

**Evaluation of ADuC7132 using CANoe.LIN**  
**Analog Devices, Inc.**  
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## Revision History

Revision	Date	Remark
1.0	27.07.2007	Initial

## Introduction

The ADuC7132 is an automotive oil level sensor ASIC. The ADuC7132 incorporates a LIN (Local Interconnect Network) communication interface, compatible with the LIN 2.0 specification. Through this LIN interface, in combination with firmware in on-chip ROM, it is possible to configure the device's peripherals, download application code to the part or observe the contents of on-chip SRAM. The application for evaluating the ADuC7132 in this manner is implemented using CANoe.LIN from Vector Informatik GmbH.

**Note:** This application is presently in Beta sampling. ADI is not liable for the use of this software.

The CAPL source code is supplied, as is, and may be modified by the user as required.

It is assumed that the user of this application is already familiar with both the functionality of the ADuC7132 Oil Level Sensor and the LIN 2.0 specification.

## Functionality Overview

The CANoe.LIN configuration provided enables the user to perform the following operations on the ADuC7132:

- Download evaluation routine code to OTP memory
- Read/Write SFRs
- Read/Write RAM
- Read MANID

### **Download**

An important feature of this download operation is that the user is able to download their code to the OTP without blowing fuses. This particular download mechanism is intended to facilitate the flexible downloading of code modules to OTP for testing purposes.

A number of code modules are provided with the download utility. The procedure for using this code is described briefly here:

1. Download the file 'Boot.hex'; this handles interrupts regardless of the location in OTP from which the dependant code is executed by the user. As such it must be downloaded prior to all other code modules. It need only be downloaded once per device.
2. Download the subsequent user code to the specified pages of OTP. The location of the code is specified via the KEIL uVision3 'Target Options' for the project.

The download functionality also includes a 'Run' feature, which enables the user to execute their code from its specified location in OTP, after it has been downloaded to the ADuC7132.

It is also possible to blow the OTP page fuses one at a time. See the section on 'Using CANoe's Built-in Interactive Generator' to see how.

### ***Read/Write SFRs***

The Special Function Registers (SFRs) of the ADuC7132 are located in internal RAM at address range 0x80-0xFF. The values at these locations are accessible for reading and writing via CANoe.LIN.

This permits the user to step by step write to SFRs, thus giving them virtually complete control of the peripherals.

### ***Read/Write RAM***

During the course of evaluation, the user may wish to avail of short sequences of code that will be downloaded to the ADuC7132 and executed, which might store a series of data into RAM for later analysis.

Therefore, capability is provided to read (and write) the internal RAM, located at address range 0x00-0x7F.

### ***Read MANID***

The top 128 bytes of OTP are reserved for ADI and programmed by ADI before shipping to the customer. This area contains calibration values and the code for loading these values to the appropriate SFRs.

These calibration values may be observed by the user through the 'Read MANID' feature.

# Using the Download Feature

## Opening the configuration

Upon opening the CANoe.LIN configuration "ADuC7132Evaluation.cfg", the user is prompted with the following message.

Click 'OK'.

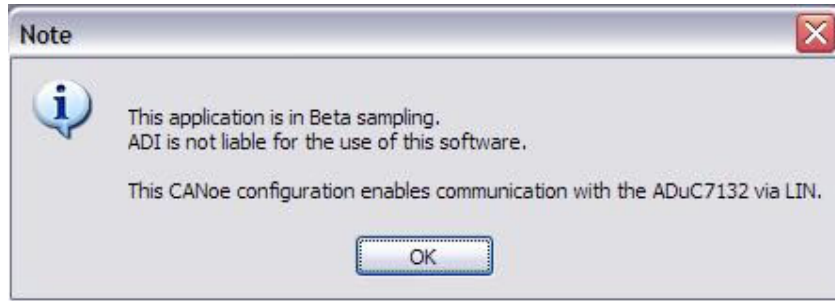


Fig. 1 – Note to user

The CANoe configuration will then load and the "ADuCEvaluationControls.ADuC7132Evaluation" panel will be displayed as shown below.

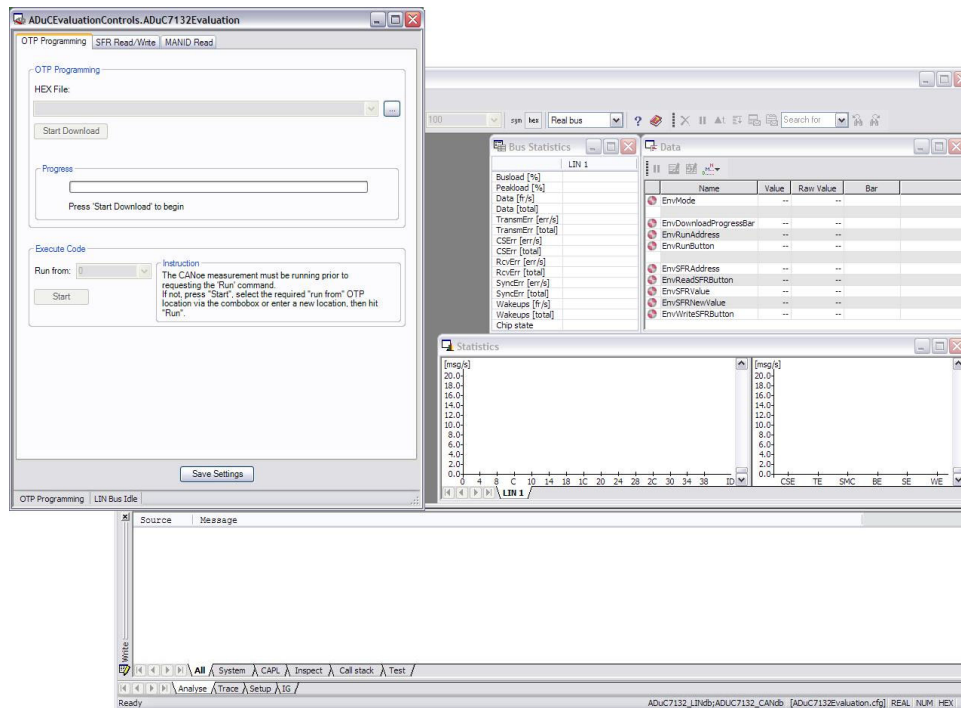
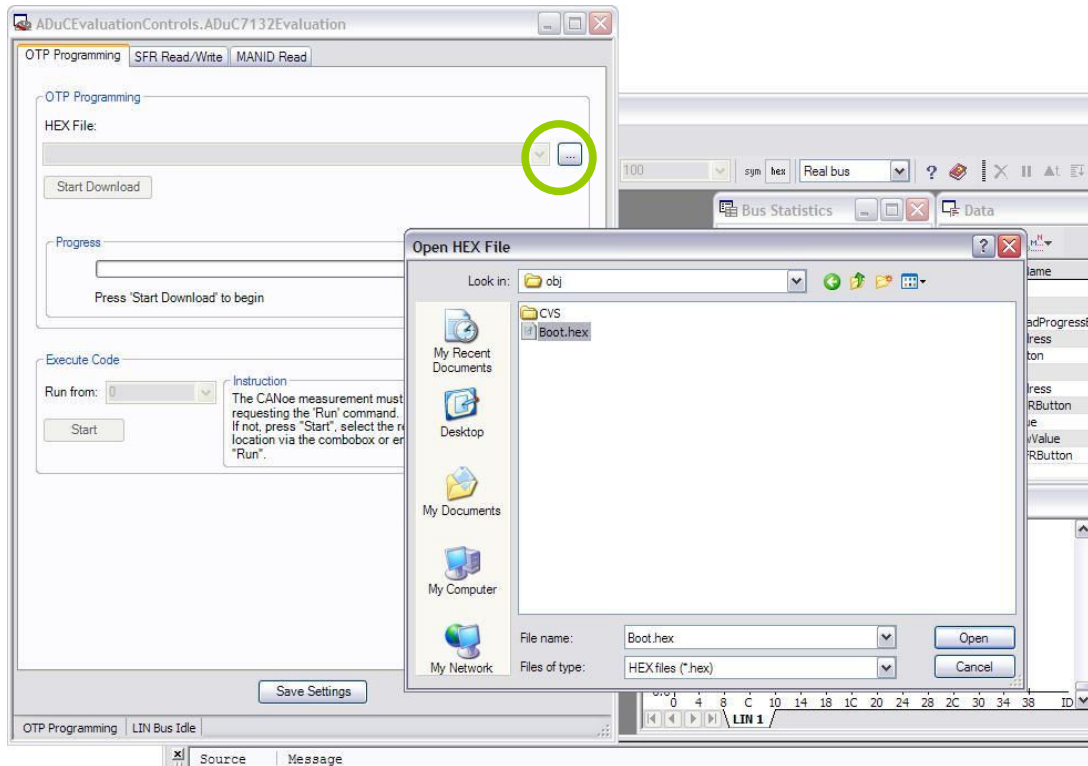


Fig. 2 – ADuC7132 Evaluation Panel in CANoe.LIN

**To start a download**

To begin downloading, click on the '...' button and browse to the Intel HEX file of the code to be programmed to the ADuC7132.

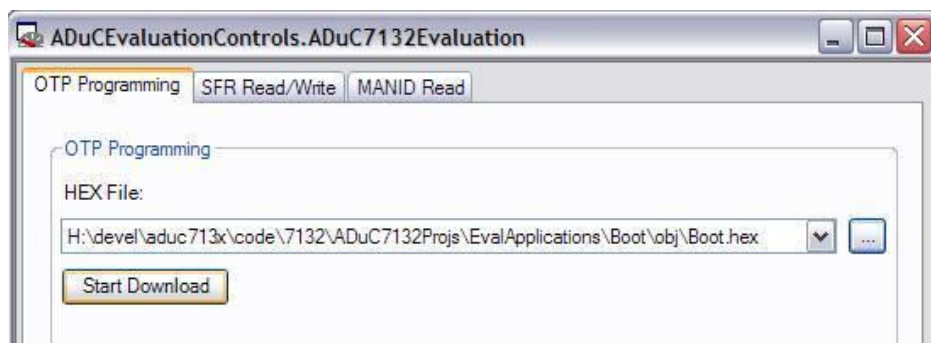


**Fig. 3 – Opening a Hex file for download**

Then click 'Start Download'.

Code should begin to be programmed to the device and the user will be updated on the progress of the download in the 'Progress' group box.

Information on the data being communicated to the ADuC7132 is also available in the analysis 'Write' and 'Trace' windows in CANoe. Please refer to the CANoe.LIN user manual for further information, if required.



**Fig. 4 – Starting the download**

Once download has completed successfully, the user may proceed to evaluate the part via the 'SFR Read/Write' tab or they may download another sequence of code to a different location in OTP.

To continue download more code sequences, click 'Stop' and repeat the procedure as described above.

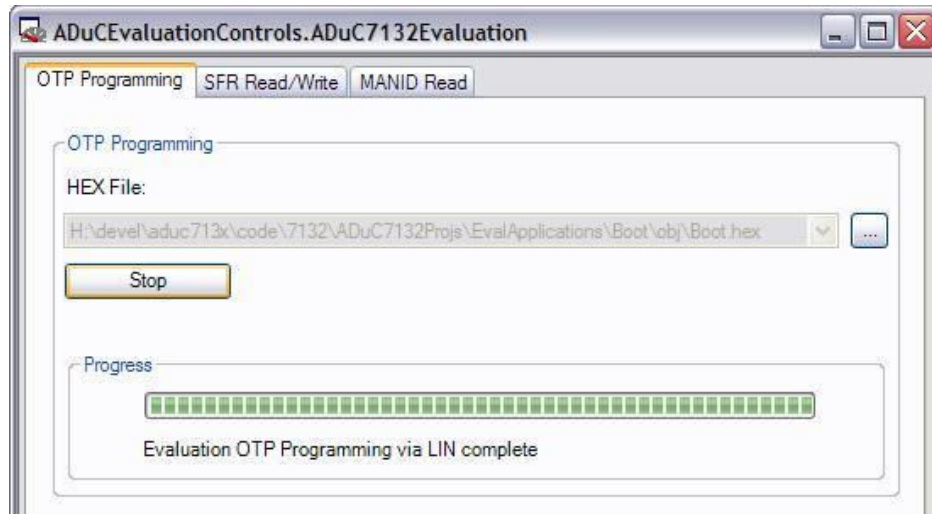


Fig. 5 – Stopping the download

### Execute Code

The downloaded code may be executed upon completion of download. The user will see the 'Run' button in the 'Execute Code' group box. The user must specify the address in OTP from which the code is to be executed. The location of the code in OTP will have been specified in the user's KEIL uVision3 project 'Target Options' and it will have been downloaded to the corresponding location by the downloader.

Enter the starting address of the code in hexadecimal format (omitting the '0x' prefix) or select previously used addresses from the dropdown list (click '▼' to show). Click 'Run'.

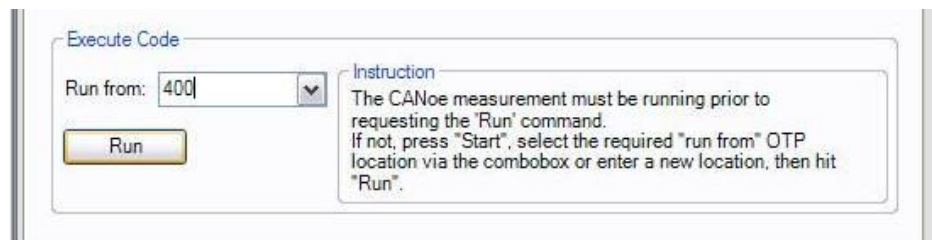
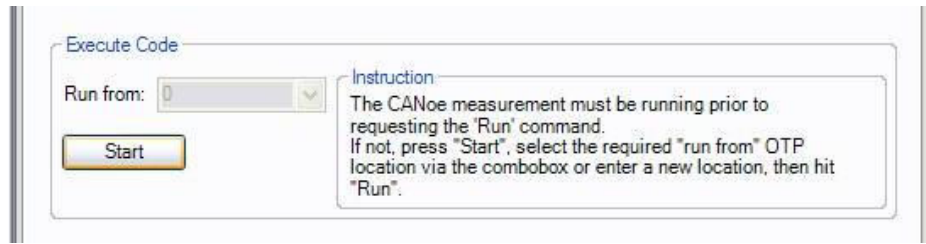


Fig. 6 – 'Run' command to execute code from OTP (e.g. @ location 0x0400)

If 'Run' is not shown, and instead the button is named 'Start', then 'Start' must be clicked to first begin the CANoe *measurement* so that the 'run' command can be requested subsequently.

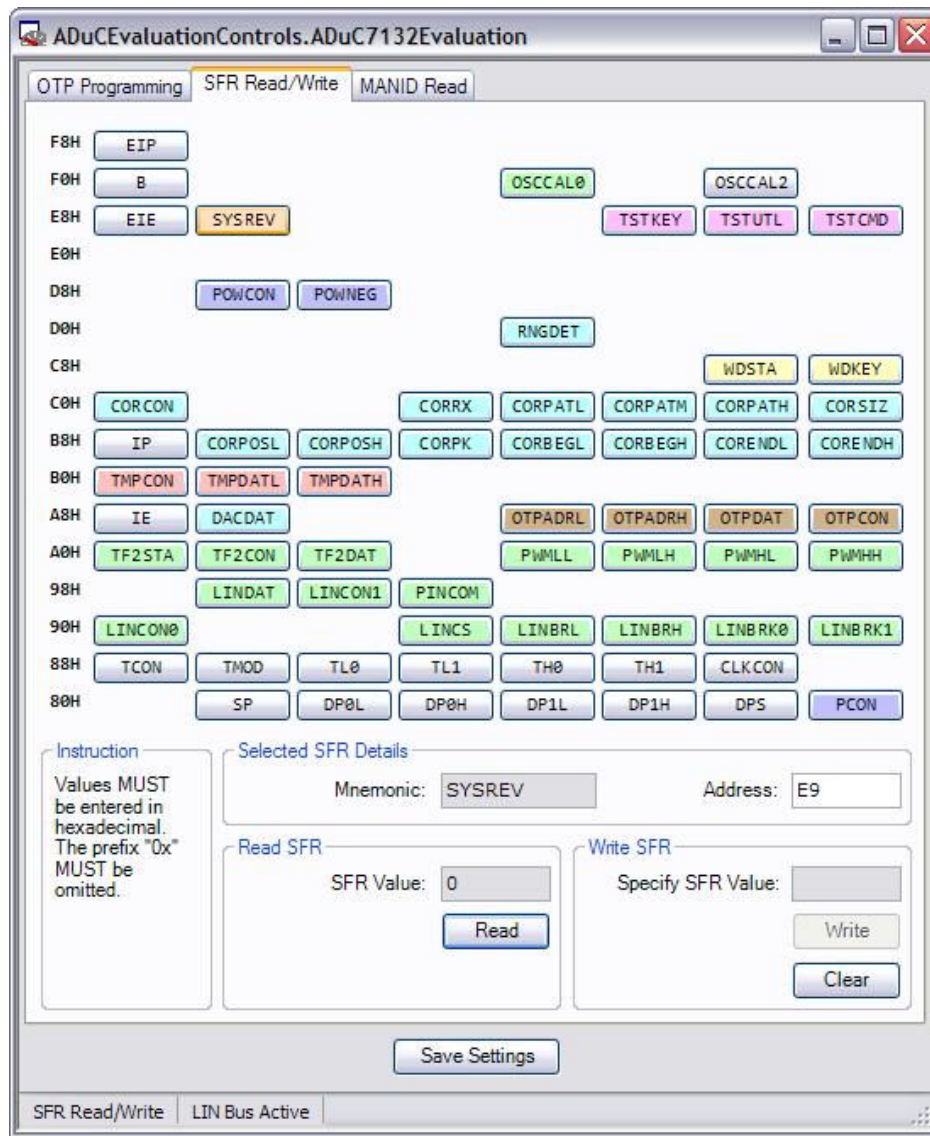


**Fig. 7 – CANoe measurement must be started before requesting 'Run' command**

On clicking 'Start', the button name will change to 'Run'.



## Using the Read/Write SFR & RAM Feature



**Fig. 8 – Read/Write SFRs tab on ADuC7132 Evaluation panel**

To read/write an SFR either select it from the table or manually enter it in the 'Address' text field.

To read the value contained in the SFR, press the 'Read' button.

To write a value to an SFR, enter the required value (in hexadecimal format, with NO '0x' prefix) into the 'New SFR Value' text field. Press the 'Write' button. Use 'Read' to subsequently read back the written value.

Some SFRs are either read-only or write-only. The accessibility of a particular SFR will be reflected in the enabled/disabled condition of the 'Read' and 'Write' buttons, i.e. for a read-only SFR, the user will only be able to click the 'Read' button, while the 'Write' button will be disabled.

This only applies for an SFR selected via the table provided.

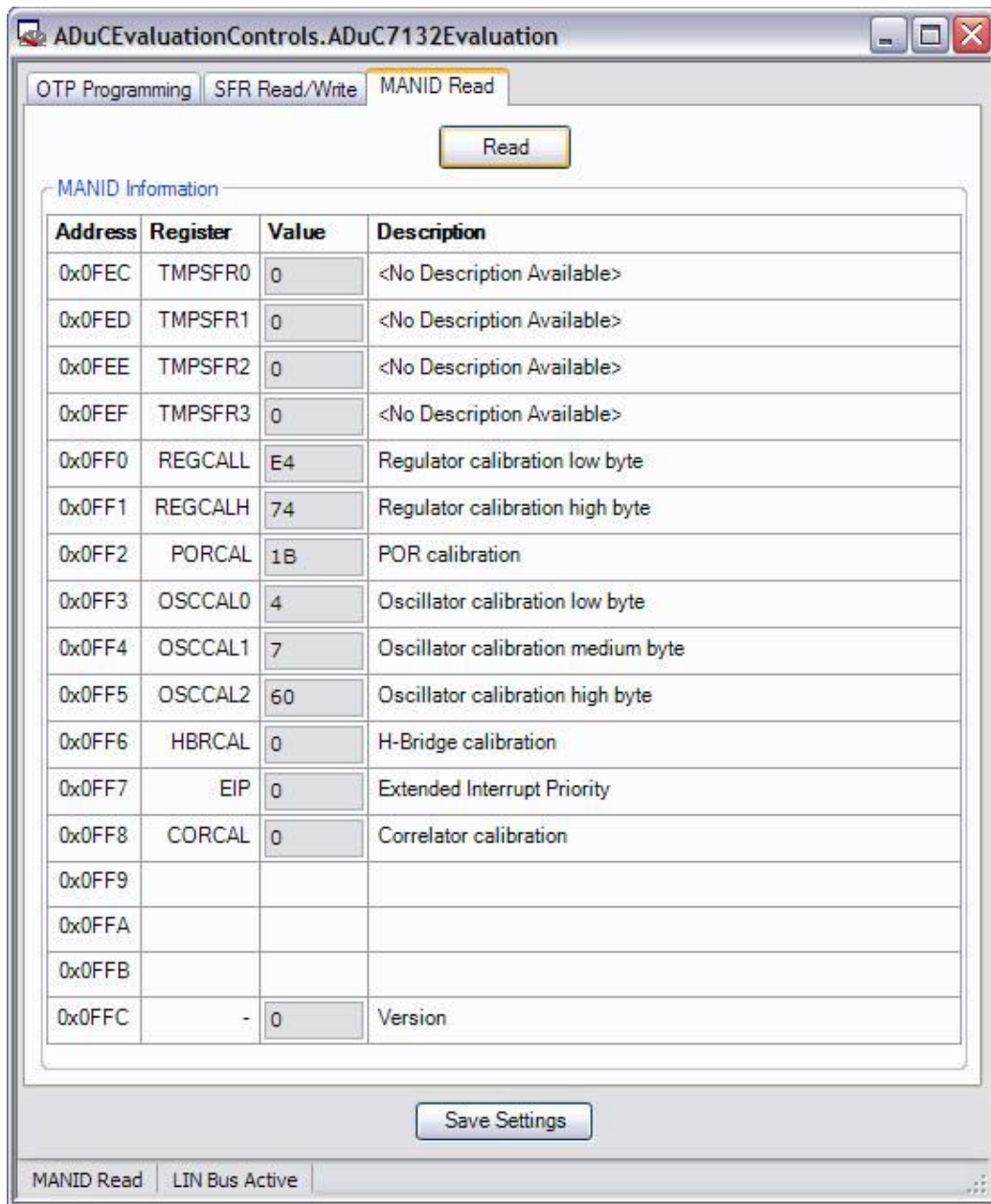
To read from or write to a location in RAM manually enter the required address in the 'Address' text field.



**Fig. 9 – Read/Write RAM (e.g. write 0xAD to RAM location 0x21)**

Reading and writing is performed in the same manner as for an SFR.

## Using the Read MANID Feature



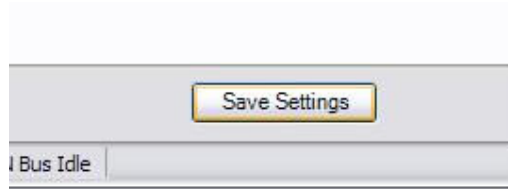
**Fig. 10 – Read/Write SFRs tab on ADuC7132 Evaluation panel**

To read the register trim values back from the MANID, select the 'MANID Read' tab and click the 'Read' button. All trim values as defined in the MANID will be read-back automatically.

## Save Settings

User selections can be saved in order to be automatically recalled the next time the CANoe configuration is opened. Saved settings include:

- File last selected for download
- Last address selected from which to execute code
- Previous SFR selected (Note: this is a reminder only, to read/write the SFR it should be selected again from the table).



**Fig. 11 – Save user settings button**

To save user selections so that they are restored the next time the configuration is opened, click the 'Save Settings' button at the bottom of the "ADuCEvaluationControls.ADuC7132Evaluation" panel.

# Using CANoe's Built-In Interactive Generator

All the commands of the downloader firmware [1] contained in ROM are available to the user via CANoe's built-in Interactive Generator (IG).

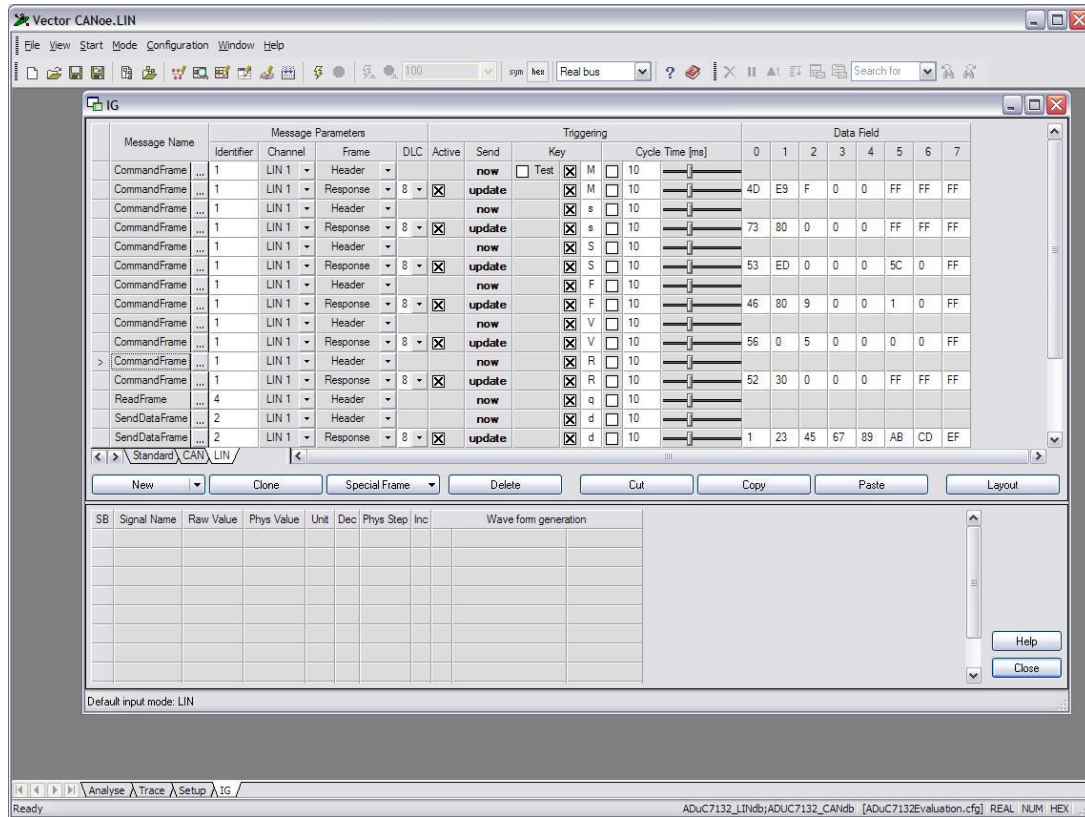


Fig. 12 – Interactive Generator feature in CANoe

All commands are as described in the ADuC7132 LIN Downloader Proposal document [1].

The user specifies the required bytes as per the LIN downloader. Note the first byte (Byte 0) of each of these commands is already correctly specified. The command is requested by pressing the corresponding 'Key' on the keyboard. **Note: 'Key' characters are case sensitive.**

### Example 1: 'Fuse' command

Action: Blow the fuse for OTP Page 3.

In the 'Data Field' corresponding to the 'Key' 'F' enter the following:

Key	Data Field							
	0	1	2	3	4	5	6	7
'F'	46	80	01	00	00	01	00	FF

The address for OTP Page 1 is 0x0080.

The LSB of the address (0x80) is stored in byte 1.

The MSB of the address (0x01) is stored in byte 2.

Setting byte 5 to '1' blows the fuse for OTP Page 3.

**Example 2: 'Verify' command**

To verify the checksum of OTP Page 1 assuming a known expected checksum of 0x1D67.

In the 'Data Field' corresponding to the 'Key' "V" enter the following:

	<b>Data Field</b>							
<b>Key</b>	0	1	2	3	4	5	6	7
'V'	46	80	00	00	00	67	1D	FF

The address for OTP Page 1 is 0x0080.

The LSB of the address (0x80) is stored in byte 1.

The MSB of the address (0x00) is stored in byte 2.

The LSB of the expected checksum (0x67) is stored in byte 5.

The MSB of the expected checksum (0x1D) is stored in byte 6.

Subsequently, the user must request a 'Read Frame' (by pressing the 'q' key).

The response bytes 0-6 should be identical to the 'Verify' command request.

Byte 7 will be 0xFF if the checksum is as expected.

OR

Byte 7 will be 0x00 if the checksum does NOT match the specified expected checksum.

## References

- [1] Analog Devices, Inc., 'ADuC7132 LIN Downloader Proposal', 1<sup>st</sup> May 2007