

**Tek UWB
Spectral Analysis
Printed Help Document**

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Tek UWB Spectral Analysis Online Help Version 2.0.1, part number 076-0085-01.

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- Worldwide, visit www.tektronix.com to find contacts in your area.

Table of Contents

Preface

Conventions	1
Updates through the Web Site	1

Getting Started

Introduction and Product Description	2
Compatibility	2
Requirements and Restrictions	2
How to Use the Software	
How to Start the Software	3
Returning to the Software	3
Returning to the TekScope Application	4
How to Exit the Software	4

Operating Basics

Software View	
Application Data Files	5
Configuring the Tek UWB	
Selecting the Analysis Type	5
Loading the WFM File	8
Selecting the Packet	10
Setting the Band Group	11
Setting the Time Frequency Codes	12
Setting the Data Rate	14
Analyzing the Waveform	
Analyzing the Waveform	16
Viewing Plots	
Voltage Versus Time	18
Constellation	20
Power Spectral Density	22
Spectrogram	24
Using Plot Cursors	26
Using Plot Zoom	27
Viewing Modulation Results History	
Listing Window Data	28
Clearing All the Results	28
Saving the Results	28

Table of Contents

Analyzing a Sequence of Waveform Files	29
Setup live Channel.....	31
Capturing Live WiMedia RF	32

Index

Conventions

The online help uses the following conventions:

- 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.
- DUT refers to the Device Under Test.
- Three dots (...) following a menu item indicate that the menu item will open a submenu.

Updates through the Web Site

Periodic software upgrades may be available.

To check for upgrades:

1. Go to the Tektronix Web site (www.tektronix.com).
2. Click Software Downloads to link to the Software and Firmware Finder Web page.
3. Enter the product name **Tek UWB** to find available software upgrades.

Introduction and Product Description

Excellent amplitude, phase flatness, and low phase noise make the DPO/DSA70000 series oscilloscopes the ideal tool for engineers designing Ultra Wideband radios used in Certified Wireless USB, MB-OFDM, MBOA, WiNet, and Bluetooth 3.0.

Tek UWB runs on TDS/DPO/DSA series oscilloscopes with single shot bandwidth ≥ 7 GHz.

TekUWB reads digital information from the RF waveform to determine the demodulation method on a packet by packet basis. The RF channel is corrected using the pilots in each packet within the optionally specified time gate. RF signal quality measurements such as EVM, spectral mask testing, and ACPR are performed using the methods agreed upon by WiMedia for key compliance based measurements. Wideband RF troubleshooting insight is aided by DPX, full span Real Time spectrograms, and Spectral displays. Frequency spans to 20 GHz are displayed with the Spectrum analyzer-like RBW for power spectrum. DPX makes specific RF visible in the presence of complex RF traffic. Time gating within the DSA70000 200 Mpt record at 50 GS/s enables the analysis of specific RF traffic separated by time, power, or frequency.

All six Band Groups, 10 Time Frequency Codes, and eight Data Rates are correctly analyzed when used on DPO/DSA71604 or DPO/DSA72004 oscilloscopes.

Compatibility

For information on instrument compatibility, refer to the *Optional Applications Software on Windows-Based Oscilloscopes Installation Manual* (Tektronix part number 071-1888-XX) available as a PDF on the CD-ROM.

For software upgrades, refer to the *Optional Applications Software on windows-Based Oscilloscopes Installation Manual* (Tektronix part number 071-1888-XX) available as a PDF on the CD-ROM.

Requirements and Restrictions

The following are recommended for running the Tek UWB:

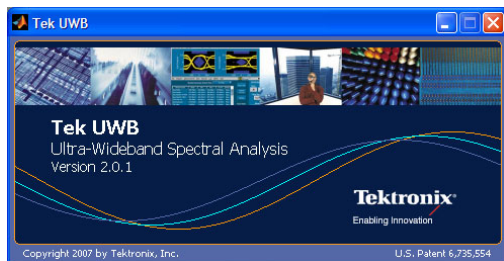
- TDS/DPO/DSA series oscilloscopes with single shot bandwidth. ≥ 7 GHz.
- Oscilloscopes with single shot bandwidth of 7 GHz for WiMedia band group 1 or DS-UWB lower band only. All six WiMedia band groups can be analyzed with single shot bandwidth ≥ 14 GHz.
- DSA72004 oscilloscopes with single shot bandwidth of 20 GHz, four 50 GS/s channels, and 200 Mpts for Radar through Xband, Ku band and into K band.

How to Start the Software

Depending on the type of oscilloscope that you have, you can start the software in one of the following ways:

- Select App > Ultra-Wideband Spectral Analysis
- Select Analyze > Ultra-Wideband Spectral Analysis

A screen indicates that the software is loading.



The oscilloscope displays the Tek UWB Ultra-Wideband Spectral Analysis software.



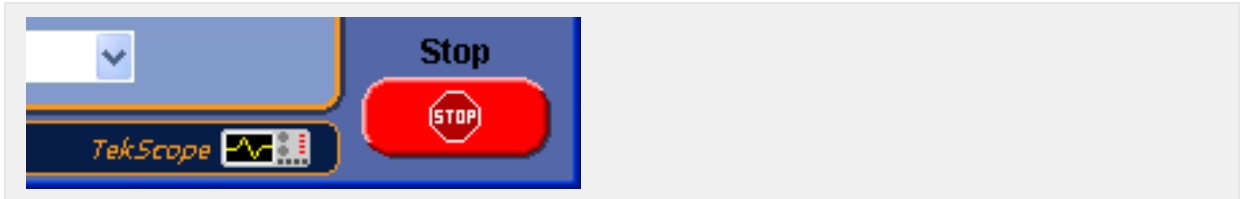
The Tek UWB sets the Analysis type to Spectral Only (no modulation) and does not show the Constellation pattern.

Returning to the Software


To return to the Ultra Wideband application, select Restore Application in the Analyze or Application menu.

Returning to the TekScope Application

To return to the oscilloscope application from the Ultra Wideband application, click the [TekScope](#) icon (near the Stop button).



How to Exit the Software

To exit the software, click  on the top-right of the software window.

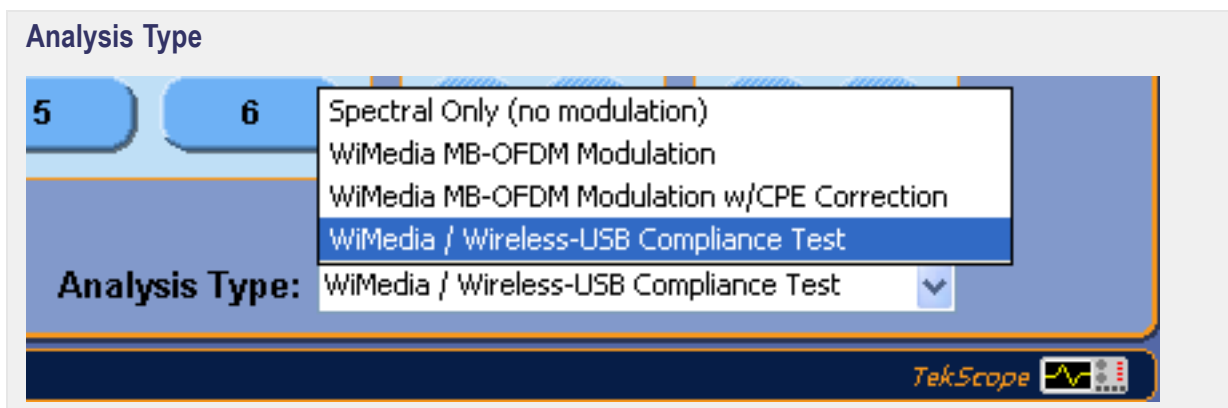
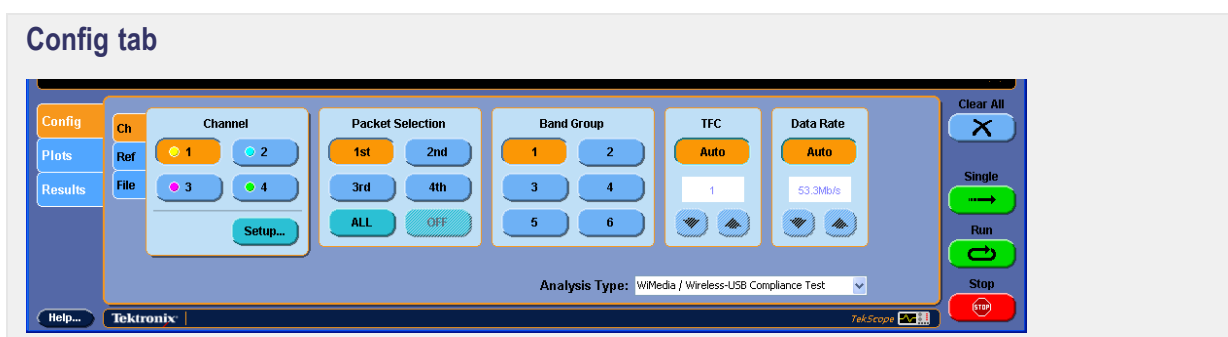
Application Data Files

The software uses the following data files:

File name extension	Directory	Description
.wfm	TekApplications\TekUWB\Waveforms...	To store the sample waveforms

Selecting the Analysis Type

To set the analysis type for debugging radios, click the [Config](#) tab, and then select one of the available options in the [Analysis Type](#) pane.



The default setting of Spectral Only (no modulation) acquires the data and does some basic spectral analysis without any demodulation.

Selecting WiMedia MB-OFDM Modulation or WiMedia MB-OFDM Modulation w/CPE Correction performs a full modulation analysis assuming that a UWB radio signal is in accordance with the WiMedia specifications.

Selecting WiMedia/Wireless-USB Compliance Test activates the CPE filter and only the first 96 symbols are analyzed.

WiMedia Analysis

Consider the following information when performing WiMedia analysis:

- You should select the appropriate band group for the signal being studied by selecting a Band Group button on the Config tab.
- This application can auto-detect the TFC of the signal. However, if problems are encountered during demodulation, you can override auto-detection by toggling the Auto/Manual button in the TFC section of the user interface.
- This application can auto-detect the data rate. However, if problems are encountered during demodulation, you can override auto-detection by toggling the Auto/Manual button in the Data Rate section of the user interface and then selecting a new data rate using the up/down arrows.
- If the data rate is set to Auto, the number of symbols to analyze is determined automatically from the packet header. If the data rate is set to Manual, all symbols found when scanning through the packet payload are analyzed.

The application displays the following information:

- A Power Spectral Density analysis separated by band with ACPR, mask test, and power measurements.
- A Constellation plot and EVM analysis.
- An Information box (containing date, instrument setting, and similar data) includes additional information on modulation.
- A Results History.

Packet Detection and Selection

This application features a packet detector, which scans the waveform and tries to identify the presence of a finite-duration signal. When multiple packets have been identified, you can select which packet to analyze using the Packet Selection buttons on the user interface:

- 1st, analyze first packet only
- 2nd, analyze second packet only
- 3rd, analyze third packet only
- 4th, analyze forth packet only
- All, analyze all packets in succession (100 maximum)
- Off, analyze the entire waveform ignoring packets

WiMedia Terminology

Band numbering. There are 14 bands (each 528 MHz wide) across the 3100 MHz to 10600 MHz UWB spectrum.

Band groups. There are 6 band groups within the UWB spectrum.

Band groups 1 through 4 and 6. These groups consist of three 528 MHz bands. Band group 5 consists of only two 528 MHz bands.

Band groups 1 through 5. These groups lie in sequence across the UWB spectrum.

Band group 6. This group straddles band groups 3 and 4, sharing 2 bands from band group 3 and 1 band from band group 4.

Time Frequency Codes (TFC). Ten hopping patterns, which determine the logical channelization. Band group 5 has only 4 possible TFCs because it occupies only two 528 MHz bands. This application automatically determines TFC from the RF waveform. To aid in debugging problematic waveforms, manual TFC specification is possible.

Common Phase Error (CPE). In the EVM calculation, CPE of the transmitter is corrected on a symbol-by-symbol basis.

CPE filtering. CPE filtering analysis allows the EVM calculation to see the transmitter phase noise impairments.

Error Voltage Measurement (EVM) calculation. EVM is calculated over the payload of the packet only. The calculation includes initial channel estimation using the CE symbols, phase and timing estimation and correction using the pilot tones as well as estimating the frequency offset. The phase error is estimated using pilot tones and the timing error, and common phase error is calculated. Timing error is corrected. The CPE is applied to the CPE filter if the appropriate WiMedia analysis type is selected in the popup menu. For each data and pilot subcarrier, the Euclidean distance to the closest constellation point is calculated. The RMS error is calculated using the WiMedia equation. The peak error and pass/fail result is displayed according to the test specification limits.

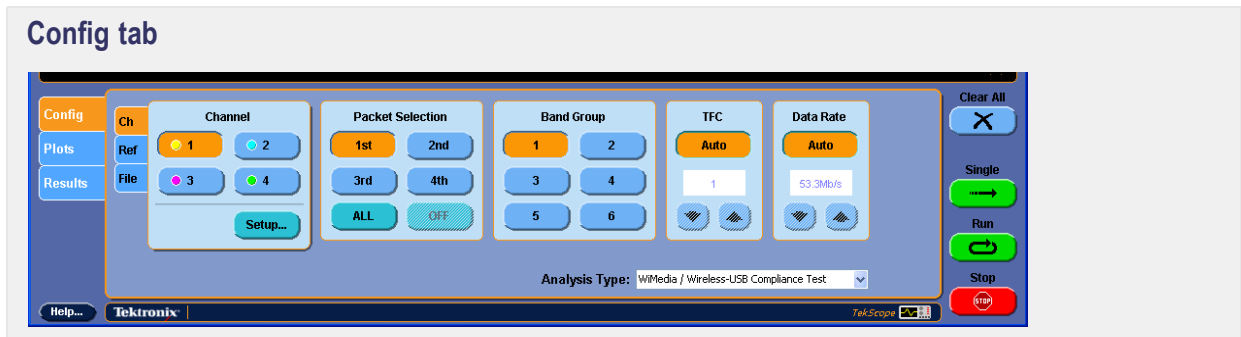
Limitations

Tektronix Ultra Wideband Spectral Analysis requires a minimum acquisition sample rate of 250 MS/s and a minimum acquisition record length of 100K points.

When using TekUWB with very long captured waveforms (generally over 100 M points), it is possible for the application to run out of available memory with the operating system. This condition depends on the number of other applications running, the length of the waveform being analyzed, and what type of analysis is being performed. If an out of memory error message is encountered, we recommend using the time gating feature of the oscilloscope to reduce the amount of data being analyzed. To do this, place the instrument cursors around the part of the captured waveform you want to analyze before beginning an analysis with TekUWB.

Loading the WFM File

To select the source of the measurement, click the [Config](#) tab.




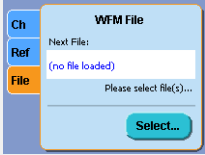
You can load the WFM file in the following ways:

Input source	Selections	Description	Default
Ch	1, 2, 3, and 4	Selects one of the four live channels as the source for acquisition.	1

Channel

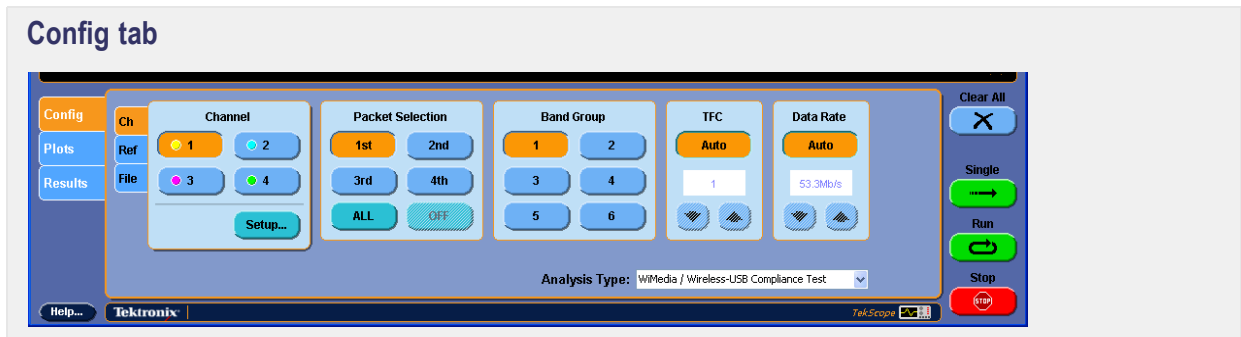
In the Config tab, click "Ch" tab to display the Channel pane.

Tek UWB acquires live signals from the channel selected.

Input source	Selections	Description	Default
<p>Ref</p> <div style="border: 1px solid gray; padding: 5px;"> <p>Reference</p> <p>In the Config tab, click "Ref" tab to display the Reference pane.</p>  <p>Tek UWB acquires the reference waveforms from the oscilloscope.</p> </div>	<p>1, 2, 3, and 4</p>	<p>Selects one of the four reference waveforms as the source for acquisition.</p>	<p>1</p>
<p>File</p> <div style="border: 1px solid gray; padding: 5px;"> <p>WFM File</p> <p>In the Config tab, click "File" tab to display the WFM File pane.</p>  <p>Select locates a .wfm file to be analyzed.</p> <p>Click Select to open the "Select File(s) to Load" window.</p> <p>Select one file or multiple files by using the Shift or Ctrl key with a mouse click.</p> </div>	<p>Select</p>	<p>Selects one or multiple files as the source of the acquisition.</p>	<p>N/A</p>

Selecting the Packet

To select the packet for performing the analysis, click the [Config](#) tab.



In the Packet Selection pane, click one of the available selections.



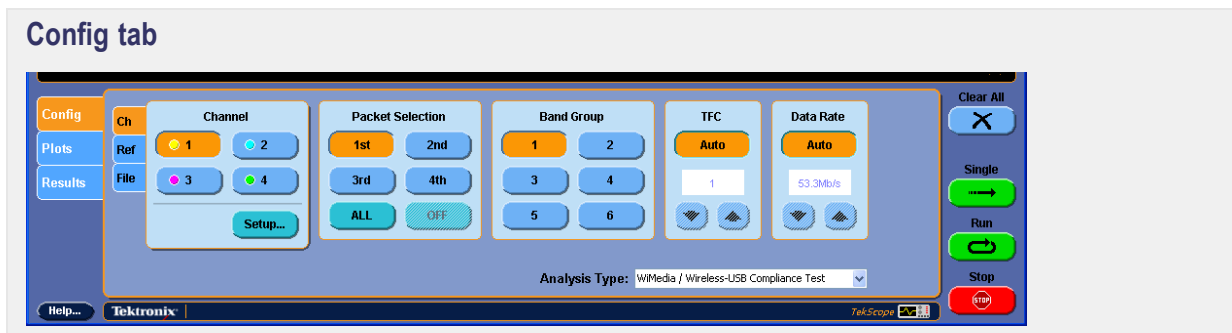
The default selection is 1st. When multiple packets are selected, each one is analyzed and results are reported sequentially for each packet separately.

NOTE. The OFF option is not available when the analysis type is set to WiMedia MB-OFDM Modulation or WiMedia MB-OFDM Modulation w/CPE Correction. But for the Spectral Only (no modulation) type, the OFF option is available to disable the packet search algorithm used for identifying MB-OFDM packets.

Setting the Band Group

Six WiMedia band groups fill the Ultra Wideband spectrum from 3.1 GHz to 10.6 GHz.

To set the band group to perform the analysis, click the [Config](#) tab.



NOTE. The Band Group pane is not available when the analysis type is set to Spectral Only (no modulation).

In the Band Group pane, click one of the available selections.

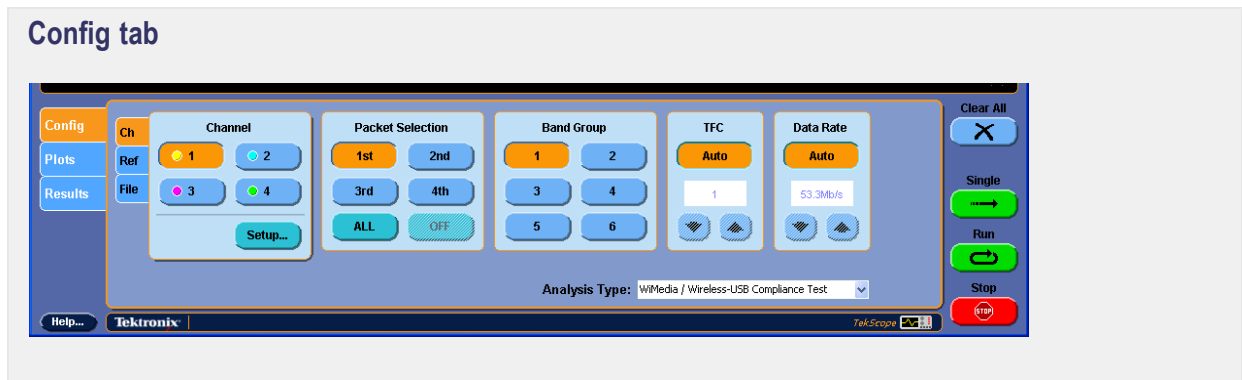


The default selection is 1.

Setting the Time Frequency Codes

To set the Time Frequency Codes, click the [Config](#) tab.

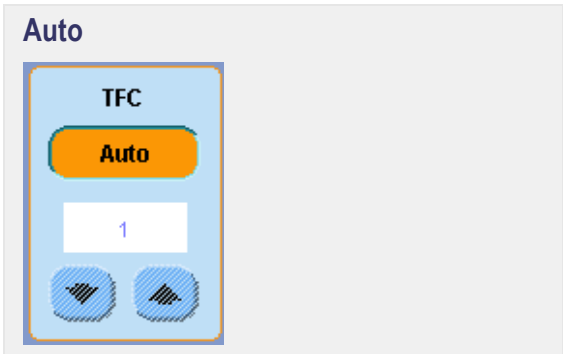
NOTE. Manual selection of TFC is only necessary if problems are encountered in demodulation.



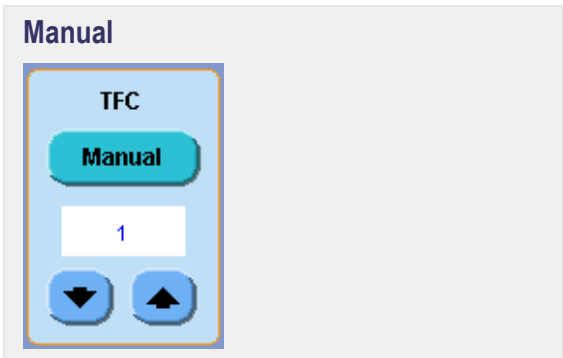
NOTE. The Time Frequency Codes pane is not available when the analysis type is set to Spectral Only (no modulation).

The following table gives the configuration options available in TFC:

Option	Description
Auto	To configure the Time Frequency Codes automatically, select Auto in the TFC pane.



Manual	To configure the Time Frequency Codes manually, select Manual in the TFC pane.
------------------------	--

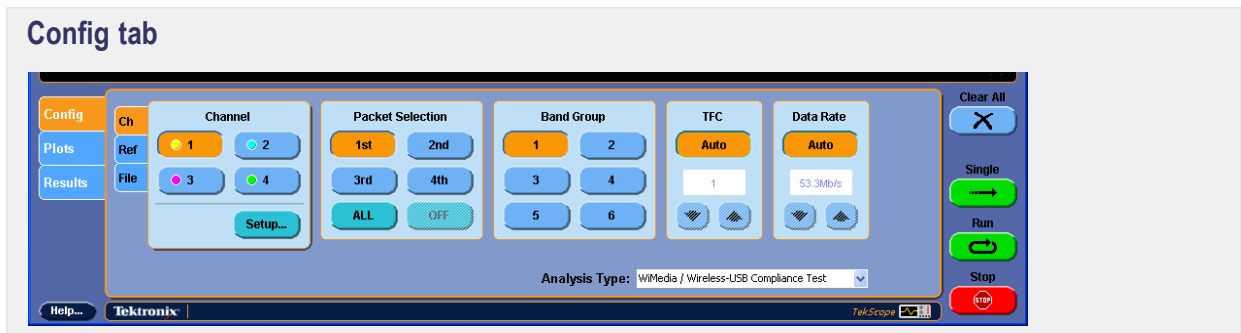


The default selection is Auto.

Setting the Data Rate

To set the Data Rate, click the [Config](#) tab.

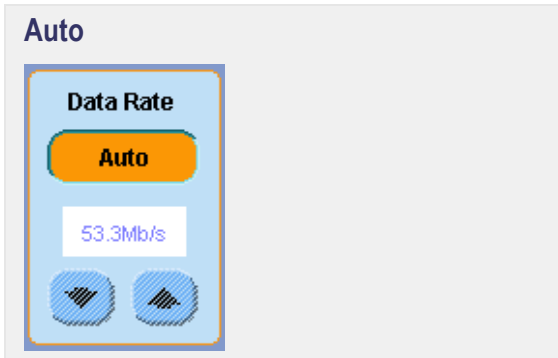
NOTE. Manual selection of Data Rate is only necessary if problems are encountered in demodulation.



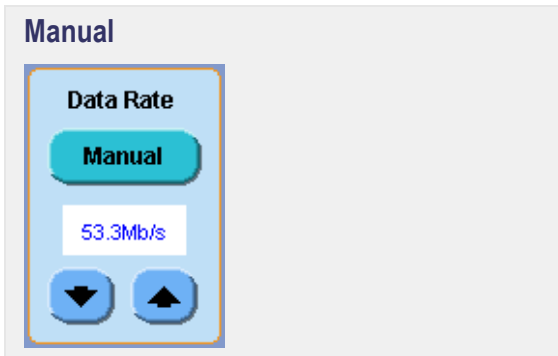
NOTE. The Data Rate pane is not available when the analysis type is set to Spectral Only (no modulation).

The following table gives the configuration options available in Data Rate:

Option	Description
Auto	To configure the Data Rate automatically, select Auto in the Data Rate pane.







Manual	To configure the Data Rate manually, select Manual in the Data Rate pane.
------------------------	---



The default selection is Auto.

Analyzing the Waveform

Click Single or Run in the software to perform an analysis. The analysis depends on the state of the source. Select a control in the configuration as follows:

Option	Live channel	Reference channel	File
<p>For live channel and reference channel options</p> <div>  </div> <p>For File Option</p> <div>  </div>	<p>The software acquires and analyzes the selected channel.</p>	<p>The software acquires and analyzes the selected reference channel.</p>	<p>The software acquires and analyzes the selected channel, reference, or file. If one file is selected, the behavior is the same as the reference waveform input.</p> <p>If multiple files (for example three waveforms) are selected, and you click Test File, the first waveform is loaded and analyzed (shows File 1 of 3 in the WFM File pane) and then the second waveform is loaded.</p> <p>When you click the Test File again, the second waveform is loaded and analyzed (shows File 2 of 3 in the WFM File pane) and then the third waveform is loaded.</p> <p>When you click the Test File again, the third waveform is loaded and analyzed (shows File 3 of 3 in the WFM File pane) and then the first waveform is loaded.</p>
<p>For live channel and reference channel options</p> <div>  </div> <p>For File Option</p> <div>  </div> <p>more information</p>	<p>The software sequentially acquires and analyzes the selected channel and logs results in the results window.</p>	<p>The software sequentially acquires and analyzes the selected reference and logs results in the results window.</p>	<p>The software acquires and analyzes all the selected files from the source directory. The software logs the results in the results window and stops.</p>

To stop all the software activity immediately and regain control, click

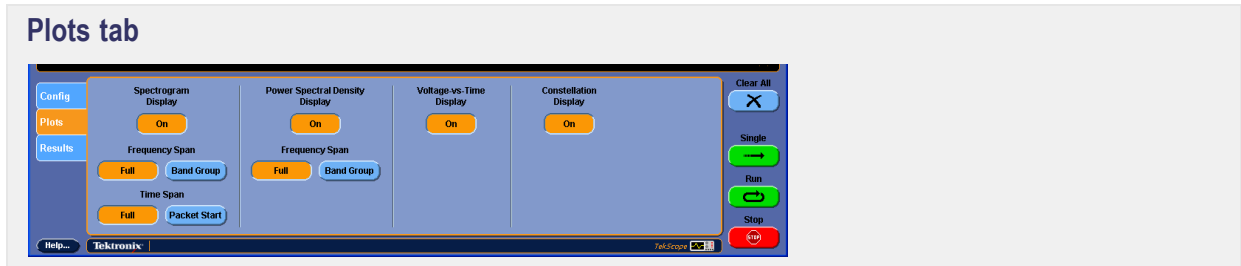


To clear all data from the Results window, click the button



Voltage Versus Time

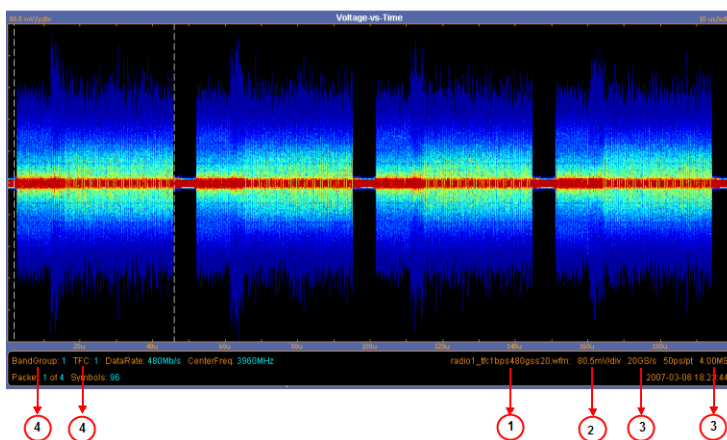
To view the plot, click the [Plots](#) tab.



In the Voltage-vs-Time Display pane, click [On](#).



Voltage-vs-Time displays the acquired waveform.



The acquired waveform in the software is defined as the portion of the oscilloscope acquisition between the cursors. You can select the data that you want to analyze. The voltage versus time data is displayed as a temperature graded display similar to WfmDB mode in the oscilloscope. Cursors are used within the Plot to highlight the packet that is being analyzed.

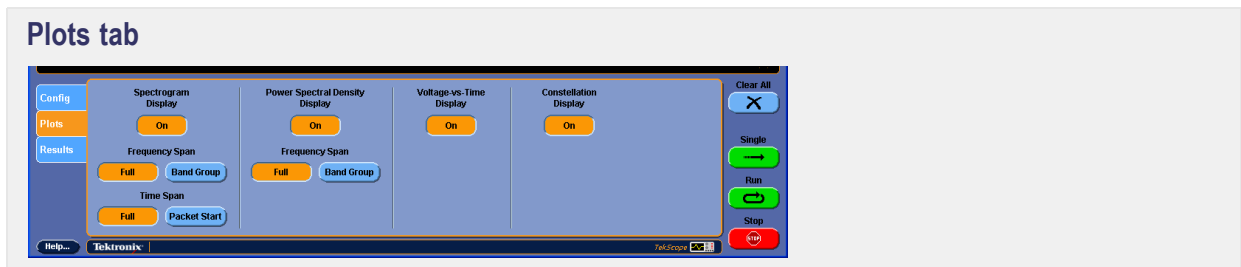
The Voltage-vs-Time plot readout provides the following information:

1. Source of measurement (file name or measurement channel)
2. Vertical Volts/Div Setting
3. Horizontal: Sample Rate, Resolution, and Record Length
4. Results of Bandgroup, TFC, and Bit Rate Auto-detection

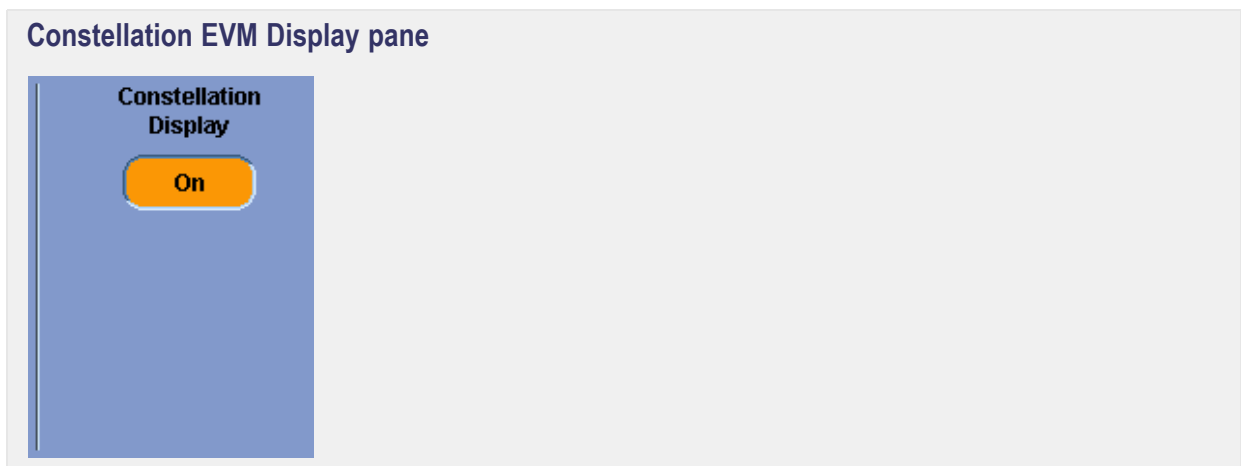
Constellation

NOTE. *The Constellation Display pane is not available when the analysis type is set to Spectral Only (no modulation).*

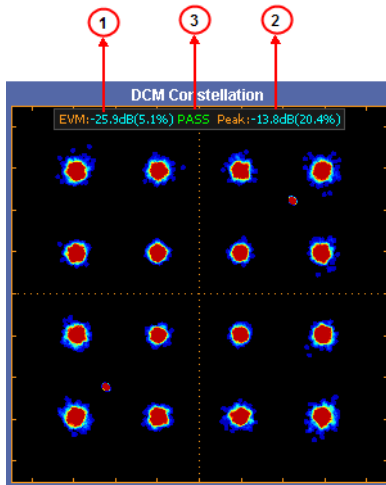
To view the plot, click the [Plots](#) tab.



In the Constellation Display pane, click [On](#).



The Constellation plot displays the constellation diagram of the packet being analyzed. Plots tab WiMedia Analysis type offers all plotting selections.

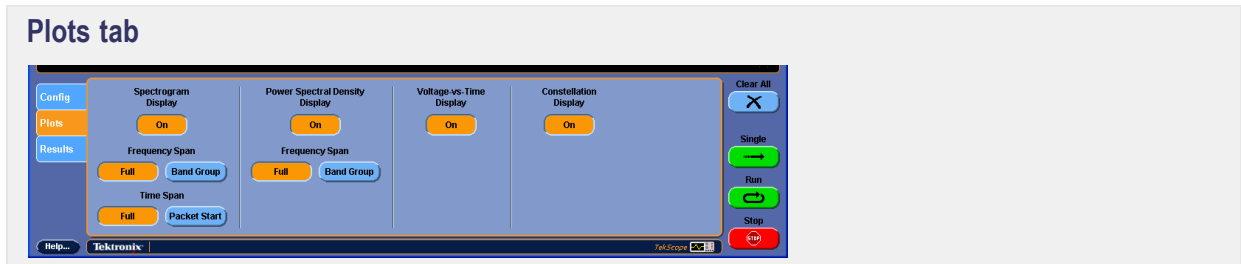


The Constellation plot readout area provides the following information:

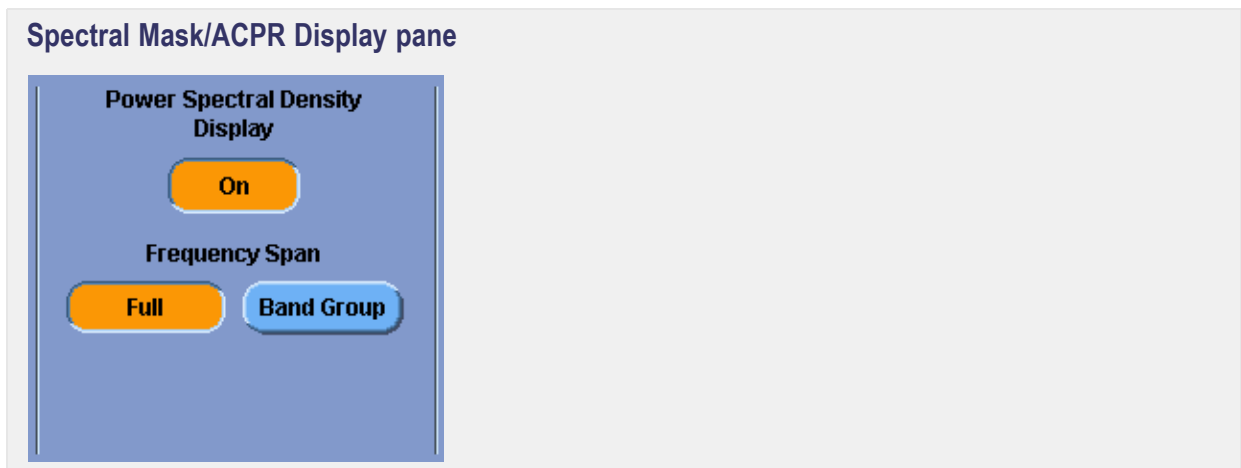
1. EVM of the packet being analyzed in db and %
2. EVM, Peak of the packet being analyzed in db and %
3. Pass/Fail limits on EVM measurements according to data rate

Power Spectral Density

To view the plot, click the [Plots](#) tab.

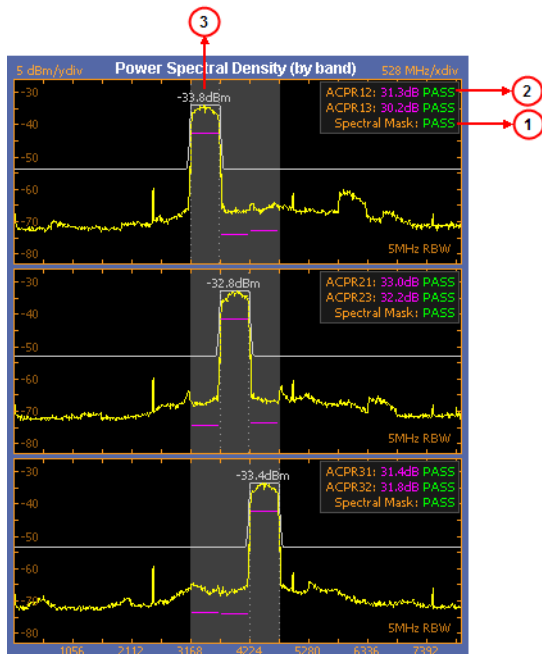


In the Power Spectral Density Display pane, click [On](#).



NOTE. The Frequency Span options are not available when the analysis type is set to Spectral Only (no modulation).

The software provides a single plot modal window of the Power Spectral Density Display.



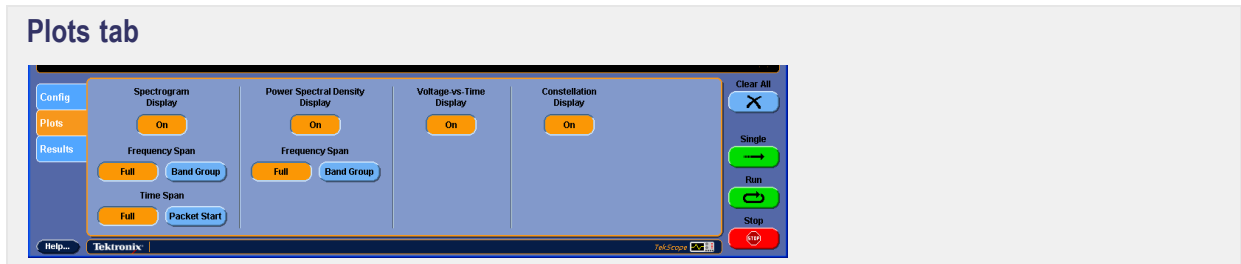
The span of the spectrum that is displayed will depend on how you want to display the spectral data.

The Power Spectral Density plot readout displays the following when doing the WiMedia radio analysis:

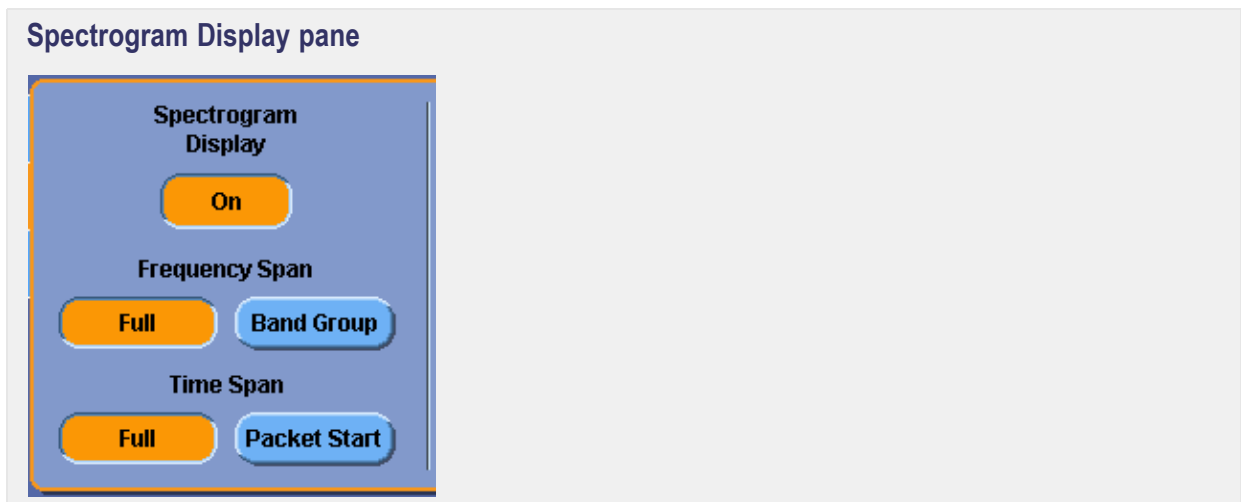
1. Spectral Mask with Pass/Fail status
2. Two ACPR Measurements with Pass/Fail status in each band
3. Power Spectral Density Measurements in each band

Spectrogram

To view the plot, click the [Plots](#) tab.

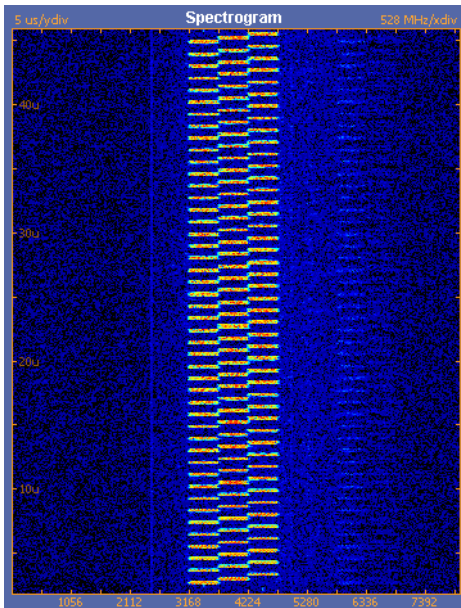


In the Spectrogram Display pane, click [On](#).



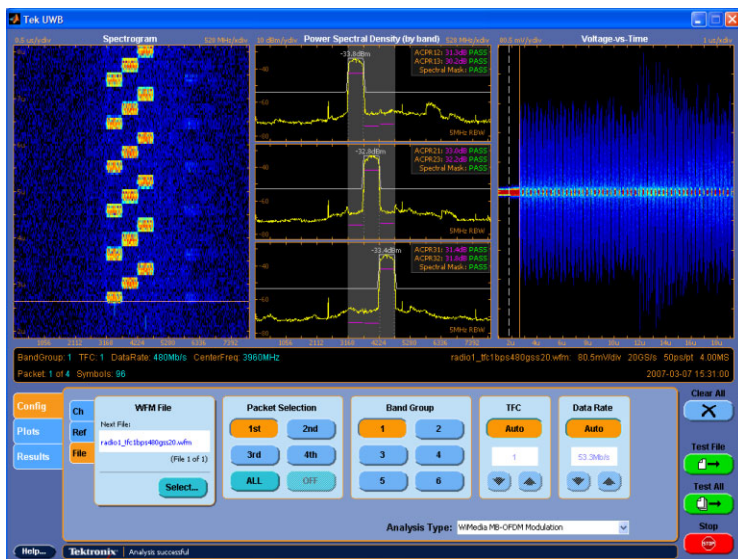
NOTE. The options for the Frequency Span and Time Span are not available when the analysis type is set to Spectral Only (no modulation).

The software provides a single plot window that incorporates the Spectrogram feature. The following diagram shows a Spectrogram plot:



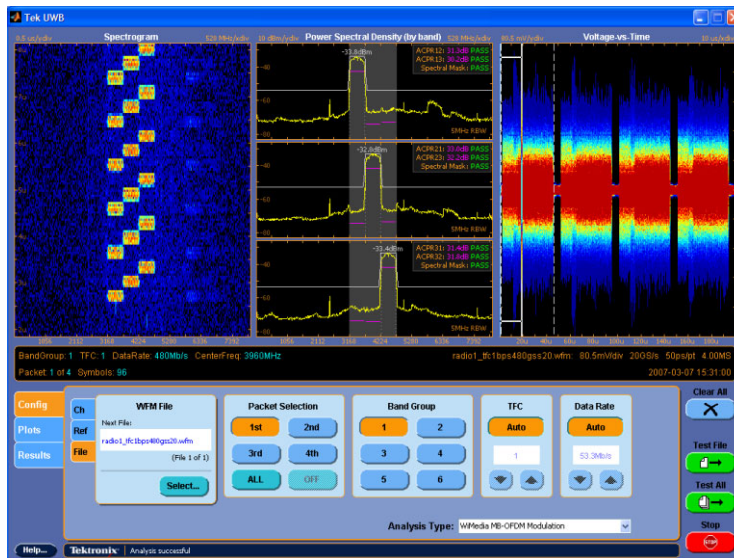
Using Plot Cursors

A cursor is established in the analysis portion of the Voltage vs. Time waveform. The cursor can be moved using mouse or finger. The cursor location in the time domain is also represented simultaneously on the spectrogram plot.



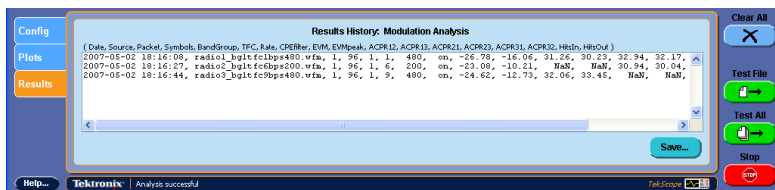
Using Plot Zoom

Within each plot window, you can define a zoom box using the mouse or oscilloscope touch screen. To zoom in, click and drag to select a zoom area. The plot displays the signal in more detail. Single-click without dragging to return to the previous view. Double-click to return to full view. The zoom box is shown in white on the following image:



Listing Window Data

To view the results, click the Results tab.



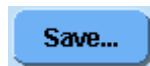
The software provides a listing of all measurement results including the Pass/Fail Status and a means of exporting the results. Use the scroll bar to scroll through the listing window. Use the vertical scroll bar to scroll the result window.

Clearing All the Results



To clear all data from the Results window, click the button

Saving the Results



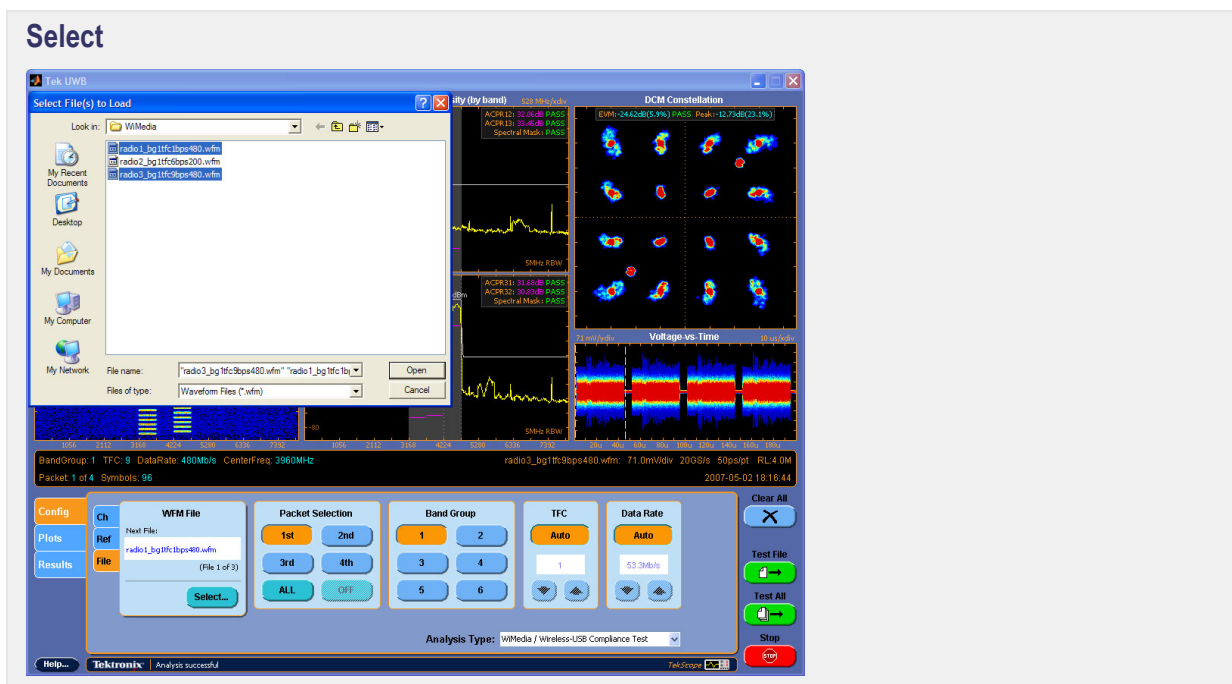
To save or export results from the Results window, click

The results are in .csv format so that they can easily be imported into the Microsoft Access database used by the WiMedia PHY group at the compliance workshop.

Analyzing a Sequence of Waveform Files

WiMedia radios operate at multiple Data Rates, Time Frequency Codes, Band Groups, and power levels. You might need to capture more than 50 waveforms to assure proper operation. It might be more convenient to capture and save the waveforms in rapid succession and then batch process the analysis.

In the Config tab, click File and then [Select](#).

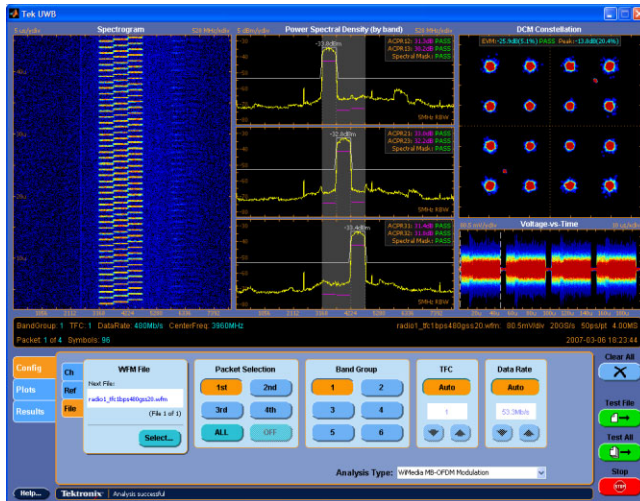


Select the files you want to analyze.

1. Click Select to open the "Select File(s) to Load" window.
2. Select one file or multiple files by using the Shift or Ctrl key with a mouse click.

Click Test All and Tek UWB will sequence through and process all the selected waveforms. Tek UWB will analyze all waveforms, and will return Analysis successful as the status.

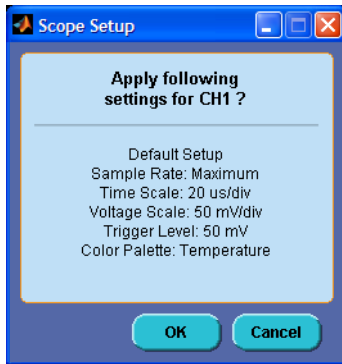
To see the result summarized for the sequence of waveforms, click the Results tab.



Setup live Channel

Channel Setup sets the selected channel in the oscilloscope to a default setup for Wideband RF.

The settings are reported on a pop-up window and can be modified using the scope controls.



Capturing Live WiMedia RF

NOTE. *The oscilloscope must be set to 20 GS/s or greater for live capture of WiMedia RF.*

RF Signal Generation

Equipment required. DPO/DSA70804 or greater, keyboard and mouse, AWG7102 with option 6 (20 GS/s) or WiMediaUWB radio, SMA cable, and Tekconnect SMA.

Load UWB waveform. UWB waveforms captured on the TDS6154C for playback on AWG7102 with option 6 are available at Tektronix.com.

1. Search keyword WiMedia.
2. Select AWG7102 WiMedia Radio Waveforms.
3. Load the file onto the AWG7102.
4. Open UWB WiMedia.awg on the AWG7102.
5. Press Run on the AWG7102.
6. Press the Ch1 On button and interleave “On”. Be sure the timing tab shows 20 GS/s on the AWG7102.
7. Connect Ch1 on the AWG7102 to Ch1 on the DPO70000 using an SMA cable or connect the antenna of the Tek UWB radio to Ch1 of the DPO70000 with an SMA cable.

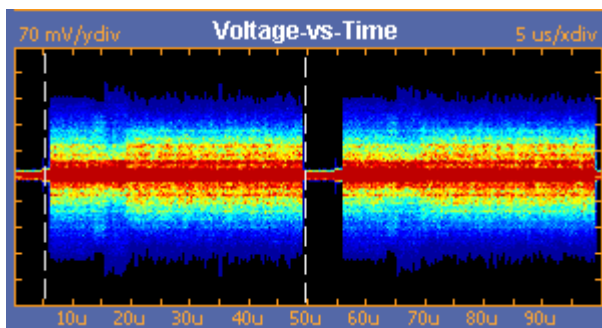
Capturing Live RF Signal

Launch Tek UWB.

1. Select Ultra-Wideband Spectral Analysis in the DPO/DSA70000 Analyze menu.
2. Press the TekScope icon on the Ultra Wideband display to return to the oscilloscope display.

Setup the DPO70804 to Capture the UWB Waveform.

1. Set the vertical sensitivity to capture the RF waveform at about 90% of full scale. Usually this requires setting variable gain in the DPO70000 vertical setup. In the following figure, it is set to 50 mV/div.
2. In the display menu, set the record view palette temperature color grading to see the information in this complex RF waveform.



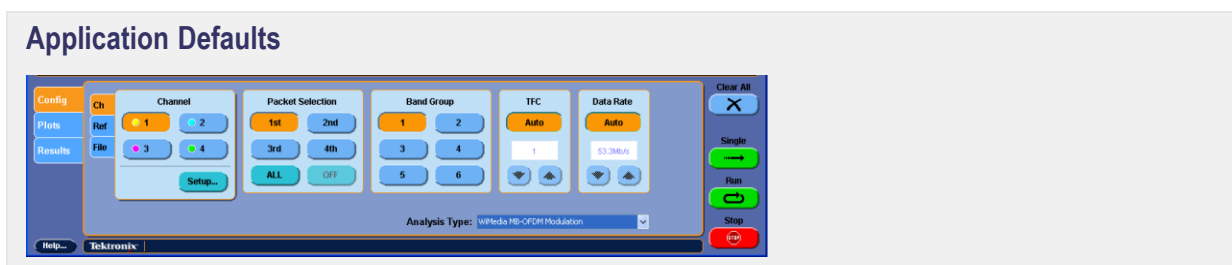
The packets are captured here at 25 GS/s, 10 us/div, 2.5 Mpts. The packet length in this example is about 40 us.

Set Trigger Holdoff for Stable Display with Continuous Transmission. If the radio or AWG7102 is in a mode to transmit continuously with default trigger holdoff by time, the display will be unstable. In this example, since the packet length is about 45 us, setting trigger holdoff by time to about 50 us, a little longer than the packet length, gives a stable display on the continuous RF waveform. If the packet length is varying from packet to packet, use “single sequence” or setup Pinpoint trigger to capture a specific packet length.

Or use “Single” sequence trigger. Real Time measurements are made from a single acquisition. A single shot, “Single sequence,” acquisition does not require “trigger holdoff by time” to be increased.

Adjust Trigger Position. Adjust trigger position so that the acquired record starts with a full packet. If the record starts in the middle of a packet, the software will have to search through the data in the packet with a correlation function to find the beginning of the header. By triggering on the beginning of a packet, analysis time is decreased.

Use Restore Application to go to TekUWB. The [application defaults](#) to Ch1, Band Group 1, and analyze the first captured packet. If you want to analyze another or all captured packets, change the selection.



To capture a waveform, click Single. Click Run and the last waveform acquired will be processed continuously.

The results of the analysis are in the results menu and may be saved and exported.

Index

B

Band groups, 6

C

Common Phase Error, 7
CPE filtering, 7

E

EVM calculation, 7

G

Getting Started,
 Compatibility, 2
 How to Exit the Software, 4
 How to Start the Software, 3
 Introduction and Product
 Description, 2
 Requirements and
 Restrictions, 2
 Returning to the Software, 3

L

Limitations, 7

O

Operating Basics,
 Analyzing a Sequence of
 Waveform Files, 29
 Analyzing the Waveform, 16
 Application Data Files, 5
 Capturing Live WiMedia
 RF, 32
 Clearing All the Results, 28
 Constellation, 20
 Listing Window Data, 28
 Loading the WFM File, 8
 Power Spectral Density, 22
 Saving the Results, 28
 Selecting the Analysis Type, 5
 Selecting the Packet, 10
 Setting the Band Group, 11
 Setting the Data Rate, 14
 Setting the Time Frequency
 Codes, 12
 Setup live Channel, 31
 Spectrogram, 24
 Using Plot Cursors, 26
 Using Plot Zoom, 27
 Voltage-vs-Time, 18

P

Packet Detection and Selection, 6
Preface,
 Conventions, 1
 Updates through the Web
 Site, 1

T

Time Frequency Codes, 7

W

WiMedia Analysis, 6
WiMedia Terminology, 6