钍地半导体
Tudi Semiconductor

Product Specification

TUDI-24LC01/24AA01

1K I2 C Serial EEPROM

网址 www.sztdbdt.com

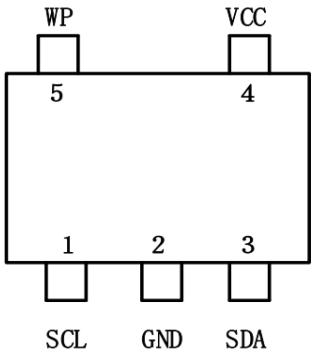
用芯智造·卓越品质

semiconductor device manufacturer

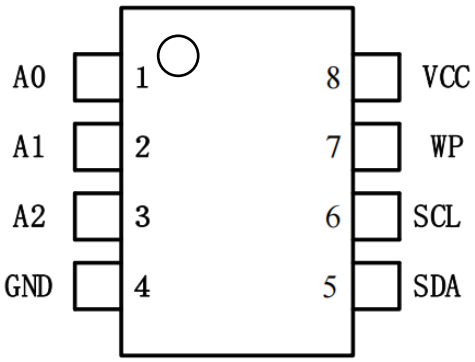
- Design
- research and development
- production
- and sales

Features

- ●Single Supply with Operation down to 1.7V for 24AA01 and 2.5V for 24LC01B Devices
- ● Low-Power CMOS Technology:
- - Read current 1 mA, maximum
- - Standby current 1 µA, maximum (I-temp.)
- ● 2-Wire Serial Interface, I2C Compatible
- ● Schmitt Trigger Inputs for Noise Suppression
- ● Output Slope Control to Eliminate Ground Bounce
- ● 100 kHz, 400 kHz and 1 MHz Compatibility
- ● Page Write Time: 5 ms, Maximum
- ● Self-Timed Erase/Write Cycle
- ● 8-Byte Page Write Buffer
- ● Hardware Write-Protect
- ● ESD Protection >6,000V
- ● More than 1 Million Erase/Write Cycles
- ●Data Retention >100 Years
- ●Factory Programming Available
- ●RoHS Compliant
- ●Temperature Ranges:
- - Industrial (I): -40°C to +85°C
- - Extended (E): -40°C to +125°C
- ●PDIP8/SOP8/TSSOP8/and SOT23-5 packages



SOT23-5



PDIP8/SOP8/TSSOP8

Description

24XX01 is a 1 Kbit Electrically Erasable PROM. The device is organized as one block of 128 x 8-bit memory with a 2-wire serial interface. Its low-voltage design permits operation down to 1.7V-5.5V with standby and active currents of only 1 µA and 1 mA, respectively. The 24XX01 also has a page write capability for up to 8 bytes of data.

Pin Descriptions

Pin Name	Type	Functions
A0-A2	I	Address Inputs
SDA	I/O	Serial Data
SCL	I	Serial Clock Input
WP	I	Write Protect
GND	P	Ground
Vcc	P	Power Supply

DEVICE/PAGE ADDRESSES (A2, A1 and A0): The A2, A1 and A0 pins are device address inputs that are hard wire for the 24XX01. Eight 1K devices may be addressed on a single bus system (device addressing is discussed in detail under the Device Addressing section).
SERIAL DATA (SDA): The SDA pin is bi-directional for serial data transfer. This pin is open-drain driven and may be wire-ORed with any number of other open-drain or open- collector devices.
SERIAL CLOCK (SCL): The SCL input is used to positive edge clock data into each EEPROM device and negative edge clock data out of each device.
WRITE PROTECT (WP): The 24XX01 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 Table 1.

WP Pin Status	24XX01
At VCC	Full(1K)Array
At GND	Normal Read/Write Operations

Table 1

Block Diagram

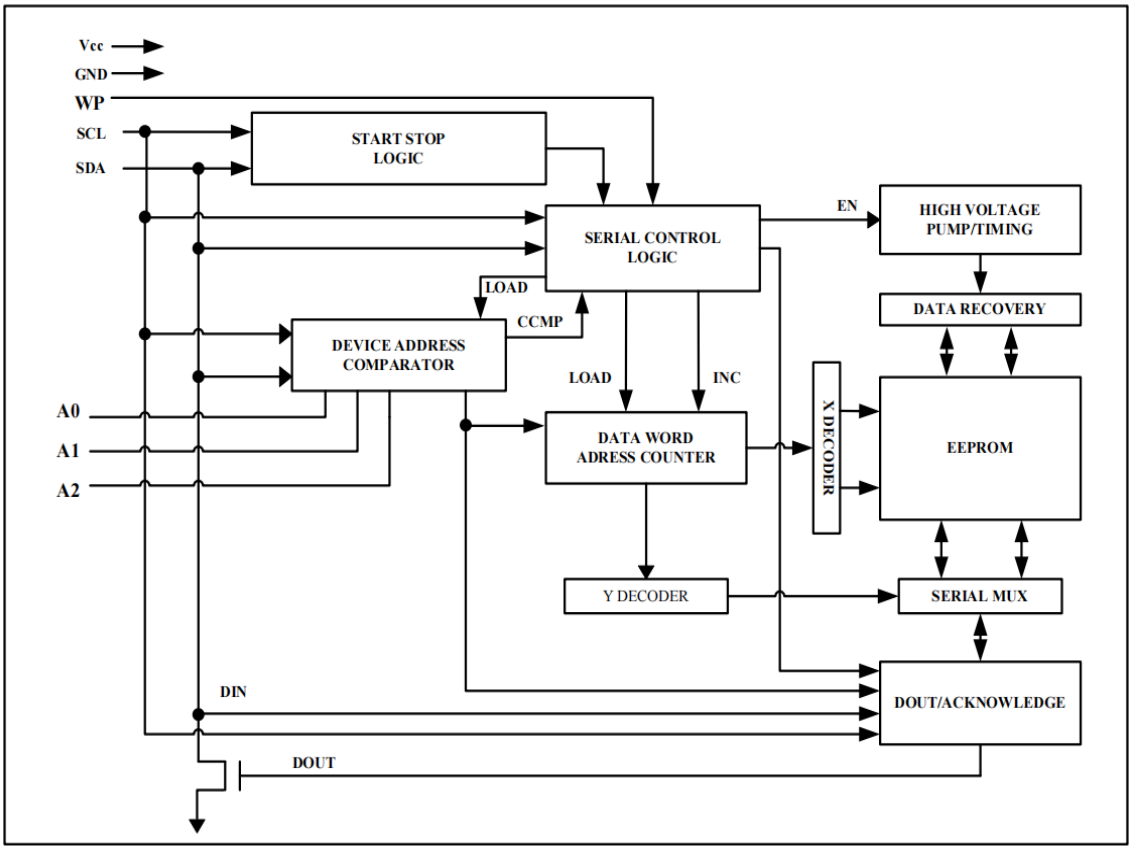


Figure 1

Electrical Characteristics

Absolute Maximum Stress Ratings	
DC Supply Voltage	- 0.3V to + 6.5V
Input /Output Voltage	GND-0.3V to VCC+0.3V
Storage Temperature	- 65℃ to + 150℃
Electrostatic pulse (Human Body model)	6000V

Comments:
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

24LC01	TA=-40℃ to +85℃	VCC=+1.7V to+5.5V@400kHz VCC=+2.5V to+5.5V@1MHz
24AA01	TA=-40℃ to +125℃	

Parameter	Symbol	Min	Typ	Max	Unit	Condition
Supply Current VCC=5.0V	Icc1	-	0.14	0.3	mA	READ at 400KHZ
Supply Current VCC=5.0V	Icc2	-	0.28	0.5	mA	WRITE at 400KHZ
Supply Current VCC=5.0V	IsB1	-	0.03	0.5	μA	VIn=Vcc or Vss
Input Leakage Current	L1		0.10	1.0	μA	VIn=Vcc or Vss
Output Leakage Current	lLo	-	0.05	1.0	μA	Vou=Vcc or Vss
Input Low Level	VIL1	-0.3	-	Vcc×0.3	V	Vcc=1.7V 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	loL=0.15mA
Output Low Level VCC=5.0V	VoL2	-	-	0.4	V	loL=3.0mA

Pin Capacitance

Applicable over recommended operating range from TA = 25°C, f = 1.0 MHz, VCC = +2.5V

Parameter	Symbol	Min	Typ	Max	Unit	Condition
Input/Output Capacitance(SDA)	CI/0	—	—	8	pF	VIo=0V
Input Capacitance(A0,A1,A2,SCL)	CIN	-	—	6	pF	VIN=0V

AC Electrical Characteristics

Applicable over recommended operating range from (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	1.3	-	-	0.5	-	-	μS
Clock Pulse Width High	tHIGH	0.6	-	-	0.26	-	-	μS
Noise Suppression Time	ti	-	-	50	-	-	50	ns
Clock Low to Data Out Valid	tAA	-	-	0.9	-	-	0.45	μS
Time the bus must be free before a new transmission can start	tBUF	1.3	-	-	0.5	-	-	μS
Start Hold Time	tHD:STA	0.6	-	-	0.25	-	-	μS
Start Setup Time	tsu:STA	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	-	-	0.12	μS
Input FallTime(1)	tF	-	-	0.3	-	-	0.12	μS
Stop Setup Time	tsuSTO	0.6	-	-	0.25	-	-	μS
Data Out Hold Time	tDH	50	-	-	50	-	-	ns
Write Cycle Time	twR	-	1.9	3	-	1.9	3	ms
5.0V,25℃,Byte Mode(1)	Endurance	1M	-	-	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.

Functional Description

1. Memory Organization

24XX01, 1KSERIAL EEPROM: Internally organized with 16 pages of 16 bytes each, the 1Krequires a 8-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

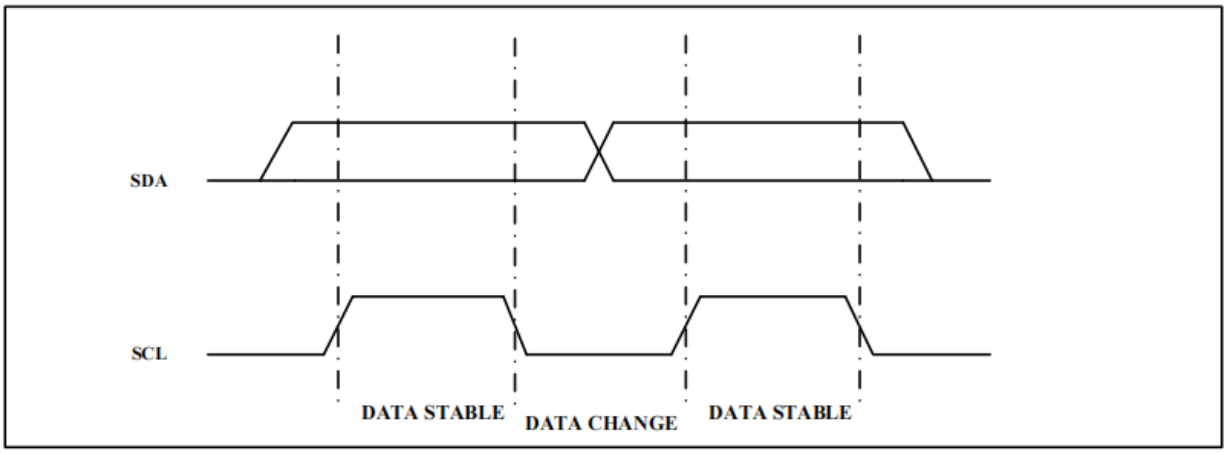


Figure 2. Data Validity

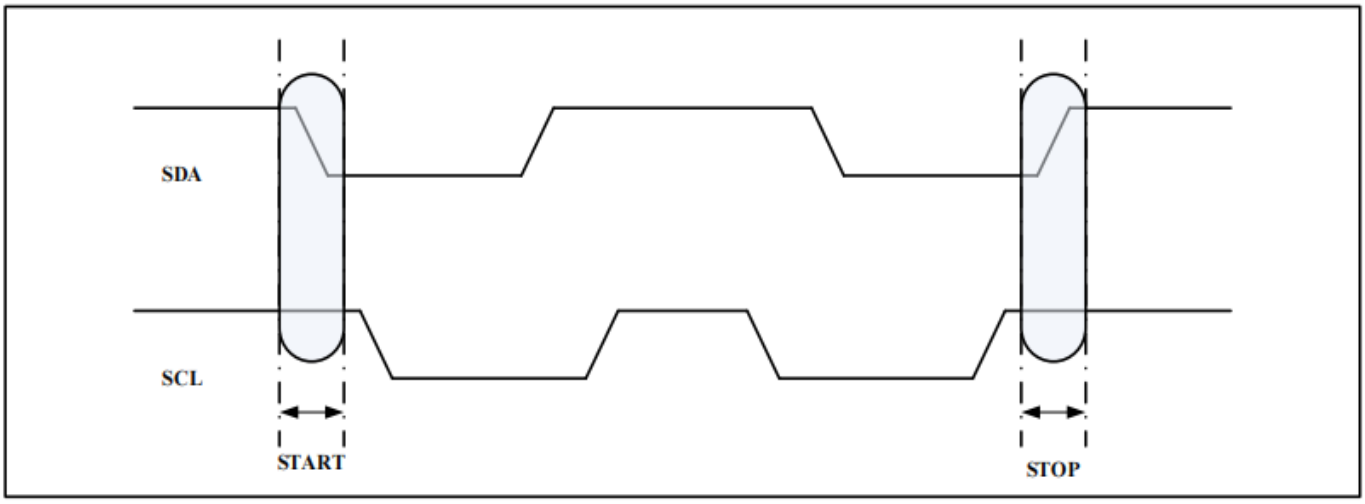


Figure 3. Start and Stop Definition

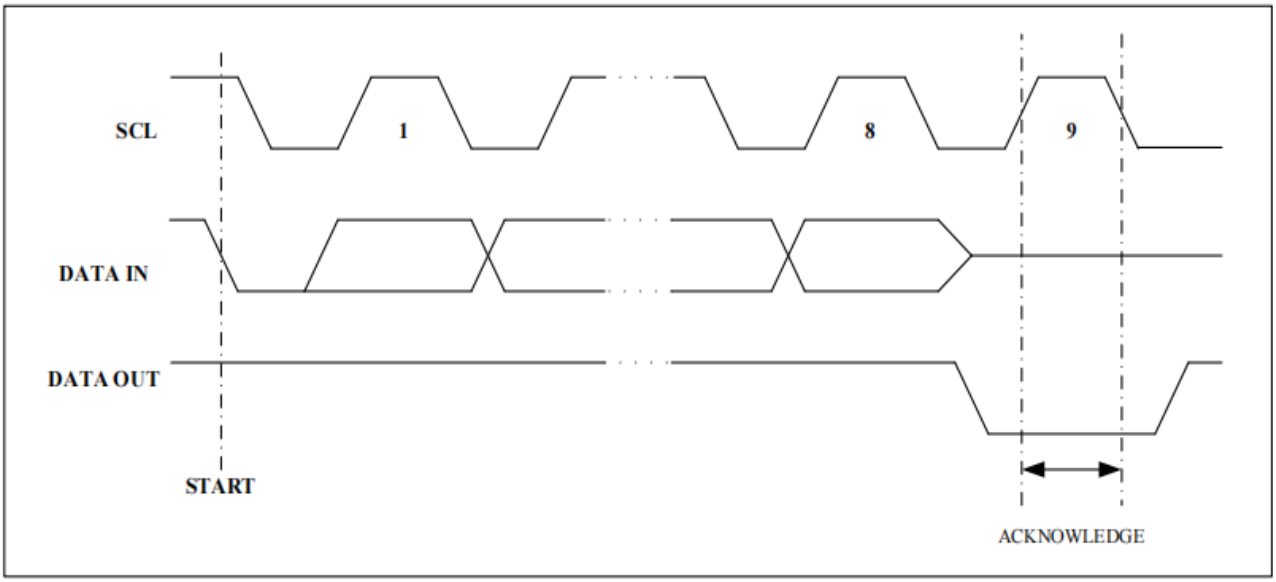


Figure 4. Output Acknowledge

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 24XX01 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. Lock SDA high in each cycle while SCL is high.
3. Create a start condition.

3. Device Addressing

The 1KEEPROM 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 5)

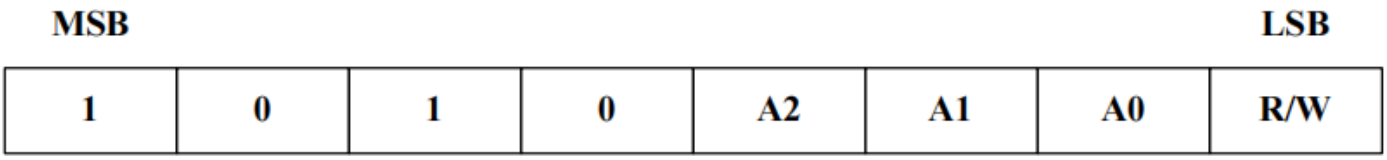


Figure 5. Device Address

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 1KEEPROM uses A2, A1 and A0 device address bits to allow as much as eight devices on the same bus. These 3 bits must be compared 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.
DATA SECURITY: The 24XX01 has a hardware data protection scheme that allows the user to write protect the entire memory when the WP pin is at VCC.

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, tWR, 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 7)

B7	B6	B5	B4	B3	B2	B1	B0

Figure 6. ADDRESS

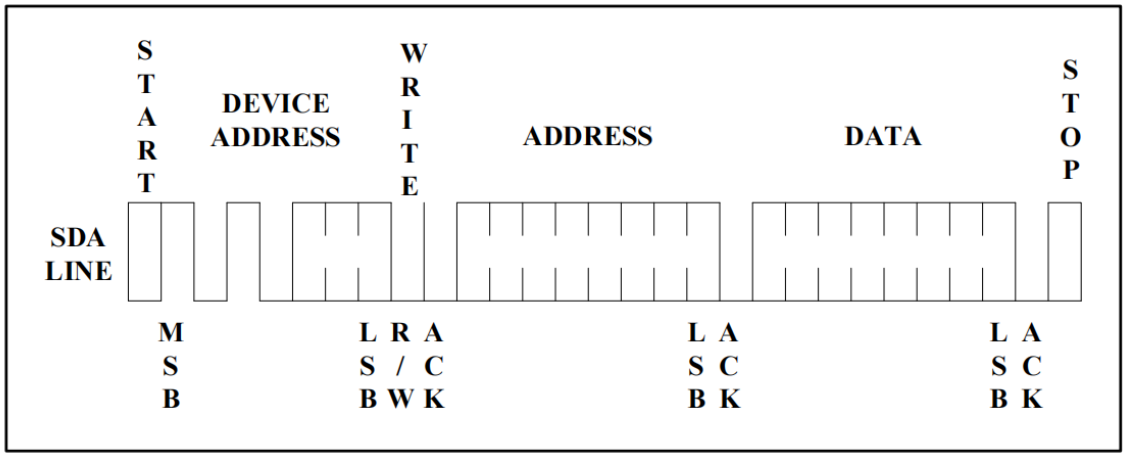


Figure 7. Byte Write

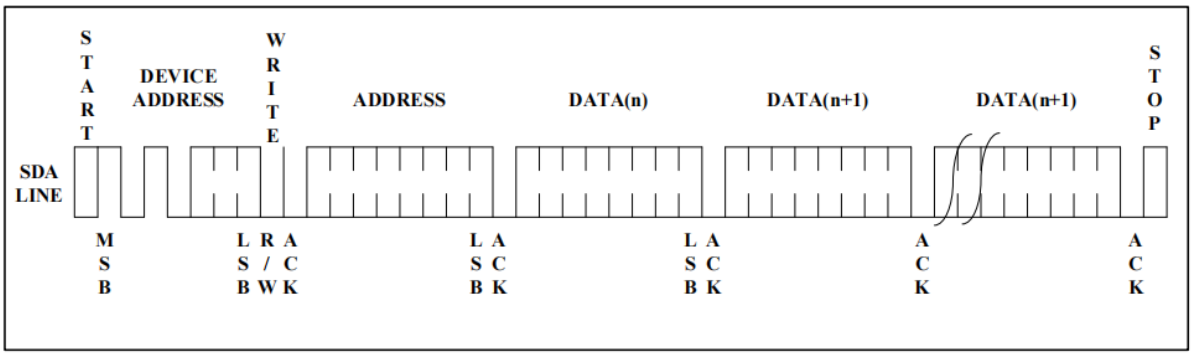


Figure 8. Page Write

PAGE WRITE: The 1K EEPROM is capable of a 16-byte page write. 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 seven 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 8)

The data word address lower three 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 eight 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.

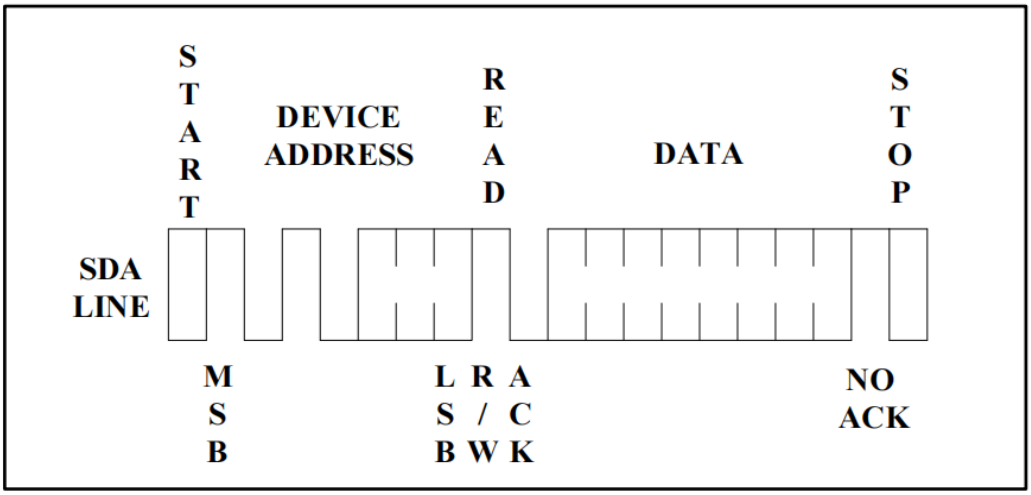


Figure 9. Current Address Read

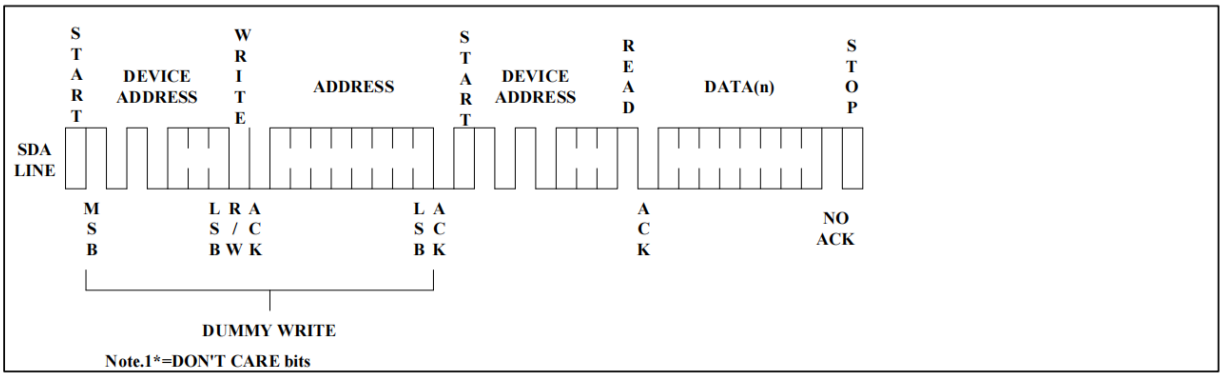


Figure 10. Random Read

5. 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 9).

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 10**)

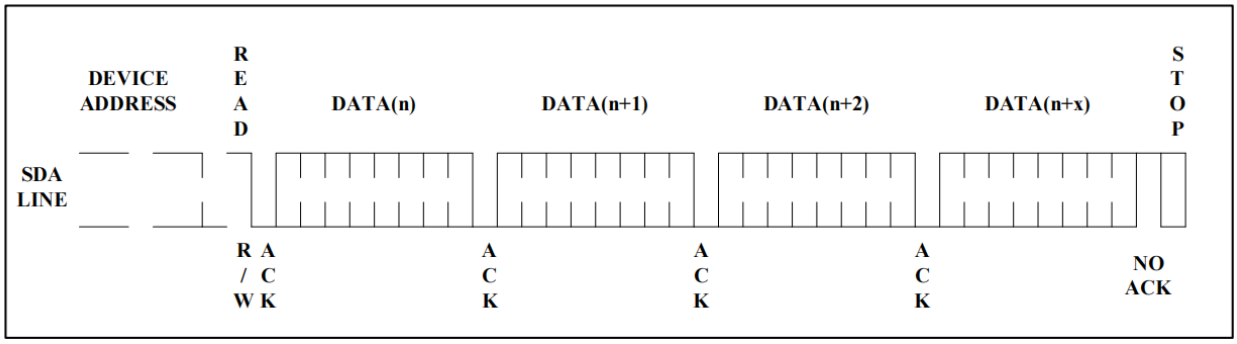


Figure 11. Sequential Read

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 11).

Bus Timing

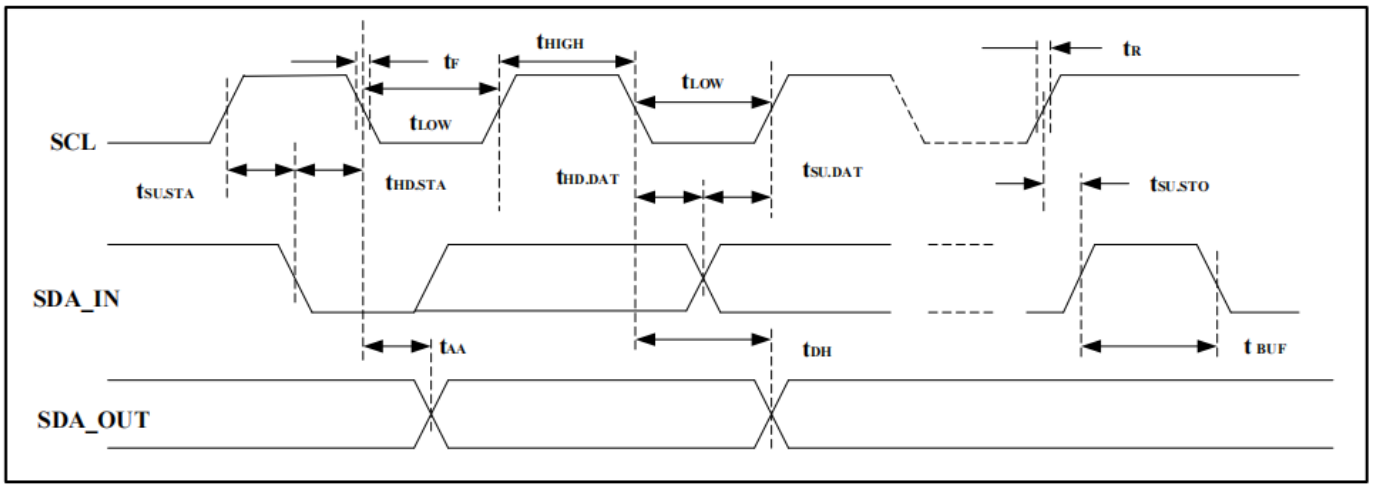


Figure 12. SCL: Serial Clock, SDA: Serial Data I/O

Write Cycle Timing

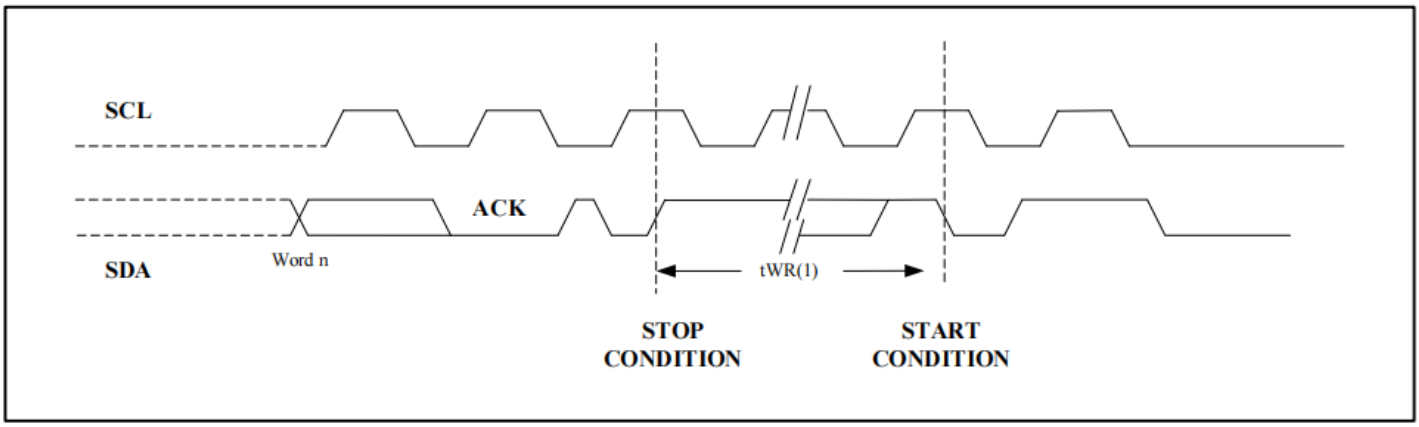
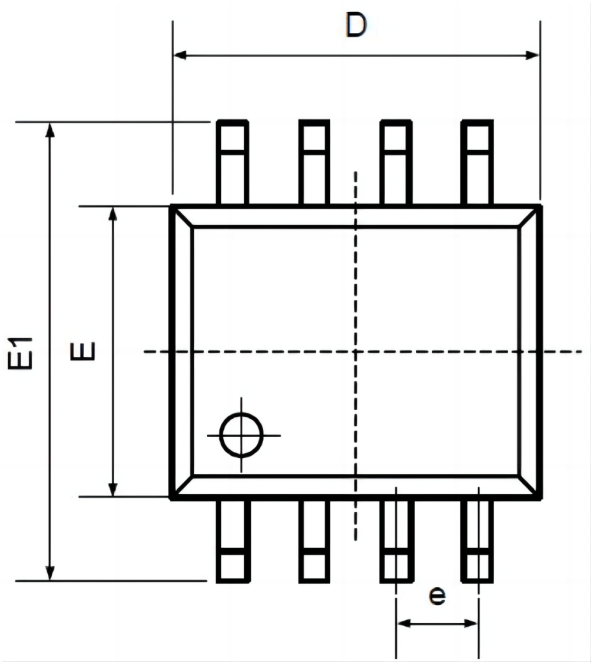


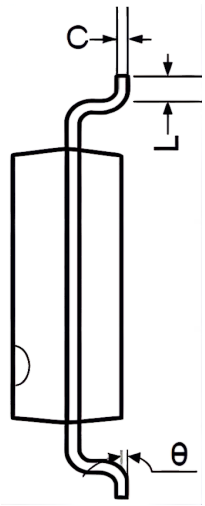
Figure 13. SCL: Serial Clock, SDA: Serial Data I/O

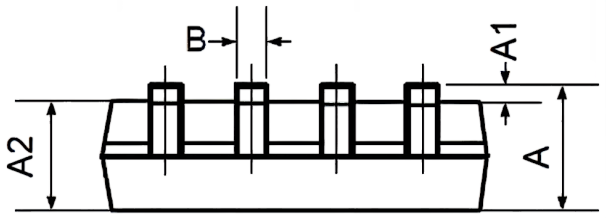
Order information

Order Number	Package	Package Quantity	Marking On The park	Temperature	Operating Voltage
24LC01BT-I/SN-TUDI	SOP8	Tape,Reel,2500	24LC01BI/SN	- 40°C to 85°C	2.5V-5.5V
24LC01BT-I/ST-TUDI	TSSOP8	Tape,Reel,2500	24LC01B		
24LC01B-I/P-TUDI	DIP8	Tube,50,A box of 2000	24LC01B-I/P		
24LC01BT-I/OT-TUDI	SOT23	Tape,Reel,3000	M1xx		
24AA01T-I/SN-TUDI	SOP8	Tape,Reel,2500	24AA01I/SN		1.7V-5.5V
24AA01T-I/ST-TUDI	TSSOP8	Tape,Reel,2500	24AA01		
24AA01-I/P-TUDI	DIP8	Tube,50,A box of 2000	24AA01-I/P		
24AA01T-I/OT-TUDI	SOT23	Tape,Reel,3000	B1xx		
24LC01BT-E/SN-TUDI	SOP8	Tape,Reel,2500	24LC01BE/SN	- 40°C to 125°C	2.5V-5.5V
24LC01BT-E/ST-TUDI	TSSOP8	Tape,Reel,2500	24LC01BE		
24LC01B-E/P-TUDI	DIP8	Tube,50,A box of 2000	24LC01B-E/P		
24LC01BT-E/OT-TUDI	SOT23	Tape,Reel,3000	N1xx		

Package SOP8

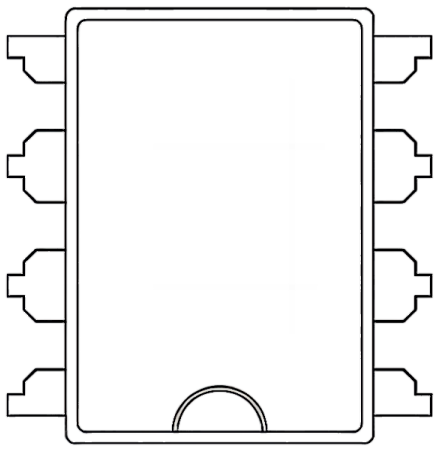


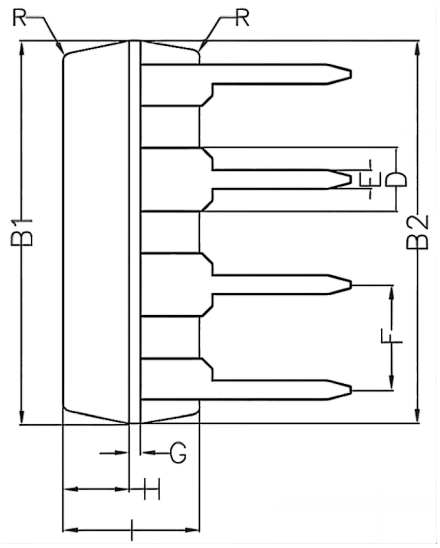


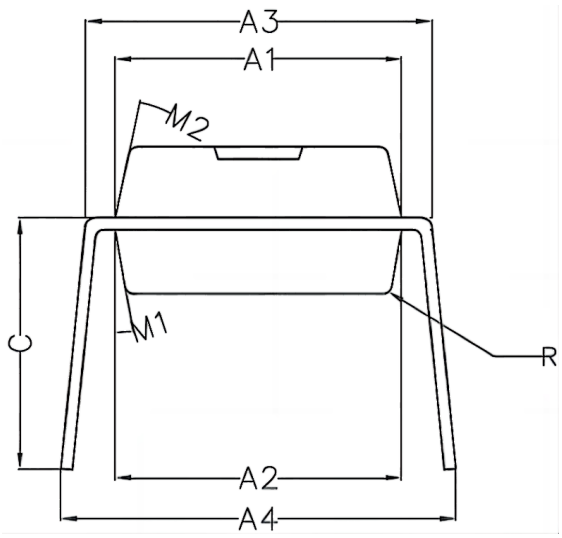


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
B	0.330	0.510	0.013	0.020
C	0.190	0.250	0.007	0.010
D	4.780	5.000	0.188	0.197
E	3.800	4.000	0.150	0.157
E1	5.800	6.300	0.228	0.248
e	1.270TYP		0.050TYP	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

Package DIP8

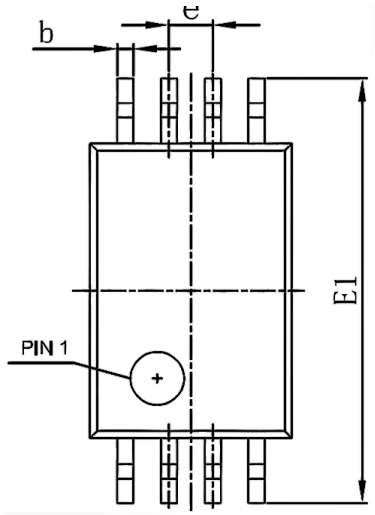


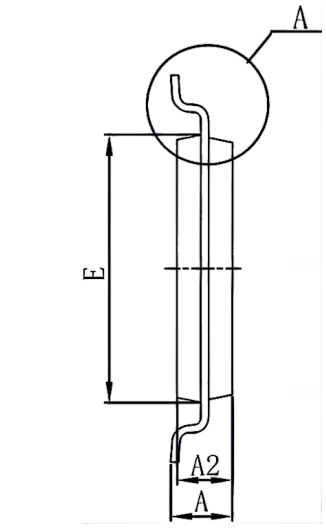


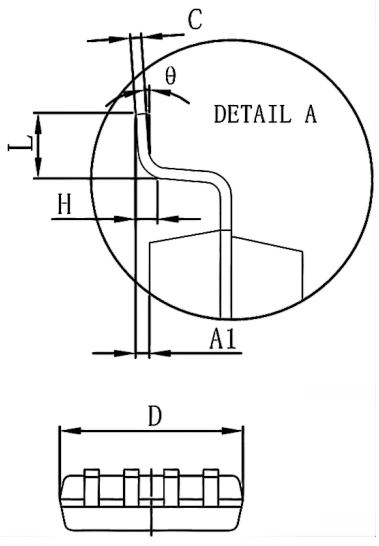


Symbol	Min	Non	Max
A1	6.28	6.33	6.38
A2	6.33	6.38	6.43
A3	7.52	7.62	7.72
A4	7.80	8.40	9.00
B1	9.15	9.20	9.25
B2	9.20	9.25	9.30
C		5.57	
D		1.52	
E	0.43	0.45	0.47
F		2.54	
G		0.25	
H	1.54	1.59	1.64
工	3.22	3.27	3.32
R		0.20	
M1	9°	10°	11°
M2	11°	12°	13°

Package TSSOP8

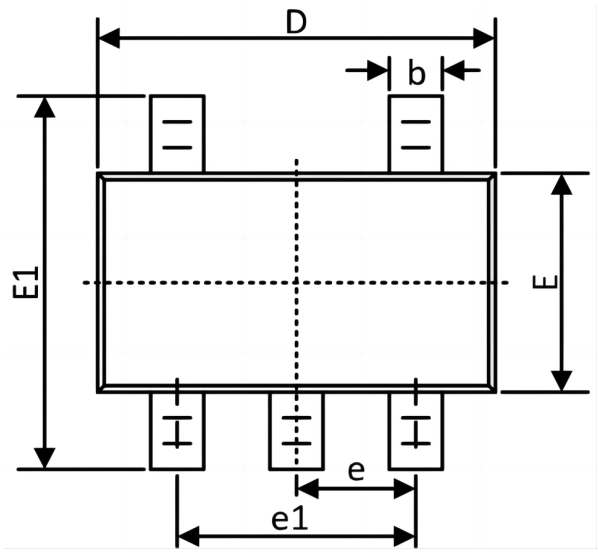


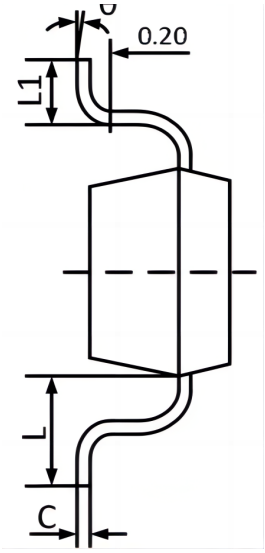


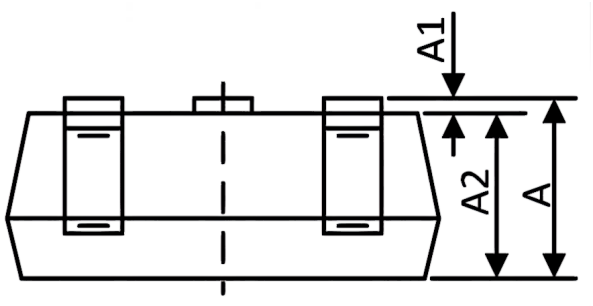


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
D	2.900	3.100	0.114	0.122
E	4.300	4.500	0.169	0.177
b	0.190	0.300	0.007	0.012
C	0.090	0.200	0.004	0.008
E1	6.250	6.550	0.246	0.258
A		1.200		0.047
A2	0.800	1.000	0.031	0.039
A1	0.050	0.150	0.002	0.006
e	0.65(BSC)		0.026(BSC)	
L	0.500	0.700	0.020	0.028
H	0.25(TYP)		0.01(TYP)	
θ	1°		1°	

Package SOT23-5







Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.400	0.012	0.016
C	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950TYP		0.037TYP	
e1	1.800	2.000	0.071	0.079
L	0.700REF		0.028REF	
L1	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

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