

Features

- Single 2.5V - 3.6V or 2.7V - 3.6V Supply
- RapidS™ Serial Interface: 66 MHz Maximum Clock Frequency
 - SPI Compatible Modes 0 and 3
- User Configurable Page Size
 - 512 Bytes per Page
 - 528 Bytes per Page
 - Page Size Can Be Factory Pre-configured for 512 Bytes
- Page Program Operation
 - Intelligent Programming Operation
 - 4,096 Pages (512/528 Bytes/Page) Main Memory
- Flexible Erase Options
 - Page Erase (512 Bytes)
 - Block Erase (4 Kbytes)
 - Sector Erase (128 Kbytes)
 - Chip Erase (16 Mbits)
- Two SRAM Data Buffers (512/528 Bytes)
 - Allows Receiving of Data while Reprogramming the Flash Array
- Continuous Read Capability through Entire Array
 - Ideal for Code Shadowing Applications
- Low-power Dissipation
 - 7 mA Active Read Current Typical
 - 25 µA Standby Current Typical
 - 9 µA Deep Power Down Typical
- Hardware and Software Data Protection Features
 - Individual Sector
- Sector Lockdown for Secure Code and Data Storage
 - Individual Sector
- Security: 128-byte Security Register
 - 64-byte User Programmable Space
 - Unique 64-byte Device Identifier
- JEDEC Standard Manufacturer and Device ID Read
- 100,000 Program/Erase Cycles Per Page Minimum
- Data Retention – 20 Years
- Industrial Temperature Range
- Green (Pb/Halide-free/RoHS Compliant) Packaging Options

1. Description

The AT45DB161D is a 2.5-volt or 2.7-volt, serial-interface sequential access Flash memory ideally suited for a wide variety of digital voice-, image-, program code- and data-storage applications. The AT45DB161D supports RapidS serial interface for applications requiring very high speed operations. RapidS serial interface is SPI compatible for frequencies up to 66 MHz. Its 17,301,504 bits of memory are organized as 4,096 pages of 512 bytes or 528 bytes each. In addition to the main memory, the AT45DB161D also contains two SRAM buffers of 512/528 bytes each. The buffers allow the receiving of data while a page in the main Memory is being reprogrammed, as well as writing a continuous data stream. EEPROM emulation (bit or byte alterability) is easily handled with a self-contained three step read-modify-write operation. Unlike conventional Flash memories that are accessed randomly with multiple



**16-megabit
2.5-volt or
2.7-volt
DataFlash®**

AT45DB161D



address lines and a parallel interface, the DataFlash uses a RapidS serial interface to sequentially access its data. The simple sequential access dramatically reduces active pin count, facilitates hardware layout, increases system reliability, minimizes switching noise, and reduces package size. The device is optimized for use in many commercial and industrial applications where high-density, low-pin count, low-voltage and low-power are essential.

To allow for simple in-system reprogrammability, the AT45DB161D does not require high input voltages for programming. The device operates from a single power supply, 2.5V to 3.6V or 2.7V to 3.6V, for both the program and read operations. The AT45DB161D is enabled through the chip select pin (\overline{CS}) and accessed via a three-wire interface consisting of the Serial Input (SI), Serial Output (SO), and the Serial Clock (SCK).

All programming and erase cycles are self-timed.

2. Pin Configurations and Pinouts

Figure 2-1. TSOP Top View: Type 1

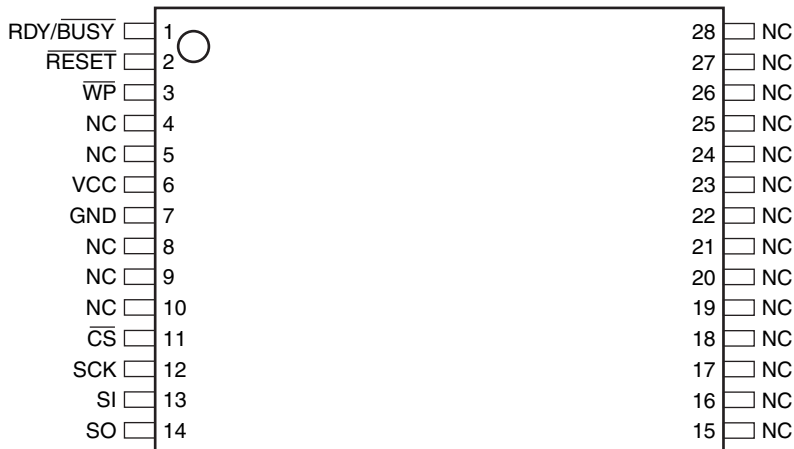
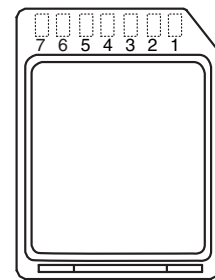


Figure 2-2. DataFlash Card⁽¹⁾
Top View through Package



Note: 1. See AT45DCB002D Datasheet.

Figure 2-3. MLF (VDFN) Top View

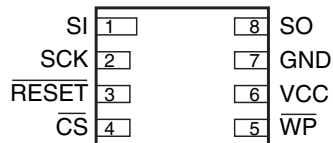
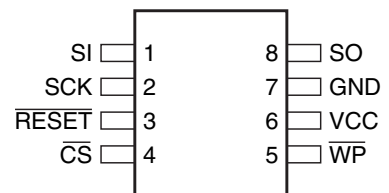


Figure 2-4. SOIC Top View



Note: 1. The metal pad on the bottom of the MLF package is floating. This pad can be a “No Connect” or connected to GND.

18. Electrical Specifications

Table 18-1. Absolute Maximum Ratings*

| | |
|--|--------------------------|
| Temperature under Bias | -55° C to +125° C |
| Storage Temperature | -65° C to +150° C |
| All Input Voltages (including NC Pins) with Respect to Ground | -0.6V to +6.25V |
| All Output Voltages with Respect to Ground | -0.6V to $V_{CC} + 0.6V$ |

*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.

Table 18-2. DC and AC Operating Range

| | | AT45DB161D (2.5V Version) | AT45DB161D |
|------------------------------|------|---------------------------|-----------------|
| Operating Temperature (Case) | Ind. | -40° C to 85° C | -40° C to 85° C |
| V_{CC} Power Supply | | 2.5V to 3.6V | 2.7V to 3.6V |

Table 18-3. DC Characteristics

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|-----------------|---|---|---------------------|-----|---------------------|---------|
| I_{DP} | Deep Power-down Current | \overline{CS} , \overline{RESET} , $\overline{WP} = V_{IH}$, all inputs at CMOS levels | | 9 | 15 | μA |
| I_{SB} | Standby Current | \overline{CS} , \overline{RESET} , $\overline{WP} = V_{IH}$, all inputs at CMOS levels | | 25 | 50 | μA |
| $I_{CC1}^{(1)}$ | Active Current, Read Operation | f = 20 MHz; $I_{OUT} = 0$ mA; $V_{CC} = 3.6V$ | | 7 | 10 | mA |
| | | f = 33 MHz; $I_{OUT} = 0$ mA; $V_{CC} = 3.6V$ | | 8 | 12 | mA |
| | | f = 50 MHz; $I_{OUT} = 0$ mA; $V_{CC} = 3.6V$ | | 10 | 14 | mA |
| | | f = 66 MHz; $I_{OUT} = 0$ mA; $V_{CC} = 3.6V$ | | 11 | 15 | mA |
| I_{CC2} | Active Current, Program/Erase Operation | $V_{CC} = 3.6V$ | | 12 | 17 | mA |
| I_{LI} | Input Load Current | $V_{IN} =$ CMOS levels | | | 1 | μA |
| I_{LO} | Output Leakage Current | $V_{IO} =$ CMOS levels | | | 1 | μA |
| V_{IL} | Input Low Voltage | | | | $V_{CC} \times 0.3$ | V |
| V_{IH} | Input High Voltage | | $V_{CC} \times 0.7$ | | | V |
| V_{OL} | Output Low Voltage | $I_{OL} = 1.6$ mA; $V_{CC} = 2.7V$ | | | 0.4 | V |
| V_{OH} | Output High Voltage | $I_{OH} = -100$ μA | $V_{CC} - 0.2V$ | | | V |

Notes: 1. I_{CC1} during a buffer read is 20 mA maximum @ 20 MHz.
2. All inputs are 5 volts tolerant.

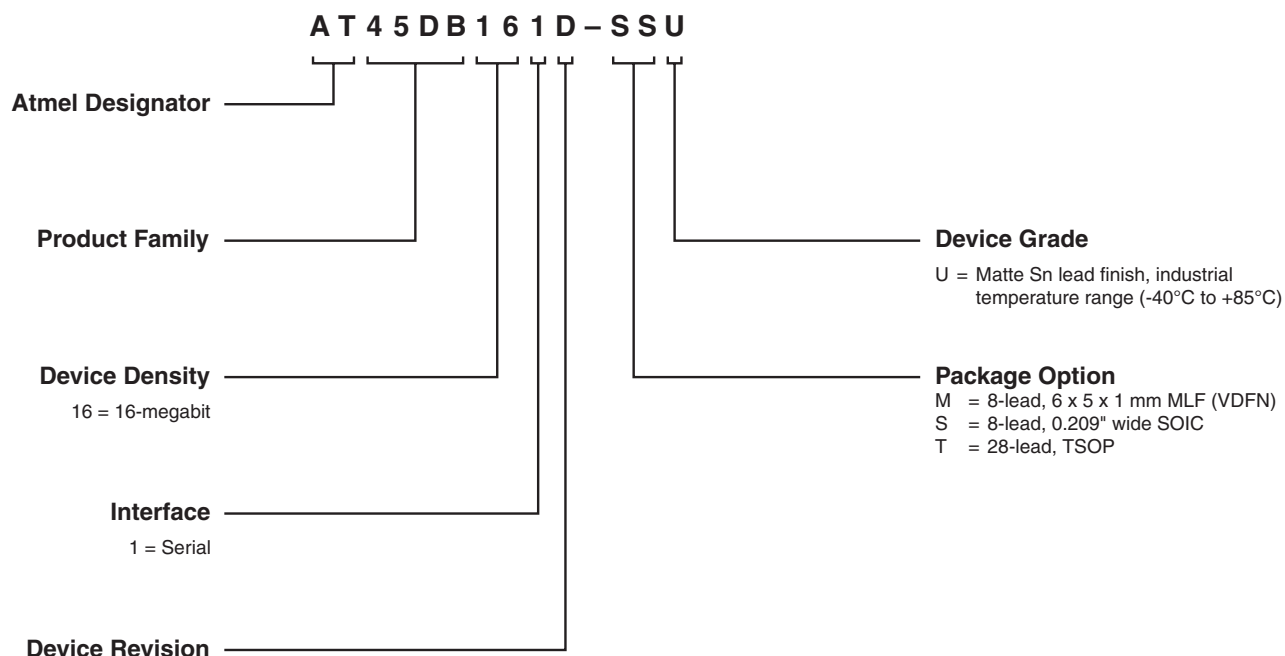
Table 18-4. AC Characteristics – RapidS/Serial Interface

| Symbol | Parameter | AT45DB161D (2.5V Version) | | | AT45DB161D | | | Units |
|------------------|---|------------------------------|-----|-----|------------|-----|-----|---------|
| | | Min | Typ | Max | Min | Typ | Max | |
| f_{SCK} | SCK Frequency | | | 50 | | | 66 | MHz |
| f_{CAR1} | SCK Frequency for Continuous Array Read | | | 50 | | | 66 | MHz |
| f_{CAR2} | SCK Frequency for Continuous Array Read (Low Frequency) | | | 33 | | | 33 | MHz |
| t_{WH} | SCK High Time | 6.8 | | | 6.8 | | | ns |
| t_{WL} | SCK Low Time | 6.8 | | | 6.8 | | | ns |
| $t_{SCKR}^{(1)}$ | SCK Rise Time, Peak-to-Peak (Slew Rate) | 0.1 | | | 0.1 | | | V/ns |
| $t_{SCKF}^{(1)}$ | SCK Fall Time, Peak-to-Peak (Slew Rate) | 0.1 | | | 0.1 | | | V/ns |
| t_{CS} | Minimum \overline{CS} High Time | 50 | | | 50 | | | ns |
| t_{CSS} | \overline{CS} Setup Time | 5 | | | 5 | | | ns |
| t_{CSH} | \overline{CS} Hold Time | 5 | | | 5 | | | ns |
| t_{CSB} | \overline{CS} High to RDY/\overline{BUSY} Low | | | 100 | | | 100 | ns |
| t_{SU} | Data In Setup Time | 2 | | | 2 | | | ns |
| t_H | Data In Hold Time | 3 | | | 3 | | | ns |
| t_{HO} | Output Hold Time | 0 | | | 0 | | | ns |
| t_{DIS} | Output Disable Time | | | 8 | | | 6 | ns |
| t_V | Output Valid | | | 8 | | | 6 | ns |
| t_{WPE} | \overline{WP} Low to Protection Enabled | | | 1 | | | 1 | μ s |
| t_{WPD} | \overline{WP} High to Protection Disabled | | | 1 | | | 1 | μ s |
| t_{EDPD} | \overline{CS} High to Deep Power-down Mode | | | 3 | | | 3 | μ s |
| t_{RDPD} | \overline{CS} High to Standby Mode | | | 35 | | | 35 | μ s |
| t_{XFR} | Page to Buffer Transfer Time | | | 200 | | | 200 | μ s |
| t_{COMP} | Page to Buffer Compare Time | | | 200 | | | 200 | μ s |
| t_{EP} | Page Erase and Programming Time (512/528 bytes) | | 17 | 40 | | 17 | 40 | ms |
| t_P | Page Programming Time (512/528 bytes) | | 3 | 6 | | 3 | 6 | ms |
| t_{PE} | Page Erase Time (512/528 bytes) | | 15 | 35 | | 15 | 35 | ms |
| t_{BE} | Block Erase Time (4096/4224 bytes) | | 45 | 100 | | 45 | 100 | ms |
| t_{SE} | Sector Erase Time (131,072/135,168 bytes) | | 1.6 | 5 | | 1.6 | 5 | s |
| t_{CE} | Chip Erase Time | | TBD | TBD | | TBD | TBD | s |
| t_{RST} | \overline{RESET} Pulse Width | 10 | | | 10 | | | μ s |
| t_{REC} | \overline{RESET} Recovery Time | | | 1 | | | 1 | μ s |

Note: 1. Values are based on device characterization, not 100% tested in production.

26. Ordering Information

26.1 Ordering Code Detail



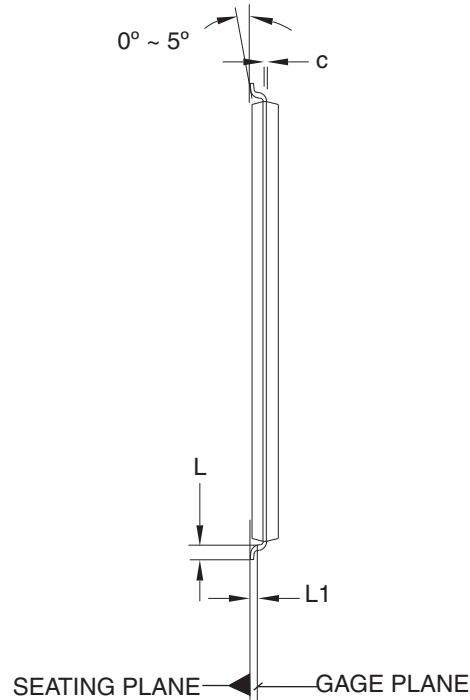
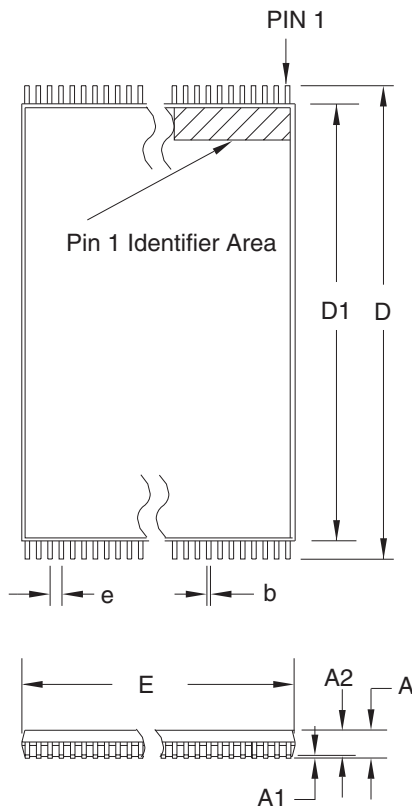
26.2 Green Package Options (Pb/Halide-free/RoHS Compliant)

| Ordering Code ⁽¹⁾⁽²⁾ | Package | Lead Finish | Operating Voltage | f _{SCK} (MHz) | Operation Range |
|---|---------|-------------|-------------------|------------------------|---|
| AT45DB161D-MU AT45DB161D-MU-SL954 ⁽³⁾ AT45DB161D-MU-SL955 ⁽⁴⁾ | 8M1-A | Matte Sn | 2.7V to 3.6V | 66 | Industrial (-40° C to 85° C) 2.7V to 3.6V |
| AT45DB161D-SU AT45DB161D-SU-SL954 ⁽³⁾ AT45DB161D-SU-SL955 ⁽⁴⁾ | 8S2 | | | | |
| AT45DB161D-TU | 28T | | | | |
| AT45DB161D-MU-2.5 | 8M1-A | Matte Sn | 2.5V to 3.6V | 50 | |
| AT45DB161D-SU-2.5 | 8S2 | | | | |
| AT45DB161D-TU-2.5 | 28T | | | | |

- Notes:
- The shipping carrier option is not marked on the devices.
 - Standard parts are shipped with the page size set to 528 bytes. The user is able to configure these parts to a 512-byte page size if desired.
 - Parts ordered with suffix SL954 are shipped in bulk with the page size set to 512 bytes. Parts will have a 954 or SL954 marked on them.
 - Parts ordered with suffix SL955 are shipped in tape and reel with the page size set to 512 bytes. Parts will have a 954 or SL954 marked on them.

| Package Type | |
|--------------|--|
| 8M1-A | 8-pad, 6 x 5 x 1.00 mm Body, Very Thin Dual Flat Package No Lead MLF™ (VDFN) |
| 8S2 | 8-lead, 0.209" Wide, Plastic Gull Wing Small Outline Package (EIAJ SOIC) |
| 28T | 28-lead, 8 mm x 13.4 mm, Plastic Thin Small Outline Package, Type I (TSOP) |

27.3 28T – TSOP, Type 1



COMMON DIMENSIONS
(Unit of Measure = mm)

| SYMBOL | MIN | NOM | MAX | NOTE |
|--------|------------|-------|-------|--------|
| A | – | – | 1.20 | |
| A1 | 0.05 | – | 0.15 | |
| A2 | 0.90 | 1.00 | 1.05 | |
| D | 13.20 | 13.40 | 13.60 | |
| D1 | 11.70 | 11.80 | 11.90 | Note 2 |
| E | 7.90 | 8.00 | 8.10 | Note 2 |
| L | 0.50 | 0.60 | 0.70 | |
| L1 | 0.25 BASIC | | | |
| b | 0.17 | 0.22 | 0.27 | |
| c | 0.10 | – | 0.21 | |
| e | 0.55 BASIC | | | |

- Notes:
1. This package conforms to JEDEC reference MO-183.
 2. Dimensions D1 and E do not include mold protrusion. Allowable protrusion on E is 0.15 mm per side and on D1 is 0.25 mm per side.
 3. Lead coplanarity is 0.10 mm maximum.



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TITLE

28T, 28-lead (8 x 13.4 mm) Plastic Thin Small Outline Package, Type I (TSOP)

DRAWING NO.

28T

REV.

C