

METAS VNA Data Explorer

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1 Installation

1.1 System Requirements

The following list describes the minimum software and hardware requirements of the METAS VNA Data Explorer.

- Microsoft Windows XP
- Microsoft .NET Framework 2.0
- Microsoft Windows Installer 3.1
- At least 512 megabytes (MB) of RAM (1024 MB is recommended)
- At least 4 megabytes (MB) of available space on the hard disk
- Video adapter and monitor with SVGA (800 x 600) or higher resolution (1280 x 1024 is recommended)

1.2 Steps

The following steps describe the installation of METAS VNA Data Explorer.

1. Double-click on the METAS VNA Data Explorer setup program
2. Accept license agreement
3. Select installation folder
4. Confirm installation
5. Installation complete

After installation, one can start METAS VNA Data Explorer by double-clicking on its desktop shortcut.

2 Overview

The METAS VNA Data Explorer is designed to visualize S-parameter files. The graphical user interface is split up into two parts. The file explorer is on the left and the visualization with different tabs is on the right.

2.1 Filetypes

Table 1 shows the supported file types. S-Parameter Data files can only contain

Table 1: File types

Description	Extension
S-Parameter Data Binary	(.sdatb)
S-Parameter Data Touchstone	(.*p)
S-Parameter Data Xml	(.sdatx)
VNA Data Binary	(.vdatb)
VNA Data CITI	(.cti;.citi)
VNA Data Xml	(.vdatx)

S-parameter data. In contrast VNA Data files can contain receiver values and ratios of receiver values.

2.2 File Explorer

The following user controls are available:

Root Path sets the root directory.

Browse selects a root directory (default: c:\).

About shows the about box.

Filter sets file filter (default: *.*).

Icons sets icon size (default: Small).

Freq List Browse can be used to select a frequency list file. All selected files in the tree view will be interpolated (default: None).

Freq List On turns frequency list interpolation on or off (default: Off).

Tree View can be used to select one or multiple files. Additional files can be selected while holding the CTRL or SHIFT key.

3 Visualization

3.1 Modes

METAS VNA Data Explorer supports different view modes:

Graph shows a graphical visualization of multiple files.

Table shows a tabular visualization of a single file.

Point shows an uncertainty budget for one frequency point and one parameter of a single file.

Info shows file information including MD5 checksum of multiple files.

3.1.1 Graph

The graph tab supports multiple selected files, see Figure 1. The following user

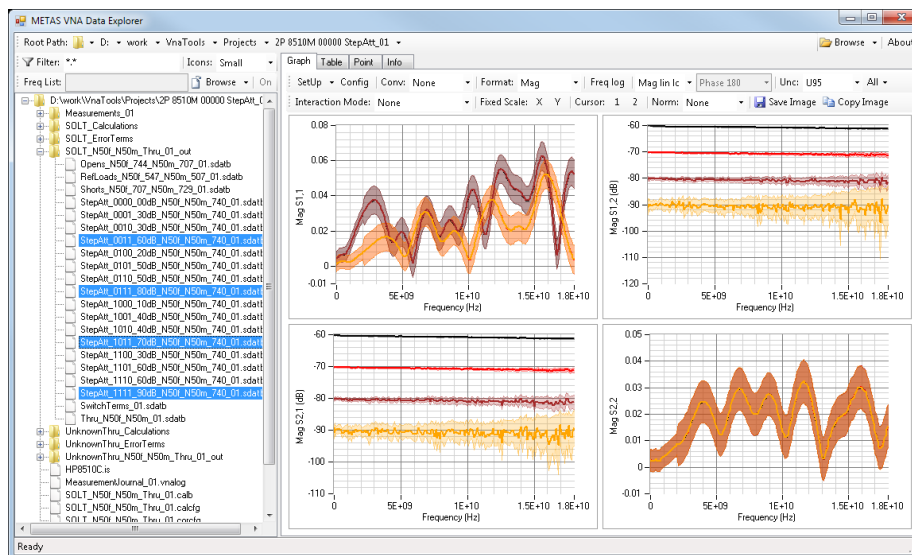


Figure 1: Data Explorer / Graph

controls are available:

Setup sets up the plots (default: $S_{x,x}$ 2-Ports).

Config selects the parameter for each subplot. The parameter can be an S-parameter, a receiver value or a user defined receiver ratio. Where **a** is the reference receiver and **b** is the test receiver.

Conv sets the conversion to None, S/S', Impedance, Admittance, VSWR or Time Domain (default: None).

Format sets the data format to Real Imag, Mag Phase, Real, Imag, Mag or Phase (default: Mag Phase).

Freq log sets the frequency axis to linear or logarithmic (default: Freq lin).

Mag format sets the magnitude format to Mag lin (reflection and transmission linear), Mag log (reflection and transmission logarithmic) or Mag lin log (reflection linear and transmission logarithmic) (default: Mag lin).

Phase format sets the phase format to Phase 180, Phase 360, Phase Unwrap, Phase Delay or Group Delay (default: Phase 180).

Unc sets the uncertainty mode to None, Standard or U95 (default: None).

Interaction Mode sets interaction mode to None, Zoom or Pan (default: None).

Fixed Scale activates or deactivates automatically scaling of the x- and y-axis.

Cursor shows or hides one or two cursors.





















Norm normalizes all traces to one selected trace or to the mean value of all traces (default: None).

Save Image saves the current plots to a bitmap file. Supported file formats are BMP, JPG and PNG.

Copy Image copies the current plots to the clipboard.

Table 2 shows the different colors for each trace and its associated uncertainty region.

Table 2: Trace Colors

Trace	Value	Unc	Color
1			black
2			brown
3			red
4			orange
5			yellow
6			green
7			blue
8			violet
9			gray
10			light gray

3.1.2 Table

The first of the selected files will be shown in the table view, see Figure 2. The

Frequency [MHz]	S11 Mag	S11 U(Mag)	S11 Phase [°]	S11 U(Phase) [°]	S21 Mag	S21 U(Mag)	S21 Phase [°]
16000.000	0.059	0.008	-129.799	7.905	0.090	0.001	-6
16100.000	0.048	0.008	-147.478	9.783	0.090	0.001	-9
16200.000	0.036	0.008	-167.178	12.941	0.090	0.001	-11
16300.000	0.024	0.008	-167.106	19.339	0.090	0.001	-13
16400.000	0.014	0.008	-123.885	32.057	0.090	0.001	-15
16500.000	0.014	0.008	-53.345	31.966	0.090	0.001	17
16600.000	0.023	0.008	9.603	19.909	0.090	0.001	15
16700.000	0.034	0.008	-15.287	13.580	0.090	0.001	13
16800.000	0.044	0.008	-34.187	10.521	0.090	0.001	10
16900.000	0.053	0.008	-50.658	8.800	0.090	0.001	8
17000.000	0.060	0.008	-66.128	7.783	0.090	0.001	6
17100.000	0.065	0.008	-81.127	7.168	0.089	0.001	3
17200.000	0.068	0.008	-96.198	6.847	0.089	0.001	1
17300.000	0.069	0.008	-110.979	6.743	0.089	0.001	-4
17400.000	0.068	0.008	-126.099	6.860	0.089	0.001	-2
17500.000	0.065	0.008	-141.297	7.207	0.089	0.001	-5
17600.000	0.061	0.008	-156.891	7.715	0.089	0.001	-7
17700.000	0.055	0.008	-172.936	8.507	0.089	0.001	-9
17800.000	0.049	0.008	-170.547	9.468	0.089	0.001	-12
17900.000	0.042	0.008	-152.883	10.943	0.089	0.001	-14
18000.000	0.036	0.008	-134.639	12.831	0.089	0.001	-16

Figure 2: Data Explorer / Table

following user controls are available:

Conv sets the conversion to None, S/S', Impedance, Admittance, VSWR or Time Domain (default: None).

Format sets the data format to Real Imag or Mag Phase (default: Mag Phase).

Mag format sets the magnitude format to Mag lin (reflection and transmission linear), Mag log (reflection and transmission logarithmic) or Mag lin log (reflection linear and transmission logarithmic) (default: Mag lin).

Phase format sets the phase format to Phase 180, Phase 360, Phase Unwrap, Phase Delay or Group Delay (default: Phase 180).

Unc sets the uncertainty mode to None, Standard or U95 (default: None).

Freq sets the frequency format to Hz, kHz, MHz or GHz (default: MHz).

Numeric Format sets the numeric format (default: f3).

Save Data saves the current data in a file. Supported file formats are S-Parameter Data (*.sdatb or *.sdatx), Touchstone (*.s1p, *.s2p, *.s*p), VNA Data (*.vdatb or *.vdatx) or CITI (*.cti or *.citi).

Save Table saves the current formatted data in a file. Supported file format is Text (*.txt).

Copy Table copies the current formatted data to the clipboard.

One can select one or more rows of the table and copy the data to the clipboard with CTRL-C or with the context menu of the table. CTRL-A selects all data.

3.1.3 Point

The first of the selected files will be shown in the point view. One can select one frequency point and one parameter and obtains the uncertainty budget of the selected data point, see Figure 3. The following user controls are available:

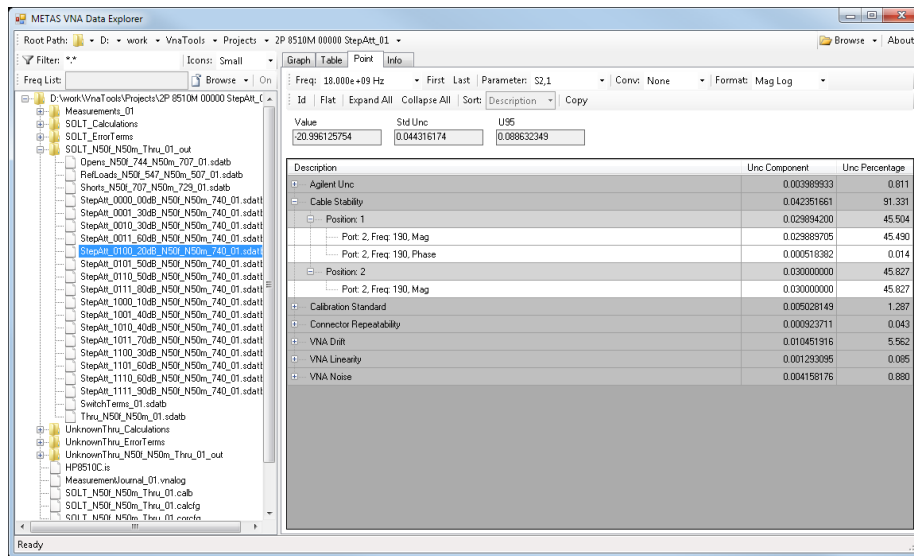


Figure 3: Data Explorer / Point

Freq selects a frequency point for the uncertainty budget (default: None).

Time selects a time point for the uncertainty budget (default: None). Only visible when conversation is set to Time Domain.

First selects the first frequency or time point.

Last selects the last frequency or time point.

Parameter selects a parameter for the uncertainty budget (default: None).

Conv sets the conversion to None, S/S', Impedance, Admittance, VSWR or Time Domain (default: None).

Format sets the format to Real, Imag, Mag, Mag log, Phase, Phase 360, Phase Unwrap, Phase Delay or Group Delay (default: Mag).

Id shows or hides the uncertainty input ids (default: Hide).

Flat shows a flat or tree uncertainty budget (default: Tree).

Expand All expands all tree nodes.

Collapse All collapses all tree nodes.

Sort sets the sort order to Description or Uncertainty (default: Description).

Copy copies the uncertainty budget to the clipboard.

The following items will be shown for the selected data point:

Value indicates the value.

Std Unc shows the standard uncertainty (67% coverage factor, $k = 1$).

U95 shows the expanded uncertainty (95% coverage factor, $k = 2$).

Unc Budget shows a tabular visualization of the uncertainty budget.

3.1.4 Info

The info tab supports multiple selected files. One can obtain information about multiple files by holding the CTRL or SHIFT key and selecting the files. The info tab shows the file name, size, modification date and computes the MD5 checksum for each selected file. See Figure 4.

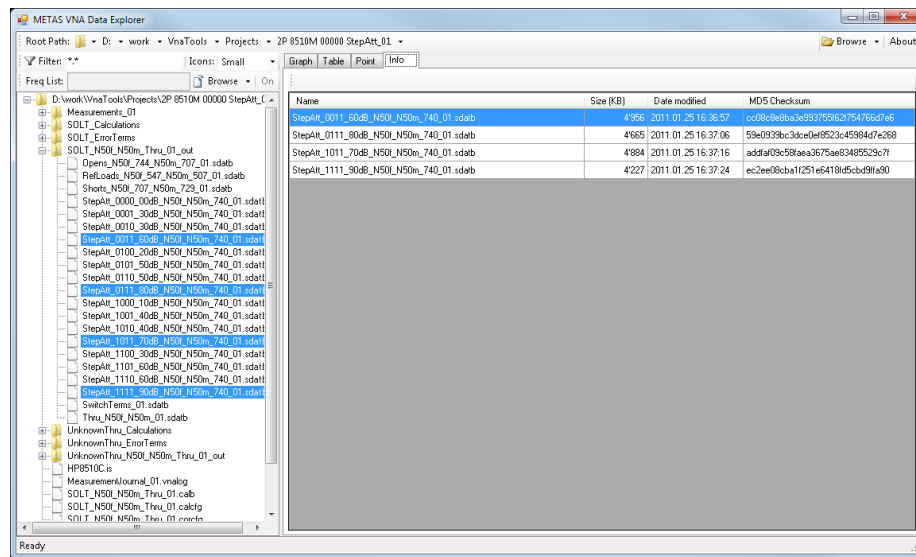


Figure 4: Data Explorer / Info

3.2 Math

The same equations are used in Graph, Table and Point tab for data conversion and formatting. Table 3 shows the equations for data conversions in METAS VNA Data Explorer. Variable x is the input quantity, y is the converted output, Z_r is the reference impedance and Y_r is the reference admittance. Index i is the frequency point, j is the receiver port and k is the source port. Table 4 shows

Table 3: Conversions

Conversion	Equation
None	$y = x$
S/S'	$y_{jk} = x_{jk}/x_{kj}$
Impedance	$y = \frac{1+x}{1-x} Z_r$
Admittance	$y = \frac{1-x}{1+x} Y_r$
VSWR	$y = \frac{1+ x }{1- x }$
Time Domain	$y = \text{ifft}(x)$ with 256 points

the equations used for data formatting. Variable y is the converted input from Table 3 and z is the formatted output.

Table 4: Formats

Format	Equation
Real	$z = \Re(y)$
Imag	$z = \Im(y)$
Mag	$z = y $
Mag log	$z = 20 \log_{10}(y)$
Phase	$z = \arg(y)$
Phase 360	$z = \arg(y)$
Phase Unwrap	$z = \text{unwrap}(\arg(y))$
Phase Delay	$z_i = -\frac{\varphi_i}{2\pi f_i}$ with $\varphi = \text{unwrap}(\arg(y))$
Group Delay	$z_i = -\frac{\varphi_i - \varphi_{i-1}}{2\pi(f_i - f_{i-1})}$ with $\varphi = \text{unwrap}(\arg(y))$

3.3 Uncertainty

There are three different uncertainty modes:

None hides the uncertainty.

Standard shows the standard uncertainty (67% coverage factor, $k = 1$).

U95 shows the expanded uncertainty (95% coverage factor, $k = 2$).

The uncertainties are computed with linear uncertainty propagation. This leads to well known problems when computing the absolute value and phase of small quantities.