

## Features

- 8-Bit Multiplexed Addresses/Outputs
- Fast Read Access Time - 70 ns
- Low Power CMOS Operation
  - 20 mA max. Active at 5 MHz
- 20-Lead TSSOP Package
- 20-Lead SOIC Package
- 28-Lead TSOP Package
- 5V  $\pm$  10% Supply
- High Reliability CMOS Technology
  - 2,000V ESD Protection
  - 200 mA Latchup Immunity
- Rapid™ Programming Algorithm - 50  $\mu$ s/byte (typical)
- CMOS and TTL Compatible Inputs and Outputs
- Integrated Product Identification Code
- Commercial and Industrial Temperature Range

## Description

The AT27C520 is a low-power, high performance 524,288 bit one-time programmable read only memory (OTP EPROM) organized 64K by 8 bits. It incorporates latches for the 8 lower order address bits to multiplex with the 8 data bits. This minimizes system chip count, reduces cost, and simplifies the design of multiplexed bus systems. It requires only one 5V power supply in normal read mode operation. Any byte can be accessed in less than 70 ns, eliminating the need for speed reducing WAIT states on high performance microprocessor systems.

Atmel's scaled CMOS technology provides high speed, lower active power consumption, and significantly faster programming. Power consumption is typically only 8 mA in Active Mode.

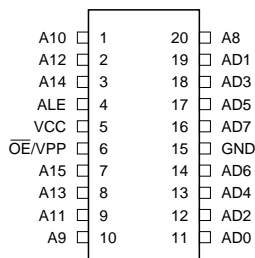
The AT27C520 is available in 173 mil, 20-pin TSSOP; 300 mil, 20-pin SOIC; and 28-pin TSOP, one-time programmable (OTP) plastic packages.

(continued)

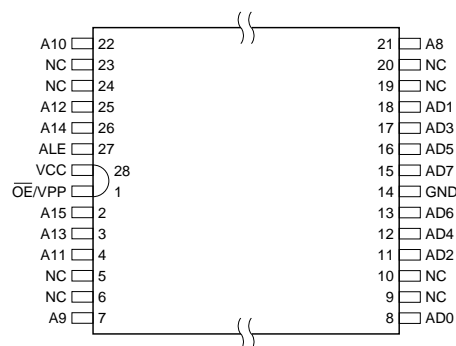
## Pin Configurations

Pin Name	Function
A8 - A15	Addresses
AD0 - AD7	Addresses/Outputs
$\overline{OE}/V_{PP}$	Output Enable/ $V_{PP}$
ALE	Address Latch Enable

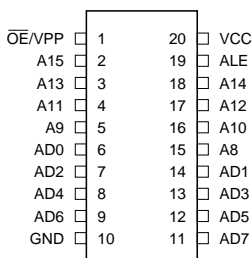
TSSOP Top View



TSOP Top View



SOIC Top View



Rev. 0752C-C-01/98



**512K (64K x 8)  
Multiplexed  
Addresses/  
Outputs  
OTP EPROM**

**AT27C520**



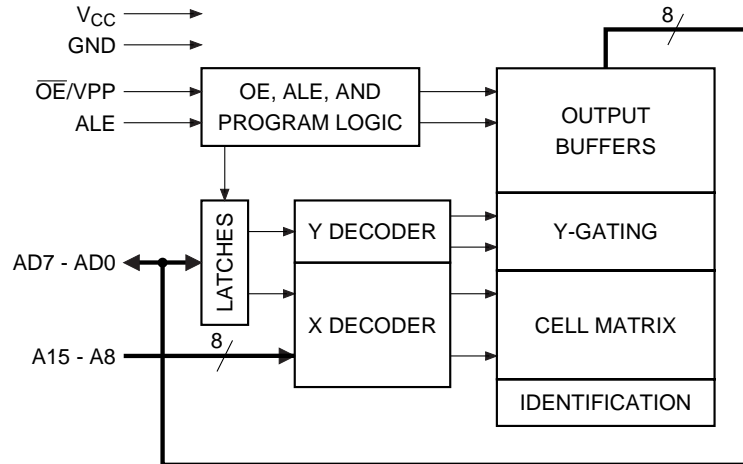
With 64K byte storage capability, the AT27C520 allows firmware to be stored reliably and to be accessed by the system without the delays of mass storage media.

Atmel's 27C520 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 50  $\mu$ 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.

## System Considerations

Switching under active conditions may produce transient voltage excursions. Unless accommodated by the system design, these transients may exceed data sheet limits, resulting in device non-conformance. At a minimum, a 0.1  $\mu$ 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  $\mu$ 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.

## Block Diagram



## 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 <sub>PP</sub> 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<sub>CC</sub> + 0.75V DC which may overshoot to +7.0V for pulses of less than 20 ns.

## Operating Modes

Mode/Pin	ALE	$\overline{OE}/V_{PP}$	A8 - A15	AD0 - AD7
Read	V <sub>IL</sub>	V <sub>IL</sub>	Ai	D <sub>OUT</sub>
Output Disable	V <sub>IL</sub> /V <sub>IH</sub>	V <sub>IH</sub>	X <sup>(1)</sup>	High Z/A0 - A7
Address Latch Enable	V <sub>IH</sub>	V <sub>IH</sub>	X	A0 - A7
Rapid Program <sup>(2)</sup>	V <sub>IH</sub>	V <sub>PP</sub>	Ai	D <sub>IN</sub>
Product Identification <sup>(3)</sup>	V <sub>IL</sub>	V <sub>IL</sub>	A9 = V <sub>H</sub> <sup>(4)</sup> A8 = V <sub>IH</sub> or V <sub>IL</sub> A10 - A15 = V <sub>IL</sub>	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 A8 - A15 inputs are held low (V<sub>IL</sub>), except A9 which is set to V<sub>H</sub> and A8 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.

## DC and AC Operating Conditions for Read Operation

		AT27C520	
		-70	-90
Operating Temp.(Case)	Com.	0°C - 70°C	0°C - 70°C
	Ind.	-40°C - 85°C	-40°C - 85°C
V <sub>CC</sub> Supply		5V ± 10%	5V ± 10%

## 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>		±1	μA
I <sub>LI2</sub> <sup>(1)</sup>	Input Load Current A13	V <sub>IN</sub> = 0V to V <sub>CC</sub>		±100	μA
I <sub>LO</sub>	Output Leakage Current	V <sub>OUT</sub> = 0V to V <sub>CC</sub>		±5	μA
I <sub>CC</sub>	V <sub>CC</sub> Active Current	f = 5 MHz, I <sub>OUT</sub> = 0 mA		20	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

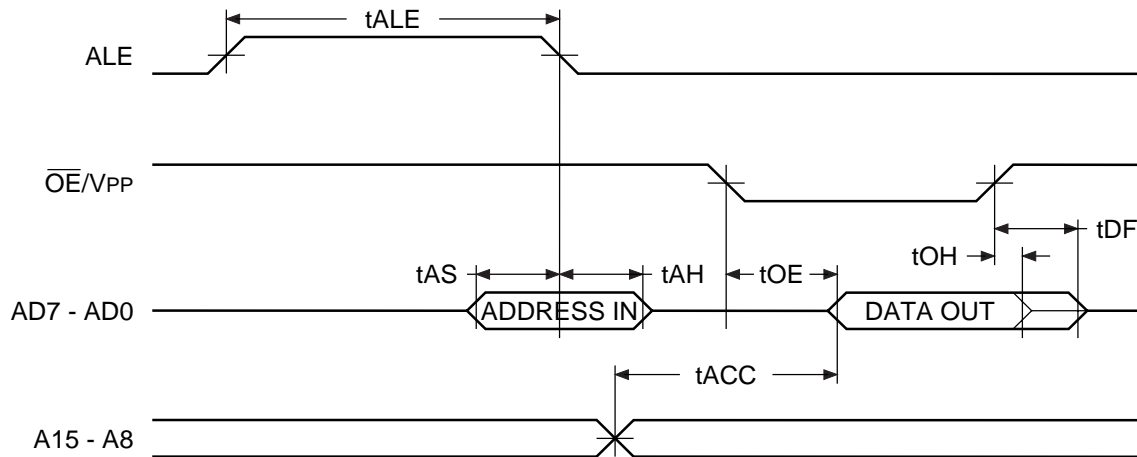
Note: 1. For address input A13 only.

## AC Characteristics for Read Operation

Symbol	Parameter	Condition	AT27C520				Units
			-70		-90		
			Min	Max	Min	Max	
t <sub>ACC</sub> <sup>(2)</sup>	Address to Output Delay	ALE = $\overline{OE}/V_{PP} = V_{IL}$		70		90	ns
t <sub>AS</sub>	Address Setup Time	$\overline{OE}/V_{PP} = V_{IH}$	12		15		ns
t <sub>AH</sub>	Address Hold Time	$\overline{OE}/V_{PP} = V_{IH}$	12		15		ns
t <sub>ALE</sub>	Address Latch Enable Width	$\overline{OE}/V_{PP} = V_{IH}$	40		45		ns
t <sub>OE</sub> <sup>(2)</sup>	$\overline{OE}/V_{PP}$ to Output Delay	ALE = V <sub>IL</sub>		30		35	ns
t <sub>DF</sub> <sup>(3)(4)</sup>	$\overline{OE}/V_{PP}$ High to Output Float	ALE = V <sub>IL</sub>		25		25	ns
t <sub>OH</sub>	Output Hold from Address or $\overline{OE}/V_{PP}$ , whichever occurred first	ALE = V <sub>IL</sub>	7		0		ns

Notes: 1. 2, 3, 4 — see AC Waveforms for Read Operation

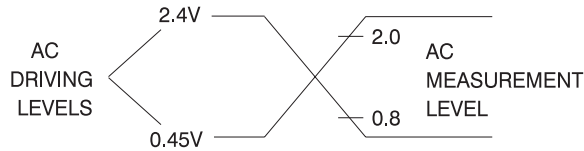
## AC Waveforms for Read Operation<sup>(1)</sup>



- Notes:
1. Timing measurement reference levels for all speed grades are  $V_{OL} = 0.8V$  and  $V_{OH} = 2.0V$ . Input AC drive levels are  $V_{IL} = 0.45V$  and  $V_{IH} = 2.4V$ .
  2.  $\overline{OE}/V_{PP}$  may be delayed up to  $t_{ACC} - t_{OE}$  after the address is valid without impact on  $t_{ACC}$ .
  3. This parameter is only sampled and is not 100% tested.
  4. Output float is defined as the point when data is no longer driven.

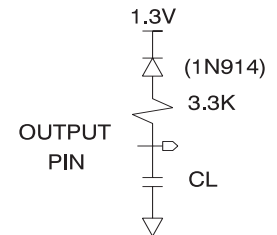
## Input Test Waveforms and Measurement Levels

For -70 and -90 devices:



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

## Output Test Load



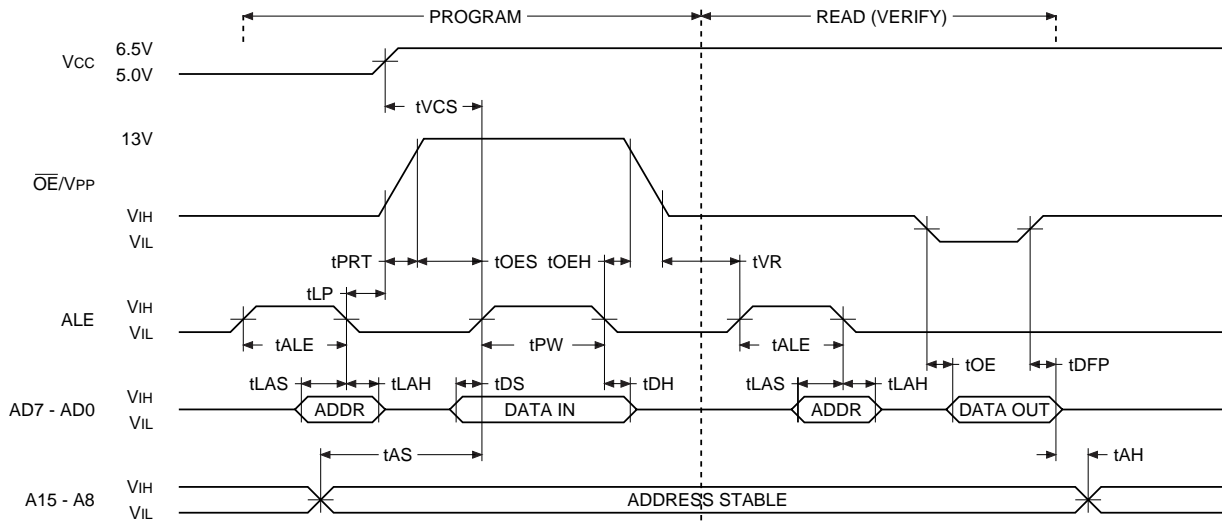
Note:  $C_L = 100 \text{ pF}$  including jig capacitance.

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

	Typ	Max	Units	Conditions
$C_{IN}$	4	6	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.

## Programming Waveforms



- Notes:
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.

## DC Programming Characteristics

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

Symbol	Parameter	Test Conditions	Limits		Units
			Min	Max	
$I_{LI}$	Input Load Current	$V_{IN} = V_{IL}, V_{IH}$		$\pm 10$	$\mu\text{A}$
$I_{LI2}^{(1)}$	Input Load Current A13	$V_{IN} = V_{IL}, V_{IH}$		$\pm 100$	$\mu\text{A}$
$V_{IL}$	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)			25	mA
$I_{PP2}$	$\overline{OE}/V_{PP}$ Current	$\text{ALE} = V_{IH}$		25	mA

Note: 1. For address input A13 only.

## AC Programming Characteristics

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

Symbol	Parameter <sup>(1)</sup>	Test Conditions	Limits		Units
			Min	Max	
$t_{ALE}$	Address Latch Enable Width	Input Rise and Fall Times (10% to 90%) 20 ns	500		ns
$t_{LAS}$	Latched Address Setup Time		100		ns
$t_{LAH}$	Latched Address Hold Time		100		ns
$t_{LP}$	ALE Low to $\overline{OE}/V_{PP}$ High Voltage Delay		2		$\mu\text{s}$
$t_{OES}$	$\overline{OE}/V_{PP}$ Setup Time		2		$\mu\text{s}$
$t_{OEH}$	$\overline{OE}/V_{PP}$ Hold Time		2		$\mu\text{s}$
$t_{DS}$	Data Setup Time	Input Pulse Levels 0.45V to 2.4V	2		$\mu\text{s}$
$t_{DH}$	Data Hold Time		2		$\mu\text{s}$
$t_{PW}$	ALE Program Pulse Width <sup>(2)</sup>	Input Timing Reference Level 0.8V to 2.0V	47.5	52.5	$\mu\text{s}$
$t_{VR}$	$\overline{OE}/V_{PP}$ Recovery Time	Output Timing Reference Level 0.8V to 2.0V	2		$\mu\text{s}$
$t_{VCS}$	$V_{CC}$ Setup Time		2		$\mu\text{s}$
$t_{OE}$	Data Valid from $\overline{OE}/V_{PP}$			150	ns
$t_{DFP}$	$\overline{OE}/V_{PP}$ High to Output Float Delay <sup>(3)</sup>		0	130	ns
$t_{AS}$	Address Setup Time		2		$\mu\text{s}$
$t_{AH}$	Address Hold Time		0		$\mu\text{s}$
$t_{PRT}$	$\overline{OE}/V_{PP}$ Pulse Rise Time During Programming		50		ns

- Notes:
- $V_{CC}$  must be applied simultaneously or before  $\overline{OE}/V_{PP}$  and removed simultaneously or after  $\overline{OE}/V_{PP}$
  - Program Pulse width tolerance is  $50 \mu\text{sec} \pm 5\%$ .
  - 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.

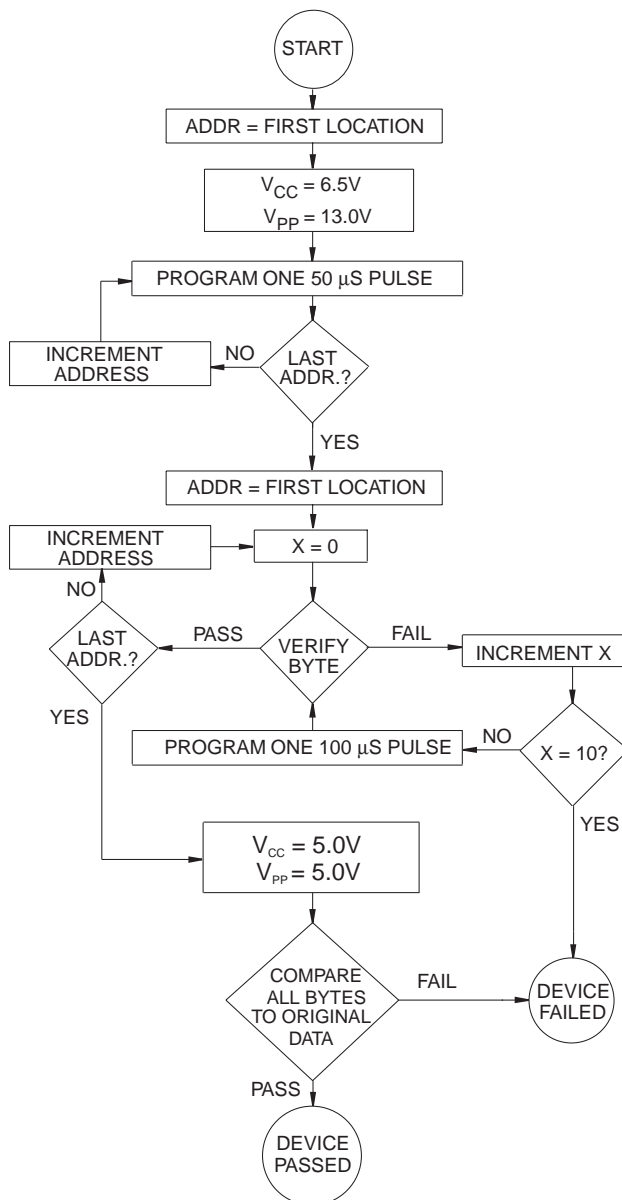
## Atmel's 27C520 Integrated Product Identification Code

Codes	Pins									Hex Data
	A8	AD7	AD6	AD5	AD4	AD3	AD2	AD1	AD0	
Manufacturer	0	0	0	0	1	1	1	1	0	1E
Device Type	1	1	0	0	1	1	1	0	1	9D

## Rapid™ Programming Algorithm

A 50  $\mu$ s ALE pulse width is used to program. The address is set to the first location.  $V_{CC}$  is raised to 6.5V and  $\overline{OE}/V_{PP}$  is raised to 13.0V. Each address is first programmed with one 50  $\mu$ s ALE pulse without verification. Then a verification/reprogramming loop is executed for each address. In the event a byte fails to pass verification, up to 10 successive 50  $\mu$ s pulses are applied with a verification after each

pulse. If the byte fails to verify after 10 pulses have been applied, the part is considered failed. After the byte verifies properly, the next address is selected until all have been checked.  $\overline{OE}/V_{PP}$  is then lowered to  $V_{IH}$  and  $V_{CC}$  to 5.0V. All bytes are read again and compared with the original data to determine if the device passes or fails.





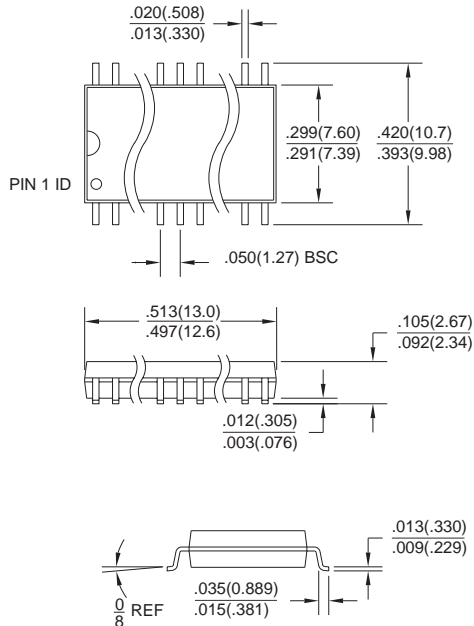
## Ordering Information

$t_{ACC}$ (ns)	$I_{CC}$ (mA) Active	Ordering Code	Package	Operation Range
70	20	AT27C520-70SC	20S	Commercial (0°C to 70°C)
		AT27C520-70TC	28T	
		AT27C520-70XC	20X	
		AT27C520-70SI	20S	Industrial (-40°C to 85°C)
		AT27C520-70TI	28T	
		AT27C520-70XI	20X	
90	20	AT27C520-90SC	20S	Commercial (0°C to 70°C)
		AT27C520-90TC	28T	
		AT27C520-90XC	20X	
		AT27C520-90SI	20S	Industrial (-40°C to 85°C)
		AT27C520-90TI	28T	
		AT27C520-90XI	20X	

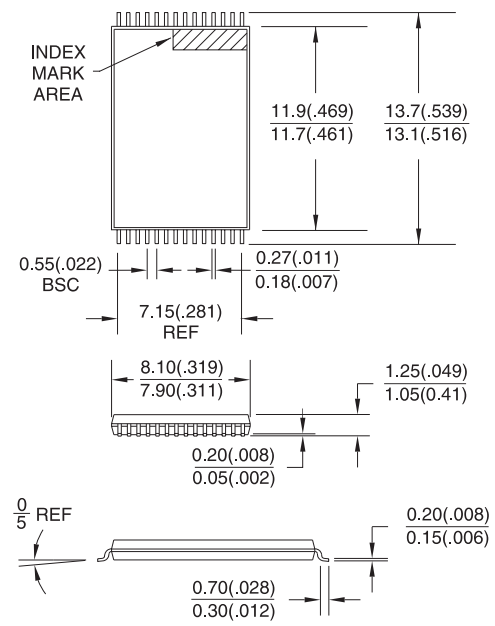
Package Type	
<b>20S</b>	20-Lead, 0.300" Wide, Plastic Gull-Wing Small Outline (SOIC)
<b>28T</b>	28-Lead, Thin Small Outline Package (TSOP)
<b>20X</b>	20-Lead, 0.173" Wide, Thin Shrink Small Outline (TSSOP)

## Packaging Information

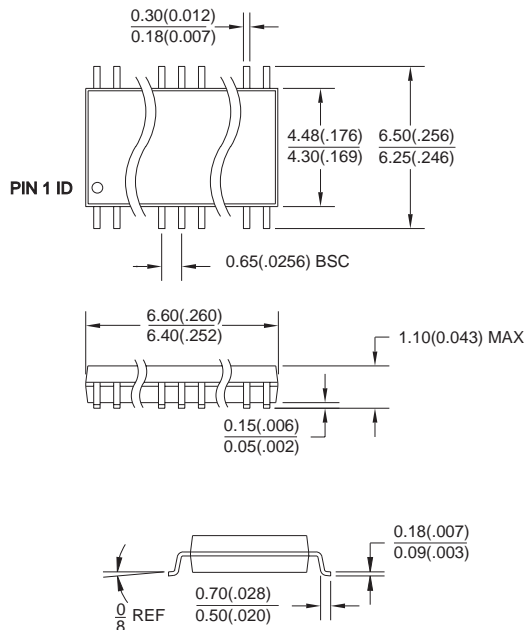
**20S**, 20-Lead, 0.300" Wide,  
Plastic Gull Wing Small Outline  
Dimensions in Inches and (Millimeters)



**28T**, 28-Lead, Plastic Thin Small Outline Package  
(TSOP)  
Dimensions in Millimeters and (Inches)



**20X**, 20-Lead, 0.173" Wide, Thin Super Small Outline  
Package (TSSOP)  
Dimensions in (Millimeters) and Inches



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