

Plot Screens

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VehicleSim products enable plotting of simulation variables with one click of the **Plot** or **Video + Plot** button from the **Run Control** screen.

When you click the **Plot** or **Video + Plot** button on the **Run Control** screen, a VS Browser such as CarSim reads all linked datasets for datasets from the **Plot: Setup** library, and sends the information to VS Visualizer. The names of variables listed in all linked **Plot Setup** datasets are activated when the simulation is run (using a **Run** button from the **Run Control** screen), to ensure that the VS Solver writes all variables of interest into the output files that will be read by VS Visualizer.

Plot Setup Screen

The main screen for defining plots is **Plot: Setup**, where each dataset defines a graphical plot with specifications of the data to plot. The numerical values of the variables are obtained from an output simulation file written in ERD, VS, or CSV (spreadsheet) format.

VehicleSim products come with many installed plot datasets. You can modify any of these existing datasets or create new ones. Once a dataset is defined, you can select it from the **Run Control** screen, the **Procedures** screen, the **VS Commands** screen, or one of many other screens that might be used to build a vehicle or procedure description.

Minimal Display

Figure 1 shows a typical dataset that has the minimal information needed to define a plot.

- ① List of variables that will be obtained from the output files when a plot is made. Each line in this field contains a Y-axis variable name, a corresponding X-axis variable name, and an optional label for the plot. When the optional label is not specified, VS Visualizer labels the plotted curves based on standard keywords obtained from the VS, ERD, or CSV file. Commas separate the names on each line.

The contents of this field can be edited manually, just like any other data field. However, names can also be inserted with point-and-click controls, as described in the next subsection.

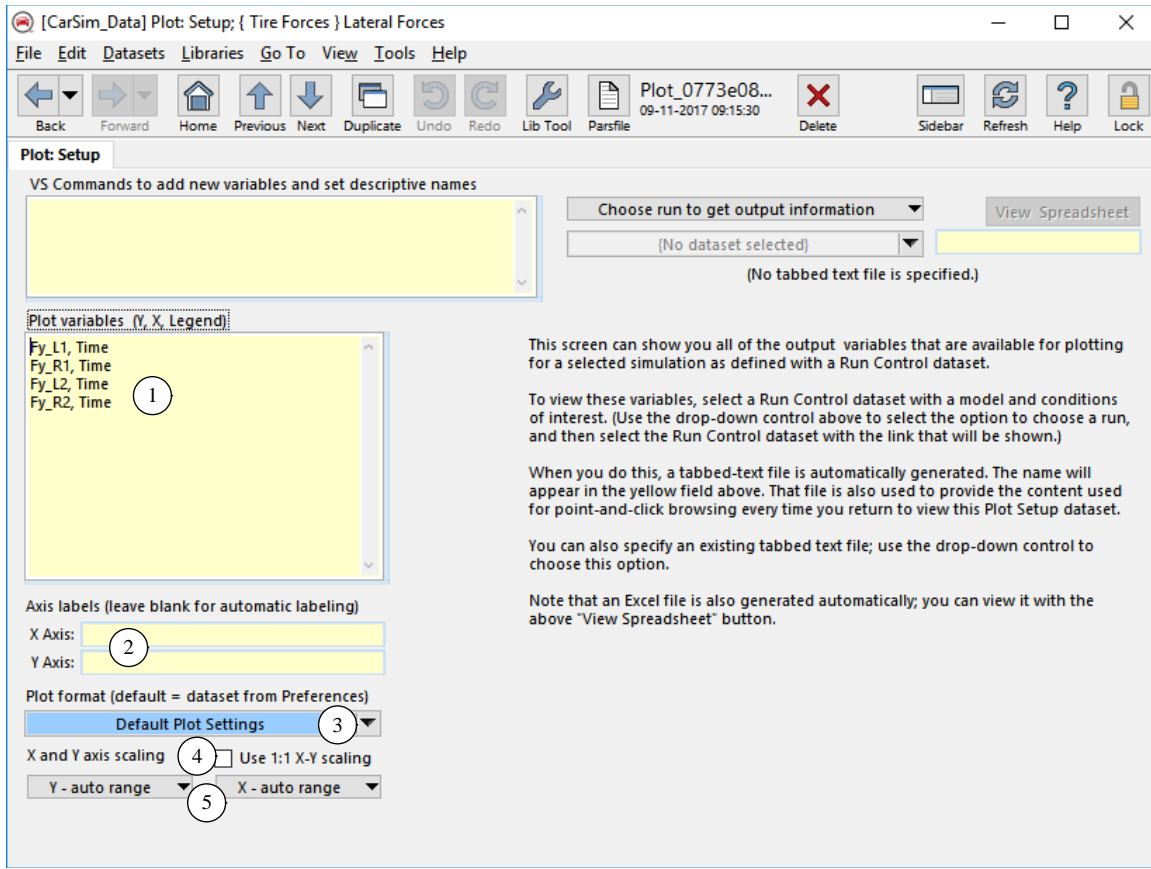


Figure 1. The Plot Setup screen (simple view).

- ② Optional labels for the X and Y axes. If these fields are blank (Figure 1), VS Visualizer labels the axes based on keywords read from the VS or ERD header files. However, you can override these labels and specify your own (Figure 2). If any text appears in these fields, it will be used to label the axes instead of the information from the output file(s).
- ③ **Plot format** link. The linked dataset determines the style and scale of a plot. See the **Plot Format** section (page 7) for information about the format options.
- ④ Checkbox to use 1:1 scaling for the X and Y axis directions. When checked, VS Visualizer will use the same scale factor in both directions. This is helpful when viewing plots of spatial Y coordinates of points cross-plotted against the X coordinates of those points, such as tire contact locations, vehicle origin points, etc. In these cases, the scaling of m/pixel is the same in both directions. Cross plots can be printed and sized to obtain useful plots of the space requirements for vehicles.
- ⑤ **X and Y auto/manual scaling** drop-down lists. Use these to choose between manual and automatic scaling for each axis. When manual scaling is chosen, additional fields are shown to specify the minimum and maximum values.

These controls are hidden if the 1:1 scaling box ④ is checked.

Interactive Browser for Variables

Figure 2 shows a dataset with more controls and field in use.

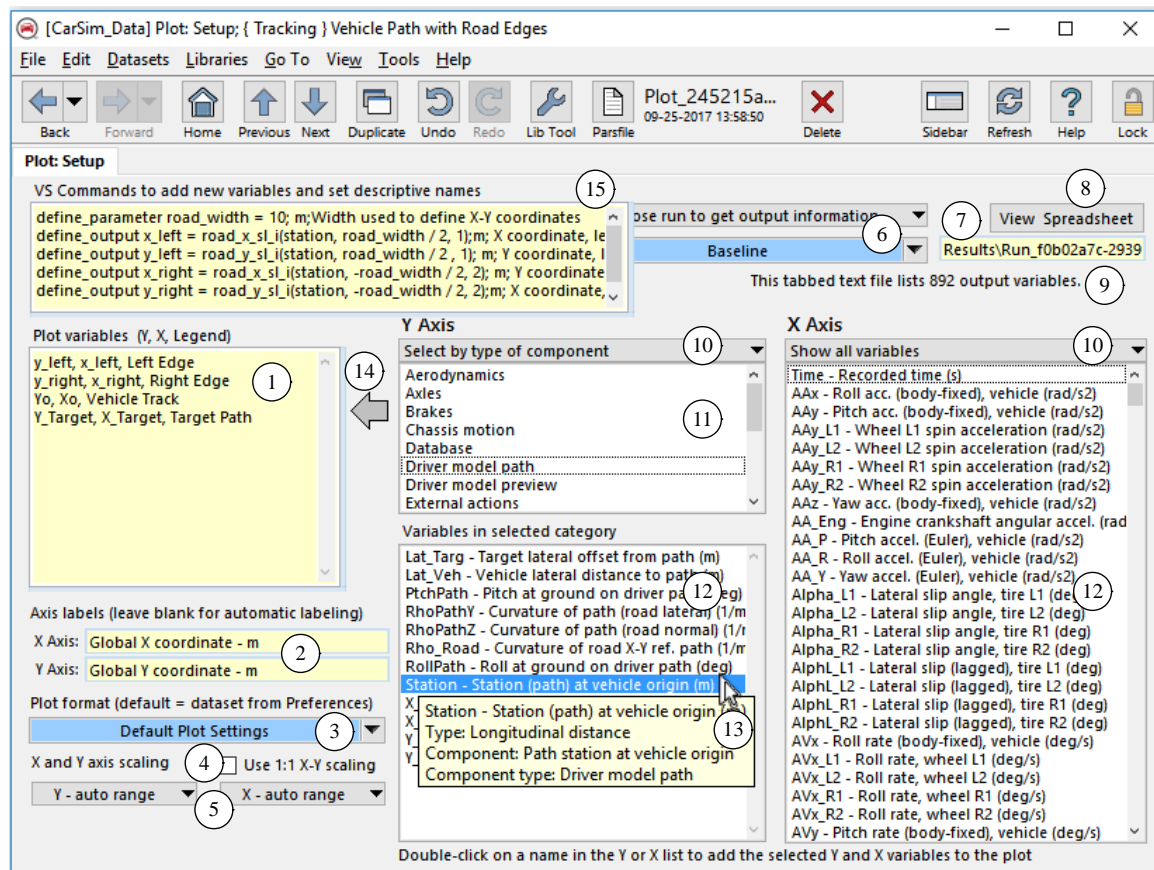


Figure 2. Plot Setup screen showing browser and advanced options.

- ⑥ Drop-down control to choose between two options for obtaining information about available output variables (Figure 3).

The first option arranges the screen to show a potential link to a dataset from the **Run Control** library. In this case, use the link to select a run that involves a vehicle model that includes all of the variables you wish to plot.

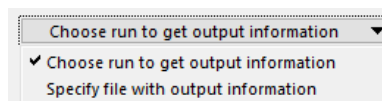


Figure 3. Options for getting output information.

When you select a dataset, the VS Browser shows all of the output variables that are available in lists on the screen ⑫.

To do this, the VS Browser performs several steps automatically:

1. It connects with the VS Solver that would be used for the simulation (e.g., the solver file `carsim_32.dll` would usually be used for CarSim), giving it all information from the datasets linked to the selected **Run Control** dataset.
2. It instructs the VS Solver to create a tabbed text file listing all output variables that are available, given the information available from the **Run Control** dataset. The tabbed text file is written in the `Results` folder associated with the **Run Control** dataset, as indicated in the adjacent yellow field (7). The VS Solver also creates a copy of the same file but with the extension `.xls` (spreadsheet).
3. The VS Solver is unloaded.
4. The name of the tabbed text file is placed in the pathname field (7).
5. The tabbed text file is scanned to obtain the information shown in the browser lists (12).
6. The number of available output variables is written in a text message (9) under the pathname field (e.g., there are 892 outputs for the example shown).

These steps take place very quickly.

When the VS Solver is used to generate documentation, it does not perform any simulation activities, and can be used even if you do not have license for the specific model of interest. For example, if you have a network license server supporting a Sensor option, you can set up output variables for a vehicle with Sensors without accessing a Sensor license.

The second option arranges the screen to show a larger field for the pathname for a tabbed text file with an adjacent file browser control (7) (Figure 4).

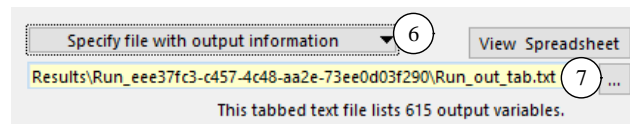


Figure 4. Display when the “specify file” option is selected.

- (7) Tabbed text file describing all of the variables available for output. This is typically generated by temporarily setting the drop-down control (6) to choose a run, as described above. Once the file is generated, you can change the drop-down control back to see the full name of the file.

The pathname shown in the field ends with the suffix `out_tab.txt`. A second file with the extension `xls` also exists for viewing with a spreadsheet program such as Excel using the adjacent button (8).

In addition to the options of using this screen or a spreadsheet program, a third option for viewing output information is available via the **View** button in the lower-right corner of the **Run Control** screen.

- (8) **View Spreadsheet** button. Click to view a spreadsheet (extension `.xls`) with the same information shown on this screen.
- (9) Text message with the number of output variables listed in the tabbed text file.

- ⑩ Drop-down controls that you use to show categories of the available variables for the X and Y axes (Figure 5). These controls are active only when there is a specified tabbed-text file ⑦ that was scanned to obtain the variable names.

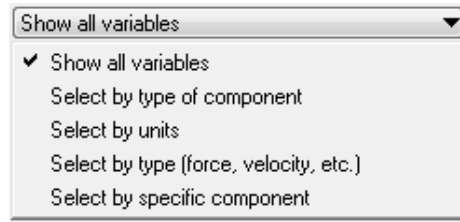


Figure 5. Categories for browsing variables.

Choose one of these options, and all categories in the selected type are shown in the list below ⑪, as seen for the Y axis in Figure 2. If the first option is chosen (Show all variables), then the list of variables is expanded to show all, as seen for the list for the X axis.

- ⑪ Category lists. Depending on the setting of the corresponding drop-down lists ⑩, these lists are hidden or show available categories.

Use this list to rapidly view subsets of the available variables. Click on a category and all variables in the category are shown in the list below ⑫.

- ⑫ Lists of output variables. Each list shows the variables that were found by reading the tabbed text file ⑦. The variables shown are in the category specified in the list above ⑪.

To add a pair of variables to the plot specification, pick a variable name from each of these two lists (one for the Y axis and one for the X axis) and click the left arrow button ⑭. Or, you can double-click a name in either the Y or X axis fields as a shortcut for clicking the arrow button.

- ⑬ Pop-up information about a variable. Right-click on a channel name from either list of output variables to see the full description of that variable.

- ⑭ Left-arrow button. Click to add the selected channels in the X- and Y-axis lists ⑫ to the **Plot** list ①. Alternatively, you can add a pair of variables by double-clicking on a name from either list ⑫.

- ⑮ Field available for advanced users to define new variables at runtime, as described in the next subsection.

Note that this field can be resized by dragging the right-hand boundary to make it wider (as in Figure 2), and/or dragging the bottom boundary to make it taller.

Defining New Variables to Plot

New variables can be defined within the VS Solver with VS Commands, or within VS Visualizer with formulas involving existing variables.

Adding Output Variables to the VS Solver

Define a new output variable for the VS Solver using the `define_output` VS Command in the text field (15). For example, four output variables are defined in the dataset shown in Figure 2 with the VS Command `define_output: x_left, y_left, x_right, and y_right`. Equations for each make use of the VS Command functions `road_x_sl_i` and `road_y_sl_i` to calculate X and Y coordinates based on distance along a road path (station) and a lateral distance.

The new outputs are added to the model if a simulation is run while being linked to the **Plot Setup** dataset containing the command. Note that if the **Plot Setup** dataset is created after the simulation is run, the variables will not be available for plotting until the simulation is run again.

More information about VS Commands is provided in the document *VS Commands Reference Manual*.

Using Formulas Involving Existing Output Variables

VS Visualizer supports the use of formulas to define a variable to plot or use in animation. and will create a new data channel by applying the formula to existing output variables. For example, Figure 6 shows how the sum of two front tire forces ($F_{y_L1} + F_{y_R1}$) is specified for VS Visualizer as first variable to plot (1).

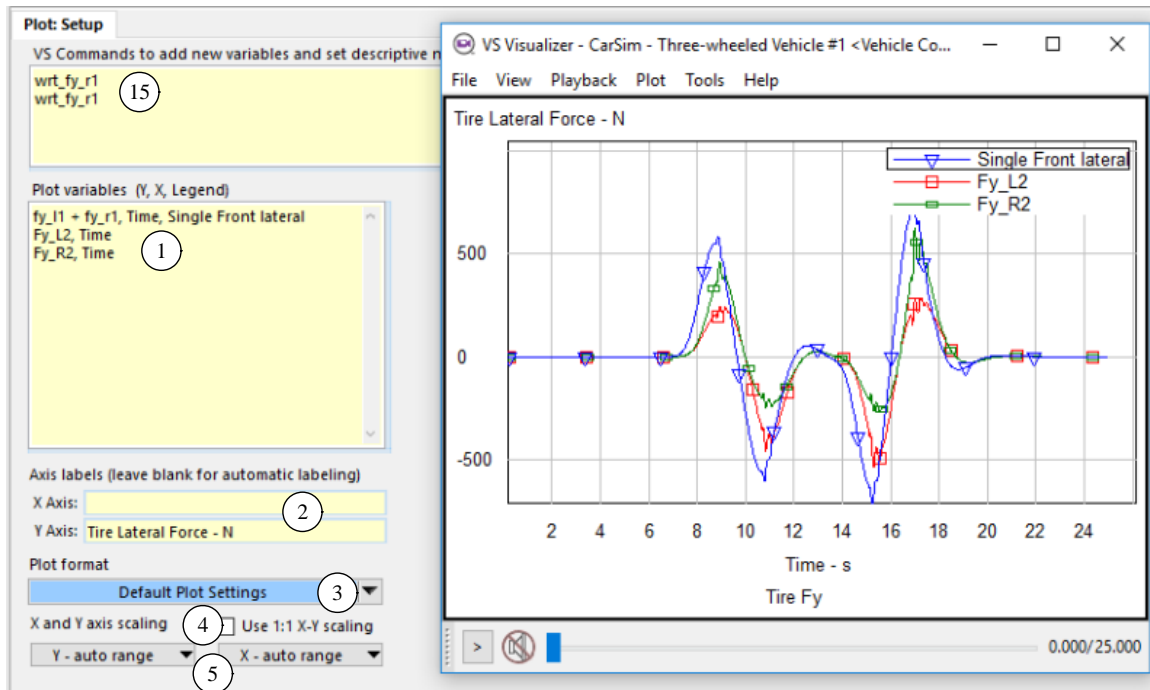


Figure 6. Using a formula to define a new output variable.

When formulas are used to define a new variable for VS Visualizer, it is important that any variables used in the formula be available to VS Visualizer. Commands to activate output variables for writing to file and streaming for live animation are automatically written to the All Parsfile sent to the VS Solver when the variables are specified with simple names. For example, the variable `Fy_L2` is listed in the field of plot variables (1), so two commands are automatically sent to the VS Solver:

WRT_FY_L2
ANI_FY_L2

This is not done when formulas are used. In the example, the variables FY_L1 and FY_R1 might not be written to the output file. To ensure that they are, the WRT_ commands were put into the miscellaneous field (15).

Plot Format Screen

The Plot Format screen (Figure 7) is used to set the style and layout of a plot in VS Visualizer. These formats cover line style, axis and grid options, and font properties.

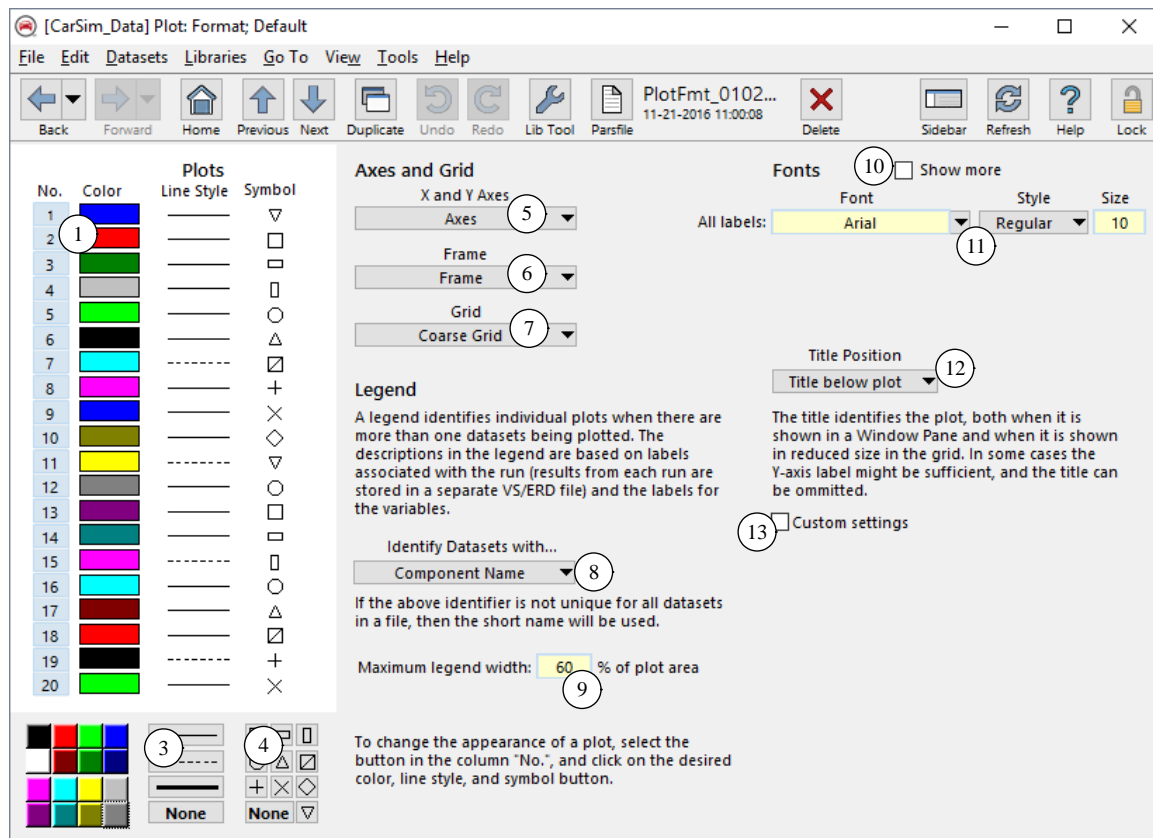


Figure 7. The Plot Format screen.

VS Visualizer supports a number of options for controlling the format of the generated plots. This screen is used to specify formats for the initial display of the plots.

- (1) VS Visualizer can show multiple datasets overlaid using the same horizontal and vertical axes. Each dataset can be represented with lines, symbols on some of the point locations, or both. The current settings are displayed in the white area on the left side of the window. This screen allows the first 20 to be configured. To change the settings for one of the datasets, select the numbered button and then click on the color, line style, and symbol buttons below ((2), (3), and (4)).

- ② Color specification for the selected dataset number. When a dataset button ① is highlighted, the associated line color can be changed using these buttons.
- ③ Line style specification for the selected dataset number. When a dataset button ① is highlighted, the associated symbol can be changed using these buttons.
- ④ Symbol specification for the selected dataset number. When a dataset button ① is highlighted, the associated symbol can be changed using these buttons.
- ⑤ **X and Y Axes** selection. This drop-down list has two options: **No Axes** or **Axes**.
- ⑥ **Frame** selection. This drop-down list has three options: **No Frame**, **Frame** (a plain rectangular frame), or **Frame with Ticks**.
- ⑦ **Grid** selection. This drop-down list has three options: **No Grid**, **Coarse Grid**, or **Fine Grid**.
- ⑧ Dataset identifier. This drop-down list has options to help determine how individual plot curves are identified in the legend (Figure 8).
- ⑨ Maximum legend width. VS Visualizer always shows the legend in the upper-right corner of the plot area. If the legend size exceeds this limit, then it is not shown. (However, you can show/hide the legend by using the L (legend) or V (legend with values) keys.)

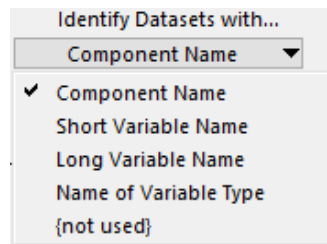


Figure 8. Options for labeling datasets in overlay plots.

- ⑩ Checkbox for showing more options for font properties. If checked, separate controls are shown for four kinds of labels (Figure 9).

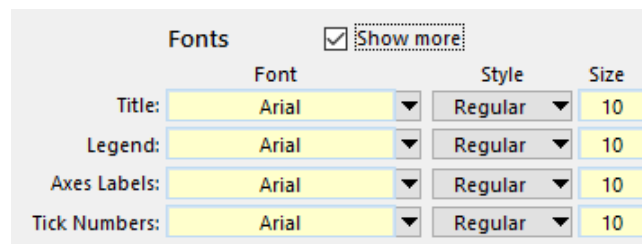


Figure 9. Controls for four types of labels when the Show more box is checked.

- ⑪ Font settings for text shown in the plot labels. If the **Show more** box ⑩ is unchecked, these settings apply to all text; if checked, separate controls are shown for the title, legend, axis labels, and tick numbers (Figure 9).

The font face can be typed or pasted into the yellow field, or you can click the adjacent pull-down control to bring up a dialog box that lists all of the installed fonts.

- ⑫ Title position. This drop-down list has three options: **Title above plot**, **No title**, and **Title below plot**.
- ⑬ Checkbox for showing a miscellaneous yellow field and generic blue link (Figure 9). These allow advanced users to provide custom settings not supported by the built-in controls.

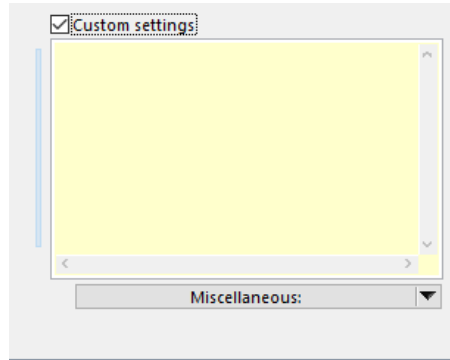


Figure 10. Custom options for advanced users.