

**RFXpress RFX100
Advanced RF/IF/IQ Waveform Creation and Editing
Software for the AWG5000 & AWG7000 Series Generators
Quick Start User Manual**



071-2167-00

Tektronix

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Advanced RF/IF/IQ Waveform Creation and Editing Software
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General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

While using this product, you may need to access other parts of a larger system. Read the safety sections of the other component manuals for warnings and cautions related to operating the system.

To Avoid Fire or Personal Injury

Connect and Disconnect Properly. Do not connect or disconnect probes or test leads while they are connected to a voltage source.

Ground the Product. This product is indirectly grounded through the grounding conductor of the mainframe power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Power Disconnect. The power cord disconnects the product from the power source. Do not block the power cord; it must remain accessible to the user at all times.

Do Not Operate Without Covers. Do not operate this product with covers or panels removed.

Do Not Operate With Suspected Failures. If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Avoid Exposed Circuitry. Do not touch exposed connections and components when power is present.

Terms in this Manual

These terms may appear in this manual:



WARNING. *Warning statements identify conditions or practices that could result in injury or loss of life.*



CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Preface

The RFXpress RFX100 is a software product that allows you to create digitally modulated baseband, IF, and RF signals that can be generated through arbitrary waveform generators (AWG). This software runs as an integral part of AWG5000 and AWG7000 series arbitrary waveform generators and can also run from an external PC.

You can use RFXpress to:

- Design, debug, and develop wideband wireless communications receivers
- Generate UWB-WiMedia compliant and custom signals
- Generate general purpose digitally modulated IQ, IF, and RF signals

Key Features

- Define baseband I and Q signals using various modulation schemes
- Create single and multi-carrier signals where each carrier is independently defined
- Apply impairments such as quadrature error and imbalance or non-linear impairments
- Add interferences during waveform creation
- Remotely connect to Tektronix oscilloscopes and to an Agilent Performance Signal Generator
- Remotely configure a Tektronix oscilloscope and an Agilent Performance Signal Generator

UWB-WiMedia

- Direct RF generation of WiMedia BG1 and BG2 waveforms
- Ability to generate IQ and IF waveforms including band hopping for all band groups
- User-defined IF frequency including TFC pattern
- Comprehensive WiMedia signal generation support for MAC and PHY layers
- Ability to UWB-WiMedia correction files which can be automatically applied as compensation to accurately generate signals
- Ability to use Gated Noise to define noise profiles for each section of the UWB packet
- Create tone nulling with intermediate values (20 dB to –100 dB) for OFDM carriers mapping

Documentation

RFXpress RFX100 Online Help, English	Tektronix part number 076-0081-XX
RFXpress RFX100 User Manual, English, (PDF)	Tektronix part number 077-0045-XX
RFXpress RFX100 Quick Start User Manual, English (PDF)	Tektronix part number 071-2167-XX
RFXpress RFX100 Installation Manual, English	Tektronix part number 071-2166-XX

Conventions Used in This Manual

When steps require a sequence of selections using the software interface, the ">" delimiter marks each transition between a menu and an option. For example, File > Save.

The document MultiBand OFDM Physical Layer Specification version 1.2 by WiMedia Alliance is referred to as the "WiMedia standard" or "WiMedia specification".

The term "DUT" refers to a device under test.

The terms "signal" and "waveform" are used interchangeably in this manual.

Installation

For information on how to install this software, refer to the *RFXpress Installation Manual*, Tektronix part number 071-2166-00.

Starting the Software

Start the software in either of the following ways:

- From Start > Program Files > Tektronix RFXpress, click RFXpress.
- Double-click the RFXpress icon on your desktop.

Closing the Software

Click File > Exit to close the software.

Software Upgrades

Periodic software upgrades may become available. The software is operational only if you have a valid option key for the specific instrument model and serial number.

To check for upgrades:

1. Go to www.tektronix.com/software.
2. Enter the product name (RFXpress).

Using the Software

This section covers the following information:

- Getting acquainted with the software
- Generating a signal
- Adding impairments to the signal
- Compiling a signal
- Graphing a signal

Getting Acquainted with the Software

Using the Software Interface

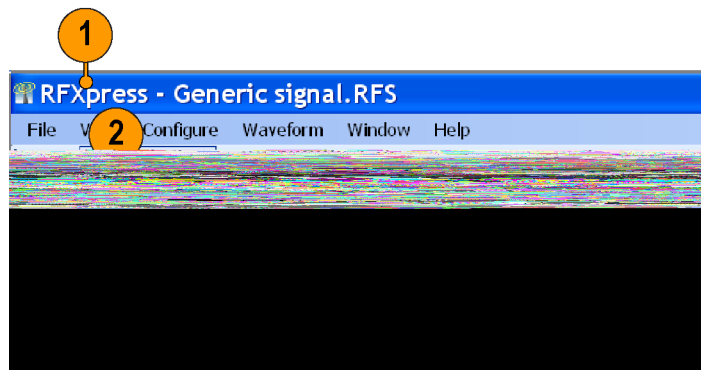
Use the keyboard or mouse to make selections in the software.

Use menus, toolbars, check boxes, and on-screen buttons to control the software functions. Use Microsoft Windows techniques to navigate menus and select or clear check boxes.

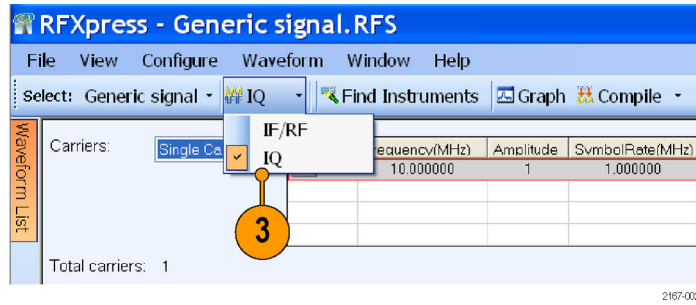
Generating a Single Carrier Signal

This section shows you a step-by-step procedure for creating a single carrier QPSK baseband signal.

1. Start RFXpress.
2. From the toolbar, click **Select > Generic Signal**.



- Set the signal type to **IQ**.



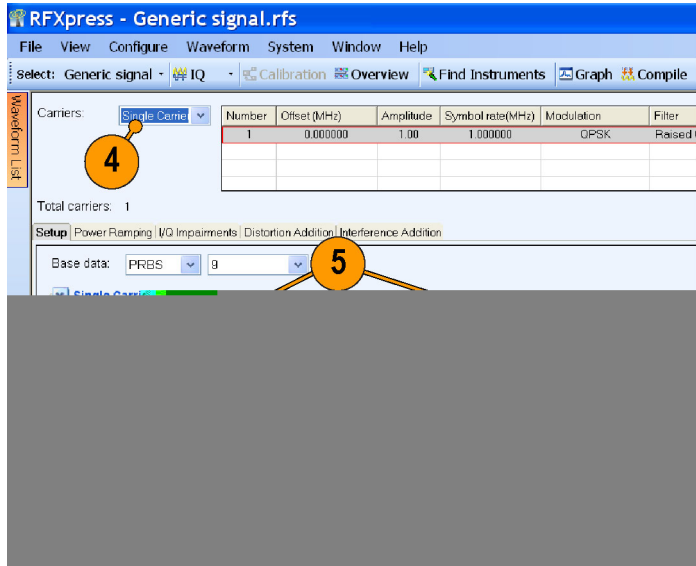
- Click **Carriers > Single Carrier**.

- Select the carrier and set the following:

- **Baseband Offset** to 0 Hz
- **Amplitude** to 1 Vrms

- Ensure that the following parameters are set:

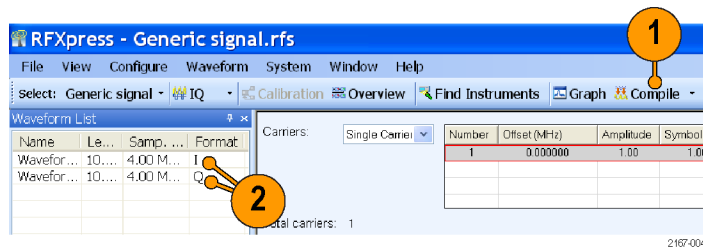
- **Modulation** is QPSK
- **Filter** is Raised Cosine
- **Symbol rate** is 1 MHz
- **Alpha/B*T** is 0.35
- **Window** is None



Compiling a Signal

Follow these steps to compile and generate a signal using the parameters that you just defined.

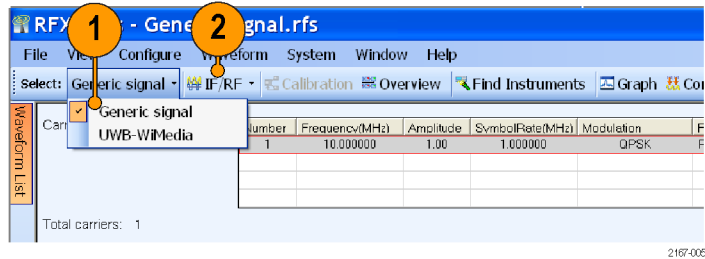
- From the toolbar, click **Compile**.
- The compiled waveform is displayed in the waveform list.



NOTE. If the waveform list is not visible, click **Window > Waveform List** to view it.

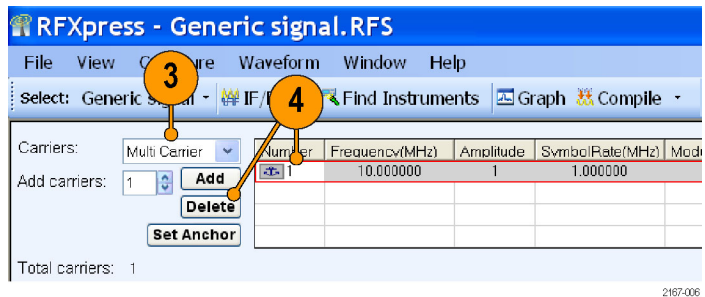
Generating a Multi-Carrier RF Signal

1. From the toolbar, click **Select > Generic Signal**.
2. Select the signal type as **IF/RF**.
3. Select **Multi Carrier**.
4. You can either add carriers directly or delete the existing carrier and add new ones. Select the carrier in the table and click **Delete**.



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5. Click **Add Carriers** and type 3.
6. Click **Range**. Set the **Base Frequency** to 10 M and the **Carrier Spacing** to 10 M.
7. Click **Add**.
8. Select the first carrier from the table. In the **Setup** tab, set the **Base Data** to PRBS and select 15 from the adjacent field.
9. Set the **Modulation** for the carrier to QPSK.
10. Repeat steps 4 and 5 for the remaining carriers, setting the **Base Data** to PRBS 21 and PRBS 7, and **Modulation** to QPSK.

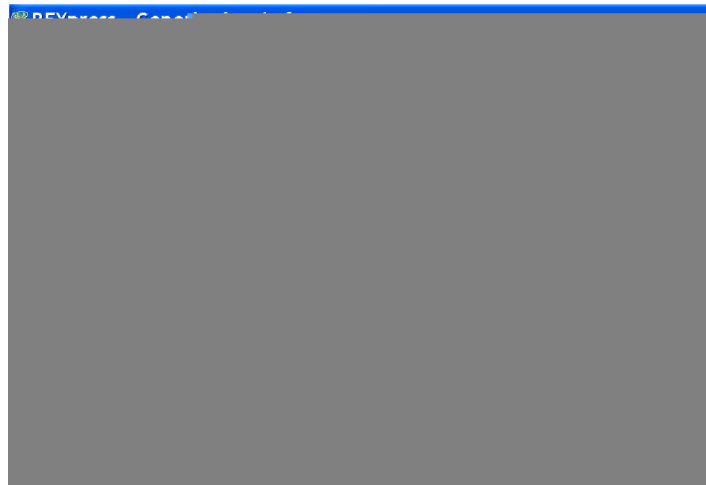
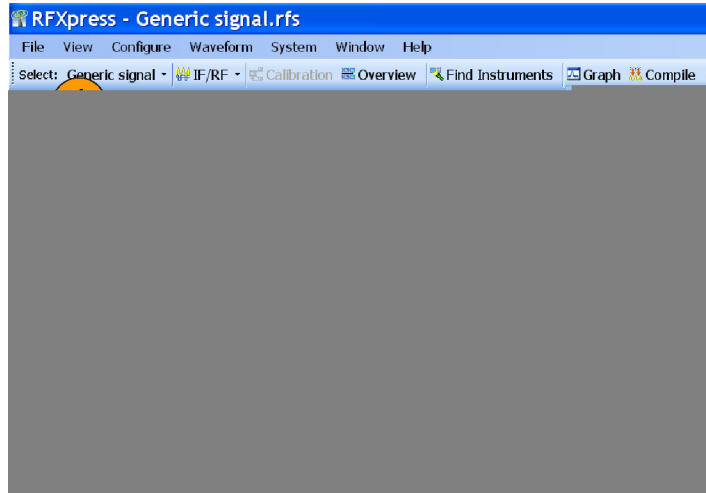


2167-006

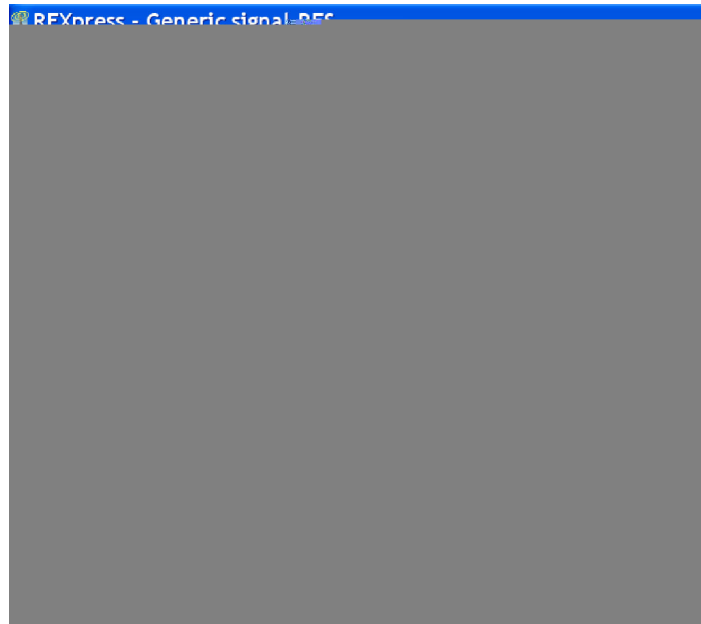


Adding Power Ramping, I/Q Impairments and Interference

1. Select the first carrier from the table. Select the **Power Ramping** tab.
2. Select **Turn On**.
3. Set the Ramp parameters:
 - **Function** to Linear
 - **Time** to 100 nsec
4. Set the Position parameters:
 - **Symbol** to 0
 - **Level** to 0.00
5. Click **Add**.
6. Repeat steps 4 and 5 two more times, adding these parameters:
 - Symbol = 100
 - Level = -80 dB
 - and
 - Symbol = 200
 - Level = 0 dB



7. Select the second carrier from the table. Select the **I/Q Impairments** tab.
8. In the Carrier Leakage group, select **Turn On**. Set the following parameters:
 - **I** to 5.0
 - **Q** to 5.0

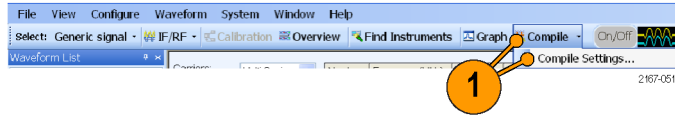


9. Select the third carrier from the table. Select the **Interference Addition** tab.
10. In the Offset group, select **Turn On**. Set the **Frequency** to 10 M.

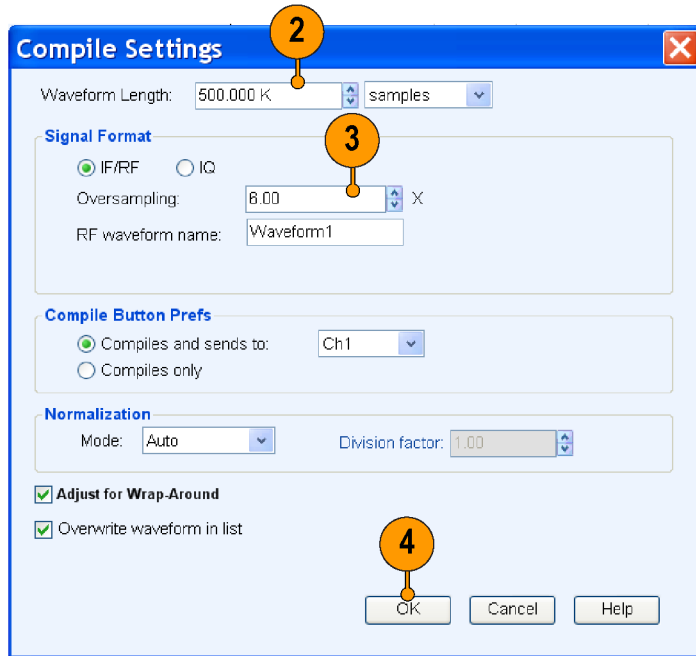


Compile Settings and Compile

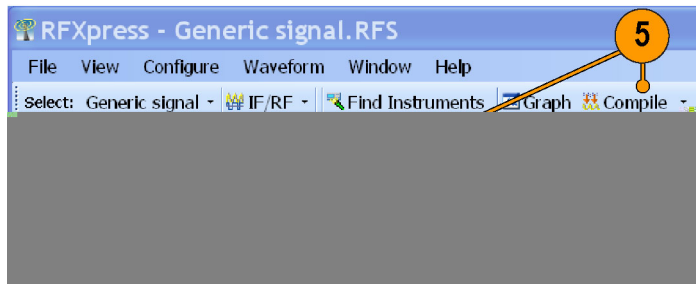
1. From the toolbar, click **Compile > Compile Settings**.



2. Set the **Waveform Length** to 500K and the units to samples.
3. Set the **Oversampling** to 6.00.
4. Click **OK**.

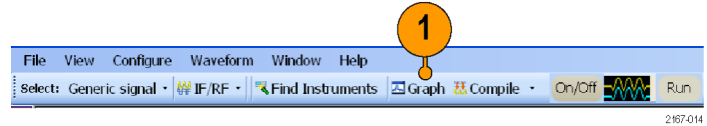


5. From the toolbar, click **Compile**. The compiled waveform is displayed in the waveform list.

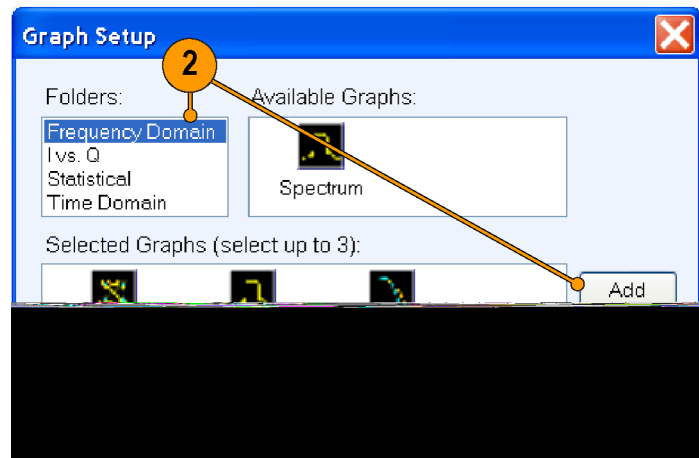


Previewing Graphs

1. From the toolbar, click **Graph**.



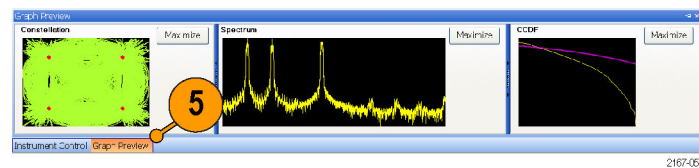
2. In Graph Setup, select the folder and click **Add** to add the following graphs.
 - Frequency Domain: Spectrum
 - I Vs Q: Constellation
 - Statistical: CCDF



3. The graphs are added to the Selected Graphs.

4. Click **OK**.

5. Click **Graph Preview** at the lower left of the screen to view the graphs.

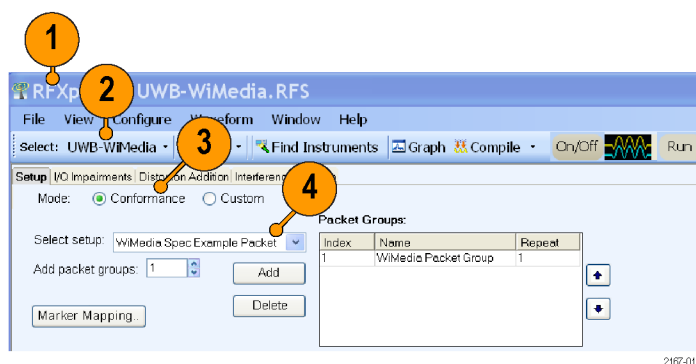


Application Examples

Creating a UWB Waveform to Test Your Receivers

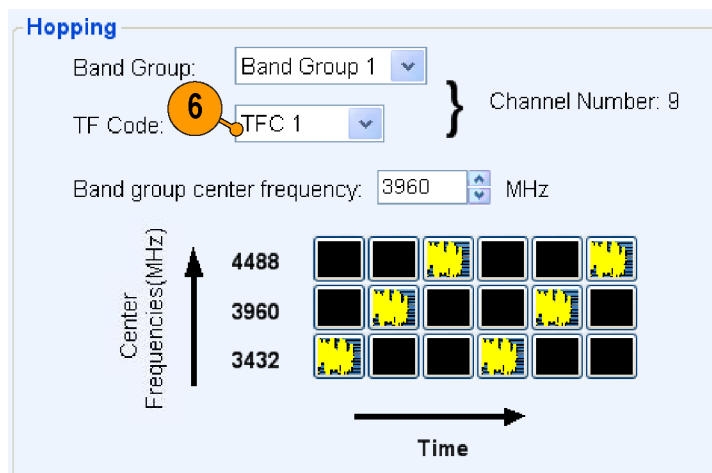
You can create an ideal waveform and use it to test whether your receivers are operating within the WiMedia specifications.

1. Start RFXpress.
2. From the toolbar, click **Select > UWB-WiMedia**.
3. By default, **Conformance** is selected.
4. From the Select Setup, select **WiMedia Spec Example Packet**.



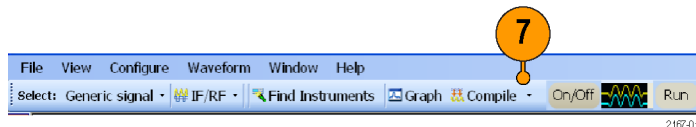
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5. The **WiMedia Spec Example Packet** settings (according to Annex A of the WiMedia specification document) are displayed in the fields in each tab.
6. Confirm the **Hopping Pattern** for TF Code 1.



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7. Click **Compile**.

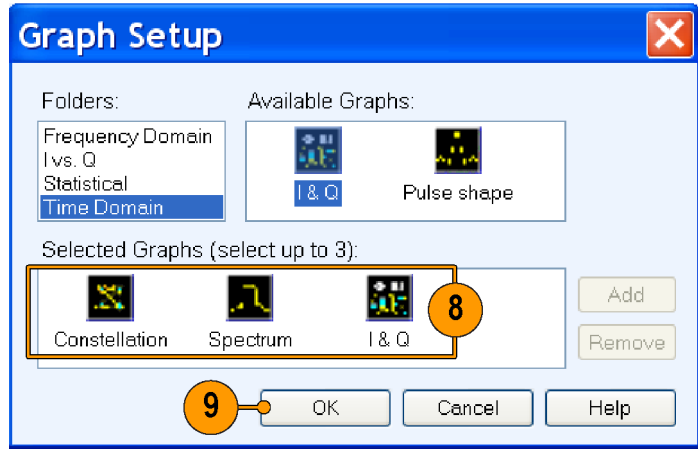


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8. Add the following graphs in Graph Setup:

- Frequency Domain: Spectrum
- I Vs Q: Constellation
- Time Domain: I & Q

9. Click **OK**.



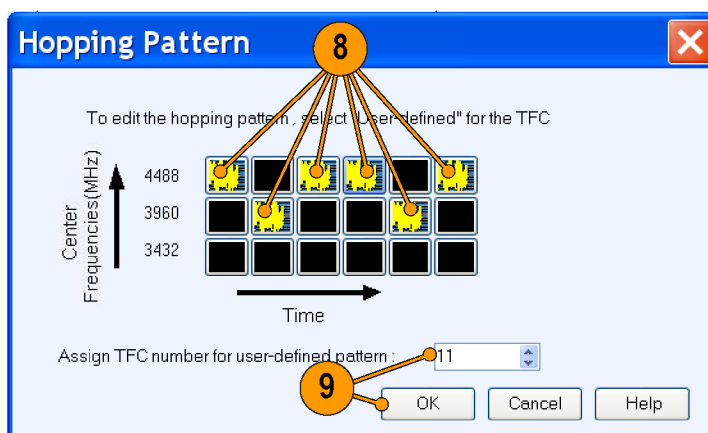
10. The graphs are as shown.



Characterize Receiver Design for Receiver Verification and Stress Test

You can generate a signal and use it to test your receiver at conditions just outside the boundary values specified by the WiMedia standard.

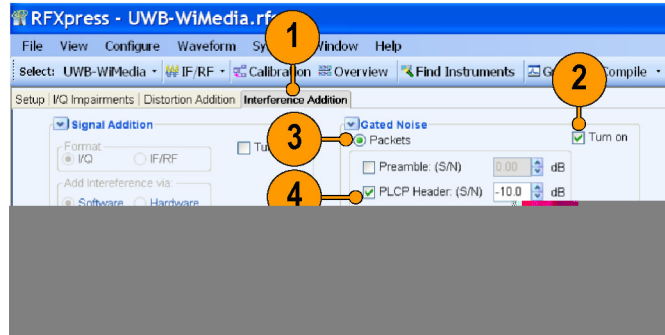
1. Start RFXpress.
2. From the toolbar, click **Select > UWB-WiMedia**.
3. Set the signal type to IF/RF.
4. Click **Custom**.
5. From the Select Setup, select **WiMedia Spec Example Packet**.
6. The default values for the selected setup and packet are shown graphically.
7. For the selected packet group, set **TF Code** to User Defined.
8. To define a hopping pattern: In each column, click the frequency that you want to use. Set the hopping pattern to: 323323.
9. Assign a TFC number for the pattern that you defined and click **OK**.



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Adding Interference

1. Click **Interference Addition**.
2. In the Gated Noise group, select **Turn On**.
3. Click **Packets**.
4. Click **PLCP Header** and set it to -10.0 .



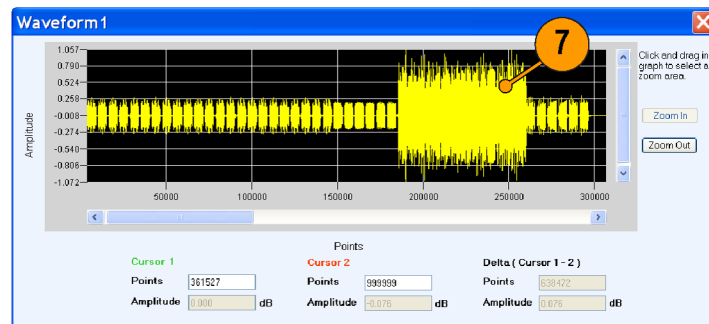
5. From the standard toolbar, click **Compile**.



6. In the Waveform List, select the IF/RF waveform and right-click. Select **Show Graph > Time Domain**.



7. Observe the noise in the header. The noise of 10 dB is greater than the signal.



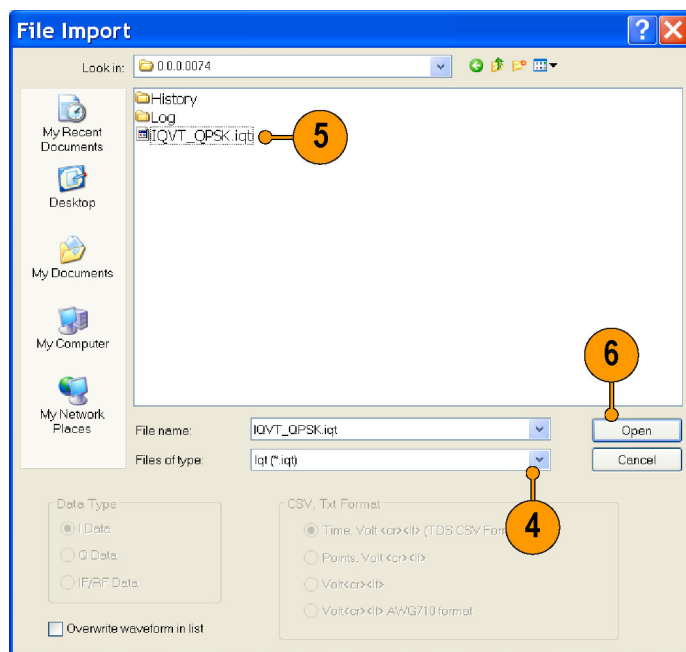
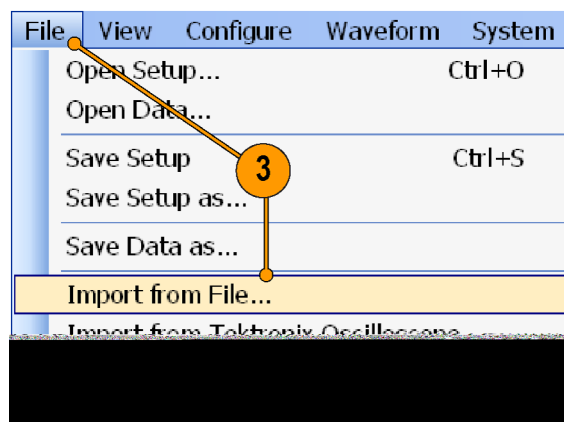
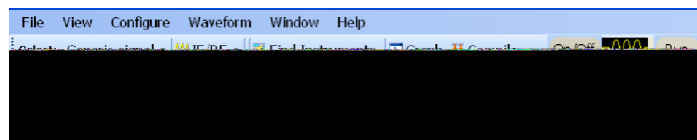
2167-050

Replay a Captured Waveform to Test Receivers

You can capture a real world signal in a real-time spectrum analyzer and play it back in multiple locations to test your DUTs.

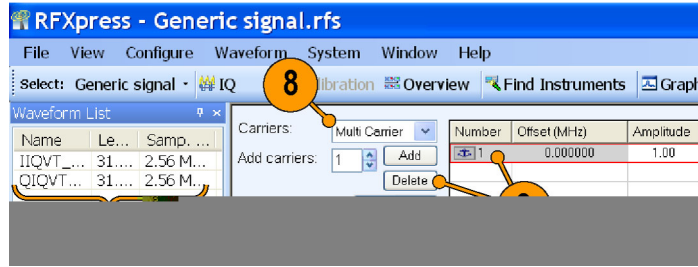
Import an RTSA File

1. Start RFXpress.
2. Ensure that the selected application is set to **Generic Signal** and the signal type is **IF/RF**.
3. From the menu, click **File > Import from File**.
4. Select the **file type** as **iq1**.
5. Select an **iq1** file.
6. Click **Open**.

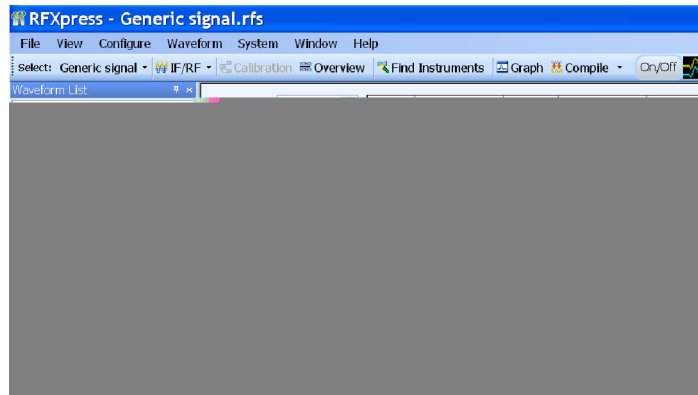


2167-028

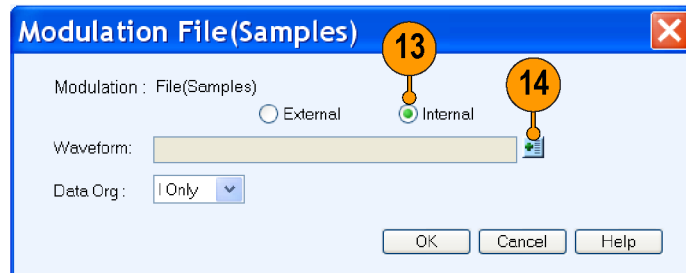
7. You will find two files, I<filename> and Q<filename>, in the waveform list.
8. Set **Carriers** as Multi Carrier.
9. Select the existing carrier and click **Delete**.



10. In **Add Carriers**, enter 1.
11. Select an empty row in the table.
12. In the **Setup** tab, set **Modulation** to File1(Samples).

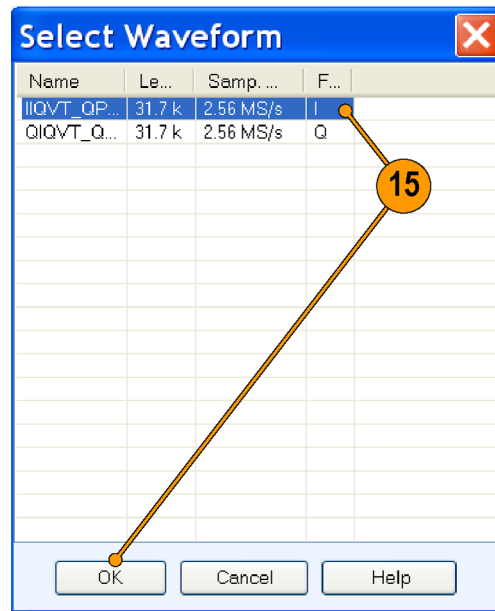


13. In the **Modulation File(Samples)** window, click **Internal**.
14. Click the waveform list icon.



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15. Select the I<filename> waveform and click **OK**.



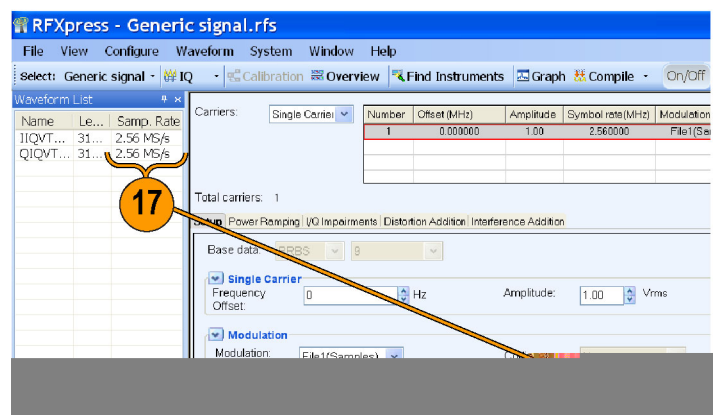
2167-031

16. Set **Data Org** to I Only and click **OK**.



17. Set the **Input File Sample Rate** to the values with which the iqt file was created.

NOTE. If you do not know the sampling rate with which the file was created, you can find it by looking at the sampling rate displayed in the waveform list.

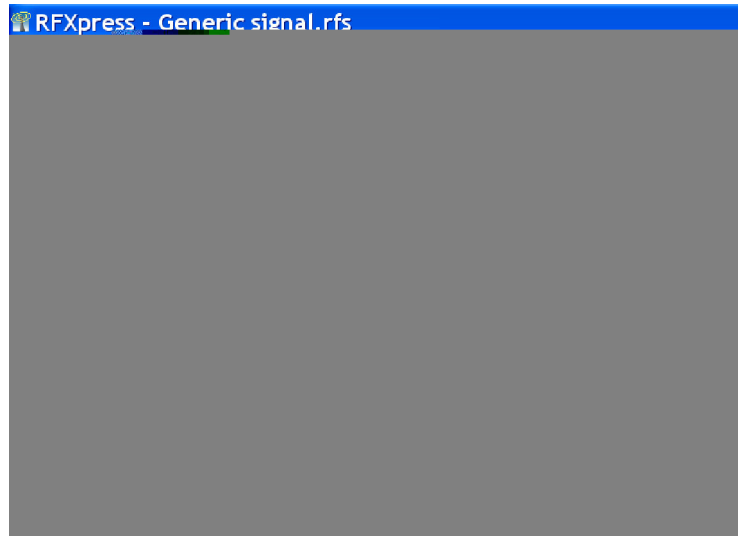


18. Set the following:

- **Frequency** to 1 GHz
- **Amplitude** to 0 dBm

19. Click **Add**.

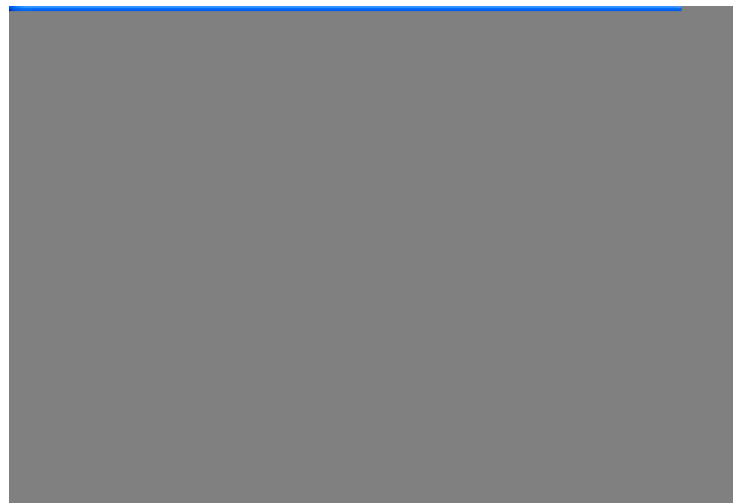
20. Repeat steps 10 through 19 for the Q<filename> waveform, setting **Data Org** to Q Only.



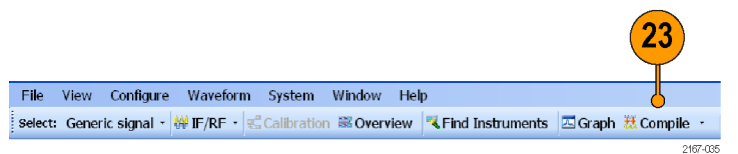
21. Click **Interference Addition**. In the Sinusoidal Interference group, select **Turn On**.

22. For each carrier, set the following:

- **C/I** to 0 dB.
- **Offset from Carrier** to -600 M.



23. From the toolbar, click **Compile**. The software uses the default compile settings to generate the waveform.

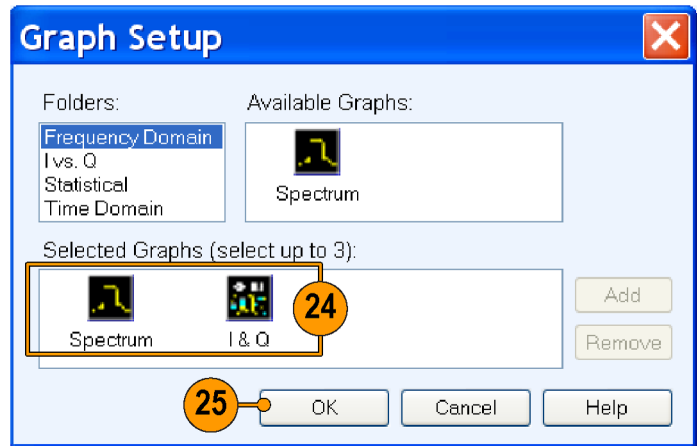


2167-035

24. Add the following graphs in Graph Setup:

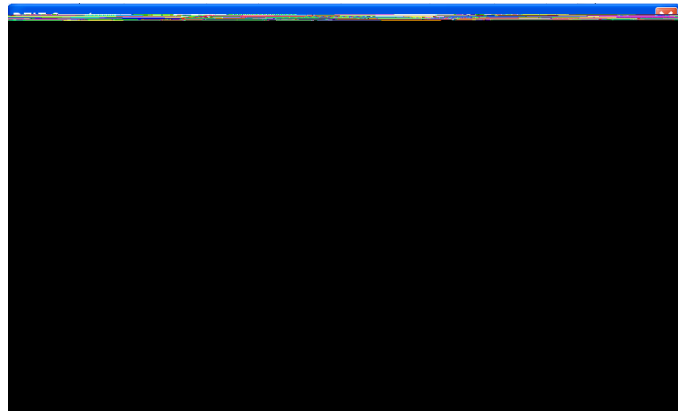
- Frequency Domain: Spectrum
- Time Domain: I & Q

25. Click **OK**.



2167-040

26. The Spectrum graph is as shown.



Using Calibration to Increase the Flatness of a UWB Signal Path up to DUT

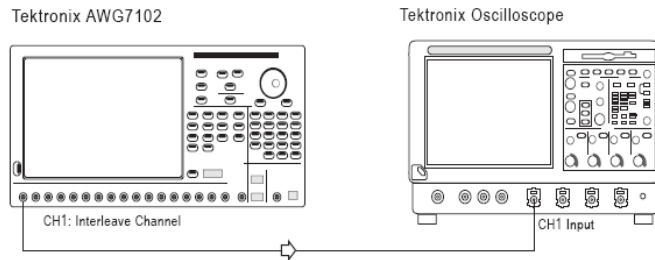
The calibration feature allows you to generate correction files that you can use during compilation to predistort the signal, thereby increasing the flatness of the signal.

1. Set up the instruments as shown. The instruments must be connected over a LAN.

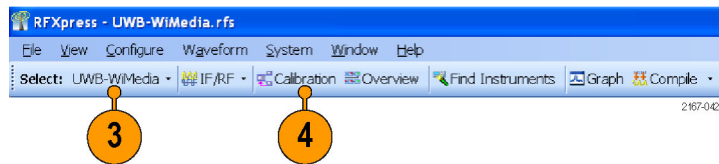
You will need:

- A Tektronix AWG7102 with Option 06 running RFXpress software
- A Tektronix TDS6154C oscilloscope to capture the signal
- Connecting cable

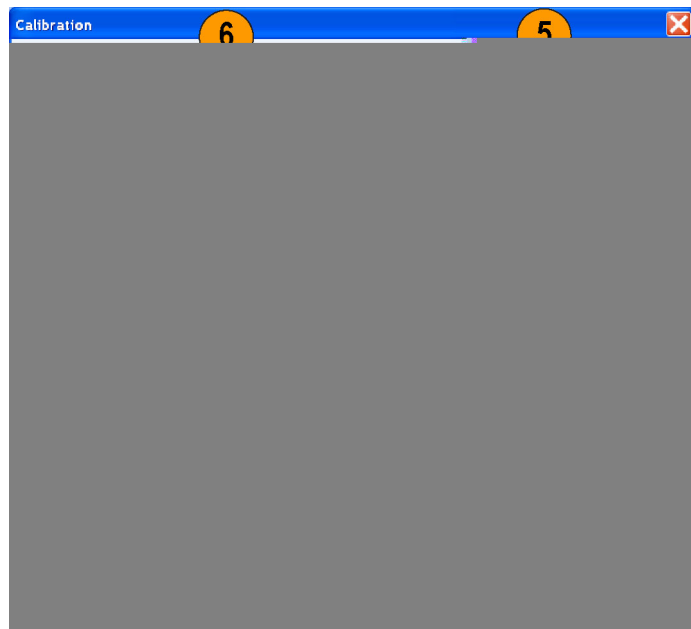
NOTE. Ensure that the output of the AWG Interleave channel is connected to Channel 1 of the oscilloscope.



2. Start RFXpress.
3. From the toolbar, click **Select > UWB-WiMedia**.



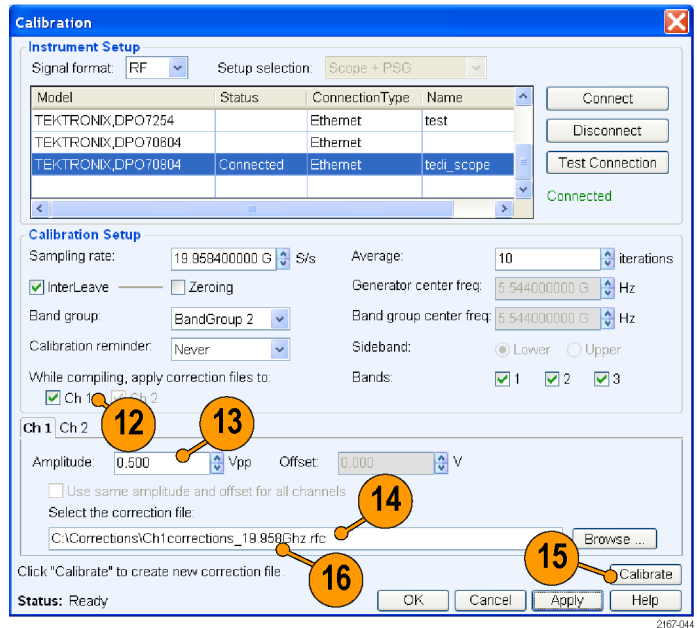
4. From the toolbar, click **Calibration**.
5. The Calibration window displays a table of instruments connected on the network. Select the TDS6154C oscilloscope and click **Connect**. Note that the status changes to Connected.



NOTE. You can click *Test Connection* to test the status of the instrument.

6. Set the **Signal Type** to RF.
7. Set the **Sampling Rate** to 19.9584 GS/s.
8. Select **Interleave**.
9. Set the **Average** to 10.
10. Set the **Band Group** to 2.
11. Select the **Bands**: 1, 2, and 3.

12. Set **When compiling, apply correction files to** to Ch1.
13. Set the **Amplitude** for Ch1 to 0.5 Vpp.
14. Set the path for **Select the correction file**.
15. Click **Calibrate** to create the correction file (.rfc). The calibration status is continually updated.
16. Confirm that the correction file that was just generated is selected.



17. Set **Band Group** to BandGroup 2.



18. From the toolbar, click **Compile > Compile Settings**.



19. Ensure that the correction file created during calibration is applied to Ch1.

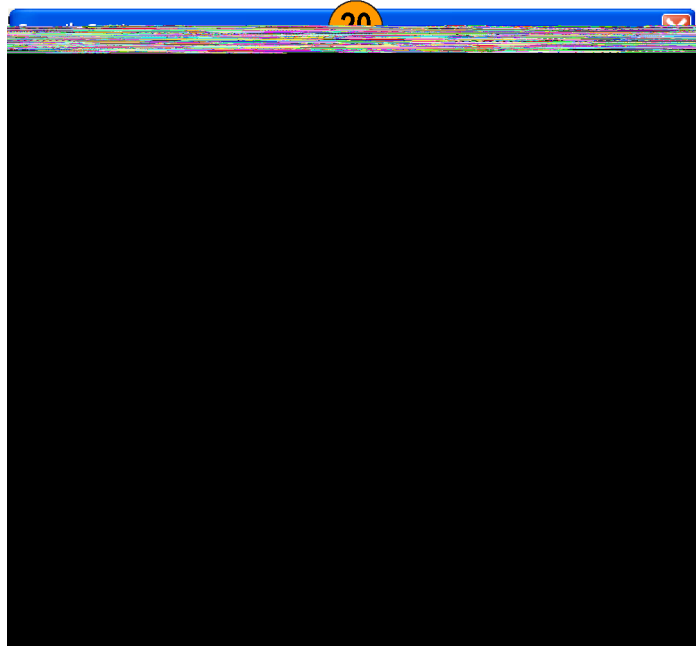
20. Set the **Waveform Length** to 1 M samples.

21. Set the Signal Format as follows:

- Select IF/RF
- Set **Oversampling** to 3.60

NOTE. *Oversampling is set to 3.60 to achieve a sampling rate of 19.9584 GS/s.*

22. Click **OK**.



23. From the toolbar, click **Compile**.



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