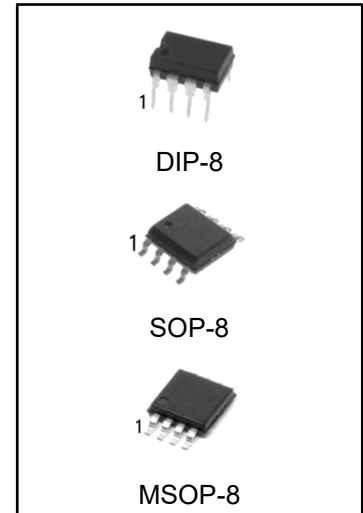


3-wire Serial EEPROMs 1k/2k/4k

FEATURES

- Internally organized as 128×8 or 64×16(1k) 256×8 or 128×16(2K), 512×8 or 256×16(4K)
- Wide-voltage range operation 1.8V-5.5V
- 3-wire serial interface bus
- Data retention:100years
- High endurance 1,000,000 Write Cycles
- 2 MHz(5V)clock rate
- Sequential read operation
- Self-timed write cycle(10ms max)
- 8-pin DIP,8-pin JEDEC SOP,and 8-pin MSOP Packages



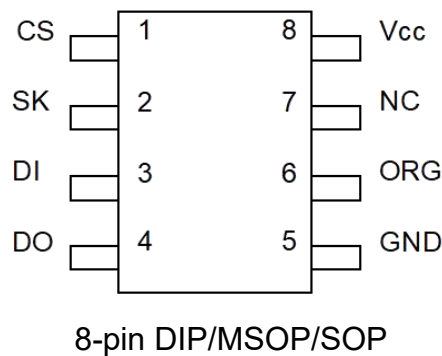
ORDERING INFORMATION:

DEVICE	Package Type	MARKING	Packing	Packing Qty
AT93C46N	DIP-8	93C46	TUBE	2000box/reel
AT93C56N	DIP-8	93C56	TUBE	2000box/reel
AT93C66N	DIP-8	93C66	REEL	2000box/reel
AT93C46M/TR	SOP-8	93C46	REEL	2500pcs/reel
AT93C56M/TR	SOP-8	93C56	REEL	2500pcs/reel
AT93C66M/TR	SOP-8	93C66	REEL	2500pcs/reel
AT93C46MM/TR	MSOP-8	93C46	REEL	3000pcs/reel
AT93C56MM/TR	MSOP-8	93C56	REEL	3000pcs/reel
AT93C66MM/TR	MSOP-8	93C66	REEL	3000pcs/reel

DESCRIPTION

The AT93Cxx family provides 1k,2k and 4k of serial electrically erasable and programmable read-only memory(EEPROM).The wide Vdd range allows for low-voltage operation down to 1.8V and up to 5.5V The device,fabricated using traditional CMOS EEPROM technology,is optimized for many industrial and commercial applications where low-voltage and low-power operation is essential.The AT93C46/56/66 is available in 8-pin DIP,8-pin JEDEC SOP,and 8-pin MSOP packages and is accessed via a 3-wire serial interface.

Figure 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
NC	No Connect

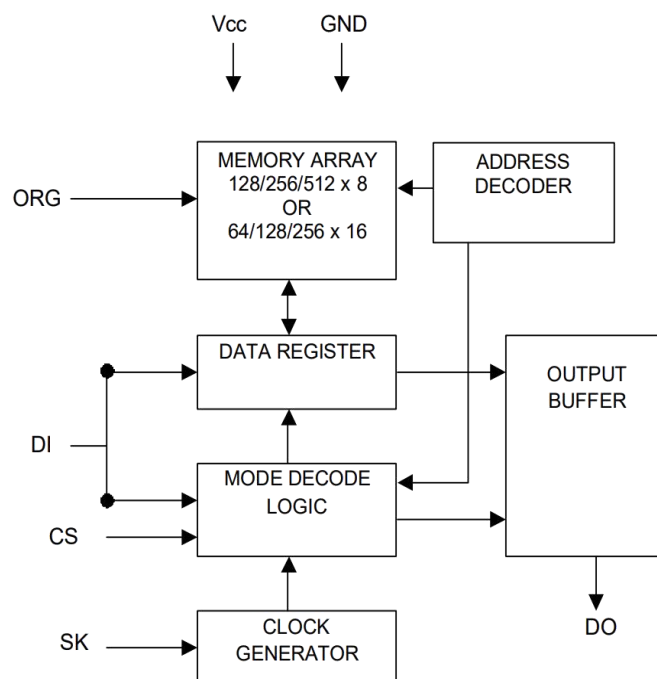
ABSOLUTE MAXIMUM RATINGS

Condition	Min	Max
Operating Temperature	-40°C	+85°C
Storage Temperature	-65°C	+150°C
Voltage on Any Pin with		
Respect to Ground	-1.0V	VCC+ 7.0V
Maximum Operating Voltage	-	6.25V
DC Output Current	-	5.0 mA
Lead Temperature (Soldering, 10 seconds)	-	245

Note: Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied.

Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Figure 2. Block Diagram



Notes

The ORG pin is used to select between x8 and x16 mode.

When the pin is connected to Vcc, x16 mode is selected. Otherwise, the ORG pin should be grounded in order to select x8 mode.

The interface for the AT93C46 / 56 / 66 is accessed through four different signals: Chip Select (CS), Data Input (DI), Data Output (DO), and Serial Data Clock (SK). The Chip Select (CS) signal must be pulled high before issuing a command through the Data Input (DI) pin. The Serial Data Clock (SK) signal is used in conjunction with the Data Input (DI) pin.

PIN CAPACITANCE

Applicable over recommended operating range from $T_A = 25^{\circ}\text{C}$, $f = 1.0\text{ MHz}$, $V_{CC} = +5.0\text{V}$

Symbol	Test Condition	Max	Units	Condition
C_{OUT}	Output Capacitance (DO)	5	pF	$V_{OUT} = 0\text{V}$
C_{IN}	Input Capacitance (CK, SK, DI)	5	pF	$V_{IN} = 0\text{V}$

DC CHARACTERISTICS

Applicable over recommended operating range from:

$T_{AMB} = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, $V_{CC} = +1.8\text{V}$ to $+5.5\text{V}$ (unless otherwise noted)

Symbol	Parameter	Test Condition	Min	Typ	Max	Units
V_{CC1}	Supply Voltage		1.8		5.5	V
V_{CC2}	Supply Voltage		2.7		5.5	V
V_{CC3}	Supply Voltage		4.5		5.5	V
I_{CC}	Supply Current $V_{CC}=5.0\text{V}$	READ at 1 MHz		0.5	2.0	mA
I_{CC}	Supply Current $V_{CC}=5.0\text{V}$	WRITE at 1 MHz		0.5	2.0	mA
I_{SB1}	Standby Current $V_{CC}=1.8\text{V}$	CS=0V		0	0.1	μA
I_{SB2}	Standby Current $V_{CC}=2.7\text{V}$	CS=0V		6.0	10.0	μA
I_{SB3}	Standby Current $V_{CC}=5.0\text{V}$	CS=0V		17	3.0	μA
I_{LI}	Input Leakage Current	$V_{IN}=0\text{V}$ to V_{CC}		0.1	3.0	μA
I_{LO}	Output Leakage Current	$V_{IN}=0\text{V}$ to V_{CC}		0.1	3.0	μA
$V_{IL1}^{(1)}$ $V_{IH1}^{(1)}$	Input Low Level Input High Level	$2.7\text{V} < V_{CC} < 5.5\text{V}$	-0.6 2.0		0.8 $V_{CC}+1$	V
$V_{IL2}^{(1)}$ $V_{IH2}^{(1)}$	Input Low Level Input High Level	$1.8\text{V} < V_{CC} < 2.7\text{V}$	-0.6 $V_{CC} \times 0.7$		$V_{CC} \times 0.3$ $V_{CC}+1$	V
V_{OL1} V_{OH1}	Output Low Level Output High Level	$2.7\text{V} < V_{CC} < 5.5\text{V}$; $I_{OL}=2.1\text{mA}$ $I_{OH}=-0.4\text{mA}$	2.4		0.4	V
V_{OL2} V_{OH2}	Output Low Level Output High LevelR	$1.8\text{V} < V_{CC} < 0.7\text{V}$; $I_{OL}=0.15\text{mA}$ $I_{OH}=-100\mu\text{A}$	$V_{CC}-0.2$		0.2	V

Note: 1. V_{IL} and V_{IH} max are reference only and are not tested

AC CHARACTERISTICS

Applicable over recommended operating range from:

TAMB=-40°C to+85°C, Vcc= As specified, CL=1 TTL Gate&100pF (unless otherwise noted).

Symbol	Parameter	Test Condition		Min	Typ	Max	Units
f _{SK}	Clock Frequency, SK	4.5V < V _{CC} < 5.5V		0		2	MHz
		2.7V < V _{CC} < 5.5V		0		1	
		1.8V < V _{CC} < 5.5V		0		0.25	
t _{SKH}	SK High Time	4.5V < V _{CC} < 5.5V		250			ns
		2.7V < V _{CC} < 5.5V		250			
		1.8V < V _{CC} < 5.5V		1000			
t _{SKL}	SK Low Time	4.5V < V _{CC} < 5.5V		250			ns
		2.7V < V _{CC} < 5.5V		250			
		1.8V < V _{CC} < 5.5V		1000			
t _{CS}	Minimum CS Low Time	4.5V < V _{CC} < 5.5V		250			ns
		2.7V < V _{CC} < 5.5V		250			
		1.8V < V _{CC} < 5.5V		1000			
t _{css}	CS Setup Time	Relative to SK	4.5V < V _{CC} < 5.5V	50			ns
			2.7V < V _{CC} < 5.5V	50			
			1.8V < V _{CC} < 5.5V	200			
t _{DIS}	DI Setup Time	Relative to SK	4.5V < V _{CC} < 5.5V	100			ns
			2.7V < V _{CC} < 5.5V	100			
			1.8V < V _{CC} < 5.5V	400			
t _{CSH}	CS Hold Time	Relative to SK		0			ns
t _{DIH}	DI Hold Time	Relative to SK	4.5V < V _{CC} < 5.5V	100			ns
			2.7V < V _{CC} < 5.5V	100			
			1.8V < V _{CC} < 5.5V	400			
t _{PD1}	Output Delay to "1"	AC Test	4.5V < V _{CC} < 5.5V			250	ns
			2.7V < V _{CC} < 5.5V			250	
			1.8V < V _{CC} < 5.5V			1000	
t _{PD0}	Output Delay to "0"	AC Test	4.5V < V _{CC} < 5.5V			250	ns
			2.7V < V _{CC} < 5.5V			250	
			1.8V < V _{CC} < 5.5V			1000	
t _{SV}	CS to Status Valid	AC Test	4.5V < V _{CC} < 5.5V			250	ns
			2.7V < V _{CC} < 5.5V			250	
			1.8V < V _{CC} < 5.5V			1000	
t _{DF}	CS to DO in High Impedance	AC Test CS = V _{IL}	4.5V < V _{CC} < 5.5V			100	ns
			2.7V < V _{CC} < 5.5V			100	
			1.8V < V _{CC} < 5.5V			400	
t _{WP}	Write Cycle Time		4.5V < V _{CC} < 5.5V		3	10	ms
Endurance	5.0V, 25°C			1M			Write Cycles

INSTRUCTION SET FOR THE AT93C46

Instruction	SB	Op Code	Address		Data		Comments
			X8	X16	X8	X16	
READ	1	10	A ₆ – A ₀	A ₅ – A ₀			Reads data stored at specified memory location.
EWEN	1	00	11xxxxx	11xxxx			Write enable command (must be issued before any erase or write operation).
ERASE	1	11	A ₆ – A ₀	A ₅ – A ₀			Erases memory location A _n – A ₀

WRITE	1	01	A ₆ – A ₀	A ₅ – A ₀	D ₇ – D ₀	D ₁₅ – D ₀	Writes to memory location A _n – A ₀
ERAL	1	00	10xxxxx	10xxxx			Erases all memory locations. Valid only at V _{cc} = 4.5V to 5.5V
WRAL 1		00	01xxxxx	01xxxx	D ₇ – D ₀	D ₁₅ – D ₀	Writes all memory locations. Valid only at V _{cc} = 4.5V to 5.5V
EWDS	1	00	00xxxxx	00xxxx			Disables all erase or write instructions

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

INSTRUCTION SET FOR THE AT93C46/56/66

Instruction	SB	Op Code	Address		Data		Comments
			X8	X16	X8	X16	
READ	1	10	A ₈ – A ₀	A ₇ – A ₀			Reads data stored at specified memory location.
EWEN	1	00	11xxxxxxx	11xxxxxxx			Write enable command (must be issued before any erase or write operation).
ERASE	1	11	A ₈ – A ₀	A ₇ – A ₀			Erase memory location A _n – A ₀
WRITE	1	01	A ₈ – A ₀	A ₇ – A ₀	D ₇ – D ₀	D ₁₅ – D ₀	Writes memory location A _n – A ₀
ERAL	1	00	10xxxxxxx	10xxxxxxx			Erases all memory locations. Valid only at V _{cc} = 4.5V to 5.5V
WRAL 1		00	01xxxxxxx	01xxxxxxx	D ₇ – D ₀	D ₁₅ – D ₀	Writes all memory locations. Valid only at V _{cc} = 4.5V to 5.5V.
EWDS	1	00	00xxxxxxx	00xxxxxxx			Disables all erase or write instructions

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

FUNCTIONAL DESCRIPTION

The AT93C46/56/66 supports 7 different instructions, which must be clocked serially using the CS, SK and DI pins. Before sending each of these instructions, the CS pin must first be pulled high followed by a START bit (logic '1'). The next sequence includes a 2-bit Op Code and usually an 8 or 16-bit address. The next description describes the various functions in the chip.

READ (READ): The Read (READ) instruction includes the Op Code ("10") followed by the memory address location to be read. After the instruction and address is sent, the data from the memory location can be clocked out using the serial output pin DO. The data changes on the rising edge of the clock, so the falling edge can be used to strobe the output.

Note that during shifting the last address bit, the DO pin is a dummy bit (logic "0").

ERASE/WRITE (EWEN): When the chip is first powered-on, no erase or write instructions can be issued. Only when the Erase/Write Enable (EWEN) instruction is sent will the

system be allowed to write to the chip. The EWEN command only needs to be issued once after being powered-on. To disable the chip again, the Erase/Write Disable (EWDS) command can be used.

ERASE (ERASE): The Erase (ERASE) instruction clears the designated memory location to a logical '1' state. After the Op Code and address location is inputted, the chip will enter into an erase cycle. When the cycle completes, the chip will automatically enter into standby mode.

WRITE (WRITE): The Write (WRITE) instruction is used to write to a specific memory location. If word mode (x16) is selected, then 16 bits of data will be written into the location. If byte mode (x8) is chosen, then 8 bits of data will be written into the location. The write cycle will begin automatically after the 8 or 16 bits are shifted into the chip.

ERASE ALL (ERAL): The Erase All (ERAL) instruction is primarily used for testing purposes and only functions when $V_{cc}=4.5\text{ V}$ to 5.5 V . This instruction will clear the entire memory array to '1'.

WRITE ALL (WRAL): The Write All (WRAL) instruction will program the entire memory array according to the 8 or 16-bit data pattern provided. The instruction will only be valid when $V_{cc}=4.5\text{ V}$ to 5.5 V .

ERASE/WRITE DISABLE (EWDS): The Erase/Write Disable (EWDS) instruction blocks any kind of erase or program operations from modifying the contents of the memory array. This instruction should be executed after erasing or programming to prevent accidental data loss.

Note also that the READ instruction will operate regardless of whether the chip is disabled from program and write operations.

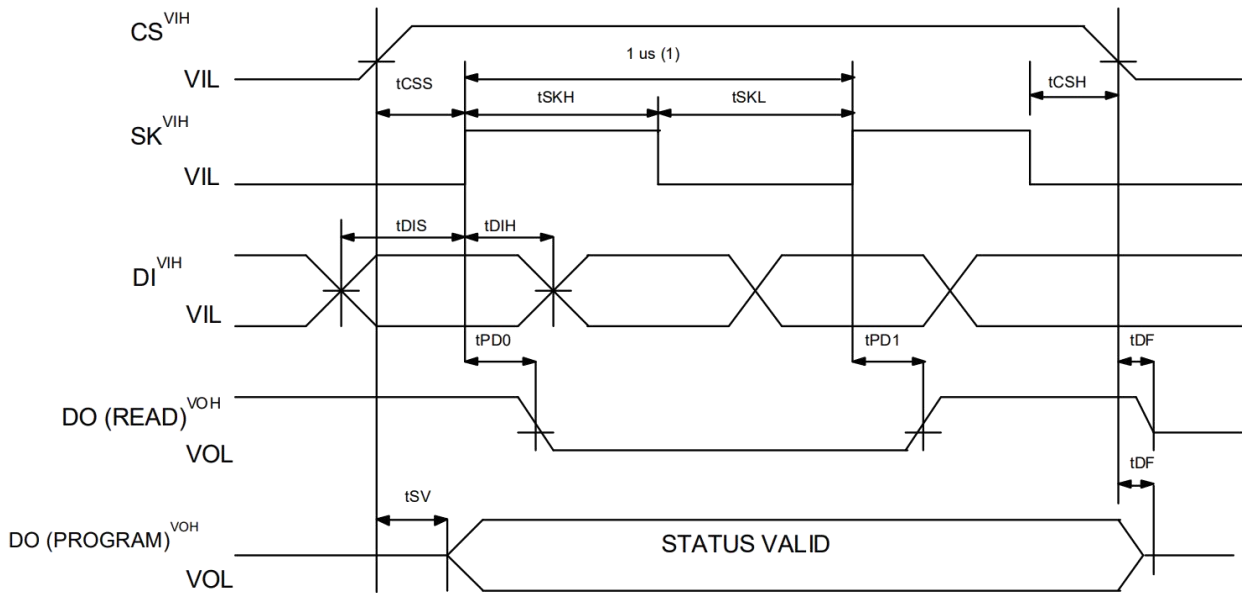
READY/BUSY

To determine whether the chip has completed an erase or write operation, the CS signal can be pulled LOW for a minimum of 250 ns (t_{cs}) and then pulled back HIGH to enter Ready/Busy mode.

If the chip is currently in the programming cycle, t_{WP} , then the DO pin will go low (logical "0"). When the write cycle completes, the DO pin is pulled high (logical "1") to indicate that the part can receive another instruction. Note that the Ready/Busy polling cannot be done if the chip has already finished and returned back to standby mode.

TIMING DIAGRAMS

SYNCHRONOUS DATA TIMING



Note (1): This is the minimum SK period.

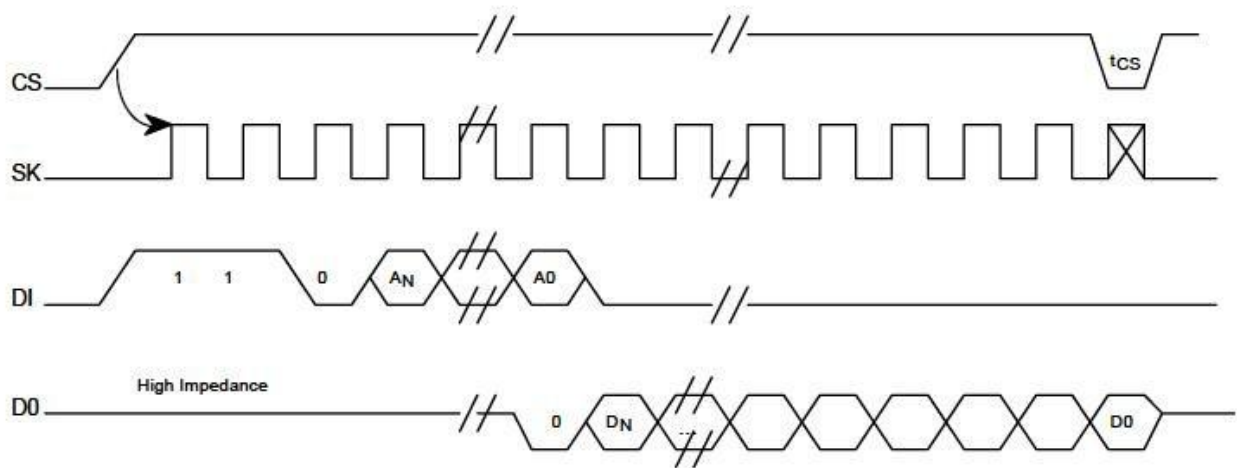
Organization Key for Timing Diagrams

I/O	93 C46(1K)		93 C56(2K)		93 C66(4K)	
	X8	X16	X8	X16	X8	X16
A _N	A ₈	A ₅	A ₈ ⁽¹⁾	A ₇ ⁽²⁾	A ₈	A ₇
D _N	D ₇	D ₁₅	D ₇	D ₁₅	D ₇	D ₁₅

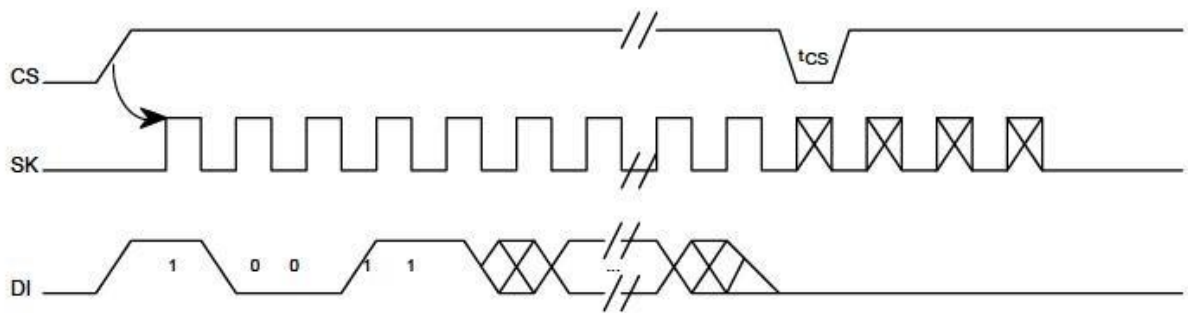
Notes:

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.

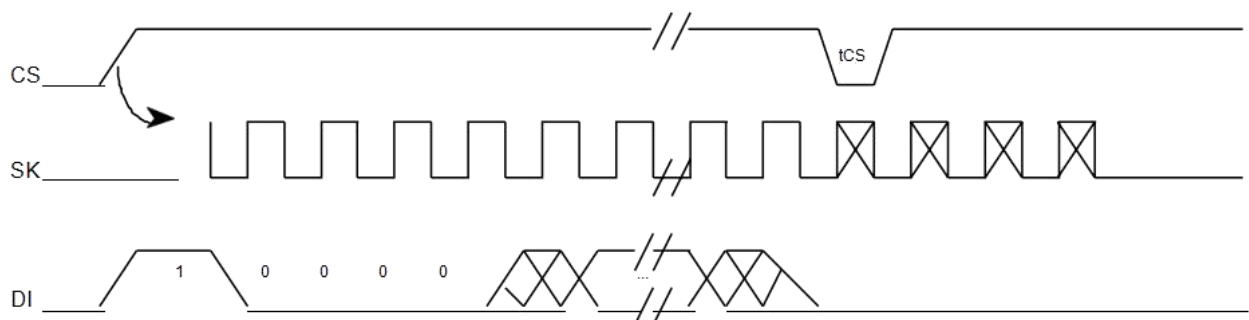
READ TIMING



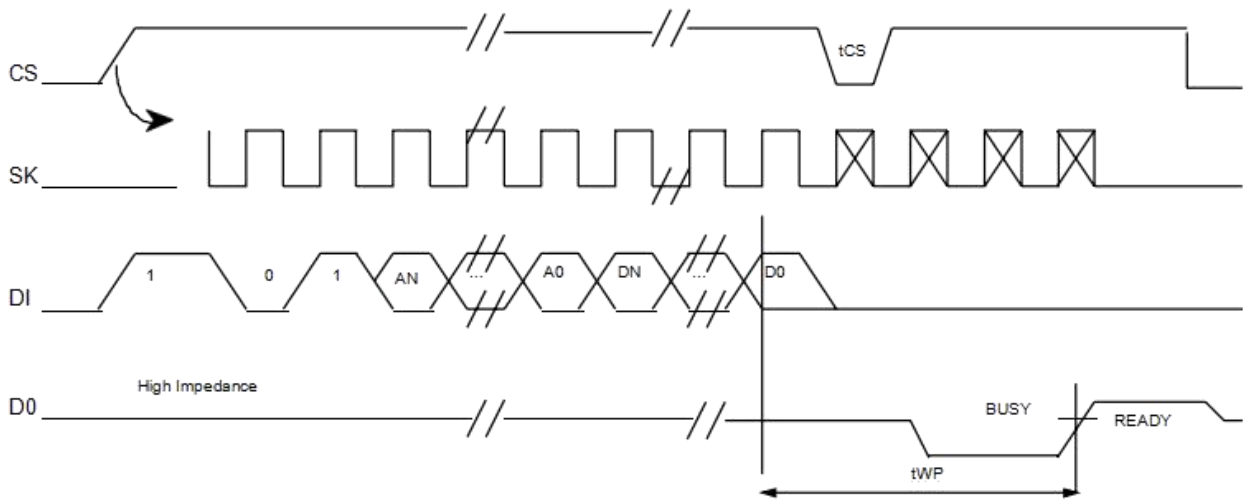
EWEN TIMING



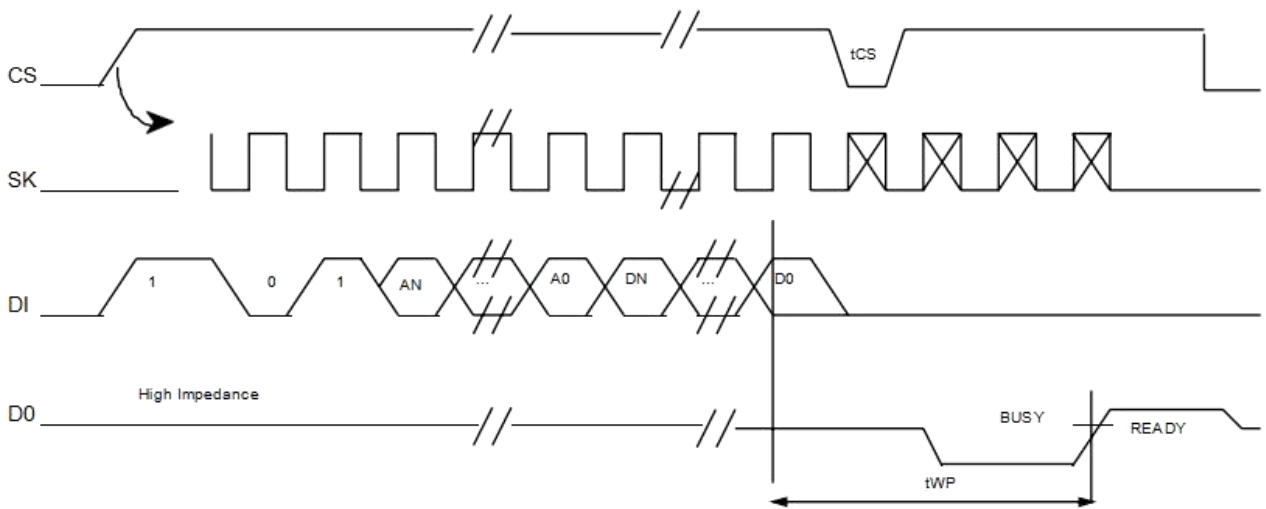
EWDS TIMING



WRITE TIMING

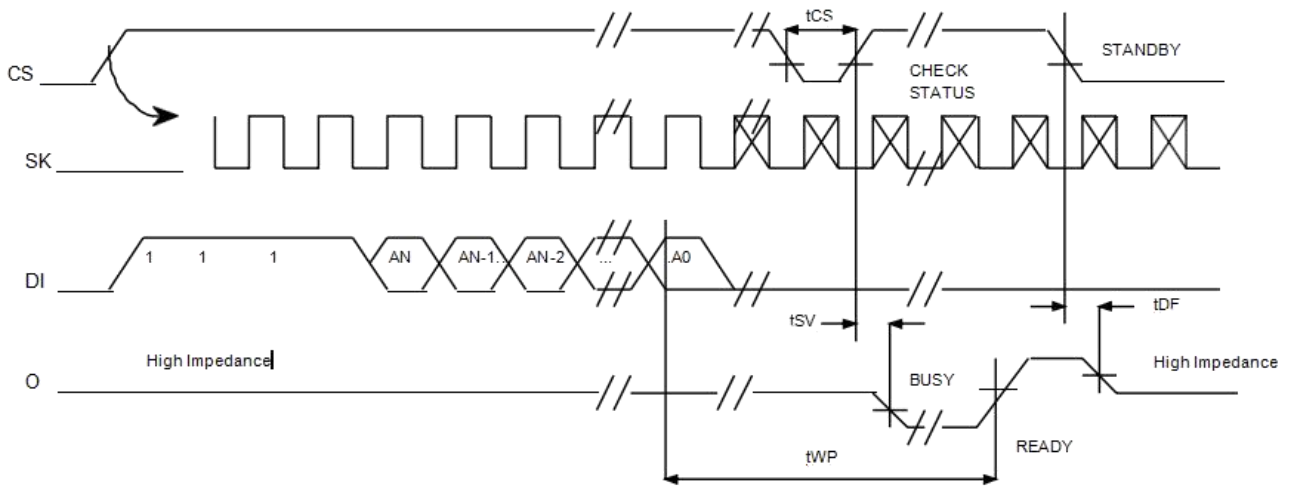


WRITE TIMING

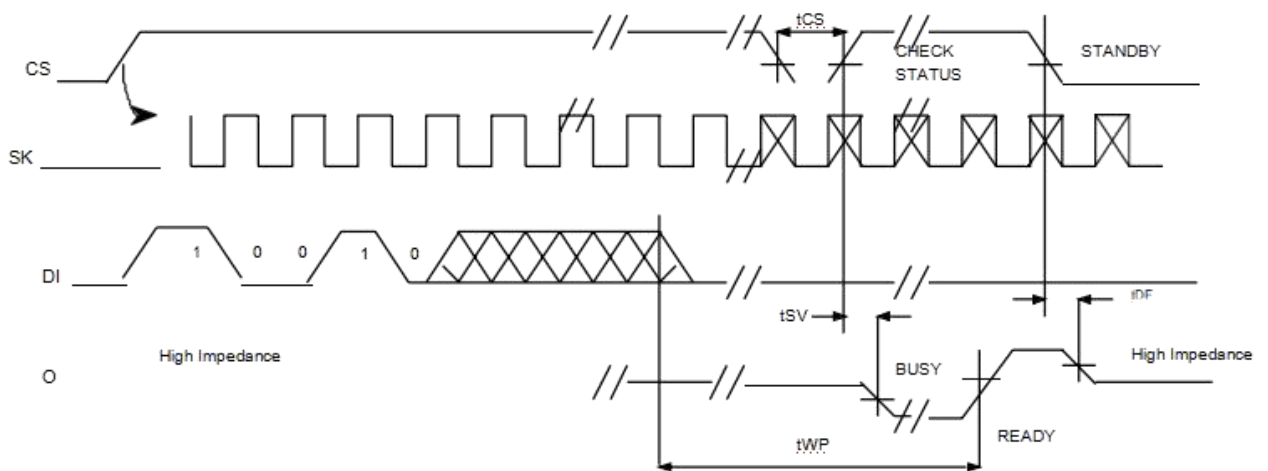


(1) Valid only at $V_{CC} = 4.5V$ to $5.5V$

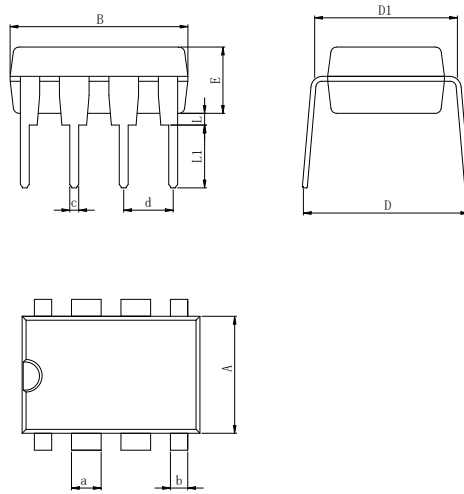
ERASE TIMING



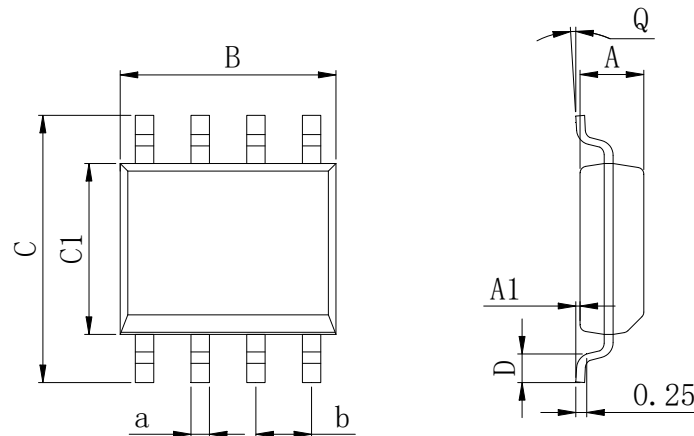
ERASE TIMING(1)



(1) Valid only at Vcc = 4.5V to 5.5V

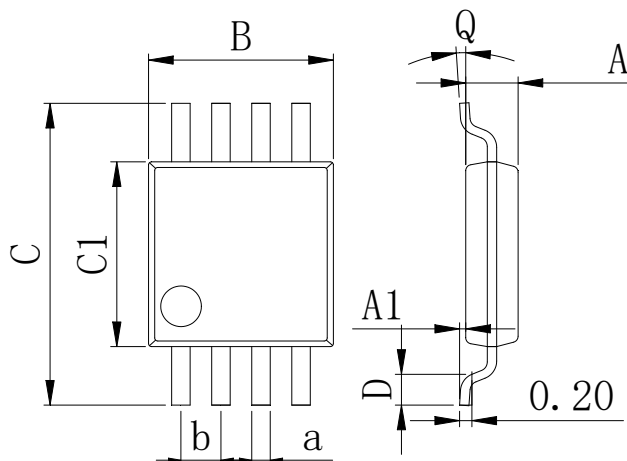
PHYSICAL DIMENSIONS
DIP-8


Dimensions In Millimeters(DIP-8)											
Symbol:	A	B	D	D1	E	L	L1	a	b	c	d
Min:	6.10	9.00	8.10	7.42	3.10	0.50	3.00	1.50	0.85	0.40	2.54 BSC
Max:	6.68	9.50	10.9	7.82	3.55	0.70	3.60	1.55	0.90	0.50	

SOP-8


Dimensions In Millimeters(SOP-8)										
Symbol:	A	A1	B	C	C1	D	Q	a	b	
Min:	1.35	0.05	4.90	5.80	3.80	0.40	0°	0.35	1.27 BSC	
Max:	1.55	0.20	5.10	6.20	4.00	0.80	8°	0.45		

MSOP-8



Dimensions In Millimeters(MSOP-8)									
Symbol:	A	A1	B	C	C1	D	Q	a	b
Min:	0.80	0.05	2.90	4.75	2.90	0.35	0°	0.25	0.65 BSC
Max:	0.90	0.20	3.10	5.05	3.10	0.75	8°	0.35	

REVISION HISTORY

DATE	REVISION	PAGE
2020-3-7	New	1-15
2023-8-31	Update encapsulation type、 Update Lead Temperature、 Updated DIP-8 dimension	1、 3、 12

IMPORTANT STATEMENT:

Huaguan Semiconductor reserves the right to change its products and services without notice. Before ordering, the customer shall obtain the latest relevant information and verify whether the information is up to date and complete. Huaguan Semiconductor does not assume any responsibility or obligation for the altered documents.

Customers are responsible for complying with safety standards and taking safety measures when using Huaguan Semiconductor products for system design and machine manufacturing. You will bear all the following responsibilities: Select the appropriate Huaguan Semiconductor products for your application; Design, validate and test your application; Ensure that your application meets the appropriate standards and any other safety, security or other requirements. To avoid the occurrence of potential risks that may lead to personal injury or property loss.

Huaguan Semiconductor products have not been approved for applications in life support, military, aerospace and other fields, and Huaguan Semiconductor will not bear the consequences caused by the application of products in these fields. All problems, responsibilities and losses arising from the user's use beyond the applicable area of the product shall be borne by the user and have nothing to do with Huaguan Semiconductor, and the user shall not claim any compensation liability against Huaguan Semiconductor by the terms of this Agreement.

The technical and reliability data (including data sheets), design resources (including reference designs), application or other design suggestions, network tools, safety information and other resources provided for the performance of semiconductor products produced by Huaguan Semiconductor are not guaranteed to be free from defects and no warranty, express or implied, is made. The use of testing and other quality control technologies is limited to the quality assurance scope of Huaguan Semiconductor. Not all parameters of each device need to be tested.

The documentation of Huaguan Semiconductor authorizes you to use these resources only for developing the application of the product described in this document. You have no right to use any other Huaguan Semiconductor intellectual property rights or any third party intellectual property rights. It is strictly forbidden to make other copies or displays of these resources. You should fully compensate Huaguan Semiconductor and its agents for any claims, damages, costs, losses and debts caused by the use of these resources. Huaguan Semiconductor accepts no liability for any loss or damage caused by infringement.