# AT24C64D

## I²C-Compatible (2-Wire) Serial EEPROM
## 64-Kbit (8,192 x 8)

**DATASHEET**

## Features

- Low-voltage and Standard-voltage Operation
  - $V_{CC}$ = 1.7V to 5.5V
- Internally Organized as 8,192 x 8 (64K)
- I²C-compatible (2-Wire) Serial Interface
- Schmitt Trigger, Filtered Inputs for Noise Suppression
- Bidirectional Data Transfer Protocol
- 400kHz (1.7V) and 1MHz (2.5V, 2.7V, 5.0V) Compatibility
- Write Protect Pin for Hardware Protection
- 32-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
- Lead-free/Halogen-free Devices Available
- Green Package Options (Pb/Halide-free/RoHS Compliant)
  - 8-lead JEDEC SOIC, 8-lead TSSOP, 8-pad UDFN, 8-pad XDFN, 8-ball VFBGA, and 4-ball/5-ball/6-ball WLCSP Packages
- Die Sale Options: Wafer Form, Waffle Pack, and Bumped Wafers

## Description

The Atmel® AT24C64D provides 65,536-bits of Serial Electrically Erasable and Programmable Read-Only Memory (EEPROM) organized as 8,192 words of 8 bits each. The device's cascading feature allows up to eight devices to share a common 2-wire bus. The device is optimized for use in many industrial and commercial applications where low-power and low-voltage operation are essential. The devices are available in space-saving 8-lead JEDEC SOIC, 8-lead TSSOP, 8-pad UDFN, 8-pad XDFN, 8-ball VFBGA, and 4-ball/5-ball/6-ball WLCSP packages. In addition, this device operates from 1.7V to 5.5V.

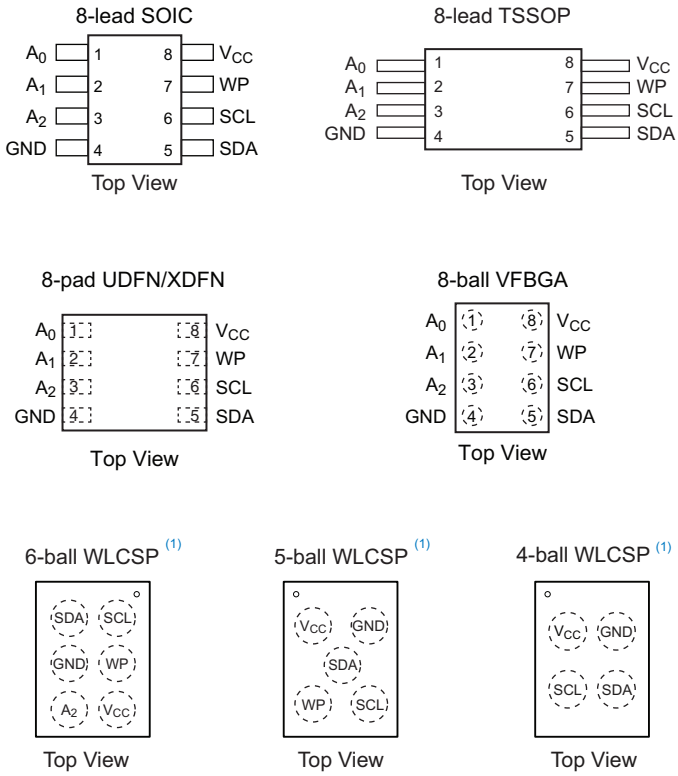
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# 1. Pin Configurations and Pinouts

**Table 1-1. Pin Configuration**

| Pin | Function |
|---|---|
| $A_0$ | Address Input |
| $A_1$ | Address Input |
| $A_2$ | Address Input |
| GND | Ground |
| SDA | Serial Data |
| SCL | Serial Clock Input |
| WP | Write Protect |
| $V_{CC}$ | Device Power Supply |

Note: 1. For use of the 4-ball, 5-ball, and 6-ball WLCSP packages, please refer to Section 7. Device Addressing on page 9 for details about setting the A2, A1, and A0 hardware address bits.




Note: Drawings are not to scale

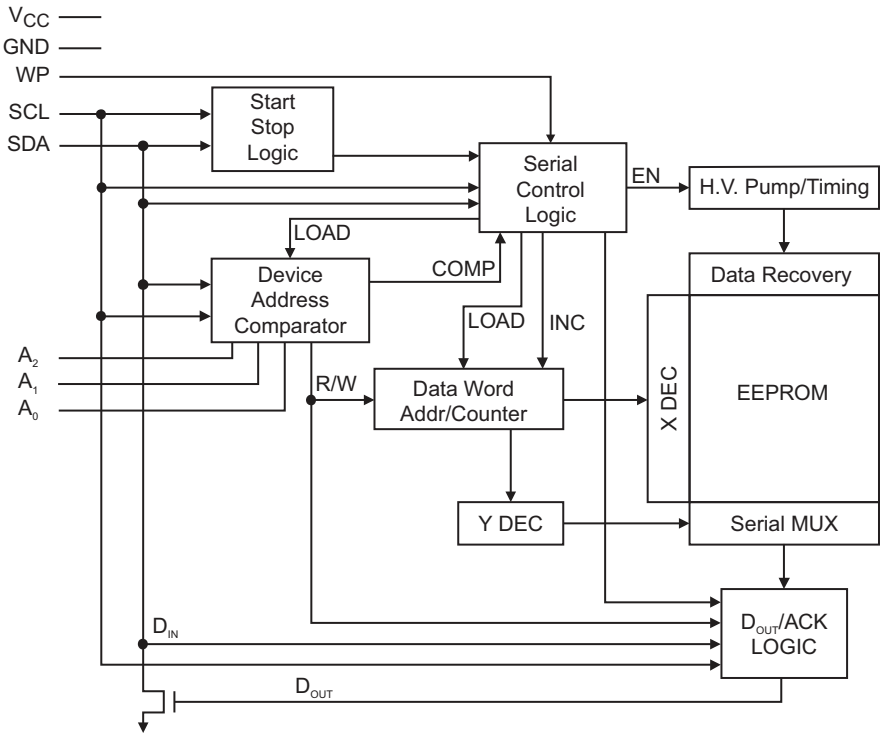
# 2. Absolute Maximum Ratings*

| | |
|---|---|
| Operating Temperature | -55°C to +125°C |
| Storage Temperature | -65°C to + 150°C |
| Voltage on any pin with respect to ground | -1.0 V +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 are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.


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# 3. Block Diagram




# 4. Pin Descriptions

**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 Addresses ($A_2$, $A_1$, $A_0$):** The $A_2$, $A_1$, and $A_0$ pins are device address inputs that are hard wired (directly to GND or to $V_{CC}$) for compatibility with other Atmel AT24C devices. When the pins are hard wired, as many as eight 64K devices may be addressed on a single bus system. (Device addressing is discussed in detail in Section 7., "Device Addressing" on page 9). A device is selected when a corresponding hardware and software match is true. If these pins are left floating, the $A_2$, $A_1$, and $A_0$ pins will be internally pulled down to GND. However, due to capacitive coupling that may appear during customer applications, Atmel recommends always connecting the address pins to a known state. When using a pull-up resistor, Atmel recommends using 10kΩ or less.

**Write Protect (WP):** The Write Protect input, when connected to GND, allows normal Write operations. When WP is connected directly to $V_{CC}$, all Write operations to the memory are inhibited. If the pin is left floating, the WP pin will be internally pulled down to GND: however, due to capacitive coupling that may appear during customer applications, Atmel recommends always connecting the WP pins to a known state. When using a pull-up resistor, Atmel recommends using 10kΩ or less.

**Table 4-1. Write Protect**

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


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# 5. Memory Organization

**AT24C64D, 64K Serial EEPROM**: The 64K is internally organized as 256 pages of 32-bytes each. Random word addressing requires a 13-bit data word address.

## 5.1 Pin Capacitance

**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 ($A_0$, $A_1$, $A_2$, and SCL) | 6 | pF | $V_{IN}$ = 0V |

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

## 5.2 DC Characteristics

**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 |
| $I_{CC1}$ | Supply Current | $V_{CC}$ = 5.0V | Read at 400kHz | | 0.4 | 1.0 | mA |
| $I_{CC2}$ | Supply Current | $V_{CC}$ = 5.0V | Write at 400kHz | | 2.0 | 3.0 | mA |
| $I_{SB1}$ | Standby Current | $V_{CC}$ = 1.7V | $V_{IN}$ = $V_{CC}$ or $V_{SS}$ | | | 1.0 | µA |
| | | $V_{CC}$ = 5.0V | | | | 6.0 | µA |
| $I_{LI}$ | Input Leakage Current $V_{CC}$ = 5.0V | $V_{IN}$ = $V_{CC}$ or $V_{SS}$ | | | 0.10 | 3.0 | µA |
| $I_{LO}$ | Output Leakage Current $V_{CC}$ = 5.0V | $V_{OUT}$ = $V_{CC}$ 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 |
| $V_{OL1}$ | Output Low Level | $V_{CC}$ = 1.7V | $I_{OL}$ = 0.15mA | | | 0.2 | V |
| $V_{OL2}$ | Output Low Level | $V_{CC}$ = 3.0V | $I_{OL}$ = 2.1mA | | | 0.4 | V |

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


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## 5.3 AC Characteristics

**Table 5-3. AC Characteristics (Industrial Temperature)**

Applicable over recommended operating range from: $T_{AI}$ = -40°C to +85°C, $V_{CC}$ = 1.7V to 5.5V, CL = 100pF *(unless otherwise noted)*. Test conditions are listed in Note 2.

| Symbol | Parameter | 1.7V | | 2.5V, 5.0V | | Units |
|---|---|---|---|---|---|---|
| | | Min | Max | Min | Max | |
| $f_{SCL}$ | Clock Frequency, SCL | | 400 | | 1000 | kHz |
| $t_{LOW}$ | Clock Pulse Width Low | 1300 | | 400 | | ns |
| $t_{HIGH}$ | Clock Pulse Width High | 600 | | 400 | | ns |
| $t_I$ | Noise Suppression Time(1) | | 100 | | 50 | ns |
| $t_{AA}$ | Clock Low to Data Out Valid | 50 | 900 | 50 | 550 | ns |
| $t_{BUF}$ | Time the bus must be free before a new transmission can start(1) | 1300 | | 500 | | ns |
| $t_{HD.STA}$ | Start Hold Time | 600 | | 250 | | ns |
| $t_{SU.STA}$ | Start Set-up Time | 600 | | 250 | | ns |
| $t_{HD.DAT}$ | Data In Hold Time | 0 | | 0 | | ns |
| $t_{SU.DAT}$ | Data In Set-up Time | 100 | | 100 | | ns |
| $t_R$ | Inputs Rise Time(1) | | 300 | | 300 | ns |
| $t_F$ | Inputs Fall Time(1) | | 300 | | 100 | ns |
| $t_{SU.STO}$ | Stop Set-up Time | 600 | | 250 | | ns |
| $t_{DH}$ | Data Out Hold Time | 50 | | 50 | | ns |
| $t_{WR}$ | Write Cycle Time | | 5 | | 5 | ms |
| Endurance(1) | 25°C, Page Mode, 3.3V | 1,000,000 | | | | Write Cycles |

Notes: 1. This parameter is ensured by characterization and is not 100% tested.

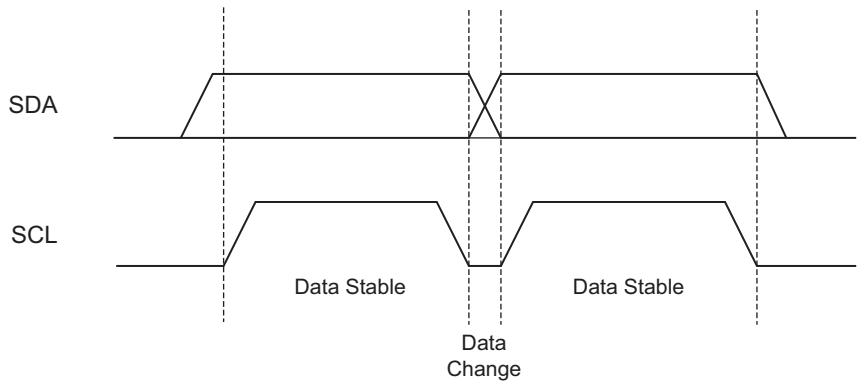
2. AC measurement conditions:
   - $R_L$ (connects to $V_{CC}$): 1.3kΩ (2.5V, 5.5V), 10kΩ (1.7V)
   - Input pulse voltages: $0.3V_{CC}$ to $0.7V_{CC}$
   - Input rise and fall times: ≤ 50ns
   - Input and output timing reference voltages: 0.5 x $V_{CC}$


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# 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. Data changes during SCL high periods will indicate a start or stop condition as defined below.

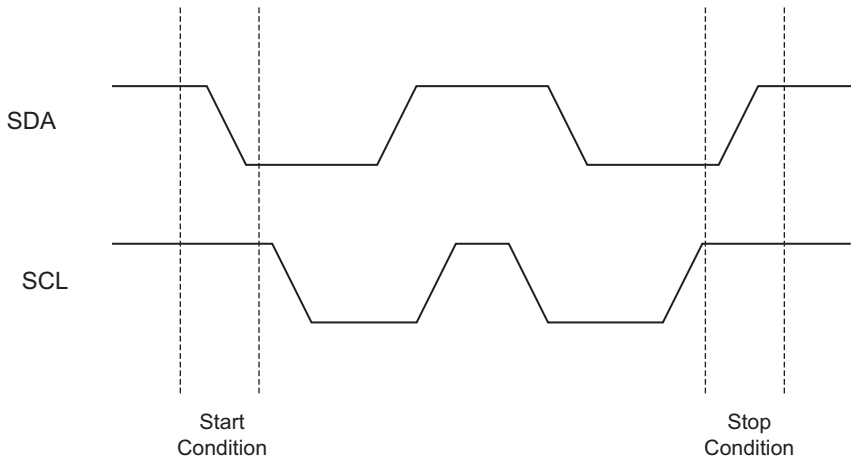
**Figure 6-1. Data Validity**




**Start Condition**: A high-to-low transition of SDA with SCL high is a Start condition that must precede every command.

**Stop Condition:** A low-to-high transition of SDA with SCL high is a Stop condition. After a Read sequence, the Stop Condition will place the EEPROM in a standby power mode.

**Figure 6-2. Start and Stop Definition**

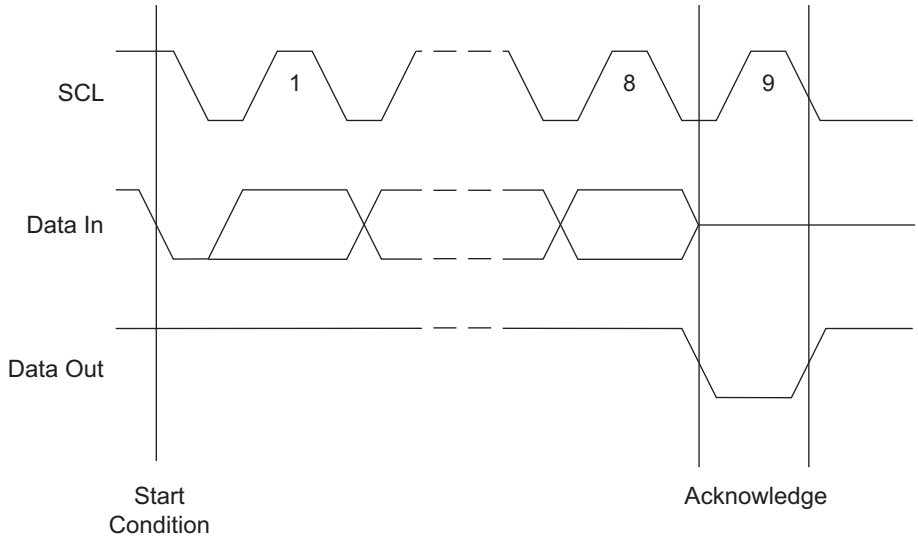




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**Acknowledge:** All addresses and data words are serially transmitted to and from the EEPROM in 8-bit words. The receiving device sends a zero during the ninth clock cycle to acknowledge that it has received each word. This zero response is referred to as an Acknowledge.

**Figure 6-3. Output Acknowledge**



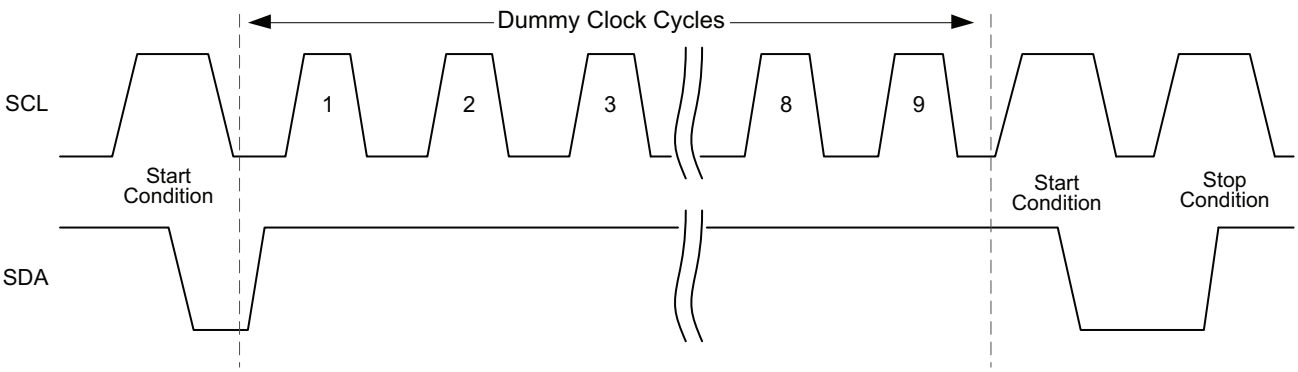

**Standby Mode:** The AT24C64D features a low-power standby mode that is enabled upon power-up and after the receipt of the Stop condition and the completion of any internal operations.

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

1. Create a Start condition (if possible).
2. Clock nine cycles.
3. Create another Start followed by Stop condition as shown below.

The device should be ready for the next communication after the above steps have been completed. In the event that the device is still non-responsive or remains active on the SDA bus, a power cycle must be used to reset the device.

**Figure 6-4. Software Reset**





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**Figure 6-5. Bus Timing**

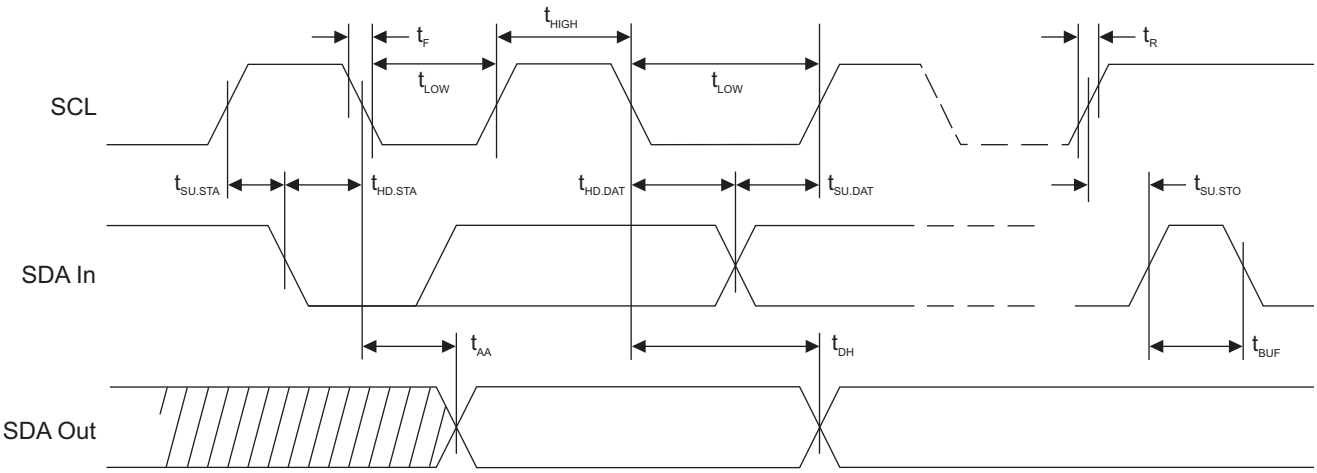
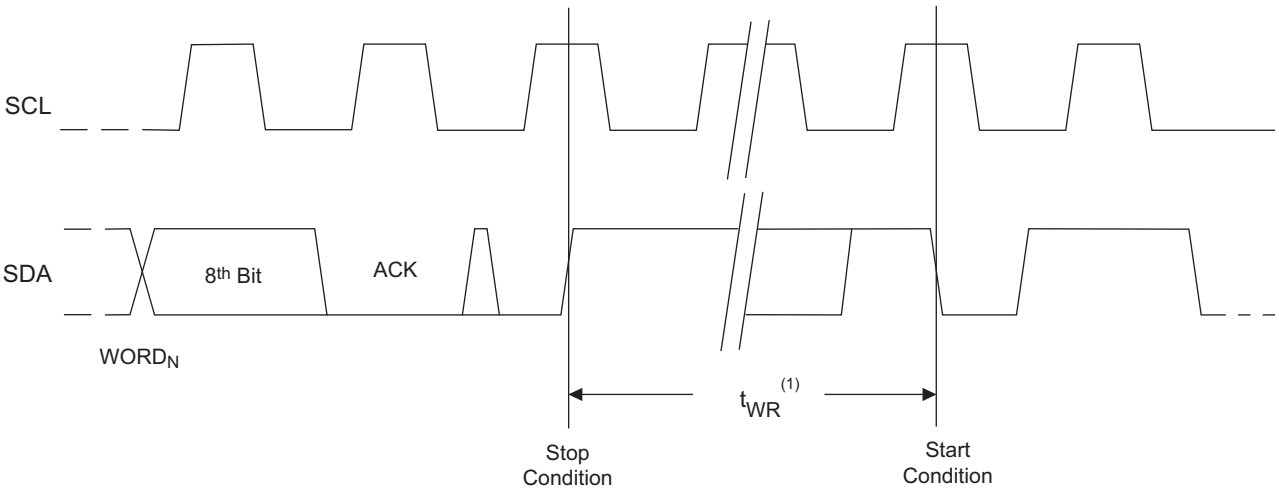



**Figure 6-6. Write Cycle Timing**




Note: 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.


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# 7. Device Addressing

The 64K EEPROM 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' sequence for the first four most significant bits (bit 7, bit 6, bit 5, and bit 4 as seen in Figure 7-1). This is common to all 2-wire Serial EEPROM devices.

The next three bits are the A2, A1, and A0 device address bits to allow as many as eight devices on the same bus. These bits must compare to their corresponding hard wired input pins, where applicable. The $A_2$, $A_1$, and $A_0$ pins use an internal proprietary circuit that pulls them to GND if the pins are allowed to float.

When utilizing the 6-ball WLCSP package, the $A_1$ and $A_0$ pins are not available and are internally pulled to ground; therefore, the A1 and A0 device address bits must always be set to a Logic 0 condition to communicate with the device. This condition is depicted in Figure 7-1 below.

When utilizing the 5-ball WLCSP package, the $A_2$, $A_1$ and $A_0$ pins are not available. The $A_2$ and $A_1$ pins are internally pulled to ground and thus the A2 and A1 device address bits must always be set to a Logic 0 condition to communicate with the device. The $A_0$ pin is internally connected to $V_{CC}$ in this specific package only; therefore, the A0 software bit must be set to Logic 1 to communicate to the device. This condition is depicted in Figure 7-1 below.

When utilizing the 4-ball WLCSP package, the $A_2$, $A_1$, and $A_0$ pins are not available and are internally pulled to ground; therefore, the A2, A1 and A0 device address bits must always be set to a Logic 0 condition to communicate with the device. This condition is depicted in Figure 7-1 below.

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 device will return to a standby state.

**Figure 7-1. Device Addressing**

| Package | Device Type Identifier | | | | Hardware Address Bits | | | R/W Select |
|---|---|---|---|---|---|---|---|---|
| | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| SOIC, TSSOP, UDFN, XDFN, and VFBGA | 1 | 0 | 1 | 0 | A2 | A1 | A0 | R/$\overline{W}$ |
| 6-ball WLCSP | 1 | 0 | 1 | 0 | A2 | 0 | 0 | R/$\overline{W}$ |
| 5-ball WLCSP | 1 | 0 | 1 | 0 | 0 | 0 | 1 | R/$\overline{W}$ |
| 4-ball WLCSP | 1 | 0 | 1 | 0 | 0 | 0 | 0 | R/$\overline{W}$ |
| | MSB | | | | | | | LSB |

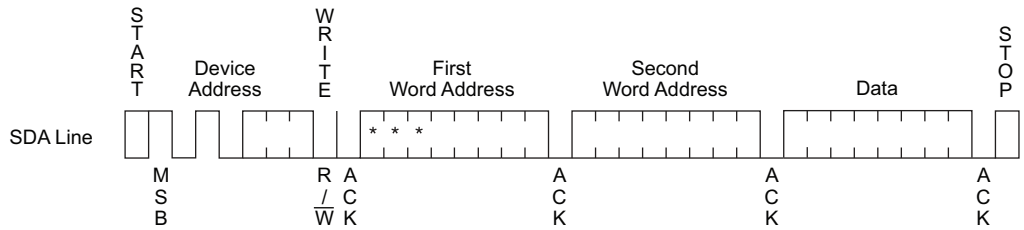
**Data Security:** AT24C64D has a hardware data protection scheme that allows the user to write protect the whole memory when the WP pin is at $V_{CC}$. The 4-ball WLCSP does not include a WP pin, and therefore no write protection is possible in this package only.


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# 8. Write Operations

**Byte Write**: A Write operation requires two 8-bit data word addresses 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. The addressing device, such as a microcontroller, must then 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 (See Figure 6-6). All inputs are disabled during this Write cycle and the EEPROM will not respond until the Write is complete.

**Figure 8-1. Byte Write**

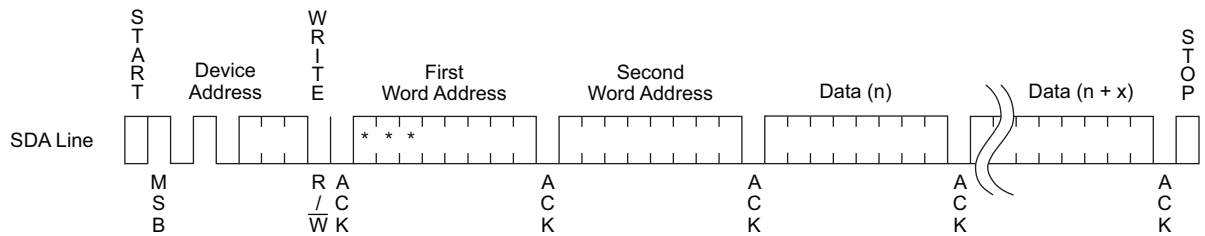



Note: * = Don't care bit.

**Page Write:** The 64K EEPROM is capable of 32-byte Page Writes.

A Page Write is initiated 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 31 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.

**Figure 8-2. Page Write**




Note: * = Don't care bit.

The data word address lower five 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 32 data words are transmitted to the EEPROM, the data word address will roll-over and the previously loaded data will be altered. The address roll-over during Write is from the last byte of the current page to the first byte of the same page.

**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.


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# 9. Read Operations

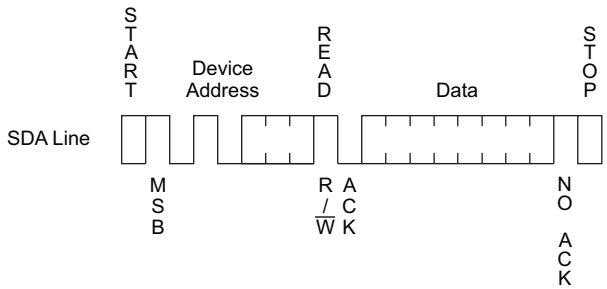
Read operations are initiated the same way as Write operations with the exception that the Read/Write select bit in the device address word is set to one. There are three Read operations:

- 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.

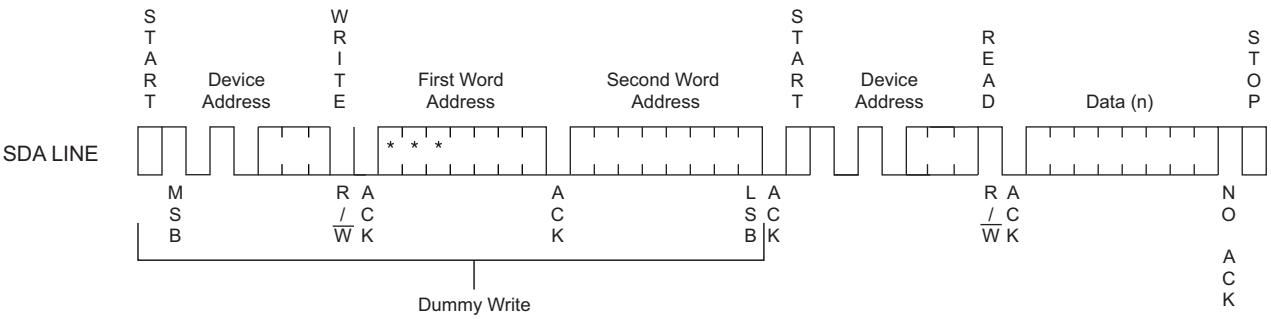
Once the device address with the Read/Write select bit set to one is clocked in and acknowledged by the EEPROM, the current address data word is serially clocked out. The microcontroller does not respond with an input zero but does generate a Stop condition.

**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 Stop condition.

**Figure 9-2. Random Read**

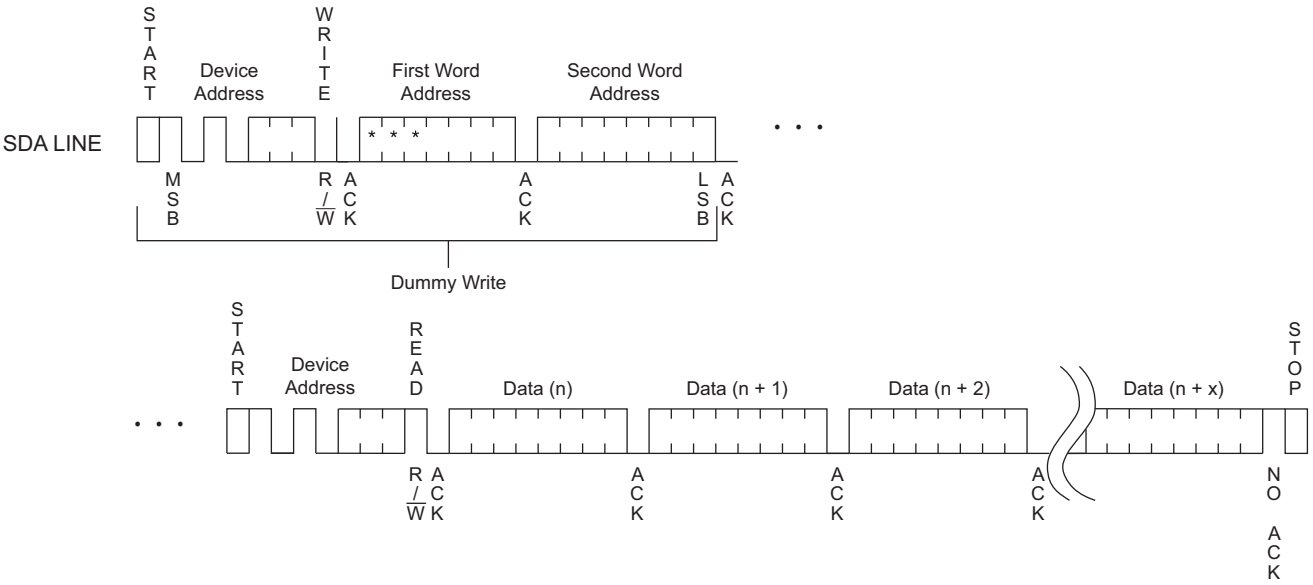



Note: * = Don't care bit.


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**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 maximum address is reached, the data word address will roll-over and the Sequential Read will continue from the beginning of the array. The Sequential Read operation is terminated when the microcontroller does not respond with a zero but does generate a Stop condition.

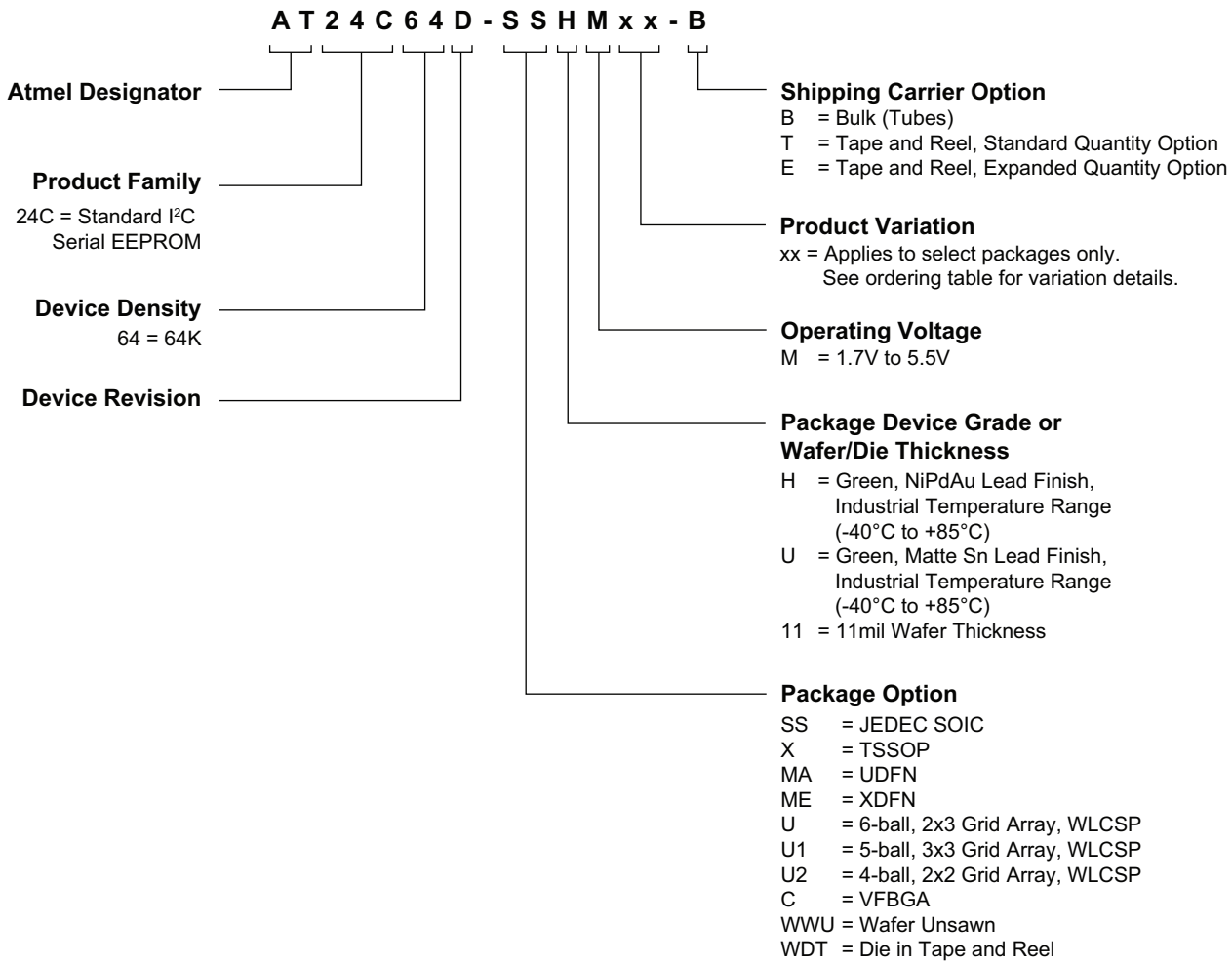
**Figure 9-3. Sequential Read**




Note: * = Don’t care bit.


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# 10. Ordering Code Detail

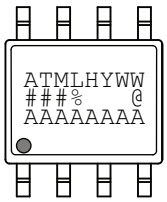
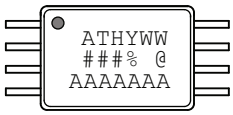
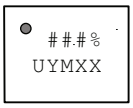
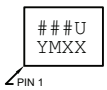




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# 11. Part Markings

## AT24C64D: Package Marking Information

| 8-lead SOIC | 8-lead TSSOP | 8-pad XDFN |
|---|---|---|
|  |  | 1.8 x 2.2 mm Body<br> |
| **8-pad UDFN** | **4, 5, and 6-ball WLCSP** | **8-ball VFBGA** |
| 2.0 x 3.0 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** | | | |
|---|---|---|---|
| AT24C64D | | Truncation Code ###: 64D | |
| **Date Codes** | | | **Voltages** |
| Y = Year | M = Month | WW = Work Week of Assembly | % = Minimum Voltage |
| 5: 2015 9: 2019<br>6: 2016 0: 2020<br>7: 2017 1: 2021<br>8: 2018 2: 2022 | 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 | | U: Industrial/Matte Tin/SnAguCu<br>H: Industrial/NiPdAu |
| **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 |

4/27/2015

| Atmel | TITLE | DRAWING NO. | REV. |
|---|---|---|---|
| Package Mark Contact:<br>DL-CSO-Assy_eng@atmel.com | **24C64DSM**, AT24C64D Package Marking Information | 24C64DSM | E |


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# 12. Ordering Information

| Atmel Ordering Code | Lead Finish | Package | Delivery Information | | Operating Range |
|---|---|---|---|---|---|
| | | | Form | Quantity | |
| AT24C64D-SSHM-B | NiPdAu (Lead-free/Halogen-free) | 8S1 | Bulk (Tubes) | 100 per Tube | Industrial Temperature (-40°C to 85°C) |
| AT24C64D-SSHM-T | | | Tape and Reel | 4,000 per Reel | |
| AT24C64D-XHM-B | | 8X | Bulk (Tubes) | 100 per Tube | |
| AT24C64D-XHM-T | | | Tape and Reel | 4,000 per Reel | |
| AT24C64D-MAHM-T | | 8MA2 | Tape and Reel | 5,000 per Reel | |
| AT24C64D-MAHM-E | | | Tape and Reel | 15,000 per Reel | |
| AT24C64D-MEHM-T | | 8ME1 | Tape and Reel | 5,000 per Reel | |
| AT24C64D-UUM0B-T(1) | SnAgCu (Lead-free/Halogen-free) | 6U-2 | Tape and Reel | 5,000 per Reel | |
| AT24C64D-U1UM0B-T(1) | | 5U-4 | Tape and Reel | 5,000 per Reel | |
| AT24C64D-U2UM0B-T(1) | | 4U-12 | Tape and Reel | 5,000 per Reel | |
| AT24C64D-CUM-T | | 8U2-1 | Tape and Reel | 5,000 per Reel | |
| AT24C64D-WWU11M(2) | N/A | Wafer Sale | Note 2 | | |

Notes: 1. WLCSP Package:
- This device includes a backside coating to increase product robustness.
- **CAUTION**: Exposure to ultraviolet (UV) light can degrade the data stored in the EEPROM cells. Therefore, customers who use a WLCSP product must ensure that exposure to ultraviolet light does ***not*** occur.

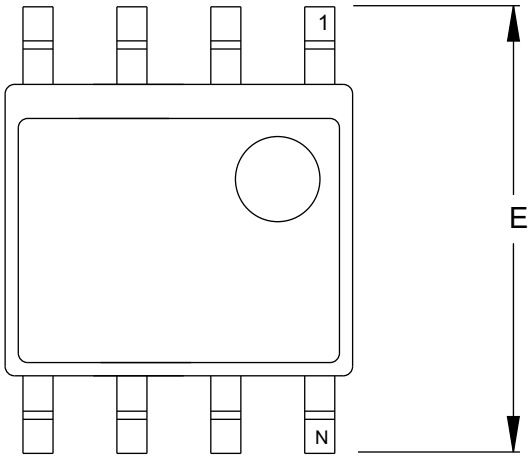
2. Contact Atmel Sales for Wafer sales.

| Package Type | |
|---|---|
| 8S1 | 8-lead, 0.150” wide, Plastic Gull Wing Small Outline (JEDEC SOIC) |
| 8X | 8-lead, 4.40mm body, Plastic Thin Shrink Small Outline Package (TSSOP) |
| 8MA2 | 8-pad, 2.00mm x 3.00mm body, 0.50mm pitch, Dual No Lead (UDFN) |
| 8ME1 | 8-pad, 1.80mm x 2.20mm body, Extra Thin DFN (XDFN) |
| 6U-2 | 6-ball, 2x3 Grid Array, Wafer Level Chip Scale Package (WLCSP) |
| 5U-4 | 5-ball, 3x3 Grid Array, Wafer Level Chip Scale Package (WLCSP) |
| 4U-12 | 4-ball, 2x2 Grid Array, Wafer Level Chip Scale Package (WLCSP) |
| 8U2-1 | 8-ball, Die Ball Grid Array (VFBGA) |

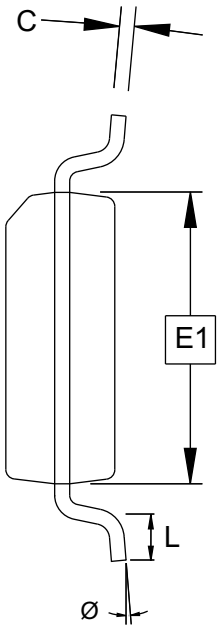

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# 13. Packaging Information

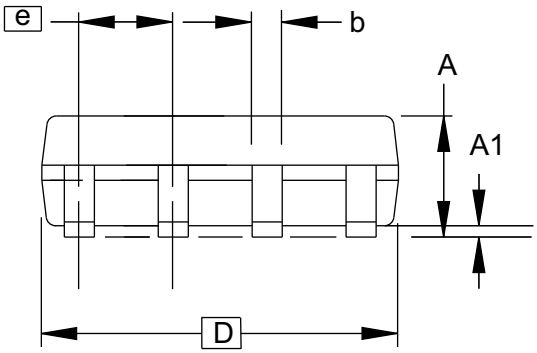
## 13.1 8S1 — 8-lead JEDEC SOIC




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)

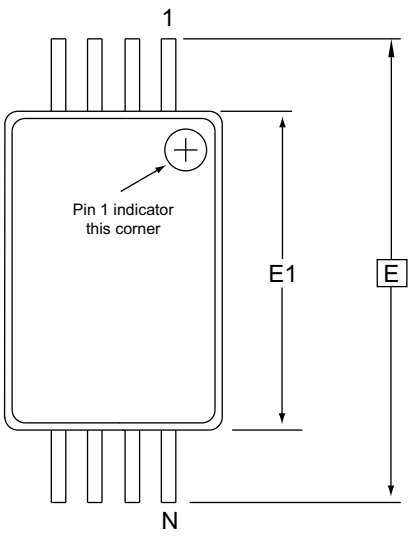
| SYMBOL | MIN | NOM | MAX | NOTE |
|---|---|---|---|---|
| A | – | – | 1.75 | |
| A1 | 0.10 | – | 0.25 | |
| b | 0.31 | – | 0.51 | |
| C | 0.17 | – | 0.25 | |
| D | | 4.90 BSC | | |
| E | | 6.00 BSC | | |
| E1 | | 3.90 BSC | | |
| e | | 1.27 BSC | | |
| L | 0.40 | – | 1.27 | |
| Ø | 0° | – | 8° | |

3/6/2015

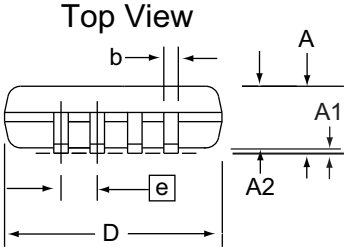
| Atmel<br>Package Drawing Contact:<br>packagedrawings@atmel.com | TITLE<br>8S1, 8-lead (0.150” Wide Body), Plastic Gull Wing Small Outline (JEDEC SOIC) | GPC<br>SWB | DRAWING NO.<br>8S1 | REV.<br>H |
|---|---|---|---|---|


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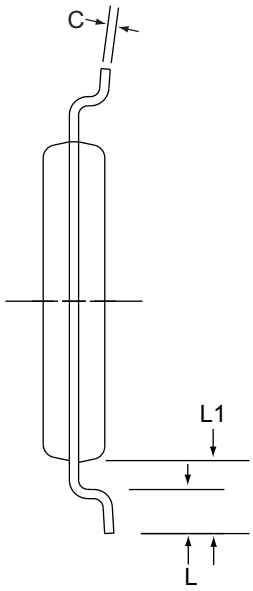
## 13.2 8X — 8-lead TSSOP




Top View




Side View




End 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)

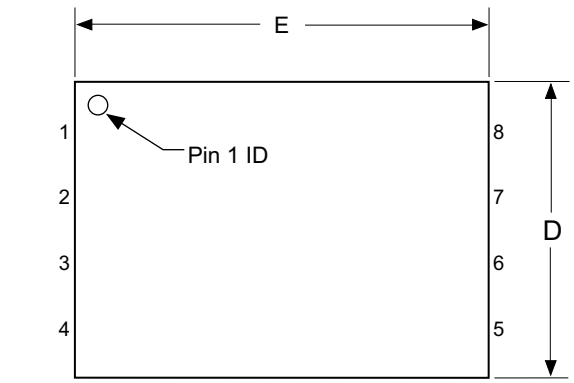
| SYMBOL | MIN | NOM | MAX | NOTE |
|---|---|---|---|---|
| A | - | - | 1.20 | |
| A1 | 0.05 | - | 0.15 | |
| A2 | 0.80 | 1.00 | 1.05 | |
| D | 2.90 | 3.00 | 3.10 | 2, 5 |
| E | | 6.40 BSC | | |
| E1 | 4.30 | 4.40 | 4.50 | 3, 5 |
| b | 0.19 | 0.25 | 0.30 | 4 |
| e | | 0.65 BSC | | |
| L | 0.45 | 0.60 | 0.75 | |
| L1 | | 1.00 REF | | |
| C | 0.09 | - | 0.20 | |

2/27/14

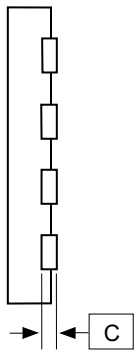
| Atmel<br>Package Drawing Contact:<br>packagedrawings@atmel.com | TITLE<br>8X, 8-lead 4.4mm Body, Plastic Thin Shrink Small Outline Package (TSSOP) | GPC<br>TNR | DRAWING NO.<br>8X | REV.<br>E |
|---|---|---|---|---|


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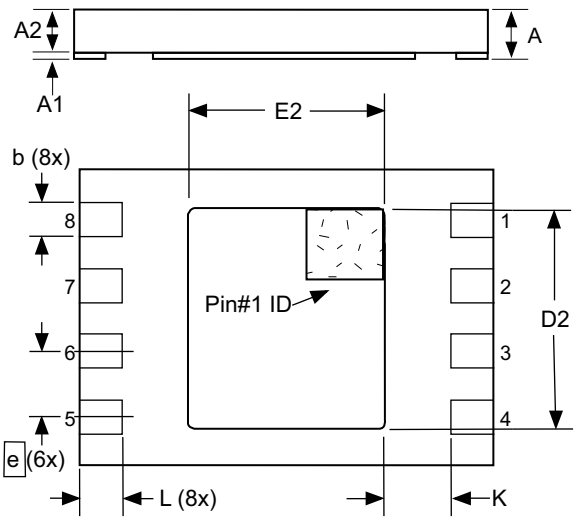
## 13.3 8MA2 — 8-pad UDFN




TOP VIEW




SIDE VIEW




BOTTOM VIEW

Notes:
1. This drawing is for general information only. Refer to Drawing MO-229, for proper dimensions, tolerances, datums, etc.
2. The Pin #1 ID is a laser-marked feature on Top View.
3. Dimensions 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.
4. The Pin #1 ID on the Bottom View is an orientation feature on the thermal pad.

COMMON DIMENSIONS
(Unit of Measure = mm)

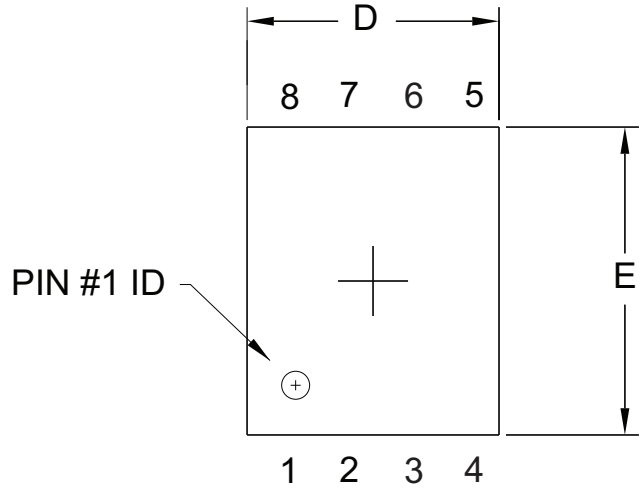
| SYMBOL | MIN | NOM | MAX | NOTE |
|---|---|---|---|---|
| A | 0.50 | 0.55 | 0.60 | |
| A1 | 0.0 | 0.02 | 0.05 | |
| A2 | - | - | 0.55 | |
| D | 1.90 | 2.00 | 2.10 | |
| D2 | 1.40 | 1.50 | 1.60 | |
| E | 2.90 | 3.00 | 3.10 | |
| E2 | 1.20 | 1.30 | 1.40 | |
| b | 0.18 | 0.25 | 0.30 | 3 |
| C | 1.52 REF | | | |
| L | 0.30 | 0.35 | 0.40 | |
| e | 0.50 BSC | | | |
| K | 0.20 | - | - | |

11/26/14

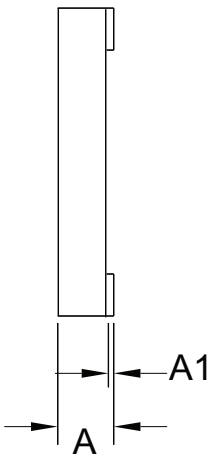
| Atmel<br>Package Drawing Contact:<br>packagedrawings@atmel.com | TITLE<br>8MA2, 8-pad 2 x 3 x 0.6mm Body, Thermally Enhanced Plastic Ultra Thin Dual Flat No-Lead Package (UDFN) | GPC<br>YNZ | DRAWING NO.<br>8MA2 | REV.<br>G |
|---|---|---|---|---|


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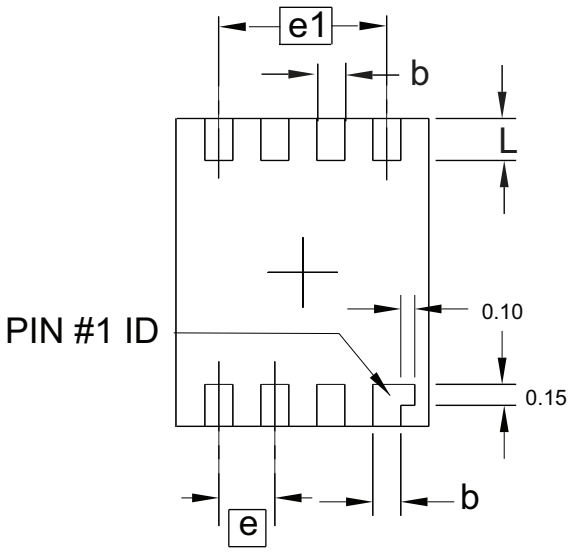
## 13.4 8ME1 — 8-pad XDFN




Top View




Side View




End View

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

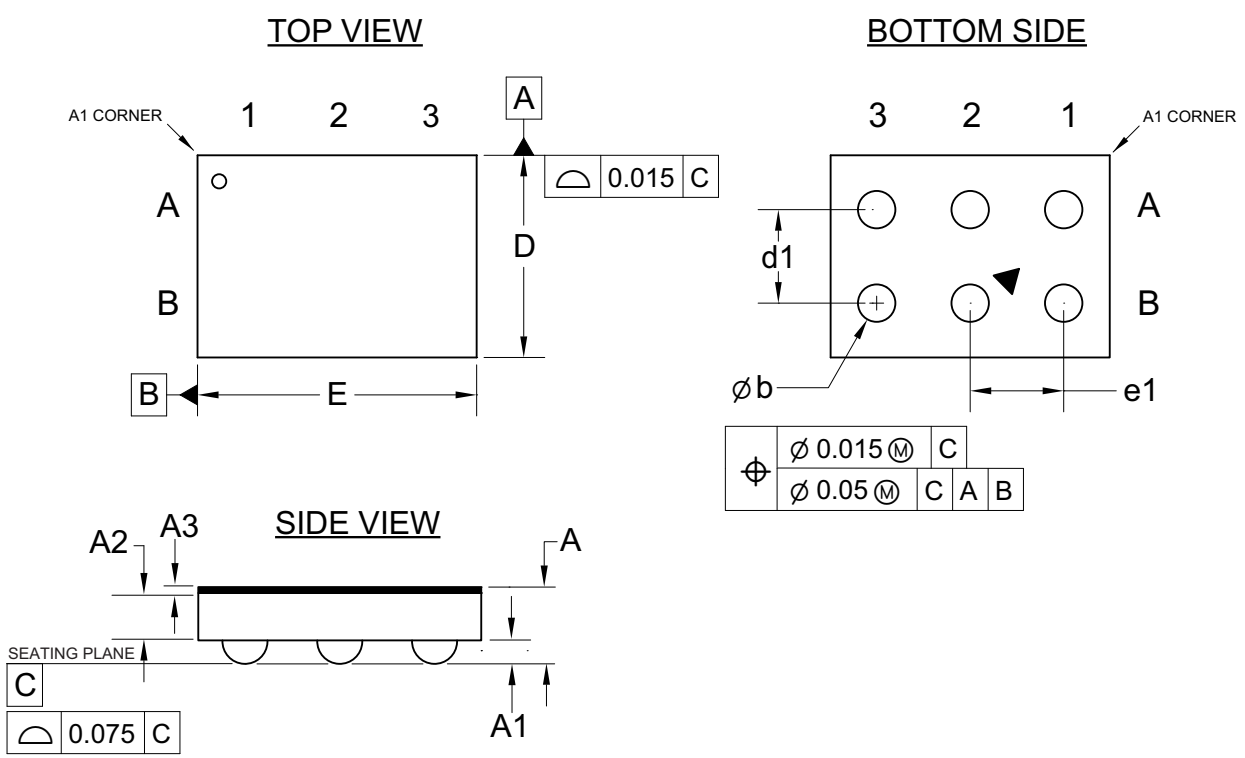
| SYMBOL | MIN | NOM | MAX | NOTE |
|---|---|---|---|---|
| A | – | – | 0.40 | |
| A1 | 0.00 | – | 0.05 | |
| D | 1.70 | 1.80 | 1.90 | |
| E | 2.10 | 2.20 | 2.30 | |
| b | 0.15 | 0.20 | 0.25 | |
| e | 0.40 TYP | | | |
| e1 | 1.20 REF | | | |
| L | 0.26 | 0.30 | 0.35 | |

9/10/2012

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


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## 13.5 6U-2 — 6-ball WLCSP




PIN ASSIGNMENT MATRIX

| | 1 | 2 | 3 |
|---|---|---|---|
| A | SCL | WP | $V_{CC}$ |
| B | SDA | GND | $A_2$ |

COMMON DIMENSIONS
(Unit of Measure = mm)

| SYMBOL | MIN | TYP | MAX | NOTE |
|---|---|---|---|---|
| A | 0.260 | 0.295 | 0.330 | |
| A1 | 0.080 | 0.095 | 0.110 | |
| A2 | 0.160 | 0.175 | 0.190 | |
| A3 | 0.025 REF | | | 3 |
| D | Contact Atmel for details | | | |
| d1 | 0.40 BSC | | | |
| E | Contact Atmel for details | | | |
| e1 | 0.40 BSC | | | |
| b | 0.170 | 0.185 | 0.200 | |

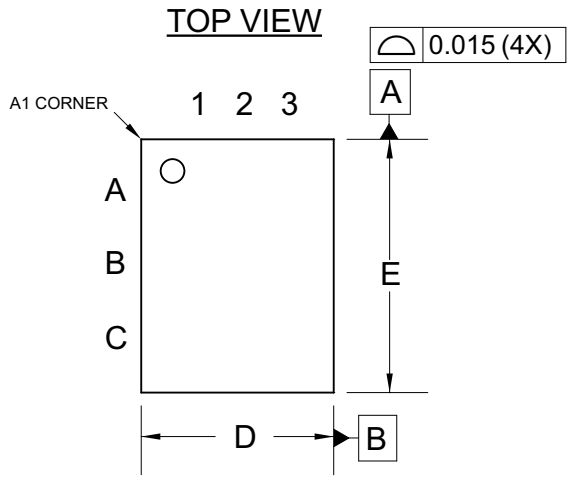
Note: 1. Dimensions are NOT to scale.
2. Solder ball composition is 95.5Sn-4.0Ag-0.5Cu.
3. Product offered with Back Side Coating (BSC)

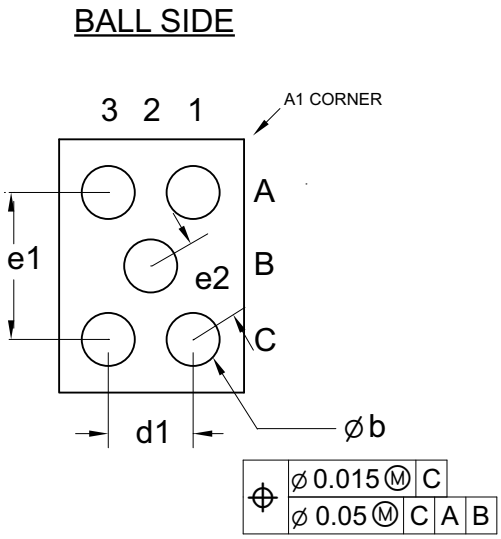
5/6/15

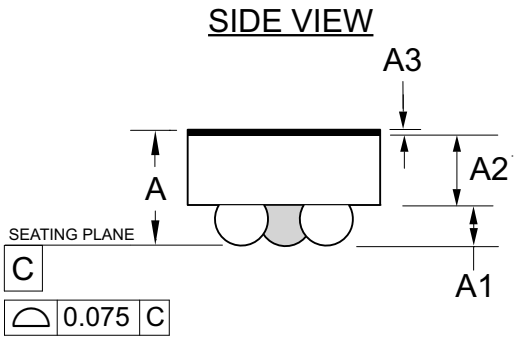
| Atmel<br>Package Drawing Contact:<br>packagedrawings@atmel.com | TITLE<br>6U-2, 6-ball, 2x3 Array, 0.40mm pitch<br>Wafer Level Chip Scale Package (WLCSP) with BSC | GPC<br>GMK | DRAWING NO.<br>6U-2 | REV.<br>C |
|---|---|---|---|---|


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## 13.6 5U-4 — 5-ball WLCSP




PIN ASSIGNMENT MATRIX

| | 1 | 2 | 3 |
|---|---|---|---|
| A | $V_{CC}$ | n/a | GND |
| B | n/a | SDA | n/a |
| C | WP | n/a | SCL |

COMMON DIMENSIONS
(Unit of Measure = mm)

| SYMBOL | MIN | TYP | MAX | NOTE |
|---|---|---|---|---|
| A | 0.260 | 0.295 | 0.330 | |
| A1 | 0.080 | 0.095 | 0.110 | |
| A2 | 0.160 | 0.175 | 0.190 | |
| A3 | 0.025 REF | | | 3 |
| D | Contact Atmel for details | | | |
| d1 | 0.400 BSC | | | |
| E | Contact Atmel for details | | | |
| e1 | 0.693 BSC | | | |
| e2 | 0.400 BSC | | | |
| b | 0.170 | 0.185 | 0.200 | |

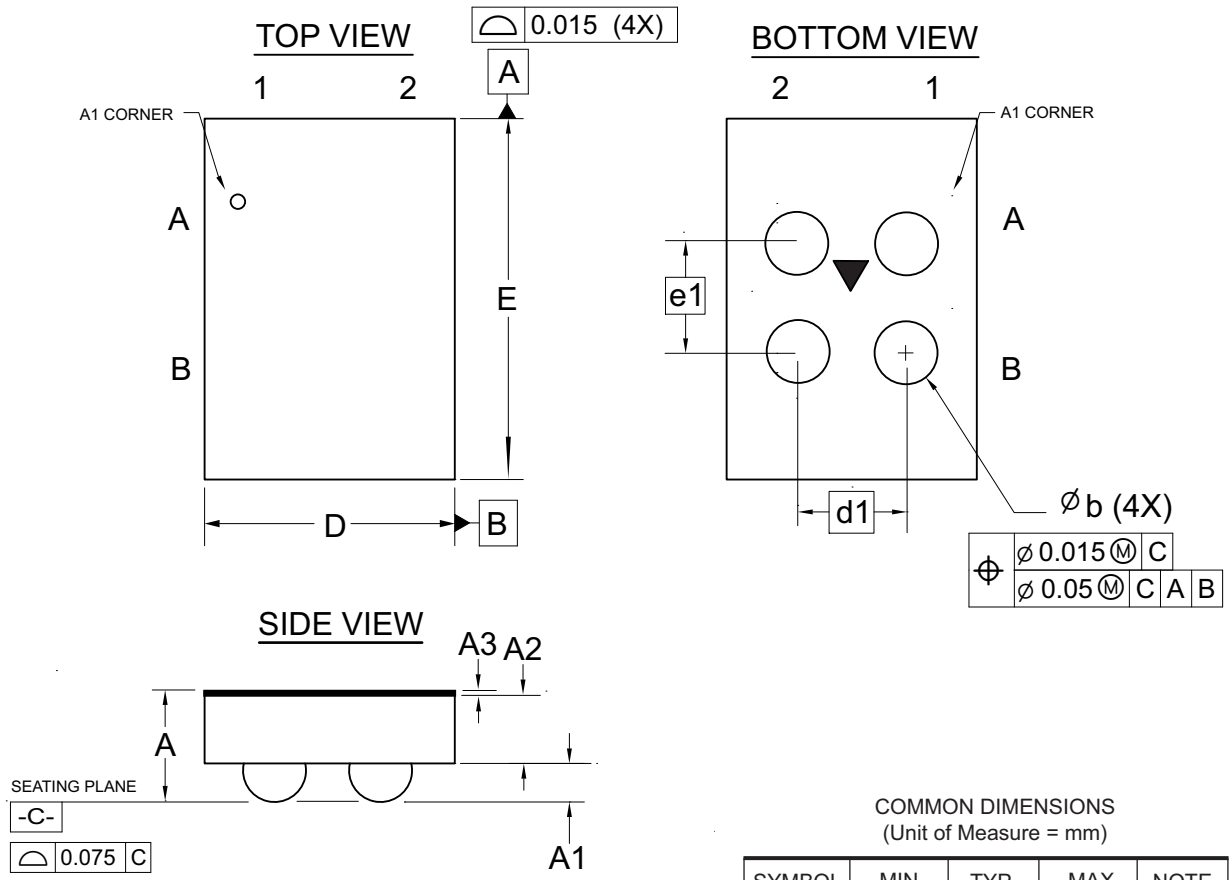
Note: 1. Dimensions are NOT to scale.
2. Solder ball composition is 95.5Sn-4.0Ag-0.5Cu.
3. Product offered with Back Side Coating (BSC)

5/6/15

| Atmel<br>Package Drawing Contact:<br>packagedrawings@atmel.com | TITLE<br>5U-4, 5-ball, 3x3 Array, 0.40mm Pitch, Wafer Level Chip Scale Package (WLCSP) with BSC | GPC<br>GNQ | DRAWING NO.<br>5U-4 | REV.<br>B |
|---|---|---|---|---|


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## 13.7 4U-12 — 4-ball WLCSP




PIN ASSIGNMENT MATRIX

| | 1 | 2 |
|---|---|---|
| A | $V_{CC}$ | $V_{SS}$ |
| B | SCL | SDA |

COMMON DIMENSIONS
(Unit of Measure = mm)

| SYMBOL | MIN | TYP | MAX | NOTE |
|---|---|---|---|---|
| A | 0.260 | 0.295 | 0.330 | |
| A1 | 0.080 | 0.095 | 0.110 | |
| A2 | 0.160 | 0.175 | 0.190 | |
| A3 | 0.025 REF | | | 3 |
| D | Contact Atmel for details | | | |
| d1 | 0.400 BSC | | | |
| E | Contact Atmel for details | | | |
| e1 | 0.400 BSC | | | |
| b | 0.170 | 0.185 | 0.200 | |

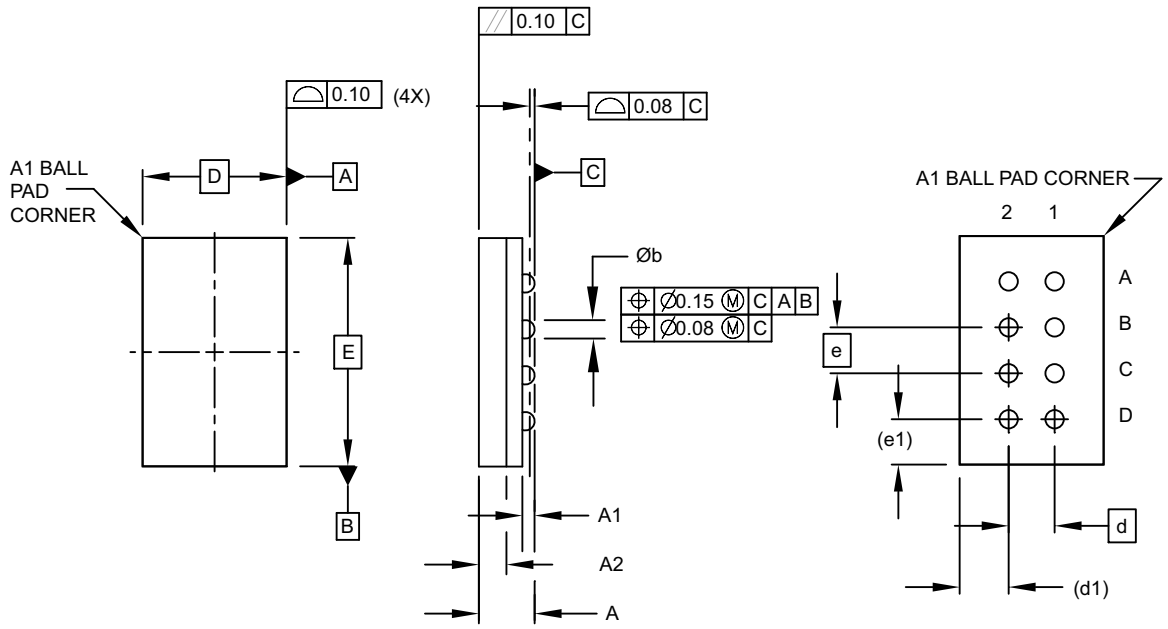
Note: 1. Dimensions are NOT to scale.
2. Solder ball composition is 95.5Sn-4.0Ag-0.5Cu.
3. Product offered with Back Side Coating (BSC)

5/6/15

| Atmel<br>Package Drawing Contact:<br>packagedrawings@atmel.com | **TITLE**<br>4U-12, 4-ball, 2x2 Array, 0.40mm Pitch<br>Wafer Level Chip Scale Package (WLCSP) with BSC | **GPC**<br>GVF | **DRAWING NO.**<br>4U-12 | **REV.**<br>A |
|---|---|---|---|---|


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## 13.8 8U2-1 — 8-ball VFBGA




COMMON DIMENSIONS
(Unit of Measure = mm)

| SYMBOL | MIN | NOM | MAX | NOTE |
|---|---|---|---|---|
| A | 0.81 | 0.91 | 1.00 | |
| A1 | 0.15 | 0.20 | 0.25 | |
| A2 | 0.40 | 0.45 | 0.50 | |
| b | 0.25 | 0.30 | 0.35 | |
| D | 2.35 BSC | | | |
| E | 3.73 BSC | | | |
| e | 0.75 BSC | | | |
| e1 | 0.74 REF | | | |
| d | 0.75 BSC | | | |
| d1 | 0.80 REF | | | |

Notes:

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

6/11/13

| Atmel<br>Package Drawing Contact:<br>packagedrawings@atmel.com | TITLE<br>8U2-1, 8-ball, 2.35 x 3.73 mm Body, 0.75 mm pitch, Very Thin, Fine-Pitch Ball Grid Array Package (VFBGA) | GPC<br>GWW | DRAWING NO.<br>8U2-1 | REV.<br>G |
|---|---|---|---|---|


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Web:www.manduic.com
Tel:150-1290-5940
Email:sales@manduic.com

# 14. Revision History

| Doc. Rev. | Date | Comments |
|---|---|---|
| 8850D | 05/2015 | Added the 4-ball WLCSP, AT24C64D-U2UM0B-T option.<br>Updated the 8S1 package drawing. |
| 8850C | 02/2015 | Updated the 6-ball and 5-ball WLCSP package outline drawings to reflect offering of product with backside coating. |
| 8850B | 12/2014 | Added the AT24C64D-MAHM-E product offering.<br>Updated the 8X, 8MA2, 5U-2, and 8U2-1 package outline drawings and the ordering information. |
| 8850A | 08/2013 | Initial document release. |


深圳市满度科技有限公司
Web:www.manduic.com
Tel:150-1290-5940
Email:sales@manduic.com






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

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