

Features

- Programmable 4,194,304 x 1 and 8,388,608 x 1-bit Serial Memories Designed to Store Configuration Programs for Field Programmable Gate Arrays (FPGAs)
- 3.3V Output Capability
- 5V Tolerant I/O Pins
- Program Support using the Atmel ATDH2200E System or Industry Third Party Programmers
- In-System Programmable (ISP) via 2-wire Bus
- Simple Interface to SRAM FPGAs
- Compatible with Atmel AT40K and AT94K Devices, Altera® FLEX®, APEX™ Devices, Lucent® ORCA® FPGAs, Xilinx® XC3000, XC4000, XC5200, Spartan®, Virtex™ FPGAs, Motorola® MPA1000 FPGAs
- Cascadable Read-back to Support Additional Configurations or Higher-density Arrays
- Low-power CMOS FLASH Process
- Available in 6 mm x 6 mm x 1 mm 8-lead LAP (Pin-compatible with 8-lead SOIC/VOIC Packages), 20-lead PLCC, 44-lead PLCC and 44-lead TQFP Packages
- Emulation of Atmel's AT24CXXX Serial EEPROMs
- Low-power Standby Mode
- Single Device Capable of Holding 4 Bit Stream Files Allowing Simple System Reconfiguration
- Fast Serial Download Speeds up to 33 MHz
- Endurance: 5,000 Write Cycles Typical
- LHF Package Available (Lead and Halide Free)

1. Description

The AT17F Series of In-System Programmable Configuration PROMs (Configurators) provide an easy-to-use, cost-effective configuration memory for Field Programmable Gate Arrays. The AT17F Series device is packaged in the 8-lead LAP, 20-lead PLCC, 44-lead PLCC and 44-lead TQFP, see [Table 1-1](#). The AT17F Series Configurator uses a simple serial-access procedure to configure one or more FPGA devices.

The AT17F Series Configurators can be programmed with industry-standard programmers, Atmel's ATDH2200E Programming Kit or Atmel's ATDH2225 ISP Cable.

Table 1-1. AT17F Series Packages

Package	AT17F040	AT17F080
8-lead LAP	Yes	Yes
20-lead PLCC	Yes	Yes
44-lead PLCC	–	Yes
44-lead TQFP	–	Yes



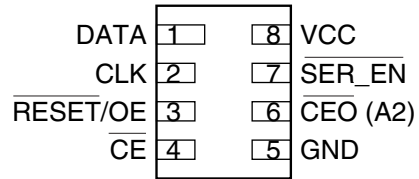
FPGA Configuration Flash Memory

AT17F040
AT17F080

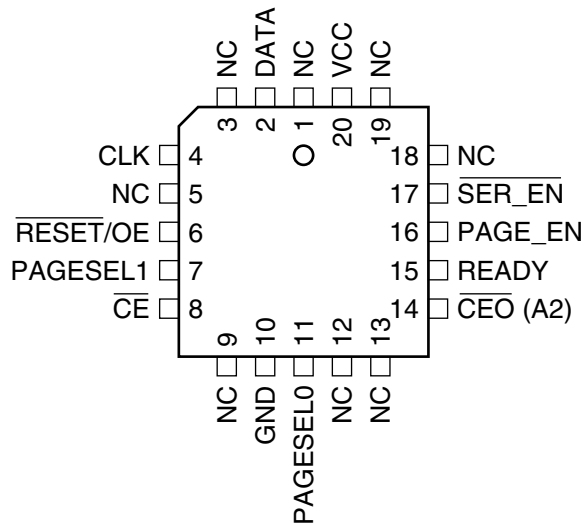


2. Pin Configuration

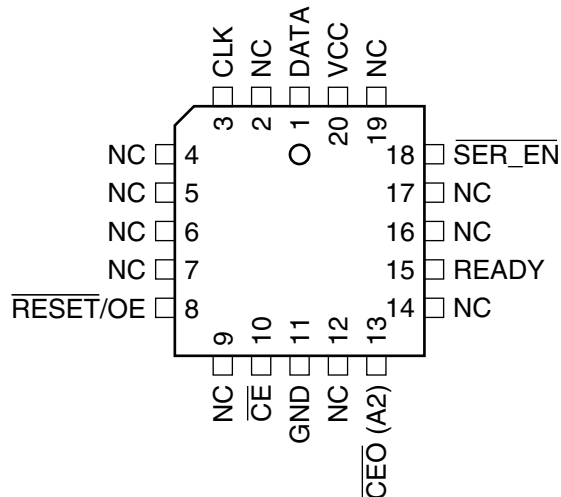
8-lead LAP



20-lead PLCC

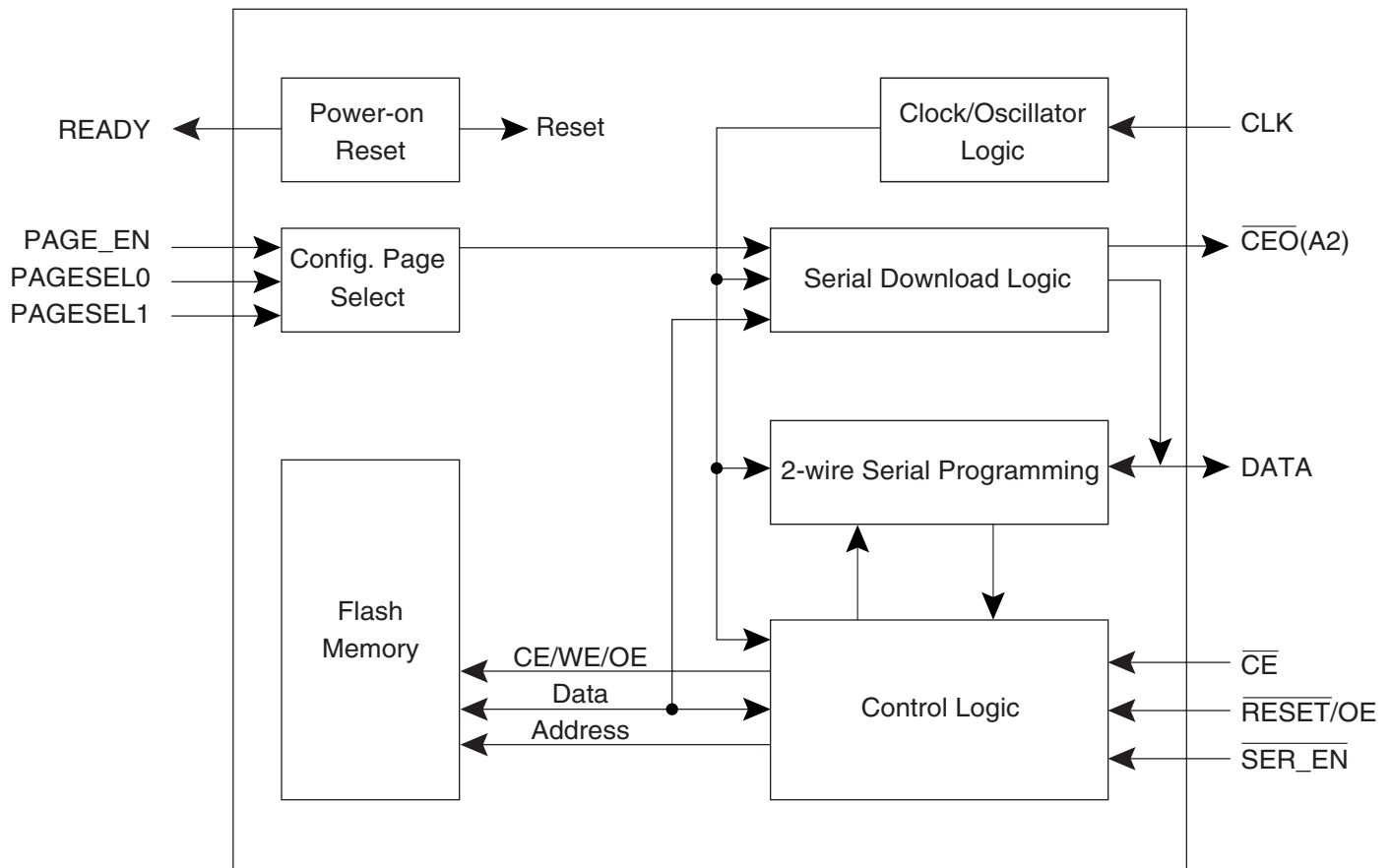


20-lead PLCC (Virtex Pinout)⁽¹⁾⁽²⁾



- Notes: 1. 20-lead PLCC (Virtex pinout) is only available in the AT17F040.
 2. Virtex pinout is compatible with the XC17V and XC18V Series PROM.

3. Block Diagram



4. Device Description

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

The $\overline{RESET/OE}$ and \overline{CE} pins control the tri-state buffer on the $DATA$ output pin and enable the address counter. When $\overline{RESET/OE}$ is driven Low, the configuration device resets its address counter and tri-states its $DATA$ pin. The \overline{CE} pin also controls the output of the AT17F Series Configurator. If \overline{CE} is held High after the $\overline{RESET/OE}$ reset pulse, the counter is disabled and the $DATA$ output pin is tri-stated. When OE is subsequently driven High, the counter and the $DATA$ output pin are enabled. When $\overline{RESET/OE}$ is driven Low again, the address counter is reset and the $DATA$ output pin is tri-stated, regardless of the state of \overline{CE} .

When the configurator has driven out all of its data and \overline{CEO} is driven Low, the device tri-states the $DATA$ pin to avoid contention with other configurators. Upon power-up, the address counter is automatically reset.

5. Pin Description

Table 5-1. Pin Description

Name	I/O	AT17F040			AT17F080			
		8 LAP	20 PLCC	20 PLCC (Virtex)	8 LAP	20 PLCC	44 PLCC	44 TQFP
DATA	I/O	1	2	1	1	2	2	40
CLK	I	2	4	3	2	4	5	43
PAGE_EN	I	–	16	–	–	16	1	39
PAGESEL0	I	–	11	–	–	11	20	14
PAGESEL1	I	–	7	–	–	7	25	19
RESET/OE	I	3	6	8	3	6	19	13
\overline{CE}	I	4	8	10	4	8	21	15
GND	–	5	10	11	5	10	24	18
\overline{CEO}	O	6	14	13	6	14	27	21
A2	I							
READY	O	–	15	15	–	15	29	23
$\overline{SER_EN}$	I	7	17	18	7	17	41	35
V _{CC}	–	8	20	20	8	20	44	38

5.1 DATA⁽¹⁾

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

5.2 CLK⁽¹⁾

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

5.3 PAGE_EN⁽²⁾

Input used to enable page download mode. When PAGE_EN is high the configuration download address space is partitioned into 4 equal pages. This gives users the ability to easily store and retrieve multiple configuration bitstreams from a single configuration device. This input works in conjunction with the PAGESEL inputs. PAGE_EN must be remain low if paging is not desired. When $\overline{SER_EN}$ is Low (ISP mode) this pin has no effect.

- Notes:
1. This pin has an internal 20 K Ω pull-up resistor.
 2. This pin has an internal 30 K Ω pull-down resistor.

5.4 PAGESEL[1:0]⁽²⁾

Page select inputs. Used to determine which of the 4 memory pages are targeted during a serial configuration download. The address space for each of the pages is shown in [Table 5-2](#). When $\overline{\text{SER_EN}}$ is Low (ISP mode) these pins have no effect.

Table 5-2. Address Space

Paging Decodes	AT17F040 (4 Mbits)	AT17F080 (8 Mbits)
PAGESEL = 00, PAGE_EN = 1	00000 – 0FFFFh	00000 – 1FFFFh
PAGESEL = 01, PAGE_EN = 1	10000 – 1FFFFh	20000 – 3FFFFh
PAGESEL = 10, PAGE_EN = 1	20000 – 2FFFFh	40000 – 5FFFFh
PAGESEL = 11, PAGE_EN = 1	30000 – 3FFFFh	60000 – 7FFFFh
PAGESEL = XX, PAGE_EN = 0	00000 – 3FFFFh	00000 – 7FFFFh

5.5 $\overline{\text{RESET/OE}}$ ⁽¹⁾

Output Enable (active High) and $\overline{\text{RESET}}$ (active Low) when $\overline{\text{SER_EN}}$ is High. A Low level on $\overline{\text{RESET/OE}}$ resets both the address and bit counters. A High level (with $\overline{\text{CE}}$ Low) enables the data output driver.

5.6 $\overline{\text{CE}}$ ⁽¹⁾

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 $\overline{\text{CE}}$ 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 2-wire Serial Programming mode ($\overline{\text{SER_EN}}$ Low).

5.7 GND

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

5.8 $\overline{\text{CEO}}$

Chip Enable Output (when $\overline{\text{SER_EN}}$ is High). This output goes Low when the internal address counter has reached its maximum value. If the PAGE_EN input is set High, the maximum value is the highest address in the selected partition. The PAGESEL[1:0] inputs are used to make the 4 partition selections. If the PAGE_EN input is set Low, the device is not partitioned and the address maximum value is the highest address in the device, see [Table 5-2 on page 6](#). In a daisy chain of AT17F Series devices, the $\overline{\text{CEO}}$ pin of one device must be connected to the $\overline{\text{CE}}$ input of the next device in the chain. It will stay Low as long as $\overline{\text{CE}}$ is Low and OE is High. It will then follow $\overline{\text{CE}}$ until OE goes Low; thereafter, $\overline{\text{CEO}}$ will stay High until the entire EEPROM is read again.

- Notes:
1. This pin has an internal 20 K Ω pull-up resistor.
 2. This pin has an internal 30 K Ω pull-down resistor.

5.9 A2⁽¹⁾

Device selection input, (when $\overline{\text{SER_EN}}$ Low). The input is used to enable (or chip select) the device during programming (i.e., when $\overline{\text{SER_EN}}$ is Low). Refer to the AT17F Programming Specification available on the Atmel web site for additional details.

5.10 READY

Open collector reset state indicator. Driven Low during power-up reset, released when power-up is complete. (recommended 4.7 k Ω pull-up on this pin if used).

5.11 $\overline{\text{SER_EN}}$ ⁽¹⁾

The serial enable input must remain High during FPGA configuration operations. Bringing $\overline{\text{SER_EN}}$ Low enables the 2-Wire Serial Programming Mode. For non-ISP applications, $\overline{\text{SER_EN}}$ should be tied to V_{CC} .

5.12 V_{CC}

+3.3V ($\pm 10\%$).

- Notes:
1. This pin has an internal 20 k Ω pull-up resistor.
 2. This pin has an internal 30 k Ω pull-down resistor.

6. 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 AT17F Serial Configuration PROM has been designed for compatibility with the Master Serial mode.

This document discusses the Atmel AT40K, AT40KAL and AT94KAL applications as well as Xilinx applications.

7. Control of Configuration

Most connections between the FPGA device and the AT17F Serial Configurator PROM are simple and self-explanatory.

- The DATA output of the AT17F Series Configurator drives DIN of the FPGA devices.
- The master FPGA CCLK output drives the CLK input of the AT17F Series Configurator.
- The $\overline{\text{CEO}}$ output of any AT17F Series Configurator drives the $\overline{\text{CE}}$ input of the next Configurator in a cascade chain of configurator devices.
- $\overline{\text{SER_EN}}$ must be connected to V_{CC} (except during ISP).
- The READY pin is available as an open-collector indicator of the device's reset status; it is driven Low while the device is in its power-on reset cycle and released (tri-stated) when the cycle is complete.
- PAGE_EN must be held Low if download paging is not desired. The PAGESEL[1:0] inputs must be tied off High or Low. If paging is desired, PAGE_EN must be High and the PAGESEL pins must be set to High or Low such that the desired page is selected, see [Table 5-2 on page 6](#).

8. Cascading Serial Configuration Devices

For multiple FPGAs configured as a daisy-chain, or for FPGAs requiring larger configuration memories, cascaded configurators provide additional memory.

After the last bit from the first configurator is read, the clock signal to the configurator asserts its $\overline{\text{CEO}}$ output Low and disables its DATA line driver. The second configurator recognizes the Low level on its $\overline{\text{CE}}$ input and enables its DATA output.

After configuration is complete, the address counters of all cascaded configurators are reset if the $\overline{\text{RESET/OE}}$ on each configurator is driven to its active (Low) level.

If the address counters are not to be reset upon completion, then the $\overline{\text{RESET/OE}}$ input can be tied to its inactive (High) level.

9. Programming Mode

The programming mode is entered by bringing $\overline{\text{SER_EN}}$ Low. In this mode the chip can be programmed by the 2-wire serial bus. The programming is done at V_{CC} supply only. Programming super voltages are generated inside the chip. The AT17F parts are read/write at 3.3V nominal. Refer to the AT17F Programming Specification available on the Atmel web site (www.atmel.com) for more programming details. AT17F devices are supported by the Atmel ATDH2200 programming system along with many third party programmers.

10. Standby Mode

The AT17F Series Configurators enter a low-power standby mode whenever $\overline{\text{SER_EN}}$ is High and $\overline{\text{CE}}$ is asserted High. In this mode, the AT17F Configurator consumes less than 1 mA of current at 3.3V. The output remains in a high-impedance state regardless of the state of the OE input.

11. 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})	-0.5V to +4.0V
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.

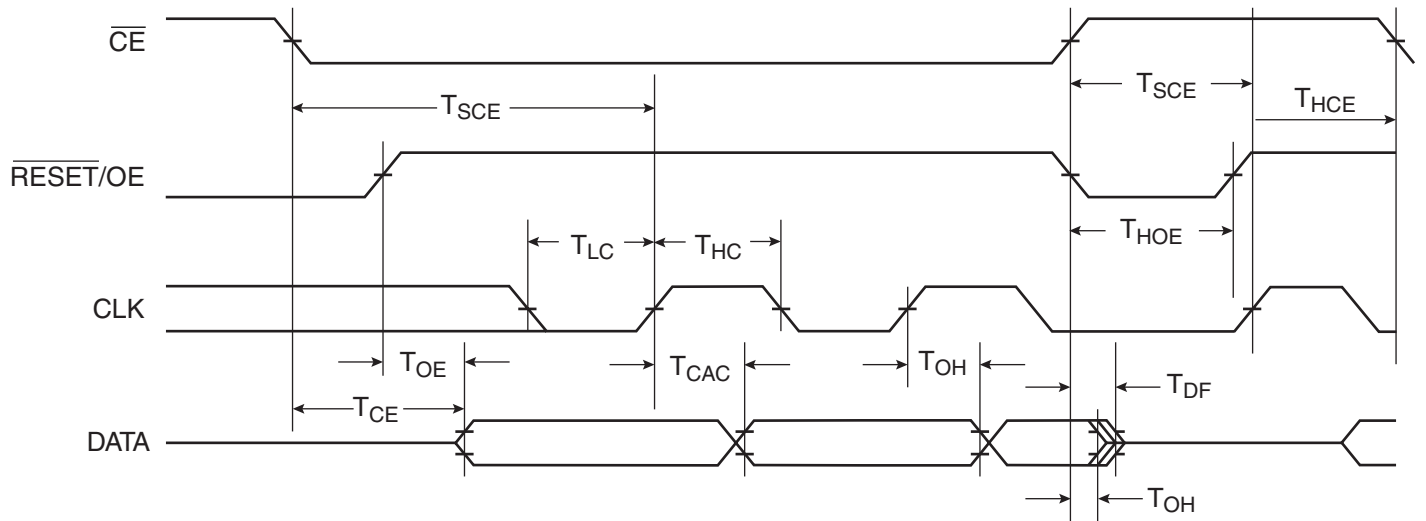
12. Operating Conditions

Symbol	Description		AT17F Series Configurator		Units
			Min	Max	
V_{CC}	Commercial	Supply voltage relative to GND -0°C to +70°C	2.97	3.63	V
	Industrial	Supply voltage relative to GND -40°C to +85°C	2.97	3.63	V

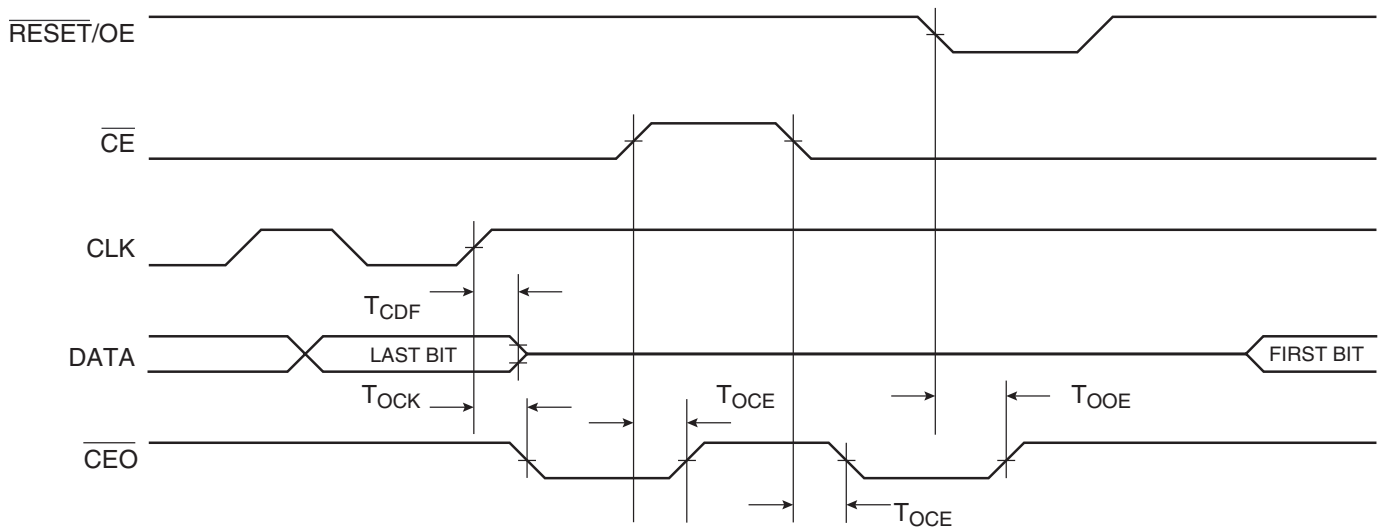
13. DC Characteristics

Symbol	Description	AT17F040		AT17F080		Units
		Min	Max	Min	Max	
V_{IH}	High-level Input Voltage	2.0	V_{CC}	2.0	V_{CC}	V
V_{IL}	Low-level Input Voltage	0	0.8	0	0.8	V
V_{OH}	High-level Output Voltage ($I_{OH} = -2.5$ mA)	2.4	0.4	2.4	0.4	V
V_{OL}	Low-level Output Voltage ($I_{OL} = +3$ mA)					
V_{OH}	High-level Output Voltage ($I_{OH} = -2$ mA)	2.4	0.4	2.4	0.4	V
V_{OL}	Low-level Output Voltage ($I_{OL} = +3$ mA)					
I_{CCA}	Supply Current, Active Mode		20		20	mA
I_L	Input or Output Leakage Current ($V_{IN} = V_{CC}$ or GND)	-10	10	-10	10	μA
I_{CCS}	Supply Current, Standby Mode	Commercial	1		1	mA
		Industrial		1		1

14. AC Characteristics



15. AC Characteristics when Cascading



16. AC Characteristics

Symbol	Description	AT17F040/080			Units
		Min		Max	
T _{OE} ⁽²⁾	OE to Data Delay	Commercial		50	ns
		Industrial ⁽¹⁾		55	ns
T _{CE} ⁽²⁾	$\overline{\text{CE}}$ to Data Delay	Commercial		55	ns
		Industrial ⁽¹⁾		60	ns
T _{CAC} ⁽²⁾	CLK to Data Delay	Commercial	3	30	ns
		Industrial ⁽¹⁾		30	ns
T _{OH}	Data Hold from $\overline{\text{CE}}$, OE, or CLK	Commercial	0		ns
		Industrial ⁽¹⁾	0		ns
T _{DF} ⁽³⁾	$\overline{\text{CE}}$ or OE to Data Float Delay	Commercial		15	ns
		Industrial ⁽¹⁾		15	ns
T _{LC}	CLK Low Time	Commercial	15		ns
		Industrial ⁽¹⁾	15		ns
T _{HC}	CLK High Time	Commercial	15		ns
		Industrial ⁽¹⁾	15		ns
T _{SCE}	$\overline{\text{CE}}$ Setup Time to CLK (to guarantee proper counting)	Commercial	20		ns
		Industrial ⁽¹⁾	25		ns
T _{HCE}	$\overline{\text{CE}}$ Hold Time from CLK (to guarantee proper counting)	Commercial	0		ns
		Industrial ⁽¹⁾	0		ns
T _{HOE}	$\overline{\text{RESET/OE}}$ Low Time (guarantees counter is reset)	Commercial	20		ns
		Industrial ⁽¹⁾	20		ns
F _{MAX}	Maximum Input Clock Frequency $\overline{\text{SEREN}} = 0$	Commercial		10	MHz
		Industrial ⁽¹⁾		10	MHz
F _{MAX}	Maximum Input Clock Frequency $\overline{\text{SEREN}} = 1$	Commercial		33	MHz
		Industrial ⁽¹⁾		33	MHz
T _{WR}	Write Cycle Time ⁽⁴⁾	Commercial		12	μs
		Industrial ⁽¹⁾		12	μs
T _{EC}	Erase Cycle Time ⁽⁴⁾	Commercial		13	s
		Industrial ⁽¹⁾		13	s

- Notes:
1. Preliminary specifications for military operating range only.
 2. AC test lead = 50 pF.
 3. Float delays are measured with 5 pF AC loads. Transition is measured ± 200 mV from steady-state active levels.
 4. See the AT17F Programming Specification for procedural information.

16.1 AC Characteristics When Cascading

Symbol	Description		AT17F040		AT17F080		Units
			Min	Max	Min	Max	
T _{CDF} ⁽³⁾	CLK to Data Float Delay	Commercial		60		50	ns
		Industrial		60		50	ns
T _{OCK} ⁽²⁾	CLK to \overline{CEO} Delay	Commercial		55		50	ns
		Industrial		60		55	ns
T _{OCE} ⁽²⁾	\overline{CE} to \overline{CEO} Delay	Commercial		55		35	ns
		Industrial		60		40	ns
T _{OOE} ⁽²⁾	\overline{RESET}/OE to \overline{CEO} Delay	Commercial		40		35	ns
		Industrial		45		35	ns
F _{MAX}	Maximum Input Clock Frequency	Commercial		33		33	MHz
		Industrial		33		33	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.

17. Thermal Resistance Coefficients

Package Type			AT17F040	AT17F080
8CN4	Leadless Array Package (LAP)	θ_{JC} [°C/W]		–
		θ_{JA} [°C/W] ⁽¹⁾		–
20J	Plastic Leaded Chip Carrier (PLCC)	θ_{JC} [°C/W]		–
		θ_{JA} [°C/W] ⁽¹⁾		–
44A	Thin Plastic Quad Flat Package (TQFP)	θ_{JC} [°C/W]	–	17
		θ_{JA} [°C/W] ⁽¹⁾	–	62
44J	Plastic Leaded Chip Carrier (PLCC)	θ_{JC} [°C/W]	–	15
		θ_{JA} [°C/W] ⁽¹⁾	–	50

Note: 1. Airflow = 0 ft/min.



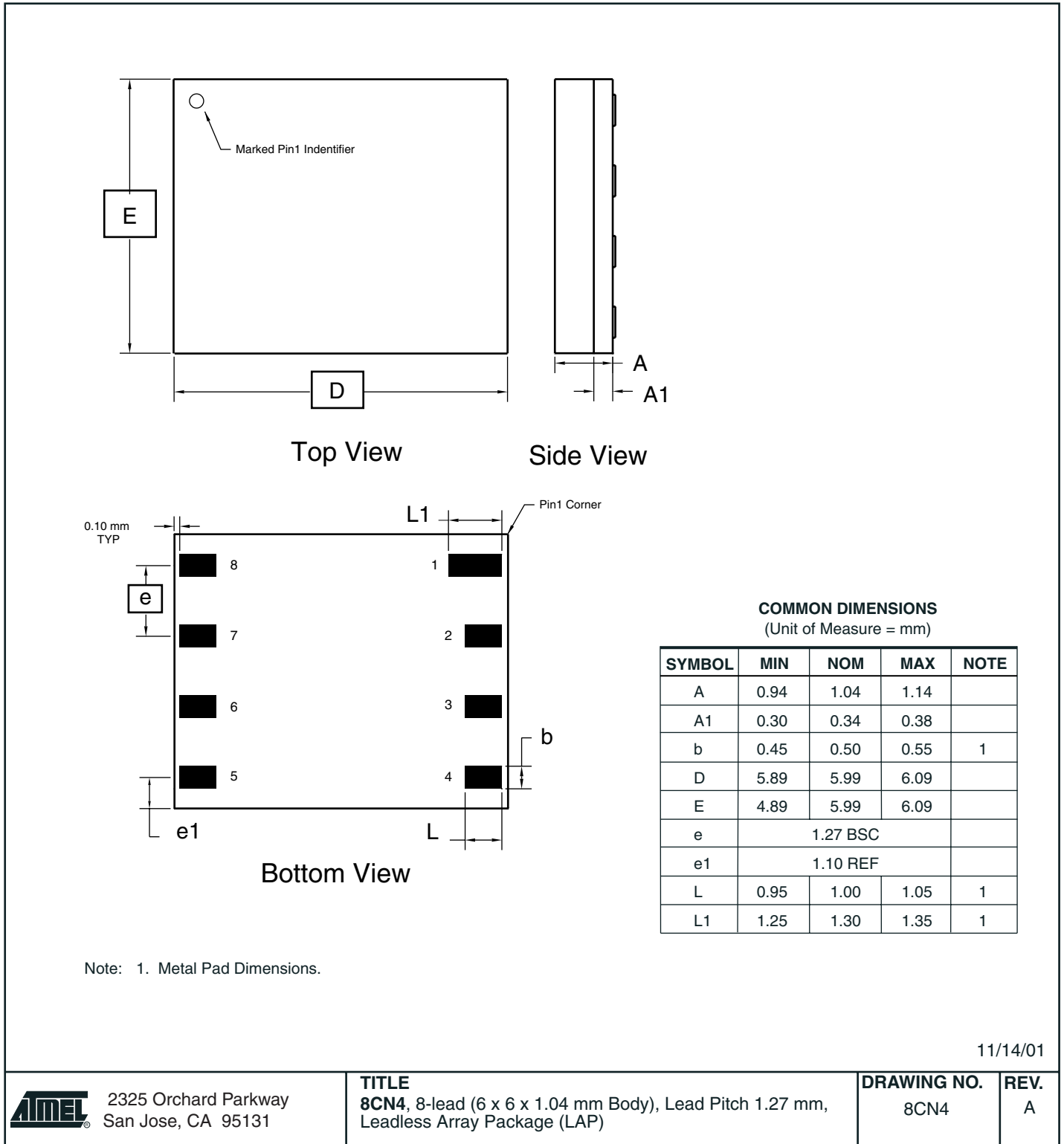
18. Ordering Information

Memory Size	Ordering Code	Package	Operation Range
4-Mbit	AT17F040-30CC AT17F040-30JC AT17F040-30VJC	8CN4 - 8 LAP 20J - 20 PLCC 20J - 20 PLCC	Commercial (0°C to 70°C)
	AT17F040-30CI AT17F040-30JI AT17F040-30VJI	8CN4 - 8 LAP 20J - 20 PLCC 20J - 20 PLCC	Industrial (-40°C to 85°C)
	AT17F040-30CU AT17F040-30JU	8CN4 - 8 LAP 20J - 20 PLCC	LHF Industrial (-40°C to 85°C)
8-Mbit	AT17F080-30CC AT17F080-30JC AT17F080-30TQC AT17F080-30BJC	8CN4 - 8 LAP 20J - 20 PLCC 44A - 44 TQFP 44J - 44 PLCC	Commercial (0°C to 70°C)
	AT17F080-30CI AT17F080-30JI AT17F080-30TQI AT17F080-30BJI	8CN4 - 8 LAP 20J - 20 PLCC 44A - 44 TQFP 44J - 44 PLCC	Industrial (-40°C to 85°C)
	AT17F080-30CU AT17F080-30JU	8CN4 - 8 LAP 20J - 20 PLCC	LHF Industrial (-40°C to 85°C)

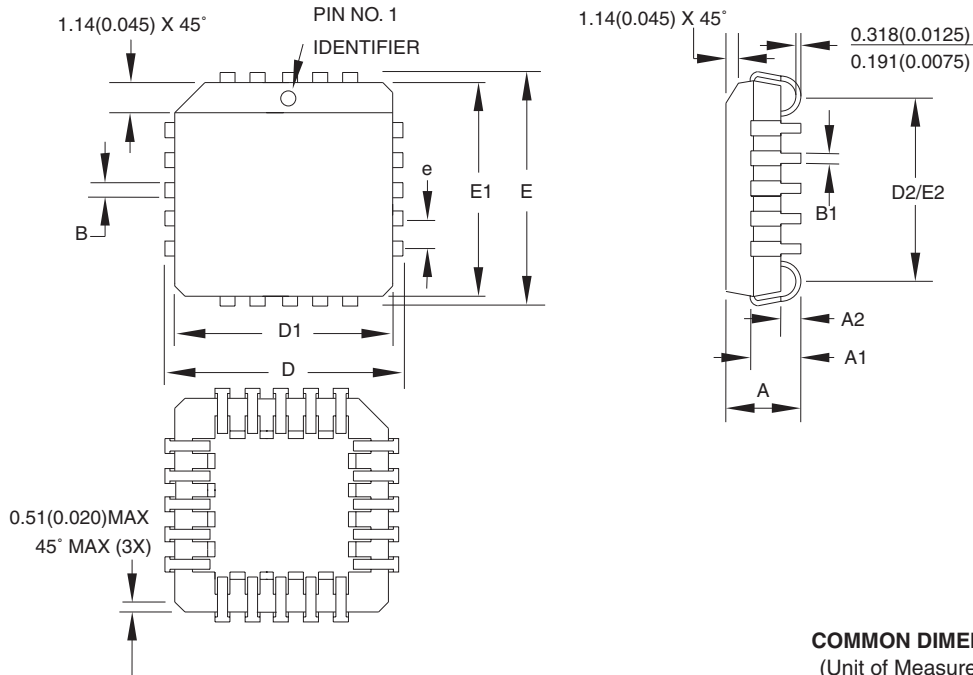
Package Type	
8CN4	8-lead, 6 mm x 6 mm x 1 mm, Leadless Array Package (LAP) – Pin-compatible with 8-lead SOIC/VOIC Packages
20J	20-lead, Plastic J-leaded Chip Carrier (PLCC)
44A	44-lead, Thin (1.0 mm) Plastic Quad Flat Package Carrier (TQFP)
44J	44-lead, Plastic J-leaded Chip Carrier (PLCC)

19. Packaging Information

19.1 8CN4 – LAP



19.2 20J – 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	9.779	–	10.033	
D1	8.890	–	9.042	Note 2
E	9.779	–	10.033	
E1	8.890	–	9.042	Note 2
D2/E2	7.366	–	8.382	
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 AA.
 2. Dimensions D1 and E1 do not include mold protrusion. Allowable protrusion is .010" (0.254 mm) 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" (0.102 mm) maximum.

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2325 Orchard Parkway
San Jose, CA 95131

TITLE

20J, 20-lead, Plastic J-leaded Chip Carrier (PLCC)

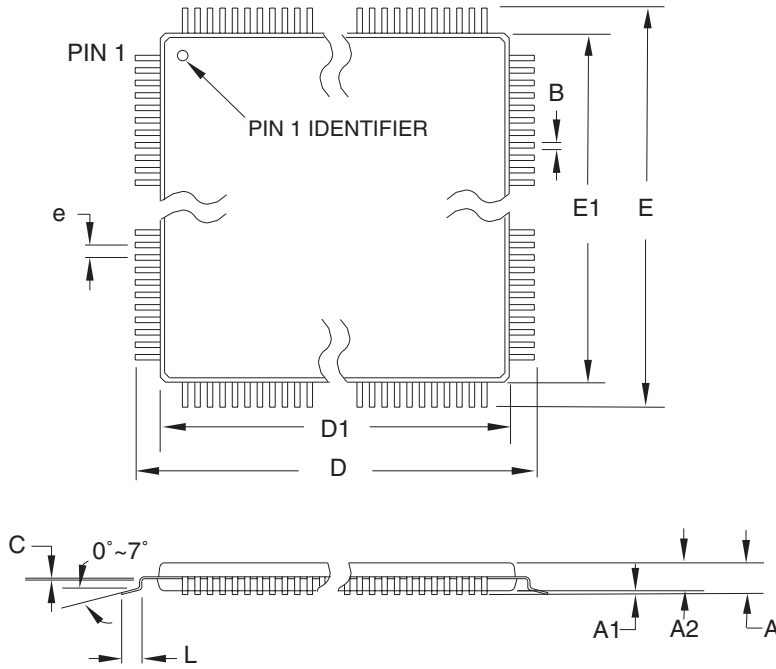
DRAWING NO.

20J

REV.

B

19.3 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

 2325 Orchard Parkway San Jose, CA 95131	TITLE 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)	DRAWING NO.	REV.
		44A	B

19.4 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" (0.254 mm) 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" (0.102 mm) maximum.

10/04/01



2325 Orchard Parkway
San Jose, CA 95131

TITLE

44J, 44-lead, Plastic J-leaded Chip Carrier (PLCC)

DRAWING NO.

44J

REV.

B



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