

## Features

- Monolithic Field Programmable System Level Integrated Circuit (FPSLIC™)
  - AT40K SRAM-based FPGA with Embedded High-performance RISC AVR® Core, Extensive Data and Instruction SRAM and JTAG ICE
- 5,000 to 40,000 Gates of Patented SRAM-based AT40K FPGA with FreeRAM™
  - 2 - 18.4 Kbits of Distributed Single/Dual Port FPGA User SRAM
  - High-performance DSP Optimized FPGA Core Cell
  - Dynamically Reconfigurable In-System – FPGA Configuration Access Available On-chip from AVR Microcontroller Core to Support Cache Logic® Designs
  - Very Low Static and Dynamic Power Consumption – Ideal for Portable and Handheld Applications
- Patented AVR Enhanced RISC Architecture
  - 120+ Powerful Instructions – Most Single Clock Cycle Execution
  - High-performance Hardware Multiplier for DSP-based Systems
  - Approaching 1 MIPS per MHz Performance
  - C Code Optimized Architecture with 32 x 8 General-purpose Internal Registers
  - Low-power Idle, Power-save and Power-down Modes
  - 100 µA Standby and Typical 2-3 mA per MHz Active
- Up to 36 Kbytes of Dynamically Allocated Instruction and Data SRAM
  - Up to 16 Kbytes x 16 Internal 15 ns Instructions SRAM
  - Up to 16 Kbytes x 8 Internal 15 ns Data SRAM
- JTAG (IEEE std. 1149.1 Compliant) Interface
  - Extensive On-chip Debug Support
  - Limited Boundary-scan Capabilities According to the JTAG Standard (AVR Ports)
- AVR Fixed Peripherals
  - Industry-standard 2-wire Serial Interface
  - Two Programmable Serial UARTs
  - Two 8-bit Timer/Counters with Separate Prescaler and PWM
  - One 16-bit Timer/Counter with Separate Prescaler, Compare, Capture Modes and Dual 8-, 9- or 10-bit PWM
- Support for FPGA Custom Peripherals
  - AVR Peripheral Control – 16 Decoded AVR Address Lines Directly Accessible to FPGA
  - FPGA Macro Library of Custom Peripherals
- 16 FPGA Supplied Internal Interrupts to AVR
- Up to Four External Interrupts to AVR
- 8 Global FPGA Clocks
  - Two FPGA Clocks Driven from AVR Logic
  - FPGA Global Clock Access Available from FPGA Core
- Multiple Oscillator Circuits
  - Programmable Watchdog Timer with On-chip Oscillator
  - Oscillator to AVR Internal Clock Circuit
  - Software-selectable Clock Frequency
  - Oscillator to Timer/Counter for Real-time Clock
- V<sub>CC</sub>: 3.0V - 3.6V
- 3.3V 33 MHz PCI-compliant FPGA I/O
  - 20 mA Sink/Source High-performance I/O Structures
  - All FPGA I/O Individually Programmable
- High-performance, Low-power 0.35µ CMOS Five-layer Metal Process
- State-of-the-art Integrated PC-based Software Suite including Co-verification
- 5V I/O Tolerant



FPSLIC™

**5K - 40K Gates  
of AT40K FPGA  
with 8-bit AVR®  
Microcontroller,  
up to 36K Bytes  
of SRAM and  
On-chip  
JTAG ICE**

**AT94KAL Series  
Field  
Programmable  
System Level  
Integrated  
Circuit**

**Summary**

Rev. 1138GS-FPSLI-11/03



Note: This is a summary document. A complete document is available on our web site at [www.atmel.com](http://www.atmel.com).



## Description

The AT94KAL Series FPSLIC family shown in Table 1 is a combination of the popular Atmel AT40K Series SRAM FPGAs and the high-performance Atmel AVR 8-bit RISC microcontroller with standard peripherals. Extensive data and instruction SRAM as well as device control and management logic are included on this monolithic device, fabricated on Atmel's 0.35µ five-layer metal CMOS process.

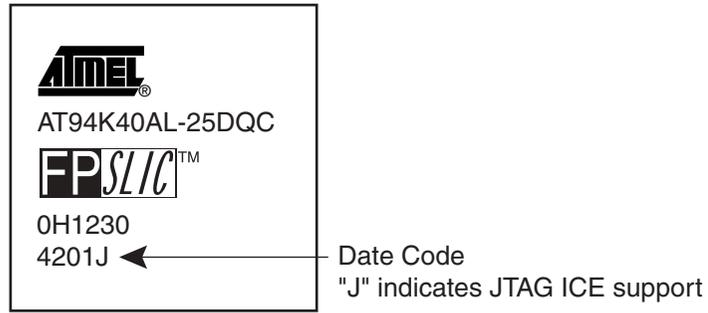
The AT40K FPGA core is a fully 3.3V PCI-compliant, SRAM-based FPGA with distributed 10 ns programmable synchronous/asynchronous, dual-port/single-port SRAM, 8 global clocks, Cache Logic ability (partially or fully reconfigurable without loss of data) and 5,000 to 40,000 usable gates.

**Table 1.** The AT94K Series Characteristics

| Device                           |          | AT94K05AL                 | AT94K10AL                 | AT94K40AL                 |
|----------------------------------|----------|---------------------------|---------------------------|---------------------------|
| FPGA Gates                       |          | 5K                        | 10K                       | 40K                       |
| FPGA Core Cells                  |          | 256                       | 576                       | 2304                      |
| FPGA SRAM Bits                   |          | 2048                      | 4096                      | 18432                     |
| FPGA Registers (Total)           |          | 436                       | 846                       | 2862                      |
| Maximum FPGA User I/O            |          | 96                        | 144                       | 288                       |
| AVR Programmable I/O Lines       |          | 8                         | 16                        | 16                        |
| Program SRAM                     |          | 4 Kbytes - 16 Kbytes      | 20 Kbytes - 32 Kbytes     | 20 Kbytes - 32 Kbytes     |
| Data SRAM                        |          | 4 Kbytes - 16 Kbytes      | 4 Kbytes - 16 Kbytes      | 4 Kbytes - 16 Kbytes      |
| Hardware Multiplier (8-bit)      |          | Yes                       | Yes                       | Yes                       |
| 2-wire Serial Interface          |          | Yes                       | Yes                       | Yes                       |
| UARTs                            |          | 2                         | 2                         | 2                         |
| Watchdog Timer                   |          | Yes                       | Yes                       | Yes                       |
| Timer/Counters                   |          | 3                         | 3                         | 3                         |
| Real-time Clock                  |          | Yes                       | Yes                       | Yes                       |
| JTAG ICE                         |          | Yes <sup>(1)</sup>        | Yes <sup>(1)</sup>        | Yes <sup>(1)</sup>        |
| Typical AVR throughput           | @ 25 MHz | 19 MIPS                   | 19 MIPS                   | 19 MIPS                   |
| Operating Voltage <sup>(2)</sup> | AL       | 3.0 - 3.6V <sup>(2)</sup> | 3.0 - 3.6V <sup>(2)</sup> | 3.0 - 3.6V <sup>(2)</sup> |

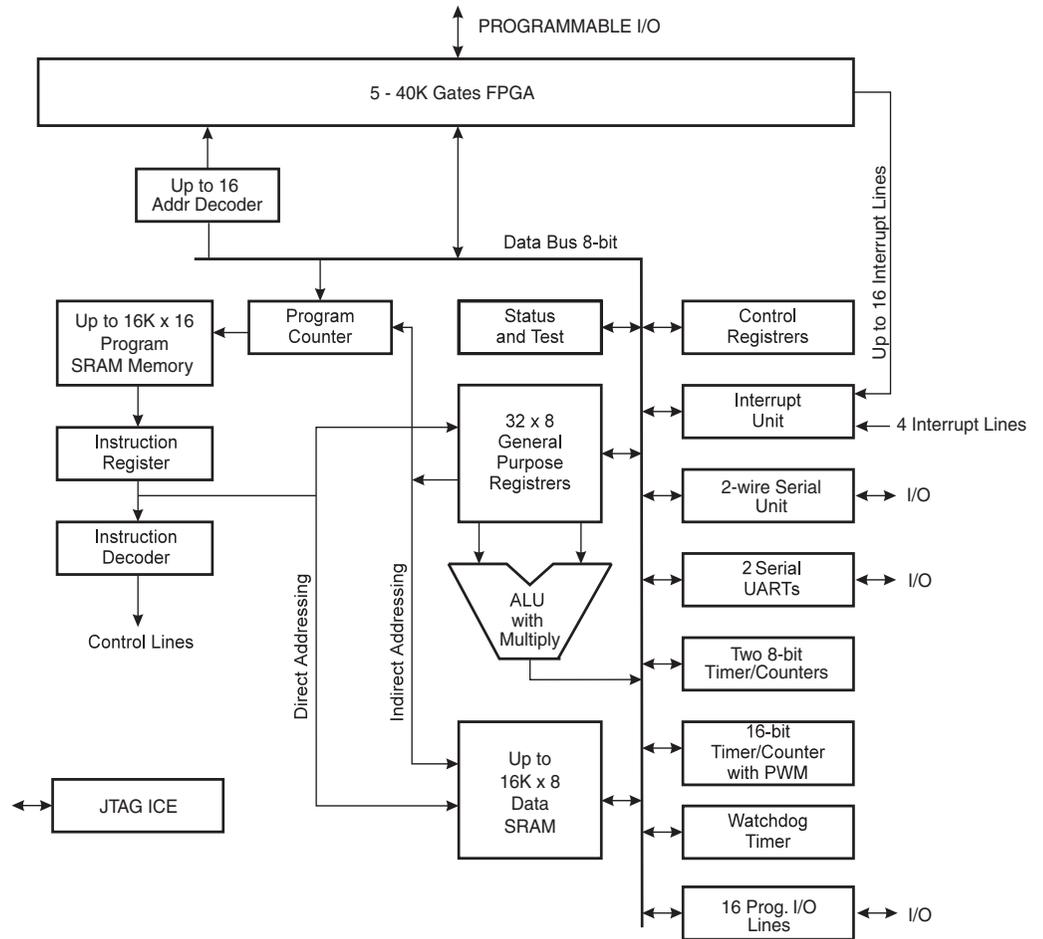
- Notes:
1. FPSLIC parts with JTAG ICE support can be identified by the letter "J" after the device date code, e.g., 4201 (no ICE support) and 4201J (with ICE support), see Figure 1.
  2. FPSLIC devices should be laid out during PCB design to support a split power supply. Please refer to the "Designing in Split Power Supply Support for AT94KAL and AT94SAL Devices" application note, available on the Atmel web site at <http://www.atmel.com/atmel/acrobat/doc2308.pdf>.

**Figure 1.** FPSLIC Device Date Code with JTAG ICE Support



The AT94K series architecture is shown in Figure 2.

**Figure 2.** AT94K Series Architecture





The embedded AVR core achieves throughputs approaching 1 MIPS per MHz by executing powerful instructions in a single-clock cycle, and allows system designers to optimize power consumption versus processing speed. The AVR core is based on an enhanced RISC architecture that combines a rich instruction set with 32 general-purpose working registers. All 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code-efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers at the same clock frequency. The AVR executes out of on-chip SRAM. Both the FPGA configuration SRAM and the AVR instruction code SRAM can be automatically loaded at system power-up using Atmel's In-System Programmable (ISP) AT17 Series EEPROM Configuration Memories or ATFS FPSLIC Support Devices.

State-of-the-art FPSLIC design tools, System Designer™, were developed in conjunction with the FPSLIC architecture to help reduce overall time-to-market by integrating microcontroller development and debug, FPGA development and Place and Route, and complete system co-verification in one easy-to-use software tool.

**Table 1.** ATFS FPSLIC Support Devices

| FPSLIC Device | FPSLIC Support Device | Configuration Data | Spare Memory |
|---------------|-----------------------|--------------------|--------------|
| AT94K05       | ATFS05                | 226520 Bits        | 35624 Bits   |
| AT94K10       | ATFS10                | 430488 Bits        | 93800 Bits   |
| AT94K40       | ATFS40                | 815382 Bits        | 233194 Bits  |



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Printed on recycled paper.

Rev. 1138GS-FPSLI-11/03