



## Tips and Tricks Using the ADSP-SC57x/ADSP-2157x Processor Boot ROM

Contributed by Lalitha Selvaraj, Dineshkumar Sithayyan, Madhumadhi Srinivasan

Rev 1 – October 14, 2020

### Introduction

The ADSP-SC57x/ADSP-2157x products (hereafter referred to as ADSP-SC57x) are members of the SHARC+<sup>®</sup> family of processors. Unlike previous SHARC processors like the ADSP-212xx, ADSP-213xx and ADSP-214xx processors, the ADSP-SC57x/ADSP-2157x processors feature an on-chip boot ROM (mapped to L2 system memory) to control the boot scenario. The boot ROM provides a mechanism via One-Time Programmable (OTP) memory to customize various aspects of the boot process including enabling/disabling of specific features such as: the use of cache memory, overriding default boot peripheral initialization and timing parameters, and disabling of boot modes. For more details on various types of memory inside these processors, refer to the *ADSP-SC57x SHARC+ Core Embedded Processor Data Sheet* [1].

The non-secure (i.e., “standard”) boot process does not verify any signatures nor perform any decryption on the application’s binary boot stream; however, the ADSP-SC57x processor supports secure booting when security is enabled, where the boot kernel uses cryptographic algorithms to perform checks of the application binary and to decrypt it. This EE-note highlights the new boot features and enables the user to create various boot streams and understand how boot customization can be achieved using the boot ROM and OTP memory.



While the term “ADSP-SC57x” includes the ADSP-2157x processors, any differences between the two are explicitly highlighted where applicable. For more information related to this, refer to the *ADSP-SC57x SHARC+ Processor Hardware Reference* [2].

### Bootting of the Processor

The boot kernel in the ADSP-SC57x processor provides support to boot from various peripherals, as defined by the `SYS_BMODE` pins:

- SPI2 Master Boot
- SPI2 Slave Boot
- LinkPort0 Slave Boot
- UART0 Slave Boot

## Booting at Power-On Reset (POR)

Upon reset, the processor begins fetching instructions from the boot ROM. The boot ROM code facilitates loading an application from the boot source. It can automatically initialize certain peripherals for communication based on a chosen boot mode prior to loading the application itself.

At POR, only the primary booting core is released from reset, while the other cores in the system are held in reset until released by the application running on the primary booting core.

During POR, the primary cores are:

- ADSP-SC57x → Core0 ARM Cortex-A5
- ADSP-2157x → Core1 SHARC+ (No ARM Core is present)

## Booting via ROM API

The Boot ROM provides several Application Interfaces (API) to customize the boot process further. The ROM API can be accessed at runtime by any core to boot an application from a boot source, but booting via the API is completely different when compared with POR. It depends on which core is calling it:

- If the ROM API is invoked from the ARM Cortex A5 (core0), then the boot kernel can boot applications to all three cores.
- If the ROM API is invoked from the primary SHARC+ (core1), then the boot kernel can boot applications to both SHARC+ cores (core1 and core2), but not to the ARM (core0).
- If the ROM API is invoked from the secondary SHARC+ (core2), then the boot kernel can only boot the core2 SHARC+ (not the core 0 ARM nor the core1 SHARC+).
- The core that is executing the second-stage loader (required to load to the other cores) can execute a call to the boot ROM to boot the main application image or even a third-stage loader, if one is required. The boot kernel API can be used to implement custom boot modes as well, using the `dbootcommand` structure. Usage of the ROM API is shown in Listing 1:

```
void * adi_rom_Boot(void *pAddress, uint32_t flags, int32_t blockCount,
ROM_BOOT_HOOK_FUNC * pHook, uint32_t dbootcommand);

#define ROMBOOTpAddress 0x60000000 //boot stream address
#define ROMBOOTflags 0 //no flags
#define ROMBOOTblockCount 0 //process until final block
#define ROMBOOTpHook 0 //NULL - no hook routine
#define ROMBOOTdbootcommand 0x207 //SPI Master boot

int main(int argc, char *argv[])
{
    adi_initComponents();

    /* Configure secure peripheral register to do secure accesses to memory */
    /* Secure peripheral register for SPI2_Rx_DMA */
    *pREG_SPU0_SECUREP74= 0x3;
    /*Secure peripheral register for MDMA0_SRC */
    *pREG_SPU0_SECUREP102= 0x3;
    /*Secure peripheral register for MDMA0_DST */
```

```

    *pREG_SPU0_SECUREP103= 0x3;
/* Call ROM API to boot via SPI2 configured for memory-mapped mode of operation */
    adi_rom_Boot(ROMBOOTpAddress , ROMBOOTflags , ROMBOOTblockCount , ROMBOOTpHook
ROMBOOTdbootcommand);
    return 0;
}

```

Listing 1. Usage of ROM API for SPI Master



Configure the `SPU_SECUREPx` register for the appropriate boot peripheral/DMA so that it performs secure accesses to the memories. This configuration avoids system fabric errors that could lead to boot failure.

## Application Types

The ADSP-SC57x processor has three cores, so various combinations of cores for an application can be developed. Depending on the boot image for the core, the following boot options are supported:

- Single-Core Application
  - Core0 ARM Cortex-A5: boot on POR and via ROM API
  - Core1/Core2 SHARC+: boot via ROM API only
- Dual-Core Application
  - With core0 ARM Cortex-A5 as the primary core: boot on POR and via ROM API
  - With core1 SHARC+ as the application core: boot via ROM API only
- Multicore Application (all three cores)
  - Booting on POR and via ROM API

The ADSP-2157x processor has two SHARC+ cores. Depending on the boot image for the core, the following boot options are supported:

- Single-Core Application
  - Core1 SHARC+: boot on POR and via ROM API
  - Core2 SHARC+: boot via ROM API only
- Dual-Core Application
  - With core1 SHARC+ as the primary core: boot on POR and via ROM API

## OTP API Overview

The ADSP-SC57x boot ROM includes a set of functions to access OTP memory, thereby providing a mechanism that uses OTP memory to customize the boot process, including configuring the Clock Generation Unit (CGU), initializing the Dynamic Memory Controller (DMC0), storing keys for the secure boot process, etc. All OTP accesses are allowed using the following OTP APIs only:

- To program the OTP data field

```
bool adi_rom_otp_pgm(otp_data* data);
```

- To read the OTP data field

```
bool adi_rom_otp_get( OTPCMD cmd, uint32_t*data);
```

- To lock the ADSP-SC57x processor (for secure booting)

```
bool adi_rom_lock();
```

The *associated ZIP file*<sup>[3]</sup> for this EE-note contains example code in the “5. OTP API code” folder to access (program/read) the ADSP-SC57x processor OTP space from the Cortex-A5 core. For more information, refer to the “OTP Controller” chapter of the Hardware Reference Manual.



Once the part is locked, it can only be accessed via JTAG with the emulation key.

## Boot Stream Generation

As mentioned, the ADSP-SC57x processors support both standard and secure booting. The secure booting is detailed in application note (*EE-366*) *Secure Booting Guide for Blackfin+ and SHARC+ Processors*<sup>[4]</sup>. Refer to this document for more details regarding secure boot mode support.

### Standard Boot Streams

The elfloader utility (‘elfloader.exe’) in the CCES installation path is used to generate standard boot streams for all three cores. Listings 2-8 depict invocation of the elfloader utility to generate the boot stream for an SPI master boot in single-bit SPI mode for numerous scenarios.

For a single-core application running on the Cortex-A5 ARM core, the executable file (for example, *ARM\_Application\_Core0*) must be designated for the appropriate core using the `-core0` switch, and an output loader stream (LDR) file name (for example, *SPIMASTER\_Single\_ARM.ldr*) can optionally be designated using the `-o` switch, as shown in [Listing 2](#):

```
"<CCES Root Directory>\elfloader.exe" -proc ADSP-SC573 -core0=ARM_Application_Core0
-b SPI -f BINARY -Width 8 -bcode 0x1 -verbose -o SPIMASTER_Single_ARM.ldr
```

*Listing 2. Elfloader Command Line for Application Created for Core0 ARM Cortex-A5*

If the single-core application instead targets either the primary or secondary SHARC+ core, a similar calling convention is used. However, the command line must associate the appropriate SHARC+ executable file (DXE) with the targeted core using the following switches:

- `-core1` for the primary SHARC+ ([Listing 3](#))
- `-core2` for the secondary SHARC+ ([Listing 4](#))

```
"<CCES Root Directory>\elfloader.exe" -proc ADSP-SC573 -
core1=SHARC0_Application_Core1.dxe -b SPI -f BINARY -Width 8 -bcode 0x1 -verbose -o
SPIMASTER_Single_SHARC0.ldr
```

*Listing 3. Elfloader Command Line for Application Created for Core1 SHARC+*

```
"<CCES Root Directory>\elfloader.exe" -proc ADSP-SC573 -
core2=SHARC1_Application_Core2.dxe -b SPI -f BINARY -Width 8 -bcode 0x1 -verbose -o
SPIMASTER_Single_SHARC1.ldr
```

*Listing 4. Elfloader Command Line for Application Created for Core2 SHARC*

For a multi-core application, the boot stream is a mix of the above invocations, but there is an additional requirement that must be considered. In the defined boot stream, there is a “Final” tag associated with the last block in the stream destined for the specified core. The tag indicates to the boot ROM during loading that this is the last block to load before exiting the boot ROM. In a multi-core scenario, however, this tag must be omitted if other cores still need to be loaded after the current one. Otherwise, the boot ROM exits prematurely during the boot after loading to that core. This sequence results in the other cores not booting at all. The capability to remove the “Final” tag from the boot stream generated for a specific core is available via the `-NoFinalTag` switch, which must be applied to the primary core loader stream in each of the two-core scenarios:

- Core0 ARM Cortex-A5 and Core1 SHARC+ ([Listing 5](#))
- Core0 ARM Cortex-A5 and Core2 SHARC+ ([Listing 6](#))
- Core1 SHARC and Core2 SHARC+ ([Listing 7](#))

```
"<CCES Root Directory>\elfloader.exe" -proc ADSP-SC573 -core0= ARM_Application_Core0
-core1= SHARC0_Application_Core1.dxe -NoFinalTag= ARM_Application_Core0 -b SPI -f
BINARY -Width 8 -bcode 0x1 -verbose -o SPIMASTER_Single_ARM_SHARC0.ldr
```

*Listing 5. Elfloader Command Line for Application Created for Core0 ARM Cortex-A5 and Core1 SHARC+*

```
"<CCES Root Directory>\elfloader.exe" -proc ADSP-SC573 -core0=
ARM_Application_Core0 -core2= SHARC1_Application_Core2.dxe -NoFinalTag=
ARM_Application_Core0 -b SPI -f BINARY -Width 8 -bcode 0x1 -verbose -o
SPIMASTER_Single_ARM_SHARC1.ldr
```

*Listing 6. Elfloader Command Line for Application Created for Core0 ARM Cortex-A5 and Core2 SHARC+*

```
"<CCES Root Directory>\elfloader.exe" -proc ADSP-SC573 -core1=
SHARC0_Application_Core1.dxe -core2 SHARC1_Application_Core2.dxe -NoFinalTag=
SHARC0_Application_Core1.dxe -b SPI -f BINARY -Width 8 -bcode 0x1 -verbose -o
SPIMASTER_Single_SHARC1_SHARC2.ldr
```

*Listing 7. Elfloader Command Line for Application Created for Core1 SHARC and Core2 SHARC*

Finally, for an application loading to all three cores, the same concept applies, except the `-NoFinalTag` switch must be applied twice (once for the ARM core, and once for the primary SHARC+ core), as shown in [Listing 8](#):

```
"<CCES Root Directory>\elfloader.exe" -proc ADSP-SC573 -core0=
ARM_Application_Core0 -core1= SHARC0_Application_Core1.dxe -core2=
SHARC1_Application_Core2.dxe -NoFinalTag= ARM_Application_Core0 -NoFinalTag=
SHARC0_Application_Core1.dxe -b SPI -f BINARY -Width 8 -bcode 0x1 -verbose -o
SPIMASTER_Single_MULTI_CORE.ldr
```

*Listing 8. Elfloader Command Line for Application Created for All Three Cores*

The `-bcode` switch in the [Listing 5](#) through [Listing 8](#) is in support of single-bit SPI data and can be modified to select among the various supported SPI operating modes (for example, 0x9 for dual-bit mode and 0xD for quad-bit mode). For more details, refer to the Hardware Reference Manual.

Usage of the elfloader utility can be extended to apply to all the supported boot sources (using the `-b` switch) and to support various LDR file formats (via the `-f` switch). For more details regarding the elfloader utility, consult the *CCES Online Help* documentation<sup>[5]</sup>.

## Generation of Secure Boot Stream

The generation of the secure boot stream is just a conversion of the standard boot stream. It involves the use of a private key to create a digital signature which is stored in a secure header as part of the secure boot stream.

The `signtool.exe` utility, via the `sign` command, is used for signing and encrypting the boot stream image, and is applied for all three secure boot types, as governed by the `-type` switch: Plaintext (BLP), Wrapped (BLw), and Keyless (BLx).

[Listing 9](#) is an example of a command line to sign a standard boot loader stream (Normal\_Boot\_Stream.ldr, identified by the `-infile` switch) for Plaintext security (`-type BLP`) using the private key stored in the key pair file `keychain.der` (designated by the `-prikey` switch), and the converted secure LDR stream (BLp\_Secure\_Boot\_Stream.ldr) is designated by the `-outfile` switch.

```
"<CCES Root Directory>\signtool.exe" sign -type BLP -prikey keychain.der -infile Normal_Boot_Stream.ldr -outfile BLp_Secure_Boot_Stream.ldr
```

*Listing 9. Signtool Command Line to Sign Boot Stream for Integrity/Authenticity Protection*

If confidentiality protection is also desired, it can be either keyless (`-type BLx`) or wrapped (`-type BLw`). For Keyless encryption, only the encryption key file is provided, using the `-enckey` switch ([Listing 10](#)):

```
"<CCES Root Directory>\signtool.exe" sign -type BLx -prikey keychain.der -enckey encrypt_key.bin -infile Normal_Boot_Stream.ldr -outfile BLx_Secure_Boot_Stream.ldr
```

*Listing 10. Signtool Command Line to Sign/Encrypt Boot Stream for Integrity/Authenticity/Confidentiality Protection*

Wrapped encryption, where the cipher key is sent along with the secure boot stream, requires both an encryption key file (using the `-enckey` switch) and a wrap key file, as specified by the `-wrapkey` switch ([Listing 11](#)):

```
"<CCES Root Directory>\signtool.exe" sign -type BLw -prikey keychain.der -enckey encrypt_key.bin -wrapkey wrapper_key.bin -infile Normal_Boot_Stream.ldr -outfile BLw_Secure_Boot_Stream.ldr
```

*Listing 11. Signtool Command Line to Sign/Encrypt Boot Stream for Integrity/Authenticity/Confidentiality Protection with Wrapped Encryption Key*



The `Normal_Boot_Stream.ldr`, `keychain.der`, `BLp_Secure_Boot_Stream.ldr`, `encrypt_key.bin`, `wrapper_key.bin`, `BLx_Secure_Boot_Stream.ldr` and `BLw_Secure_Boot_Stream.ldr` files are in binary format.

## Tips for Booting

### Secure SPI Master Boot

For SPI master boot mode, the ROM code checks for the `-bcode` value present in the standard boot stream to determine the SPI configuration to be used. For a secure boot stream, which may be encrypted, extra steps are required to perform the same auto-detect functionality. The standard boot image can be signed with attribute `0x80000002` set to a value of `0x0` through `0xF`, which will determine the SPI configuration to use. If the attribute was not found in the secure header, the default `bcode` of `0x1` is applied. For example, if the SPI needed to be configured for quad-bit mode, the value `0xD` must be associated with attribute `0x80000002`, as in [Listing 12](#):

```
"<CCES Root Directory>\signtool.exe" sign -type BLw -prikey keychain.der -enckey
encrypt_key.bin -wrapkey wrapper_key.bin -attribute 0x80000002=0xD -infile
Normal_Boot_Stream.ldr -outfile BLw_Secure_Boot_Stream.ldr
```

*Listing 12. Signtool Command Line to Sign/Encrypt Boot Stream for Integrity/Authenticity/Confidentiality Protection with Wrapped Encryption Key for Attribute `0x80000002 = 0xD`.*

### Tips for Secure Slave Boot

To boot the ADSP-SC57x processor in slave boot mode, the host code should send an extra 1024 dummy bytes at the end of all secure boot streams. This ensures that the boot stream is completely sent from the host and is received by the processor to boot an application.

The *associated ZIP file* has a ‘2. Loader Streams’ folder which generates both standard and secure boot streams for a simple LED\_Blink application (‘1. Led\_Blink\_Code’) running on an ADSP-SC57x EZ-KIT® evaluation system.

## Boot Support in Open/Locked Parts

By default, the processor is considered to be an “open” part non-secure, default state). Open parts support both standard and secure boot. To lock a processor and enable security, a particular location in OTP memory must be written.



Standard booting is no longer supported once the part is locked.

- The plaintext format (BLp) boot stream can be authenticated by pre-programming the corresponding public key of the ECDSA-224-bit algorithm into the OTP `public_key` field using the OTP program API.



- The wrapped key format (BL<sub>w</sub>) boot stream image data is encrypted with the wrapped key, preventing cloning. An additional key is required to unwrap the wrapped key in the header. This key must be pre-programmed into the OTP `pvt_128key` field using the OTP program API.
- The keyless format (BL<sub>x</sub>) is similar to the wrapped key format, except the image does not contain the key. The decryption key for the data must be pre-programmed into the OTP `pvt_128key` field using the OTP program API.
- Once the part is locked, the debugger only has access when the userkey passed from the debugger matches the emulation key. The emulation key must be programmed into the OTP `secure_emu_key` field using the OTP program API *before* locking the part.

### Public and Encryption (Private) Key in OTP Space

- There are two instances of public keys and four instances of confidentiality keys in the OTP space available. By default, the `public_key0` field and the `pvt_128key0` field are used for authentication and decryption of the secure boot stream. To use the other instances of the keys, like `public_key1` and `pvt_128key1`, the previous instances must be invalidated in the OTP space by setting the `pubkey0Inv` and `privkey0Inv` bits in the OTP space using the OTP program API.
- All the public and private keys can be invalidated using the various `key*Inv` fields provided in the `ADI_ROM_OTP_BOOT_INFO` structure. This feature is useful when a new key is required, because the boot ROM always uses the lowest valid key enumeration. If `key0` is valid, then it is used; if `key0` is invalid and `key1` is valid, then `key1` is used.



Once a key is invalidated, it cannot be used again.

## Testing Secure Boot Using ROM API

The ROM code provides a mechanism to boot a secure boot stream without writing any keys into OTP memory. This mechanism is useful when validating the generated keys and application stream before writing to OTP memory and locking the part. Secure booting is accomplished by loading an application into memory using the emulator. The emulator utilizes the ROM API function `adi_rom_Boot` in conjunction with a hook function, configuring the kernel for secure boot, and initiating the boot process. The *associated ZIP file* contains a '4. ROM\_API\_Flags' folder which has example code for using the ROM API hook function.

## Useful Boot ROM Features

### Booting to External Memory

The following techniques can be used to boot an application that is mapped to external memory:

- The boot ROM supports initialization blocks to load code on-chip and run it prior to attempting to load the next block in the stream. This small executable code can initialize the DMC controllers prior to any attempt by the boot sequence to load code/data to external DDR memory, and it is supported using the `-init` switch in the elfloader command line ([Listing 13](#)).



```
"<CCES Root Directory>\elfloader.exe" -proc ADSP-SC573 -core0=ARM_Application_Core0
-init Initcode_Core0 -b SPI -f BINARY -Width 8 -bcode 0x1 -verbose -o
SPIMASTER_Single_ARM.ldr"
```

Listing 13. Elfloader Command Line for Application in Cortex-A5 Core with Initialization Block

- DMC initialization can be pre-programmed into the OTP `dmcEn` field using the OTP Program API. By setting the `dmcEn` field of the `ADI_ROM_BOOT_CONFIG` structure, the `ADI_ROM_OTP_DMC_CONFIG` structure is read from OTP and used to configure the DMC peripheral.
- A second-stage loader can be implemented, where the first application configures the external memory controller and then issues a call using the boot routine to boot an application into external memory.

## Optimizing Boot Time

Overall boot time performance can be increased using the following techniques:

- Program the CGU to increase clocks throughout the device by programming the OTP `cgu` field using the OTP Program API.
- Use an initialization block to customize boot mechanisms exposed by the boot kernel. In addition to configuring the external memory controllers, initialization block code can also be used to modify the CGU and peripheral bit rates/settings. Because this code is executed at the start of the boot process, the rest of the application can load much faster with whatever optimized settings are set in the initialization block.



Initialization blocks require a call to user application code prior to the authentication of the boot image; therefore, they are not supported for secure boot streams.

- SPI master boot mode can occur in dual-bit or quad-bit mode, if the flash supports it, which is supported via the `-bcode` switch when generating the boot stream.
  - A second-stage loader can be implemented, where the first application configures the CGU to run the processor at maximum speed and then issues a call using the boot routine to boot at the desired speed.
  - Secure boot image authentication can be disabled by setting the `ADI_ROM_OTP_BOOT_INFO` field `decryptOnlyEn` to 1 and field `decryptOnlyEnInv` to 0, which will remove the overhead associated with authenticating the boot stream.

## Debugging Boot Using Global Boot Flags in `adi_rom_Boot`

The `adi_rom_Boot()` API supports additional flags which can impact the processing of the boot stream or modify some control behavior after the boot stream has been processed. For more information, refer to the “Boot ROM and Booting the Processor” chapter of the ADSP-SC57x SHARC+ Processor Hardware Reference.

### *ROM\_BFLAG\_RETURN*

The `ROM_BFLAG_RETURN` flag can be set in the boot routine call from the Cortex-A5 core to boot an application to the SHARC+ cores. When set, the boot code does not vector to the entry address of the loaded

application once booted. Instead, it returns to the original calling routine like any other function call and return. This mechanism allows for a core to load a single-core boot stream intended for another core.

The *associated ZIP file* contains a '4. ROM\_API\_Flags' folder, which has example code for using the ROM API function.

### ROM\_BFLAG\_HOOK

When enabled, the `ROM_BFLAG_HOOK` flag allows a callback hook routine to be called after the execution of the initialization and configuration functions that were registered with the boot kernel. The address of the hook function to execute is passed as a parameter when calling the boot routine.

When using the ROM API, this mechanism allows user routines in SRAM to be registered and called. The boot software passes a flag to the hook routine, indicating whether the call was due to completion of the initialization routine or the configuration routine. In addition, a pointer to the entire boot configuration structure is passed, allowing the hook routine to reconfigure the boot process. Thus, the hook routine is called twice, once during initialization and later during boot process.



Hook routines provide an efficient means of performing validation of the configuration of a boot peripheral at boot-time. Software can call the boot API with a specific configuration. The hook routine can then verify that the configuration is correct for the parameters passed. It can then pass or fail without progressing through the entire boot sequence.

### Booting using Non-Default Peripheral Instances

By default, the ADSP-SC57x processor supports booting using the SPI2, UART0, and LP0 peripherals. To boot an application using an alternate instance of a supported peripheral (for example, SPI0, UART1, LP1, etc.), the `dbootcommand` in the boot routine call can be modified accordingly.

The `dbootcommand` can also be programmed into the OTP `bcmd` field of the `ADI_ROM_OTP_BOOT_INFO` structure using the OTP program API.

The ROM code also provides the option to disable a particular boot mode by programming the OTP `bootModeDisable` field using the OTP program API.

### Using ROM API for a Second-Stage Loader (SSL)

To support extensions to the boot process, a second-stage loader (SSL) can be introduced, where a small application is loaded into the processor using a natively supported boot mode. This SSL kernel can be used to customize the configuration of the processor and/or perform automated tasks as part of the boot process.

An SSL is a stand-alone application that is executed at boot time before the actual application is dynamically loaded into memory. The SSL can be used to invoke a ROM API to boot a second application. For example, this approach can be used to boot an application from external memory mapped to the DMC0 controller into the cores of the ADSP-SC57x processor. The *associated ZIP file* contains a '3. SSL\_Code\_Example' folder, which implements this approach.



The boot kernel requires 8k of SRAM (0x200fe000 to 0x200ffff) for the stack and buffers. This space is reserved until AFTER the boot process is complete, and the boot kernel will flag an exception if this rule is violated.

## Conclusions

This EE-Note summarizes the steps and requirements to generate both standard and secure boot streams for all boot modes of the ADSP-SC57x processor family. It also explains the usage of the ROM API with accompanying examples in use case scenarios such as SSL implementation and secure boot on open parts.

## References

- [1] *ADSP-SC570/SC571/SC572/SC573/ADSP-21571/21573: SHARC+ Dual-Core DSP with arm® Cortex-A5 Data Sheet, Rev B, June 2018. Analog Devices, Inc.*
- [2] *ADSP-SC57x/ADSP-2157x SHARC+ Processor Hardware Reference. Revision 1.1, January 2020. Analog Devices, Inc.*
- [3] *Associated ZIP File for EE-428. Analog Devices, Inc.*
- [4] *Secure Booting Guide for Blackfin+ and SHARC+ Processors (EE-366)*
- [5] *CrossCore® Embedded Studio online Help > SHARC® Development Tools Documentation > Loader and Utilities Manual > Loader for ADSP-SC5xx/ADSP-215xx Processors*

## Document History

| Revision   | Description     |
|--|-----------------|
| <i>Rev 1 – October ,2020<br/>by Lalitha Selvaraj,<br/>Dineshkumar Sithayyan,<br/>Madhumadhi Srinivasan</i> | Initial Release |