```
================================================
VNA Tools V2.1.1 (2.1.6908.24816) - 30.11.2018
================================================

- Uses improved METAS UncLib V2.1.5:
  - UncNumber (LinProp, MCProp and DistProp) improved:
    - Tan method improved.
    - Sinh, Cosh, Tanh methods improved.
  - Complex improved:
    - Sin, Cos, Tan methods improved.
    - Sinh, Cosh, Tanh methods improved.
- Data Explorer improved:
  - Changing the x-axis scale will auto scale the y-axis to the visible
part.
  - Changing the x-axis scale in one plot will change the x-axis scale in
all other plots (except Cartesian).
- Support added for Touchstone V2.0 file format.
- Touchstone file format support improved:
  - New data line for each matrix row added when number of ports is
greater than 2.
  - Formatting improved (padding).
  - Port assignment added (comment line).
  - Assembly name and version added (comment line).
  - Creation date added (comment line).
- DataCovarText file format improved:
  - Assembly name and version added (comment line).
  - Creation date added (comment line).
- New Databased Standard Wizard improved (Source Ports added).
- Create Databased Standard added to content menu of Data Explorer.
- Fit Calibration Standard Model added to content menu of Data Explorer.
- Tabular page called Cal Std Model Fit removed from VNA Tools. It's now
part of the content menu of the Data Explorer.
- Measurement series added with experiment a several DUT measurements.
- Measurement series dialog remembers old settings.
- Global Root Path renamed to Root Path.
- Label Root Path not visible (Data Explorer and VNA Tools).
- Browse button not visible for Root Path (Data Explorer and VNA Tools).

================================================
VNA Tools V2.1.0 (2.1.6876.16039) - 29.10.2018
================================================

- Uses improved METAS UncLib V2.1.4:
  - Integrate method added to NumLib class.
  - SplineInterpolation added to NumLib class.
  - Bug fixed (deserialize a generic type from an older version).
- Data Explorer improved:
  - Bug in compare VnaParameters fixed (VnaReceiverType.one).
  - GuiVnaParameter improved (disable Port when VnaReceiverType.one is
selected).
- CmcTools improved (exceptions added):
  - Calibration Config must be two-port calibration.
  - First port of calibration config must be port 1.
  - Second port of calibration config must be port 2.
  - VNA Error Terms must be two-port calibration.
  - First port of VNA error terms must be port 1.
  - Second port of VNA error terms must be port 2.
- VNA Characterize Noise improved:
  - Default VNA Mode: Linear frequency with same start and stop
frequency.
```

  - If not supported CW VNA Mode.
- SParamTools.Interpolation uses NumLib.SplineInterpolation2.
- SParamTools.InterpolationReImMP uses NumLib.Interpolation2 (linear).
- VnaDataTools.Interpolation uses NumLib.SplineInterpolation2.
- VnaDataTools.InterpolationReImMP uses NumLib.Interpolation2 (linear).
- Metas.Vna.Data.SignalProcessing.Transforms uses NumLib.SplineInterpolation2.
- PostProcessTimeDomainData improved (uses NumLib.Integrate for mode low pass step).
- BeginExperimentJournalItem modified (default experiment type changed to statistical).

==========
VNA Tools V2.0.4 (2.0.6814.27933) - 28.08.2018
==========

- Uses improved METAS UncLib V2.1.0:
  - Atan2 improved (Atan2(0, 0) --> 0, Atan2(NaN, x) --> NaN and Atan2(x, NaN) --> NaN, sensitivities in all cases).
  - NonLinearEig method added to LinProp/UncLinAlg class.
  - Solve over-determined non-linear Eigenvalue problem improved (smaller residuals):
    - new: over-determined non-linear system --> determined non-linear system --> determined linear system
    - old: over-determined non-linear system --> over-determined linear system --> determined quadratic system --> determined linear system.
- Data Explorer improved:
  - Legend added to Graph.
  - XY plot improved (show single point).
  - Cartesian plot improved (frequency information added).
  - MultiSelectTreeView HighDPI bug fixed (uses TextRenderer.MeasureText).
- Measurement series with different VNA settings (e.g.: source power) added.
- Port assignment column added to calibration config.
- Bug in renaming measurement journal item fixed (.vdatb extension).
- Bug when opening a vnalog, calcfg or vercfg file from command line or windows explorer fixed.

==========
VNA Tools V2.0.3 (2.0.6785.14432) - 30.07.2018
==========

- Agilent ENA and PNA drivers improved (set byte order to normal).
- Anritsu ShockLine driver added.
- AnritsuAutocalOverShockLine driver added.
- Metas.Instr.Driver.Vna.AnritsuVectorStar.dll renamed to Metas.Instr.Driver.Vna.Anritsu.dll.
- TestVna High DPI bug fixed.
- CmcCalculationMode (min, mean, max) added to Database / CMC Entry (default: min).
- VnaErrorTermsCalibrationFile added to Database / CMC Entry (default: none --> ideal VNA).
- Raw data in CmcTools are set to Port Zr of the VNA and not changed to Port Zr of the VNA (using SParamTools.ChangeZr) --> ideal VNA error terms in all cases.
- Fatal error fixed in ComputeLinearity fixed (same ids when measurement level is NaN).
- Non leaky mask of error terms for a new configuration of an optimization calibration.

- Time gating dialog improved: Conv enabled (without item Time Domain) in frequency domain.
- Time gating dialog bug fixed (minimum value of time span set to 100 ps).
- InterpolationReImMP added to SParamTools and VnaDataTools.
- InterpolationMagPhase added to SParamTools and VnaDataTools.
- Atan2 improved (sensitivities in all cases).

==========
VNA Tools V2.0.2 (2.0.6732.13864) - 07.06.2018
==========

- On Wafer Offset Short Standard added.

==========
VNA Tools V2.0.1 (2.0.6724.25834) - 31.05.2018
==========

- .NET target version changed to V4.5.
- Support for vdatb files as raw data added.
- New switch term format (vdatb).
- Examples modified (new switch term format).
- Custom VNA Parameter Setup improved.
- Support for CITI files improved.
- Support for VNA Data Covariance Text files (*.vdatcv) added.
- Support for S-Parameter Data Collection Covariance Text files (*.scolcv) added.
- Support for VNA Data Collection Covariance Text files (*.vcolcv) added.
- Support for S-Parameter Data Collection Binary files (*.scolb) added.
- Support for VNA Data Collection Binary files (*.vcolb) added.
- Support for ZIP files (*.zip) added.
- Save Collection As .. added to content menu of the Data Explorer.
- Check Connector Parameters added.
- Reciproc and OptReciproc methods added to Script class.
- MATLAB support improved.

==========
VNA Tools V2.0.0 (2.0.6667.33608) - 03.04.2018
==========

- Tool Tips added.
- Support for PDF files with embedded data files added to Data Explorer.
- Data Explorer improved: Open file menu item added to content menu.
- Number of Points added to VNA Device Characterize Noise dialog added (before 801 points per frequency point was used).
- VNA Settings: default value of Zr changed to 50 Ohm.
- Journal VNA Settings: Zr enabled when no VNA session is open.

==========
VNA Tools V1.9.2 (1.9.6621.25325) - 16.02.2018
==========

- Time Domain added:
  - Frequency Domain to Time Domain
  - Time Gating

```
================================================
VNA Tools V1.9.1 (1.9.6563.29785) - 20.12.2017
================================================

- Data Explorer improved:
  - Auto Refresh
  - Auto Update Panel
  - Sort Selected Items
  - Update Icon Status
- Optimization calibration improved: up to 65535 objective functions.
- Interpolation improved: check if interpolation order out of range -->
NaN.
- LookUpId improved: return guid as string if not found.
- Improved time scale axis in Data Logger.
- ReplaceLaTeXCharacters method added. Fix bug with special characters,
e.g.: Omega.
- High DPI improved.

================================================
VNA Tools V1.9.0 (1.9.6491.14270) - 09.10.2017
================================================

- Uses METAS UncLib V1.9.0.
- Data Explorer improved:
  - Show reference impedance (Zr info) in column headers of GuiVnaTable.
  - ReIm, MP format added to graph and table (reflection: real and
imaginary parts, transmission: magnitude and phase).
  - Time format for phase delay and group delay added to table.
- Debug mode added to error correction (stores R, V, D and C uncertainty
influences for each measurement).
- Transmission connector repeatability added.
- CreateDatabaseStandard method added to script class.
- VNA Settings System Zr is read only.
- Complex reference impedance is not allowed for a VNA device.
- Metas.Vna.RealTime.COM.dll improved:
  - Evaluation key added which expires after 90 days.
  - VerificationToolsCOM class added with NormalizedError method.
  - Transmission uncertainty added for connector repeatability.
- Waveguide example added, see '08_Waveguide_Example_WR10'.
- On-Wafer example added, see '09_OnWafer_Example_GGB_CS-5'.
- Bug in GuiXYPlot fixed (BackgroundWorker).
- Bug in FindParameterIndex in VnaData class fixed (convert switch term
to S-parameter).
- Bug in drivers fixed (VISA Dispose added).

================================================
VNA Tools V1.8.6 (1.8.6430.18695) - 09.08.2017
================================================

- Data Explorer improved:
  - Z-parameter and Y-parameter data added:
    - VnaDataConv.Z_Parameter : Z-parameter
    - VnaDataConv.Y_Parameter : Y-parameter
    - VnaDataConv.Impedance   : Impedance (only reflection parameters,
other ports are terminated with an ideal load)
    - VnaDataConv.Admittance  : Y-parameter(only reflection parameters,
other ports are terminated with an ideal load)
  - Conversion mode VSWR moved to magnitude format.
- LRRM calibration added.
- Agilent Model Standard improved:
```

  - Magnitude uncertainty added for Agilent model standard (open or short).
  - Transmission uncertainty added for Agilent model standard (delay thru).
- Bug in optimization calibration fixed (switch terms with noise, linearity and drift).
- Bug in calibration cache fixed (do not add uncompress data to cache).

==
VNA Tools V1.8.5 (1.8.6400.24590) - 10.07.2017
==

- Bugs in GuiXYPlot fixed (ProcessSpecialValues, MoveCursorSafe).

==
VNA Tools V1.8.4 (1.8.6400.16000) - 10.07.2017
==

- Unknown series inductance and unknown capacitance calibration standards added.
- Bugs in GuiCable, GuiConnector and GuiDUTUncertainty fixed.
- Bug in GuiXYPlot fixed (move cursor to NaN).

==
VNA Tools V1.8.3 (1.8.6395.15968) - 05.07.2017
==

- Database: Uncertainties are labeled with (k = 1) or (k = 2).
- Cable Transmission Stability is now one-way (Ct) and not two-way (Ct*Ct).
- Cable Symmetry Stability is now one-way (Cs).
- Noise Floor (db rms) with k = 1.
- Characterization of noise floor changed:
  - new: 20*log10(max(std(syx_re), std(syx_im))
  - old: mean(20*log10(syx - mean(sxy)))
- Show uncertainty budget for cursors added.
- Cursors are coupled between plots.
- Verification added to VNA Tools.
- Agilent Model Standard extended for Waveguide.
- LHKM TRL LRL improved (choosing the eigenvalue for the unknown reflection).
- Bug in save frequency list fixed.
- Logger Device added to Database and Journal.
- Reset states of step attenuator after measurement series has completed.
- On wafer line standard improved: frequency independent conductivity, relative permittivity and tan delta added.

==
VNA Tools V1.8.2 (1.8.6297.14029) - 29.03.2017
==

- Uses METAS UncLib V1.8.2.
- Database / CMC Entry editor added.
- CMC Tools added to content menu of Data Explorer.
- Different hash algorithms to compute checksums.
- IronPython 2.7.7 used in Script editor.
- Bug in compute waveguide offset fixed.
- Database tab page order changed.

```
================================================
VNA Tools V1.8.1 (1.8.6262.24056) - 22.02.2017
================================================

- Uses METAS UncLib V1.8.1:
  - Chain Rule improved (faster).
  - LinAlg improved (Dot_invA_B and Dot_A_invB added).
  - Complex division improved.
- Parallelization of SParamTools (Cascade and Decascade).
- LHKM TRM LRL support for multiple lines added.
- Switched Error Terms normalized to 1.
- Helper methods added for Metas.Vna.RealTime.COM.dll.
- Metas.Instr.Driver.Logger.dll added.
- Rohde & Schwarz cables added.

================================================
VNA Tools V1.8.0 (1.8.6198.18768) - 20.12.2016
================================================

- Uses METAS UncLib V1.8.0.
- .NET target version changed to V4.0.
- High DPI scaling supported.
- Icons replaced with High DPI Icons.
- Bug with cursors fixed in XYPlot.

================================================
VNA Tools V1.7.10 (1.7.6177.29900) - 29.11.2016
================================================

- Support for waveguide standards with ratio not equal to two added
(simulation data updated).
- Bug in Journal Editor fixed. Add Measurement / Custom.
- Bug in RohdeSchwarz_ZNx_ZVx driver fixed: VnaParameter2String "S101" --
> "S1001".
- Clear cache method added.
- CmcTables supports specifying VNA Device.

================================================
VNA Tools V1.7.9 (1.7.6102.30094) - 28.09.2016
================================================

- Bugs in Metas.Vna.RealTime.dll fixed.
- Context menu for changing time stamp format added to header cell of the
time stamp column.
- DirectoryInfoExtensions added. Used to get directories and files
natural sorted by name.

================================================
VNA Tools V1.7.8 (1.7.6094.23660) - 07.09.2016
================================================

- Bugs in Metas.Vna.RealTime.COM.dll fixed.
- VnaToolsGuiCOM class added.
- Support for waveguide standards with ratio not equal to two added.
- Simulation data not yet updated.
```

```
================================================
VNA Tools V1.7.7 (1.7.6087.19110) - 31.08.2016
================================================

- User settings are stored to registry:
'HKEY_CURRENT_USER\Software\METAS\VNA Tools'.
- Metas.Vna.RealTime improved.

================================================
VNA Tools V1.7.6 (1.7.6082.14268) - 26.08.2016
================================================

- Data Explorer and VNA Tools: set root path from command prompt added.
- Remove small influences option added to optimization calibration.
- ECal renamed to ECU (Electronic Calibration Unit).
- Metas.Vna.RealTime.dll added.
- Metas.Vna.RealTime.COM.dll added.

================================================
VNA Tools V1.7.5 (1.7.6022.29592) - 29.06.2016
================================================

- Uses METAS UncLib V1.7.0.

================================================
VNA Tools V1.7.4 (1.7.6005.16561) - 21.06.2016
================================================

- Simple Line standard added.
- On-Wafer Line standard added.
- DUT Uncertainty added (can be used to represent on-wafer crosstalk).

================================================
VNA Tools V1.7.3 (1.7.5989.15887) - 25.05.2016
================================================

- Compress other frequency influences added for optimization calibration
over all frequency points.
- Show Journal Info in Unc Budget added.
- RemoveSmallUncInfluencesLimit changed from 1e-8 to 1e-7.

================================================
VNA Tools V1.7.2 (1.7.5952.18825) - 19.04.2016
================================================

- Error Model Zr bugs fixed:
  - Use Cable Zr for non-waveguide measurements.
  - Use Connector Zr for non-waveguide measurements.
  - Use VNA Zr for Drift for non-waveguide measurements.
- Shift reference plane:
  - Z_Y_Polynom added.
  - SParamTools: PolyFitZandY, PolyValZandY and MeanZandYPolynom added.
  - CalibrationTools: ComputeFitandMeanZ0andGamma using the Z_Y_Polynom
added.
- Copper Mountain Planar VNA driver added.
```

```
================================================
VNA Tools V1.7.1 (1.7.5924.24352) - 21.03.2016
================================================

- LHKM_TRL_LRL calibration added.
- LHKM_TRM_LRM calibration added.
- Bug (weighting with covariance) in optimization calibration fixed.
- Optimization calibration improved:
  - Variables of the calibration standards are stored in the calb file.
  - ComputeZ0andGamma method added.

================================================
VNA Tools V1.7.0 (1.7.5883.24145) - 09.02.2016
================================================

- New drift model: drift of ideal VNA.
- Symmetry drift added.
- Cable reflection stability added.
- Cable symmetry stability added.

================================================
VNA Tools V1.6.5 (1.6.5854.25873) - 11.01.2016
================================================

- Unknown Load calibration standard improved:
  - Fit uncertainty changed (random ID).

================================================
VNA Tools V1.6.4 (1.6.5820.31869) - 08.12.2015
================================================

- Unknown Load calibration standard improved:
  - Fit frequency added.
  - Fit uncertainty added.

================================================
VNA Tools V1.6.3 (1.6.5813.20164) - 01.12.2015
================================================

- User Weight Table added in standard description.
- Add Series Impedance and Shunt Admittance to SParamTools.
- Add Unknown Load as calibration standard.

================================================
VNA Tools V1.6.2 (1.6.5801.18094) - 20.11.2015
================================================

- More information during start up.
- Measure run time of VNA Tools.
- Upgrade Settings problem fixed.
- Add IronPython.Modules.dll.

================================================
VNA Tools V1.6.1 (1.6.5777.20096) - 26.10.2015
================================================

- Bug in new version 2 of calb fixed.
- Performance improvements.
```

```
================================================
VNA Tools V1.6.0 (1.6.5773.34394) - 22.10.2015
================================================

- New version 2 of sdatb and vdatb:
  - Smaller uncompressed file size.
  - GZIP not needed.
  - Faster loading and saving of files.

================================================
VNA Tools V1.5.4 (1.5.5764.15746) - 13.10.2015
================================================

- Complete rewrite of all GUI editors.
- Drag and drop support improved.
- Split View added.
- VNA Device added to measurement journal file.
- .NET target version changed to V3.5.

================================================
VNA Tools V1.5.3 (1.5.5743.23902) - 22.09.2015
================================================

- Bug in Agilent_8720_53_Series driver fixed.
- Alglib uses Intel MKL for Cholesky decomposition.
- Faster optimization calibration.

================================================
VNA Tools V1.5.2 (1.5.5730.25433) - 15.09.2015
================================================

- Experiment uncertainties:
    - Add support for independent S-parameters, e.g.: 2 one port
components measured at the same time.
- LHKM calibration added.

================================================
VNA Tools V1.5.1 (1.5.5697.15735) - 07.08.2015
================================================

- Improved Data Explorer:
    - Set as Root Path in content menu.
    - Root Path is expanded.
    - Add Plot Font Dialog.
    - Decascade changed. Now all four cases are supported.
    - No autoscale when setting interaction mode to none. Autoscale when
unchecking zoom button.
    - Bugs in PlotCartesian fixed.
- Covariance tab page in calibration standard editor.
- Renaming measurement journal item added.
- Import measurement in journal ignores time stamp of file.
- Add measurement: trigger cont when sweep is complete and file dialog is
shown.
- Bug in GuiJournalCableConnectorTable fixed.
- Bug in Waveguide Offset Short Standard fixed (length offset).
- Bug in Database / VNA Device / Update Linearity Plot fixed
(SetYRange(NaN, NaN)).
- Bug in compute noise factor fixed. Do not under estimate the
uncertainty if meas ifbw is smaller than spec_ifbw.
```

- New linearity model. The linearity is discretized in 0.02 dB steps over all receiver values. The discretion points are correlated with the 10 neighbor points.
- Width offset and height offset added to waveguide shim section.
- Add Waveguide Connector Offset class which use COMSOL simulation data
- Add Anritsu 3650A, 3651A, 3652A, 3653A, 3654D calibration kits.
- Add Anritsu 3656B and 3659 calibration kits.
- Add 0.8 mm connector.
- Add Anritsu standard cables.
- Add Anritsu Autocal.
- First version of Agilent_8720_53_Series driver based on the HP8753D driver.

==========
VNA Tools V1.5.0 (1.5.5595.21600) - 27.04.2015
==========

- Improved Data Explorer:
    - New possibility to expand Windows shortcuts (links) to drives, directories, files and files with sub items
    - New Folder dialog added,
    - New Shortcut dialog added,
    - the cursor label in the tabular page graph shows now to which trace it's locked to.
    - Show properties in content menu of Data Explorer added.
- Primary Airline Standard and Primary Offset Short Standard changed. Ideal line section for propagation constant has zero length now. This is needed to couple offset shorts with different length.
- Covariance for experiment uses n - 1.
- Statistics: dof = n - 1 for coverage factor.
- Bug in time stamp of user comment fixed.
- Bugs in calibration standard fit for 2 ports fixed:
    - Offset Loss (Anritsu and Rohde Schwarz models) is divided by factor two for two-ports.
    - Offset Delay (Anritsu model) has the correct unit now.
- Offset Loss (Anristu model) is fitted now.
- Equivalent Source Match Palmer added.
- Support for MMS4 DSD files (read only) integrated.
- Measurement Journal / Custom Cable and Custom Connector Plots added.
- VNA Device / Noise, Linearity and Drift Plots added.
- Database / Cable and Connector Plots added.
- Comments field in all calibration standard database items added.
- VNA Device / Noise Characterization added.
- Color for user comments in Journal editor changed (light cyan).
- Load and Save VNA Graph Settings added.
- Waveguide Shim Standard and Waveguide Offset Short Standard added.
- Uncertainty interpolation changed.
- Obsolete Tools tabular page removed.
- Support for Rohde & Schwarz ZVK (RohdeSchwarz_ZVC_M_R driver) added.
- Support for Keysight ENA E5080A (Agilent_PNA_Series driver) added.
- New Logo for VNA Tools II and Data Explorer.
- Strong names for all assemblies except driver and example assemblies.
- Digital signed installers.

==========
VNA Tools V1.4.0 (1.4.5403.29510) - 20.10.2014
==========

- CITI files with Mag Phase uncertainties supported.
- DC and HF conductivity for primary calibration standards.

- Optimization calibration supports different user weights for reflection and transmission.
- Unknown Reflection Calibration Standard added (passive).
- Unknown Line Calibration Standard added (S11 = ?, S22 = ?, S21 = S12 = e^(-(g1*f^0.5 + g2*f)).
- Juroshek calibration added for splitter characterization.
- METAS VNA Tools II help file added.

==========
VNA Tools V1.3.2 (1.3.5238.16528) - 05.05.2014
==========

- Data Explorer improved:
    - content menu for post-processing of data,
    - supports to show error terms of calibration binary files (*.calb),
    - colored icons in file explorer and
    - norm to value or to value and uncertainty.
- New primary airline and offset short standard in database.
- Optimization calibration can optimize all frequencies at once. This is needed when calibration standards are used with unknown parameters which are constant over frequency.
- It supports the following VNA's: Agilent ENA, PNA, Anritsu VectorStar, Hewlett Packard 8510C, 8751A, 8753D and Rohde & Schwarz ZNB, ZNC, ZVA, ZVB, ZVT, ZVC, ZVM, ZVR.

==========
VNA Tools V1.2.1 (1.2.5042.15584) - 28.10.2013
==========

- Multiport support in VNA drivers.
- Compute error correction for new measurements only if error correction configuration is saved and calibration file exists.
- New Cable Connector Table in Journal Editor and Measurement Series to support multiport measurements.
- TRL calibration works no right. Allows offset delay for thru connection and definition for high reflect, used to choose the right square root.
- New Graph Custom Set Up dialog which allows to configure the parameters.
- Norm in graph is not changed if number of measurements change.
- Metas.Vna.Matlab is now part of the installer.

==========
VNA Tools V1.1.2 (1.1.4881.16734) - 13.05.2013
==========

- sdatcv file specification. New ASCII file format.
- Covariance view for visualizing the covariance or correlation
  - between S-parameters at a single frequency point or
  - between all frequency points for a single S-parameter.
- Cartesian view for visualizing S-parameter in a complex plane.
- New wizards improve the usability of VNA Tools II.
  - New Project helps creating a new project.
  - New Databased Standard helps creating a new calibration standard in the database.
- New linearity model improves the measurement model.
- New Tools: Change Port Assignment and Data Converter.
- Metas.Vna.Matlab provides some functions to interact with VNA Tools II from MATLAB, e.g.: load and save sdatb files.

==========
VNA Tools V0.9.1 (0.9.4617.19294) - 22.08.2012
==========

- New drift model with correlation.
- More information in the measurement journal.
- Round up uncertainties in the data explorer.
- Bug fixes.

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Michael Wollensack METAS