Voltage	2.0		V_{CC} + 1	V	
V_{IL}	Low Level Input Voltage	–0.1		0.8	V	
V_{OH}	High Level Output Voltage	2.4			V	I_{OH} = –400µA
V_{OL}	Low Level Output Voltage			0.4	V	I_{OL} = 2.1mA

Note:
(1) The minimum DC input voltage is –0.5V. During transitions, inputs may undershoot to –2.0V for periods of less than 20 ns. Maximum DC voltage on output pins is V_{CC} +0.5V, which may overshoot to V_{CC} +2.0V for periods of less than 20 ns.
(2) Output shorted for no more than one second. No more than one output shorted at a time.
(3) This parameter is tested initially and after a design or process change that affects the parameter.
(4) Latch-up protection is provided for stresses up to 100 mA on address and data pins from –1V to V_{CC} +1V.

INSTRUCTION SET

Instruction	Start Bit	Opcode	Address	Data	Comments
READ	1	1 0	A5–A0		Read Address AN–A0
ERASE	1	1 1	A5–A0		Clear Address AN–A0
WRITE	1	0 1	A5–A0	D15–D0	Write Address AN–A0
EWEN	1	0 0	11XXXX		Write Enable
EWDS	1	0 0	00XXXX		Write Disable
ERAL	1	0 0	10XXXX		Clear All Addresses
WRAL	1	0 0	01XXXX	D15–D0	Write All Addresses

A.C. CHARACTERISTICS

CAT93C46A T_A= 0°C to +70°C, V_{CC} = +5V±10%, unless otherwise specified.
CAT93C46AI T_A= –40°C to +85°C, V_{CC} = +5V±10%, unless otherwise specified.

Symbol	Parameter	Limits			Units	Test Conditions
		Min.	Typ.	Max.		
t_{CSS}	CS Setup Time	50			ns	
t_{CSH}	CS Hold Time	0			ns	
t_{DIS}	DI Setup Time	100			ns	C_L = 100pF
t_{DIH}	DI Hold Time	100			ns	V_{OL} = 0.8V, V_{OH} = 2.0V
t_{PD1}	Output Delay to 1			500	ns	V_{IL} = 0.45V, V_{IH} = 2.4V
t_{PD0}	Output Delay to 0			500	ns	
t_{HZ}(3)	Output Delay to High-Z			100	ns	
t_{EW}	Program/Erase Pulse Width			10	ms	
t_{CSMIN}	Minimum CS Low Time	250			ns	
t_{SKHI}	Minimum SK High Time	100			ns	
t_{SKLOW}	Minimum SK Low time	660			ns	
t_{SV}	Output Delay to Status Valid			500	ns	C_L = 100pF
SK_{MAX}	Maximum Clock Frequency	DC		1	MHz	

Note:
(3) This parameter is tested initially and after a design or process change that affects the parameter.

DEVICE OPERATION

The CAT93C46A/CAT93C46AI is a 1024 bit nonvolatile memory intended for use with industry standard microprocessors. The CAT93C46A/CAT93C46AI is organized as 64 registers by 16 bits. Seven 9 bit instructions control the reading, writing and erase operations of the device. The CAT93C46A/CAT93C46AI operates on a single 5V supply and will generate on chip, the high voltage required during any write operation.

Instructions, addresses, and write data are clocked into the DI pin on the rising edge of the clock (SK). The DO pin is normally in a high impedance state except when reading data from the device, or when checking the ready/busy status after a write operation.

The ready/busy status can be determined after a write operation by selecting the device (CS high) and polling the DO pin; DO low indicates that the write operation is not completed, while DO high indicates that the device is ready for the next instruction. If necessary, the DO pin may be placed back into a high impedance state during chip select by shifting a dummy "1" into the DI pin. The DO pin will enter the high impedance state on the falling edge of the clock (SK). Placing the DO pin into the high impedance state is recommended in applications where the DI pin and the DO pin are to be tied together to form a common DI/O pin.

The format for all instructions sent to the CAT93C46A/CAT93C46AI is a logical "1" start bit, a 2 bit (or 4 bit) op code, a 6 bit address, and for write operations, a 16 bit data field.

Figure 1. Sychronous Data Timing

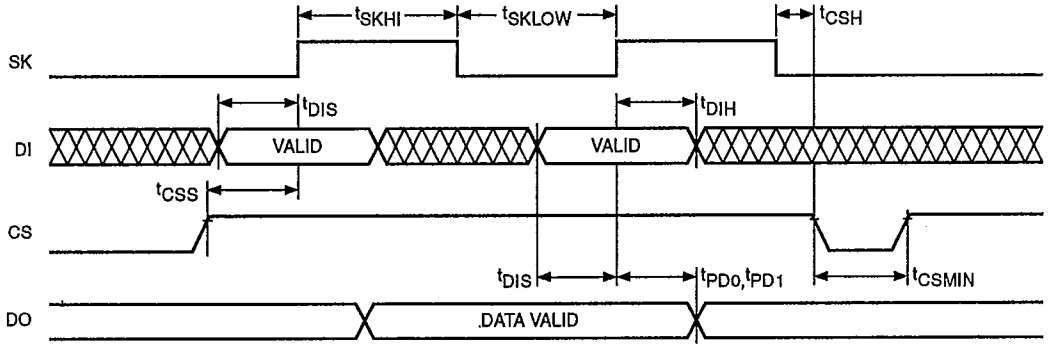
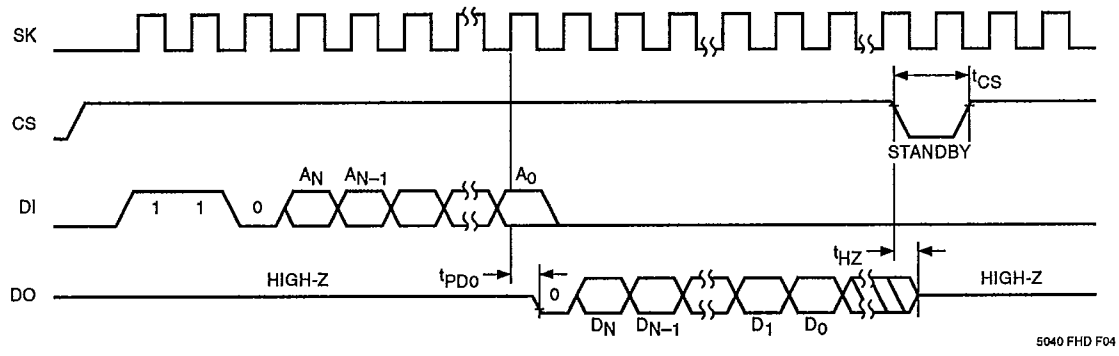


Figure 2. Read Instruction Timing



At power-down, when V_{CC} falls below a threshold of approximately 3.5V, the data protection circuitry inhibits the erase and write instructions and a write disable (EWDS) is executed internally.

NOTE: This device will accept a start bit that is generated when both SK and DI are high with respect to a low to high transition of CS.

Read

Upon receiving a READ command and an address (clocked into the DI pin), the DO pin of the CAT93C46A/CAT93C46AI will come out of the high impedance state and, after sending an initial dummy zero bit, will begin shifting out the data addressed. The output data bits will toggle on the rising edge of the SK clock and are stable after the specified time delay (t_{PD0} or t_{PD1}).

Write

After receiving a WRITE command, address and the data, the CS (chip select) pin must be deselected for a minimum of 250ns (t_{CSMIN}). The falling edge of CS will start the self clocking clear and data store cycle of the memory location specified in the instruction. The clocking of the SK pin is not necessary after the device has entered the self clocking mode. The ready/busy status of the CAT93C46A/CAT93C46AI can be determined by selecting the device and polling the DO pin. Since this device features Auto-Clear before write, it is NOT necessary to erase a memory location before the WRITE command is sent.

Erase

Upon receiving an ERASE command and address, the CS (chip select) pin must be deselected for a minimum of 250ns (t_{CSMIN}). The falling edge of CS will start the self clocking clear cycle of the memory location specified in the instruction. The clocking of the SK pin is not necessary after the device has entered the self clocking mode. The ready/busy status of the CAT93C46A/CAT93C46AI

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Figure 3. Write Instruction Timing

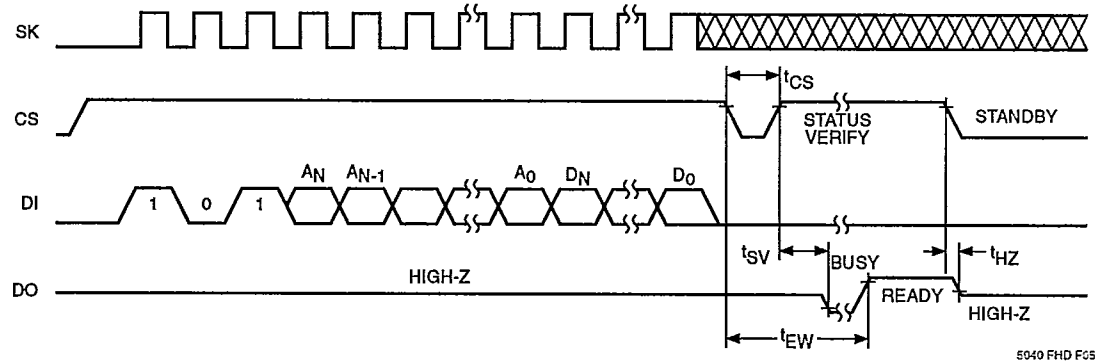
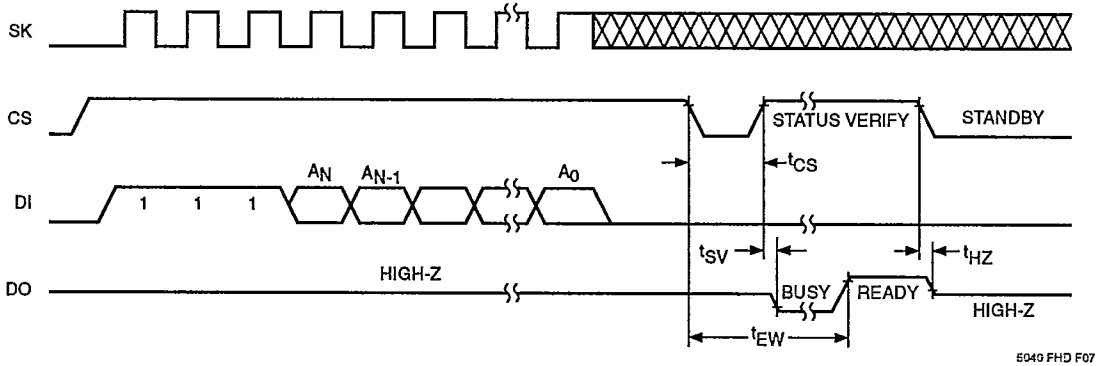


Figure 4. Erase Instruction Timing



can be determined by selecting the device and polling the DO pin. Once cleared, the content of a cleared location returns to a logical "1" state.

Erase/Write Enable and Disable

The CAT93C46A/CAT93C46AI powers up in the write disable state. Any writing after power-up or after an EWDS (write disable) instruction must first be preceded by the EWEN (write enable) instruction. Once the write instruction is enabled, it will remain enabled until power to the device is removed, or the EWDS instruction is sent. The EWDS instruction can be used to disable all CAT93C46A/CAT93C46AI write and clear instructions, and will prevent any accidental writing or clearing of the device. Data can be read normally from the device regardless of the write enable/disable status.

Erase All

Upon receiving an ERAL command, the CS (chip select) pin must be deselected for a minimum of 250ns (t_{CSMIN}). The falling edge of CS will start the self clocking clear cycle of all memory locations in the device. The clocking of the SK pin is not necessary after the device has entered the self clocking mode. The ready/busy status of the CAT93C46A/CAT93C46AI can be determined by selecting the device and polling the DO pin. Once cleared, the contents of all memory bits return to a logical "1" state.

Write All

Upon receiving a WRAL command and data, the CS (chip select) pin must be deselected for a minimum of 250ns (t_{CSMIN}). The falling edge of CS will start the self clocking data write to all memory locations in the device. The clocking of the SK pin is not necessary after the device has entered the self clocking mode. The ready/busy status of the CAT93C46A/CAT93C46AI can be determined by selecting the device and polling the DO pin. It IS necessary for all memory locations to be cleared before the WRAL command is executed.

Figure 5. EWEN/EWDS Instruction Timing

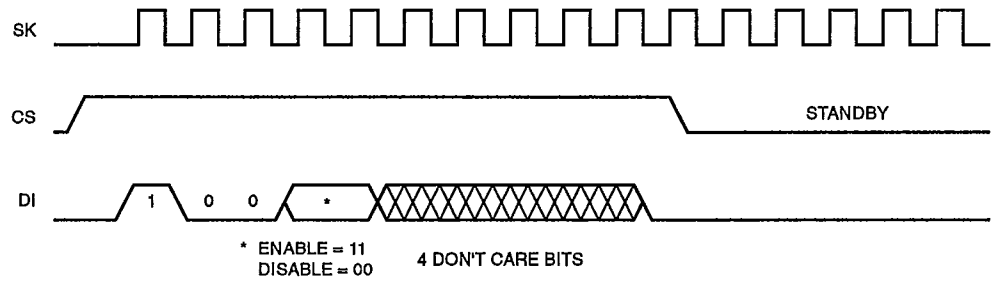


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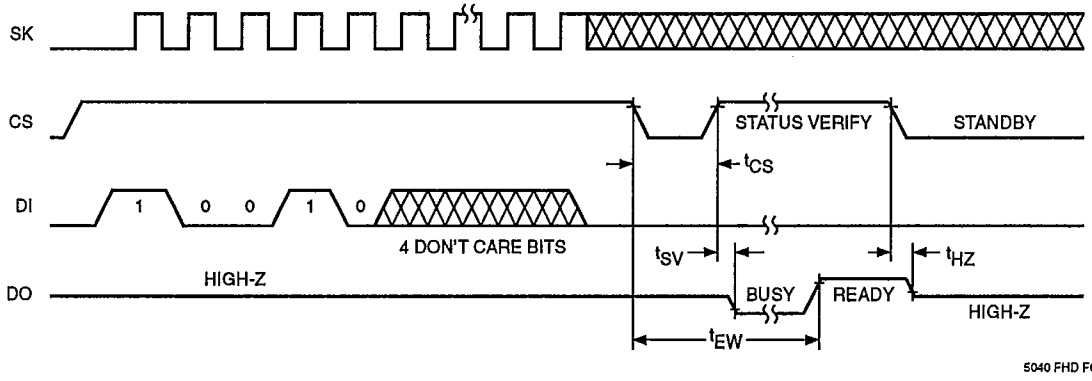
Figure 6. ERAL Instruction Timing



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Start Bit Timing

The CAT93C46A/CAT93C46AI features an alternate start bit timing where the device will accept a start bit that is generated when both SK and DI are high with respect to a low to high transition of CS (see Figure 8). This allows the user to send instructions from microprocessors that transmit and receive data using a sequence of 8 clock cycles only. Once this start bit is generated all subsequent data is clocked into the device on the positive clock edge of SK.

Figure 7. WRAL Instruction Timing

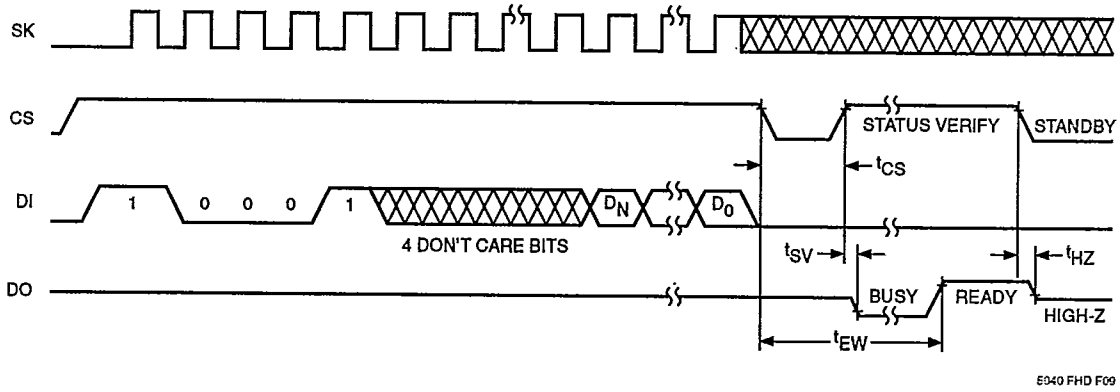

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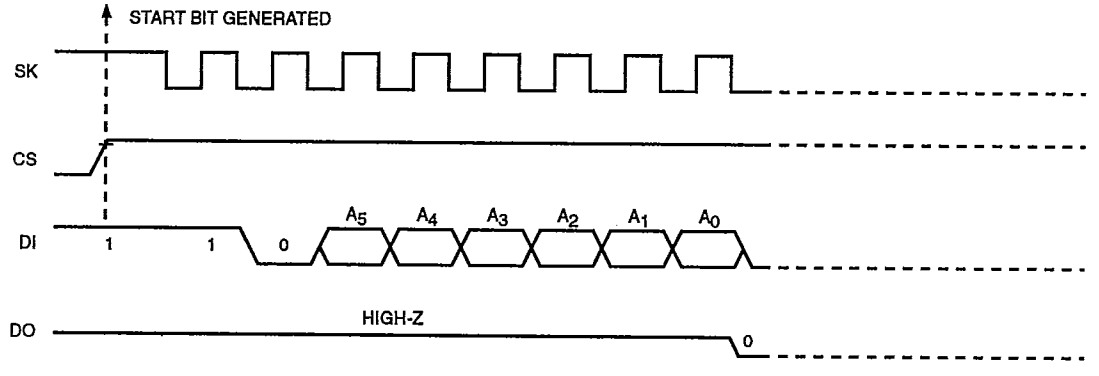
Figure 8. Alternate Start Bit Timing Example: Read Instruction



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