Setting up a Local Interconnect Network (LIN) using dSPACE MicroAutoBox 1401/1501 Simulink Blocks

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Executive Summary

Learn how to setup and properly use the Real-Time Interface LIN MultiMessage (RTILINMM) MATALB/SIMULINK block set provided by dSPACE. This library will allow the user to set up a Local Interconnect (LIN) driver that can be downloaded into C code and used in the Control Desk testing application for the 1401/1501 MicroAutoBox.

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Introduction

Automobile manufacturers are converting their control systems from analog interfaces to a LIN serial data interfaces. LIN allows for the communication between a single master, which is the 1401/1501MicroAutoBox, and up to sixteen slaves, which could be various different sensors or actuators, on a single bus system. This eliminates the need for several different analog channels which brings extra cost and weight into the production of an automobile. In order to implement this single bus system, the proper MATLAB/SIMULINK libraries are required which can be acquired through obtaining a dSPACE software license. dSPACE provides the basic blocks that allow for the implementation LIN between the master and the slaves through RTILINMM. The Simulink block diagram will then converted to real time C code, cross compiled and downloaded to the 1401/1501 board. Control Desk software is also available for controlling the MicroAutoBox from the PC and plotting variables in real time which is outside the scope of this document.

Overview

Assuming the user already has the dSPACE software installation and correct MATLAB license already downloaded on their computer, the following steps should be taken.

- Step one will give an overview on how to startup MATLAB and connect it to the MicroAutoBox 1401 board platform.
- Step two will show how to navigate to the RTILINMM Simulink block sets and create a Simulink block diagram.
- Step three will show how to setup the RTILINMM blocks.
- Step four will show how to download the Simulink model into C code using Real-Time Workshop (RTW) which can be used in the Control Desk software.

Step One: Matlab and dSPACE Board Connection

dSPACE will have provided the user with a Dongle which is a green USB device that plugs into the hosts computer. This device contains the Simulink libraries that include the necessary blocksets to utilize LIN. Upon startup of Matlab, the user will be prompted to choose a board platform. Select the necessary board platform for the 1401/1501MicroAutoBox which is the 1401 button shown below in figure 1.

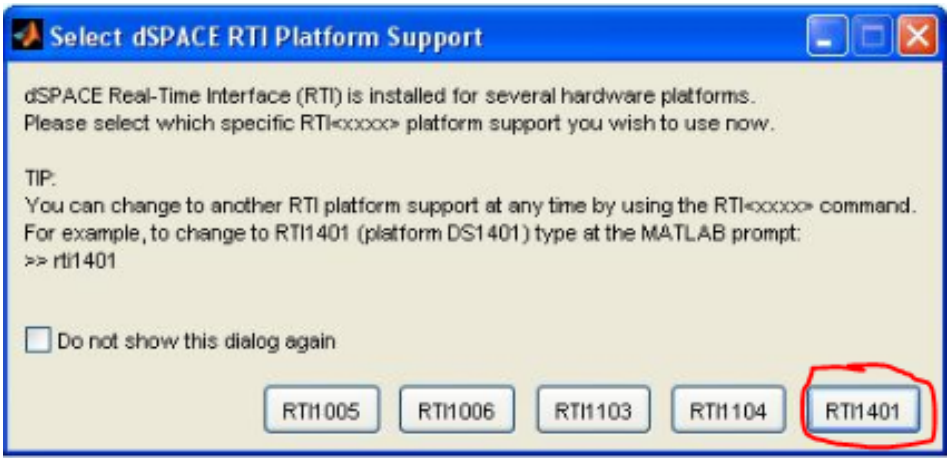

Figure 1 – Platform Selection

When the platform is properly connected, MATLAB will display the following message in the command window which can be seen below in figure 2.

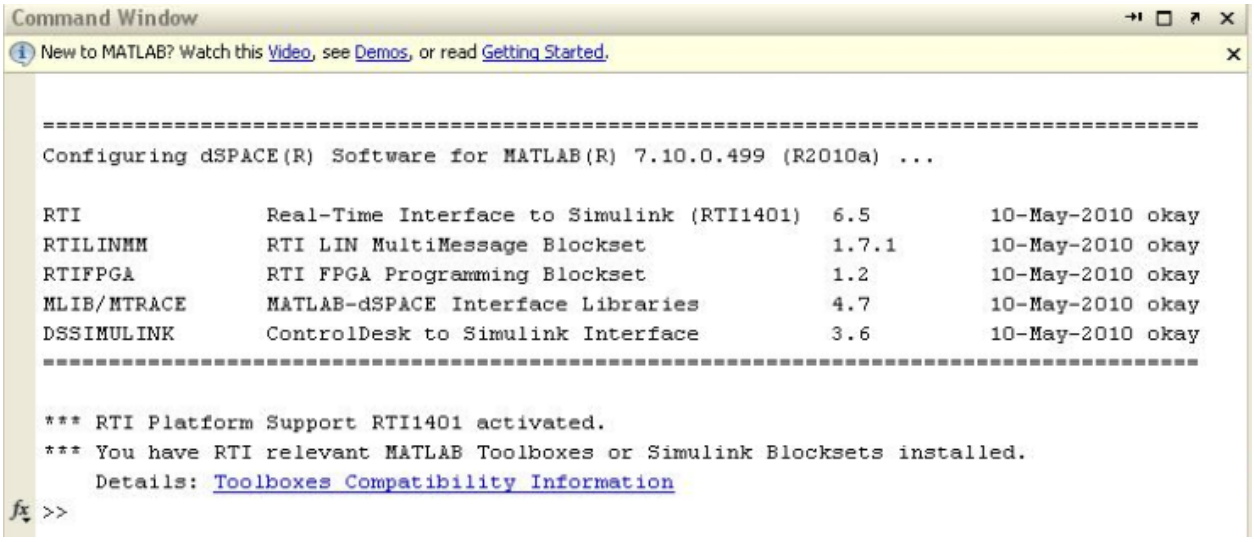

Figure 2 – Command Window Verification

If this message is not seen and errors occur, check to ensure that the MATLAB version is compatible with the version of dSPACE obtained or contact dSPACE help to ensure that the user has properly installed dSPACE software and Dongle.

Step Two: How to Navigate to the RTILINMM Simulink Blocks

The user can access the RTILINMM Simulink blocks in two different ways. The user can type ‘simulink’ into the MATLAB Command Window which will open the full Simulink library. Scroll all the way to the bottom of the library and locate the header for RTILINMM as shown below in figure 3. The three RTILINMM blocks will appear on the Simulink window.

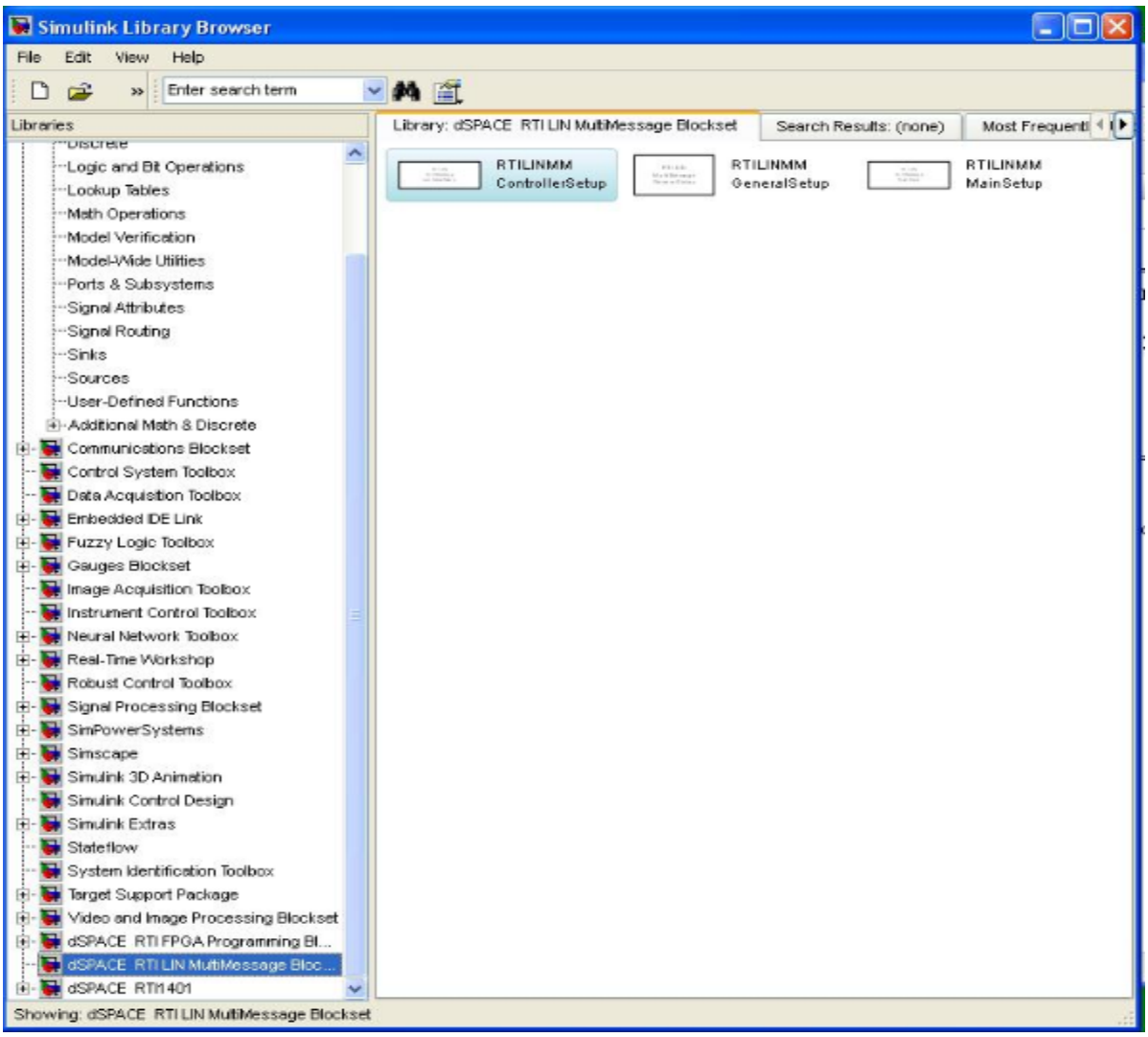

Figure 3 – Simulink RTILINMM Block Set

The user can also simply type ‘rti’ into the MATLAB Command Window which will introduce the window in the top left shown in figure 4. Double click on the ‘blocksets’ block and the top right window will appear. Double click on the ‘RTILINMM ‘Blockset’ block and the bottom right window will appear. The resulting blocks are what is used in setting up a functioning LIN controller. Drag all three blocks into a new Simulink file to begin LIN controller assembly.

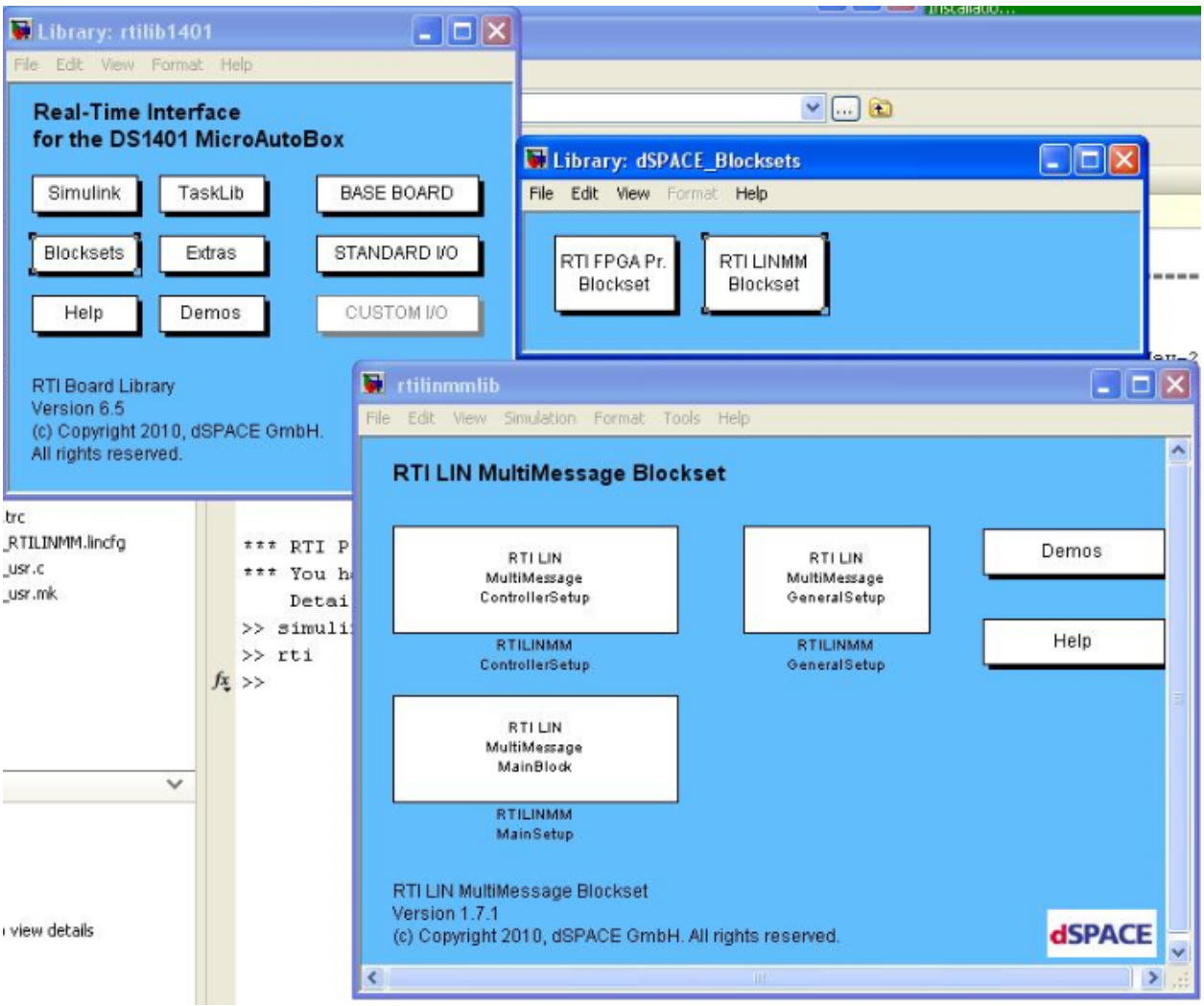

Figure 4 – Simulink RTILINMM Blockset

Step Three: RTILINMM Simulink Block Description and Use

The General Setup block provides the LIN controller with information on defining the necessary folders for the RTILINMM blockset. This can be seen in figure 5 below.

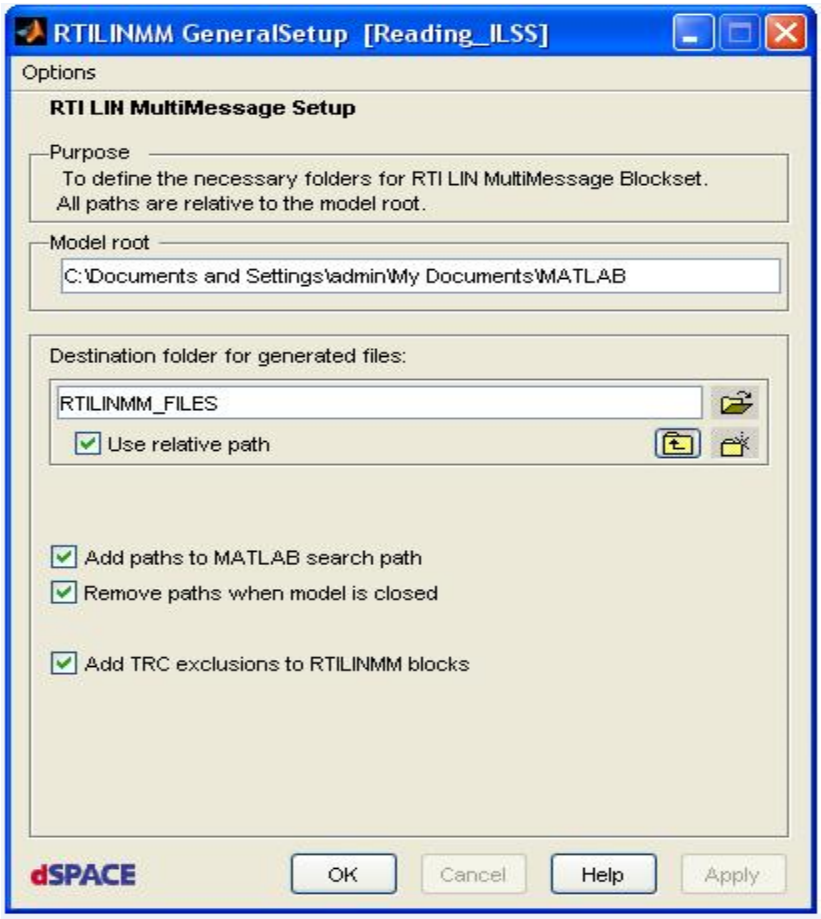

Figure 5 – RTILINMM General Setup

The Controller Setup block allows the user to specify the basic settings of the LIN controller. Options such as the module type, number, and channel as well as the baud rate, break length, and break delimiter. This block also allows the user to set the transceiver type. For configuring the 1401/1501 MicroAutoBox as the LIN master, click on the 'Master Termination (1kOhm)' button. Pressing the 'OK' button will create an S-function.

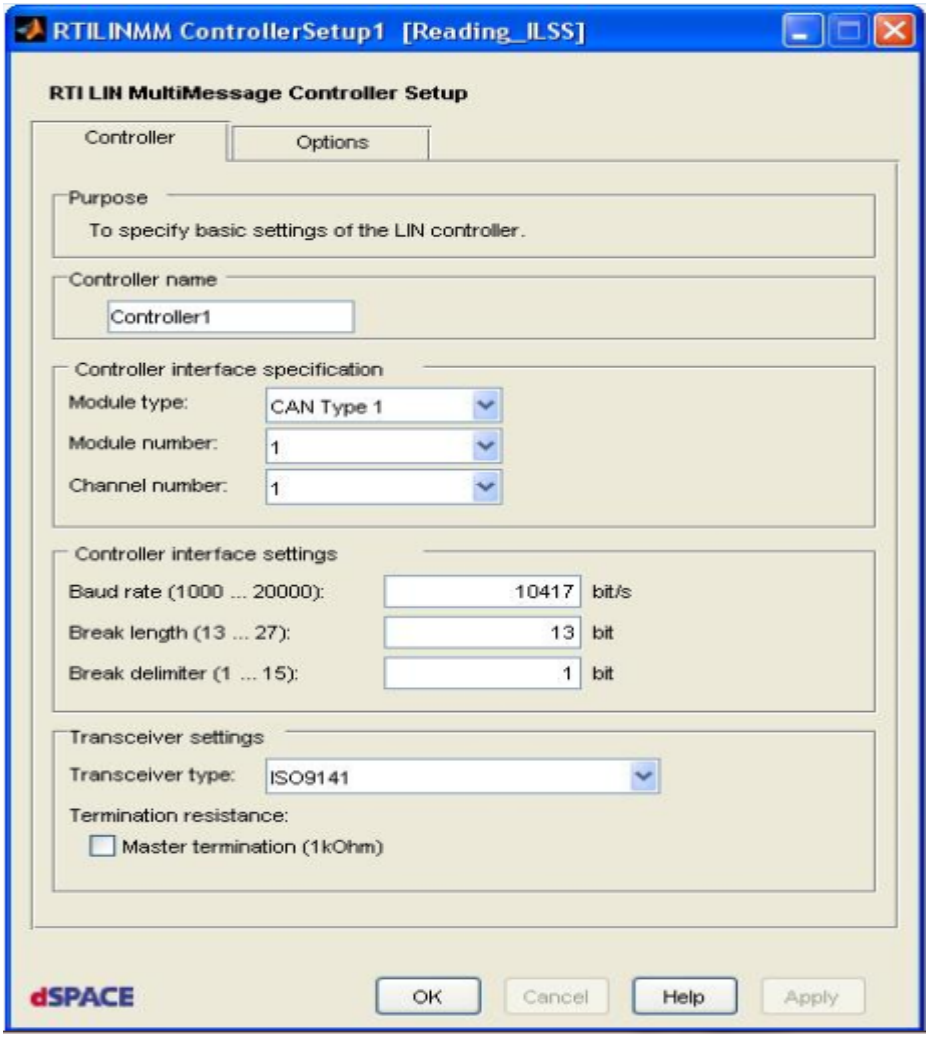

Figure 6 – RTILINMM Controller Setup

The Main Setup block is used to setup and configure LIN communication for a LIN controller. The RTILINMM window shows each LIN channel being emulated and the Node Information defined in the LIN Description File (LDF) through an expandable tree format. The block interface can be seen below in figure 7.

The tree view tab allows for the user to select additional options from which they can delegate specific headers, frames, Tx signals, Rx signals, layouts, etc. In the General Settings tab, the user can select the path for the LDF. This file defines the master/slave nodes, the master/slave signals, frame delegation, frame tolerances, and the error and schedule table information. All this information is defined in the LIN 2.0 Specification. The resulting information can then be filtered and selected using the following tabs.

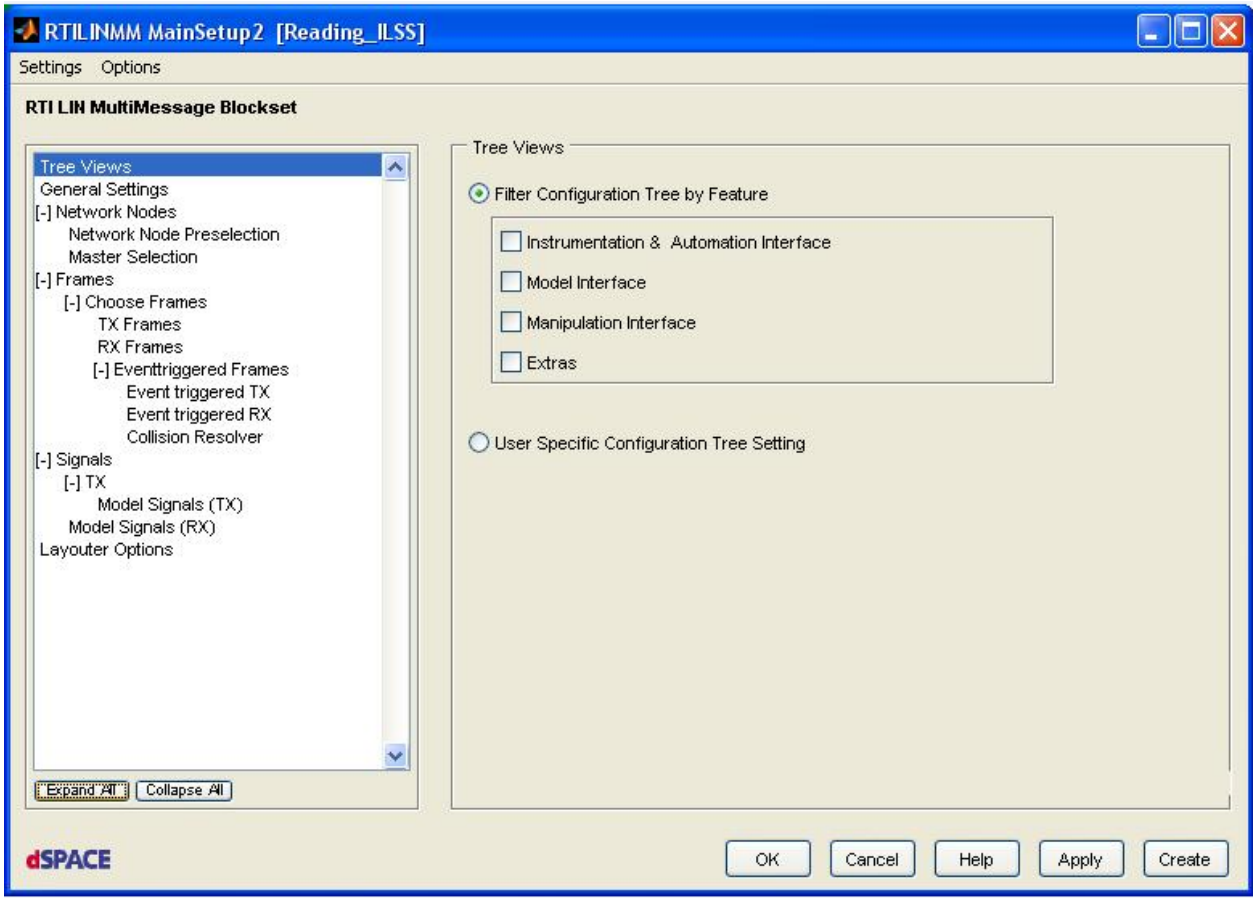

Figure 7 – RTILINMM Main Setup Block

Pressing the 'create' button in the lower right hand corner of the Main Setup window will compile the LIN controller.

Step Four: Converting the Simulink Model to C Code

Once the user has completed setting up the LIN controller. They are then ready to convert it into C code and test using The Control Desk software provided by dSPACE. In order to do this, the user must navigate to the tools section in Simulink. In the drop down list, select Real-Time Workshop and then select Build Model. This can also be done by pressing Ctrl+B on the keyboard. By building the application, an .sdf file,.trc file, and the controller layouts built in this step will be constructed which are to be used in Control Desk.

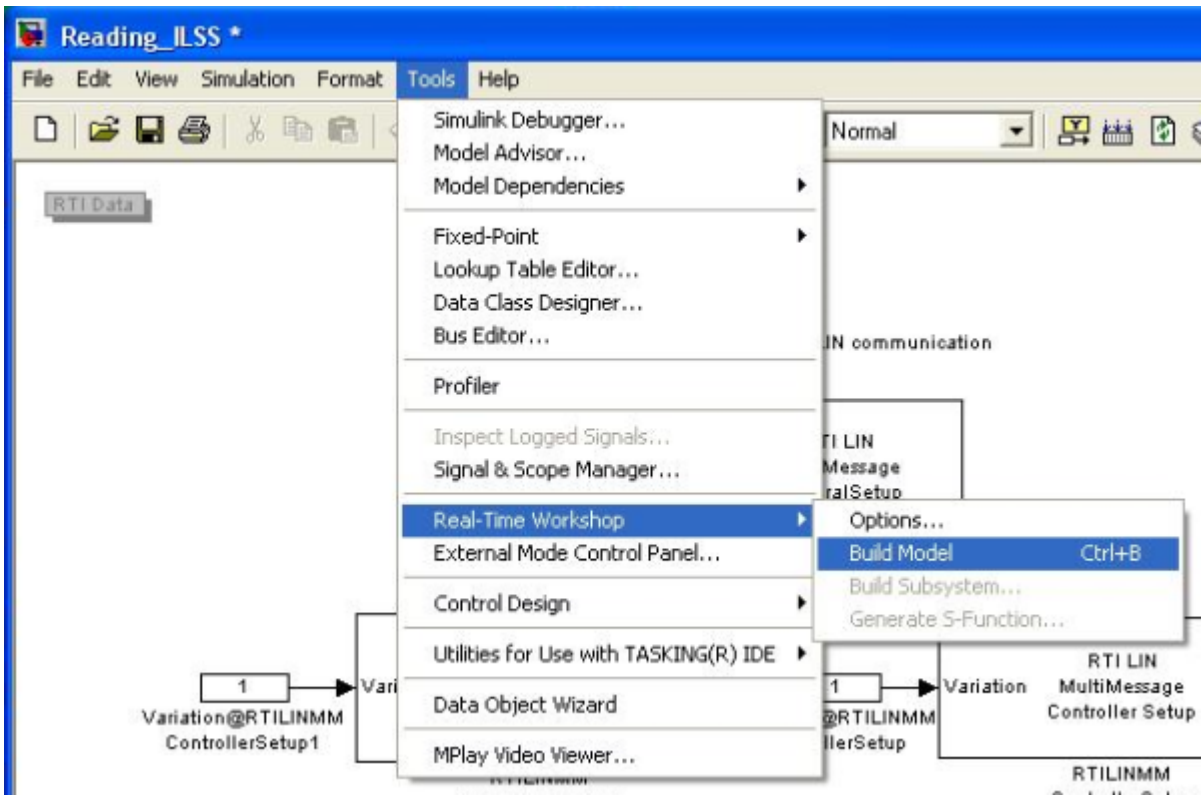

Figure 8 – Converting to C Code using RTW

Once RTW has been completed and properly built, it will display a message in the MATLAB command window verifying a successful build. If errors occur, a MATLAB error window will pop-up explaining what to fix. Follow the directions and attempt to rebuild the Simulink model.