Agilent Technologies N5461A Serial Data Equalization Software for Infiniium Series Oscilloscopes

Data Sheet

Significantly reduce receiver errors by opening even tightly shut eyes through equalization emulation

The Agilent Technologies serial data equalization software for Infiniium Series oscilloscopes provides fast and accurate equalization using decision feedback equalization (DFE), feed-forward equalization (FFE), and continuous time linear equalization (CTLE) modeling in real time. Serial data equalization software allows users to input their own self-designated tap values to verify design or will find the optimal tap values for the designer. CTLE allows DC gain and two pole modeling.

Used in conjunction with the Infiniium Series unique Infiniium data accelerator (IDA) chip, serial data equalization software provides fast update rates and rapid analysis of real-time eyes that have been partially or fully closed by the serial data link. In addition to providing equalization, the software also provides basic convolve and de-convolve functions to enable basic de-embedding and embedding capability. Finally the serial data equalization package includes a wizard that provides an easy-to-follow step-by-step process to full equalization.

Figure 1: Serial data equalization software

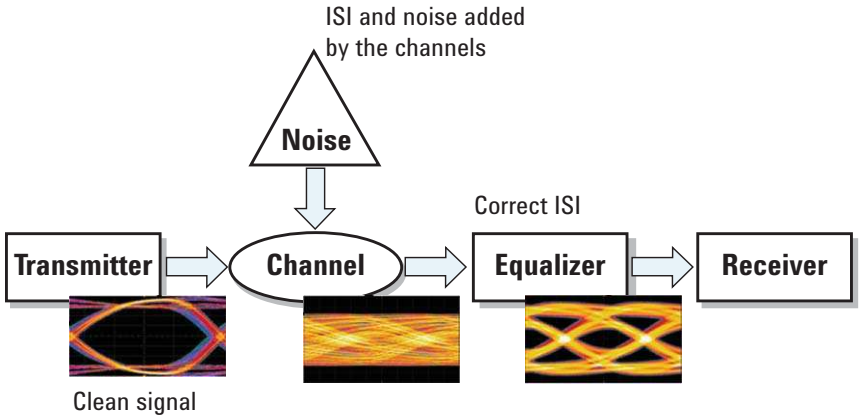

Figure 2: Complete link

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Equalization FAQ

1. Why do I need equalization?

   As data rates go up, the signal deteriorates from the transmitter to the receiver due to ISI, noise, etc. The more loss that occurs, the more difficult it is for a receiver comparator to distinguish a "1" from a "0". A high data rate coupled with a lossy channel will cause an open eye at a transmitter to be closed at the receiver. Receivers need to be able to evaluate a 1 or 0; fully or partially closed eyes cause receiver errors and data corruption. Equalization uses advanced filtering techniques to correct the voltage level of the current bit. It changes closed eyes to open eyes, to provide insight to reciever design and function.

2. What is the difference between decision feedback equalization (DFE) and feed-forward equalization (FFE)?

   FFE typically looks only at the bits preceding the current bit to open the eye while DFE dynamically will change based on the current bit in addition to any previous bits. FFE uses the same filter for each receiver and every bit. DFE is adaptive and can vary by device. DFE can be used in addition to FFE; however FFE cannot be used in addition to DFE.

3. What role does the 90000A scope hardware play in equalizing eyes with the serial data equalization software?

   The low noise floor of the 90000A means the equalization technique will open the eye wider. Equalization will amplify any noise not caused by ISI, which by definition includes oscilloscope noise. Because the 90000A Series has the industry's lowest noise floor, there is much less noise to be amplified. This results in greater equalization accuracy.

4. Why does the equalization software require serial data analysis software?

   Equalization requires the oscilloscope to know where the clock transitions. Clock data recovery allows the scope to know where the transition occurs, making equalization possible. Full clock data recovery can only be found in the serial data analysis software package.

Easy equalization setup

Serial data equalization software extends the ease-of-use advantages of Agilent's Infiniium oscilloscopes to complete analysis of the receiver. A wizard walks you quickly through the steps required to setup and perform equalization. Intuitive displays and clear labeling of information make it easy to perform complex equalization set ups. The serial data equalization wizard walks you through seven different equalization possibilities.

Equalization wizard options

1. FFE is applied, but the real time eye is not displayed. You will see only the waveform.
2. No equalization applied. This is to compare an equalized signal versus a non-equalized signal.
3. FFE is applied only to recover the clock, but the referenced eye is unequalized. This is useful for finding the recovered clock from a closed eye.
4. Standard FFE equalization.
5. Standard DFE equalization for a non closed eye.
6. Standard DFE equalization for a closed eye. Note the FFE is used to recover the clock, but is not displayed in the real time eye.
7. FFE is applied and then DFE is applied to the real time eye. Both are displayed in the resulting real time eye.

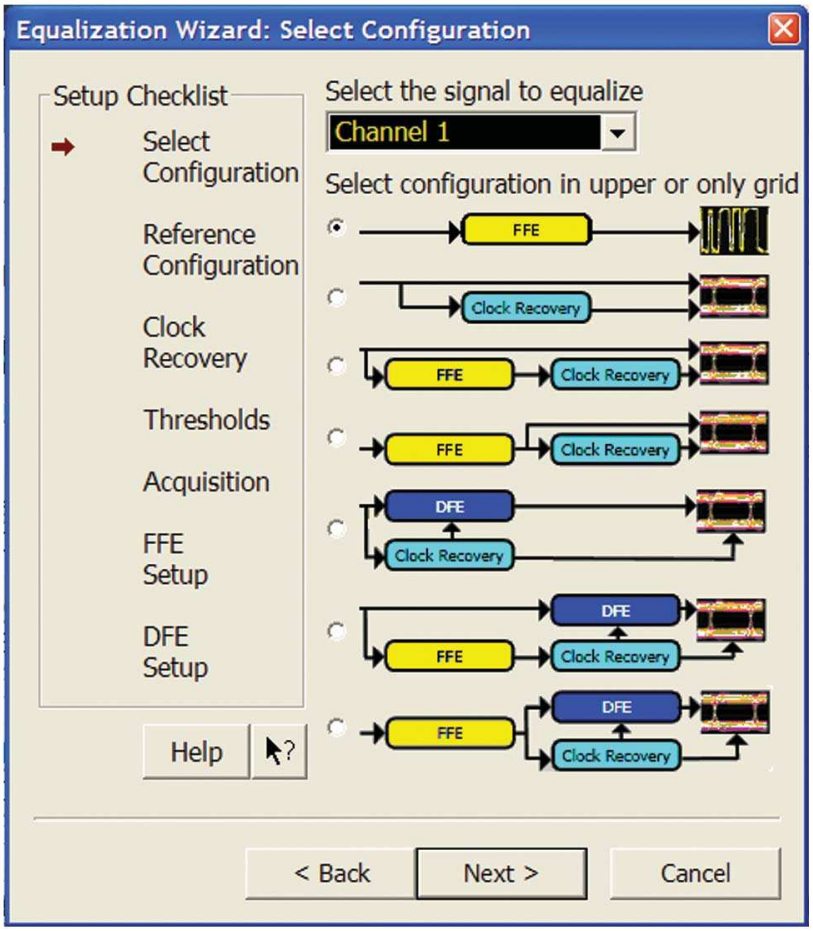


Figure 3: Equalization options from the wizard

DFE and FFE equalization

The serial data equalization software provides full equalization of both decision feedback equalization and feed-forward equalization (also known as linear feed-forward equalization). Two windows can be open so you can compare the results of FFE and DFE.

In addition to allowing you to compare DFE versus FFE equalization techniques, the serial data equalization software allows you to quickly compare different tap values. Tap values are dimensionless correction factors applied to the bit voltage levels in serial data patterns during equalization. Tap values can be viewed as the ratio of the voltage the receiver should have seen versus what the receiver actually did see. Accurate tap values are essential for modeling an ideal real time eye at the receiver. Serial data equalization software will save you time by modeling up to forty tap values for you. In addition to this, you can use the serial data equalization software package to find what combination of tap values will maximize eye height. Finally SDE software provides pre cursor tap functionality for FFE emulation.

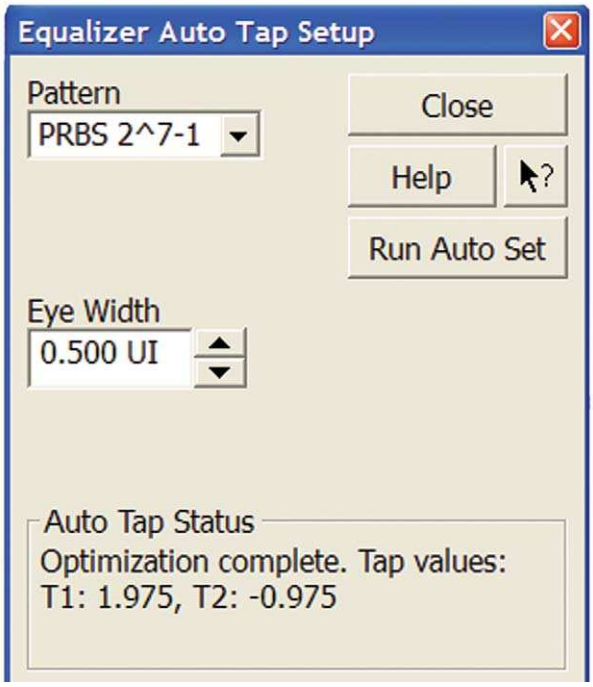


Figure 4: Tap values are automatically found

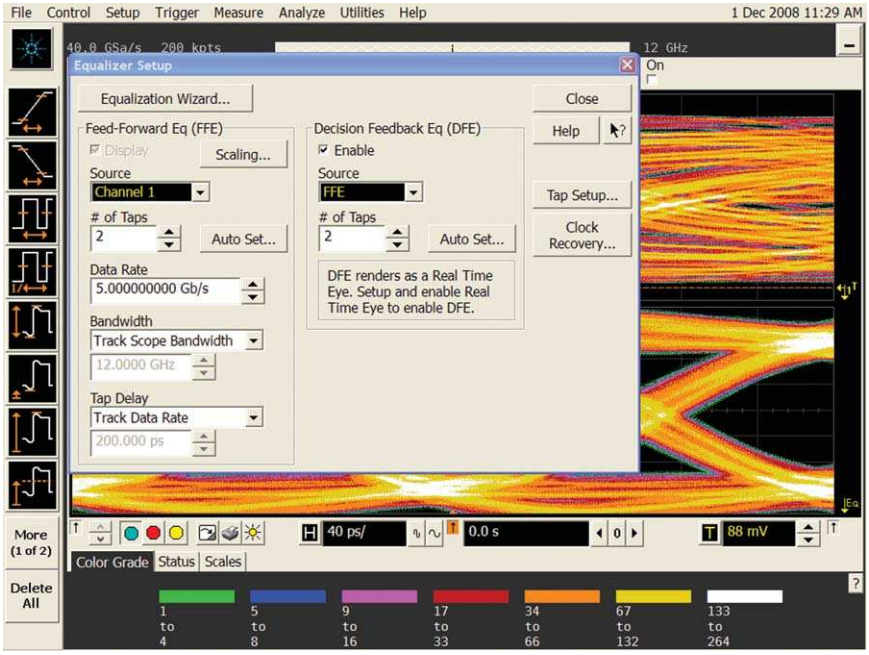
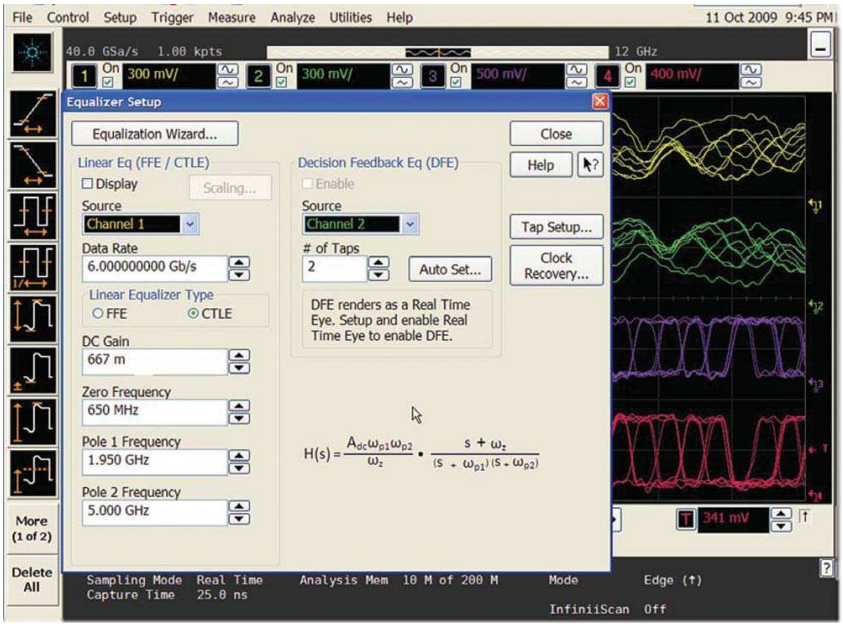


Figure 5: Complete equalization menu

CTLE Equalization

CTLE

Many of today's standards require CTLE as part of compliance testing. The SDE software makes verifying emulation easy. Simply enter your DC gain value, zero frequency, and pole1 and pole2 frequency values to verify your design.



Flexible clock recovery

You can choose constant-frequency, first-order phase-locked loop (PLL), second-order PLL clock recovery, explicit clock, explicit first order PLL, explicit second order PLL or FibreChannel clock recovery methods. You can adjust the center frequency and bandwidth, and in the case of second-order PLL, the damping factor.

New to the equalization software is the equalized first and second order PLL, which allows you to recover the clock on a closed eye. This is accomplished by first applying FFE to the eye, and then recovering the clock, making DFE possible on closed eyes..

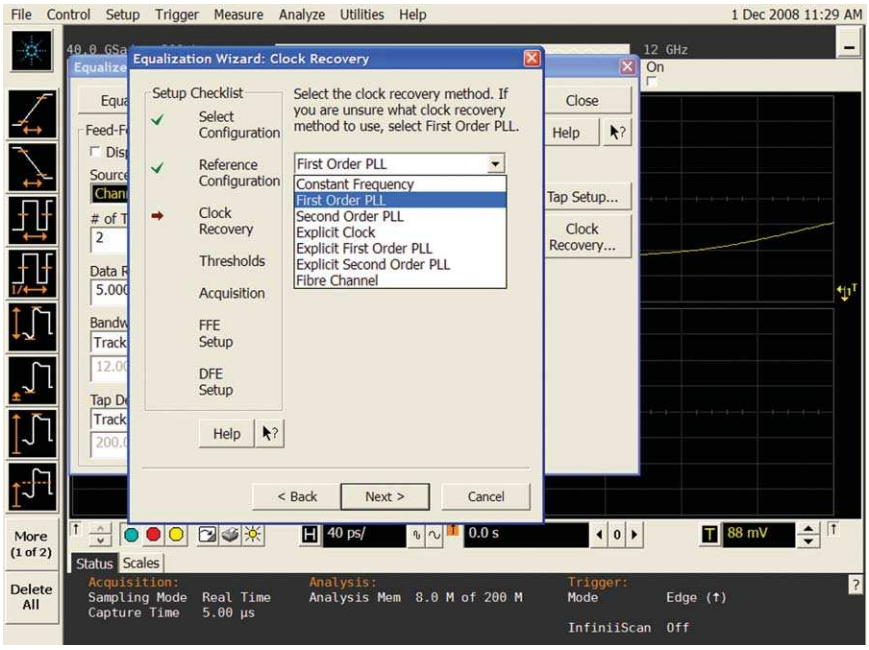


Figure 7: Clock recovery set up

Oscilloscope compatibility

The N5461A Infiniium serial data equalization software is compatible with Agilent 90000 and 9000 Series oscilloscopes with operating software revision 1.40 or higher (Windows® XP Pro). For oscilloscopes with earlier software revisions, free upgrade software is available at:
http://www.agilent.com/find/infiniium_sw_download.

Ordering information

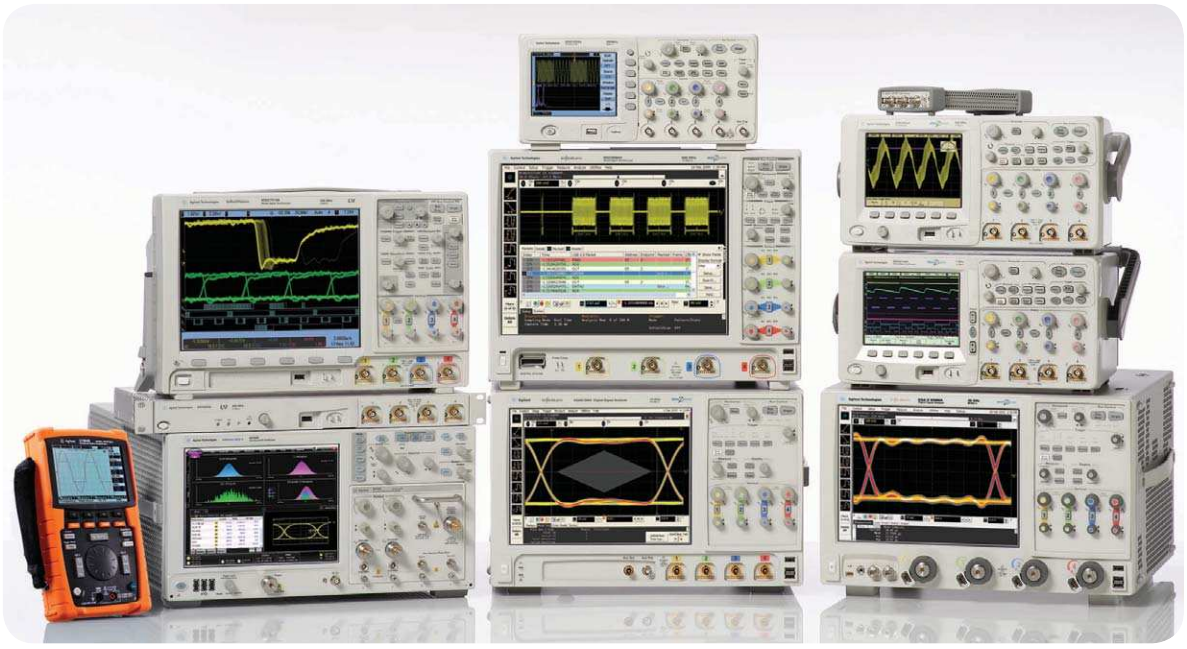
To purchase the N5461A Infiniium serial data equalization software for your new or existing 90000 X, 90000 or 9000 Series oscilloscope, order the following:

For Infiniium Series oscilloscopes

Model number	Description
DSO9000A	Infiniium 9000 Series scope with software 2.1 or higher
DSO90000A	Infiniiium 90000 Series scope with software 1.40 or higher
DSOX90000A	Infiniium 90000 X-Series scope with software 3.0 or higher
E2688A	Serial data analysis (SDA)
N5461A	Infiniium serial data equalization software

Related Literature

Publication title	Publication type	Publication number
Agilent Infiniium 90000 Series Oscilloscope	Data sheet	5989-7819EN
Agilent E2688A, N5384A High-Speed Serial Data Analysis and Clock Recovery Software for Infiniium Oscilloscopes	Data sheet	5989-0108EN
Infiniium 9000 Series Oscilloscopes	Data sheet	5990-3746EN
Infiniium 90000 X-Series Oscilloscopes	Data sheet	5990-5271EN



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