Secure Hash Algorithm (SHA-1 and SHA-256) User's Guide

Version 1.00 BETA

For use with SHA versions 1.2 and above
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Encryption Documents Home
1 System Overview

1.1 Introduction

This guide is for those who want to generate hash codes for data by using the Secure Hash Algorithm 1 (SHA-1) or Secure Hash Algorithm 256 (SHA-256). The SHA module implements both the SHA-1 and SHA-256 hash algorithms.

You register the SHA module with HCC's Embedded Encryption Manager (EEM), making it usable by other applications (for example, HCC's TLS/SSL) through a standard interface. The EEM is the core component of HCC's encryption system.

The system structure is shown below:

Note:

- Although every attempt has been made to simplify the system’s use, to get the best results you must understand clearly the requirements of the systems you design.
- HCC Embedded offers hardware and firmware development consultancy to help you implement your system; contact sales@hcc-embedded.com.
1.2 Feature Check

The main features of the SHA module are the following:

- It conforms to the HCC Advanced Embedded Framework.
- It conforms to the HCC Coding Standard including full MISRA compliance.
- It conforms to the HCC Embedded Encryption Manager (EEM) standard and is compatible with the EEM.
- It can be verified by using the HCC Encryption Test Suite.
- The SHA-1 implementation conforms to RFC 3174.
- The SHA-256 implementation conforms to RFC 4634.

1.3 Packages and Documents

Packages

The table below lists the packages that you need in order to use this module.

<table>
<thead>
<tr>
<th>Package</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>hcc_base_docs</td>
<td>This contains the two guides that will help you get started.</td>
</tr>
<tr>
<td>enc_base</td>
<td>The EEM base package.</td>
</tr>
<tr>
<td>enc_sha</td>
<td>The SHA package described in this document.</td>
</tr>
</tbody>
</table>

Documents

Readers should note the points in the HCC Documentation Guidelines on the HCC documentation website.

HCC Firmware Quick Start Guide

This document describes how to install packages provided by HCC in the target development environment. Also follow the Quick Start Guide when HCC provides package updates.

HCC Source Tree Guide

This document describes the HCC source tree. It gives an overview of the system to make clear the logic behind its organization.

HCC Embedded Encryption Manager User’s Guide

This document describes the EEM.

HCC Secure Hash Algorithm (SHA-1 and SHA-256) User’s Guide

This is this document.
2 Source File List

This section describes all the source code files included in the system. These files follow the HCC Embedded standard source tree system, described in the HCC Source Tree Guide. All references to file pathnames refer to locations within this standard source tree, not within the package you initially receive.

**Note:** Do not modify any of these files.

### 2.1 API Header File

The file `src/api/api_enc_sw_sha.h` is the only file that should be included by an application using this module. For details of the functions, see Application Programming Interface (API).

### 2.2 System Files

The file `src/enc/software/sha/sha.c` is the source code file. This file should only be modified by HCC.

### 2.3 Version File

The file `src/version/ver_enc_sw_sha.h` contains the version number of this module. This version number is checked by all modules that use this module to ensure system consistency over upgrades.
3 Application Programming Interface (API)

This section describes the API functions, the hash output sizes, and the error codes.

3.1 sha1_init_fn

Call this function from the EEM to forward the structure containing SHA-1 functions to it.

Format

```c
int sha1_init_fn ( t_enc_driver_fn const * const pp_encdriver )
```

Arguments

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>pp_encdriver</td>
<td>A pointer to a structure containing SHA-1 functions.</td>
<td>t_enc_driver_fn * *</td>
</tr>
</tbody>
</table>

Return Values

<table>
<thead>
<tr>
<th>Return value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENC_SUCCESS</td>
<td>Successful execution.</td>
</tr>
<tr>
<td>ENC_INVALID_ERR</td>
<td>The module has already been initialized.</td>
</tr>
</tbody>
</table>
3.2 sha256_init_fn

Call this function from the EEM to forward the structure containing SHA-256 functions to it.

Format

```
t_enc_ret sha256_init_fn ( t_enc_driver_fn const * * const pp_encdriver )
```

Arguments

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>pp_encdriver</td>
<td>A pointer to a structure containing SHA-256 functions.</td>
<td>t_enc_driver_fn * *</td>
</tr>
</tbody>
</table>

Return Values

<table>
<thead>
<tr>
<th>Return value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENC_SUCCESS</td>
<td>Successful execution.</td>
</tr>
<tr>
<td>ENC_INVALID_ERR</td>
<td>The module has already been initialized.</td>
</tr>
</tbody>
</table>
## 3.3 Hash Output Sizes

The hash output sizes are defined in the file `src/api/api_enc_sw_sha.h`.

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHA1_OUT_LEN</td>
<td>20U</td>
<td>The size of the SHA-1 hash output.</td>
</tr>
<tr>
<td>SHA256_OUT_LEN</td>
<td>32U</td>
<td>The size of the SHA-256 hash output.</td>
</tr>
</tbody>
</table>
3.4 Error Codes

The table below lists the error codes that may be generated by the API calls.

<table>
<thead>
<tr>
<th>Error code</th>
<th>Value</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENC_SUCCESS</td>
<td>0U</td>
<td>Successful execution.</td>
</tr>
<tr>
<td>ENC_INVALID_ERR</td>
<td>1U</td>
<td>The module has already been initialized.</td>
</tr>
</tbody>
</table>
4 Integration

The SHA module is designed to be as open and as portable as possible. No assumptions are made about
the functionality, the behavior, or even the existence, of the underlying operating system. For the system to
work at its best, perform the porting outlined below. This is a straightforward task for an experienced
engineer.

4.1 PSP Porting

The Platform Support Package (PSP) is designed to hold all platform-specific functionality, either because it
relies on specific features of a target system, or because this provides the most efficient or flexible solution
for the developer.

The module makes use of the following standard PSP functions:

<table>
<thead>
<tr>
<th>Function</th>
<th>Package</th>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>psp_memcpy</code></td>
<td><code>psp_base</code></td>
<td><code>psp_string</code></td>
<td>Copies a block of memory. The result is a binary copy of the data.</td>
</tr>
<tr>
<td><code>psp_memset()</code></td>
<td><code>psp_base</code></td>
<td><code>psp_string</code></td>
<td>Sets the specified area of memory to the defined value.</td>
</tr>
</tbody>
</table>

The module makes use of the following standard PSP macros:

<table>
<thead>
<tr>
<th>Macro</th>
<th>Package</th>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>PSP_RD_BE32</code></td>
<td><code>psp_base</code></td>
<td><code>psp_endianness</code></td>
<td>Reads a 32 bit value stored as big-endian from a memory location.</td>
</tr>
<tr>
<td><code>PSP_WR_BE32</code></td>
<td><code>psp_base</code></td>
<td><code>psp_endianness</code></td>
<td>Writes a 32 bit value stored as big-endian to a memory location.</td>
</tr>
</tbody>
</table>