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Not recommended for new designs – Please use 93LC76C or 93LC86C.

93C76/86

8K/16K 5.0V Microwire Serial EEPROM

Features:

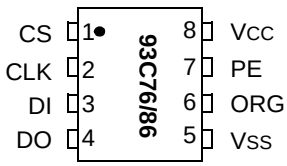
- Single 5.0V supply
- Low-power CMOS technology
  - 1 mA active current typical
- ORG pin selectable memory configuration
  1024 x 8- or 512 x 16-bit organization (93C76)
  2048 x 8- or 1024 x 16-bit organization (93C86)
- Self-timed erase and write cycles (including auto-erase)
- Automatic ERAL before WRAL
- Power on/off data protection circuitry
- Industry standard 3-wire serial I/O
- Device status signal during erase/write cycles
- Sequential read function
- 1,000,000 erase/write cycles ensured
- Data retention > 200 years
- 8-pin PDIP/SOIC package
- Temperature ranges supported
  - Commercial (C): 0°C to +70°C
  - Industrial (I): -40°C to +85°C
  - Automotive (E) -40°C to +125°C

Description:

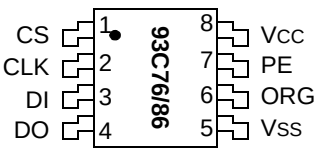
The Microchip Technology Inc. 93C76/86 are 8K and 16K low voltage serial Electrically Erasable PROMs. The device memory is configured as x8 or x16 bits depending on the ORG pin setup. Advanced CMOS technology makes these devices ideal for low power nonvolatile memory applications. These devices also have a Program Enable (PE) pin to allow the user to write protect the entire contents of the memory array. The 93C76/86 is available in standard 8-pin PDIP and 8-pin surface mount SOIC packages.

Package Types

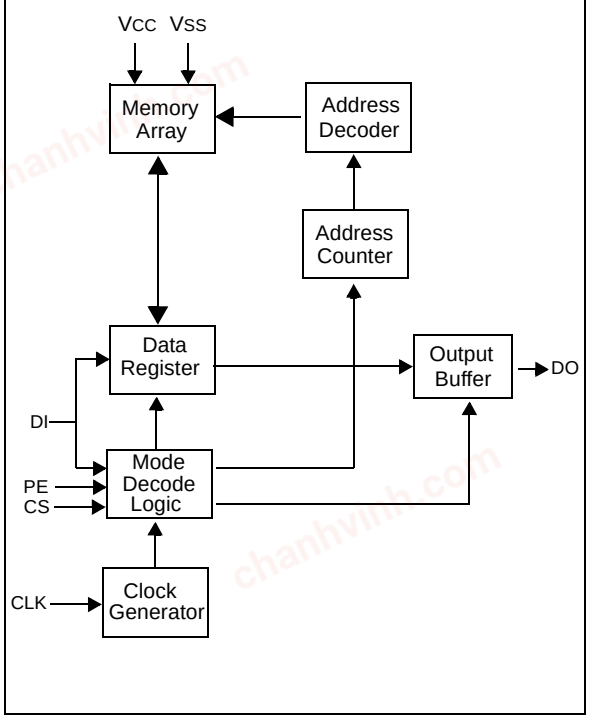
PDIP Package



SOIC Package



Block Diagram



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1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings(†)

VCC.....7.0V

All inputs and outputs w.r.t. VSS .....-0.6V to Vcc + 1.0V

Storage temperature .....-65°C to +150°C

Ambient temperature with power applied.....-40°C to +125°C

Soldering temperature of leads (10 seconds) .....+300°C

ESD protection on all pins.....4 kV

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

1.1 AC Test Conditions

AC Waveform:

VLO = 2.0V

VHI = Vcc - 0.2V **(Note 1)**

VHI = 4.0V for **(Note 2)**

Timing Measurement Reference Level

Input	0.5 VCC
Output	0.5 VCC

Note 1: For VCC ≤ 4.0V

2: For VCC > 4.0V

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TABLE 1-1: DC CHARACTERISTICS

DC CHARACTERISTICS	Applicable over recommended operating ranges shown below unless otherwise noted: V_{CC} = +4.5V to +5.5V Commercial (C): T_A = 0°C to -40°C Industrial (I): T_A = -40°C to +85°C Automotive (E): T_A = -40°C to +125°C				
Parameter	**Symbol**	**Min.**	**Max.**	**Units**	**Conditions**
High-level input voltage	V_{IH1}	2.0	V_{CC} +1	V	—
Low-level input voltage	V_{IL1}	-0.3	0.8	V	—
Low-level output voltage	V_{OL1}	—	0.4	V	I_{OL} = 2.1 mA; V_{CC} = 4.5V
	V_{OL2}	—	0.2	V	I_{OL} =100 µA; V_{CC} = 4.5V
High-level output voltage	V_{OH1}	2.4	—	V	I_{OH} = -400 µA; V_{CC} = 4.5V
	V_{OH2}	V_{CC}-0.2	—	V	I_{OH} = -100 µA; V_{CC} = 4.5V.
Input leakage current	I_{LI}	-10	10	µA	V_{IN} = 0.1V to V_{CC}
Output leakage current	I_{LO}	-10	10	µA	V_{OUT} = 0.1V to V_{CC}
Pin capacitance (all inputs/outputs)	C_{INT}	—	7	pF	**(Note 1)** T_A = +25°C, F_{CLK} = 1 MHz
Operating current	I_{CC} write	—	3	mA	F_{CLK} = 2 MHz; V_{CC} = 5.5V
	I_{CC} read	—	1.5	mA	F_{CLK} = 2 MHz; V_{CC} = 5.5V
Standby current	I_{CCS}	—	100	µA	CLK = CS = 0V; V_{CC} = 5.5V DI = PE = V_{SS} ORG = V_{SS} or V_{CC}

Note 1: This parameter is periodically sampled and not 100% tested.

TABLE 1-2: AC CHARACTERISTICS

AC CHARACTERISTICS	Applicable over recommended operating ranges shown below unless otherwise noted: V_{CC} = +4.5V to +5.5V Commercial (C): T_A = 0°C to -40°C Industrial (I): T_A = -40°C to +85°C Automotive (E): T_A = -40°C to +125°C				
Parameter	**Symbol**	**Min.**	**Max.**	**Units**	**Conditions**
Clock frequency	F_{CLK}	—	2	MHz	Vcc ≥ 4.5V
Clock high time	T_{CKH}	300	—	ns	
Clock low time	T_{CKL}	200	—	ns	
Chip select setup time	T_{CSS}	50	—	ns	Relative to CLK
Chip select hold time	T_{CSH}	0	—	ns	
Chip select low time	T_{CSL}	250	—	ns	Relative to CLK
Data input setup time	T_{DIS}	100	—	ns	Relative to CLK
Data input hold time	T_{DIH}	100	—	ns	Relative to CLK
Data output delay time	T_{PD}	—	400	ns	C_L = 100 pF
Data output disable time	T_{CZ}	—	100	ns	**(Note 1)**
Status valid time	T_{SV}	—	500	ns	C_L = 100 pF
Program cycle time	T_{WC}	—	10	ms	Erase/Write mode **(Note 2)**
	T_{EC}	—	15	ms	ERAL mode
	T_{WL}	—	30	ms	WRAL mode
Endurance	—	1M	—	cycles	25°C, V_{CC} = 5.0V, Block mode **(Note 3)**

Note 1: This parameter is periodically sampled and not 100% tested.

2: Typical program cycle is 4 ms per word.

3: This parameter is not tested but ensured by characterization. For endurance estimates in a specific application, please consult the Total Endurance™ Model which can be obtained from Microchip's web site at www.microchip.com.

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TABLE 1-3: INSTRUCTION SET FOR 93C76: ORG=1 (X16 ORGANIZATION)

Instruction	SB	Opcode	Address	Data In	Data Out	Req. CLK Cycles
READ	1	10	X A8 A7 A6 A5 A4 A3 A2 A1 A0	—	D15 - D0	29
EWEN	1	00	1 1 X X X X X X X X	—	High-Z	13
ERASE	1	11	X A8 A7 A6 A5 A4 A3 A2 A1 A0	—	(RDY/BSY)	13
ERAL	1	00	1 0 X X X X X X X X	—	(RDY/BSY)	13
WRITE	1	01	X A8 A7 A6 A5 A4 A3 A2 A1 A0	D15 - D0	(RDY/BSY)	29
WRAL	1	00	0 1 X X X X X X X X	D15 - D0	(RDY/BSY)	29
EWDS	1	00	0 0 X X X X X X X X	—	High-Z	13

TABLE 1-4: INSTRUCTION SET FOR 93C76: ORG=0 (X8 ORGANIZATION)

Instruction	SB	Opcode	Address	Data In	Data Out	Req. CLK Cycles
READ	1	10	X A9 A8 A7 A6 A5 A4 A3 A2 A1 A0	—	D7 - D0	22
EWEN	1	00	1 1 X X X X X X X X X	—	High-Z	14
ERASE	1	11	X A9 A8 A7 A6 A5 A4 A3 A2 A1 A0	—	(RDY/BSY)	14
ERAL	1	00	1 0 X X X X X X X X X	—	(RDY/BSY)	14
WRITE	1	01	X A9 A8 A7 A6 A5 A4 A3 A2 A1 A0	D7 - D0	(RDY/BSY)	22
WRAL	1	00	0 1 X X X X X X X X X	D7 - D0	(RDY/BSY)	22
EWDS	1	00	0 0 X X X X X X X X X	—	High-Z	14

TABLE 1-5: INSTRUCTION SET FOR 93C86: ORG=1 (X16 ORGANIZATION)

Instruction	SB	Opcode	Address	Data In	Data Out	Req. CLK Cycles
READ	1	10	A9 A8 A7 A6 A5 A4 A3 A2 A1 A0	—	D15 - D0	29
EWEN	1	00	1 1 X X X X X X X X	—	High-Z	13
ERASE	1	11	A9 A8 A7 A6 A5 A4 A3 A2 A1 A0	—	(RDY/BSY)	13
ERAL	1	00	1 0 X X X X X X X X	—	(RDY/BSY)	13
WRITE	1	01	A9 A8 A7 A6 A5 A4 A3 A2 A1 A0	D15 - D0	(RDY/BSY)	29
WRAL	1	00	0 1 X X X X X X X X	D15 - D0	(RDY/BSY)	29
EWDS	1	00	0 0 X X X X X X X X	—	High-Z	13

TABLE 1-6: INSTRUCTION SET FOR 93C86: ORG=0 (X8 ORGANIZATION)

Instruction	SB	Opcode	Address	Data In	Data Out	Req. CLK Cycles
READ	1	10	A10 A9 A8 A7 A6 A5 A4 A3 A2 A1 A0	—	D7 - D0	22
EWEN	1	00	1 1 X X X X X X X X X	—	High-Z	14
ERASE	1	11	A10 A9 A8 A7 A6 A5 A4 A3 A2 A1 A0	—	(RDY/BSY)	14
ERAL	1	00	1 0 X X X X X X X X X	—	(RDY/BSY)	14
WRITE	1	01	A10 A9 A8 A7 A6 A5 A4 A3 A2 A1 A0	D7 - D0	(RDY/BSY)	22
WRAL	1	00	0 1 X X X X X X X X X	D7 - D0	(RDY/BSY)	22
EWDS	1	00	0 0 X X X X X X X X X	—	High-Z	14

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2.0 PRINCIPLES OF OPERATION

When the ORG pin is connected to VCC, the x16 organization is selected. When it is connected to ground, the x8 organization is selected. Instructions, addresses and write data are clocked into the DI pin on the rising edge of the clock (CLK). The DO pin is normally held in a high-Z state except when reading data from the device, or when checking the Ready/Busy status during a programming operation. The Ready/Busy status can be verified during an erase/write operation by polling the DO pin; DO low indicates that programming is still in progress, while DO high indicates the device is ready. The DO will enter the high-impedance state on the falling edge of the CS.

2.1 Start Condition

The Start bit is detected by the device if CS and DI are both high with respect to the positive edge of CLK for the first time.

Before a Start condition is detected, CS, CLK and DI may change in any combination (except to that of a Start condition), without resulting in any device operation (Read, Write, Erase, EWEN, EWDS, ERAL and WRAL). As soon as CS is high, the device is no longer in the Standby mode.

An instruction following a Start condition will only be executed if the required amount of opcode, address and data bits for any particular instruction are clocked in.

After execution of an instruction (i.e., clock in or out of the last required address or data bit) CLK and DI become “don't care” bits until a new Start condition is detected.

2.2 DI/DO

It is possible to connect the Data In and Data Out pins together. However, with this configuration it is possible for a “bus conflict” to occur during the “dummy zero” that precedes the read operation, if A0 is a logic high level. Under such a condition the voltage level seen at Data Out is undefined and will depend upon the relative impedances of Data Out and the signal source driving A0. The higher the current sourcing capability of A0, the higher the voltage at the Data Out pin.

2.3 Erase/Write Enable and Disable (EWEN, EWDS)

The 93C76/86 powers up in the Erase/Write Disable (EWDS) state. All programming modes must be preceded by an Erase/Write Enable (EWEN) instruction. Once the EWEN instruction is executed, programming remains enabled until an EWDS instruction is executed or VCC is removed from the device. To protect against accidental data disturb, the EWDS instruction can be used to disable all erase/write functions and should follow all programming operations. Execution of a READ instruction is independent of both the EWEN and EWDS instructions.

2.4 Data Protection

During power-up, all programming modes of operation are inhibited until VCC has reached a level greater than 1.4V. During power-down, the source data protection circuitry acts to inhibit all programming modes when VCC has fallen below 1.4V.

The EWEN and EWDS commands give additional protection against accidentally programming during normal operation.

After power-up, the device is automatically in the EWDS mode. Therefore, an EWEN instruction must be performed before any ERASE or WRITE instruction can be executed.

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3.0 DEVICE OPERATION

3.1 Read

The READ instruction outputs the serial data of the addressed memory location on the DO pin. A dummy zero bit precedes the 16-bit (x16 organization) or 8-bit (x8 organization) output string. The output data bits will toggle on the rising edge of the CLK and are stable after the specified time delay (TPD). Sequential read is possible when CS is held high and clock transitions continue. The memory address pointer will automatically increment and output data sequentially.

3.2 Erase

The ERASE instruction forces all data bits of the specified address to the logical "1" state. The self-timed programming cycle is initiated on the rising edge of CLK as the last address bit (A0) is clocked in. At this point, the CLK, CS and DI inputs become "don't cares".

The DO pin indicates the Ready/$\overline{\text{Busy}}$ status of the device if the CS is high. The Ready/Busy status will be displayed on the DO pin until the next Start bit is received as long as CS is high. Bringing the CS low will place the device in Standby mode and cause the DO pin to enter the high-impedance state. DO at logical "0" indicates that programming is still in progress. DO at logical "1" indicates that the register at the specified address has been erased and the device is ready for another instruction.

The erase cycle takes 3 ms per word (typical).

3.3 Write

The WRITE instruction is followed by 16 bits (or by 8 bits) of data to be written into the specified address. The self-timed programming cycle is initiated on the rising edge of CLK as the last data bit (D0) is clocked in. At this point, the CLK, CS and DI inputs become "don't cares".

The DO pin indicates the Ready/$\overline{\text{Busy}}$ status of the device if the CS is high. The Ready/Busy status will be displayed on the DO pin until the next Start bit is received as long as CS is high. Bringing the CS low will place the device in Standby mode and cause the DO pin to enter the high-impedance state. DO at logical "0" indicates that programming is still in progress. DO at logical "1" indicates that the register at the specified address has been written and the device is ready for another instruction.

The write cycle takes 3 ms per word (typical).

3.4 Erase All (ERAL)

The ERAL instruction will erase the entire memory array to the logical "1" state. The ERAL cycle is identical to the erase cycle except for the different opcode. The ERAL cycle is completely self-timed and commences on the rising edge of the last address bit (A0). Note that the Least Significant 8 or 9 address bits are "don't care" bits, depending on selection of x16 or x8 mode. Clocking of the CLK pin is not necessary after the device has entered the self clocking mode. The ERAL instruction is ensured at Vcc = +4.5V to +5.5V.

The DO pin indicates the Ready/$\overline{\text{Busy}}$ status of the device if the CS is high. The Ready/Busy status will be displayed on the DO pin until the next Start bit is received as long as CS is high. Bringing the CS low will place the device in Standby mode and cause the DO pin to enter the high-impedance state. DO at logical "0" indicates that programming is still in progress. DO at logical "1" indicates that the entire device has been erased and is ready for another instruction.

The ERAL cycle takes 15 ms maximum (8 ms typical).

3.5 Write All (WRAL)

The WRAL instruction will write the entire memory array with the data specified in the command. The WRAL cycle is completely self-timed and commences on the rising edge of the last address bit (A0). Note that the Least Significant 8 or 9 address bits are "don't cares", depending on selection of x16 or x8 mode. Clocking of the CLK pin is not necessary after the device has entered the self clocking mode. The WRAL command does include an automatic ERAL cycle for the device. Therefore, the WRAL instruction does not require an ERAL instruction but the chip must be in the EWEN status. The WRAL instruction is ensured at Vcc = +4.5V to +5.5V.

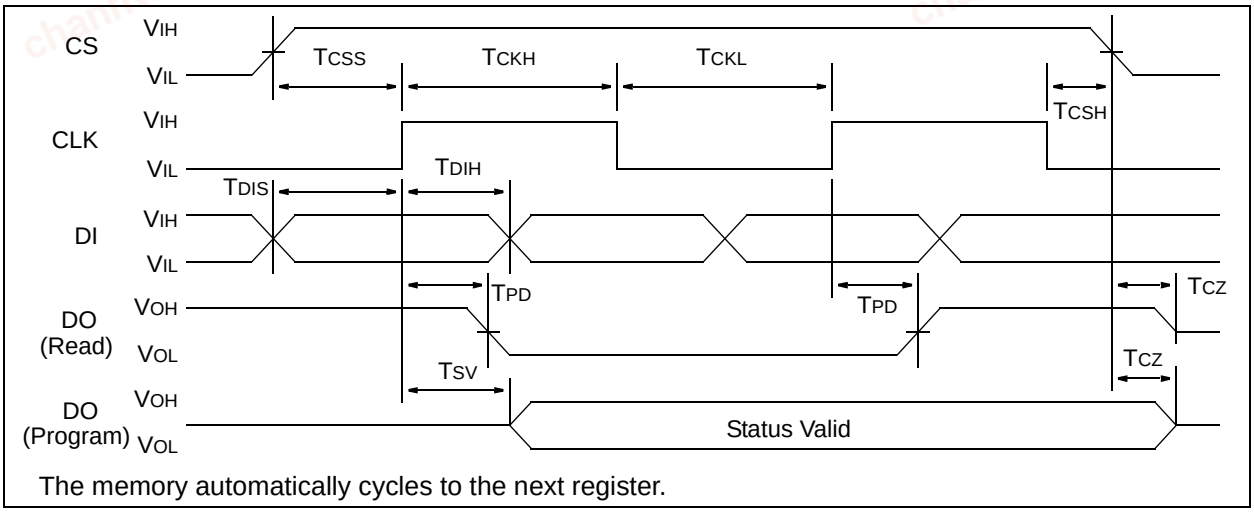
The DO pin indicates the Ready/$\overline{\text{Busy}}$ status of the device if the CS is high. The Ready/Busy status will be displayed on the DO pin until the next Start bit is received as long as CS is high. Bringing the CS low will place the device in Standby mode and cause the DO pin to enter the high-impedance state. DO at logical "0" indicates that programming is still in progress. DO at logical "1" indicates that the entire device has been written and is ready for another instruction.

The WRAL cycle takes 30 ms maximum (16 ms typical).

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FIGURE 3-1: SYNCHRONOUS DATA TIMING



The memory automatically cycles to the next register.

FIGURE 3-2: READ

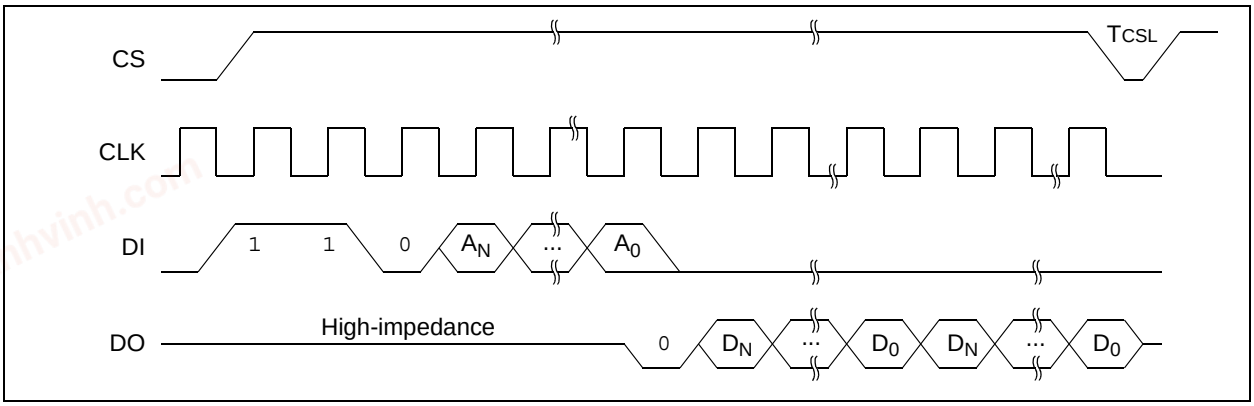
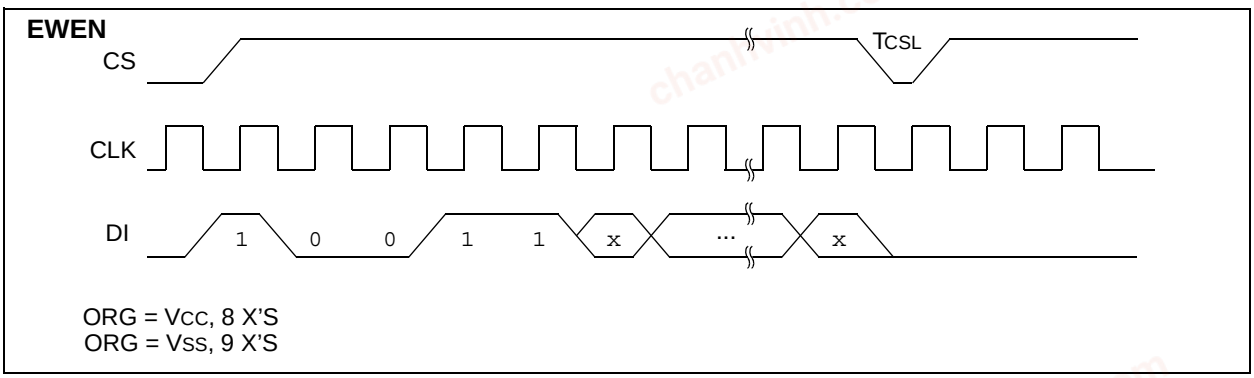


FIGURE 3-3: EWEN



ORG = VCC, 8 X'S
ORG = VSS, 9 X'S

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FIGURE 3-4: EWDS

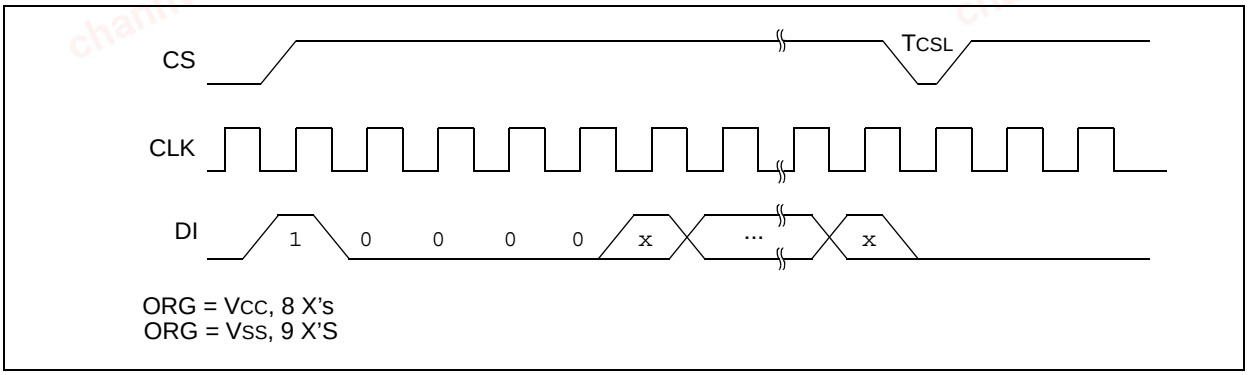


FIGURE 3-5: WRITE

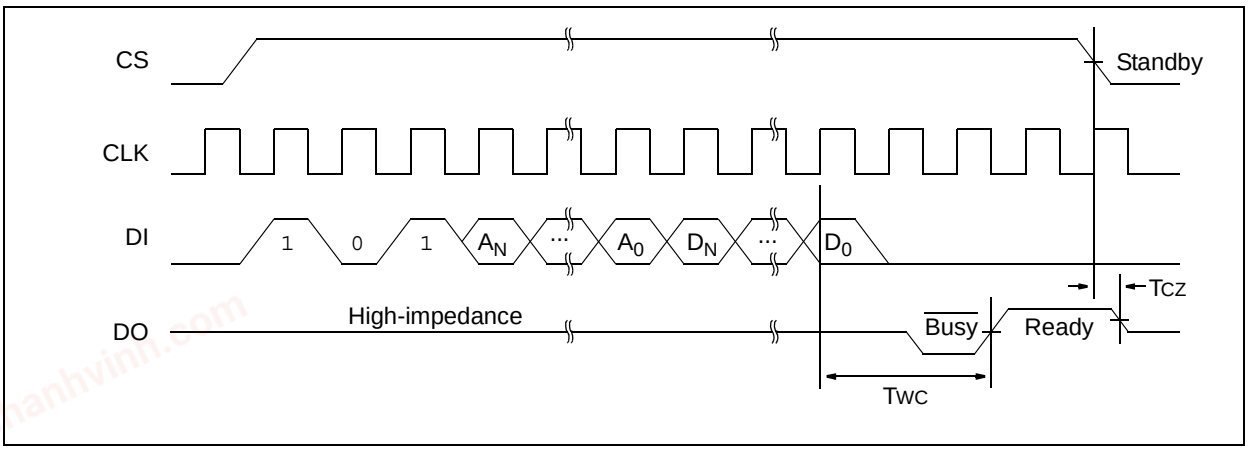
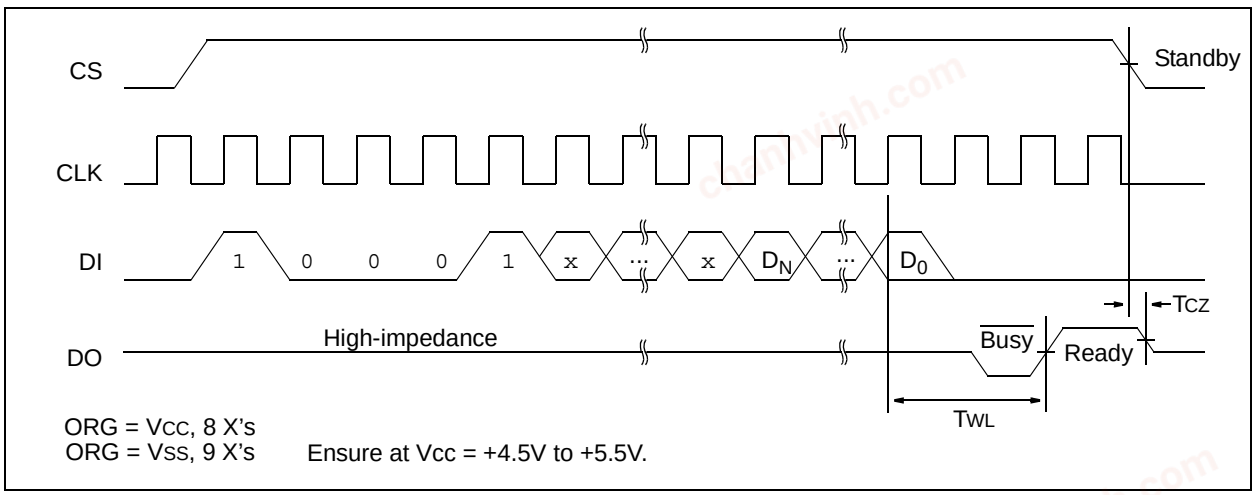


FIGURE 3-6: WRAL



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FIGURE 3-7: ERASE

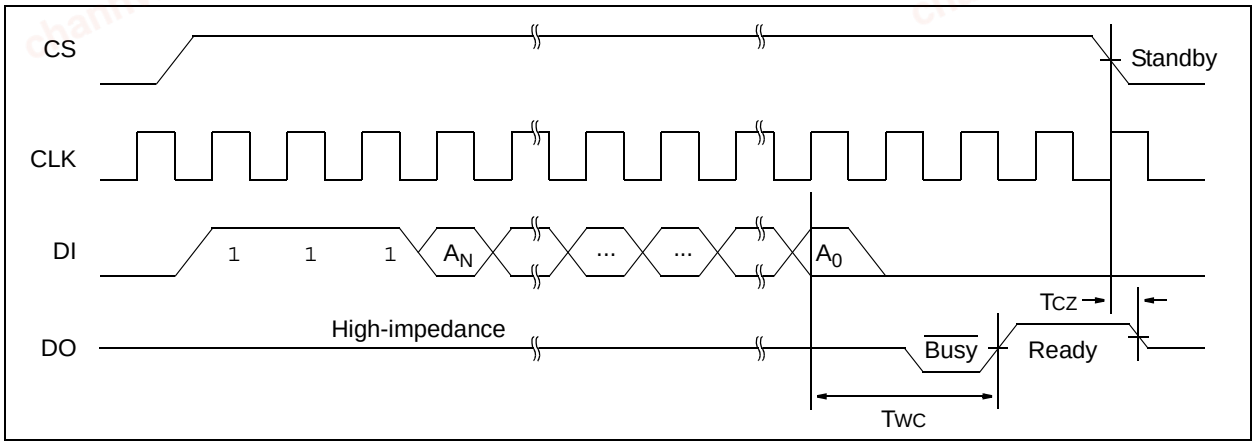
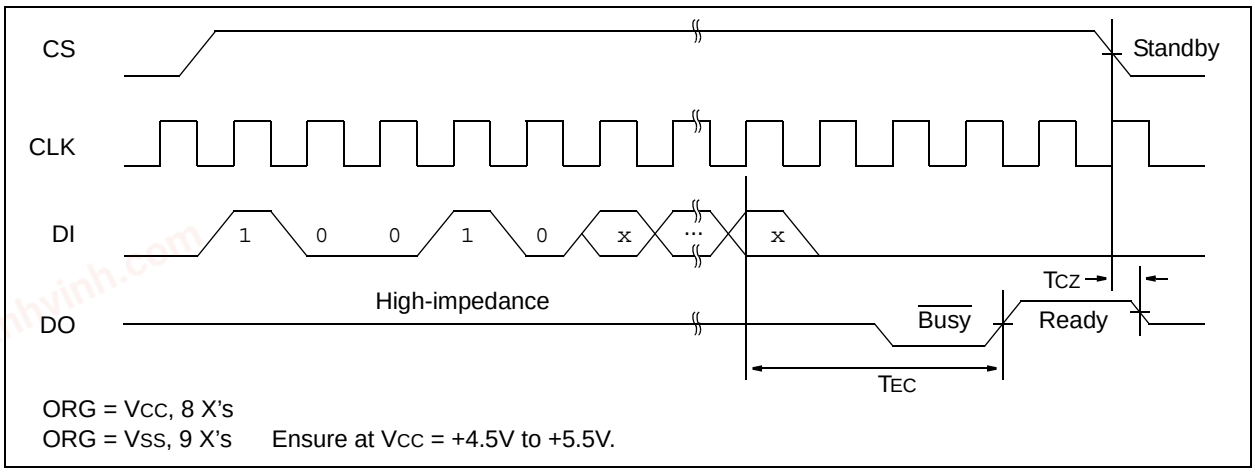


FIGURE 3-8: ERAL



ORG = Vcc, 8 X's
ORG = Vss, 9 X's Ensure at Vcc = +4.5V to +5.5V.

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4.0 PIN DESCRIPTIONS

TABLE 4-1: PIN FUNCTION TABLE

Name	Function
CS	Chip Select
CLK	Serial Data Clock
DI	Serial Data Input
DO	Serial Data Output
VSS	Ground
ORG	Memory Configuration
PE	Program Enable
VCC	Power Supply

4.1 Chip Select (CS)

A high level selects the device. A low level deselects the device and forces it into Standby mode. However, a programming cycle which is already initiated will be completed, regardless of the CS input signal. If CS is brought low during a program cycle, the device will go into Standby mode as soon as the programming cycle is completed.

CS must be low for 250 ns minimum (TCSL) between consecutive instructions. If CS is low, the internal control logic is held in a RESET status.

4.2 Serial Clock (CLK)

The Serial Clock is used to synchronize the communication between a master device and the 93C76/86. Opcode, address and data bits are clocked in on the positive edge of CLK. Data bits are also clocked out on the positive edge of CLK.

CLK can be stopped anywhere in the transmission sequence (at high or low level) and can be continued anytime with respect to clock high time (TCKH) and clock low time (TCKL). This gives the controlling master freedom in preparing opcode, address and data.

CLK is a “don't care” if CS is low (device deselected). If CS is high, but Start condition has not been detected, any number of clock cycles can be received by the device without changing its status (i.e., waiting for Start condition).

CLK cycles are not required during the self-timed write (i.e., auto erase/write) cycle.

After detection of a Start condition the specified number of clock cycles (respectively low-to-high transitions of CLK) must be provided. These clock cycles are required to clock in all opcode, address, and data bits before an instruction is executed (see Table 1-3 through Table 1-6 for more details). CLK and DI then become don't care inputs waiting for a new Start condition to be detected.

Note:	CS must go low between consecutive instructions, except when performing a sequential read (Refer to **Section 3.1 “Read”** for more detail on sequential reads).

4.3 Data In (DI)

Data In is used to clock in a Start bit, opcode, address and data synchronously with the CLK input.

4.4 Data Out (DO)

Data Out is used in the Read mode to output data synchronously with the CLK input (TPD after the positive edge of CLK).

This pin also provides Ready/$\overline{\text{Busy}}$ status information during erase and write cycles. Ready/$\overline{\text{Busy}}$ status information is available when CS is high. It will be displayed until the next Start bit occurs as long as CS stays high.

4.5 Organization (ORG)

When ORG is connected to VCC, the x16 memory organization is selected. When ORG is tied to VSS, the x8 memory organization is selected. There is an internal pull-up resistor on the ORG pin that will select x16 organization when left unconnected.

4.6 Program Enable (PE)

This pin allows the user to enable or disable the ability to write data to the memory array. If the PE pin is floated or tied to VCC, the device can be programmed. If the PE pin is tied to VSS, programming will be inhibited. There is an internal pull-up on this device that enables programming if this pin is left floating.

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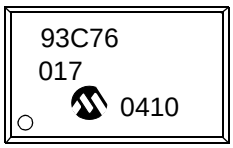
5.0 PACKAGING INFORMATION

5.1 Package Marking Information

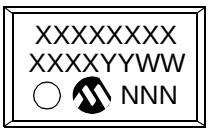
8-Lead PDIP



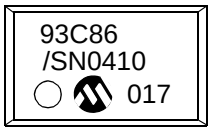
Example



8-Lead SOIC (.150”)



Example



Legend:	XX...X	Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week ‘01’)
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on the outer packaging for this package.

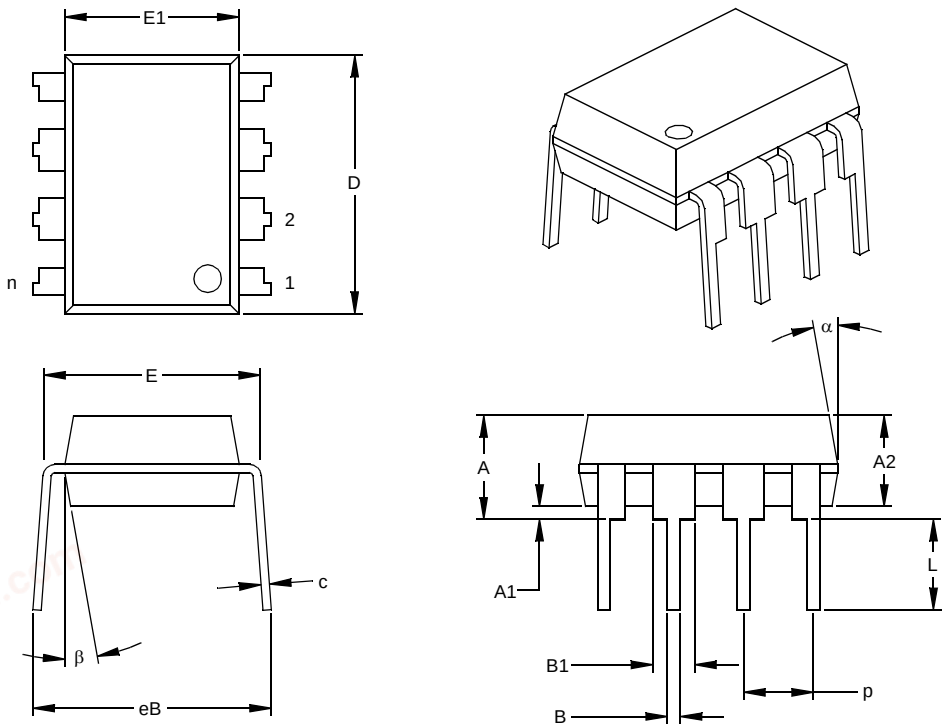
Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information.

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8-Lead Plastic Dual In-line (P) – 300 mil Body (PDIP)

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Units		INCHES*			MILLIMETERS		
Dimension Limits		MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		8			8	
Pitch	p		.100			2.54	
Top to Seating Plane	A	.140	.155	.170	3.56	3.94	4.32
Molded Package Thickness	A2	.115	.130	.145	2.92	3.30	3.68
Base to Seating Plane	A1	.015			0.38		
Shoulder to Shoulder Width	E	.300	.313	.325	7.62	7.94	8.26
Molded Package Width	E1	.240	.250	.260	6.10	6.35	6.60
Overall Length	D	.360	.373	.385	9.14	9.46	9.78
Tip to Seating Plane	L	.125	.130	.135	3.18	3.30	3.43
Lead Thickness	c	.008	.012	.015	0.20	0.29	0.38
Upper Lead Width	B1	.045	.058	.070	1.14	1.46	1.78
Lower Lead Width	B	.014	.018	.022	0.36	0.46	0.56
Overall Row Spacing §	eB	.310	.370	.430	7.87	9.40	10.92
Mold Draft Angle Top	α	5	10	15	5	10	15
Mold Draft Angle Bottom	β	5	10	15	5	10	15

* Controlling Parameter
§ Significant Characteristic

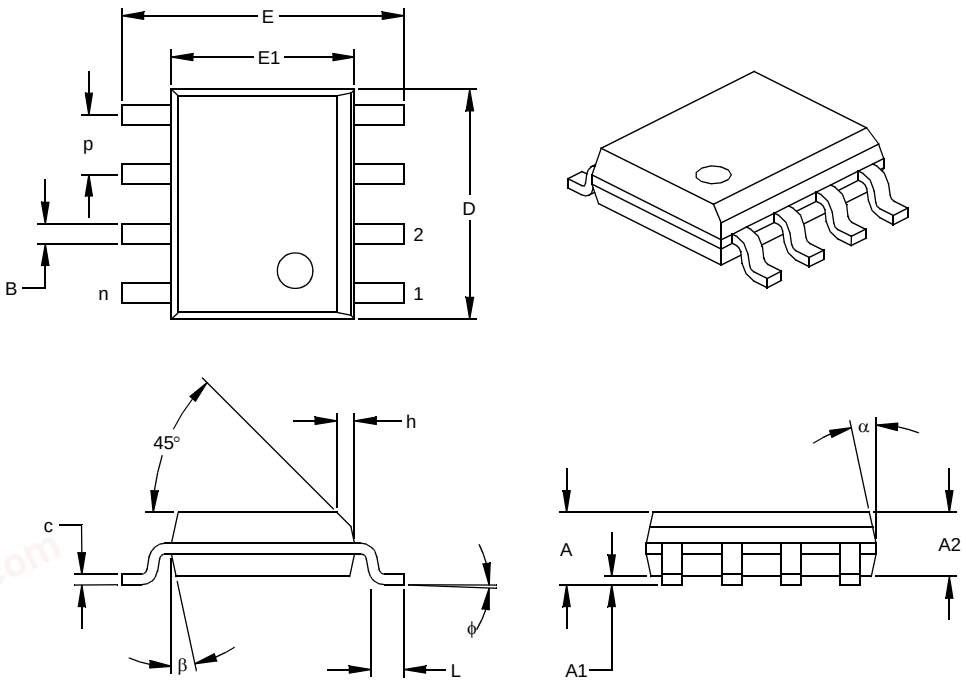
Notes:
Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010” (0.254mm) per side.
JEDEC Equivalent: MS-001
Drawing No. C04-018

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8-Lead Plastic Small Outline (SN) – Narrow, 150 mil Body (SOIC)

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Units		INCHES*			MILLIMETERS		
Dimension Limits		MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		8			8	
Pitch	p		.050			1.27	
Overall Height	A	.053	.061	.069	1.35	1.55	1.75
Molded Package Thickness	A2	.052	.056	.061	1.32	1.42	1.55
Standoff §	A1	.004	.007	.010	0.10	0.18	0.25
Overall Width	E	.228	.237	.244	5.79	6.02	6.20
Molded Package Width	E1	.146	.154	.157	3.71	3.91	3.99
Overall Length	D	.189	.193	.197	4.80	4.90	5.00
Chamfer Distance	h	.010	.015	.020	0.25	0.38	0.51
Foot Length	L	.019	.025	.030	0.48	0.62	0.76
Foot Angle	φ	0	4	8	0	4	8
Lead Thickness	c	.008	.009	.010	0.20	0.23	0.25
Lead Width	B	.013	.017	.020	0.33	0.42	0.51
Mold Draft Angle Top	α	0	12	15	0	12	15
Mold Draft Angle Bottom	β	0	12	15	0	12	15

* Controlling Parameter
§ Significant Characteristic

Notes:
Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010” (0.254mm) per side.
JEDEC Equivalent: MS-012
Drawing No. C04-057

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APPENDIX A: REVISION HISTORY

Revision E

Added note to page 1 header (Not recommended for new designs).

Added Section 5.0: Package Marking Information.

Added On-line Support page.

Updated document format.

Revision F

Added a note to each package outline drawing.

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Package	P = Plastic DIP (300 mil Body), 8-lead SN = Plastic SOIC (150 mil Body), 8-lead	

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