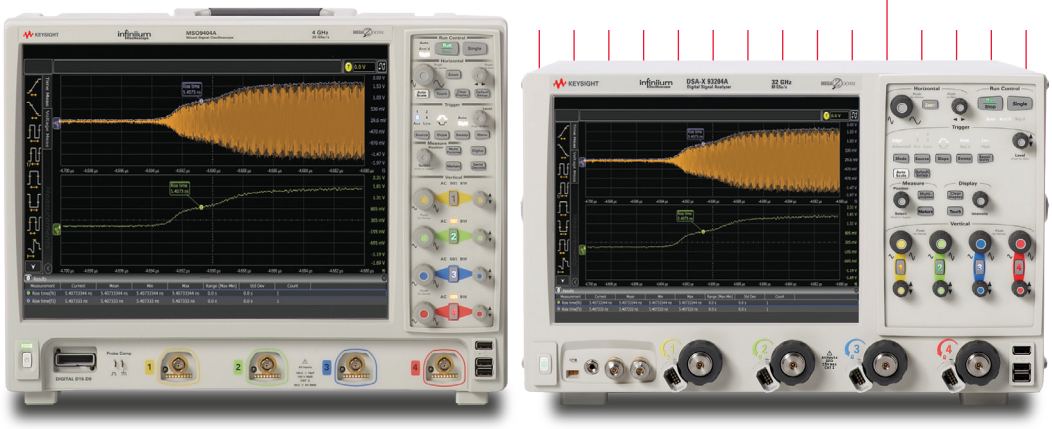
Keysight Technologies

N8806A User Defined Function for Editing and Execution for Infiniium Oscilloscopes

Data Sheet



MATLAB Enabled

MathWorks Partner

KEYSIGHT TECHNOLOGIES

Introduction

- Create your own custom functions (or modify included functions) using the power of MATLAB software
- Enables Infiniium oscilloscopes to execute customized math and analysis functions
- Enhance your Infiniium oscilloscope with the analysis power of MATLAB software
- Live waveform update from a seamless gateway to the MATLAB functionality
- Combinable with other Keysight Technologies, Inc. analysis software solutions
- Only Keysight provides both the custom measurement capability and the MATLAB software environment in a single oscilloscope option

Create and execute custom math and analysis functions

Have you ever wanted to create your own math functions or filters for your specific needs? With today's increasingly complex signals, the standard analysis routines provided with an oscilloscope are sometimes not enough.

Now, Keysight and the MathWorks have teamed up to offer the perfect solution to meet your specific needs – on demand. The Keysight Technologies' N8806A User Defined Function for editing and execution allows you to create and execute your own custom math and analysis functions using the power of the MATLAB software environment all in a single software package.

The MathWorks MATLAB is a software environment and high-level language used to acquire, analyze, and visualize data. With a seamless integration to the MATLAB environment, Keysight's UDF allows you to display your math and analysis functions created in MATLAB live on the oscilloscope screen, just like any of the scope's standard functions. Or, you can interactively analyze and visualize your results in the MATLAB environment, with capabilities such as graphically plotting results or automatically generating reports.

Use with Keysight 9000, 90000A, 90000 X-, S-Series, Z-Series or 86100D DCA-X oscilloscopes or 90008A oscilloscope/digitizers.

User Defined Function with MATLAB software

Creating a User Defined Function - It's easy and simple. User-defined function = XML + MATLAB script

The Keysight Infiniium user-defined function consists of two components: an XML file and a MATLAB script file.

The XML file defines the components of the graphical user interface that appears on the "Math" dialog box shown in the right side in Figure 3. An example XML file used to create a user interface for a Butterworth low-pass filter is shown in Figure-1. You will define the name of the function, abbreviation, source types, and controls in the XML file. The Infiniium user-defined function can support up to two sources (one source, two sources, or clock/data combination) and two controls. It also comes with a standard XML schema if you wish to validate your XML file. (Look on public Web sites for a free XML syntax checker that you can use in conjunction with the XML schema.)

The MATLAB script (the .m script file) will be the main program of the function, which is developed in the MATLAB environment using MATLAB's software tools and programming language. Figure 2 shows an example of a Butterworth low-pass filter shown in the MATLAB editor. The functions "butter" and "filter" available in MATLAB and its Signal Processing Toolbox are the essential components for making this user-definable filter (Signal processing toolbox is standard for N8806A.

Multiple custom user defined functions are already provided with the Infiniium oscilloscope when you purchase the N8806A UDF option. Provided functions include Butterworth filtering, FIR, LFE, and RTEye. Use MATLAB to create your own new functions or modify and execute existing functions to meet your own unique testing challenges.

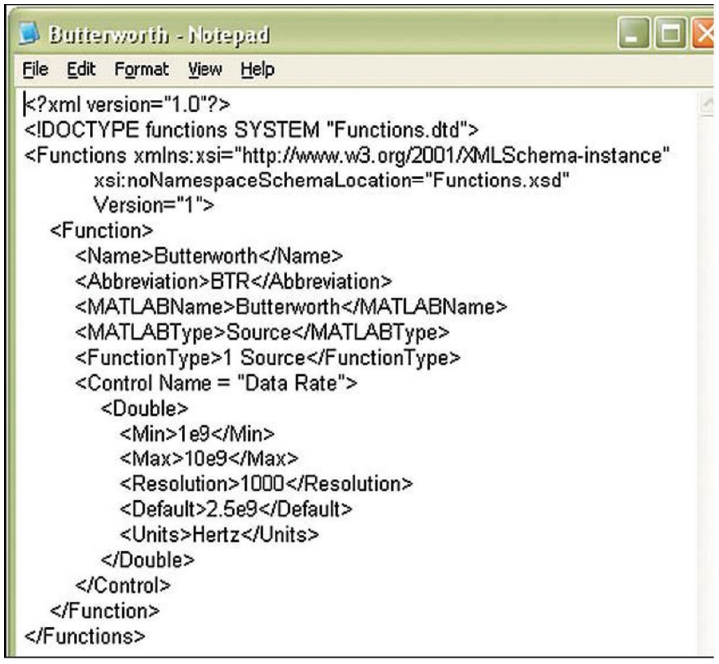


Figure 1. XML file example

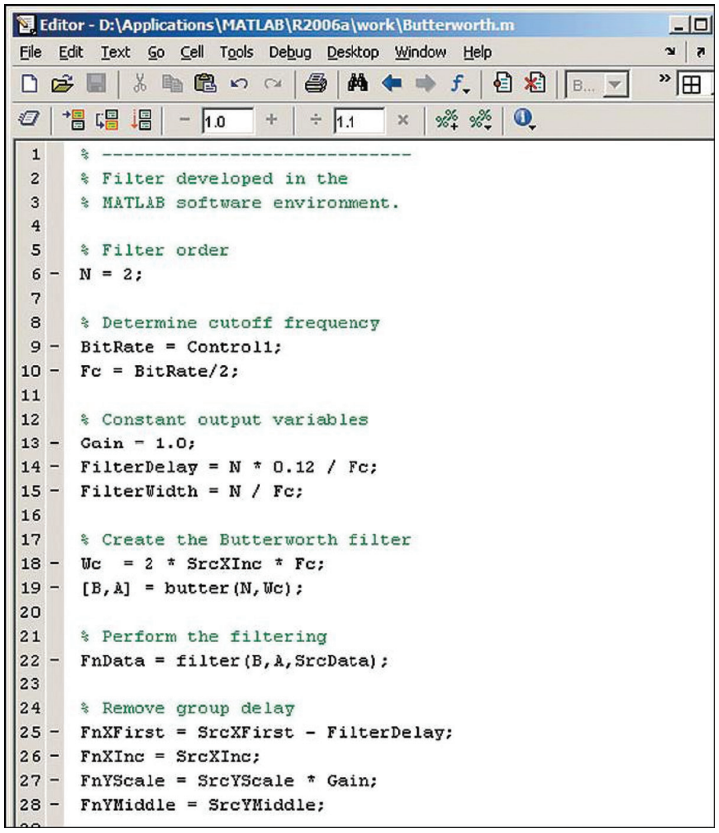


Figure 2. MATLAB script example (shown in the MATLAB editor)

User Defined Function with MATLAB software

The results of using the Butterworth low-pass filter are shown in Figure 5. A live swept sine wave signal is input into channel 1 (the first waveform – yellow), where the signal is shown with infinite persistence. An FFT analysis of channel 1 with infinite persistence is shown in the second waveform (pink).

The third waveform (purple) is the time domain waveform result after going through the Butterworth low-pass filter created in the MATLAB editor. Finally, an FFT analysis of the filtered data is shown in the bottom waveform (pale pink). You can observe that the Butterworth low-pass filter is successfully cutting off the high-frequency components.

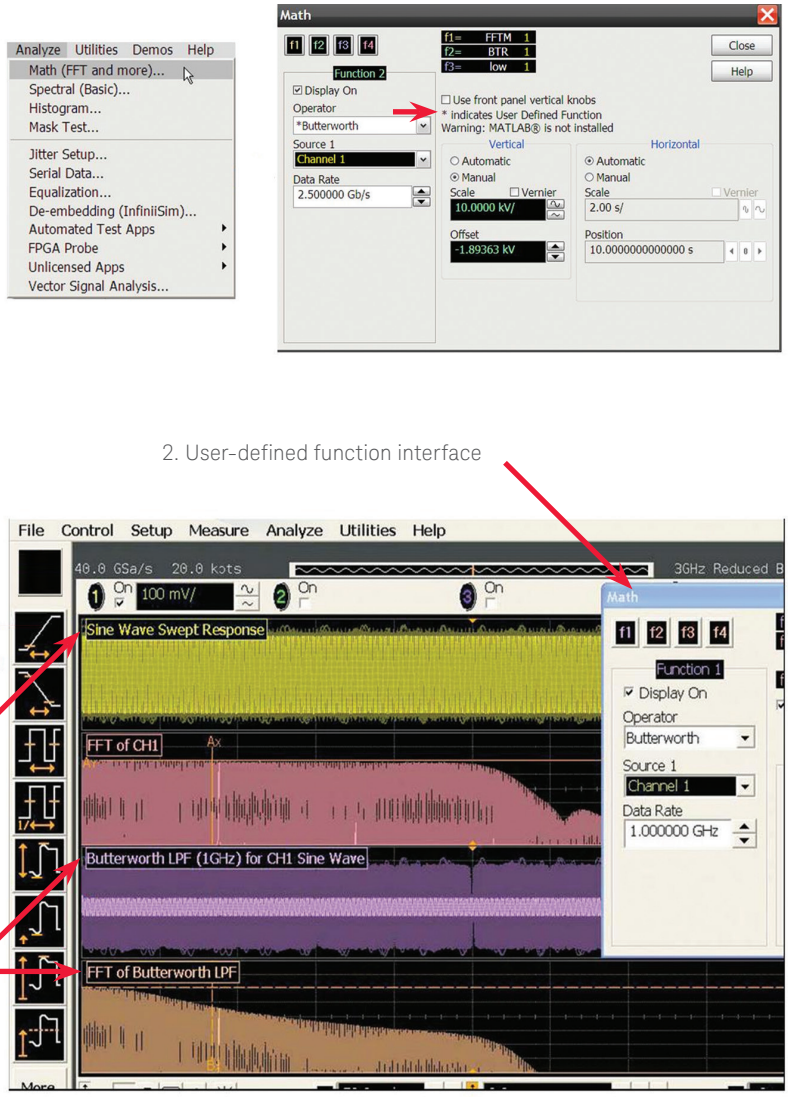


Figure 3. User-defined function overview. Comparison of waveform before and after going through the Butterworth low-pass filter created in the MATLAB editor

User Defined Function with MATLAB software

MATLAB Software Included

N8806A User Defined Function for editing and execution comes with MATLAB software environment plus three additional toolboxes for MATLAB: Instrument Control Toolbox, DSP System Toolbox, and Signal Processing Toolbox.

MATLAB is the foundation product that provides the software environment to create, edit, execute and save MATLAB commands, files, and data. It provides mathematical functions for linear algebra, statistics, Fourier analysis, filtering, optimization, and numerical integration. It also provides 2-D and 3-D graphics functions for visualizing data and tools for building custom graphical user interfaces.

Instrument Control Toolbox lets you use MATLAB to communicate with instruments, such as Keysight oscilloscopes, function generators and signal analyzers. The toolbox enables you to communicate with instruments via instrument drivers, such as IVI, and commonly used communication protocols, such as GPIB, VISA, TCP/IP, and USB. With Instrument Control Toolbox, you can generate data in MATLAB to send out to an instrument, or read data into MATLAB software for analysis and visualization.

Signal Processing Toolbox provides a collection of industry standard algorithms for analog and digital signal processing (DSP). This toolbox enables you to create your own filters and apply them directly to your live or recorded oscilloscope signals to test or otherwise gain insight into your designs.

The DSP System Toolbox is a collection of tools that provide advanced techniques for designing, simulating, and analyzing digital filters. It extends the Signal Processing Toolbox with filter architectures and design methods for complex real-time DSP applications, including adaptive and multirate filtering.

Only Keysight provides both the custom measurement capability and the MATLAB software environment in a single oscilloscope option. Only Keysight has teamed up with the MathWorks to provide this level of analysis.

The N8806A is a full featured licensed copy of MATLAB. You can decide whether to install MATLAB directly on the scope or on a remote PC.

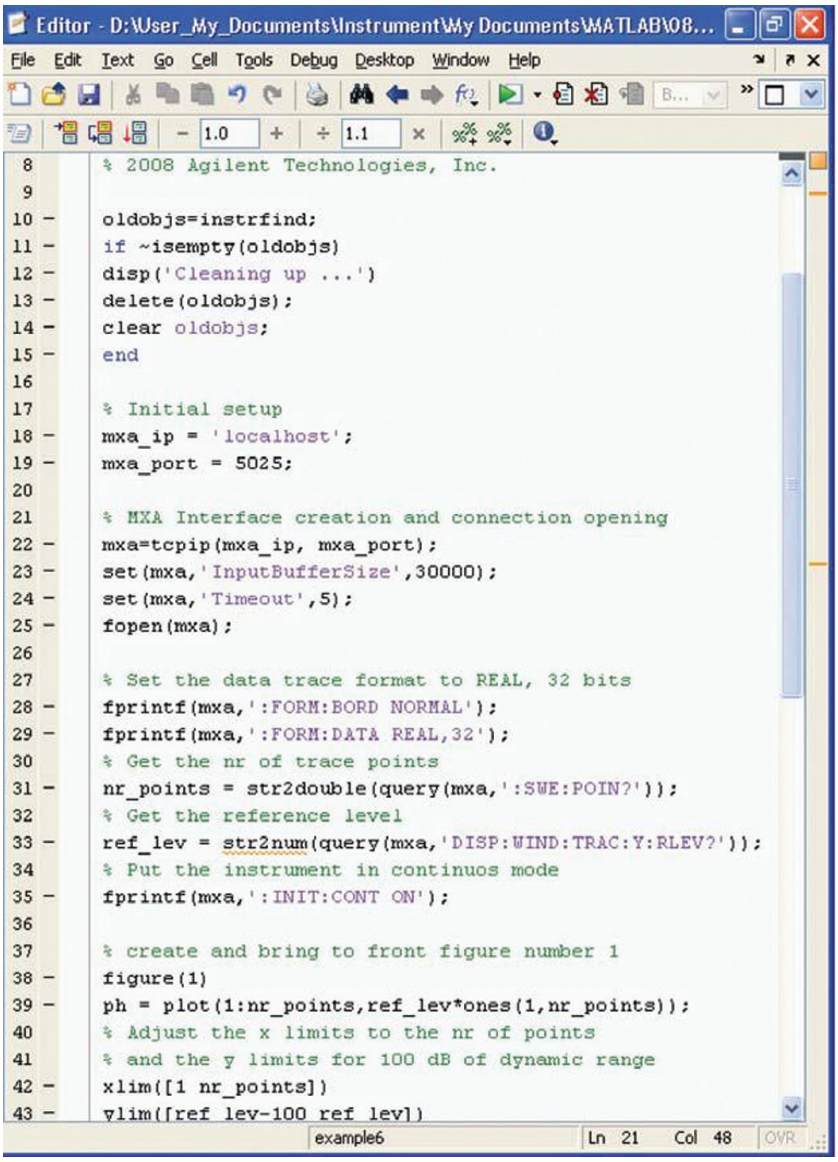


Figure 4: Developing a new MATLAB application or modifying an existing MATLAB application using the MATLAB Editor provided by MATLAB

User Defined Function with MATLAB software

Use in combination with other Keysight application packages

User-Defined function gives you the capability you need to develop custom measurement functions, you can extend your capabilities by combining it with other Keysight application solution software, such as the EZJIT Plus jitter analysis software and High-Speed Serial Data Analysis software.

For example, you can equalize the attenuated signal transmitted through an FR4 PCB using a "linear feed-forward equalizer" created by an Infiniium user-defined function (see Figure 6), then apply the EZJIT Plus to evaluate the total jitter by decomposing jitter components into random and deterministic jitter. Or, perhaps you can obtain the clock location using the High-Speed Serial Data Analysis software, and create an eye pattern for visual analysis using the MATLAB plotting feature (Figure 7).

Finally, you can compare the measurement results before and after applying the equalization in order to analyze the effect of equalization. This analysis was only possible previously using an external PC. Now you can use the Infiniium user-defined function with MATLAB functionality to make custom measurements directly on Infiniium oscilloscopes

For more information on using MATLAB together with Keysight oscilloscopes, visit: www.keysight.com/find/matlab_oscilloscopes

Figure 6. The signal on channel 1 went through linear feed-forward equalization and is displayed in function 1.

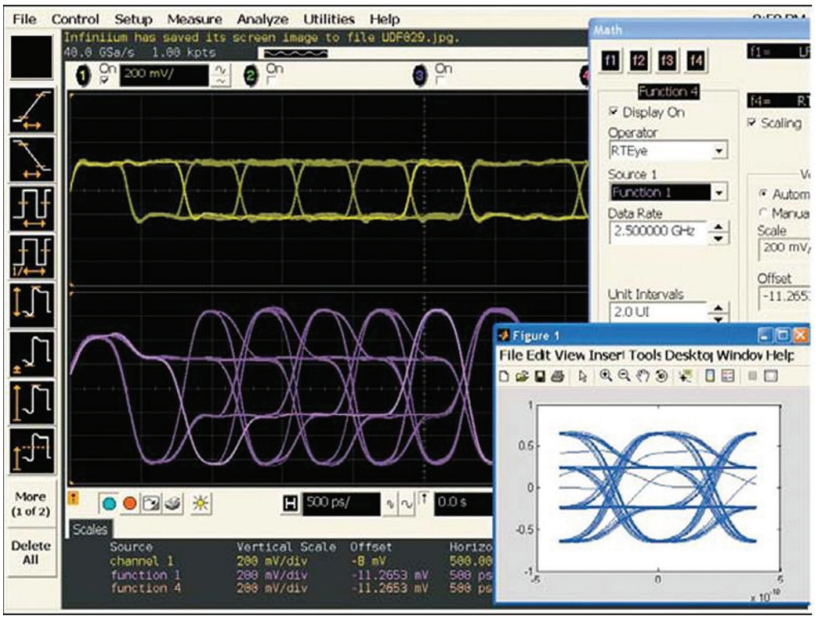


Figure 7. The eye pattern of an equalized signal created using High-Speed Serial Data Analysis software and the MATLAB plotting feature.

Key Specifications/System Requirements/Compatibilities

Specifications	
One source, two sources, or clock and data combination are supported	
Up to two controls (user input passed on to MATLAB) are supported	
Controls can be “double,” “enumeration,” “integer,” or “string”	
Up to four simultaneous MATLAB functions are supported	
Up to 20 user-defined functions are supported	
Recommended MATLAB Toolbox installations	Instrument Control Toolbox Signal Processing Toolbox

Oscilloscopes	Required software revision
Infiniium DSO/DSA Z-Series	Rev 5.0 or later
Infiniium DSO/DSA 90000 Series	Rev 3.0 or later
Infiniium DSO/DSA 90000 X-Series	Rev 3.0 or later
Infiniium DSO/MSO S-Series	Rev 5.0 or later
Infiniium DSO/MSO 9000 Series	Rev 3.0 or later

For software upgrade, visit: http://software.cos.keysight.com/Infiniium/

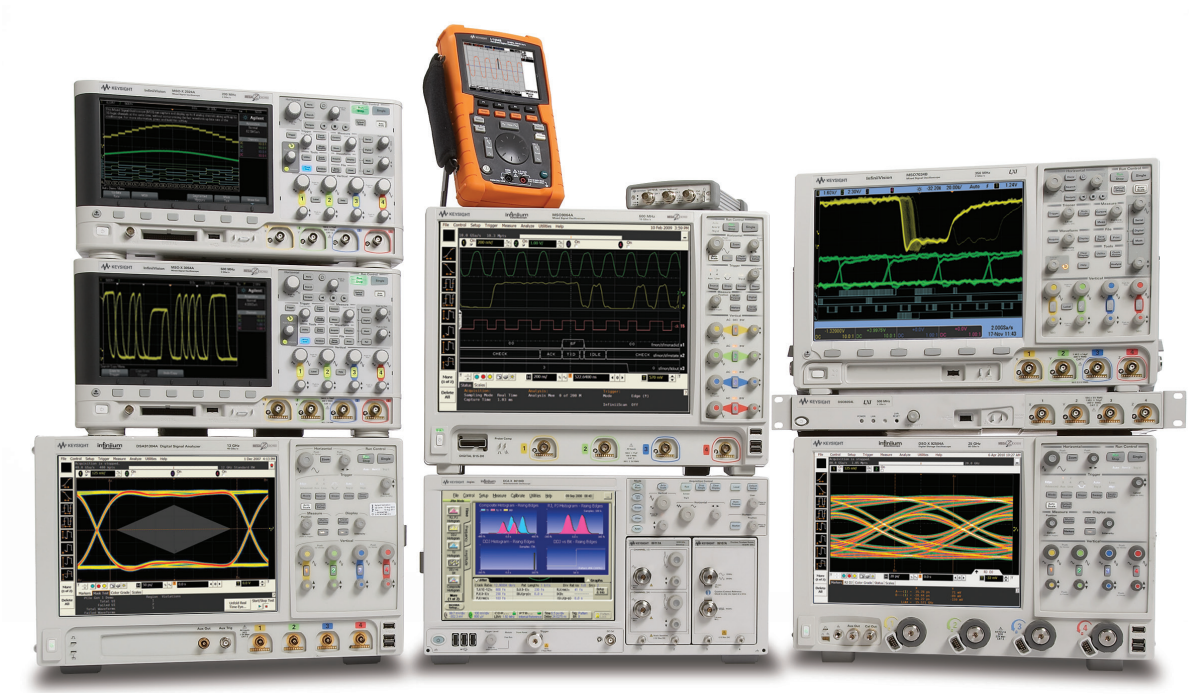
Ordering information

Software options

Application	License type		Infiniium S- and Z-Series	Infiniium 9000 and 90000 Series
User-Defined Function (UDF)	Fixed	Factory-installed	N8806A-1FP	–
		User-installed	N8806A-1FP	N8806A-1NL

Related Literature

Title	Publication type	Publication number
Infiniium DSO90000 Series Oscilloscopes and InfiniiMax Series Probes	Data sheet	5989-7819EN
Infiniium 90000 X-Series Oscilloscopes	Data sheet	5990-5271EN
Infiniium 8000 Series Oscilloscopes	Data sheet	5989-4271EN
Infiniium 9000 Series Oscilloscopes	Data sheet	5990-3746EN



Keysight Oscilloscopes

Multiple form factors from 20 MHz to > 90 GHz | Industry leading specs | Powerful applications

Evolving Since 1939

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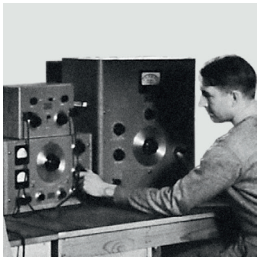
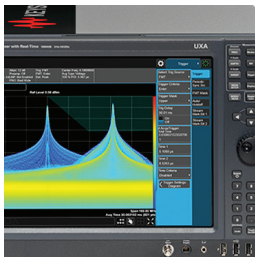
From Hewlett-Packard to Agilent to Keysight.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