Keysight
N9051B Pulse Measurement Software

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KEYSIGHT TECHNOLOGIES

Getting Started Guide

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Keysight N9051B
Pulse Measurement Software

Getting Started Guide

1 Introduction to Pulse Measurement Software

The N9051B Pulse Measurement Software provides easy-to-use, time measurements of Pulsed RF or Microwave signals in Keysight X-series signal analyzers. It automatically finds pulse edges in time, and then measures parameters such as rise time, fall time, pulse width, PRI, PRF, duty cycle, peak-to-average ratio and several others. Algorithms determine pulse characteristics according to methods from IEEE standard 181.

Parameters are listed in a table for each pulse, up to 1050 pulses.

The vertical axis is calibrated in dBm, Watts, or Volts. Compared to solutions based on diode detectors or oscilloscopes, the amplitude values are trustworthy to within ~1 dB.

It is designed to support the Keysight PSA and X-Series signal analyzers (to 50 GHz center frequencies and 510 MHz bandwidth).

It can be installed in a CXA, EXA, MXA, PXA, UXA signal analyzer, and appears in the “MODE” menu and cooperates with mode switching mechanisms.

2 Installation and Licensing

This section describes the installation of the N9051B Pulse Measurement Software (Pulse) onto a Windows 7-64 bit-based Keysight signal analyzer, as well as how to license, configure and connect it. A single installation package provides all the necessary software.

For X-Series signal analyzers (CXA N9000A, EXA N9010A, MXA N9020A, PXA N9030A, UXA), beginning with instrument software version A.14.56, Pulse is pre-installed on the instrument's disk drive. If Pulse is already installed on your instrument you can skip to Section 3. License The Software on page 17.

The installation is delivered in DVD and or the Pulse Measurement Software can be downloaded via the web.

Installation Procedure Overview

1. **Plan your installation:** Refer to Section 1. System Configurations on page 11 to review procedures and compatibility notes, especially in the lists of system configurations. Verify that you have all the needed equipment, parts, and procedures for installation. If the instrument needs to be upgraded, do that first.
2. Run the Pulse (N9051B) Installer. Refer to “2. Installing N9051B Pulse Measurement Software” on page 12.
3. License the software. Locate your **Certificate of Entitlement**, and follow the instructions to redeem it for a license, and install the license into the instrument. Refer to “3. License The Software ” on page 17 for complete instructions.
4. Finally, start Pulse, and verify that it operates properly. Refer to “4. Starting Pulse Measurement Software and Verifying Installation” on page 18.

There are sample measurements listed in the latter part of this manual that can be used to demonstrate that Pulse is operating correctly.

1. System Configurations

There are several different system configurations. These are presented below:

System Configurations: Instrument Hardware.

System Configurations: Instrument Hardware

The following instruments are supported. The option information for each instrument is usually found under the "System" key.

Instrument Family	**Model Numbers**	**Options** **@ = Required** *** = Recommended**
X-Series Signal Analyzers[a]	CXA N9000A EXA N9010A MXA N9020A PXA N9030A UXA	@ any frequency option * B25 (25 MHz), or * B40 (40 MHz), or * B1X (160 MHz), or * B2X (250 MHz), or * B5X (510 MHz)

a. The X-Series XSA firmware revision must be A.13.12 and higher in a Windows 7 operating system.

NOTE A mouse and keyboard, plugged into the USB ports are required to operate Pulse, since it does not use front panel keys of the instrument.

2. Installing N9051B Pulse Measurement Software

NOTE The N9051B Software is already installed on most newer instruments. Perform an installation only if needed or to update to a newer version.

Administrator privileges are required to install new software.

Pulse (N9051B) Installer and Installation Procedure:

Pulse (N9051B) Installer

The Pulse (N9051B) installer will overwrite any previous installations of N9051B. However, previous installations of N9051A are stored in a different directory than the N9051B ("Program Files (x86)\Agilent" vs. "Program Files\Keysight", respectively).

The installer will notify you that a previous installation of N9051A is on the instrument. However, N9051A is not removed by the N9051B installer. It is not necessary to remove N9051A in order to install N9051B. If installation problems occur and it appears that having N9051A on the instrument is a problem, N9051A can be removed with the following procedure:

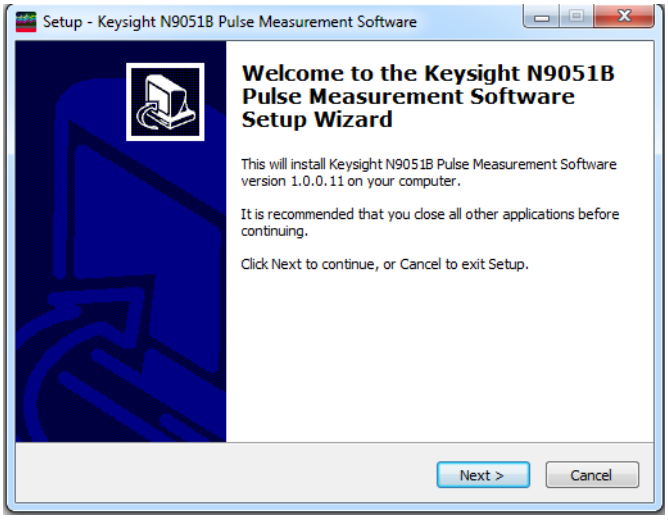
1. Start Button/Control Panel/Programs/Programs and Features/Uninstall a program
2. Find Keysight N9051A Pulse Analysis Software, select (left mouse click)
3. Click on Uninstall in the toolbar and follow the instructions.

The N9051B installer will instruct you to restart the XSA instrument software prior to using the N9051B.

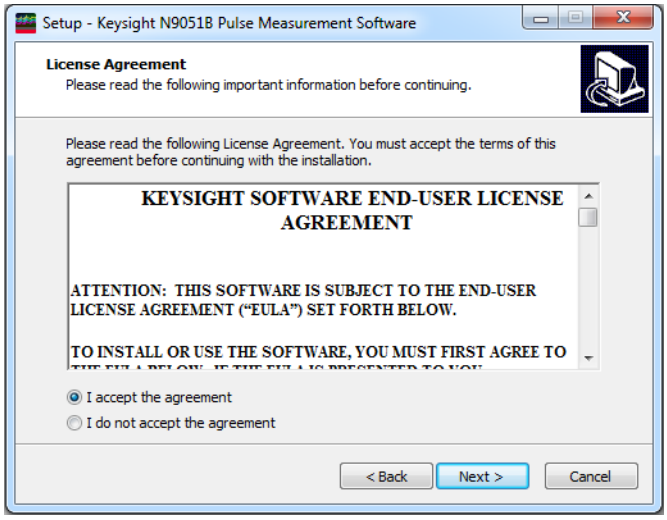
(A restart is necessary, because the instrument software reads the location of the Pulse software upon startup. If N9051B is installed while the instrument software is running in the background this location information is not updated, so the instrument software must be restarted for the N9051B installation to take effect. Alternately, the entire instrument can be restarted.)

Installation Procedure:

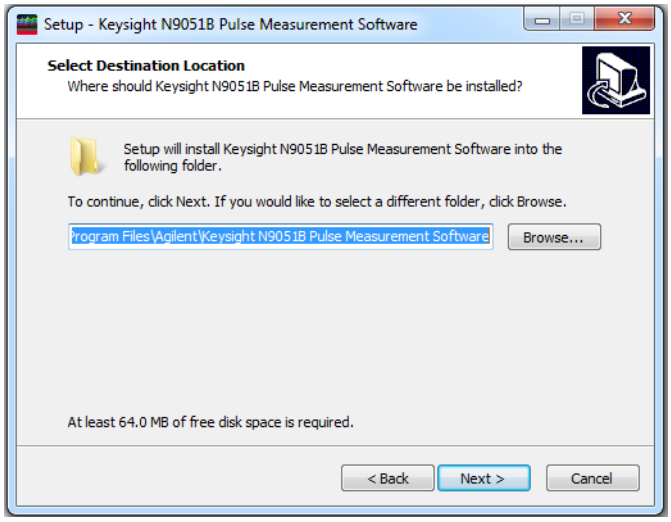
1. The installation program (PulseInstaller.exe) can be executed either from a USB stick or as a file on the harddrive. Copy "PulseInstaller.exe" to either a USB stick or to a location on the instrument harddrive.
2. Locate PulseInstaller.exe using File Explorer, right click on it, and select "Run as administrator". The administrator password is "`Keysight4u`!".
3. The Pulse installer displays the following screens. The first tells you what you are installing. Click on **Next**.



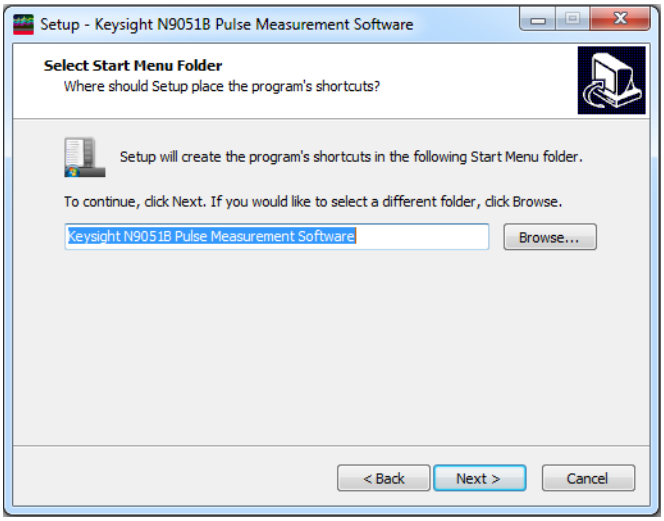
4. The next screen displays the license agreement and asks for confirmation. Select accept to continue and click on **Next**.



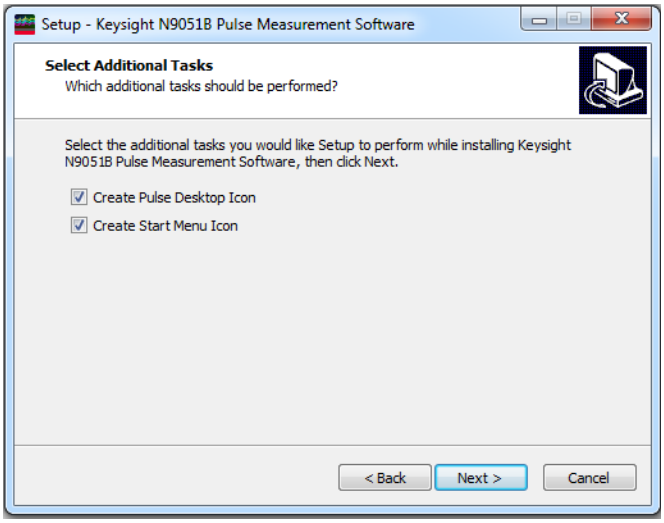
5. The following screen suggests a harddisk location for Pulse. The default should be used unless there is a good reason to do otherwise. Click **Next**.



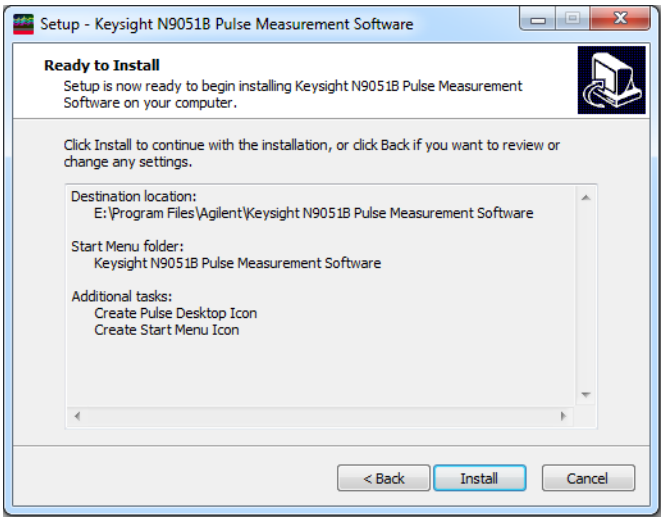
6. Next is the harddisk location for the shortcuts. Again, use the default values unless there is a good reason to do otherwise. Click on **Next**.



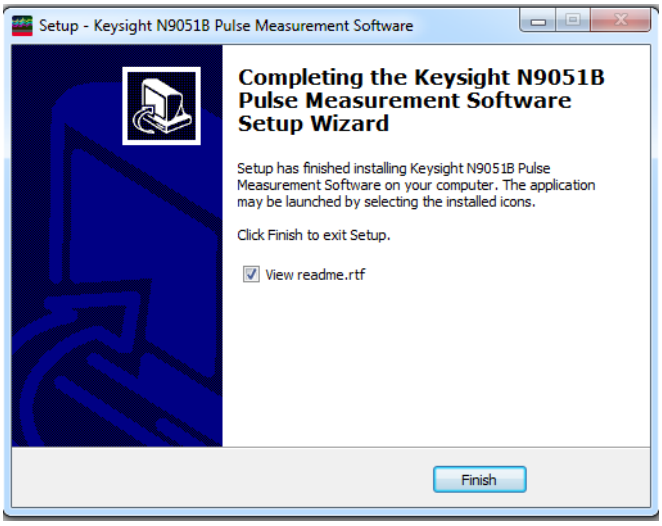
7. The next screen allows you to create program icons on the desktop and start menu. Modify the checkboxes as appropriate and click **Next**.



8. The next screen begins copying files to the harddisk. Click **Install**.



9. The final screen allows you to display the readme file. Click **Finish**.



3. License The Software

A licensing technology is used to enable authorized customers to use Keysight software. N9051B licenses are available in "fixed, perpetual" (FP) type ("node-locked" permanently to an instrument) or "transportable, perpetual" (TP) type (can be moved from one instrument to another).

When Keysight ships a copy of Pulse as part of an order, an Entitlement Certificate is included which can be redeemed for a license key. Follow the instructions that accompany the certificate to obtain the license key.

In order to use the license activation website, you will need the following information:

- Your order number and certificate number from the top of the Entitlement Certificate.
- The model number and serial number displayed by the X-Series instrument.

NOTE **There are separate licenses for the base Pulse program (N9051B-2FP), Phase and Frequency option (N9051B-3FP), the Extended Analysis option (N9051B-4FP), and the Deep Capture option (N9051B-5FP). The licenses for the options must be installed for the options to become active.**

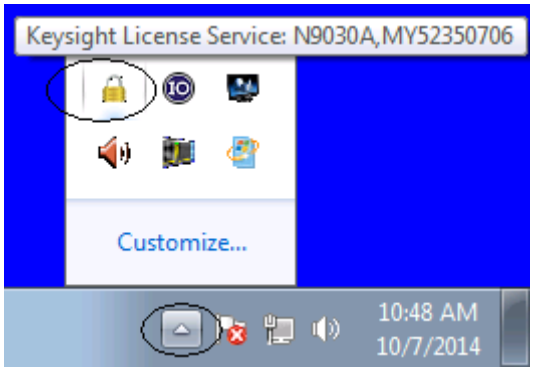
Pulse displays a warning message and exits if valid licenses are not found.

To enable the product you must redeem the entitlement for a license key from:

http://www.keysight.com/find/softwarelicense

Each instrument has a unique HostID number. The HostID is read by clicking on the up arrow at the bottom of the Windows 7 screen (minimize the instrument program if it is currently running by pressing the File button followed by the Minimize button to see the Windows 7 screen).

Clicking on the up arrow will bring up the display shown below. Hover the mouse pointer over the lock icon and the HostID will be visible. In this example, the HostID is MY52350706 and the instrument is a N9030A.



Be extremely careful to transfer and enter information accurately.

Double-check each field carefully before redemption. If a mistake is made, the license issued will not work, and the certificate will no longer be valid to generate another license!

Keysight will send the license key as a file. The license key is easily installed using a USB memory stick. Copy the license file to the memory stick and then plug the memory stick into the instrument. Administrator access is required. The license key will be installed automatically.

4. Starting Pulse Measurement Software and Verifying Installation

NOTE Make sure the system is powered on and connected properly and is licensed as described in “3. License The Software ” on page 17.

Make sure the instrument is running. Press the **Mode** key (on the instrument front panel), then select and press **Pulse** from the list of softkeys. You may need to press **More** to see successive pages of applications. You will be warned that a USB mouse and keyboard (plugged into the instrument) are required to control Pulse. Click **OK** if you have these connected and want to continue.

Pulse initially starts up with default settings, continuous acquisitions, and free-run trigger. At this point, the **Program Status** line at the bottom of the Pulse window should be cycling through the reading, update, and idle states. A yellow trace should be visible, even if noisy or unstable.

If there are any difficulties press the **Preset** button in the Pulse toolbar followed by **Ok**. If there are still problems, please refer to Chapter 4, “Troubleshooting ”, on page 47.

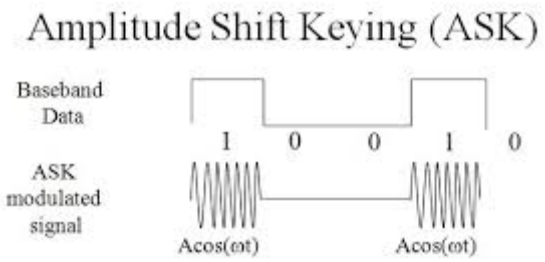
3 Making Measurements

The N9051B Pulse Measurement Software (Pulse) measures several pulse parameters including rise time, fall time, pulse width, over-shoot, droop, pulse period and many more.

This chapter shows you how to make basic measurements using Pulse. The purpose is to familiarize you with operation and key features. Refer to the User's Reference for a complete description of all features.

Pulse-Modulated RF Signals

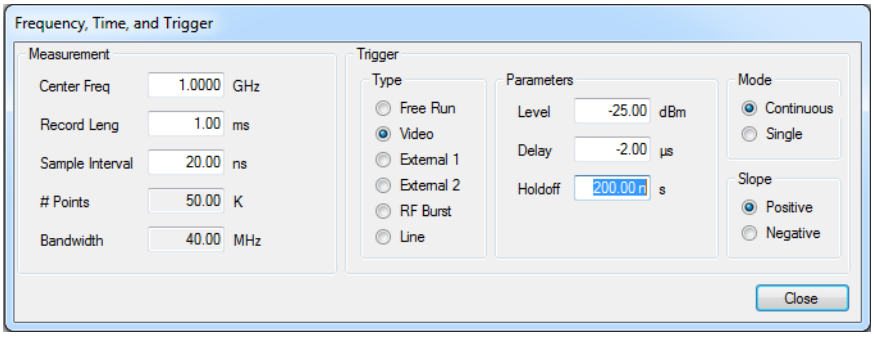
Pulse measurements can be made on RF or microwave signals that are pulse-modulated, where an underlying high-frequency signal is turned on or off. (Pulse-modulation can also be thought of as deep amplitude modulation (AM) or amplitude shift keying (ASK).)



Measurement 1: Display Data in Upper Window

1. Connect a pulse-modulated signal source to the instrument.
2. Set the source to provide a signal with the following parameters:
    a. center frequency = 1 GHz
    b. amplitude = –15 dBm
    c. PRI = 80 us
    d. duty cycle = 50%
3. Start **Pulse (Mode key/Pulse)**.
4. Press the blue **Preset** button in the toolbar and select OK from the dialog box.
5. Press the **Set Freq/Time/Trigger** button in the toolbar.
6. Set the following parameters, by clicking on the value field.

NOTE Double-clicking retains the engineering units prefix, such as "m" (milli-) or "k" (kilo-). A single-click requires you to use fundamental units (such as seconds or Hz) or to append the appropriate alpha character at the end of your numeric entry.

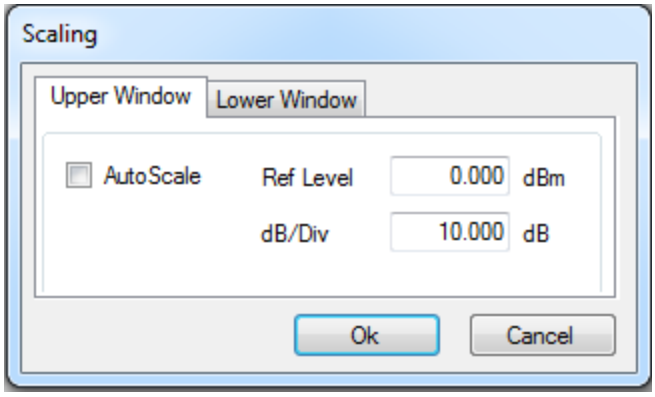


    a. Center Frequency = 1 GHz
    b. Record Length = 1 ms
    c. Sample Interval = 20 ns
    d. Trigger
        – Type = Free Run
        – Level = –25 dBm

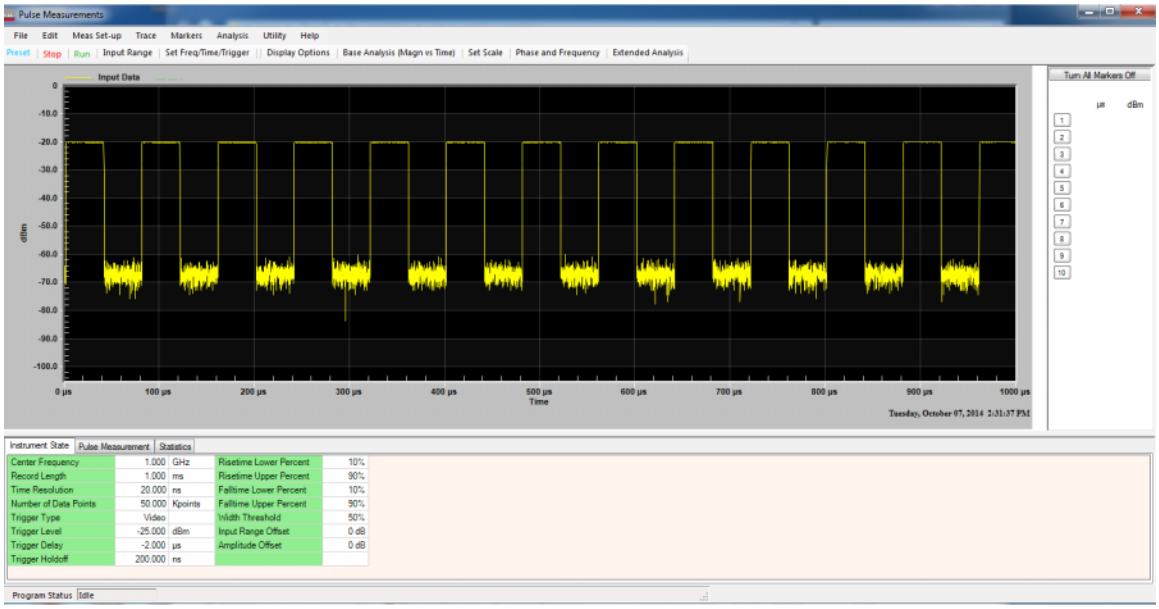
- Delay = –2 us
- Holdoff = 200 ns
- Mode = Continuous
- Slope = Positive

e. E. Click **Close**

7. Press the **Set Scale** button on the toolbar and uncheck the **AutoScale** textbox. Press **Ok**.

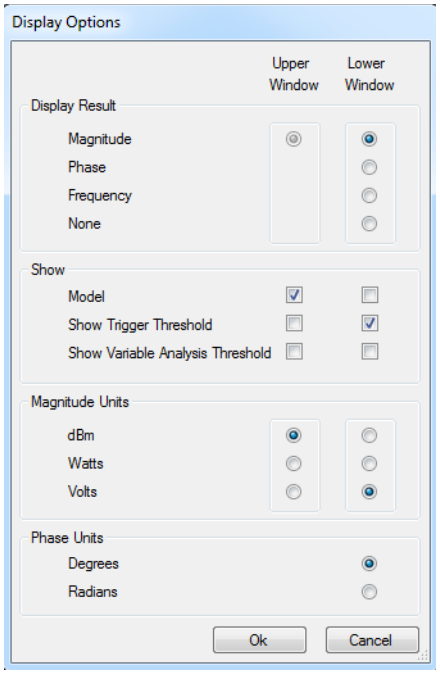


The display should look like:



Measurement 2: Display Measurement Data in Lower Window, Display in Volts; Model in Upper Window; Show Trigger Line in Lower Window

1. Perform all of the steps for Measurement #1.
2. Press the Display Options button on the toolbar.
3. In the Lower Window column of the Display Options dialog:
    a. Click the **Magnitude** radio button
    b. Click the **Volts** radio button
    c. Click the **Model** checkbox in the Upper Window column.
    d. Click on **Ok**



4. Press the Set Scale button on the toolbar.

   Upper Window - turn off AutoScale; Ref Level = 0 dBm; dB/Div = 10 dB

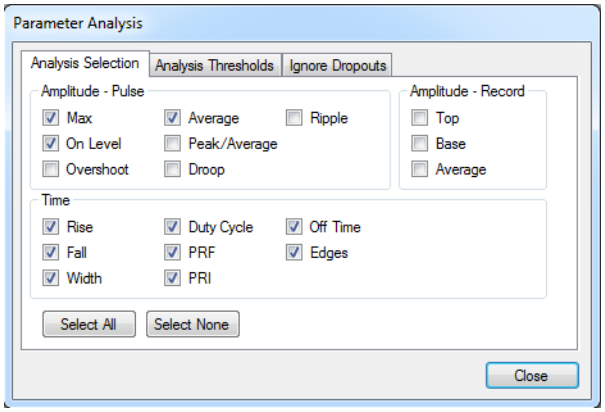
   Lower Window - turn off AutoScale; Ref Level = 50 mV; V/Div = 5 mV

The display should look like:

This window shows the input signal in dBm. The green line superimposed in the upper window is the model. It corresponds to a line model fit to the data points (least squares). The lower window shows the input signal in volts. The dashed white line shows the trigger level. The trigger level line can be dragged by the mouse to change trigger level.

Measurement 3: Display Tabular Data

1. Perform all of the steps for Measurement #1.
2. Click on Base Analysis (Magn vs Time) in the toolbar and click Max, On Level, Average, and all of the checkboxes in the Time groupbox.



3. Click on the Pulse Measurement tab in the lower display.

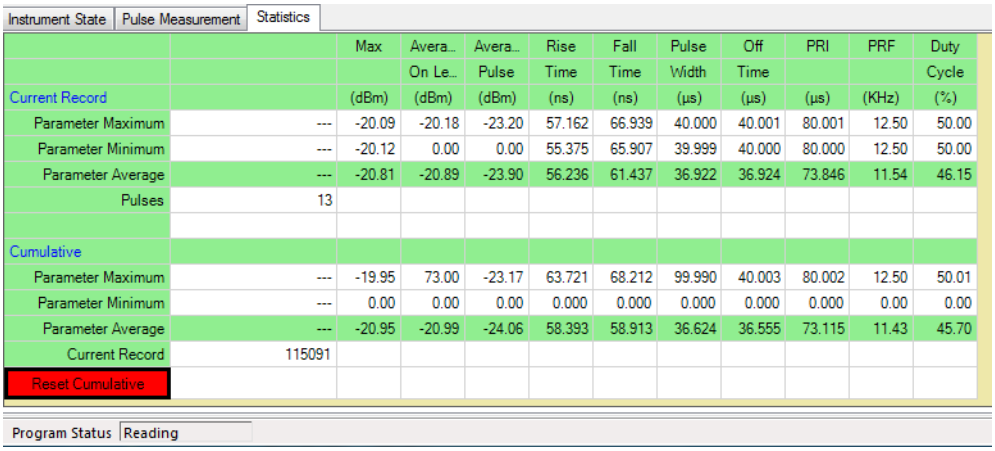
The Pulse Measurement display should look like:

Instrument State | Pulse Measurement | Statistics

Pulse	Rising Edge (µs)	Falling Edge (µs)	Max (dBm)	Average On Level (dBm)	Average Pulse (dBm)	Rise Time (ns)	Fall Time (ns)	Pulse Width (µs)	Off Time (µs)	PRI (µs)	PRF (KHz)	Duty Cycle (%)
1	1.9676	42.0227	-20.11	-20.19	-23.20	60.329	61.292	39.999	40.001	80.000	12.50	50.00
2	81.9680	122.0234	-20.11	-20.20	-23.21	61.099	62.182	39.999	40.001	80.000	12.50	50.00
3	161.9680	202.0232	-20.11	-20.19	-23.20	62.469	61.709	39.999	40.001	80.000	12.50	50.00
4	241.9679	282.0236	-20.11	-20.19	-23.21	62.093	62.368	39.999	40.001	80.000	12.50	50.00
5	321.9680	362.0238	-20.09	-20.20	-23.21	61.521	62.652	39.999	40.001	79.999	12.50	50.00
6	401.9675	442.0233	-20.12	-20.20	-23.21	61.489	61.839	39.999	40.001	80.000	12.50	50.00
7	481.9676	522.0235	-20.12	-20.19	-23.20	60.252	61.988	39.999	40.001	80.000	12.50	50.00
8	561.9680	602.0237	-20.11	-20.19	-23.20	60.003	62.343	39.999	40.001	80.000	12.50	50.00

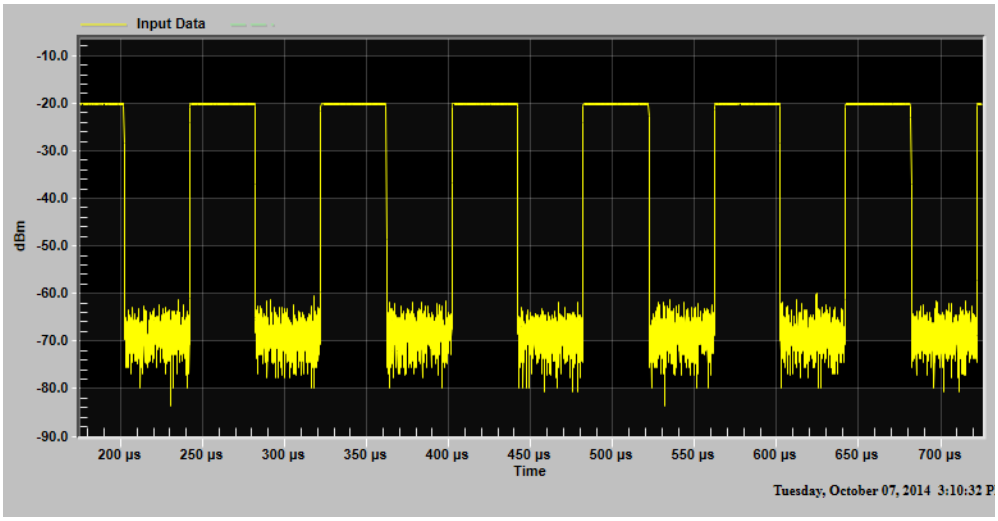
Program Status | Idle

For the Statistics tab, the display should look like:

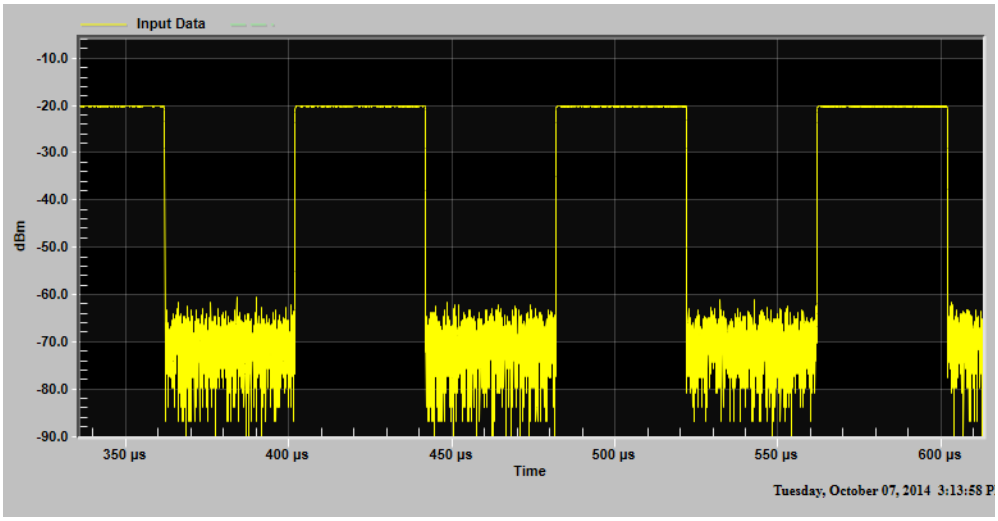


Measurement 4: Zoom in and Out

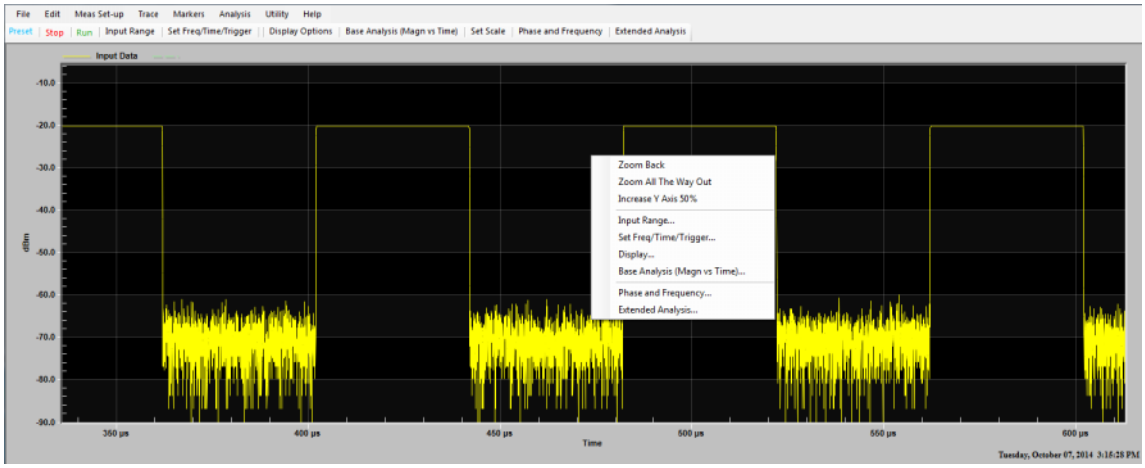
1. Perform all of the steps for Measurement #1.
2. Zoom in to 200 us to 700 us:
    a. Place the cursor at -10 dBm/200 us using the mouse.
    b. Press the left mouse button and hold the button down.
    c. Drag the mouse to -90 dBm/700 us.
    d. Release the left mouse button.
    e. This process is referred to as zooming.



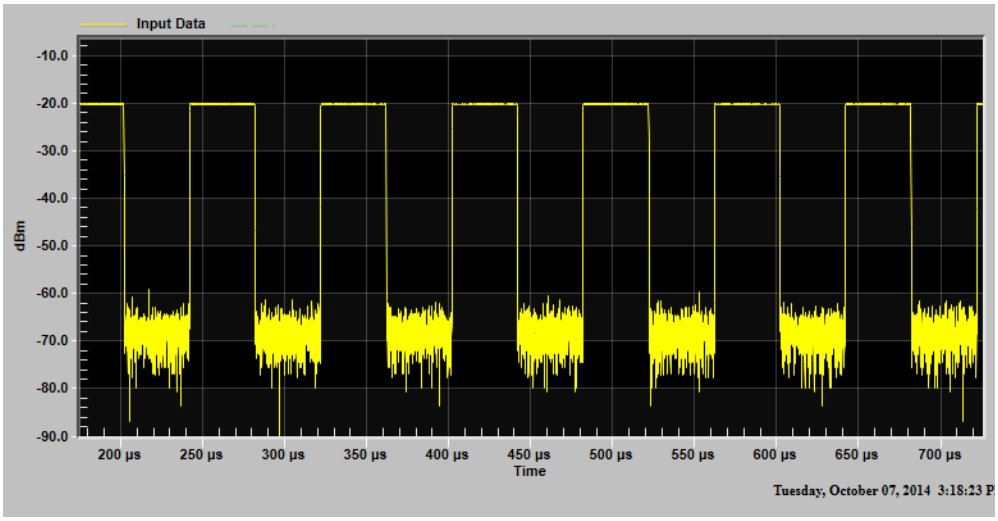
3. Zoom in 10 dBm/350 us to -90 dBm/600 us.



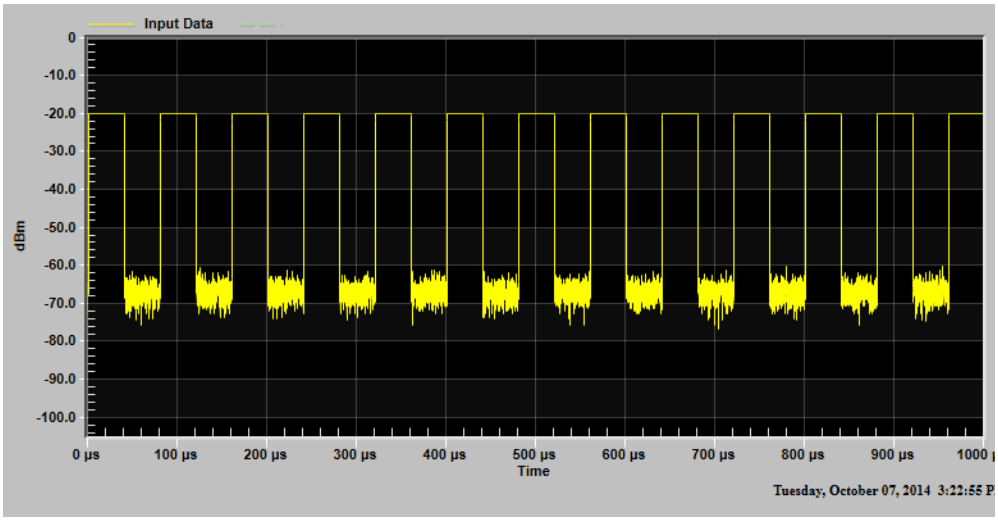
4. Place the cursor anywhere in the upper window and press and release the right mouse button (right click).



5. Press **Zoom Back** on the new menu displayed (Context Menu). This returns the display to the image before the latest zoom.

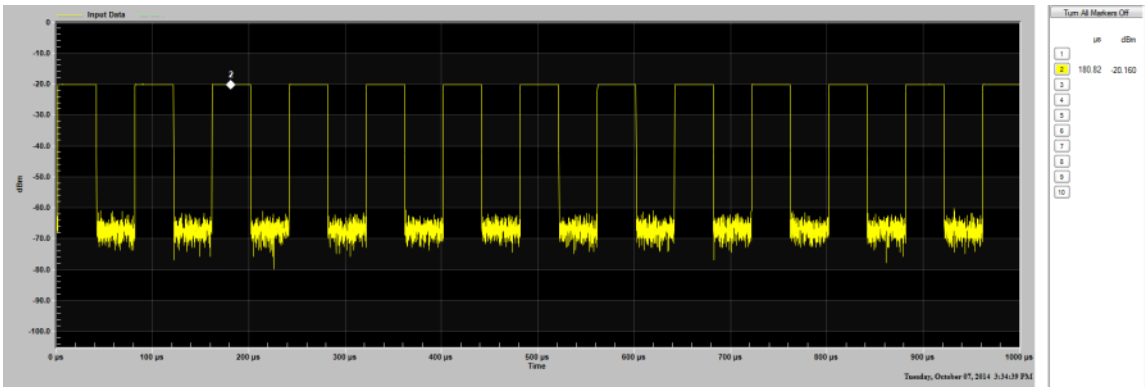


6. Right Click in the upper window and select **Zoom All The Way Out**. This returns the display to the original image.

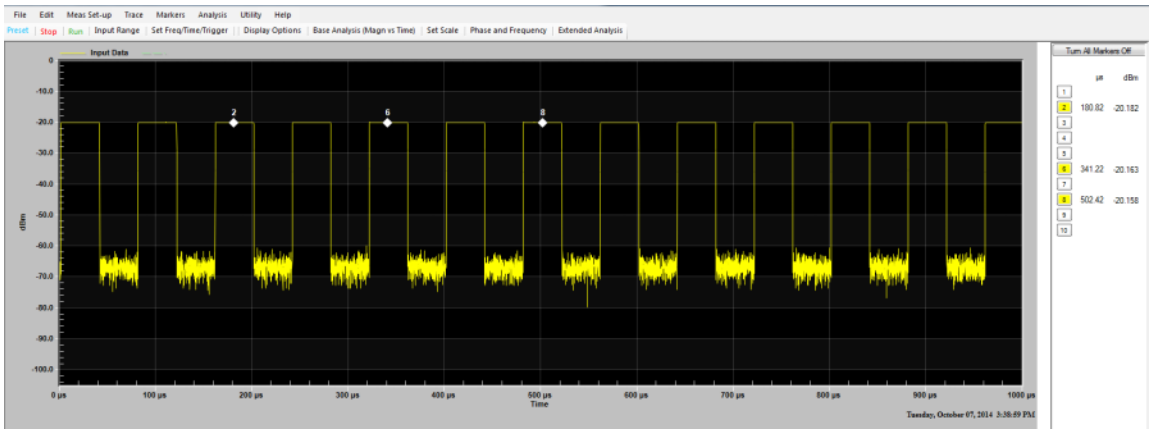


Measurement 5: Place Regular and Delta Markers

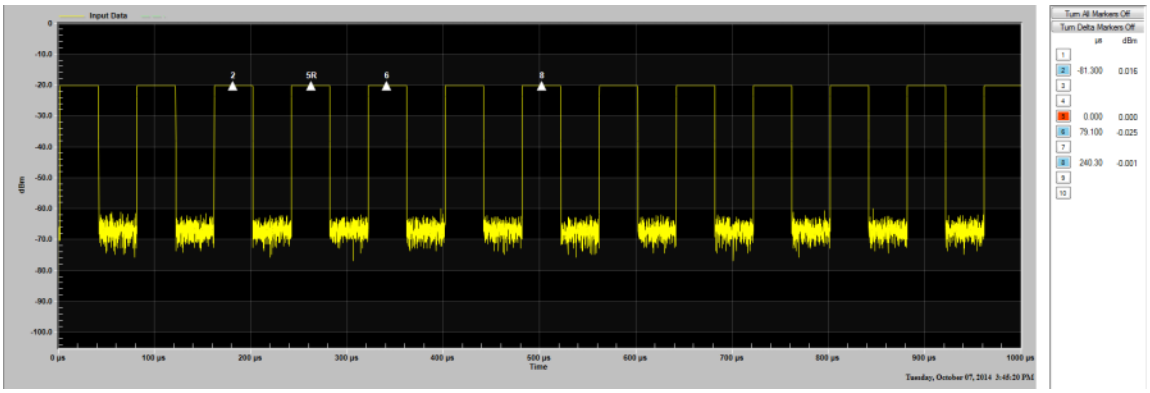
1. Perform all of the steps for Measurement #1.
2. The marker region is to the right of the upper window. (There is a similar marker region to the right of the lower window when it is displayed.) Click on the button showing 2 in the marker region by putting the cursor over it with the mouse and pressing the left mouse button. The boundary of the button turns blue, indicating that it is waiting to be placed.
3. Place the cursor over the middle of the third pulse and press and release the left mouse button. (X axis placement is significant. Y axis placement is not - Pulse automatically moves the marker to the trace.) The display should look like:



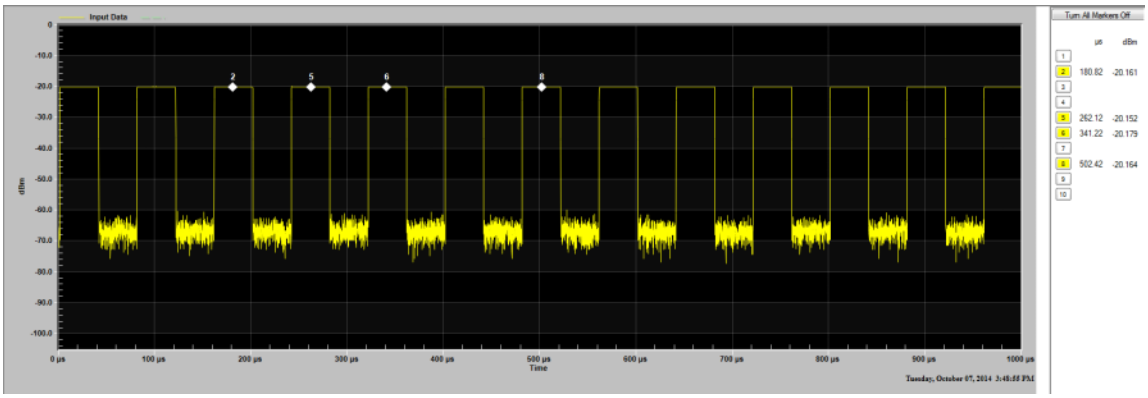
4. The background color for the 2 button in the marker area has turned yellow, indicating that the marker has been placed. The location (180.82 us/ -20.16 dBm) of the marker is listed in the marker area.
5. Add markers 6 and 8 to the center of the 5th and 7th pulses, respectively. The display should look like:



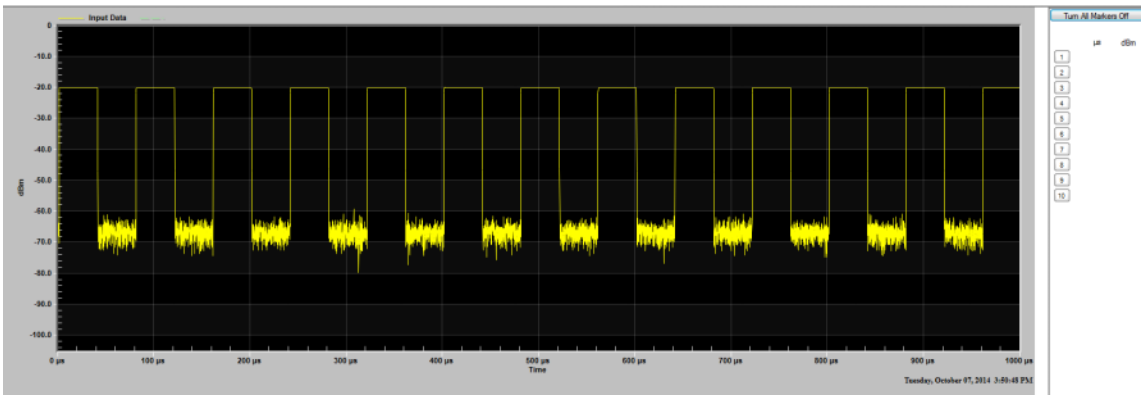
6. Double click on marker button 5 in the marker region. The border of marker button 5 has turned blue, indicating that it is waiting to be set. The background for marker buttons 2, 6, and 8 are set to blue, indicating they are delta markers.
7. Place the cursor over the middle of the fourth pulse and press the left mouse button. Marker button 5 background is now red, indicating that it is the reference marker for delta markers. The upper window shows the letter R after the 5, indicating that it is the reference marker. The information for the rest of the markers in the marker region is now relative to the reference marker (marker 5 in this case). The display should look like:



8. Click to Turn Delta Markers Off in the marker region. All markers are now regular markers.



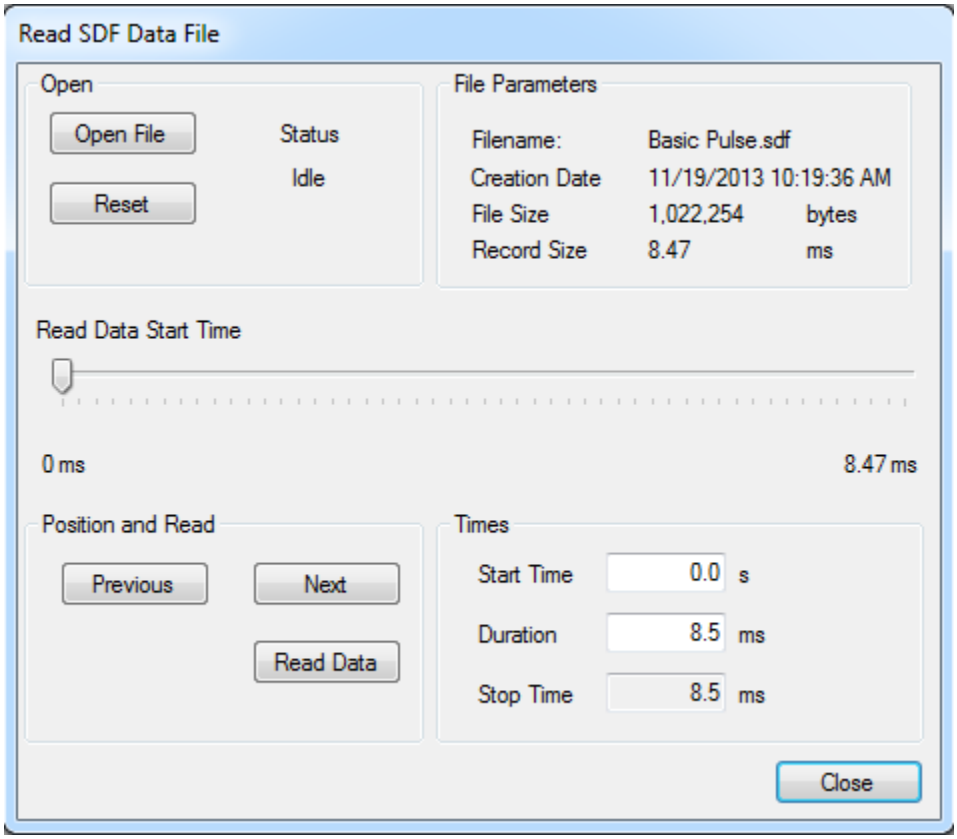
9. Click Turn All Markers Off button, to turn off markers



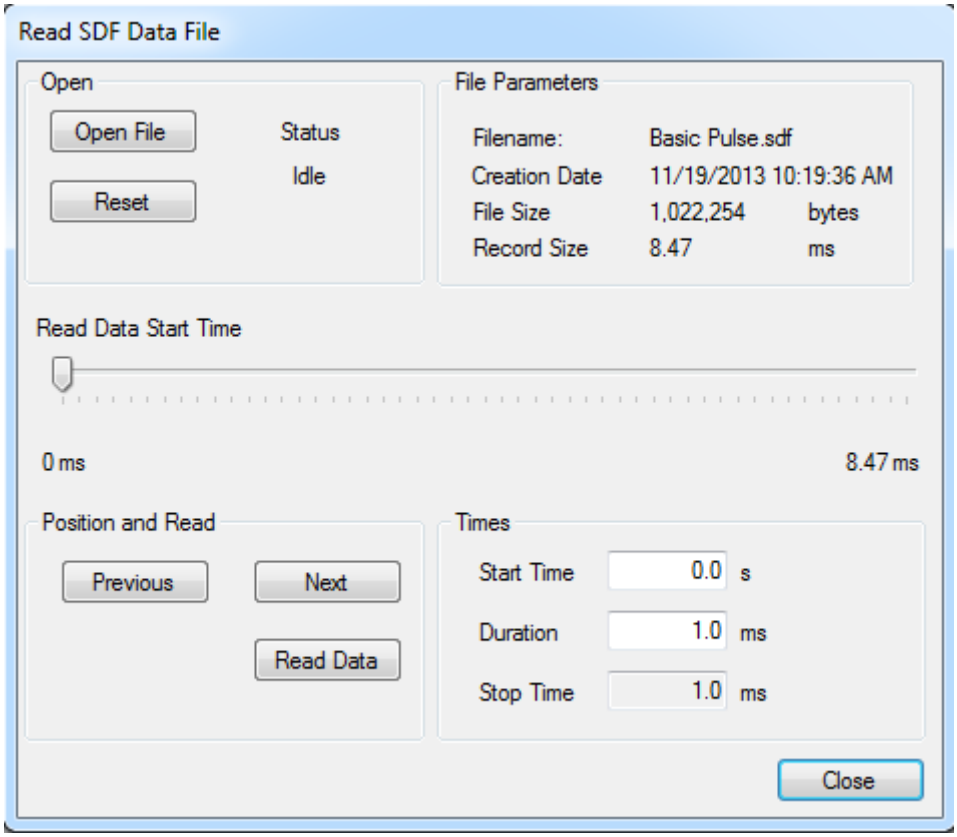
Measurement 6: Retrieve SDF File

1. Click on the **File/Read SDF** File menu.
2. Click on the **Open File** button, select file "Basic Pulse.sdf", and click Open.

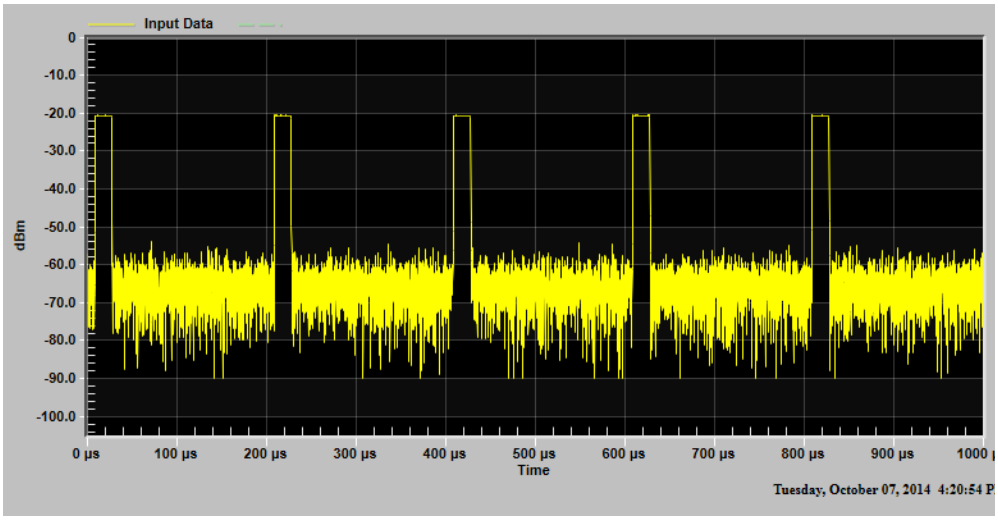
NOTE The file parameters are listed in the upper right hand portion of the dialog.



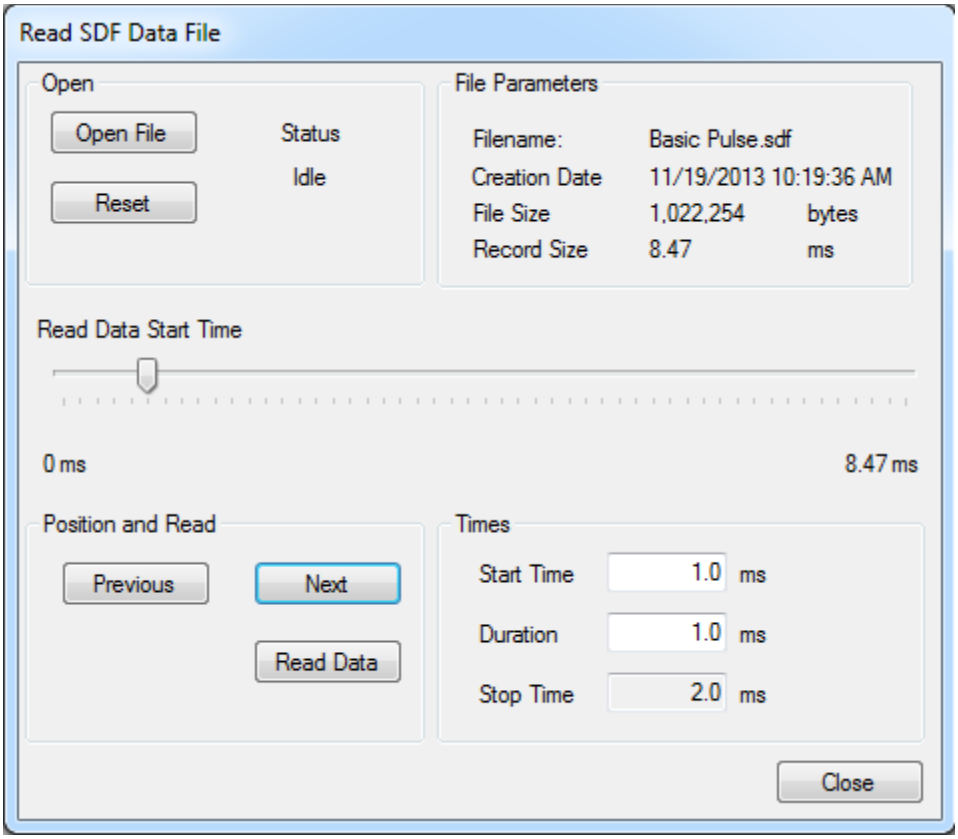
3. Set the Duration to 300 us.



1. Press **Read Data**. The display should look like:



1. Click **Next**.

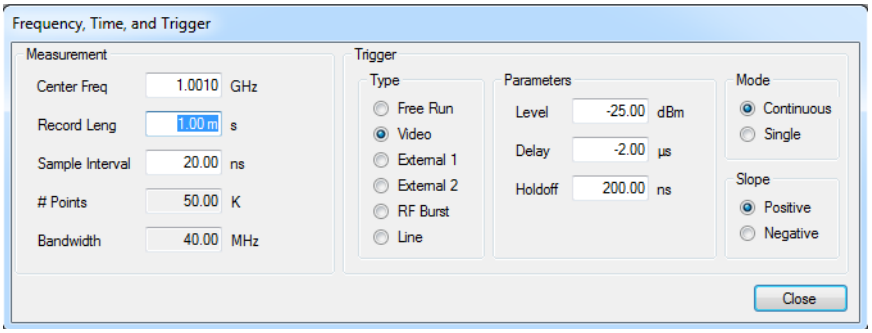


NOTE Verify that by clicking Next, advanced the Start Time to 1.0 ms (the amount of the Duration), set the Stop Time to 2.0 ms (Start Time plus Duration), and moved the slider to reflect the new start time (1.0 ms).

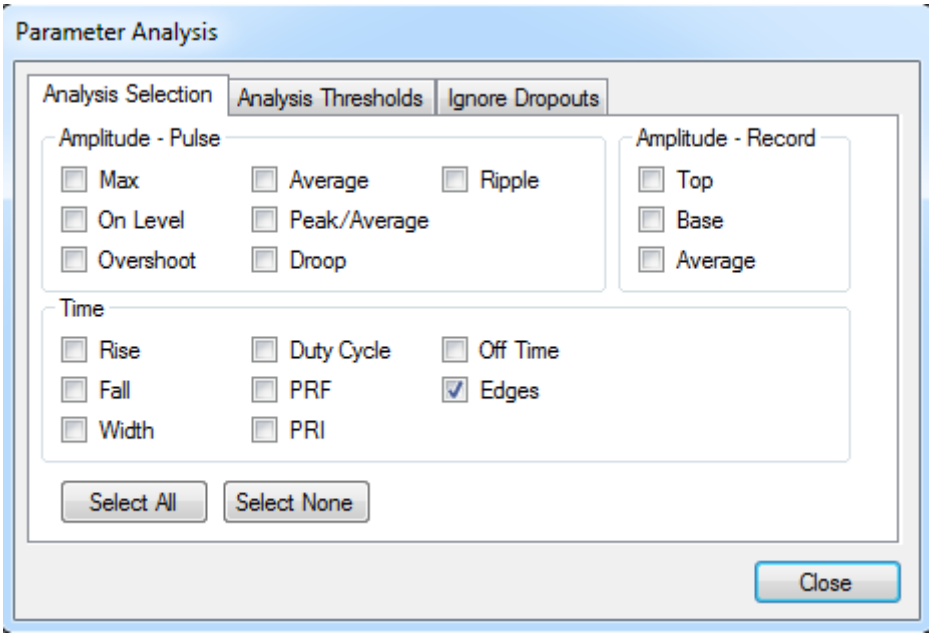
2. Clicking the Run button on the main taskbar returns Pulse to taking live measurements.

Measurement 7: Phase and Frequency (Requires 3FP License)

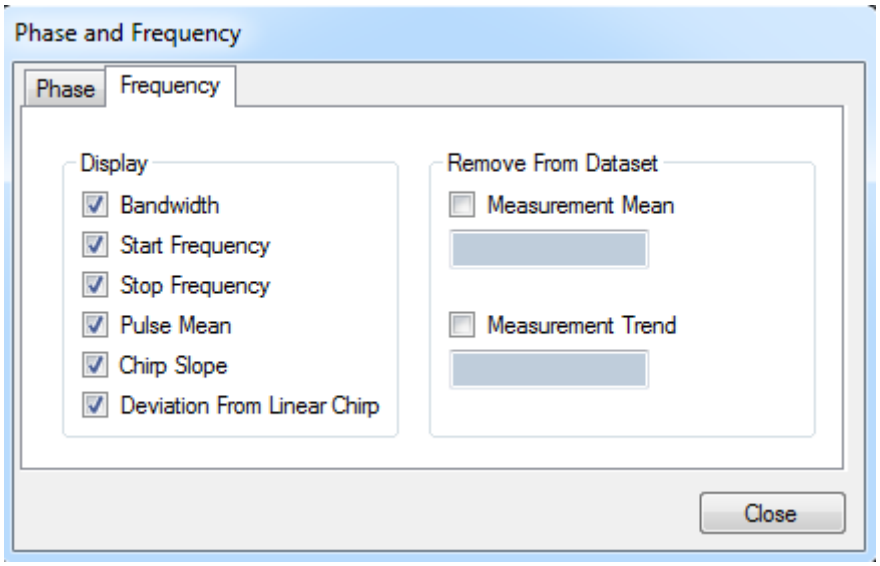
1. Perform all of the steps for Measurement #1.
2. Click the Set Freq/Time/Trigger button and change the Center Frequency to 1.001 GHz. The purpose of setting the center frequency in Pulse differently from the signal generator is to create an artificial phase change. There is a difference in frequency between the signal generator (1.000 GHz) and Pulse/instrument setting (1.001 GHz) of 1 MHz. Noting that df = d(phi)/dt and that the on times of the pulses are 40 us (PRI = 80 us, duty cycle = 50%), the generated phase should be equal to df * dt = 1 MHz * 40 us * 360 deg/Hz = 14.4 Kdeg.



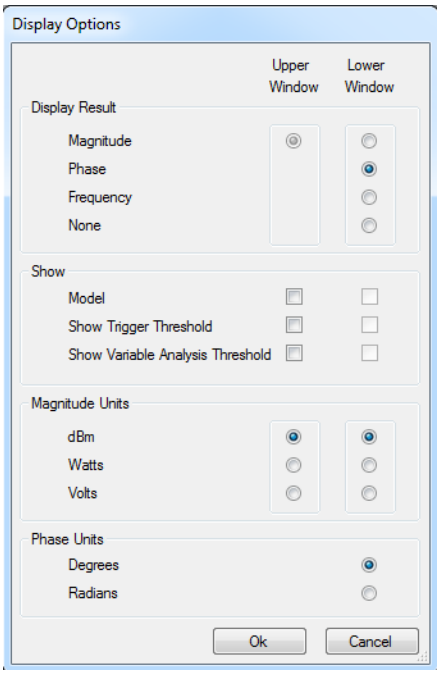
3. Click Base Analysis (Magn vs Time) and clear all of the checkboxes.
4. Set the Edges checkbox. Click Close.



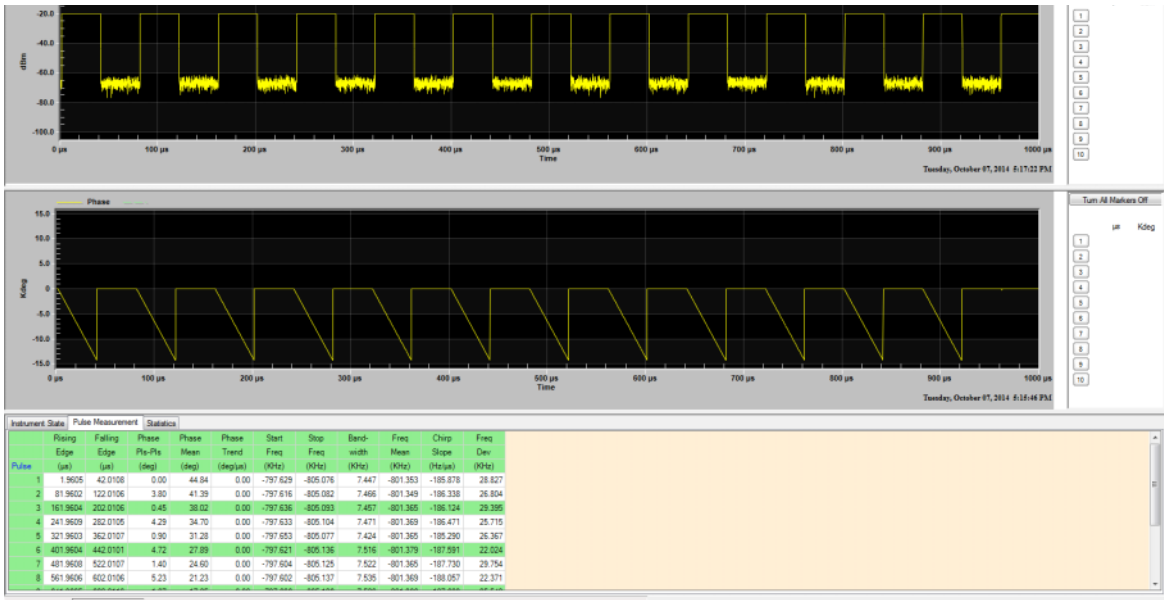
5. Click Phase and Frequency and check all of the checkboxes for Phase/Display and Frequency/Display.



6. Click Display Options and check Phase under the Lower Window column.



The display should look like:



7. Click Display Options and check Frequency under the Lower Window column.

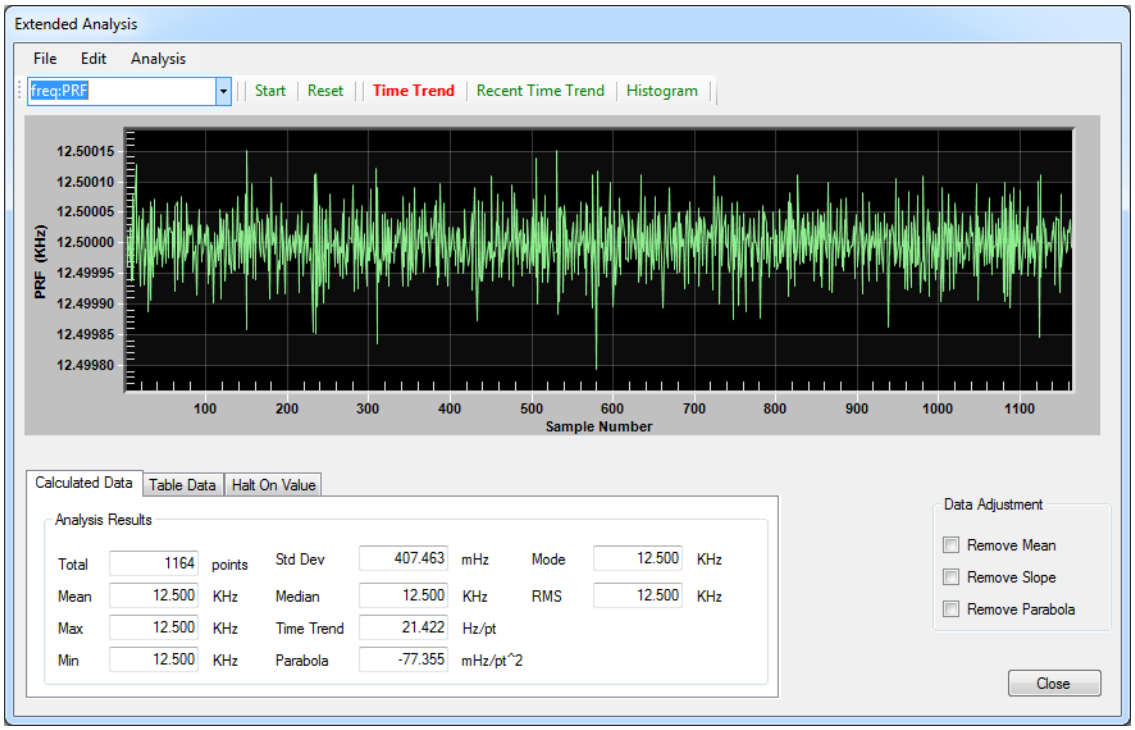
   The display should look like:

The frequency during the pulse on times is 1 MHz, equal to the difference between the signal generator frequency and what was entered in the Freq/Time/Trigger dialog (1.001 GHz – 1.000 GHz).

Pulse calculates frequencies from the phase data, which are calculated from I/Q data. The 1 MHz calculated frequency represents a round trip from setting the difference in the center frequency compared to the frequency of the signal generator, to I/Q data, to phase calculations, to frequency calculations, matching the 1 MHz offset.

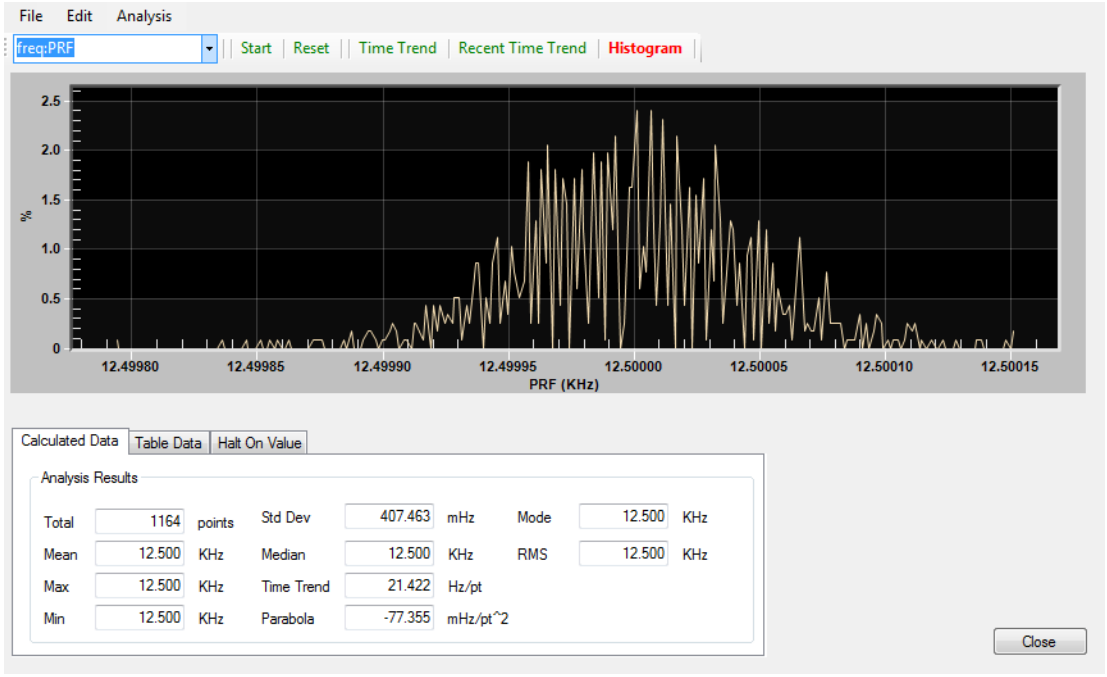
Measurement 8: Extended Analysis (Requires 4FP License)

1. Perform all of the steps for Measurement #1.
2. Click on the **Extended Analysis** tab in the main toolbar.
3. Select **freq:PRF** from the drop down box in the **Extended Analysis** toolbar (upper left corner of the dialog).
4. Click **Start** in the toolbar.
5. Wait until about 1,000 samples have been collected and click **Stop** in the toolbar. The display should look like:



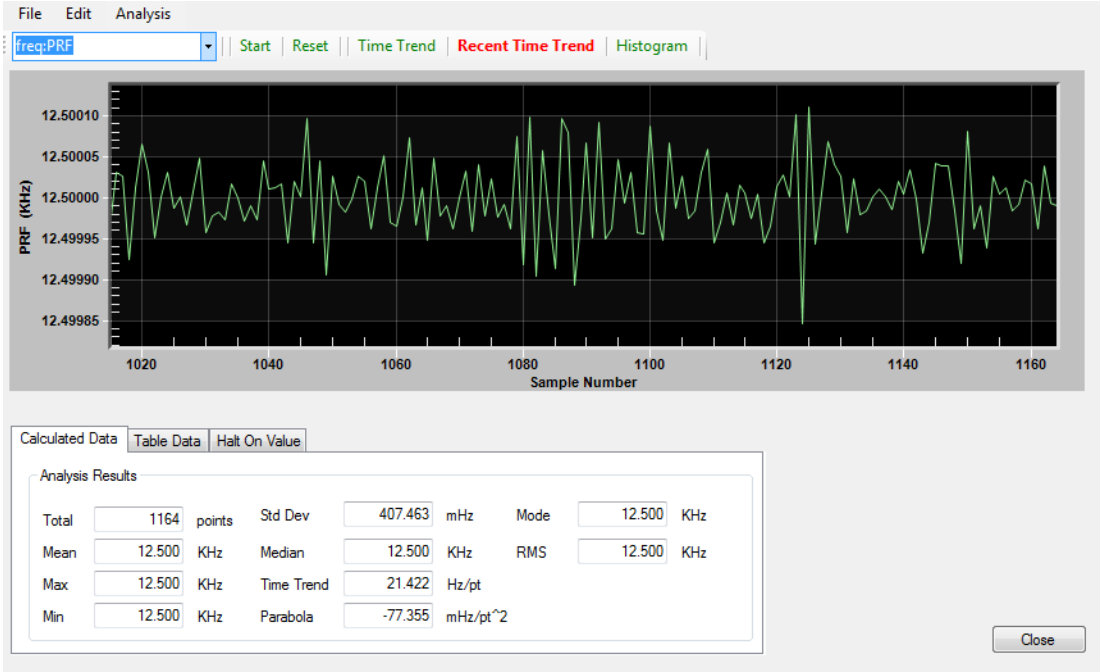
This shows a mean value of PRF of 12.5 Khz with a standard deviation of 0.4 Hz.

6. Click on **Histogram** in the toolbar. The display should look like:



7. Click on **Recent Time Trend** in the toolbar. This shows the latest 150 samples.

   The display should look like:



8. Click on **Time Trend** in the taskbar.
9. Click on the **Table Data** tab in the lower part of the **Extended Analysis** dialog.
10. Zoom in on an area.

11. Click on any point on the graph. The table lists the actual values for several data points around the one selected. The selected point is highlighted in blue. The display should look like:

12. Click on the **Halt On Value** tab. This feature halts the acquisition process if a data value is found outside of the specified threshold. The parameter being monitored is PRF, which was selected in step 3. The Halt On Value filter can be set to halt if the PRF is greater or less than a threshold value.

In this case, the PRF is 12.500 KHz with a standard deviation of 0.4 Hz. If the threshold is set to 12.5001 Khz (0.1 Hz above the mean), then it is likely that the filter will trip.

Pressing the **Auto Set** button sets the threshold to the mean plus 4 * standard deviation.

13. Set the threshold to 12.5001 Khz.

14. Click on **Base Analysis (Magn vs Time)** in the main toolbar.

15. Click on **Select All**.

16. Click on **Extended Analysis** to bring the dialog back.

17. Click the **Enabled** radio button - this engages the filter.

Filter indicator showing Measurement Halted in red is displayed and the acquisition process has been halted.

The pulse that triggered the filter should be listed in the first few pulses in the table.

18. Clicking the **Enabled** radio button arms the filter. Clicking the **Run** button in the **Extended Analysis** dialog resumes acquisition (essentially the same as the **Run** button in the main taskbar).

4 Troubleshooting

The Troubleshooting information is provided in several forms to help you isolate and solve problems you may encounter while making measurements.

Problems with Installation

The installer will normally over-write an older version of the software. However, it may be necessary to manually remove a previous version of Pulse Measurement Software:

1. Click **Start > Control Panel >Add** or **Remove Software**.
2. Wait until the list of currently installed programs is populated. Scroll down the list until you find **Keysight N9051B Pulse Measurement Software** and click on it.
3. Click **Remove.**

Problems with Licenses

Problems Licensing Pulse Measurement Software

If you need to restore a valid license after an instrument failure, replacement license files can be obtained from http://www.keysight.com/find/softwarelicense.

NOTE If you made an error entering data while redeeming your license, or lost your Certificate of Entitlement contact your Keysight Call Center, or visit the Technical Support website at http://www.keysight.com/find/assist.

Problems While Running the Program

Look in the bottom-left corner of the display for activity in the **Program Status** fields. If these are "frozen", try clicking **Stop** followed by **Run**; check for Continuous acquisition mode (under Meas Set-up); and check that **Trigger set-up** (part of **Set Freq / Time / Trigger** dialog, under **Meas Set-up**) is **Free Run** (or, if not, that trigger conditions specified are being met).

If the **Program Status** indicates that repetitive acquisitions are taking place, but there is no trace visible on the screen, check that the display scaling matches the expected amplitude level. Adjust the **SetScale** dialog (under **Trace**).

If `Waiting for Trigger` message appears, then the system is set up to wait for a trigger condition, but that condition is not yet satisfied. Check the settings for **Trigger** (under **Meas Set-up** then **Set Freq/Time/Trigger**).

NOTE An RF signal which is continuously on, as well as a signal that is continuously off, will not contain an edge transition that crosses the trigger threshold for Level trigger.

Pulsed signals often have very a low duty cycle; for example, the signal is off most of the time. Therefore, if using **Free Run** trigger (without a trigger setting to "catch" the infrequent pulses), the trace may display noise most of the time.

NOTE Preset can be used to put Pulse into a known state. Click the **Preset** button in the toolbar followed by **Ok** in the next message box.

Status Indicators

The Pulse Measurement Software provides status indicators that inform you of a condition that may affect the measurement and needs your attention.

Program Status

This describes the status of the Pulse Measurement Software program.

- "Idle
- "Armed = Waiting for trigger.
- "Processing = Calculating.
- "Reading = Transferring data from instrument.
- "Reading File = Reading data file.

Calibration Status

- "Calibration Needed = Some part of the instrument needs to be aligned to remain with specification.
- "Aligning = Instrument is calibrating.

Deep Capture Process

- "Shows Deep Capture percentage complete.

Input Overload Status

- "Illuminated when instrument input is overloaded.

Other Error Messages

Pulse Measurement Software provides you with other messages (usually in a dialog box) to indicate error conditions and help you diagnose or solve the problem.

Startup

The following error message may occur during the Pulse Measurement Software startup. Error messages are shown in an error dialog box.

Error Messages	**Explanation**
Waiting for Trigger.	Check to be sure the triggering conditions have been met. Be sure there are pulses of proper magnitude at the input. If using external triggering, be sure cabling is properly connected and configured. A scope may be useful in determining if the trigger signal is present at the input.

Measurements

This troubleshooting table includes problems you may encounter in making measurements and possible solutions.

Problem	**Possible Cause/Solution**
Measurements fail, and input signal power is greater than range, but the Overload indicator is blank.	If a measurement result fails due to significant distortion present in the input signal, the input signal may be causing an overload condition in the measurement hardware. In some cases the overload indicator may not display this condition.
Overload indicator.	This indicates that the input signal level exceeds the input range setting of the instrument. You need to either increase the range setting, or reduce the signal level at the analyzer input.
A copy of Pulse is already open. Please check your system tray (notification area).	Open the Windows Task Manager (**ctrl+alt+del**), and click **Processes**. Check to see if there is an orphan copy of Pulse running (which could happen if the program was not closed properly). If there is a copy running, terminate the process. Then restart the Pulse program.

Problem	Possible Cause/Solution
Help file not found	Check to be sure that the .PDF help files are present in the Doc subdirectory where the Pulse Measurement Software was installed (usually `C:\Program Files\Agilent\Keysight N9051B Pulse Measurement Software`)
Pulse Measurement tab is blank. Statistics tab is blank.	All of these tabs remain blank if the appropriate analysis feature is not turned on. Click **Analysis** > **Base Analysis (Magn vs Time)**, then choose the analysis features you wish to see.

Contacting Keysight

Keysight on the Web

You can find information about technical and professional services, product support, and equipment repair and service on the Web:

http://www.keysight.com

1. Click **Test and Measurement** > **Select a Country**.
2. Click **Contact Us** for contact information.

Questions or Comments on the Documentation

The latest documentation can be found on our Web site:

http://www.keysight.com/find/N9051B