SmartDesign MSS

Embedded Nonvolatile Memory (eNVM) Configuration

Actel® POWER MATTERS

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Introduction

The MSS Embedded Nonvolatile Memory (eNVM) configurator enables you to create various memory regions (clients) that need to be programmed in the SmartFusion device eNVM block(s).

In this document we describe in details how to configure the eNVM block(s). For more details about eNVM, please refer to the Actel SmartFusion Microcontroller Subsystem User's Guide.

Important Information About eNVM User Pages

The MSS configurator uses a certain number of user eNVM pages to store the MSS configuration. These pages are located at the top of the eNVM address space. The number of pages is variable based on the your MSS configuration (ACE, GPIOs and eNVM Init Clients). Your application code should not write in these user pages as it will most likely cause a runtime failure for your design. Note also that if these pages have been corrupted by mistake, the part will not boot again and will need to be re-programmed.

The first 'reserved' address can be computed as follows. After the MSS has been successfully generated, open the eNVM configurator and record the number of available pages shown in the Usage Statistics group on the main page. The first reserved address is defined as:

```
first_reserved_address = 0x60000000 + (available_pages * 128)
```

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Creating and Configuring Clients

Creating Clients

The main page of the eNVM configurator enables you to add various clients to your eNVM block. There are 2 available client types:

- **Data Storage client** - Use the data storage client to define a generic memory region in the eNVM block. This region can be used to hold your application code or any other data content that your application may need.
- **Initialization client** - Use the initialization client to define a memory region that needs to be copied at system boot time at a specified Cortex-M3 address location.

The main grid also displays characteristics of any configured clients. These characteristics are:

- **Client Type** - Type of the client that is added to the system
- **Client Name** - Name of the client. It must be unique across the system.
- **Start Address** - The address in hex at which the client is located in eNVM. It must be on a page boundary. No overlapping addresses between different clients are allowed.
- **Word Size** - Word size of the client in bits
- **Page Start** - Page on which the start address begins.
- **Page End** - Page on which the client memory region ends. It is automatically computed based on the start address, word size, and number of words for a client.
- **Initialization Order** - This field is not used by the SmartFusion eNVM configurator.
- **Lock Start Address** - Specify this option if you do not want the eNVM configurator to change your start address when hitting the "Optimize" button.

Usage statistics are also reported:

- **Available Pages** - Total number of pages available to create clients. The number of available pages varies based on how the overall MSS is configured. For instance, the ACE configuration takes up user pages where ACE initialization data is programmed in eNVM.
- **Used Pages** - Total number of pages used by the configured clients.
- **Free Pages** - Total number of pages still available for configuring data storage and initialization clients.

Use the **Optimize** feature to resolve the conflicts on overlapping base addresses for clients. This operation will not modify the base addresses for any clients that have Lock Start Address checked (as shown in the Figure 1-1).

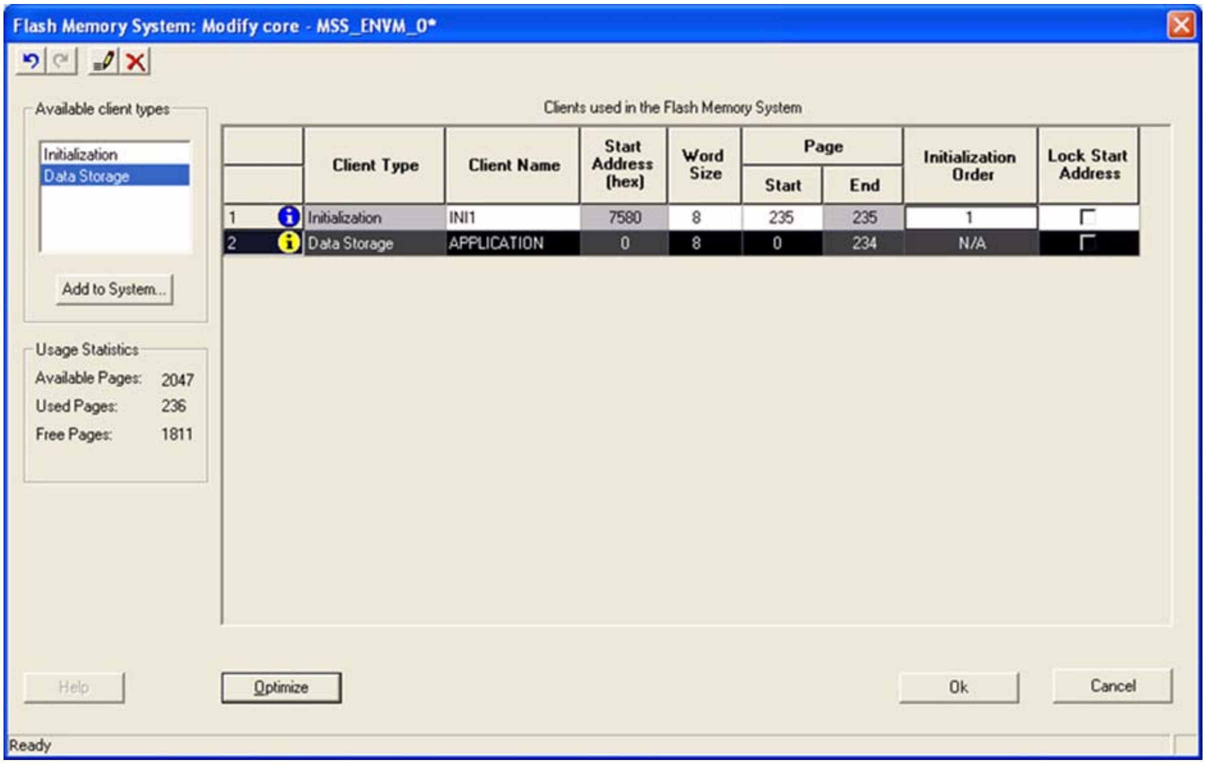

Figure 1-1 · eNVM GUI

Configuring a Data Storage Client

In the Client Configuration dialog you need to specify the values listed below.

eNVM Content Description

- **Content** - Specify the memory content that you want to program into eNVM. You may choose one of the two following options:
  - **Memory File** - You need to select a file on disk that matches one of the following memory file formats - Intel-Hex, Motorola-S, Actel-S or Actel-Binary. See "Memory File Formats" on page 11 for more information.
  - **No content** - The client is a place holder. You will be available to load a memory file using FlashPro/FlashPoint at programming time without having to go back to this configurator.
- **Use absolute addressing** - Lets the memory content file dictate where the client is placed in the eNVM block. The addressing in the memory content file for the client becomes absolute to the whole eNVM block. Once you choose the absolute addressing option, the software extracts the smallest address from the memory content file and uses that address as the start address for the client.
- **Start Address** - The eNVM address where the content is programmed.
- **Size of Word** - Word size, in bits, of the initialized client; can be either 8, 16 or 32.
- **Number of words** - Number of words of the client.

JTAG Protection

Prevents read and write of eNVM content from JTAG port. This is a security feature for application code (Figure 1-2).

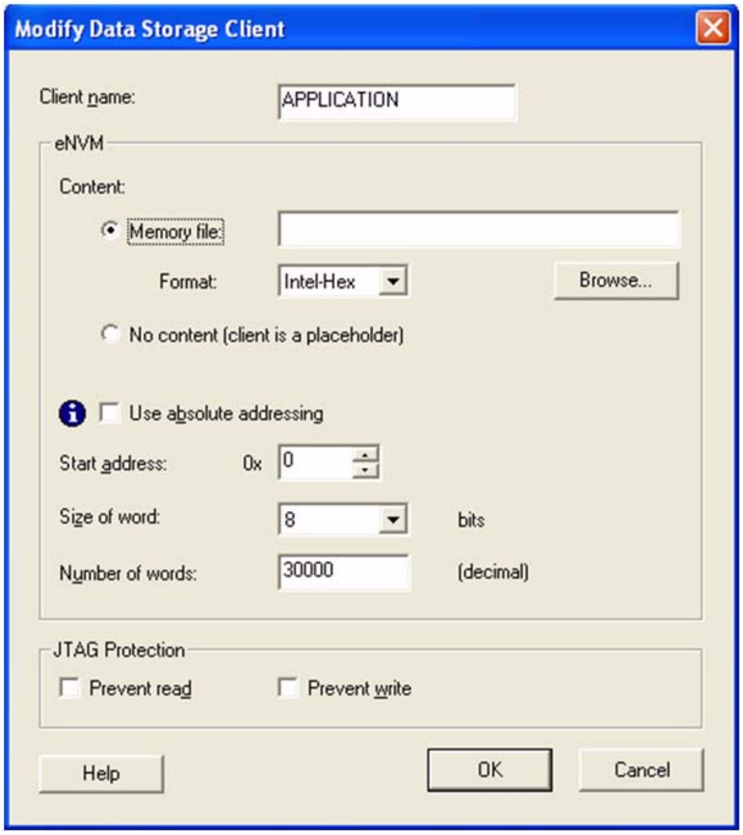

Figure 1-2 · Modify Data Storage Client in eNVM

Configuring an Initialization Client

For this client, the eNVM content and JTAG protection information is the same as the one described in "Configuring a Data Storage Client" on page 8.

Destination Information

- **Target address** - The address of your storage element in terms of the Cortex-M3 system memory map. Certain regions of the system memory map are not allowed to be specified for this client because they contain reserved system blocks. The tool informs you of the legal regions for your client.
- **Transaction size** - The size (**8**, **16** or **32**) of the APB transfers when the data is copied from the eNVM memory region to the target destination by the Actel system boot code.

- **Number of writes** - The number of APB transfers when the data is copied from the eNVM memory region to the target destination by the Actel system boot code. This field is automatically computed by the tool based on the eNVM content information (size and number of words) and the destination transaction size (as shown in Figure 1-3).

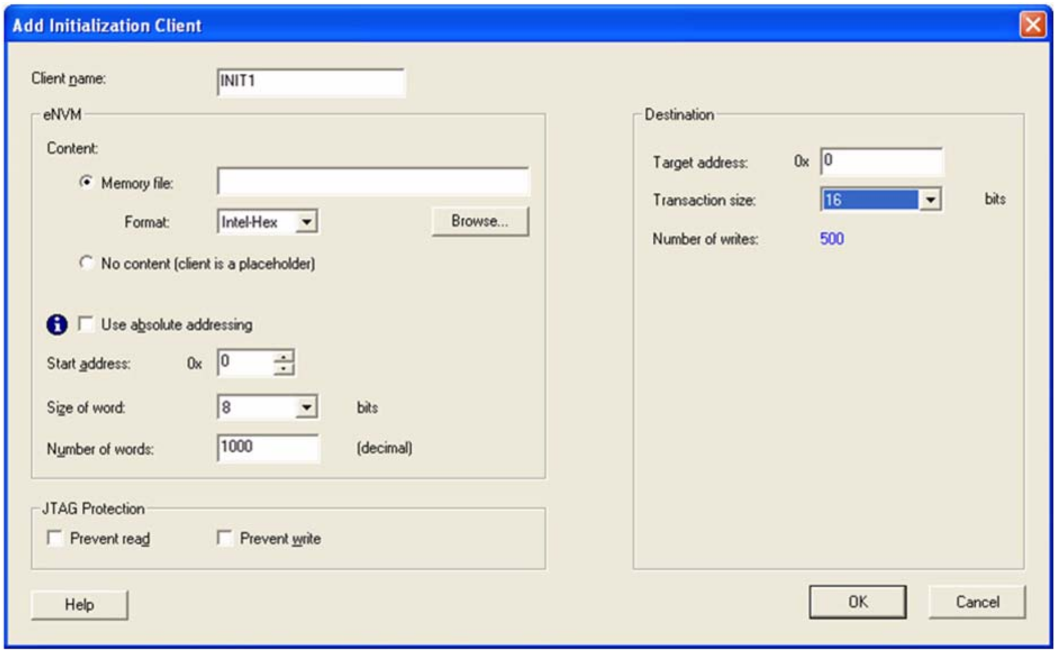

Figure 1-3 · Add Initialization Client in eNVM

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Memory File Formats

The following memory file formats are available as input files into the eNVM Configurator:

- INTEL-HEX
- MOTOROLA S-record
- Actel BINARY
- ACTEL-HEX

INTEL-HEX

Industry standard file. Extensions are HEX and IHX. For example, file2.hex or file3.ihx.

A standard format created by Intel. Memory contents are stored in ASCII files using hexadecimal characters. Each file contains a series of records (lines of text) delimited by new line, '\n', characters and each record starts with a ':' character. For more information regarding this format, refer to the Intel-Hex Record Format Specification document available on the web (search Intel Hexadecimal Object File for several examples).

The Intel Hex Record is composed of five fields and arranged as follows:

:llaaaatt[dd...]cc

Where:

- : is the start code of every Intel Hex record
- ll is the byte count of the data field
- aaaa is the 16-bit address of the beginning of the memory position for the data. Address is big endian.
- tt is record type, defines the data field:
  - 00 data record
  - 01 end of file record
  - 02 extended segment address record
  - 03 start segment address record (ignored by Actel tools)
  - 04 extended linear address record
  - 05 start linear address record (ignored by Actel tools)
- [dd...] is a sequence of n bytes of the data; n is equivalent to what was specified in the ll field
- cc is a checksum of count, address, and data

Example Intel Hex Record:

```
:10000000112233445566778899FFFA
```

Where 11 is the LSB and FF is the MSB.

MOTOROLA S-record

Industry standard file. File extension is S, such as file4.s

This format uses ASCII files, hex characters, and records to specify memory content in much the same way that Intel-Hex does. Refer to the Motorola S-record description document for more information on this format (search Motorola S-record description for several examples). The RAM Content Manager uses only the S1 through S3 record types; the others are ignored.

The major difference between Intel-Hex and Motorola S-record is the record formats, and some extra error checking features that are incorporated into Motorola S.

In both formats, memory content is specified by providing a starting address and a data set. The upper bits of the data set are loaded into the starting address and leftovers overflow into the adjacent addresses until the entire data set has been used.

The Motorola S-record is composed of 6 fields and arranged as follows:

Stllaaaa[dd...]cc

Where:

- S is the start code of every Motorola S-record
- t is record type, defines the data field
- ll is the byte count of the data field
- aaaa is a 16-bit address of the beginning of the memory position for the data. Address is big endian.
- [dd...] is a sequence of n bytes of the data; n is equivalent to what was specified in the ll field
- cc is the checksum of count, address, and data

Example Motorola S-Record:

```
S10a0000112233445566778899FFFA
```

Where 11 is the LSB and FF is the MSB.

Actel Binary

The simplest memory format. Each memory file contains as many rows as there are words. Each row is one word, where the number of binary digits equals the word size in bits. This format has a very strict syntax. The word size and number of rows must match exactly. The file extension is MEM; for example, file1.mem.

Example: Depth 6, Width is 8

```
01010011
11111111
01010101
11100010
10101010
11110000
```

Actel HEX

A simple address/data pair format. All the addresses that have content are specified. Addresses with no content specified will be initialized to zeroes. The file extension is AHX, such as filex.ahx. The format is:

AA:D0D1D2

Where AA is the address location in hex. D0 is the MSB and D2 is the LSB.

The data size must match the word size. Example: Depth 6, Width is 8

```
00:FF
01:AB
02:CD
03:EF
04:12
05:BB
```

All other addresses will be zeroes.

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Interpreting Memory Content

Absolute vs. Relative Addressing

In Relative Addressing, the addresses in the memory content file did not determine where the client was placed in memory. You specify the location of the client by entering the start address. This becomes the 0 address from the memory content file perspective and the client is populated accordingly.

For example, if we place a client at 0x80 and the content of the memory file is as follows:

Address: 0x0000 data: 0102030405060708

Address: 0x0008 data: 090A0B0C0D0E0F10

Then the first set of bytes of this data is written to address 0x80 + 0000 in the eNVM block. The second set of bytes is written to address 0x80 + 0008 = 0x88, and so on.

Thus the addresses in the memory content file are relative to the client itself. Where the client is placed in memory is secondary.

For absolute addressing, the memory content file dictates where the client is placed in the eNVM block. So the addressing in the memory content file for the client becomes absolute to the whole eNVM block. Once you enable absolute addressing option, the software extracts the smallest address from the memory content file and uses that address as the start address for the client.

Data Interpretation Example

The following examples illustrate how the data is interpreted for various word sizes:

For the given data: FF 11 EE 22 DD 33 CC 44 BB 55 (where 55 is the MSB and FF is the LSB)

For 32-bit word size:

```
0x22EE11FF (address 0)
0x44CC33DD (address 1)
0x000055BB (address 2)
```

For 16-bit word size:

```
0x11FF (address 0)
0x22EE (address 1)
0x33DD (address 2)
0x44CC (address 3)
0x55BB (address 4)
```

For 8-bit word size:

```
0xFF (address 0)
0x11 (address 1)
0xEE (address 2)
0x22 (address 3)
0xDD (address 4)
0x33 (address 5)
0xCC (address 6)
0x44 (address 7)
0xBB (address 8)
0x55 (address 9)
```

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Product Support

Actel backs its products with various support services including Customer Service, a Customer Technical Support Center, a web site, an FTP site, electronic mail, and worldwide sales offices. This appendix contains information about contacting Actel and using these support services.

Customer Service

Contact Customer Service for non-technical product support, such as product pricing, product upgrades, update information, order status, and authorization.

From Northeast and North Central U.S.A., call **650.318.4480**
From Southeast and Southwest U.S.A., call **650. 318.4480**
From South Central U.S.A., call **650.318.4434**
From Northwest U.S.A., call **650.318.4434**
From Canada, call **650.318.4480**
From Europe, call **650.318.4252** or **+44 (0) 1276 401 500**
From Japan, call **650.318.4743**
From the rest of the world, call **650.318.4743**
Fax, from anywhere in the world **650.318.8044**

Actel Customer Technical Support Center

Actel staffs its Customer Technical Support Center with highly skilled engineers who can help answer your hardware, software, and design questions. The Customer Technical Support Center spends a great deal of time creating application notes and answers to FAQs. So, before you contact us, please visit our online resources. It is very likely we have already answered your questions.

Actel Technical Support

Visit the Actel Customer Support website (www.actel.com/support/search/default.aspx) for more information and support. Many answers available on the searchable web resource include diagrams, illustrations, and links to other resources on the Actel web site.

Website

You can browse a variety of technical and non-technical information on Actel's home page, at www.actel.com.

Contacting the Customer Technical Support Center

Highly skilled engineers staff the Technical Support Center from 7:00 A.M. to 6:00 P.M., Pacific Time, Monday through Friday. Several ways of contacting the Center follow:

Email

You can communicate your technical questions to our email address and receive answers back by email, fax, or phone. Also, if you have design problems, you can email your design files to receive assistance. We constantly monitor the email account throughout the day. When sending your request to us, please be sure to include your full name, company name, and your contact information for efficient processing of your request.

The technical support email address is tech@actel.com.

Phone

Our Technical Support Center answers all calls. The center retrieves information, such as your name, company name, phone number and your question, and then issues a case number. The Center then forwards the information to a queue where the first available application engineer receives the data and returns your call. The phone hours are from 7:00 A.M. to 6:00 P.M., Pacific Time, Monday through Friday. The Technical Support numbers are:

650.318.4460
800.262.1060

Customers needing assistance outside the US time zones can either contact technical support via email (tech@actel.com) or contact a local sales office. Sales office listings can be found at www.actel.com/company/contact/default.aspx.

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