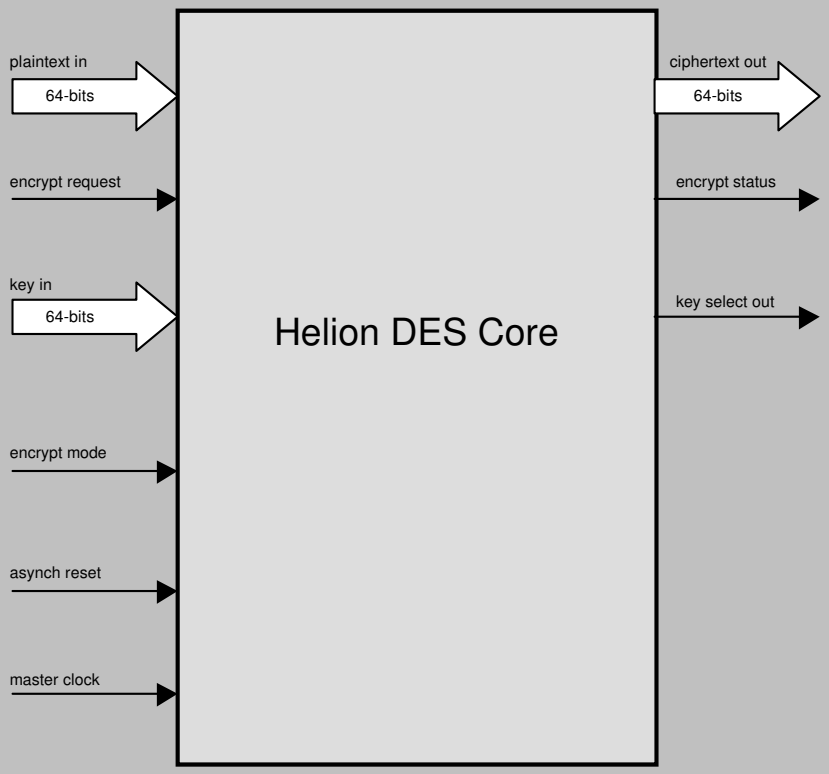
Helion Technology

DATASHEET – High Performance DES and Triple-DES cores for Xilinx FPGA



Features

- Implements DES and Triple-DES to NIST FIPS publication 46-3
- Two versions available; user can choose best balance of speed and size for application
- Very fast operation – Single DES Encryption/Decryption takes only 9-clock cycles in fastest version
- Same core offers dynamically selectable single DES/triple DES and encrypt/decrypt modes
- All DES operating modes easily implemented (eg. ECB, CBC, OFB, CFB, CTR, CBC-MAC)
- Simple external interface
- Highly optimised for use in Xilinx FPGA technologies

Deliverables

- Target specific netlist or fully synthesisable RTL VHDL/Verilog
- VHDL/Verilog simulation model and testbench with FIPS test vectors
- User documentation

Overview

These high performance cores from Helion are intended exclusively for use in Xilinx FPGA, and implement the DES and triple-DES encryption standards, as described in NIST Federal Information Processing Standard (FIPS) publication 46-3.

Two versions are available, each offering different trade-offs between area and speed. The smallest solution is a one-round-per-clock solution, which has been very carefully designed for minimum area in Xilinx FPGA. The faster variant is somewhat different to most others commercially available in that it operates at a rate of two-rounds-per-clock. This results in a core which will run significantly faster for a given gate-count, so for high performance designs, where either speed is essential or space is limited, these cores may be the perfect solution.

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Functional Description

The Helion DES cores implement the NIST FIPS 46-3 DES and triple-DES algorithms. They accept a 64-bit plaintext input word, and generate a corresponding 64-bit ciphertext output word using a supplied 64- or 192-bit key. The cores offer dynamically selectable DES and triple-DES operation, both in encrypt and decrypt modes. When triple-DES is selected, both two and three key variants are supported. Keys are stored externally to the cores for maximum system flexibility, and a key-select control from the core tells external logic which of these keys is required at any time.

The DES algorithm as described requires 16 rounds for a complete encryption, and triple-DES requires 48 rounds. The Standard Helion DES core executes one round for every master clock cycle, so a DES encryption is completed in 16 master clock cycles (and triple-DES in 48 cycles). The Fast Helion DES core executes two rounds for every master clock cycle, so for this core a DES encryption is completed in 8 master clock cycles (and triple-DES in 24 cycles). For the Standard and Fast cores, one additional cycle is required to unload the resulting ciphertext, and simultaneously load in the next plaintext.

The Helion cores implement DES in basic Electronic Code Book (ECB) mode. This is an ideal building block on which to base any of the more commonly used operational modes, and 'wrapper' logic is available which offers users several alternative modes (CBC, OFB ,CFB, CTR); other modes are very easy to add.

Core Performance

Unlike most FPGA core vendors, Helion is a certified Xilinx AllianceCORE IP provider and Xpert consultancy. We therefore take our Xilinx implementations very seriously. This core has been designed from the ground up to be highly optimal in Xilinx FPGA designs; it is not simply based on a generic ASIC design like much of its competition.

The Helion DES cores make use of Xilinx-specific architectural features in order to achieve high performance and efficient logic resource utilisation. It is available for any of the current families including, Spartan-3/3E, Virtex-4 and Virtex-5.

For our figures below, we have targeted the cores at fast Virtex-5 and Virtex-4 plus low cost Spartan-3 devices. Obviously, different device families will yield different performance results; we would be pleased to provide details specific to your own applications on request.

	Standard DES	**Fast DES**	**Fast DES**
technology	Xilinx Spartan-3 –4	Xilinx Virtex-4 –11	Xilinx Virtex-5 –3
typical core gate count	305 slices 0 BlockRAM	467 slices 0 BlockRAM	110 slices 0 BlockRAM
max master clock	132MHz	196MHz	303MHz
max data rate single-DES, ECB mode	**496Mbps**	**1393Mbps**	**2.15Gbps**
max data rate triple-DES, ECB mode	**172Mbps**	**501Mbps**	**775Mbps**

More information

For more detailed information on this or any of our other products and services, please contact Helion and we will be pleased to discuss how we can assist with your individual requirements.

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