Features

- **EE Programmable 262,144 x 1-, 524,288 x 1-, 1,048,576 x 1-, 2,097,152 x 1-, and 4,194,304 x 1-bit Serial Memories Designed to Store Configuration Programs for Field Programmable Gate Arrays (FPGAs)**
- **Available as a 3.3V (±10%) Commercial and Industrial Version**
- **Simple Interface to SRAM FPGAs**
- **Pin Compatible with Xilinx® XC17SXXXA and XC17SXXXXL PROMs**
- **Compatible with Xilinx Spartan®-II, Spartan-IIE and Spartan XL FPGAs in Master Serial Mode**
- **Very Low-power CMOS EEPROM Process**
- **Available in 6 mm x 6 mm x 1 mm 8-lead LAP (Pin-compatible with 8-lead SOIC/VOIC Packages), 8-lead PDIP, 8-lead SOIC, 20-lead SOIC and 44-lead TQFP Packages for a Specific Density**
- **Low-power Standby Mode**
- **High-reliability**
  - **Endurance: Minimum 10 Write Cycles**
  - **Data Retention: 20 Years at 85°C**

Description

The AT17N series FPGA Configuration EEPROM (Configurators) provide an easy-to-use, cost-effective configuration memory for Field Programmable Gate Arrays. The AT17N series device is packaged in the 8-lead LAP, 8-lead PDIP, 8-lead SOIC, 20-lead SOIC and 44-lead TQFP, see Table 1. The AT17N series Configurators uses a simple serial-access procedure to configure one or more FPGA devices.

The AT17N series configurators can be programmed with industry-standard programmers, Atmel's ATDH2200E Programming Kit or Atmel's ATDH2225 ISP Cable and factory programming.

Table 1. AT17N Series Packages

Package	AT17N256	AT17N512/ AT17N010	AT17N002	AT17N040
8-lead LAP	–	Yes	Yes	–
8-lead PDIP	Yes	Yes	–	–
8-lead SOIC	Yes	Use 8-lead LAP(1)	Use 8-lead LAP(1)	–
20-lead SOIC	Yes	Yes	Yes	–
44-lead TQFP	–	–	Yes	Yes

Note: 1. The 8-lead LAP package has the same footprint as the 8-lead SOIC. Since an 8-lead SOIC package is not available for the AT17N512/010/002 devices, it is possible to use an 8-lead LAP package instead.

FPGA Configuration Memory

AT17N256
AT17N512
AT17N010
AT17N002
AT17N040

3.3V System Support

Rev. 3020A–CNFG–05/03

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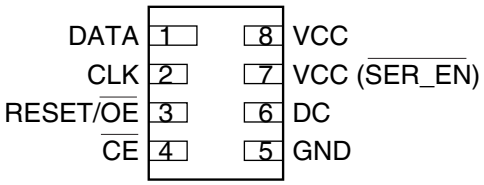
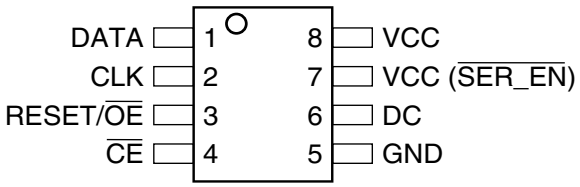
Pin Configuration

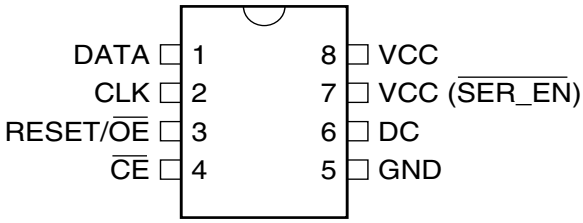
8-lead LAP



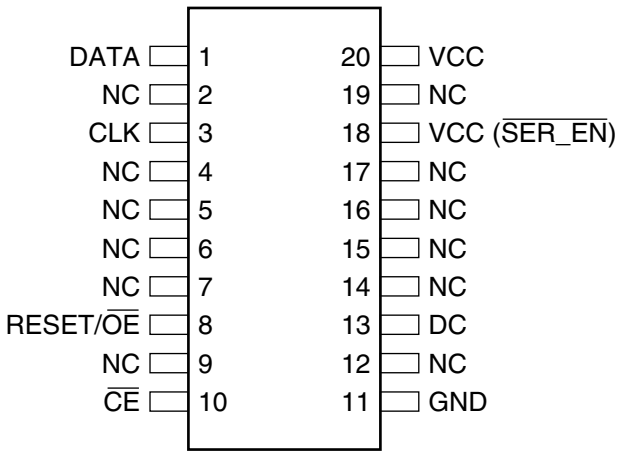
8-lead SOIC



8-lead PDIP



20-lead SOIC



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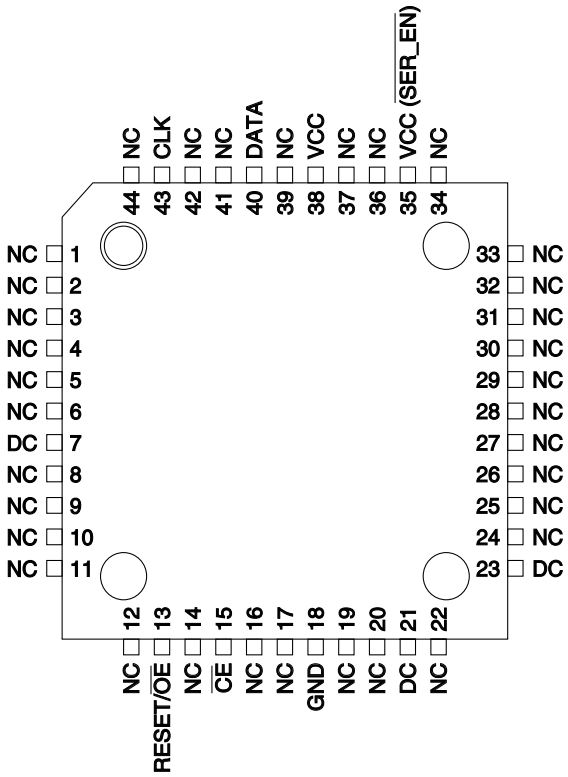
44 TQFP



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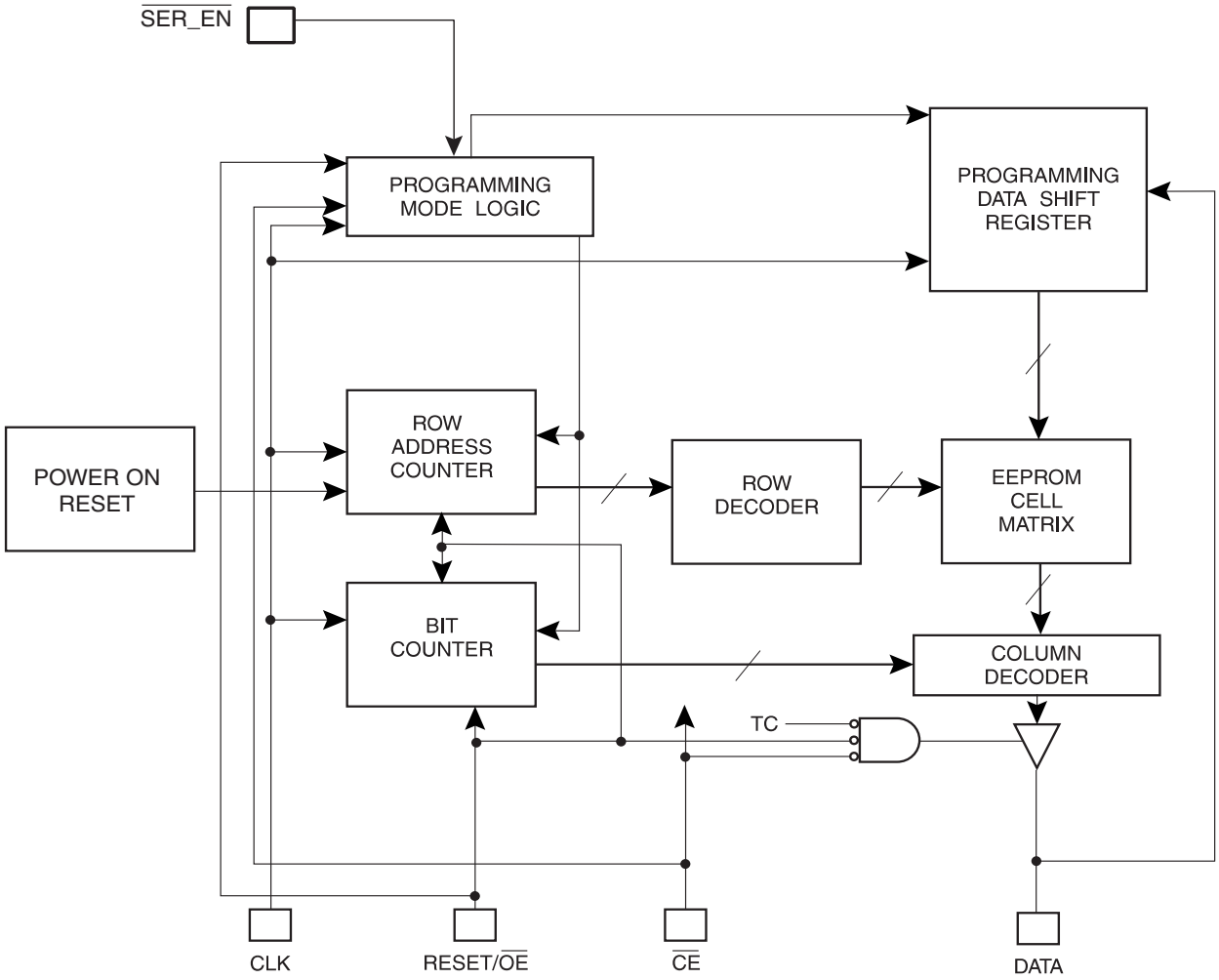
Block Diagram



Device Description

The control signals for the configuration EEPROM ($\overline{CE}$, RESET/$\overline{OE}$ and CCLK) interface directly with the FPGA device control signals. All FPGA devices can control the entire configuration process and retrieve data from the configuration EEPROM without requiring an external intelligent controller.

The configuration EEPROM RESET/$\overline{OE}$ and $\overline{CE}$ pins control the tri-state buffer on the DATA output pin and enable the address counter. When RESET/$\overline{OE}$ is driven High, the configuration EEPROM resets its address counter and tri-states its DATA pin. The $\overline{CE}$ pin also controls the output of the AT17N series configurator. If $\overline{CE}$ is held High after the RESET/$\overline{OE}$ reset pulse, the counter is disabled and the DATA output pin is tri-stated. When $\overline{OE}$ is subsequently driven Low, the counter and the DATA output pin are enabled. When RESET/$\overline{OE}$ is driven High again, the address counter is reset and the DATA output pin is tri-stated, regardless of the state of $\overline{CE}$. Upon power-up, the address counter is automatically reset.

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Pin Description

Name	I/O	AT17N256		AT17N512/ AT17N010		AT17N002			AT17N040
		8 DIP/ SOIC	20 SOIC	8 DIP/ LAP	20 SOIC	8 LAP	20 SOIC	44 TQFP	44 TQFP
DATA	I/O	1	1	1	1	1	1	40	40
CLK	I	2	3	2	3	2	3	43	43
RESET/$\overline{OE}$	I	3	8	3	8	3	8	13	13
$\overline{CE}$	I	4	10	4	10	4	10	15	15
GND		5	11	5	11	5	11	18	18
DC	O	6	13	6	13	6	13	21	21
DC	O	–	–	–	–	–	–	23	23
VCC($\overline{SER\_EN}$)	I	7	18	7	18	7	18	35	35
V_{CC}		8	20	8	20	8	20	38	38

DATA Three-state DATA output for configuration. Open-collector bi-directional pin for programming.

CLK Clock input. Used to increment the internal address and bit counter for reading and programming.

RESET/$\overline{OE}$ Output Enable (active High) and RESET (active Low) when $\overline{SER\_EN}$ is High. A Low level on $\overline{RESET}$/OE resets both the address and bit counters. A High level (with $\overline{CE}$ Low) enables the data output driver. The logic polarity of this input is programmable as either RESET/$\overline{OE}$ or $\overline{RESET}$/OE. For most applications, RESET should be programmed active Low. This document describes the pin as $\overline{RESET}$/OE.

$\overline{CE}$ Chip Enable input (active Low). A Low level (with OE High) allows CLK to increment the address counter and enables the data output driver. A High level on $\overline{CE}$ disables both the address and bit counters and forces the device into a low-power standby mode. Note that this pin will *not* enable/disable the device in the Two-Wire Serial Programming mode ($\overline{SER\_EN}$ Low).

GND Ground pin. A 0.2 µF decoupling capacitor between V_{CC} and GND is recommended.

VCC($\overline{SER\_EN}$) Serial enable must be held High during FPGA loading operations. Bringing $\overline{SER\_EN}$ Low enables the Two-Wire Serial Programming Mode. For non-ISP applications, $\overline{SER\_EN}$ should be tied to V_{CC}.

V_{CC} 3.3V (±10%) Commercial and Industrial power supply pin.

NC NC pins are No Connect pins, which are not internally bonded out to the die.

DC DC pins are No Connect pins internally connected to the die. It is not recommended to connect these pins to any external signal.

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FPGA Master Serial Mode Summary

The I/O and logic functions of any SRAM-based FPGA are established by a configuration program. The program is loaded either automatically upon power-up, or on command, depending on the state of the FPGA mode pins. In Master mode, the FPGA automatically loads the configuration program from an external memory. The AT17N Serial Configuration EEPROM has been designed for compatibility with the Master Serial mode.

This document discusses the master serial mode configuration of Atmel AT17N series configuration memories, pin compatible with Spartan-II, Spartan-IIE and Spartan XL OTP PROMs.

Control of Configuration

Most connections between the FPGA device and the AT17N Serial EEPROM are simple and self-explanatory.

- The DATA output of the AT17N series configurator drives DIN of the FPGA devices.
- The master FPGA CCLK output drives the CLK input of the AT17N series configurator.
- $\overline{\text{SER\_EN}}$ must be connected to V_{CC} (except during ISP).
- The $\overline{\text{CE}}$ and OE/$\overline{\text{Reset}}$ are driven by the FPGA to enable output data buffer of the EEPROM.

Programming Mode

The programming mode is entered by bringing $\overline{\text{SER\_EN}}$ Low. In this mode the chip can be programmed by the Two-Wire serial bus. The programming is done at V_{CC} supply only. Programming super voltages are generated inside the chip.

Standby Mode

The AT17N series configurators enter a low-power standby mode whenever $\overline{\text{CE}}$ is asserted High. In this mode, the AT17N256 configurator consumes less than 50 µA of current at 3.3V (100 µA for the AT17N512/010 and 200 µA for the AT17N002/040).

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Absolute Maximum Ratings*

Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +150°C
Voltage on Any Pin with Respect to Ground	-0.1V to V_{CC} +0.5V
Supply Voltage (V_{CC})	3.0V to +3.6V
Maximum Soldering Temp. (10 sec. @ 1/16 in.)	260°C
ESD (R_{ZAP} = 1.5K, C_{ZAP} = 100 pF)	2000V

*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 listed under operating conditions is not implied. Exposure to Absolute Maximum Rating conditions for extended periods of time may affect device reliability.

Operating Conditions

Symbol	Description		3.3V Min	3.3V Max	Units
V_{CC}	Commercial	Supply voltage relative to GND -0°C to +70°C	3.0	3.6	V
	Industrial	Supply voltage relative to GND -40°C to +85°C	3.0	3.6	V

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DC Characteristics

V_{CC} = 3.3V ± 10%

Symbol	Description		AT17N256 Min	AT17N256 Max	AT17N512/ AT17N010 Min	AT17N512/ AT17N010 Max	AT17N002/ AT17N040 Min	AT17N002/ AT17N040 Max	Units
V_{IH}	High-level Input Voltage		2.0	V_{CC}	2.0	V_{CC}	2.0	V_{CC}	V
V_{IL}	Low-level Input Voltage		0	0.8	0	0.8	0	0.8	V
V_{OH}	High-level Output Voltage (I_{OH} = -2.5 mA)		2.4		2.4		2.4		V
V_{OL}	Low-level Output Voltage (I_{OL} = +3 mA)	Commercial		0.4		0.4		0.4	V
V_{OH}	High-level Output Voltage (I_{OH} = -2 mA)		2.4		2.4		2.4		V
V_{OL}	Low-level Output Voltage (I_{OL} = +3 mA)	Industrial		0.4		0.4		0.4	V
I_{CCA}	Supply Current, Active Mode			5		5		5	mA
I_L	Input or Output Leakage Current (V_{IN} = V_{CC} or GND)		-10	10	-10	10	-10	10	µA
I_{CCS}	Supply Current, Standby Mode	Commercial		50		100		150	µA
		Industrial		100		100		150	µA

AC Characteristics

V_{CC} = 3.3V ± 10%

Symbol	Description	AT17N256 Commercial Min	AT17N256 Commercial Max	AT17N256 Industrial Min	AT17N256 Industrial Max	AT17N512/010/002/040 Commercial Min	AT17N512/010/002/040 Commercial Max	AT17N512/010/002/040 Industrial Min	AT17N512/010/002/040 Industrial Max	Units
T_{OE}[1]	OE to Data Delay		50		55		50		55	ns
T_{CE}[1]	$\overline{CE}$ to Data Delay		60		60		55		60	ns
T_{CAC}[1]	CLK to Data Delay		75		80		55		60	ns
T_{OH}	Data Hold from $\overline{CE}$, OE, or CLK	0		0		0		0		ns
T_{DF}[2]	$\overline{CE}$ or OE to Data Float Delay		55		55		50		50	ns
T_{LC}	CLK Low Time	25		25		25		25		ns
T_{HC}	CLK High Time	25		25		25		25		ns
T_{SCE}	$\overline{CE}$ Setup Time to CLK (to guarantee proper counting)	35		60		30		35		ns
T_{HCE}	$\overline{CE}$ Hold Time from CLK (to guarantee proper counting)	0		0		0		0		ns
T_{HOE}	OE High Time (guarantees counter is reset)	25		25		25		25		ns
F_{MAX}	Maximum Clock Frequency		10		10		15		10	MHz

Notes: 1. AC test lead = 50 pF.
2. Float delays are measured with 5 pF AC loads. Transition is measured ± 200 mV from steady-state active levels.

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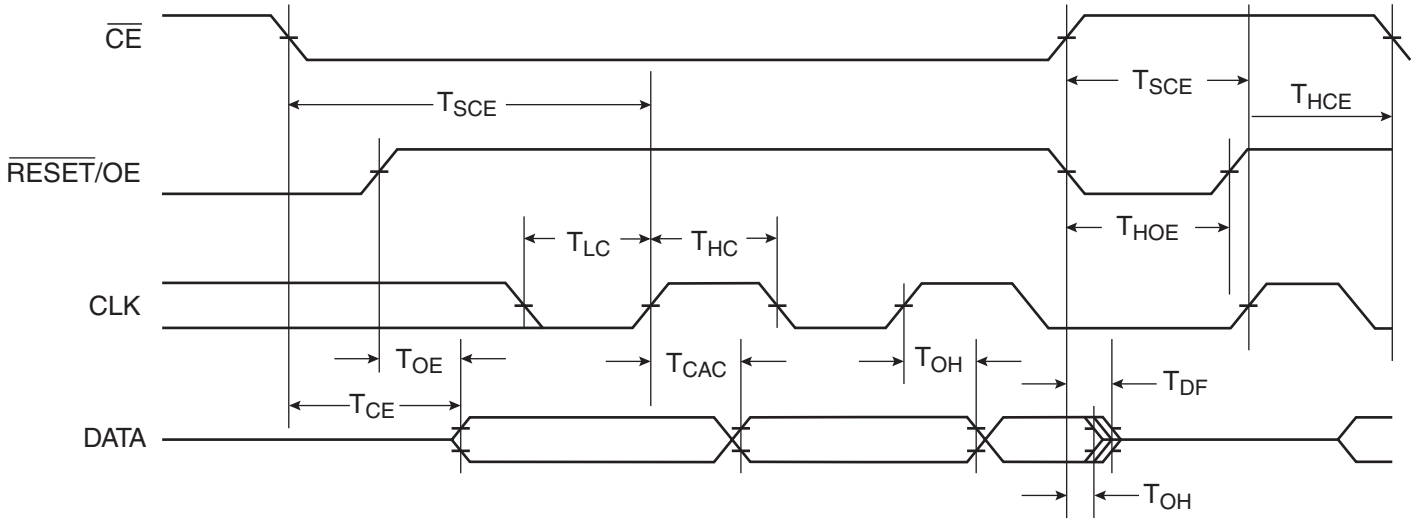
AC Characteristics



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Thermal Resistance Coefficients[1]

Package Type			AT17N256	AT17N512/ AT17N010	AT17N002	AT17N040
8CN4	Leadless Array Package (LAP)	θ_{JC} [°C/W]	–	45	45	–
		θ_{JA} [°C/W][2]	–	135.71	159.60	–
8P3	Plastic Dual Inline Package (PDIP)	θ_{JC} [°C/W]	37	37	–	–
		θ_{JA} [°C/W][2]	107	107	–	–
8S1	Plastic Gull Wing Small Outline (SOIC)	θ_{JC} [°C/W]	45	–	–	–
		θ_{JA} [°C/W][2]	150	–	–	–
20S2	Plastic Gull Wing Small Outline (SOIC)	θ_{JC} [°C/W]				–
		θ_{JA} [°C/W][2]				–
44A	Thin Plastic Quad Flat Package (TQFP)	θ_{JC} [°C/W]	–	–	17	17
		θ_{JA} [°C/W][2]	–	–	62	62

Notes: 1. For more information refer to the “Thermal Characteristics of Atmel’s Packages”, available on the Atmel web site.
2. Airflow = 0 ft/min.

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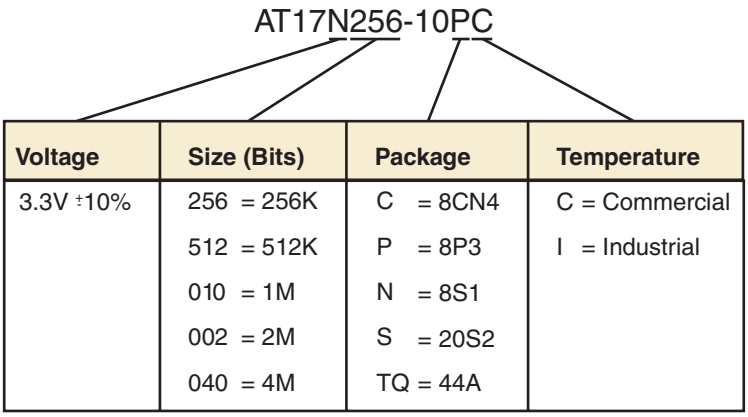
Figure 1. Ordering Code



Package Type	
8CN4	8-lead, 6 mm x 6 mm x 1 mm, Leadless Array Package (LAP) – Pin-compatible with 8-lead SOIC/VOID Packages
8P3	8-lead, 0.300" Wide, Plastic Dual Inline Package (PDIP)
8S1	8-lead, 0.150" Wide, Plastic Gull Wing Small Outline (JEDEC SOIC)
20S2	20-lead, 0.300" Wide, Plastic Gull Wing Small Outline (JEDEC SOIC)
44A	44-lead, Thin (1.0 mm) Plastic Quad Flat Package Carrier (TQFP)

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Ordering Information

Memory Size	Ordering Code	Package	Operation Range
256-Kbit	AT17N256-10PC AT17N256-10NC AT17N256-10SC	8P3 8S1 20S2	Commercial (0°C to 70°C)
	AT17N256-10PI AT17N256-10NI AT17N256-10SI	8P3 8S1 20S2	Industrial (-40°C to 85°C)
512-Kbit	AT17N512-10CC AT17N512-10PC AT17N512-10SC	8CN4 8P3 20S2	Commercial (0°C to 70°C)
	AT17N512-10CI AT17N512-10PI AT17N512-10SI	8CN4 8P3 20S2	Industrial (-40°C to 85°C)
1-Mbit	AT17N010-10CC AT17N010-10PC AT17N010-10SC	8CN4 8P3 20S2	Commercial (0°C to 70°C)
	AT17N010-10CI AT17N010-10PI AT17N010-10SI	8CN4 8P3 20S2	Industrial (-40°C to 85°C)
2-Mbit	AT17N002-10CC AT17N002-10SC AT17N002-10TQC	8CN4 20S2 44A	Commercial (0°C to 70°C)
	AT17N002-10CI AT17N002-10SI AT17N002-10TQI	8CN4 20S2 44A	Industrial (-40°C to 85°C)
4-Mbit	AT17N040-10TQC	44A	Commercial (0°C to 70°C)
	AT17N040-10TQI	44A	Industrial (-40°C to 85°C)

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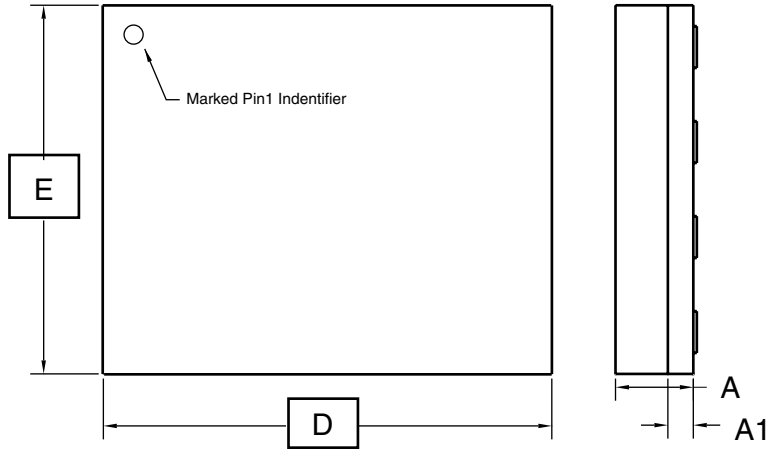
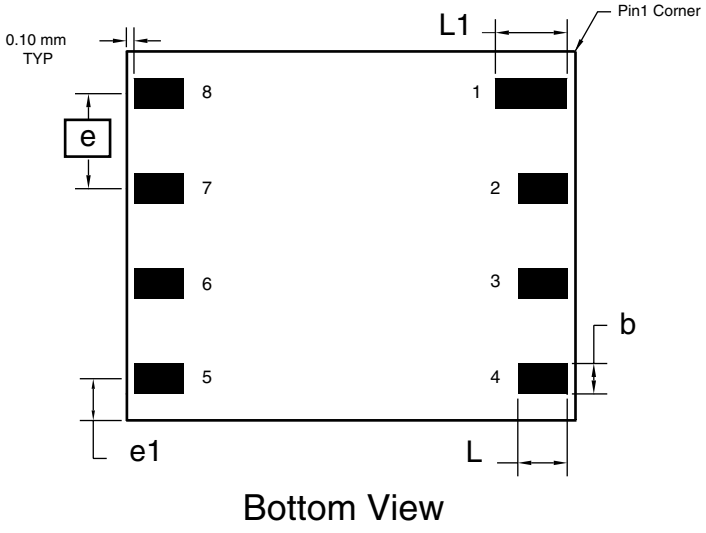
Packaging Information

8CN4 – LAP





COMMON DIMENSIONS
(Unit of Measure = mm)

SYMBOL	MIN	NOM	MAX	NOTE
A	0.94	1.04	1.14	
A1	0.30	0.34	0.38	
b	0.45	0.50	0.55	1
D	5.89	5.99	6.09	
E	4.89	5.99	6.09	
e		1.27 BSC		
e1		1.10 REF		
L	0.95	1.00	1.05	1
L1	1.25	1.30	1.35	1

Note: 1. Metal Pad Dimensions.

11/14/01

2325 Orchard Parkway San Jose, CA 95131	**TITLE** **8CN4**, 8-lead (6 x 6 x 1.04 mm Body), Lead Pitch 1.27 mm, Leadless Array Package (LAP)	**DRAWING NO.** 8CN4	**REV.** A

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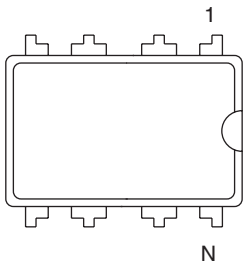
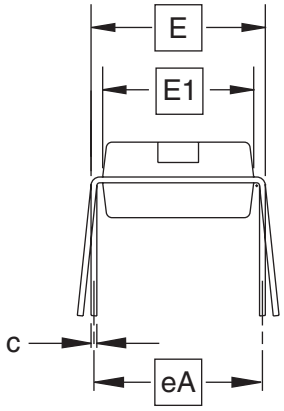
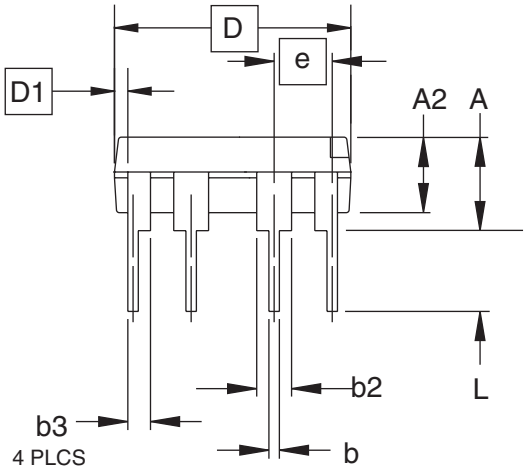
8P3 – PDIP



Top View



End View



Side View

COMMON DIMENSIONS
(Unit of Measure = inches)

SYMBOL	MIN	NOM	MAX	NOTE
A			0.210	2
A2	0.115	0.130	0.195	
b	0.014	0.018	0.022	5
b2	0.045	0.060	0.070	6
b3	0.030	0.039	0.045	6
c	0.008	0.010	0.014	
D	0.355	0.365	0.400	3
D1	0.005			3
E	0.300	0.310	0.325	4
E1	0.240	0.250	0.280	3
e	0.100 BSC			
eA	0.300 BSC			4
L	0.115	0.130	0.150	2

Notes:
1. This drawing is for general information only; refer to JEDEC Drawing MS-001, Variation BA for additional information.
2. Dimensions A and L are measured with the package seated in JEDEC seating plane Gauge GS-3.
3. D, D1 and E1 dimensions do not include mold Flash or protrusions. Mold Flash or protrusions shall not exceed 0.010 inch.
4. E and eA measured with the leads constrained to be perpendicular to datum.
5. Pointed or rounded lead tips are preferred to ease insertion.
6. b2 and b3 maximum dimensions do not include Dambar protrusions. Dambar protrusions shall not exceed 0.010 (0.25 mm).

01/09/02

	TITLE	DRAWING NO.	REV.
2325 Orchard Parkway San Jose, CA 95131	**8P3**, 8-lead, 0.300" Wide Body, Plastic Dual In-line Package (PDIP)	8P3	B

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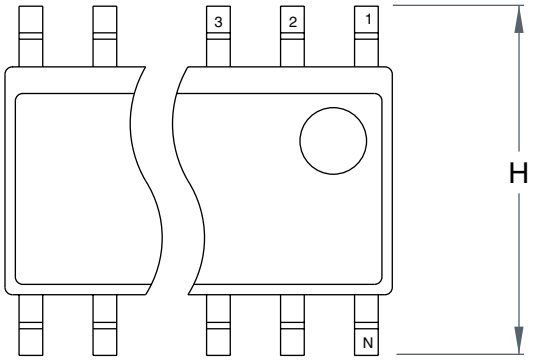
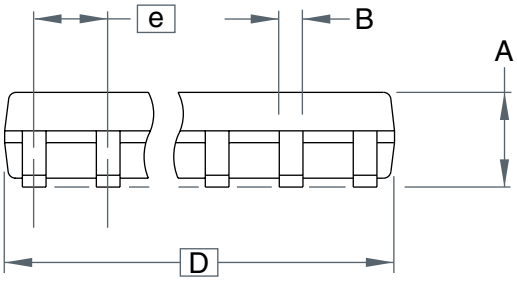
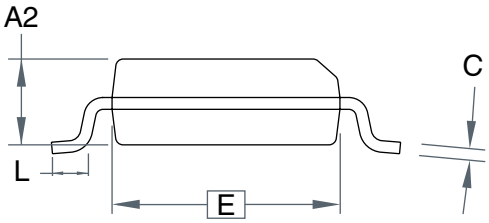
8S1 – SOIC



Top View



Side View



End View

COMMON DIMENSIONS
(Unit of Measure = mm)

SYMBOL	MIN	NOM	MAX	NOTE
A	–	–	1.75	
B	–	–	0.51	
C	–	–	0.25	
D	–	–	5.00	
E	–	–	4.00	
e		1.27 BSC		
H	–	–	6.20	
L	–	–	1.27	

Note: This drawing is for general information only. Refer to JEDEC Drawing MS-012 for proper dimensions, tolerances, datums, etc.

10/10/01

2325 Orchard Parkway San Jose, CA 95131	**TITLE** **8S1**, 8-lead (0.150" Wide Body), Plastic Gull Wing Small Outline (JEDEC SOIC)	**DRAWING NO.** 8S1	**REV.** A

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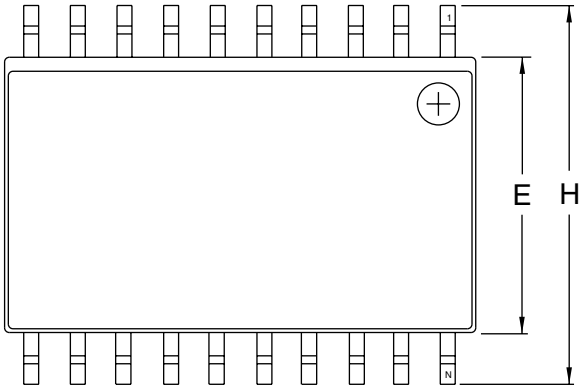
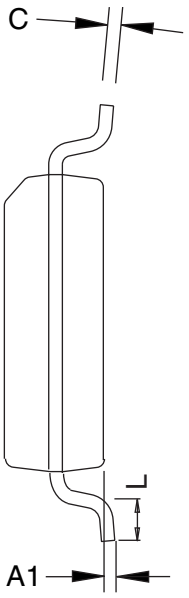
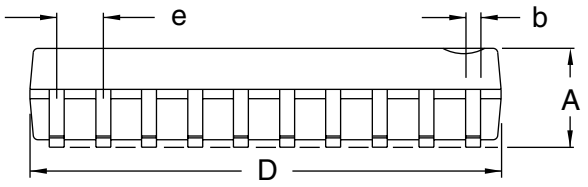
20S2 – SOIC



Top View



End View



Side View

COMMON DIMENSIONS
(Unit of Measure = inches)

SYMBOL	MIN	NOM	MAX	NOTE
A	0.0926		0.1043	
A1	0.0040		0.0118	
b	0.0130		0.0200	4
C	0.0091		0.0125	
D	0.4961		0.5118	1
E	0.2914		0.2992	2
H	0.3940		0.4190	
L	0.0160		0.050	3
e	0.050 BSC			

Notes:
1. This drawing is for general information only; refer to JEDEC Drawing MS-013, Variation AC for additional information.
2. Dimension "D" does not include mold Flash, protrusions or gate burrs. Mold Flash, protrusions and gate burrs shall not exceed 0.15 mm (0.006") per side.
3. Dimension "E" does not include inter-lead Flash or protrusion. Inter-lead Flash and protrusions shall not exceed 0.25 mm (0.010") per side.
4. "L" is the length of the terminal for soldering to a substrate.
5. The lead width "b", as measured 0.36 mm (0.014") or greater above the seating plane, shall not exceed a maximum value of 0.61 mm (0.024") per side.

1/9/02

	TITLE	DRAWING NO.	REV.
2325 Orchard Parkway San Jose, CA 95131	**20S2**, 20-lead, 0.300" Wide Body, Plastic Gull Wing Small Outline Package (SOIC)	20S2	A

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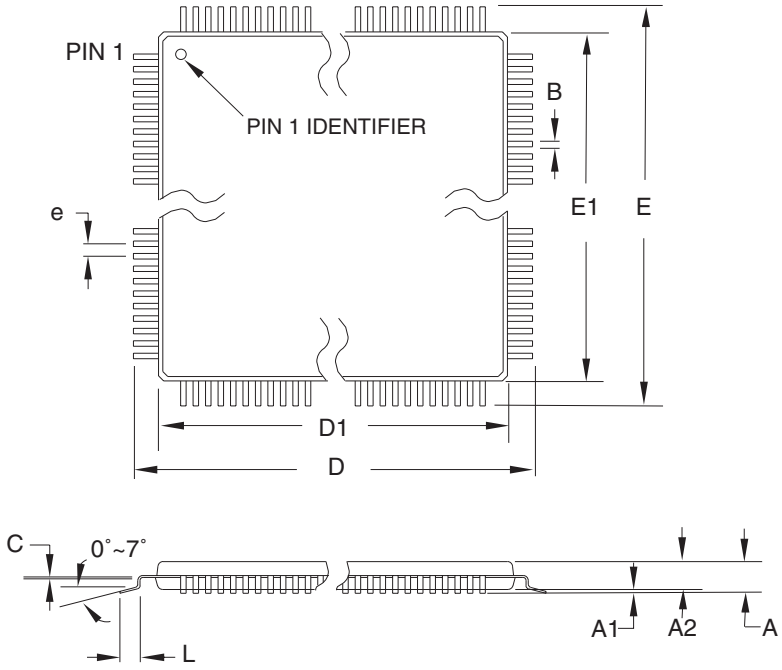
44A – TQFP



COMMON DIMENSIONS
(Unit of Measure = mm)

SYMBOL	MIN	NOM	MAX	NOTE
A	–	–	1.20	
A1	0.05	–	0.15	
A2	0.95	1.00	1.05	
D	11.75	12.00	12.25	
D1	9.90	10.00	10.10	Note 2
E	11.75	12.00	12.25	
E1	9.90	10.00	10.10	Note 2
B	0.30	–	0.45	
C	0.09	–	0.20	
L	0.45	–	0.75	
e	0.80 TYP			

Notes:
1. This package conforms to JEDEC reference MS-026, Variation ACB.
2. Dimensions D1 and E1 do not include mold protrusion. Allowable protrusion is 0.25 mm per side. Dimensions D1 and E1 are maximum plastic body size dimensions including mold mismatch.
3. Lead coplanarity is 0.10 mm maximum.

10/5/2001

	TITLE	DRAWING NO.	REV.
2325 Orchard Parkway San Jose, CA 95131	**44A,** 44-lead, 10 x 10 mm Body Size, 1.0 mm Body Thickness, 0.8 mm Lead Pitch, Thin Profile Plastic Quad Flat Package (TQFP)	44A	B

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