DESCRIPTION

A24C32 provides 32768 bits of serial electrically erasable and programmable read-only memory (EEPROM) organized as 4096 words of 8 bits each.

The A24C32 is optimized for use in many industrial and commercial applications where low-power and low-voltage operations are essential.

The A24C32 is accessed via a two-wire serial interface.

The A24C32 is available in SOP8, TSSOP8 and DFN8 packages.

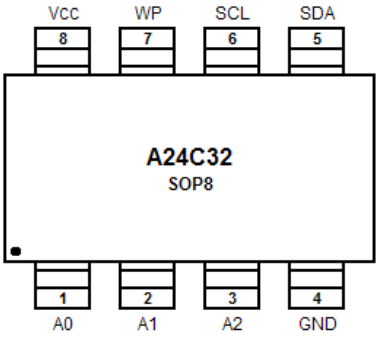
FEATURES

- Two-Wire Serial Interface
- V_{CC} = 1.8V To 5.5V
- Bi-Directional Data Transfer Protocol
- Internal Organized 4096x8(32K bits)
- 400KHz (1.8V, 2.7V, 5V) Compatibility
- 32-byte Page(32K) Write Mode
- Partial Page Writes Allowed
- Self-Timed Write Cycle (5ms Max)
- High-Reliability
- 1 Million Write Cycles guaranteed
- Data Retention > 100 Years
- Operating Temperature: -40°C to +85°C
- Available in SOP8, TSSOP8 and DFN8 Package

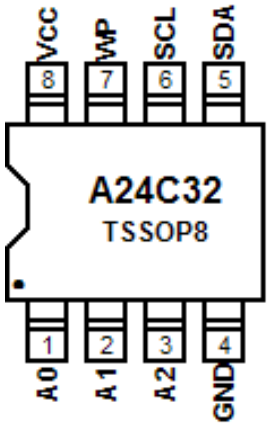
ORDERING INFORMATION

Package Type	Part Number	
SOP8	M8	A24C32M8R
		A24C32M8VR
		A24C32M8U
		A24C32M8VU
TSSOP8	TMX8	A24C32TMX8R
		A24C32TMX8VR
		A24C32TMX8U
		A24C32TMX8VU
DFN8	J8	A24C32J8R
		A24C32J8VR
Note	R: Tape & Reel U: Tube V: Halogen free Package	
AiT provides all RoHS products suffix " V " means Halogen free Package		

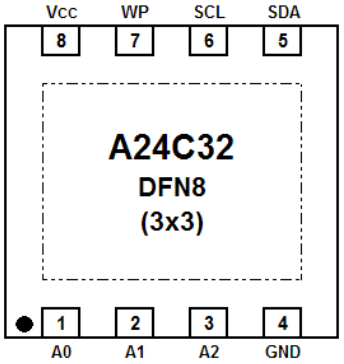
PIN DESCIPTION



Top View



Top View



Top View

Pin #			Symbol	Type	Functions
SOP8	TSSOP8	DFN8			
1	1	1	A0	I	Address Input
2	2	2	A1	I	Address Input
3	3	3	A2	I	Address Input
4	4	4	GND	P	Ground
5	5	5	SDA	I/O & Open-drain	Serial Data
6	6	6	SCL	I	Serial Clock Input
7	7	7	WP	I	Write Protect NOTE1
8	8	8	V_{CC}	P	Power Supply

NOTE1 Write Protect

WP Pin Status	Part of the Array Protected
At V_{CC}	Full (32K) Array
At GND	Normal Read/Write Operations

ABSOLUTE MAXIMUM RATINGS

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

Stresses above may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the Electrical Characteristics is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

Applicable over recommended operating range from: T_A = -40°C to +85°C, V_{CC} = +1.8V to +5.5V, unless otherwise noted

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
DC ELECTRICAL CHARACTERISTICS						
Supply Voltage	V_{CC}		1.8	-	5.5	V
Supply Current V_{CC} = 5.0V	I_{CC1}	Read at 100KHz	-	0.4	1.0	mA
Supply Current V_{CC} = 5.0V	I_{CC2}	Write at 100KHz	-	2.0	3.0	mA
Standby Current	I_{SB}	V_{IN} = V_{CC} or GND	-	-	1.0	µA
Input Leakage Current	I_{LI}	V_{IN} = V_{CC} or GND	-	-	3.0	µA
Output Leakage Current	I_{LO}	V_{OUT} = V_{CC} or GND	-	0.05	3.0	µA
Input Low Level	V_{IL}		-0.6	-	V_{CC} x 0.3	V
Input High Level	V_{IH}		V_{CC} x0.7	-	V_{CC}+0.5	V
Output Low Level V_{CC} = 5.0V	V_{OL3}	I_{OL} = 3.0mA	-	-	0.4	V
Output Low Level V_{CC} = 3.0V	V_{OL2}	I_{OL} = 2.1mA	-	-	0.4	V
Output Low Level V_{CC} = 1.8V	V_{OL1}	I_{OL} = 0.15mA	-	-	0.2	V

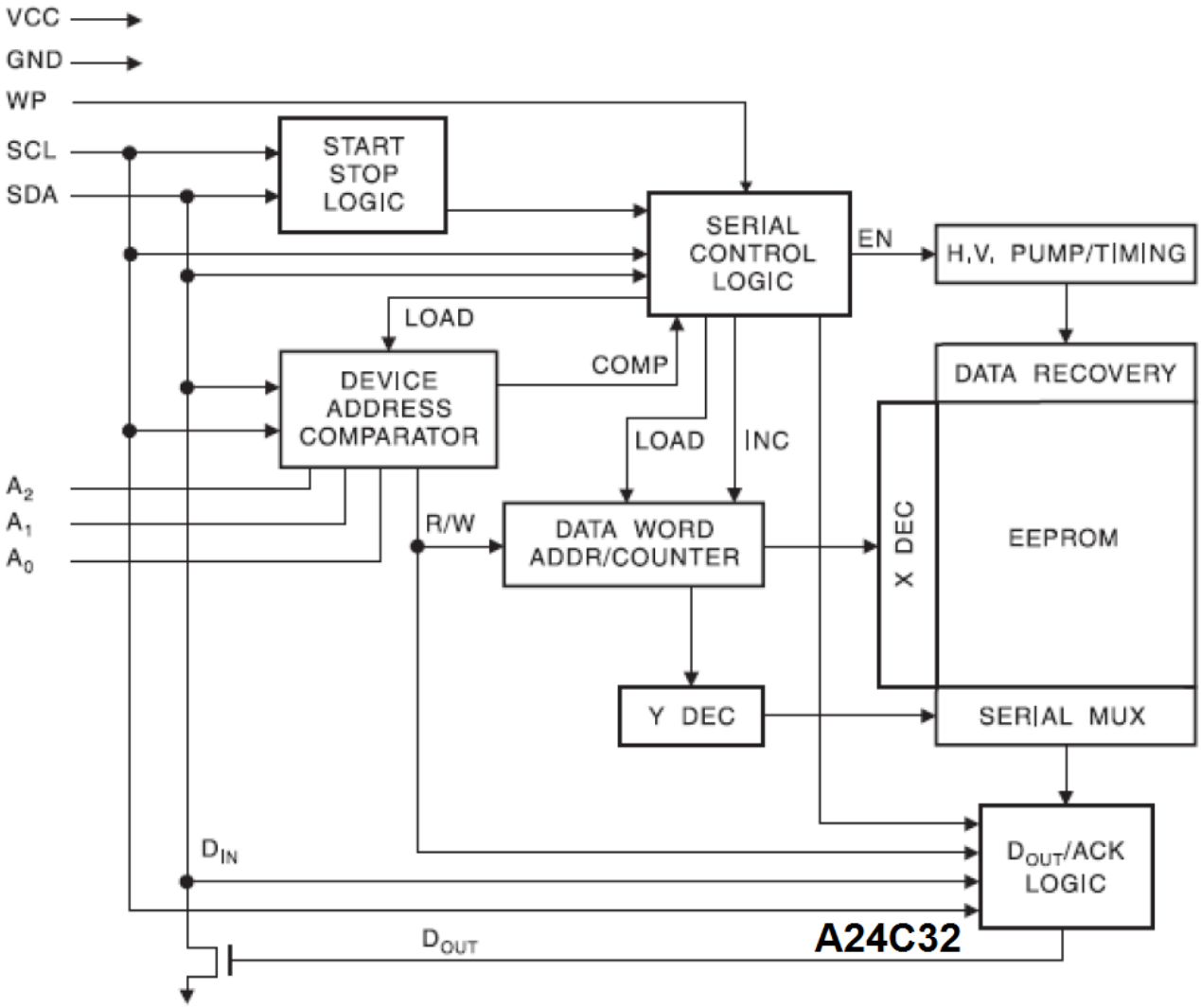
Applicable over recommended operating range from: T_A = 25°C, f = 1.0MHz, V_{CC} = +1.8V

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
PIN CAPACITANCE						
Input / Output Capacitance (SDA)	$C_{I/O}$	$V_{I/O}$ = 0V	-	-	8	pF
Input Capacitance (A0, A1, A2, SCL)	C_{IN}	V_{IN} = 0V	-	-	6	pF

Applicable over recommended operating range from: T_A = -40°C to +85°C, V_{CC} = +1.8V to +5.5V, C_L = 1 TTL Gate and 100pF, unless otherwise noted

Parameter	Symbol	Condition	1.8, 2.7, 5.0		Unit
			Min.	Max.	
AC ELECTRICAL CHARACTERISTICS					
Clock Frequency, SCL	f_{SCL}		-	400	KHz
Clock Pulse Width Low	t_{LOW}		1.2	-	µs
Clock Pulse Width High	t_{HIGH}		0.6	-	µs
Noise Suppression Time	t_I		-	50	ns
Clock Low to Data Out Valid	t_{AA}		0.1	0.9	µs
Time the bus must be free before a new transmission can start	t_{BUF}		1.2	-	µs
Start Hold Time	$t_{HD.STA}$		0.6	-	µs
Start Setup Time	$t_{SU.STA}$		0.6	-	µs
Data In Hold Time	$t_{HD.DAT}$		0	-	µs
Data In Setup Time	$t_{SU.DAT}$		100	-	ns
Inputs Rise Time	t_R		-	0.3	µs
Inputs Fall Time	t_F		-	300	ns
Stop Setup Time	$t_{SU.STO}$		0.6	-	µs
Data Out Hold Time	t_{DH}		50	-	ns
Write Cycle Time	t_{WR}		-	5	ms
5.0V, 25°C, Byte Mode	Endurance		1M	-	Write Cycles

BLOCK DIAGRAM



DETAILED INFORMATION

Memory Organization

A24C32 SERIAL EEPROM: The 32K is internally organized as 128 pages of 32 bytes each. Random word addressing requires a 12-bit data word address.

Device Operation

Clock and Data Transitions: The SDA pin is normally pulled high with an external device. Data on the SDA pin may change only during SCL low time periods (see Figure 1 on page10). Data changes during SCL high periods will indicate a start or stop condition as defined below.

START CONDITION

A high-to-low transition of SDA with SCL high is a start condition which must precede any other command (see Figure 2 on page10).

STOP CONDITION

A low-to-high transition of SDA with SCL high is a stop condition. After a read sequence, the stop command will place the EEPROM in a standby power mode (see Figure 2 on page10).

ACKNOWLEDGE

All addresses and data words are serially transmitted to and from the EEPROM in 8-bit words. The EEPROM sends a “0” to acknowledge that it has received each word. This happens during the ninth clock cycle.

STANDBY MODE

The A24C32 features a low-power standby mode which is enabled: (a) upon power-up and (b) after the receipt of the STOP bit and the completion of any internal operations.

MEMORY RESET

After an interruption in protocol, power loss or system reset, any two-wire part can be reset by following these steps:

1. Clock up to 9 cycles.
2. Look for SDA high in each cycle while SCL is high.
3. Create a start condition.

Device Addressing

The 32K EEPROM devices all require an 8-bit device address word following a start condition to enable the chip for a read or write operation (see Figure 4 on page10).

The device address word consists of a mandatory “1”, “0” sequence for the first four most significant bits as shown. This is common to all the Serial EEPROM devices.

The 32K uses the three device address bits A2, A1, A0 to allow as many as eight devices on the same bus. These bits must compare to their corresponding hardwired input pins. The A2, A1, and A0 pins use an internal proprietary circuit that biases them to a logic low condition if the pins are allowed to float.

The eighth bit of the device address is the read/write operation select bit. A read operation is initiated if this bit is high and a write operation is initiated if this bit is low.

Upon a compare of the device address, the EEPROM will output a “0”. If a compare is not made, the chip will return to a standby state.

NOISE PROTECTION

Special internal circuitry placed on the SDA and SCL pins prevent small noise spikes from activating the device.

DATA SECURITY

The A24C32 has a hardware data protection scheme that allows the user to write protect the entire memory when the WP pin is at V_{CC}.

Write Operations

BYTE WRITE

A write operation requires an 8-bit data word address following the device address word and acknowledgment. Upon receipt of this address, the EEPROM will again respond with a “0” and then clock in the first 8-bit data word. Following receipt of the 8-bit data word, the EEPROM will output a “0” and the addressing device, such as a microcontroller, must terminate the write sequence with a stop condition. At this time the EEPROM enters an internally timed write cycle, t_{WR}, to the nonvolatile memory. All inputs are disabled during this write cycle and the EEPROM will not respond until the write is complete (see Figure 5 on page11).

PAGE WRITE

The 32K devices are capable of 32-byte page writes.

A page write is initiated the same as a byte write, but the microcontroller does not send a stop condition after the first data word is clocked in. Instead, after the EEPROM acknowledges receipt of the first data word, the microcontroller can transmit up to 31 more data words. The EEPROM will respond with a “0” after each data word received. The microcontroller must terminate the page write sequence with a stop condition (see Figure 6 on page11).

The data word address lower five (32K) bits are internally incremented following the receipt of each data word. The higher data word address bits are not incremented, retaining the memory page row location. When the word address, internally generated, reaches the page boundary, the following byte is placed at the beginning of the same page. If more than 32 data words are transmitted to the EEPROM, the data word address will “roll over” and previous data will be overwritten.

ACKNOWLEDGE POLLING

Once the internally timed write cycle has started and the EEPROM inputs are disabled, acknowledge polling can be initiated. This involves sending a start condition followed by the device address word. The read/write bit is representative of the operation desired. Only if the internal write cycle has completed will the EEPROM respond with a “0”, allowing the read or write sequence to continue.

Read Operations

Read operations are initiated the same way as write operations with the exception that the read/write select bit in the device address word is set to “1”. There are three read operations: current address read, random address read and sequential read.

CURRENT ADDRESS READ

The internal data word address counter maintains the last address accessed during the last read or write operation, incremented by one. This address stays valid between operations as long as the chip power is maintained. The address “roll over” during read is from the last byte of the last memory page to the first byte of the first page. The address “roll over” during write is from the last byte of the cur- rent page to the first byte of the same page. Once the device address with the read/write select bit set to “1” is clocked in and acknowledged by the EEPROM, the current address data word is serially clocked out. The microcontroller does not respond with an input “0” but does generate a following stop condition (see Figure 7 on page11).

RANDOM READ

A random read requires a “dummy” byte write sequence to load in the data word address. Once the device address word and data word address are clocked in and acknowledged by the EEPROM, the microcontroller must generate another start condition. The microcontroller now initiates a current address read by sending a device address with the read/write select bit high. The EEPROM acknowledges the device address and serially clocks out the data word. The microcontroller does not respond with a “0” but does generate a following stop condition (see Figure 8 on page12).

SEQUENTIAL READ

Sequential reads are initiated by either a current address read or a random address read. After the microcontroller receives a data word, it responds with an acknowledge. As long as the EEPROM receives an acknowledge, it will continue to increment the data word address and serially clock out sequential data words. When the memory address limit is reached, the data word address will “roll over” and the sequential read will continue. The sequential read operation is terminated when the microcontroller does not respond with a “0” but does generate a following stop condition (see Figure 9 on page12)

Figure 1 Data Validity

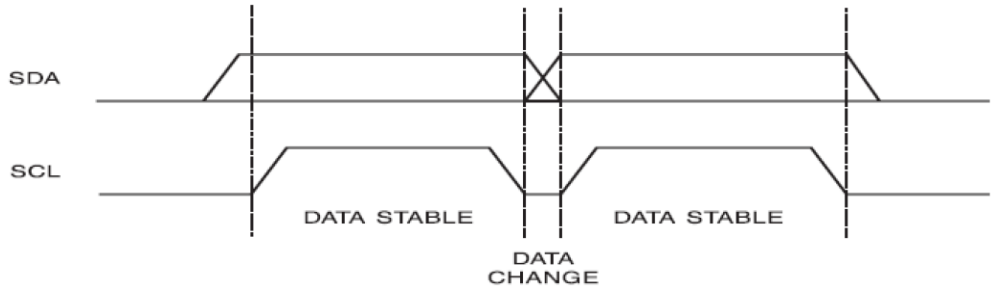


Figure 2 Start and Stop Definition

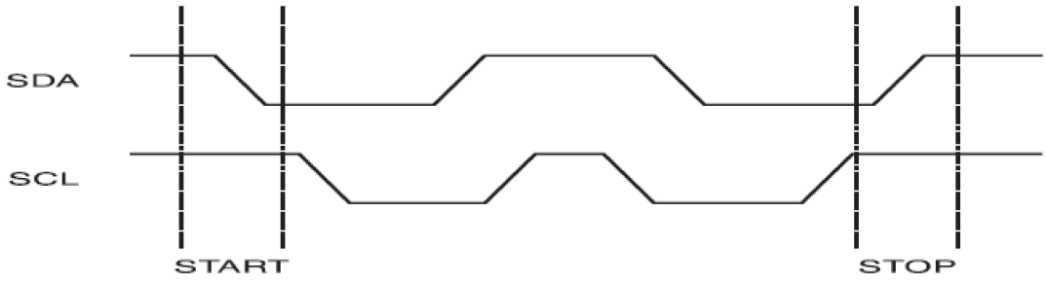


Figure 3 Output Acknowledge

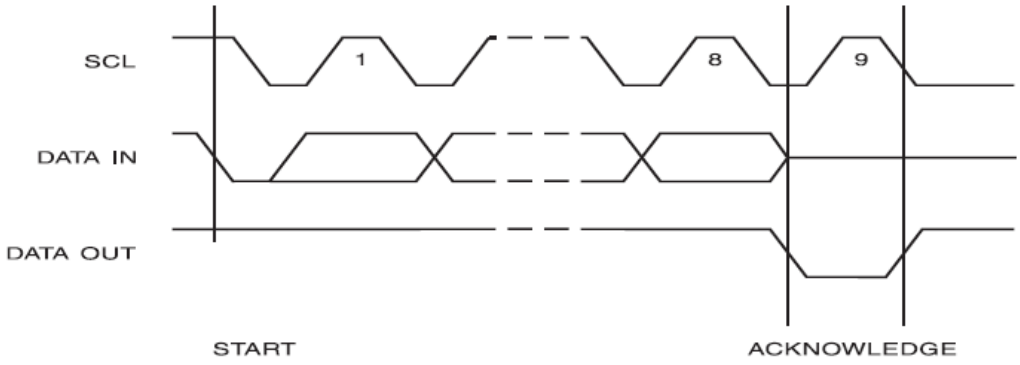


Figure 4 Device Address

1	0	1	0	A_2	A_1	A_0	R/W

MSB LSB

Figure 5 Byte Write

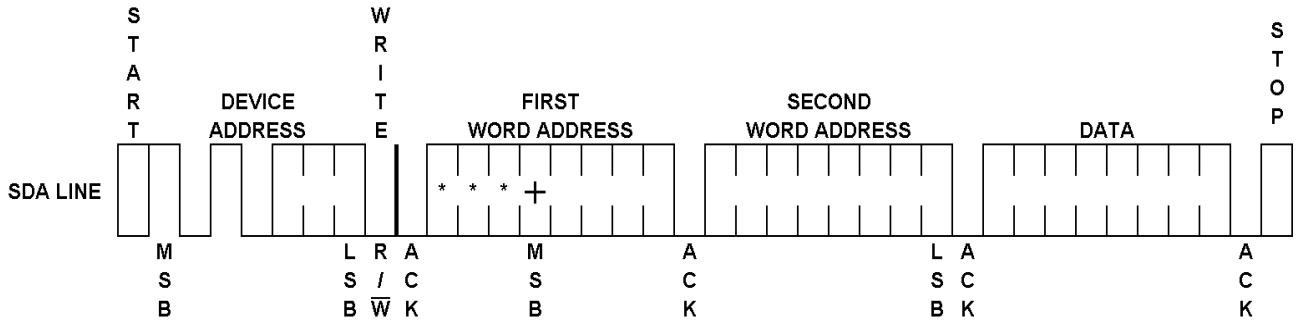


Figure 6 Page Write

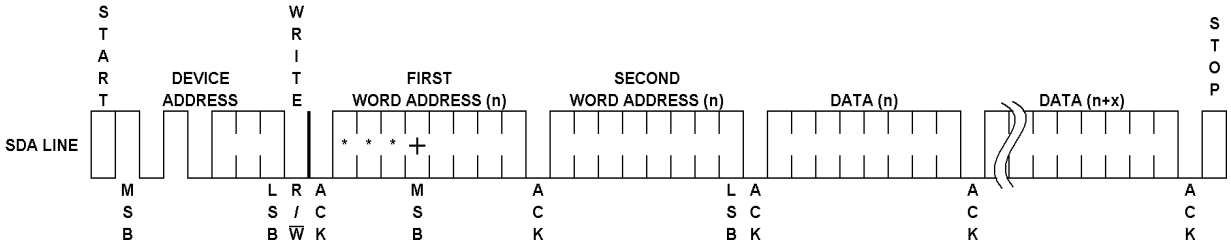


Figure 7 Current Address Read

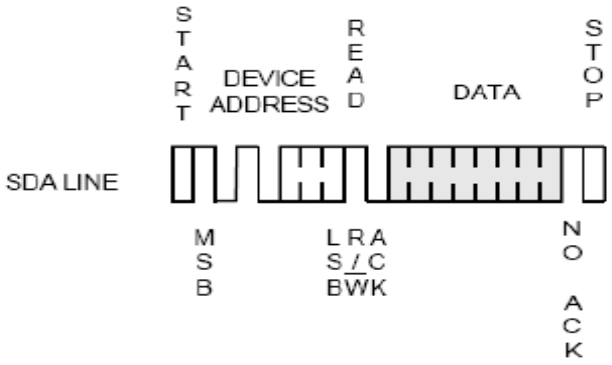


Figure 8 Random Read

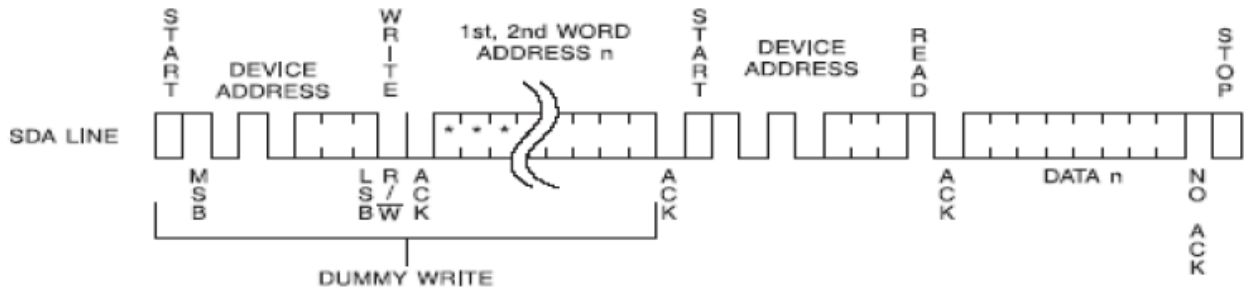
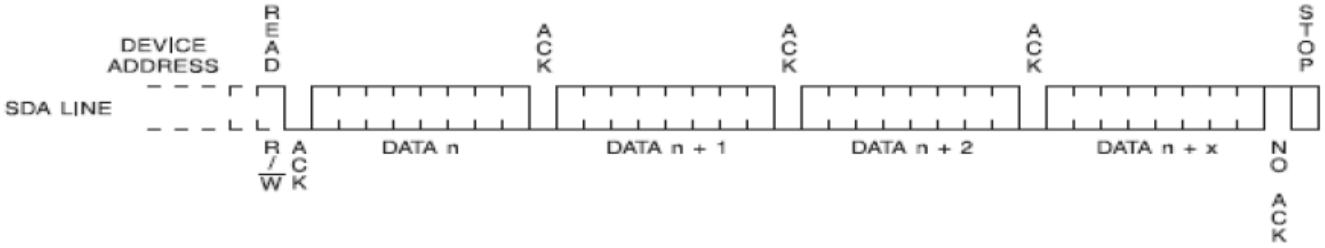
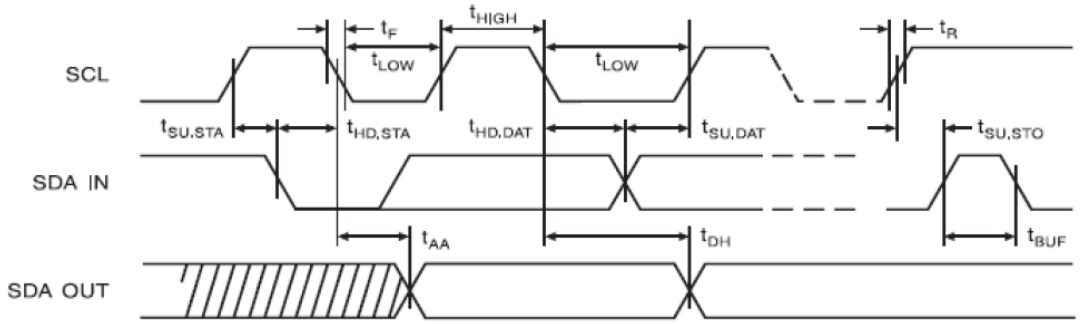


Figure 9 Sequential Read



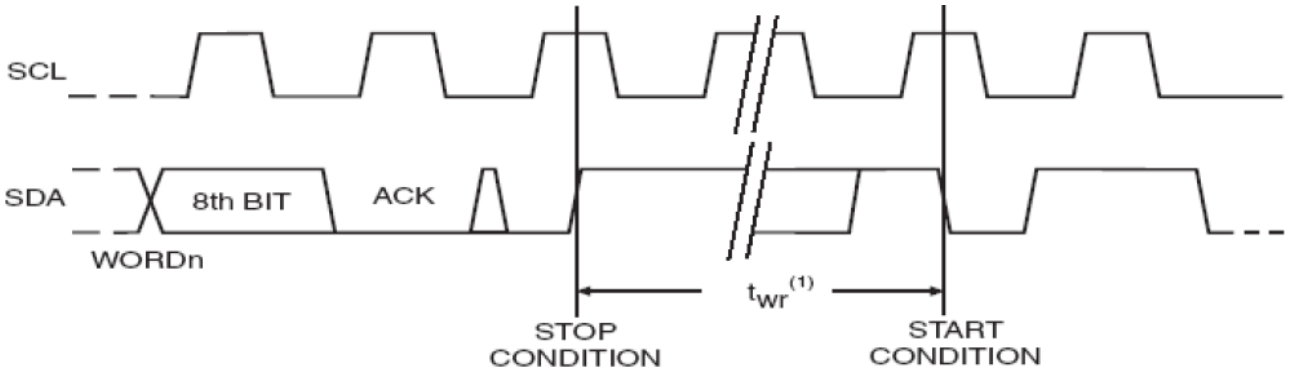
Bus Timing

Figure 10 SCL: Serial Clock, SDA: Serial Data I/O



Write Cycle Timing

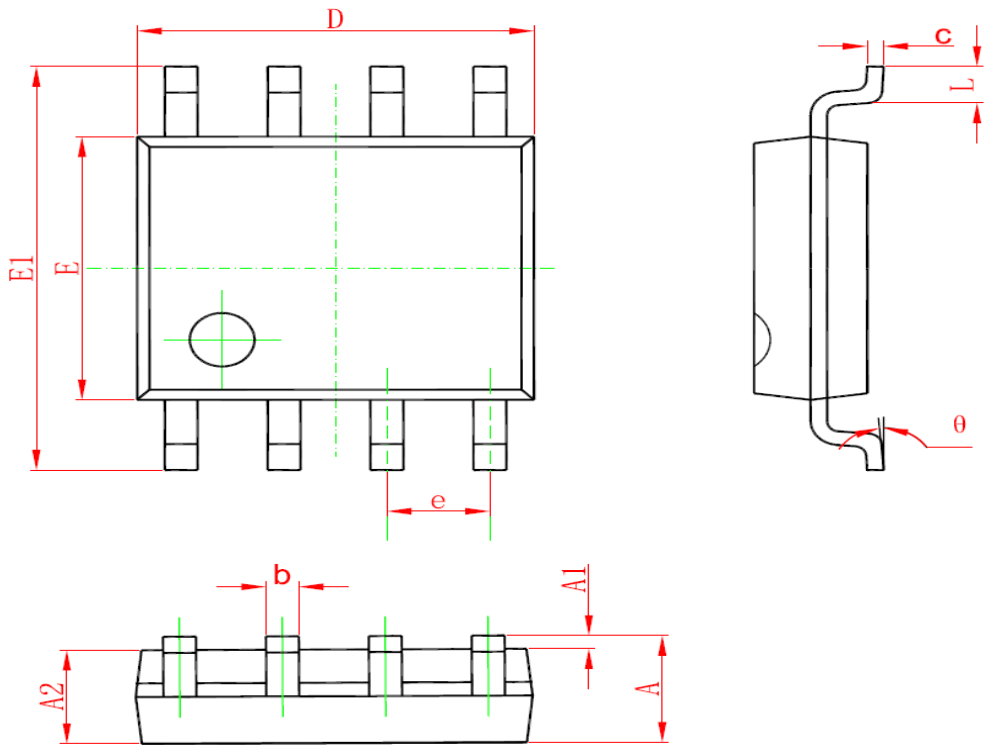
Figure 11 SCL: Serial Clock, SDA: Serial Data I/O



NOTE: The write cycle time t_{WR} is the time from a valid stop condition of a write sequence to the end of the internal clear/write cycle.

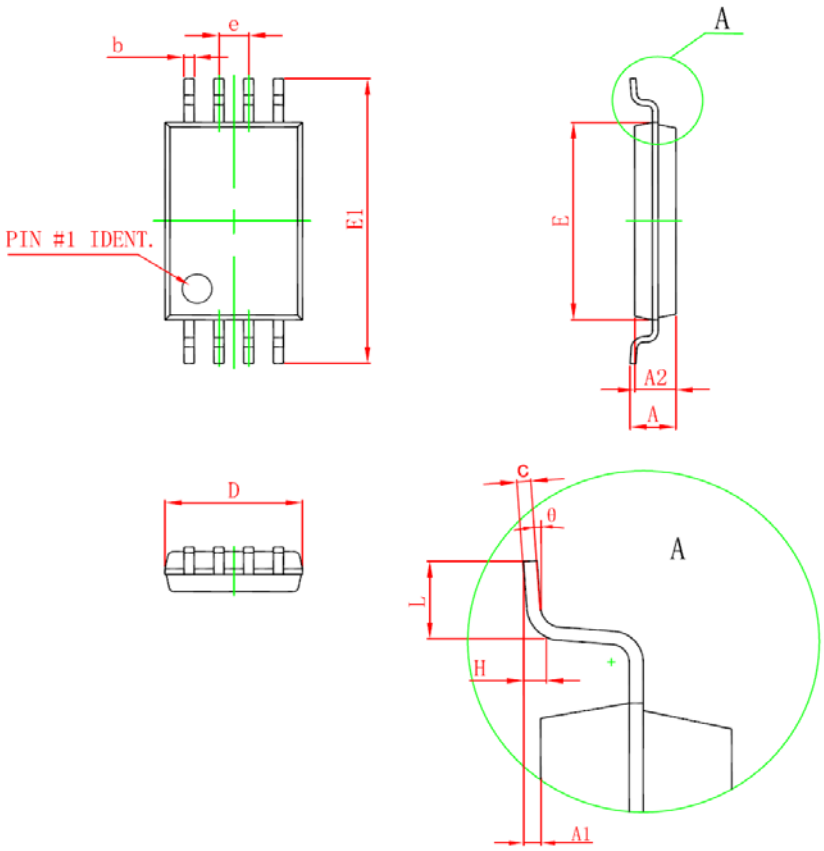
PACKAGE INFORMATION

Dimension in SOP8 (Unit: mm)



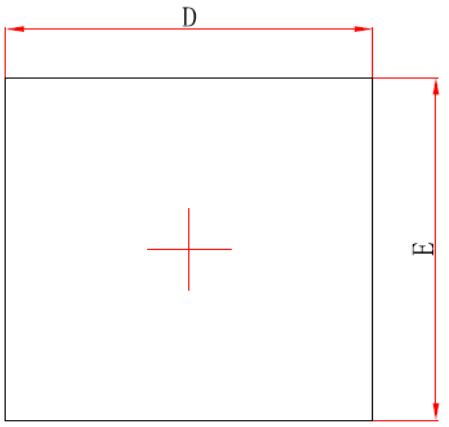
Symbol	Min	Max
A	1.350	1.750
A1	0.100	0.250
A2	1.350	1.550
b	0.330	0.510
c	0.170	0.250
D	4.700	5.100
E	3.800	4.000
E1	5.800	6.200
e	1.270(BSC)	
L	0.400	1.270
θ	0°	8°

Dimension in TSSOP8 Package (Unit: mm)

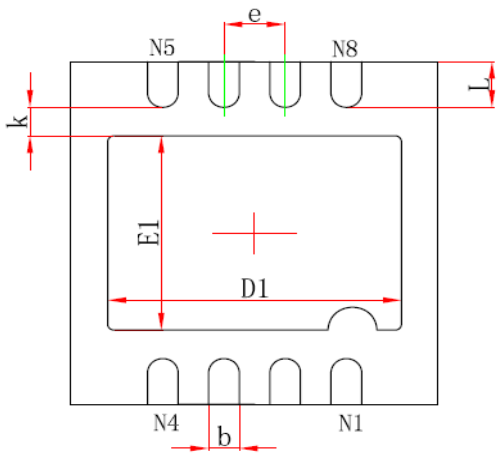


Symbol	Min	Max
D	2.900	3.100
E	4.300	4.500
b	0.190	0.300
c	0.090	0.200
E1	6.250	6.550
A	-	1.100
A2	0.800	1.000
A1	0.020	0.150
e	0.65 (BSC)	
L	0.500	0.700
H	0.25(TYP)	
θ	1°	7°

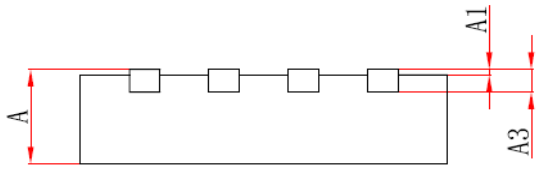
Dimension in DFN8 (Unit: mm)



Top View



Bottom View



Side View

Symbol	Min	Max
A	0.700/0.800	0.800/0.900
A1	0.000	0.050
A3	0.203REF.	
D	2.900	3.100
E	2.900	3.100
D1	2.300	2.500
E1	1.600	1.800
k	0.200MIN.	
b	0.180	0.300
e	0.500TYP.	
L	0.300	0.500

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