

A&D Guide for VehicleSim Products

Introduction	1
Example Datasets Installation	2
Tutorial: Run Baseline Simulink Example	4
CarSim Setup	4
VirtualDSPConsole Setup	9
Run the Simulation	12
Vehicle Model Pause/Start Option	14

Introduction

This technical memo describes how to use an A&D Real-Time (RT) system with the real-time versions of BikeSim, CarSim, and TruckSim. The example shown was made with CarSim RT, but the same controls and methods are also used for BikeSim RT and TruckSim RT. In this guide, we assume you are using CarSim 2019.1 or newer. The system requirements are listed in Table 1.

Table 1. System requirements.

Target Hardware	Development Environment	VirtualDSPConsole	Operating System
AD5436	01.04.00 and up	03.03 and up	Windows 7/8/10
AD5445/5446/5447	02.07.00 and up	03.03 and up	Windows 7/8/10

The MATLAB/Simulink versions that are supported follow A&D's specifications.

To run a simulation using a VehicleSim model with A&D, you must have the following correctly installed:

- Solver license for LINUX-RT
- MATLAB\Simulink
- the MATLAB Coder (formerly Real-Time Workshop)
- the Simulink Coder
- A&D software

Note Any firewall should be configured to allow the host and real time target to communicate.

This Technical Memo assumes that you have some familiarity with A&D software, Simulink, and the desktop version of your VehicleSim product. If you are a new VehicleSim user, we recommend that you begin with the Quick Start Guide for your product and the *Running a VS Math Model in Simulink* tutorial. Both documents are available from the **Help** menu of your VehicleSim product.

Example Datasets Installation

The VS Math Models and example datasets for A&D can be installed by using the Database Builder to build a new database or by importing a consolidated parsfile (CPAR) to an existing database. Either method will install the necessary VS Math Models, corresponding A&D files, and supporting VehicleSim datasets.

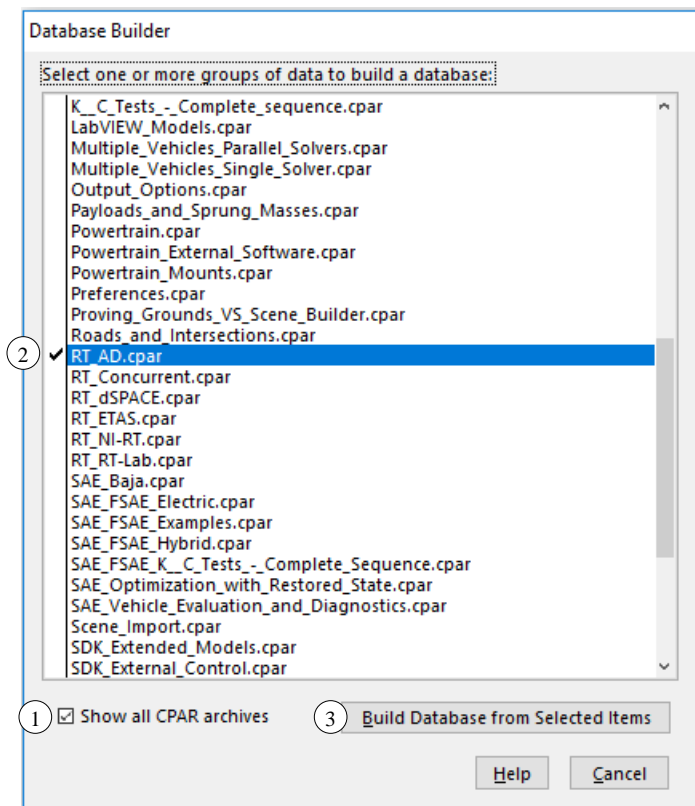


Figure 1. Database Builder

To build a new database, launch CarSim and select **Open Database Builder...** from the Select Recent Database window. In the Database Builder window (Figure 1), toggle on **Show all CPAR archives** ①. Select **RT_AD.cpar** ② along with any other data groups that you would like to include in the new database. Click **Build Database from Selected Items** ③. Select the folder where you would like to save the database and click **OK**.

To import a CPAR file to an existing database, launch CarSim and select the database that you will use with A&D.

1. Go to **File > Import Parsfile (Any Export Type)** and import the following CPAR file:
CarSim_Prog\Resources\CPAR_Archives\RT_AD.cpar
2. Click **OPEN**.
3. You should click **OK** to accept the default **Import Parsfile – Settings** (Figure 2) as shown.
4. The **Import Data Preview** window will appear (Figure 3). Click **OK** to import the files.
5. After the parsfile is imported, the A&D examples can be found in **Datasets > RT: A&D** (Figure 4).

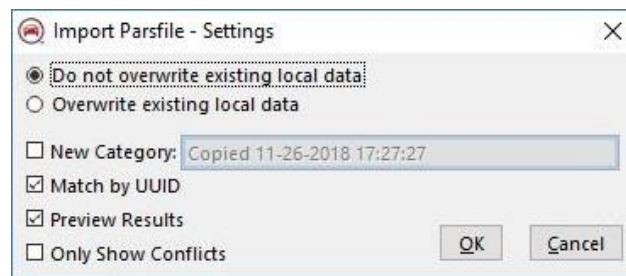


Figure 2. Import Parsfile Default Settings

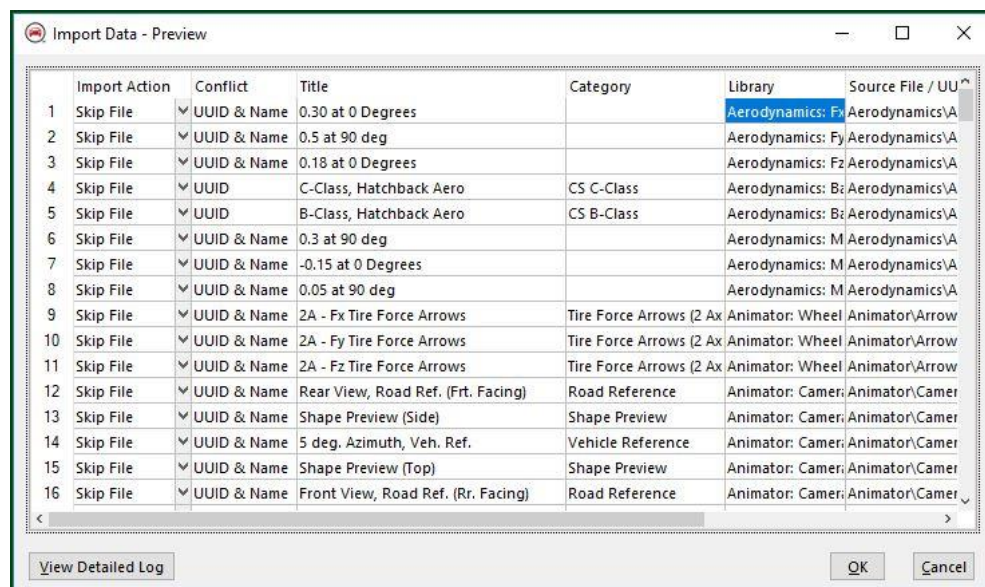


Figure 3. Import Data – Preview.

Error! Reference source not found. lists the example models in the CarSim Database menu that are included with A&D Real-Time.

Table 2. Example Models.

CarSim Datasets Menu	CarSim Models	Simulink Models
A&D Real-Time	AD5436 Baseline	Baseline.mdl
	AD5436 Ext. ABS Split Mu	ABS_Example.mdl
	AD5445 Baseline	Baseline.mdl
	AD5445 Ext. ABS Split Mu	ABS_Example.mdl

Tutorial: Run Baseline Simulink Example

The installed database has example datasets that are ready to run on an A&D system. You need to have an active Linux-RT license to run the examples. This tutorial is based on A&D version 5445.

CarSim Setup

1. In CarSim, select **Datasets > RT: A&D > AD5445: Baseline** to open the baseline example (Figure 4).
2. Under Run Control, click the **Models** drop-down list to confirm that the library is set to **Models: Transfer to Remote RT Target** ⁽¹⁾ (Figure 5).
3. Click the **AD5445: Baseline** blue link ⁽²⁾ to open the **Models** dataset (Figure 6).
4. Modify the target computer (RT computer) IP address and local computer (Windows computer) IP address based on your configuration ⁽³⁾. The IP addresses must be on the same subnet to allow the target computer and local computer to connect.
5. Verify that **Simulink S-Function** is selected for the **Use Simulink or FMU** pull-down menu ⁽⁴⁾.
6. Confirm that the integrator settings match those shown in Figure 6.

Note We recommend using the AM-2 integrator with 2 updates per step for most real time simulations. We also recommend setting the time step for the math model to .001 second (frequency = 1000 Hz), and the output time step to .025 seconds (frequency = 40 Hz). In the example models, the integration method is automatically set to AM-2 with the time steps mentioned above. When you build your own models, you may need to set the integrator method to AM-2.

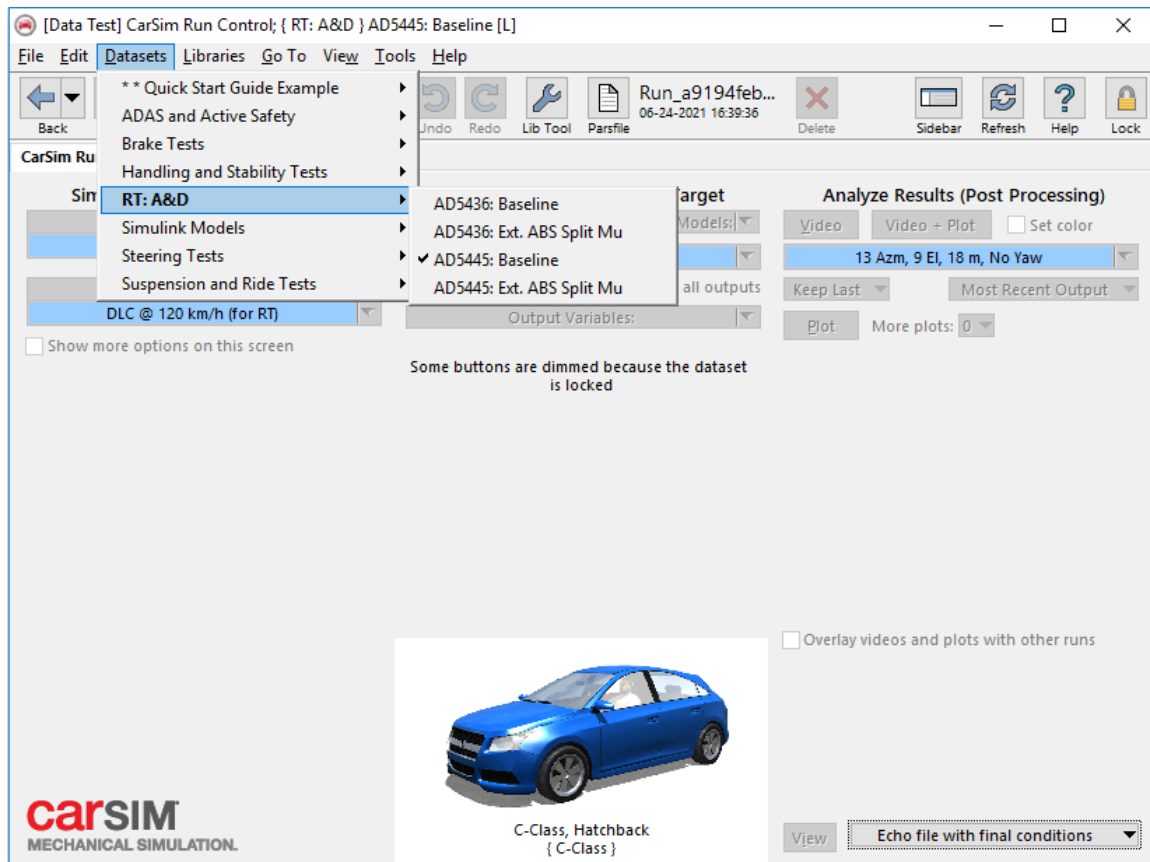


Figure 4. A&D Examples.

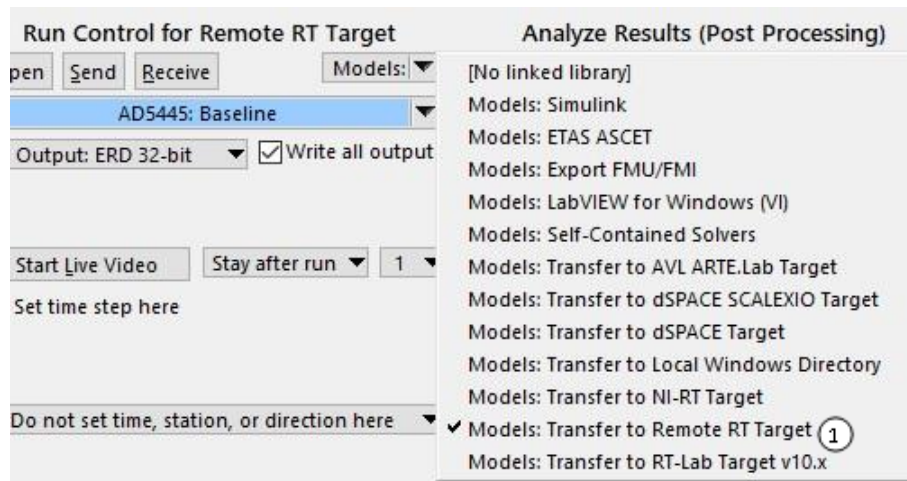


Figure 5. Drop-down Model List.

Click **Back** to return to the CarSim **Run Control** Screen (7.). Click the **Open** (5) button to open the Simulink model (Figure 8).

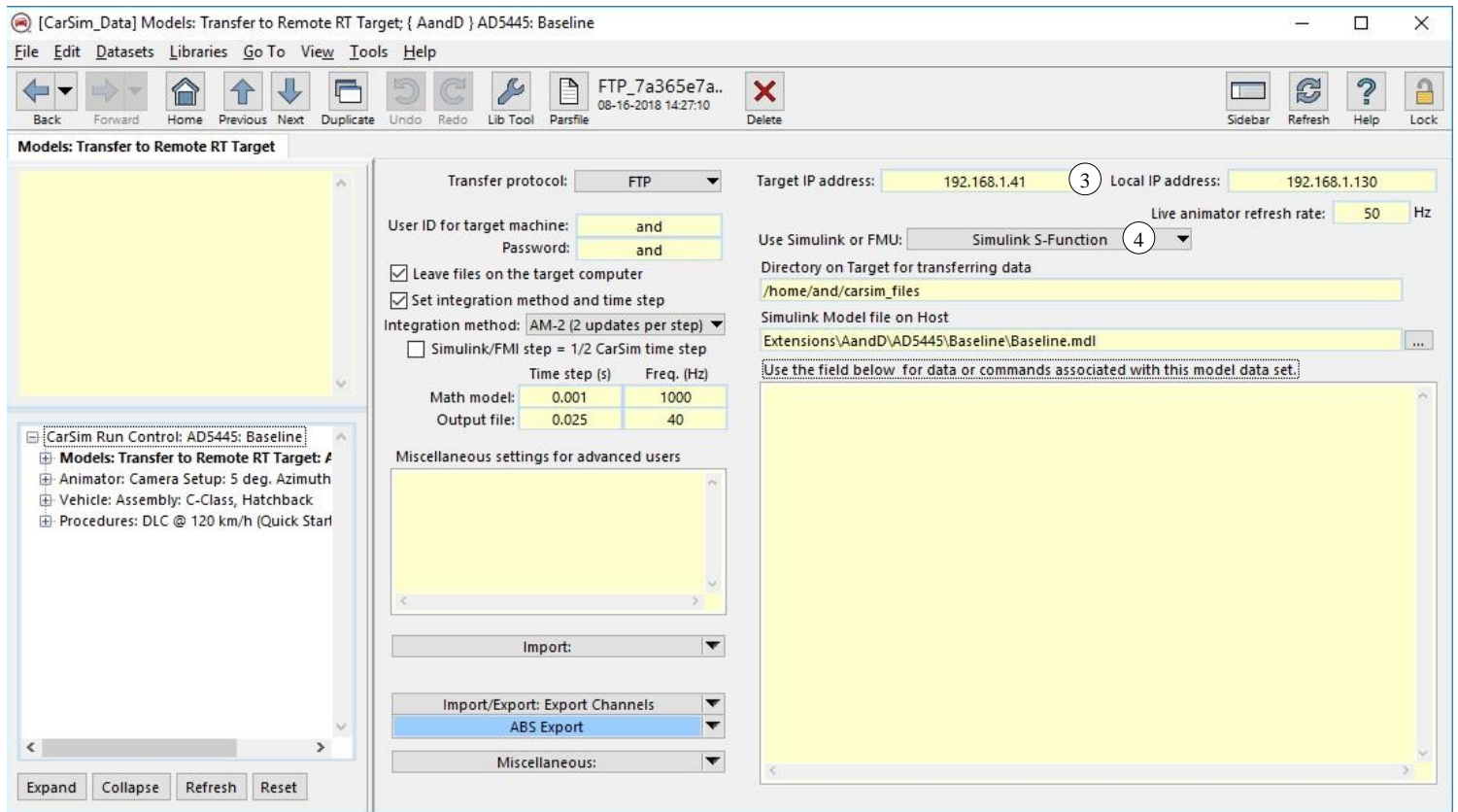


Figure 6. Models: Transfer to Remote RT Target dataset.

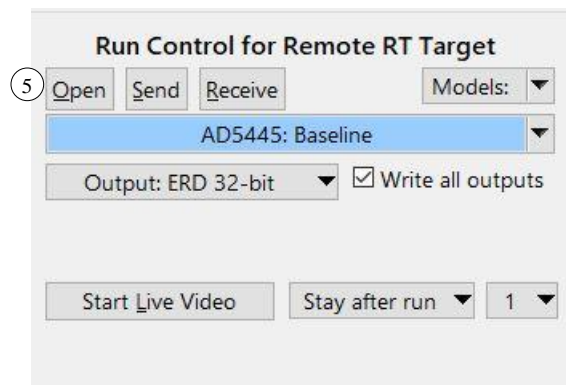


Figure 7. Run Control Screen

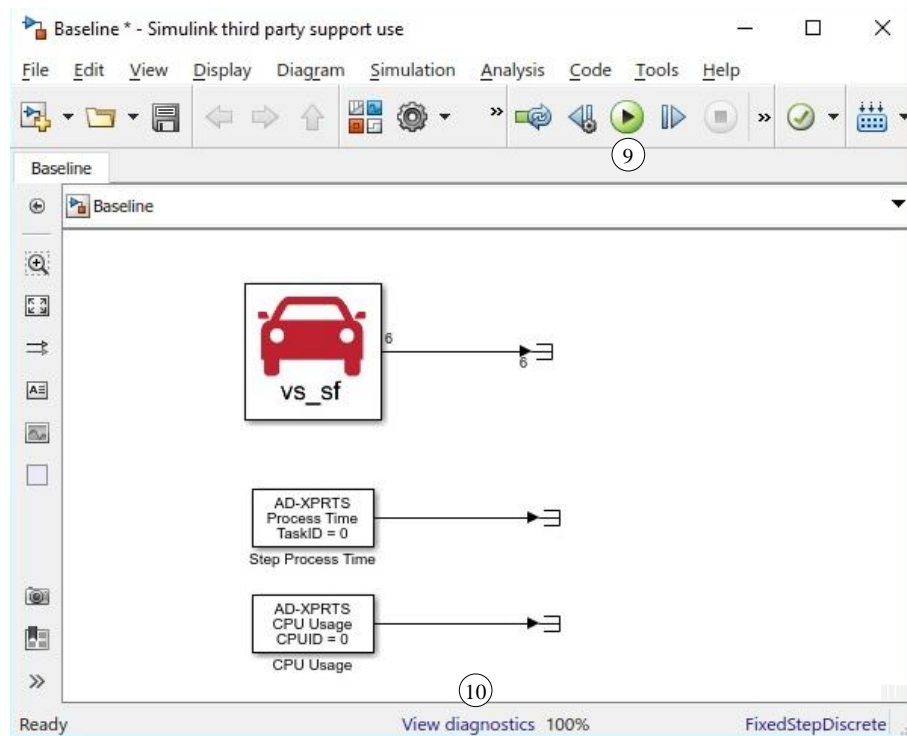


Figure 8. Simulink window

Note The system target file is correctly defined in the CarSim example models. When you build your own models, you will need to ensure that the system target file is set correctly.

8. To check that the system target file is set correctly, select **Simulation > Model Configuration Parameters** from the Simulink menu to open the Configuration Parameters window (Figure 9).
9. On the left side of the **Configuration Parameters** window, select **Code Generation** (6) (formerly Real Time Workshop). Then click **Browse...** (7).
10. The **System Target File Browser** will open (Figure 10). Select the correct target file for the version of A&D that you are running, which is “aandd_ad5445.tlc” (8) for this tutorial. Click **OK** to close.

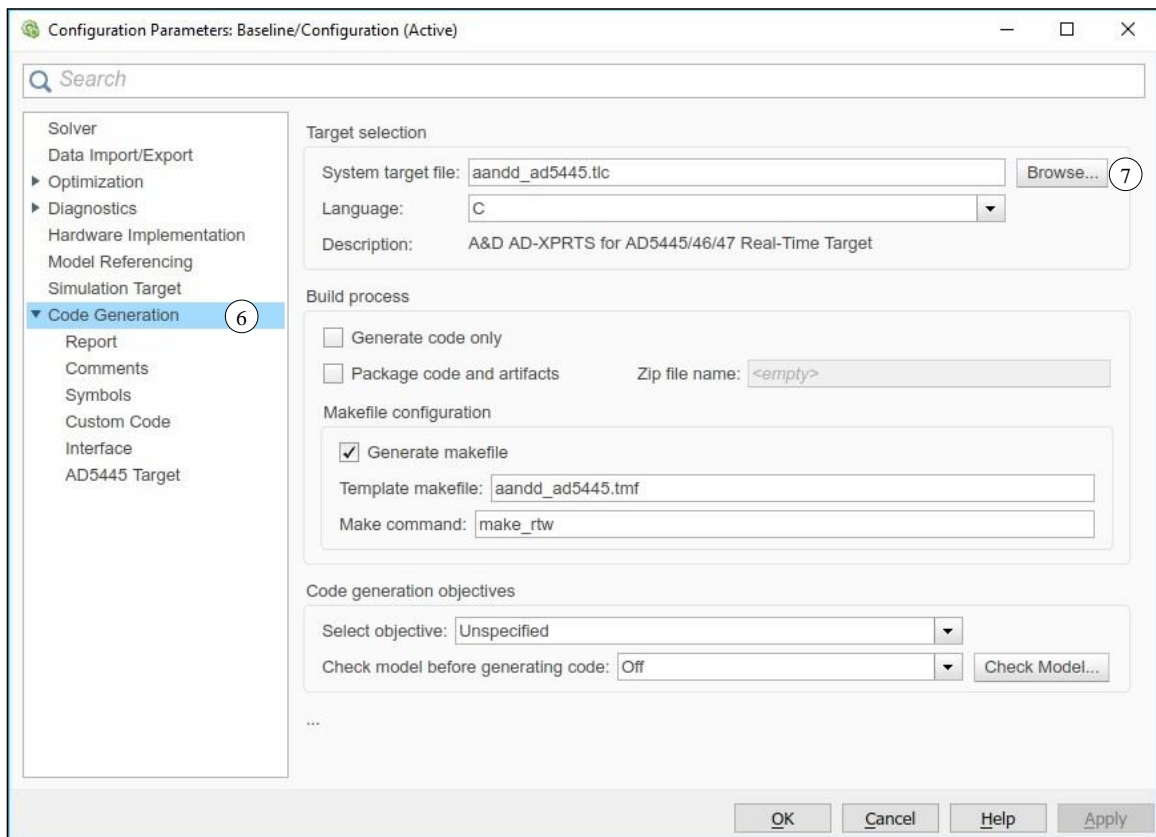


Figure 9. Configuration Parameters.

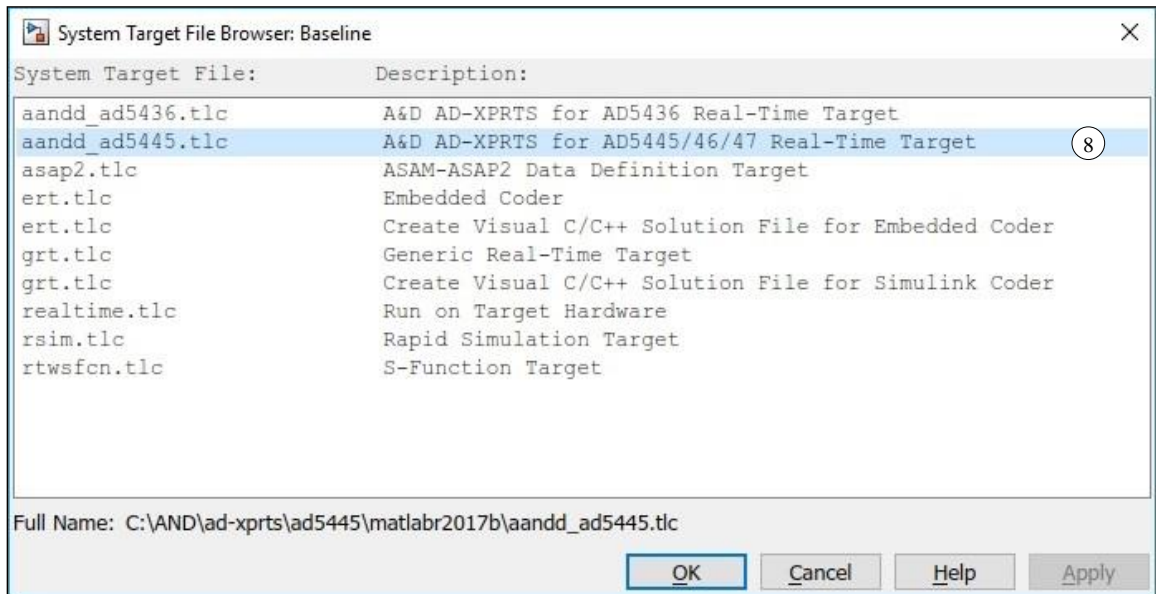


Figure 10. System Target File Browser.

11. Click the green arrow in the toolbar of the Simulink window (9) to run the model (Figure 8).
12. Click on **View Diagnostics** (10) to check for errors.
13. Press **Control-B** to build the model. When the build is completed, you should see “Build process completed successfully” at the bottom of the Diagnostic Viewer (11) (Figure 11).

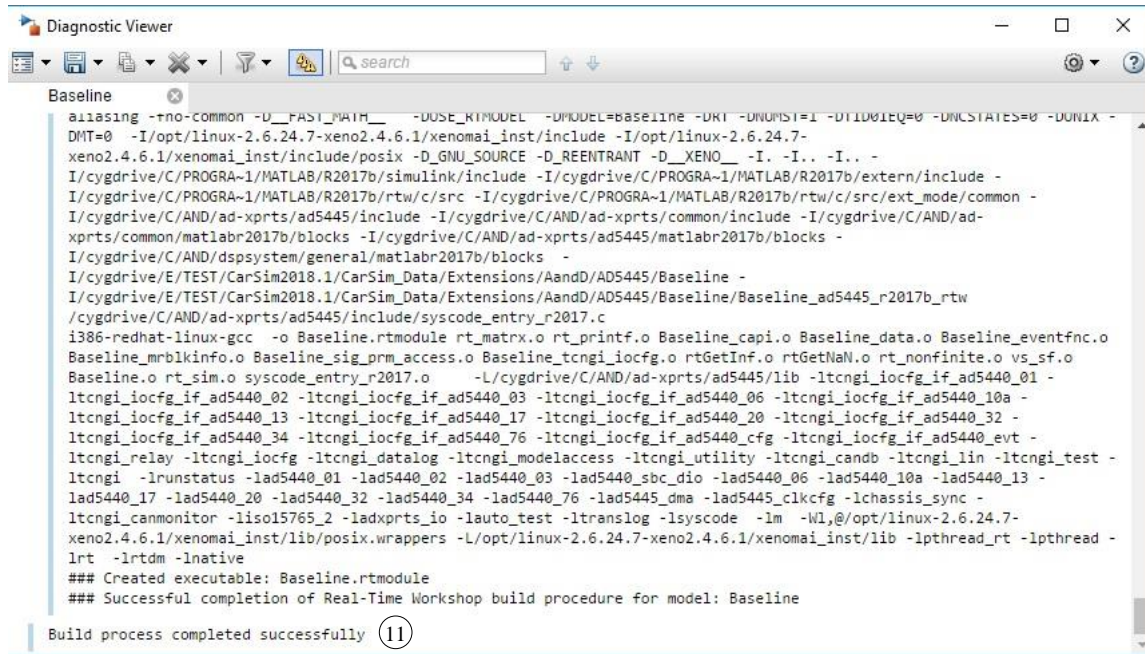


Figure 11. Simulink Diagnostic Viewer.

VirtualDSPConsole Setup

14. Go to the CarSim database to the CarSim_Data > Extensions > AandD > AD5445 > Baseline folder. Double click on the Virtual Console application project file, “baseline.apf,” to open VirtualDSPConsole (Figure 12). Alternatively, you can start VirtualDSPConsole from your desktop or Start Menu and open the project file from within the GUI.
15. Right click on Model_1 (12) and select Properties to open the **Target Properties** window (Figure 13).
16. Click on “...” next to the **Model Execution File** field (13) in the Target Properties window. Select the “baseline.rtmodule” file. The file should be in the following directory: Data > Extensions > AandD > AD5445 > Baseline > Baseline_ad5445_r2017b_rtw. The Baseline_ad5445_r2017b_rtw directory name is dependent on your version of MATLAB. For example, MATLAB 2017b was used with this tutorial. Only part of the path may appear in the field with the filename. Verify that the path and file are correct. Click **Open**.
17. Confirm that the IP address in the **Target Properties** window (14) is correct. Click **OK**.

18. The first time that you set up an A&D RT model with CarSim, the **Step Size Settings** window will open (Figure 14). Click **Close** to accept the default settings.

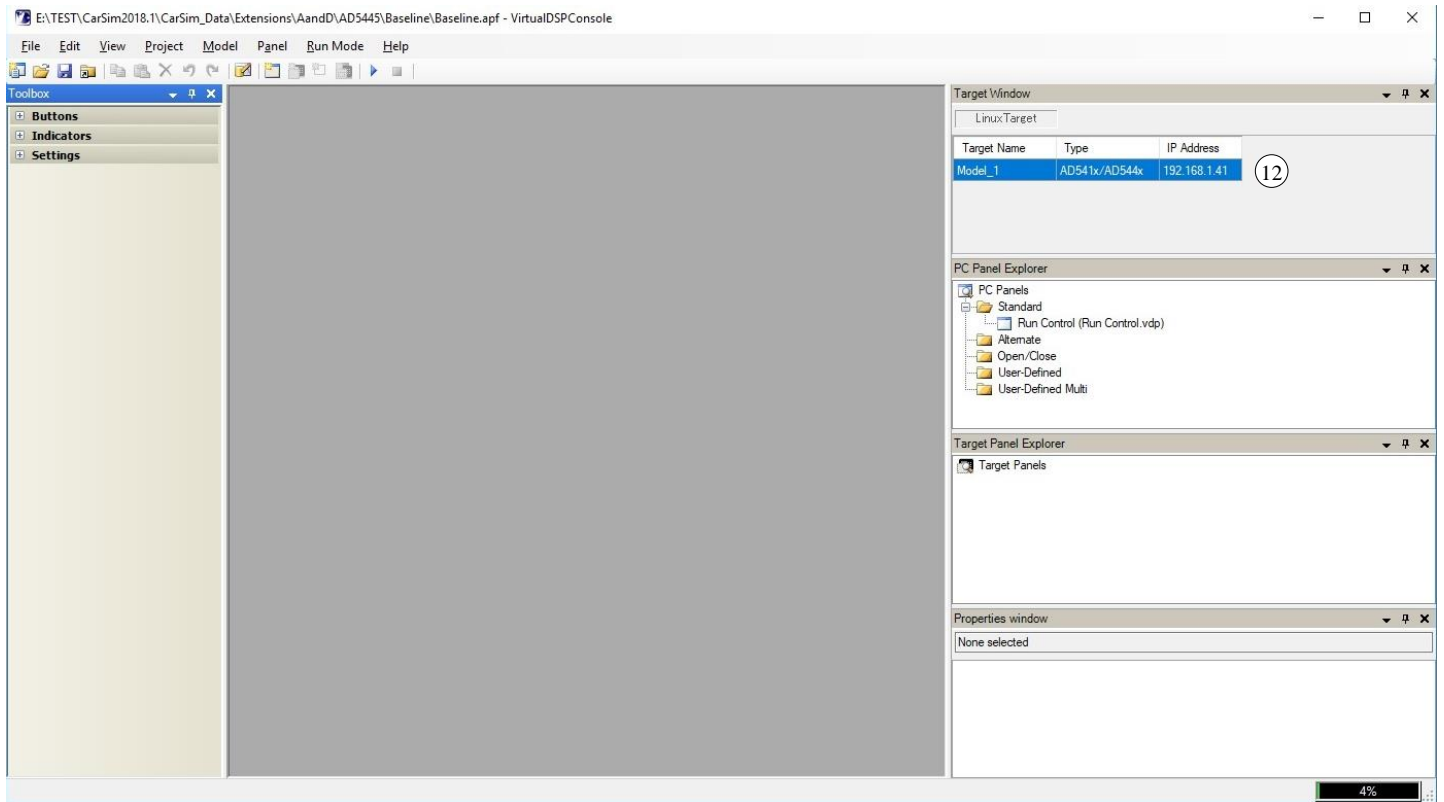


Figure 12. VirtualDSPConsole

Target Properties [X]

Front End Type: LinuxTarget

Model Source: Info File

Model Execution File: Baseline_ad5445_r2017b_rtw\Baseline.rtmodule 13

IO Configuration

☐ Use IO Configurator

Type: AD541x/AD544x

Name: Model_1

Target Name: Model_1

IP Address: 192.168.1.43 14

Time History Data Buffer Size: 100000 Point Data

Inter-computer Synchronization: OFF

☐ When connecting, always get the model parameters from target

Options... OK Cancel Help

Figure 13. Target Properties

Step Size Settings [X]

Target Name: Model_1

Step Sizes (s): 0.001

Sampling Intervals (s): 0.001

Sampling Decimation Count: 0

$\text{Step Sizes (s)} = \text{Sampling Intervals (s)} \times (\text{Sampling Decimation Count} + 1)$

☒ Display this dialog box when model information is read

Close Help

Figure 14. Step Size Settings.

Run the Simulation

Note When running the real time solver, the CarSim GUI must be running.

1. Go back to the **CarSim Run Control Screen**. Verify that the Live Animator window is enabled as shown in Figure 7. If the Live Animator is not enabled, the Run Control Screen will appear as shown in Figure 15, and you should toggle the **Number of live animators for this run** to **1**.
2. In the Run Control screen, click **Send**. The VS Visualizer window will appear with the unassembled model.
3. Click on the blue arrow in the VirtualDSPConsole window tool bar (15) (Figure 16) to open the Run Control window (Figure 17).
4. Click **Run** in the Run Control window (16) to start the simulation. You can press **Run** to re-run the simulation as many times as you wish. You can also press **Pause** or **Stop** during the simulation.
5. When you are done running the simulation, click **Quit Simulation** in the Run Control window (17) or click on the blue square in the VirtualDSPConsole toolbar (18) (Figure 18) to stop run mode. The Run Control Window will close.
6. After the run, the results are automatically transferred back to the host. If there are any problems, you can manually transfer results back to the host by clicking the **Receive** button on the CarSim **Run Control** screen. However, normally, this is not necessary.

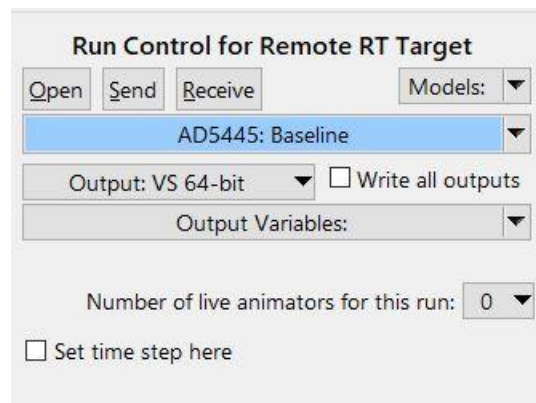


Figure 15. CarSim Run Control with live animator not enabled.

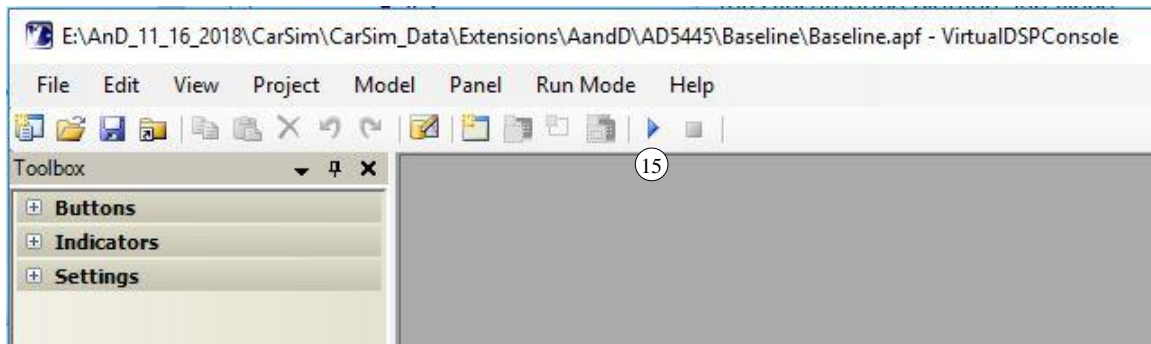


Figure 16. VirtualDSPConsole toolbar.

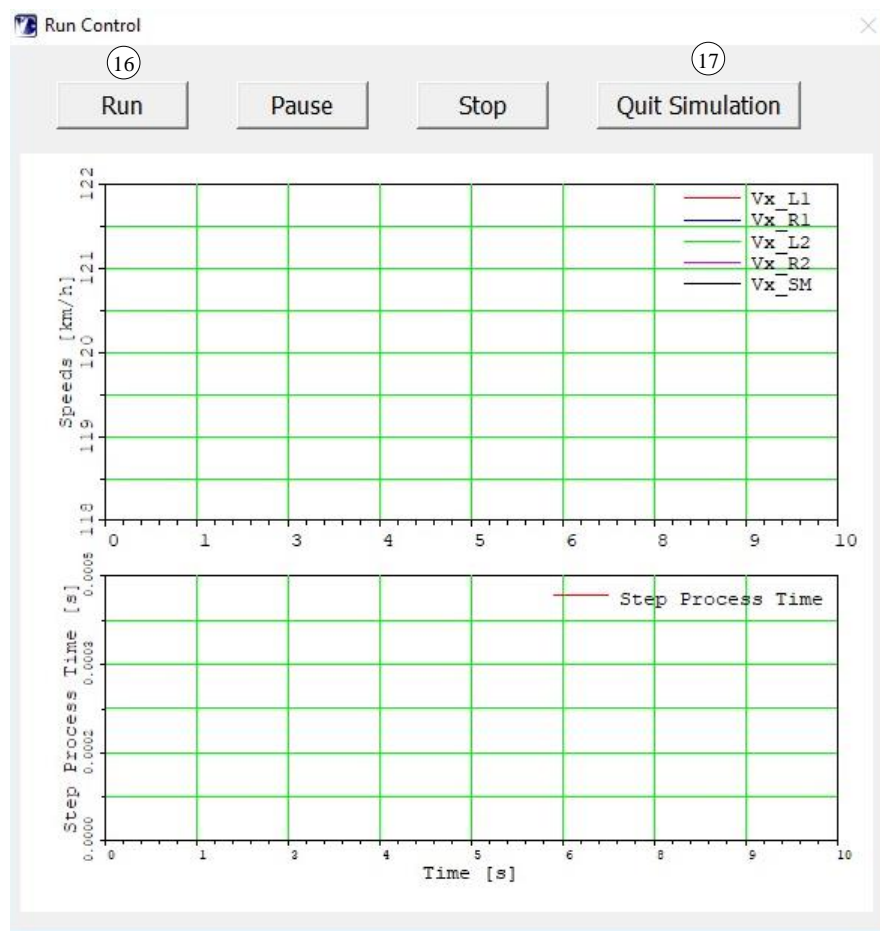


Figure 17. Run Control window.

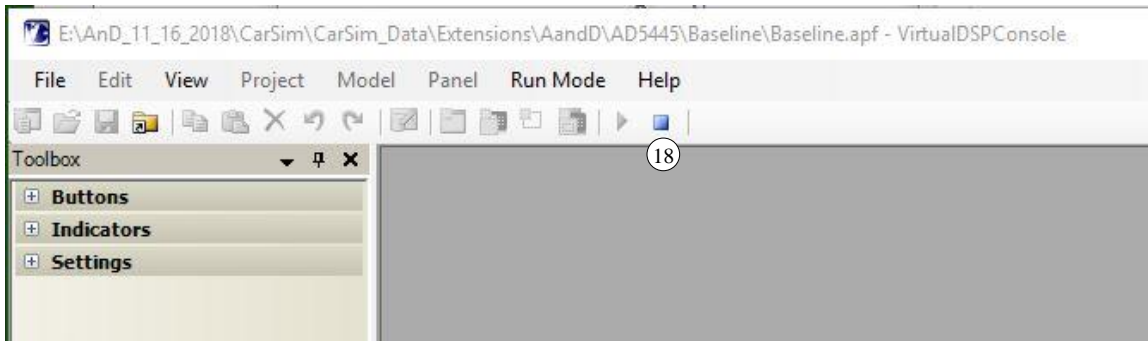


Figure 18. VirtualDSPConsole toolbar.

Vehicle Model Pause/Start Option

Inside the S-Function block, there are two tunable parameters: **Initial Vehicle Model State** and **System Terminate Control** (Figure 19). Even though there is an option for System Terminate Control, this option is for other Real Time systems and it is not available for A&D system. However, the user can toggle between **Pause** and **Run** for **Initial Vehicle Model State**. The default of **Initial Vehicle Model State** is **Run**. When the simulation starts, the vehicle runs immediately. If this is set to **Pause**, the vehicle will not run until the Run is enabled by the Run Control Window in VirtualDSPConsole.

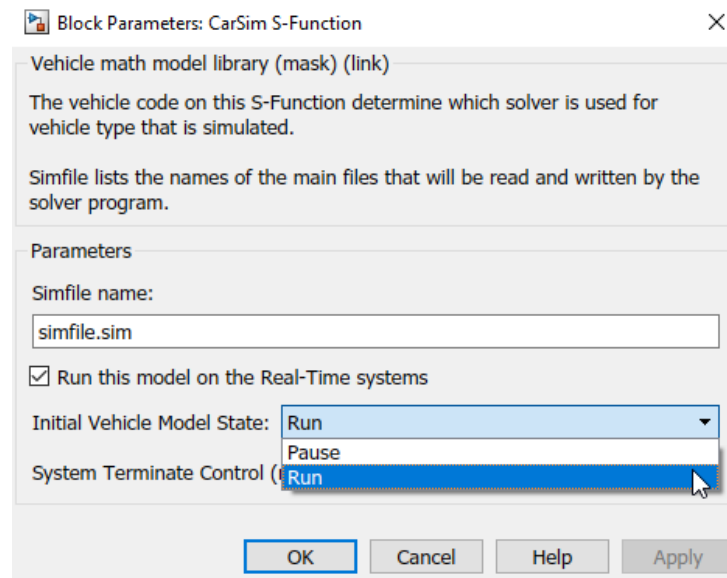


Figure 19. S-Function Block.

Using the `vs_state` parameter, the button control can be added like the one shown at the top right corner in Figure 20. The Baseline project which is included in the shipping CPAR file contains this button as an example.

The value of the parameter `vs_state` is defined as:

- **Pause:** 1

- **Run:** 2

The user can pause or run the simulation by using this button. To stop the simulation, press the Stop button in System Run Control.

Note In Figure 20, the three top left buttons (Run, Pause, Stop) are for the system run control. When this Stop button is pressed, the whole system stops. Using Vehicle Model Pause/Run from the `vs_state` parameter will run/pause just the vehicle model. Other hardware/software in the system can still be running.

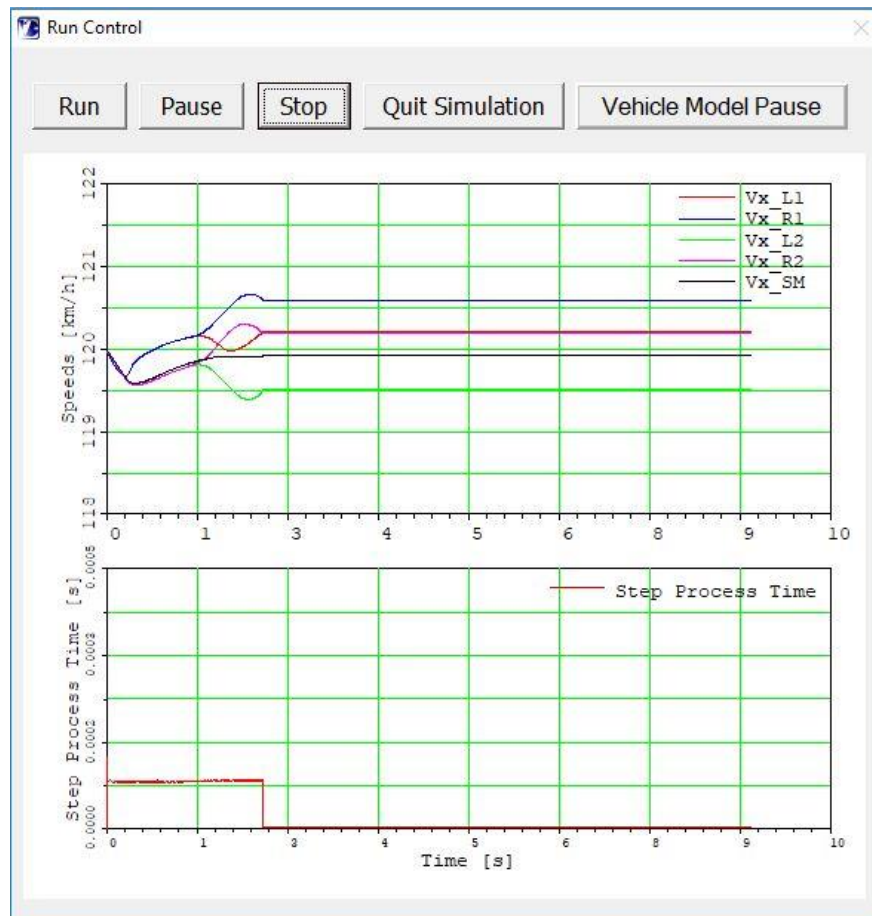


Figure 20. Vehicle Model Pause/Run Option.

Note that the example projects are created by an older version of VirtualDSPConsole. If the Vehicle Model Pause/Run button in Figure 20 is not working, remap this button using the `vs_state` parameter using PC Panel Explorer.