Tektronix EVM Compliance Test Procedure

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Revision 1.0

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Revision History

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Table of Contents

1. Summary

This document illustrates EVM application technical instructions and operation. A qualified systems technician should perform the procedures. Instructions included in this document:

- System Preparation
- SW and Scope Setup
- EVM Application operation

2. Introduction

The Wireless USB Compliance Committee under the direction of the USB-IF, Inc., develops the Wireless USB EVM Test Procedures. This is one of three documents for the Wireless USB EVM Test Procedures. These documents are provided as a resource for EVM compliance testing and is recommended when compliance testing WUSB products and is required for WUSB Compliance Certification.

The Wireless USB EVM Compliance Test Procedures provide a method of verifying compliance parameters as defined in the EVM Test Specification, using a Known Good Wireless USB Host or Device as defined by the Wireless USB specification. In addition to passing the EVM test requirements, WUSB capable products must also complete and pass the applicable compliance tests identified in these documents in order to be posted on the USB-IF Integrators List and use the USB-IF logo in conjunction with the said product (if the vendor has signed the USB-IF Trademark License Agreement).

This test procedure is the USB-IF Host and Device EVM Test Procedures written to support Tektronix, DSA 72004 but does not exclude other USB-IF approved scope vendors or their equivalent hardware.

3. Scope

This USB-IF EVM Test Procedure document and tests are used to evaluate the WUSB peripherals and systems operating wirelessly. These tests are also used to evaluate the operation of wireless USB silicon incorporated in ready-to-ship products, reference designs, proofs of concept and one of kind prototypes of peripherals, add-in cards, motherboards, or systems.

This test procedure makes reference to the test assertions in the USB-IF EVM Test Specification, and Wireless USB specification.

Instructions will cover workstation setup, system hardware requirements, and software installation guidelines. All required program settings to insure the EVM tool will function properly. The workstation setup environment, system hardware specifications, and software installation have been tested and proven by qualified technicians. Any deviation may result in unpredictable behavior. WUSB testing assumes there will not be anyway to connect the DUT output (known as conducted testing) or to directly put the Device into a test mode. Therefore the tests have been structured as radiated tests using Loopback protocol defined in the Wireless USB specification to cycle the DUT through test modes.

4. References

EVM Test Specification
Appendix A for EVM Compliance Testing Laptops
Wireless USB Specification
http://www.usb.org/developers/wusb/docs

PDK System Overview
http://www.usb.org/developers/estoreinfo/PDK_Overview/

Acronyms

ACPR	Adjacent Channel Power Ratio
ATX/BTX	Advanced/Balanced Technology Extended. Current industry standard motherboard form factor
BNC	Coaxial connector with bayonet coupling mechanism
BPS	Bits Per Second
BR	EVM Test Tool designation for Burst Mode
CDID	Connection Device ID
CH	Channel
CHID	Connection Host ID
CK	Connection Key
DUT	Device Under Test
DWA	Device Wire Adapter
EVM	Error Vector Magnitude
GSS	Giga Sample Per Second
GUI	Graphical User Interface
HW	Hardware
HWA	Host Wire Adapter; defined in this specification as a USB 2.0 connected Wireless USB Host Controler.
MIFS	Minimum Inter-Frame Spacing. The minimum time between to successive transmitted packets. For burst-mode transfers, this is the exact required time between successive packet transmissions.
MMC	Micro-scheduled Management Command
PCI	Peripheral Component Interconnect
PDK	Product/Peripheral Development Kit
PHY	Physical Layer. In the Wireless USB specification, the PHY is specifically the MBOA PHY[4]
PL	Power Level, also known as TPC or Transmit Power Control
PSD	Power Spectral Density
RF	Radio Frequency
SMA	Sub Miniature version A Coax Cable Connection
SN	Serial Number
SW	Software
SYM	Symbol
TFC	(TF Code) Time/Frequency Code
TFI/FFI	Time/Fixed-Frequency Interleaving
TID	Test Identification for products submitted for certification
Tx	Transmit
USB	Universal Serial Bus
UWB	Ultra Wide Band
WHCI	Wireless Host Controller Interface
WUSB-CV	(Wireless USB-CV or CV) Wireless USB Command Verifier a compliance test tool that evaluates WUSB devices for conformance
WLAN	Wireless Local Area Network
WUSB	Wireless Universal Serial Bus

5. Workstation Preparation

5.1. Equipment and Materials

The following list of commercial test equipment is based on positive experience by the USB-IF members in executing the WUSB EVM tests. This test procedure is written with a set of specific models we use to develop this procedure.

Required:

- High Speed Scope
    - Tektronix DSA 72004 Digital Serial Analyzer, Tektronix scope front end adapter TCA-SMA (female SMA interconnect), or equivalent
- Required: 50-ohm coaxial Cable 1m (3') length with male SMA to male SMA connectors at both ends, (Astrolabs minibend R-36 0712), qty = 3
- Required: Antenna with male SMA (ACON Dipole ADM3S-300014), qty = 2
    - Required: coaxial adapter female SMA to female SMA (Pasternack, PE9070)
- Required: Broadband Amplifier with female SMA input to female output and heat sink (Mini Circuits ZVA-183-S+)
    - 12V DC Power Supply (Linear Power, 179-2302-ND)
    - 1m (3') 22 gauge wire to provide power to the amplifier from the power supply, qty 2
    - 1m (3') 24 gauge twisted pair wire providing power source regulator feedback to power supply from amplifier
    - Power Supply Enclosure/Cover Panel
    - 12V DC Fan
    - Power Cord and fused input connector
- Required: Test Probe holder or vise to position the scope antenna
- Required: Metric or English tape measure
- Required: Wireless USB test Device
- Required: USB-IF WHCI or HWA Wireless USB based PDK
    - Coaxial cables and adapters included with the USB-IF WHCI and HWA
- Technical Documentation
- Recommended: UWB/Wireless USB Protocol Analyzer to enable advanced scope input triggering
- Optional: Spectrum Analyzer 30Hz -18GHz
- Optional: Power Meter and appropriate test head
- Optional: USB-IF WHCI, or HWA and a known good DWA for test setup and test bed debug

5.2. Software and Drivers

- Wireless USB-CV Test Software
- Host Channel Changing application
- EVM Test Tool Software

5.3. Recommended Computer System

Current model computer system with available PCI slots with clearance for the WHCI USB-IF PDK. Refer to Wireless USB-CV documentation and USB-IF WHCI or HWA Based PDK technical installation instructions for system requirements.

The following system requirements are tested and insure the highest system stability for EVM testing. Any modifications to this list may result in system related failures or system crashes.

- ATX or BTX Mid Tower Desktop System Case
- Intel Desktop Board (or equivalent) with 2 adjacent 5v PCI slots, for PDK card clearance
- Intel Pentium 4 processor 1.8GHz or Higher clock speed
- 512MB or more of RAM
- Minimum 450W Power Supply Unit with AC Power Switch
- DVD/CD-Rom Drive
- Minimum 40GB Hard Disk with at least 10GB of free space
- Monitor, Keyboard and Mouse
- Windows XP Professional Edition SP2 (English) OS,
- USB-IF PDK WHCI or HWA
- Wireless USB-CV test driver and application installed
- EVM Tool post processing compliance application installed

5.4. Host Computer HW/SW Configuration

5.4.1. Recommended system requirements: The following system requirements are tested and insure the highest system stability for the PDK. Any modifications to this list of hardware may result in system related failures or system crashes.

5.4.2. The listed equipment is the official Known Good test bed used by the USB-IF and affiliated test houses for certification purposes. If a specific known good device cannot be obtained, it may be substituted with a similar, certified device. If a substitution is necessary, the following guidelines will help to select an appropriate replacement.

5.4.3. WUSB Host System: The motherboard should have 2 adjacent PCI slots one to hold the WHCI WUSB Host Adapter and the second provides adequate space for the attached PHY. The second computer must have an Embedded EHCI including 2 adjacent USB ports for HWA WUSB dongle preferably located in the front panel.

5.4.4. When testing EVM on a vendor supported WHCI or HWA. (Configurations such as: WUSB PCI Host cards in desktop computers or integrated WUSB hosts inside laptops) A known good native device or DWA is required to verify the WHCI or HWA under test. Before EVM testing, insure the required test software configuration is running and the most recent PC software is up to date. NOTE: If the DUT and system under test fails to support the software and the tools described in this test procedure, the DUT will be recorded as a failure.

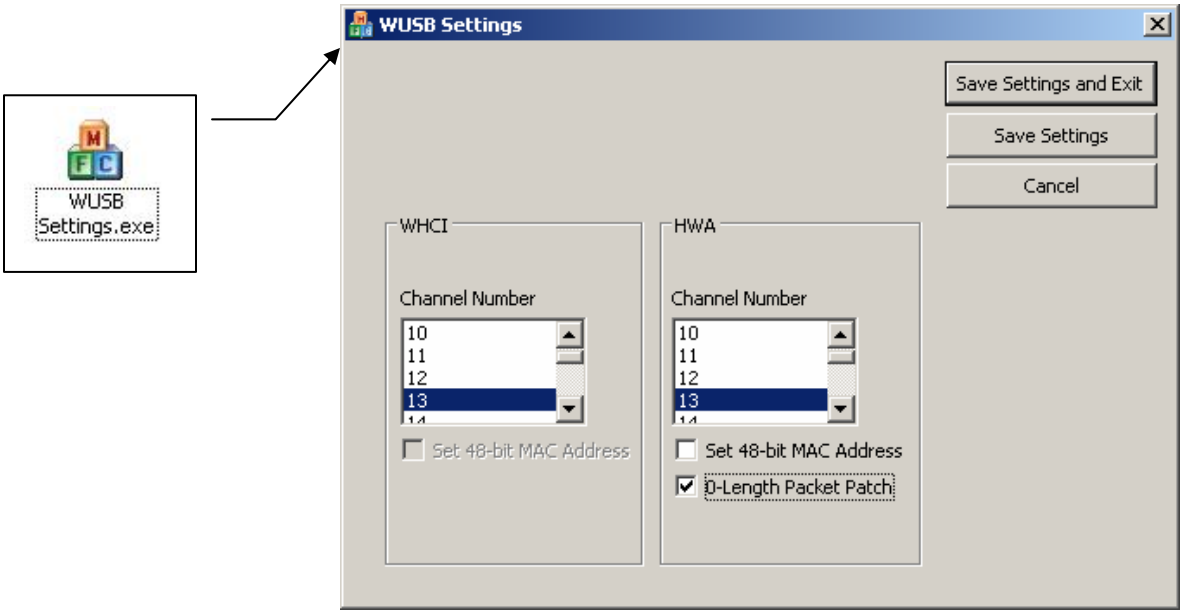
5.4.5. The processor speed is not important, but the fact it supports hyper-threading is. Using a hyper-threaded processor significantly improves performance of multiple high-speed WUSB devices and operating the EVM test tool software. Memory and disk storage should provide enough storage space to eliminate insufficient resources for software.

5.5. Software Installation

5.5.1. Install the latest recommended Wireless USB-CV msi file and EVM tool software provided by USB-IF.

1. Install Wireless USB-CV.msi
2. Install the “Host Channel Change Application” (primarily for diagnostics purposes while testing). Recommended but not required when running the automated EVM Test Modes.
    - This utility allows channel setting for the WHCI and HWA compliance device drivers.
    - Note: after a change, you must either, click the “Save Settings” button, or the “Save Settings and Exit” button for the changes to take place.
    - Creating a shortcut on the desktop for the WUSB Settings.exe is recommended
    - To find the WUSB Settings.exe and application setups navigate to: C:\Program Files\USB-IF Test Suite\Wireless USB-CV\Driver\Channel Change Application
    - Rename: HWADriverRegistrySample_reg to = HWADriverRegistrySample.reg; WHCIDriverRegistrySample_reg to = WHCIDriverRegistrySample.reg
    - When prompted confirm each file rename and execute each, confirming the install when prompted.
    - Refer to 5.5 Figure 1 for an example of the WUSB Settings application GUI.
    - **Channel Number**: This is the channel number that the driver will use for radio traffic. This will be read each time the driver initializes, at start-up and also at the beginning of a new run of CV tests.

- **0-Length Packet**: For diagnostics purposes and testing. Enable this setting for products that expect an extra 0-length packet. When recording the packet waveform, expect to see this behavior from the *HWA* control packets, they should fall on a 512-byte boundary.



5.5 Figure 1

3. Install the EVM Tool

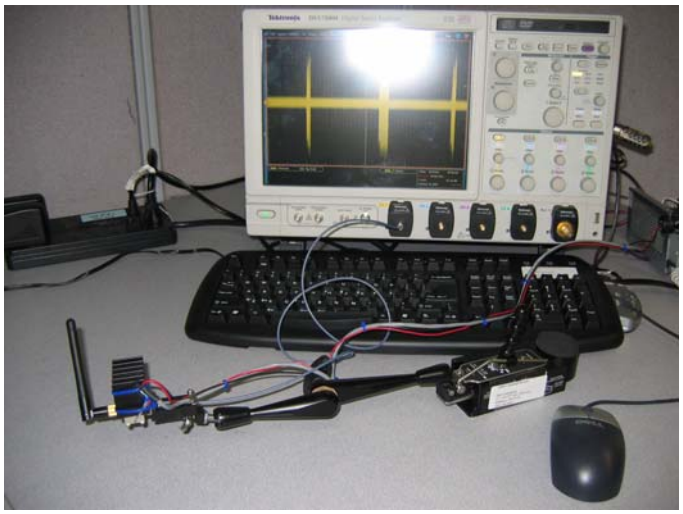
   - The latest EVM Tool application should be downloaded from the WUSB-IF website.
   - Use a separate computer to analyze data. NOTE: Do not install the software on the oscilloscope used for data collection. The EVM software is labor intensive, therefore it is recommended to capture each waveform and post process data on a separate computer.
   - Once the software is downloaded, double click on the setup.exe file to install the software.
   - After the EVM Tool is installed (setup.exe default: C:\Program Files\WMCompTestRelease) locate the WMCompTestRelease.exe

5.5.2. After the software installation is finished, shut down and restart then install hardware as described per vendor instructions or setup documentation.

5.5.3. It is not recommended to use the same computer for WUSB-CV and EVM Testing. However, if the same computer is used, store the EVM data analysis in a file location isolated from the primary operating system disk. Create an HTML file for each waveform recorded

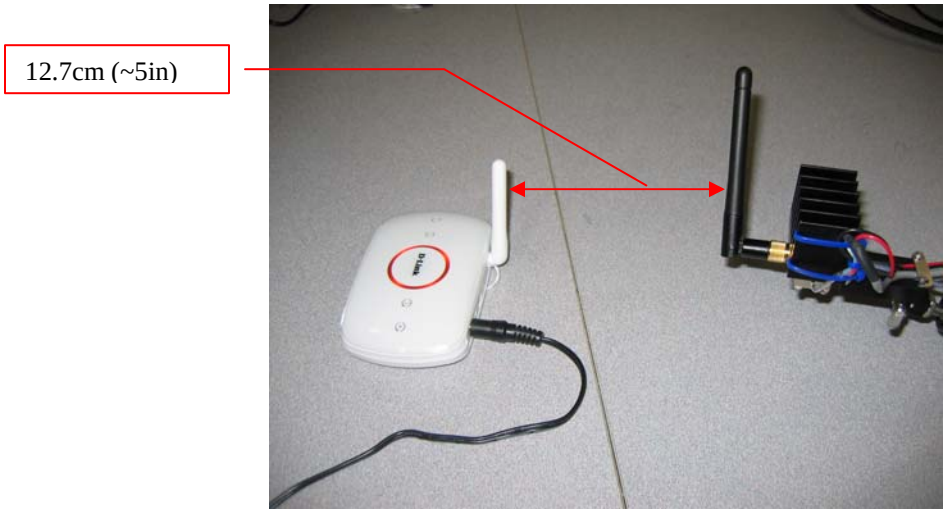
5.6. EVM Test Bed and Hardware Setup

5.6.1. Connect an antenna directly to the input of a UWB amplifier. Connect the output of the amplifier to the oscilloscope via a high bandwidth SMA cable. Refer to 5.6 Figure 1. In some cases an adapter might be necessary at the scope front end.



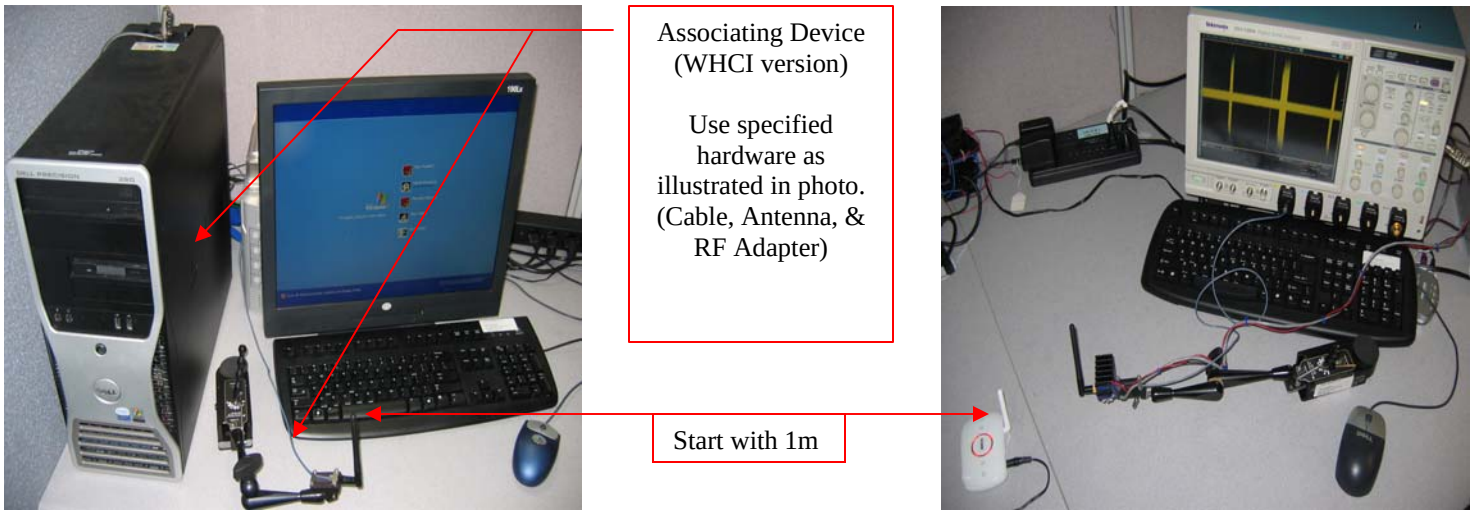
5.6 Figure 1

5.6.2. Mount the antenna in the test probe holder and adjust to be orthogonal to the test bench. The DUT antenna also should be positioned orthogonal to the test bench. Begin with the receiving antenna 12.7cm or 5 inches from the DUT antenna. Refer to 5.6 Figure 2.



5.6 Figure 2

5.6.3. Insure adequate distance is placed between the association device's antenna and the DUT. This gives the ability to distinguish DUT signals from those of the associating device. Refer to 5.6 Figure 3. A minimum of 1m is sufficient, but may need to be moved closer for higher data rates. Figure 1 shows an EVM test bed setup. Further discussion of antenna setup is discussed in section 5.7.



5.6 Figure 3

5.6.4. While a variety of sample rates may be utilized to capture these signals, care must be taken if sample rates below the Nyquist frequency of the highest frequency complement is utilized. For simplicity, alias protection, and file size optimization, 20GSa/s is the recommended sample rate for Band Group One MB-OFDM UWB and utilized in this document. Higher sample rates can be used, but will increase the file sizes.

5.6.5. Set the horizontal resolution to 100µs. This can be adjusted during test procedure to give maximum resolution of packets.

5.7. Record Waveform Data from DUT

5.7.1. Expect two types of WUSB devices, either host side or device side. Host adapters can also be found embedded in laptop systems. For test setup of these devices refer to Appendix A on the USB-IF website. To prevent loss of data, the waveforms and analyzed waveform data should be saved in a vendor specific folder isolated from the operating system drive. Before any testing, create a known good test condition by restoring a known good backup image.

5.7.2. Each DWA or Native device requires a numeric or cable association between the PDK test system and the DUT. A Wireless USB cable association driver is supplied with Wireless USB-CV. When testing numeric devices, the vender supported device must support

- A CHID value of: (00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F)
- Any CDID value: (example: 0F 0E 0D 0C 0B 0A 09 08 07 06 05 04 03 02 01 00)
- CK of all zeros: (00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00)

5.7.3. Use this driver location when using the hardware install wizard to install the CK of zero driver:

5.7.3.1. C:\Program Files\USB-IF Test Suite\Wireless-USBCV\Driver\CK_of_Zero

5.7.4. Each WHCI or HWA requires an up to date operating system including all hardware drivers running the latest version of the WUSB-CV tool and drivers. Use a known good test device when performing the loopback tests.

5.7.5. Begin with insuring the host computer is transmitting using TFC1 (channel 9) via the WUSB Settings tool. Refer to 5.5 Figure 1 (note: Some Japanese products only operate on TFC7 (channel 15)). Begin with scope and DUT antenna adjustment before EVM testing. (Detailed instructions to achieve equivalent amplitudes are explained later in this section) Note: while running "The Host or Device Tx Loopback only" tests Wireless USB-CV will automatically perform a channel change.

5.7.6. The first four EVM test modes using Rates 53.3, 106.7 & 200 are required per channel for certification. Time permitting, it is encouraged to run all channels and data rates supported by the device. Save one waveform per "EVM Test Mode". Pass criteria is displayed using the EVM tool. The tool also generates an HTML log file.

5.7.7. Note: If a failure occurs, record **three** waveforms for each failing channel and data rate. If adjustment to the antenna orientation is made (discussed later in this section), then record each channel and data rate again.

Automated EVM Test Modes

1. TFC1, Rates 53.3, 106.7, 200, 480
2. TFC7; Rates 53.3, 106.7, 200, 480
3. TFC5; Rates 53.3, 106.7, 200, 480
4. TFC6; Rates 53.3, 106.7, 200, 480
5. Test the remaining TFC2-4 Rates 53.3, 106.7, 200, 480
6. Test the remaining device supported rates

5.7.8. From the test suite window, select the appropriate EVM test mode resembling the automated EVM test modes referenced in section 5.7.7.

5.7.9. Note: **Compliance Test** modes are recommended with advanced scope triggers by default. The test application is setup to transmit 10K packets for each test iteration. Select **Debug** mode for manual trigger methods. If a reliable waveform acquisition was not acquired with the manual scope trigger method, repeat the WUSB-CV test mode.

1. **TD_7_53 Data loopback Supported Rate Test:** Used to verify what rates the DUT supports when an adequate distance is placed between the association device's antenna and the DUT for adequate distance reference refer to section 5.6.
2. **The Data Loopback Test** is used for setup and diagnostics. It provides customizable TX parameters.
3. In the next window, select the "Device Tx Data Only" for DWA/native device or "Host Tx Data Only" for HWA/host, and then click OK for antenna positioning. The next window will ask for a max packet size, use Table 1 below to select the minimum packet size to be transmitted. Larger packet sizes, up to the device maximum can be entered if desired. Once a value is entered select "DONE".

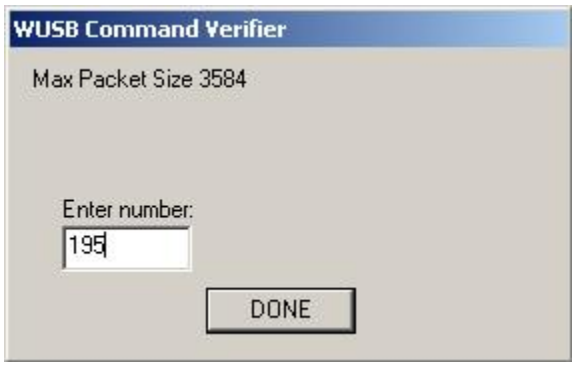
5.7.10. Run the selected test iteration, next select OK to initialize the hardware. If the DUT does not auto connect, press the manual connection button indicated by the vendor documentation.

5.7.11. CV will insert the appropriate number of symbols per packet to insure the payload can be measured by the EVM tool. If a waveform was not captured, rerun the same test. The test mode can also be interrupted while transmitting each test packet by selecting Esc twice between a reported data transfer. This type of interruption may require a WUSB-CV restart.

Number of Bytes for each Rate to Produce a 96 Symbol Payload

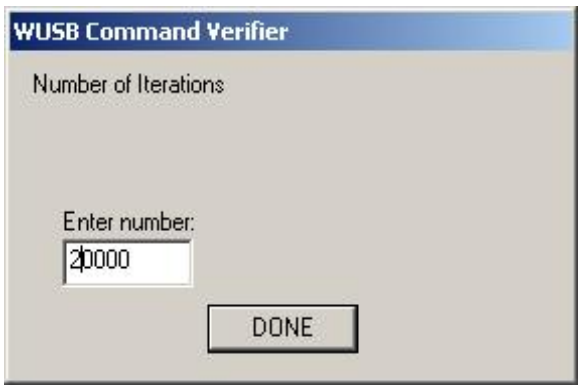
Rate	Num Payload Bytes (dec)	Num Payload Bytes (hex)
53.3	195	C3
106.7	395	18B
200	745	2E9
320	1195	4AB
400	1495	5D7
480	1795	703

5.7 Table 1



5.7 Figure 4

5.7.12. The next window will ask for the number of iterations. This value represents the number of packets transmitted by the device. On the first run enter 20000, this value can be adjusted up or down on subsequent executions for more efficient data collection. Once the value is entered, select “DONE” to continue.



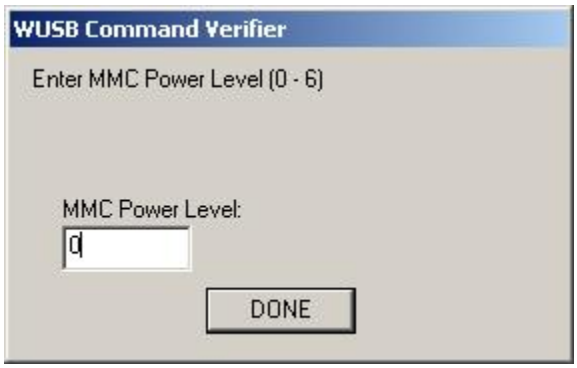
5.7 Figure 5

5.7.13. The PHY Rate refers to the data rate to be measured. Be sure this value coincides with the packet size chosen from table 1. It is recommended to choose the lowest data rate, 53.3Mb/s, as a starting point. Once the value is selected, select “OK” to continue.

5.7 Figure 6

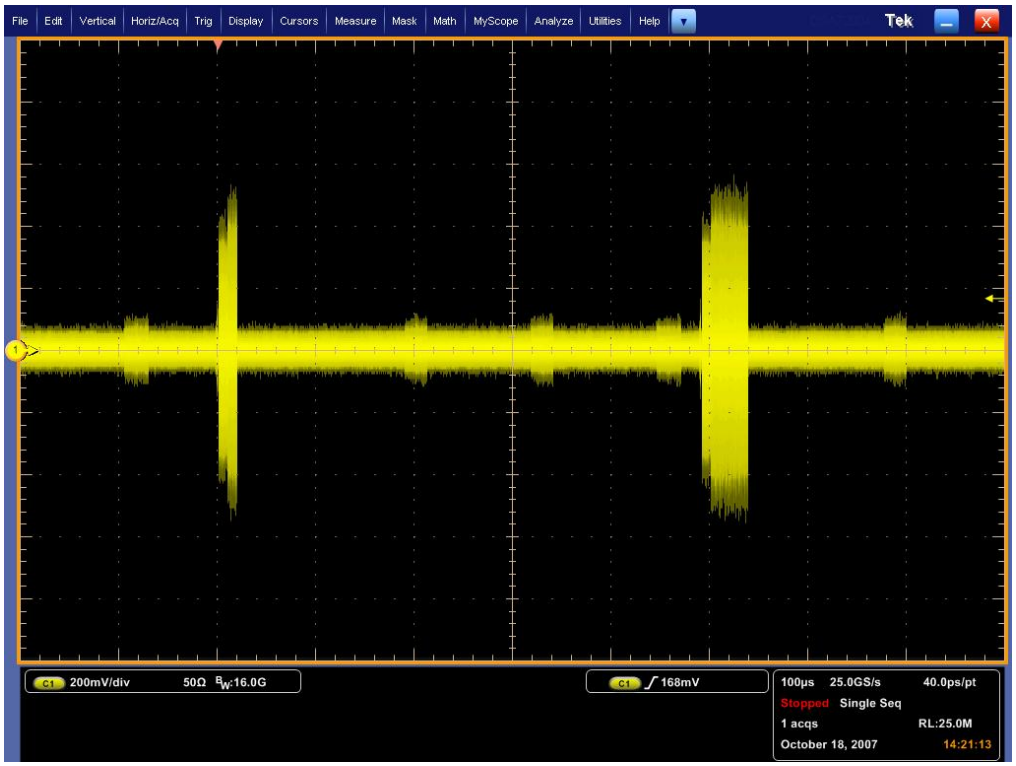
5.7.14. The next two windows will ask for MMC and device power levels respectively. For the purposes of EVM testing, zero should be entered for both windows. Select “DONE” in both windows to continue.

5.7.15. Note: A functional power level test is required for each WUSB device. A waveform power level comparison can be verified using the HTML log file generated by the EVM tool. Record data for the adjusted power level and compare the results. When power level testing refer to the Wireless USB specification for specific power level settings. Each PL (0-6) coincides with the specification, providing a range of 7 settings.

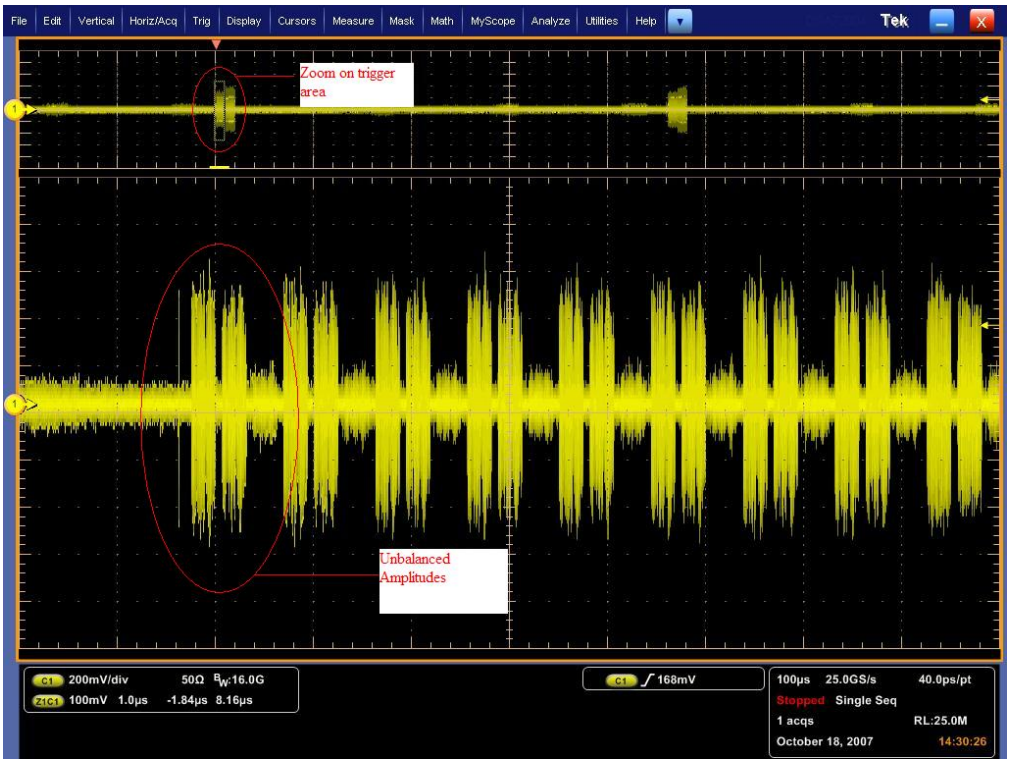


5.7 Figure 7

5.7.16. The DUT will now transmit packets using the automated test mode or at the specified data rate for the specified number of iterations. Once you select Run/Stop on the oscilloscope, packets of information will begin displaying on the screen. Observe the smaller amplitude transmissions from the WHCI/associating device, which is positioned further from the receiving antenna. The larger amplitude bursts contain data packets, beacons and MMC's. Refer to figure 8. Press the oscilloscope "Stop" button, then use the oscilloscope's zoom controls to zoom in on the first 10 to 30 symbols of the triggering area. You can now see the symbol amplitudes. Refer to figure 9.

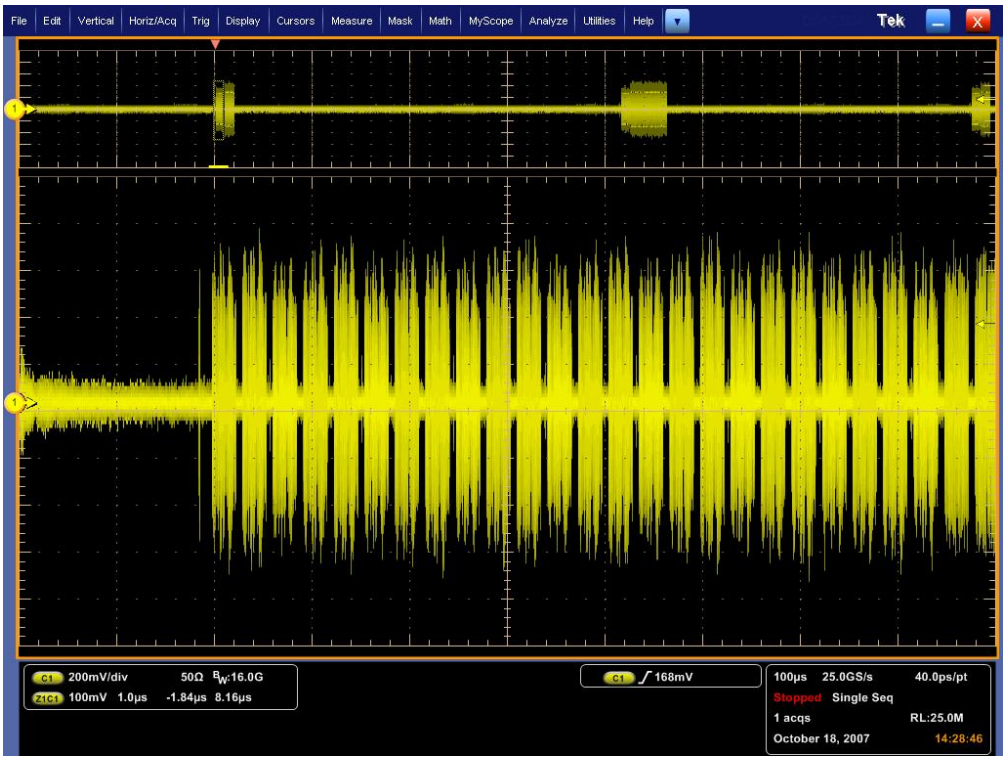


5.7 Figure 8



5.7 Figure 9

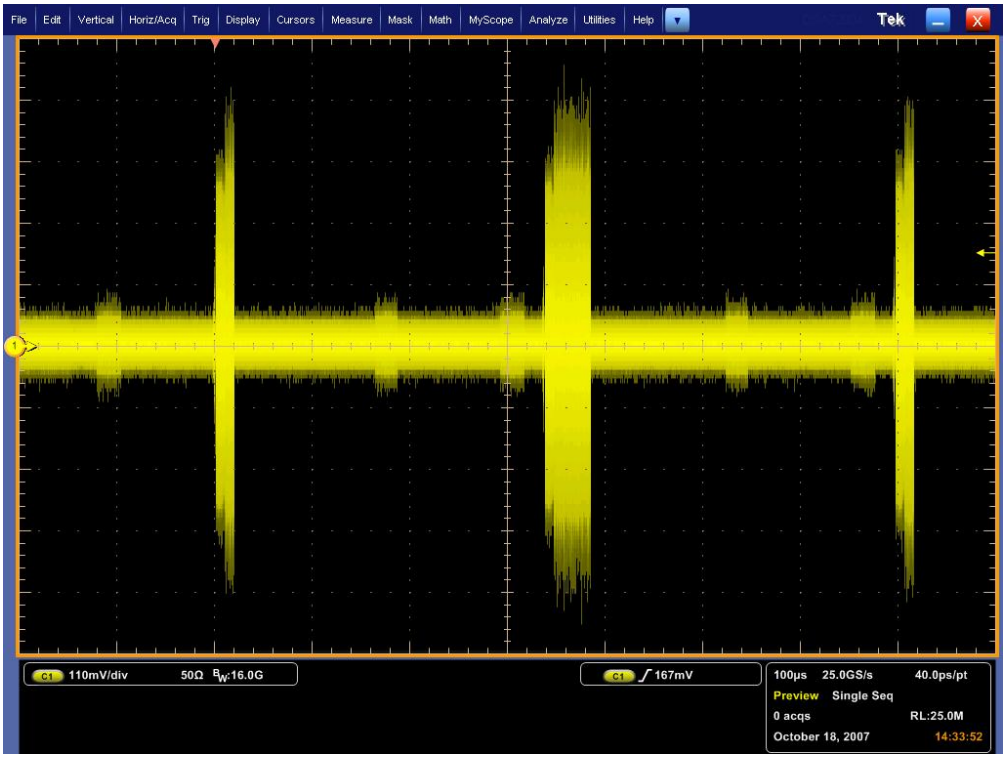
5.7.17. Each symbol represents one frequency band within the band group. For TFC1, symbol one represents band one, symbol two represents band 2, etc. It is important to insure that each band has equivalent amplitudes. If the amplitudes are not equal, begin rotating the receiving antenna in a clock wise manner until the amplitudes level out. If this does not achieve the desired effect, it may be necessary to move the receiving antenna up or down, relative to the DUT antenna. Refer to figure 10.


File Edit Vertical Horiz/Acq Trig Display Cursors Measure Mask Math MyScope Analyze Utilities Help
Tek
C1 200mV/div 50Ω BW:16.0G
Z1C1 100mV 1.0µs -1.84µs 8.16µs
C1 168mV
100µs 25.0GS/s 40.0ps/pt
Stopped Single Seq
1 acqs RL:25.0M
October 18, 2007 14:28:46

5.7 Figure 10

5.7.18. Once the amplitudes are equal across all bands, adjust the vertical resolution on the scope such that the packet amplitude extends to one division from the top and bottom of the display. This takes maximum advantage of the A/D converters within the oscilloscope. However, it is very important to insure the signal does not extend vertically outside the viewing area.

5.7.19. At this acquisition rate, beacons will appear as very narrow bursts while data packets will appear approximately five times wider (depending on the data rate and selected payload size). If you can not see beacons and data packets on the same display, it may be necessary to adjust the oscilloscope's horizontal time scale. See figure 8. Only the 96 symbol packets are used for WiMedia and Certified Wireless USB testing, therefore it is necessary to insure these packets are saved for processing. This can be done by randomly hitting run until the packet is captured or triggering can be setup to deterministically capture the signal, the latter is the recommended method.



5.7 Figure 11

5.7.20. If the test finishes before the setup is complete, rerun the loopback test. It needs to be running the entire time to make sure there is a signal to acquire.

5.7.21. Use the single step feature of the oscilloscope to freeze the incoming wave on the display. Continue to do this until at least one entire data packet can be seen. At this point, you can save the waveform in the oscilloscope's native format (.wfm, .bin, .tfc, etc.). Use the file naming structures located in section 5.8 to name the waveforms. These files will need to be stored on the computer running the EVM tool. See section 6 for operation of the EVM Tool software.

5.8. Saving Scope Waveform Data

5.8.1. The file name should contain all pertinent information about the acquisition, including: TFC, data rate, and acquisition sample rate (in giga-samples per second). An identifier for the device under test is optional (The product TID number is recommended, however if this is not available use the product model number). NOTE: If the unique file name is not included, all files for a single device must be saved in a unique folder to avoid confusing data from different devices. The syntax is as follows (case is not important; any combination of lower and upper case is allowed):

1. PHY1_TFC4_BPS053_GSS20_TID-10000001.txt (text file or csv, tsv file).
2. PHY5_tfc6_Bps480_gss20_SNDeviceName.wfm (Tektronix wfm format).

Syntax	Description	Example
tfcX	X is one of 1, 2, 3, 4, 5, 6, 7 (TFC1 – TFC4 are TFI modes, TFC5 – TFC7 are FFI modes)	tfc1 TFC5
bpsXXX	XXX is one of 053, 080, 106, 160, 200, 320, 400, 480 (the data rate in bits per second)	bps053 BPS106
gssXX	XX is one of 20, 25, 40 or other value determined by scope (giga samples per second)	gss20 GSS25
tpcXX	XX is one of 0, 2, 4, 6, 8, 10, 12 (transmit power control, 0 to -12dB attenuation)	tpc0 TPC2
phyXX	XX is a number between 0 and 20 inclusive or a letter from a to z (identifies the PHY being used)	phy1 PHYA
bXXXX	XXXX is a number between 1 and 8192 (number of bytes in payload)	b256 B4096
symXXXX	XXXX is a number between 1 and1024 (number of symbols in payload)	sym96 SYM256
br	When present, indicates packet or packets were transmitted in burst mode	br BR
snXXXX	XXXX is a number between 0 and 2048 (a sequence number)	sn0000 SN1

5.8 Chart 1

5.8.2. The TFC can be detected from the data but the BPS always needs to be specified to make sure the correct EVM computation is done.

5.8.3. If the file name does not contain the necessary information, it will need to be entered via controls on the analysis tool before the data is tested.

6. EVM Software Operation

6.1. Operating EVM Software

6.1.1. Running the EVM application causes the main window to appear. This document covers testing in the "default" mode, for operation in the "debug" mode refer to the EVM Tool software manual. (The EVM Tool Software is installed with the EVM tool application)

6.1.2. Several tests can be performed including:

6.1.2.1. Burst packet timing (verifies MIFS timing between packets in burst mode),

6.1.2.2. Preamble symbol count (there must be either 12 or 24 symbols in the preamble),

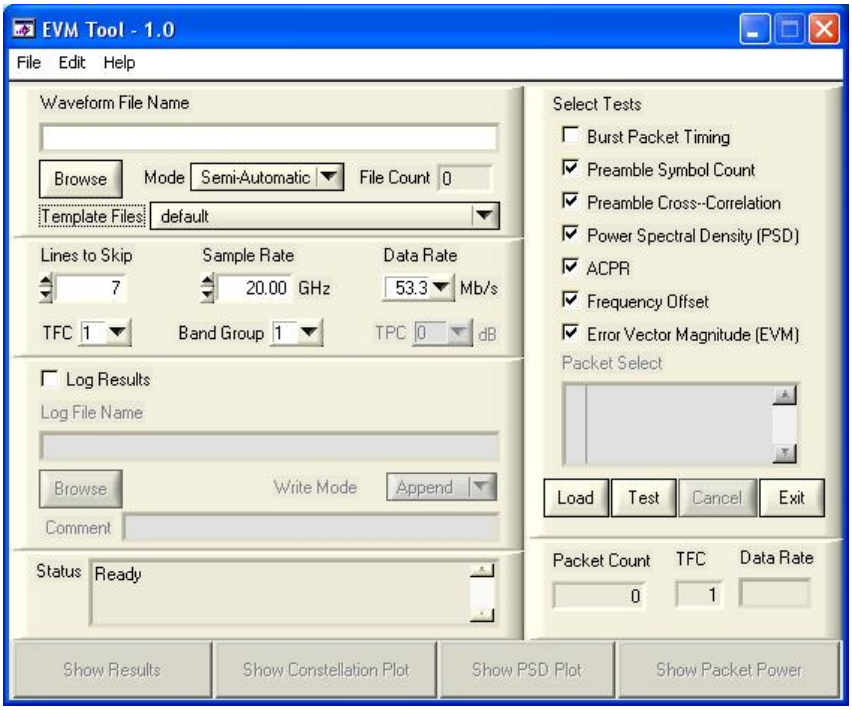
6.1.2.3. Preamble cross-correlation (cross-correlation of symbols must exceed 87%).

6.1.2.4. Power Spectral Density (PSD) (power spectrum must fit within defined mask).

6.1.2.5. Adjacent Channel Power Ratio (ACPR) (the ratio of power in band to power out of band must exceed 20).

6.1.2.6. Frequency offset (carrier frequencies must be within 20 parts per million of specification).

6.1.2.7. Error Vector Magnitude (EVM) (error magnitude in dB must not exceed limit based on transmit data rate).

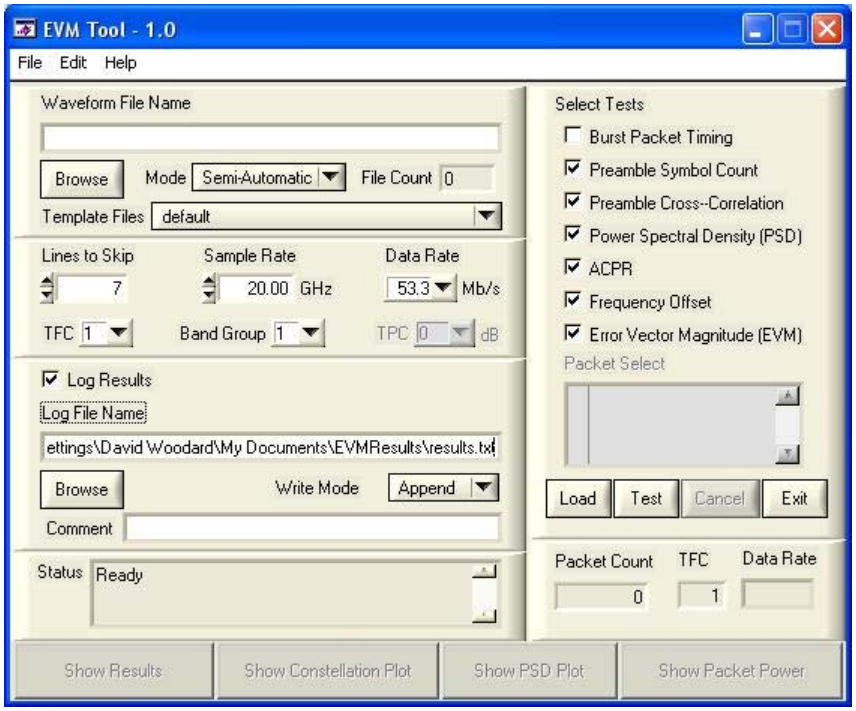


6.1 Figure 1

6.1.3. For the demonstration in this document, all tests are performed with the exception of Burst Packet Timing. Select "Semi-Automatic" from the mode drop down menu. Also make sure "default" is located in the Template File drop down menu.

6.1.4. A text file will log the results of the test by placing a check in the Log Results block. If a file exists, click browse to choose the desired output file. If no file exists, enter the path to where the output will be

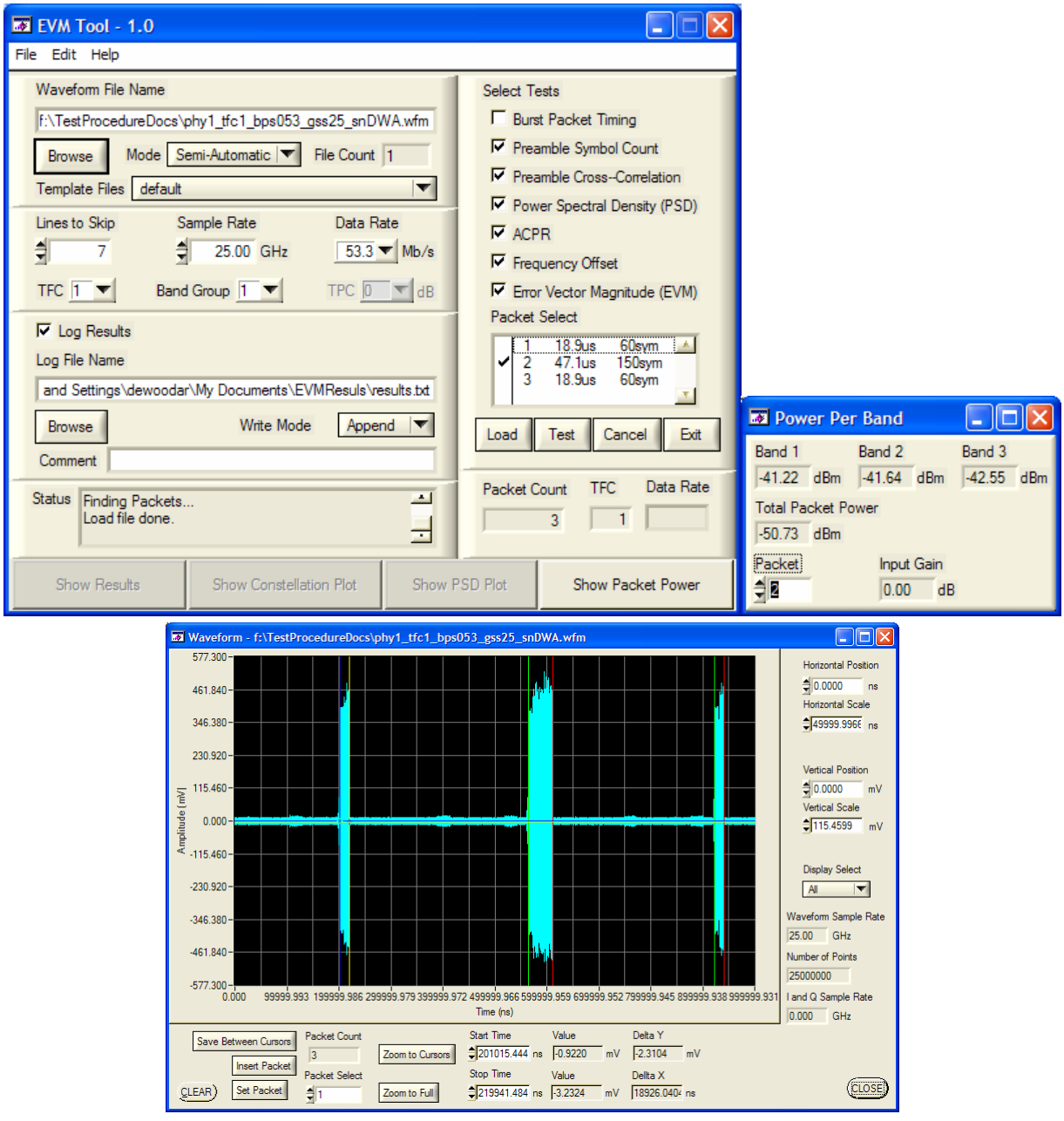
saved and include the log file name (ex: Results.txt). Write mode allows you the ability to add to or overwrite an existing file.



6.1 Figure 2

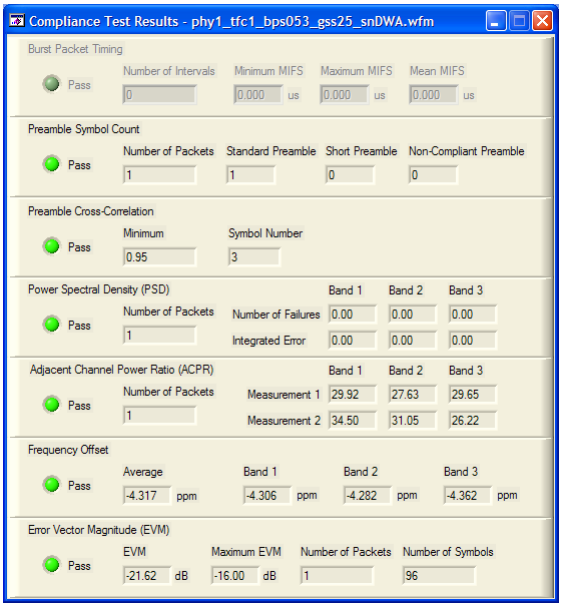
6.1.5. Underneath the waveform file name window, click the browse button to locate the waveform to be tested. Once the waveform is located, click “add”, then click “OK”. This will cause two new windows to appear, one showing the waveform and the other showing power information. This is a good chance to verify that the power across the three bands are within 2-3dB of each other while in TFI modes.

6.1.6. At this point the packet select window is also propagated. Any packets with a check will be processed during testing. All data packets are automatically checked, if you have multiple data packets you may choose to test all or only specific packets by adding or removing the check marks. Once the packet(s) to be tested are identified, click the “Test” button.



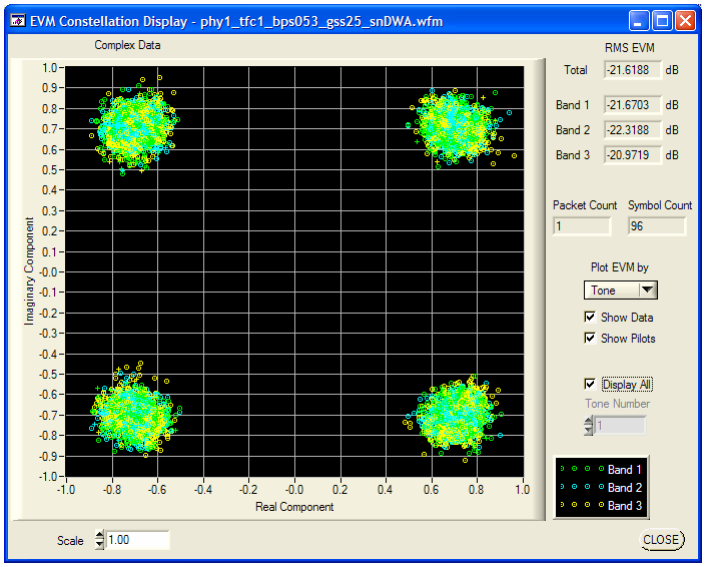
6.1 Figure 3

6.1.7. Once the testing algorithms have finished, a compliance test results window appears. This window displays pass or fail status along with numerical results from the tests.

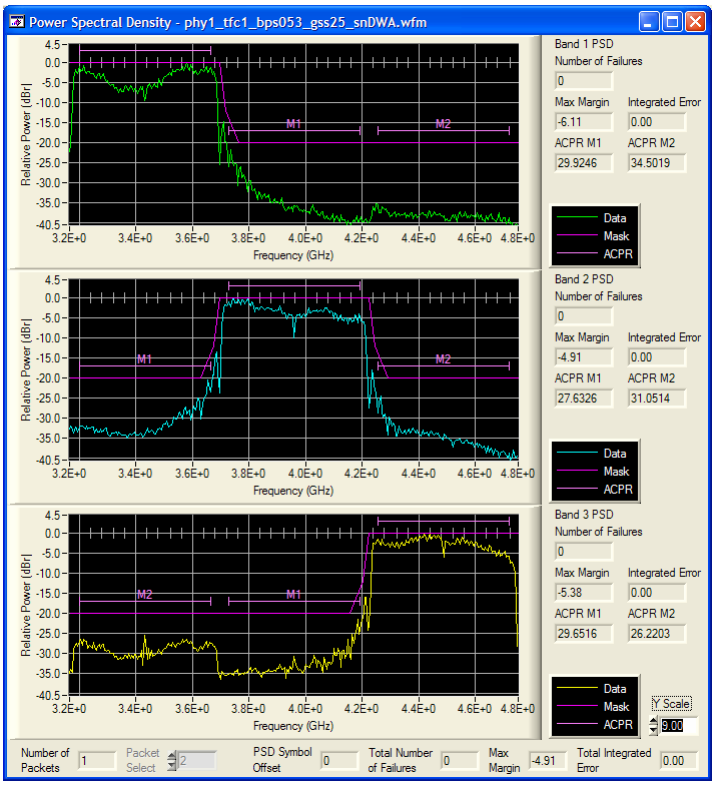


6.1 Figure 4

6.1.8. Buttons are located across the bottom of the main panel to allow viewing of graphical results related to the tests. “Show Packet Power” and “Show Results” are open by default. Clicking “Show Constellation Plot” or “Show PSD Plot” produces the graphical displays shown in figures 5 and 6 respectively.



6.1 Figure 5



6.1 Figure 6

6.2. Log File and HTML Results

6.2.1. If the “Log Results” box was checked at the beginning of testing, a text was created in the desired directory. An example of this results file is show in figure 7 below.

Fri Oct 19 09:23:01 2007

File	Total Packet Power	Power Per Band			EVM	Sync XCorr	XCorr Index	PSD Mask	Max Margin	ACPR Band 1		ACPR Band 2		ACPR Band 3		Freq Offset
		Band1	Band2	Band3						M1	M2	M1	M2	M1	M2	
phy1_tfc1_bps053_gss25_snDWA	-46.77	-37.27	-37.68	-38.56	-21.62	0.95	3	0	-4.91	29.92	34.50	27.63	31.05	29.65	26.22	-4.32
phya_tfc1_bps053_gss20	-55.01	-46.31	-46.60	-48.39	-17.80	0.98	8	7	* 13.48	26.85	30.91	26.71	30.80	22.13	23.65	-7.74

6.2 Figure 7

6.2.2. This file is useful for keeping a running compilation of all tests done on a single device. Any failures by the device are noted by and asterisk (*) to the left of the failing value.

6.2.3. Also created in this directory is a HTML file for each waveform tested. This file also contains all relevant results with pass/fail information.

6.2.4. For more information regarding options and functionality of the EVM Tool software, please see the EVM Tool documentation.

For more information, contact USB-IF at **admin@usb.org**