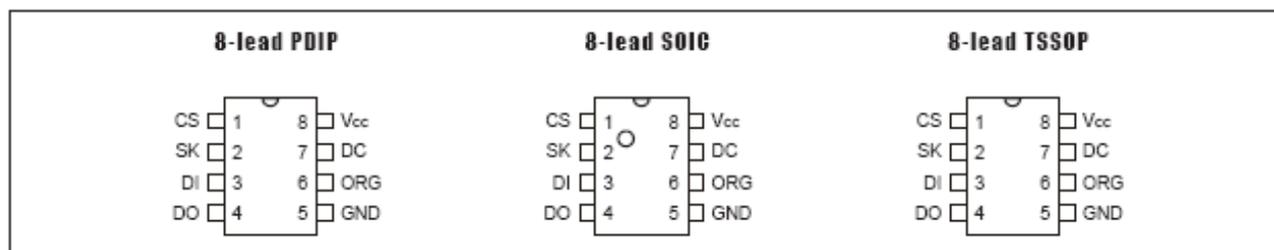


# BL93C56/BL93C66

2K bits (256 X 8 or 128 X 16)/ 4K bits (512 X 8 or 256 X 16) Three-wire Serial EEPROM

## ■ Features

- Three-wire Serial Interface
- Vcc = 1.8V to 5.5V
- Sequential Read Operation
- 2 MHz Clock Rate (5V) Compatibility
- Self-timed Write Cycle (5 ms max)
- 1 Million Write Cycles guaranteed
- Data Retention > 100 Years
- 8-lead PDIP, 8-lead JEDEC SOIC and 8-lead TSSOP Packages



## ■ Description

The BL93C56/66 provides 2048/4096 bits of serial electrically erasable programmable read only memory (EEPROM) organized as 128/256 words of 16 bits each, when the ORG pin is connected to VCC and 256/512 words of 8 bits each when it is tied to ground. The BL93C56/66 is available in space-saving 8-lead PDIP, 8-lead TSSOP and 8-lead JEDEC SOIC packages. The BL93C56/66 is enabled through the Chip Select pin (CS), and accessed via a 3-wire serial interface consisting of Data Input (DI), Data Output (DO), and Shift Clock (SK). Upon receiving a Read instruction at DI, the address is decoded and the data is clocked out serially on the data output pin DO. The WRITE cycle is completely self-timed and no separate erase cycle is required before write. The Write cycle is only enabled when it is in the Erase/Write Enable state. When CS is brought "high" following the initiation of a write cycle, the DO pin outputs the Ready/Busy status.

### Order information

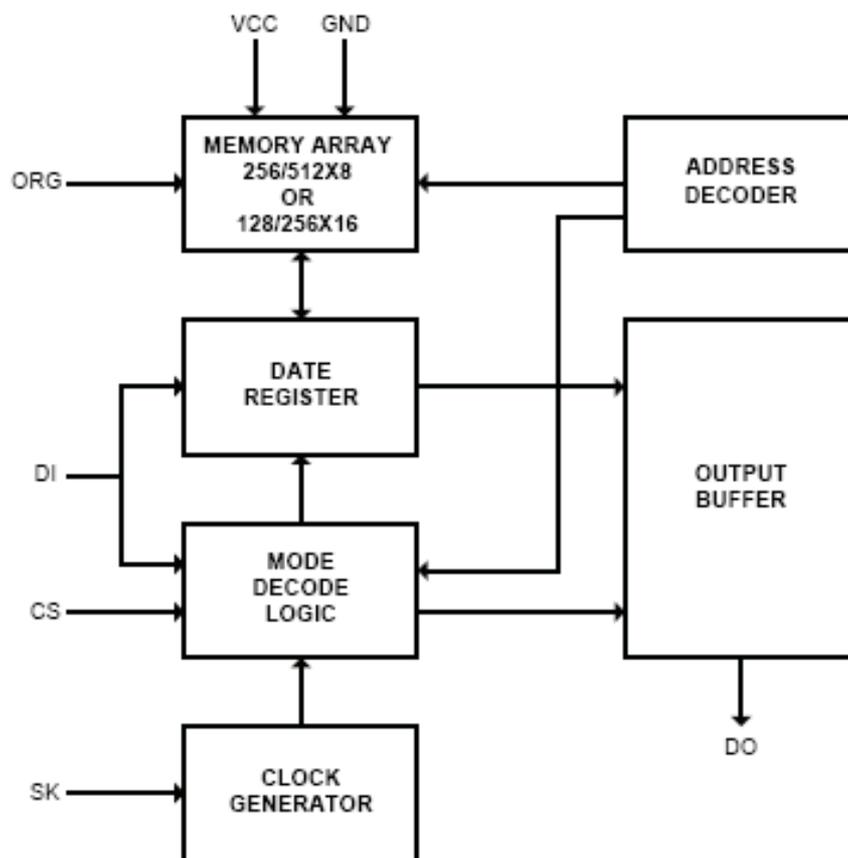
Part Number	Package	shipping
BL93C56/66-DIP	PDIP8	tube
BL93C56/66-SOP	SOP8	tube; 2500 pcs / Tape & Reel
BL93C56/66-TSSOP	TSSOP8	tube; 3000 pcs / Tape & Reel

## ■ Pin Descriptions

► Table 1: Pin Configuration

Pin Name	Function
CS	Chip Select
SK	Serial Data Clock
DI	Serial Data Input
DO	Serial Data Output
GND	Ground
Vcc	Power Supply
ORG	Internal Organization
DC	Don't Connect

### Block Diagram



Notes: When the ORG pin is connected to VCC, the "x 16" organization is selected. When it is connected to ground, the "x 8" organization is selected. If the ORG pin is left unconnected and the application does not load the input beyond the capability of the internal 1 Meg ohm pullup, then the "x 16" organization is selected.

## ■ Electrical Characteristics

### ► Absolute Maximum Ratings\*

DC Supply Voltage	-0.3V to +6.5V
Input / Output Voltage	GND-0.3V to V <sub>CC</sub> +0.3V
Operating Ambient Temperature	-40°C to +85°C
Storage Temperature	-65°C to +150°C

### ► \*NOTICE:

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

### ■ Table 2. Pin Capacitance (1)

► Applicable over recommended operating range from TA = 25°C, f = 1.0 MHz, V<sub>CC</sub> = +1.8V (unless otherwise noted)

Symbol	Test Conditions	Max	Unit	Conditions
C <sub>OUT</sub>	Output Capacitance (DO)	5	pF	V <sub>OUT</sub> = 0V
C <sub>IN</sub>	Input Capacitance (CS, SK, DI)	5	pF	V <sub>IN</sub> = 0V

### ■ Table 3 . DC Characteristics

► Applicable over recommended operating range from: TA = -40°C to +85°C, V<sub>CC</sub> = +1.8V to +5.5V, (unless otherwise noted)

Symbol	Parameter	Test Condition	Min	Typ	Max	Units
V <sub>CC1</sub>	Supply Voltage	-	1.8	-	5.5	V
V <sub>CC2</sub>	Supply Voltage	-	2.7	-	5.5	V
V <sub>CC3</sub>	Supply Voltage	-	4.5	-	5.5	V
I <sub>CC</sub>	Supply Current	V <sub>CC</sub> = 5.0V Read at 1.0 MHz Write at 1.0 MHz	-	0.2 0.9	2.0 3.0	mA
I <sub>SB1</sub>	Standby Current	V <sub>CC</sub> = 1.8V CS = 0V	-	-	1.0	μA
I <sub>SB2</sub>	Standby Current	V <sub>CC</sub> = 2.7V CS = 0V	-	-	1.0	μA
I <sub>SB3</sub>	Standby Current	V <sub>CC</sub> = 5.0V CS = 0V	-	-	1.0	μA
I <sub>IL(1)</sub>	Input Leakage	V <sub>IN</sub> = 0V to V <sub>CC</sub>	-	0.1	1.0	μA
I <sub>IL(2)</sub>	Input Leakage	V <sub>IN</sub> = 0V to V <sub>CC</sub>	-	2.0	3.0	μA
I <sub>OL</sub>	Output Leakage	V <sub>IN</sub> = 0V to V <sub>CC</sub>	-	0.1	1.0	μA
V <sub>IL(1,2)</sub>	Input Low Voltage	2.7V ≤ V <sub>CC</sub> ≤ 5.5V	-0.3	-	0.8	V
V <sub>OH(1,2)</sub>	Input High Voltage		2.0	-	V <sub>CC</sub> + 0.3	V
V <sub>IL(3)</sub>	Input Low Voltage	1.8V ≤ V <sub>CC</sub> ≤ 2.7V	-0.5	-	V <sub>CC</sub> + 0.3	V
V <sub>OH(3)</sub>	Input High Voltage		V <sub>CC</sub> × 0.7	-	V <sub>CC</sub> + 0.3	V
V <sub>OL1</sub>	Output Low Voltage	2.7V ≤ V <sub>CC</sub> ≤ 5.5V I <sub>OL</sub> = 2.1mA	-	-	0.4	V
V <sub>OH1</sub>	Output High Voltage		2.4	-		V
V <sub>OL2</sub>	Output Low Voltage	1.8V ≤ V <sub>CC</sub> ≤ 2.7V I <sub>OL</sub> = 0.15mA	-	-	0.2	V
V <sub>OH2</sub>	Output High Voltage		V <sub>CC</sub> -0.2	-	-	V

Notes: 1. DI, CS, SK input pin  
2. ORG input pin  
3. VIL min and VIH max are reference only and are not tested.

## ■ AC Electrical Characteristics

► Applicable over recommended operating range from  $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $V_{CC} = +1.8\text{V}$  to  $+5.5\text{V}$ ,

CL = 1 TTL Gate and 100pF (unless otherwise noted)

Symbol	Parameter	Test Condition		Min	Typ	Max	Units
$f_{SK}$	SK Clock Frequency	$4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$		0	-	2	MHz
		$2.7\text{V} \leq V_{CC} \leq 5.5\text{V}$		0	-	1	
		$1.8\text{V} \leq V_{CC} \leq 5.5\text{V}$		0	-	0.25	
$t_{SKH}$	SK High Time	$4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$		250	-	-	ns
		$2.7\text{V} \leq V_{CC} \leq 5.5\text{V}$		250	-	-	
		$1.8\text{V} \leq V_{CC} \leq 5.5\text{V}$		1000	-	-	
$t_{SKL}$	SK Low Time	$4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$		250	-	-	ns
		$2.7\text{V} \leq V_{CC} \leq 5.5\text{V}$		250	-	-	
		$1.8\text{V} \leq V_{CC} \leq 5.5\text{V}$		1000	-	-	
$t_{CS}$	Minimum CS Low Time	$4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$		250	-	-	ns
		$2.7\text{V} \leq V_{CC} \leq 5.5\text{V}$		250	-	-	
		$1.8\text{V} \leq V_{CC} \leq 5.5\text{V}$		1000	-	-	
$t_{CSS}$	CS Setup Time	Relative to SK	$4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$	50	-	-	ns
			$2.7\text{V} \leq V_{CC} \leq 5.5\text{V}$	50	-	-	
			$1.8\text{V} \leq V_{CC} \leq 5.5\text{V}$	200	-	-	
$t_{DIS}$	DI Setup Time	Relative to SK	$4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$	100	-	-	ns
			$2.7\text{V} \leq V_{CC} \leq 5.5\text{V}$	100	-	-	
			$1.8\text{V} \leq V_{CC} \leq 5.5\text{V}$	400	-	-	
$t_{CSH}$	CS Hold Time	Relative to SK		0	-	-	ns
$t_{DIH}$	DI Hold Time	Relative to SK	$4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$	100	-	-	ns
			$2.7\text{V} \leq V_{CC} \leq 5.5\text{V}$	100	-	-	
			$1.8\text{V} \leq V_{CC} \leq 5.5\text{V}$	400	-	-	
$t_{PD1}$	Output Delay to "1"	AC Test	$4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$	-	-	250	ns
			$2.7\text{V} \leq V_{CC} \leq 5.5\text{V}$	-	-	250	
			$1.8\text{V} \leq V_{CC} \leq 5.5\text{V}$	-	-	1000	
$t_{P00}$	Output Delay to "0"	AC Test	$4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$	-	-	250	ns
			$2.7\text{V} \leq V_{CC} \leq 5.5\text{V}$	-	-	250	
			$1.8\text{V} \leq V_{CC} \leq 5.5\text{V}$	-	-	1000	
$t_{SV}$	CS to Status Valid	AC Test	$4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$	-	-	250	ns
			$2.7\text{V} \leq V_{CC} \leq 5.5\text{V}$	-	-	250	
			$1.8\text{V} \leq V_{CC} \leq 5.5\text{V}$	-	-	1000	
$t_{DF}$	CS to DO in High Impedance	AC Test CS = VIL	$4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$	-	-	100	ns
			$2.7\text{V} \leq V_{CC} \leq 5.5\text{V}$	-	-	100	
			$1.8\text{V} \leq V_{CC} \leq 5.5\text{V}$	-	-	400	
$t_{WP}$	Write Cycle Time	-	-	-	1.5	5	ms
Endurance <sup>(1)</sup>	5.0V, 25°C	-	-	1M	-	-	Write Cycle

Notes: 1. This parameter is characterized and is not 100% tested.

## ■ Functional Description

The BL93C56/66 is accessed via a simple and versatile three-wire serial communication interface. Device operation is controlled by seven instructions issued by the host processor. A valid instruction starts with a rising edge of CS and consists of a start bit (logic“1”) followed by the appropriate op code and the desired memory address location.

Table5. Instruction Set for the BL93C56/66

Instruction	SB	OP Code	Address		Data		Comments
			x8	x16	x8	x16	
READ	1	10	A <sub>8</sub> - A <sub>0</sub>	A <sub>7</sub> - A <sub>0</sub>			Reads data stored in memory, at specified address
EWEN	1	00	11XXXXXX	11XXXXXX			Write enable must precede all programming modes
ERASE	1	11	A <sub>8</sub> - A <sub>0</sub>	A <sub>7</sub> - A <sub>0</sub>			Erase memory location A <sub>n</sub> - A <sub>0</sub>
WRITE	1	01	A <sub>8</sub> - A <sub>0</sub>	A <sub>7</sub> - A <sub>0</sub>	D <sub>7</sub> - D <sub>0</sub>	D <sub>15</sub> - D <sub>0</sub>	Writes memory location A <sub>n</sub> - A <sub>0</sub>
ERAL	1	00	10XXXXXX	10XXXXXX			Erases all memory locations. Valid only at VCC = 4.5V to 5.5V
WRAL	1	00	01XXXXXX	01XXXXXX	D <sub>7</sub> - D <sub>0</sub>	D <sub>15</sub> - D <sub>0</sub>	Writes all memory locations. Valid only at VCC = 4.5V to 5.5V
EWDS	1	00	00XXXXXX	00XXXXXX			Disables all programming instructions

Notes: The X's in the address field represent don't care values and must be clocked.

**READ (READ):** The Read (READ) instruction contains the address code for the memory location to be read. After the instruction and address are decoded, data from the selected memory location is available at the serial output pin DO. Output data changes are synchronized with the rising edges of serial clock SK. It should be noted that a dummy bit (logic “0”) precedes the 8- or 16-bit data output string. The BL93C56/66 supports sequential read operations. The device will automatically increment the internal address pointer and clock out the next memory location as long as Chip Select (CS) is held high. In this case, the dummy bit (logic “0”) will not be clocked out between memory locations, thus allowing for a continuous stream of data to be read.

**ERASE/WRITE (EWEN):** To assure data integrity, the part automatically goes into the Erase/Write Disable (EWDS) state when power is first applied. An Erase/Write Enable (EWEN) instruction must be executed first before any programming instructions can be carried out. Please note that once in the EWEN state, programming remains enabled until an EWDS instruction is executed or VCC power is removed from the part.

**ERASE (ERASE):** The Erase (ERASE) instruction programs all bits in the specified memory location to the logical “1” state. The self-timed erase cycle starts once the ERASE instruction and address are decoded. The DO pin outputs the Ready/Busy status of the part if CS is brought high after being kept low for a minimum of 250 ns (TCS). A logic “1” at pin DO indicates that the selected memory location has been erased, and the part is ready for another instruction.

**WRITE (WRITE):** The Write (WRITE) instruction contains the 8 or 16 bits of data to be written into the specified memory location. The self-timed programming cycle, tWP, starts after the last bit of data is received at serial data input pin DI. The DO pin outputs the Ready/Busy status of the part if CS is brought high after being kept low for a minimum of 250 ns (TCS). A logic “0” at DO indicates that programming is still in progress. A logic “1” indicates that the memory location at the specified address has been written with the data pattern contained in the instruction and the part is ready for further instructions. A Ready/Busy status cannot be obtained if the CS is brought high after the end of the self-timed programming cycle, TWP.

**ERASE ALL (ERAL):** The Erase All (ERAL) instruction programs every bit in the memory array to the logic “1” state and is primarily used for testing purposes. The DO pin outputs the Ready/Busy status of the part if CS is brought high after being kept low for a minimum of 250 ns (TCS). The ERAL instruction is valid only at VCC = 5.0V ± 10%.

**WRITE ALL (WRAL):** The Write All (WRAL) instruction programs all memory locations with the data patterns specified in the instruction. The DO pin outputs the Ready/Busy status of the part if CS is brought high after being kept low for a minimum of 250 ns (TCS). The WRAL instruction is valid only at VCC = 5.0V ± 10%.

**ERASE/WRITE DISABLE (EWDS):** To protect against accidental data disturb, the Erase/Write Disable (EWDS) instruction disables all programming modes and should be executed after all programming operations. The operation of the Read instruction is independent of both the EWEN and EWDS instructions and can be executed at any time.

### ■ Timing Diagrams

►Figure 2: Synchronous Data Timing

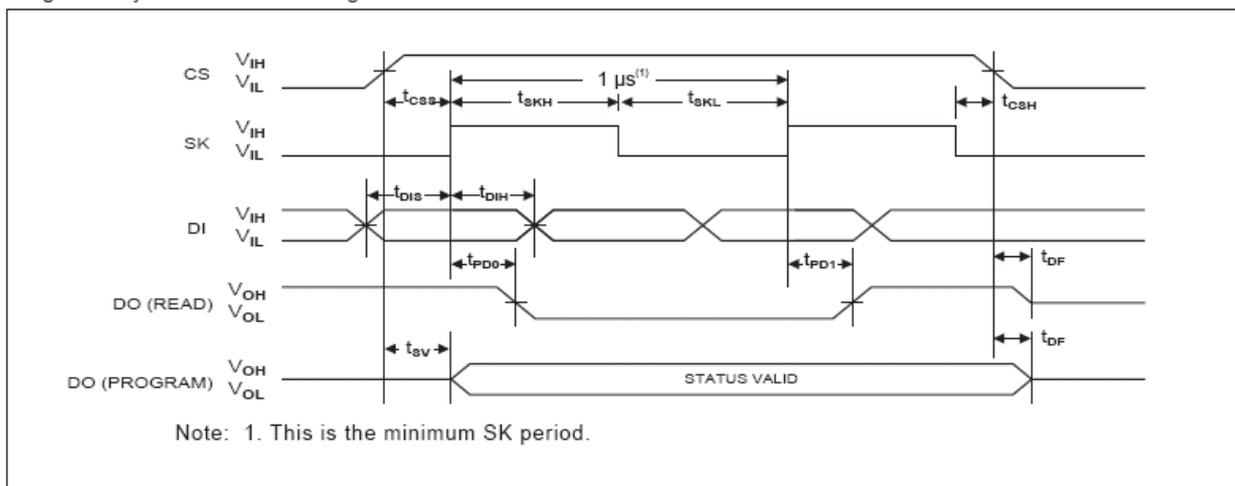


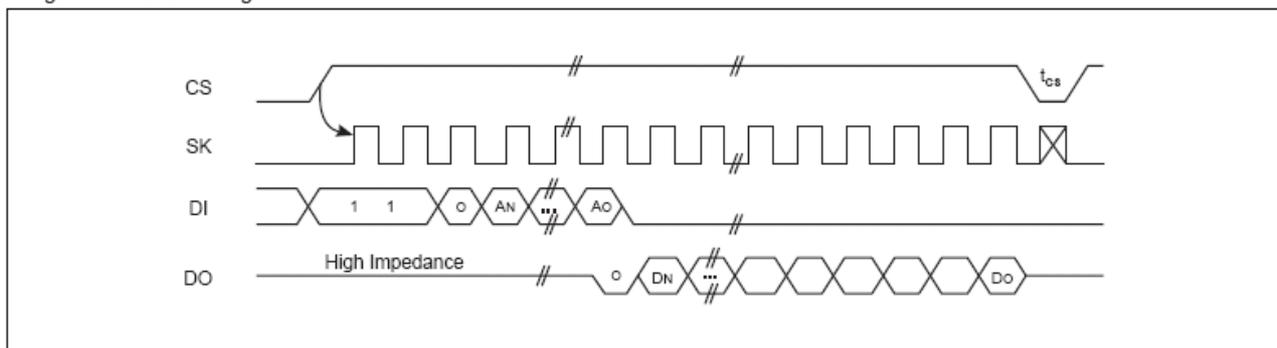
Table 6. Organization Key for Timing Diagrams

I/O	BL93C56(2K)		BL93C66(4K)	
	X8	X16	X8	X16
AN	A8(1)	A7(2)	A8	A7
DN	D7	D15	D7	D15

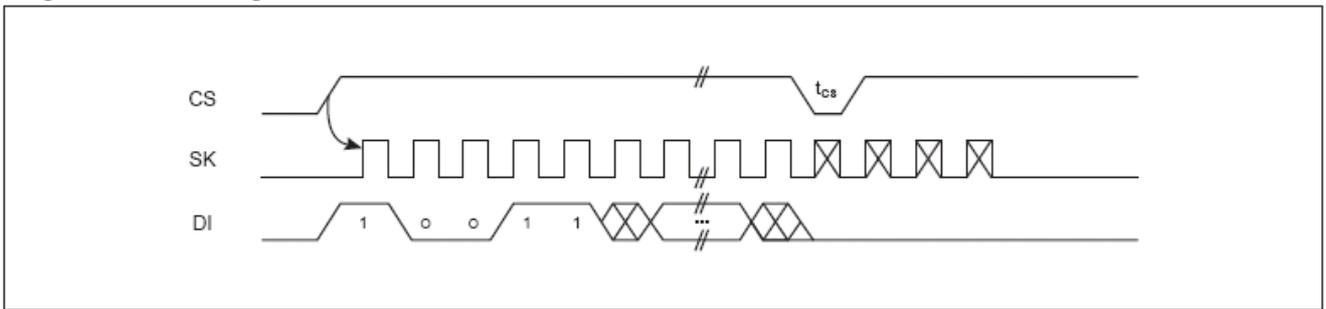
Note:1 A8 is a DON'T CARE value,but the extra clock is required

2 A7 is a DON'T CARE value,but the extra clock is required

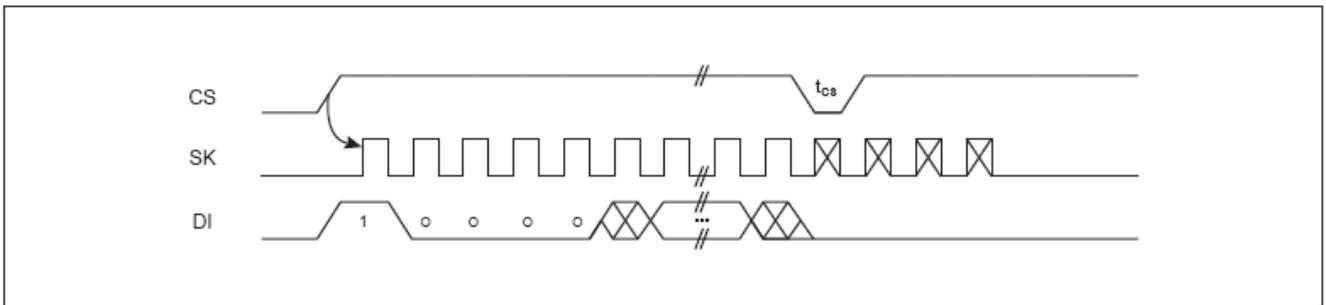
►Figure 3: READ Timing



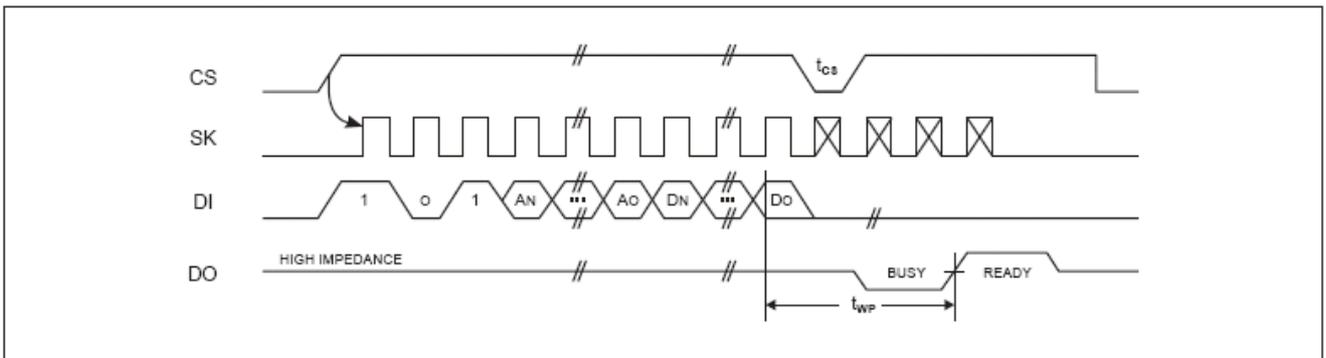
► Figure 4: EWEN Timing



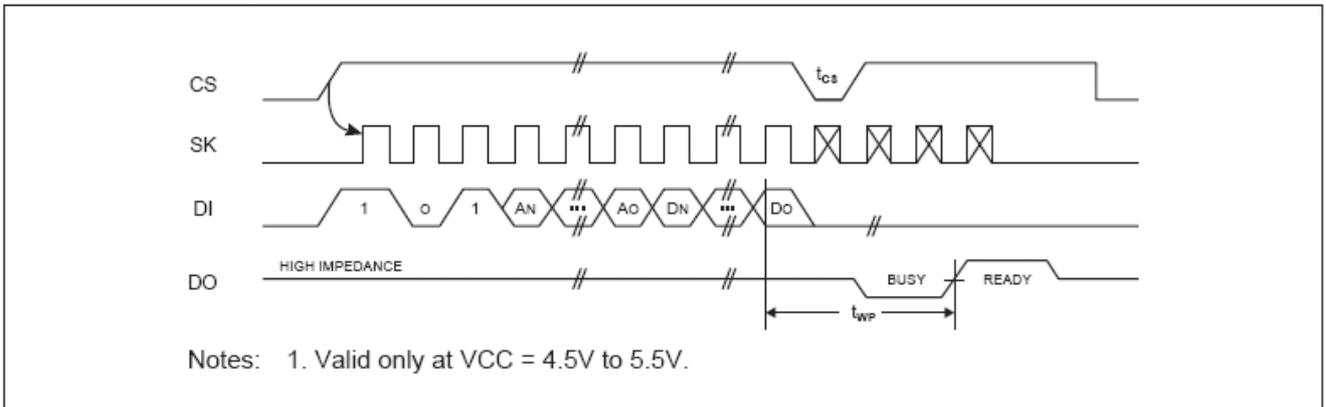
► Figure 5: EWDS Timing



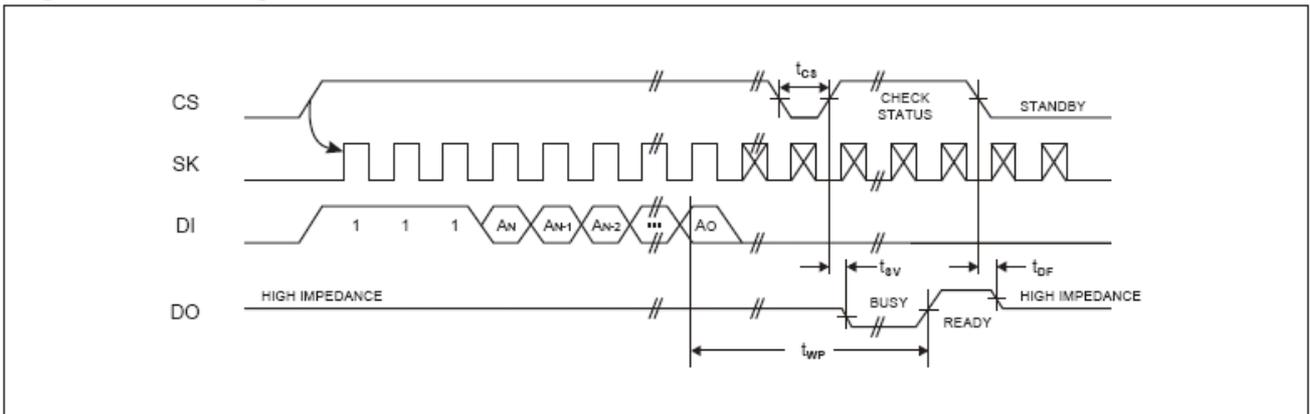
► Figure 6: WRITE Timing



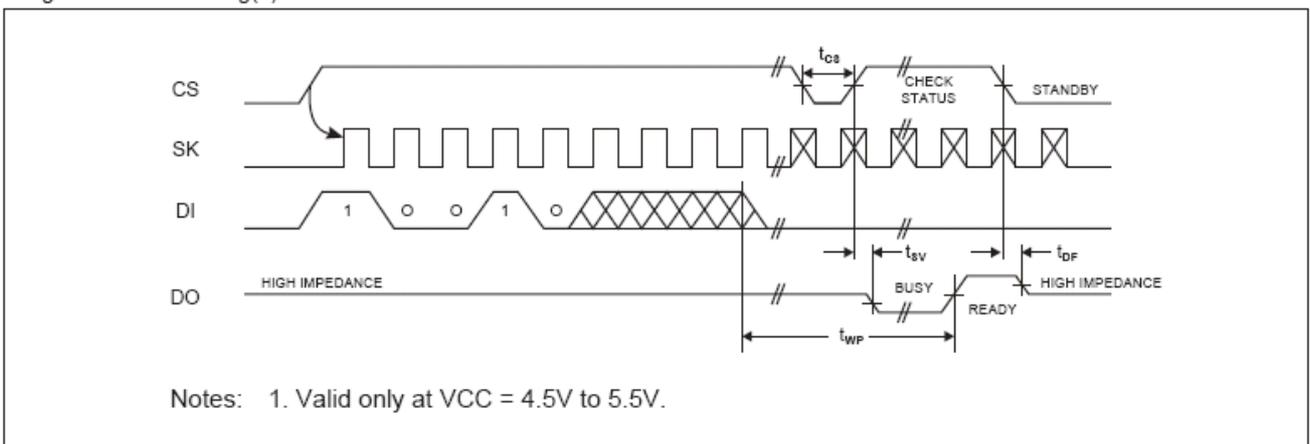
► Figure 7: WRAL Timing(1)



► Figure 8: ERASE Timing



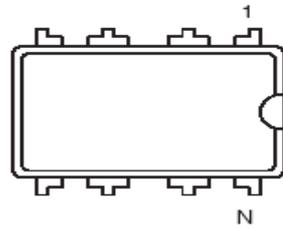
► Figure 9: ERAL Timing(1)



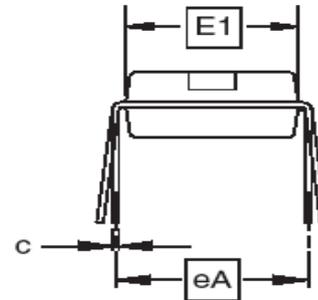
Notes: 1. Valid only at VCC = 4.5V to 5.5V.

## Package Information

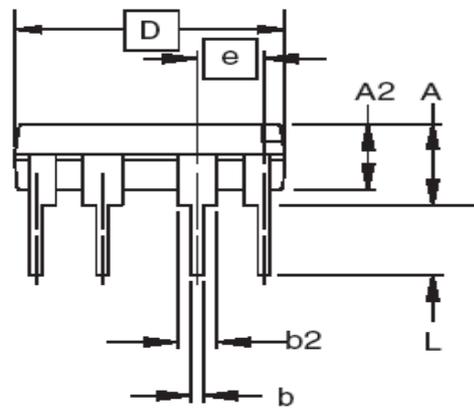
### 8-lead PDIP Outline Dimensions



Top View



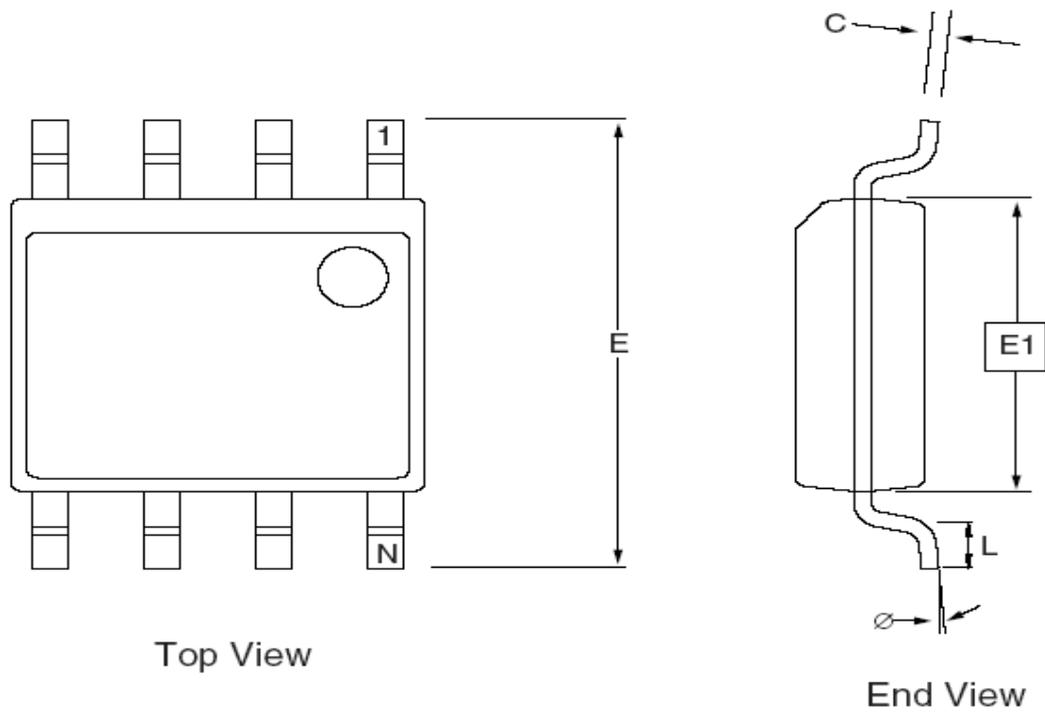
End View



Side View

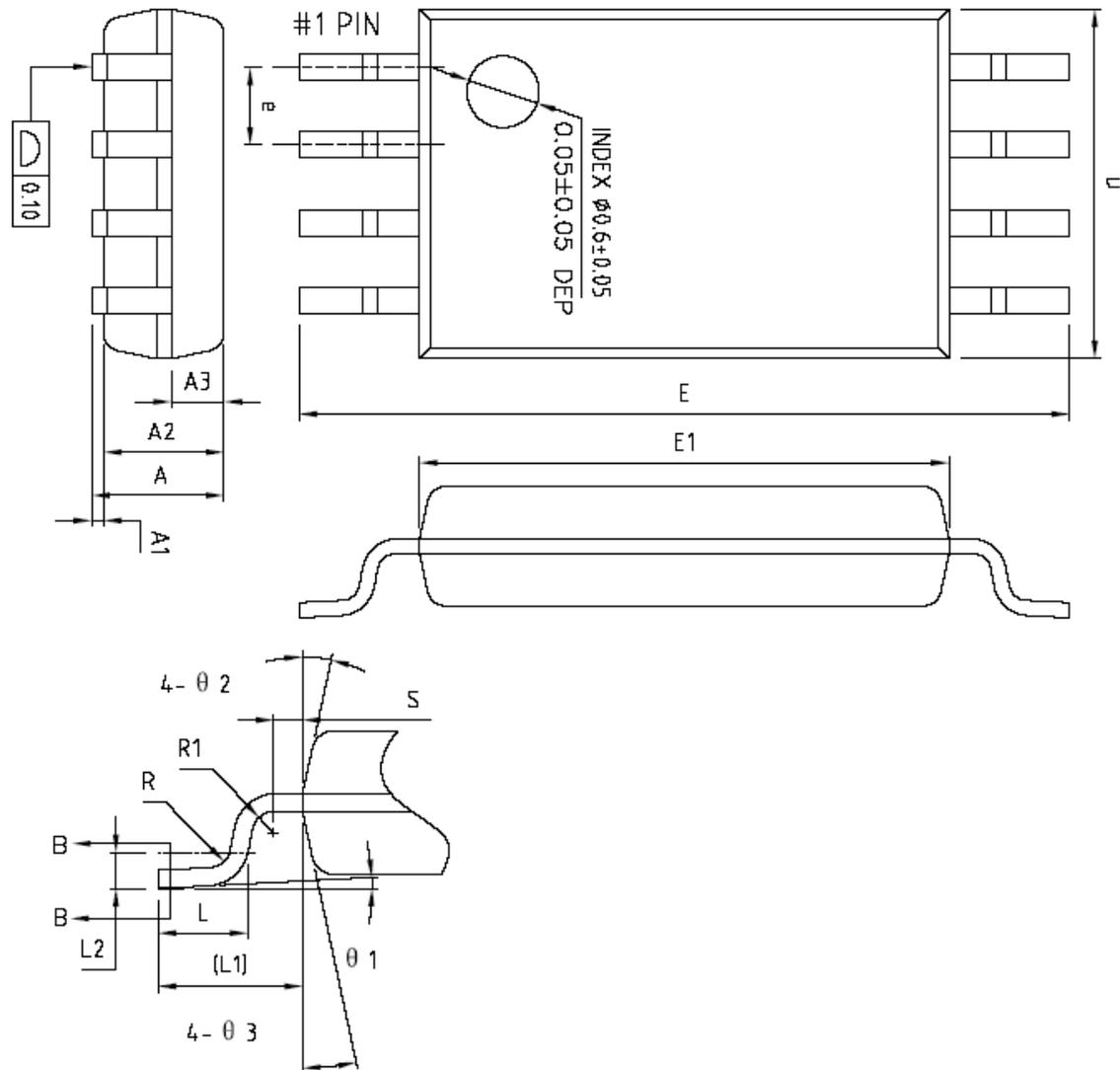
SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	3.60	3.80	4.00
A2	3.10	3.30	3.50
b	0.44	-	0.53
B1	1.52BSC		
c	0.25	-	0.31
c1	0.24	0.25	0.26
D	9.05	9.25	9.45
E1	6.15	6.35	6.55
e	2.54BSC		
eA	7.62BSC		
L	3.00	-	-

8-lead SOIC Outline Dimensions



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	-	-	1.77
A1	0.08	0.18	0.28
b	0.44	-	0.53
c	0.21	-	0.26
D	4.70	4.90	5.10
E	5.80	6.00	6.20
E1	3.70	3.90	4.10
e	1.27BSC		
Θ	0	-	8°

8-lead TSSOP Outline Dimensions



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	-	-	1.20
A1	0.05	-	0.15
A2	0.90	1.00	1.05
A3	0.34	0.44	0.54
b	0.20	-	0.28
b1	0.20	0.22	0.24
c	0.10	-	0.19
c1	0.10	0.13	0.15
D	2.83	2.93	3.03
E	6.20	6.40	6.60

E1	4.30	4.40	4.50
e	0.65BSC		
L	0.45	0.60	0.75
L1	1.00REF		
L2	0.25BSC		
R	0.09	-	-
R1	0.09	-	-
S	0.20	-	-
Θ1	0°	-	8°
Θ2	10°	12°	14°
Θ3	10°	12°	14°