



ACE93C46A/56A/66A Three-wire Serial EEPROM

Description

The ACE93C46A/56A/66A series are 1024/2048/4096 bits of serial Electrical Erasable and Programmable Read Only Memory, commonly known as EEPROM. They are organized as 64/128/256 words of 16 bits each when the ORG pin is connected to VCC (or unconnected) and 128/256/512 words of 8 bits (1 byte) each when the ORG pin is tied to ground. The devices are fabricated with proprietary advanced CMOS process for low power and low voltage applications. These devices are available in standard 8-lead DIP, 8-lead JEDEC SOP, 8-lead TSSOP and 8-lead DFN packages. Our extended VCC range (1.8V to 5.5V) devices enables wide spectrum of applications.

The ACE93C46A/56A/66A 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 (SCL). 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 the part is in the ERASE/WRITE ENABLE state. Once a device begins its self-timed program procedure, the data out pin (DO) can indicate the READY/BUSY status by rising chip select (CS).

Features

- Standard Voltage and Low Voltage Operation:
 - ACE 93C46A/56A/66A: $V_{CC} = 1.8V$ to $5.5V$
- User Selectable Internal Organization:
 - ACE 93C46A: 128 x 8 or 64 x 16
 - ACE 93C56A: 256 x 8 or 128 x 16
 - ACE 93C66A: 512 x 8 or 256 x 16
- 2 MHz Clock Rate (5V) Compatibility.
- Industry Standard 3-wire Serial Interface.
- Self-Timed ERASE/WRITE Cycles (5ms max including auto-erase).
- Automatic ERAL before WRAL.
- Sequential READ Function.
- High Reliability: Typical 1 Million Erase/Write Cycle Endurance.
- 100 Years Data Retention.
- Industrial Temperature Range ($-40^{\circ}C$ to $85^{\circ}C$).
- Standard 8-pin DIP/SOP/TSSOP/DFN Pb-free Packages



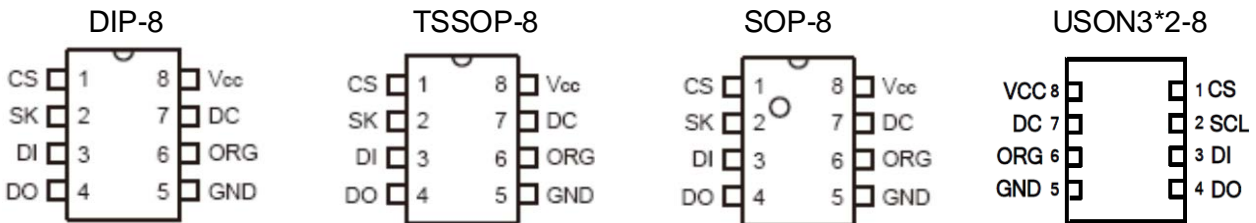
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Absolute Maximum Ratings

Industrial operating temperature	-40°C to 85°C
Storage temperature	-50°C to 125°C
Input voltage on any pin relative to ground	-0.3V to $V_{CC} + 0.3V$
Maximum voltage	8V

*Notice: Stresses exceed those listed under “Absolute Maximum Rating” may cause permanent damage to the device. Functional operation of the device at conditions beyond those listed in the specification is not guaranteed. Prolonged exposure to extreme conditions may affect device reliability or functionality.

Packaging Type



Pin Configurations

NO	Pin Name	Function
1	CS	Chip select
2	SK	Serial Data Clock
3	DI	Serial Data Input
4	DO	Serial Data Output
5	GND	Ground
6	ORG	Internal Organization
7	DC	Don't Connect
8	Vcc	Power Supply



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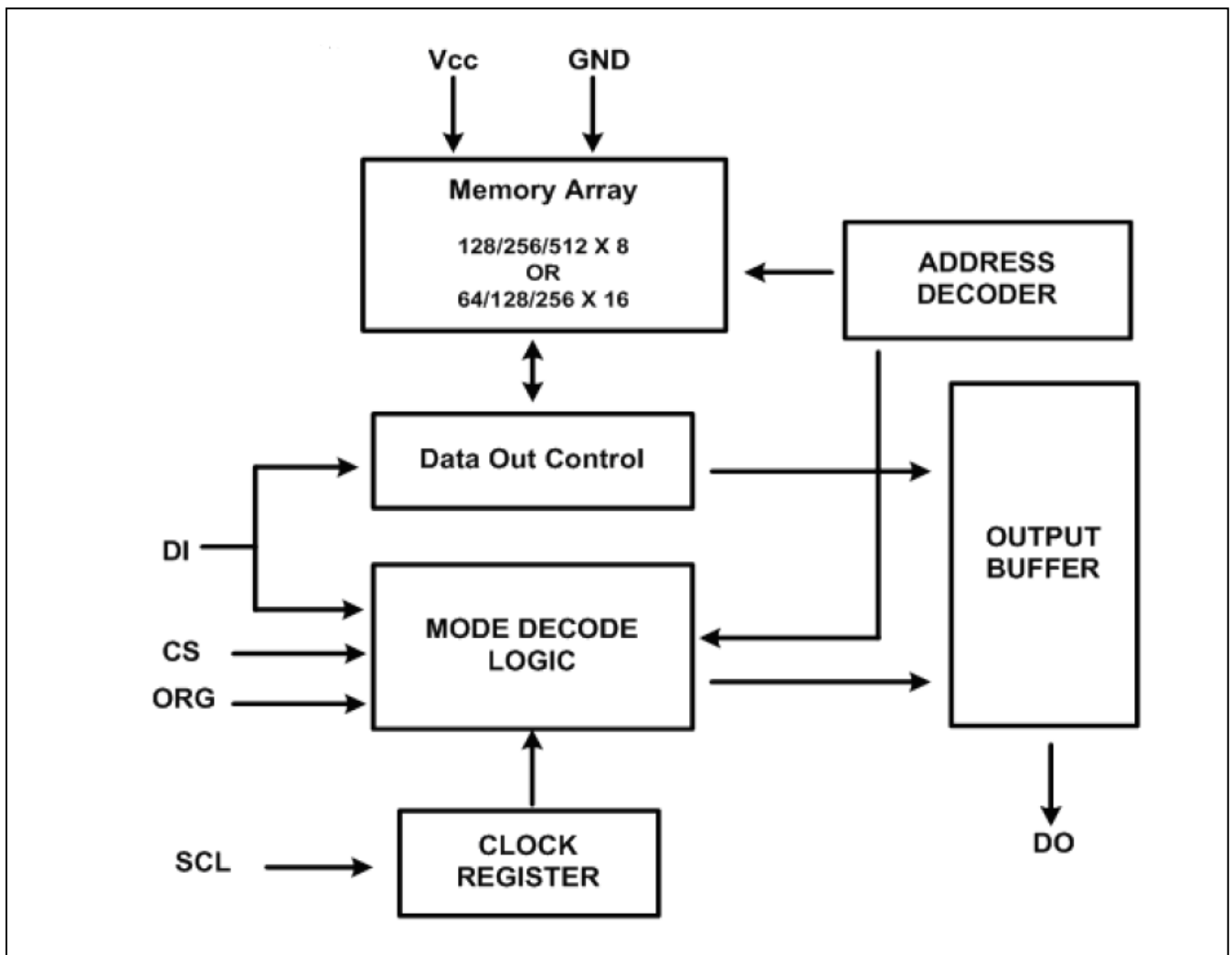
Ordering information

ACE93C46A/56A/66A XX + X H

- Halogen-free
- U: Tube
- T : Tape and Reel
- Pb - free

- DP: DIP-8
- FM: SOP-8
- TM: TSSOP-8
- UA8: USON3*2-8

Block Diagram





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Pin Descriptions

(A) SERIAL CLOCK (SCL)

The rising edge of this SCL input is to latch data into the EEPROM device while the rising edge of this clock is to clock data out of the EEPROM device.

(B) CHIP SELECT (CS)

This is the chip select input signal for the serial EEPROM device.

(C) SERIAL DATA INPUT (DI)

This is data input signal for the serial device.

(D) SERIAL DATA OUTPUT (DO)

This is data output signal for the serial device.

(E) INTERNAL ORGANIZATION (ORG)

This is internal organization input signal for the serial EEPROM device. When the ORG pin is connected to VCC or unconnected the EEPROM is organized as 64/128/256 word of 16 bits each and when ORG pin is connected to ground the EEPROM is organized as 128/256/512 byte of 8 bits each. Typically, these signals are hardwired to either V_{IH} or V_{IL} . If left unconnected, they are internally recognized as V_{IH} .

Memory Organization

The ACE93C46A/56A/66A memory is organized either as bytes (x8) or as words (x16). If Internal Organization (ORG) is unconnected (or connected to VCC) the words (x16) organization is selected; When Internal Organization is connected to ground the bytes (x8) organization is selected.

Instruction set

Instruction	Device Type	SB	Op code	Address		Data		Comments
				*8 ⁽¹⁾⁽²⁾	*16 ⁽¹⁾⁽³⁾	*8	*16	
READ	ACE93C46A	1	10	A ₆ -A ₀	A ₅ -A ₀			Reads data stored in memory, at specified address.
	ACE93C56A	1	10	A ₈ -A ₀	A ₇ -A ₀			
	ACE93C66A	1	10	A ₈ -A ₀	A ₇ -A ₀			
EWEN	ACE93C46A	1	00	11XXXXXX	11XXXX			Write enable must precede all programming modes.
	ACE93C56A	1	00	11XXXXXXXX	11XXXXXX			
	ACE93C66A	1	00	11XXXXXXXX	11XXXXXX			
EWDS	ACE93C46A	1	11	00XXXXXX	00XXXX			Disables all programming instructions.
	ACE93C56A	1	11	00XXXXXXXX	00XXXXXX			
	ACE93C66A	1	11	00XXXXXXXX	00XXXXXX			
ERASE	ACE93C46A	1	01	A ₆ -A ₀	A ₅ -A ₀			Erase memory location A _n - A ₀ .
	ACE93C56A	1	01	A ₈ -A ₀	A ₇ -A ₀			
	ACE93C66A	1	01	A ₈ -A ₀	A ₇ -A ₀			



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WRITE	ACE93C46A	1	00	A ₆ -A ₀	A ₅ -A ₀	D ₇ -D ₀	D ₁₅ -D ₀	Writes memory location A _n -A ₀ .
	ACE93C56A	1	00	A ₈ -A ₀	A ₇ -A ₀	D ₇ -D ₀	D ₁₅ -D ₀	
	ACE93C66A	1	00	A ₈ -A ₀	A ₇ -A ₀	D ₇ -D ₀	D ₁₅ -D ₀	
ERASE	ACE93C46A	1	00	10XXXXXX	10XXXXX			Erases all memory locations.
	ACE93C56A	1	00	10XXXXXXXX	10XXXXXXXX			
	ACE93C66A	1	00	10XXXXXXXX	10XXXXXXXX			
WRAL	ACE93C46A	1	00	01XXXXXX	01XXXXX	D ₇ -D ₀	D ₁₅ -D ₀	Writes all memory locations.
	ACE93C56A	1	00	01XXXXXXXX	01XXXXXXXX	D ₇ -D ₀	D ₁₅ -D ₀	
	ACE93C66A	1	00	01XXXXXXXX	01XXXXXXXX	D ₇ -D ₀	D ₁₅ -D ₀	

(A) START BIT (SB)

Each instruction is preceded by a rising edge on Chip Select (CS) with Serial Clock (SCL) being held Low.

(B) OPERATION CODE (OP-CODE)

Two op-code bits, read on Serial Data Input (DI) during the rising edge of Serial Clock (SCL).

(C) ADDRESS

The address bits of the byte or word that is to be accessed. For the ACE93C46A, the address is made up of 6 bits for the x16 organization or 7 bits for x8 organization. For the ACE93C56A, the address is made up of 7 bits for the x16 organization or 8 bits for x8 organization. For the ACE93C66A, the address is made up of 8 bits for the x16 organization or 9 bits for x8 organization.

(D) DATA

The data bits of the byte or word that is to be accessed. For the ACE93C46A/56A/66A, the data is made up of 16 bits (word) for the x16 organization or 8 bits (byte) for x8 organization.

Instruction Sets Description

(A) 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 when a dummy bit (logic "0") precedes the 8- or 16-bit data output string.

(B) ERASE/WRITE ENABLE

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 Erase/Write Enable state, programming remains enabled until an Erase/Write Disable (EWDS) instruction is executed or VCC power is removed from the part.



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(C) ERASE/WRITE DISABLE

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.

(D) 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 (t_{CS}). A logic “1” at pin DO indicates that the selected memory location has been erased, and the part is ready for another instruction.

(E) 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, t_{WP} , 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 (t_{IP}). 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, t_{WP} .

(F) ERASE ALL

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 (t_{CS}). The ERAL instruction is valid only at $V_{CC} = 5.0V \pm 10\%$.

(G) WRITE ALL

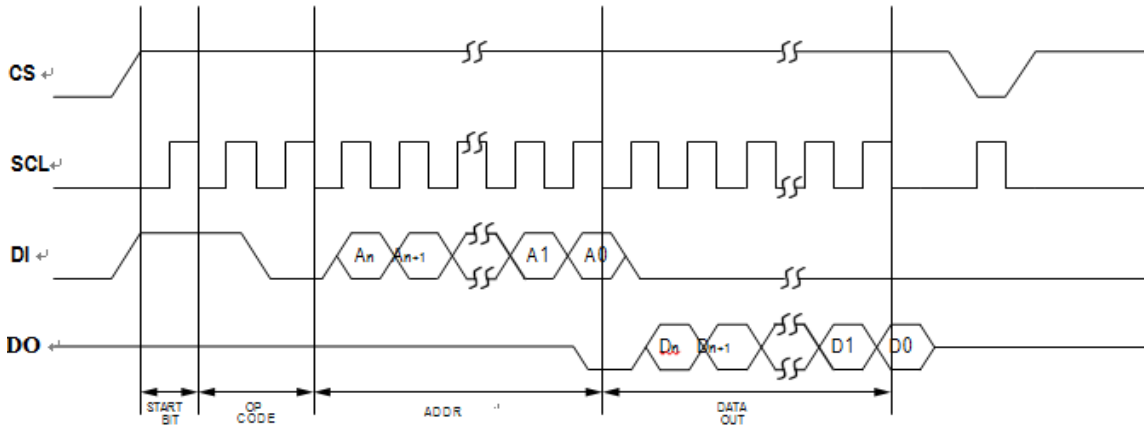
The Write All (WRAL) instruction programs all memory locations with the data patterns specified in the instruction. The DO pin outputs the READY/BUSY status of the part if CS is brought high after being kept low for a minimum of 250 ns (t_{CS}). The WRAL instruction is valid only at $V_{CC} = 5.0V \pm 10\%$.



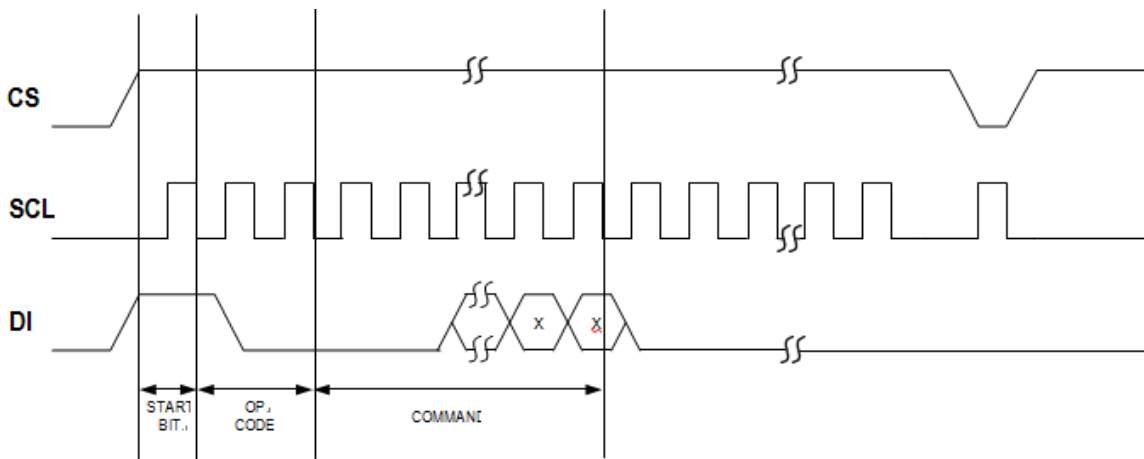
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Timing Diagrams

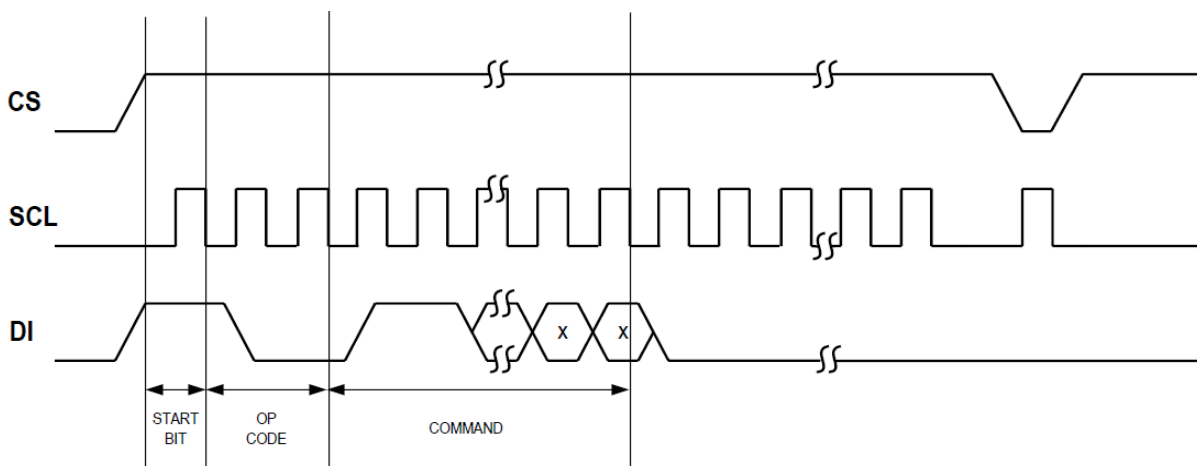
READ Timing



EWDS Timing



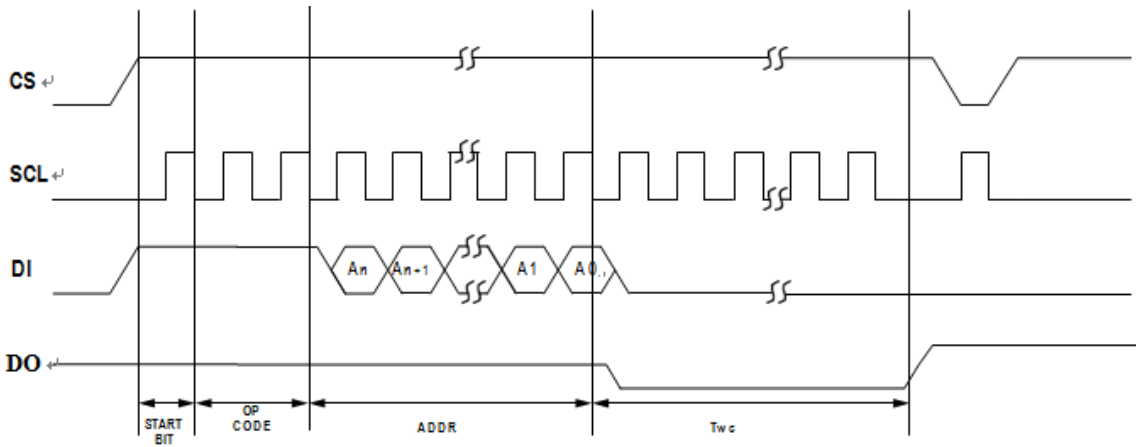
EWEN Timing



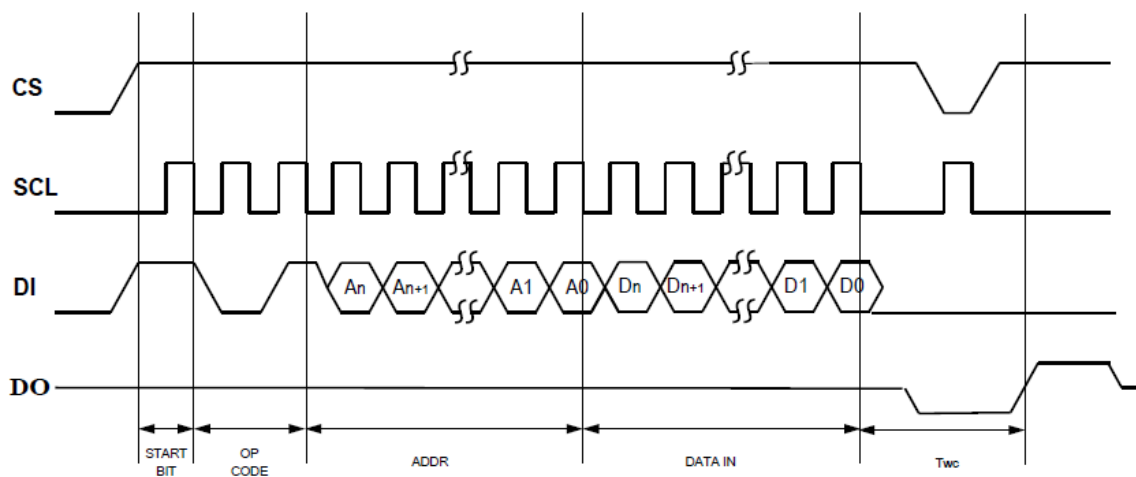


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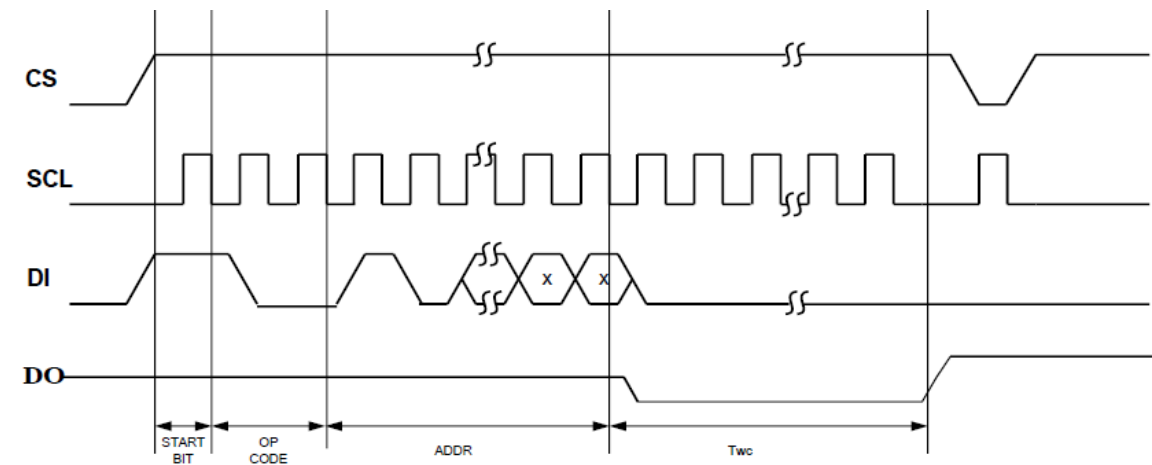
ERASE Timing



WRITE Timing



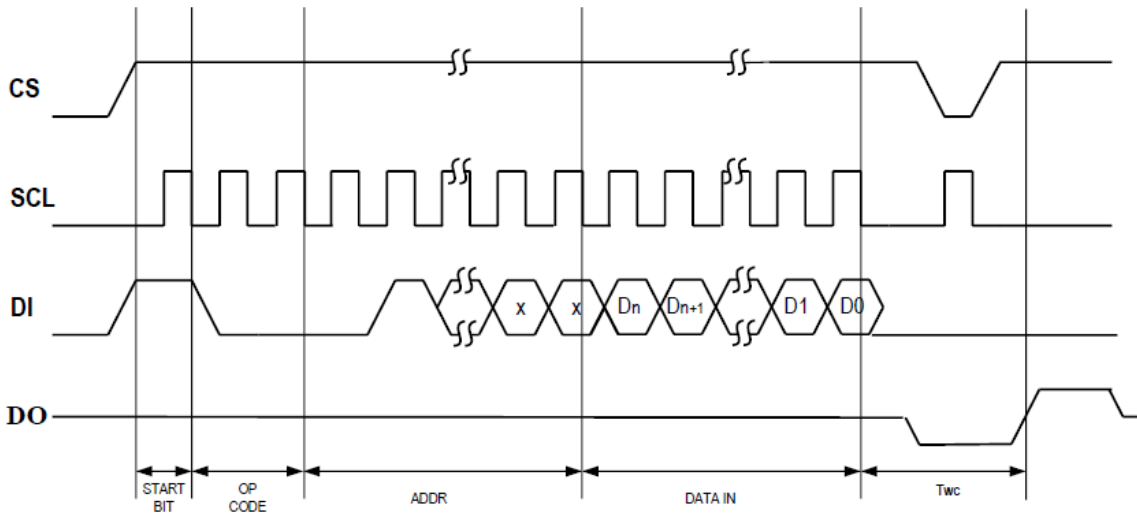
ERAL Timing(1)





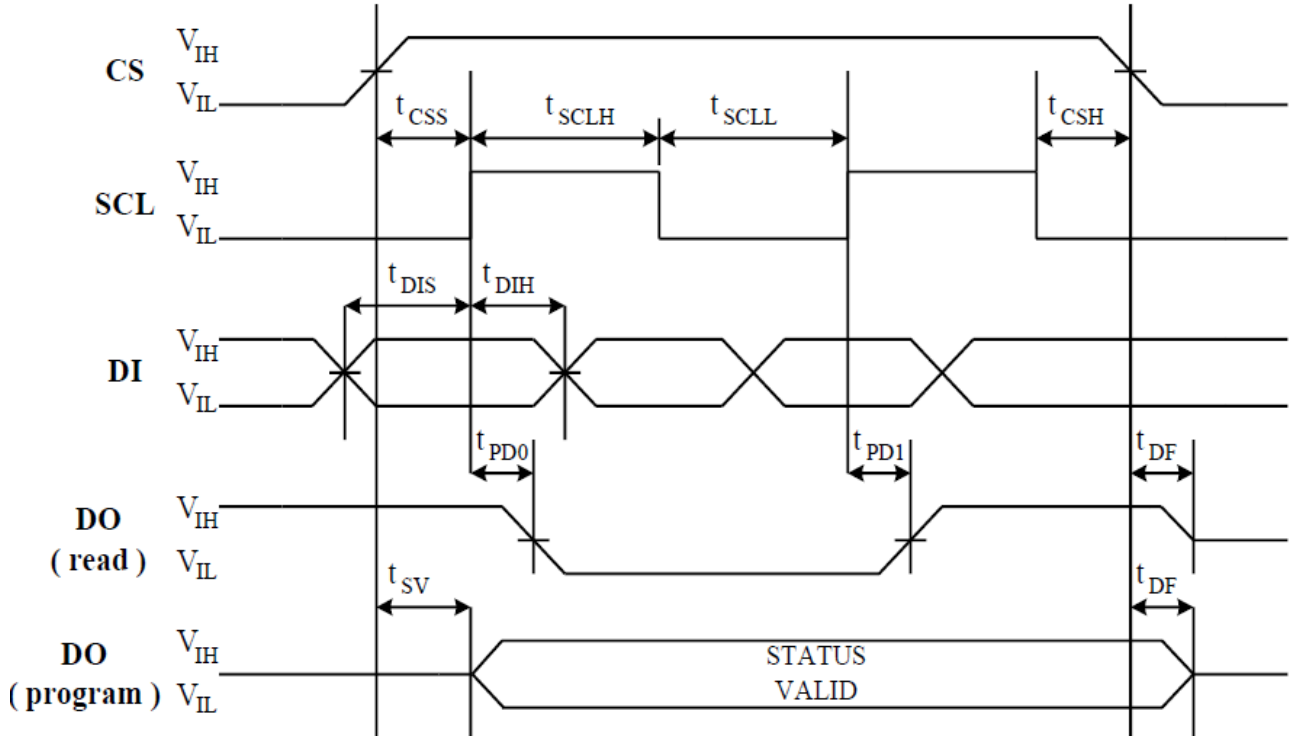
ACE93C46A/56A/66A Three-wire Serial EEPROM

WRAL Timing(2)



- Note : 1. Valid only at VCC=4.5V to 5.5V
2. Valid only at VCC=4.5V to 5.5V

Synchronous Data Timing





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AC characteristics

Applicable over recommended operating range from: $T_{AI} = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, $V_{CC} = +1.8\text{V}$ to $+5.5\text{V}$, $T_{AC} = 0^{\circ}\text{C}$ to $+70^{\circ}\text{C}$, $V_{CC} = +1.8\text{V}$ to $+5.5\text{V}$ (unless otherwise noted).

Symbol	Parameter	Test Condition	Min	Typ	Max	Units
f_{SCL}	SCL Clock Frequency	$4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$ $2.7\text{V} \leq V_{CC} \leq 5.5\text{V}$ $1.8\text{V} \leq V_{CC} \leq 5.5\text{V}$	0 0 0		2 1 0.25	MHz
t_{SHLH}	SCL High Time	$4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$ $2.7\text{V} \leq V_{CC} \leq 5.5\text{V}$ $1.8\text{V} \leq V_{CC} \leq 5.5\text{V}$	250 250 1000			ns
t_{SCLL}	SCL Low Time	$4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$ $2.7\text{V} \leq V_{CC} \leq 5.5\text{V}$ $1.8\text{V} \leq V_{CC} \leq 5.5\text{V}$	250 250 1000			ns
t_{CS}	Minimum CS Low Time	$4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$ $2.7\text{V} \leq V_{CC} \leq 5.5\text{V}$ $1.8\text{V} \leq V_{CC} \leq 5.5\text{V}$	250 250 1000			ns
t_{CSS}	CS Setup Time	Relative to SCL	$4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$ $2.7\text{V} \leq V_{CC} \leq 5.5\text{V}$ $1.8\text{V} \leq V_{CC} \leq 5.5\text{V}$	50 50 200		ns
t_{DIS}	DI Setup Time	Relative to SCL	$4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$ $2.7\text{V} \leq V_{CC} \leq 5.5\text{V}$ $1.8\text{V} \leq V_{CC} \leq 5.5\text{V}$	100 100 400		ns
t_{CSH}	CS Hold Time	Relative to SCL		0		ns
t_{DIH}	DI Setup Time	Relative to SCL	$4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$ $2.7\text{V} \leq V_{CC} \leq 5.5\text{V}$ $1.8\text{V} \leq V_{CC} \leq 5.5\text{V}$	100 100 400		ns
t_{PD1}	Output Delay to "1"	AC Test	$4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$ $2.7\text{V} \leq V_{CC} \leq 5.5\text{V}$ $1.8\text{V} \leq V_{CC} \leq 5.5\text{V}$		250 250 1000	ns
t_{PD0}	Output Delay to "0"	AC Test	$4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$ $2.7\text{V} \leq V_{CC} \leq 5.5\text{V}$ $1.8\text{V} \leq V_{CC} \leq 5.5\text{V}$		250 250 1000	ns
t_{SV}	CS to Status Valid	AC Test	$4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$ $2.7\text{V} \leq V_{CC} \leq 5.5\text{V}$ $1.8\text{V} \leq V_{CC} \leq 5.5\text{V}$		250 250 1000	ns
t_{DF}	CS to DO in High Impedance	AC Test CS= V_{IL}	$4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$ $2.7\text{V} \leq V_{CC} \leq 5.5\text{V}$ $1.8\text{V} \leq V_{CC} \leq 5.5\text{V}$		100 100 400	ns
t_{WC}	Write Cycle Time		$4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$	3	10	ms



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DC characteristics

Applicable over recommended operating range from $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$, $V_{CC} = \text{As Specified}$, $CL = 1$ TTL Gate and 100 pF (unless otherwise noted).

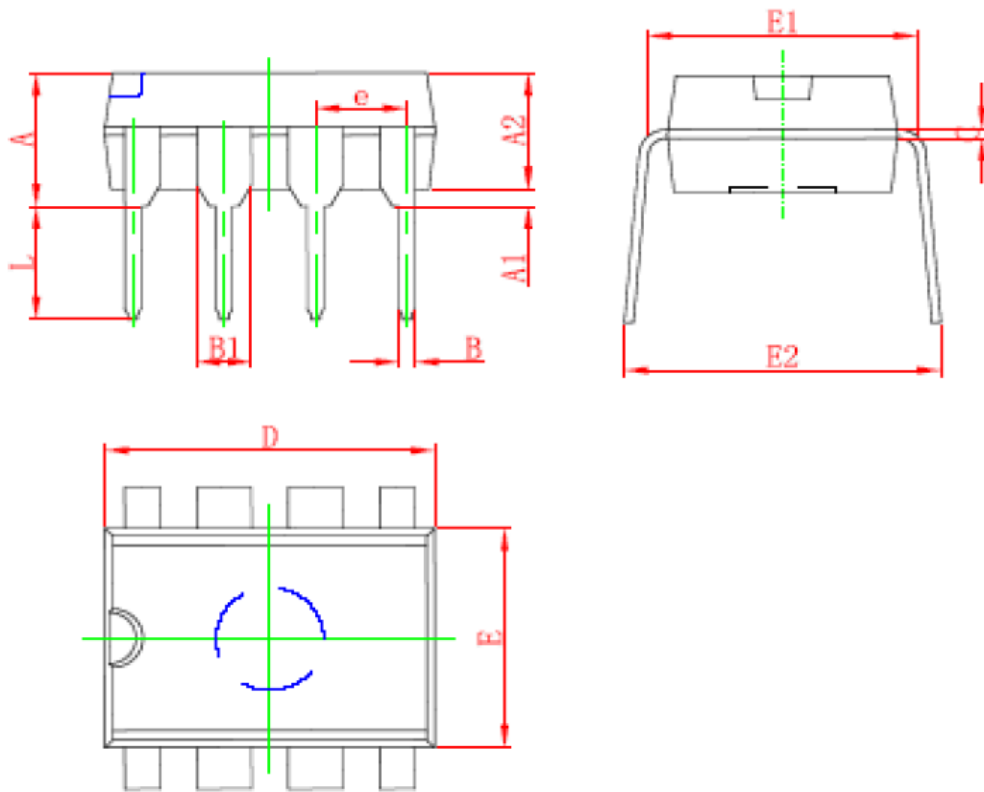
Symbol	Parameter	Test condition		Min	Typ	Max	Units
V_{CC1}	Supply voltage			1.8		5.5	V
V_{CC2}	Supply voltage			2.5		5.5	
V_{CC3}	Supply voltage			2.7		5.5	
V_{CC4}	Supply voltage			4.5		5.5	
I_{CC}	Supply	$V_{CC}=5.0\text{V}$,	READ at 1.0 MHz		0.5	2.0	mA
			WRITE at 1.0 MHz		0.5	1.0	mA
I_{SB1}	Standby current	$V_{CC}=1.8\text{V}$	$CS=0\text{V}$			0.1	μA
I_{SB2}	Standby current	$V_{CC}=2.5\text{V}$	$CS=0\text{V}$			1.5	μA
I_{SB3}	Standby current	$V_{CC}=2.7\text{V}$	$CS=0\text{V}$			1.5	μA
I_{SB4}	Standby current	$V_{CC}=5.0\text{V}$	$CS=0\text{V}$			1.5	μA
I_{LI}	Input leakage	$V_{in} = 0\text{V to } V_{CC}$			0.1	1.0	μA
I_{OL}	Output low voltage	$V_{in} = 0\text{V to } V_{CC}$			0.1	1.0	μA
V_{IL1} V_{IH1}	Input low voltage Input high voltage	$4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$		-0.6 2.0		0.8 $V_{CC}+1$	V
V_{IL2} V_{IH2}	Input low voltage Input high voltage	$1.8\text{V} \leq V_{CC} \leq 2.7\text{V}$		-0.6 $V_{CC} \times 0.7$		$V_{CC} \times 0.3$ $V_{CC}+1$	V
V_{OL1}	Output low voltage		$I_{OL}=2.1\text{mA}$			0.4	V
V_{OH1}	Output high voltage	$4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$	$I_{OH}=-0.4\text{mA}$	2.4			V
V_{OL12}	Output low voltage		$I_{OL}=0.15\text{mA}$			0.2	V
V_{OH2}	Output high voltage	$1.8\text{V} \leq V_{CC} \leq 2.7\text{V}$	$I_{OH}=-100\mu\text{A}$	$V_{CC}-0.2$			V



ACE93C46A/56A/66A Three-wire Serial EEPROM

Packaging information

DIP-8



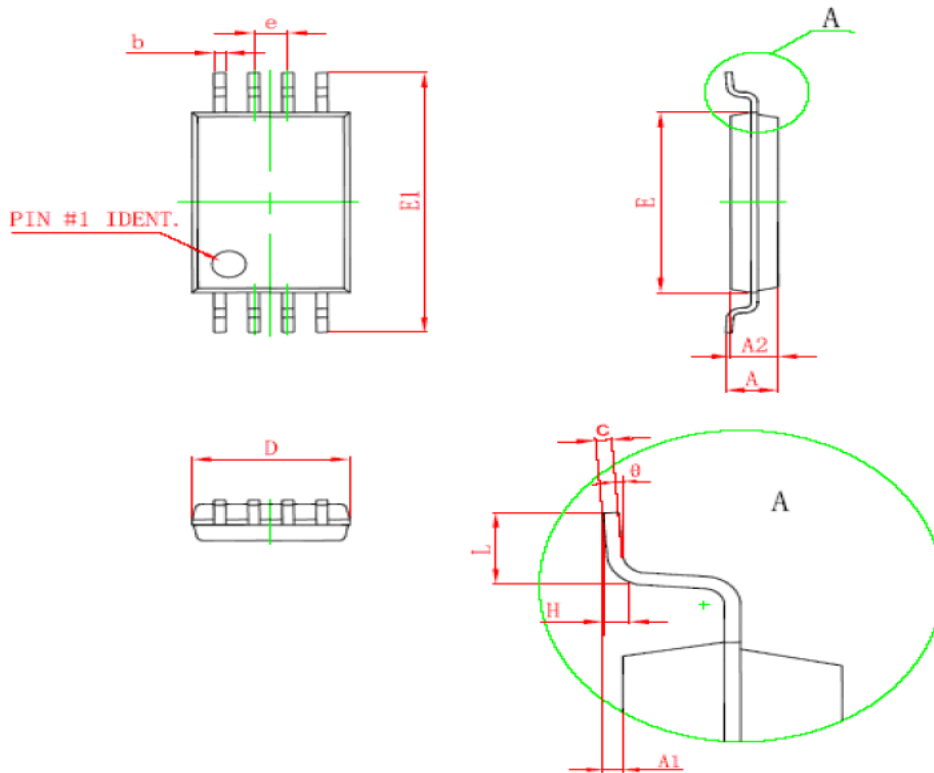
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	3.710	4.310	0.146	0.170
A1	0.510		0.020	
A2	3.200	3.600	0.126	0.142
B	0.380	0.570	0.015	0.022
B1	1.524 (BSC)		0.060 (BSC)	
C	0.204	0.360	0.008	0.014
D	9.000	9.400	0.354	0.370
E	6.200	6.600	0.244	0.260
E1	7.320	7.920	0.288	0.312
e	2.540 (BSC)		0.100 (BSC)	
L	3.000	3.600	0.118	0.142
E2	8.400	9.000	0.331	0.354



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Packaging information

TSSOP-8



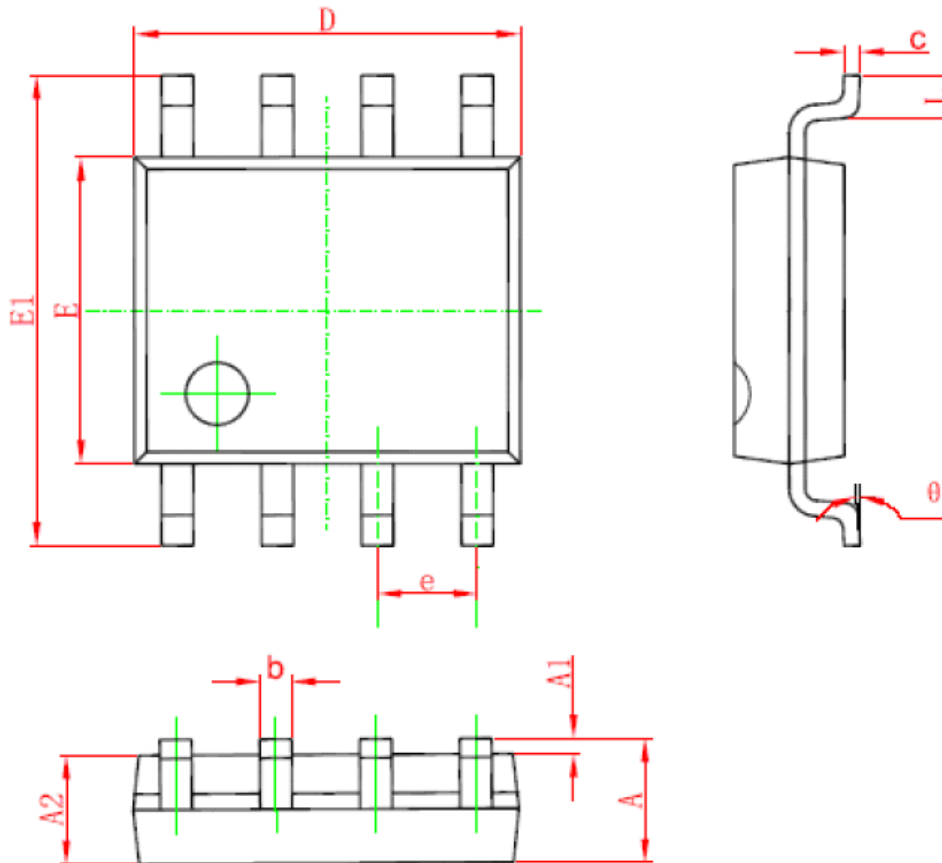
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
D	2.900	3.100	0.114	0.122
E	4.300	4.500	0.169	0.177
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
E1	6.250	6.550	0.246	0.258
A		1.100		0.043
A2	0.800	1.000	0.031	0.039
A1	0.020	0.150	0.001	0.006
e	0.65 (BSC)		0.026 (BSC)	
L	0.500	0.700	0.020	0.028
H	0.25 (TYP)		0.01 (TYP)	
θ	1°	7°	1°	7°



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Packaging information

SOP-8



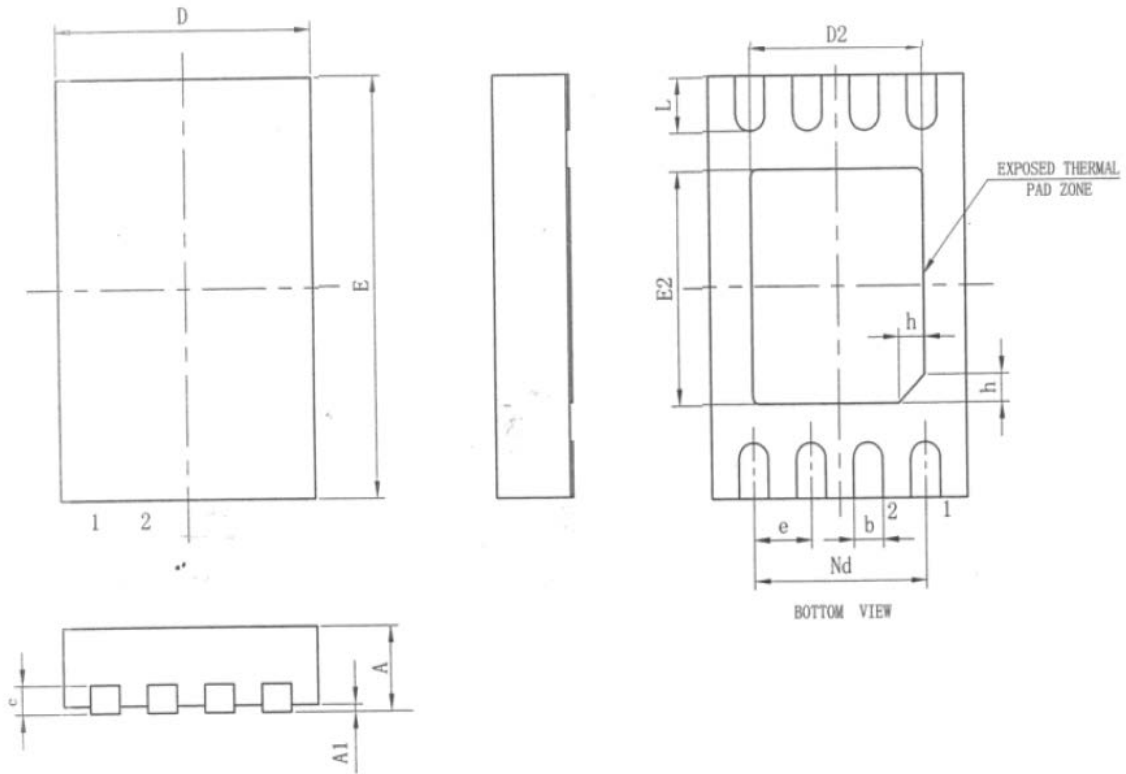
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270 (BSC)		0.050 (BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°



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Packaging information

USON3*2-8



Symbol	Dimensions In Millimeters		
	Min	Nom	Max
A	0.70	0.75	0.80
A1		0.02	0.05
b	0.18	0.25	0.30
c	0.18	0.20	0.25
D	1.90	2.00	2.10
D2		1.50REF	
e		0.50BSC	
Nd		1.50BSC	
E	2.90	3.00	3.10
E2	1.40		1.60
L	0.20		0.40
h	0.20	0.25	0.30



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Notes

ACE does not assume any responsibility for use as critical components in life support devices or systems without the express written approval of the president and general counsel of ACE Electronics Co., LTD. As sued herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.