



# **CEC1702 Efuse Generator Tool Guide**

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Derek Carlson  
VP Development Tools

12-Sep-14  
Date

# CEC1702 Efuse Generator Tool Guide

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NOTES:

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### NOTES:

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# Chapter 1. Introduction

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## 1.1 CEC1702 EFUSE GENERATOR TOOL

### 1.1.1 Purpose

This document gives the introduction to the steps involved in CEC1702 Efuse programming as well as the hardware and software requirements for the custom Efuse programming once you get the blank part from Microchip.

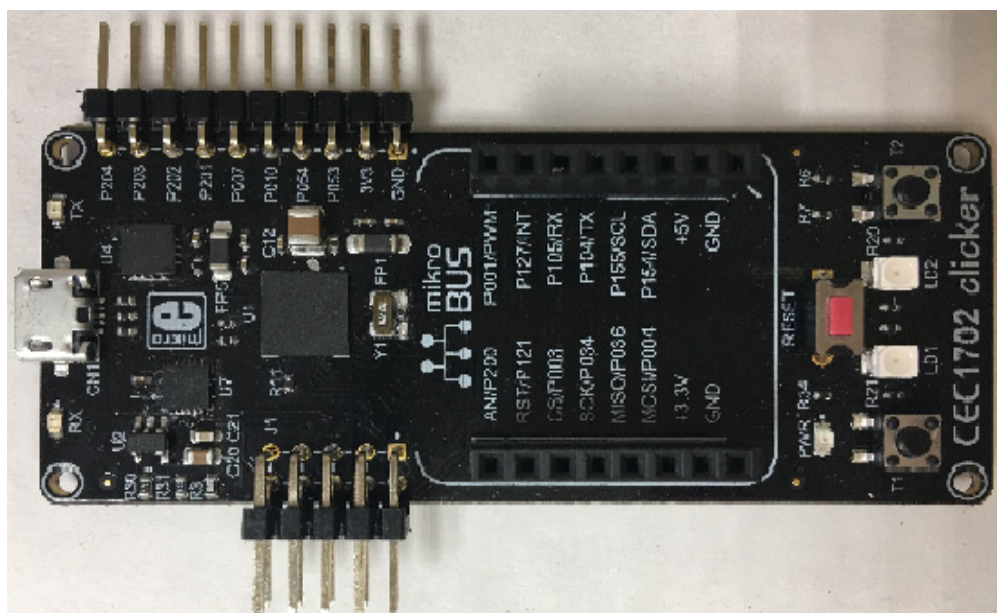
### 1.1.2 Introduction

This document gives a step by step information on programming the Efuse using the CEC1702 Efuse Generator Tool. Following these steps will ensure that the CEC1702 part is programmed correctly each time without facing any difficulty. The CEC1702 Efuse Generator Tool is responsible for generating private and public key pair, verifying private-public key pair validity, disabling the JTAG and ATE modes and generating the Efuse programming values. The input from the user is GUI based and is simple to use. The output from the tool is the binary file for programming the CEC1702 part on the Clicker board using any JTAG programmer tool. The tool also writes the Private and Public Key in an output file protected with the password set by the user while entering the parameters.

### 1.1.3 Introduction to Hardware

The picture of the hardware board used for programming is shown below in **Figure 1-1: “CEC1702 Clicker board”**.

**FIGURE 1-1: CEC1702 CLICKER BOARD**

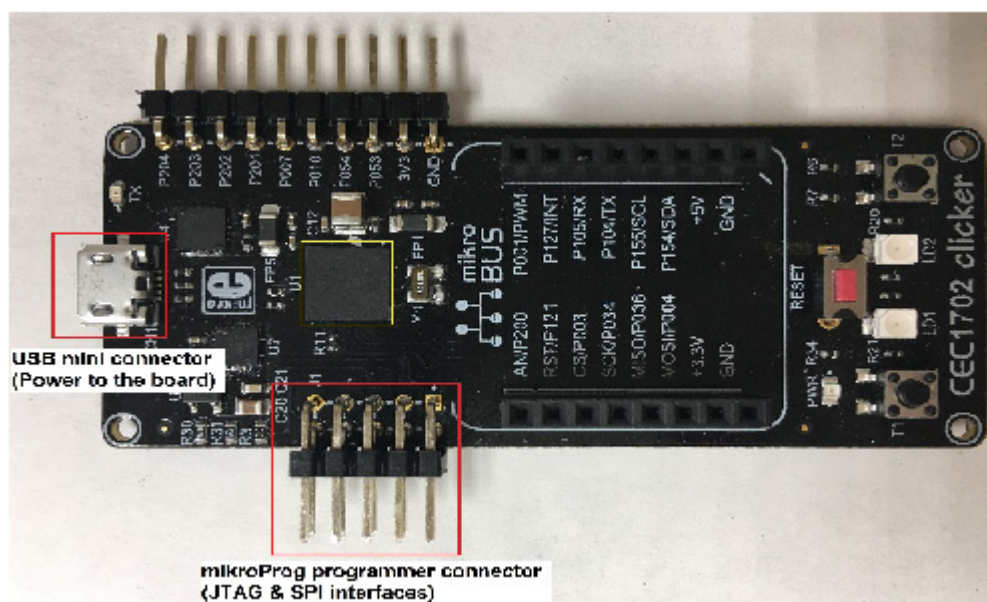


The Clicker board consist of following interfaces

1. USB mini Connector (Power to the board)
2. MikroProg Programmer connector (JTAG and SPI)

**Figure 1-2: “CEC1702 Clicker board Interface details”** shows the location of various interfaces listed above on the Clicker board:

**FIGURE 1-2: CEC1702 CLICKER BOARD INTERFACE DETAILS**



### 1.1.4 Introduction to Programming Utility

The CEC1702 Efuse Generator Tool is an executable file with the name “CEC1702\_efuseGEN.exe”. This tool is targeted to program following bits in the OTP:

1. ATE mode disable bit - Efuse byte 35 bit[7]
2. TAG enable bit on Boot ROM Exit - Efuse byte 34 bit[1] - Bit[4]
3. Authentication Bit for the ECDSA key generation - Efuse byte 483 bit[0]
4. Authentication key region - Efuse bytes 128 - 191
5. ECC private key region - Efuse byte 0 - 31
6. Custom User space region - Efuse byte 192 - 479
7. Custom TAG update region - Efuse bytes 508 - 509

Once you run the utility, **Figure 1-3: “CEC1702 Efuse Programming tool input form”** opens up. The user is required to fill the following information in the tool to generate the binary and hex file required to program the Efuse in CEC1702. Details about using this tool are described in **Chapter 2. “CEC1702 Efuse Generator Tool Procedure”**.



**FIGURE 1-3: CEC1702 EFUSE PROGRAMMING TOOL INPUT FORM**

CEC1702 Efuse Generator Tool Ver: 03.00

Set Environment Variables

Output Dir  Settings Browse

ATE Mode ☒ Enable ☐ Disable

JTAG ☒ Enable ☐ Disable

JTAG Mode ☐ SWD ☒ JTAG

Authentication ☐ Enable ☒ Disable

ECDSA Key filename  Enter ECDSA Key filename to generate

ECDSA password  Enter ECDSA Password

Use ECC Encryption Keys ☐

ECDH Key filename  Enter ECDH Key filename to generate

ECDH password  Enter ECDH Password

Use Alternate Tag0 ☐

Alternate TAG0  0000 Hex value - bit[23:8]

Use Custom space ☐

Custom input IDX  00  00 Data  Enter ☒ Hex ☐ Dec

GENERATE\_EFUSE\_DATA QUIT HELP

### 1.1.5 Prerequisites

Following are the prerequisites for generating the header, hex and binary file for programming described in **Chapter 2. “CEC1702 Efuse Generator Tool Procedure”**:

1. Clicker board with blank CEC1702 should be available.
2. The hardware board must have proper input circuitry for providing 1.59V Efuse programming voltage.
3. PC should have Windows10.
4. The user is expected to have downloaded and installed openssl version 1.0.1e. Please refer to following **Note**:
5. The user is expected to have downloaded the CEC1702 Efuse Generator Tool on your PC.
6. The user is expected to have any JTAG programmer tool installed on your PC for programming the Efuse hex / binary file in CEC1702 on Clicker board.
7. The user is expected to have read the CEC1702 data sheet and known all the encryption modes planned to be used in your system.
8. The user is expected to know which keys need to be generated for your system and application.

**Note:** CEC1702 Efuse Generator Tool is only supported for Windows at this time.

**Note:** One may download openssl from <https://www.openssl.org/source/old/1.0.1/>. Version number is openssl-1.0.1e.tar.gz or later.

**Note:** Please refer to CEC1702 Clicker board documentation for other requirements for executing step **2**.

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## Chapter 2. CEC1702 EFUSE GENERATOR TOOL PROCEDURE

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### 2.1 CEC1702 EFUSE PROGRAMMING PROCEDURE

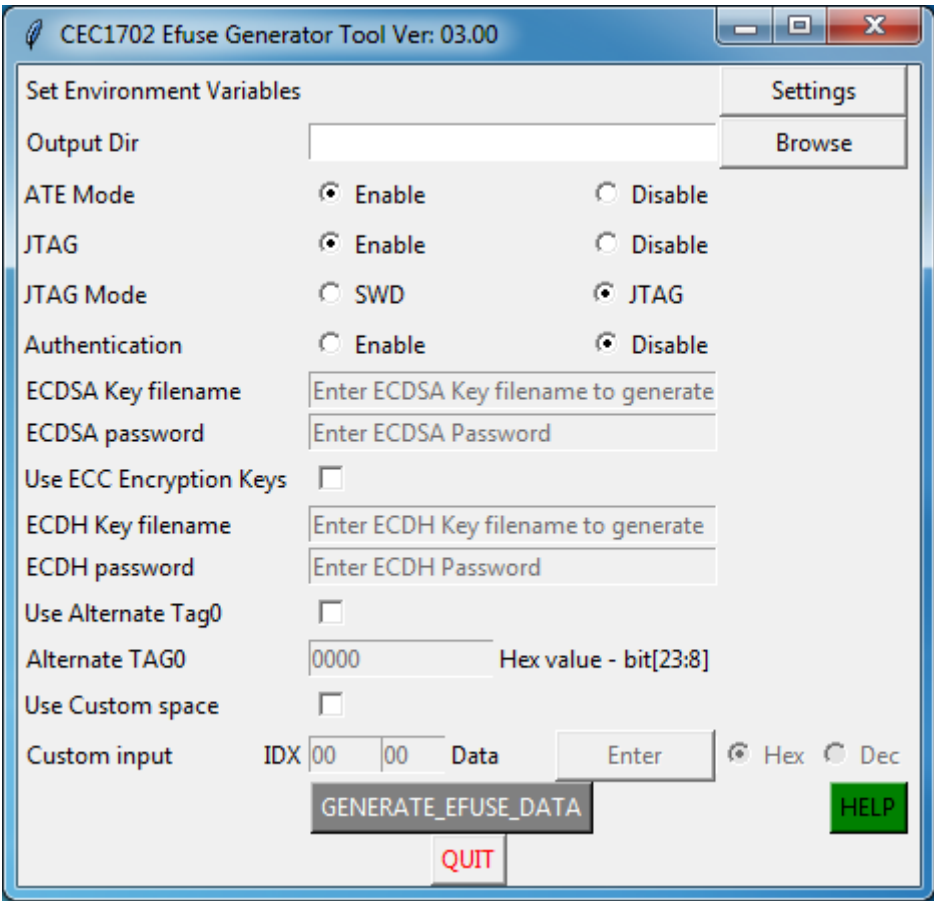
#### 2.1.1 Directory Structure

Once you download and uncompress the “CEC1702 Efuse Generator Tool” utility, the directory structure appears as shown below:

```
<efuse_generator>
| CEC1702_efuseGEN.exe      -> CEC1702 efuse generator
| config.ini                -> Environment file details
+---efuse
| +---original_binary      -> Build output Binaries
| |   otp_prog_original.bin -> Binary format
| |   otp_prog_original.hex -> Intel Hex format
| |
| \---test_keys            -> Test Key files
|   ecprivkey001.pem       -> Sample Private key
|   ecprivkey001_crt.pem   -> Sample Private Certificate
|   ecprivkey002.pem       -> Sample Private key
|   keys.txt
\---tools                  -> Support tools
    CEC1702_key_extractor.exe -> Tool to extract Key content
    openssl.exe              -> Tool to generate Keys
    srec_cat.exe             -> Tool for bin to hex conversion
```

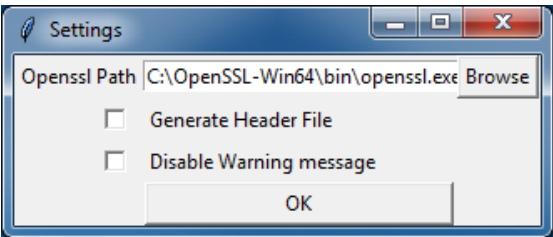
You may install the openssl tool at any other directory path also. In such a case you will have to provide the openssl tool path in Set Environment Variable “Settings” button. This is shown in **Figure 2-1: “CEC1702 Efuse Generator Tool Main Form”**.

FIGURE 2-1: CEC1702 EFUSE GENERATOR TOOL MAIN FORM



When you click the Settings button, form in **Figure 2-2: “Openssl Tool Path Setting”** opens up. Please set the path either by typing the full path or using the Browse option. Click “OK” button after entering the path and making the other choices in this window. The explanation of other options is mentioned in steps 3. and 4. of 2.1.3 “**Key Generation Steps**”.

FIGURE 2-2: OPENSSSL TOOL PATH SETTING

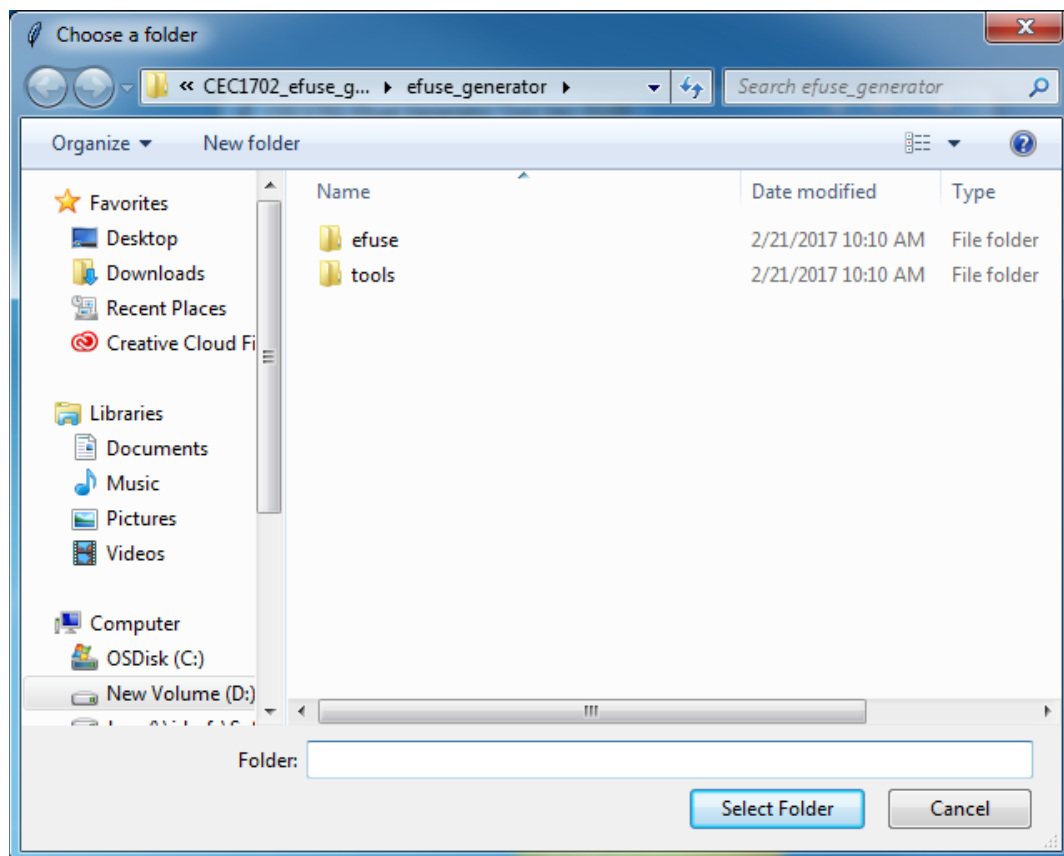


The setting of openssl tool path needs to be done only for the first time when you launch the program.

## 2.1.2 Output Files

You may define your own output directory for the output files generated from the tool. You may type the output directory path directly or select the output directory by clicking “Browse” button shown in **Figure 2-1: “CEC1702 Efuse Generator Tool Main Form”**. The window in **Figure 2-3: “Select Output Directory Form”** will open up. If the “Output Dir” field is left blank, the tool will be generating runtime output directory under <root>\efuse\ as efuse\_<YYYYMMDD>\_<WHHMMSS> where YYYYMMDD represents Year, Month and Date respectively and WHHMMSS represents the Week of the month, Hour, Minute and Second respectively.

**FIGURE 2-3: SELECT OUTPUT DIRECTORY FORM**



On program execution the tool generates two folders in the output directory “Output Dir”. These are “keys” and “out\_binaries”. As the name suggests, the files for programming the CEC1702 are stored in the “out\_binaries” directory. The ECDH private key (AES Encrypted), self signed certificate, ECDSA private key (AES Encrypted), ECDSA Self Signed Certificate and their corresponding certificate requests are stored in the “keys” directory. The pictorial representation of the same is given below:

```
<efuse_generator>
|
+---efuse
      |--efuse_<YYYYMMDD>_<WHHMMSS>  -> Output Dir self generated
      +---keys                        -> Contains all the keys
```

```
| <ECDH>.pem      -> ECDH Private key AES Encrypted
| <ECDH>_cert.pem -> ECDH Self Signed Certificate
| <ECDH>_csr.pem  -> ECDH Certificate Request
| <ECDSA>.pem     -> ECDSA Private key AES Encrypted
| <ECDSA>_cert.pem-> ECDSA Self Signed Certificate
| <ECDSA>_csr.pem -> ECDSA Certificate Request
| keys_info.txt   -> Generated Key details
| key_file.bin    -> key_file.bin extracted key output
|
|---out_binaries
| otp_efuse.bin   -> updated Binary with Efuse details
| otp_efuse.hex   -> Equivalent hex file for download
|
|---efuse_log.txt -> Efuse Log file
```

### 2.1.3 Key Generation Steps

Following are the steps to generate the Efuse binary and hex file for programming the CEC1702 blank chip:

1. Click on the “CEC1702\_efuseGEN.exe” file icon. This will open up **Figure 2-1: “CEC1702 Efuse Generator Tool Main Form”**.
2. Set the openssl path as described in section 2.1.1 “**Directory Structure**”.
3. If “Generate Header File” is selected in **Figure 2-2: “Openssl Tool Path Setting”**, the utility will generate a header file equivalent to the Efuse binary file. This file may then be used to add to any project environment, if required. If “Generate Header File” option is not selected, utility will not generate the header file. “Generate Header File” option must be used if the Efuse programmer tool requires header file.

**Note:** Please refer to JTAG programmer documentation for deciding which file format (.hex, .bin or .h) it requires for programming the Efuse of CEC1702.

4. The CEC1702 Efuse Generator Tool generates a warning message shown in **Figure 2-8: “Warning Message Before Generating The Keys”** and described in step 26. This message could be disabled using the “Disable Warning message” select option provided in settings window in **Figure 2-2: “Openssl Tool Path Setting”**.
5. Set the output directory path as described in section 2.1.2 “**Output Files**”.
6. Select Disable ATE radio button to bring the chip out of the ATE mode after Efuse / OTP programming. See **Figure 2-4: “Sample CEC1702 Efuse Generator Tool Entry”** for reference.
7. If there are more programming steps, you may choose to leave ATE Mode enabled.
8. Select JTAG Disable radio button to disable the JTAG interface after Efuse programming. See **Figure 2-4: “Sample CEC1702 Efuse Generator Tool Entry”** for reference.
9. Our recommendation is to disable JTAG mode after all the programming is completed in production.
10. JTAG mode allows you to choose between SWD (2-Wire) or JTAG(4-wire) mode. This option is only available when JTAG is Enabled. One may use this on engi-

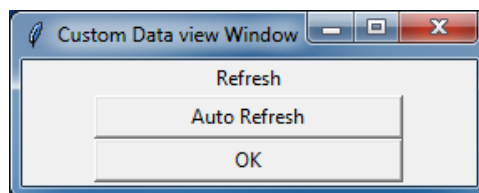
- 
- 
- neering parts for run time debug.
11. In case you would like to have authentication enabled, select the “Authentication” Enable radio button. This will in turn enable the firmware Header and Image signing.
  12. Only when authentication is enabled, one can generate the ECDSA Key. See **Figure 2-4: “Sample CEC1702 Efuse Generator Tool Entry”** for reference.
  13. If authentication of the firmware binary is enabled, in the field marked “ECDSA Key filename”, enter the file name for the ECDSA Key. One just needs to enter the key file name without extension. For example: myECDSAkey. See **Figure 2-4: “Sample CEC1702 Efuse Generator Tool Entry”** for reference.
  14. The “ECDSA Password” field will be used to protect the ECDSA Key using AES-256-CBC encryption. The generated Keys and Signatures will be encrypted using AES-256-CBC mode and stored in the output directory. See **Figure 2-4: “Sample CEC1702 Efuse Generator Tool Entry”** for reference.
  15. If ECC encryption Keys are required, select the “Use ECC Encryption Keys” select button. This will enable entry into the “ECDH Key filename” field. See **Figure 2-4: “Sample CEC1702 Efuse Generator Tool Entry”** for reference.
  16. If “Use ECC Encryption Keys” is selected, enter the file name for the ECDH Key. One just needs to enter the key file name without extension. For example: myECDHkey. See **Figure 2-4: “Sample CEC1702 Efuse Generator Tool Entry”** for reference.
  17. The “ECDH Password” field will be used to protect the ECDH Key using AES-256-CBC encryption. The generated Keys and Signatures will be encrypted using AES-256-CBC mode and stored in the output directory.
  18. If user wishes to use alternate Tag0, select “Alternate Tag0”.
  19. If “Alternate Tag0” is enabled, alternate TAG Fields will be added to the Efuse data. The user needs to provide bits [23:8] for the Alternate TAG address. The field must be written with hexadecimal value. For example: If address in SPI Flash is 0xAABBCC00, the user needs to write alternate tag field with 0xBBCC value. See **Figure 2-4: “Sample CEC1702 Efuse Generator Tool Entry”** for reference.
  20. If the user wishes to program the custom space in Efuse / OTP, one must select the “Use Custom space” field. See **Figure 2-4: “Sample CEC1702 Efuse Generator Tool Entry”** for reference.

**FIGURE 2-4: SAMPLE CEC1702 EFUSE GENERATOR TOOL ENTRY**

21. If “Use Custom space” field is enabled, Custom Efuse data space from 192-479 can be used for storing user data. Please refer to Chapter 37 “eFUSE Block” of CEC1702 Datasheet for more details.
22. The “Custom input” will be active if 'Use Custom Space' is selected. “IDX” refers to the custom space offset from 192-479 (decimal value, the equivalent hexadecimal value is 0xC0 to 0x1DF). “Data” refers to the data value to be written to the offset address. This tool allows the IDX and Data value to be entered in Hexadecimal (Hex) or Decimal (Dec) format with Radio Button selection option. The default mode is Hexadecimal. The user will need to add one data at a given address at a time and will need to use “Enter” button on the form to enter each data value in the location. IDX will be checked against valid entry for the custom space and return an error message, if the address offset value is outside range. **Figure 2-7: “Index Out Of Range Indication”** shows the error message window that would be displayed, if wrong entry is done. If the entry is correct the window shown in **Figure 2-5: “Custom Data View Window”** will pop up.
23. Clicking on “Auto Refresh” button of **Figure 2-5: “Custom Data View Window”** refreshes the custom data and address as it is entered. This is shown in **Figure 2-6: “Example Of Custom input Data display”**. Clicking the “OK” button will close the window and no further information on “Custom input” data will be displayed.

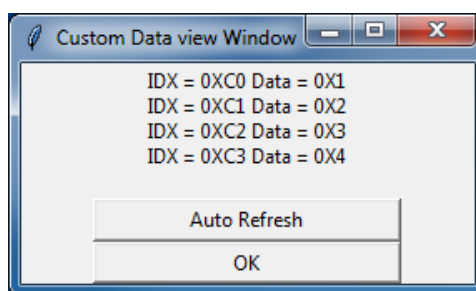


**FIGURE 2-5: CUSTOM DATA VIEW WINDOW**



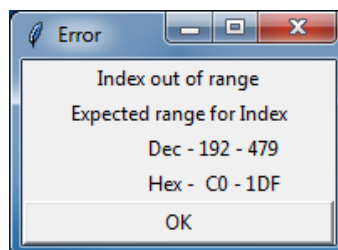
24. **Figure 2-6: “Example Of Custom input Data display”** shows an example of how the Custom input data would appear in the Custom Data View Window. These values in **Figure 2-6: “Example Of Custom input Data display”** are just for an example. Customers must program their required values in the custom data input field.

**FIGURE 2-6: EXAMPLE OF CUSTOM INPUT DATA DISPLAY**



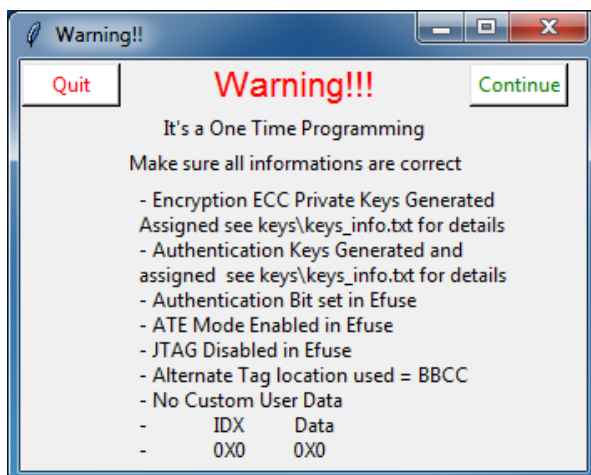
25. Click the “Generate Efuse” button to generate the Efuse key.
26. If “Disable Warning message” is not selected, the window shown in **Figure 2-8: “Warning Message Before Generating The Keys”** will pop up and will display the configuration options selected by the user along with the list of Custom inputs entered by the user along with the address where these are being programmed.
27. If there are changes to be made, the user may click the “Quit” button in the form shown in **Figure 2-8: “Warning Message Before Generating The Keys”** and re-enter his configuration. 'Quit' will exist out without generating any output files with default menu option. This means that the option selected earlier will be discarded and a fresh selection will have to be done.

**FIGURE 2-7: INDEX OUT OF RANGE INDICATION**



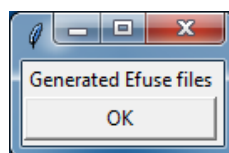
28. If the configuration is correct, the user may click the “Continue” button in the form shown in **Figure 2-8: “Warning Message Before Generating The Keys”** and generate the files.

**FIGURE 2-8: WARNING MESSAGE BEFORE GENERATING THE KEYS**



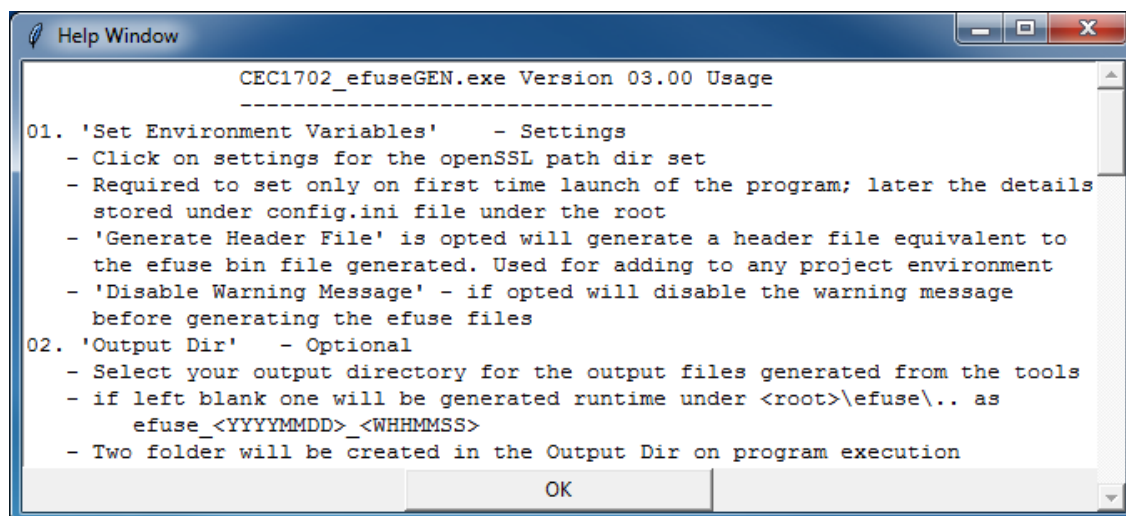
29. Once the generation is complete, you would get a pop up window as shown in **Figure 2-9: “Efuse File Generation Completion Message”**.
30. The output binary and hex file will be generated and stored in out\_binaries directory.
31. The output file names are fixed. These are otp\_efuse.bin, efuse\_data.h and otp\_efuse.hex.
32. If the programmer require a header file to compile with the environment, the efuse\_data.h header file may be used as the input. Please refer to step 3.
33. If any JTAG programmer is used to program the board, then otp\_efuse.hex or otp\_efuse.bin file will be used as the input, depending on the tool requirements. The start address of JTAG download code should be 0xE0000. Once your Efuse download is completed, write 0xE0349 to address 0x40002738 to the reset handler address itself, to launch the downloaded code.

**FIGURE 2-9: EFUSE FILE GENERATION COMPLETION MESSAGE**



34. The “HELP” button shown in **Figure 2-1: “CEC1702 Efuse Generator Tool Main Form”** is a good source of quick reference. The form shown in **Figure 2-10: “Help Window”** opens up on clicking the “HELP” button.

**FIGURE 2-10: HELP WINDOW**



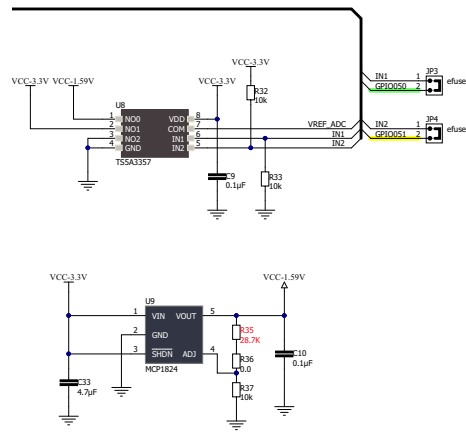
**Note:** Keys will not be visible in text format, unless requested to extract the portion of the keys.

**Note:** The user must ensure to keep the keys and password secure in his possession as there is no way to recover the keys after the device is programmed and the password for the encrypted keys is lost.





FIGURE A-2: SCHEMATIC DIAGRAM OF CEC1702 CLICKER BOARD



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