



# 93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

## 1K Microwire®-Compatible Serial EEPROM

**Device Selection Table**

| Part Number | Vcc Range | ORG Pin | Word Size   | Temp Ranges | Packages          |
|-------------|-----------|---------|-------------|-------------|-------------------|
| 93AA46A     | 1.8-5.5   | No      | 8-bit       | I           | P, SN, ST, MS, OT |
| 93AA46B     | 1.8-5.5   | No      | 16-bit      | I           | P, SN, ST, MS, OT |
| 93LC46A     | 2.5-5.5   | No      | 8-bit       | I, E        | P, SN, ST, MS, OT |
| 93LC46B     | 2.5-5.5   | No      | 16-bit      | I, E        | P, SN, ST, MS, OT |
| 93C46A      | 4.5-5.5   | No      | 8-bit       | I, E        | P, SN, ST, MS, OT |
| 93C46B      | 4.5-5.5   | No      | 16-bit      | I, E        | P, SN, ST, MS, OT |
| 93AA46C     | 1.8-5.5   | Yes     | 8 or 16-bit | I           | P, SN, ST, MS     |
| 93LC46C     | 2.5-5.5   | Yes     | 8 or 16-bit | I, E        | P, SN, ST, MS     |
| 93C46C      | 4.5-5.5   | Yes     | 8 or 16-bit | I, E        | P, SN, ST, MS     |

### Features

- Low power CMOS technology
- ORG pin to select word size for '46C version
- 128 x 8-bit organization 'A' ver. devices (no ORG)
- 64 x 16-bit organization 'B' ver. devices (no ORG)
- Self-timed ERASE/WRITE cycles (including auto-erase)
- Automatic ERL before WRAL
- Power on/off data protection circuitry
- Industry standard 3-wire serial I/O
- Device status signal (READY/BUSY)
- Sequential READ function
- 1,000,000 E/W cycles
- Data retention > 200 years
- Temperature ranges supported
  - Industrial (I) -40°C to +85°C
  - Automotive (E) -40°C to +125°C

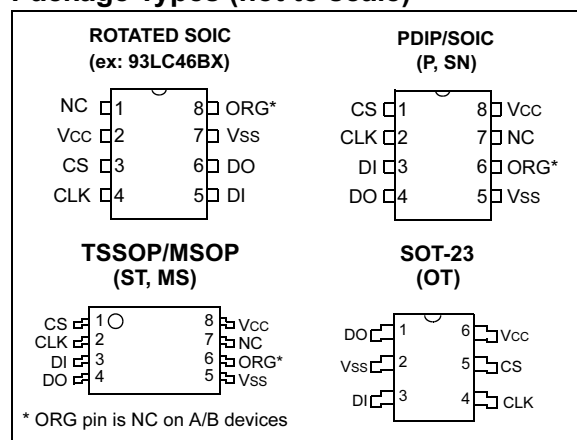
### Pin Function Table

| Name | Function               |
|------|------------------------|
| CS   | Chip Select            |
| CLK  | Serial Data Clock      |
| DI   | Serial Data Input      |
| DO   | Serial Data Output     |
| Vss  | Ground                 |
| NC   | No internal connection |
| ORG  | Memory Configuration   |
| Vcc  | Power Supply           |

### Description

The Microchip Technology Inc. 93XX46A/B/C devices are 1K bit low voltage serial Electrically Erasable PROMs (EEPROM). Word-selectable devices such as the 93AA46C, 93LC46C or 93C46C are dependent upon external logic levels driving the ORG pin to set word size. For dedicated 8-bit communication, the 93AA46A, 93LC46A or 93C46A devices are available, while the 93AA46B, 93LC46B and 93C46B devices provide dedicated 16-bit communication. Advanced CMOS technology makes these devices ideal for low power, non-volatile memory applications. The entire 93XX Series is available in standard packages including 8-lead PDIP and SOIC, and advanced packaging including 8-lead MSOP, 6-lead SOT-23, and 8-lead TSSOP. Pb-free (Pure Matte Sn) finish is also available.

### Package Types (not to scale)



Microwire is a registered trademark of National Semiconductor.

# 93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings†

|                                                     |                                |
|-----------------------------------------------------|--------------------------------|
| V <sub>CC</sub> .....                               | 7.0V                           |
| All inputs and outputs w.r.t. V <sub>SS</sub> ..... | -0.6V to V <sub>CC</sub> +1.0V |
| Storage temperature .....                           | -65°C to +150°C                |
| Ambient temperature with power applied .....        | -40°C to +125°C                |
| ESD protection on all pins .....                    | ≥ 4 kV                         |

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

### DC CHARACTERISTICS

| All parameters apply over the specified ranges unless otherwise noted. |                                       |                                                                          | V <sub>CC</sub> = range by device (see Table on Page 1)<br>Industrial (I): T <sub>AMB</sub> = -40°C to +85°C<br>Automotive (E): T <sub>AMB</sub> = -40°C to +125°C |               |                                          |                |                                                                                                                                                          |
|------------------------------------------------------------------------|---------------------------------------|--------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------------------------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Param. No.                                                             | Symbol                                | Parameter                                                                | Min                                                                                                                                                                | Typ           | Max                                      | Units          | Conditions                                                                                                                                               |
| D1                                                                     | V <sub>IH1</sub><br>V <sub>IH2</sub>  | High level input voltage                                                 | 2.0<br>0.7 V <sub>CC</sub>                                                                                                                                         | —<br>—        | V <sub>CC</sub> +1<br>V <sub>CC</sub> +1 | V<br>V         | V <sub>CC</sub> ≥ 2.7V<br>V <sub>CC</sub> < 2.7V                                                                                                         |
| D2                                                                     | V <sub>IL1</sub><br>V <sub>IL2</sub>  | Low level input voltage                                                  | -0.3<br>-0.3                                                                                                                                                       | —<br>—        | 0.8<br>0.2 V <sub>CC</sub>               | V<br>V         | V <sub>CC</sub> ≥ 2.7V<br>V <sub>CC</sub> < 2.7V                                                                                                         |
| D3                                                                     | V <sub>OL1</sub><br>V <sub>OL2</sub>  | Low level output voltage                                                 | —<br>—                                                                                                                                                             | —<br>—        | 0.4<br>0.2                               | V<br>V         | I <sub>OL</sub> = 2.1 mA, V <sub>CC</sub> = 4.5V<br>I <sub>OL</sub> = 100 μA, V <sub>CC</sub> = 2.5V                                                     |
| D4                                                                     | V <sub>OH1</sub><br>V <sub>OH2</sub>  | High level output voltage                                                | 2.4<br>V <sub>CC</sub> - 0.2                                                                                                                                       | —<br>—        | —<br>—                                   | V<br>V         | I <sub>OH</sub> = -400 μA, V <sub>CC</sub> = 4.5V<br>I <sub>OH</sub> = -100 μA, V <sub>CC</sub> = 2.5V                                                   |
| D5                                                                     | I <sub>LI</sub>                       | Input leakage current                                                    | —                                                                                                                                                                  | —             | ±10                                      | μA             | V <sub>IN</sub> = V <sub>SS</sub> to V <sub>CC</sub>                                                                                                     |
| D6                                                                     | I <sub>LO</sub>                       | Output leakage current                                                   | —                                                                                                                                                                  | —             | ±10                                      | μA             | V <sub>OUT</sub> = V <sub>SS</sub> to V <sub>CC</sub>                                                                                                    |
| D7                                                                     | C <sub>IN</sub> ,<br>C <sub>OUT</sub> | Pin capacitance<br>(all inputs/outputs)                                  | —                                                                                                                                                                  | —             | 7                                        | pF             | V <sub>IN</sub> /V <sub>OUT</sub> = 0V ( <b>Note 1</b> )<br>T <sub>AMB</sub> = 25°C, F <sub>CLK</sub> = 1 MHz                                            |
| D8                                                                     | I <sub>CC</sub><br>write              | Write current                                                            | —<br>—                                                                                                                                                             | —<br>500      | 2<br>—                                   | mA<br>μA       | F <sub>CLK</sub> = 3 MHz, V <sub>CC</sub> = 5.5V<br>F <sub>CLK</sub> = 2 MHz, V <sub>CC</sub> = 2.5V                                                     |
| D9                                                                     | I <sub>CC</sub> read                  | Read current                                                             | —<br>—<br>—                                                                                                                                                        | —<br>—<br>100 | 1<br>500<br>—                            | mA<br>μA<br>μA | F <sub>CLK</sub> = 3 MHz, V <sub>CC</sub> = 5.5V<br>F <sub>CLK</sub> = 2 MHz, V <sub>CC</sub> = 3.0V<br>F <sub>CLK</sub> = 2 MHz, V <sub>CC</sub> = 2.5V |
| D10                                                                    | I <sub>CCS</sub>                      | Standby current                                                          | —<br>—                                                                                                                                                             | —<br>—        | 1<br>5                                   | μA<br>μA       | I-Temp<br>E-Temp<br>CLK = CS = 0V<br>ORG = DI = V <sub>SS</sub> or V <sub>CC</sub><br>( <b>Note 2</b> ) ( <b>NOTE 3</b> )                                |
| D11                                                                    | V <sub>POR</sub>                      | V <sub>CC</sub> voltage detect<br>93AA46A/B/C, 93LC46A/B/C<br>93C46A/B/C | —<br>—                                                                                                                                                             | 1.5V<br>3.8V  | —<br>—                                   | V<br>V         | ( <b>Note 1</b> )                                                                                                                                        |

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

**2:** ORG pin not available on 'A' or 'B' versions.

**3:** READY/BUSY status must be cleared from DO, see Section 3.4.

# 93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

## AC CHARACTERISTICS

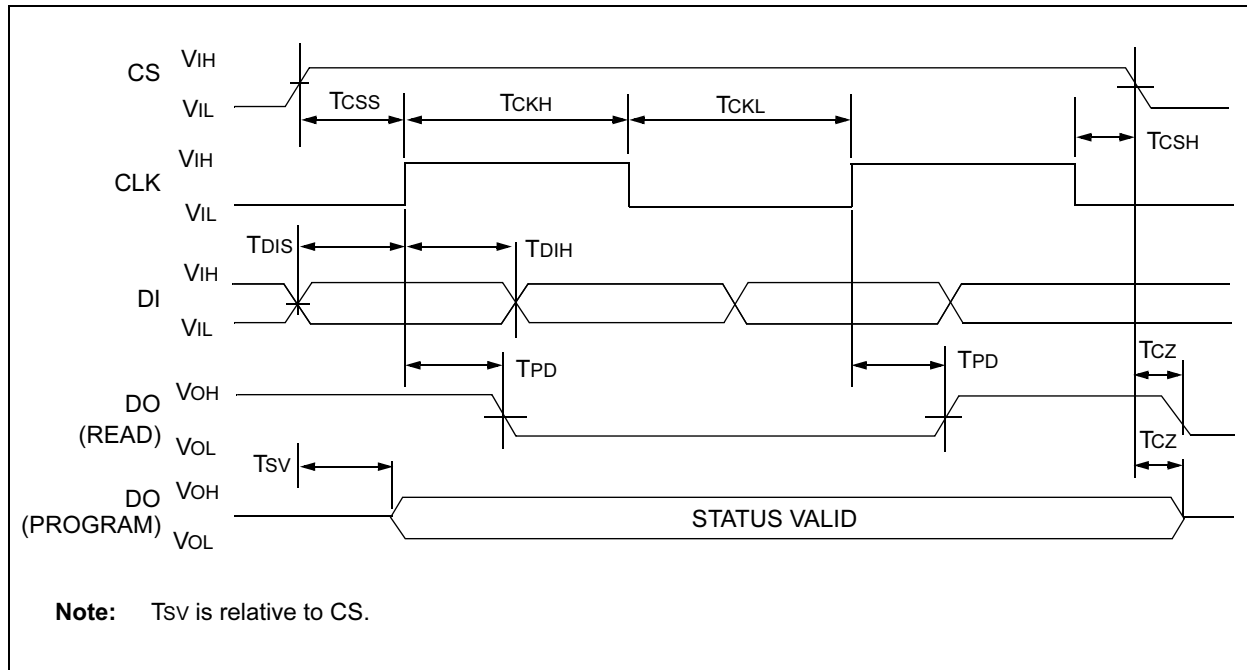
| All parameters apply over the specified ranges unless otherwise noted. |        |                          | VCC = range by device (see Table on Page 1)<br>Industrial (I): TAMB = -40°C to +85°C<br>Automotive (E): TAMB = -40°C to +125°C |                   |                   |                                                                                                    |
|------------------------------------------------------------------------|--------|--------------------------|--------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------|----------------------------------------------------------------------------------------------------|
| Param. No.                                                             | Symbol | Parameter                | Min                                                                                                                            | Max               | Units             | Conditions                                                                                         |
| A1                                                                     | FCLK   | Clock frequency          | —                                                                                                                              | 3<br>2<br>1       | MHz<br>MHz<br>MHz | 4.5V ≤ VCC < 5.5V, 93XX46C only<br>2.5V ≤ VCC < 5.5V<br>1.8V ≤ VCC < 2.5V                          |
| A2                                                                     | TCKH   | Clock high time          | 200<br>250<br>450                                                                                                              | —                 | ns<br>ns<br>ns    | 4.5V ≤ VCC < 5.5V, 93XX46C only<br>2.5V ≤ VCC < 5.5V<br>1.8V ≤ VCC < 2.5V                          |
| A3                                                                     | TCKL   | Clock low time           | 100<br>200<br>450                                                                                                              | —                 | ns<br>ns<br>ns    | 4.5V ≤ VCC < 5.5V, 93XX46C only<br>2.5V ≤ VCC < 5.5V<br>1.8V ≤ VCC < 2.5V                          |
| A4                                                                     | Tcss   | Chip select setup time   | 50<br>100<br>250                                                                                                               | —                 | ns<br>ns<br>ns    | 4.5V ≤ VCC < 5.5V<br>2.5V ≤ VCC < 4.5V<br>1.8V ≤ VCC < 2.5V                                        |
| A5                                                                     | Tcsh   | Chip select hold time    | 0                                                                                                                              | —                 | ns                | 1.8V ≤ VCC < 5.5V                                                                                  |
| A6                                                                     | TCSL   | Chip select low time     | 250                                                                                                                            | —                 | ns                | 1.8V ≤ VCC < 5.5V                                                                                  |
| A7                                                                     | TDis   | Data input setup time    | 50<br>100<br>250                                                                                                               | —                 | ns                | 4.5V ≤ VCC < 5.5V, 93XX46C only<br>2.5V ≤ VCC < 5.5V<br>1.8V ≤ VCC < 2.5V                          |
| A8                                                                     | TDIH   | Data input hold time     | 50<br>100<br>250                                                                                                               | —                 | ns                | 4.5V ≤ VCC < 5.5V, 93XX46C only<br>2.5V ≤ VCC < 5.5V<br>1.8V ≤ VCC < 2.5V                          |
| A9                                                                     | TPD    | Data output delay time   | —<br>—<br>—                                                                                                                    | 200<br>250<br>400 | ns                | 4.5V ≤ VCC < 5.5V, CL = 100 pF<br>2.5V ≤ VCC < 4.5V, CL = 100 pF<br>1.8V ≤ VCC < 2.5V, CL = 100 pF |
| A10                                                                    | TcZ    | Data output disable time | —<br>—                                                                                                                         | 100<br>200        | ns                | 4.5V ≤ VCC < 5.5V, (Note 1)<br>1.8V ≤ VCC < 4.5V, (Note 1)                                         |
| A11                                                                    | Tsv    | Status valid time        | —                                                                                                                              | 200<br>300<br>500 | ns                | 4.5V ≤ VCC < 5.5V, CL = 100 pF<br>2.5V ≤ VCC < 4.5V, CL = 100 pF<br>1.8V ≤ VCC < 2.5V, CL = 100 pF |
| A12                                                                    | TWC    | Program cycle time       | —                                                                                                                              | 6                 | ms                | ERASE/WRITE mode (AA and LC versions)                                                              |
| A13                                                                    | TWC    |                          | —                                                                                                                              | 2                 | ms                | ERASE/WRITE mode (93C versions)                                                                    |
| A14                                                                    | TEC    |                          | —                                                                                                                              | 6                 | ms                | ERAL mode, 4.5V ≤ VCC ≤ 5.5V                                                                       |
| A15                                                                    | TWL    |                          | —                                                                                                                              | 15                | ms                | WRAL mode, 4.5V ≤ VCC ≤ 5.5V                                                                       |
| A16                                                                    | —      | Endurance                | 1M                                                                                                                             | —                 | cycles            | 25°C, VCC = 5.0V, (Note 2)                                                                         |

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

**2:** This application is not tested but ensured by characterization. For endurance estimates in a specific application, please consult the Total Endurance Model which may be obtained on [www.microchip.com](http://www.microchip.com).

# 93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

**FIGURE 1-1: SYNCHRONOUS DATA TIMING**



**TABLE 1-1: INSTRUCTION SET FOR X 16 ORGANIZATION (93XX46B OR 93XX46C WITH ORG = 1)**

| Instruction | SB | Opcode | Address           | Data In  | Data Out                        | Req. CLK Cycles |
|-------------|----|--------|-------------------|----------|---------------------------------|-----------------|
| ERASE       | 1  | 11     | A5 A4 A3 A2 A1 A0 | —        | (RDY/ $\overline{\text{BSY}}$ ) | 9               |
| ERAL        | 1  | 00     | 1 0 X X X X       | —        | (RDY/ $\overline{\text{BSY}}$ ) | 9               |
| EWDS        | 1  | 00     | 0 0 X X X X       | —        | HIGH-Z                          | 9               |
| EWEN        | 1  | 00     | 1 1 X X X X       | —        | HIGH-Z                          | 9               |
| READ        | 1  | 10     | A5 A4 A3 A2 A1 A0 | —        | D15 - D0                        | 25              |
| WRITE       | 1  | 01     | A5 A4 A3 A2 A1 A0 | D15 - D0 | (RDY/ $\overline{\text{BSY}}$ ) | 25              |
| WRAL        | 1  | 00     | 0 1 X X X X       | D15 - D0 | (RDY/ $\overline{\text{BSY}}$ ) | 25              |

**TABLE 1-2: INSTRUCTION SET FOR X 8 ORGANIZATION (93XX46A OR 93XX46C WITH ORG = 0)**

| Instruction | SB | Opcode | Address              | Data In | Data Out                        | Req. CLK Cycles |
|-------------|----|--------|----------------------|---------|---------------------------------|-----------------|
| ERASE       | 1  | 11     | A6 A5 A4 A3 A2 A1 A0 | —       | (RDY/ $\overline{\text{BSY}}$ ) | 10              |
| ERAL        | 1  | 00     | 1 0 X X X X X        | —       | (RDY/ $\overline{\text{BSY}}$ ) | 10              |
| EWDS        | 1  | 00     | 0 0 X X X X X        | —       | HIGH-Z                          | 10              |
| EWEN        | 1  | 00     | 1 1 X X X X X        | —       | HIGH-Z                          | 10              |
| READ        | 1  | 10     | A6 A5 A4 A3 A2 A1 A0 | —       | D7 - D0                         | 18              |
| WRITE       | 1  | 01     | A6 A5 A4 A3 A2 A1 A0 | D7 - D0 | (RDY/ $\overline{\text{BSY}}$ ) | 18              |
| WRAL        | 1  | 00     | 0 1 X X X X X        | D7 - D0 | (RDY/ $\overline{\text{BSY}}$ ) | 18              |

# 93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

## 2.0 FUNCTIONAL DESCRIPTION

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. **DO** will enter the HIGH-Z state on the falling edge of **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**, or **WRAL**). As soon as **CS** is HIGH, the device is no longer in Standby mode.

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

### 2.2 Data In/Data Out (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. In order to limit this current, a resistor should be connected between **DI** and **DO**.

## 2.3 Data Protection

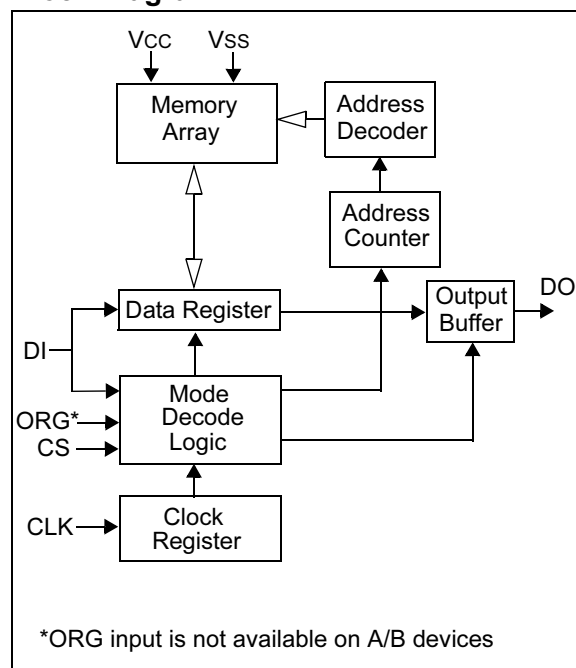
All modes of operation are inhibited when **VCC** is below a typical voltage of 1.5V for '93AA' and '93LC' devices or 3.8V for '93C' devices.

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

**Note:** For added protection, an **EWDS** command should be performed after every write operation.

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

### Block Diagram



# 93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

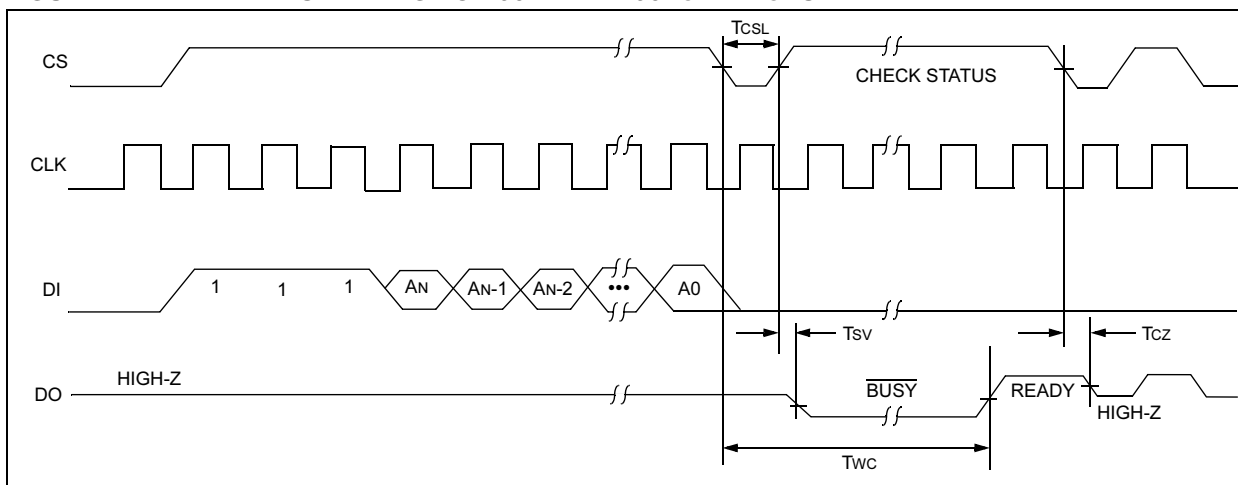
## 2.4 ERASE

The **ERASE** instruction forces all data bits of the specified address to the logical “1” state. CS is brought low following the loading of the last address bit. This falling edge of the CS pin initiates the self-timed programming cycle, except on ‘93C’ devices where the rising edge of CLK before the last address bit initiates the write cycle.

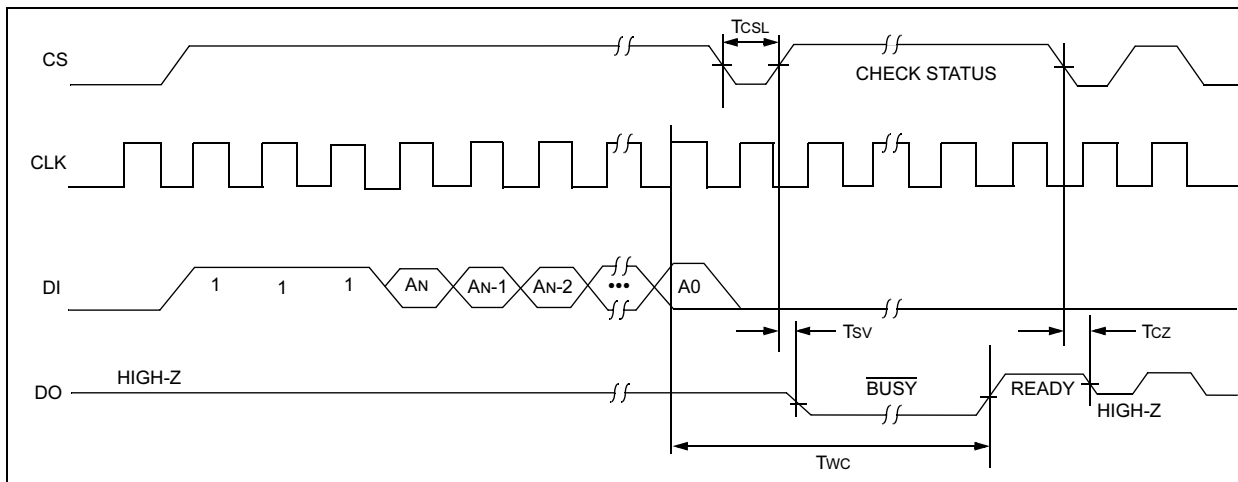
The DO pin indicates the  $\overline{\text{READY}}/\overline{\text{BUSY}}$  status of the device if CS is brought high after a minimum of 250 ns low ( $T_{\text{CSL}}$ ). DO at logical “0” indicates that programming is still in progress. DO at logical “1” indicates that the register at the specified address has been erased and the device is ready for another instruction.

**Note:** Issuing a START bit and then taking CS low will clear the  $\overline{\text{READY}}/\overline{\text{BUSY}}$  status from DO.

**FIGURE 2-1: ERASE TIMING FOR 93AA AND 93LC DEVICES**



**FIGURE 2-2: ERASE TIMING FOR 93C DEVICES**



# 93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

## 2.5 ERASE ALL (ERAL)

The Erase All (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 at the falling edge of the CS, except on '93C' devices where the rising edge of CLK before the last data bit initiates the write cycle. Clocking of the CLK pin is not necessary after the device has entered the ERAL cycle.

The DO pin indicates the READY/ $\overline{\text{BUSY}}$  status of the device, if CS is brought high after a minimum of 250 ns low ( $T_{\text{CSL}}$ ).

**Note:** Issuing a START bit and then taking CS low will clear the READY/ $\overline{\text{BUSY}}$  status from DO.

VCC must be  $\geq 4.5\text{V}$  for proper operation of ERAL.

FIGURE 2-3: ERAL TIMING FOR 93AA AND 93LC DEVICES

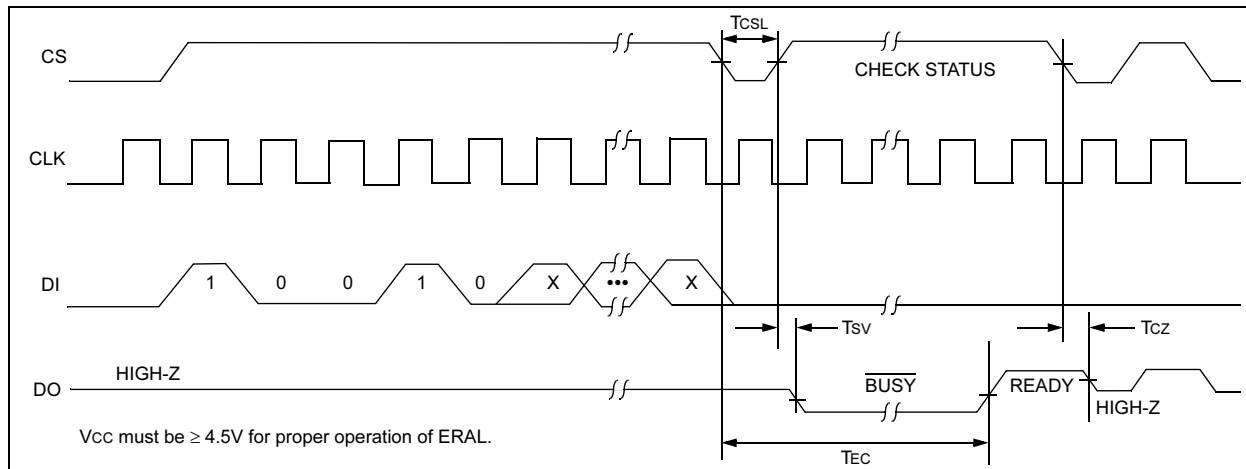
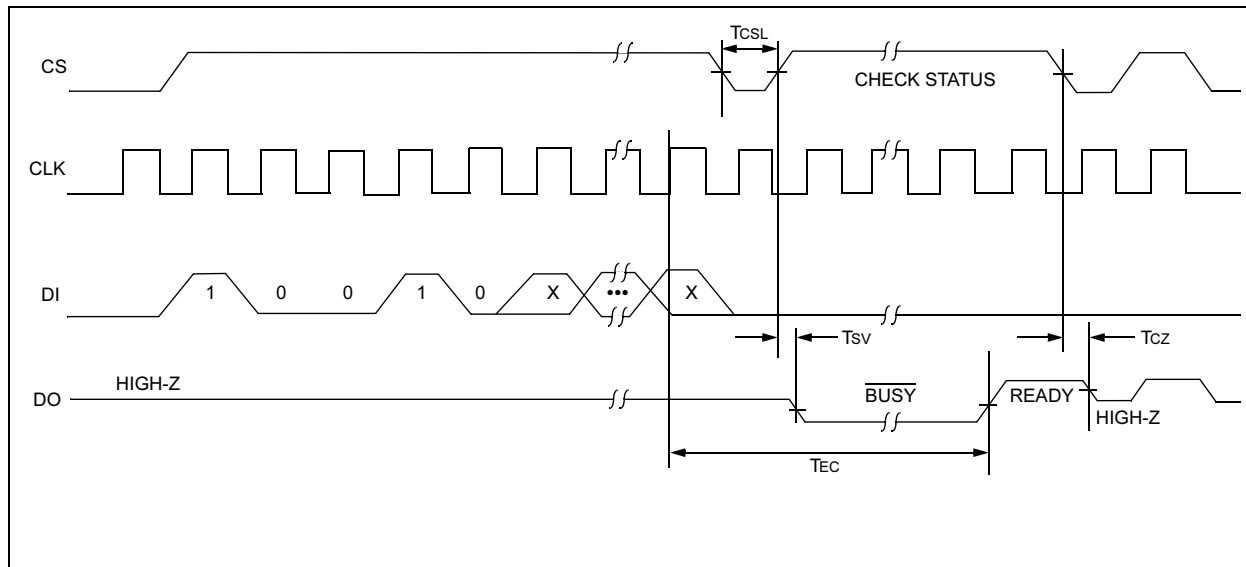


FIGURE 2-4: ERAL TIMING FOR 93C DEVICES



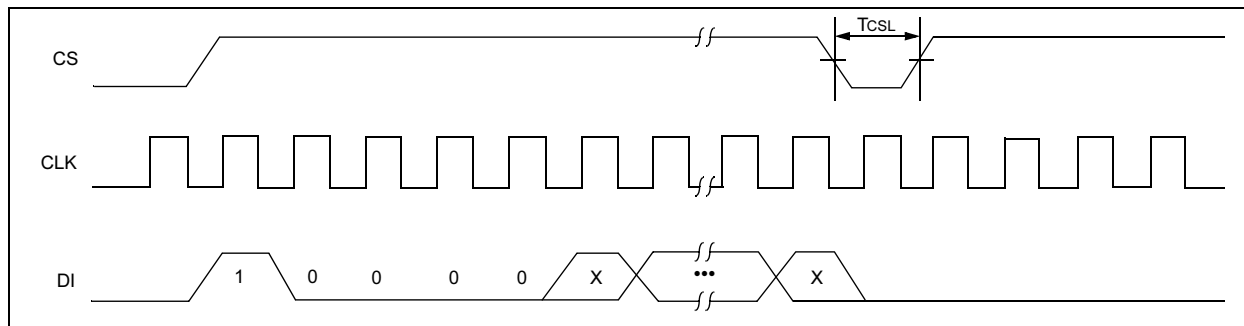
# 93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

## 2.6 ERASE/WRITE DISABLE And ENABLE (EWDS/EWEN)

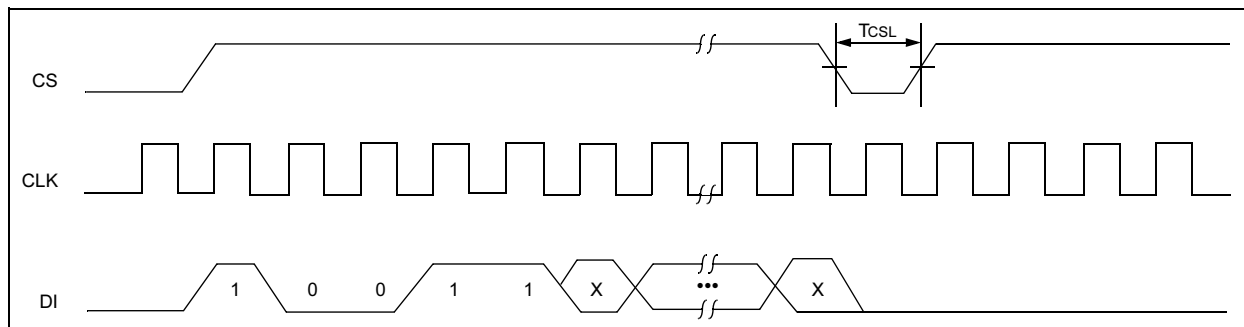
The 93XX46A/B/C powers up in the ERASE/WRITE Disable (EWDS) state. All Programming modes must be preceded by an ERASE/WRITE Enable (EWEN) instruction. Once the EWEN instruction is executed, programming remains enabled until an EWDS instruction is executed or Vcc is removed from the device. To protect

against accidental data disturbance, 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.

**FIGURE 2-5: EWDS TIMING**



**FIGURE 2-6: EWEN TIMING**

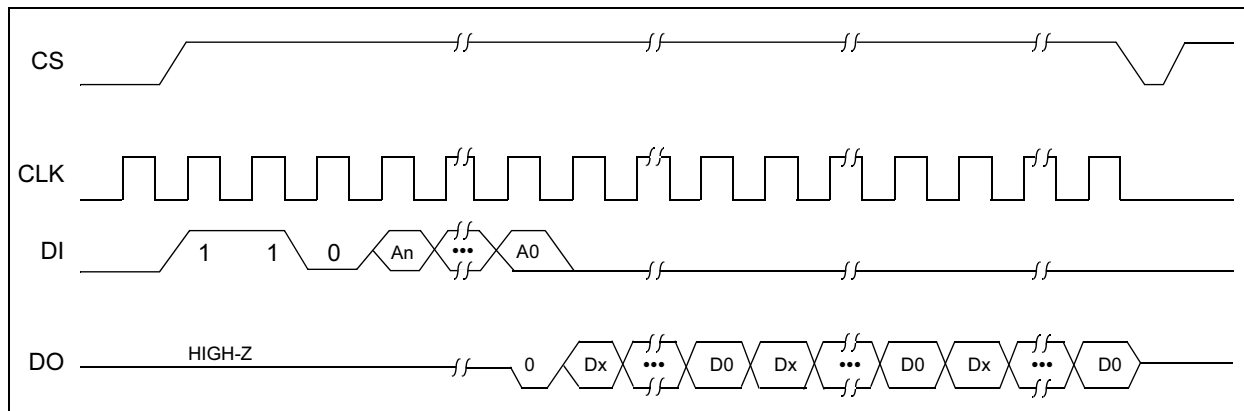


## 2.7 READ

The READ instruction outputs the serial data of the addressed memory location on the DO pin. A dummy zero bit precedes the 8-bit (If ORG pin is low or A-Version devices) or 16-bit (If ORG pin is high or B-version devices) 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. The memory data will automatically cycle to the next register and output sequentially.

**FIGURE 2-7: READ TIMING**



# 93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

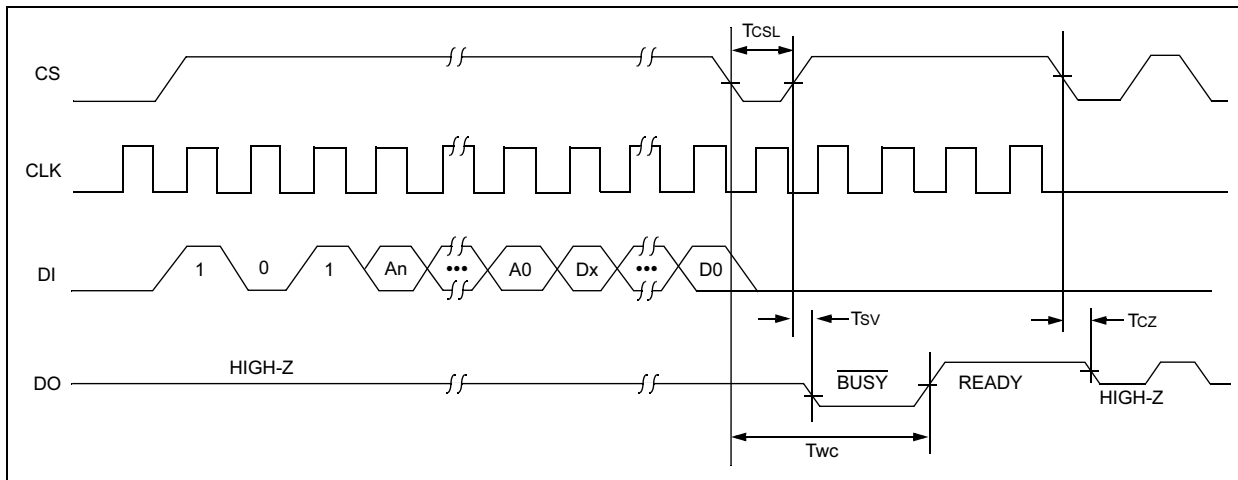
## 2.8 WRITE

The WRITE instruction is followed by 8 bits (If ORG is low or A-version devices) or 16 bits (If ORG pin is high or B-version devices) of data which are written into the specified address. For 93AA46A/B/C and 93LC46A/B/C devices, after the last data bit is clocked into DI, the falling edge of CS initiates the self-timed auto-erase and programming cycle. For 93C46A/B/C devices, the self-timed auto-erase and programming cycle is initiated by the rising edge of CLK on the last data bit.

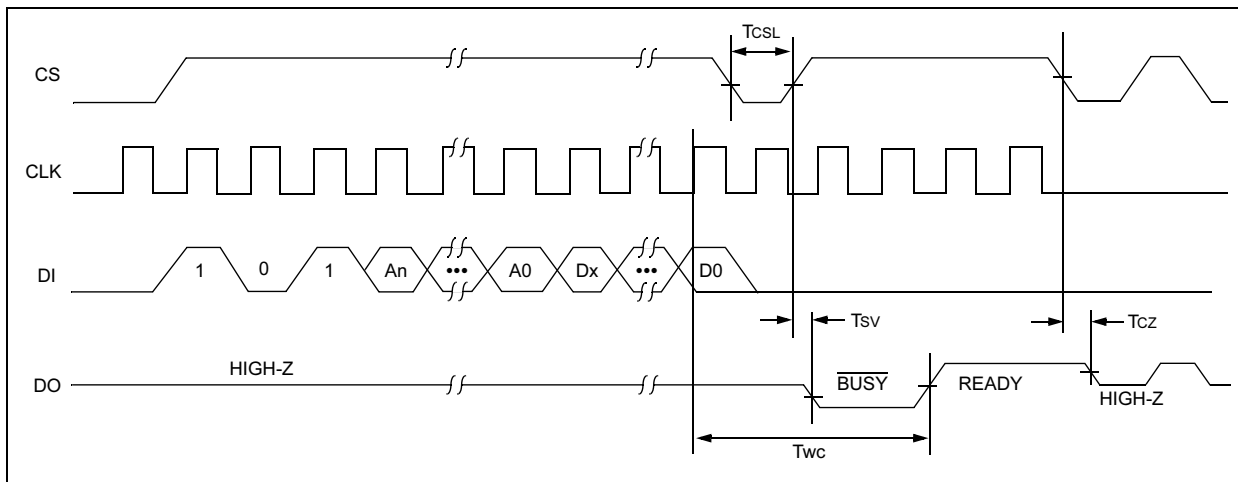
The DO pin indicates the READY/ $\overline{\text{BUSY}}$  status of the device, if CS is brought high after a minimum of 250 ns low ( $T_{\text{CSL}}$ ). DO at logical "0" indicates that programming is still in progress. DO at logical "1" indicates that the register at the specified address has been written with the data specified and the device is ready for another instruction.

**Note:** Issuing a START bit and then taking CS low will clear the READY/ $\overline{\text{BUSY}}$  status from DO.

**FIGURE 2-8: WRITE TIMING FOR 93AA AND 93LC DEVICES**



**FIGURE 2-9: WRITE TIMING FOR 93C DEVICES**



# 93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

## 2.9 WRITE ALL (WRAL)

The Write All (WRAL) instruction will write the entire memory array with the data specified in the command. For 93AA46A/B/C and 93LC46A/B/C devices, after the last data bit is clocked into DI, the falling edge of CS initiates the self-timed auto-erase and programming cycle. For 93C46A/B/C devices, the self-timed auto-erase and programming cycle is initiated by the rising edge of CLK on the last data bit. Clocking of the CLK pin is not necessary after the device has entered the WRAL cycle. 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 DO pin indicates the READY/BUSY status of the device if CS is brought high after a minimum of 250 ns low ( $T_{CSL}$ ).

**Note:** Issuing a START bit and then taking CS low will clear the READY/BUSY status from DO.

$V_{CC}$  must be  $\geq 4.5V$  for proper operation of WRAL.

FIGURE 2-10: WRAL TIMING FOR 93AA AND 93LC DEVICES

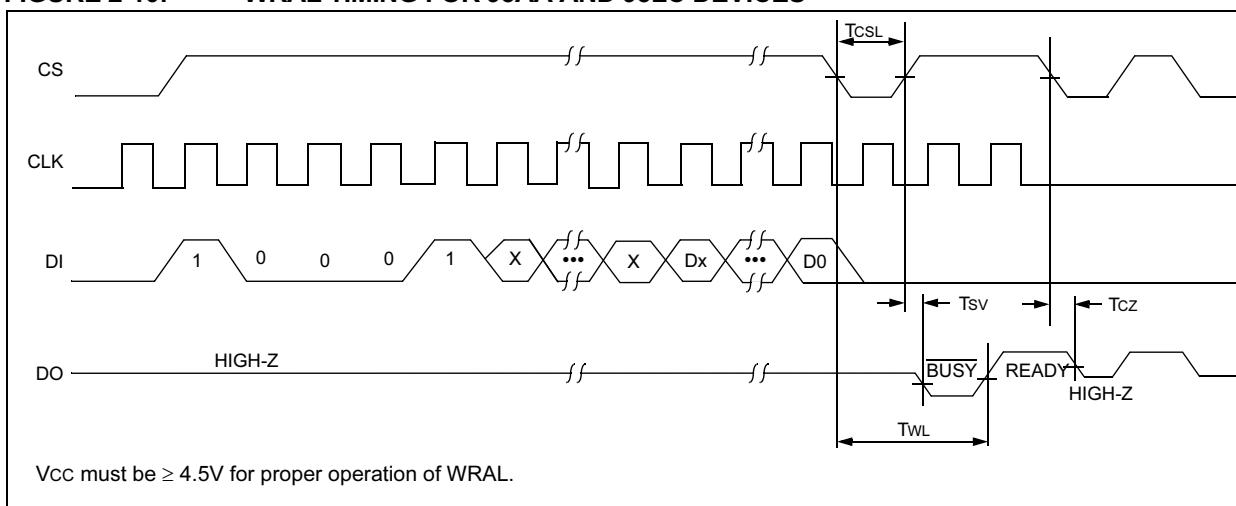
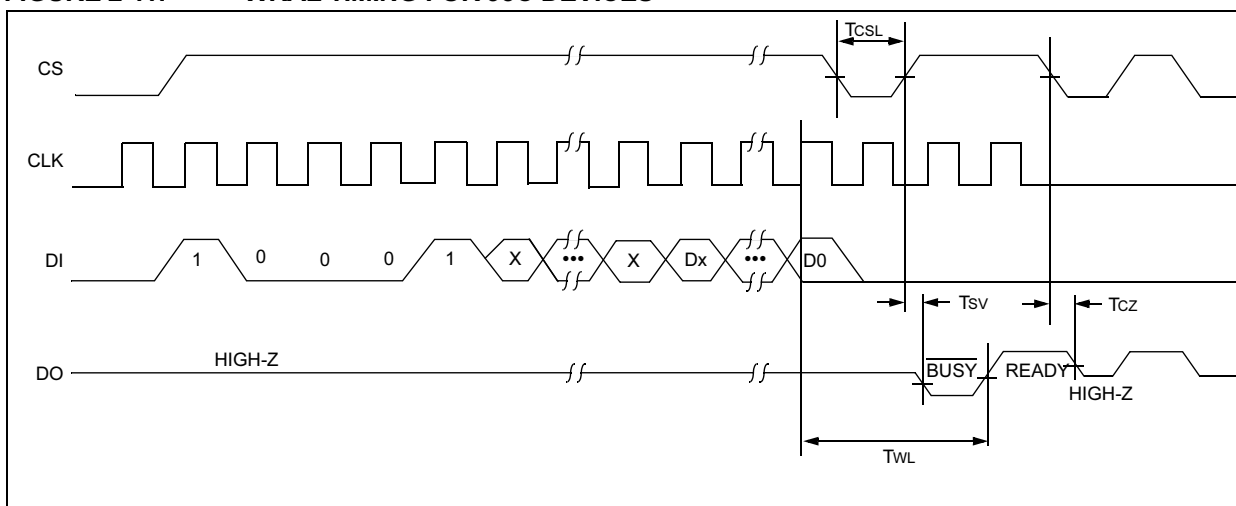


FIGURE 2-11: WRAL TIMING FOR 93C DEVICES



# 93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

## 3.0 PIN DESCRIPTIONS

TABLE 3-1: PIN DESCRIPTIONS

| Name   | SOIC/PDIP/<br>MSOP/<br>TSSOP | SOT-23 | Rotated SOIC | Function                                                     |
|--------|------------------------------|--------|--------------|--------------------------------------------------------------|
| CS     | 1                            | 5      | 3            | Chip Select                                                  |
| CLK    | 2                            | 4      | 4            | Serial Clock                                                 |
| DI     | 3                            | 3      | 5            | Data In                                                      |
| DO     | 4                            | 1      | 6            | Data Out                                                     |
| Vss    | 5                            | 2      | 7            | Ground                                                       |
| ORG/NC | 6                            | N/A    | 8            | Organization / 93XX46C<br>No internal connection / 93XX46A/B |
| NC     | 7                            | N/A    | 1            | No Internal Connection                                       |
| Vcc    | 8                            | 6      | 2            | Power Supply                                                 |

### 3.1 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 in progress will be completed, regardless of the Chip Select (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.

### 3.2 Serial Clock (CLK)

The Serial Clock is used to synchronize the communication between a master device and the 93XX series device. Opcodes, 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 the START condition has not been detected (DI = 0), any number of clock cycles can be received by the device without changing its status (i.e., waiting for a 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 required opcode, address and data bits before an instruction is executed. CLK and DI then become don't care inputs waiting for a new START condition to be detected.

### 3.3 Data In (DI)

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

### 3.4 Data Out (DO)

Data Out (DO) 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/BUSY status information during ERASE and WRITE cycles. READY/BUSY status information is available on the DO pin if CS is brought high after being low for minimum chip select low time (TCSL) and an ERASE or WRITE operation has been initiated.

The status signal is not available on DO, if CS is held low during the entire ERASE or WRITE cycle. In this case, DO is in the HIGH-Z mode. If status is checked after the ERASE/WRITE cycle, the data line will be high to indicate the device is ready.

**Note:** Issuing a START bit and then taking CS low will clear the READY/BUSY status from DO.

### 3.5 Organization (ORG)

When the ORG pin is connected to Vcc or Logic HI, the (x16) memory organization is selected. When the ORG pin is tied to Vss or Logic LO, the (x8) memory organization is selected. For proper operation, ORG must be tied to a valid logic level.

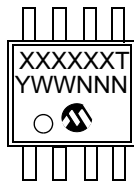
93XX46A devices are always x8 organization and 93XX46B devices are always x16 organization.

# 93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

## 4.0 PACKAGING INFORMATION

### 4.1 Package Marking Information

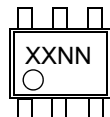
8-Lead MSOP (150 mil)



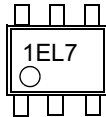
Example:



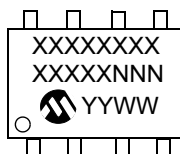
6-Lead SOT-23



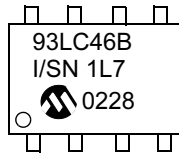
Example:



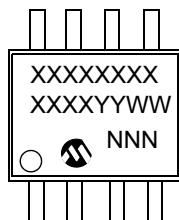
8-Lead PDIP



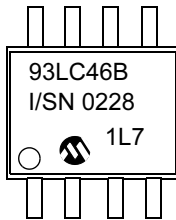
Example:



8-Lead SOIC



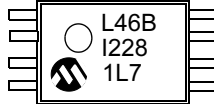
Example:



8-Lead TSSOP



Example:



MSOP 1st Line Marking Codes

| Device  | std mark | Pb-free mark |
|---------|----------|--------------|
| 93AA46A | 3A46AT   | GA46AT       |
| 93AA46B | 3A46BT   | GA46BT       |
| 93AA46C | 3A46CT   | GA46CT       |
| 93LC46A | 3L46AT   | GL46AT       |
| 93LC46B | 3L46BT   | GL46BT       |
| 93LC46C | 3L46CT   | GL46CT       |
| 93C46A  | 3C46AT   | GC46AT       |
| 93C46B  | 3C46BT   | GC46BT       |
| 93C46C  | 3C46CT   | GC46CT       |

T = blank for commercial, "I" for Industrial, "E" for Extended.

SOT23 Marking Codes

| Device  | I-temp | E-temp |
|---------|--------|--------|
| 93AA46A | 1BNN   | —      |
| 93AA46B | 1LNN   | —      |
| 93LC46A | 1ENN   | 1FNN   |
| 93LC46B | 1PNN   | 1RNN   |
| 93C46A  | 1HNN   | 1JNN   |
| 93C46B  | 1TNN   | 1UNN   |

Pb-free topside mark is same; Pb-free noted only on carton label.

TSSOP 1st Line Marking Codes

| Device  | std mark | Pb-free mark |
|---------|----------|--------------|
| 93AA46A | A46A     | GAAA         |
| 93AA46B | A46B     | GAAB         |
| 93AA46C | A46C     | GAAC         |
| 93LC46A | L46A     | GLAA         |
| 93LC46B | L46B     | GLAB         |
| 93LC46C | L46C     | GLAC         |
| 93C46A  | C46A     | GCAA         |
| 93C46B  | C46B     | GCAB         |
| 93C46C  | C46C     | GCAC         |

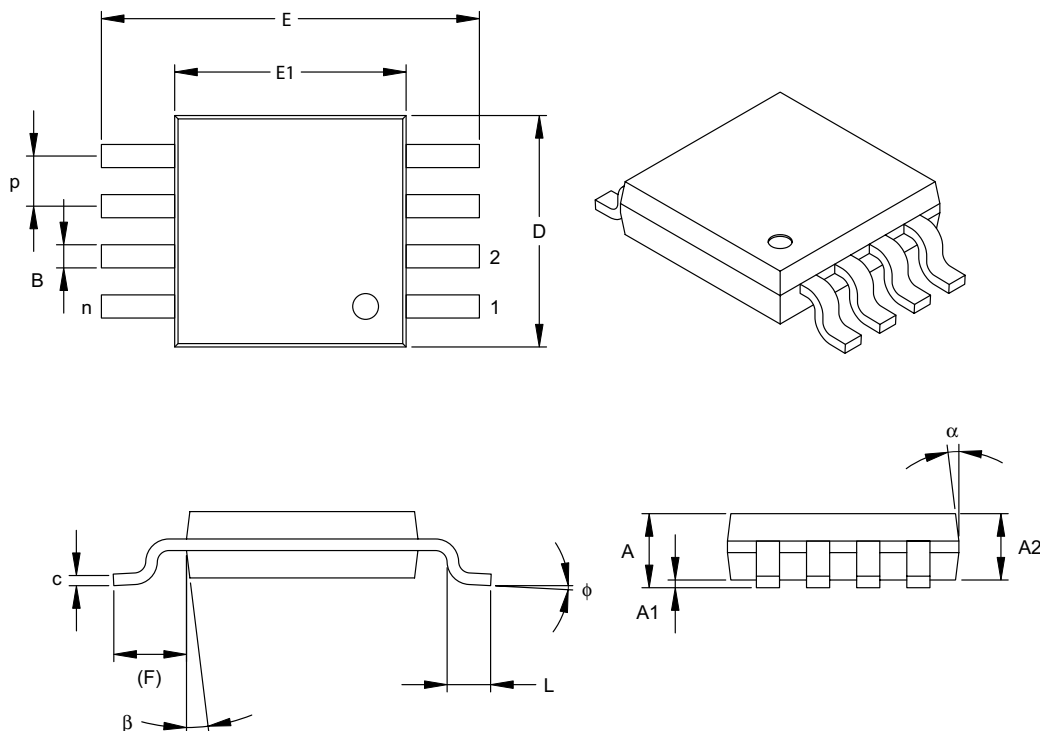
Temperature grade is marked on line 2.

|                |        |                                                                                                  |
|----------------|--------|--------------------------------------------------------------------------------------------------|
| <b>Legend:</b> | XX...X | Part number                                                                                      |
|                | T      | Temperature                                                                                      |
|                | Blank  | Commercial                                                                                       |
|                | I      | Industrial                                                                                       |
|                | E      | Extended                                                                                         |
|                | YY     | Year code (last 2 digits of calendar year) except TSSOP and MSOP which use only the last 1 digit |
|                | WW     | Week code (week of January 1 is week '01')                                                       |
|                | NNN    | Alphanumeric traceability code                                                                   |

**Note:** Custom marking available.

# 93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

## 8-Lead Plastic Micro Small Outline Package (MS) (MSOP)



| Units                    |       | INCHES    |      |      | MILLIMETERS* |      |      |
|--------------------------|-------|-----------|------|------|--------------|------|------|
| Dimension Limits         |       | MIN       | NOM  | MAX  | MIN          | NOM  | MAX  |
| Number of Pins           | n     | 8         |      |      | 8            |      |      |
| Pitch                    | P     | .026 BSC  |      |      | 0.65 BSC     |      |      |
| Overall Height           | A     | -         | -    | .043 | -            | -    | 1.10 |
| Molded Package Thickness | A2    | .030      | .033 | .037 | 0.75         | 0.85 | 0.95 |
| Standoff                 | A1    | .000      | -    | .006 | 0.00         | -    | 0.15 |
| Overall Width            | E     | .193 TYP. |      |      | 4.90 BSC     |      |      |
| Molded Package Width     | E1    | .118 BSC  |      |      | 3.00 BSC     |      |      |
| Overall Length           | D     | .118 BSC  |      |      | 3.00 BSC     |      |      |
| Foot Length              | L     | .016      | .024 | .031 | 0.40         | 0.60 | 0.80 |
| Footprint (Reference)    | F     | .037 REF  |      |      | 0.95 REF     |      |      |
| Foot Angle               | phi   | 0°        | -    | 8°   | 0°           | -    | 8°   |
| Lead Thickness           | c     | .003      | .006 | .009 | 0.08         | -    | 0.23 |
| Lead Width               | B     | .009      | .012 | .016 | 0.22         | -    | 0.40 |
| Mold Draft Angle Top     | alpha | 5°        | -    | 15°  | 5°           | -    | 15°  |
| Mold Draft Angle Bottom  | beta  | 5°        | -    | 15°  | 5°           | -    | 15°  |

\*Controlling Parameter

Notes:

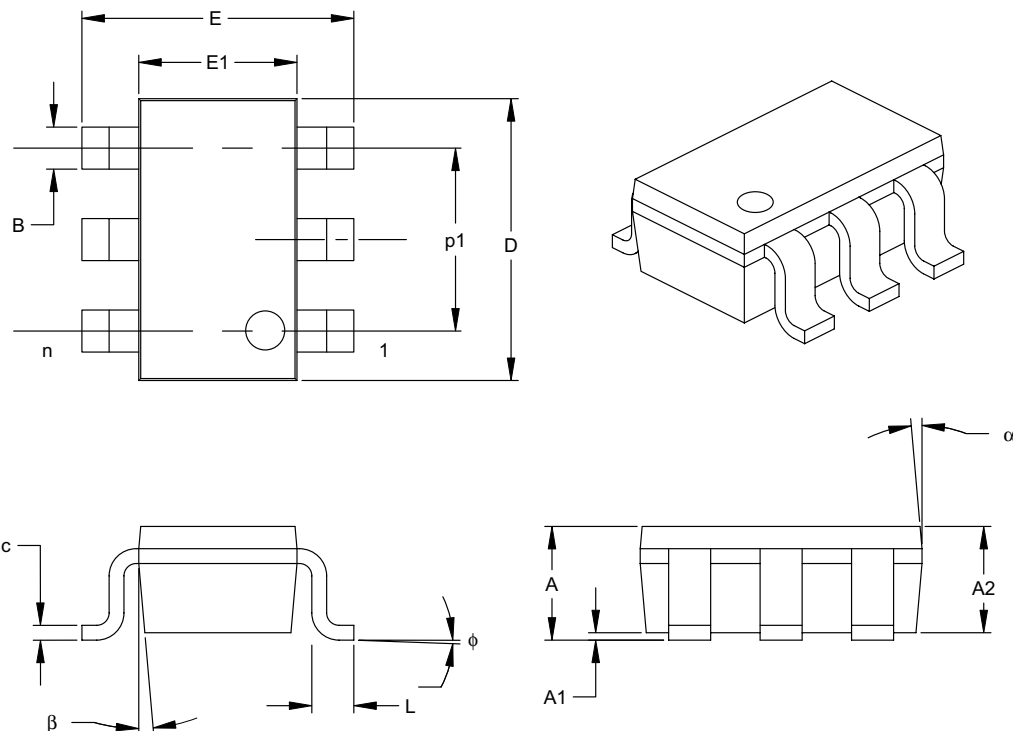
Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" (0.254mm) per side.

JEDEC Equivalent: MO-187

Drawing No. C04-111

# 93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

## 6-Lead Plastic Small Outline Transistor (CH) (SOT23)



| Units                      |       | INCHES* |      |      | MILLIMETERS |      |      |
|----------------------------|-------|---------|------|------|-------------|------|------|
| Dimension Limits           |       | MIN     | NOM  | MAX  | MIN         | NOM  | MAX  |
| Number of Pins             | n     |         | 6    |      |             | 6    |      |
| Pitch                      | p     |         | .038 |      |             | 0.95 |      |
| Outside lead pitch (basic) | p1    |         | .075 |      |             | 1.90 |      |
| Overall Height             | A     | .035    | .046 | .057 | 0.90        | 1.18 | 1.45 |
| Molded Package Thickness   | A2    | .035    | .043 | .051 | 0.90        | 1.10 | 1.30 |
| Standoff                   | A1    | .000    | .003 | .006 | 0.00        | 0.08 | 0.15 |
| Overall Width              | E     | .102    | .110 | .118 | 2.60        | 2.80 | 3.00 |
| Molded Package Width       | E1    | .059    | .064 | .069 | 1.50        | 1.63 | 1.75 |
| Overall Length             | D     | .110    | .116 | .122 | 2.80        | 2.95 | 3.10 |
| Foot Length                | L     | .014    | .018 | .022 | 0.35        | 0.45 | 0.55 |
| Foot Angle                 | phi   | 0       | 5    | 10   | 0           | 5    | 10   |
| Lead Thickness             | c     | .004    | .006 | .008 | 0.09        | 0.15 | 0.20 |
| Lead Width                 | B     | .014    | .017 | .020 | 0.35        | 0.43 | 0.50 |
| Mold Draft Angle Top       | alpha | 0       | 5    | 10   | 0           | 5    | 10   |
| Mold Draft Angle Bottom    | beta  | 0       | 5    | 10   | 0           | 5    | 10   |

\*Controlling Parameter

Notes:

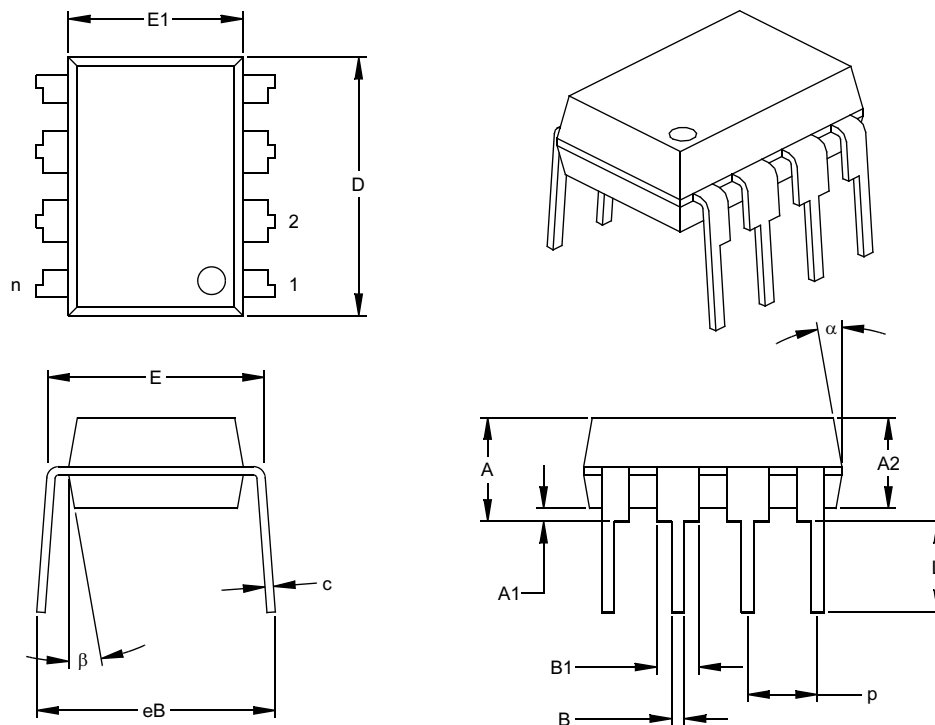
Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .005" (0.127mm) per side.

JEITA (formerly EIAJ) equivalent: SC-74A

Drawing No. C04-120

# 93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

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



| 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:

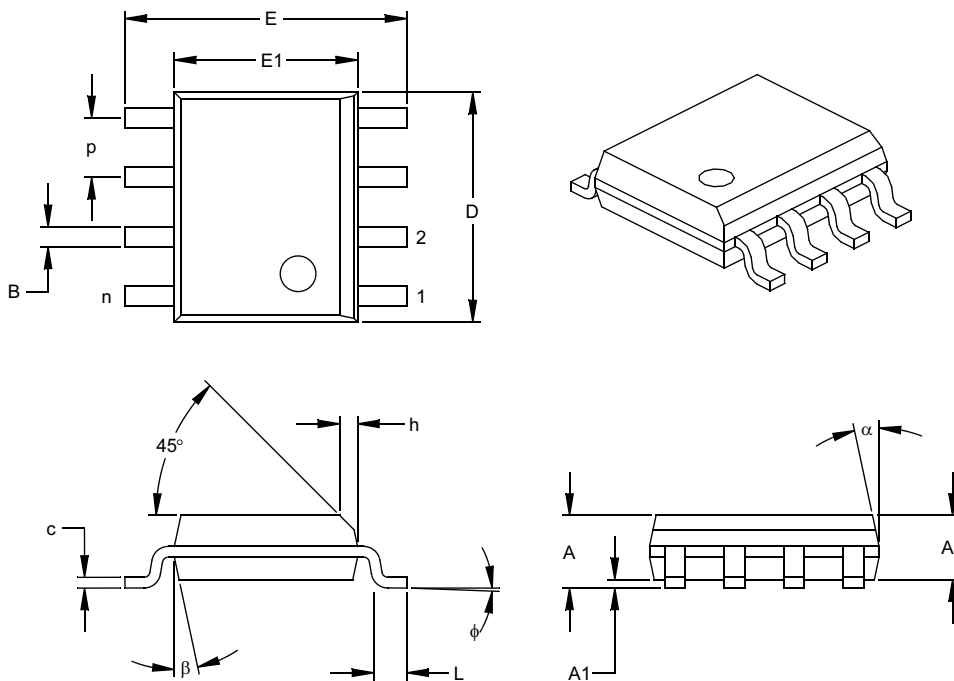
Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" (0.254mm) per side.

JEDEC Equivalent: MS-001

Drawing No. C04-018

# 93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

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



| 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:

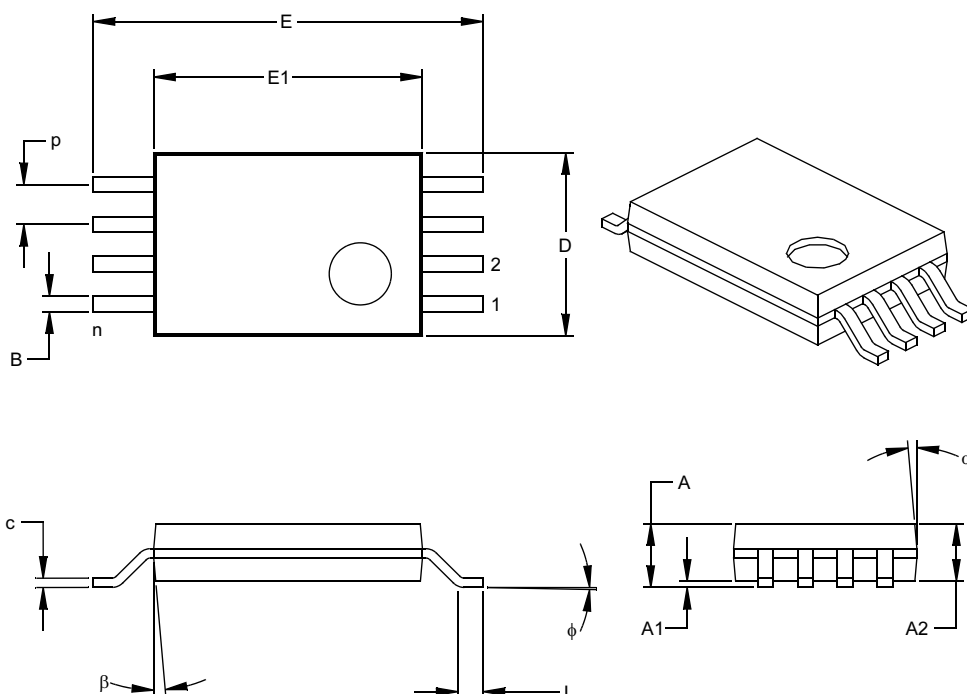
Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" (0.254mm) per side.

JEDEC Equivalent: MS-012

Drawing No. C04-057

# 93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

## 8-Lead Plastic Thin Shrink Small Outline (ST) – 4.4 mm (TSSOP)



| Units                    |    | INCHES |      |      | MILLIMETERS* |      |      |
|--------------------------|----|--------|------|------|--------------|------|------|
| Dimension Limits         |    | MIN    | NOM  | MAX  | MIN          | NOM  | MAX  |
| Number of Pins           | n  |        | 8    |      |              | 8    |      |
| Pitch                    | p  |        | .026 |      |              | 0.65 |      |
| Overall Height           | A  |        |      | .043 |              |      | 1.10 |
| Molded Package Thickness | A2 | .033   | .035 | .037 | 0.85         | 0.90 | 0.95 |
| Standoff §               | A1 | .002   | .004 | .006 | 0.05         | 0.10 | 0.15 |
| Overall Width            | E  | .246   | .251 | .256 | 6.25         | 6.38 | 6.50 |
| Molded Package Width     | E1 | .169   | .173 | .177 | 4.30         | 4.40 | 4.50 |
| Molded Package Length    | D  | .114   | .118 | .122 | 2.90         | 3.00 | 3.10 |
| Foot Length              | L  | .020   | .024 | .028 | 0.50         | 0.60 | 0.70 |
| Foot Angle               | φ  | 0      | 4    | 8    | 0            | 4    | 8    |
| Lead Thickness           | c  | .004   | .006 | .008 | 0.09         | 0.15 | 0.20 |
| Lead Width               | B  | .007   | .010 | .012 | 0.19         | 0.25 | 0.30 |
| Mold Draft Angle Top     | α  | 0      | 5    | 10   | 0            | 5    | 10   |
| Mold Draft Angle Bottom  | β  | 0      | 5    | 10   | 0            | 5    | 10   |

\* Controlling Parameter

§ Significant Characteristic

### Notes:

Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .005" (0.127mm) per side.

JEDEC Equivalent: MO-153

Drawing No. C04-086

# 93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

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NOTES:

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The Microchip web site is available at the following URL:

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The file transfer site is available by using an FTP service to connect to:

**<ftp://ftp.microchip.com>**

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- Latest Microchip Press Releases
- Technical Support Section with Frequently Asked Questions
- Design Tips
- Device Errata
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- Microchip Consultant Program Member Listing
- Links to other useful web sites related to Microchip Products
- Conferences for products, Development Systems, technical information and more
- Listing of seminars and events

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1-800-755-2345 for U.S. and most of Canada, and

1-480-792-7302 for the rest of the world.

042003

# 93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

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## READER RESPONSE

It is our intention to provide you with the best documentation possible to ensure successful use of your Microchip product. If you wish to provide your comments on organization, clarity, subject matter, and ways in which our documentation can better serve you, please FAX your comments to the Technical Publications Manager at (480) 792-4150.

Please list the following information, and use this outline to provide us with your comments about this document.

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Application (optional):

Would you like a reply? \_\_\_Y \_\_\_N

Device: 93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C Literature Number: DS21749C

Questions:

1. What are the best features of this document?

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2. How does this document meet your hardware and software development needs?

---

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3. Do you find the organization of this document easy to follow? If not, why?

---

---

4. What additions to the document do you think would enhance the structure and subject?

---

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5. What deletions from the document could be made without affecting the overall usefulness?

---

---

6. Is there any incorrect or misleading information (what and where)?

---

---

7. How would you improve this document?

---

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# 93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

## PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

| <u>PART NO.</u>   | <u>X</u>                                                                                                                                                                                              | <u>X</u>                                                                                                                                                                                                                                                                                                                                                                                                                        | <u>X</u>          | <u>/XX</u> | <u>X</u>    |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|------------|-------------|
| Device            | Pinout                                                                                                                                                                                                | Tape & Reel                                                                                                                                                                                                                                                                                                                                                                                                                     | Temperature Range | Package    | Lead Finish |
| Device            |                                                                                                                                                                                                       | 93AA46A: 1K 1.8V Microwire Serial EEPROM<br>93AA46B: 1K 1.8V Microwire Serial EEPROM<br>93AA46C: 1K 1.8V Microwire Serial EEPROM w/ORG<br><br>93LC46A: 1K 2.5V Microwire Serial EEPROM<br>93LC46B: 1K 2.5V Microwire Serial EEPROM<br>93LC46C: 1K 2.5V Microwire Serial EEPROM w/ORG<br><br>93C46A: 1K 5.0V Microwire Serial EEPROM<br>93C46B: 1K 5.0V Microwire Serial EEPROM<br>93C46C: 1K 5.0V Microwire Serial EEPROM w/ORG |                   |            |             |
| Pinout:           | Blank = Standard pinout<br>X = Rotated pinout                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                 |                   |            |             |
| Tape & Reel:      | Blank = Standard packaging<br>T = Tape & Reel                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                 |                   |            |             |
| Temperature Range | I = -40°C to +85°C<br>E = -40°C to +125°C                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                 |                   |            |             |
| Package           | MS = Plastic MSOP (Micro Small outline, 8-lead)<br>OT = SOT-23, 6-lead (Tape & Reel only)<br>P = Plastic DIP (300 mil body), 8-lead<br>SN = Plastic SOIC (150 mil body), 8-lead<br>ST = TSSOP, 8-lead |                                                                                                                                                                                                                                                                                                                                                                                                                                 |                   |            |             |
| Lead Finish:      | Blank = Standard 63% / 37% SnPb<br>G = Pure Matte Sn                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                 |                   |            |             |

**Examples:**

- a) 93AA46C-I/MS: 1K, 128x8 or 64x16 Serial EEPROM, MSOP package, 1.8V
- b) 93AA46B-I/MS: 1K, 64x16 Serial EEPROM, MSOP package, 1.8V
- c) 93AA46AT-I/OT: 1K, 128x8 Serial EEPROM, SOT-23 package, tape and reel, 1.8V
- d) 93AA46CT-I/MS: 1K, 128x8 or 16x16 Serial EEPROM, MSOP package, tape and reel, 1.8V
- a) 93LC46A-I/MS: 1K, 128x8 Serial EEPROM, MSOP package, 2.5V
- b) 93LC46BT-I/OT: 1K, 64x16 Serial EEPROM, SOT-23 package, tape and reel, 2.5V
- c) 93LC46B-I/MS: 1K, 64x16 Serial EEPROM, MSOP package, 2.5V
- d) 93LC46BXT-I/SNG: 1K, 64x16 Serial EEPROM, SOIC package, rotated pinout, Industrial temperature, Pb-free finish, 2.5V
- a) 93C46B-I/MS: 1K, 64x16 Serial EEPROM, MSOP package, 5.0V
- b) 93C46C-I/MS: 1K, 128x8 or 16x16 Serial EEPROM, MSOP package, 5.0V
- c) 93C46AT-I/OT: 1K, 128x8 Serial EEPROM, SOT-23 package, tape and reel, 5.0V

## Sales and Support

### Data Sheets

Products supported by a preliminary Data Sheet may have an errata sheet describing minor operational differences and recommended workarounds. To determine if an errata sheet exists for a particular device, please contact one of the following:

1. Your local Microchip sales office
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# 93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

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NOTES:

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- Microchip products meet the specification contained in their particular Microchip Data Sheet.
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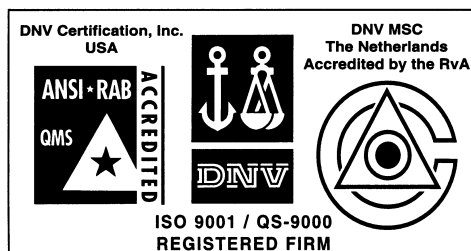
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## WORLDWIDE SALES AND SERVICE

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#### Corporate Office

2355 West Chandler Blvd.  
Chandler, AZ 85224-6199  
Tel: 480-792-7200 Fax: 480-792-7277  
Technical Support: 480-792-7627  
Web Address: <http://www.microchip.com>

#### Atlanta

3780 Mansell Road, Suite 130  
Alpharetta, GA 30022  
Tel: 770-640-0034 Fax: 770-640-0307

#### Boston

2 Lan Drive, Suite 120  
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Tel: 978-692-3848 Fax: 978-692-3821

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#### Dallas

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Tri-Atria Office Building  
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Tel: 248-538-2250 Fax: 248-538-2260

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Tel: 949-263-1888 Fax: 949-263-1338

#### Phoenix

2355 West Chandler Blvd.  
Chandler, AZ 85224-6199  
Tel: 480-792-7966 Fax: 480-792-4338

#### San Jose

Microchip Technology Inc.  
2107 North First Street, Suite 590  
San Jose, CA 95131  
Tel: 408-436-7950 Fax: 408-436-7955

#### Toronto

6285 Northam Drive, Suite 108  
Mississauga, Ontario L4V 1X5, Canada  
Tel: 905-673-0699 Fax: 905-673-6509

### ASIA/PACIFIC

#### Australia

Microchip Technology Australia Pty Ltd  
Marketing Support Division  
Suite 22, 41 Rawson Street  
Epping 2121, NSW  
Australia  
Tel: 61-2-9868-6733 Fax: 61-2-9868-6755

#### China - Beijing

Microchip Technology Consulting (Shanghai)  
Co., Ltd., Beijing Liaison Office  
Unit 915  
Bei Hai Wan Tai Bldg.  
No. 6 Chaoyangmen Beidajie  
Beijing, 100027, No. China  
Tel: 86-10-85282100 Fax: 86-10-85282104

#### China - Chengdu

Microchip Technology Consulting (Shanghai)  
Co., Ltd., Chengdu Liaison Office  
Rm. 2401-2402, 24th Floor,  
Ming Xing Financial Tower  
No. 88 TIDU Street  
Chengdu 610016, China  
Tel: 86-28-86766200 Fax: 86-28-86766599

#### China - Fuzhou

Microchip Technology Consulting (Shanghai)  
Co., Ltd., Fuzhou Liaison Office  
Unit 28F, World Trade Plaza  
No. 71 Wusi Road  
Fuzhou 350001, China  
Tel: 86-591-7503506 Fax: 86-591-7503521

#### China - Hong Kong SAR

Microchip Technology Hongkong Ltd.  
Unit 901-6, Tower 2, Metroplaza  
223 Hing Fong Road  
Kwai Fong, N.T., Hong Kong  
Tel: 852-2401-1200 Fax: 852-2401-3431

#### China - Shanghai

Microchip Technology Consulting (Shanghai)  
Co., Ltd.  
Room 701, Bldg. B  
Far East International Plaza  
No. 317 Xian Xia Road  
Shanghai, 200051  
Tel: 86-21-6275-5700 Fax: 86-21-6275-5060

#### China - Shenzhen

Microchip Technology Consulting (Shanghai)  
Co., Ltd., Shenzhen Liaison Office  
Rm. 1812, 18/F, Building A, United Plaza  
No. 5022 Binhe Road, Futian District  
Shenzhen 518033, China  
Tel: 86-755-82901380 Fax: 86-755-82966626

#### China - Qingdao

Rm. B505A, Fullhope Plaza,  
No. 12 Hong Kong Central Rd.  
Qingdao 266071, China  
Tel: 86-532-5027355 Fax: 86-532-5027205

#### India

Microchip Technology Inc.  
India Liaison Office  
Marketing Support Division  
Divyasree Chambers  
1 Floor, Wing A (A3/A4)  
No. 11, O'Shaughnessy Road  
Bangalore, 560 025, India  
Tel: 91-80-2290061 Fax: 91-80-2290062

### Japan

Microchip Technology Japan K.K.  
Benex S-1 6F  
3-18-20, Shinyokohama  
Kohoku-Ku, Yokohama-shi  
Kanagawa, 222-0033, Japan  
Tel: 81-45-471-6166 Fax: 81-45-471-6122

### Korea

Microchip Technology Korea  
168-1, Youngbo Bldg. 3 Floor  
Samsung-Dong, Kangnam-Ku  
Seoul, Korea 135-882  
Tel: 82-2-554-7200 Fax: 82-2-558-5934

### Singapore

Microchip Technology Singapore Pte Ltd.  
200 Middle Road  
#07-02 Prime Centre  
Singapore, 188980  
Tel: 65-6334-8870 Fax: 65-6334-8850

### Taiwan

Microchip Technology (Barbados) Inc.,  
Taiwan Branch  
11F-3, No. 207  
Tung Hua North Road  
Taipei, 105, Taiwan  
Tel: 886-2-2717-7175 Fax: 886-2-2545-0139

### EUROPE

#### Austria

Microchip Technology Austria GmbH  
Durisolstrasse 2  
A-4600 Wels  
Austria  
Tel: 43-7242-2244-399  
Fax: 43-7242-2244-393

#### Denmark

Microchip Technology Nordic ApS  
Regus Business Centre  
Lautrup hof 1-3  
Ballerup DK-2750 Denmark  
Tel: 45 4420 9895 Fax: 45 4420 9910

#### France

Microchip Technology SARL  
Parc d'Activite du Moulin de Massy  
43 Rue du Saule Trapu  
Batiment A - 1er Etage  
91300 Massy, France  
Tel: 33-1-69-53-63-20 Fax: 33-1-69-30-90-79

#### Germany

Microchip Technology GmbH  
Steinheilstrasse 10  
D-85737 Ismaning, Germany  
Tel: 49-89-627-144-0  
Fax: 49-89-627-144-44

#### Italy

Microchip Technology SRL  
Via Quasimodo, 12  
20025 Legnano (MI)  
Milan, Italy  
Tel: 39-0331-742611 Fax: 39-0331-466781

#### United Kingdom

Microchip Ltd.  
505 Eskdale Road  
Winnersh Triangle  
Wokingham  
Berkshire, England RG41 5TU  
Tel: 44 118 921 5869 Fax: 44-118 921-5820

03/25/03