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VS / ERD File Utility

Introduction

Mechanical Simulation Corporation produces and distributes software tools for simulating and analyzing the dynamic behavior of motor vehicles in response to inputs from steering, braking, throttle, road, and aerodynamics. The simulation packages are organized into families of products named BikeSim®, CarSim®, SuspensionSim®, and TruckSim®. All are based on the simulation architecture named VehicleSim®.

On the Windows operating System, a VS Browser provides a graphical user interface (GUI) with controls for browsing a database of parameters and other properties of the math models, along with controls for performing simulations and viewing results with VS Visualizer (Figure 1). Simulations can also be run on the Linux operating system using the command line solver wrapper.

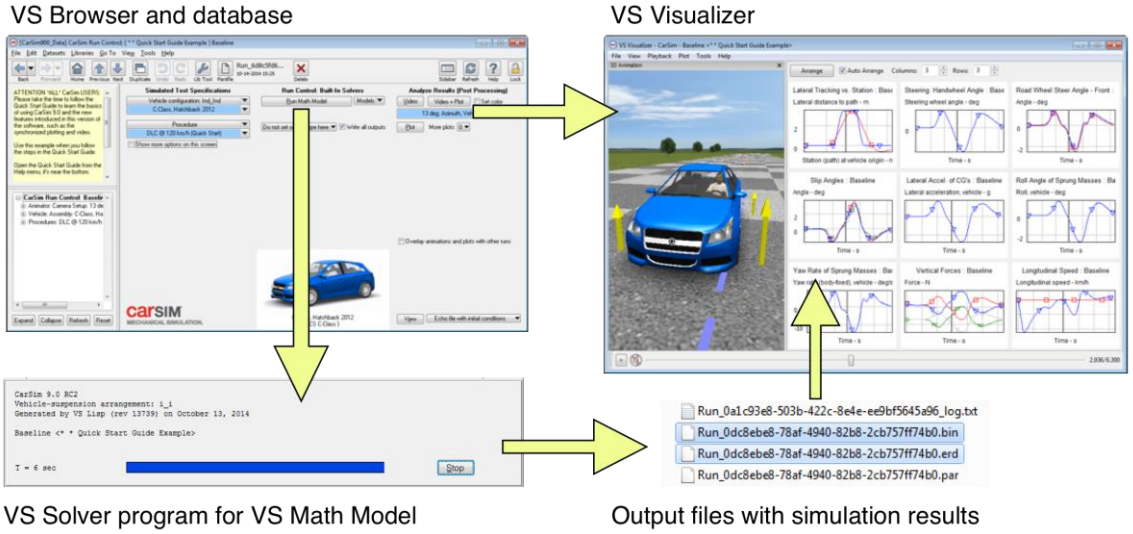


Figure 1. Main parts of a VehicleSim product.

VS Solver programs perform simulations and generate output files with time histories of variables of interest, such as motion variables, forces, controls, etc. Depending on the type of model, a VS Solver calculates hundreds to thousands of variables that can be written to file for post-processing analysis. VS Solvers write the time histories in an efficient binary format, along with a text header file that contains names of the variables and other information.

All versions of VehicleSim products can generate output files using a format called ERD (developed at the University of Michigan Transportation Research Institute, UMTRI, in 1984). With this format, the header file has the extension ERD, and the associated binary file has the same root name with the extension BIN. Starting with Version 9 (October 2014), VS Solvers can also

write the time histories in a VS format that supports both 32-bit and 64-bit floating-point numbers. With this format, the header file has the extension VS and the binary file has the same root name with extension VSB.

VS Visualizer reads all forms of VS/VSB and ERD/BIN files that can be generated by VS Solvers.

If a **Run Control** dataset links to a dataset from the **I/O Channels: Write** library, which in turn specifies options for writing outputs, then additional files can be generated automatically that can be read by Microsoft Excel® and/or MATLAB®.

If additional output files for Excel and/or MATLAB were generated, the outputs can be viewed after the simulation has finished by clicking the **View** button in the lower-right corner of the **Run Control** screen (Figure 2). This process is documented for the VS Browser libraries **I/O Channels: Write** (specifying which variables to write and which kinds of files to generate) and **Run Control** (using the **View** button and adjacent drop-down control to view the outputs).

It is also possible to write output files in one format using information from existing files in a different format without running new simulations, using a tool named VS/ERD File Utility, as described in this document.

VS/ERD File Utility Screen

Running from a VS Browser such as CarSim, launch the VS/ERD File Utility using the **Tools** menu item **VS/ERD File Utility**. Figure 3 shows the appearance of the window using default options for generating new files.

Creating new files involves three kinds of specifications:

1. What are the existing files that contain time histories of variables of interest?
2. What format and naming convention should be used for the new files that will be written?
3. What information should go into the new files?

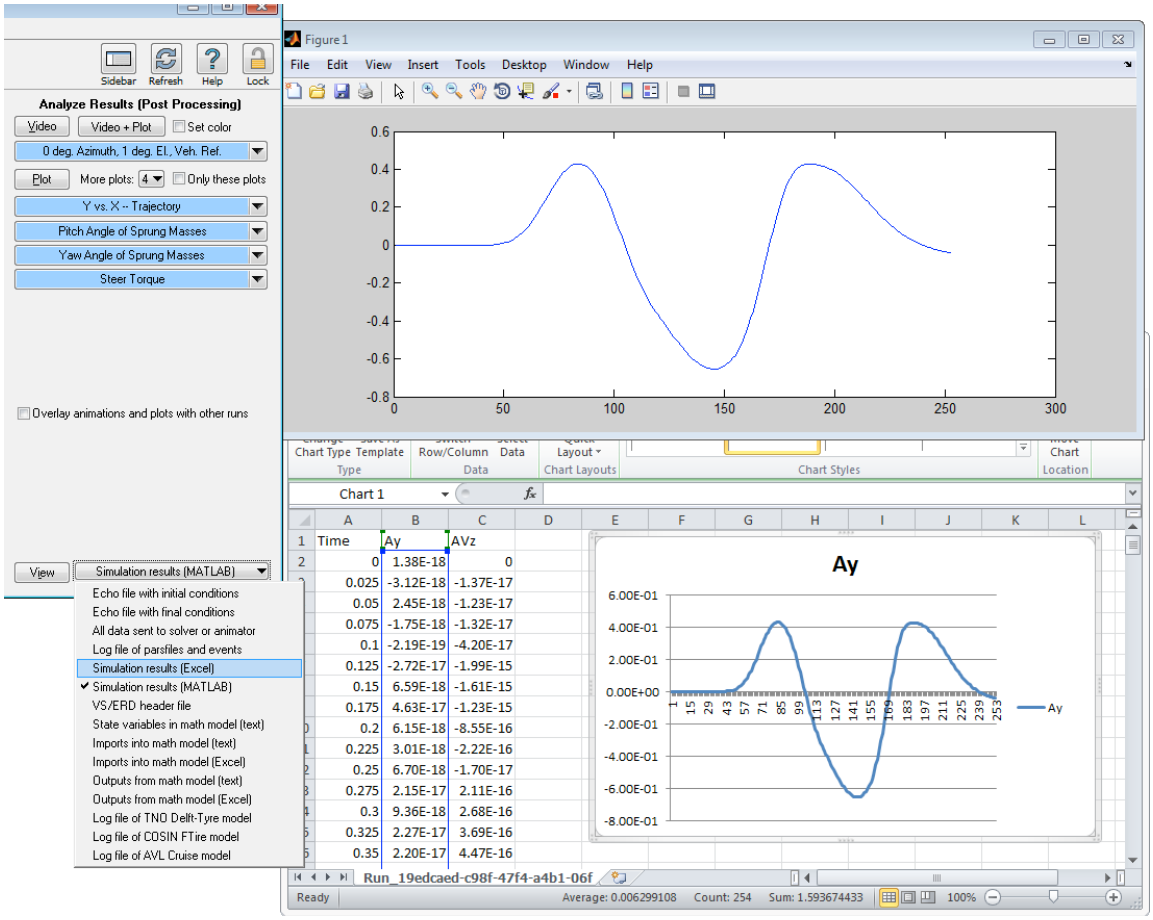


Figure 2. Simulation results from a VehicleSim product can be viewed in Excel and MATLAB.

This information is used when you click the **Convert File(s)** button (21) (Figure 3) to generate one new output file for each specified input file. This button is dimmed unless two conditions are met:

1. There must be a least one input file specified in the list (2).
2. There must be a valid naming convention defined for output files, as described below.

When the **Convert File(s)** button becomes active, you can click the button to have VS/ERD File Utility scan all of the input files specified in the list and write new output files with the specified properties.

Input Files

Names of existing files with information of interest (e.g., simulation output files) are put into a list (2) using controls as described below.

(1) Drop-down control to specify the type of input file to convert. There are three options (Figure 4). The VS and ERD formats are typically written by VS Solvers from a VehicleSim product. These options support the use of VS/ERD File Utility for exporting VS Data to other software, such as Excel or MATLAB.

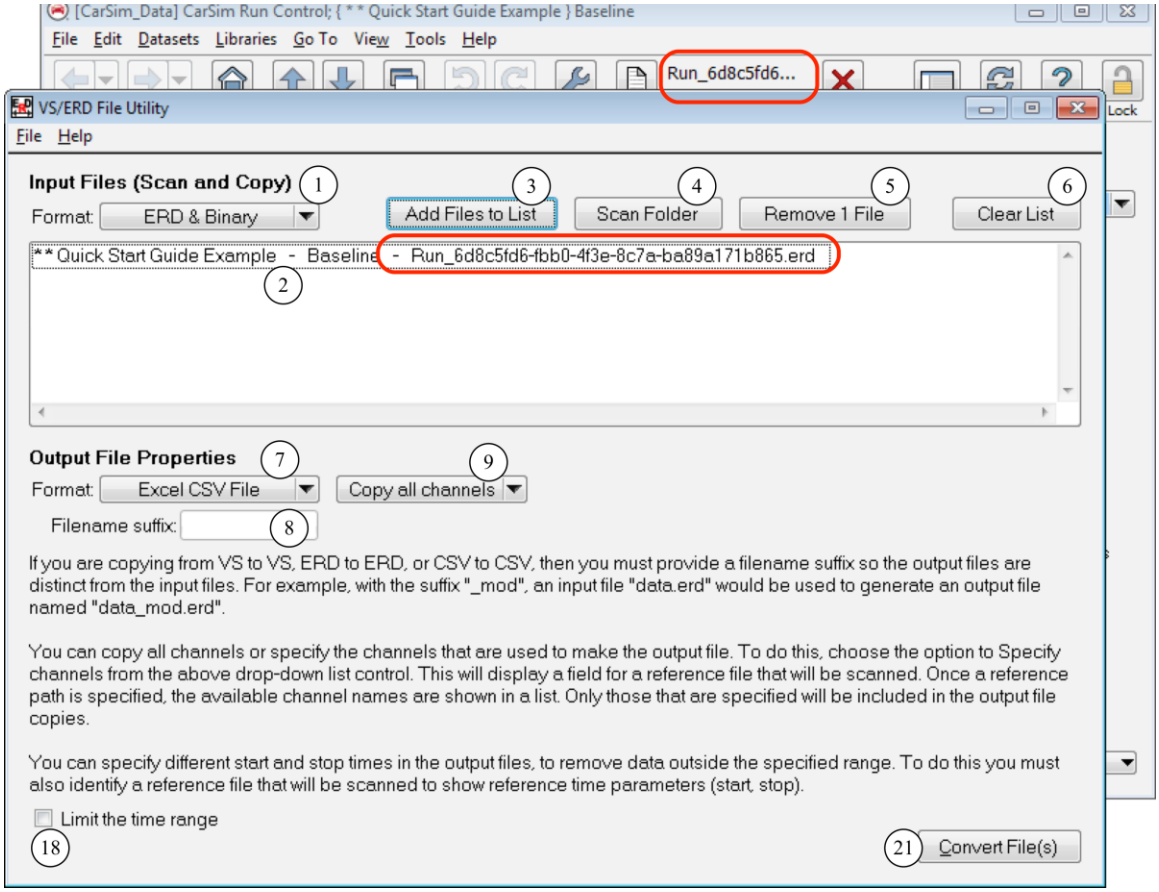


Figure 3. The VS/ERD File Utility screen with basic controls.

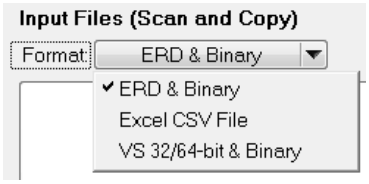


Figure 4. Drop-down control to specify format for input files.

The option to specify the Excel CSV format is provided to generate VS or ERD files in order to make use of VS Visualizer for viewing data that was generated from outside sources (i.e., not from a VS Solver).

(2) **Input Files (Scan and Copy)**. This list shows all selected files. If the file type is VS or ERD, the list shows the category, title, and filename. (VS/ERD File Utility opens each selected file and scans the first few lines to obtain the category and title information.)

If the file type is Excel CSV, then only the file names are shown. (CSV files do not contain title information.)

Add files to this list using the two buttons above (3 and 4). You also add a file to the list when you select a reference file as shown later (Figure 6, page 6).

Remove a file from the list using the above button 5 or by double-clicking on the filename in the list.

3 **Add Files to List** button. Click this button to bring up the Windows file browser to select input files that will be added to the list 2. When browsing, you will only see the file name.

The files that are created automatically by VehicleSim products have names that are machine-generated. In VehicleSim versions prior to 2014 (versions less than 9.0) the machine-generated filenames used integer indices starting at 100, with names such as `Run123.erd`. In more recent versions, the machine-generated filenames use universal unique ID (UUID) numbers that have 32 hexadecimal characters, with names such as the one shown in the figure (`Run_6d8c5…65.erd`).

In order to identify the filenames for simulations of interest, you can look at the displays of the simulations from the **Run Control** screen. For example, Figure 3 uses two red outlines to identify the full filename in the VS/ERD File Utility screen and the first part of the filename at the top of the **Run Control** screen in CarSim.

4 **Scan Folder** button. Click to bring up the Windows file browser to select a folder by viewing its contents. This will add all files of the selected type 1 to the list 2. If the type is ERD or VS, then the categories and titles are shown along with the file names (Figure 5). The files are sorted alphabetically using categories and titles, similar to the display seen from the **Datasets** menu from the **Run Control** screen.

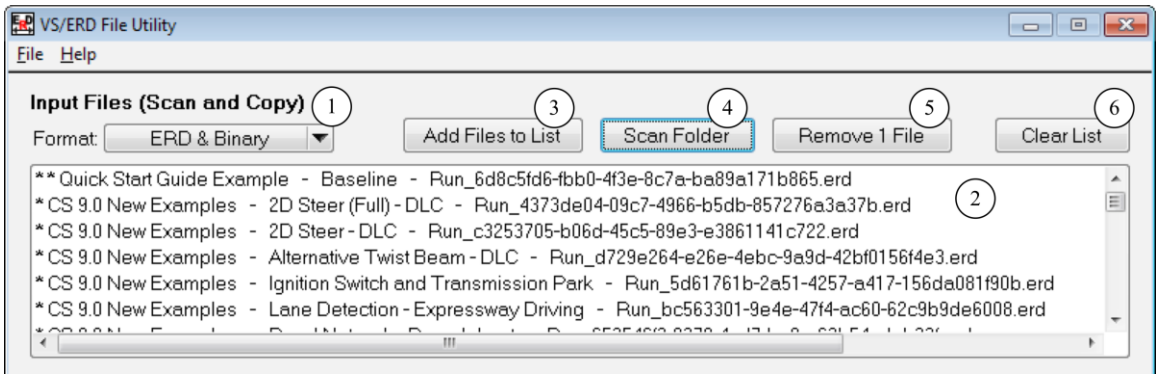


Figure 5. Use the Scan Folder button to add all files with the specified type to the list.

If the file type is Excel CSV, then only the file names are shown.

5 **Remove 1 File** button. Click this button to remove the currently selected line from the list 2. (It has no effect on the file itself.) As a shortcut, double-click on a line in the list to remove it.

(6) **Clear List** button. This clears all file names from the list (2).

Output File Properties

Figure 6 shows the bottom part of the screen when the output files have only channels that were specified.

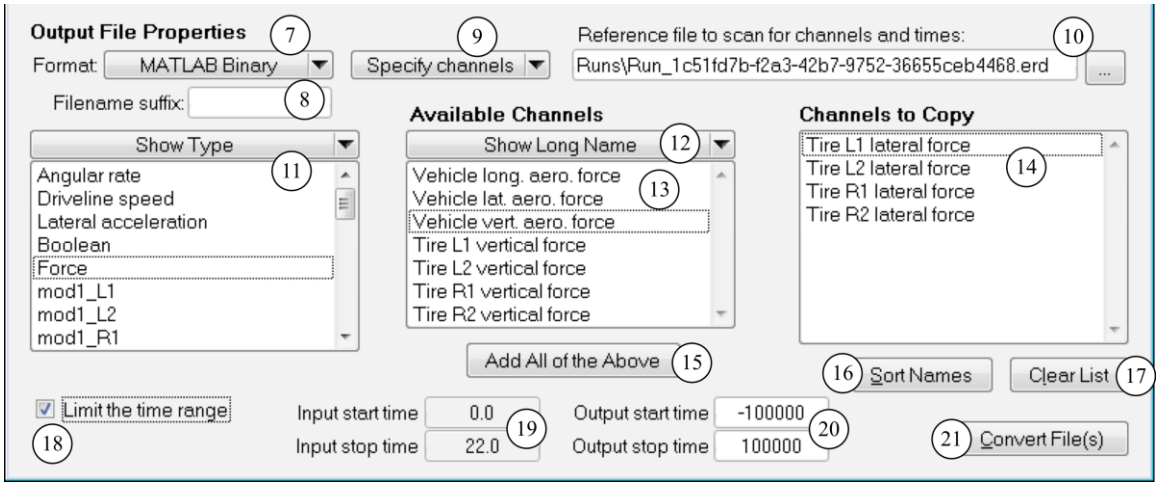


Figure 6. Controls to specify the properties of output files.

(7) Drop-down list to specify the output file format. There are five options (Figure 7).

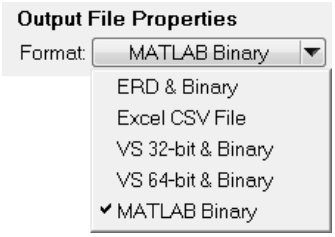


Figure 7. Options for output file format.

The first, **ERD & Binary**, will results in the output files following the ERD convention. This is used to import external CSV files for use with VS Visualizer. Another reason for using this option might be to extract variables from existing ERD files or to remove parts of the time histories.

The second option, **Excel CSV File**, will cause the output files to be ASCII text files whose first line is a list of short variable names, and whose subsequent lines are the values of the variables at each time step. The file format is called comma-separated values (CSV) because the items in each line of text are separated by commas. This generic text file can be loaded without modification into many programs, including Microsoft Excel.

The third and fourth options, **VS files**, will cause the output files to be VS header and VSB binary files that can be 32-bit or 64-bit in data size.

The fifth option, **MATLAB Binary**, will cause the output files to be binary MAT files that can be loaded directly into MATLAB.

(8) Filename suffix. When output files are created, the name is created as:

new_name = old_name + suffix . extension

where *suffix* is the content of this field, and extension is ERD, BIN, VS, CSV, or MAT, depending on the file format. If the output format specified in the drop-down list (7) is different from the input format specified in the drop-down list (1), then this suffix is optional. However, if the output format is the same as the input format, then the extensions for the output files are the same as those of the input files, and the suffix is required to create output file names that are distinct from the input file names.

(9) Drop-down control to specify one of two options involving the channels (variables) contained in the input files (Figure 8).

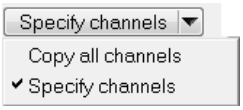


Figure 8. Two options for handling copying channels from an input file.

When all channels are specified, the converted file contains every variable that was in the original. (In addition, a variable will be added for time when writing to CSV or MAT files.) In this case, all of the controls associated with selecting channels (items (11) - (17)) are hidden, as shown earlier in Figure 3.

(10) Reference file to scan for channels and times. This control is shown only if you are specifying the channels to copy into the output file (as specified with the drop-down control (9)) or if you are going to limit the time range (as specified with the check-box (18)).

Use the browse button to bring up the Windows file browser window to locate the file. Once selected, VS/ERD File Utility will scan the file for information, display the pathname, and show additional controls with information obtained from the file.

When you select a file to use as a reference, it is also added to the list of input files to convert (2).

(11) Drop-down list to specify categories of channel names (Figure 9). This control is only available if the input file format (1) is **ERD** or **VS**. There are three options available:

Figure 9. Drop-down control to show categories.

If the first option (**Show All**) is selected, then all channels from the reference file are initially shown in the list of available channels (13).

If the either the second or third option is selected, then a list of categories shows the available components or types, as shown in Figure 6.

Use this list to rapidly view subsets of the available channels. Click on a category and all unused channels in the category are shown in the adjacent list (13).

(12) Drop-down list to specify the display of channel names (Figure 10). This control is not available if the input file format (1) is **Excel CSV** (CSV files have only short names for channels). For VS and ERD files there are two options (Figure 10).

Figure 10. Drop-down control to short or long names of variables.

The short names are the names used by the VS/ERD File Utility when scanning the ERD files. The long names are more descriptive.

(13) **Available Channels** list. This shows the names of all channels that are available for being added to the output list (14). If the input file format (1) is **Excel CSV File**, only the short names of the variables listed in the CSV file are displayed in this box. If the input file format is **ERD** or **VS**, more options exist.

If the **Categories** drop-down list (11) is set to **Show Type** or **Show Component**, then this list shows all variables whose names were read from the reference VS or ERD file (10) that are in the category selected from the list to the left (11) and have not been put in the **Channels to Copy** list (14).

The channels can be shown using their short unique names (eight characters, no embedded spaces), or with their longer unique names (32 characters, including spaces), based on the status of the above drop-down list (12).

You can perform actions on the names in this list with the left mouse button.

a. Double-clicking on a name adds it to the **Channels to Copy** list (14).

b. If the reference file was an ERD file, then clicking and holding brings up full information about the variable (Figure 11). While holding the left button, you can slide the mouse up and down to view full information about any of the variables in the list.

(14) **Channels to Copy** list. These channels will be copied into any converted files. The names shown will be long or short, depending on the status of the nearby drop-down control (12).

You can perform actions on the names in this list with the left mouse button.

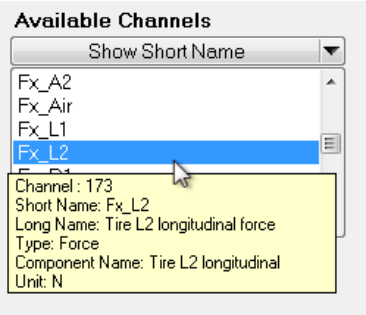


Figure 11. Click and hold for more information about a variable.

a. Double-clicking on a name removes it from the list.

b. If the reference file was an ERD file, then clicking and holding brings up full information about the variable, as shown above for the **Available Channels** list (Figure 11). While holding the left button, you can slide the mouse up and down to view full information about any of the variables in the list.

(15) **Add All of the Above** button. Click to add all variables listed in the **Available Channels** list (13) to the **Channels to Copy** list (14).

(16) **Sort Names** button. Click to sort the names in the **Channels to Copy** list (14) alphabetically. The sorting is based on the current type of name (short or long) selected by the drop-down control (12).

(17) **Clear List** button. Click to clear the **Channels to Copy** list (14).

(18) Checkbox to limit the output time range. When this is not checked, the output files include the entire time histories of the original files. When it is checked, more controls are shown for specifying start and stop times.

(19) Start and stop times from the reference file (10). These two times are provided only for information about the range covered in the example. They cannot be edited and have no effect on the processing of other files.

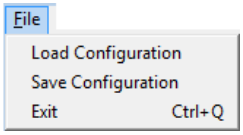
(10) These fields are visible only if the time range checkbox (18) is checked, and a reference file has been scanned.

(20) Output start and stop times. These values limit the range of outputs that will be written into files created by the VS/ERD File Utility. For example, if the start time is 10 and the stop time is 20, then any data for time less than 10 seconds or greater than 20 seconds will be excluded from the output files.

The defaults are large numbers that are probably outside the range of any input files that will be encountered.

(21) **Convert File(s)** button. This button writes new files based on the settings on the screen. It is dimmed unless there are files specified to process (2) and the output files are setup to have different names from the input files. If both the input (1) and output (7) file types are the same, then a suffix must be specified for the new file names (8).

File Menu



The settings of the interactive controls can be saved for reuse. Commands for saving and loading configurations are provided on the **File** menu.

Load Configuration

Select this item to load a configuration file saved previously.

Save Configuration

Select this item to save the current state of the VS/ERD File Utility in a configuration file. The file will be given a suffix based on the output format:

- For ERD-BIN output, the file will end with the suffix `_bin.cvt_cfg`
- For MATLAB output, the file will end with the suffix `_mat.cvt_cfg`
- For CSV output, the file will end with the suffix `_csv.cvt_cfg`
- For VS output, the file will end with the suffix `_vs.cvt_cfg`

Exit

Select this item to exit the VS/ERD File Utility. The keyboard command is Ctrl+Q.

Command Line Control of VS/ERD File Utility

> **Note** The VS/ERD File Utility requires that a VS Browser be running. (The Browser may be minimized if desired.)

VS/ERD File Utility can be run from a command line with the normal convention that optional arguments are enclosed in square braces [], the full command line is:

`erdconverter.exe` [[–b *datafile*] –i *inifile*]

The options are:

- `-b` run in batch mode to convert the file *datafile*. This file should be the ERD or CSV file to be converted. This option does not work unless the –i option is also specified.
- `-i` load the existing configuration file, *inifile*. This file details the conversion settings. Create this file using the user interface as normal, and then save the settings using the **File** menu item **Save Configuration**.

To convert a file without using the user interface, you need to supply the program with both the file to be converted and the configuration file. The following example converts `MyData.erd` using the configuration file `config_csv.cvt_cfg`. The text is wrapped but should appear as one command.

```
erdconverter.exe –b C:\Path_to_datafile\MyData.erd
                 –i C:\Path_to_inifile\config_csv.cvt_cfg
```

Some additional options are:

- `-h` this prints out a usage or help statement for ERDConverter.exe
- `-v` this causes the routine to print out additional information when operating. This can be useful if the routine is not operating as expected, or you'd like to know what operations are performed when it is operating on a given set of inputs.

The routine can also convert an output without the use of a configuration file. This is how the converter operates when performing automatic conversions on new runs. With this operation, the converter uses the consolidated pars file (`*_all.par` files) and some added switches to convert either an **ERD/BIN file** or **VS/VSB file** to **CSV** or **MAT** format.

- `-a` load the existing **PAR file** *allparfile*. This file can contain channel selection information (set in I/O Channels: Write) to indicate which channels are output. It can also pass through all channels for conversion as well.
- `-c` output a converted file in the **Excel CSV file** format when using the –a switch. Applied .csv extension to input **ERD file** or **VS file**. Cannot be used with –m switch.

`-m` output a converted file in the MAT format when using the –a switch. Applied .mat extension to input ERD or VS file. Cannot be used with –c switch

Example calls using these switches:

```
erdconverter.exe –b C:\Path_to_datafile\MyData.erd
                 –a C:\Path_to_datafile\MyData _all.par -c

erdconverter.exe –b C:\Path_to_datafile\MyData.vs
                 –a C:\Path_to_datafile\MyData _all.par -m
```