

## Features

- Industry-standard Architecture
  - Emulates Many 20-pin PALs®
  - Low-cost Easy-to-use Software Tools
- High-speed Electrically-erasable Programmable Logic Devices
  - 10 ns Maximum Pin-to-pin Delay
- Several Power Saving Options

Device	I <sub>CC</sub> , Standby	I <sub>CC</sub> , Active
ATF16V8B	50 mA	55 mA
ATF16V8BQ	35 mA	40 mA
ATF16V8BQL	5 mA	20 mA

- CMOS and TTL Compatible Inputs and Outputs
  - Input and I/O Pull-up Resistors
- Advanced Flash Technology
  - Reprogrammable
  - 100% Tested
- High-reliability CMOS Process
  - 20 Year Data Retention
  - 100 Erase/Write Cycles
  - 2,000V ESD Protection
  - 200 mA Latchup Immunity
- Commercial, and Industrial Temperature Ranges
- Dual-in-line and Surface Mount Packages in Standard Pinouts
- PCI-compliant
- Green Package Options (Pb/Halide-free/RoHS Compliant) Available

## 1. Description

The ATF16V8B is a high-performance CMOS (electricallyerasable) programmable logic device (PLD) that utilizes Atmel's proven electrically-erasable Flash memory technology. All speed ranges are specified over the full 5V ± 10% range for industrial temperature ranges, and 5V ± 5% for commercial temperature ranges.

Several low-power options allow selection of the best solution for various types of power-limited applications. Each of these options significantly reduces total system power and enhances system reliability.

The ATF16V8Bs incorporate a superset of the generic architectures, which allows direct replacement of the 16R8 family and most 20-pin combinatorial PLDs. Eight outputs are each allocated eight product terms. Three different modes of operation, configured automatically with software, allow highly complex logic functions to be realized.



**High-  
performance  
EE PLD**

**ATF16V8B  
ATF16V8BQ  
ATF16V8BQL**



### 3. 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 .....	-2.0 V to +7.0 V <sup>(1)</sup>
Voltage on Input Pins with Respect to Ground During Programming.....	-2.0 V to +14.0 V <sup>(1)</sup>
Programming Voltage with Respect to Ground .....	-2.0 V to +14.0 V <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  $V_{CC} + 0.75V$  DC, which may overshoot to 7.0V for pulses of less than 20 ns.

### 4. DC and AC Operating Conditions

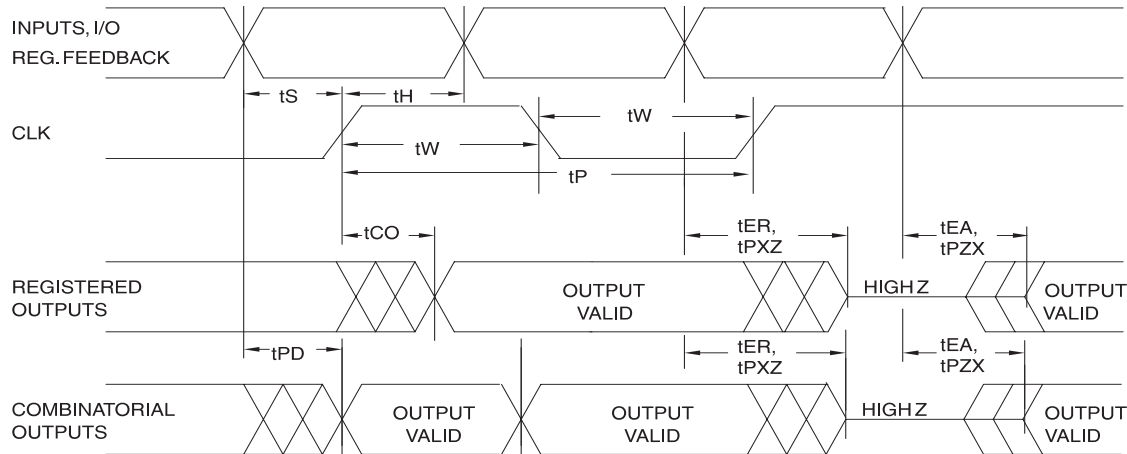
	Commercial	Industrial
Operating Temperature (Ambient)	0°C - 70°C	-40°C - 85°C
$V_{CC}$ Power Supply	5V $\pm$ 5%	5V $\pm$ 10%

#### 4.1 DC Characteristics

Symbol	Parameter	Condition			Min	Typ	Max	Units
I <sub>IL</sub>	Input or I/O Low Leakage Current	0 ≤ V <sub>IN</sub> ≤ V <sub>IL</sub> (Max)				-35	-100	μA
I <sub>IH</sub>	Input or I/O High Leakage Current	3.5 ≤ V <sub>IN</sub> ≤ V <sub>CC</sub>					10	μA
I <sub>CC</sub>	Power Supply Current, Standby	V <sub>CC</sub> = Max, V <sub>IN</sub> = Max, Outputs Open	B-10	Com.		55	85	mA
				Ind.		55	95	mA
			B-15	Com.		50	75	mA
				Ind.		50	80	mA
			BQ-10	Com.		35	55	mA
			BQL-15	Com.		5	10	mA
			BQL-15	Ind.		5	15	mA
I <sub>CC2</sub>	Clocked Power Supply Current	V <sub>CC</sub> = Max, Outputs Open, f = 15 MHz	B-10	Com.		60	90	mA
				Ind.		60	100	mA
			B-15	Com.		55	85	mA
				Ind.		55	95	mA
			BQ-10	Com.		40	55	mA
			BQL-15	Com.		20	35	mA
			BQL-15	Ind.		20	40	mA
I <sub>OS</sub> <sup>(1)</sup>	Output Short Circuit Current	V <sub>OUT</sub> = 0.5 V					-130	mA
V <sub>IL</sub>	Input Low Voltage				-0.5		0.8	V
V <sub>IH</sub>	Input High Voltage				2.0		V <sub>CC</sub> +0.75	V
V <sub>OL</sub>	Output High Voltage	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> , V <sub>CC</sub> = Min	I <sub>OL</sub> = -24 mA Com., Ind.				0.5	V
V <sub>OH</sub>	Output High Voltage	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> , V <sub>CC</sub> = Min	I <sub>OH</sub> = -4.0 mA		2.4			V

Note: 1. Not more than one output at a time should be shorted. Duration of short circuit test should not exceed 30 sec.

## 4.2 AC Waveforms<sup>(1)</sup>



Note: 1. Timing measurement reference is 1.5V. Input AC driving levels are 0.0V 3.0V, unless otherwise specified.

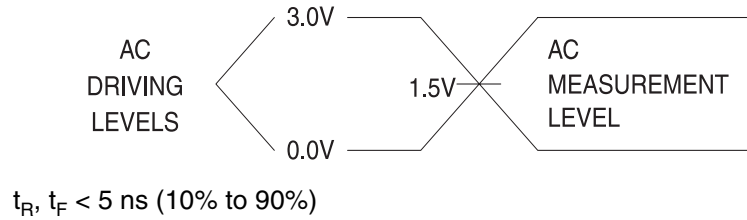
## 4.3 AC Characteristics<sup>(1)</sup>

Symbol	Parameter	-10		-15		Units
		Min	Max	Min	Max	
$t_{PD}$	Input or Feedback to Non-Registered Output	3	10	3	15	ns
	8 outputs switching					
$t_{CF}$	Clock to Feedback		6		8	ns
$t_{CO}$	Clock to Output	2	7	2	10	ns
$t_S$	Input or Feedback Setup Time	7.5		12		ns
$t_H$	Hold Time	0		0		ns
$t_P$	Clock Period	12		16		ns
$t_W$	Clock Width	6		8		ns
$f_{MAX}$	External Feedback $1/(t_S + t_{CO})$		68		45	MHz
	Internal Feedback $1/(t_S + t_{CF})$		74		50	MHz
	No Feedback $1/(t_P)$		83		62	MHz
$t_{EA}$	Input to Output Enable — Product Term	3	10	3	15	ns
$t_{ER}$	Input to Output Disable — Product Term	2	10	2	15	ns
$t_{PZX}$	$\overline{OE}$ pin to Output Enable	2	10	2	15	ns
$t_{PXZ}$	$\overline{OE}$ pin to Output Disable	1.5	10	1.5	15	ns

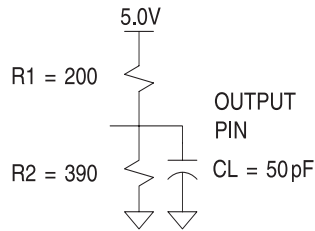
Note: 1. See ordering information for valid part numbers and speed grades.

## 4.4 Input Test Waveforms

### 4.4.1 Input Test Waveforms and Measurement Levels



### 4.4.2 Output Test Loads (Commercial)



$C_L$  includes Test fixture and Probe capacitance

## 4.5 Pin Capacitance

**Table 4-1.** Pin Capacitance ( $f = 1 \text{ MHz}$ ,  $T = 25^\circ\text{C}^{(1)}$ )

	Typ	Max	Units	Conditions
$C_{IN}$	5	8	pF	$V_{IN} = 0V$
$C_{OUT}$	6	8	pF	$V_{OUT} = 0V$

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

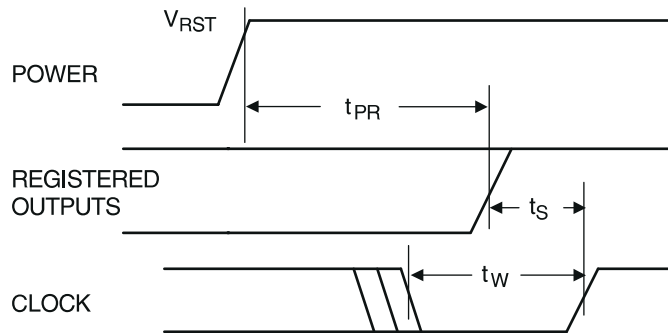
## 4.6 Power-up Reset

The registers in the ATF16V8Bs are designed to reset during power-up. At a point delayed slightly from  $V_{CC}$  crossing  $V_{RST}$ , all registers will be reset to the low state. As a result, the registered output state will always be high on power-up.

This feature is critical for state machine initialization. However, due to the asynchronous nature of reset and the uncertainty of how  $V_{CC}$  actually rises in the system, the following conditions are required:

1. The  $V_{CC}$  rise must be monotonic,
2. After reset occurs, all input and feedback setup times must be met before driving the clock pin high, and
3. The clock must remain stable during  $t_{PR}$ .

**Figure 4-1.** Power-up Reset Waveforms



**Table 4-2.** Power-up Reset Parameters

Parameter	Description	Typ	Max	Units
$t_{PR}$	Power-up Reset Time	600	1,000	ns
$V_{RST}$	Power-up Reset Voltage	3.8	4.5	V

## 4.7 Preload of Registered Outputs

The ATF16V8B's registers are provided with circuitry to allow loading of each register with either a high or a low. This feature will simplify testing since any state can be forced into the registers to control test sequencing. A JEDEC file with preload is generated when a source file with vectors is compiled. Once downloaded, the JEDEC file preload sequence will be done automatically by most of the approved programmers after the programming.

## 5. Security Fuse Usage

A single fuse is provided to prevent unauthorized copying of the ATF16V8B fuse patterns. Once programmed, fuse verify and preload are inhibited. However, the 64-bit User Signature remains accessible.

The security fuse should be programmed last, as its effect is immediate.

## 14. ATF16V8BQ/BQL Ordering Information

### 14.1 ATF16V8BQ and ATF16V8BQL Ordering Information

$t_{PD}$ (ns)	$t_S$ (ns)	$t_{CO}$ (ns)	Ordering Code	Package	Operation Range
10	7.5	7	ATF16V8BQ-10JC	20J	Commercial (0°C to 70°C)
			ATF16V8BQ-10PC	20P3	
			ATF16V8BQ-10SC	20S	
			ATF16V8BQ-10XC	20X	
15	12	10	ATF16V8BQL-15JC	20J	Commercial (0°C to 70°C)
			ATF16V8BQL-15PC	20P3	
			ATF16V8BQL-15SC	20S	
			ATF16V8BQL-15XC	20X	
			ATF16V8BQL-15JI	20J	Industrial (-40°C to 85°C)
			ATF16V8BQL-15PI	20P3	
			ATF16V8BQL-15SI	20S	
			ATF16V8BQL-15XI	20X	

Note: The last time buy date is Sept. 30, 2005 for shaded parts.

### 14.2 ATF16V8BQ and ATF16V8BQL Green Package Options (Pb/Halide-free/RoHS Compliant)

$t_{PD}$ (ns)	$t_S$ (ns)	$t_{CO}$ (ns)	Ordering Code	Package	Operation Range
15	12	10	ATF16V8BQL-15JU	20J	Industrial (-40°C to 85°C)
			ATF16V8BQL-15PU	20P3	
			ATF16V8BQL-15SU	20S	
			ATF16V8BQL-15XU	20X	

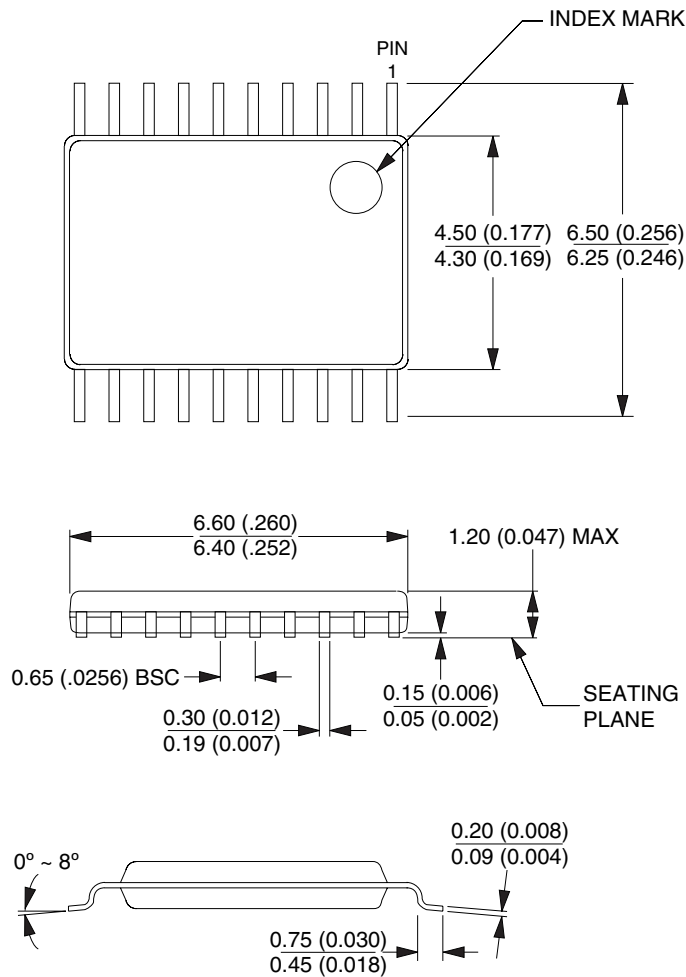
### 14.3 Using “C” Product for Industrial

To use commercial product for Industrial temperature ranges, down-grade one speed grade from the “I” to the “C” device (7 ns “C” = 10 ns “I”) and de-rate power by 30%.

Package Type	
<b>20J</b>	20-lead, Plastic J-leaded Chip Carrier (PLCC)
<b>20P3</b>	20-lead, 0.300" Wide, Plastic Dual Inline Package (PDIP)
<b>20S</b>	20-lead, 0.300" Wide, Plastic Gull-Wing Small Outline (SOIC)
<b>20X</b>	20-lead, 4.4 mm Wide, Plastic Thin Shrink Small Outline (TSSOP)

## 15.4 20X – TSSOP

Dimensions in Millimeters and (Inches).  
Controlling dimension: Millimeters.  
JEDEC Standard MO-153 AC



### TITLE

**20X**, (Formerly 20T), 20-lead, 4.4 mm Body Width,  
Plastic Thin Shrink Small Outline Package (TSSOP)

### DRAWING NO.

20X