Communications Technology Laboratory
Wireless Networks Division

National Institute of
Standards and Technology

Instructions for Running the RF Sensor Test Harness

Introduction

This document is a step-by-step set of instructions for downloading and operating the RF Sensor Test Harness. The RF Sensor Test Harness consists of a Python web server, LabVIEW server (LabVIEW player), and a web browser. The player accepts the waveforms via HTTP, converts the binary waveform files to TDMS (a LabVIEW specific file format), and plays the waveforms.

Hardware Prerequisites[1]

- National Instruments PXIe-1085 (chassis)
- National Instruments PXIe-8880 (controller)
- National Instruments PXIe-5646 (VST)

Software Prerequisites

- Windows 7 or higher
- LabVIEW 2017
  - An FPGA bit file is needed to run the modified version of the VST Player. The bit file is included with an installation of “NI Streaming Host Example for the NI PXIe-5644R-45R” which is available online via the JKI Package Manager.
- Python 2.7 with the following packages:
  - Flask 0.12
  - Requests
  - Pycurl 7.43

Procedure

Download the RF Sensor Test Harness master branch from https://github.com/usnistgov/RF_Sensor_Test_Harness. Expand the compressed file to the controller (PXIe-8880) hosting LabVIEW.

1) **Starting the RF Sensor Test Harness (Python Server, LabVIEW player, and web browser)**
   a) Locate and double click the “StartUp.bat” file located in the “RF Sensor Test Harness master” folder as shown in Figure 1.
      - The Python status window will appear as shown in Figure 1a.
      - The LabVIEW player will appear as shown in Figure 2a.
      - A web browser will be launched automatically.

   b) Start the LabVIEW player by right clicking on the “v1” as shown in Figure 2a. Select “Start” to initiate the session (Figure 2b). A Debug web service window will appear as shown in Figure 3. Click “OK”.
      - The RF Sensor Test Harness user interface (web browser) is already launched and will appear as shown in Figure 4.

[1] Certain commercial equipment, instruments, or materials are identified in this document in order to specify the procedure adequately. Such identification is not intended to imply recommendation or endorsement by the National Institute of Standards and Technology, nor is it intended to imply that the materials or equipment identified are necessarily the best available for the purpose.

- Press “log in”. The default user name and password are “admin” and “default”.

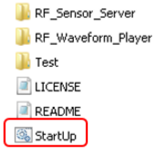
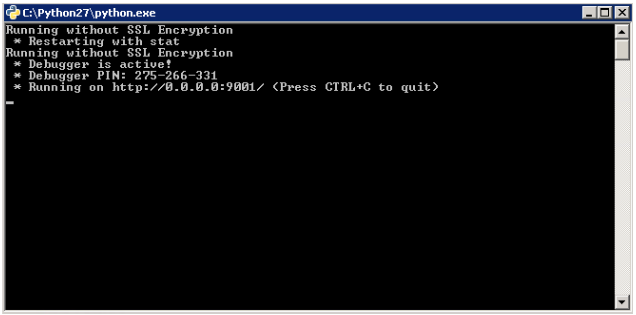


Figure 1: Start up in directory



```
Running without SSL Encryption
 * Restarting with stat
Running without SSL Encryption
 * Debugger is active!
 * Debugger PIN: 275-266-331
 * Running on http://0.0.0.0:9001/ (Press CTRL+C to quit)
```

Figure. 1a: Python window

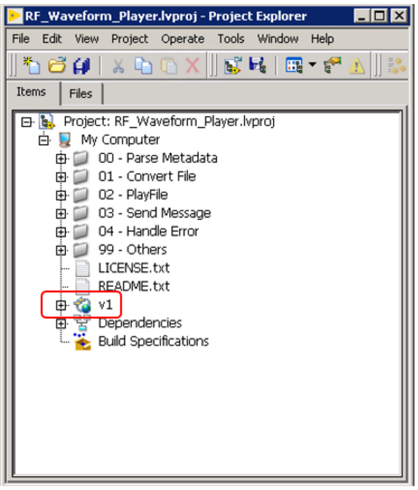


Figure 2a: LabVIEW project window

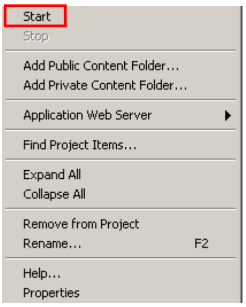


Figure 2b: Start up LabVIEW player

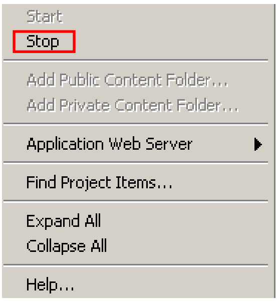
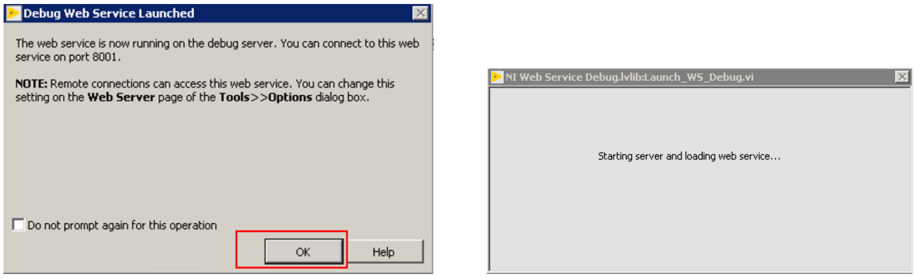


Figure 2c: Stop LabVIEW player


Debug Web Service Launched

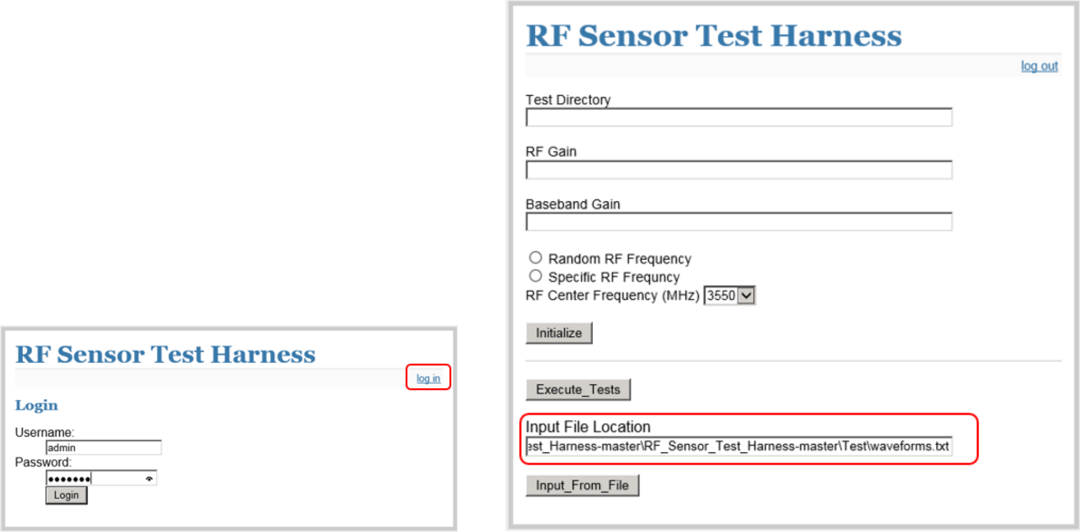
The web service is now running on the debug server. You can connect to this web service on port 8001.

NOTE: Remote connections can access this web service. You can change this setting on the **Web Server** page of the **Tools>>Options** dialog box.

□ Do not prompt again for this operation
OK
Help
NI Web Service Debug.lvlib:Launch_WS_Debug.vi

Starting server and loading web service…

Figure 3: LabVIEW Debug window



RF Sensor Test Harness

log in

Login

Username: admin

Password: •••••••

Login

RF Sensor Test Harness

log out

Test Directory

RF Gain

Baseband Gain

○ Random RF Frequency

○ Specific RF Frequncy

RF Center Frequency (MHz) 3550

Initialize

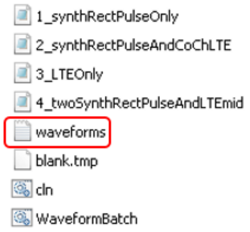
Execute_Tests

Input File Location

est_Harness-master\RF_Sensor_Test_Harness-master\Test\waveforms.txt

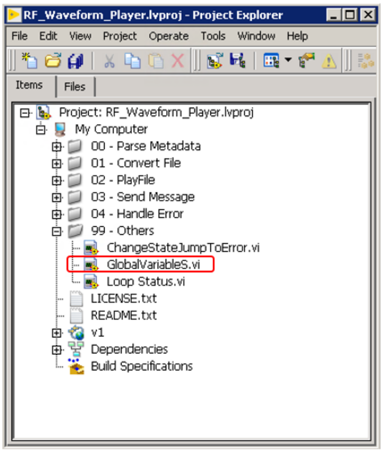
Input_From_File

Figure 4: RF Sensor Test Harness user interface



1_synthRectPulseOnly
2_synthRectPulseAndCoChLTE
3_LTEOnly
4_twoSynthRectPulseAndLTEmid
waveforms
blank.tmp
cln
WaveformBatch

Figure 5: waveforms.txt file



RF_Waveform_Player.lvproj - Project Explorer

Project: RF_Waveform_Player.lvproj
My Computer
00 - Parse Metadata
01 - Convert File
02 - PlayFile
03 - Send Message
04 - Handle Error
99 - Others
ChangeStateJumpToError.vi
GlobalVariableS.vi
Loop Status.vi
LICENSE.txt
README.txt
v1
Dependencies
Build Specifications

Figure 6: Location for global variables status

2) **Playing the waveforms**

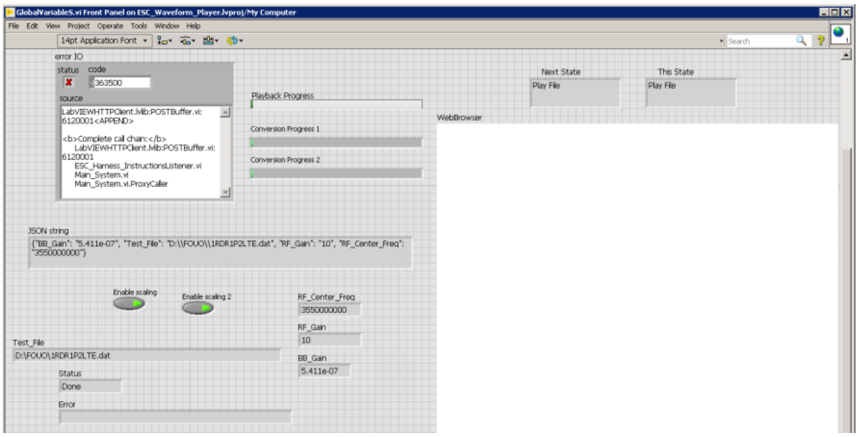
a) Locate the “waveforms.txt” file located in your “Test” folder. See Figure 5.

- Enter the full path of the “waveforms.txt” file into the “Input File Location” field of the user interface and press “Input_From_File” to play the waveforms as shown in Figure 4.

The initial run of the RF Sensor Test Harness will convert the included waveforms from binary (.dat) to .tdms format prior to playing the waveforms. As a result, there will be a delay of 60 s before the waveforms play. Once each of the waveforms is converted to .tdms, each waveform will play sequentially with no delay. The new TDMS files will appear in the “Test” directory as shown in Figure 8.

The status of the waveform conversions and waveform playing can be monitored on the GlobalVariables.vi Front Panel.

b) Go to the LabVIEW project and expand the folder “99 – Others”. Double click the “GlobalVariables.vi”. The GlobalVariables.vi front panel will appear as shown in Figure 7.



GlobalVariables.vi Front Panel on ESC_Waveform_Player.lvproj/My Computer

error IO
status ✘ code 363500
source
LabVIEWHTTPClient.lvlib:POSTBuffer.vi:
6120001<APPEND>

<b>Complete call chain:</b>
    LabVIEWHTTPClient.lvlib:POSTBuffer.vi:
6120001
    ESC_Harness_InstructionsListener.vi
    Main_System.vi
    Main_System.vi.ProxyCaller

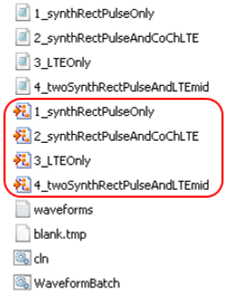
Next State: Play File
This State: Play File

JSON string
{"BB_Gain": "5.411e-07", "Test_File": "D:\\FOUO\\1RDR1P2LTE.dat", "RF_Gain": "10", "RF_Center_Freq": "3550000000"}

Test_File: D:\FOUO\1RDR1P2LTE.dat
Status: Done
Error:
RF_Center_Freq: 3550000000
RF_Gain: 10
BB_Gain: 5.411e-07

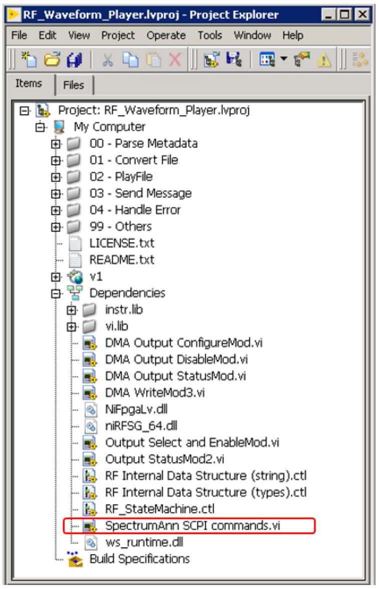
Figure 7: Status of waveform playback

Note: the waveforms can be viewed on your spectrum analyzer. See optional step 5 for configuring your spectrum analyzer.



1_synthRectPulseOnly
2_synthRectPulseAndCoChLTE
3_LTEOnly
4_twoSynthRectPulseAndLTEmid
1_synthRectPulseOnly
2_synthRectPulseAndCoChLTE
3_LTEOnly
4_twoSynthRectPulseAndLTEmid
waveforms
blank.tmp
cln
WaveformBatch

Figure 8: TDMS files



RF_Waveform_Player.lvproj - Project Explorer

Project: RF_Waveform_Player.lvproj
    My Computer
        00 - Parse Metadata
        01 - Convert File
        02 - PlayFile
        03 - Send Message
        04 - Handle Error
        99 - Others
        LICENSE.txt
        README.txt
        v1
        Dependencies
            instr.lib
            vi.lib
            DMA Output ConfigureMod.vi
            DMA Output DisableMod.vi
            DMA Output StatusMod.vi
            DMA WriteMod3.vi
            NiFpgaLv.dll
            niRFSG_64.dll
            Output Select and EnableMod.vi
            Output StatusMod2.vi
            RF Internal Data Structure (string).ctl
            RF Internal Data Structure (types).ctl
            RF_StateMachine.ctl
            SpectrumAnn SCPI commands.vi
            ws_runtime.dll
        Build Specifications

Figure 9: Location of SCPI commands

3) **Stopping the RF Sensor Test Harness (Python Server, LabVIEW player)**

- To stop the Python web server, select the running Python screen as shown in Figure 1a. Press “Ctrl + C”.
- To stop the LabVIEW player, right-click on “v1” as shown in Figure 2c. Select “Stop”.

4) **Customizing the waveform parameters (optional)**

- The waveforms.txt file included in the download uses the following convention:
  <Path> \waveform.dat, Center Frequency, Scale Factor, Waveform Gain

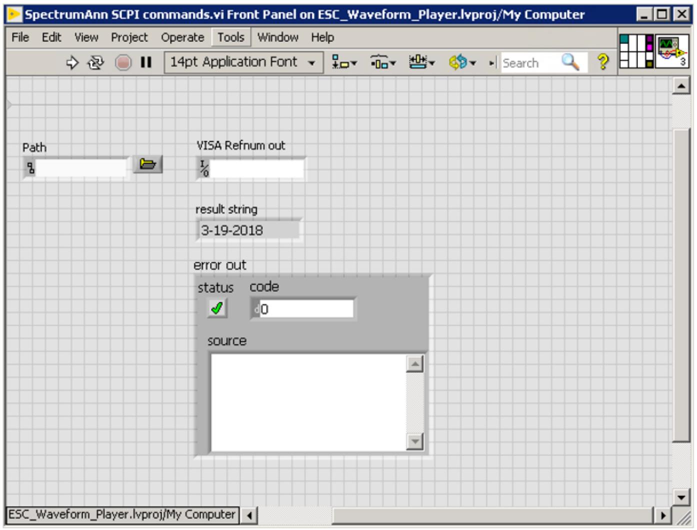
- The included “WaveformBatch.bat” file can be used to create a new waveforms.txt file. Change the center frequency, scale factor, and waveform gain located in the WaveformBatch.bat file and save the file.
- Double-click the updated batch file to create a new waveforms.txt file.
- Repeat step 2a to play the updated waveforms.

5) **Configuring your spectrum analyzer (optional)**

The spectrum analyzer settings are controlled with SCPI commands. The address for the VISA connection will need to be changed.

- To change the VISA address, go to the LabVIEW Project Explorer, expand the Dependencies tab.
- Locate and open the "SpectrumAnn SCPI commands.vi" as shown in Figure 9.
- Enter the VISA address for your instrument. See Figure 11.
- Expand the menu in the case structure to reveal the spectrum analyzer settings for the different waveforms as shown in Figure 12.

If manual configurations are preferred, the "local" key on the spectrum analyzer will end the remote session.


SpectrumAnn SCPI commands.vi Front Panel on ESC_Waveform_Player.lvproj/My Computer
File
Edit
View
Project
Operate
Tools
Window
Help
14pt Application Font
Search
ESC_Waveform_Player.lvproj/My Computer

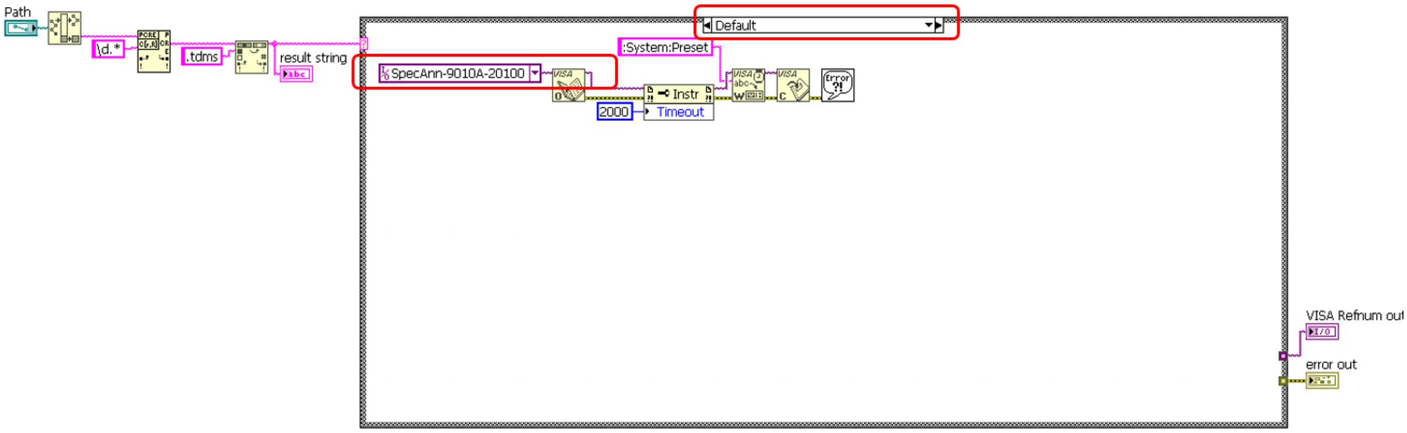
Path

VISA Refnum out

result string
3-19-2018

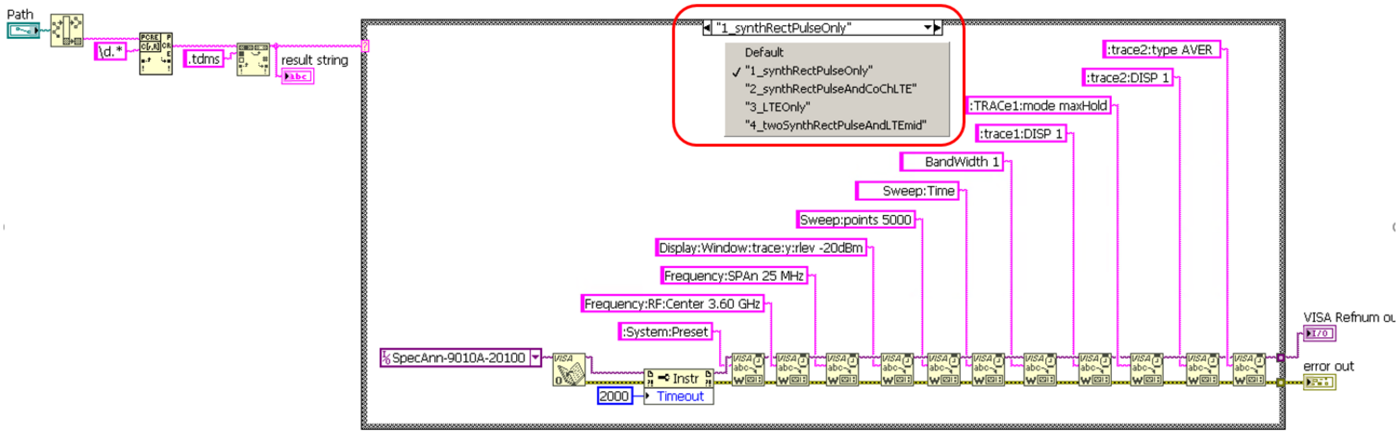
error out
status ✓
code 0
source

Figure 10: Spectrum analyzer configuration front panel



```
:System:Preset
```

Figure 11: Spectrum analyzer settings



```
:trace2:type AVER
:trace2:DISP 1
:TRACe1:mode maxHold
:trace1:DISP 1
BandWidth 1
Sweep:Time
Sweep:points 5000
Display:Window:trace:y:rlev -20dBm
Frequency:SPAn 25 MHz
Frequency:RF:Center 3.60 GHz
:System:Preset
```

Figure 12: Spectrum analyzer settings

Technical Contacts

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Dr. Michael Souryal, souryal@nist.gov

LIST OF ACRONYMS

FPGA	field programable gate array
HTTP	hypertext transfer protocol
PCI	Peripheral Component Interconnect
PXIe	PCI extensions for instrumentation
RF	radio frequency
SCPI	Standard Commands for Programmable Instruments
TDMS	Technical Data Management System
VISA	Virtual Instrument Software Architecture
VST	vector signal transceiver