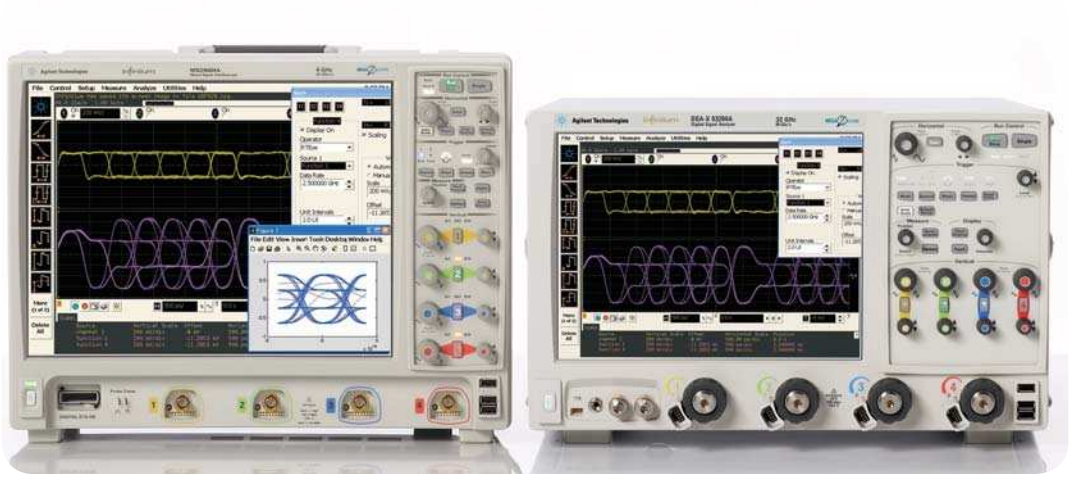
# Agilent N8806A User Defined Function for Editing and Execution for Infiniium Oscilloscopes

Data Sheet



- 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 Agilent analysis software solutions
- Only Agilent 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 wished your oscilloscope had more math and analysis capability? 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, Agilent and the MathWorks have teamed up to offer the perfect solution to meet your specific needs – on demand. The Agilent 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, Agilent'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 Agilent 9000, 90000, 90000X 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 Agilent 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.

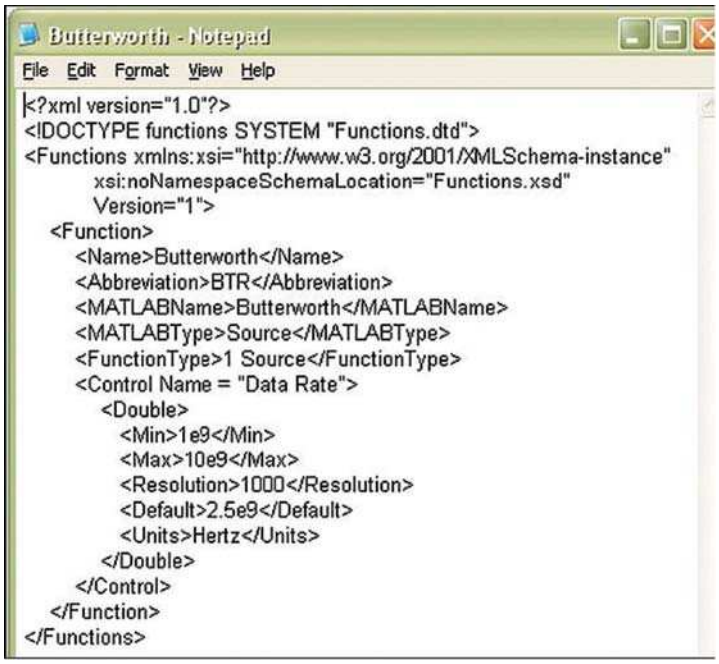



*Figure 1. XML file example*

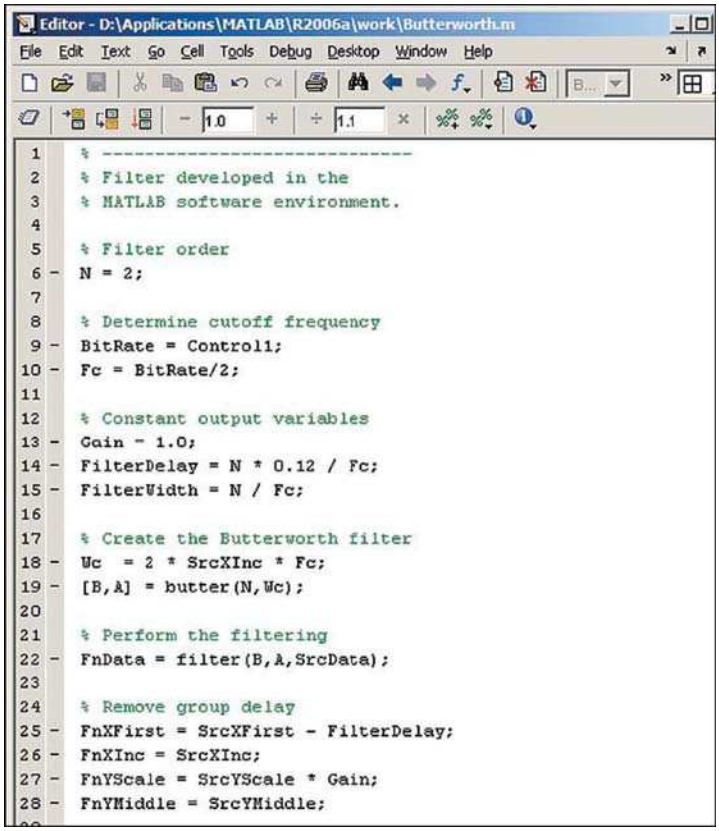



*Figure 2. MATLAB script example (shown in the MATLAB editor)*

# User Defined Function with MATLAB software

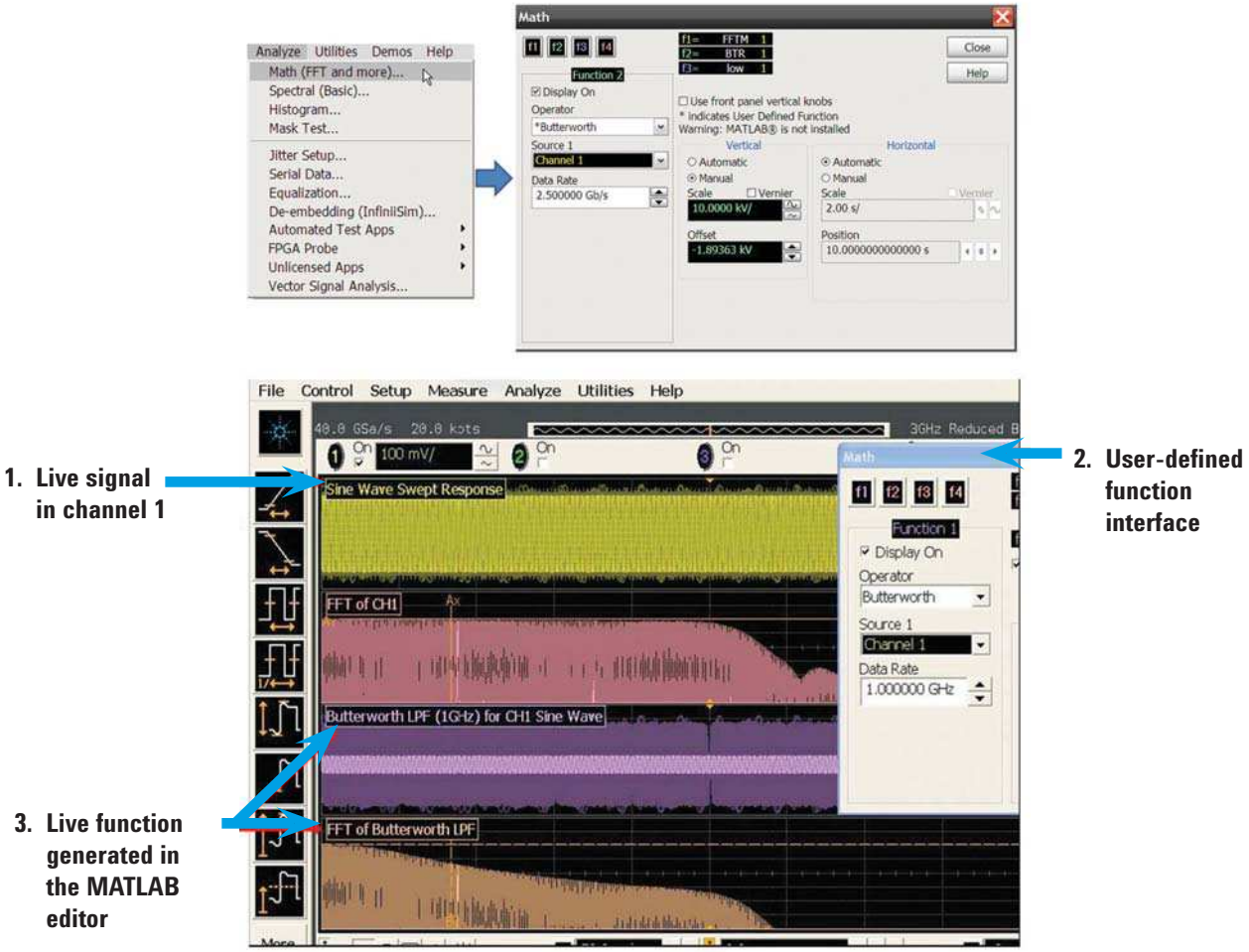



***Figure 3. User-defined function overview. Comparison of waveform before and after going through the Butterworth low-pass filter created in the MATLAB editor***

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.

# 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 Agilent 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.

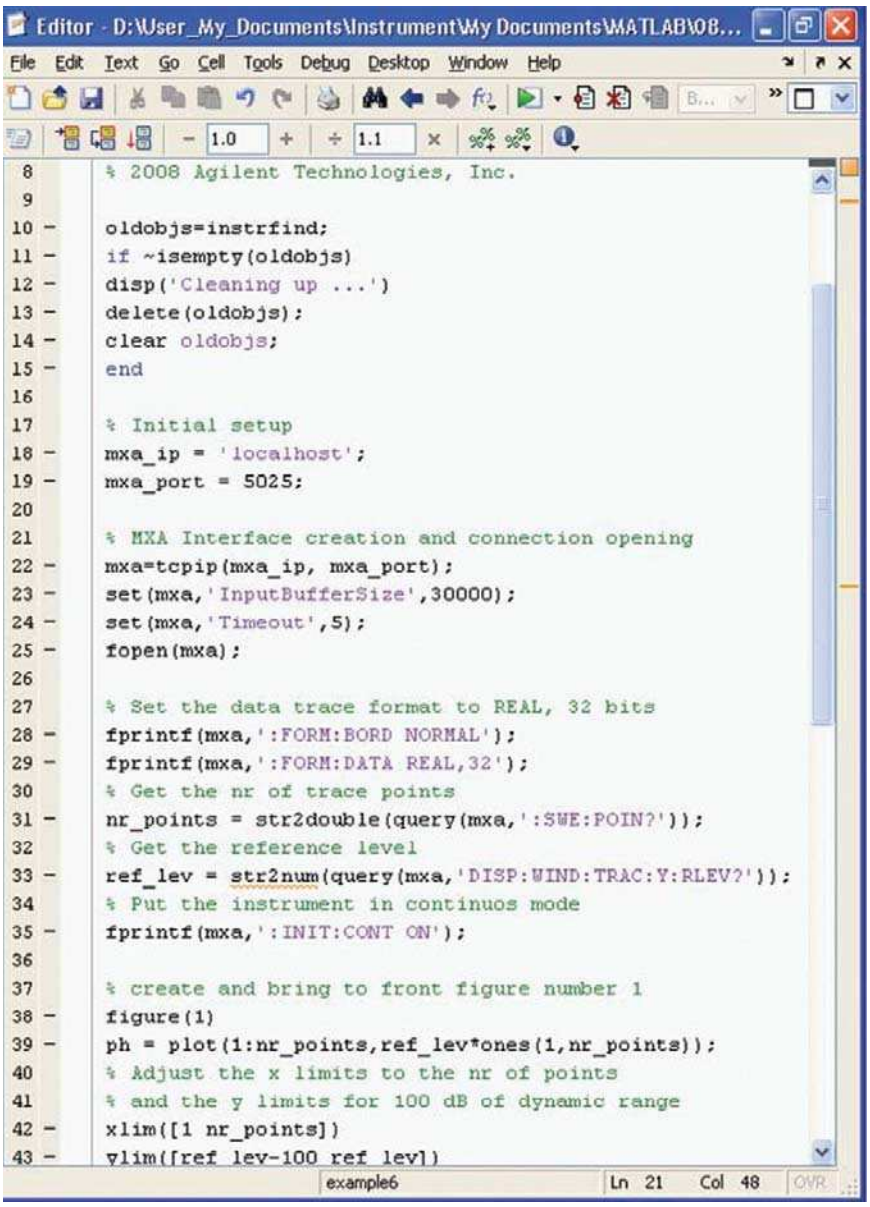



***Figure 4: Developing a new MATLAB application or modifying an existing MATLAB application using the MATLAB Editor provided by MATLAB***

Only Agilent provides both the custom measurement capability and the MATLAB software environment in a single oscilloscope option. Only Agilent 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.

# User Defined Function with MATLAB software

### Use in combination with other Agilent 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 Agilent application solution software, such as the Agilent N5400A EZJIT Plus jitter analysis software and E2688A 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 N5400A 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 E2688A 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 Agilent oscilloscopes, visit:
www.agilent.com/find/matlab_oscilloscopes

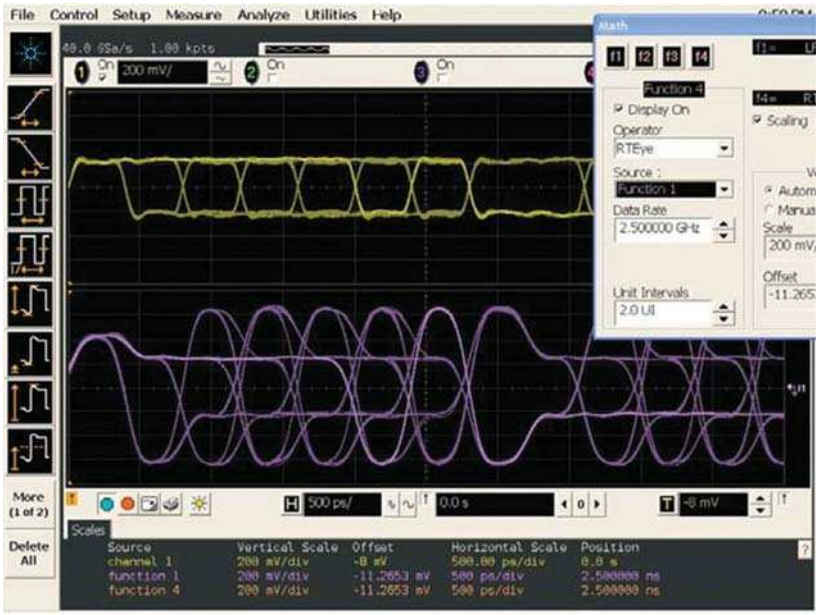



*Figure 6. The signal on channel 1 went through linear feed-forward equalization and is displayed in function 1.*

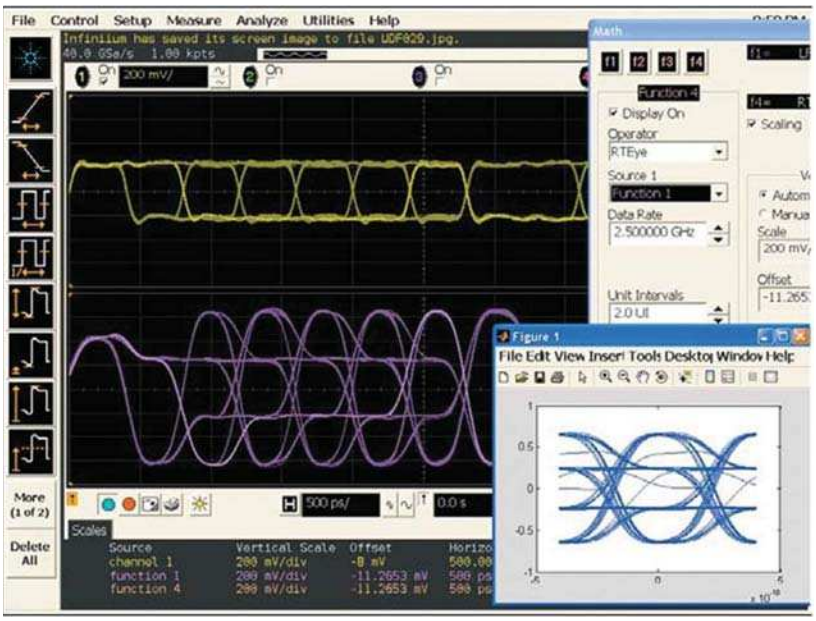



*Figure 7. The eye pattern of an equalized signal created using E2688A high-speed serial data analysis software and the MATLAB plotting feature.*

## 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<br>Signal Processing Toolbox |

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

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

## Ordering Information

| Model | Description |
|---|---|
| N8806A | User Defined Function for Editing and Execution |

## Related Literature

| Publication 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 |
| E2699A My Infiniium Integration Package for Infiniium Oscilloscopes | Data sheet | 5990-9934EN |
| Infiniium 9000 Series Oscilloscopes | Data sheet | 5990-3746EN |

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Product specifications and descriptions in this document subject to change without notice.


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