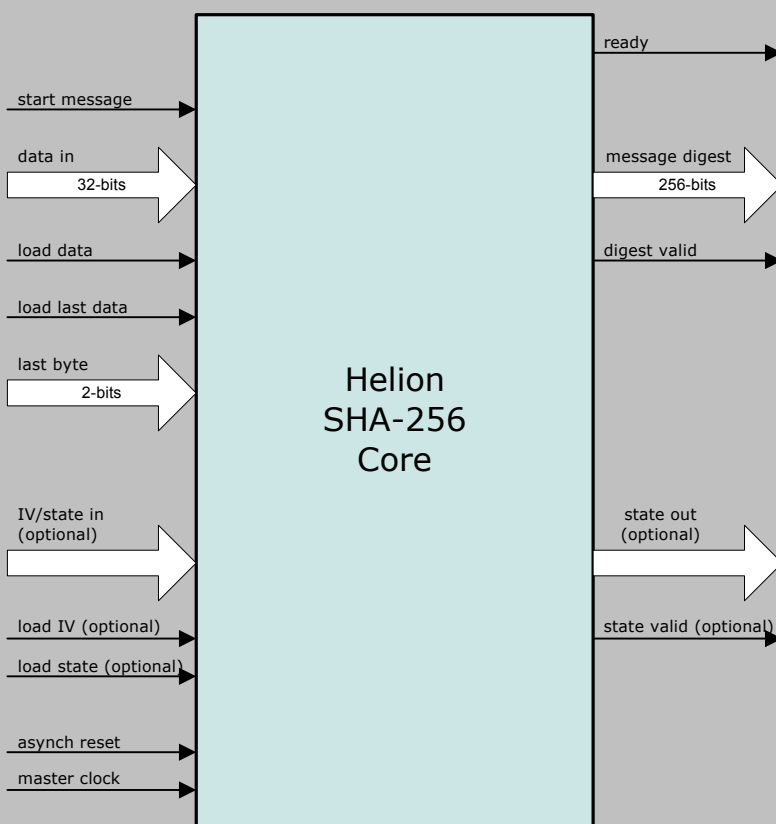


# Helion Technology

## DATASHEET - Fast SHA-256 Hash Core for ASIC



### Features

- Implements SHA-256 secure hash algorithm to NIST FIPS Publication 180-2
- Fast operation – each 512-bit block requires only 66 master clock cycles
- Performs automatic message length calculation and padding insertion
- Optional user initialisation of IVs for optimised HMAC support
- HMAC wrapper available to make implementations quick and easy
- Optional state unload/reload feature for handling fragmented messages
- Simple external interface

### Deliverables

- Fully synthesisable RTL source (VHDL or Verilog available)
- VHDL/Verilog simulation model and testbench with FIPS test vectors
- Comprehensive user documentation

## Overview

**This high performance core from Helion is intended exclusively for use in ASIC and implements the SHA-256 secure hash algorithm to NIST FIPS Publication 180-2.**

**The SHA-256 hash algorithm takes as input a message of arbitrary length, processes the message in 512-bit blocks, and produces as output a 256-bit message digest. It is intended for use in secure protocols and digital signature applications, where a large file must be compressed in a secure manner before being encrypted.**

**Applications include hardware implementations of the Internet standard HMAC (RFC 2104) used in the IPsec and SSL protocols, and in digital signature applications where a hash function is used to generate and verify signatures for data integrity and origin authentication .**

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## Functional Description

The Helion Fast SHA-256 hash core implements the latest NIST approved secure hash algorithm, and can be used wherever data integrity needs to be guaranteed. The SHA-256 hash function processes an arbitrary length input message by operating on successive 512-bit blocks of data, producing as output a 256-bit message digest.

The core contains an internal 16x32-bit block store which may be loaded with message data under the control of external logic or a microprocessor, when the core indicates it is ready. Once the block store is full the core indicates it is busy and executes the hash algorithm; on completion the core indicates it is ready to accept a further message block. The external logic is responsible for informing the core when the last message word is available at the data inputs and the location of the last message byte within the last word. This allows the core to calculate the exact message length and append message padding accordingly. When the last message block has been processed the core outputs the resulting digest of the message and indicates its validity to the external logic.

Optionally, whilst loading the first message word, the external logic may also load customised initial values into the core. This allows pre-computed initial values to be used for efficient implementation of a Hash-based Message Authentication Code (HMAC); loading of these incurs no throughput penalty since they have their own dedicated input port. In addition, the internal hash state can be made accessible, so that it may be stored externally and subsequently re-instated; this may be a useful option where fragmented messages are being hashed.

## Core Performance and Resource Requirements

This core has been designed for efficient implementation in ASIC with particular emphasis on maximising the data throughput capabilities, whilst keeping the gatecount down to a reasonable level.

The illustrative gate count figures shown below have been based on synthesis with Synopsys Design Compiler targeting a Chartered Semiconductor 0.18um CMOS technology library. The table illustrates the relationship between the gate count and the required clock frequency using different optimisation goals; one at a nominal 150MHz clock; and one for the fastest possible performance. These figures are included for illustrative purposes only.

	<b>0.18um CMOS</b>	
<b>typical gate count</b>	approx. 23k gates	approx. 26k gates
<b>clock</b>	150 MHz	253 MHz
<b>throughput</b>	1163 Mbps	1963 Mbps

## Other variants

This datasheet details our Fast SHA-256 hash core. Other members of our Fast hash core family are available which implement single mode SHA-1 or MD5 hash operations, as well as a dual mode SHA-1/SHA-256 core and a dual mode SHA-1/MD5 core.

## 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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