



**Generic Precompensation
Plug-in Application
Printable Help Document**



077-1212-02



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Plug-in Application
Printable Help Document**

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Supports Precompensation Plug-in application Version 1.4.x and above.

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- In North America, call 1-800-833-9200.
- Worldwide, visit www.tek.com to find contacts in your area.

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Welcome

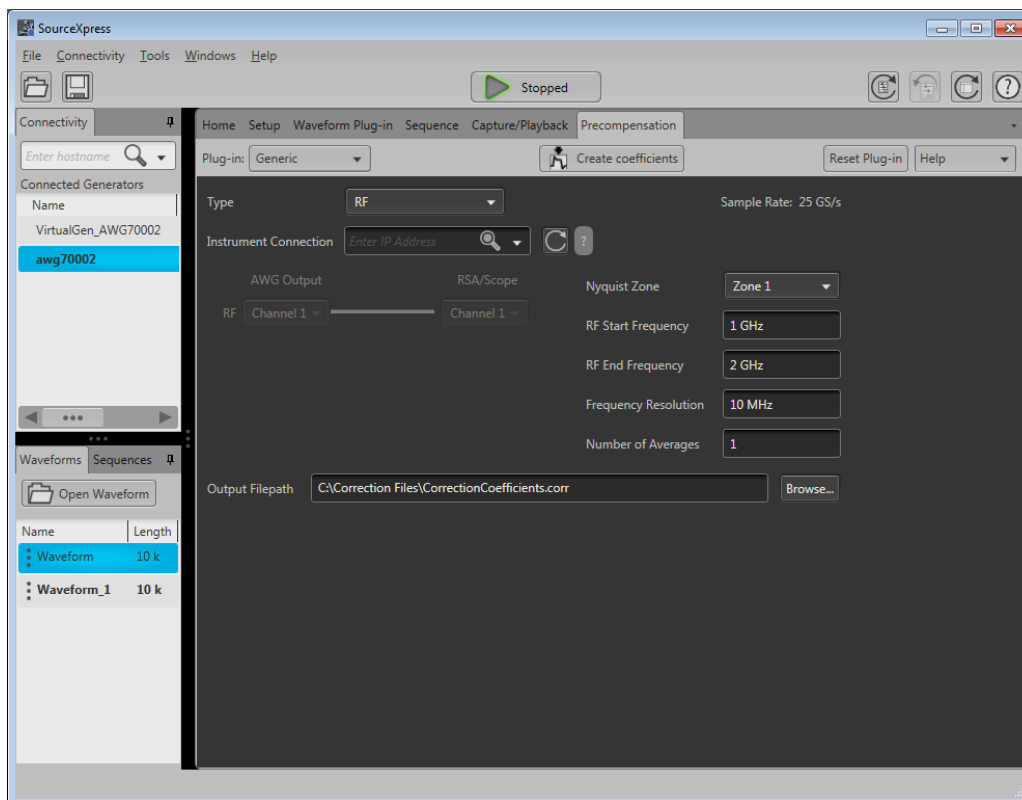
The Generic Precompensation plug-in application is used to create correction coefficients that can be applied to waveforms to obtain a flat frequency response and linear phase response.

The plug-in is designed to integrate and operate seamlessly as an enhancement to the SourceXpress waveform creation software application and the AWG70000A and AWG5200 series arbitrary waveform generators.

NOTE. *When using the Generic Precompensation Plug-in with SourceXpress, SourceXpress must be connected to an Arbitrary Waveform Generator (AWG). You cannot use a virtual generator connection to create coefficient files. Refer to the SourceXpress help for information about establishing a connection to an AWG.*

To create the correction coefficients, a known stimulus signal (golden signal) is generated and passed through the entire system to the point it is connected to an oscilloscope or analyzer. The captured waveform is then compared to the stimulus signal. From the compared data, the magnitude and the phase characteristics of the system is obtained and is used to create a correction file.

This illustration shows the Generic Precompensation plug-in viewed from the SourceXpress application.



Documentation

In addition to this application Help system, the following documentation is available for the software.

All documentation is available on the Tektronix Web site (www.Tektronix.com/manuals).

To read about	Use these documents
Generic Precompensation plug-in operation and user interface help	Access the plug-in application help from the plug-in Help menu for information on all controls and elements on screen. The plug-in help system is also available in PDF format located in the program's installation folder and also available on the Tektronix web site.
Generic Precompensation plug-in programmer commands	Access the plug-in programmer manual for the syntax of remote commands specific to the plug-in. This is available on the Tektronix web site.
SourceXpress operation and user interface help	Access the SourceXpress application help from the Help menu for information on all controls and elements on screen. The SourceXpress help system is also available in PDF format, available on the Tektronix web site.
SourceXpress programmer commands	Access the SourceXpress programmer manual for the syntax of remote commands. This document is available in PDF format located in the program's installation folder and also available on the Tektronix web site.
Connected instrument operation and user interface help	For operation and interface help of a connected instrument, refer to the instrument's documentation. This is available with the instrument or on the Tektronix web site
Connected instrument programmer commands	For programming information of a connected instrument, refer to the instrument's documentation. This is available with the instrument or on the Tektronix web site.

Support information

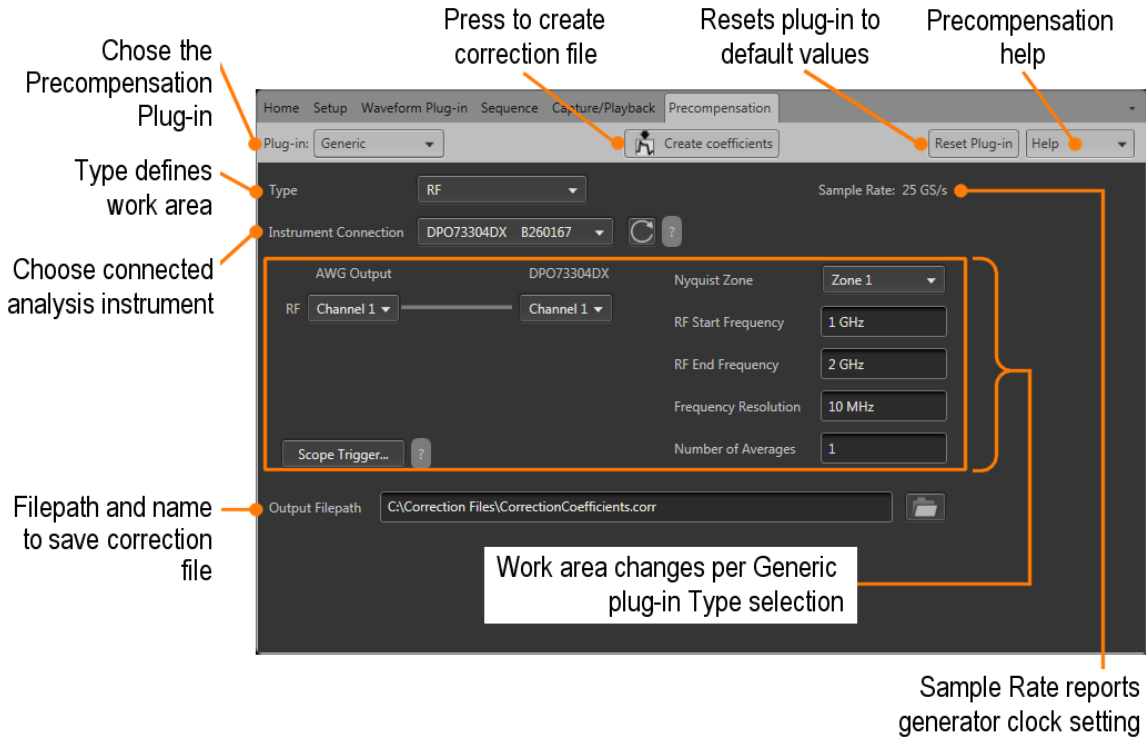
Tektronix offers the following services in support of their products:

- **Technical Support.** For application-related questions about a Tektronix product, [contact us by telephone or email](#)).
- **Service Support.** For service-related questions about a Tektronix product, [contact us by telephone or email](#)).

Tektronix also offers extended warranty and calibration programs as options on many products. Contact your local Tektronix distributor or sales office.

Elements of the display

The main areas of the plug-in window are shown in the following figure.



Plug-in selection button

This button selects specific types of correction coefficients. At this time, only Generic type precompensation coefficients (RF, IF, IQ) are available.

Future enhancements to Precompensation will provide additional plug-in selections.

Create coefficients button

Select to create the coefficient file as defined.

The following conditions must be met to create a coefficient file:

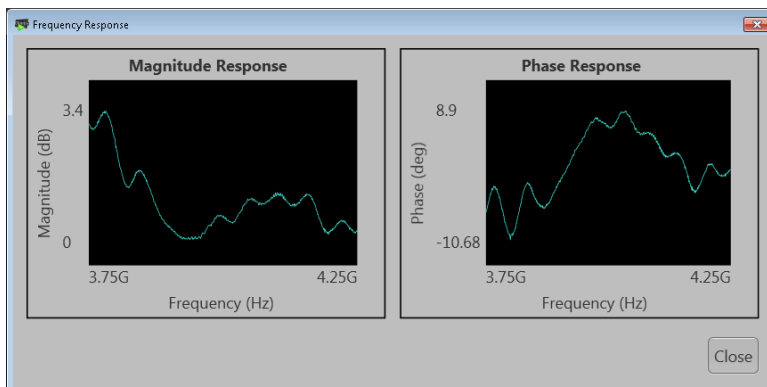
- The Generic Precompensation plug-in must be licensed for use with the application you are creating the coefficient file (i.e. SourceXpress or an AWG70000A or AWG5200 series generator).

For example, if you connect SourceXpress (without the plug-in license) to an AWG70000A series generator that is licensed to use the plug-in, you cannot use SourceXpress to create the coefficients.

Refer to the documentation for SourceXpress or the generators for details about obtaining and using license files.

- Coefficient files cannot be created without the proper instrument connections.
- If using the Precompensation Plug-in with SourceXpress, SourceXpress must be connected to an Arbitrary Waveform Generator (AWG). You cannot use a virtual generator to create coefficient files. Refer to the SourceXpress help for information about establishing a connection to an AWG.

Upon completion of the coefficient file, a response plot is displayed in the Frequency Response display. Close the window to complete the operation.



NOTE. If using a Real-time Signal Analyzer (RSA) as the analysis instrument, only Magnitude coefficients are obtained.

NOTE. If using the Generic Precompensation plug-in from an AWG70000A series instrument, coefficients can not be created if Synchronization (Sync Hub) is enabled. Refer to the instrument's help system for information.

Reset Plug-in button

Returns the plug-in to the RF type and returns all settings to their default values.

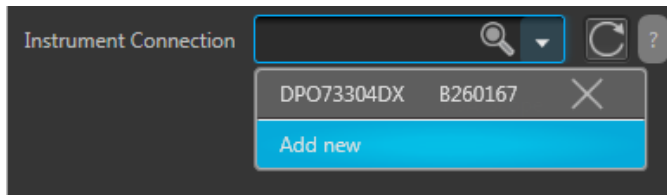
Selecting Reset does not affect the Instrument Connection.

Help button

Help button: Provides links where you can obtain additional product help and documentation.

Item	Description
User manual	Opens the plug-in help system.
About ...	Provides you with information about your plug-in application. This information is helpful when contacting Tektronix about your application.

Instrument connection




The Instrument Connection is a common element regardless of the Type selection.

In order to create a coefficient file (correction file), a connection to a Tektronix Real-time Signal Analyzer (RSA) or a Tektronix oscilloscope (Scope) is required. The RSA or Scope replaces the device under test (DUT) which is at the end-point of the signal.

NOTE. *When using a Real-time Signal Analyzer (RSA) to create coefficients, only the magnitude is corrected. To create coefficients for both magnitude and phase, you must use an oscilloscope.*

Scan for instruments

Press the Refresh button  to scan for available instruments.

Scanning requires that TekVISA is installed and operating on both the host instrument and the target instruments.



Once the scan is complete, use the Instrument Connection pull-down list to view the available instruments.

Connection to the following instruments is supported:

- Oscilloscopes
 - DPO70000DX series
 - DPO70000(A,B,C,D) series
 - DPO70000SX series
- Analyzers
 - RSA5000 series
 - RSA6000 series

Connect and Disconnect

The Instrument Connection pull-down list contains a list of available instruments. The Refresh button automatically populates this list.

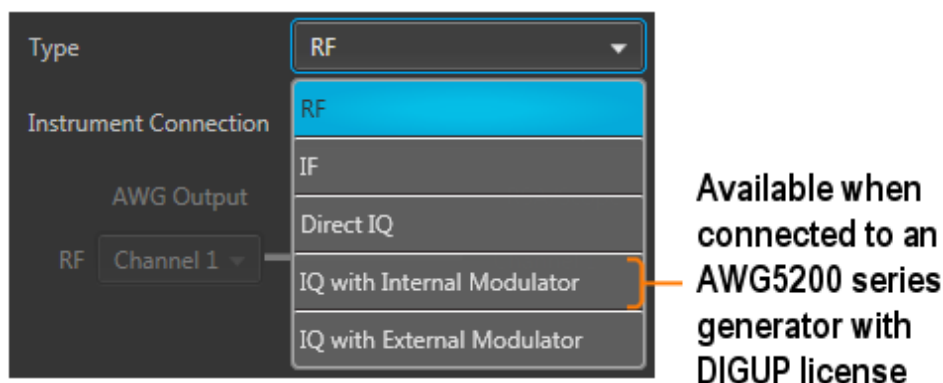
You can connect directly to a networked instrument by entering the IP address of the instrument (e.g. 192.168.1.101) directly into the Instrument Connection box and select the find icon  or press return. Pressing the  next to a connected instrument disconnects the instrument and removes it from the list.

Generic Precompensation Plug-in coefficient types

The Generic Precompensation plug-in provides the capability to create the following types of coefficient files:

- [RF \(see page 9\)](#)
- [IF \(see page 11\)](#)
- [Direct IQ \(see page 12\)](#)
- [IQ with internal modulator \(see page 13\)](#)
- [IQ with external modulator \(see page 15\)](#)

Use the Type pull down menu to select the type signal you want to create the correction file (coefficients) based on your setup.



As you choose the different Types, the available settings change along with an illustration of the connections that must be made between the arbitrary waveform generator output and the instrument being used to capture the resulting signal.

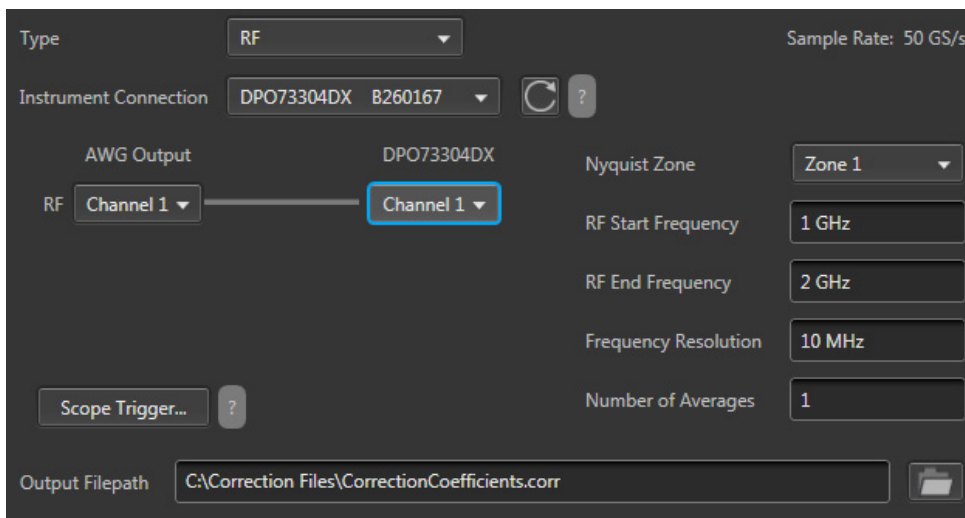
RF coefficients

The RF coefficients are for a single RF signal from the AWG to the device under test (DUT).

For RF type coefficients, you can connect to either an oscilloscope or a real time signal analyzer (RSA) to capture the waveform.

In the example shown, the RF signal is being output from channel 1 of the AWG and input to channel 1 of the connected oscilloscope (DPO73304DX).

Use the connection diagram pull-down lists to select the proper output and input channels of your setup.



The settings for the RF type include:

Item	Description
Sample Rate:	The Sample Rate displays the current AWG's clock rate. It is not adjustable from the Precompensation plug-in.
Nyquist Zone	Choose Nyquist Zone 1, Zone 2, or Zone 3. <div style="text-align: center;"> </div>
RF Start Frequency	Used in conjunction with the RF End Frequency setting, select the frequency range you want to create a correction file. Start and Stop Frequency settings are based on 1/2 the available Sample Rate of the AWG and the Nyquist Zone selection.
RF End Frequency	Used in conjunction with the RF Start Frequency setting, select the frequency range you want to create a correction file. Start and Stop Frequency settings are based on 1/2 the available Sample Rate of the AWG and the Nyquist Zone selection.
Frequency Resolution	Enter the frequency resolution of the signal to determine the number of frequency points between start and end frequencies that coefficients will be created.

Item	Description
Number of Averages	Enter the number of times the software sends and captures the signal through the user defined configuration to create an average. Increasing the number of averages reduces the noise level but increases processing time.
Scope Trigger...	The Scope Trigger button is available when connected to an oscilloscope. Selecting Scope Trigger displays the Scope Trigger options dialog screen which allows you to define the trigger source for the connected oscilloscope. See Scope Trigger options (see page 16) for detailed information.

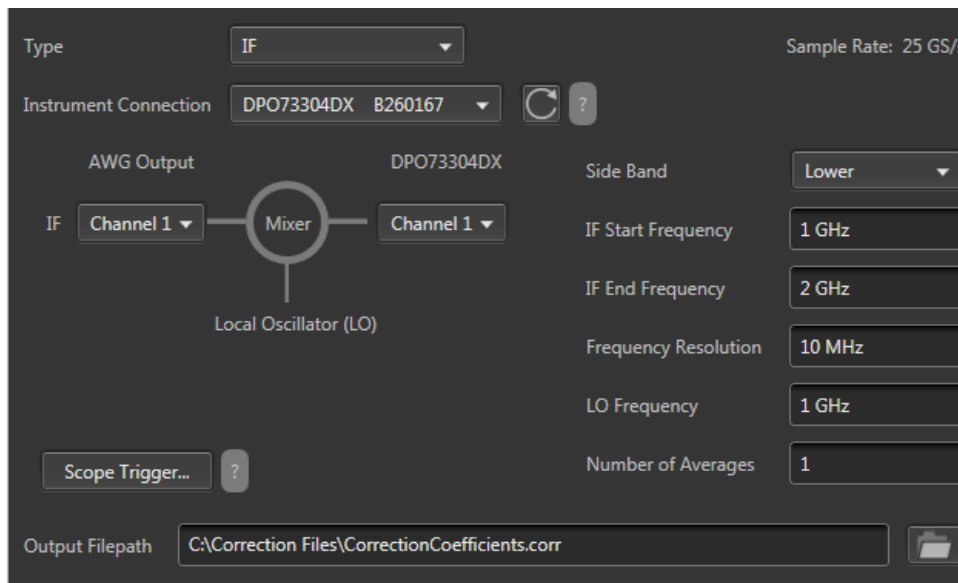
IF coefficients

The IF coefficients are for a single IF signal from the AWG to the device under test (DUT).

For IF type coefficients, you can connect to either an oscilloscope or a real time signal analyzer (RSA) to capture the waveform.

In the example shown, the IF signal is being output from channel 1 of the AWG, mixed with the local oscillator, and input to channel 1 of the connected oscilloscope (DPO73304DX).

Use the connection diagram pull-down lists to select the proper output and input channels of your setup.



The settings for the IF type include:

Item	Description
Sample Rate:	The Sample Rate displays the current AWG's clock rate. It is not adjustable from the Precompensation plug-in.
Sideband	Select the frequency band (Upper or Lower) which is to be calibrated.

Item	Description
IF Start Frequency	Used in conjunction with the IF End Frequency setting, select the frequency range you want to create a correction file.
IF End Frequency	Used in conjunction with the IF Start Frequency setting, select the frequency range you want to create a correction file.
Frequency Resolution	Enter the frequency resolution of the signal to determine the number of frequency points between start and end frequencies that coefficients will be created.
LO Frequency	Enter the frequency of the local oscillator to be mixed with the IF signal
Number of Averages	Enter the number of times the software sends and captures the signal through the user defined configuration to create an average. Increasing the number of averages reduces the noise level but increases processing time.
Scope Trigger...	The Scope Trigger button is available when connected to an oscilloscope. Selecting Scope Trigger displays the Scope Trigger options dialog screen which allows you to define the trigger source for the connected oscilloscope. See Scope Trigger options (see page 16) for detailed information.

Direct IQ coefficients

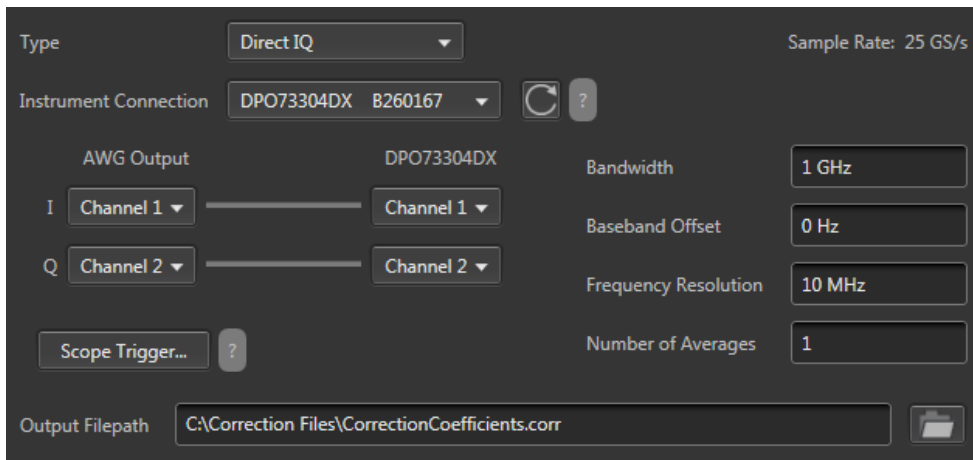
The Direct IQ coefficients are individual I and Q signals from the AWG and connected directly to the device under test (DUT).

NOTE. *The IQ with Modulator selection is only available if the active generator has individual channels available for the I and Q signals.*

For Direct IQ coefficients, you must connect to an oscilloscope to capture the waveform since two channels are required.

In the example shown, the I and Q signals are being output from channels 1 and 2 of the AWG and input to channels 1 and 3 of the connected oscilloscope (DPO73304DX).

Use the connection diagram pull-down lists to select the proper output and input channels of your setup.



The settings for the Direct IQ type include:

Item	Description
Sample Rate:	The Sample Rate displays the current AWG's clock rate. It is not adjustable from the Precompensation plug-in.
Bandwidth	Enter the bandwidth of the signal. The available bandwidth setting is dependent on the AWG's sample rate and the Frequency Resolution setting.
Baseband Offset	The default signal is centered at the Bandwidth Frequency. The Baseband Offset changes moves the signal center + or - from the bandwidth frequency.
Frequency Resolution	Enter the frequency resolution of the signal to select the number of samples between start and end frequencies.
Number of Averages	Enter the number of times the software sends and captures the signal through the user defined configuration to create an average. Increasing the number of averages reduces the noise level but increases processing time.
Scope Trigger...	The Scope Trigger button is available when connected to an oscilloscope. Selecting Scope Trigger displays the Scope Trigger options dialog screen which allows you to define the trigger source for the connected oscilloscope. See Scope Trigger options (see page 16) for detailed information.

IQ with internal modulator coefficients

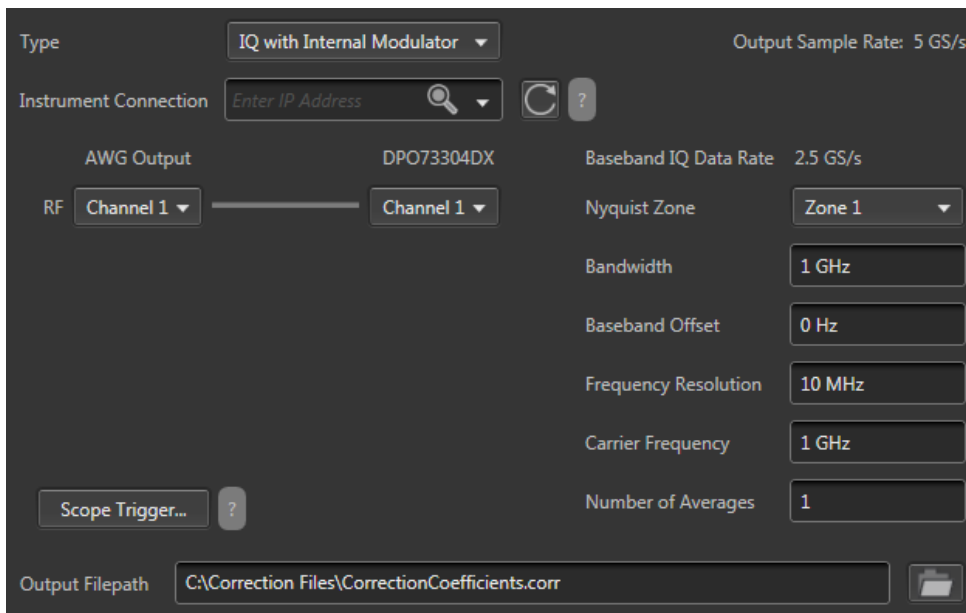
The IQ with internal modulator selection is only available when the AWG generator is an AWG5200 series generator and must have the DIGUP feature licensed.

The AWG5200 digitally up-converts the I and Q signals, providing a single RF output to the connected instrument.

You can connect to either an oscilloscope or a real time signal analyzer (RSA) to capture the waveform.

In the example shown, the RF signal is being output from channel 1 of the AWG and input to channel 1 of the connected oscilloscope (DPO73304DX).

Use the connection diagram pull-down lists to select the proper output and input channels of your setup.



The settings for the IQ with internal modulator type include:

Item	Description
Sample Rate:	The Sample Rate displays the current AWG's clock rate. It is not adjustable from the Precompensation plug-in.
Nyquist Zone	Choose Nyquist Zone 1, Zone 2, or Zone 3. <div style="text-align: center;"> </div>
Bandwidth	Enter the bandwidth of the signal. The available bandwidth setting is dependent on the AWG's sample rate and the Frequency Resolution setting.
Baseband Offset	The default signal is centered at the Carrier Frequency. The Baseband Offset changes moves the signal center + or - from the carrier frequency.
Frequency Resolution	Enter the frequency resolution of the signal to determine the number of frequency points between start and end frequencies that coefficients will be created.
Carrier Frequency	Enter the carrier frequency of the RF signal.

Item	Description
Number of Averages	Enter the number of times the software sends and captures the signal through the user defined configuration to create an average. Increasing the number of averages reduces the noise level but increases processing time.
Scope Trigger...	The Scope Trigger button is available when connected to an oscilloscope. Selecting Scope Trigger displays the Scope Trigger options dialog screen which allows you to define the trigger source for the connected oscilloscope. See Scope Trigger options (see page 16) for detailed information.

IQ with external modulator coefficients

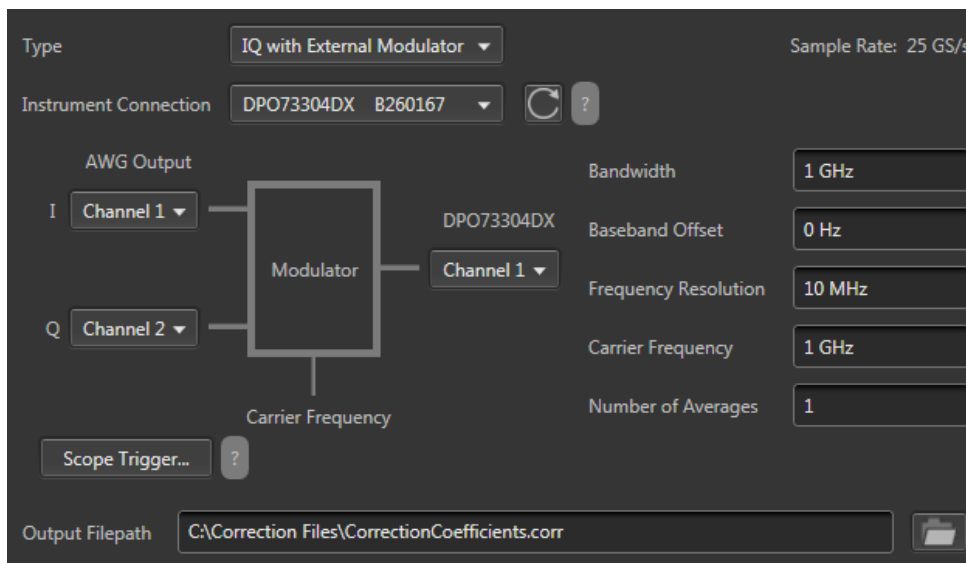
The IQ with external modulator coefficients are individual I and Q signals from the AWG and modulated (using an external modulator) with a carrier frequency to provide a single RF signal to the device under test (DUT).

NOTE. The IQ with External Modulator selection is only available if the active generator has individual channels available for the I and Q signals.

For IQ type coefficients using an external modulator, you can connect to either an oscilloscope or a real time signal analyzer (RSA) to capture the waveform.

In the example shown, the I and Q signals are being output from channels 1 and 2 of the AWG, modulated with a 30 GHz carrier frequency, and input to channel 1 of the connected oscilloscope (DPO73304DX).

Use the connection diagram pull-down lists to select the proper output and input channels of your setup.



The settings for the IQ with external modulator type include:

Item	Description
Sample Rate:	The Sample Rate displays the current AWG's clock rate. It is not adjustable from the Precompensation plug-in.
Baseband Offset	The default signal is centered at the Carrier Frequency. The Baseband Offset changes moves the signal center + or – from the carrier frequency.
Frequency Resolution	Enter the frequency resolution of the signal to determine the number of frequency points between start and end frequencies that coefficients will be created.
Carrier Frequency	Enter the carrier frequency of the modulator to create the RF signal.
Number of Averages	Enter the number of times the software sends and captures the signal through the user defined configuration to create an average. Increasing the number of averages reduces the noise level but increases processing time.
Scope Trigger...	The Scope Trigger button is available when connected to an oscilloscope. Selecting Scope Trigger displays the Scope Trigger options dialog screen which allows you to define the trigger source for the connected oscilloscope. See Scope Trigger options (see page 16) for detailed information.

Scope Trigger options

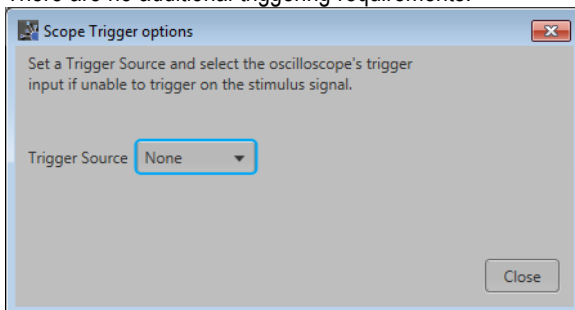
When Instrument Connection has successfully connected to an oscilloscope, you have the ability to define the trigger source for the oscilloscope.

Trigger type

None

When triggering is set to None, the oscilloscope uses the stimulus signal from the AWG as the trigger signal.

There are no additional triggering requirements.



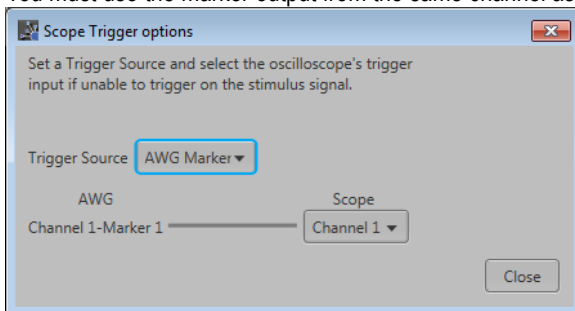
Triggering with the stimulus signal may result in triggering problems due to trigger bandwidth limitations. In these instances, you may want to trigger the oscilloscope with the AWG marker signal or provide an external trigger signal.

AWG Marker

When triggering is set to AWG Marker, the oscilloscope uses the Marker signal from the AWG as the trigger signal. Use the Scope pull-down menu to specify what input the oscilloscope is to use for the trigger source.

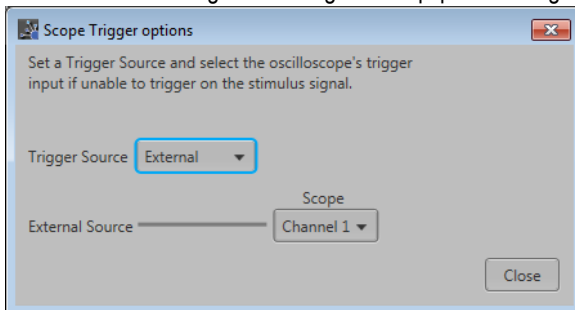
Connect the AWG marker output to the specified trigger source for the oscilloscope.

You must use the marker output from the same channel as the waveform source.




External

When triggering is set to External, the trigger signal for the oscilloscope is not derived from the AWG. Use this setting when using other equipment or signals to trigger the oscilloscope.



Output Filepath

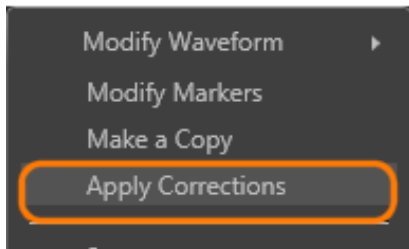
The Output Filepath is a common element to all Generic plug-in Types.

You can enter a directory path and file name directly in the field or use the browse folder icon  to display the Save As screen and navigate to a location to name and save the file.

Apply the Coefficient file

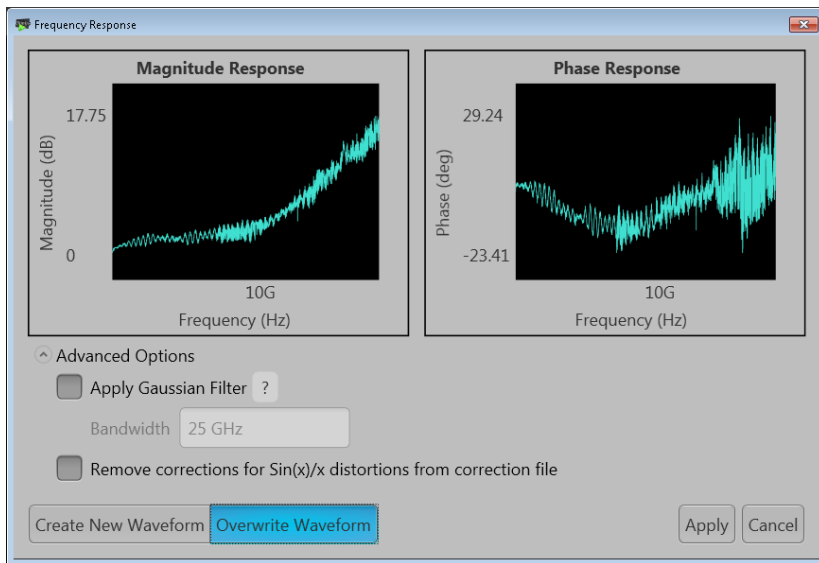
To use a coefficient file, you need to apply the correction file to a waveform. You can use either the SourceXpress application or an AWG70000A or AWG5200 series instrument to perform the operation.

Use the Waveforms list to select the waveform(s) and then select Apply Corrections.



- RF coefficients can be applied to Real, I, or Q files. Select a single waveform and apply the correction file.
- IQ coefficients must be applied to two waveforms, I and Q. Select the two waveforms (high lighting both at the same time) and apply the correction file.

A window opens to allow you to navigate to the saved coefficient file (correction file). When applying corrections, the application displays a Frequency Response window showing the plot information and actions to take.



Choose to either create a new waveform or overwrite the existing waveform. (For RF type corrections, you also have the Advanced options to apply a Gaussian filter or remove Sin(x)/x distortions.

Select Apply to complete the operation.

Refer to the application help (for either SourceXpress or the AWG70000A or AWG5200 series instruments) for information about using the Waveforms list.

Coefficient file structure

The coefficient file created is an ascii (human readable) file with .corr as the file extension. This section describes the structure and contents of a typical correction file.

```

1 ! Generic Precompensation Calculated Coefficients
2 ! S1P DATA File Format
3 ! Date=8/31/2015
4 ! SerialNumber=B010264
5 ! Model=AWG70002A
6 ! SampleRate=25000000000
7 ! NyquistZone=1
8 ! Channel=1
9 ! Amplitude=0.5
10 ! AnalyzerType=Scope
11 ! AnalyzerSerialNumber=B260167
12 ! Type=RF
13 ! FrequencyResolution=1000000
14 ! NumberOfFrequencies=12499
15 # Hz S DB R 50
16 !      Freq          dB(S21)          deg(S21)
17 1.000000000E+006  5.407519770E-002  0.000000000E+000
18 2.000000000E+006  3.137009836E-001  -4.243139251E-001
19 3.000000000E+006  1.836373572E-001  -7.957089428E-001
20 4.000000000E+006  8.891616085E-002  -3.538308799E-001
21 5.000000000E+006  1.067637314E-001  -2.352129529E-001
22 6.000000000E+006  1.172397923E-001  -3.204048584E-001
23 7.000000000E+006  2.419145575E-001  -6.529653631E-001
24 8.000000000E+006  4.599761419E-001  -3.452067439E-001
25 9.000000000E+006  7.843344842E-002  -4.616272213E-001
26 1.000000000E+007  4.962496071E-002  -1.775152249E-001
27 1.100000000E+007  2.095510774E-001  2.300469508E-001
28 1.200000000E+007  2.116381898E-001  -8.732627635E-002
29 1.300000000E+007  0.000000000E+000  1.011070187E-002
    
```

! symbols indicate comment lines

symbol required to indicate start of data

Header provides basic setup information

Coefficient data

Coefficient files are created using the Touchstone file format.

Referencing the example coefficient file provided, here are some key elements:

Line	Description
1 — 14	Comments lines providing basic setup information, including the instruments that were used.
15	This line includes the # symbol, indicating the start of the coefficient data. The # symbol is required. The characters following the # symbol are not required. In this example, they indicate the following: <ul style="list-style-type: none"> ■ Hz: The data is in Hertz. ■ S: S-Parameter file format ■ DB: Data is in magnitude (dB) ■ R 50: The coefficients are in reference to a 50 Ω system setup
16	A comment line indicating the contents of the data columns. In the example, the columns are: Frequency, Magnitude (dB (S21), and Phase (deg (s21))
17 — ...	Contains the coefficient data.

Licensing

A license is required for this plug-in to become operational. The plug-in must be licensed for use with the host application from where you want to use the plug-in.

For example, to use the plug-in from SourceXpress, SourceXpress must have a license. To use the plug-in from an instrument, the instrument must have a license.

Refer to the application help (for either SourceXpress or the AWG70000A or AWG5200 series instruments) for complete information about obtaining and installing license files.

Error codes

The following table lists error codes and messages that are unique to the Generic Precompensation plug-in.

Error code	Error message
7812	Instrument Connection Error. Failed to connect to the selected instrument.
7813	Instrument Connection Error. Please connect to an instrument to continue.
7814	Precompensation Error. Error during calculation of coefficients.
7815	Precompensation Error. Error while setting Oscilloscope Record Length. Check instrument connections and retry.
7816	Precompensation Error. Access to correction file denied.
7817	Precompensation Error. Invalid Output Filepath for correction file.
7818	Precompensation Error. Correction file not found.
7819	Precompensation Error. Cannot calculate coefficients using a virtual generator.
7820	Precompensation Setup Error. Cannot use an RSA with a Direct IQ setup.
7821	Precompensation Error. No good signal correlation between the captured and reference signals.
7822	Precompensation Error. Unable to trigger, signal amplitude too low.
7823	Precompensation Error. Unable to capture signal, signal is clipping.
7824	Precompensation Error. Unable to capture signal. Amplitude is too large.
7825	Sample Rate Error. Insufficient sample rate. Please increase to <recommended value> or higher. Recommended value is dependent on current setup.
7826	Precompensation Error. Captured waveform length is insufficient for calculation of coefficients.
7830	Precompensation Error. Resolution too large. Need a better resolution.
7831	Precompensation Error. Too few trace points.
7832	Precompensation Error. Unable to create stimulus. Requires more than two tones. Need a larger span or smaller resolution.
7833	Precompensation Error. Desired start frequency is lower than the set resolution.
7834	Precompensation Error. 80% of the data captured is below noise floor.
7835	Precompensation Error. Bandwidth cannot be less than or equal to 0.
7836	Precompensation Error. Creation of coefficients already in progress.
7837	Precompensation Setup Error. Cannot use an ATI Channel and Non-ATI channel with a Direct IQ setup.
7838	Precompensation Setup Error. Cannot use the same AWG Channel for I and Q with an IQ setup.
7839	Precompensation Setup Error. Cannot use the same Scope Channel for I and Q with an IQ setup.
7840	Precompensation Setup Error. Input parameters are greater than instrument parameters. Please reduce Bandwidth/Start/End Frequencies.
7841	Precompensation Setup Error. Input parameters is setting analysis frequency to less than or equal to zero.
7842	Precompensation Setup Error. Sample Rate cannot be less than or equal to 0 or NaN.
7843	Precompensation Error. AWG play timed out. Please check settings and try again.

Error code	Error message
7844	Precompensation Error. Cannot create correction coefficients with Sync Hub enabled.
7850	Asset not found. Unable to access selected asset.
7851	Correction file not supported. Only dB-Angle correction files are supported. Refer to Coefficient file structure (see page 23) .
7852	Correction file not supported. Only Scattering correction files are supported. Refer to Coefficient file structure (see page 23) .
7853	Error Calculating Correction Parameter. Unable to calculate <parameter> from correction file.
7854	Frequency Count Mismatch. When reading the correction file, the number of frequencies <current value> did not match the expected number <expected value>. The current value is based on the correction file.
7856	Precompensation Apply Error. Error while applying correction coefficients.
7857	Error using Waveform Sample Rate. Sampling Rate must be set for <waveform name> waveform to apply correction coefficients.
7858	Precompensation Apply Error. Cannot apply IQ Correction Coefficients to a Real Signal.
7859	Precompensation Apply Error. Cannot apply <signal format> Correction Coefficient to a <signal format value> Signal Format waveform. Refer to Apply the Coefficient file (see page 21) .
7860	Precompensation Apply Error. Corrections are currently being applied.
7861	Precompensation Apply Error. No sample rate detected in file.
7862	Precompensation Apply Error. Too few frequency points detected in file.

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