

## 8K BITS EEPROM

### Features

- Compatible with all I2C bidirectional data transfer protocol
- Memory array:
  - 8K bits (1024 X 8) of EEPROM
  - Page size: 16 bytes
- Single supply voltage and high speed: 1 MHz
- Random and sequential Read modes
- Write:
  - Byte Write within 3 ms
  - Page Write within 3 ms
  - Partial Page Writes Allowed
- Write Protect Pin for Hardware Data Protection
- Schmitt Trigger, Filtered Inputs for Noise Suppression
- High-reliability
  - Endurance: 1 Million Write Cycles
  - Data Retention: 100 Years
- 8-lead DIP/SOP/TSSOP/SOT-23-5 and DFN package



### Ordering Information

DEVICE	Package Type	MARKING	Packing	Packing Qty
HG24C08AN	DIP-8	24C08A	TUBE	2000/box
HG24C08AM/TR	SOP-8	24C08A	REEL	2500/reel
HG24C08AMM/TR	MSOP-8	24C08A	REEL	3000/reel
HG24C08AMT/TR	TSSOP-8	24C08A	REEL	3000/reel
HG24C08ADQ/TR	DFN-8 2*3	C08A	REEL	3000/reel
HG24C08AM5/TR	SOT-23-5	8CMU	REEL	3000/reel

### General Description

The HG24C08A provides 8192 bits of serial electrically erasable and programmable read-only memory (EEPROM), organized as 1024 words of 8 bits each.

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



**WRITE PROTECT (WP):** The HG24C08A has a Write Protect pin that provides hardware data protection. The Write Protect pin allows normal read/write operations when connected to ground (GND). When the Write Protection pin is connected to Vcc, the write protection feature is enabled and operates as shown in the following

WP Pin Status	HG24C08A
At VCC	Full Array
At GND	Normal Read/Write Operations

## Functional Description

### 1. Memory Organization

**HG24C08A, 8K SERIAL EEPROM:** Internally organized with 64 pages of 16 bytes each, the 8K requires a 10-bit data word address for random word addressing.

### 2. 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 2**). 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 3**).

**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 3**).

**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 HG24C08A 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.

Figure 2. Data Validity

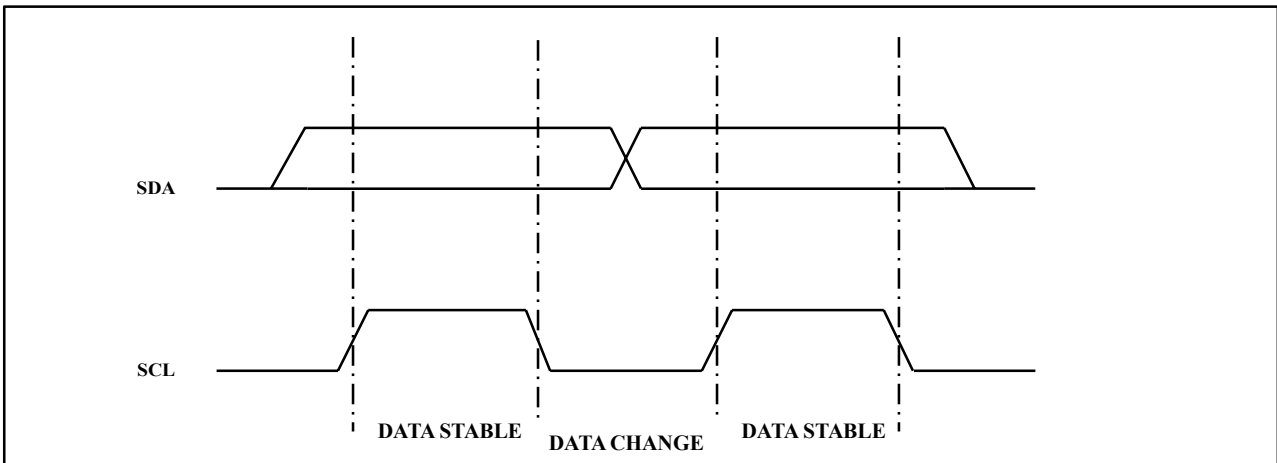


Figure 3. Start and Stop Definition

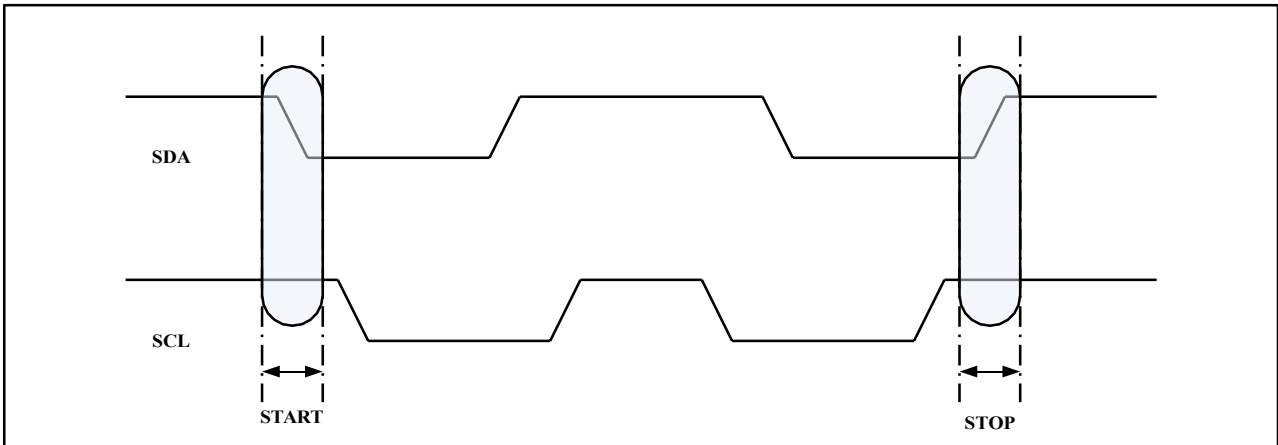
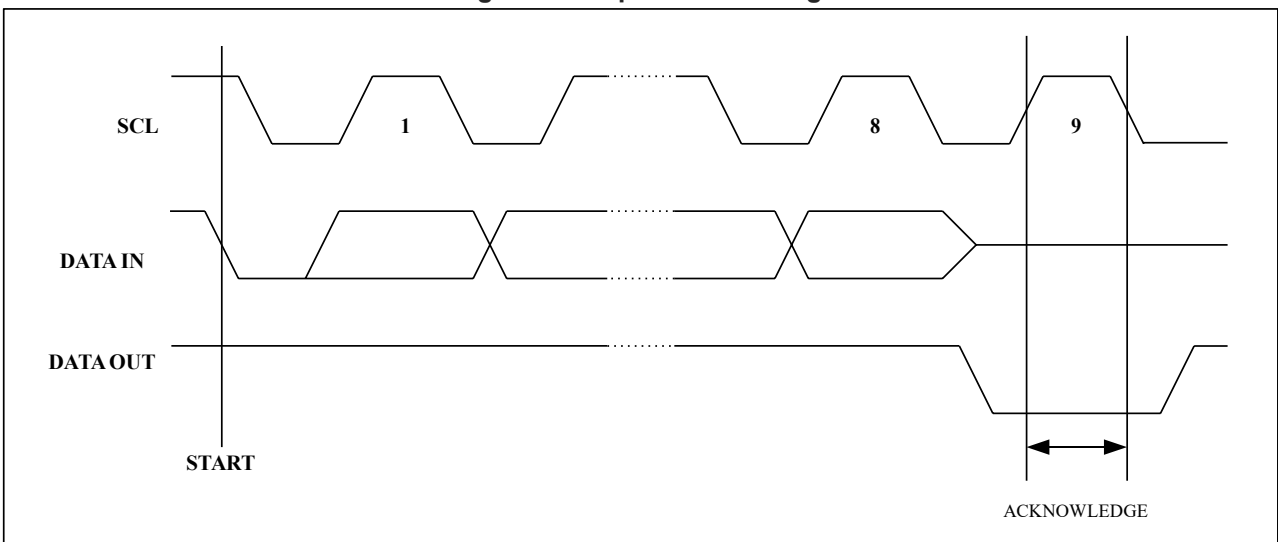


Figure 4. Output Acknowledge



### 3. Device Addressing

The HG24C08A EEPROM devices require an 8-bit device address word following a start condition to enable the chip for a read or write operation (see **Figure 5**)

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.

For the 8K EEPROM, uses the A2 input for hardwire addressing and the next 2 bits being for memory page addressing.

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.

### 4. 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 6**).

**PAGE WRITE:** The HG24C08 EEPROM devices are capable of 16-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 fifteen (8K) 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 7**).

The data word address lower four (8K) 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 sixteen (8K) 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 current 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 8**).

**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 9**).

**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 10**).

Figure 5. Device Address

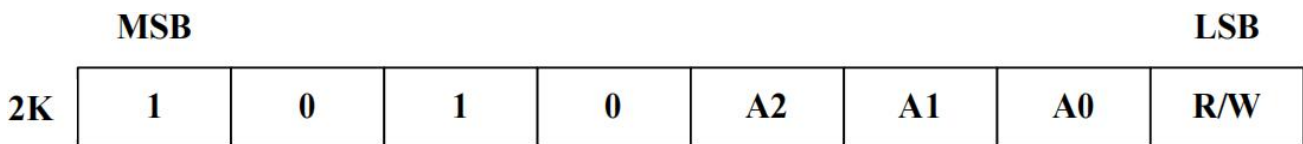


Figure 6. Byte Write

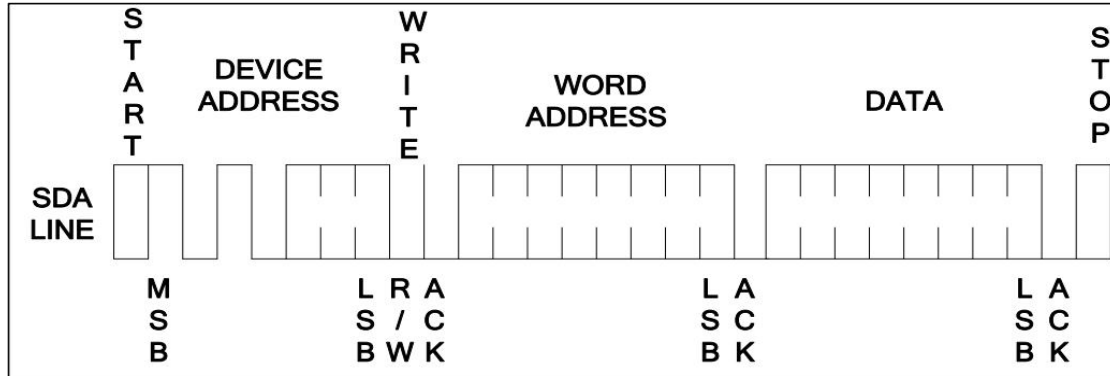


Figure 7. Page Write

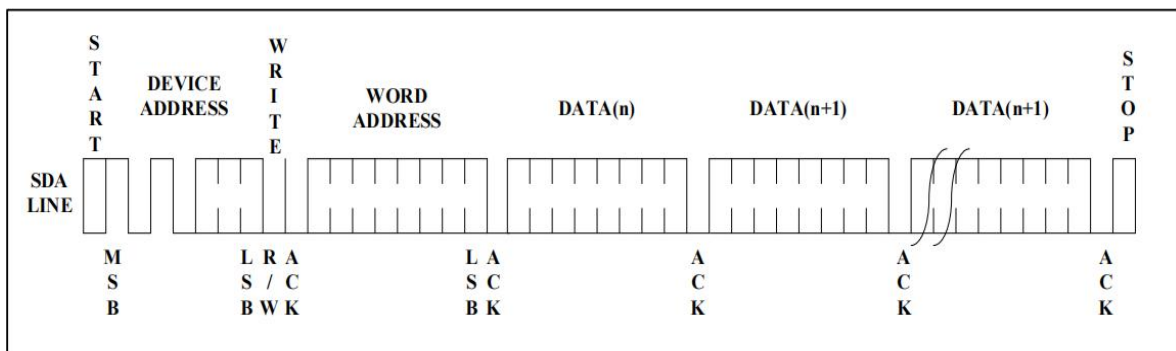


Figure 8. Current Address Read

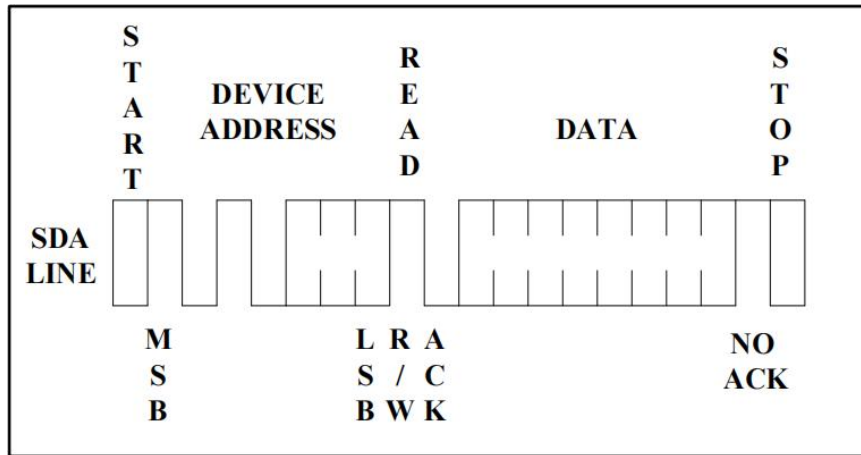


Figure 9. Random Read

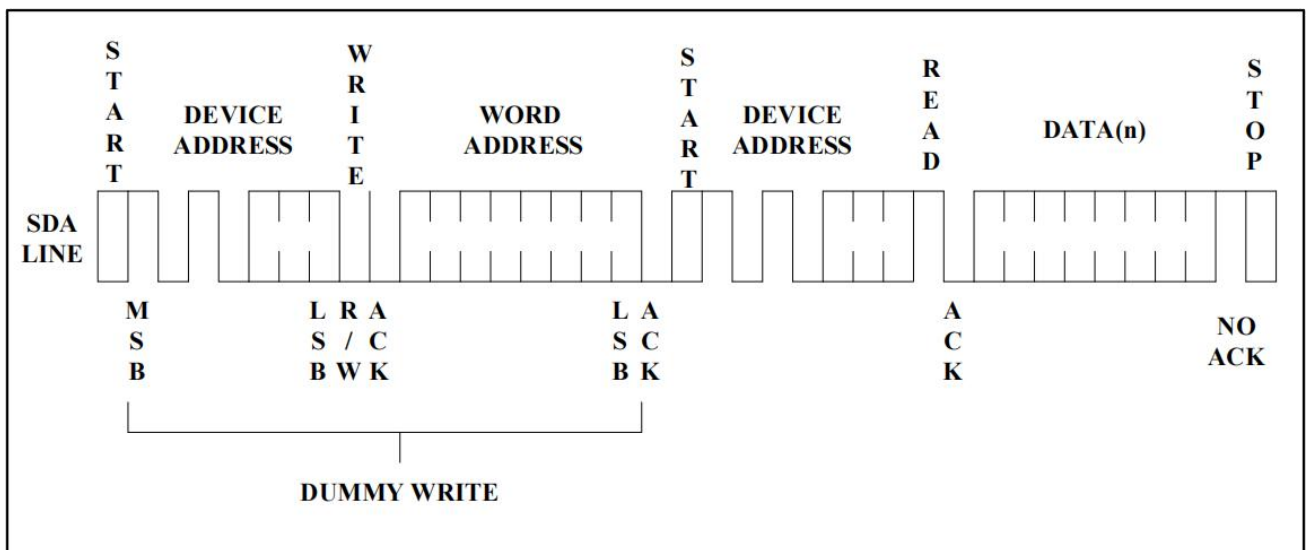
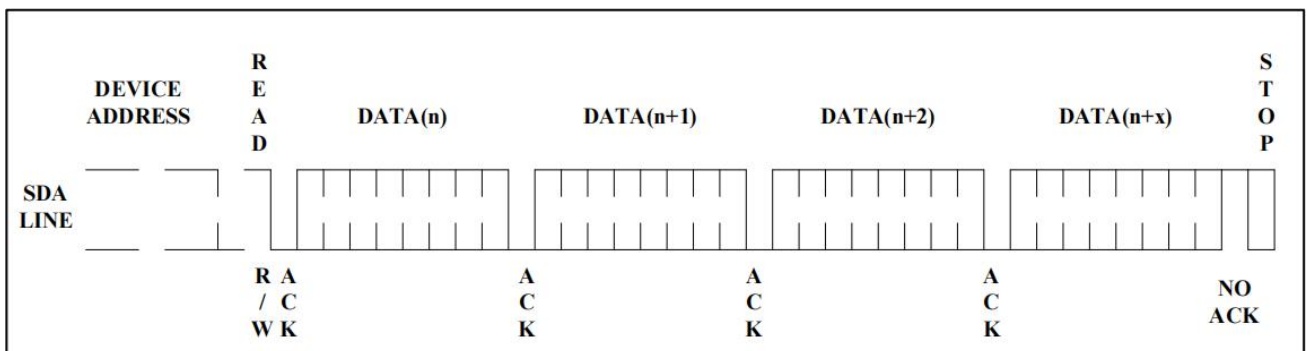


Figure 10. Sequential Read



## Electrical Characteristics

### Absolute Maximum Stress Ratings:

Parameter	Limits
DC Supply Voltage	-0.3V to +6.5V
Input / Output Voltage	GND-0.3V to VCC+0.3V
Operating Ambient Temperature	-40°C to +85°C
Storage Temperature	-65°C to +150°C
Lead Temperature (Soldering, 10 seconds)	245°C

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.

### DC Electrical Characteristics

Applicable over recommended operating range from: TA = -40°C to +85°C, VCC = +1.7V to +5.5V

(unless otherwise noted)

Parameter	Symbol	Min	Typ	Max	Unit	Condition
Supply Current VCC=5.0V	ICC2	-	1.50	2.0	mA	VCC=5V;WRITE at 400KHZ
Supply Current VCC=5.5V	ISB1	-	1.50	2.0	μA	VIN=VCC or VSS/VCC=1.7V
Input Leakage Current	IL1	-	0.10	30.0	μA	VIN=VCC or VSS
Output Leakage Current	ILO	-	0.05	2.0	μA	VOUT=VCC or VSS
Input Low Level	VIL1	-0.3	-	VCC×0.3	V	VCC=1.8V to 5.5V
Input High Level	VIH1	VCC×0.7	-	VCC+0.3	V	VCC=1.7V to 5.5V
Output Low Level VCC=1.7V	VOL1	-	-	0.2	V	IOL=0.15mA
Output Low Level VCC=5.0V	VOL2	-	-	0.4	V	IOL=3.0mA

### Thermal Characteristics

Thermal Resistance,Junction-to-Ambient	R <sub>θJA</sub>	125	°C/W
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### Pin Capacitance

Applicable over recommended operating range from TA = 25°C, f = 1.0 MHz, VCC = +1.7V

Parameter	Symbol	Min	Typ	Max	Unit	Condition
Input/Output Capacitance(SDA)	C <sub>I/O</sub>	-	-	8	pF	V <sub>IO</sub> =0V
Input Capacitance(SCL)	C <sub>IN</sub>	-	-	6	pF	V <sub>IN</sub> =0V



## AC Electrical Characteristics

Applicable over recommended operating range from TA = -40°C to +85°C, VCC = +1.7V to +5.5V, CL = 1 TTL Gate and 100 pF (unless otherwise noted)

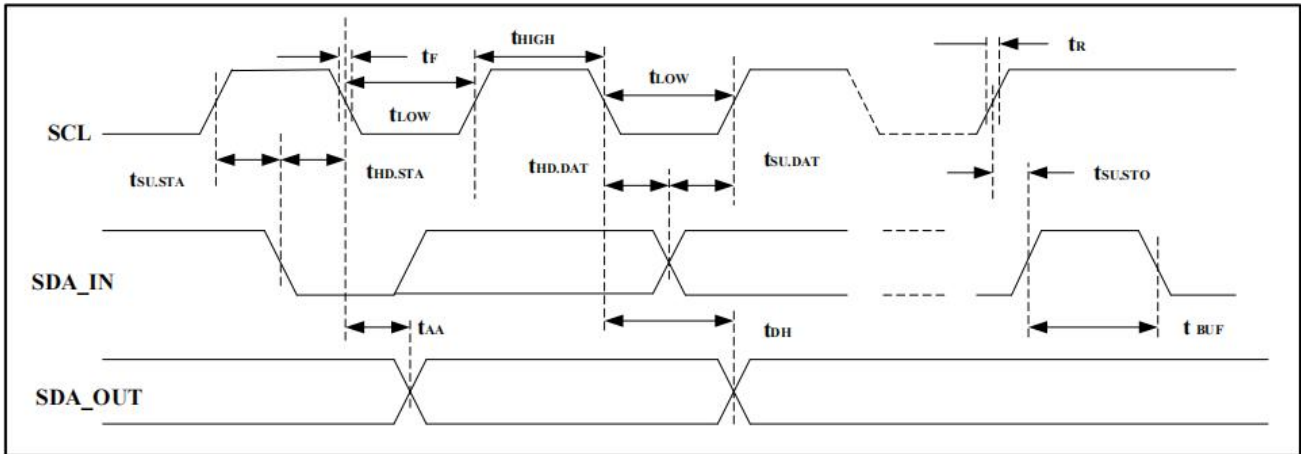
Parameter	Symbol	1.7V ≤ VCC < 2.5V			2.5V ≤ VCC < 5.5V			Units
		Min	Typ	Max	Min	Typ	Max	
Clock Frequency, SCL	fSCL	-	-	400	-	-	1000	KHZ
Clock Pulse Width Low	tLOW	1.2	-	-	0.6	-	-	μs
Clock Pulse Width High	tHIGH	0.6	-	-	0.4	-	-	μs
Noise Suppression Time	tI	-	-	50	-	-	50	ns
Clock Low to Data Out Valid	tAA	0.1	-	0.9	0.05	-	0.9	μs
Time the bus must be free before a new transmission can start	tBUF	1.2	-	-	0.5	-	-	μs
Start Hold Time	tHD:STA	0.6	-	-	0.25	-	-	μs
Start Setup Time	tSU:DAT	0.6	-	-	0.25	-	-	μs
Data In Hold Time	tHD:DAT	0	-	-	0	-	-	μs
Data in Setup Time	tSU:DAT	100	-	-	100	-	-	ns
Input Rise Time(1)	tR	-	-	0.3	-	-	0.3	μs
Input Fall Time(1)	tF	-	-	0.3	-	-	0.1	μs
Stop Setup Time	tSu:STO	0.6	-	-	0.25	-	-	μs
Data Out Hold Time	tDH	50	-	-	50	-	-	ns
Write Cycle Time	twR	-	3.3	4	-	3.3	4	ms
5.0V, 25°C, Byte Mode(1)	Endurance	1M	-	-	-	-	-	Write Cycle

### Notes:

1. This parameter is characterized and is not 100% tested.
2. AC measurement conditions:  
 RL (connects to VCC): 1.3 k  
 Input pulse voltages: 0.3 VCC to 0.7 VCC  
 Input rise and fall time: 50 ns  
 Input and output timing reference voltages: 0.5 VCC  
 The value of RL should be concerned according to the actual loading on the user's system.

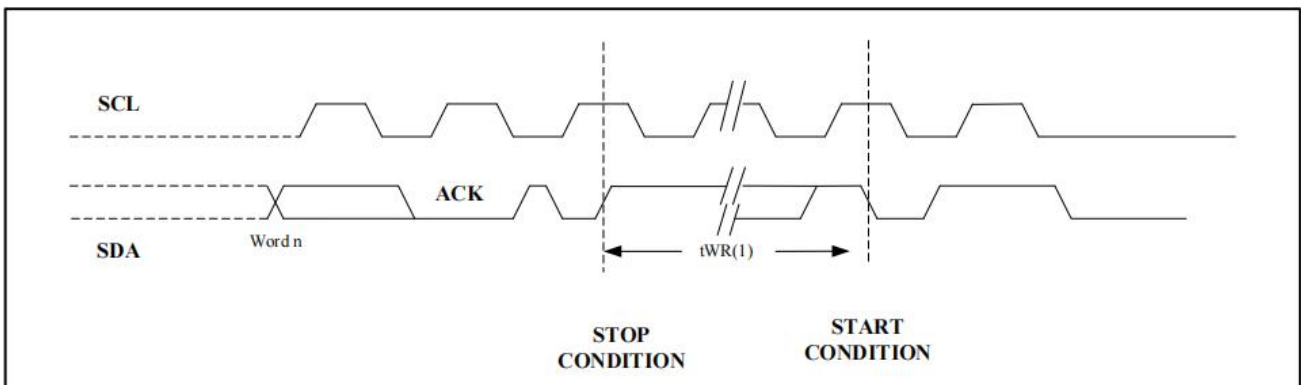
**Bus Timing**

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



**Write Cycle Timing**

**Figure 12. SCL: Serial Clock, SDA: Serial Data I/O**

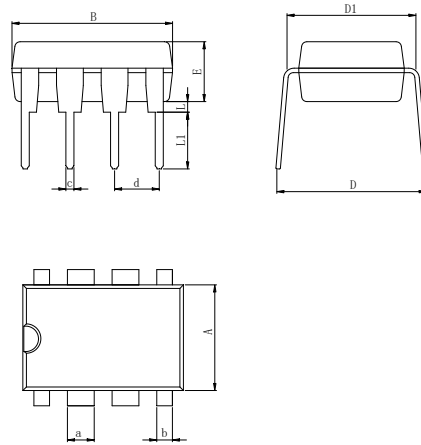


**Notes:**

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.

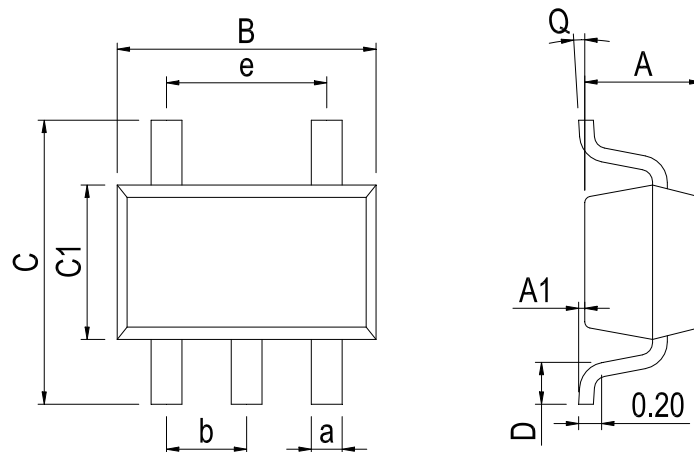
## Physical Dimensions

### 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	

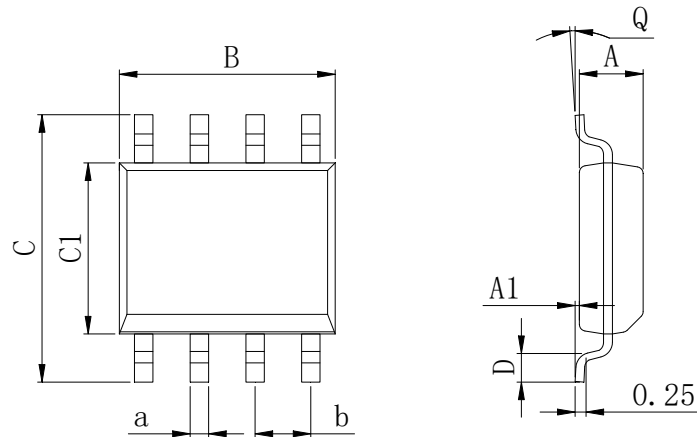
### SOT-23-5



Dimensions In Millimeters(SOT-23-5)										
Symbol:	A	A1	B	C	C1	D	Q	a	b	e
Min:	1.05	0.00	2.82	2.65	1.50	0.30	0°	0.30	0.95 BSC	1.90 BSC
Max:	1.15	0.15	3.02	2.95	1.70	0.60	8°	0.40		

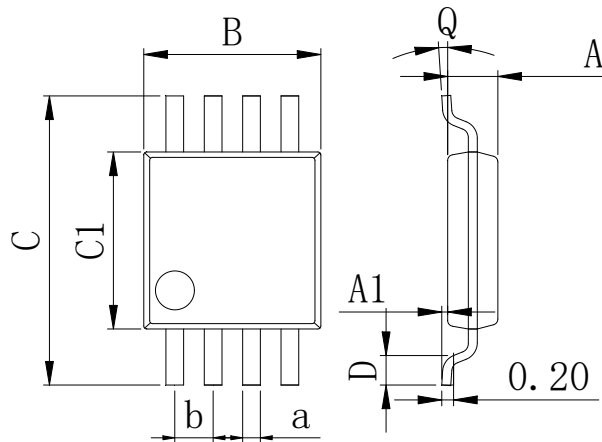
**Physical Dimensions**

SOP-8 (150mil)



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	

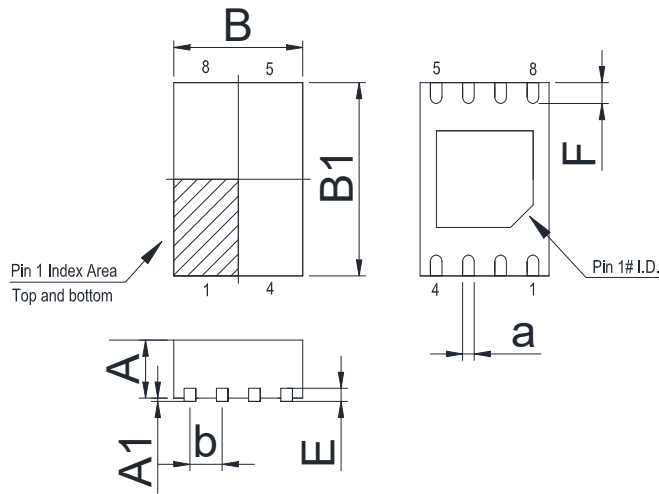
MSOP-8



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	

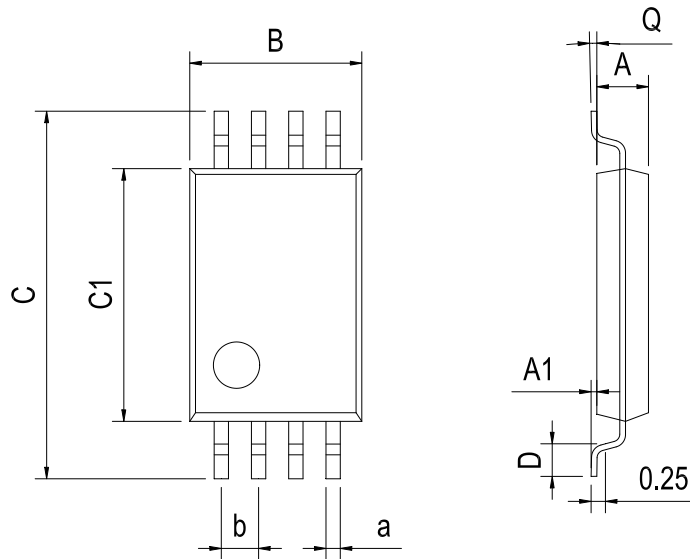
## Physical Dimensions

DFN-8 2\*3



Dimensions In Millimeters(DFN-8 2*3)								
Symbol:	A	A1	B	B1	E	F	a	b
Min:	0.85	0	1.90	2.90	0.15	0.25	0.20	0.50TYP
Max:	0.95	0.05	2.10	3.10	0.25	0.35	0.30	

TSSOP-8 (4.4\*3.0)



Dimensions In Millimeters(TSSOP-8)									
Symbol:	A	A1	B	C	C1	D	Q	a	b
Min:	0.85	0.05	2.90	6.20	4.30	0.40	0°	0.20	0.65 BSC
Max:	0.95	0.20	3.10	6.60	4.50	0.80	8°	0.25	

## Revision History

DATE	REVISION	PAGE
2019-12-13	New	1-15
2023-8-30	Update encapsulation type、 Update Lead Temperature、 Updated DIP-8 dimension	1、 8、 11

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