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How to Use Mathematical Processing for the Device Trace

STARTER; SIMOTION SCOUT

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1 Abstract

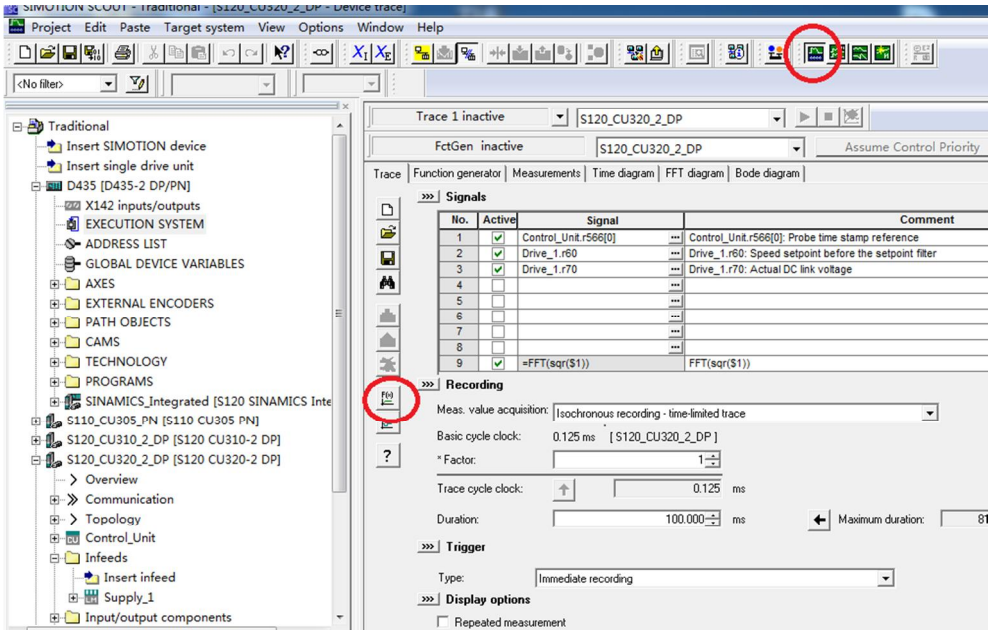
“Device Trace” is a very powerful tool in the commissioning software SIMOTION STARTER or SCOUT. It can be used to record measured values over a defined period, depending on trigger conditions. The traced curves can be used to check the operating status of the machine, optimize parameters of controllers, or trouble-shooting, etc.

Under specific circumstances, it is necessary to make a mathematic processing to the original signals, to make further analysis on the curve data. The commonly used mathematic processing methods including Add/Sub/Mul/Div, Square/Square Root, Int/Dif, FFT/Bode diagram, etc.

In STARTER or SIMOTION SCOUT, the mathematical processing is based on signals which have already been parameterized for the trace recording. Parameterized mathematical channels are displayed on the Device trace or Measurements tab. The Mathematical function button can be selected on the Device trace (before recording) tab or Measurements (after recording) tab.

This document introduces the usage of the mathematic processing methods in the device trace tool.

Figure 1-1 Device trace tool in STARER or SIMOTION SCOUT



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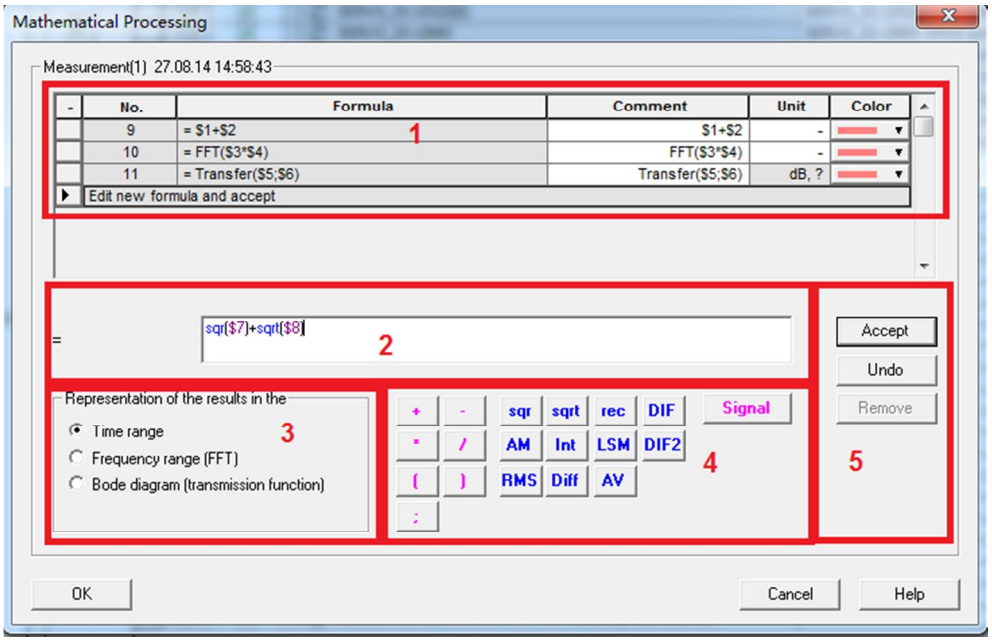
2 Function description of mathematical processing

Push the button on the toolbar of device trace can open the dialog box of mathematical processing

Figure 2-1 Dialog box of mathematic processing



2.1 Formula table

The edited formula is displayed in the formula table **1**.

Here, the number and formula are displayed, and the comment/Unit/Color of the display channel can be modified. The selected mathematical function is identified by a triangle.

Formulas can only be defined in the input field **2**.

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2.2 Formula input field

You can enter the formula for the mathematical channel or change existing formulas in the input field **2**. Click the Accept button to transfer the edited formula to the table. A formula must always refer to a signal. If the formula syntax is not correct, an error message will appear when you click Accept or the Accept button will not be enabled.

The nesting depth of formulas can be arbitrary by setting the appropriate parentheses. However, the length of the formula is limited to 256 characters.

Examples of correct syntax:

- $1+4
- $1*$2
- 4*($1+$2)
- Int($1+$2)

Examples of incorrect syntax:

- 4+5 (no reference to a signal present)
- FFT(FFT($1)) (FFT of an FFT not possible)
- Int(FFT($1)) (numerical operations in the frequency range not possible)

2.3 Result display

The result **3** of the mathematical processing can be displayed in the following format:

- Time Range
- Frequency Range
  You have the possibility of performing a Fast Fourier Transformation with recorded signal curves. This allows the frequency components of signals to be analyzed. The resonance frequencies of the mechatronic systems can be the maxima of the calculation. You can analyze system variables/parameters at will. We recommend LREAL for SIMOTION and FLOAT for SINAMICS.
  The result is displayed in the FFT diagram tab.
- Bode Diagram
  You have the possibility of using the response characteristic on measured signal curves. The response characteristic is the ratio of the Laplace-transformed output variable to the Laplace-transformed input variable of a transfer element. The response of a linear transfer element can be described via the frequency response. The frequency response is displayed in the form of a Bode diagram. The absolute value of the frequency response is applied via the frequency f in logarithmic scaling.
  The result is displayed in the Bode diagram tab.

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2.4 Mathematical functions

Click the buttons to select the mathematical functions **4**.

For further information, please refer to the online help.

- + - * / Add/Sub/Mul/Div
- () Parentheses
- ; Semicolon
- sqr Square
- sqrt Square root
- rec Reciprocal value
- DIF Simple differentiation
- AM Arithmetic mean of 5 interpolation points
- Int Numerical integration
- LSM Lease squares method
- DIF2 Double differentiation
- RMS Root mean square
- Diff Numerical differentiation
- AV Average value
- Signal Select signal, eg. $1

2.5 Operation button

If the formula is finished, we can accept or remove the formula by the operation button **5**:

- Accept Accept the edited formula
- Undo Undo the most recent changes to the formula
- Remove Remove the selected line from the table

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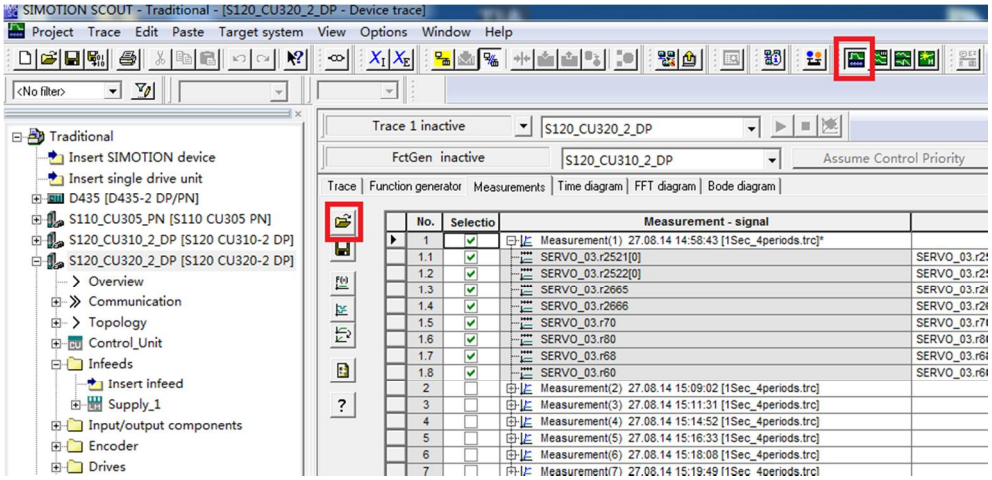
3 Example: Use mathematic processing for existing traced curves

3.1 Open existing traced curves

In the SIMOTION SCOUT or STARTER software, click the button on the toolbar to open the device trace tool. Open an existing traced curves in the measurement tab, and the result is shown in Fig3-1.

Figure 3-1 Open existing traced curves



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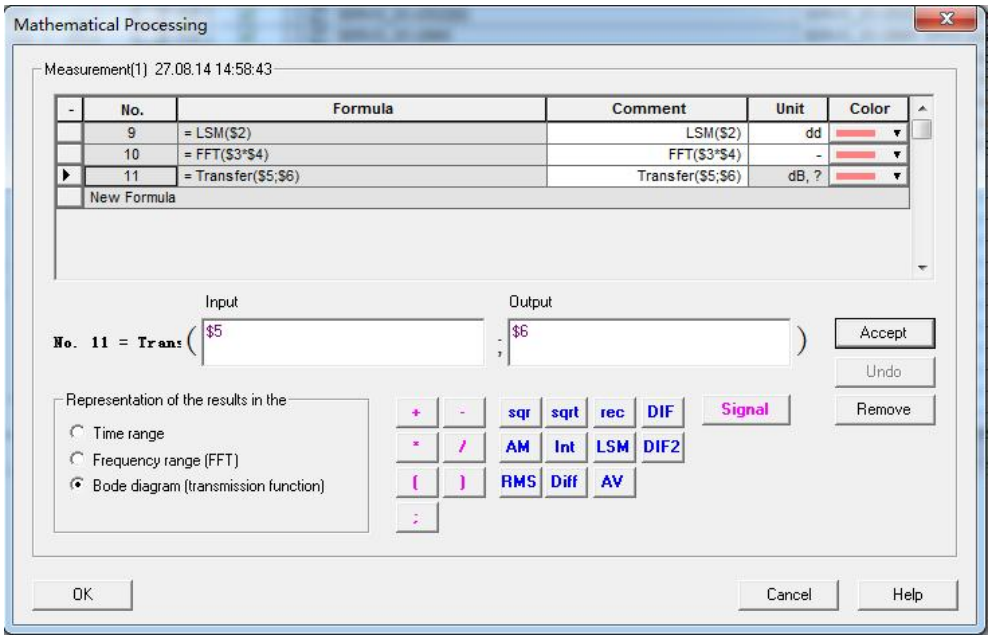
3.2 Add mathematical processing functions

In the measurement tab, select a group of measured curves, and click the button on the toolbar. Then, you can add formulas for the selected signals. For example, we add 3 formulas to the orginal signals, as shown in the Fig3-2.

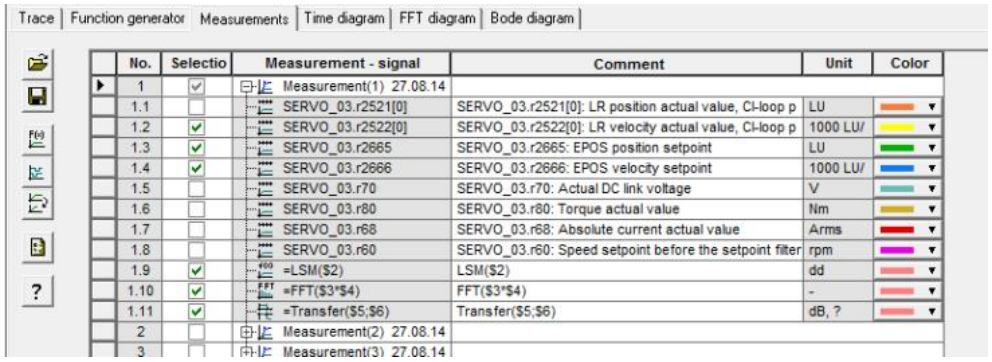
Figure 3-2 Add mathematical formulas



3.3 Read the processing result

In the measurement tab, select the signals by activating the checkbox on the left side. At most, 8 signals can be selected at the same time. See Fig3-3.

Figure 3-3 Select the signals to read



Then, the selected curves are shown in the tabs: Time diagram, FFT diagram, and Bode diagram. As shown below in Fig3-4 ~ Fig3-6.

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Figure 3-4 Display in the Time Diagram tab

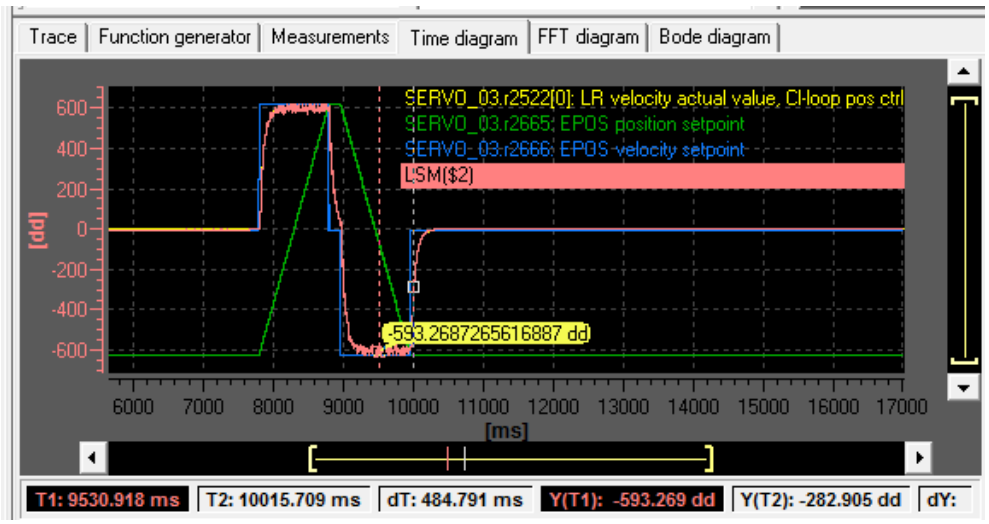

Figure 3-5 Display in the FFT diagram tab

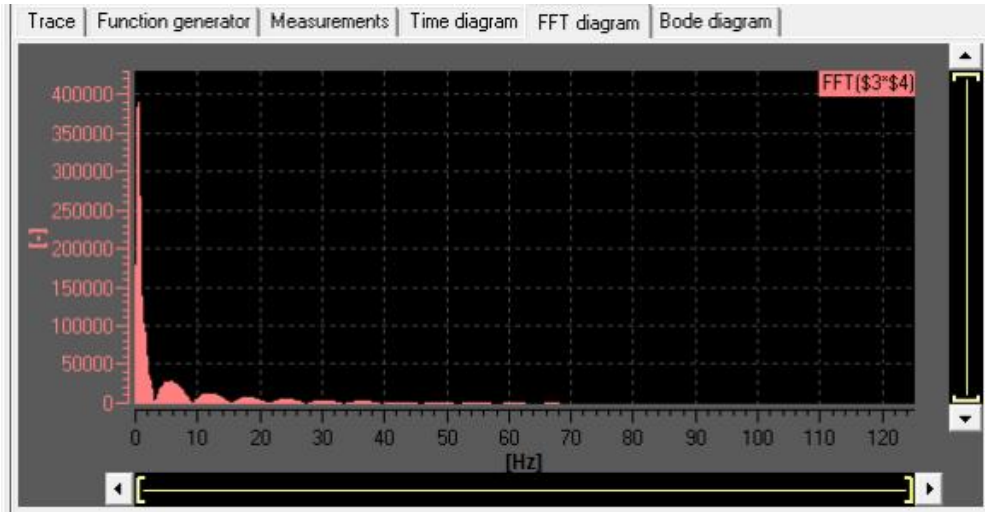

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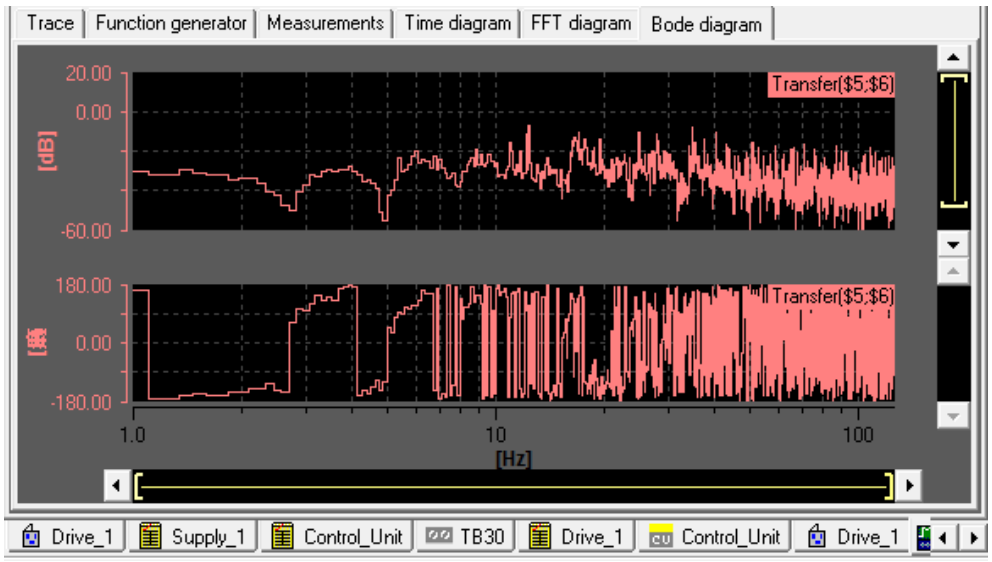
Figure 3-6 Display in the Bode diagram tab



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