Features

- Fast read access time – 90ns
- Dual voltage range operation
  - Unregulated battery power supply range, 2.7V to 3.6V, or
  - Standard power supply range, 5V ± 10%
- Pin compatible with JEDEC standard Atmel® AT27C1024
- Low-power CMOS operation
  - 20µA max standby (less than 1µA, typical) for V_{CC} = 3.6V
  - 36mW max active at 5MHz for V_{CC} = 3.6V
- JEDEC standard surface mount package
  - 44-lead PLCC
- High-reliability CMOS technology
  - 2,000V ESD protection
  - 200mA latchup immunity
- Rapid programming algorithm – 100µs/word (typical)
- CMOS- and TTL-compatible inputs and outputs
  - JEDEC standard for LVTTL and LVBO
- Integrated product identification code
- Industrial temperature range

1Mb (64K x 16) Unregulated Battery Voltage, High-speed, One-time Programmable, Read-only Memory

Atmel AT27BV1024

1. Description

The Atmel AT27BV1024 is a high-performance, low-power, low-voltage, 1,048,576-bit, one-time programmable, read-only memory (OTP EPROM) organized as 64K by 16 bits. It requires only one supply in the range of 2.7V to 3.6V in normal read mode operation. The x16 organization makes this part ideal for portable and handheld 16- and 32-bit microprocessor-based systems using either regulated or unregulated battery power.

The Atmel innovative design techniques provide fast speeds that rival 5V parts, while keeping the low power consumption of a 3V supply. At V_{CC} = 2.7V, any word can be accessed in less than 90ns. With a typical power dissipation of only 18mW at 5MHz and V_{CC} = 3V, the AT27BV1024 consumes less than one-fifth the power of a standard, 5V EPROM.

Standby mode supply current is typically less than 1µA at 3V. The AT27BV1024 simplifies system design and stretches battery lifetime even further by eliminating the need for power supply regulation.

The AT27BV1024 is available in an industry-standard, JEDEC-approved, one-time programmable (OTP) PLCC package. All devices feature two-line control ($\overline{CE}$, $\overline{OE}$) to give designers the flexibility to prevent bus contention.

The AT27BV1024 operating with V_{CC} at 3.0V produces TTL-level outputs that are compatible with standard TTL logic devices operating at V_{CC} = 5.0V. At V_{CC} = 2.7V, the part is compatible with JEDEC-approved, low-voltage battery operation (LVBO) interface specifications. The device is also capable of standard, 5V operation making it ideally suited for dual supply range systems or card products that are pluggable in both 3V and 5V hosts.

The AT27BV1024 has additional features to ensure high quality and efficient production use. The rapid programming algorithm reduces the time required to program the part and guarantees reliable programming. Programming time is typically only 100 µs/word. The integrated product identification code electronically identifies the device and

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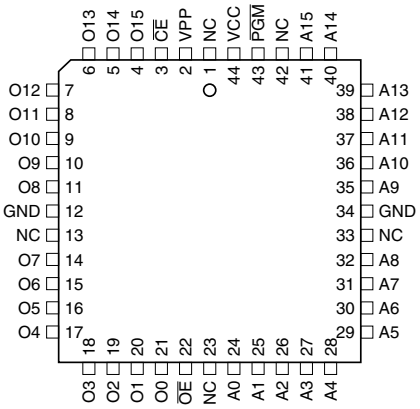
manufacturer. This feature is used by industry-standard programming equipment to select the proper programming algorithms and voltages. The AT27BV1024 programs in exactly the same way as a standard, 5V Atmel AT27C1024, and uses the same programming equipment.

2. Pin configurations

Pin Name	Function
A0 - A15	Addresses
O0 - O15	Outputs
$\overline{CE}$	Chip enable
$\overline{OE}$	Output enable
$\overline{PGM}$	Program strobe
NC	No connect

Note: Both GND pins must be connected.

44-lead PLCC
Top view

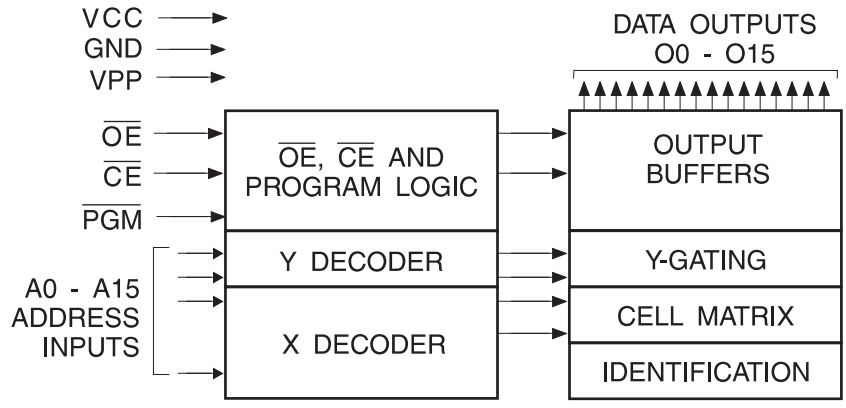


Note: PLCC Package Pins 1 and 23 are "don't connect."

3. System considerations

Switching between active and standby conditions via the chip enable pin may produce transient voltage excursions. Unless accommodated by the system design, these transients may exceed datasheet limits, resulting in device non-conformance. At a minimum, a 0.1µF, high-frequency, low inherent inductance, ceramic capacitor should be utilized for each device. This capacitor should be connected between the V_{CC} and ground terminals of the device, as close to the device as possible. Additionally, to stabilize the supply voltage level on printed circuit boards with large EPROM arrays, a 4.7µF bulk electrolytic capacitor should be utilized, again connected between the V_{CC} and ground terminals. This capacitor should be positioned as close as possible to the point where the power supply is connected to the array.

Figure 3-1. Block diagram



4. Absolute maximum ratings*

Temperature under bias	-55°C to +125°C
Storage temperature	-65°C to +150°C
Voltage on any pin with respect to ground	-2.0V to +7.0V(1)
Voltage on A9 with respect to ground	-2.0V to +14.0V(1)
V_{PP} supply voltage with respect to ground	-2.0V to +14.0V(1)

*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.

Note: 1. Minimum voltage is -0.6V DC ,which may undershoot to -2.0V for pulses of less than 20ns. Maximum output pin voltage is V_{CC} + 0.75V DC, which may overshoot to +7.0V for pulses of less than 20ns.

5. AC and DC characteristics

Table 5-1. Operating modes

Mode/Pin	$\overline{CE}$	$\overline{OE}$	$\overline{PGM}$	Ai	V_{PP}	V_{CC}	Outputs
Read(2)	V_{IL}	V_{IL}	X(1)	Ai	X	V_{CC}	D_{OUT}
Output disable(2)	X	V_{IH}	X	X	X	V_{CC}	High Z
Standby(2)	V_{IH}	X	X	X	X(5)	V_{CC}	High Z
Rapid program(3)	V_{IL}	V_{IH}	V_{IL}	Ai	V_{PP}	V_{CC}	D_{IN}
PGM verify(3)	V_{IL}	V_{IL}	V_{IH}	Ai	V_{PP}	V_{CC}	D_{OUT}
PGM inhibit(3)	V_{IH}	X	X	X	V_{PP}	V_{CC}	High Z
Product identification(3)(5)	V_{IL}	V_{IL}	X	A9 = V_H(4) A0 = V_{IH} or V_{IL} A1 - A15 = V_{IL}	V_{CC}	V_{CC}	Identification code

Notes:
1. X can be V_{IL} or V_{IH}.
2. Read, output disable, and standby modes require 2.7V ≤ V_{CC} ≤ 3.6V or 4.5V ≤ V_{CC} ≤ 5.5V.
3. Refer to programming characteristics. Programming modes require V_{CC} = 6.5V.
4. V_H = 12.0 ± 0.5V.
5. Two identifier words may be selected. All Ai inputs are held low (V_{IL}) except A9, which is set to V_H, and A0, which is toggled low (V_{IL}) to select the manufacturer's identification word and high (V_{IH}) to select the device code word.

Table 5-2. DC and AC operating conditions for read oepration

	Atmel AT27BV1024-90
Industrial operating temperature (case)	-40°C - 85°C
V_{CC} power supply	2.7V to 3.6V
	5V ± 10%

Table 5-3. DC and operating characteristics for read operation

Symbol	Parameter	Condition	Min	Max	Units
V_{CC} = 2.7V to 3.6V					
I_{LI}	Input load current	V_{IN} = 0V to V_{CC}		±1	µA
I_{LO}	Output leakage current	V_{OUT} = 0V to V_{CC}		±5	µA
I_{PP1} (2)	V_{PP} (1) read/standby current	V_{PP} = V_{CC}		10	µA
I_{SB}	V_{CC} (1) standby current	I_{SB1} (CMOS), $\overline{CE}$ = V_{CC} ± 0.3V		20	µA
		I_{SB2} (TTL), $\overline{CE}$ = 2.0 to V_{CC} + 0.5V		100	µA
I_{CC}	V_{CC} active current	f = 5MHz, I_{OUT} = 0mA, $\overline{CE}$ = V_{IL}, V_{CC} = 3.6V		8	mA
V_{IL}	Input low voltage	V_{CC} = 3.0 to 3.6V	-0.6	0.8	V
		V_{CC} = 2.7 to 3.6V	-0.6	0.2 x V_{CC}	V
V_{IH}	Input high voltage	V_{CC} = 3.0 to 3.6V	2.0	V_{CC} + 0.5	V
		V_{CC} = 2.7 to 3.6V	0.7 x V_{CC}	V_{CC} + 0.5	V
V_{OL}	Output low voltage	I_{OL} = 2.0mA		0.4	V
		I_{OL} = 100µA		0.2	V
		I_{OL} = 20µA		0.1	V
V_{OH}	Output high voltage	I_{OH} = -2.0mA	2.4		V
		I_{OH} = -100µA	V_{CC} - 0.2		V
		I_{OH} = -20µA	V_{CC} - 0.1		V
V_{CC} = 4.5V to 5.5V					
I_{LI}	Input load current	V_{IN} = 0V to V_{CC}		±1	µA
I_{LO}	Output leakage current	V_{OUT} = 0V to V_{CC}		±5	µA
I_{PP1} (2)	V_{PP} (1) read/standby current	V_{PP} = V_{CC}		10	µA
I_{SB}	V_{CC} (1) standby current	I_{SB1} (CMOS), $\overline{CE}$ = V_{CC} ± 0.3V		100	µA
		I_{SB2} (TTL), $\overline{CE}$ = 2.0 to V_{CC} + 0.5V		1	mA
I_{CC}	V_{CC} active current	f = 5MHz, I_{OUT} = 0mA, $\overline{CE}$ = V_{IL}		30	mA
V_{IL}	Input low voltage		-0.6	0.8	V
V_{IH}	Input high voltage		2.0	V_{CC} + 0.5	V
V_{OL}	Output low voltage	I_{OL} = 2.1mA		0.4	V
V_{OH}	Output high voltage	I_{OH} = -400µA	2.4		V

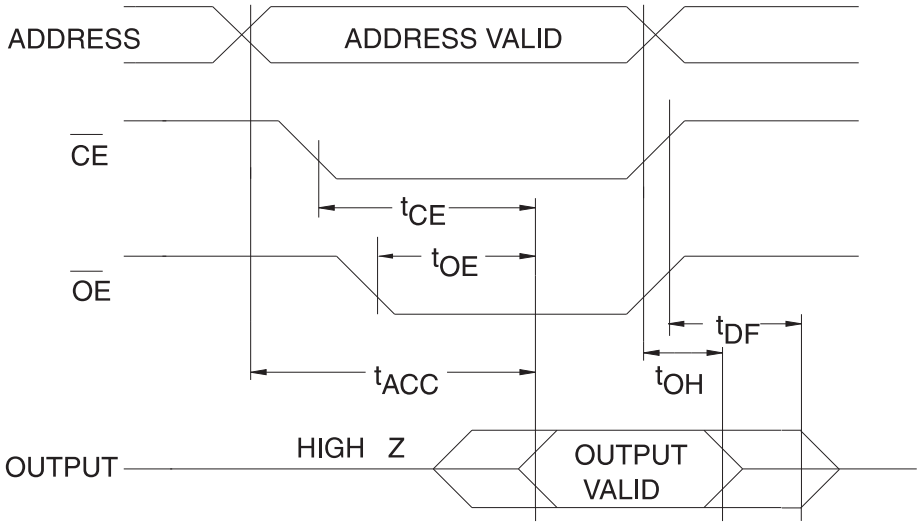
Notes: 1. V_{CC} must be applied simultaneously with or before V_{PP}, and removed simultaneously with or after V_{PP}.

2. V_{PP} may be connected directly to V_{CC}, except during programming. The supply current would then be the sum of I_{CC} and I_{PP}.

Table 5-4. AC characteristics for read operation

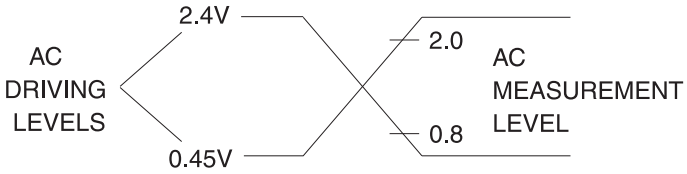
Symbol	Parameter	Condition	Atmel AT27BV1024-90		Unit
			Min	Max	
t_{ACC} (3)	Address to output delay	$\overline{CE}$ = $\overline{OE}$ = V_{IL}		90	ns
t_{CE} (2)	$\overline{CE}$ to output delay	$\overline{OE}$ = V_{IL}		90	ns
t_{OE} (2)(3)	$\overline{OE}$ to output delay	$\overline{CE}$ = V_{IL}		30	ns
t_{DF} (4)(5)	$\overline{OE}$ or $\overline{CE}$ High to output float, whichever occurred first			30	ns
t_{OH}	Output hold from address, $\overline{CE}$ or $\overline{OE}$, whichever occurred first		0		ns

Figure 5-1. AC waveforms for read operation (1)



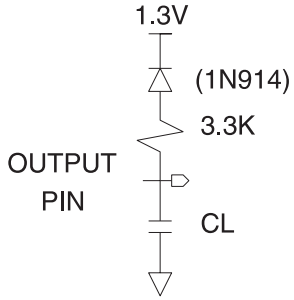
Note:
1. Timing measurement references are 0.8V and 2.0V. Input AC drive levels are 0.45V and 2.4V, unless otherwise specified.
2. $\overline{OE}$ may be delayed up to t_{CE} - t_{OE} after the falling edge of $\overline{CE}$ without impact on t_{CE}.
3. $\overline{OE}$ may be delayed up to t_{ACC} - t_{OE} after the address is valid without impact on t_{ACC}.
4. This parameter is only sampled, and is not 100% tested.
5. Output float is defined as the point when data is no longer driven.
6. When reading an Atmel AT27BV1024, a 0.1µF capacitor is required across V_{CC} and ground to suppress spurious voltage transients.

Figure 5-2. Input test waveforms and measurement levels



t_R, t_F < 20ns (10% to 90%)

Figure 5-3. Output test load



Note: CL = 100pF including jig capacitance.

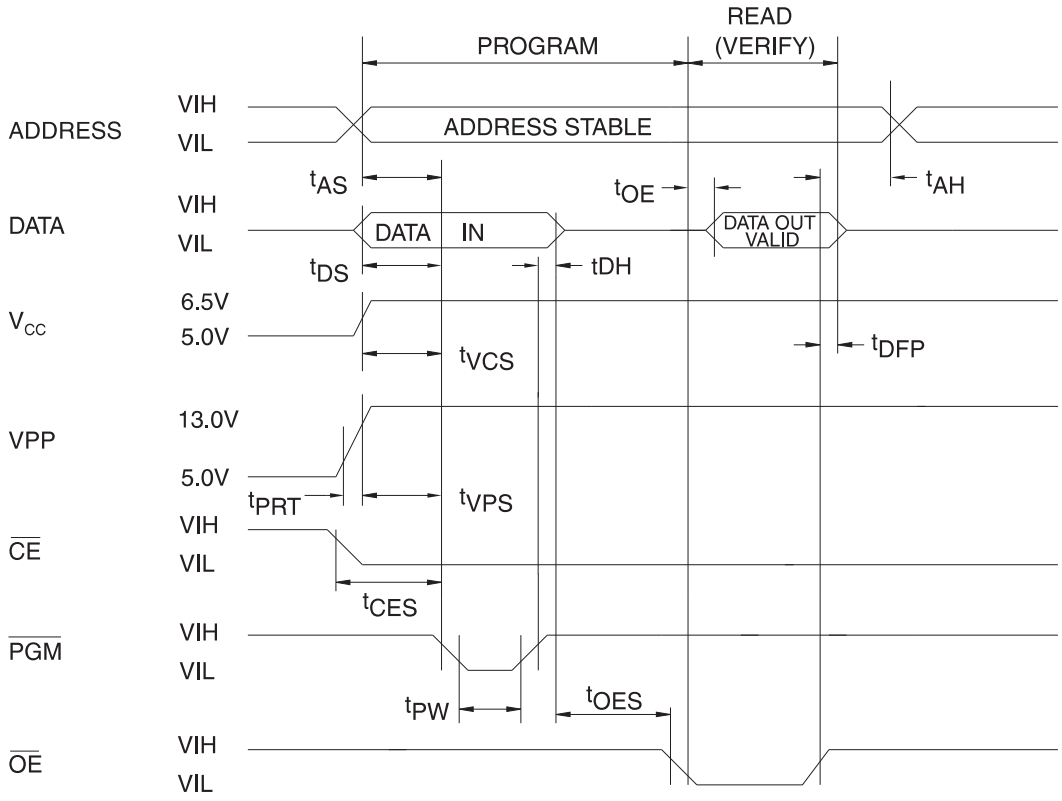
Table 5-5. Pin capacitance

f = 1MHz T = 25°C [1]

Symbol	Typ	Max	Units	Conditions
C_{IN}	4	10	pF	V_{IN} = 0V
C_{OUT}	8	12	pF	V_{OUT} = 0V

Note: 1. Typical values for nominal supply voltage. This parameter is only sampled, and is not 100% tested.

Figure 5-4. Programming waveforms[1]



Note: 1. The input timing reference is 0.8V for V_{IL} and 2.0V for V_{IH}.

2. t_{OE} and t_{DFP} are characteristics of the device, but must be accommodated by the programmer.

3. When programming the Atmel AT27BV1024 a 0.1µF capacitor is required across V_{PP} and ground to suppress spurious voltage transients.

Table 5-6. DC programming characteristics

T_A = 25 ± 5° C, V_{CC} = 6.5 ± 0.25V, V_{PP} = 13.0 ± 0.25V

Symbol	Parameter	Test conditions	Limits		Units
			Min	Max	
I_{LI}	Input load current	$V_{IN} = V_{IL}, V_{IH}$		±10	µA
V_{IL}	Input low level		-0.6	0.8	V
V_{IH}	Input high level		2.0	V_{CC} + 0.1	V
V_{OL}	Output low voltage	I_{OL} = 2.1mA		0.4	V
V_{OH}	Output high voltage	I_{OH} = -400µA	2.4		V
I_{CC2}	V_{CC} supply current (program and verify)			50	mA
I_{PP2}	V_{PP} supply current	$\overline{CE} = \overline{PGM} = V_{IL}$		30	mA
V_{ID}	A9 product identification voltage		11.5	12.5	V

Table 5-7. AC programming characteristics

T_A = 25 ± 5° C, V_{CC} = 6.5 ± 0.25V, V_{PP} = 13.0 ± 0.25V

Symbol	Parameter	Test conditions[1]	Limits		Units
			Min	Max	
t_{AS}	Address setup time	Input rise and fall times: (10% to 90%) 20ns Input pulse levels: 0.45V to 2.4V Input timing reference level: 0.8V to 2.0V Output timing reference level: 0.8V to 2.0V	2		µs
t_{CES}	$\overline{CE}$ setup time		2		µs
t_{OES}	$\overline{OE}$ setup time		2		µs
t_{DS}	Data setup time		2		µs
t_{AH}	Address hold time		0		µs
t_{DH}	Data hold time		2		µs
t_{DFP}	$\overline{OE}$ high to output float delay[2]		0	130	ns
t_{VPS}	V_{PP} setup time		2		µs
t_{VCS}	V_{CC} setup time		2		µs
t_{PW}	$\overline{PGM}$ program pulse width[3]		95	105	µs
t_{OE}	Data valid from $\overline{OE}$			150	ns
t_{PRT}	V_{PP} pulse rise time during programming		50		ns

Notes:
1. V_{CC} must be applied simultaneously with or before V_{PP} and removed simultaneously with or after V_{PP}.
2. This parameter is only sampled, and is not 100% tested. Output float is defined as the point where data is no longer driven. See timing diagram.
3. Program pulse width tolerance is 100µsec ± 5%.

Table 5-8. The Atmel AT27BV1024 integrated product identification code[1]

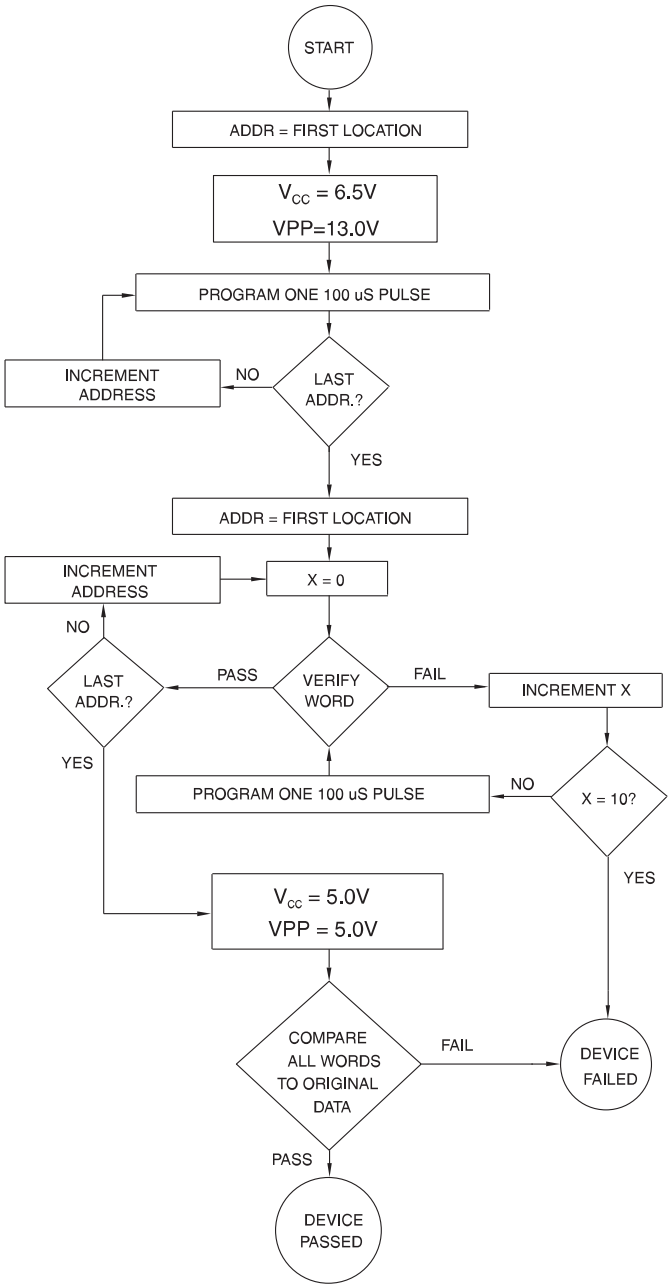
Codes	Pins										Hex data
	A0	O15-O8	O7	O6	O5	O4	O3	O2	O1	O0	
Manufacturer	0	0	0	0	0	1	1	1	1	0	001E
Device type	1	0	1	1	1	1	0	0	0	1	00F1

Note: 1. The Atmel AT27BV1024 has the same product identification code as the Atmel AT27C1024. Both are programming compatible

6. Rapid programming algorithm

A 100µs $\overline{PGM}$ pulse width is used to program. The address is set to the first location. V_{CC} is raised to 6.5V and V_{PP} is raised to 13.0V. Each address is first programmed with one 100µs $\overline{PGM}$ pulse without verification. Then a verification/reprogramming loop is executed for each address. In the event a word fails to pass verification, up to 10 successive 100µs pulses are applied with a verification after each pulse. If the word fails to verify after 10 pulses have been applied, the part is considered failed. After the word verifies properly, the next address is selected until all have been checked. V_{PP} is then lowered to 5.0V and V_{CC} to 5.0V. All words are read again and compared with the original data to determine if the device passes or fails.

Figure 6-1. Rapid programming algorithm



7. Ordering information

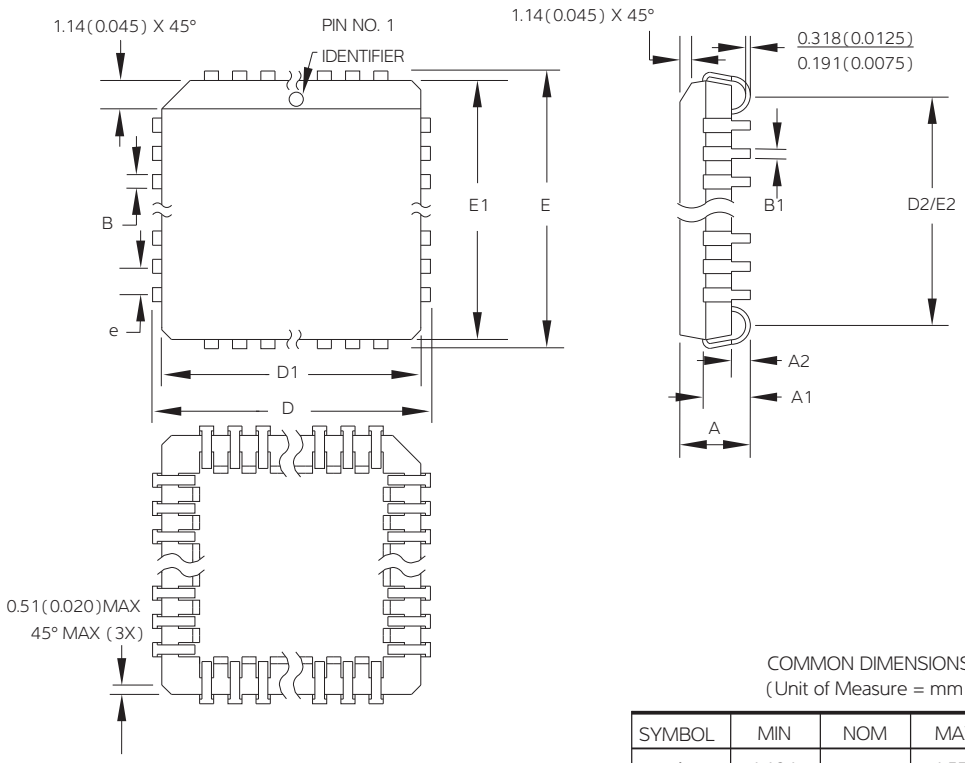
Green package (Pb/hailde-free)

t_{ACC} (ns)	I_{CC} (mA)		Atmel ordering code	Lead finish	Package	Operation range
	Active	Standby				
90	8	0.02	AT27BV1024-90JU	Matte tin	44J	Industrial (-40°C to 85°C)

Package type	
44J	44-lead, plastic, J-leaded chip carrier (PLCC)

8. Packaging Information

44J – PLCC



COMMON DIMENSIONS
(Unit of Measure = mm)

SYMBOL	MIN	NOM	MAX	NOTE
A	4.191	–	4.572	
A1	2.286	–	3.048	
A2	0.508	–	–	
D	17.399	–	17.653	
D1	16.510	–	16.662	Note 2
E	17.399	–	17.653	
E1	16.510	–	16.662	Note 2
D2/E2	14.986	–	16.002	
B	0.660	–	0.813	
B1	0.330	–	0.533	
e	1.270 TYP			

Notes:
1. This package conforms to JEDEC reference MS-018, Variation AC
2. Dimensions D1 and E1 do not include mold protrusion. Allowable protrusion is .010"(0.254mm) per side. Dimension D1 and E1 include mold mismatch and are measured at the extreme material condition at the upper or lower parting line.
3. Lead coplanarity is 0.004" (0.102mm) maximum

10/04/01

	TITLE	DRAWING NO.	REV.
Package Drawing Contact: packagedrawings@atmel.com	44J, 44-lead, Plastic J-leaded chip carrier (PLCC)	44J	B

9. Revision history

Doc. rev.	Date	Comments
0631F	04/2011	Remove VSOP package Add lead finish to ordering information Change 120ns to 90ns
0631E	12/2007	