



# 25AA256/25LC256

## 256K SPI Bus Serial EEPROM

### Device Selection Table

Part Number	Vcc Range	Page Size	Temp. Ranges	Packages
25LC256	2.5V-5.5V	64 Bytes	I, E	MF, P, SN, SM, ST
25AA256	1.8V-5.5V	64 Bytes	I, E	MF, P, SN, SM, ST

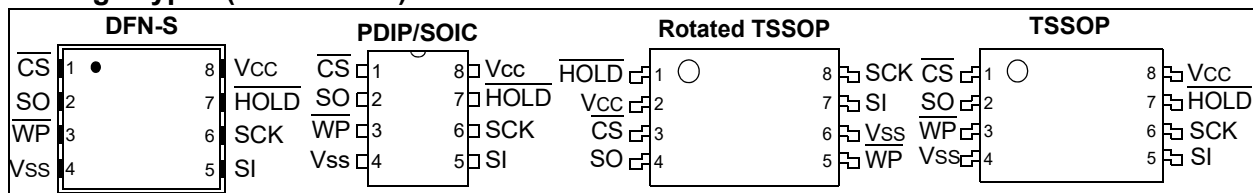
### Features

- Maximum Clock 10 MHz
- Low-Power CMOS Technology:
  - Maximum Write current: 5 mA at 5.5V, 10 MHz
  - Read current: 6 mA at 5.5V, 10 MHz
  - Standby current: 1  $\mu$ A at 5.5V
- 32,768 x 8-Bit Organization
- 64-Byte Page
- Self-Timed Erase and Write Cycles (5 ms maximum)
- Block Write Protection:
  - Protect none, 1/4, 1/2 or all of array
- Built-In Write Protection:
  - Power-on/off data protection circuitry
  - Write enable latch
  - Write-protect pin
- Sequential Read
- High Reliability:
  - Endurance: 1,000,000 erase/write cycles
  - Data retention: > 200 years
  - ESD protection: > 4000V
- Temperature Ranges Supported:
  - Industrial (I): -40°C to +85°C
  - Extended (E): -40°C to +125°C
- RoHS Compliant
- Automotive AEC-Q100 Qualified

### Packages

- 8-Lead DFN-S, 8-Lead PDIP, 8-Lead SOIC, 8-Lead SOIJ and 8-Lead TSSOP

### Package Types (not to scale)



### Pin Function Table

Name	Function
$\overline{\text{CS}}$	Chip Select Input
SO	Serial Data Output
$\overline{\text{WP}}$	Write-Protect
Vss	Ground
SI	Serial Data Input
SCK	Serial Clock Input
$\overline{\text{HOLD}}$	Hold Input
Vcc	Supply Voltage

### Description

The Microchip Technology Inc. 25AA256/25LC256 (25XX256<sup>(1)</sup>) are 256-Kbit Serial Electrically Erasable PROMs. The memory is accessed via a simple Serial Peripheral Interface (SPI) compatible serial bus. The bus signals required are a clock input (SCK) plus separate data in (SI) and data out (SO) lines. Access to the device is controlled through a Chip Select ( $\overline{\text{CS}}$ ) input.

Communication to the device can be paused via the hold pin ( $\overline{\text{HOLD}}$ ). While the device is paused, transitions on its inputs will be ignored, with the exception of Chip Select, allowing the host to service higher priority interrupts.

**Note 1:** 25XX256 is used in this document as a generic part number for the 25AA256/25LC256 devices.

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## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings (†)

V <sub>CC</sub> .....	6.5V
All inputs and outputs w.r.t. V <sub>SS</sub> .....	-0.6V to V <sub>CC</sub> +1.0V
Storage temperature .....	-65°C to +150°C
Ambient temperature under bias .....	-40°C to +125°C
ESD protection on all pins .....	4 kV

† **NOTICE:** Stresses above 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 those or any other conditions above those indicated in the operational listings of this specification is not implied. Exposure to maximum rating conditions for an extended period of time may affect device reliability.

**TABLE 1-1: DC CHARACTERISTICS**

DC CHARACTERISTICS			Industrial (I): TA = -40°C to +85°C V <sub>CC</sub> = 1.8V to 5.5V Extended (E): TA = -40°C to +125°C V <sub>CC</sub> = 1.8V to 5.5V			
Param. No.	Symbol	Characteristic	Minimum	Maximum	Units	Test Conditions
D001	V <sub>IH</sub>	High-Level Input Voltage	0.7 V <sub>CC</sub>	V <sub>CC</sub> + 1	V	
D002	V <sub>IL</sub>	Low-Level Input Voltage	-0.3	0.3 V <sub>CC</sub>	V	V <sub>CC</sub> ≥ 2.5V
D003	V <sub>IL</sub>		-0.3	0.2 V <sub>CC</sub>	V	V <sub>CC</sub> < 2.5V
D004	V <sub>OL</sub>	Low-Level Output Voltage	—	0.4	V	I <sub>OL</sub> = 2.1 mA, V <sub>CC</sub> = 4.5V
D005	V <sub>OL</sub>		—	0.2	V	I <sub>OL</sub> = 1.0 mA, V <sub>CC</sub> = 2.5V
D006	V <sub>OH</sub>	High-Level Output Voltage	V <sub>CC</sub> - 0.5	—	V	I <sub>OH</sub> = -400 μA
D007	I <sub>LI</sub>	Input Leakage Current	—	±1	μA	$\overline{CS}$ = V <sub>CC</sub> , V <sub>IN</sub> = V <sub>SS</sub> or V <sub>CC</sub>
D008	I <sub>LO</sub>	Output Leakage Current	—	±1	μA	$\overline{CS}$ = V <sub>CC</sub> , V <sub>OUT</sub> = V <sub>SS</sub> or V <sub>CC</sub>
D009	C <sub>INT</sub>	Internal Capacitance (All Inputs and Outputs)	—	7	pF	T <sub>A</sub> = 25°C, F <sub>CLK</sub> = 1.0 MHz, V <sub>CC</sub> = 5.0V ( <b>Note 2</b> )
D010	I <sub>CC</sub> Read	Operating Current	—	6	mA	V <sub>CC</sub> = 5.5V; F <sub>CLK</sub> = 10.0 MHz; SO = Open
			—	2.5	mA	V <sub>CC</sub> = 2.5V; F <sub>CLK</sub> = 5.0 MHz; SO = Open
D011	I <sub>CC</sub> Write		—	5	mA	V <sub>CC</sub> = 5.5V
			—	3	mA	V <sub>CC</sub> = 2.5V
D012	I <sub>CCS</sub>	Standby Current	—	5	μA	$\overline{CS}$ = V <sub>CC</sub> = 5.5V, Inputs tied to V <sub>CC</sub> or V <sub>SS</sub> , +125°C
			—	1	μA	$\overline{CS}$ = V <sub>CC</sub> = 5.5V, Inputs tied to V <sub>CC</sub> or V <sub>SS</sub> , +85°C

- Note 1:** Typical measurements taken at room temperature (+25°C).  
**Note 2:** This parameter is periodically sampled and not 100% tested.

**TABLE 1-2: AC CHARACTERISTICS**

AC CHARACTERISTICS			Industrial (I): TA = -40°C to +85°C Vcc = 1.8V to 5.5V Extended (E): TA = -40°C to +125°C Vcc = 1.8V to 5.5V			
Param. No.	Symbol	Characteristic	Minimum	Maximum	Units	Test Conditions
1	FCLK	Clock Frequency	—	10	MHz	$4.5V \leq V_{CC} \leq 5.5V$
			—	5	MHz	$2.5V \leq V_{CC} < 4.5V$
			—	3	MHz	$1.8V \leq V_{CC} < 2.5V$
2	TCSS	$\overline{CS}$ Setup Time	50	—	ns	$4.5V \leq V_{CC} \leq 5.5V$
			100	—	ns	$2.5V \leq V_{CC} < 4.5V$
			150	—	ns	$1.8V \leq V_{CC} < 2.5V$
3	TCSH	$\overline{CS}$ Hold Time	100	—	ns	$4.5V \leq V_{CC} \leq 5.5V$
			200	—	ns	$2.5V \leq V_{CC} < 4.5V$
			250	—	ns	$1.8V \leq V_{CC} < 2.5V$
4	TCSD	$\overline{CS}$ Disable Time	50	—	ns	
5	TSU	Data Setup Time	10	—	ns	$4.5V \leq V_{CC} \leq 5.5V$
			20	—	ns	$2.5V \leq V_{CC} < 4.5V$
			30	—	ns	$1.8V \leq V_{CC} < 2.5V$
6	THD	Data Hold Time	20	—	ns	$4.5V \leq V_{CC} \leq 5.5V$
			40	—	ns	$2.5V \leq V_{CC} < 4.5V$
			50	—	ns	$1.8V \leq V_{CC} < 2.5V$
7	TR	CLK Rise Time	—	100	ns	Note 1
8	TF	CLK Fall Time	—	100	ns	Note 1
9	THI	Clock High Time	50	—	ns	$4.5V \leq V_{CC} \leq 5.5V$
			100	—	ns	$2.5V \leq V_{CC} < 4.5V$
			150	—	ns	$1.8V \leq V_{CC} < 2.5V$
10	TLO	Clock Low Time	50	—	ns	$4.5V \leq V_{CC} \leq 5.5V$
			100	—	ns	$2.5V \leq V_{CC} < 4.5V$
			150	—	ns	$1.8V \leq V_{CC} < 2.5V$
11	TCLD	Clock Delay Time	50	—	ns	
12	TCLE	Clock Enable Time	50	—	ns	
13	TV	Output Valid from Clock Low	—	50	ns	$4.5V \leq V_{CC} \leq 5.5V$
			—	100	ns	$2.5V \leq V_{CC} < 4.5V$
			—	160	ns	$1.8V \leq V_{CC} < 2.5V$
14	THO	Output Hold Time	0	—	ns	Note 1
15	TDIS	Output Disable Time	—	40	ns	$4.5V \leq V_{CC} \leq 5.5V$ (Note 1)
			—	80	ns	$2.5V \leq V_{CC} < 4.5V$ (Note 1)
			—	160	ns	$1.8V \leq V_{CC} < 2.5V$ (Note 1)
16	THS	$\overline{HOLD}$ Setup Time	20	—	ns	$4.5V \leq V_{CC} \leq 5.5V$
			40	—	ns	$2.5V \leq V_{CC} < 4.5V$
			80	—	ns	$1.8V \leq V_{CC} < 2.5V$

**Note 1:** This parameter is periodically sampled and not 100% tested.

**2:** TWC begins on the rising edge of  $\overline{CS}$  after a valid write sequence and ends when the internal write cycle is complete.

**3:** This parameter is not tested but ensured by characterization.

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**TABLE 1-2: AC CHARACTERISTICS (CONTINUED)**

AC CHARACTERISTICS			Industrial (I): TA = -40°C to +85°C Vcc = 1.8V to 5.5V Extended (E): TA = -40°C to +125°C Vcc = 1.8V to 5.5V			
Param. No.	Symbol	Characteristic	Minimum	Maximum	Units	Test Conditions
17	T <sub>HH</sub>	$\overline{\text{HOLD}}$ Hold Time	20	—	ns	4.5V ≤ Vcc ≤ 5.5V
			40	—	ns	2.5V ≤ Vcc < 4.5V
			80	—	ns	1.8V ≤ Vcc < 2.5V
18	T <sub>HZ</sub>	$\overline{\text{HOLD}}$ Low to Output High-Z	—	30	ns	4.5V ≤ Vcc ≤ 5.5V (Note 1)
			—	60	ns	2.5V ≤ Vcc < 4.5V (Note 1)
			—	160	ns	1.8V ≤ Vcc < 2.5V (Note 1)
19	T <sub>HV</sub>	$\overline{\text{HOLD}}$ High to Output Valid	—	30	ns	4.5V ≤ Vcc ≤ 5.5V
			—	60	ns	2.5V ≤ Vcc < 4.5V
			—	160	ns	1.8V ≤ Vcc < 2.5V
20	T <sub>WC</sub>	Internal Write Cycle Time	—	5	ms	Note 2
21		Endurance	1M	—	E/W Cycles	+25°C, Vcc = 5.5V (Note 3)

**Note 1:** This parameter is periodically sampled and not 100% tested.

**2:** T<sub>WC</sub> begins on the rising edge of  $\overline{\text{CS}}$  after a valid write sequence and ends when the internal write cycle is complete.

**3:** This parameter is not tested but ensured by characterization.

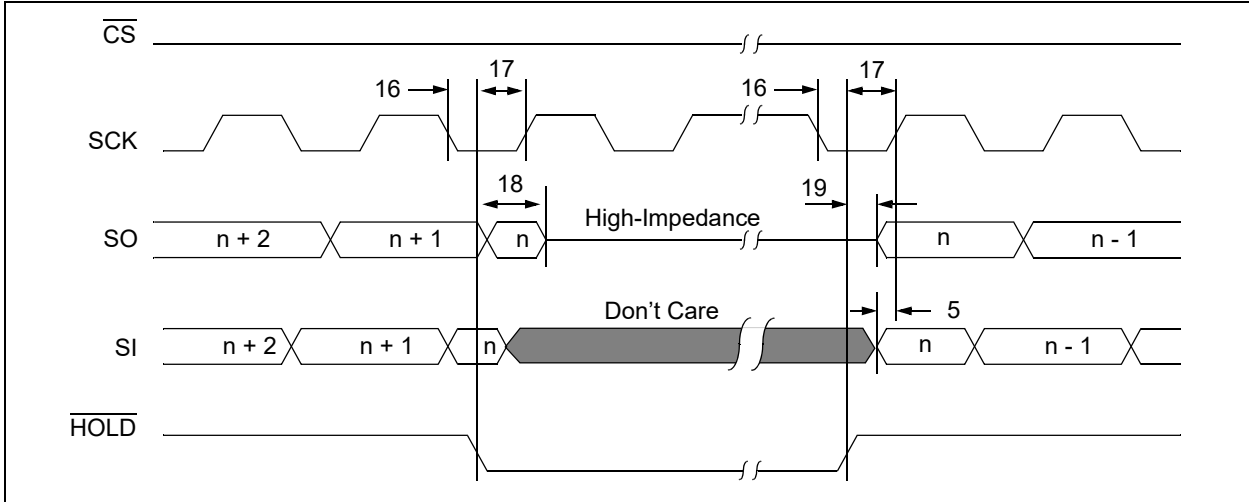
**TABLE 1-3: AC TEST CONDITIONS**

AC Waveform	
V <sub>LO</sub> = 0.2V	—
V <sub>HI</sub> = Vcc – 0.2V	Note 1
V <sub>HI</sub> = 4.0V	Note 2
C <sub>L</sub> = 50 pF	—
Timing Measurement Reference Level	
Input	0.5 Vcc
Output	0.5 Vcc

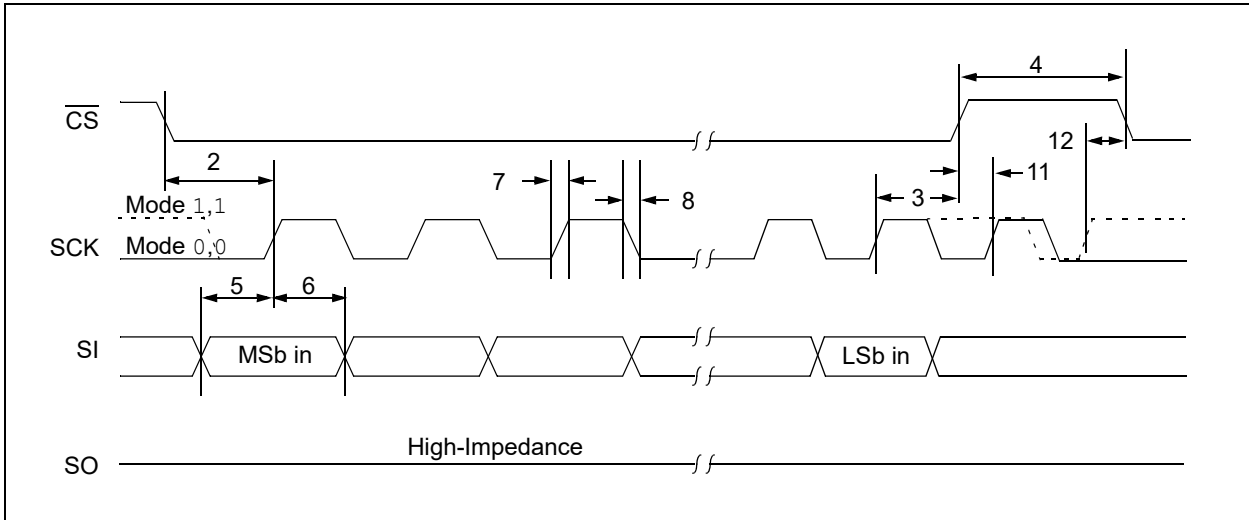
**Note 1:** For Vcc ≤ 4.0V

**2:** For Vcc > 4.0V

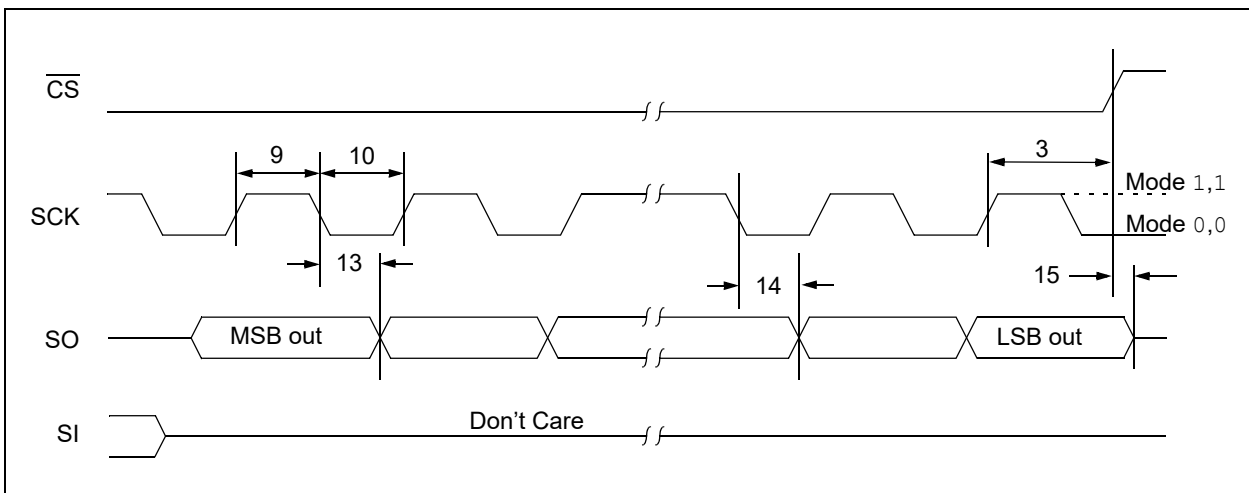
**FIGURE 1-1: HOLD TIMING**



**FIGURE 1-2: SERIAL INPUT TIMING**



**FIGURE 1-3: SERIAL OUTPUT TIMING**



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## 2.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in [Table 2-1](#).

**TABLE 2-1: PIN FUNCTION TABLE**

Name	DFN-S <sup>(1)</sup>	PDIP	SOIC	TSSOP	Rotated TSSOP	Function
$\overline{\text{CS}}$	1	1	1	1	3	Chip Select Input
SO	2	2	2	2	4	Serial Data Output
$\overline{\text{WP}}$	3	3	3	3	5	Write-Protect Pin
Vss	4	4	4	4	6	Ground
SI	5	5	5	5	7	Serial Data Input
SCK	6	6	6	6	8	Serial Clock Input
$\overline{\text{HOLD}}$	7	7	7	7	1	Hold Input
Vcc	8	8	8	8	2	Supply Voltage

**Note 1:** Exposed pad on DFN-S package can be connected to Vss or left floating.

### 2.1 Chip Select ( $\overline{\text{CS}}$ )

A low level on this pin selects the device. A high level deselects the device and forces it into Standby mode. However, a programming cycle which is already initiated or in progress will be completed, regardless of the  $\overline{\text{CS}}$  input signal. If  $\overline{\text{CS}}$  is brought high during a program cycle, the device will go into Standby mode as soon as the programming cycle is complete. When the device is deselected, SO goes to the high-impedance state, allowing multiple parts to share the same SPI bus. A low-to-high transition on  $\overline{\text{CS}}$  after a valid write sequence initiates an internal write cycle. After power-up, a low level on  $\overline{\text{CS}}$  is required prior to any sequence being initiated.

### 2.2 Serial Output (SO)

The SO pin is used to transfer data out of the 25XX256. During a read cycle, data are shifted out on this pin after the falling edge of the serial clock.

### 2.3 Write-Protect ( $\overline{\text{WP}}$ )

This pin is used in conjunction with the WPEN bit in the STATUS register to prohibit writes to the nonvolatile bits in the STATUS register. When  $\overline{\text{WP}}$  is low and WPEN is high, writing to the nonvolatile bits in the STATUS register is disabled. All other operations function normally. When  $\overline{\text{WP}}$  is high, all functions, including writes to the nonvolatile bits in the STATUS register, operate normally. If the WPEN bit is set,  $\overline{\text{WP}}$  low during a STATUS register write sequence will disable writing to the STATUS register. If an internal write cycle has already begun,  $\overline{\text{WP}}$  going low will have no effect on the write. The  $\overline{\text{WP}}$  pin function is blocked when the WPEN bit in the STATUS register is low. This allows the user to install the 25XX256 in a system with  $\overline{\text{WP}}$  pin grounded and still be able to write to the STATUS register. The  $\overline{\text{WP}}$  pin functions will be enabled when the WPEN bit is set high.

### 2.4 Serial Input (SI)

The SI pin is used to transfer data into the device. It receives instructions, addresses and data. Data are latched on the rising edge of the serial clock.

### 2.5 Serial Clock (SCK)

The SCK is used to synchronize the communication between a host and the 25XX256. Instructions, addresses or data present on the SI pin are latched on the rising edge of the clock input, while data on the SO pin is updated after the falling edge of the clock input.

### 2.6 Hold ( $\overline{\text{HOLD}}$ )

The  $\overline{\text{HOLD}}$  pin is used to suspend transmission to the 25XX256 while in the middle of a serial sequence without having to retransmit the entire sequence again. It must be held high any time this function is not being used. Once the device is selected and a serial sequence is underway, the  $\overline{\text{HOLD}}$  pin may be pulled low to pause further serial communication without resetting the serial sequence. The  $\overline{\text{HOLD}}$  pin must be brought low while SCK is low, otherwise the HOLD function will not be invoked until the next SCK high-to-low transition. The 25XX256 must remain selected during this sequence. The SI and SCK levels are "don't cares" during the time the device is paused and any transitions on these pins will be ignored. To resume serial communication,  $\overline{\text{HOLD}}$  must be brought high while the SCK pin is low, otherwise serial communication will not be resumed until the next SCK high-to-low transition.

The SO line will tri-state immediately upon a high-to-low transition of the  $\overline{\text{HOLD}}$  pin and will begin outputting again immediately upon a subsequent low-to-high transition of the  $\overline{\text{HOLD}}$  pin, independent of the state of SCK.

## 3.0 FUNCTIONAL DESCRIPTION

### 3.1 Principles of Operation

The 25XX256 is a 32,768-byte Serial EEPROM designed to interface directly with the Serial Peripheral Interface (SPI) port of many of today's popular micro controller families, including Microchip's PIC® micro-controllers. It may also interface with microcontrollers that do not have a built-in SPI port by using discrete I/O lines programmed properly in firmware to match the SPI protocol.

The 25XX256 contains an 8-bit instruction register. The device is accessed via the SI pin, with data being clocked in on the rising edge of SCK. The  $\overline{\text{CS}}$  pin must be low and the  $\overline{\text{HOLD}}$  pin must be high for the entire operation.

Table 3-1 contains a list of the possible instruction bytes and format for device operation. All instructions, addresses and data are transferred MSb first, LSB last.

Data (SI) are sampled on the first rising edge of SCK after  $\overline{\text{CS}}$  goes low. If the clock line is shared with other peripheral devices on the SPI bus, the user can assert the  $\overline{\text{HOLD}}$  input and place the 25XX256 in HOLD mode. After releasing the  $\overline{\text{HOLD}}$  pin, operation will resume from the point when the  $\overline{\text{HOLD}}$  was asserted.

### BLOCK DIAGRAM

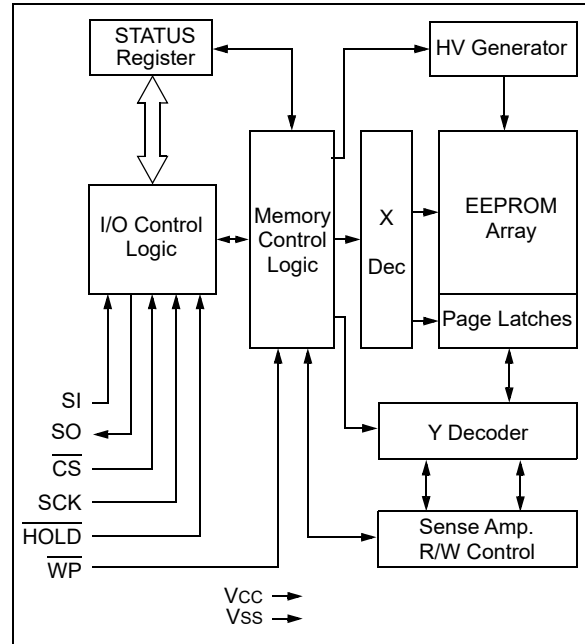


TABLE 3-1: INSTRUCTION SET

Instruction Name	Instruction Format	Description
READ	0000 0011	Read data from memory array beginning at selected address
WRITE	0000 0010	Write data to memory array beginning at selected address
WRDI	0000 0100	Reset the write enable latch (disable write operations)
WREN	0000 0110	Set the write enable latch (enable write operations)
RDSR	0000 0101	Read STATUS register
WRSR	0000 0001	Write STATUS register

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## 3.2 Read Sequence

The device is selected by pulling  $\overline{CS}$  low. The 8-bit `READ` instruction is transmitted to the 25XX256 followed by the 16-bit address, with the first MSb of the address being a “don’t care” bit. After the correct `READ` instruction and address are sent, the data stored in the memory at the selected address are shifted out on the `SO` pin. The data stored in the memory at the next address can be read sequentially by continuing to provide clock pulses. The internal Address Pointer is automatically incremented to the next higher address after each byte of data is shifted out. When the highest address is reached (7FFFh), the address counter rolls over to address 0000h allowing the read cycle to be continued indefinitely. The read operation is terminated by raising the  $\overline{CS}$  pin (Figure 3-1).

## 3.3 Write Sequence

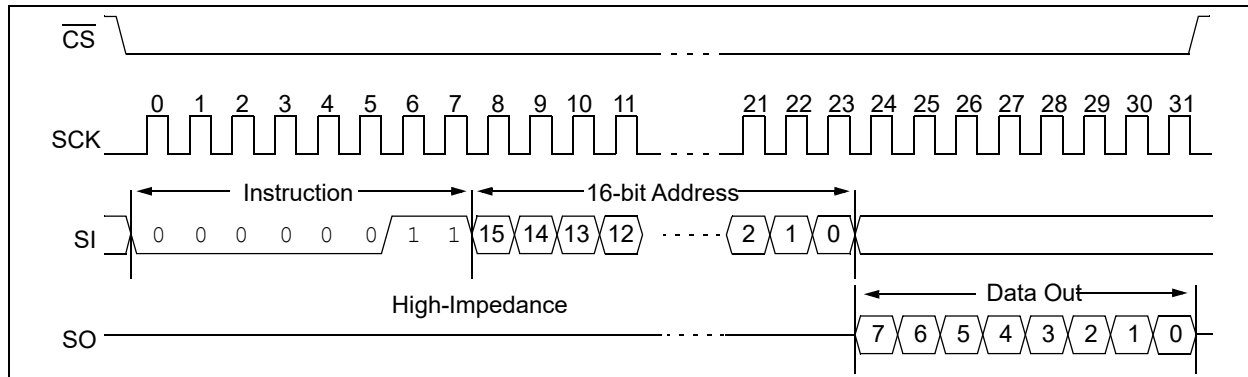
Prior to any attempt to write data to the 25XX256, the write enable latch must be set by issuing the `WREN` instruction (Figure 3-4). This is done by setting  $\overline{CS}$  low and then clocking out the proper instruction into the 25XX256. After all eight bits of the instruction are transmitted, the  $\overline{CS}$  must be brought high to set the write enable latch. If the write operation is initiated immediately after the `WREN` instruction without  $\overline{CS}$  being brought high, the data will not be written to the array because the write enable latch will not have been properly set.

Once the write enable latch is set, the user may proceed by setting the  $\overline{CS}$  low, issuing a `WRITE` instruction, followed by the 16-bit address, with the first MSb of the address being a “don’t care” bit and then the data to be written. Up to 64 bytes of data can be sent to the device before a write cycle is necessary. The only restriction is that all of the bytes must reside in the same page.

**Note:** Page write operations are limited to writing bytes within a single physical page, **regardless** of the number of bytes actually being written. Physical page boundaries start at addresses that are integer multiples of the page buffer size (or ‘page size’) and, end at addresses that are integer multiples of page size – 1. If a page write command attempts to write across a physical page boundary, the result is that the data wraps around to the beginning of the current page (overwriting data previously stored there), instead of being written to the next page as might be expected. It is therefore necessary for the application software to prevent page write operations that would attempt to cross a page boundary.

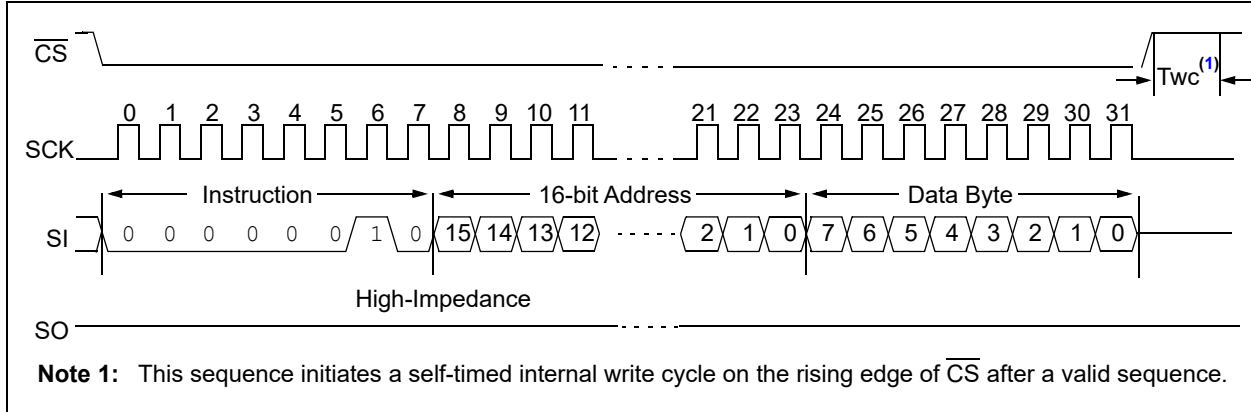
For the data to be actually written to the array, the  $\overline{CS}$  must be brought high after the Least Significant bit (D0) of the  $n^{th}$  data byte has been clocked in. If  $\overline{CS}$  is brought high at any other time, the write operation will not be completed. Refer to Figure 3-2 and Figure 3-3 for more detailed illustrations on the byte write sequence and the page write sequence, respectively. While the write is in progress, the `STATUS` register may be read to check the status of the Write-In-Process (WIP) bit (Figure 3-6). A read attempt of a memory array location will not be possible during a write cycle. When the write cycle is completed, the write enable latch is reset.

FIGURE 3-1: READ SEQUENCE

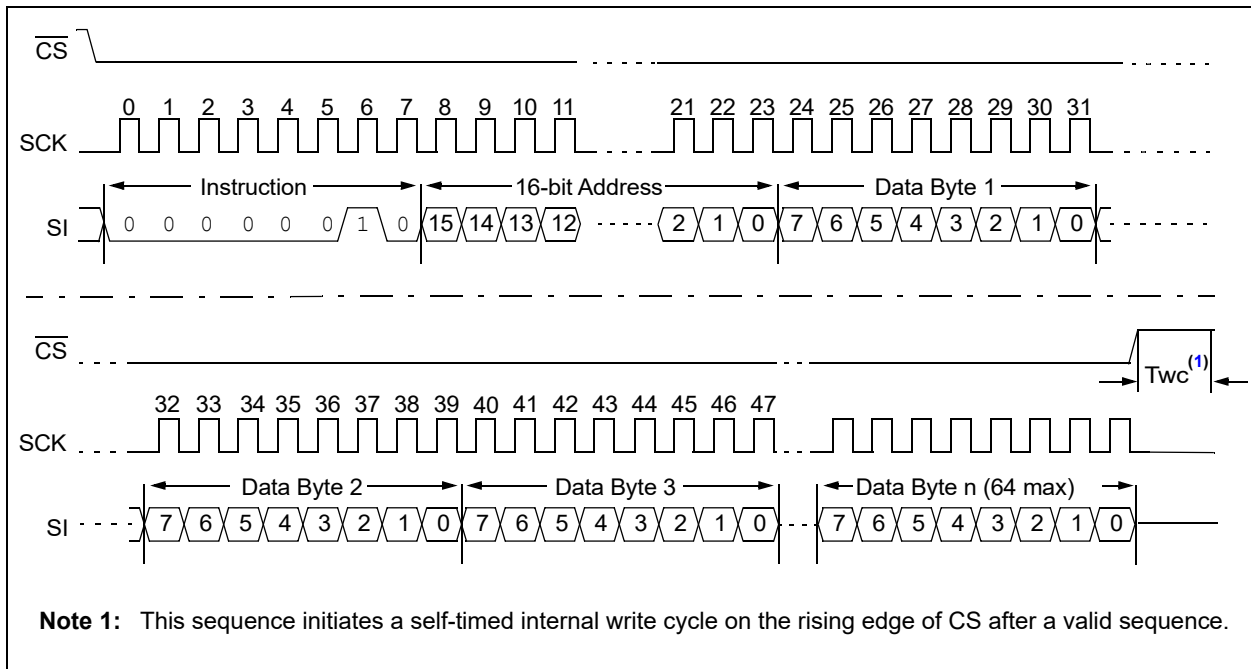




**FIGURE 3-2: BYTE WRITE SEQUENCE**



**FIGURE 3-3: PAGE WRITE SEQUENCE**



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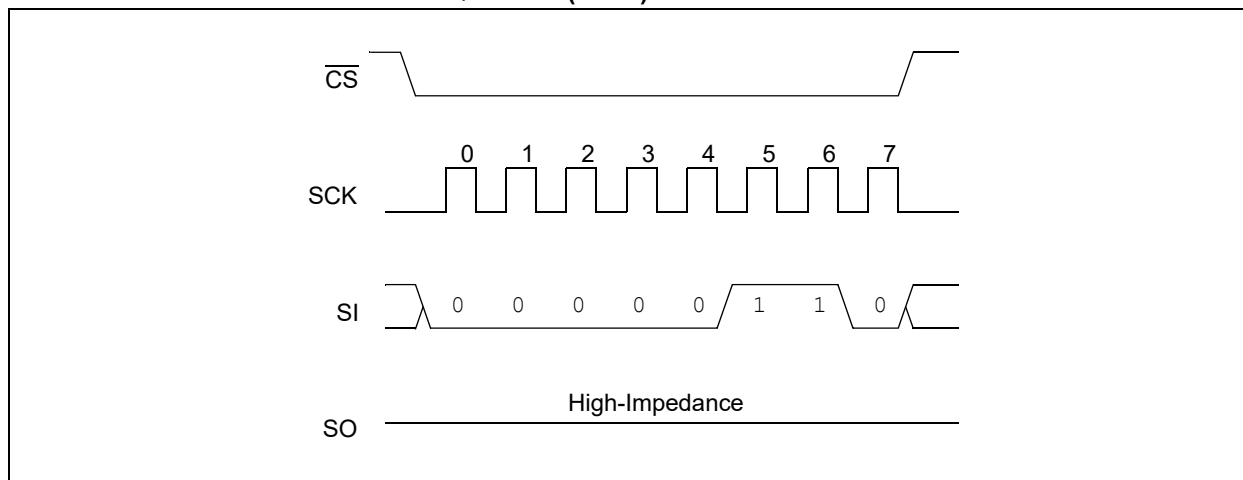
## 3.4 Write Enable (WREN) and Write Disable (WRDI)

The 25XX256 contains a write enable latch. See [Table 5-1](#) for the Write-Protect Functionality Matrix. This latch must be set before any write operation will be completed internally. The WREN instruction will set the latch and the WRDI will reset the latch.

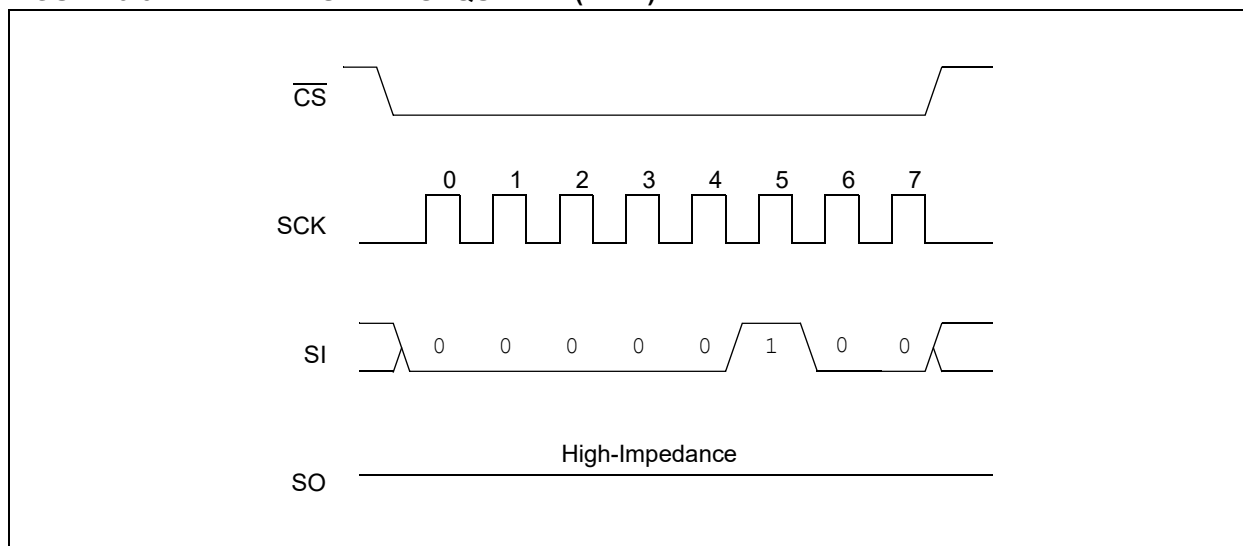
The following is a list of conditions under which the write enable latch will be reset:

- Power-up
- WRDI instruction successfully executed
- WRSR instruction successfully executed
- WRITE instruction successfully executed

**FIGURE 3-4: WRITE ENABLE SEQUENCE (WREN)**



**FIGURE 3-5: WRITE DISABLE SEQUENCE (WRDI)**



## 3.5 Read STATUS Register Instruction (RDSR)

The Read STATUS Register instruction (RDSR) provides access to the STATUS register. The STATUS register may be read at any time, even during a write cycle. The STATUS register is formatted as follows:

**TABLE 3-2: STATUS REGISTER**

7	6	5	4	3	2	1	0
W/R	-	-	-	W/R	W/R	R	R
WPEN	x	x	x	BP1	BP0	WEL	WIP

**Note 1:** W/R = writable/readable. R = read-only.

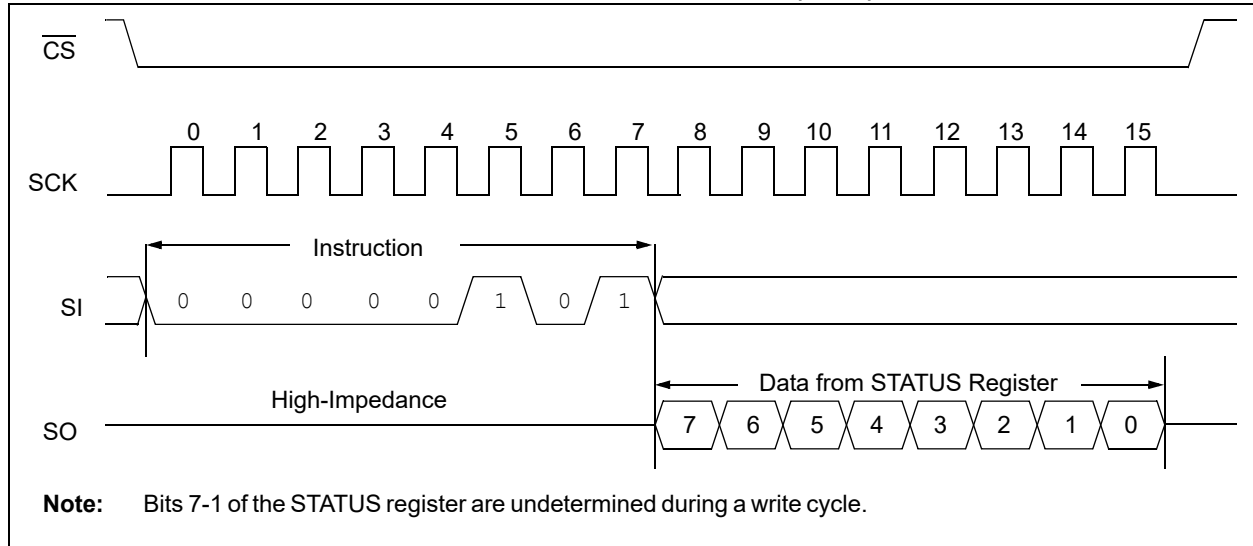
The **Write-In-Process (WIP)** bit indicates whether the 25XX256 is busy with a write operation. When set to a '1', a write is in progress, when set to a '0', no write is in progress. This bit is read-only.

The **Write Enable Latch (WEL)** bit indicates the STATUS of the write enable latch and is read-only. When set to a '1', the latch allows writes to the array, when set to a '0', the latch prohibits writes to the array. The state of this bit can always be updated via the WREN or WRDI commands, regardless of the state of write protection on the STATUS register. These commands are shown in Figure 3-4 and Figure 3-5.

The **Block Protection (BP0 and BP1)** bits indicate which blocks are currently write-protected. These bits are set by the user issuing the WRSR instruction. These bits are nonvolatile and are shown in Table 3-3.

See Figure 3-6 for the RDSR timing sequence.

**FIGURE 3-6: READ STATUS REGISTER TIMING SEQUENCE (RDSR)**



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## 3.6 Write STATUS Register Instruction (WRSR)

The Write STATUS Register instruction ( $WRSR$ ) allows the user to write to the nonvolatile bits in the STATUS register as shown in Table 3-2. The user is able to select one of four levels of protection for the array by writing to the appropriate bits in the STATUS register. The array is divided up into four segments. The user has the ability to write-protect none, one, two or all four of the segments of the array. The partitioning is controlled as shown in Table 3-3.

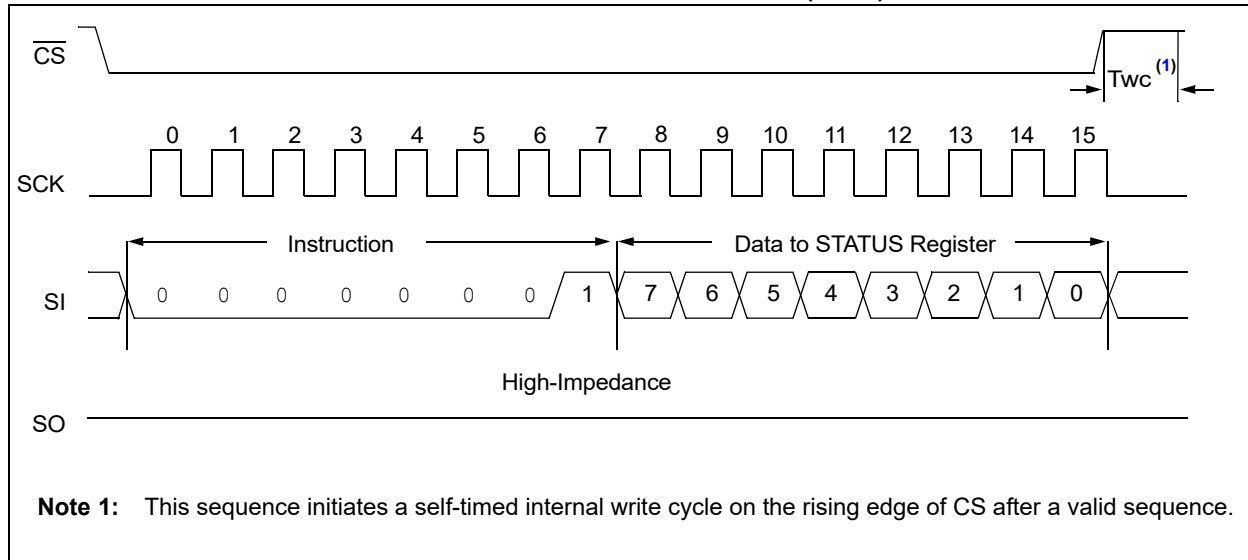
The Write-Protect Enable (WPEN) bit is a nonvolatile bit that is available as an enable bit for the  $\overline{WP}$  pin. The Write-Protect ( $\overline{WP}$ ) pin and the Write-Protect Enable (WPEN) bit in the STATUS register control the programmable hardware write-protect feature. Hardware write protection is enabled when  $\overline{WP}$  pin is low and the WPEN bit is high. Hardware write protection is disabled when either the  $\overline{WP}$  pin is high or the WPEN bit is low. When the chip is hardware Write-Protected, only writes to nonvolatile bits in the STATUS register are disabled. See Table 5-1 for a matrix of functionality on the WPEN bit.

See Figure 3-7 for the  $WRSR$  timing sequence.

TABLE 3-3: ARRAY PROTECTION

BP1	BP0	Array Addresses Write Protected
0	0	none
0	1	upper 1/4 (6000h-7FFFh)
1	0	upper 1/2 (4000h-7FFFh)
1	1	all (0000h-7FFFh)

FIGURE 3-7: WRITE STATUS REGISTER TIMING SEQUENCE ( $WRSR$ )



## 4.0 DATA PROTECTION

The following protection has been implemented to prevent inadvertent writes to the array:

- The write enable latch is reset on power-up
- A write enable instruction must be issued to set the write enable latch
- After a byte write, page write or STATUS register write, the write enable latch is reset
- $\overline{CS}$  must be set high after the proper number of clock cycles to start an internal write cycle
- Access to the array during an internal write cycle is ignored and programming is continued

## 5.0 POWER-ON STATE

The 25XX256 powers on in the following state:

- The device is in low-power Standby Mode ( $\overline{CS} = 1$ )
- The write enable latch is reset
- SO is in high-impedance state
- A high-to-low-level transition on  $\overline{CS}$  is required to enter active state

**TABLE 5-1: WRITE-PROTECT FUNCTIONALITY MATRIX**

WEL (SR bit 1)	WPEN (SR bit 7)	$\overline{WP}$ pin	Protected Blocks	Unprotected Blocks	STATUS Register
0	x	x	Protected	Protected	Protected
1	0	x	Protected	Writable	Writable
1	1	0 (low)	Protected	Writable	Protected
1	1	1 (high)	Protected	Writable	Writable

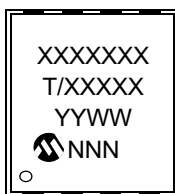
**Note 1:** x = don't care

# 25AA256/25LC256

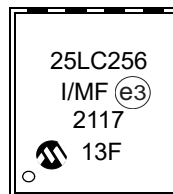
## 6.0 PACKAGING INFORMATION

### 6.1 Package Marking Information

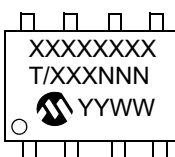
8-Lead DFN-S



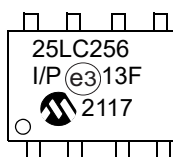
Example



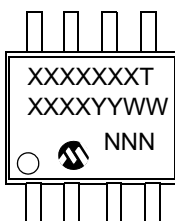
8-Lead PDIP



Example



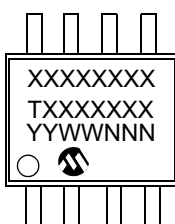
8-Lead SOIC



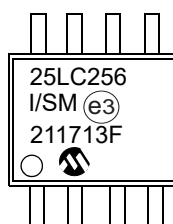
Example



8-Lead SOIJ



Example



8-Lead TSSOP



Example



# 25AA256/25LC256

1 <sup>st</sup> Line Marking Codes						
Device	DFN-S	PDIP	SOIC	SOIJ	TSSOP	Rotated TSSOP
25AA256	25AA256	25AA256	25AA256T	25AA256	5AE	5AEX
25LC256	25LC256	25LC256	25LC256T	25LC256	5LE	5LEX

<b>Legend:</b>	XX...X	Part number or part number code
	T	Temperature (I, E)
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code (2 characters for small packages)
	(e3)	RoHS-compliant JEDEC designator for Matte Tin (Sn)

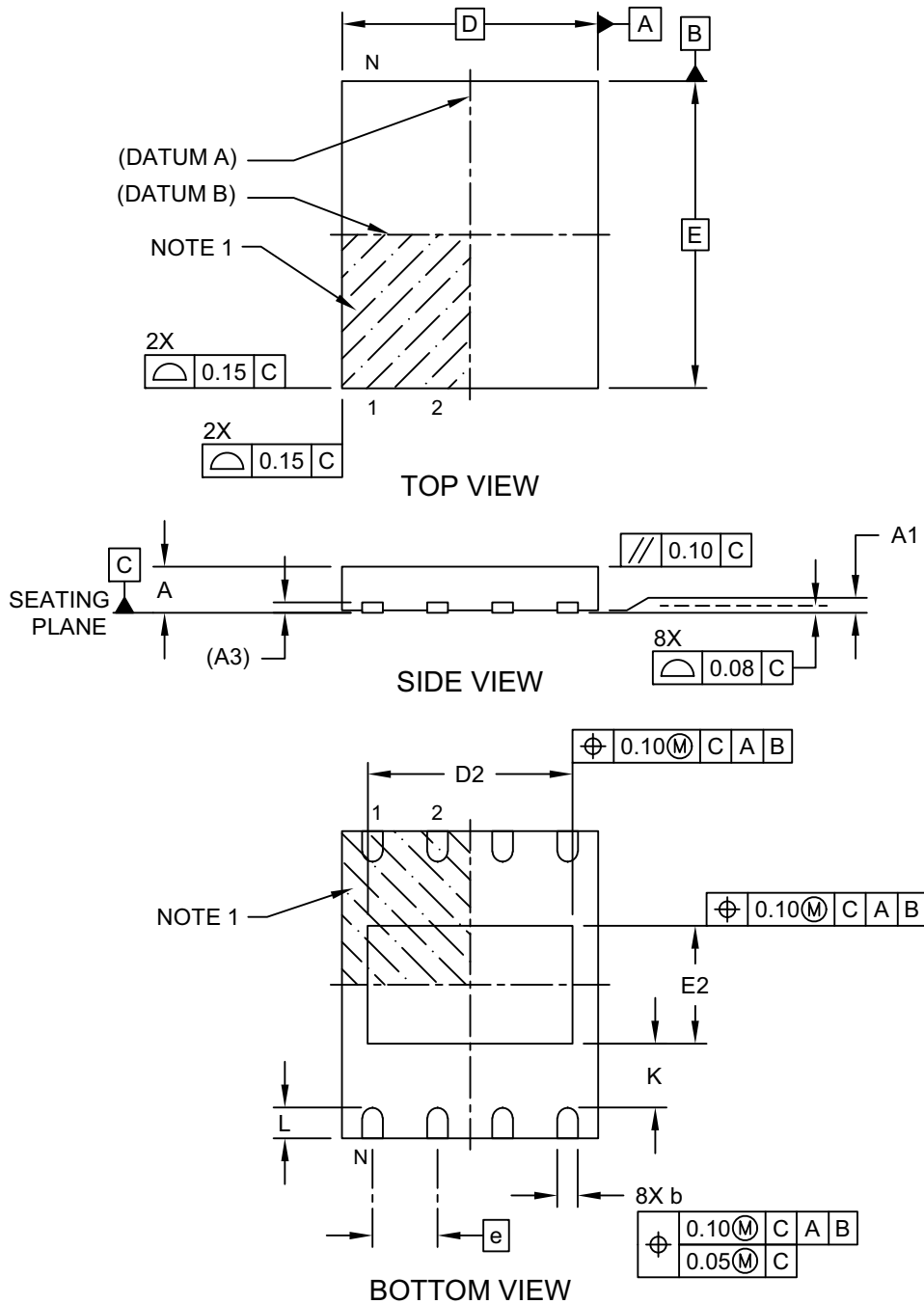
**Note:** For very small packages with no room for the RoHS-compliant JEDEC designator (e3), the marking will only appear on the outer carton or reel label.

**Note:** In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information.

# 25AA256/25LC256

## 8-Lead Plastic Dual Flat, No Lead Package (MF) - 6x5 mm Body [DFN-S] Saw Singulated

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>

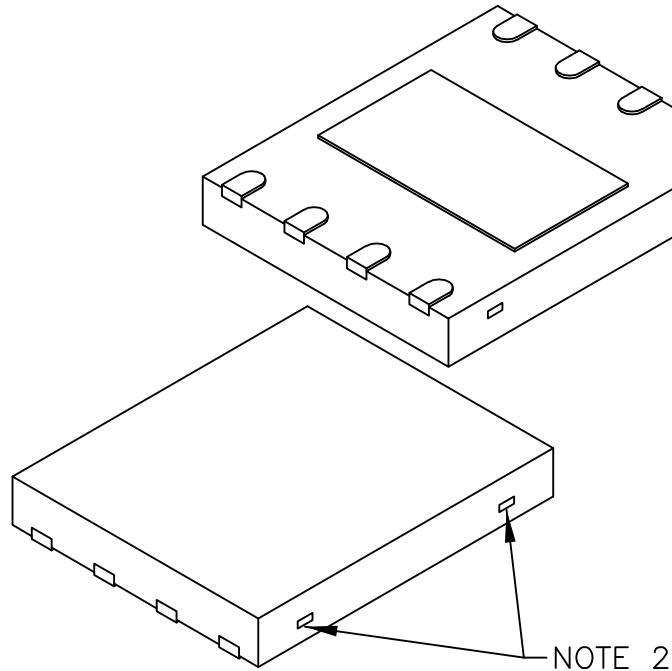


Microchip Technology Drawing C04-122 Rev C Sheet 1 of 2



## 8-Lead Plastic Dual Flat, No Lead Package (MF) - 6x5 mm Body [DFN-S] Saw Singulated

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Number of Terminals	N	8		
Pitch	e	1.27 BSC		
Overall Height	A	0.80	0.85	1.00
Standoff	A1	0.00	0.02	0.05
Terminal Thickness	A3	0.20 REF		
Overall Length	D	5.00 BSC		
Exposed Pad Length	D2	3.90	4.00	4.10
Overall Width	E	6.00 BSC		
Exposed Pad Width	E2	2.20	2.30	2.40
Terminal Width	b	0.30	0.40	0.50
Terminal Length	L	0.50	0.60	0.75
Terminal-to-Exposed-Pad	K	0.20	-	-

**Notes:**

- Pin 1 visual index feature may vary, but must be located within the hatched area.
- Package may have one or more exposed tie bars at ends.
- Package is saw singulated
- Dimensioning and tolerancing per ASME Y14.5M

BSC: Basic Dimension. Theoretically exact value shown without tolerances.

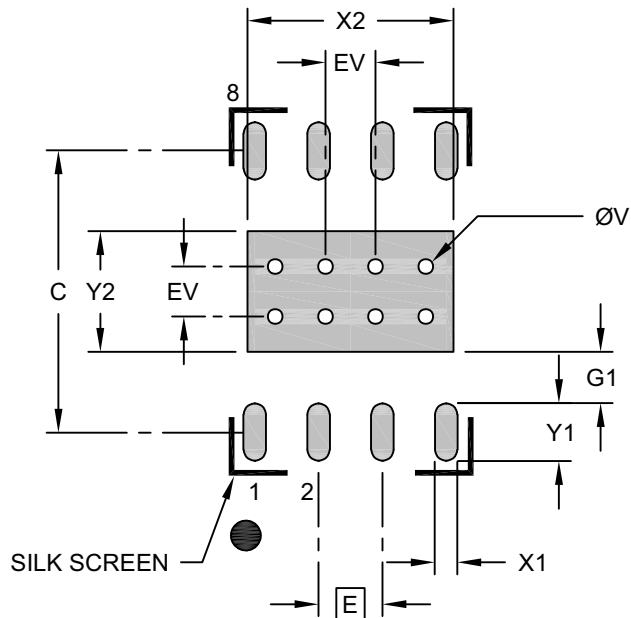
REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-122 Rev C Sheet 2 of 2

# 25AA256/25LC256

## 8-Lead Plastic Dual Flat, No Lead Package (MF) - 6x5 mm Body [DFN-S] Saw Singulated

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packageing>



### RECOMMENDED LAND PATTERN

Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Contact Pitch	E	1.27 BSC		
Optional Center Pad Width	X2			2.40
Optional Center Pad Length	Y2			4.10
Contact Pad Spacing	C		5.60	
Contact Pad Width (X20)	X1			0.45
Contact Pad Length (X20)	Y1			1.15
Contact Pad to Center Pad (X20)	G1	0.20		
Thermal Via Diameter	V		0.30	
Thermal Via Pitch	EV		1.00	

**Notes:**

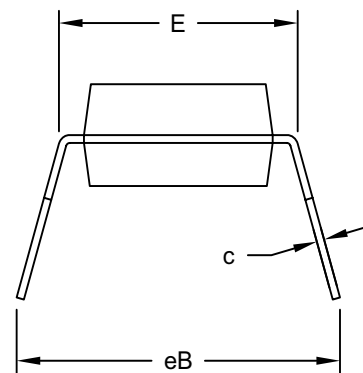
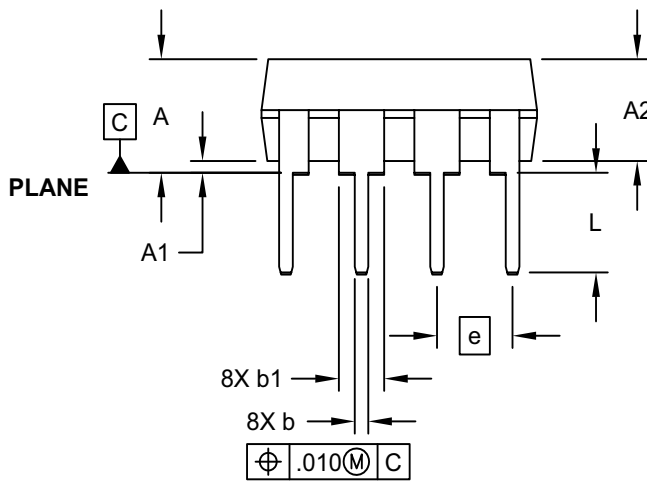
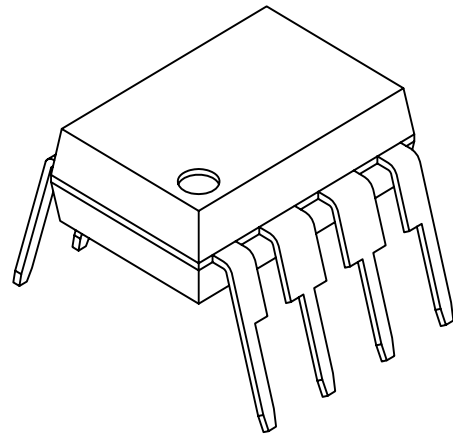
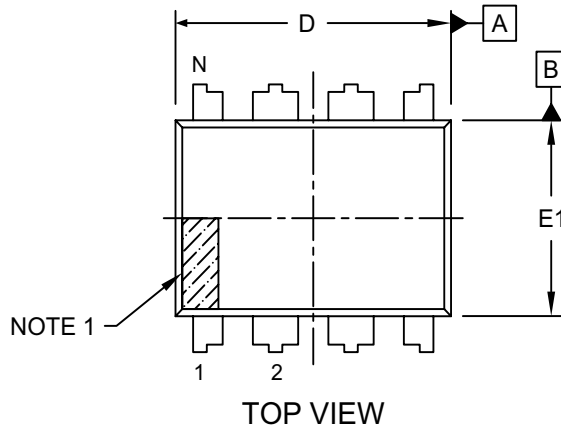
- Dimensioning and tolerancing per ASME Y14.5M  
BSC: Basic Dimension. Theoretically exact value shown without tolerances.
- For best soldering results, thermal vias, if used, should be filled or tented to avoid solder loss during reflow process

Microchip Technology Drawing C04-2122 Rev C

# 25AA256/25LC256

## 8-Lead Plastic Dual In-Line (P) - 300 mil Body [PDIP]

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



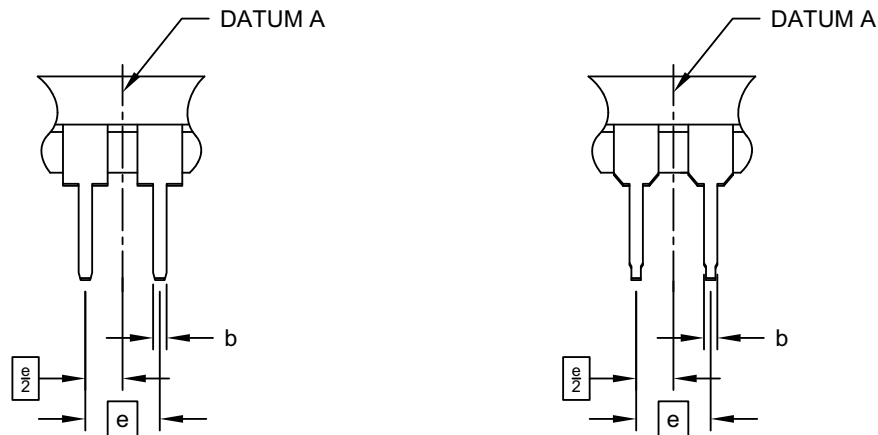
Microchip Technology Drawing No. C04-018-P Rev E Sheet 1 of 2

# 25AA256/25LC256

## 8-Lead Plastic Dual In-Line (P) - 300 mil Body [PDIP]

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>

### ALTERNATE LEAD DESIGN (NOTE 5)



Dimension Limits	Units	INCHES		
		MIN	NOM	MAX
Number of Pins	N	8		
Pitch	e	.100 BSC		
Top to Seating Plane	A	-	-	.210
Molded Package Thickness	A2	.115	.130	.195
Base to Seating Plane	A1	.015	-	-
Shoulder to Shoulder Width	E	.290	.310	.325
Molded Package Width	E1	.240	.250	.280
Overall Length	D	.348	.365	.400
Tip to Seating Plane	L	.115	.130	.150
Lead Thickness	c	.008	.010	.015
Upper Lead Width	b1	.040	.060	.070
Lower Lead Width	b	.014	.018	.022
Overall Row Spacing §	eB	-	-	.430

#### Notes:

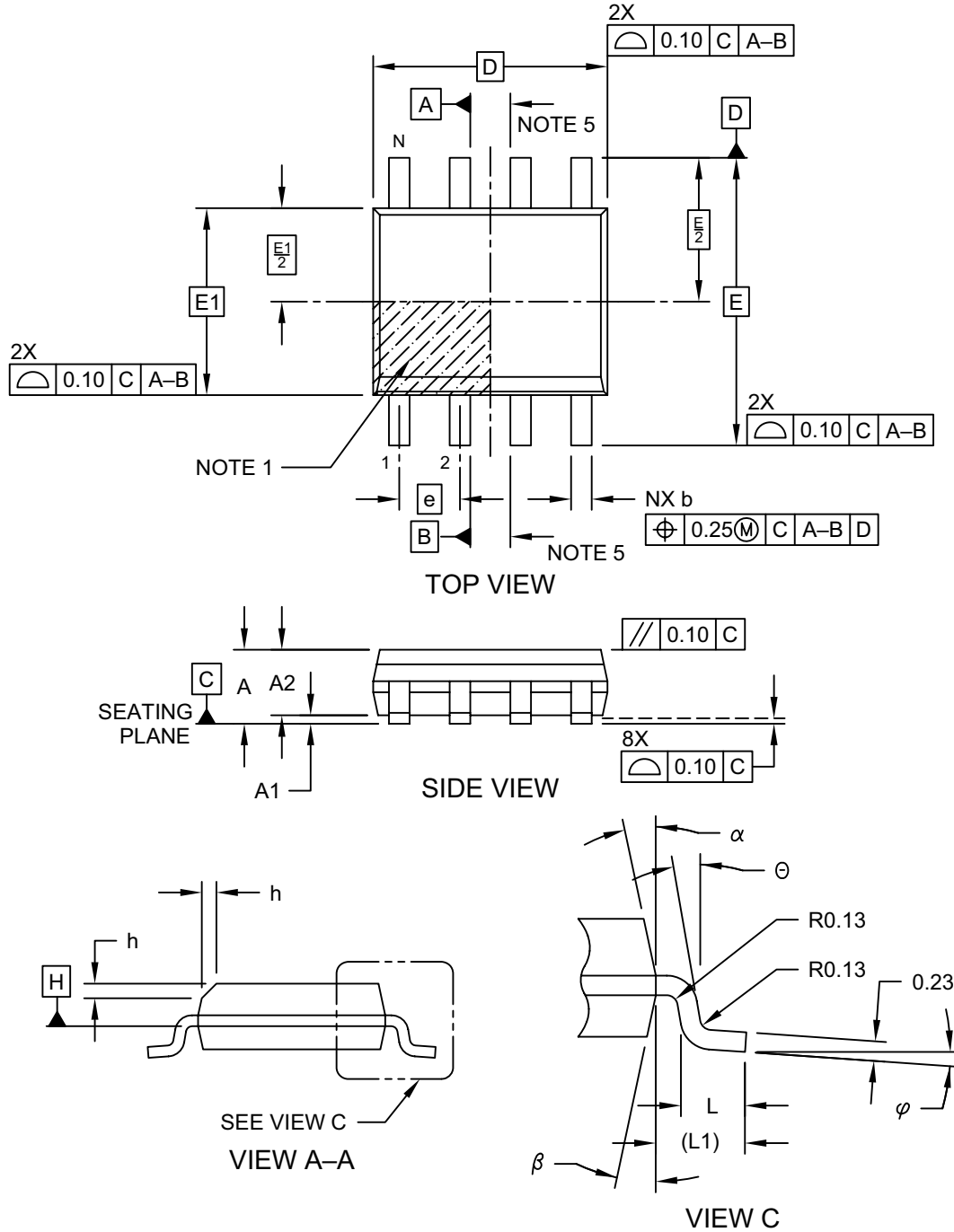
- Pin 1 visual index feature may vary, but must be located within the hatched area.
- § Significant Characteristic
- Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" per side.
- Dimensioning and tolerancing per ASME Y14.5M  
BSC: Basic Dimension. Theoretically exact value shown without tolerances.
- Lead design above seating plane may vary, based on assembly vendor.

Microchip Technology Drawing No. C04-018-P Rev E Sheet 2 of 2

# 25AA256/25LC256

## 8-Lead Plastic Small Outline (SN) - Narrow, 3.90 mm (.150 In.) Body [SOIC]

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>

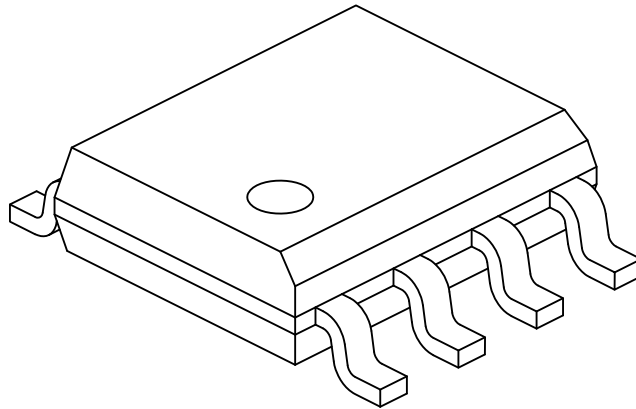


Microchip Technology Drawing No. C04-057-SN Rev F Sheet 1 of 2

# 25AA256/25LC256

## 8-Lead Plastic Small Outline (SN) - Narrow, 3.90 mm (.150 In.) Body [SOIC]

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Number of Pins	N	8		
Pitch	e	1.27 BSC		
Overall Height	A	-	-	1.75
Molded Package Thickness	A2	1.25	-	-
Standoff §	A1	0.10	-	0.25
Overall Width	E	6.00 BSC		
Molded Package Width	E1	3.90 BSC		
Overall Length	D	4.90 BSC		
Chamfer (Optional)	h	0.25	-	0.50
Foot Length	L	0.40	-	1.27
Footprint	L1	1.04 REF		
Foot Angle	φ	0°	-	8°
Lead Thickness	c	0.17	-	0.25
Lead Width	b	0.31	-	0.51
Mold Draft Angle Top	α	5°	-	15°
Mold Draft Angle Bottom	β	5°	-	15°

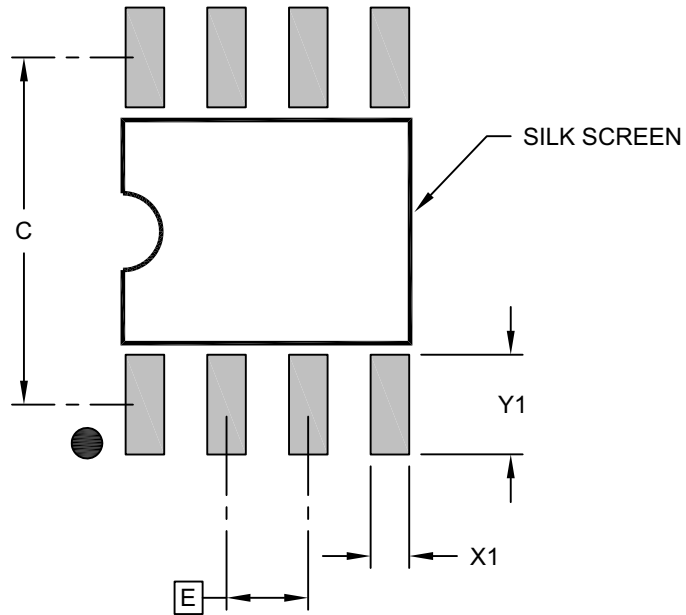
**Notes:**

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. § Significant Characteristic
3. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15mm per side.
4. Dimensioning and tolerancing per ASME Y14.5M  
BSC: Basic Dimension. Theoretically exact value shown without tolerances.  
REF: Reference Dimension, usually without tolerance, for information purposes only.
5. Datums A & B to be determined at Datum H.

Microchip Technology Drawing No. C04-057-SN Rev F Sheet 2 of 2

## 8-Lead Plastic Small Outline (SN) - Narrow, 3.90 mm (.150 In.) Body [SOIC]

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



RECOMMENDED LAND PATTERN

Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Contact Pitch	E	1.27 BSC		
Contact Pad Spacing	C		5.40	
Contact Pad Width (X8)	X1			0.60
Contact Pad Length (X8)	Y1			1.55

**Notes:**

1. Dimensioning and tolerancing per ASME Y14.5M

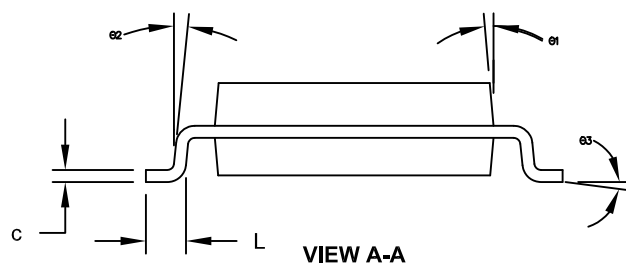
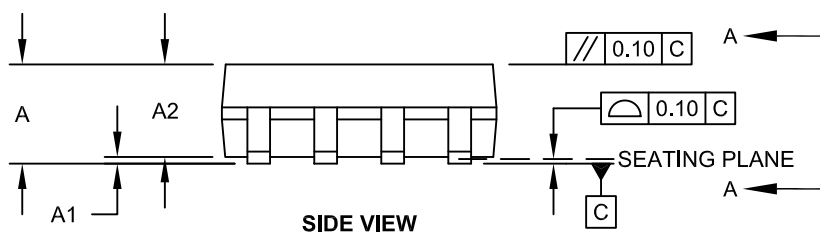
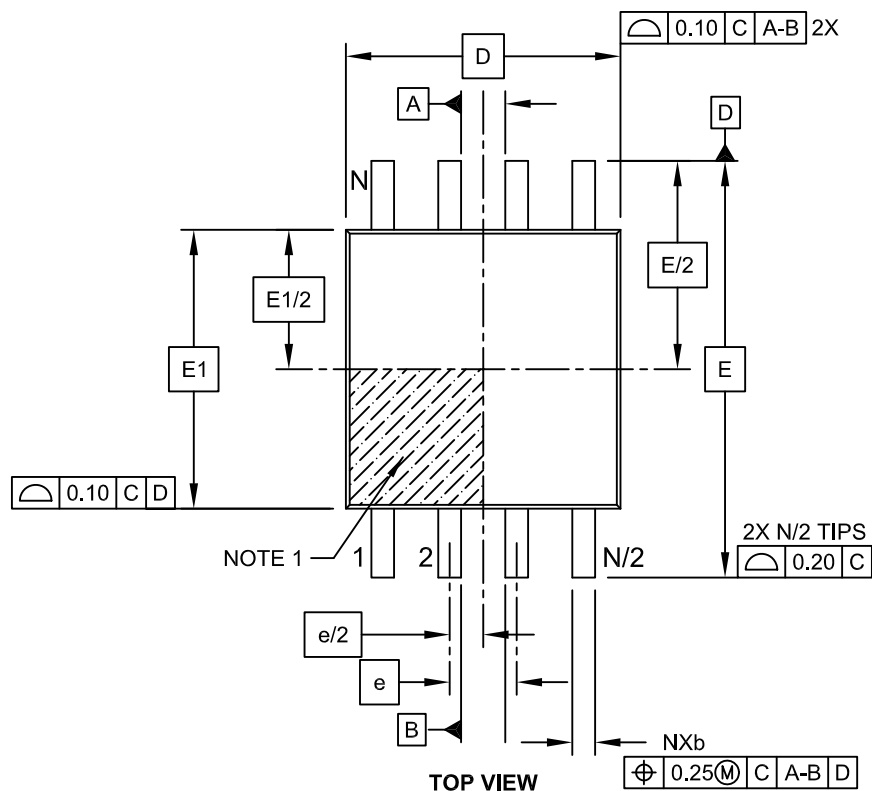
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing C04-2057-SN Rev F

# 25AA256/25LC256

## 8-Lead Plastic Small Outline (SM) - Medium, 5.28 mm Body [SOIJ]

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



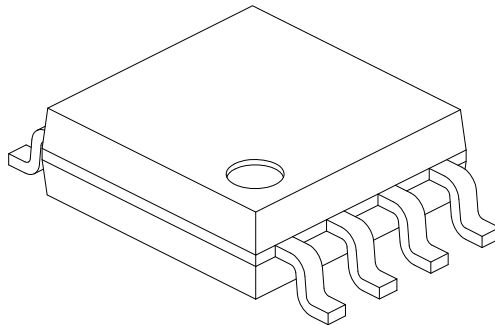
Microchip Technology Drawing C04-056C Sheet 1 of 2



# 25AA256/25LC256

## 8-Lead Plastic Small Outline (SM) - Medium, 5.28 mm Body [SOIJ]

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Number of Pins	N	8		
Pitch	e	1.27 BSC		
Overall Height	A	1.77	-	2.03
Standoff §	A1	0.05		0.25
Molded Package Thickness	A2	1.75	-	1.98
Overall Width	E	7.94 BSC		
Molded Package Width	E1	5.25 BSC		
Overall Length	D	5.26 BSC		
Foot Length	L	0.51	-	0.76
Lead Thickness	c	0.15	-	0.25
Lead Width	b	0.36	-	0.51
Mold Draft Angle	Ø1	-	-	15°
Lead Angle	Ø2	0°	-	8°
Foot Angle	Ø3	0°	-	8°

**Notes:**

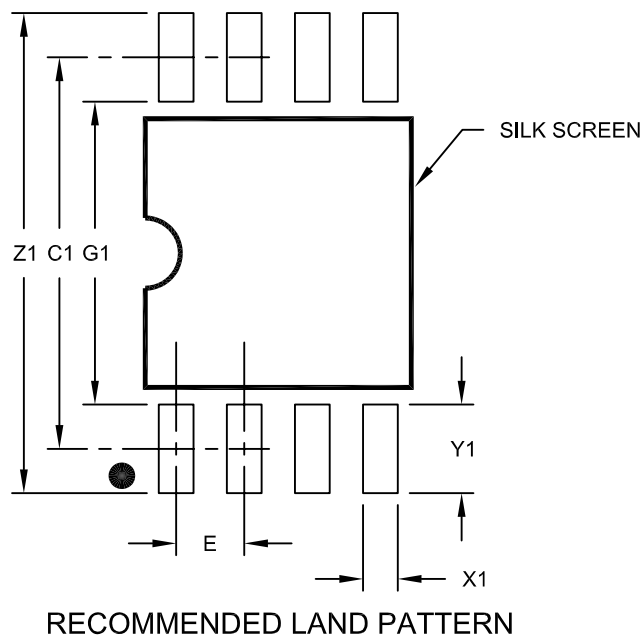
1. SOIJ, JEITA/EIAJ Standard, Formerly called SOIC
2. § Significant Characteristic
3. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.25mm per side.

Microchip Technology Drawing No. C04-056C Sheet 2 of 2

# 25AA256/25LC256

8-Lead Plastic Small Outline (SM) - Medium, 5.28 mm Body [SOIJ]

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



		Units	MILLIMETERS		
Dimension Limits			MIN	NOM	MAX
Contact Pitch	E		1.27 BSC		
Overall Width	Z1				9.00
Contact Pad Spacing	C1			7.30	
Contact Pad Width (X8)	X1				0.65
Contact Pad Length (X8)	Y1				1.70
Distance Between Pads	G1	5.60			
Distance Between Pads	G	0.62			

Notes:

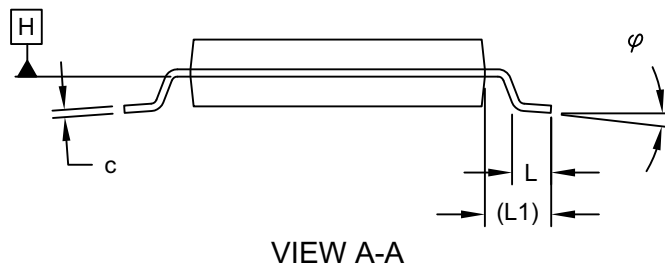
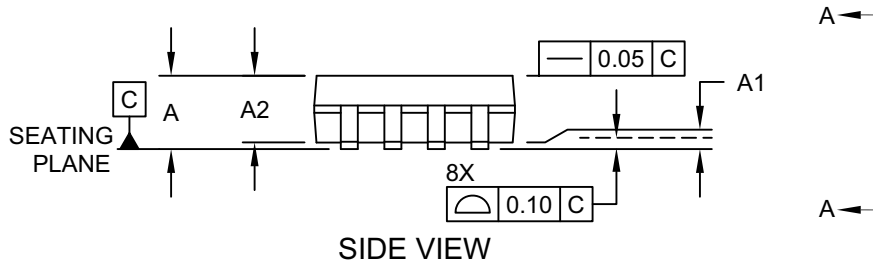
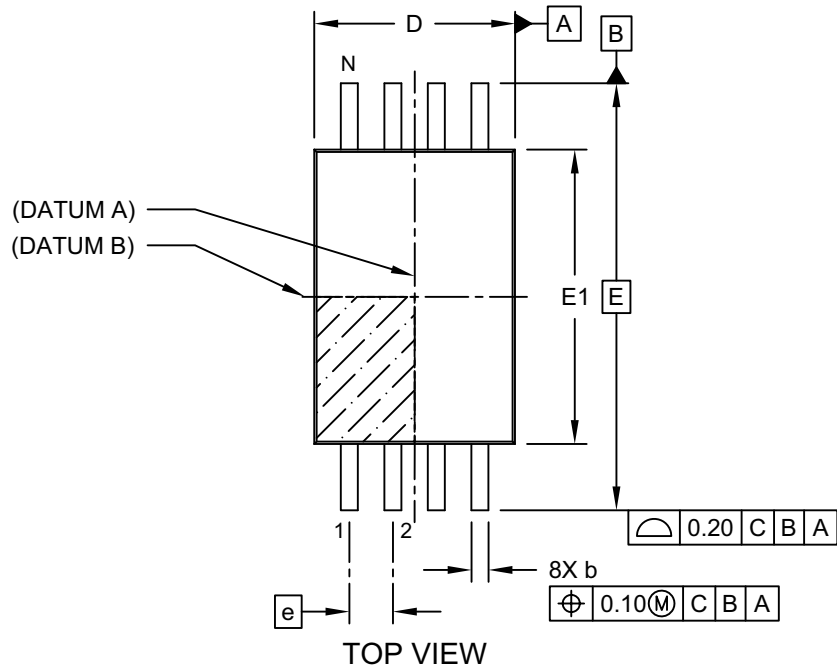
1. Dimensioning and tolerancing per ASME Y14.5M

BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing No. C04-2056C

## 8-Lead Plastic Thin Shrink Small Outline (ST) - 4.4 mm Body [TSSOP]

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>

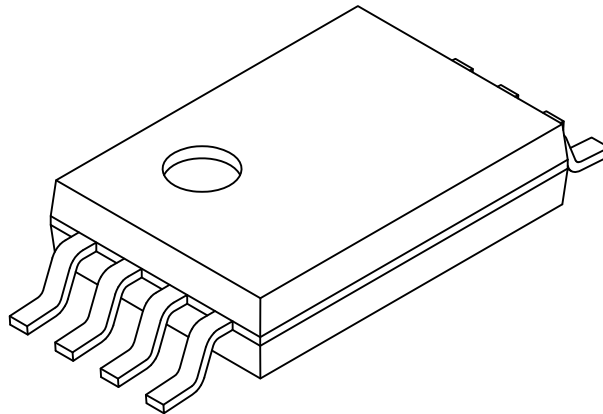


Microchip Technology Drawing C04-086 Rev C Sheet 1 of 2

# 25AA256/25LC256

## 8-Lead Plastic Thin Shrink Small Outline (ST) - 4.4 mm Body [TSSOP]

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Number of Pins	N	8		
Pitch	e	0.65 BSC		
Overall Height	A	-	-	1.20
Molded Package Thickness	A2	0.80	1.00	1.05
Standoff	A1	0.05	-	-
Overall Width	E	6.40 BSC		
Molded Package Width	E1	4.30	4.40	4.50
Overall Length	D	2.90	3.00	3.10
Foot Length	L	0.45	0.60	0.75
Footprint	L1	1.00 REF		
Lead Thickness	c	0.09	-	0.25
Foot Angle	$\varphi$	0°	4°	8°
Lead Width	b	0.19	-	0.30

### Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.20mm per side.
3. Dimensioning and tolerancing per ASME Y14.5M

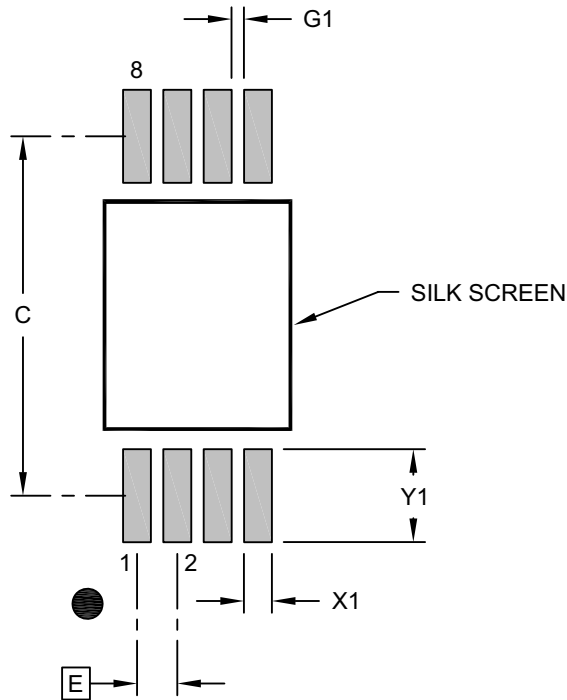
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-086 Rev C Sheet 2 of 2

## 8-Lead Plastic Thin Shrink Small Outline (ST) - 4.4 mm Body [TSSOP]

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



RECOMMENDED LAND PATTERN

Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Contact Pitch	E	0.65 BSC		
Contact Pad Spacing	C		5.80	
Contact Pad Width (X8)	X1			0.45
Contact Pad Length (X8)	Y1			1.50
Contact Pad to Center Pad (X6)	G1	0.20		

**Notes:**

- Dimensioning and tolerancing per ASME Y14.5M  
BSC: Basic Dimension. Theoretically exact value shown without tolerances.
- For best soldering results, thermal vias, if used, should be filled or tented to avoid solder loss during reflow process

Microchip Technology Drawing C04-2086 Rev B

# 25AA256/25LC256

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## APPENDIX A: REVISION HISTORY

### Revision J (07/2021)

Added Automotive Product ID section; Replaced “master” and “slave” terminology with “host” and “client”, respectively; Updated DFN-S, SOIC and TSSOP package drawings; Reformatted some sections for better readability.

### Revision H (08/2019)

Revise Product ID System, packages and notes; Clarified Extended E-Temp description; Update RoHS compliant description; Update PDIP package drawing.

### Revision G (01/2013)

Revise Automotive E Temp; Revise Table 1-2, Param. No. 21.

### Revision F (05/07)

Update Pb-free; Replace Package Drawings (Rev. AP); Update Product ID section.

### Revision E (08/05)

Remove Preliminary status. Revise Table 1-1, Params. D011 and D012.

### Revision D (06/05)

Update package information

### Revision C (11/03)

Corrections to Section 1.0, Electrical Characteristics.

## THE MICROCHIP WEBSITE

Microchip provides online support via our website at [www.microchip.com](http://www.microchip.com). This website is used as a means to make files and information easily available to customers. Accessible by using your favorite Internet browser, the website contains the following information:

- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQ), technical support requests, online discussion groups, Microchip consultant program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

## CUSTOMER CHANGE NOTIFICATION SERVICE

Microchip's customer notification service helps keep customers current on Microchip products. Subscribers will receive e-mail notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

To register, access the Microchip website at [www.microchip.com](http://www.microchip.com). Under "Support", click on "Customer Change Notification" and follow the registration instructions.

## CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support

Customers should contact their distributor, representative or Field Application Engineer (FAE) for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in the back of this document.

**Technical support is available through the website at: <http://microchip.com/support>**

# 25AA256/25LC256

## PRODUCT IDENTIFICATION SYSTEM (NON-AUTOMOTIVE)

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

<u>PART NO.</u>	<u>I</u> <sup>(1)</sup>	<u>X</u>	<u>/XX</u>
Device	Tape and Reel Option	Temperature Range	Package
<b>Device:</b>	25AA256:	256 Kbit, 1.8V, 64-Byte Page, SPI Serial EEPROM	
	25LC256:	256 Kbit, 2.5V, 64-Byte Page, SPI Serial EEPROM	
	25AA256X:	256 Kbit, 1.8V, 64-Byte Page, SPI Serial EEPROM, in alternate pinout (ST only)	
	25LC256X:	256 Kbit, 2.5V, 64-Byte Page, SPI Serial EEPROM, in alternate pinout (ST only)	
<b>Tape and Reel Option:</b>	Blank =	Standard packaging (tube)	
	T =	Tape and Reel <sup>(1)</sup>	
<b>Temperature Range:</b>	I =	-40°C to +85°C (Industrial)	
	E =	-40°C to +125°C (Extended)	
<b>Package:</b>	MF =	Plastic Micro Lead Frame (6 x 5 mm body), 8-lead (DFN-S)	
	P =	Plastic Dual In-Line - 300 mil Body, 8-lead (PDIP)	
	SN =	Plastic Small Outline - Narrow, 3.90 mm Body, 8-lead (SOIC)	
	SM =	Plastic Small Outline - Wide, 5.28 mm Body, 8-lead (SOIJ)	
	ST =	Plastic Thin Shrink Small Outline - 4.4 mm, 8-lead (TSSOP)	

### Examples:

- 25AA256T-I/SN: 256 Kbit, 1.8V Serial EEPROM, Industrial temperature, Tape and Reel, SOIC package
- 25AA256T-I/ST: 256 Kbit, 1.8V Serial EEPROM, Industrial temperature, Tape and Reel, TSSOP package
- 25LC256-I/P: 256 Kbit, 2.5V Serial EEPROM, Industrial temperature, PDIP package
- 25LC256T-E/ST: 256 Kbit, 2.5V Serial EEPROM, Extended temperature, Tape and Reel, TSSOP package
- 25LC256XT-I/ST: 256 Kbit, 2.5V Serial EEPROM, Industrial temperature, Tape and Reel, Alternate pinout, TSSOP package
- 25AA256T-E/SM: 256 Kbit, 1.8V Serial EEPROM, Extended temperature, Tape

**Note 1:** Tape and Reel identifier only appears in the catalog part number description. This identifier is used for ordering purposes only and is not printed on the device package. Check with your Microchip Sales Office for package availability with the Tape and Reel option.



## PRODUCT IDENTIFICATION SYSTEM (AUTOMOTIVE)

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

<u>PART NO.</u>	<u>IXI</u> <sup>(1)</sup>	<u>-X</u>	<u>IXX</u>	<u>XXX</u> <sup>(2,3)</sup>	<b>Examples:</b>
Device	Tape and Reel Option	Temperature Range	Package	Variant	
<b>Device:</b>	25AA256:	256 Kbit, 1.8V, 64-Byte Page, SPI Serial EEPROM			a) 25AA256T-I/SN16KVAO: 256 Kbit, 1.8V Serial EEPROM, Automotive Grade 3, Tape and Reel, SOIC package
	25LC256:	256 Kbit, 2.5V, 64-Byte Page, SPI Serial EEPROM			b) 25AA256T-I/ST16KVAO: 256 Kbit, 1.8V Serial EEPROM, Automotive Grade 3, Tape and Reel, TSSOP package
<b>Tape and Reel Option:</b>	Blank =	Standard packaging (tube)			c) 25LC256-E/SN16KVAO: 256 Kbit, 2.5V Serial EEPROM, Automotive Grade 1, SOIC package
	T =	Tape and Reel <sup>(1)</sup>			d) 25LC256T-E/ST16KVAO: 256 Kbit, 2.5V Serial EEPROM, Automotive Grade 1, Tape and Reel, Rotated TSSOP package
<b>Temperature Range:</b>	I =	-40°C to +85°C (AEC-Q100 Grade 3)			e) 25LC256T-E/SM16KVAO: 256 Kbit, 2.5V Serial EEPROM, Automotive Grade 1, Tape and Reel, SOIJ package
	E =	-40°C to +125°C (AEC-Q100 Grade 1)			
<b>Package:</b>	SN =	Plastic Small Outline - Narrow, 3.90 mm Body, 8-lead (SOIC)			<b>Note 1:</b> Tape and Reel identifier only appears in the catalog part number description. This identifier is used for ordering purposes only and is not printed on the device package. Check with your Microchip Sales Office for package availability with the Tape and Reel option.
	SM =	Plastic Small Outline - Wide, 5.28 mm Body, 8-lead (SOIJ)			<b>2:</b> The VAO/XXX automotive variants have been designed, manufactured, tested and qualified in accordance with AEC-Q100 requirements for automotive applications.
	ST =	Plastic Thin Shrink Small Outline - 4.4 mm, 8-lead (TSSOP)			<b>3:</b> For customers requesting a PPAP, a customer-specific part will be generated and provided. A PPAP is not provided for VAO part numbers.
<b>Variant<sup>(2,3)</sup>:</b>	16KVAO =	Standard Automotive, 16K Process			
	16KVXX =	Customer-Specific Automotive, 16K Process			

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