

## Features

- Fast Read Access Time – 55 ns
- Low-power CMOS Operation
  - 100  $\mu$ A Max Standby
  - 25 mA Max Active at 5 MHz
- JEDEC Standard Packages
  - 32-lead PDIP
  - 32-lead PLCC
  - 32-lead TSOP
- 5V  $\pm$  10% Supply
- High-reliability CMOS Technology
  - 2,000V ESD Protection
  - 200 mA Latch-up Immunity
- Rapid Programming Algorithm – 100  $\mu$ s/Byte (Typical)
- CMOS- and TTL-compatible Inputs and Outputs
- Integrated Product Identification Code
- Industrial and Automotive Temperature Ranges
- Green (Pb/Halide-free) Packaging Option

## 1. Description

The AT27C020 is a low-power, high-performance, 2,097,152-bit, one-time programmable read-only memory (OTP EPROM) organized as 256K by 8 bits. It requires only one 5V power supply in normal read mode operation. Any byte can be accessed in less than 55 ns, eliminating the need for speed-reducing WAIT states on high-performance microprocessor systems.

In read mode, the AT27C020 typically consumes 8 mA. Standby mode supply current is typically less than 10  $\mu$ A.

The AT27C020 is available in a choice of industry-standard JEDEC-approved one-time programmable (OTP) plastic PDIP, PLCC and TSOP packages. All devices feature two-line control ( $\overline{CE}$ ,  $\overline{OE}$ ) to give designers the flexibility to prevent bus contention.

With 256K bytes storage capability, the AT27C020 allows firmware to be stored reliably and to be accessed by the system without the delays of mass storage media.

Atmel's AT27C020 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  $\mu$ s/byte. The Integrated Product Identification Code electronically identifies the device and manufacturer. This feature is used by industry-standard programming equipment to select the proper programming algorithms and voltages.



**2-megabit  
(256K x 8)  
OTP EPROM**

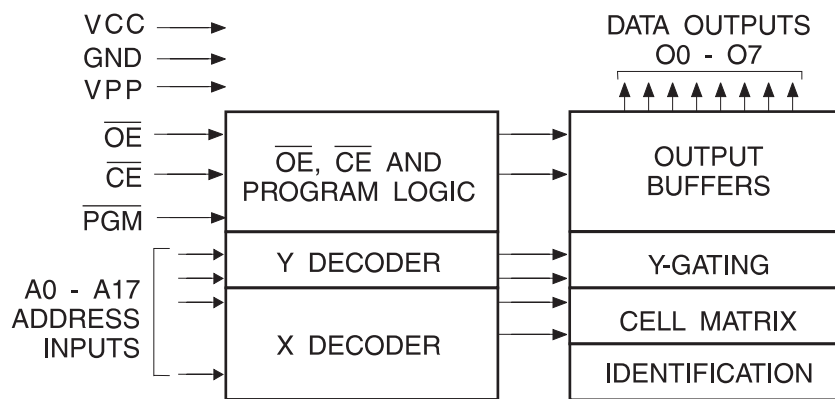
**AT27C020**



### 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 0.1  $\mu\text{F}$  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 4.7  $\mu\text{F}$  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.

### 4. Block Diagram



### 5. 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 <sup>(1)</sup>
Voltage on A9 with Respect to Ground .....	-2.0V to +14.0V <sup>(1)</sup>
$V_{PP}$ Supply Voltage with Respect to Ground .....	-2.0V to +14.0V <sup>(1)</sup>

**\*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 20 ns. Maximum output pin voltage is  $V_{CC} + 0.75\text{V}$  DC, which may overshoot to +7.0V for pulses of less than 20 ns.

## 6. Operating Modes

Mode/Pin	$\overline{CE}$	$\overline{OE}$	$\overline{PGM}$	Ai	V <sub>PP</sub>	Outputs
Read	V <sub>IL</sub>	V <sub>IL</sub>	X <sup>(1)</sup>	Ai	X	D <sub>OUT</sub>
Output Disable	X	V <sub>IH</sub>	X	X	X	High-Z
Standby	V <sub>IH</sub>	X	X	X	X	High-Z
Rapid Program <sup>(2)</sup>	V <sub>IL</sub>	V <sub>IH</sub>	V <sub>IL</sub>	Ai	V <sub>PP</sub>	D <sub>IN</sub>
PGM Verify	V <sub>IL</sub>	V <sub>IL</sub>	V <sub>IH</sub>	Ai	V <sub>PP</sub>	D <sub>OUT</sub>
PGM Inhibit	V <sub>IH</sub>	X	X	X	V <sub>PP</sub>	High-Z
Product Identification <sup>(4)</sup>	V <sub>IL</sub>	V <sub>IL</sub>	X	A9 = V <sub>H</sub> <sup>(3)</sup> A0 = V <sub>IH</sub> or V <sub>IL</sub> A1 - A17 = V <sub>IL</sub>	X	Identification Code

Notes: 1. X can be V<sub>IL</sub> or V<sub>IH</sub>.

2. Refer to Programming Characteristics.

3. V<sub>H</sub> = 12.0 ± 0.5V.

4. Two identifier bytes may be selected. All Ai inputs are held low (V<sub>IL</sub>) except A9, which is set to V<sub>H</sub> and A0, which is toggled low (V<sub>IL</sub>) to select the Manufacturer's Identification byte and high (V<sub>IH</sub>) to select the Device Code byte.

## 7. DC and AC Operating Conditions for Read Operation

		AT27C020	
		-55	-90
Operating Temperature (Case)	Ind.	-40° C - 85° C	-40° C - 85° C
	Auto.		-40° C - 125° C
V <sub>CC</sub> Power Supply		5V ± 10%	5V ± 10%

## 8. DC and Operating Characteristics for Read Operation

Symbol	Parameter	Condition	Min	Max	Units
I <sub>LI</sub>	Input Load Current	V <sub>IN</sub> = 0V to V <sub>CC</sub> (Com., Ind.)		±1.0	μA
I <sub>LO</sub>	Output Leakage Current	V <sub>OUT</sub> = 0V to V <sub>CC</sub> (Com., Ind.)		±5.0	μA
I <sub>PP</sub> <sup>(2)</sup>	V <sub>PP</sub> <sup>(1)</sup> Read/Standby Current	V <sub>PP</sub> = V <sub>CC</sub>		±10	μA
I <sub>SB</sub>	V <sub>CC</sub> <sup>(1)</sup> Standby Current	I <sub>SB1</sub> (CMOS), $\overline{CE} = V_{CC} \pm 0.3V$		100	μA
		I <sub>SB2</sub> (TTL), $\overline{CE} = 2.0$ to V <sub>CC</sub> + 0.5V		1.0	mA
I <sub>CC</sub>	V <sub>CC</sub> Active Current	f = 5 MHz, I <sub>OUT</sub> = 0 mA, $\overline{CE} = V_{IL}$		25	mA
V <sub>IL</sub>	Input Low Voltage		-0.6	0.8	V
V <sub>IH</sub>	Input High Voltage		2.0	V <sub>CC</sub> + 0.5	V
V <sub>OL</sub>	Output Low Voltage	I <sub>OL</sub> = 2.1 mA		0.4	V
V <sub>OH</sub>	Output High Voltage	I <sub>OH</sub> = -400 μA	2.4		V

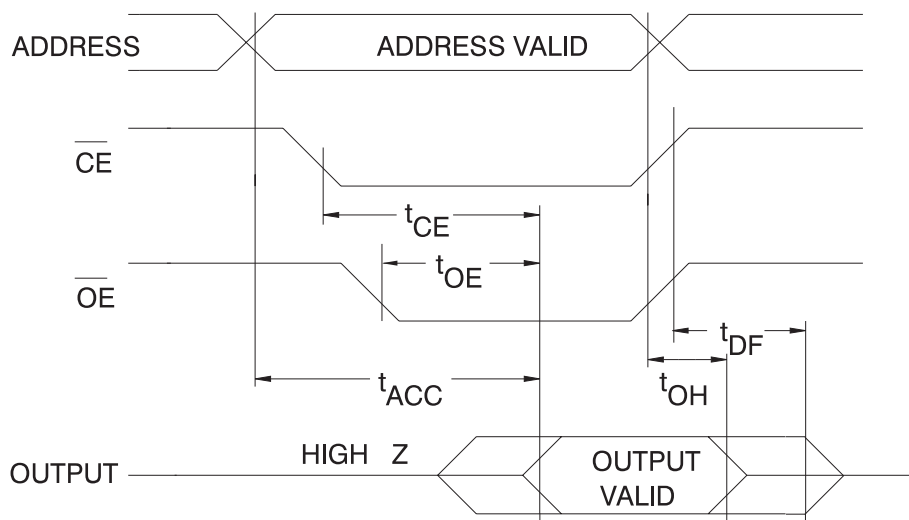
Notes: 1. V<sub>CC</sub> must be applied simultaneously or before V<sub>PP</sub>, and removed simultaneously or after V<sub>PP</sub>.

2. V<sub>PP</sub> may be connected directly to V<sub>CC</sub> except during programming. The supply current would then be the sum of I<sub>CC</sub> and I<sub>PP</sub>.

### 9. AC Characteristics for Read Operation

Symbol	Parameter	Condition	AT27C020				Units
			-55		-90		
			Min	Max	Min	Max	
$t_{ACC}^{(3)}$	Address to Output Delay	$\overline{CE} = \overline{OE} = V_{IL}$		55		90	ns
$t_{CE}^{(2)}$	$\overline{CE}$ to Output Delay	$\overline{OE} = V_{IL}$		55		90	ns
$t_{OE}^{(2)(3)}$	$\overline{OE}$ to Output Delay	$\overline{CE} = V_{IL}$		20		35	ns
$t_{DF}^{(4)(5)}$	$\overline{OE}$ or $\overline{CE}$ High to Output Float, Whichever Occurred First			18		20	ns
$t_{OH}$	Output Hold from Address, $\overline{CE}$ or $\overline{OE}$ , Whichever Occurred First		7		0		ns

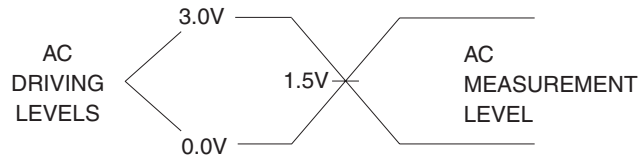
### 10. AC Waveforms for Read Operation<sup>(1)</sup>



- Notes:
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.

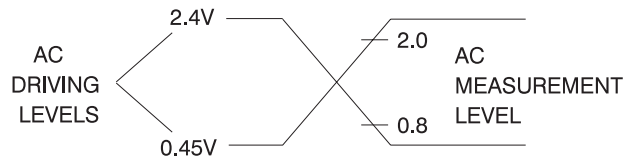
## 11. Input Test Waveforms and Measurement Levels

For -55 devices only:



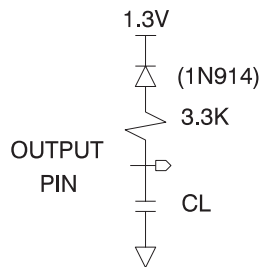
$t_R, t_F < 5 \text{ ns}$  (10% to 90%)

For -90 devices only:



$t_R, t_F < 20 \text{ ns}$  (10% to 90%)

## 12. Output Test Load



Note:  $CL = 100 \text{ pF}$  including jig capacitance except -55 devices, where  $CL = 30 \text{ pF}$ .

## 13. Pin Capacitance

$f = 1 \text{ MHz}$ ,  $T = 25^\circ \text{C}$ <sup>(1)</sup>

Symbol	Typ	Max	Units	Conditions
$C_{IN}$	4	8	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.

## 15. DC Programming Characteristics

$T_A = 25 \pm 5^\circ\text{C}$ ,  $V_{CC} = 6.5 \pm 0.25\text{V}$ ,  $V_{PP} = 13.0 \pm 0.25\text{V}$

Symbol	Parameter	Test Conditions	Limits		Units
			Min	Max	
$I_{LI}$	Input Load Current	$V_{IN} = V_{IL}, V_{IH}$		$\pm 10$	$\mu\text{A}$
$V_{IL}$	Input Low Level		-0.6	0.8	V
$V_{IH}$	Input High Level		2.0	$V_{CC} + 1.0$	V
$V_{OL}$	Output Low Voltage	$I_{OL} = 2.1 \text{ mA}$		0.4	V
$V_{OH}$	Output High Voltage	$I_{OH} = -400 \mu\text{A}$	2.4		V
$I_{CC2}$	$V_{CC}$ Supply Current (Program and Verify)			40	mA
$I_{PP2}$	$V_{PP}$ Supply Current	$\overline{CE} = \overline{PGM} = V_{IL}$		20	mA
$V_{ID}$	A9 Product Identification Voltage		11.5	12.5	V

## 16. AC Programming Characteristics

$T_A = 25 \pm 5^\circ\text{C}$ ,  $V_{CC} = 6.5 \pm 0.25\text{V}$ ,  $V_{PP} = 13.0 \pm 0.25\text{V}$

Symbol	Parameter	Test Condition (1)	Limits		Units
			Min	Max	
$t_{AS}$	Address Setup Time	Input Rise and Fall Times: (10% to 90%) 20 ns	2		$\mu\text{s}$
$t_{CES}$	$\overline{CE}$ Setup Time		2		$\mu\text{s}$
$t_{OES}$	$\overline{OE}$ Setup Time		2		$\mu\text{s}$
$t_{DS}$	Data Setup Time		2		$\mu\text{s}$
$t_{AH}$	Address Hold Time	Input Pulse Levels: 0.45V to 2.4V	0		$\mu\text{s}$
$t_{DH}$	Data Hold Time		2		$\mu\text{s}$
$t_{DFP}$	$\overline{OE}$ High to Output Float Delay(2)	Input Timing Reference Level: 0.8V to 2.0V	0	130	ns
$t_{VPS}$	$V_{PP}$ Setup Time		2		$\mu\text{s}$
$t_{VCS}$	$V_{CC}$ Setup Time		2		$\mu\text{s}$
$t_{PW}$	$\overline{PGM}$ Program Pulse Width(3)		95	105	$\mu\text{s}$
$t_{OE}$	Data Valid from $\overline{OE}$	Output Timing Reference Level: 0.8V to 2.0V		150	ns
$t_{PRT}$	$V_{PP}$ Pulse Rise Time During Programming		50		ns

- Notes:
- $V_{CC}$  must be applied simultaneously or before  $V_{PP}$  and removed simultaneously or after  $V_{PP}$ .
  - 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.
  - Program Pulse width tolerance is  $100 \mu\text{s} \pm 5\%$ .

## 17. Atmel's AT27C020 Integrated Product Identification Code

Codes	Pins									Hex Data
	A0	O7	O6	O5	O4	O3	O2	O1	O0	
Manufacturer	0	0	0	0	1	1	1	1	0	1E
Device Type	1	1	0	0	0	0	1	1	0	86



## 19. Ordering Information

### 19.1 Standard Package

$t_{Acc}$ (ns)	$I_{CC}$ (mA)		Ordering Code	Package	Operation Range
	Active	Standby			
55	25	0.1	AT27C020-55JI	32J	Industrial (-40° C to 85° C)
			AT27C020-55PI	32P6	
			AT27C020-55TI	32T	
90	25	0.1	AT27C020-90JI	32J	Industrial (-40° C to 85° C)
			AT27C020-90PI	32P6	
			AT27C020-90TI	32T	
	25	0.1	AT27C020-90JA	32J	Automotive (-40° C to 125° C)
			AT27C020-90PA	32P6	

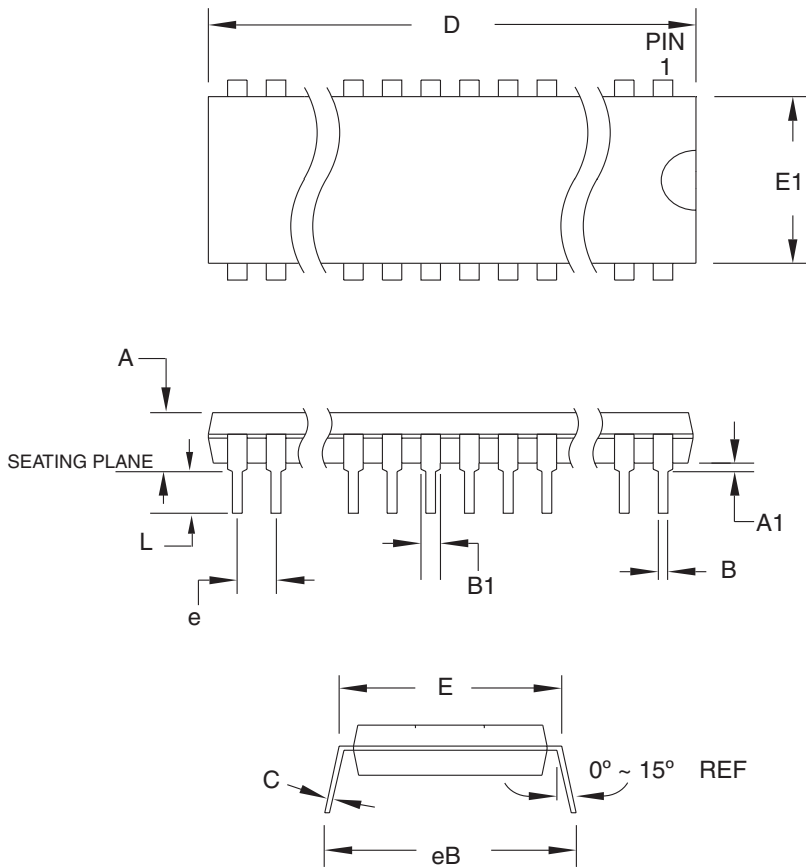
Note:  Not recommended for new designs. Use Green package option.

### 19.2 Green Package (Pb/Halide-free)

$t_{Acc}$ (ns)	$I_{CC}$ (mA)		Ordering Code	Package	Operation Range
	Active	Standby			
55	25	0.1	AT27C020-55JU	32J	Industrial (-40° C to 85° C)
			AT27C020-55PU	32P6	
			AT27C020-55TU	32T	
90	25	0.1	AT27C020-90JU	32J	Industrial (-40° C to 85° C)
			AT27C020-90PU	32P6	
			AT27C020-90TU	32T	

Package Type	
<b>32J</b>	32-lead, Plastic J-leaded Chip Carrier (PLCC)
<b>32P6</b>	32-lead, 0.600" Wide, Plastic Dual Inline Package (PDIP)
<b>32T</b>	32-lead, Plastic Thin Small Outline Package (TSOP)

## 20.2 32P6 – PDIP



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

SYMBOL	MIN	NOM	MAX	NOTE
A	–	–	4.826	
A1	0.381	–	–	
D	41.783	–	42.291	Note 1
E	15.240	–	15.875	
E1	13.462	–	13.970	Note 1
B	0.356	–	0.559	
B1	1.041	–	1.651	
L	3.048	–	3.556	
C	0.203	–	0.381	
eB	15.494	–	17.526	
e	2.540 TYP			

Note: 1. Dimensions D and E1 do not include mold Flash or Protrusion.  
Mold Flash or Protrusion shall not exceed 0.25 mm (0.010").



2325 Orchard Parkway  
San Jose, CA 95131

**TITLE**

**32P6**, 32-lead (0.600"/15.24 mm Wide) Plastic Dual  
Inline Package (PDIP)

**DRAWING NO.**

32P6

**REV.**

B