AT28BV64B

64K (8K x 8) Industrial Battery-Voltage Parallel EEPROM with Page Write and Software Data Protection

Features

- Single 2.7V to 3.6V Supply
- Hardware and Software Data Protection
- Low-Power Dissipation:
  - 15 mA active current
  - 50 µA CMOS standby current
- Fast Read Access Time: 200 ns
- Automatic Page Write Operation:
  - Internal address and data latches for 64 bytes
  - Internal control timer
- Fast Write Cycle Time:
  - Page Write cycle time: 10 ms maximum
  - 1 to 64-byte Page Write operation
- $\overline{\text{DATA}}$ Polling for End of Write Detection
- High-Reliability CMOS Technology:
  - Endurance: 100,000 cycles
  - Data retention: 10 years
- JEDEC® Approved Byte-Wide Pinout
- Industrial Temperature Ranges
- Green (Pb/Halide-free) Packaging Only

Packages

- 32-Lead PLCC, 28-Lead SOIC, 28-Lead TSOP

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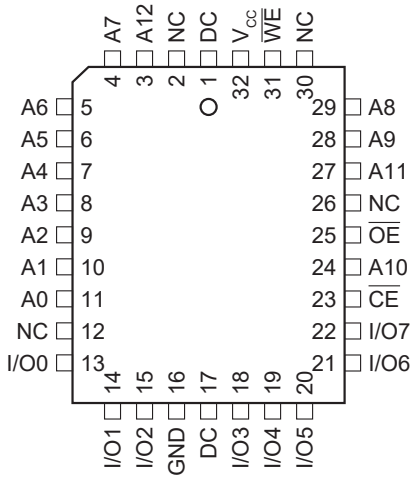
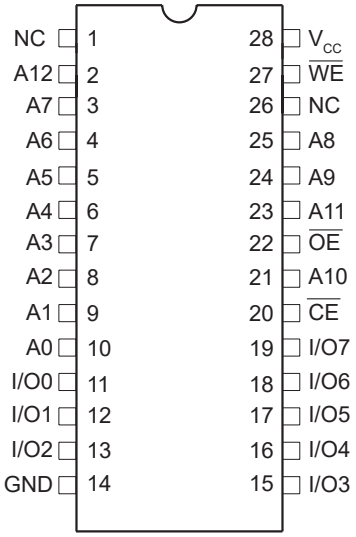
Table of Contents

1. Package Types (Not to Scale)

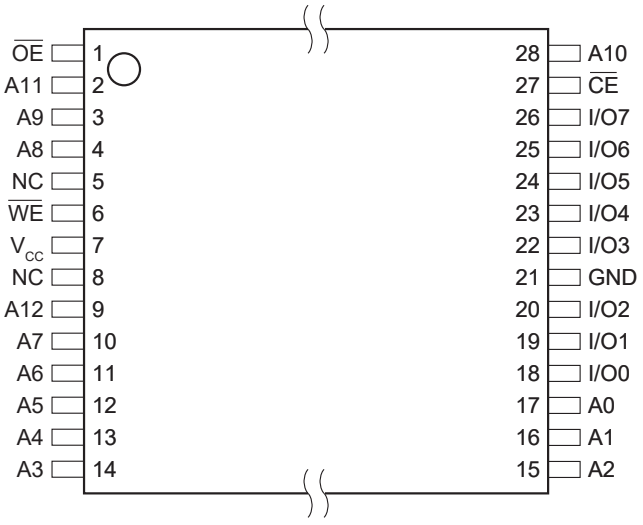
32-Lead PLCC
Top View



28-Lead SOIC
Top View



28-Lead TSOP
Top View



2. Pin Descriptions

The descriptions of the pins are listed in Table 2-1.

Table 2-1. Pin Function Table

Name	32-Lead PLCC	28-Lead SOIC	28-Lead TSOP	Function
DC	1	—	—	Don't Connect
NC	2	1	5	No Connect
A12	3	2	9	Address
A7	4	3	10	Address
A6	5	4	11	Address
A5	6	5	12	Address
A4	7	6	13	Address
A3	8	7	14	Address
A2	9	8	15	Address
A1	10	9	16	Address
A0	11	10	17	Address
NC	12	—	8	No Connect
I/O0	13	11	18	Data Input/Output
I/O1	14	12	19	Data Input/Output
I/O2	15	13	20	Data Input/Output
GND	16	14	21	Ground
DC	17	—	—	Don't Connect
I/O3	18	15	22	Data Input/Output
I/O4	19	16	23	Data Input/Output
I/O5	20	17	24	Data Input/Output
I/O6	21	18	25	Data Input/Output
I/O7	22	19	26	Data Input/Output
$\overline{CE}$	23	20	27	Chip Enable
A10	24	21	28	Address
$\overline{OE}$	25	22	1	Output Enable
NC	26	—	—	No Connect
A11	27	23	2	Address
A9	28	24	3	Address
A8	29	25	4	Address
NC	30	26	—	No Connect
$\overline{WE}$	31	27	6	Write Enable
V_{CC}	32	28	7	Device Power Supply

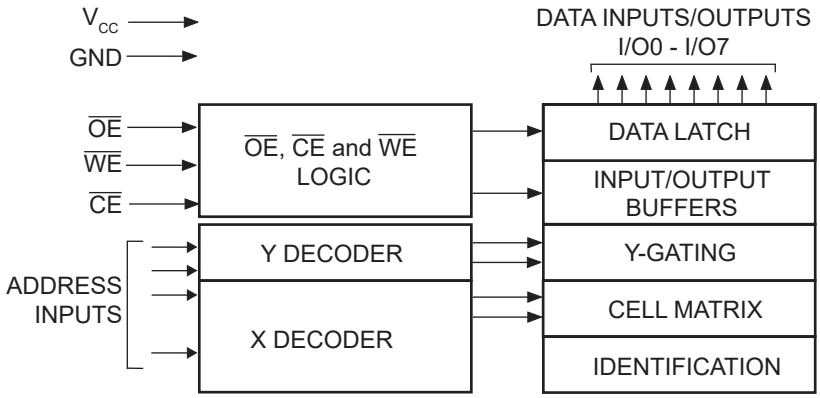
3. Description

The AT28BV64B is a high-performance Electrically Erasable and Programmable Read-Only Memory (EEPROM). Its 64K memory is organized as 8,192 words by 8 bits. Manufactured with Microchip's advanced nonvolatile CMOS technology, the device offers access times to 200 ns with power dissipation of just 54 mW. When the device is deselected, the CMOS standby current is less than 50 µA.

The AT28BV64B is accessed like a Static RAM for the read or write cycle without the need for external components. The device contains a 64-byte page register to allow for writing up to 64 bytes simultaneously. During a write cycle, the addresses and 1 to 64 bytes of data are internally latched, freeing the address and data bus for other operations. Following the initiation of a write cycle, the device will automatically write the latched data using an internal control timer. The end of a write cycle can be detected by $\overline{DATA}$ polling of I/O7. Once the end of a write cycle was detected, a new access for a read or write can begin.

The AT28BV64B has additional features to ensure high quality and manufacturability. An optional software data protection mechanism is available to guard against inadvertent writes. The device also includes an extra 64 bytes of EEPROM for device identification or tracking.

3.1 Block Diagram



4. Electrical Characteristics

4.1 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
Voltage on $\overline{OE}$ and A9 with respect to ground	-0.6V to +13.5V

Note: Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operation listings of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

4.2 DC and AC Operating Range

Table 4-1. DC and AC Operating Range

		AT28BV64B-20
Operating Temperature (Case)	Industrial	-40°C to +85°C
V_{CC} Power Supply		2.7V to 3.6V

4.3 DC Characteristics

Table 4-2. DC Characteristics

Parameter	Symbol	Minimum	Maximum	Units	Test Conditions
Input Load Current	I_{LI}	—	10	µA	V_{IN} = 0V to V_{CC} + 1V
Output Leakage Current	I_{LO}	—	10	µA	$V_{I/O}$ = 0V to V_{CC}
V_{CC} Standby Current CMOS	I_{SB}	—	50	µA	$\overline{CE}$ = V_{CC} - 0.3V to V_{CC} + 1V
V_{CC} Active Current	I_{CC}	—	15	mA	f = 5 MHz; I_{OUT} = 0 mA
Input Low Voltage	V_{IL}	—	0.6	V	
Input High Voltage	V_{IH}	2.0	—	V	
Output Low Voltage	V_{OL}	—	0.45	V	I_{OL} = 1.6 mA
Output High Voltage	V_{OH}	2.0	—	V	I_{OH} = -100 µA

4.4 Pin Capacitance

Table 4-3. Pin Capacitance[1,2]

Symbol	Typical	Maximum	Units	Conditions
C_{IN}	4	6	pF	V_{IN} = 0V
C_{OUT}	8	12	pF	V_{OUT} = 0V

Notes:

1. This parameter is characterized but is not 100% tested in production.
2. f = 1 MHz, T_A = 25°C

5. Device Operation

5.1 Read

The AT28BV64B is accessed like a Static RAM. When $\overline{CE}$ and $\overline{OE}$ are low and $\overline{WE}$ is high, the data stored at the memory location determined by the address pins is asserted on the outputs. The outputs are put in the high-impedance state when either $\overline{CE}$ or $\overline{OE}$ is high. This dual-line control gives designers flexibility in preventing bus contention in their system.

5.2 Byte Write

A low pulse on the $\overline{WE}$ or $\overline{CE}$ input with $\overline{CE}$ or $\overline{WE}$ low (respectively) and $\overline{OE}$ high initiates a write cycle. The address is latched on the falling edge of $\overline{CE}$ or $\overline{WE}$, whichever occurs last. The data is latched by the first rising edge of $\overline{CE}$ or $\overline{WE}$. Once a byte write is started, it will automatically time itself to completion. Once a programming operation is initiated and for the duration of t_{WC}, a read operation will effectively be a polling operation.

5.3 Page Write

The page write operation of the AT28BV64B allows 1 to 64 bytes of data to be written into the device during a single internal programming period. A page write operation is initiated in the same manner as a byte write; the first byte written can then be followed by 1 to 63 additional bytes. Each successive byte must be written within 100 µs (t_{BLC}) of the previous byte. If the t_{BLC} limit is exceeded, the AT28BV64B will cease accepting data and commence the internal programming operation. All bytes during a page write operation must reside on the same page as defined by the state of the A6 to A12 inputs. For each $\overline{WE}$ high-to-low transition during the page write operation, A6 to A12 must be the same. The A0 to A5 inputs are used to specify which bytes within the page are to be written. The bytes may be loaded in any order and may be altered within the same load period. Only bytes which are specified for writing will be written; unnecessary cycling of other bytes within the page does not occur.

5.4 $\overline{\text{Data}}$ Polling

The AT28BV64B features $\overline{DATA}$ Polling to indicate the end of a write cycle. During a byte or page write cycle, an attempted read of the last byte written will result in the complement of the written data to be presented on I/O7. Once the write cycle was completed, true data is valid on all outputs and the next write cycle may begin. $\overline{DATA}$ Polling may begin at any time during the write cycle.

5.5 Toggle Bit

In addition to $\overline{DATA}$ Polling, the AT28BV64B provides another method for determining the end of a write cycle. During the write operation, successive attempts to read data from the device will result in I/O6 toggling between one and zero. Once the write is completed, I/O6 will stop toggling and valid data will be read. Reading the toggle bit may begin at any time during the write cycle.

5.6 Data Protection

If precautions are not taken, inadvertent writes may occur during transitions of the host system power supply. Microchip incorporated both hardware and software features that will protect the memory against inadvertent writes.

5.6.1 Hardware Data Protection

Hardware features protect against inadvertent writes to the AT28BV64B in the following ways:

- V_{CC} power-on delay – once V_{CC} has reached 1.8V, the device will automatically time out 10 ms (typical) before allowing a write
- Write inhibit – holding any one of $\overline{OE}$ low, $\overline{CE}$ high or $\overline{WE}$ high inhibits write cycles
- Noise filter – pulses of less than 15 ns (typical) on the $\overline{WE}$ or $\overline{CE}$ inputs will not initiate a write cycle

5.6.2 Software Data Protection

A software-controlled data protection feature has been implemented on the AT28BV64B. Software data protection (SDP) helps prevent inadvertent writes from corrupting the data in the device. SDP can prevent inadvertent writes during power-up and power-down as well as any other potential periods of system instability.

The AT28BV64B can only be written using the software data protection feature. A series of three write commands to specific addresses with specific data must be presented to the device before writing in the byte or page mode. The same three write commands must begin each write operation. All software write commands must obey the page mode write timing specifications.

The data in the 3-byte command sequence is not written to the device; the addresses in the command sequence can be utilized just like any other location in the device. Any attempt to write to the device without the 3-byte sequence will start the internal write timers. No data will be written to the device; however, for the duration of t_{WC}, read operations will effectively be polling operations.

5.7 Device Identification

An extra 64 bytes of EEPROM memory are available to the user for device identification. By raising A9 to 12V ± 0.5V and using address locations 0000H to 003FH, the additional bytes may be written to or read from in the same manner as the regular memory array.

5.8 Operating Modes

Table 5-1. Operating Modes

Mode	$\overline{CE}$	$\overline{OE}$	$\overline{WE}$	I/O
Read	V_{IL}	V_{IL}	V_{IH}	D_{OUT}
Write(1)	V_{IL}	V_{IH}	V_{IL}	D_{IN}
Standby/Write Inhibit	V_{IH}	X(2)	X	High-Z
Write Inhibit	X	X	V_{IH}	—
Write Inhibit	X	V_{IL}	X	—
Output Disable	X	V_{IH}	X	High-Z
Chip Erase	V_{IL}	V_H(3)	V_{IL}	High-Z

Notes:

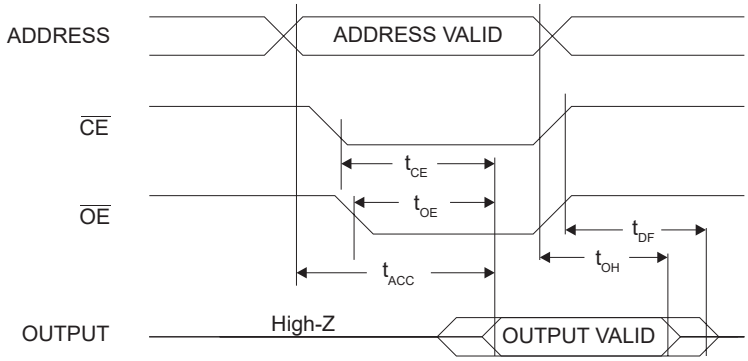
1. Refer to AC Write Waveforms.
2. X can be V_{IL} or V_{IH}.
3. V_H = 12.0 V ± 0.5V

5.9 AC Read Characteristics

Table 5-2. AC Read Characteristics

Parameter	Symbol	AT28BV64B-15		Units
		Min.	Max.	
Address to Output Delay	t_{ACC}	—	200	ns
$\overline{CE}$ to Output Delay	t_{CE}(1)	—	200	ns
$\overline{OE}$ to Output Delay	t_{OE}(2)	0	80	ns
$\overline{CE}$ or $\overline{OE}$ to Output Float	t_{DF}(3,4)	0	55	ns
Output Hold from $\overline{OE}$, $\overline{CE}$ or Address, whichever occurred first	t_{OH}	0	—	ns

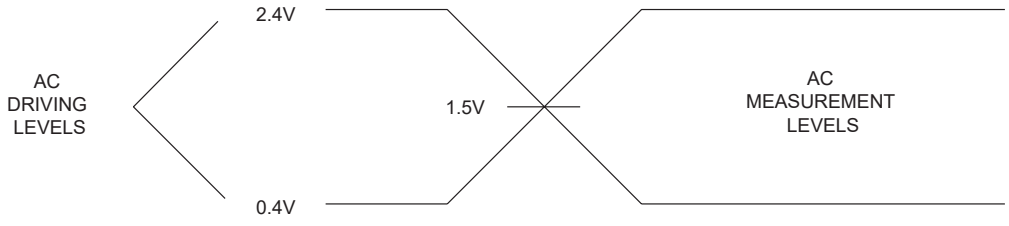
5.10 AC Read Waveforms(1,2,3,4)



Notes:

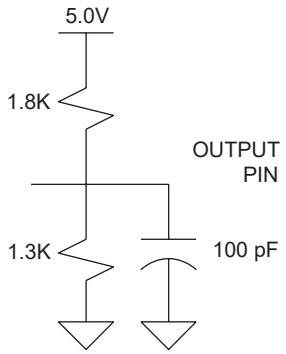
1. $\overline{CE}$ may be delayed up to t_{ACC}-t_{CE} after the address transition without impact on t_{ACC}.
2. $\overline{OE}$ may be delayed up to t_{CE}-t_{OE} after the falling edge of $\overline{CE}$ without impact on t_{CE} or by t_{ACC}-t_{OE} after an address change without impact on t_{ACC}.
3. t_{DF} is specified from $\overline{OE}$ or $\overline{CE}$, whichever occurs first (C_L = 5 pF).
4. This parameter is characterized and is not 100% tested.

5.11 Input Test Waveforms and Measurement Level



Note: t_R, t_F < 20 ns

5.12 Output Test Load



5.13 AC Write Characteristics

Table 5-3. AC Write Characteristics

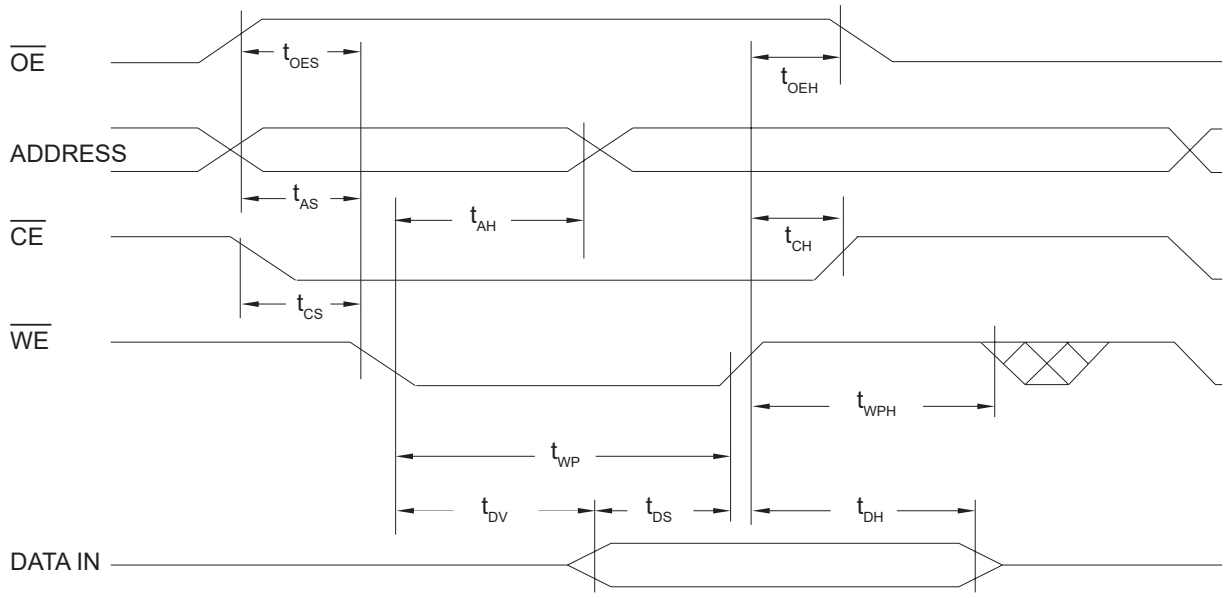
Parameter	Symbol	Minimum	Maximum	Units
Address, $\overline{OE}$ Setup Time	t_{AS}, t_{OES}	0	—	ns
Address Hold Time	t_{AH}	100	—	ns
Chip Select Setup Time	t_{CS}	0	—	ns
Chip Select Hold Time	t_{CH}	0	—	ns
Write Pulse Width ($\overline{WE}$ or $\overline{CE}$)	t_{WP}	200	—	ns
Data Setup Time	t_{DS}	100	—	ns
Data, $\overline{OE}$ Hold Time	t_{DH}, t_{OEH}	0	—	ns
Time to Data Valid	t_{DV}	NR(1)	—	ns
Write Pulse Width High	t_{WPH}	100	—	ns

Notes:

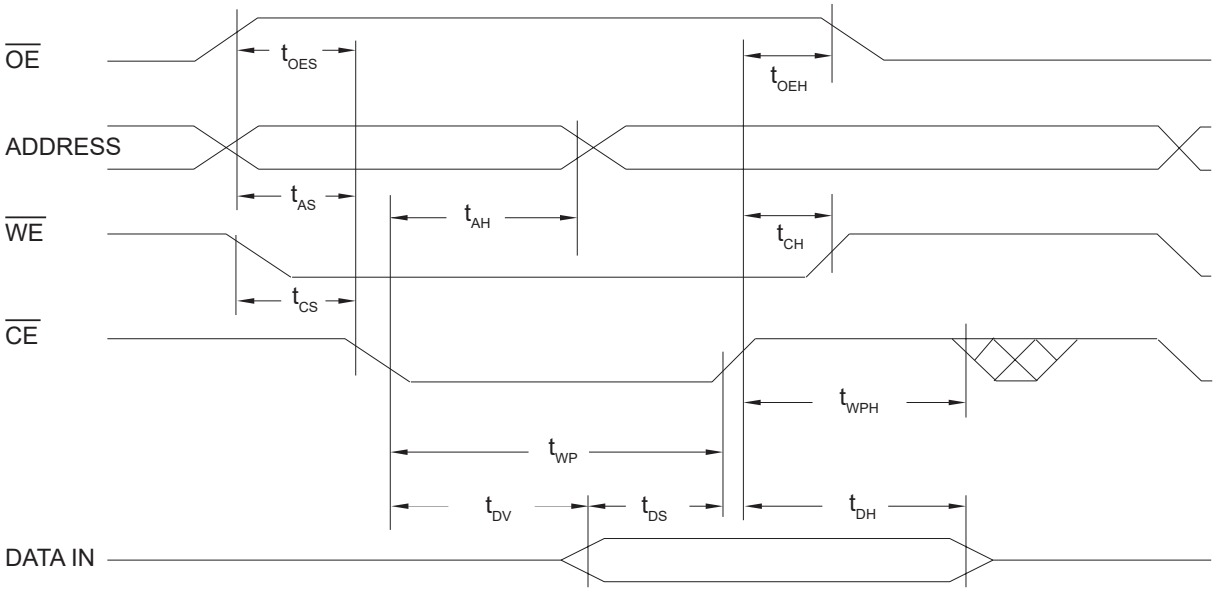
1. NR = No Restriction
2. All byte write operations must be preceded by the SDP command sequence.

5.14 AC Write Waveforms

5.14.1 $\overline{WE}$ Controlled



5.14.2 $\overline{CE}$ Controlled

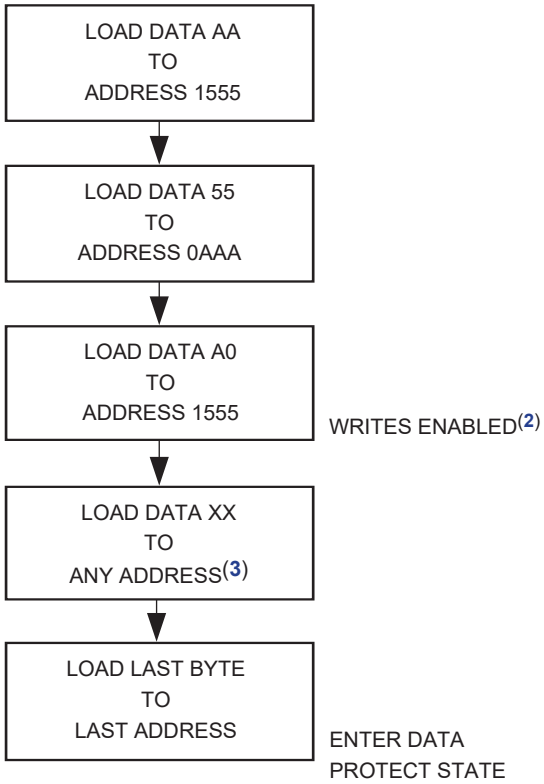


5.15 Page Mode Characteristics

Table 5-4. Page Mode Characteristics

Parameter	Symbol	Minimum	Maximum	Units
Write Cycle Time	t_{WC}	—	10	ms
Address Setup Time	t_{AS}	0	—	ns
Address Hold Time	t_{AH}	100	—	ns
Data Setup Time	t_{DS}	100	—	ns
Data Hold Time	t_{DH}	0	—	ns
Write Pulse Width	t_{WP}	200	—	ns
Byte Load Cycle Time	t_{BLC}	—	100	µs
Write Pulse Width High	t_{WPH}	100	—	ns

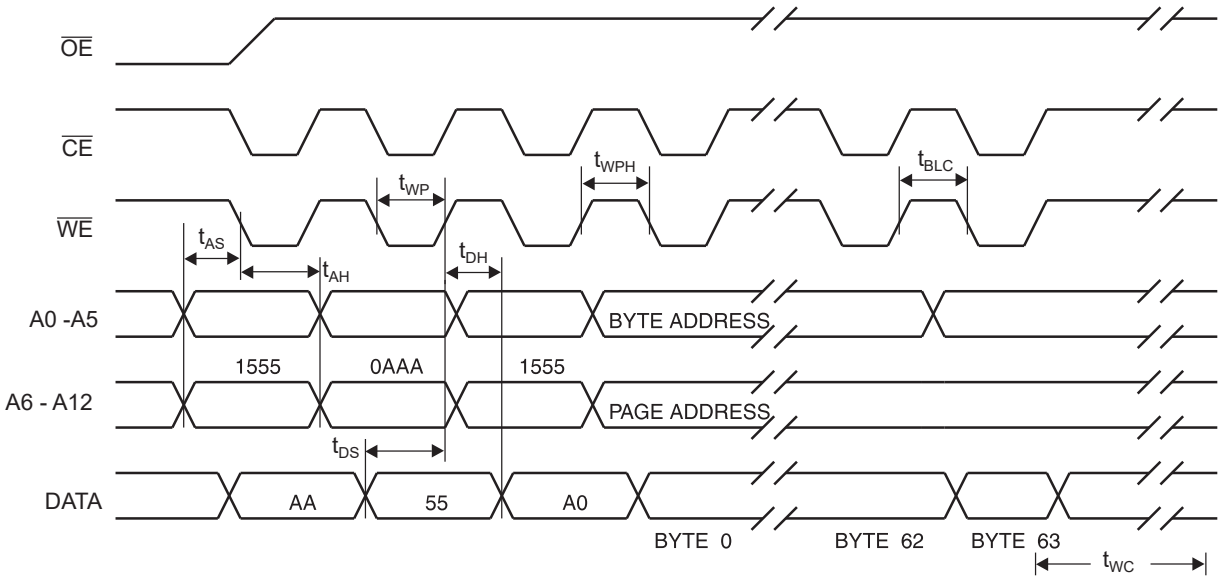
5.16 Write Algorithm(1)



Notes:

1. Data Format: I/O7-I/O0 (Hex); Address Format: A12-A0 (Hex).
2. Data protect state will be reactivated at the end of the write cycle.
3. 1 to 64 bytes of data are loaded.

5.17 Software Protected Write Cycle Waveform[1,2,3]



Notes:

1. A0-A12 must conform to the addressing sequence for the first three bytes as shown above.
2. A6 through A12 must specify the same page address during each high-to-low transition of $\overline{WE}$ (or $\overline{CE}$) after the software code was entered.
3. $\overline{OE}$ must be high only when $\overline{WE}$ and $\overline{CE}$ are both low.

5.18 $\overline{Data}$ Polling Characteristics[1]

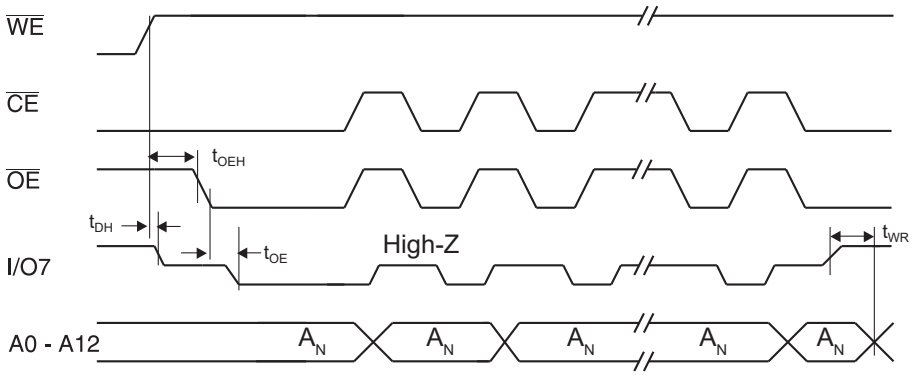
Table 5-5. Data Polling Characteristics

Parameter	Symbol	Minimum	Typical	Maximum	Units
Data Hold Time	t_{DH}	0	—	—	ns
$\overline{OE}$ Hold Time	t_{OEH}	0	—	—	ns
$\overline{OE}$ to Output Delay[2]	t_{OE}	—	—	—	ns
Write Recovery Time	t_{WR}	0	—	—	ns

Notes:

1. These parameters are characterized and not 100% tested.
2. See AC Read Characteristics.

5.19 $\overline{\text{Data}}$ Polling Waveforms



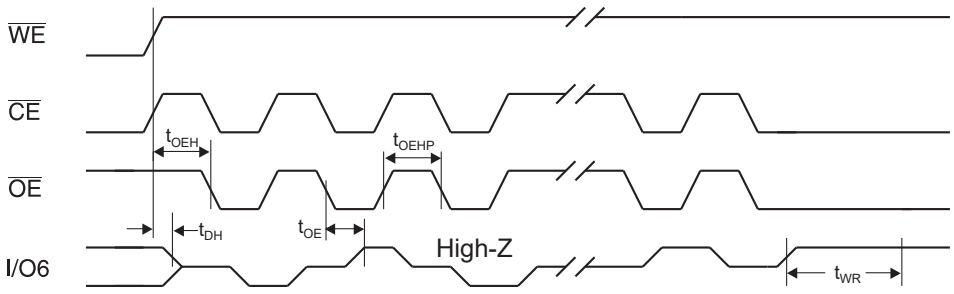
5.20 Toggle Bit Characteristics(1)

Table 5-6. Toggle Bit Characteristics

Parameter	Symbol	Minimum	Typical	Maximum	Units
Data Hold Time	t_{DH}	10	—	—	ns
$\overline{\text{OE}}$ Hold Time	t_{OEH}	10	—	—	ns
$\overline{\text{OE}}$ to Output Delay(2)	t_{OE}	—	—	—	ns
$\overline{\text{OE}}$ High Pulse	t_{OEHP}	150	—	—	ns
Write Recovery Time	t_{WR}	0	—	—	ns

Notes:
1. These parameters are characterized and not 100% tested.
2. See AC Read Characteristics.

5.21 Toggle Bit Waveforms(1,2,3)



Notes:
1. Toggling either $\overline{\text{OE}}$ or $\overline{\text{CE}}$ or both $\overline{\text{OE}}$ and $\overline{\text{CE}}$ will operate toggle bit.
2. Beginning and ending state of I/O6 will vary.
3. Any address location may be used but the address should not vary.

6. Packaging Information

6.1 Package Marking Information

AT28BV64B: Package Marking Information

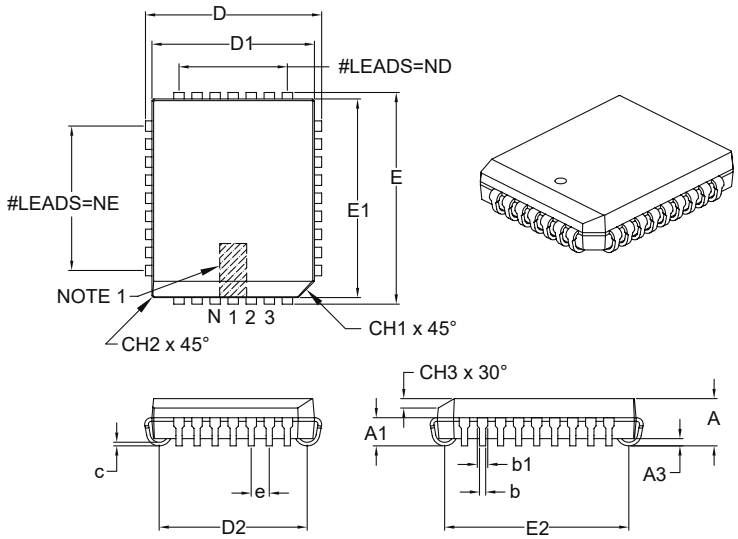
28-Lead SOIC		32-Lead PLCC	
Topside	Backside	Topside	Backside
ATMEL 19803A 28BV64B-%%U YYWWNNN		ATMEL AT28BV64B %%U-19803A YYWWNNN	
28-Lead TSOP			
Topside	Backside		
ATMEL AT28BV64B %%U-19803A YYWWNNN			

Note: no backside markings

		%% = Access Time	
		20: 200 ns	
	Lot Trace Code		
	YWWNNN: Lot Trace Code Y: Year, WW: Work Week NNN: Assembly Trace Code		

32-Lead Plastic Leaded Chip Carrier (L) – Rectangle [PLCC]

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



Units		INCHES		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		32	
Pitch	e		.050	
Pins along Length	ND		7	
Pins along Width	NE		9	
Overall Height	A	.125	–	.140
Contact Height	A1	.060	–	.095
Standoff §	A3	.015	–	–
Corner Chamfer	CH1	.042	–	.048
Chamfers	CH2	–	–	.020
Side Chamfer Height	CH3	.023	–	.029
Overall Length	D	.485	–	.495
Overall Width	E	.585	–	.595
Molded Package Length	D1	.447	–	.453
Molded Package Width	E1	.547	–	.553
Footprint Length	D2	.376	–	.446
Footprint Width	E2	.476	–	.546
Lead Thickness	c	.008	–	.013
Upper Lead Width	b1	.026	–	.032
Lower Lead Width	b	.013	–	.021

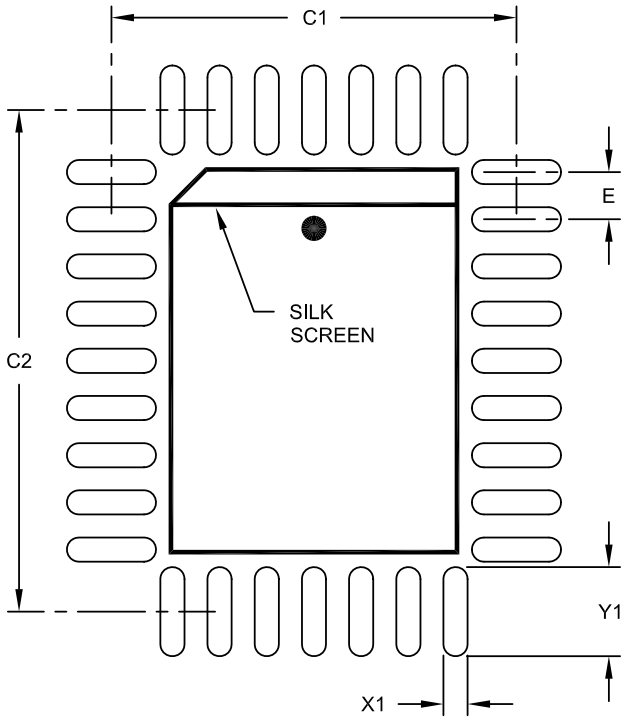
Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. § Significant Characteristic.
3. Dimensions D1 and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" per side.
4. Dimensioning and tolerancing per ASME Y14.5M.

Microchip Technology Drawing C04-023B

32-Lead Plastic Leaded Chip Carrier (L) - Rectangle [PLCC]

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



RECOMMENDED LAND PATTERN

Units		INCHES		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E		.050 BSC	
Contact Pad Spacing	C1		.429	
Contact Pad Spacing	C2		.531	
Contact Pad Width (X32)	X1			,026
Contact Pad Length (X32)	Y1			.094

Notes:

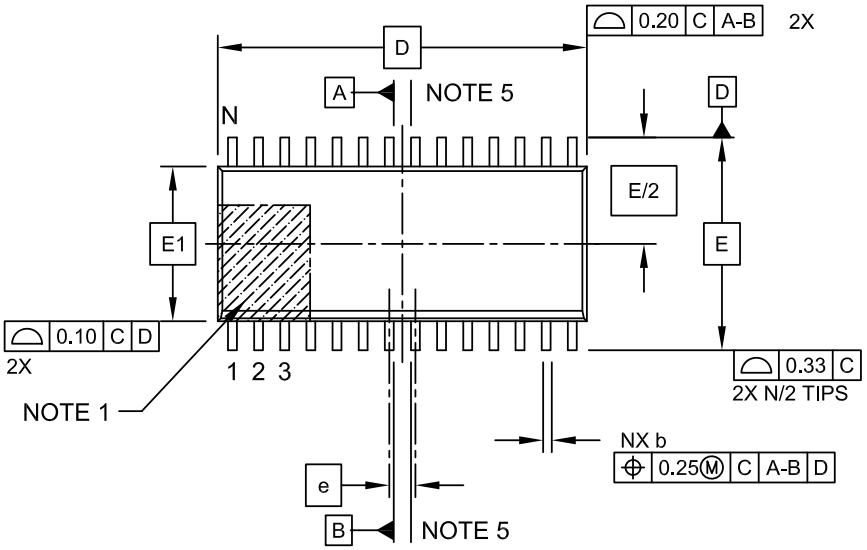
1. Dimensioning and tolerancing per ASME Y14.5M

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

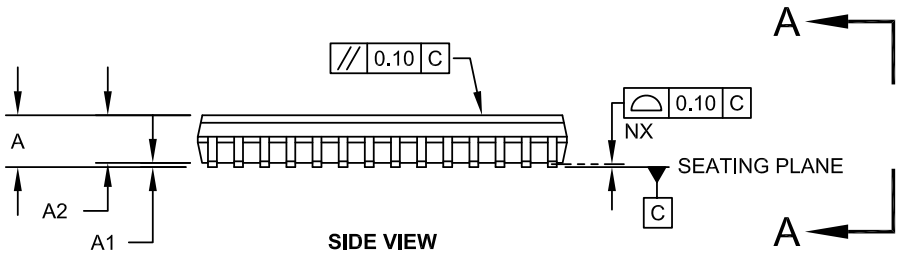
Microchip Technology Drawing No. C04-2023A

28-Lead Plastic Small Outline (SO) - Wide, 7.50 mm Body [SOIC]

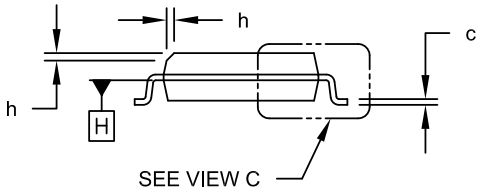
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



TOP VIEW



SIDE VIEW

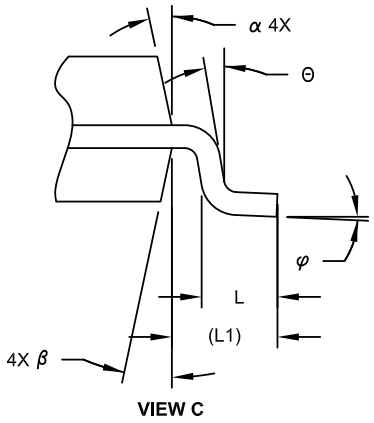


VIEW A-A

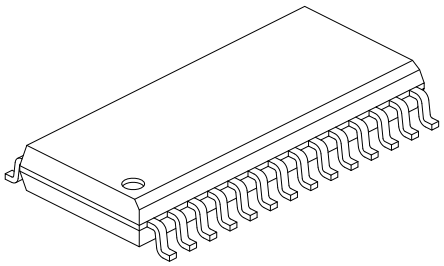
Microchip Technology Drawing C04-052C Sheet 1 of 2

28-Lead Plastic Small Outline (SO) - Wide, 7.50 mm Body [SOIC]

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



VIEW C



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		28	
Pitch	e		1.27 BSC	
Overall Height	A	-	-	2.65
Molded Package Thickness	A2	2.05	-	-
Standoff §	A1	0.10	-	0.30
Overall Width	E		10.30 BSC	
Molded Package Width	E1		7.50 BSC	
Overall Length	D		17.90 BSC	
Chamfer (Optional)	h	0.25	-	0.75
Foot Length	L	0.40	-	1.27
Footprint	L1		1.40 REF	
Lead Angle	Θ	0°	-	-
Foot Angle	φ	0°	-	8°
Lead Thickness	c	0.18	-	0.33
Lead Width	b	0.31	-	0.51
Mold Draft Angle Top	α	5°	-	15°
Mold Draft Angle Bottom	β	5°	-	15°

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. § Significant Characteristic
3. Dimension D does not include mold flash, protrusions or gate burrs, which shall not exceed 0.15 mm per end. Dimension E1 does not include interlead flash or protrusion, which shall not exceed 0.25 mm per side.
4. Dimensioning and tolerancing per ASME Y14.5M

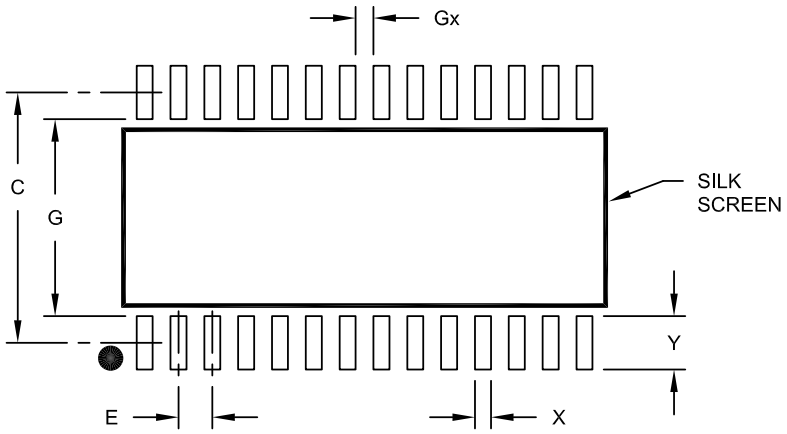
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

   REF: Reference Dimension, usually without tolerance, for information purposes only.
5. Datums A & B to be determined at Datum H.

Microchip Technology Drawing C04-052C Sheet 2 of 2

28-Lead Plastic Small Outline (SO) - Wide, 7.50 mm Body [SOIC]

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



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E		1.27 BSC	
Contact Pad Spacing	C		9.40	
Contact Pad Width (X28)	X			0.60
Contact Pad Length (X28)	Y			2.00
Distance Between Pads	Gx	0.67		
Distance Between Pads	G	7.40		

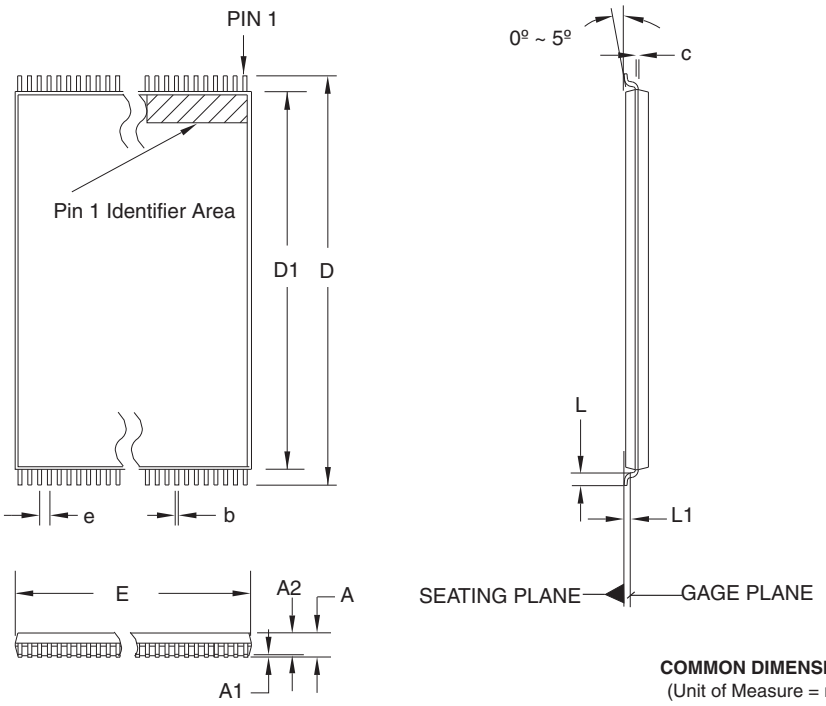
Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing No. C04-2052A

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



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.

12/06/02

	TITLE	DRAWING NO.	REV.
	28T, 28-lead (8 x 13.4 mm) Plastic Thin Small Outline Package, Type I (TSOP)	28T	C

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

7. Revision History

Revision A (September 2020)
Updated to the Microchip template. Microchip DS20006434 replaces Atmel document 0299. Added updated Part Markings to include new trace code format. Replaced Atmel 32J and 28S package drawings with Microchip 32-Lead PLCC and 28-Lead SOIC package drawings.

Atmel Document 0299 Revision K (July 2014)
Correct displayed 28T package drawing.

Atmel Document 0299 Revision J (April 2013)
Correct Device ID addressing. Updated Atmel branding and disclaimer page.

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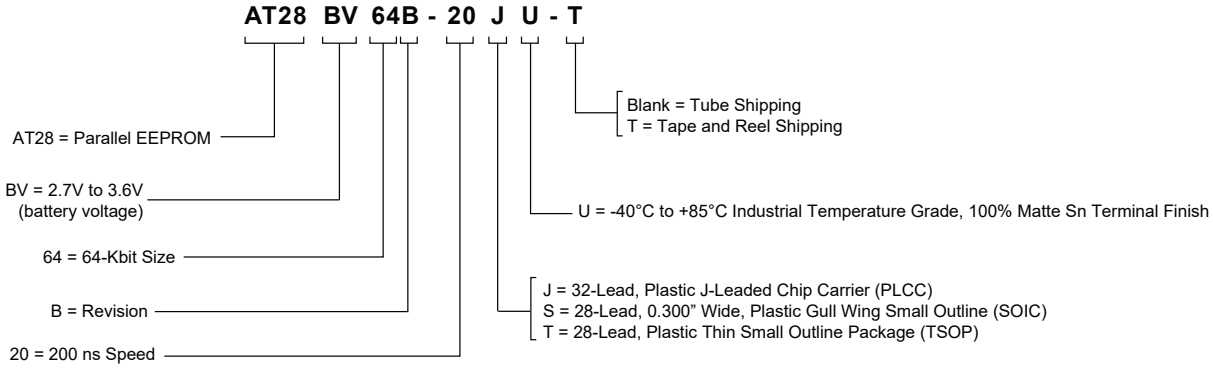

Examples

Table 11-1. Ordering Information

Ordering Code	Package Drawing Code	Package Option	t_{ACC} (ns)	Quantity	Operating Range
AT28BV64B-20JU	L	J	200	32 Tube	Industrial Temperature (-40°C to +85°C)
AT28BV64B-20JU-T				750 Reel	
AT28BV64B-20SU	SO	S		27 Tube	
AT28BV64B-20SU-T				1000 Reel	
AT28BV64B-20TU	28T	T		234 Tray	
AT28BV64B-20TU-T				2000 Reel	

Package Types	
J	32-Lead, Plastic J-leaded Chip Carrier (PLCC)
S	28-Lead, 0.300" Wide, Plastic Gull Wing Small Outline (SOIC)
T	28-Lead, Plastic Thin Outline Package (TSOP)

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