# CAV25256

# EEPROM Serial 256-Kb SPI Automotive Grade 1

### Description

The CAV25256 is a EEPROM Serial 256−Kb SPI Automotive Grade 1 device internally organized as 32Kx8 bits. This features a 64−byte page write buffer and supports the Serial Peripheral Interface (SPI) protocol. The device is enabled through a Chip Select ($\overline{CS}$) input. In addition, the required bus signals are clock input (SCK), data input (SI) and data output (SO) lines. The $\overline{HOLD}$ input may be used to pause any serial communication with the CAV25256 device. The device features software and hardware write protection, including partial as well as full array protection.

On−Chip ECC (Error Correction Code) makes the device suitable for high reliability applications.

### Features

- Automotive AEC−Q100 Grade 1 (−40°C to +125°C) Qualified
- 10 MHz (5 V) SPI Compatible
- 2.5 V to 5.5 V Supply Voltage Range
- SPI Modes (0,0) & (1,1)
- 64−byte Page Write Buffer
- Additional Identification Page with Permanent Write Protection
- Self−timed Write Cycle
- Hardware and Software Protection
- Block Write Protection
  – Protect 1/4, 1/2 or Entire EEPROM Array
- Low Power CMOS Technology
- 1,000,000 Program/Erase Cycles
- 100 Year Data Retention
- 8−lead SOIC, TSSOP and 8−Ball WLCSP Packages
- This Device is Pb−Free, Halogen Free/BFR Free, and RoHS Compliant

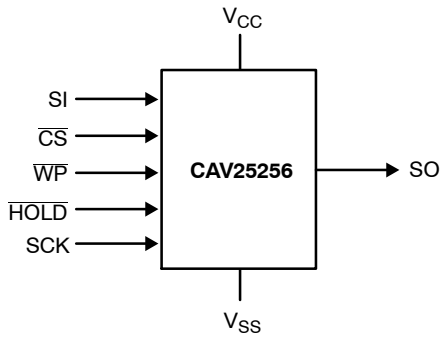



**Figure 1. Functional Symbol**

This document contains information on some products that are still under development. ON Semiconductor reserves the right to change or discontinue these products without notice.

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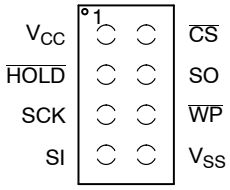
| WLCSP−8* | SOIC−8 | TSSOP−8 |
|---|---|---|
| C8A SUFFIX | V SUFFIX | Y SUFFIX |
| CASE 567DG | CASE 751BD | CASE 948AL |

(*Under development. Contact Sales for availability.)

### PIN CONFIGURATIONS




SOIC (V), TSSOP (Y)




CSP−8B (X)

(Top Views)

### PIN FUNCTION

| Pin Name | Function |
|---|---|
| $\overline{CS}$ | Chip Select |
| SO | Serial Data Output |
| $\overline{WP}$ | Write Protect |
| $V_{SS}$ | Ground |
| SI | Serial Data Input |
| SCK | Serial Clock |
| $\overline{HOLD}$ | Hold Transmission Input |
| $V_{CC}$ | Power Supply |

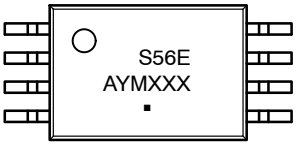
### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 10 of this data sheet.

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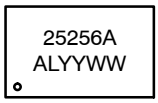
## DEVICE MARKINGS

(TSSOP−8)



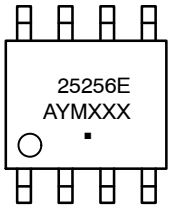

S56E = Specific Device Code
A = Assembly Location
Y = Production Year (Last Digit)
M = Production Month (1-9, O, N, D)
XXX = Last Three Digits of Assembly Lot Number
▪ = Pb−Free Package

(WLCSP−8)




25256E = Specific Device Code
A = Assembly Location
L = Wafer Lot
YY = Year
WW = Work Week

(SOIC−8)




25256E = Specific Device Code
A = Assembly Location
Y = Production Year (Last Digit)
M = Production Month (1-9, O, N, D)
XXX = Last Three Digits of Assembly Lot Number
▪ = Pb−Free Package

**Table 1. ABSOLUTE MAXIMUM RATINGS**

| Parameters | Ratings | Units |
|---|---|---|
| Operating Temperature | −45 to +130 | °C |
| Storage Temperature | −65 to +150 | °C |
| Voltage on any Pin with Respect to Ground (Note 1) | −0.5 to +6.5 | V |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. The DC input voltage on any pin should not be lower than −0.5 V or higher than $V_{CC}$ + 0.5 V. During transitions, the voltage on any pin may undershoot to no less than −1.5 V or overshoot to no more than $V_{CC}$ + 1.5 V, for periods of less than 20 ns.

**Table 2. RELIABILITY CHARACTERISTICS** (Note 2)

| Symbol | Parameter | Min | Units |
|---|---|---|---|
| $N_{END}$ (Notes 3, 4) | Endurance | 1,000,000 | Program / Erase Cycles |
| $T_{DR}$ | Data Retention | 100 | Years |

2. These parameters are tested initially and after a design or process change that affects the parameter according to appropriate AEC−Q100 and JEDEC test methods.
3. Page Mode, $V_{CC}$ = 5 V, 25°C.
4. The device uses ECC (Error Correction Code) logic with 6 ECC bits to correct one bit error in 4 data bytes. Therefore, when a single byte has to be written, 4 bytes (including the ECC bits) are re-programmed. It is recommended to write by multiple of 4 bytes in order to benefit from the maximum number of write cycles.

**Table 3. D.C. OPERATING CHARACTERISTICS** ($V_{CC}$ = 2.5 V to 5.5 V, $T_A$ = −40°C to +125°C, unless otherwise specified.)

| Symbol | Parameter | Test Conditions | Min | Max | Units |
|---|---|---|---|---|---|
| $I_{CCR}$ | Supply Current (Read Mode) | Read, SO open, $f_{SCK}$ = 10 MHz | | 2 | mA |
| $I_{CCW}$ | Supply Current (Write Mode) | Write, $\overline{CS}$ = $V_{CC}$ | | 2 | mA |
| $I_{SB1}$ | Standby Current | $V_{IN}$ = GND or $V_{CC}$, $\overline{CS}$ = $V_{CC}$, $\overline{WP}$ = $V_{CC}$, $V_{CC}$ = 5.5 V | | 3 | μA |
| $I_{SB2}$ | Standby Current | $V_{IN}$ = GND or $V_{CC}$, $\overline{CS}$ = $V_{CC}$, $\overline{WP}$ = GND, $V_{CC}$ = 5.5 V | | 5 | μA |
| $I_L$ | Input Leakage Current | $V_{IN}$ = GND or $V_{CC}$ | −2 | 2 | μA |
| $I_{LO}$ | Output Leakage Current | $\overline{CS}$ = $V_{CC}$ $V_{OUT}$ = GND or $V_{CC}$ | −2 | 2 | μA |
| $V_{IL}$ | Input Low Voltage | | −0.5 | 0.3 $V_{CC}$ | V |
| $V_{IH}$ | Input High Voltage | | 0.7 $V_{CC}$ | $V_{CC}$ + 0.5 | V |
| $V_{OL}$ | Output Low Voltage | $I_{OL}$ = 3.0 mA | | 0.4 | V |
| $V_{OH}$ | Output High Voltage | $I_{OH}$ = −1.6 mA | $V_{CC}$ − 0.8 V | | V |

**Table 4. PIN CAPACITANCE** (Note 5) ($T_A$ = 25°C, f = 1.0 MHz, $V_{CC}$ = +5.0 V)

| Symbol | Test | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| $C_{OUT}$ | Output Capacitance (SO) | $V_{OUT}$ = 0 V | | | 8 | pF |
| $C_{IN}$ | Input Capacitance ($\overline{CS}$, SCK, SI, $\overline{WP}$, $\overline{HOLD}$) | $V_{IN}$ = 0 V | | | 8 | pF |

5. These parameters are tested initially and after a design or process change that affects the parameter according to appropriate AEC−Q100 and JEDEC test methods.

**Table 5. A.C. CHARACTERISTICS** ($V_{CC}$ = 2.5 V to 5.5 V, $T_A$ = −40°C to +125°C, unless otherwise specified.) (Note 6)

| Symbol | Parameter | Min | Max | Units |
|---|---|---|---|---|
| $f_{SCK}$ | Clock Frequency | DC | 10 | MHz |
| $t_{SU}$ | Data Setup Time | 10 | | ns |
| $t_H$ | Data Hold Time | 10 | | ns |
| $t_{WH}$ | SCK High Time | 40 | | ns |
| $t_{WL}$ | SCK Low Time | 40 | | ns |
| $t_{LZ}$ | $\overline{HOLD}$ to Output Low Z | | 25 | ns |
| $t_{RI}$ (Note 7) | Input Rise Time | | 2 | μs |
| $t_{FI}$ (Note 7) | Input Fall Time | | 2 | μs |
| $t_{HD}$ | $\overline{HOLD}$ Setup Time | 0 | | ns |
| $t_{CD}$ | $\overline{HOLD}$ Hold Time | 10 | | ns |
| $t_V$ | Output Valid from Clock Low | | 40 | ns |
| $t_{HO}$ | Output Hold Time | 0 | | ns |
| $t_{DIS}$ | Output Disable Time | | 20 | ns |
| $t_{HZ}$ | $\overline{HOLD}$ to Output High Z | | 25 | ns |
| $t_{CS}$ | $\overline{CS}$ High Time | 40 | | ns |
| $t_{CSS}$ | $\overline{CS}$ Setup Time | 30 | | ns |
| $t_{CSH}$ | $\overline{CS}$ Hold Time | 30 | | ns |
| $t_{CNS}$ | $\overline{CS}$ Inactive Setup Time | 20 | | ns |
| $t_{CNH}$ | $\overline{CS}$ Inactive Hold Time | 20 | | ns |
| $t_{WPS}$ | $\overline{WP}$ Setup Time | 10 | | ns |
| $t_{WPH}$ | $\overline{WP}$ Hold Time | 10 | | ns |
| $t_{WC}$ (Note 8) | Write Cycle Time | | 5 | ms |

6. AC Test Conditions:
   Input Pulse Voltages: 0.3 $V_{CC}$ to 0.7 $V_{CC}$
   Input rise and fall times: ≤ 10 ns
   Input and output reference voltages: 0.5 $V_{CC}$
   Output load: current source $I_{OL\ max}/I_{OH\ max}$; $C_L$ = 30 pF
7. This parameter is tested initially and after a design or process change that affects the parameter.
8. $t_{WC}$ is the time from the rising edge of $\overline{CS}$ after a valid write sequence to the end of the internal write cycle.

**Table 6. POWER−UP TIMING** (Notes 7, 9)

| Symbol | Parameter | Min | Max | Units |
|---|---|---|---|---|
| $t_{PUR}$ | Power−up to Read Operation | 0.1 | 1 | ms |
| $t_{PUW}$ | Power−up to Write Operation | 0.1 | 1 | ms |

9. $t_{PUR}$ and $t_{PUW}$ are the delays required from the time $V_{CC}$ is stable until the specified operation can be initiated.

### Pin Description

**SI:** The serial data input pin accepts op−codes, addresses and data. In SPI modes (0,0) and (1,1) input data is latched on the rising edge of the SCK clock input.

**SO:** The serial data output pin is used to transfer data out of the device. In SPI modes (0,0) and (1,1) data is shifted out on the falling edge of the SCK clock.

**SCK:** The serial clock input pin accepts the clock provided by the host and used for synchronizing communication between host and CAV25256.

**$\overline{CS}$:** The chip select input pin is used to enable/disable the CAV25256. When $\overline{CS}$ is high, the SO output is tri−stated (high impedance) and the device is in Standby Mode (unless an internal write operation is in progress). *Every communication session between host and CAV25256 must be preceded by a high to low transition and concluded with a low to high transition of the $\overline{CS}$ input.*

**$\overline{WP}$:** The write protect input pin will allow all write operations to the device when held high. When $\overline{WP}$ pin is tied low and the WPEN bit in the Status Register (refer to Status Register description, later in this Data Sheet) is set to "1", writing to the Status Register is disabled.

**$\overline{HOLD}$:** The $\overline{HOLD}$ input pin is used to pause transmission between host and CAV25256, without having to retransmit the entire sequence at a later time. To pause, $\overline{HOLD}$ must be taken low and to resume it must be taken back high, with the SCK input low during both transitions. When not used for pausing, it is recommended the $\overline{HOLD}$ input to be tied to $V_{CC}$, either directly or through a resistor.

### Functional Description

The CAV25256 device supports the Serial Peripheral Interface (SPI) bus protocol, modes (0,0) and (1,1). The device contains an 8−bit instruction register. The instruction set and associated op−codes are listed in Table 7.

Reading data stored in the CAV25256 is accomplished by simply providing the READ command and an address. Writing to the CAV25256, in addition to a WRITE command, address and data, also requires enabling the device for writing by first setting certain bits in a Status Register, as will be explained later.

After a high to low transition on the $\overline{CS}$ input pin, the CAV25256 will accept any one of the six instruction op−codes listed in Table 7 and will ignore all other possible 8−bit combinations. The communication protocol follows the timing from Figure 2.

The CAV25256 features an additional Identification Page (64 bytes) which can be accessed for Read and Write operations when the IPL bit from the Status Register is set to "1". The user can also choose to make the Identification Page permanent write protected.

**Table 7. INSTRUCTION SET**

| Instruction | Opcode | Operation |
|---|---|---|
| WREN | 0000 0110 | Enable Write Operations |
| WRDI | 0000 0100 | Disable Write Operations |
| RDSR | 0000 0101 | Read Status Register |
| WRSR | 0000 0001 | Write Status Register |
| READ | 0000 0011 | Read Data from Memory |
| WRITE | 0000 0010 | Write Data to Memory |

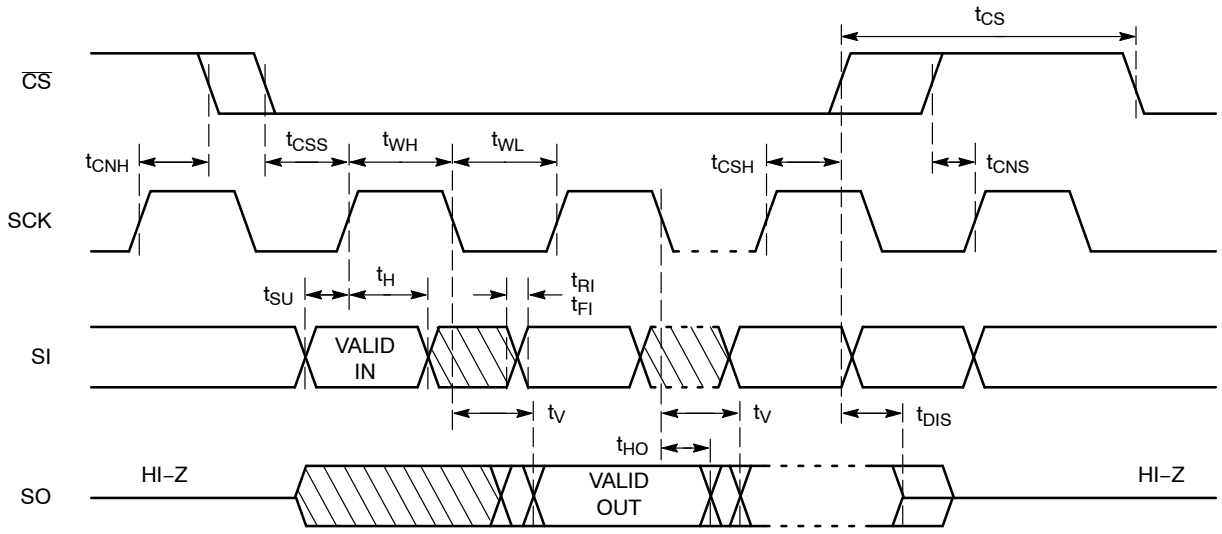



**Figure 2. Synchronous Data Timing**

### Status Register

The Status Register, as shown in Table 8, contains a number of status and control bits.

The $\overline{\text{RDY}}$ (Ready) bit indicates whether the device is busy with a write operation. This bit is automatically set to 1 during an internal write cycle, and reset to 0 when the device is ready to accept commands. For the host, this bit is read only.

The WEL (Write Enable Latch) bit is set/reset by the WREN/WRDI commands. When set to 1, the device is in a Write Enable state and when set to 0, the device is in a Write Disable state.

The BP0 and BP1 (Block Protect) bits determine which blocks are currently write protected. They are set by the user with the WRSR command and are non−volatile. The user is allowed to protect a quarter, one half or the entire memory, by setting these bits according to Table 9. The protected blocks then become read−only.

The WPEN (Write Protect Enable) bit acts as an enable for the $\overline{\text{WP}}$ pin. Hardware write protection is enabled when the $\overline{\text{WP}}$ pin is low and the WPEN bit is 1. This condition prevents writing to the status register and to the block protected sections of memory. While hardware write protection is active, only the non−block protected memory can be written. Hardware write protection is disabled when the $\overline{\text{WP}}$ pin is high or the WPEN bit is 0. The WPEN bit, $\overline{\text{WP}}$ pin and WEL bit combine to either permit or inhibit Write operations, as detailed in Table 10.

The IPL (Identification Page Latch) bit determines whether the additional Identification Page (IPL = 1) or main memory array (IPL = 0) can be accessed both for Read and Write operations. The IPL bit is set by the user with the WRSR command and is volatile. The IPL bit is automatically reset after read/write operations.

The LIP bit is set by the user with the WRSR command and is non−volatile. When set to 1, the Identification Page is permanently write protected (locked in Read−only mode).

***Note: The IPL and LIP bits cannot be set to 1 using the same WRSR instruction. If the user attempts to set (“1”) both the IPL and LIP bit in the same time, these bits cannot be written and therefore they will remain unchanged.***

**Table 8. STATUS REGISTER**

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| WPEN | IPL | 0 | LIP | BP1 | BP0 | WEL | $\overline{\text{RDY}}$ |

**Table 9. BLOCK PROTECTION BITS**

| Status Register Bits | | Array Address Protected | Protection |
|---|---|---|---|
| BP1 | BP0 | | |
| 0 | 0 | None | No Protection |
| 0 | 1 | 6000−7FFF | Quarter Array Protection |
| 1 | 0 | 4000−7FFF | Half Array Protection |
| 1 | 1 | 0000−7FFF | Full Array Protection |

**Table 10. WRITE PROTECT CONDITIONS**

| WPEN | $\overline{\text{WP}}$ | WEL | Protected Blocks | Unprotected Blocks | Status Register |
|---|---|---|---|---|---|
| 0 | X | 0 | Protected | Protected | Protected |
| 0 | X | 1 | Protected | Writable | Writable |
| 1 | Low | 0 | Protected | Protected | Protected |
| 1 | Low | 1 | Protected | Writable | Protected |
| X | High | 0 | Protected | Protected | Protected |
| X | High | 1 | Protected | Writable | Writable |

## WRITE OPERATIONS

The CAV25256 device powers up into a write disable state. The device contains a Write Enable Latch (WEL) which must be set before attempting to write to the memory array or to the status register. In addition, the address of the memory location(s) to be written must be outside the protected area, as defined by BP0 and BP1 bits from the status register.

### Write Enable and Write Disable

The internal Write Enable Latch and the corresponding Status Register WEL bit are set by sending the WREN instruction to the CAV25256. Care must be taken to take the $\overline{CS}$ input high after the WREN instruction, as otherwise the Write Enable Latch will not be properly set. WREN timing is illustrated in Figure 3. The WREN instruction must be sent prior to any WRITE or WRSR instruction.

The internal write enable latch is reset by sending the WRDI instruction as shown in Figure 4. Disabling write operations by resetting the WEL bit, will protect the device against inadvertent writes.

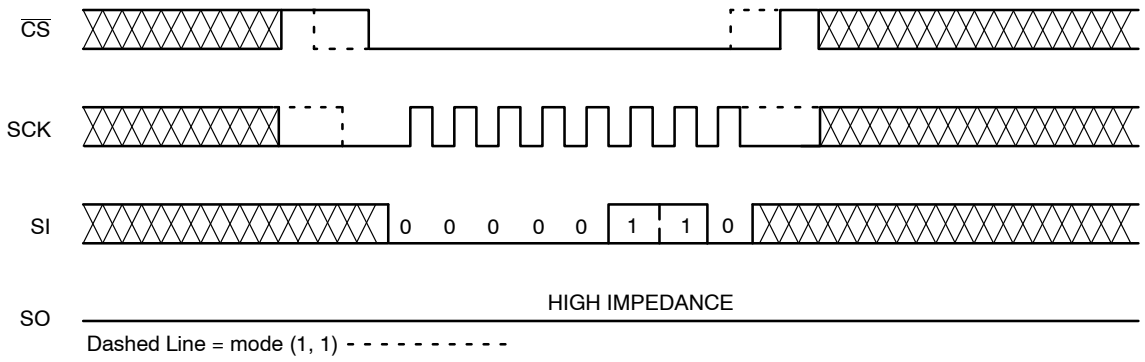



**Figure 3. WREN Timing**

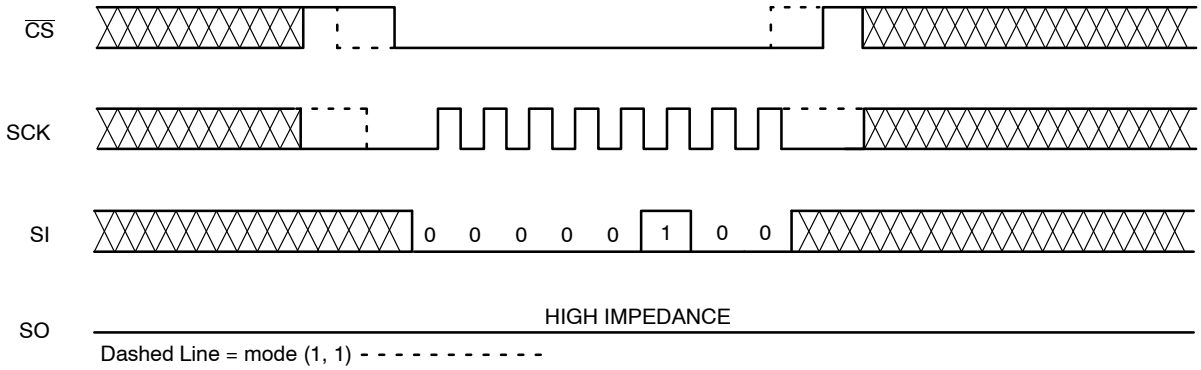



**Figure 4. WRDI Timing**

### Byte Write

Once the WEL bit is set, the user may execute a write sequence, by sending a WRITE instruction, a 16−bit address and data as shown in Figure 5. Only 15 significant address bits are used by the CAV25256. The 16th address bit is don't care, as shown in Table 11. Internal programming will start after the low to high $\overline{CS}$ transition. During an internal write cycle, all commands, except for RDSR (Read Status Register) will be ignored. The $\overline{RDY}$ bit will indicate if the internal write cycle is in progress ($\overline{RDY}$ high), or the device is ready to accept commands ($\overline{RDY}$ low).

### Page Write

After sending the first data byte to the CAV25256, the host may continue sending data, up to a total of 64 bytes, according to timing shown in Figure 6. After each data byte, the lower order address bits are automatically incremented, while the higher order address bits (page address) remain unchanged. If during this process the end of page is exceeded, then loading will "roll over" to the first byte in the page, thus possibly overwriting previously loaded data. Following completion of the write cycle, the CAV25256 is automatically returned to the write disable state. While the internal write cycle is in progress, the RDSR command will output the $\overline{RDY}$ (Ready) bit status only (i.e., data out = FFh).

### Write Identification Page

The additional 64−byte Identification Page (IP) can be written with user data using the same Write commands sequence as used for Page Write to the main memory array (Figure 6). ***The IPL bit from the Status Register must be set (IPL = 1) using the WRSR instruction, before attempting to write to the IP.***

The address bits [A15:A6] are Don't Care and the [A5:A0] bits define the byte address within the Identification Page. In addition, the Byte Address must point to a location outside the protected area defined by the BP1, BP0 bits from the Status Register. When the full memory array is write protected (BP1, BP0 = 1,1), the write instruction to the IP is not accepted and not executed.

Also, the write to the IP is not accepted if the LIP bit from the Status Register is set to 1 (the page is locked in Read−only mode).

**Table 11. BYTE ADDRESS**

| | Address Significant Bits | Address Don't Care Bits | # Address Clock Pulses |
|---|---|---|---|
| Main Memory Array | A14 – A0 | A15 | 16 |
| Identification Page | A5 – A0 | A15 – A6 | 16 |

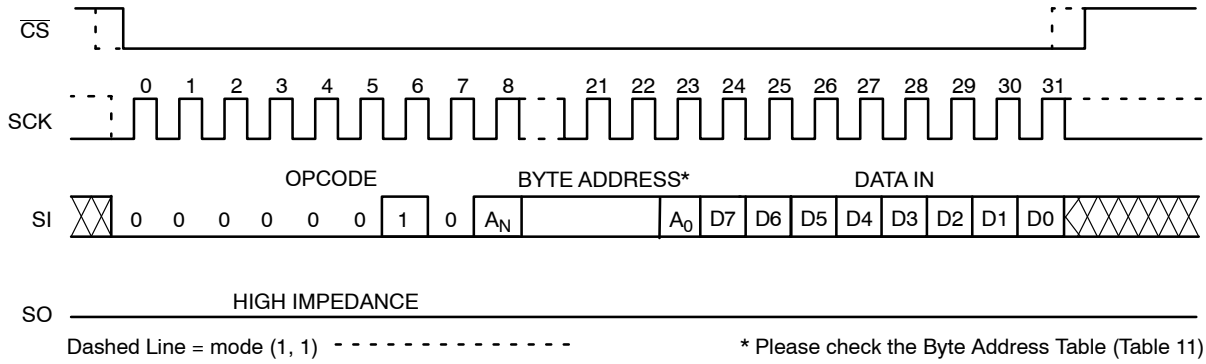



**Figure 5. Byte WRITE Timing**

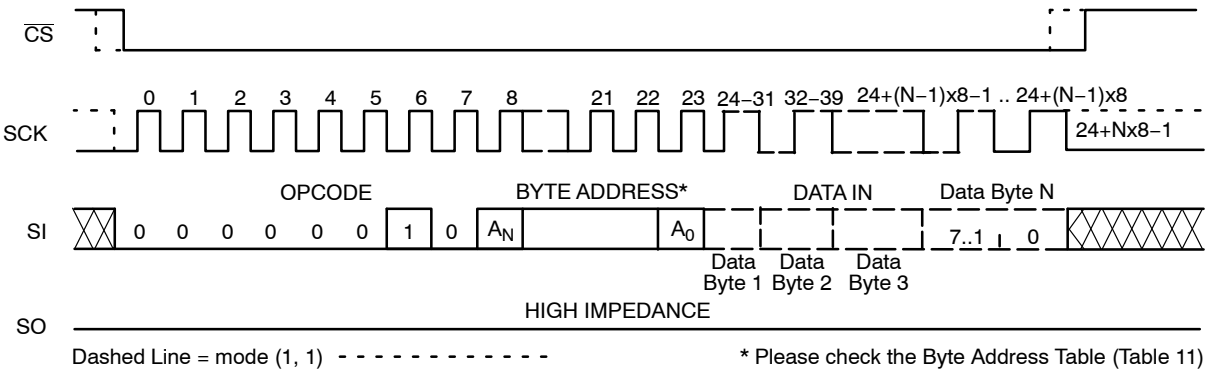



**Figure 6. Page WRITE Timing**

### Write Status Register

The Status Register is written by sending a WRSR instruction according to timing shown in Figure 7. Only bits 2, 3, 4, 6 and 7 can be written using the WRSR command.

### Write Protection

The Write Protect ($\overline{WP}$) pin can be used to protect the Block Protect bits BP0 and BP1 against being inadvertently altered. When $\overline{WP}$ is low and the WPEN bit is set to “1”, write operations to the Status Register are inhibited. $\overline{WP}$ going low while $\overline{CS}$ is still low will interrupt a write to the status register. If the internal write cycle has already been initiated, $\overline{WP}$ going low will have no effect on any write operation to the Status Register. The $\overline{WP}$ pin function is blocked when the WPEN bit is set to “0”. The $\overline{WP}$ input timing is shown in Figure 8.

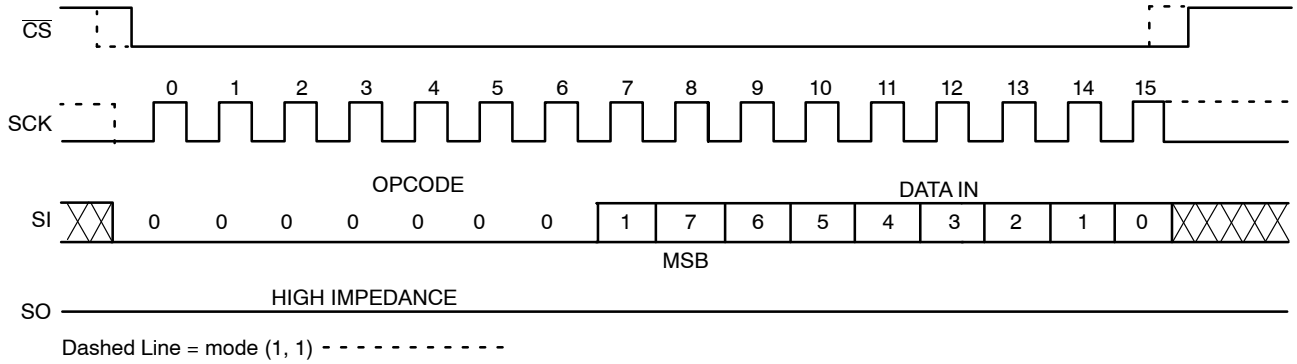



**Figure 7. WRSR Timing**

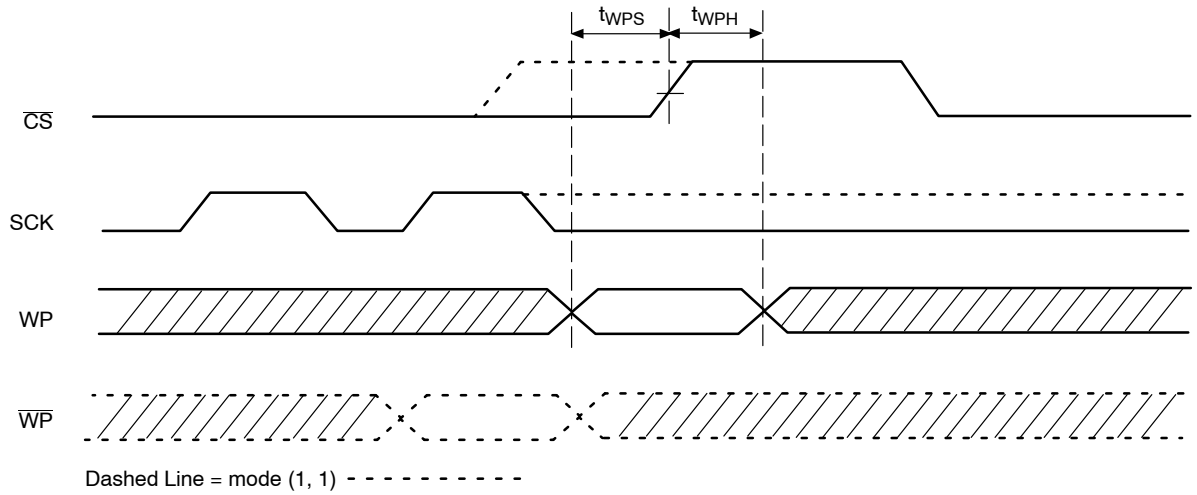



**Figure 8. $\overline{WP}$ Timing**

## READ OPERATIONS

### Read from Memory Array

To read from memory, the host sends a READ instruction followed by a 16−bit address (see Table 11 for the number of significant address bits).

After receiving the last address bit, the CAV25256 will respond by shifting out data on the SO pin (as shown in Figure 9). Sequentially stored data can be read out by simply continuing to run the clock. The internal address pointer is automatically incremented to the next higher address as data is shifted out. After reaching the highest memory address, the address counter "rolls over" to the lowest memory address, and the read cycle can be continued indefinitely. The read operation is terminated by taking $\overline{CS}$ high.

### Read Identification Page

Reading the additional 64−byte Identification Page (IP) is achieved using the same Read command sequence as used for Read from main memory array (Figure 9). ***The IPL bit from the Status Register must be set (IPL = 1) before attempting to read from the IP.*** The [A5:A0] are the address significant bits that point to the data byte shifted out on the SO pin. If the CS continues to be held low, the internal address register defined by [A5:A0] bits is automatically incremented and the next data byte from the IP is shifted out. The byte address must not exceed the 64−byte page boundary.

### Read Status Register

To read the status register, the host simply sends a RDSR command. After receiving the last bit of the command, the CAV25256 will shift out the contents of the status register on the SO pin (Figure 10). The status register may be read at any time, including during an internal write cycle. While the internal write cycle is in progress, the RDSR command will output the full content of the status register. For easy detection of the internal write cycle completion, both during writing to the memory array and to the status register, we recommend sampling the RDY bit only through the polling routine. After detecting the RDY bit "0", the next RDSR instruction will always output the expected content of the status register.

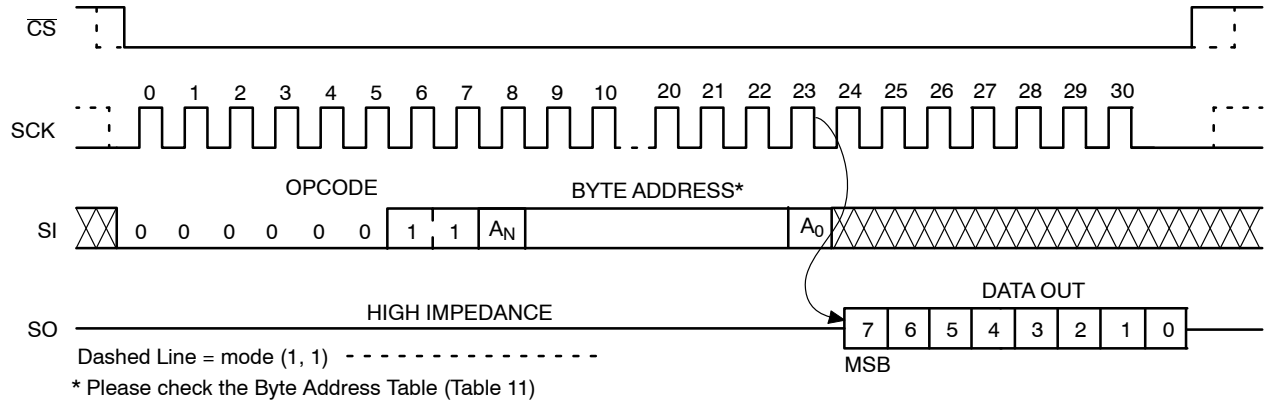



**Figure 9. READ Timing**

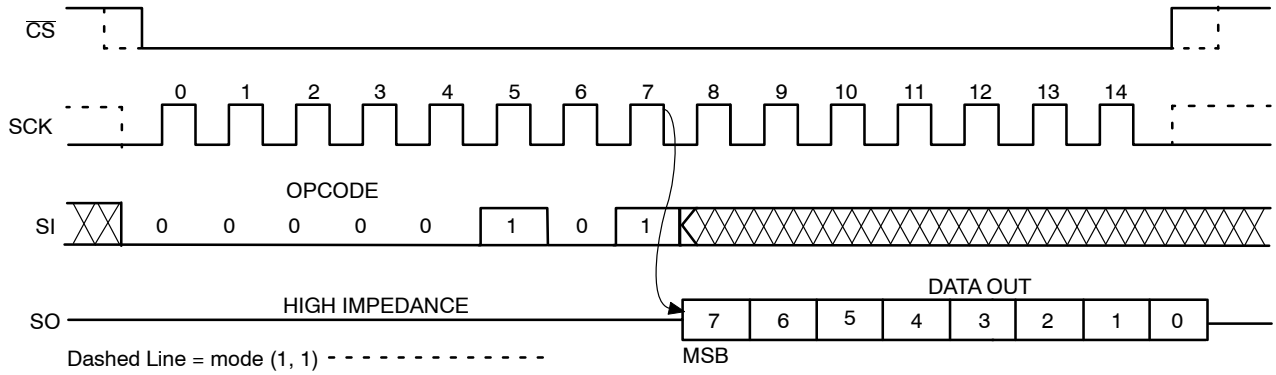



**Figure 10. RDSR Timing**

### Hold Operation

The $\overline{\text{HOLD}}$ input can be used to pause communication between host and CAV25256. To pause, $\overline{\text{HOLD}}$ must be taken low while SCK is low (Figure 11). During the hold condition the device must remain selected ($\overline{\text{CS}}$ low). During the pause, the data output pin (SO) is tri−stated (high impedance) and SI transitions are ignored. To resume communication, $\overline{\text{HOLD}}$ must be taken high while SCK is low.

### Design Considerations

The CAV25256 device incorporates Power−On Reset (POR) circuitry which protects the internal logic against powering up in the wrong state. The device will power up into Standby mode after $V_{CC}$ exceeds the POR trigger level and will power down into Reset mode when $V_{CC}$ drops below the POR trigger level. This bi−directional POR behavior protects the device against 'brown−out' failure following a temporary loss of power.

The CAV25256 device powers up in a write disable state and in a low power standby mode. A WREN instruction must be issued prior to any writes to the device.

After power up, the $\overline{\text{CS}}$ pin must be brought low to enter a ready state and receive an instruction. After a successful byte/page write or status register write, the device goes into a write disable mode. The $\overline{\text{CS}}$ input must be set high after the proper number of clock cycles to start the internal write cycle. Access to the memory array during an internal write cycle is ignored and programming is continued. Any invalid op−code will be ignored and the serial output pin (SO) will remain in the high impedance state.

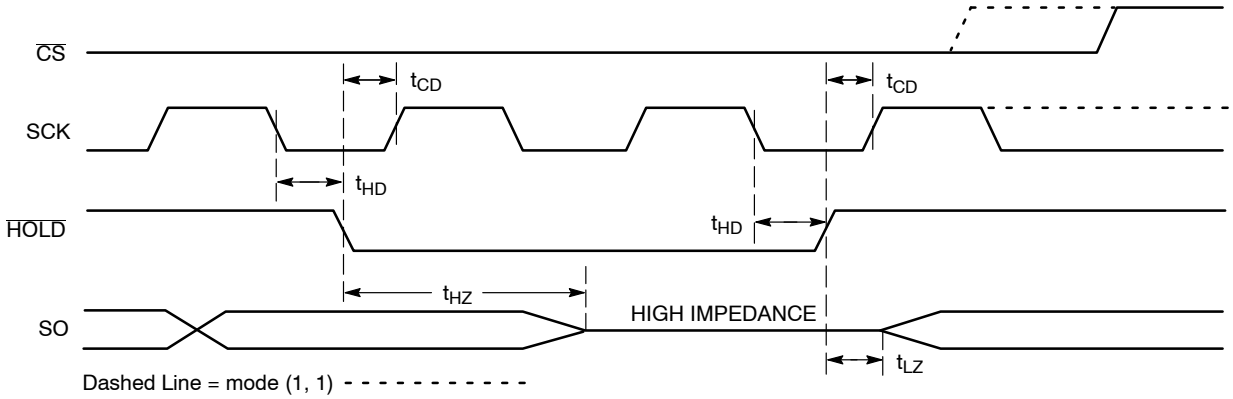



**Figure 11. $\overline{\text{HOLD}}$ Timing**

**ORDERING INFORMATION** (Notes 10 − 12)

| Device Order Number | Specific Device Marking | Package Type | Temperature Range | Lead Finish | Shipping† |
|---|---|---|---|---|---|
| CAV25256VE−GT3 | 25256E | SOIC−8 | −40°C to +125°C | NiPdAu | Tape & Reel, 3,000 Units / Reel |
| CAV25256YE−GT3 | S56E | TSSOP−8 | −40°C to +125°C | NiPdAu | Tape & Reel, 3,000 Units / Reel |
| CAV25256C8ATR (Note 13) | 25256A | WLCSP−8 | −40°C to +125°C | SnAgCu | Tape & Reel, 4,000 Units / Reel |

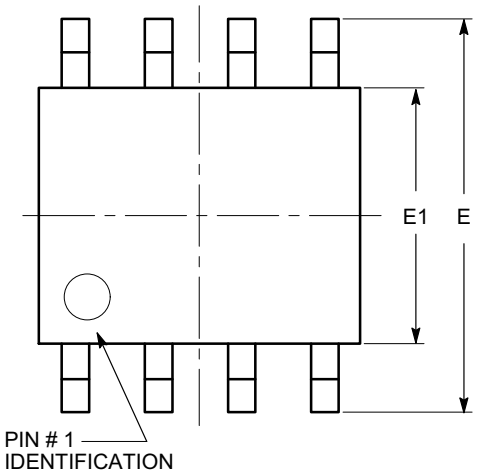
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

10. All packages are RoHS−compliant (Lead−free, Halogen−free).
11. For detailed information and a breakdown of device nomenclature and numbering systems, please see the ON Semiconductor Device Nomenclature document, TND310/D, available at www.onsemi.com
12. For additional package and temperature options, please contact your nearest ON Semiconductor Sales office.
13. This package option is currently under development. Please contact your nearest ON Semiconductor Sales office for availability.

# MECHANICAL CASE OUTLINE
## PACKAGE DIMENSIONS

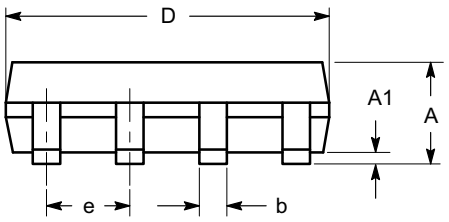
**SOIC−8, 150 mils**
CASE 751BD
ISSUE O

DATE 19 DEC 2008

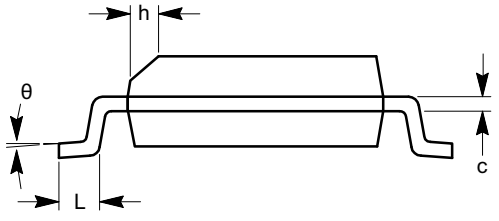



**TOP VIEW**

| SYMBOL | MIN | NOM | MAX |
|---|---|---|---|
| A | 1.35 | | 1.75 |
| A1 | 0.10 | | 0.25 |
| b | 0.33 | | 0.51 |
| c | 0.19 | | 0.25 |
| D | 4.80 | | 5.00 |
| E | 5.80 | | 6.20 |
| E1 | 3.80 | | 4.00 |
| e | 1.27 BSC | | |
| h | 0.25 | | 0.50 |
| L | 0.40 | | 1.27 |
| θ | 0º | | 8º |




**SIDE VIEW**




**END VIEW**

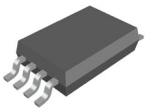
**Notes:**
(1) All dimensions are in millimeters. Angles in degrees.
(2) Complies with JEDEC MS-012.

| | | | |
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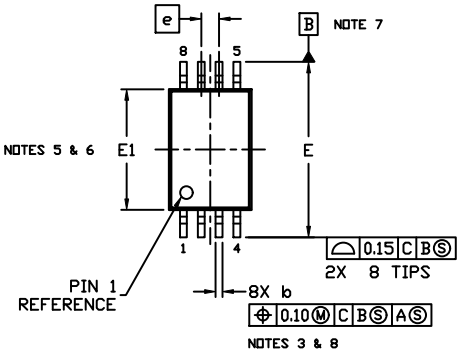
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# MECHANICAL CASE OUTLINE
## PACKAGE DIMENSIONS

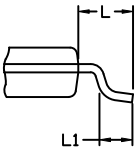


**TSSOP8, 4.4x3.0, 0.65P**
CASE 948AL
ISSUE A

DATE 20 MAY 2022



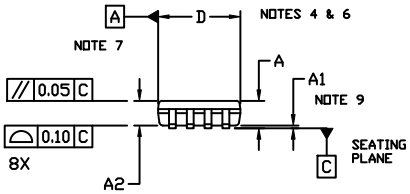

TOP VIEW



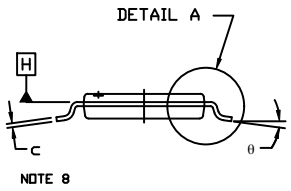

DETAIL A

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5, 2009..
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL NOT BE 0.15 IN EXCESS OF MAXIMUM MATERIAL CONDITION.
4. DIMENSION D DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15 PER SIDE.
5. DIMENSION E1 DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 PER SIDE.
6. THE PACKAGE TOP MAY BE SMALLER THAN THE PACKAGE BOTTOM. DIMENSIONS D AND E1 ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY AT DATUM PLANE H.
7. DATUMS A AND B ARE TO BE DETERMINED AT DATUM H.
8. DIMENSIONS b AND c APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.10 AND 0.25 FROM THE LEAD TIP..
9. A1 IS DEFINED AS THE LOWEST VERTICAL DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY..



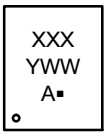

SIDE VIEW




END VIEW

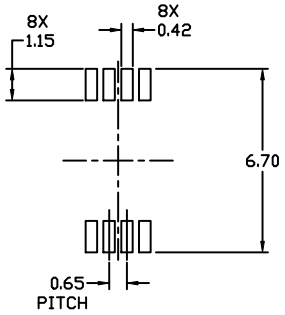
| DIM | MILLIMETERS | | |
|---|---|---|---|
| | MIN. | NOM. | MAX. |
| A | --- | --- | 1.20 |
| A1 | 0.05 | --- | 0.15 |
| A2 | 0.80 | 0.90 | 1.05 |
| b | 0.19 | --- | 0.30 |
| c | 0.09 | --- | 0.20 |
| D | 2.90 | 3.00 | 3.10 |
| E | 6.30 | 6.40 | 6.50 |
| E1 | 4.30 | 4.40 | 4.50 |
| e | 0.65 BSC | | |
| L | 1.00 REF | | |
| L1 | 0.50 | 0.60 | 0.70 |
| θ | 0° | --- | 8° |

### GENERIC MARKING DIAGRAM*




XXX = Specific Device Code
Y = Year
WW = Work Week
A = Assembly Location
▪ = Pb−Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “▪”, may or may not be present. Some products may not follow the Generic Marking.




RECOMMENDED
MOUNTING FOOTPRINT*

* For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

| | | |
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