Analog Devices, Inc.
Protocol 6 Flash/EE Programming via LIN
Downloading software with CANoe.LIN

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Version: 3.0

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Purpose

This document describes an application which demonstrates programming the ADuC703X series device's integrated Flash/EE using *CANoe.LIN* from *Vector* (http://www.vector-informatik.de).

This is a draft document and is subject to change.

It is assumed that the user is familiar with Vector CANoe and with the LIN 2.0 specification.

Overview

The ADuC703X series of microconverters from Analog Devices Inc. support the programming of the device's integrated Flash/EE via LIN [1]. This feature is targeted towards automotive applications where the ADuC703X can be integrated into a *LIN network cluster* as a *LIN slave node*, thereby enabling the device to be programmed as required without the need to physically dismount the electronic control unit (ECU) that houses the ADuC703X device.

This document describes a demo application that enables the programming of an ADuC703X device via LIN. The application uses Vector's CANoe with the LIN bus option (referred to as CANoe.LIN) and the *CANcaseXL* hardware with a single LIN channel.

The LIN downloader application adheres to the LIN Flash/EE programming requirements specification [1].

Introduction

This document provides the user with a simple step-by-step procedure on how to program the ADuC703X using the CANoe.LIN-based LIN downloader application.

Setup

The first step is the connection and configuration of the physical hardware involved. This section describes the setup of the hardware components used in the application. The ADuC703X device, acting as a LIN slave, should be connected via the LIN bus to the LIN Master, which in this case is emulated by the Vector CANcaseXL hardware. As LIN messages are transmitted on the bus by the LIN Master according to a predefined schedule, all LIN traffic will be traced and can be observed on the PC using CANoe.LIN. The hardware interconnection is illustrated in figure 1.

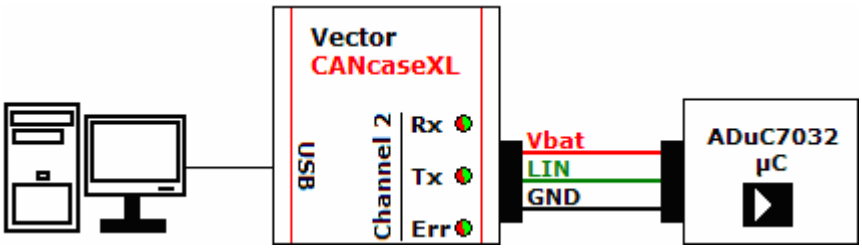


Figure 1 - Hardware setup for CANoe.LIN LIN downloader application

Vector CANcaseXL

The Vector CANcaseXL hardware with LIN channel is connected to the PC via USB. The CANcaseXL, or equivalent Vector hardware, is configured via the '*Vector Hardware Config*' window, which is accessed by going to:

- **Start > Control Panel > Vector Hardware**

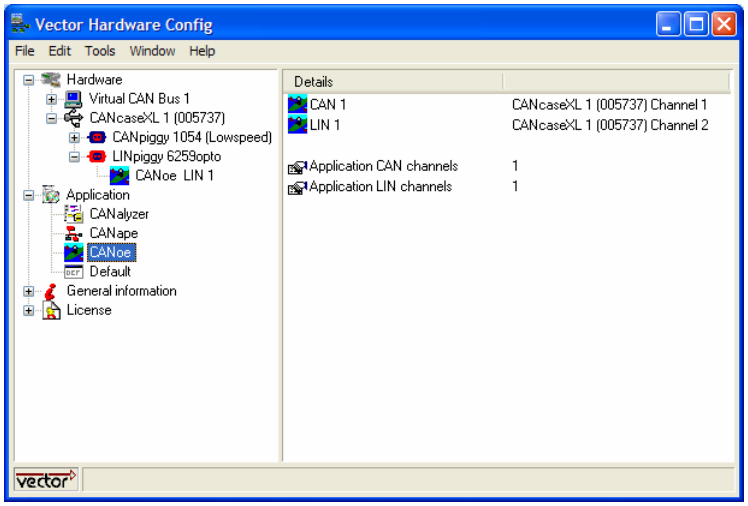


Figure 2 - Vector CANcaseXL hardware configuration

Figure 2 shows the CANcaseXL configuration for the CANoe application. The LIN bus, named LIN 1, is active on Channel 2 (via the LINpiggy 6259opto).

Note: Interconnecting Pin3 and Pin4 of the D-Sub connector on the XL Interface causes the internal voltage supply of the LINpiggy to be disconnected. Since the recessive level on the bus depends on the supply voltage of the Master it is advisable to operate the LINpiggy with an external supply voltage that is also used by the other bus nodes. Only then cross currents can be prevented between the individual nodes on the LIN bus.

ADuC703X Microcontroller

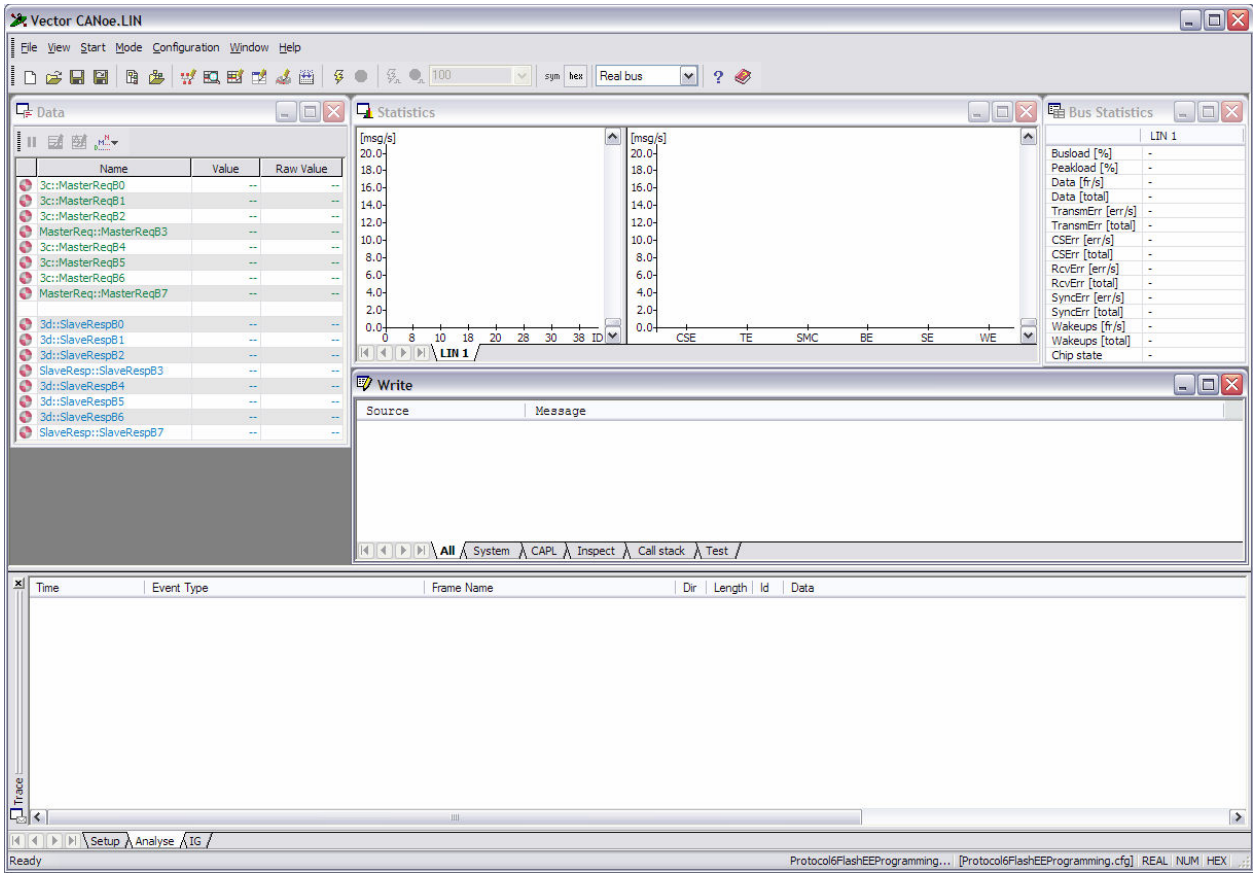
The ADuC703X series microcontrollers contain a kernel which implements the LIN Flash/EE Programming protocol as described in [1].

Procedure

The step-by-step procedure of programming the Flash/EE on the ADuC703X device via LIN using CANoe.LIN is described in this section.

How to…

1. Open the CANoe configuration file: "Protocol6FlashEEProgramming.cfg"



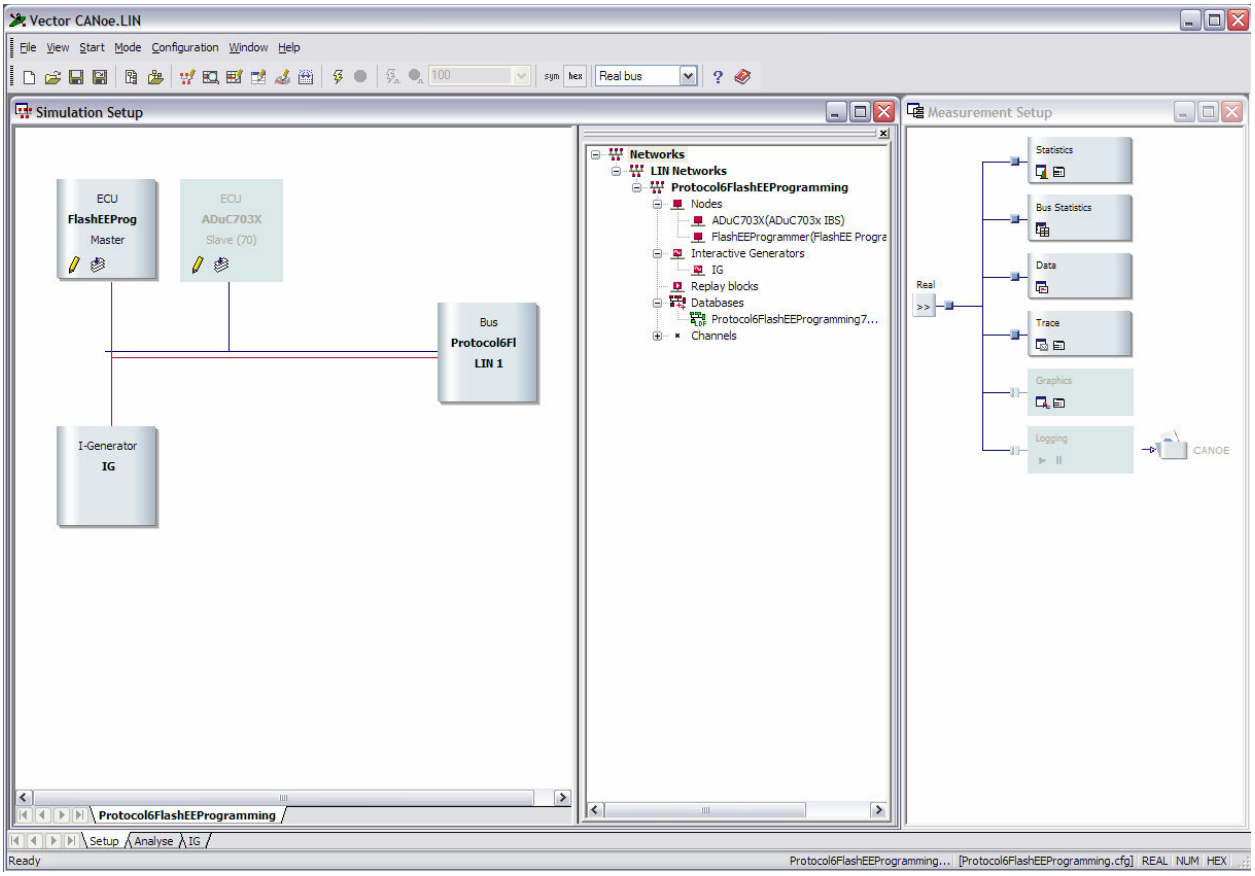


Figure 3 - CANoe.LIN configuration for LIN Flash/EE Programming application

This application is configured for two nodes: *FlashEEProgrammer* (LIN Master) and *ADuC703X* (LIN Slave).

The CANcaseXL is setup to simulate the LIN Master and the *'ADuC703X'* is implemented by a real ADuC703X node.

Note: the state of the node is indicated by the color of the bus line to which the node is connected:

——— Simulated

——— Real

2. Specify the file to be Flash/EE programmed via LIN

Firstly the user should generate the required binary file using either the *'Binary LIN Data Generator (BLDGenee)'* GUI application [3], or the '*Binary LIN-downloadable File Generator (BLFGenee)*' command line version [2]. The generated '.blf' file is a binary formatted file which contains the data that is to be programmed to the ADuC703X's integrated Flash/EE via LIN.

Note: The generated '.blf' file should be saved to the same directory as that of the CANoe application's configuration (.cfg) file.

The user must then manually code the filename of this '.blf' file into the CAPL program block that represents the LIN Master. The file that implements the LIN Master CAPL program block is *'Protocol6FlashEEr.can'*. In order to open *'Protocol6FlashEEr.can'*:

- Left-click the pencil icon on the *'FlashEEProgrammer'* node in the *'Simulation Setup'* window of CANoe.LIN as shown in figure 4.

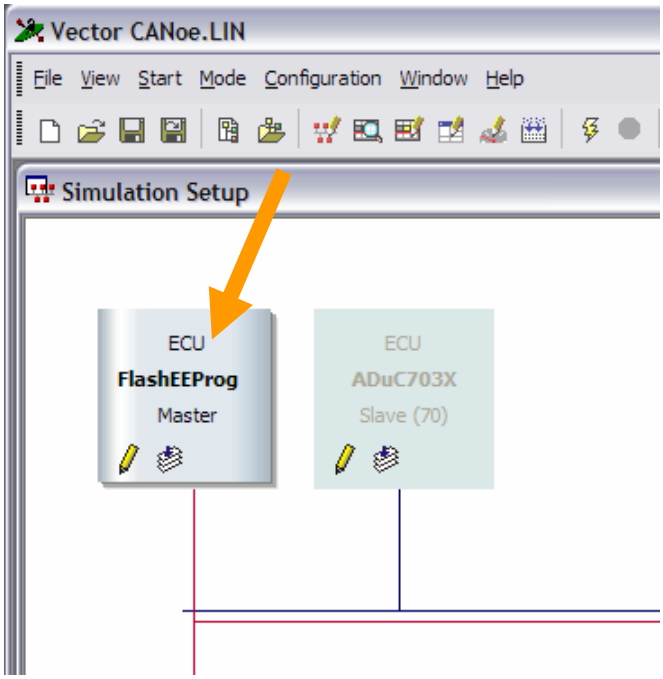


Figure 4 - Opening the LIN Master CAPL program block

The location where the '.blf' filename is to be coded into *'Protocol6FlashEEr.can'* is shown in figure 5. This depicts the *'Variables'* window and the ***'char caAppCode[32]'*** variable that is to be edited.

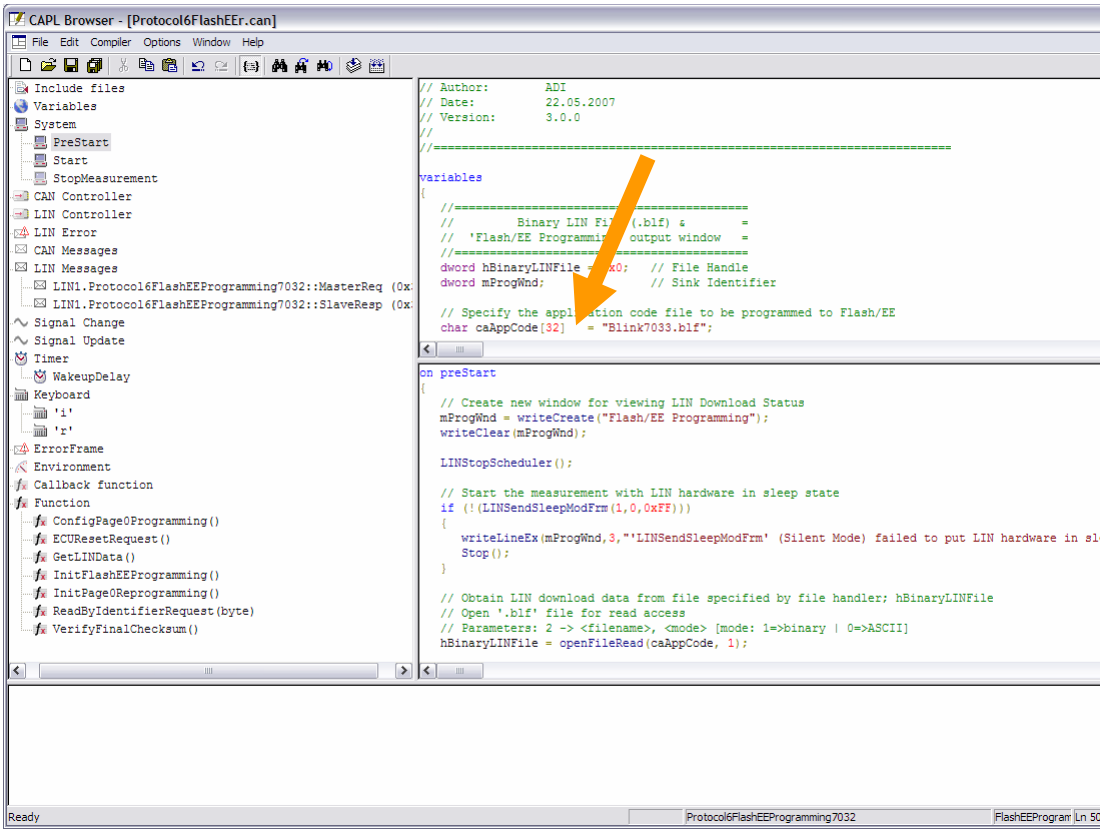


Figure 5 - LIN Master CAPL program block (LinMaster.can)

3. Enter download mode of the ADuC703X microconverter

For convenience, a typical entry procedure is briefly described here:

i. Ensure location 0x14 in Flash/EE memory is set to the 32 bit value: 0xFFFFFFFF

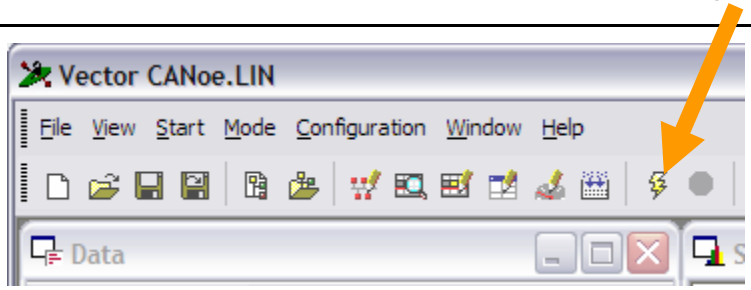
ii. Hold the *nTRST* pin low (e.g. connect Pin 11 on the ADuC703X to ground)

iii. Perform a reset.

After a reset the kernel checks the *nTRST* pin to see which state it is in. If it is held low the kernel monitors location 0x14. If the 32 bit contents at that location equal 0xFFFFFFFF the kernel download mode is entered.

4. Start the simulation

To start the LIN Flash/EE programming application, on the CANoe.LIN window click the *'Start'* icon or press the *F9* key.



The ADuC703X Flash/EE Programming via LIN begins automatically.

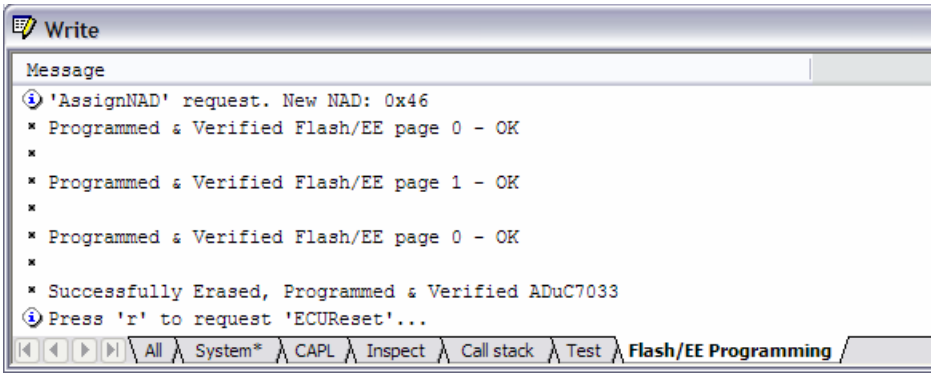
5. Observe the 'ADuC703X Flash/EE Programming via LIN' sequence

Two useful methods of observing the progress of the Protocol 6 Flash/EE Programming via LIN are described in this section. These can be found by going to the CANoe application desktop labeled 'Analyse'.

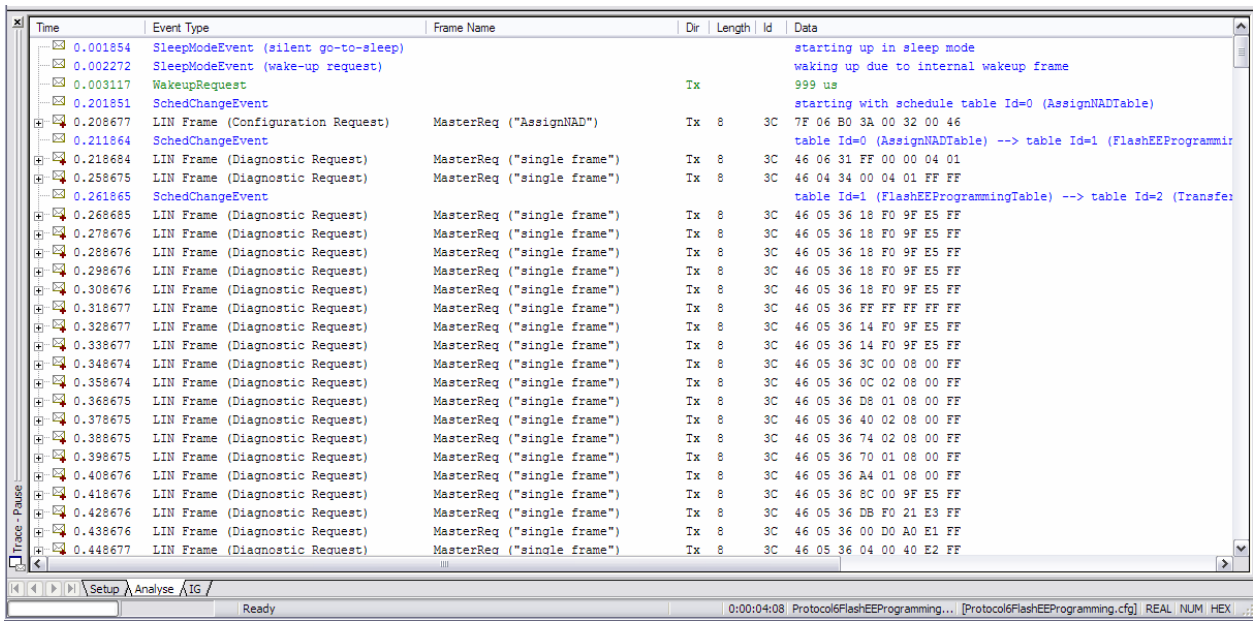
i. When the CANoe application is started a tab called *'Flash/EE Programming'* is added to the write window. Information about the progress of the download is output here, including:

- The status of the current Flash/EE page programmed
- When all pages have been programmed, the checksum across all pages is calculated and output to this tab
- Error information
- Required user action prompt

The following figure illustrates these points.



ii. The user can observe all LIN messages transmitted and received over the entire Flash/EE programming sequence in the *'Trace'* window.



6. Request adhoc LIN diagnostic commands

All LIN diagnostics commands specified in the “Protocol 6 Flash/EE Programming via LIN” specification may be requested manually by the user. This functionality is provided via the *‘Interactive Generator’* feature of CANoe, which enables the user to specify the values of a particular LIN Diagnostic command prior to requesting it. This feature is located on the CANoe application desktop labeled ‘IG’.

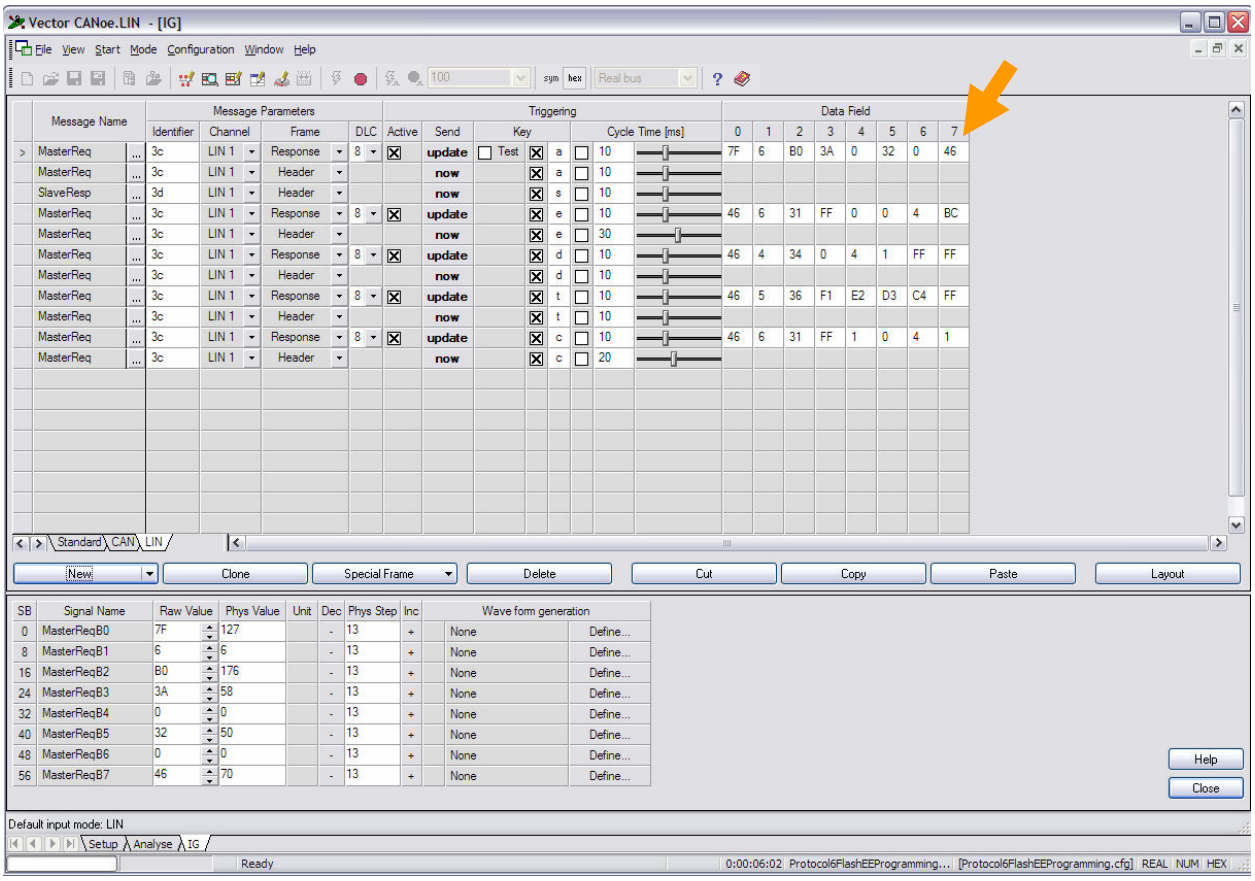


Figure 6 – CANoe Interactive Generator for Protocol 6 Flash/EE Programming via LIN

Note: If the 'AssignNAD' command is requested, whereby a new NAD is assigned, the NAD byte (which is the first byte in all LIN diagnostic frames) of each subsequent LIN diagnostic command request must be changed individually to match the new NAD value.

With the CANoe application running and Flash/EE programming of the specified file completed (and prior to an 'ECU Reset' request), the user may request LIN diagnostic commands by pressing keys as shown in table 1. The values that are transmitted are specified in the 'Data Field' is illustrated down the right hand side of figure 6.

LIN Diagnostic Command	*Key*	*Description*	*Returns*
AssignNAD	***a***	Assigns a new NAD to the ADuC703X	No response
ECUReset	***r***	Resets the ADuC703X	No response
SlaveResp	***s***	Requests a response frame from the ADuC703X. Must be sent after transmitting a Master Request frame that requires a Slave Response frame	Depends on the previous Master Request Frame
ReadByIdentifier::0x0	***i***	Requests identification of the ADuC703X slave node	ADuC703X Supplier ID, Function ID & Variant
ReadByIdentifier::0x32	***i***	Requests 5 bytes of customer-specific data from Flash/EE memory	5 bytes stored at 0x977ED-0x977F1
ReadByIdentifier::0x33	***i***	Requests 5 bytes of customer-specific data from Flash/EE memory	5 bytes stored at 0x977F2-0x977F6
ReadByIdentifier::0x34	***i***	Requests 5 bytes of customer-specific data from Flash/EE memory	5 bytes stored at 0x977F7-0x977FB
RequestDownload	***d***	Requests the programming of a specified range of Flash/EE pages	No response
EraseRoutine	***e***	Erases a specified range of Flash/EE pages	No response
CheckRoutine	***c***	Calculates the checksum over a specified range of Flash/EE pages	Calculated checksum

Table 1 – Interactive Generator LIN Diagnostic command keys

7. Reset the ADuC703X node

The ADuC703X microconverter is reset via requesting an 'ECU Reset' diagnostic frame, as described in table 1. Requesting a reset automatically implies that the simulation is stopped. Following a reset no further LIN diagnostic commands can be sent until the next Flash/EE Programming via LIN sequence is started.

Known Issues/Assumptions/Omissions

Issue 1: User reset request

The user must request the reset upon finish of download by manually pressing the 'r' key on the PC keyboard.

Issue 2: Configuration LDF file must be specific to part

If the parts being programmed are ADuC703**2**'s, the following LDF must be used:

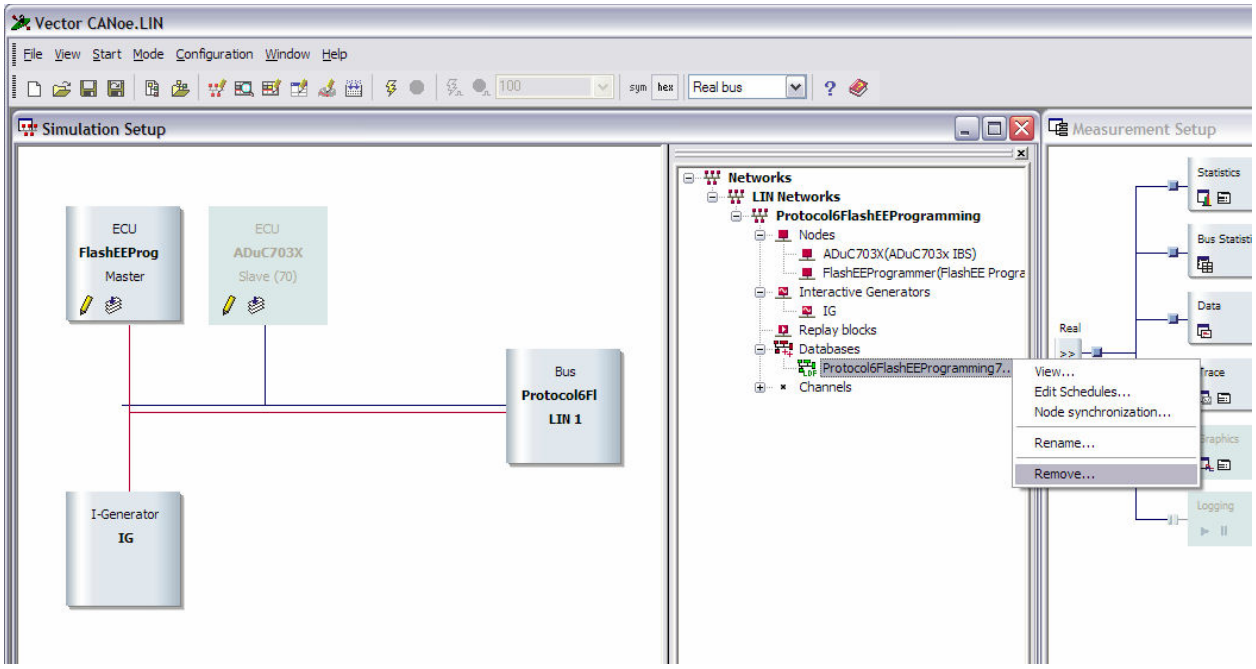
- Protocol6FlashEEProgramming7032.ldf

Alternatively, if the parts being programmed are ADuC703**3**'s then the following LDF must be used:

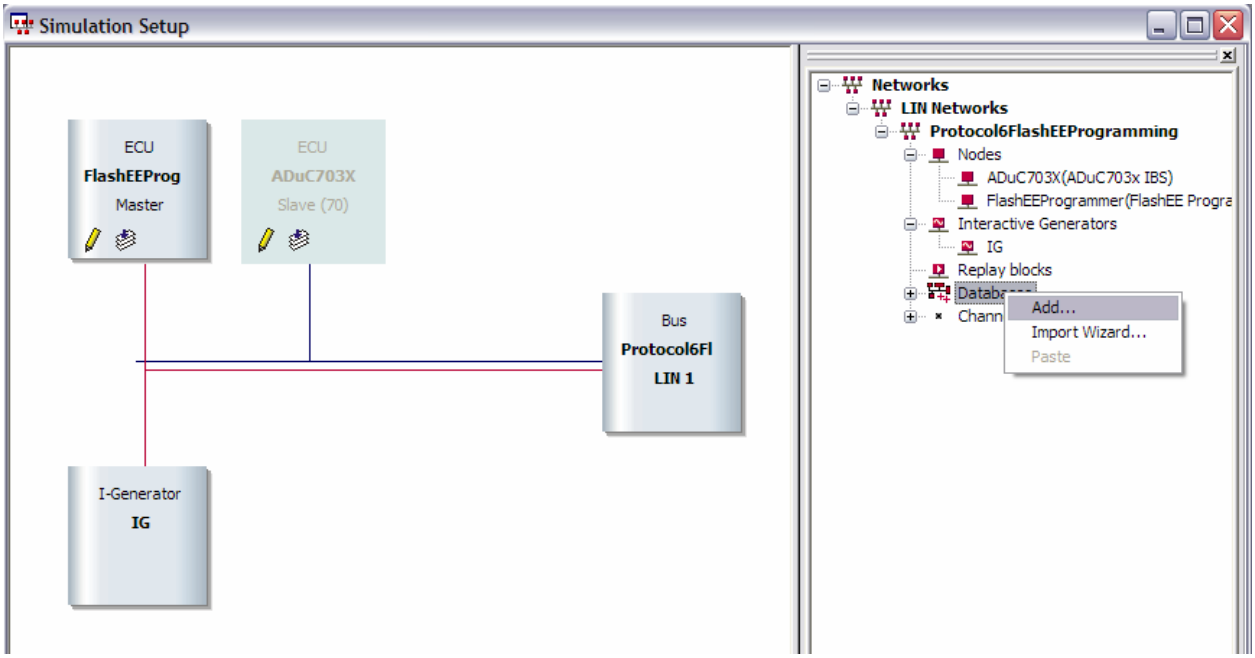
- Protocol6FlashEEProgramming7033.ldf

The existing LDF must first be removed before the new LDF can be added. This action is performed in the right-hand-side pane of the 'Simulation Setup' window on the 'Setup' tab of the 'Protocol 6 Flash/EE Programming' configuration.

Step 1:



Step 2:


Simulation Setup
ECU
FlashEEProg
Master
ECU
ADuC703X
Slave (70)
Bus
Protocol6Fl
LIN 1
I-Generator
IG
Networks
LIN Networks
Protocol6FlashEEProgramming
Nodes
ADuC703X(ADuC703x IBS)
FlashEEProgrammer(FlashEE Progra
Interactive Generators
IG
Replay blocks
Add...
Import Wizard...
Paste

References

[1] Analog Devices, Inc., ADuC703X Flash/EE Programming via LIN – Protocol 6', Rev. 1.0, June 2007.
[2] Analog Devices, Inc., 'Hex-to-Binary LIN-downloadable File Generator - Command Line Version', Version 3.0, May 2007.
[3] Analog Devices, Inc., 'Hex-to-Binary LIN Data Generator – GUI Application Version', Version 1.3, June 2007.