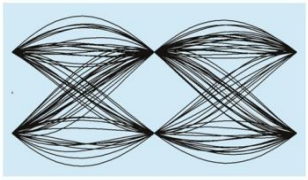


MaxEye Digital Video Signal Generation Toolkit

DVB-T2

Version 1.2.0.2

Getting Started Guide

MAXEYE TECHNOLOGIES

Contents

For more information please contact info@maxeyetech.com

MAXEYE TECHNOLOGIES

1. Introduction

MaxEye Technologies provides generation functions in LabVIEW for generating the standard complaint signals for various digital video broadcasting standards. This guide explains how to use the DVB-T2 signal generation toolkit using the programming examples.

2. Installed File Location

The example VIs are installed in, <LabVIEW>\examples\MaxEye\Digital Video Toolkits\DVB-T2Generation(Multiple PLP).

The toolkit API files are installed in, <LabVIEW>\vi.lib\addons\MaxEye\Digital Video Toolkits\DVB-T2Generation(Multiple PLP)\Generation\API.

The toolkit help fileis installed in, <LabVIEW>\help\MaxEye\Digital Video Toolkits\DVB-T2 Generation(Multiple PLP)\ DVB-T2 Multiple PLP Signal Generation Help.chm.

The other documentation files are installed in, <LabVIEW>\vi.lib\addons\MaxEye\Digital Video Toolkits\DVB-T2 Generation(Multiple PLP)\Generation\Documentation

You can also find a shortcut to the above location from the windows start menu.

Start->All Programs->MaxEye->Digital Video Toolkits->DVB-T2 Generation(Multiple PLP)

3. Programming Examples

The DVB-T2Signal generation toolkit contains examples for performing the following

i. Creating the waveform based on the standard specific user input parameters and then downloads the waveform to NI RFSG.
ii. Creating the waveform based on the standard specific user input parameters and then writes the waveform to the file.
iii. Playing the waveform using NI RFSG and NI USRP.

For more information please contact info@maxeyetech.com

iv. Creating multi-carrier signal; reads the stored waveform from the files and then combines the waveforms into one multi-carrier waveform based on the centre frequencies of each waveform. The resulting multi-carrier waveform is stored in a file.

The programming examples are created using the LabVIEW API VIs. For more information about the API VI used in the example VIs refer to the **MaxEye DVBT2Multiple PLP Signal Generation Help.chm** document, accessible at **Start->All Programs->MaxEye->Digital Video Toolkits->DVBT2Generation(Multiple PLP) -><LabVIEW>->Generation->Documentation**.

3.1. Create and Download Waveform

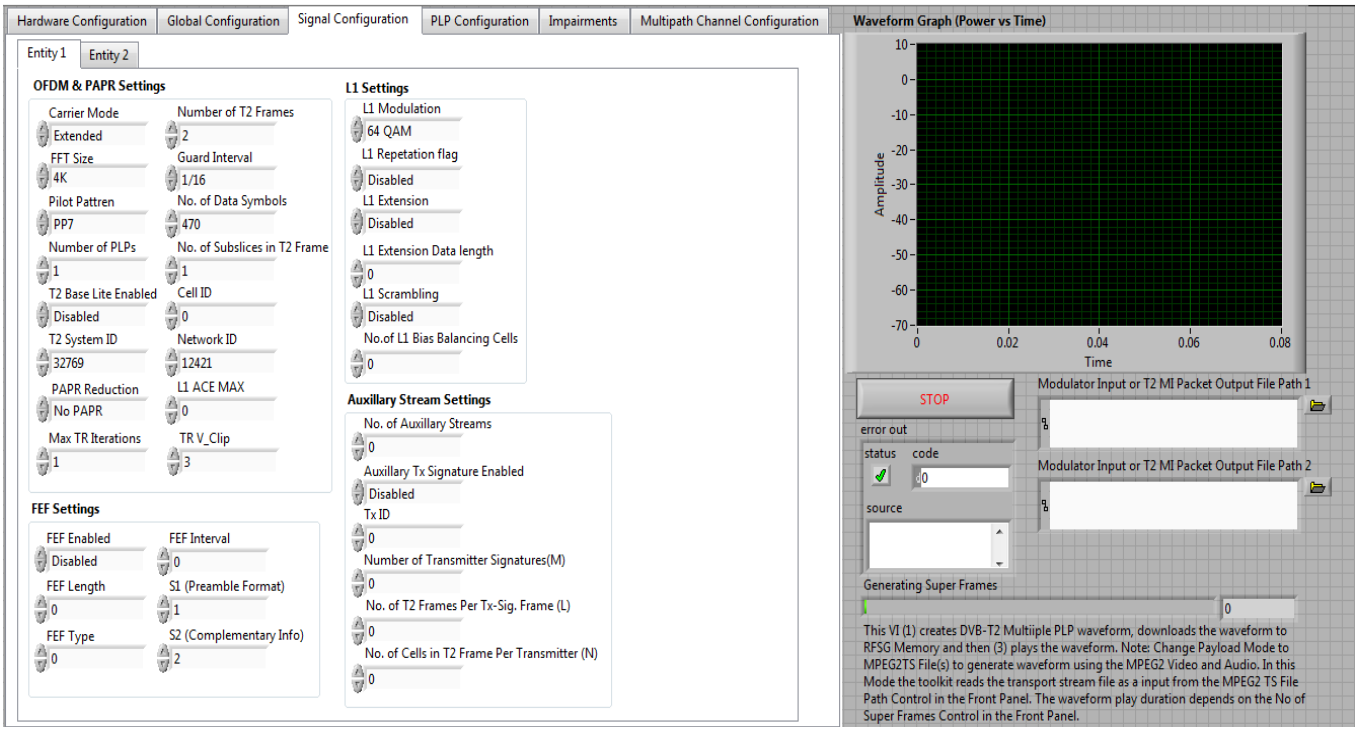
The DVB-T2 system transmits compressed digital audio, video and other data in "physical layer pipes" (PLPs), using OFDM modulation with concatenated channel coding and modulation. The DVB-T2 Generation Toolkit from MaxEye Technologies supports ETSI EN 302 755 V1.3.1 (2012-14), "Digital Video Broadcasting (DVB); Frame structure, channel coding and modulation for a second generation digital terrestrial television broadcasting system (DVB-T2)".

3.1.1 MaxEye DVB-T2 RFSG Generate Multiple Frames

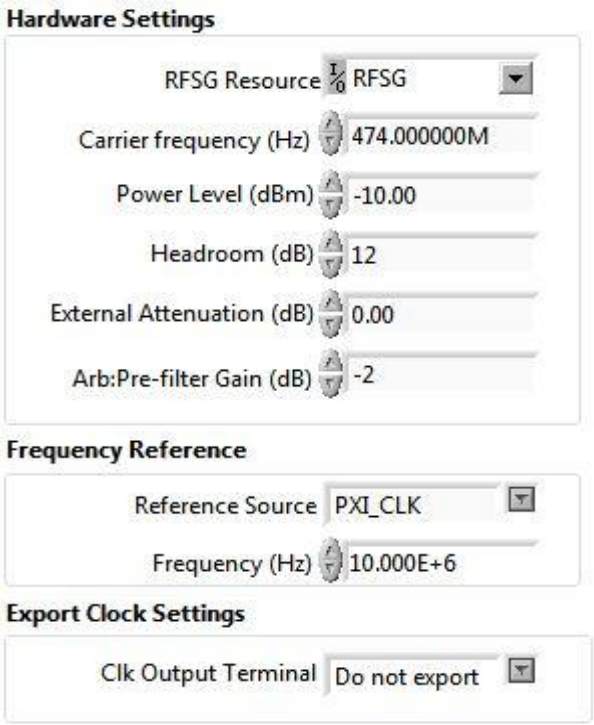
This Example is used to generate multiple DVB-T2 super frames, download the waveform to the RFSG memory and then play the waveform from the memory continuously. The figure below shows the front panel of the Example VI.

The user configurations are divided in to the following categories,

i. Hardware Configuration
ii. Global Configuration
iii. Signal Configuration
iv. PLP Configuration
v. Impairments
vi. Multipath Channel Configuration



3.1.1.1 Hardware Configuration



RFSG Resource – Configure the resource name used in NI Measurement and Automation explorer for the NIPXIe-5673/5673Eor NI PXIe-5672 or NIPXIe-5644R/5645R/5646Rdevices.

CarrierFrequency(Hz)–Center Frequency of theDVB-T2signal in Hz.

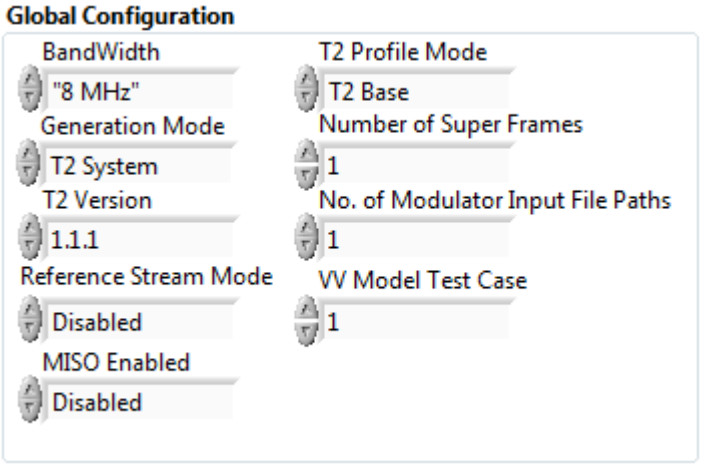
PowerLevel (dBm) –Average Power level of the signal in dBm.

Headroom (dB) – Configure the Headroom value higher than PAPR of the signal to be generated. Refer MaxEyeDVB-T2 Multiple PLP Signal Generation Help.chm.

ExternalAttenuation(dB),Arb:Pre-filterGain(dB),ReferenceSource,Frequency(Hz),Clk
Output Terminal – Refer NIRFSG Signal Generators help file.

3.1.1.2 Global Configuration

The Global Configuration includes the DVB-T2 standard specific configuration. The help for each of the properties are available in DVB-T2 Multiple PLP Signal Generation Help.chm file.



The T2 Profile Mode property decides the mode of operation. The**T2 Base** Profile Mode allows the configuration according to the DVB T2 Standard ETSI EN 302 755 V1.3.1 document. The **T2 Lite** Profile Mode allows the configuration according to the Annex I of the document. In **T2 Base** + **T2 Lite** Profile Mode T2 Lite waveform sent in the **T2 Base FEF** (Future Extension Frames) part.

The T2 Generation Mode property decides the mode of input and output types. In **T2 System** Generation Mode the input taken as Transport streams (TS) and output is a Modulated waveform. In **T2 Modulator** Generation Mode input is T2 Modulator Interface (T2-MI) file and output is a modulated waveform. In **T2 Gateway** Generation Mode input is TS and output is T2-MI file. If T2

Profile Mode is T2 Base + T2 Lite and Generation Mode is T2 Gateway then two T2-MI files are generated one for T2 Base and second one is for T2 Lite.

If the Generation Mode is **T2 System** then no need to configure **Modulator Input or T2 MI Packet Output File Path 1 and 2**properties.

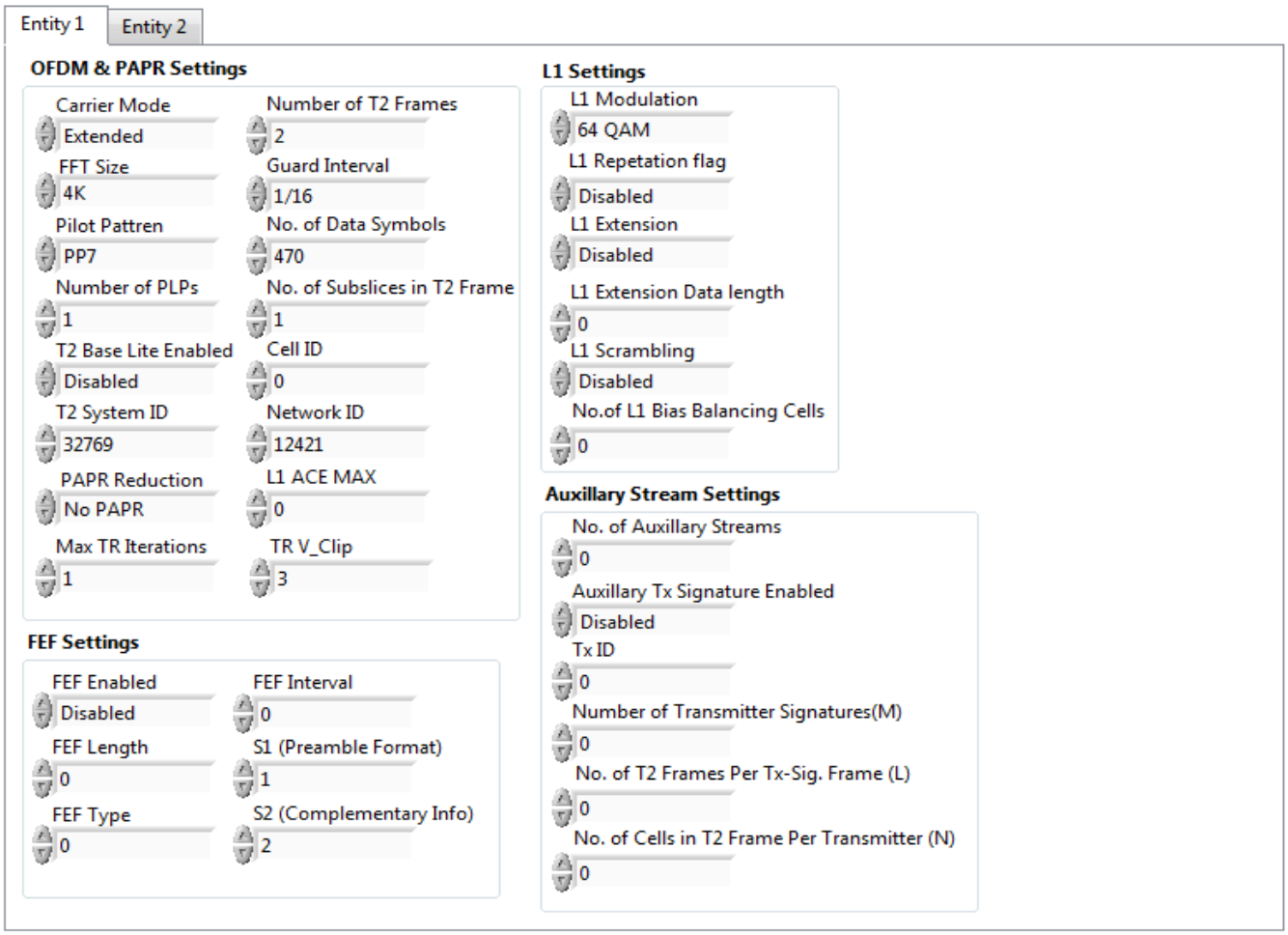
If the Generation Mode is T2 Modulator then **No. of Modulator Input File Paths** specifies number of input T2 MI Packet streams. Input T2 MI File Paths are need to configured properties **Modulator Input or T2 MI Packet Output File Path 1 and 2**.

The DVB-T2 Verification & Validation Working Group has defined set of configurations to generate reference streams for the verification and the validation of the DVB-T2 specification. These reference streams can be generated by configuring **Reference Stream Mode** and **VV Model Test Case** properties. If the Reference Stream Mode is enabled then the toolkit ignores all other properties except the following PLP specific properties like Payload Mode, Common Mode Splitting Enabled, Program Number, New TS ID, Number of Programs, TS File Path, and VV Model Test Case. The payload mode should be same for all the PLPs in a group.

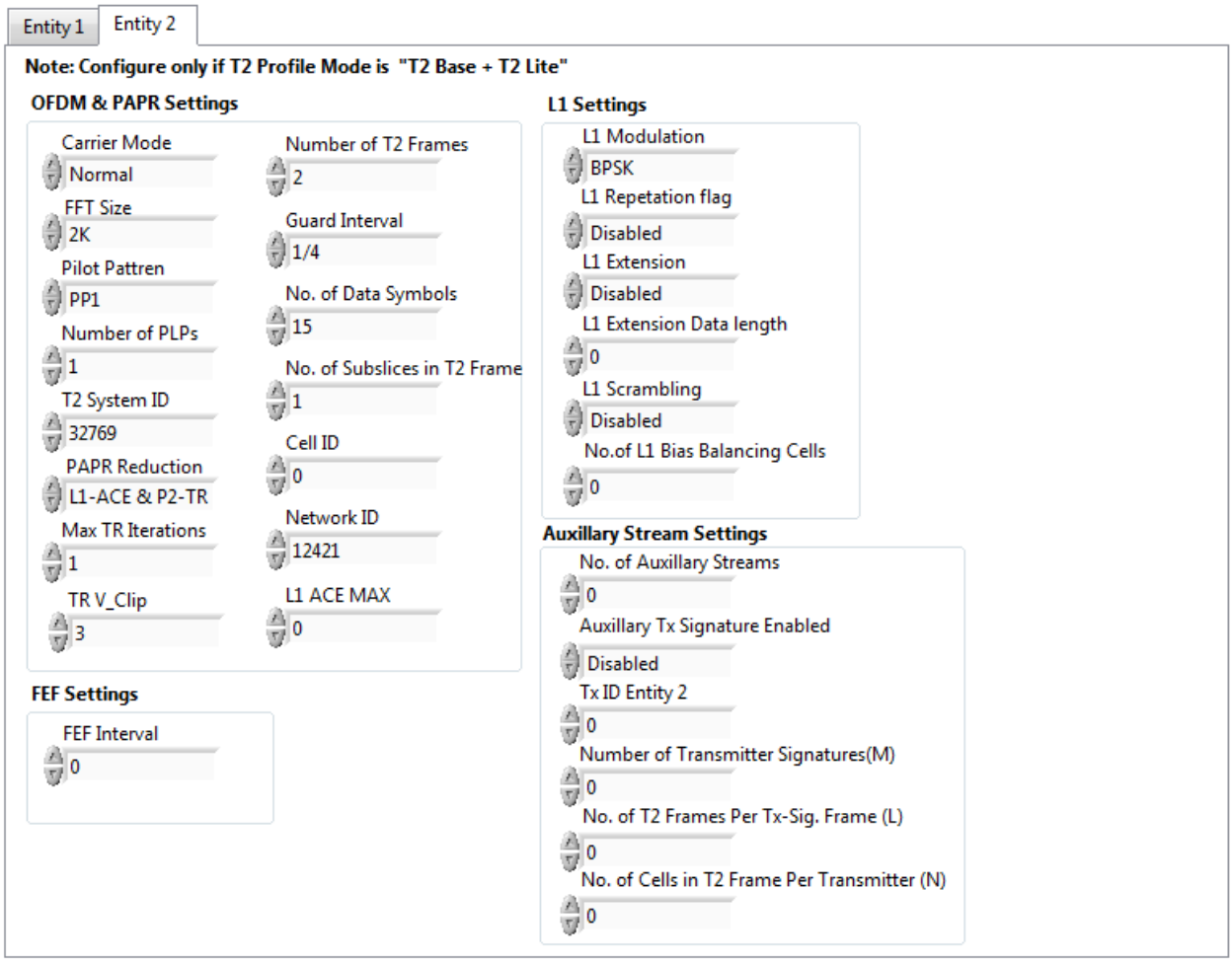
The Number of Super Frames and Number of T2 frames property decides the length of waveform to be generated. In each super frame there are integral numbers of T2 frames as per the DVB-T2 standard. To generate longer duration of the waveform increase the Number of Super Frames and Number of T2 frames in a Super Frame. For more information about the duration of one T2 frame refer section 8.3.1 of the DVB-T2 standard ETSI EN 302 755 V1.3.1.

3.1.1.3 Signal Configuration

The Signal Configuration includes the DVB-T2 standard specific configuration. The help for each of the properties are available in DVB-T2 Multiple PLP Signal Generation Help.chm file.



If the T2 Profile Mode is either T2 Base or T2 Lite then T2 Base or T2 Lite specific configuration need to be configured in the Entity 1. If the T2 Profile Mode is T2 Base + T2 Lite then only T2 Base specific configuration need to be configured in Entity 1.



Entity 2 need to configure only when T2 Profile Mode is T2 Base + T2 Lite. In this only T2 Lite specific configuration need to configure.

Entities configuration depending on the T2 Profile Mode is explained in the below Table.

T2 Profile Mode	Entity 1Configuration	Entity 2 Configuration
T2 Base	T2 Base specific	None
T2 Lite	T2 Lite specific	None
T2 Base + T2 Lite	T2 Base specific	T2 Lite specific

Note: No need configure the FEF Length in the Entity 1 when T2 Profile Mode is T2 Base + T2 Lite. The DVB-T2 standard allows only certain combinations of FFT Mode, Guard Interval and Pilot Pattern. Refer section 8.3.2 of the DVB-T2 standard ETSI EN 302 755 V1.3.1.

3.1.1.3 PLP Configuration

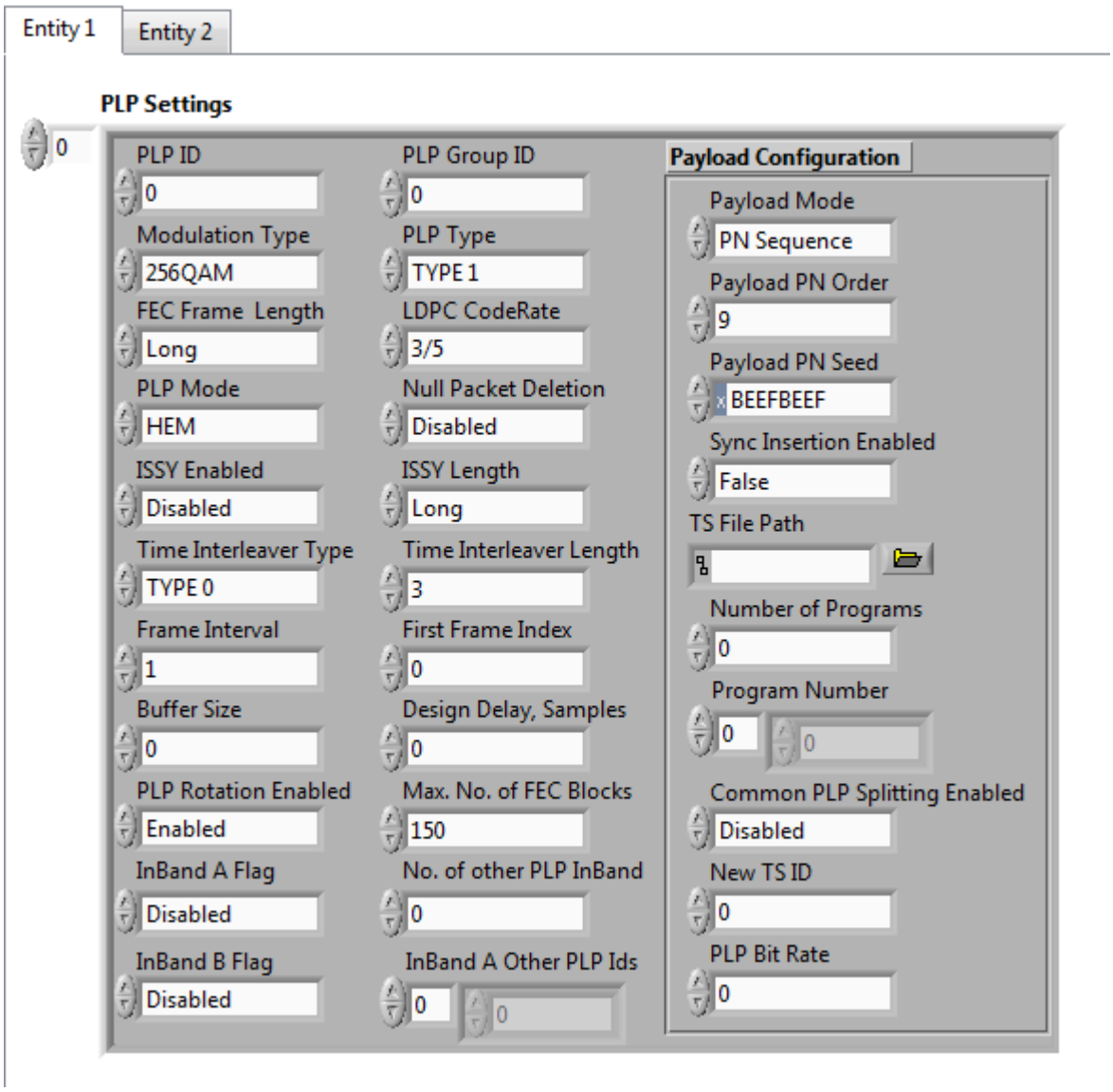
MaxEye Digital Video Toolkit allows you to configure PLP parameter settings. The possible PLP options are

i. Big TS – In this mode the toolkit extracts the TS Packets from the Big TS File corresponding to the program numbers (service ids) configured in the Program number. Program Number and Number of Programs for each PLP in the PLP group should be configured. In the Big-TS mode, All the PLPs in the same PLP group should be configured with the same TS file path.

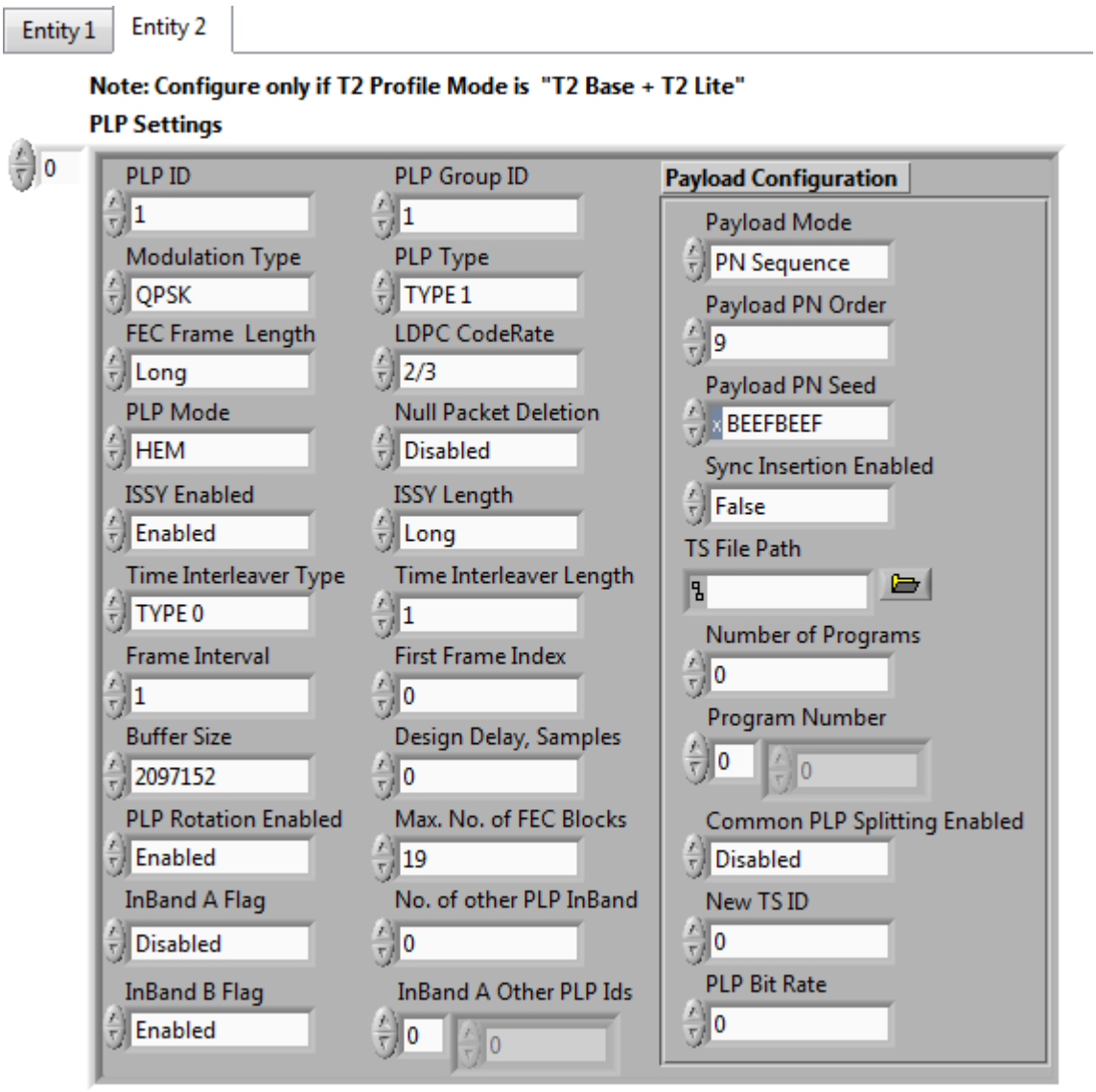
ii. Separate TS –In this mode each PLP in the PLP group should be configured with the separate TS File paths. If the group has a common PLP and Common PLP Splitting is enabled then the toolkit internally generates the data for the common PLP. If the group has a common PLP and Common PLP Splitting is disabled then common PLP file path also should be configured.

iii. PN Sequence – The toolkit generates pseudo random sequence based on the PN order and seed value, the generated bit sequence is used as a payload for generating the signal. Use this mode for testing the receiver performance for random payload values. When the number of super frames is more than 1 then the toolkit maintains payload continuity across the super frames.

Formore information on the individual properties of PLP configuration please refer DVB-T2 Multiple PLP Signal Generation Help.chm file.



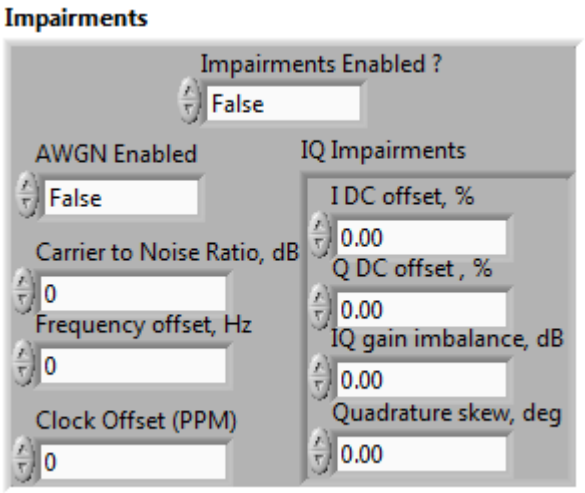
PLP configuration corresponding to the PLPs either T2 Base or T2 Lite depending on the T2 Profile Mode is configured in Entity 1.



PLP configuration corresponding to the PLPs T2 Lite when the T2 Profile Mode is T2 Base + T2 Lite. If the T2 Profile Mode is T2 Base or T2 Lite No need to configure Entity 2 PLP Configuration.

3.1.1.3 Impairments

The toolkit adds impairments to the generated DVB-T2 waveform. The impairment configuration is shown in the figure below,



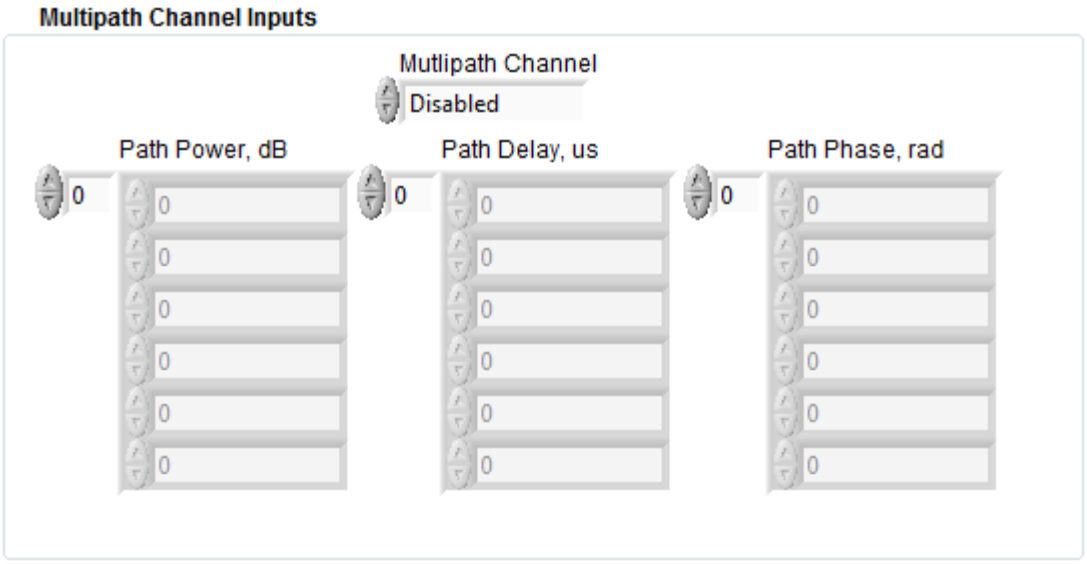
The help for the each of the impairment properties can be found in the property specific API VIs.

For more information on the individual properties of Impairments configuration please refer DVB-T2 Multiple PLP Signal Generation Help.chm file.

3.1.1.4 Multipath Channel Configuration

The toolkit simulates the static multipath channel based on the path delay, path gain and path phase to output waveform.

The path delay, path gain and path phase has to be same order, if the Multipath Channel Property is Enabled.

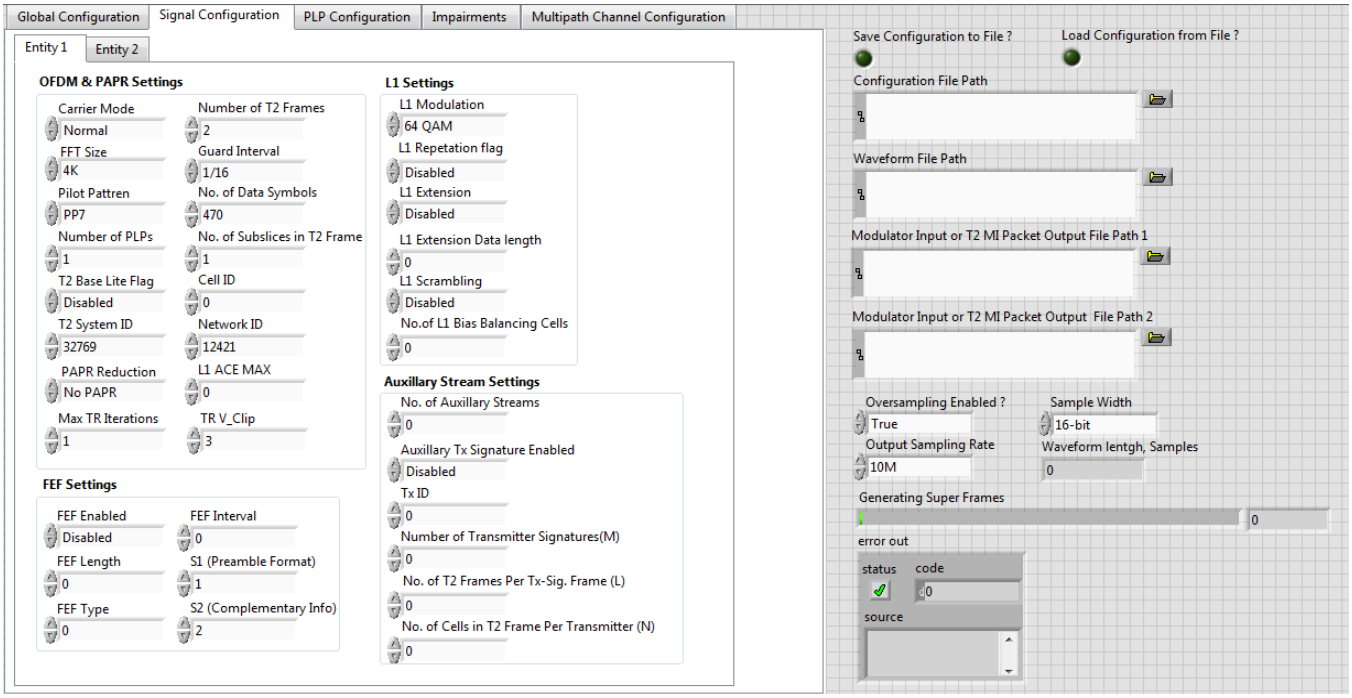


3.2. Create and Save Waveform in File

This Example is used to generate multiple DVB-T2 super frames and the generated waveform is stored in a file for play back. Use this example

- To generate and store the custom waveforms based on your test requirement.
- To avoid generating the waveform at the beginning of your test every time. This reduces the test starting time as some of the signal configuration will take longer to generate the waveform.
- To generate the longer duration waveform as the RFSG memory size is limited.
- Testing the receiver for continuous signal reception.
- Receiver functionality verification tests that require longer duration of video to be played.
- Receiver sensitivity measurement (BER) for longer duration.

The figure below shows the front panel of the Example VI.



The toolkit configurations are same as specified in section 3.1. This example requires the following additional input parameters.

1. **Waveform File Path** – The toolkit writes the generated waveform in a file specified by this file path control.
2. **Configuration File Path**–Save/Load complete signal configuration into/from binary file.
3. **Oversampling Enabled**– set this property value to TRUE if resampling is required.
4. **Output Sampling Rate (Hz) –** Configure this control to a suitable value if Oversampling Enabled property is set to TRUE.
5. **Output Sample Width –** The default sample width of the output waveform is 8-bits. The available options are 8-bits and 16-bits. We recommend 16-bits sample width for better signal quality of the generated waveform.
6. **Modulator Input or T2 MI Packet Output File Path 1 –**The toolkit writes the generated T2-MI Packets if Generation Mode is T2 Gateway or toolkit reads the T2-MI Packets as input if Generation Mode is T2 Modulator. T2 Base or T2 Lite T2-MI Packets are stored or given as input depending upon T2 Profile Mode.
7. **Modulator Input or T2 MI Packet Output File Path 2–**The toolkit writes or take as input the T2-Lite T2-MI Packets. This is used only if t2 Profile Mode is "T2 Base + T2 Lite".

Note: Modulator Input or T2 MI Packet Output File Paths are used only whenT2 Generation Mode is T2 Gateway or T2 Modulator. The toolkit ignores these file paths if T2 Generation Mode is T2 System.

If the **Load Configuration from File** is set to **TRUE,** then the toolkit loads all the configuration from the file except the Number of Super Frames and Waveform File path.

3.3. Play Waveform from File

This example reads the DVB-T2 waveform from the file created using the previous example in section 3.2 and then downloads the waveform in real-time to NI RFSG Memory and then plays the waveform. This example is created using the NI RFSG streaming example available in the NI website.

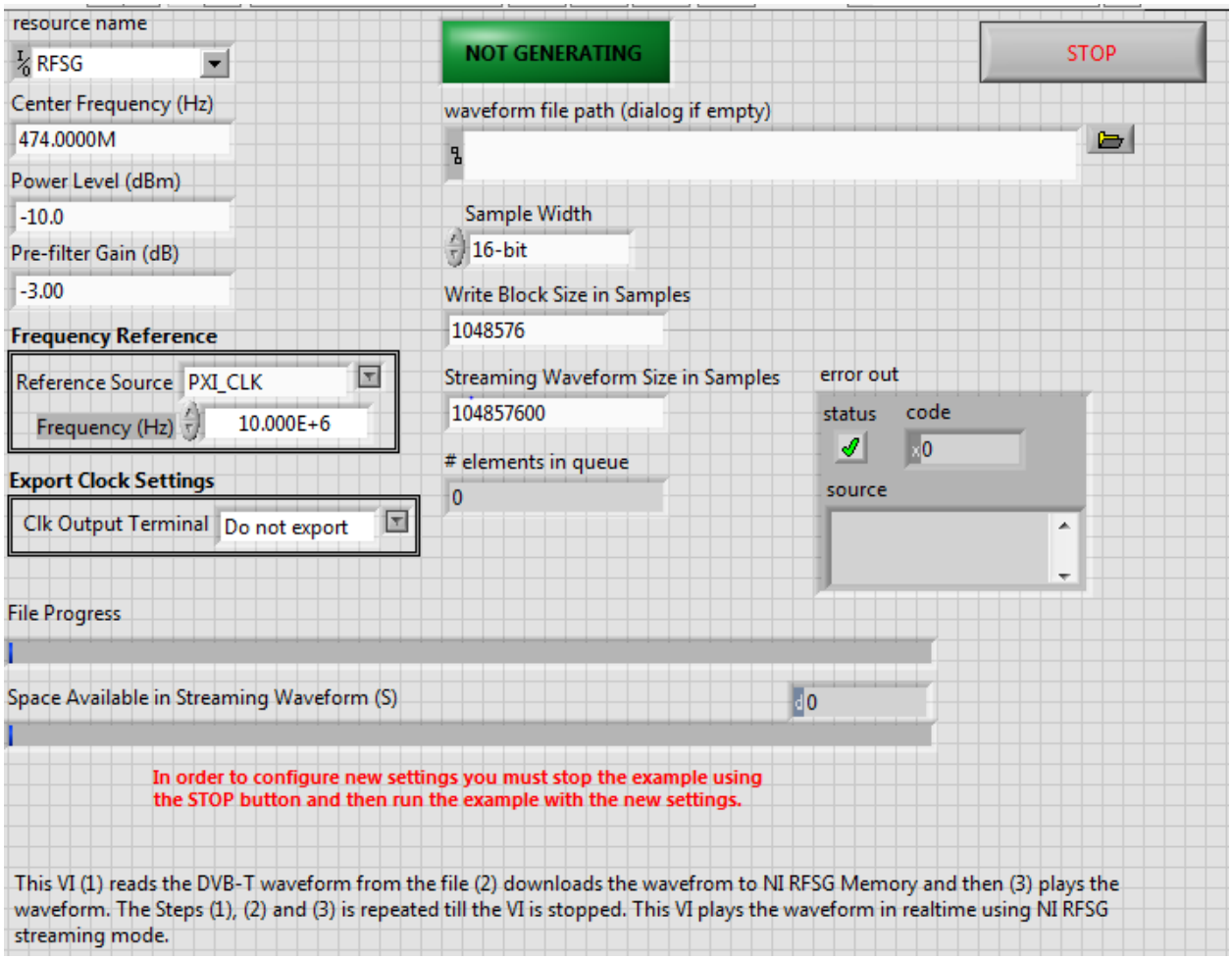
This example uses NI RFSG in streaming mode for playing the waveform in real-time. The performance of this example is related to the performance of your CPU and available RAM memory.

The figure below shows the front panel of the Example VI. For more information about NI RFSG streaming refer to the web link below.

http://zone.ni.com/reference/en-XX/help/371025K-01/rfsg/streaming/

Sample Width – use the same sample width value used for storing the waveform in the file.

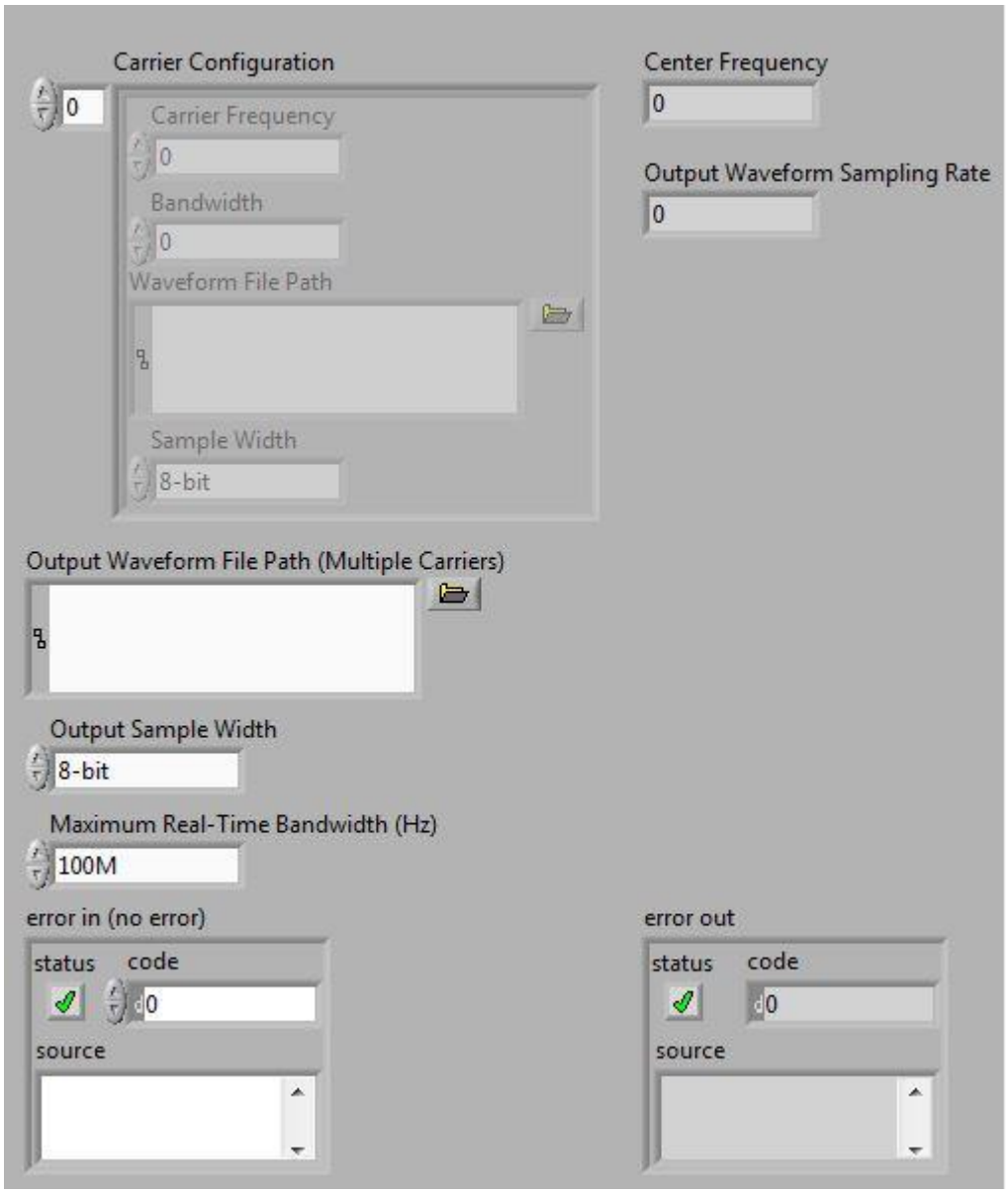
MAXEYE TECHNOLOGIES



For more information please contact info@maxeyetech.com

3.4 Multi-Carrier Signal Generation

This example combines the multiple waveform files generated using the example mentioned in the Section 3.2 into a single multi-carrier waveform. Then the waveform is stored in a file using either 8-bit or 16-bit sample width based on the **Output Sample Width** parameter. The front panel of the example VI is shown below.



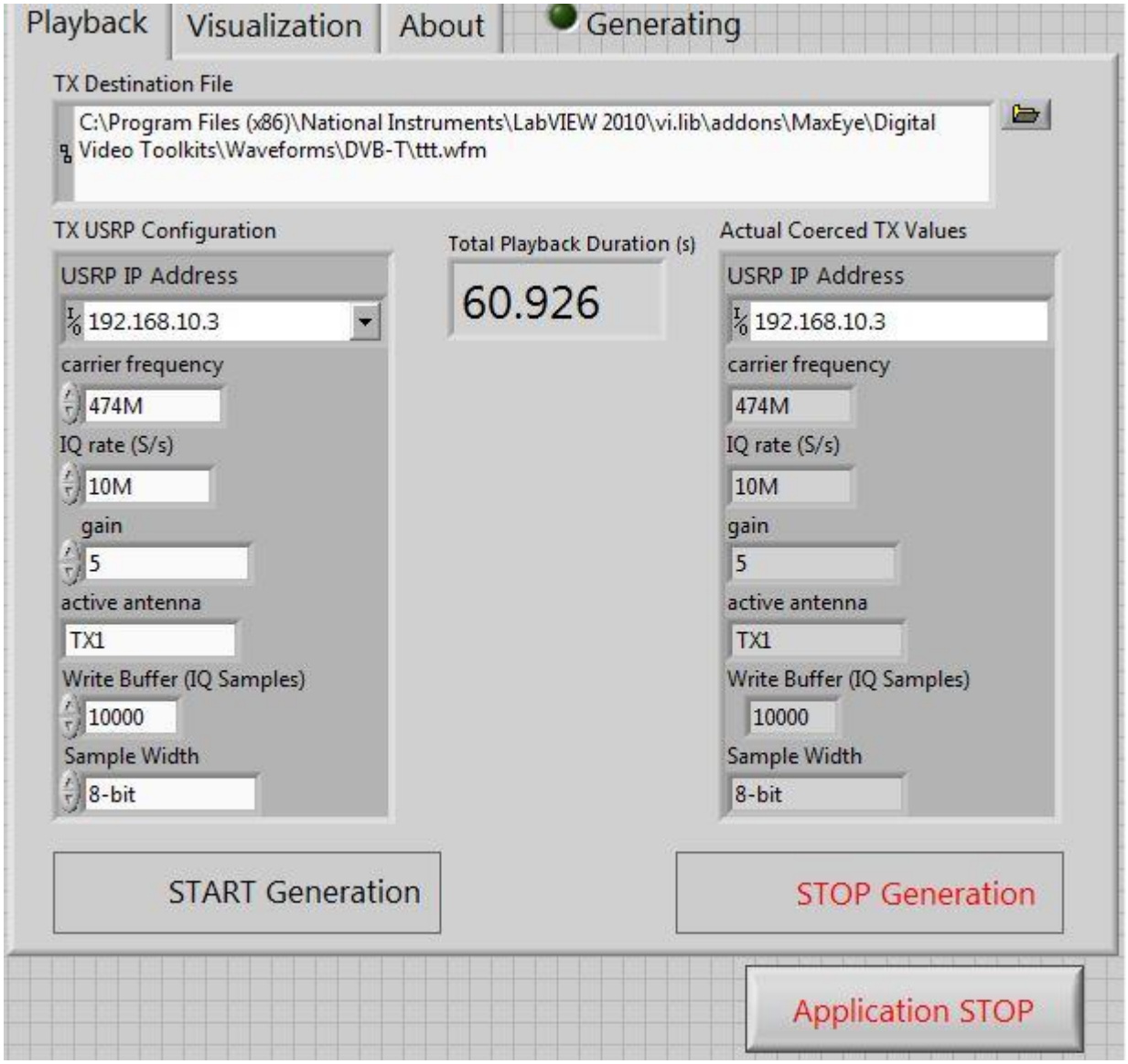
3.5 Play Waveform from File (USRP)

3.5.1 MaxEye DVBT2 USRP Play Waveform from File

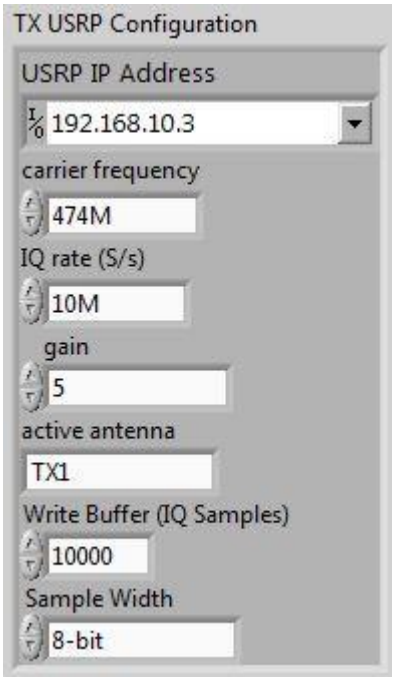
This example reads the DVB-T2 waveform from the file created using the example mentioned in the Section 3.2 and then downloads the waveform in real time to NI USRP memory and then plays the waveform.

The performance of this example is related to the performance of your CPU and available RAM memory.

The figure below shows the front panel of the Example VI.



3.5.1.1 TX USRP Configuration



USRP IP Address – IP address of the NI USRP

Carrier Frequency – Center Frequency of the DVB-T2 signal in Hz.

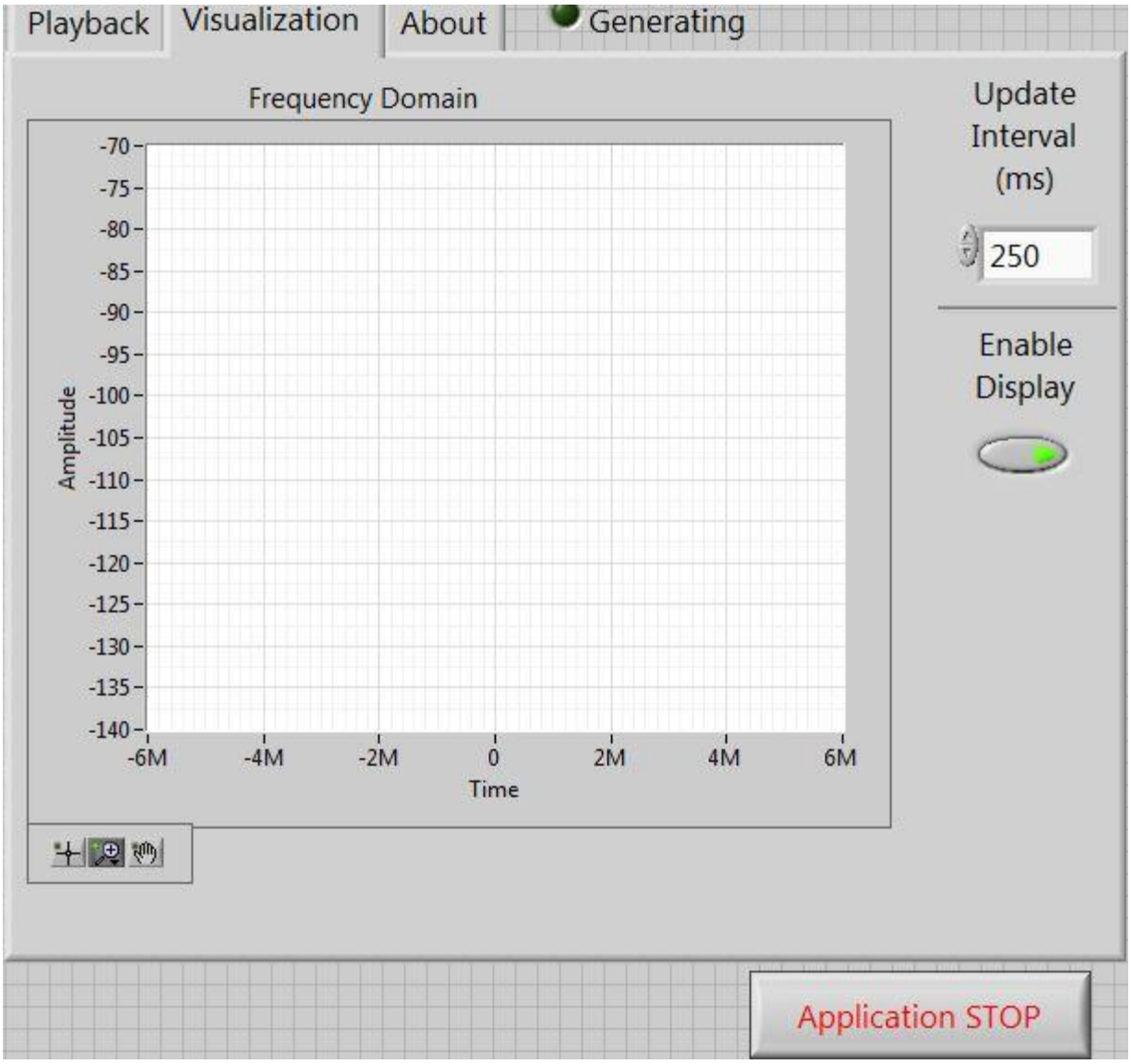
IQ Rate (S/s) – Rate of the baseband I/Q data in samples per second (S/s).

Sample Width– configure the sample width used to generate waveform file.

Active Antenna, Gain, Expected Peak, coerced IQ rare, coerced carrier frequency, and coerced gain – Refer NI USRP help file.

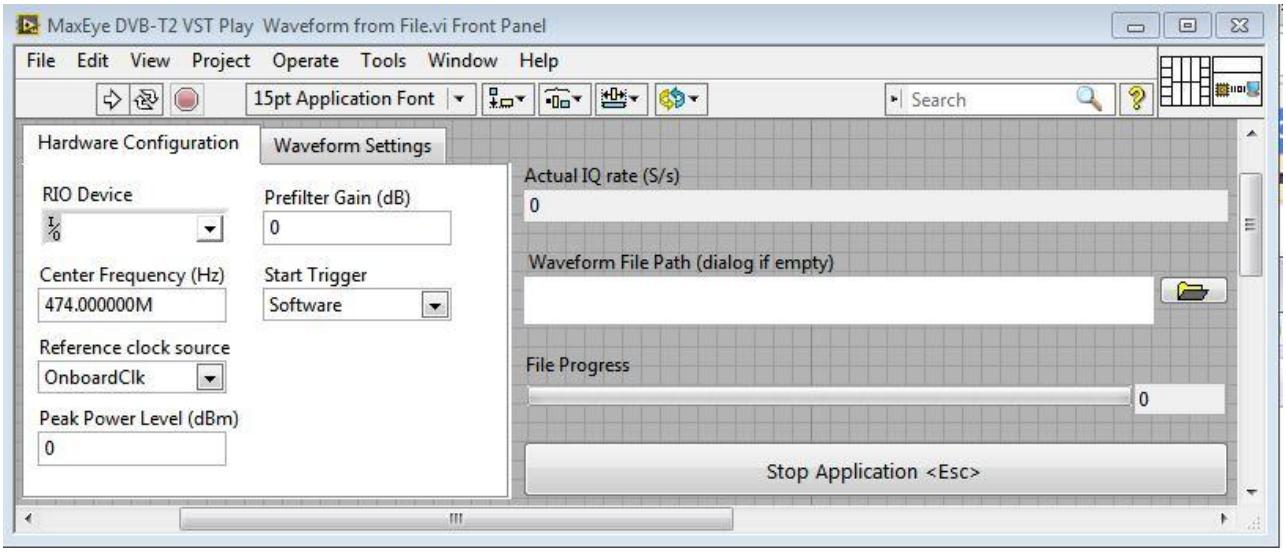
3.5.1.1 Visualization

The spectrum of the generated waveform can be monitored in the Visualization Tab as in the example VI shown below. Enable Display button needs to be set to ON state in order to view the spectrum.

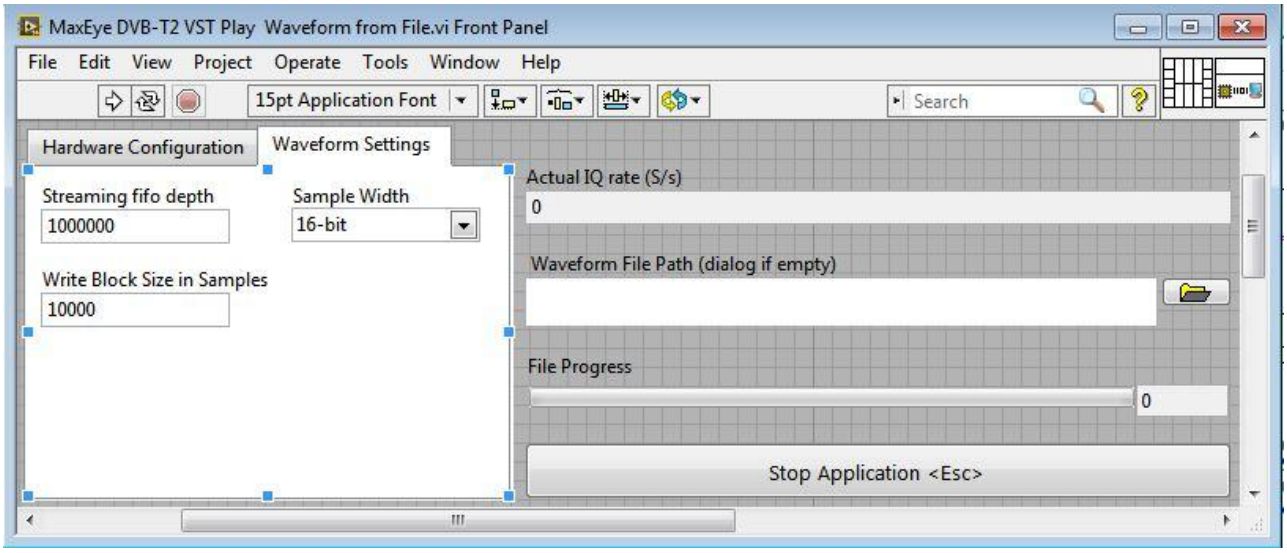


3.6 Play Waveform from File (VST)

This example reads the DVB-T2 waveform from the file created using the example mentioned in the Section3.2. This example deploy the bitfile dynamically to the respective target(FPGA) and configures a stream from the Host to the FPGA target and writes waveform data to the streaming DMA FIFO



3.6.1 Waveform Settings



MAXEYE TECHNOLOGIES

4 Tips for searching examples in NI Example Finder

Use any of the following keywords to search DVB-T2Generation (Multiple PLP) examples in the NI Example Finder,

Keywords: DVB-T2, signal, generation, Multiple PLP

For more information please contact info@maxeyetech.com