# Atmel AT24C16C

## I²C-Compatible, (2-Wire) Serial EEPROM

**16-Kbit (2048 x 8)**

**DATASHEET**

## Standard Features

- Low-voltage and standard-voltage operation
  - $V_{CC}$ = 1.7V to 5.5V
- Internally organized as 2,048 x 8 (16K)
- I²C-compatible (2-wire) serial interface
- Schmitt Trigger, filtered inputs for noise suppression
- Bidirectional data transfer protocol
- 1MHz (2.5V, 2.7V, 5V), 400kHz (1.7V) compatibility
- Write Protect pin for hardware data protection
- 16-byte Page Write mode
  - Partial page writes allowed
- Self-timed write cycle (5ms max)
- High-reliability
  - Endurance: 1,000,000 write cycles
  - Data retention: 100 years
- Green package options (Pb/Halide-free/RoHS compliant)
  - 8-lead PDIP, 8-lead SOIC, 8-lead TSSOP, 8-pad UDFN, 8-pad XDFN, 5-lead SOT23, and 8-ball VFBGA
- Die options: wafer form and tape and reel

## Description

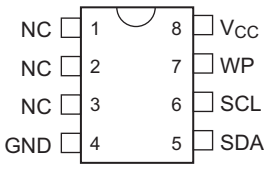
The Atmel® AT24C16C provides 16,384 bits of Serial Electrically Erasable and Programmable Read-Only Memory (EEPROM) organized as 2,048 words of eight bits each. The device is optimized for use in many industrial and commercial applications where low-power and low-voltage operation are essential. AT24C16C is available in space-saving 8-lead PDIP, 8-lead JEDEC SOIC, 8-lead TSSOP, 8-pad UDFN, 8-pad XDFN, 5-lead SOT23, and 8-ball VFBGA packages and is accessed via a 2-wire serial interface.

# 1. Pin Configurations and Pinouts

**Table 1. Pin Configuration**

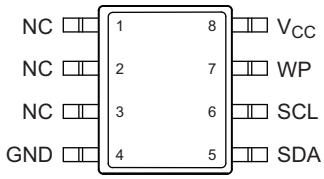
| Pin Name | Function |
|---|---|
| NC | No Connect |
| SDA | Serial Data |
| SCL | Serial Clock Input |
| WP | Write Protect |
| GND | Ground |
| $V_{CC}$ | Power Supply |

8-lead PDIP




Top View

8-lead SOIC

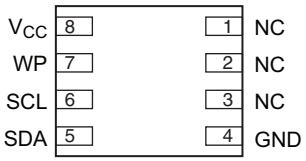



Top View

8-lead TSSOP

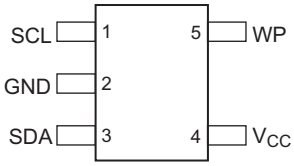

Top View

8-pad UDFN/XDFN



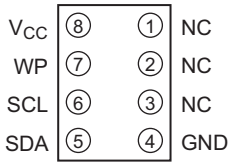

Bottom View

5-lead SOT23




Top View

8-ball VFBGA




Bottom View

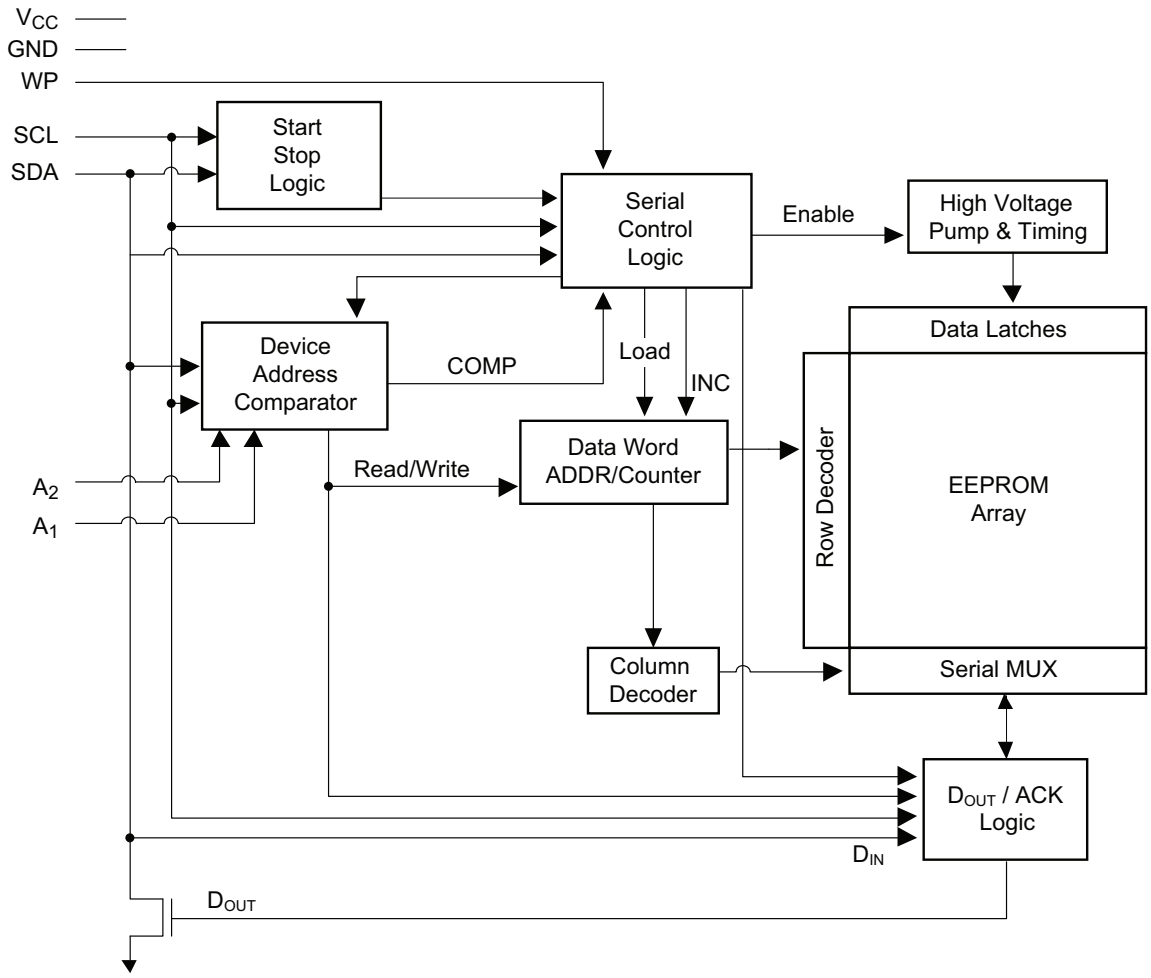
Note: Drawings are not to scale.

# 2. Absolute Maximum Ratings

| | |
|---|---|
| Operating Temperature | –55°C to +125°C |
| Storage Temperature | –65°C to +150°C |
| Voltage on any pin with respect to ground | –1.0V to +7.0V |
| Maximum Operating Voltage | 6.25V |
| DC Output Current | 5.0mA |

*Notice: Stresses beyond 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 these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

# 3. Block Diagram




# 4. Pin Description

**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.

**Serial Data (SDA):** The SDA pin is bidirectional 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.

**Device/Page Addresses:** The AT24C16C does not use the device address pins, which limits the number of devices on a single bus to one (see Section 7. “Device Addressing” on page 9).

**Write Protect (WP):** AT24C16C 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 Protect pin is connected to $V_{CC}$, the Write Protection feature is enabled and operates as shown in Table 4-1.

**Table 4-1. Write Protect**

| WP Pin Status | Part of the Array Protected<br>AT24C16C |
|---|---|
| At $V_{CC}$ | Full Array |
| At GND | Normal Read/Write Operations |

# 5. Memory Organization

**AT24C16C, 16K Serial EEPROM:** Internally organized with 128 pages of 16 bytes each, the 16K requires a 11-bit data word address for random word addressing.

**Table 5-1. Pin Capacitance**[1]

Applicable over recommended operating range from $T_A$ = 25°C, f = 1.0MHz, $V_{CC}$ = 5.5V.

| Symbol | Test Condition | Max | Units | Conditions |
|---|---|---|---|---|
| $C_{I/O}$ | Input/Output capacitance (SDA) | 8 | pF | $V_{I/O}$ = 0V |
| $C_{IN}$ | Input capacitance ($A_0$, $A_1$, $A_2$, SCL) | 6 | pF | $V_{IN}$ = 0V |

Note: 1. This parameter is characterized and is not 100% tested.

**Table 5-2. DC Characteristics**

Applicable over recommended operating range from: $T_{AI}$ = -40°C to +85°C, $V_{CC}$ = 1.7V to 5.5V (unless otherwise noted).

| Symbol | Parameter | Test Condition | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| $V_{CC1}$ | Supply Voltage | | 1.7 | | 5.5 | V |
| $I_{CC}$ | Supply Current $V_{CC}$ = 5.0V | Read at 100kHz | | 0.4 | 1.0 | mA |
| $I_{CC}$ | Supply Current $V_{CC}$ = 5.0V | Write at 100kHz | | 2.0 | 3.0 | mA |
| $I_{SB1}$ | Standby Current $V_{CC}$ = 1.7V | $V_{IN}$ = $V_{CC}$ or $V_{SS}$ | | | 1.0 | µA |
| $I_{SB2}$ | Standby Current $V_{CC}$ = 5.5V | $V_{IN}$ = $V_{CC}$ or $V_{SS}$ | | | 6.0 | µA |
| $I_{LI}$ | Input Leakage Current | $V_{IN}$ = $V_{CC}$ or $V_{SS}$ | | 0.10 | 3.0 | µA |
| $I_{LO}$ | Output Leakage Current | $V_{OUT}$ = $V_{CC}$ or $V_{SS}$ | | 0.05 | 3.0 | µA |
| $V_{IL}$ | Input Low Level[1] | | –0.6 | | $V_{CC}$ x 0.3 | V |
| $V_{IH}$ | Input High Level[1] | | $V_{CC}$ x 0.7 | | $V_{CC}$ + 0.5 | V |
| $V_{OL2}$ | Output Low Level $V_{CC}$ = 3.0V | $I_{OL}$ = 2.1mA | | | 0.4 | V |
| $V_{OL1}$ | Output Low Level $V_{CC}$ = 1.7V | $I_{OL}$ = 0.15mA | | | 0.2 | V |

Note: 1. $V_{IL}$ min and $V_{IH}$ max are reference only and are not tested.

**Table 5-3. AC Characteristics**

Applicable over recommended operating range from $T_{AI}$ = -40°C to 85°C, $V_{CC}$ = +1.7V to 5.5V, CL = 1TTL Gate and 100pF (unless otherwise noted).

| Symbol | Parameter | 1.7V | | 2.5V, 2.7V, 5.0V | | Units |
|---|---|---|---|---|---|---|
| | | Min | Max | Min | Max | |
| $f_{SCL}$ | Clock Frequency, SCL | | 400 | | 1000 | kHz |
| $t_{LOW}$ | Clock Pulse Width Low | 1.2 | | 0.4 | | µs |
| $t_{HIGH}$ | Clock Pulse Width High | 0.6 | | 0.4 | | µs |
| $t_I$ | Noise Suppression Time | | 100 | | 50 | ns |
| $t_{AA}$ | Clock Low to Data Out Valid | 0.1 | 0.9 | 0.05 | 0.55 | µs |
| $t_{BUF}$ | Time the bus must be free before a new transmission can start. | 1.2 | | 0.5 | | µs |
| $t_{HD.STA}$ | Start Condition Hold Time | 0.6 | | 0.25 | | µs |
| $t_{SU.STA}$ | Start Condiition Setup Time | 0.6 | | 0.25 | | µs |
| $t_{HD.DAT}$ | Data In Hold Time | 0 | | 0 | | µs |
| $t_{SU.DAT}$ | Data In Setup Time | 100 | | 100 | | ns |
| $t_R$ | Inputs Rise Time[1] | | 0.3 | | 0.3 | µs |
| $t_F$ | Inputs Fall Time[1] | | 300 | | 100 | ns |
| $t_{SU.STO}$ | Stop Condition Setup Time | 0.6 | | .25 | | µs |
| $t_{DH}$ | Data Out Hold Time | 50 | | 50 | | ns |
| $t_{WR}$ | Write Cycle Time | | 5 | | 5 | ms |
| Endurance[1] | 3.3V, 25°C, Page Mode | 1,000,000 | | | | Write Cycles |

Note: 1. This parameter is ensured by characterization only.

# 6. 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 6-4 on page 8). Data changes during SCL high periods will indicate a Start or Stop Condition as defined below.

**Start Condition:** A high-to-low transition of SDA with SCL high is a Start Condition which must precede any other command (see Figure 6-5 on page 8).

**Stop Condition:** A low-to-high transition of SDA with SCL high is a Stop Condition. After a read sequence, the Stop Condition command will place the EEPROM in a standby power mode (see Figure 6-5 on page 8).

**Acknowledge:** All addresses and data words are serially transmitted to and from the EEPROM in eight bit words. The EEPROM sends a zero to acknowledge that it has received each word. This happens during the ninth clock cycle.

**Standby Mode:** The AT24C16C features a low-power standby mode which is enabled:

- Upon power-up.
- After the receipt of the Stop Condition and the completion of any internal operations.

**2-wire Software Reset:** After an interruption in protocol, power loss or system reset, any 2-wire part can be reset by following these steps:

1. Create a Start Condition,
2. Clock nine cycles,
3. Create another Start Condition followed by Stop Condition as shown below.

The device is ready for next communication after above steps have been completed.

**Figure 6-1. Software Reset**

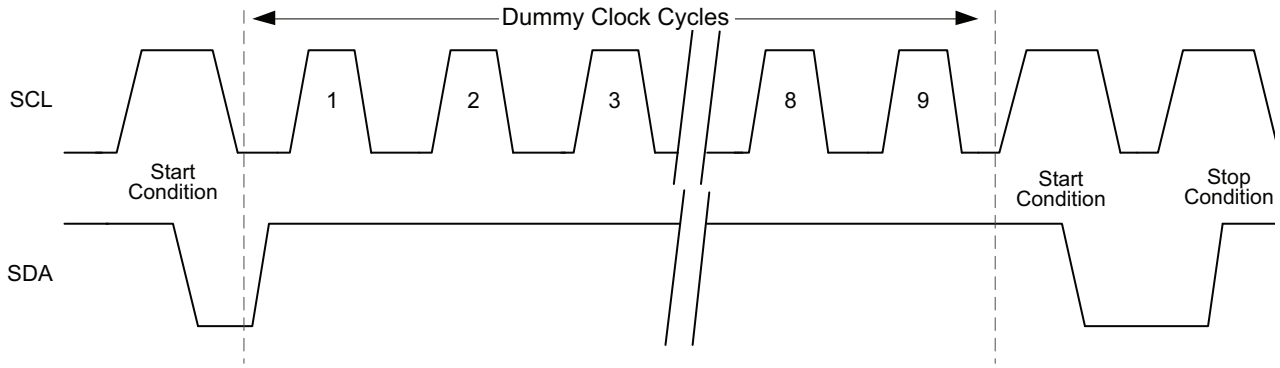


**Figure 6-2. Bus Timing**

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

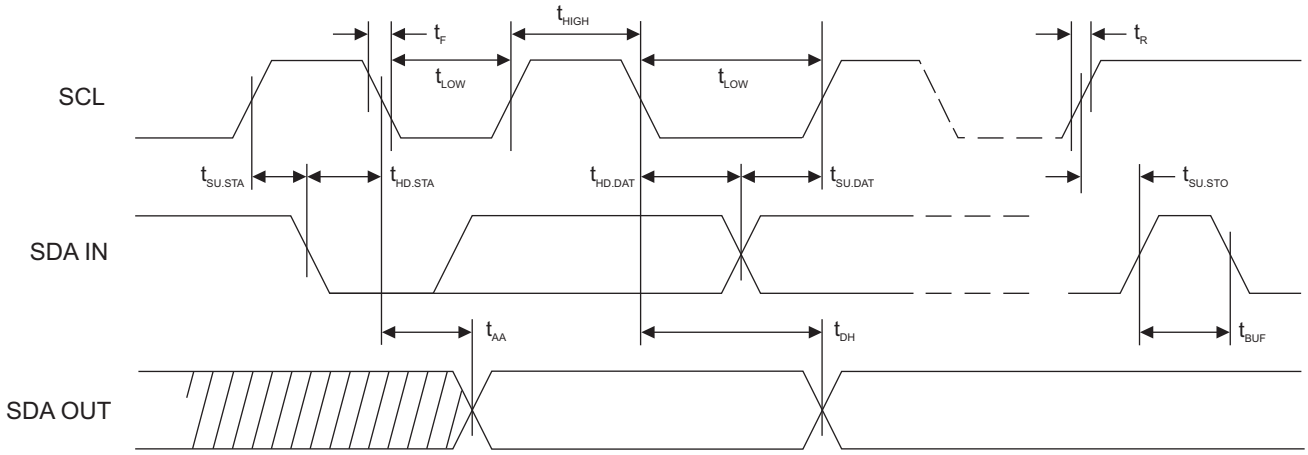
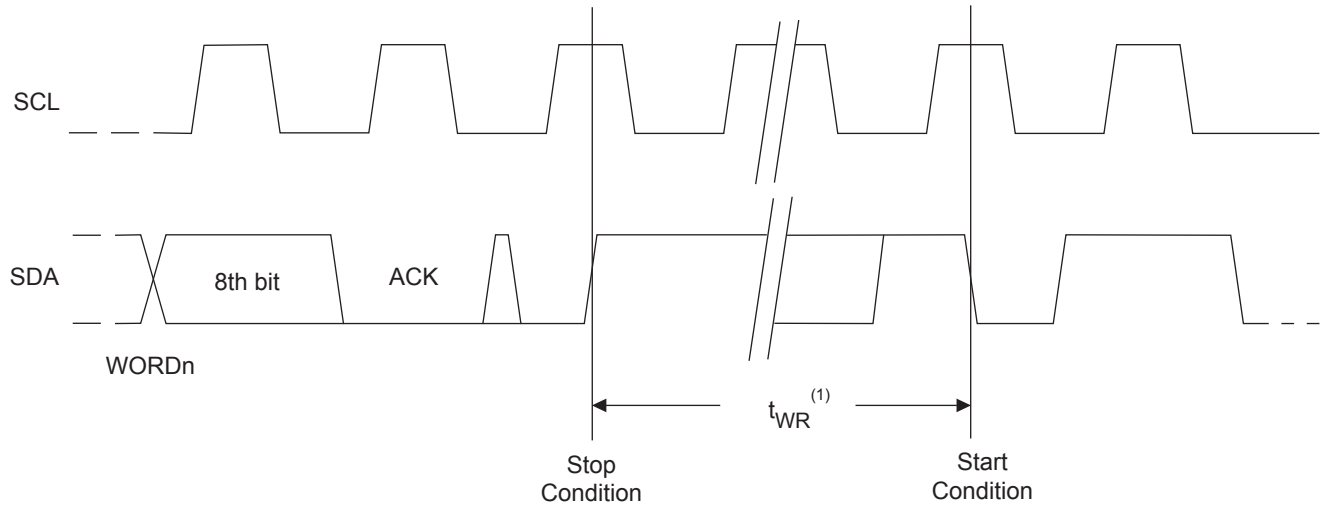



**Figure 6-3. Write Cycle Timing**

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




Notes: 1. The write cycle time $t_{WR}$ is the time from a valid Stop Condition of a Write sequence to the end of the internal clear/write cycle.

**Figure 6-4. Data Validity**

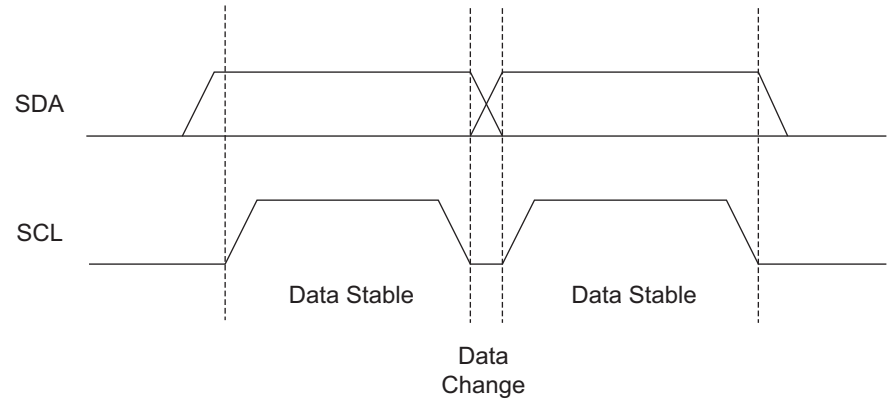



**Figure 6-5. Start Condition and Stop Condition Definition**

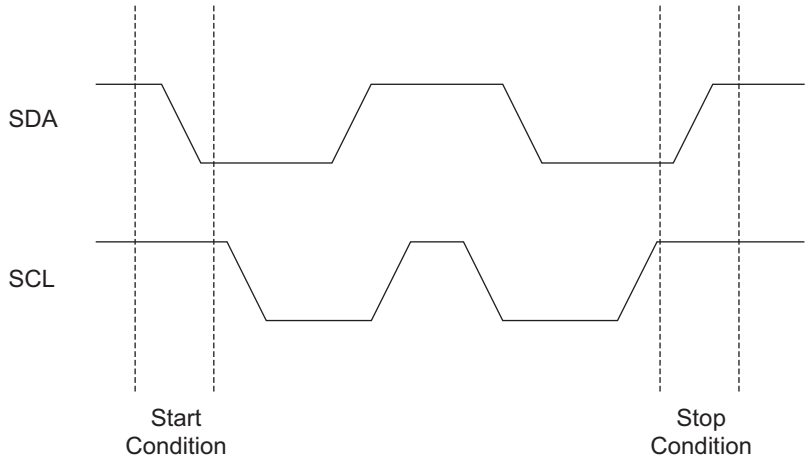
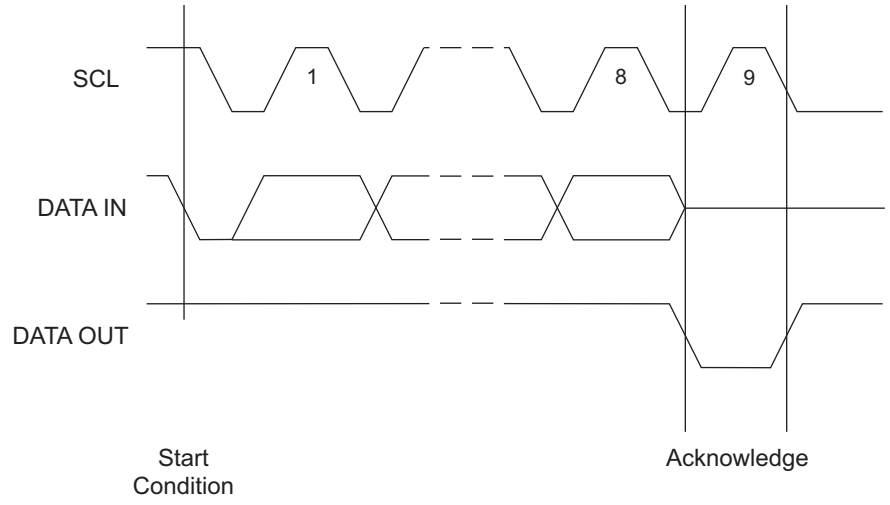



**Figure 6-6. Output Acknowledge**



# 7. Device Addressing

**Standard EEPROM Access:** The 16K EEPROM device requires an 8-bit device address word following a Start Condition to enable the chip for a Read or Write operation. The device address word consists of a mandatory "1010" (Ah) sequence for the first four Most Significant Bits (MSB) as shown in Figure 10. on page 12. This is common to all the EEPROM devices.

The next three bits used for memory page addressing are the most significant bits of the data word address which follows.

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 zero. If a compare is not made, the chip will return to a standby state.

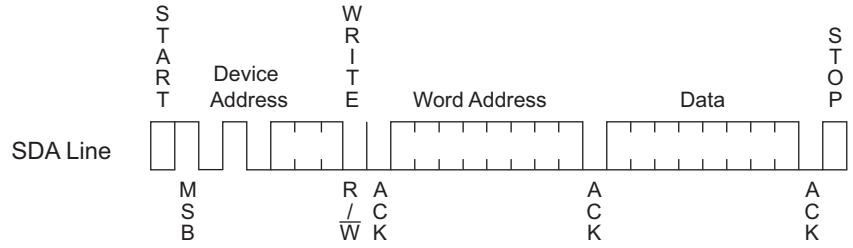
**Figure 7-1. Device Address**

| Density | Access Area | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|---|---|---|---|---|
| 16K | EEPROM | 1 | 0 | 1 | 0 | P2 | P1 | P0 | R/$\overline{W}$ |
| | | MSB | | | | | | | LSB |

# 8. 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 zero and then clock in the first 8-bit data word. Following receipt of the 8-bit data word, the EEPROM will output a zero and the addressing device, such as a microcontroller, must terminate the Write sequence with a Stop Condition. At this time the EEPROM enters an internally timed write cycle, $t_{WR}$, to the nonvolatile memory. All inputs are disabled during this write cycle and the EEPROM will not respond until the Write is complete (see Figure 8-1).

**Figure 8-1. Byte Write**

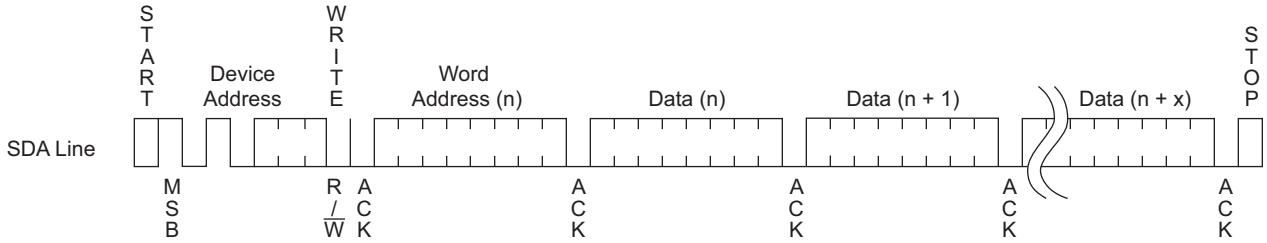


**Page Write:** The 16K EEPROM devices are capable of a 16-byte Page Write.

A Page Write is initiated in the same way as a Byte Write, but the microcontroller does not send a Stop Condition after the first data word is clocked in. Instead, after the EEPROM acknowledges receipt of the first data word, the microcontroller can transmit up to fifteen more data words. The EEPROM will respond with a zero after each data word received. The microcontroller must terminate the Page Write sequence with a Stop Condition (see Figure 8-2).

The data word address lower four 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.

**Figure 8-2. Page Write**




**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 zero allowing the Read or Write sequence to continue.

# 9. Read Operations

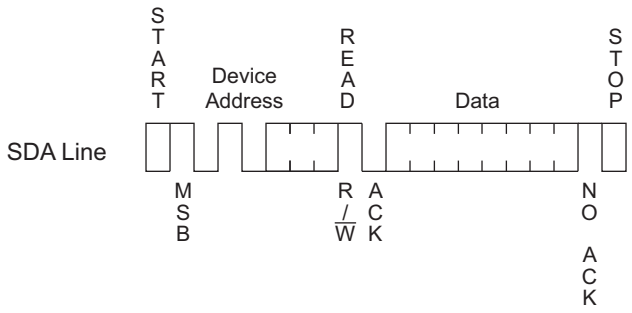
Read operations are initiated in the same way as Write operations with the exception that the Read/Write select bit in the device address word is set to one. There are three read operations:

- Current Address Read
- Random Address Read
- 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.

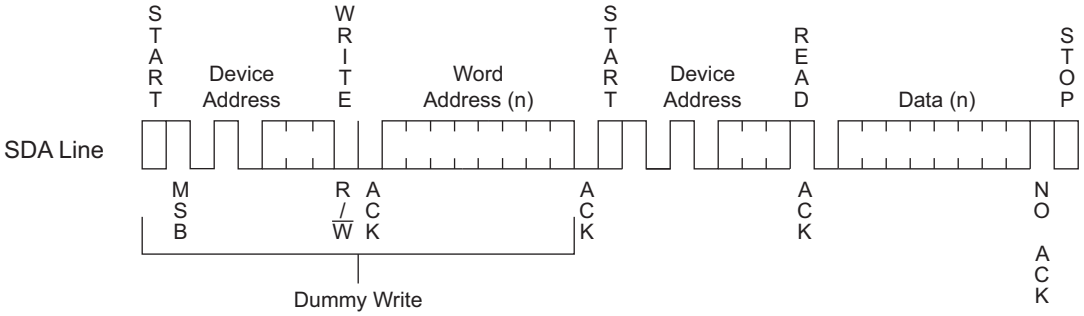
Once the device address with the Read/Write select bit set to one is clocked in and acknowledged by the EEPROM, the current address data word is serially clocked out. The microcontroller does not respond with an input zero but does generate a following Stop Condition (see Figure 9-1).

**Figure 9-1. Current Address Read**



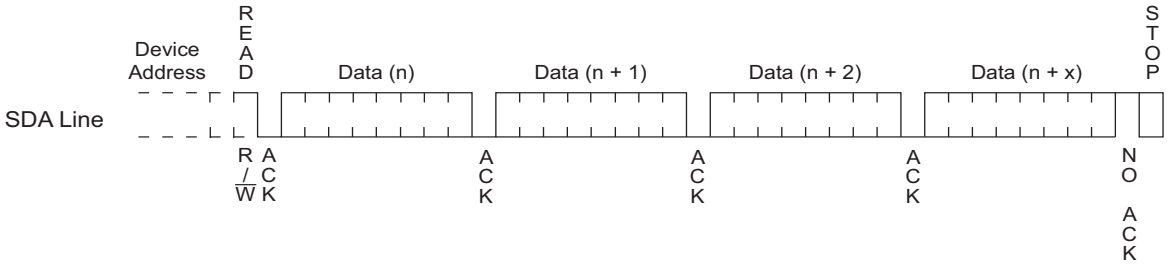
**Random Read:** A Random Read requires a Dummy Byte Write sequence to load in the data word address. Once the device address word and data word address are clocked in and acknowledged by the EEPROM, the microcontroller must generate another Start Condition. The microcontroller now initiates a Current 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 zero but does generate a following Stop Condition (see Figure 9-2).

**Figure 9-2. Random Read**

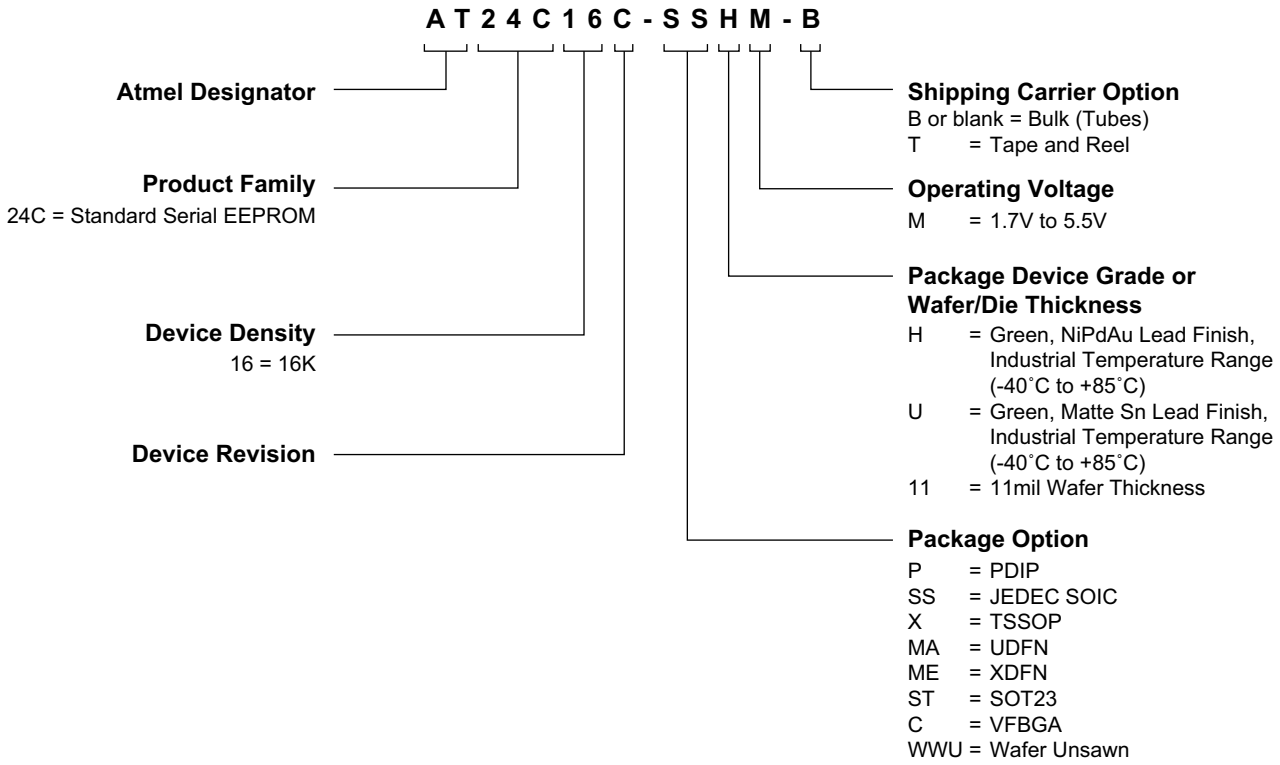



**Sequential Read:** Sequential Reads are initiated by either a Current Address Read or a Random Address Read. After the microcontroller receives a data word, it responds with an Acknowledge. As long as the EEPROM receives an Acknowledge, it will continue to increment the data word address and serially 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 zero but does generate a following Stop Condition (see Figure 9-3).

**Figure 9-3. Sequential Read**

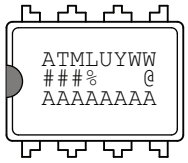
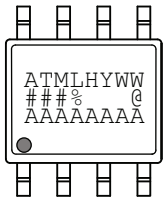
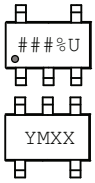
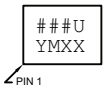


# 10. Ordering Code Detail



# 11. Product Markings

## AT24C16C: Package Marking Information

| 8-lead PDIP | 8-lead SOIC | 8-lead TSSOP | 8-pad UDFN |
|---|---|---|---|
|  |  |  | 2.0 x 3.0 mm Body<br>  |
| **8-pad XDFN** | **5-lead SOT-23** | **8-ball VFBGA** | |
| 1.8 x 2.2 mm Body<br>  |  | 1.5 x 2.0 mm Body<br>  | |

*Note 1: ● designates pin 1*

*Note 2: Package drawings are not to scale*

| **Catalog Number Truncation** | | | |
|---|---|---|---|
| AT24C16C | | Truncation Code ###: 16C | |
| **Date Codes** | | | **Voltages** |
| Y = Year | M = Month | WW = Work Week of Assembly | % = Minimum Voltage |
| 3: 2013 7: 2017<br>4: 2014 8: 2018<br>5: 2015 9: 2019<br>6: 2016 0: 2020 | A: January<br>B: February<br>...<br>L: December | 02: Week 2<br>04: Week 4<br>...<br>52: Week 52 | M: 1.7V min |
| **Country of Assembly** | **Lot Number** | | **Grade/Lead Finish Material** |
| @ = Country of Assembly | AAA...A = Atmel Wafer Lot Number | | H: Industrial/NiPdAu<br>U: Industrial/Matte Tin/SnAgCu |
| **Trace Code** | | | **Atmel Truncation** |
| XX = Trace Code (Atmel Lot Numbers Correspond to Code)<br>Example: AA, AB.... YZ, ZZ | | | AT: Atmel<br>ATM: Atmel<br>ATML: Atmel |

7/8/13

| Atmel<br>Package Mark Contact:<br>DL-CSO-Assy_eng@atmel.com | **TITLE**<br>**24C16CSM**, AT24C16C Package Marking Information | **DRAWING NO.**<br>24C16CSM | **REV.**<br>D |
|---|---|---|---|

# 12. Ordering Codes

## 12.1 AT24C16C Ordering Information

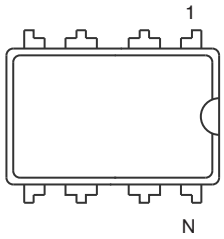
| Atmel Ordering Code | Lead Finish | Package | Voltage | Operation Range |
|---|---|---|---|---|
| AT24C16C-PUM | Bulk Form Only (Lead-free/Halogen-free) | 8P3 | 1.7V to 5.5V | Industrial Temperature (–40°C to 85°C) |
| AT24C16C-SSHM-B[1] | NiPdAu (Lead-free/Halogen-free) | 8S1 | | |
| AT24C16C-SSHM-T[2] | | | | |
| AT24C16C-XHM-B[1] | | 8X | | |
| AT24C16C-XHM-T[2] | | | | |
| AT24C16C-MAHM-T[2] | | 8MA2 | | |
| AT24C16C-MEHM-T[2] | — | 8ME1 | | |
| AT24C16C-STUM-T[2] | Matte Sn (Lead-free/Halogen-free) | 5TS1 | | |
| AT24C16C-CUM-T[2] | SnAgCu (Lead-free/Halogen-free) | 8U3-1 | | |
| AT24C16C-WWU11M[3] | — | Wafer Sale | | |

Notes:
1. B = Bulk
2. T = Tape and Reel
   - SOIC = 4K per reel
   - TSSOP, UDFN, XDFN, SOT23, and VFBGA = 5K per reel
3. For Wafer sales, please contact Atmel Sales.

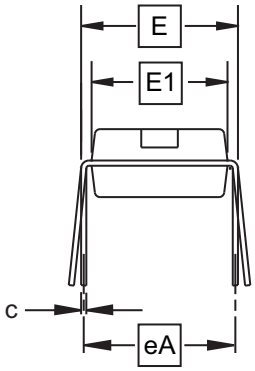
| Package Type | |
|---|---|
| **8P3** | 8-lead, 0.300" wide, Plastic Dual Inline (PDIP) |
| **8S1** | 8-lead, 0.150" wide, Plastic Gull Wing Small Outline (JEDEC SOIC) |
| **8X** | 8-lead, 4.40mm body, Plastic Thin Shrink Small Outline (TSSOP) |
| **8MA2** | 8-pad, 2.00mm x 3.00mm body, 0.50mm pitch, Plastic Ultra Thin Dual Flat No Lead (UDFN) |
| **8ME1** | 8-lead, 1.80mm x 2.20mm body, 0.40mm pitch, Extra Thin Dual Flat No Lead (XDFN) |
| **5TS1** | 5-lead, 2.90mm x 1.60mm body, Plastic Thin Shrink Small Outline (SOT23) |
| **8U3-1** | 8-ball, 1.50mm x 2.00mm body, 0.50mm pitch, Die Ball Grid Array (VFBGA) |

# 13. Packaging Information

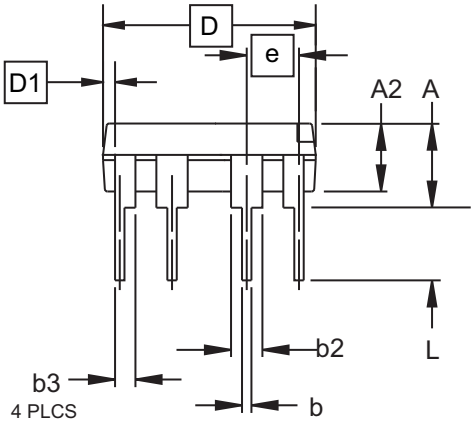
## 8P3 — 8-lead PDIP




Top View




End View




Side View

COMMON DIMENSIONS
(Unit of Measure = inches)

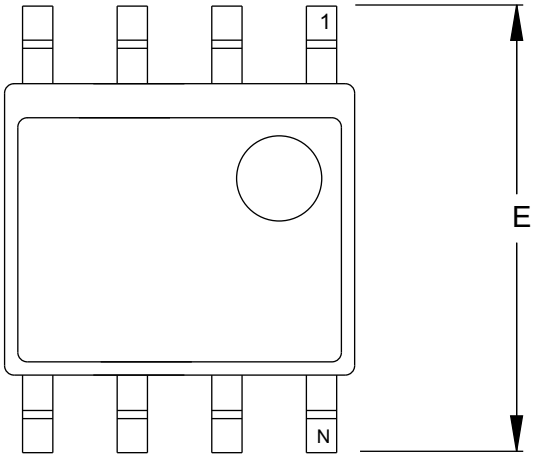
| SYMBOL | MIN | NOM | MAX | NOTE |
|---|---|---|---|---|
| A | | | 0.210 | 2 |
| A2 | 0.115 | 0.130 | 0.195 | |
| b | 0.014 | 0.018 | 0.022 | 5 |
| b2 | 0.045 | 0.060 | 0.070 | 6 |
| b3 | 0.030 | 0.039 | 0.045 | 6 |
| c | 0.008 | 0.010 | 0.014 | |
| D | 0.355 | 0.365 | 0.400 | 3 |
| D1 | 0.005 | | | 3 |
| E | 0.300 | 0.310 | 0.325 | 4 |
| E1 | 0.240 | 0.250 | 0.280 | 3 |
| e | 0.100 BSC | | | |
| eA | 0.300 BSC | | | 4 |
| L | 0.115 | 0.130 | 0.150 | 2 |

Notes:
1. This drawing is for general information only; refer to JEDEC Drawing MS-001, Variation BA for additional information.
2. Dimensions A and L are measured with the package seated in JEDEC seating plane Gauge GS-3.
3. D, D1 and E1 dimensions do not include mold Flash or protrusions. Mold Flash or protrusions shall not exceed 0.010 inch.
4. E and eA measured with the leads constrained to be perpendicular to datum.
5. Pointed or rounded lead tips are preferred to ease insertion.
6. b2 and b3 maximum dimensions do not include Dambar protrusions. Dambar protrusions shall not exceed 0.010 (0.25 mm).

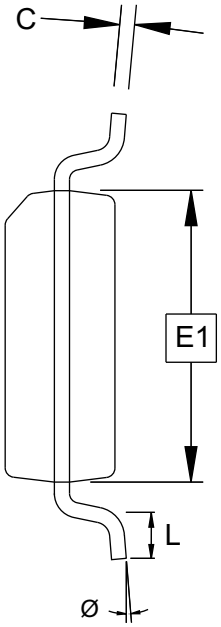
06/21/11

| Atmel<br>Package Drawing Contact:<br>packagedrawings@atmel.com | TITLE<br>8P3, 8-lead, 0.300” Wide Body, Plastic Dual In-line Package (PDIP) | GPC<br>PTC | DRAWING NO.<br>8P3 | REV.<br>D |
|---|---|---|---|---|

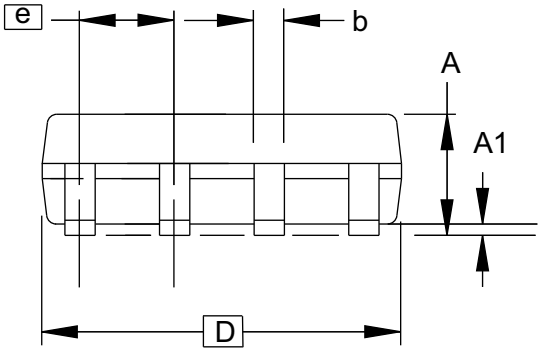
## 13.1 8S1 — 8-leadJEDEC SOIC




TOP VIEW




END VIEW




SIDE VIEW

Notes: This drawing is for general information only.
Refer to JEDEC Drawing MS-012, Variation AA
for proper dimensions, tolerances, datums, etc.

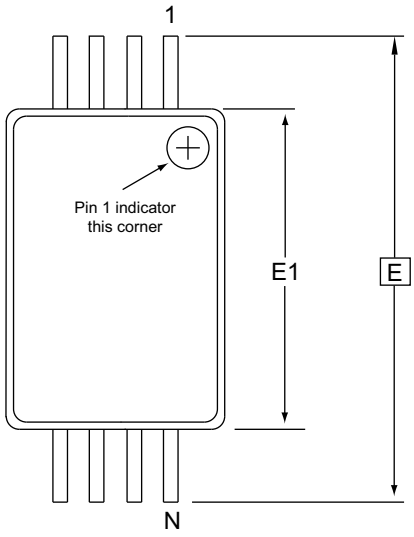
COMMON DIMENSIONS
(Unit of Measure = mm)

| SYMBOL | MIN | NOM | MAX | NOTE |
|---|---|---|---|---|
| A | 1.35 | – | 1.75 | |
| A1 | 0.10 | – | 0.25 | |
| b | 0.31 | – | 0.51 | |
| C | 0.17 | – | 0.25 | |
| D | 4.80 | – | 5.05 | |
| E1 | 3.81 | – | 3.99 | |
| E | 5.79 | – | 6.20 | |
| e | 1.27 BSC | | | |
| L | 0.40 | – | 1.27 | |
| Ø | 0° | – | 8° | |

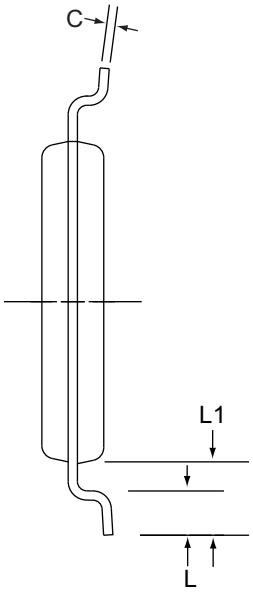
6/22/11

| Atmel<br>Package Drawing Contact:<br>packagedrawings@atmel.com | **TITLE**<br>8S1, 8-lead (0.150” Wide Body), Plastic Gull Wing Small Outline (JEDEC SOIC) | **GPC**<br>SWB | **DRAWING NO.**<br>8S1 | **REV.**<br>G |
|---|---|---|---|---|

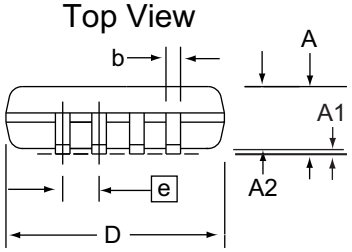
## 13.2 8X — 8-lead TSSOP




Top View




End View




Side View

Notes:
1. This drawing is for general information only. Refer to JEDEC Drawing MO-153, Variation AA, for proper dimensions, tolerances, datums, etc.
2. Dimension D does not include mold Flash, protrusions or gate burrs. Mold Flash, protrusions and gate burrs shall not exceed 0.15mm (0.006in) per side.
3. Dimension E1 does not include inter-lead Flash or protrusions. Inter-lead Flash and protrusions shall not exceed 0.25mm (0.010in) per side.
4. Dimension b does not include Dambar protrusion. Allowable Dambar protrusion shall be 0.08mm total in excess of the b dimension at maximum material condition. Dambar cannot be located on the lower radius of the foot. Minimum space between protrusion and adjacent lead is 0.07mm.
5. Dimension D and E1 to be determined at Datum Plane H.

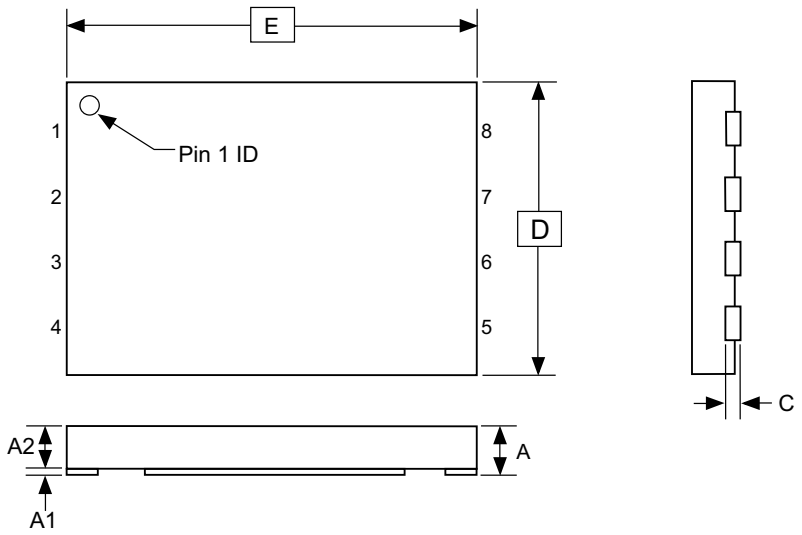
COMMON DIMENSIONS
(Unit of Measure = mm)

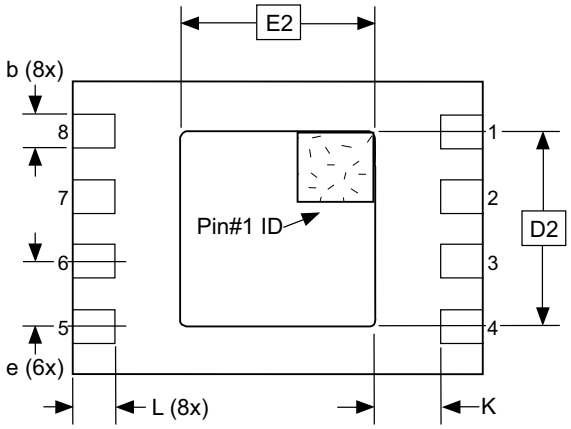
| SYMBOL | MIN | NOM | MAX | NOTE |
|---|---|---|---|---|
| A | - | - | 1.20 | |
| A1 | 0.05 | - | 0.15 | |
| A2 | 0.80 | 1.00 | 1.05 | |
| D | 2.90 | 3.00 | 3.10 | 2, 5 |
| E | | 6.40 BSC | | |
| E1 | 4.30 | 4.40 | 4.50 | 3, 5 |
| b | 0.19 | – | 0.30 | 4 |
| e | | 0.65 BSC | | |
| L | 0.45 | 0.60 | 0.75 | |
| L1 | | 1.00 REF | | |
| C | | 0.09 | - | 0.20 |

6/22/11

| Atmel<br>Package Drawing Contact:<br>packagedrawings@atmel.com | **TITLE**<br>8X, 8-lead 4.4mm Body, Plastic Thin Shrink Small Outline Package (TSSOP) | **GPC**<br>TNR | **DRAWING NO.**<br>8X | **REV.**<br>D |
|---|---|---|---|---|

## 13.3 8MA2 — 8-pad UDFN




COMMON DIMENSIONS
(Unit of Measure = mm)

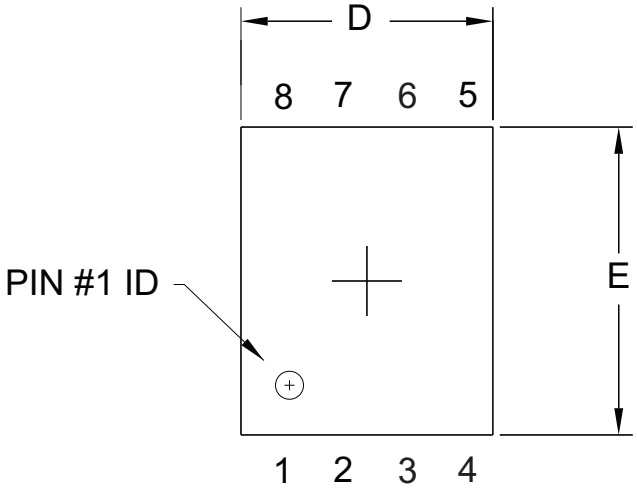
| SYMBOL | MIN | NOM | MAX | NOTE |
|---|---|---|---|---|
| D | | 2.00 BSC | | |
| E | | 3.00 BSC | | |
| D2 | 1.40 | 1.50 | 1.60 | |
| E2 | 1.20 | 1.30 | 1.40 | |
| A | 0.50 | 0.55 | 0.60 | |
| A1 | 0.0 | 0.02 | 0.05 | |
| A2 | – | – | 0.55 | |
| C | | 0.152 REF | | |
| L | 0.30 | 0.35 | 0.40 | |
| e | | 0.50 BSC | | |
| b | 0.18 | 0.25 | 0.30 | 3 |
| K | 0.20 | – | – | |

Notes:
1. This drawing is for general information only. Refer to JEDEC Drawing MO-229, for proper dimensions, tolerances, datums, etc.
2. The terminal #1 ID is a laser-marked feature.
3. Dimension b applies to metallized terminal and is measured between 0.15 mm and 0.30 mm from the terminal tip. If the terminal has the optional radius on the other end of the terminal, the dimension should not be measured in that radius area.

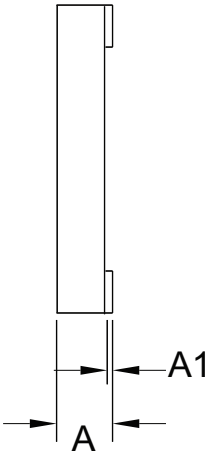
7/15/11

| Atmel<br>Package Drawing Contact:<br>packagedrawings@atmel.com | **TITLE**<br>8MA2, 8-pad, 2 x 3 x 0.6 mm Body, Thermally Enhanced Plastic Ultra Thin Dual Flat No Lead Package (UDFN) | **GPC**<br>YNZ | **DRAWING NO.**<br>8MA2 | **REV.**<br>B |
|---|---|---|---|---|

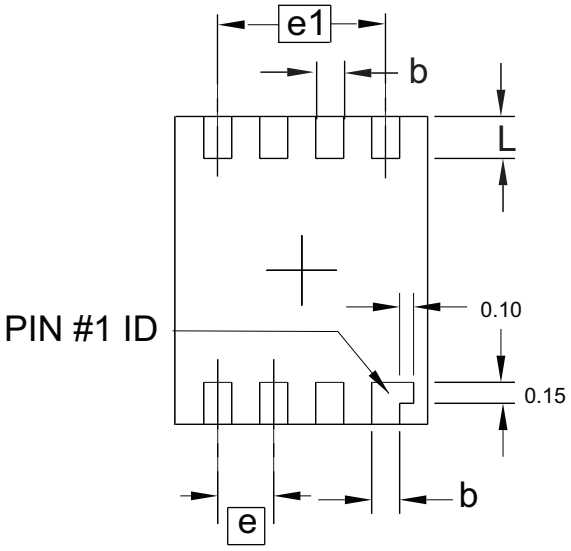
## 13.4 8ME1 — 8-pad XDFN




Top View




Side View




End View

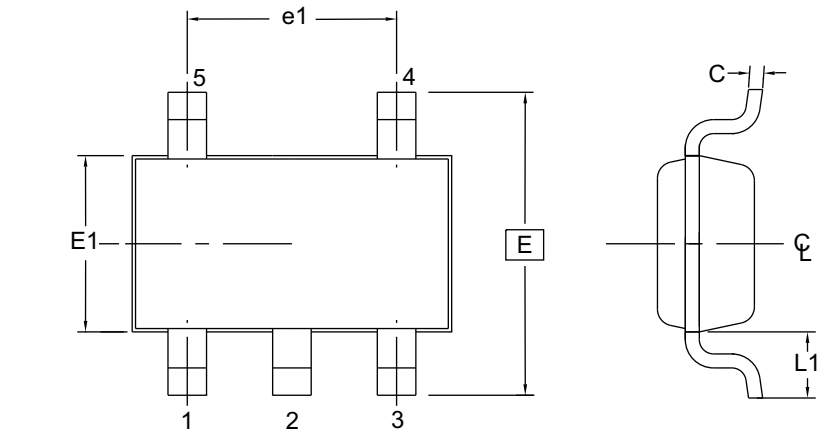
**COMMON DIMENSIONS**
(Unit of Measure = mm)

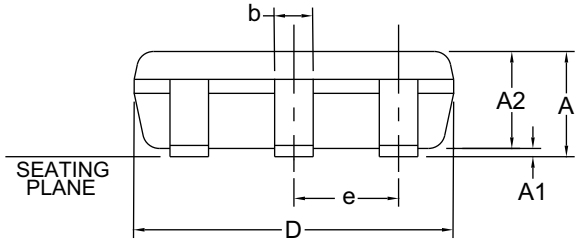
| SYMBOL | MIN | NOM | MAX | NOTE |
|---|---|---|---|---|
| A | – | – | 0.40 | |
| A1 | 0.00 | – | 0.05 | |
| D | 1.70 | 1.80 | 1.90 | |
| E | 2.10 | 2.20 | 2.30 | |
| b | 0.15 | 0.20 | 0.25 | |
| e | 0.40 TYP | | | |
| e1 | 1.20 REF | | | |
| L | 0.26 | 0.30 | 0.35 | |

9/10/2012

| Atmel<br>Package Drawing Contact:<br>packagedrawings@atmel.com | **TITLE**<br>**8ME1**, 8-pad (1.80mm x 2.20mm body) Extra Thin DFN (XDFN) | **GPC**<br>DTP | **DRAWING NO.**<br>8ME1 | **REV.**<br>B |
|---|---|---|---|---|

## 13.5 5TS1 — 5-lead SOT23




1. Dimension D does not include mold flash, protrusions or gate burrs. Mold flash, protrusions or gate burrs shall not exceed 0.15 mm per end. Dimension E1 does not include interlead flash or protrusion. Interlead flash or protrusion shall not exceed 0.15 mm per side.
2. The package top may be smaller than the package bottom. Dimensions D and E1 are determined at the outermost extremes of the plastic body exclusive of mold flash, tie bar burrs, gate burrs and interlead flash, but including any mismatch between the top and bottom of the plastic body.
3. These dimensions apply to the flat section of the lead between 0.08 mm and 0.15 mm from the lead tip.
4. Dimension "b" does not include dambar protrusion. Allowable dambar protrusion shall be 0.08 mm total in excess of the "b" dimension at maximum material condition. The dambar cannot be located on the lower radius of the foot. Minimum space between protrusion and an adjacent lead shall not be less than 0.07 mm.

This drawing is for general information only. Refer to JEDEC Drawing MO-193, Variation AB for additional information.

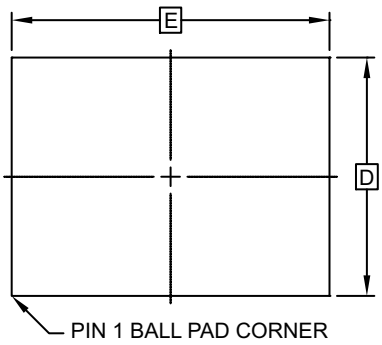
COMMON DIMENSIONS
(Unit of Measure = mm)

| SYMBOL | MIN | NOM | MAX | NOTE |
|---|---|---|---|---|
| A | - | - | 1.00 | |
| A1 | 0.00 | - | 0.10 | |
| A2 | 0.70 | 0.90 | 1.00 | |
| c | 0.08 | - | 0.20 | 3 |
| D | 2.90 BSC | | | 1,2 |
| E | 2.80 BSC | | | 1,2 |
| E1 | 1.60 BSC | | | 1,2 |
| L1 | 0.60 REF | | | |
| e | 0.95 BSC | | | |
| e1 | 1.90 BSC | | | |
| b | 0.30 | - | 0.50 | 3,4 |

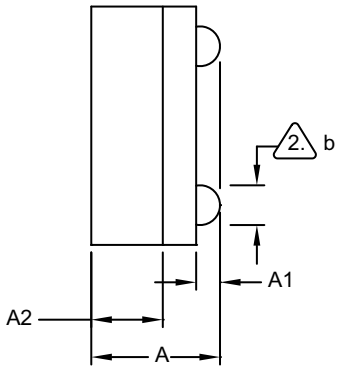
5/31/12

| Atmel<br>Package Drawing Contact:<br>packagedrawings@atmel.com | TITLE<br>5TS1, 5-lead 1.60mm Body, Plastic Thin Shrink Small Outline Package (Shrink SOT) | GPC<br>TSZ | DRAWING NO.<br>5TS1 | REV.<br>D |
|---|---|---|---|---|

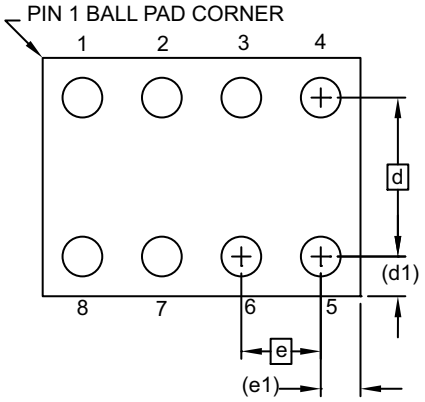
## 13.6 8U3-1 — 8-ball VFBGA




TOP VIEW




SIDE VIEW




BOTTOM VIEW
8 SOLDER BALLS

Notes:

1. This drawing is for general information only.
2. Dimension 'b' is measured at maximum solder ball diameter.
3. Solder ball composition shall be 95.5Sn-4.0Ag-.5Cu.

COMMON DIMENSIONS
(Unit of Measure - mm)

| SYMBOL | MIN | NOM | MAX | NOTE |
|---|---|---|---|---|
| A | 0.73 | 0.79 | 0.85 | |
| A1 | 0.09 | 0.14 | 0.19 | |
| A2 | 0.40 | 0.45 | 0.50 | |
| b | 0.20 | 0.25 | 0.30 | 2 |
| D | 1.50 BSC | | | |
| E | 2.0 BSC | | | |
| e | 0.50 BSC | | | |
| e1 | 0.25 REF | | | |
| d | 1.00 BSC | | | |
| d1 | 0.25 REF | | | |

3/27/12

| | | | | |
|---|---|---|---|---|
| Atmel<br>Package Drawing Contact:<br>packagedrawings@atmel.com | TITLE<br>8U3-1, 8-ball, 1.50mm x 2.00mm body, 0.50mm pitch, VFBGA Package | GPC<br>GXU | DRAWING NO.<br>8U3-1 | REV.<br>E |

# 14. Revision History

| Doc. Rev. | Date | Comments |
|---|---|---|
| 8719B | 07/2013 | Minor grammetical corrections.<br>Update Atmel logos and template. |
| 8719A | 09/2010 | Initial document release. |

Atmel | Enabling Unlimited Possibilities®

**Atmel Corporation** 1600 Technology Drive, San Jose, CA 95110 USA **T:** (+1)(408) 441.0311 **F:** (+1)(408) 436.4200 | **www.atmel.com**