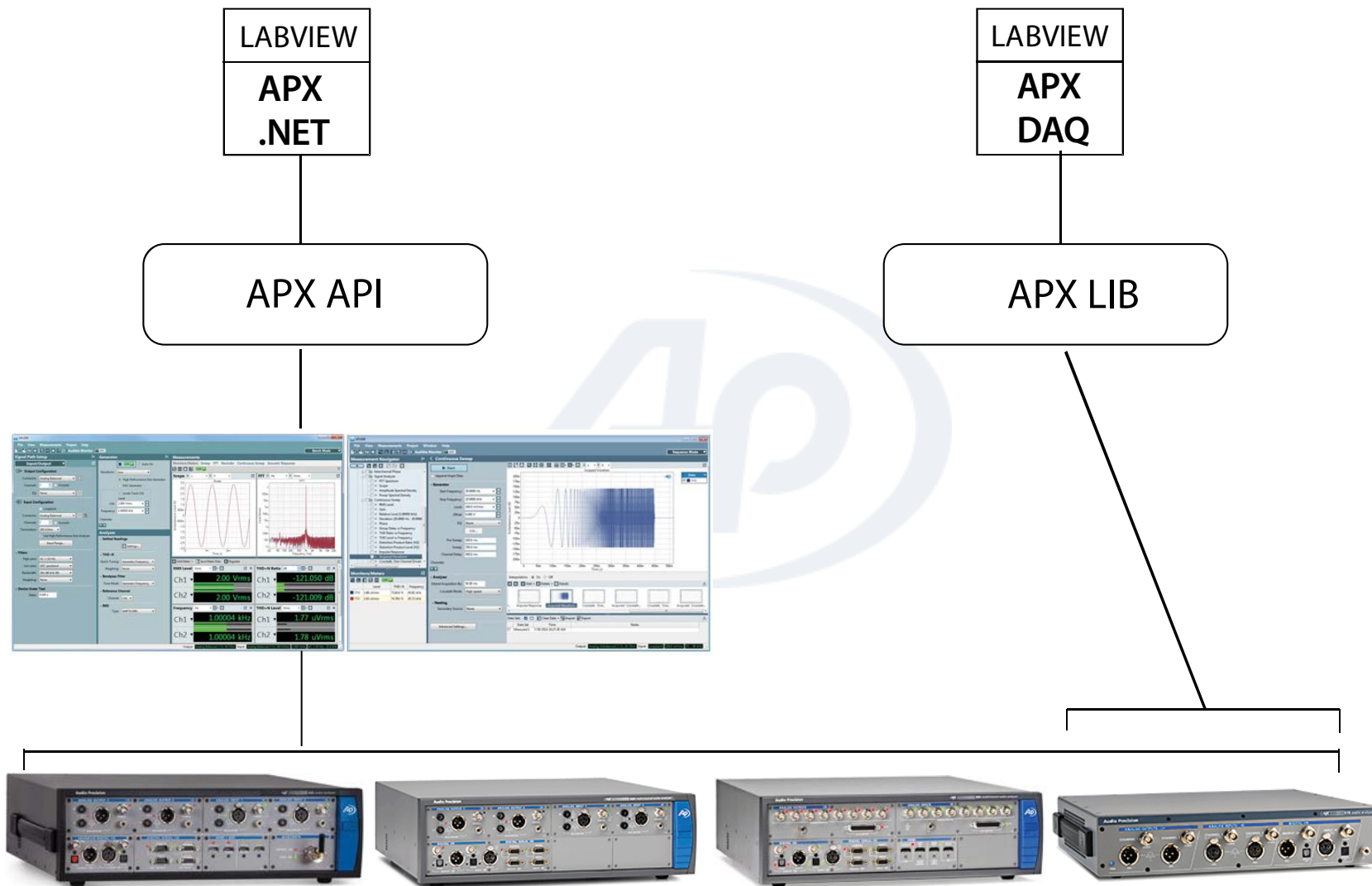


# *Audio Precision Technical Training*

**LabVIEW Drivers for  
APx Instruments**



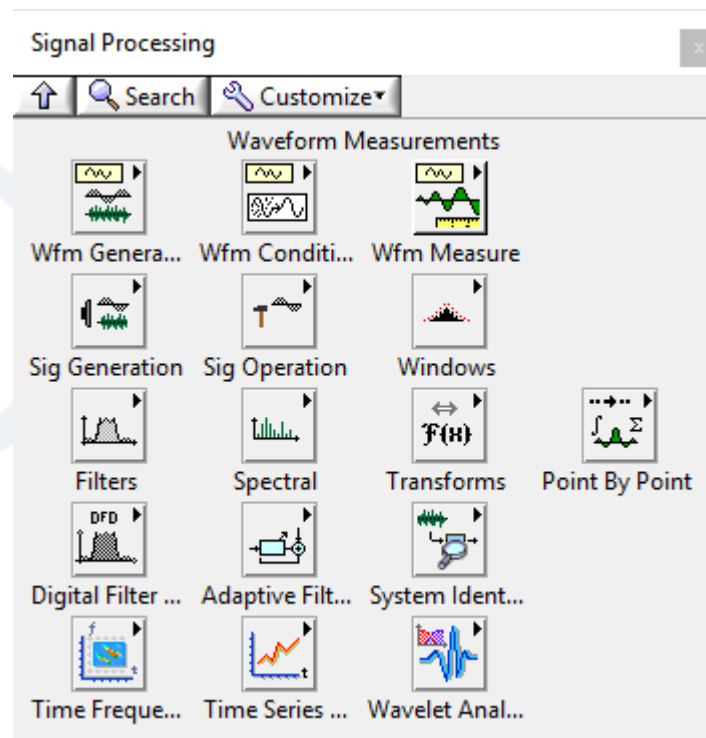
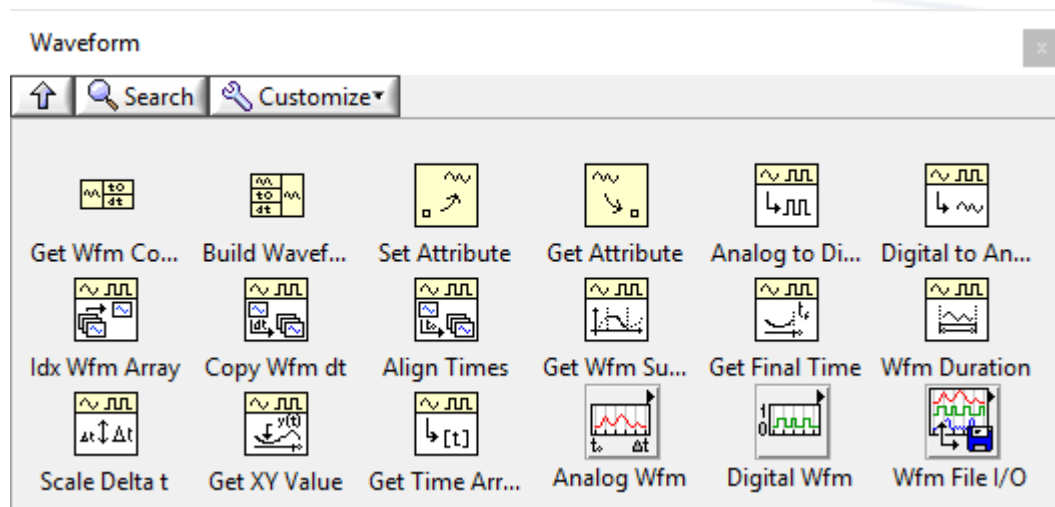
# APx LabVIEW .NET versus DAQ Driver

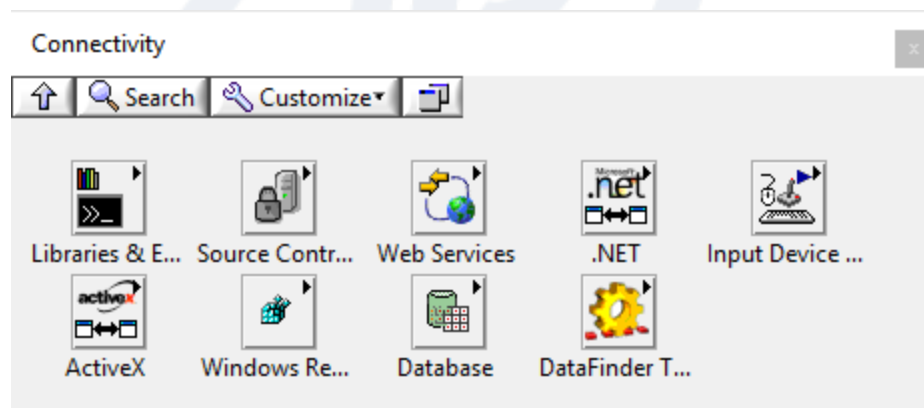
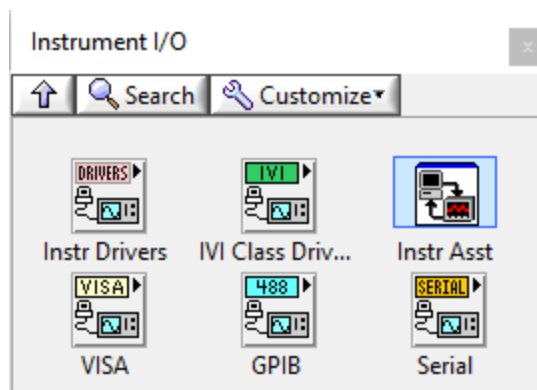
APx LabVIEW .NET Driver	APx LabVIEW DAQ Driver
Requires APx500 software	Independent of APx500 software
Requires Microsoft .NET	Based on low level C++ functions
LabVIEW framework and wrapper for APx500 API	True instrument driver
Complex	Simple
Any APx Audio Analyzer	APx515 only

# APx LabVIEW .NET Driver

1. **Why LabVIEW**
2. Driver Structure
3. Signal Path
4. Measurements
5. Other VIs
6. Examples
7. Constructing LV Projects
8. Constructing LV VIs

# LabVIEW Waveforms and Signal Processing





[Home](#) > [Support](#) > [Downloads](#) > [Drivers](#) > 3rd Party Instrument Drivers

Search Entire Site

Search Within

Drivers

NI Drivers

Instrument Drivers

Narrow by

▼ Manufacturer

A (2059)

B-C (607)

D-E (216)

F-H (441)

I-K (1760)

## Instrument Driver Network (IDNet)

Find, download, or submit a driver to communicate with third-party Drivers.

Instrument Drivers | ▼

Enter keywords

### Popular Drivers

[Tektronix TDS 200 1000 2000 Series](#)

[Agilent 34970A](#)

[Agilent 34401](#)

[Keithley 2400 Series](#)

[Agilent 33XXX Series](#)

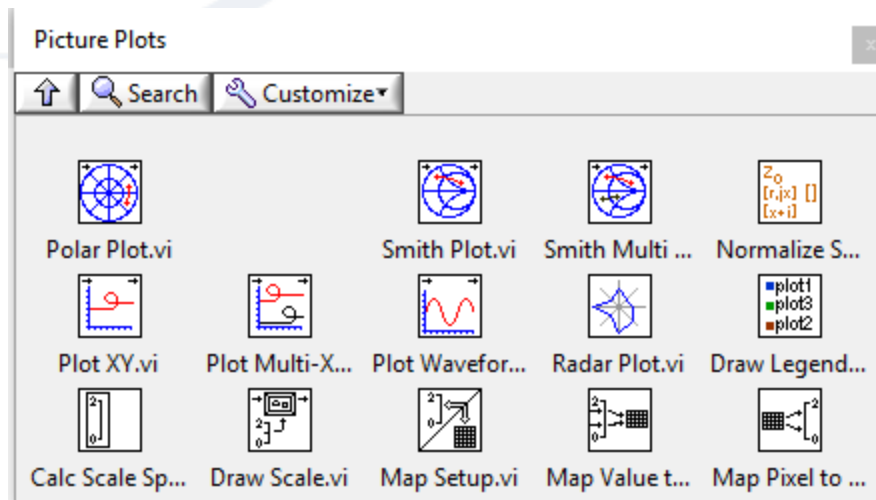
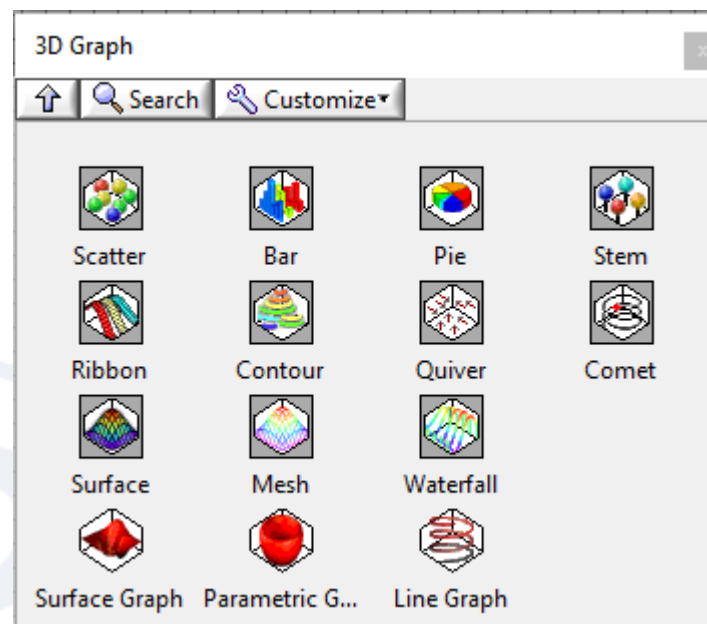
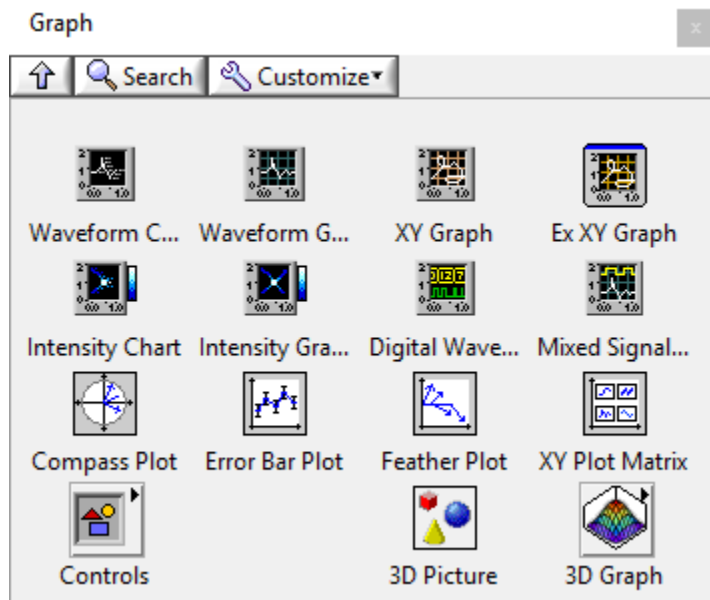
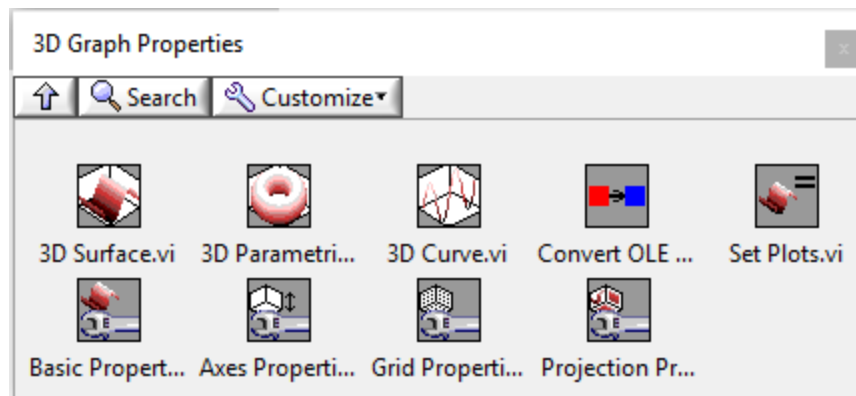
[Agilent E363XA Series](#)

[Tektronix TDS 3000 series](#)

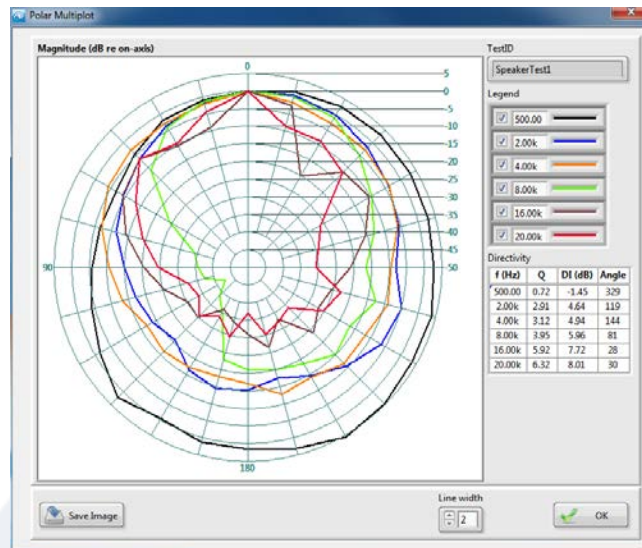
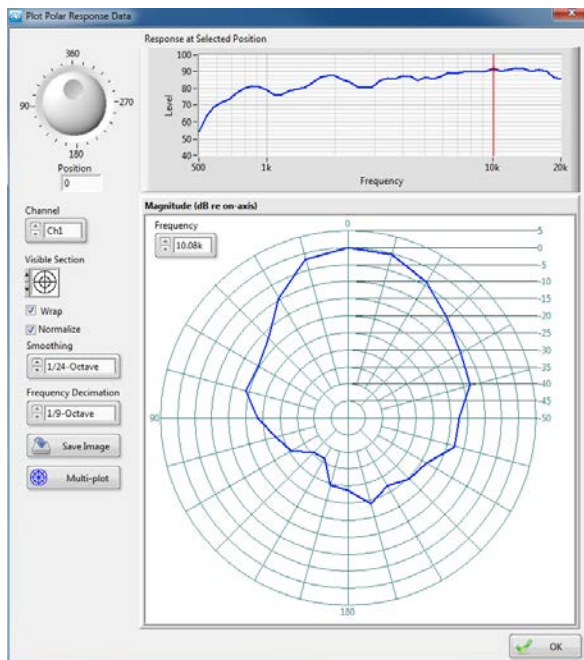
[Tektronix MDO MSO DPO 2000 3000 4000 Series](#)

[Ocean Optics 2000 4000 Series](#)

[Agilent MXA Series](#)

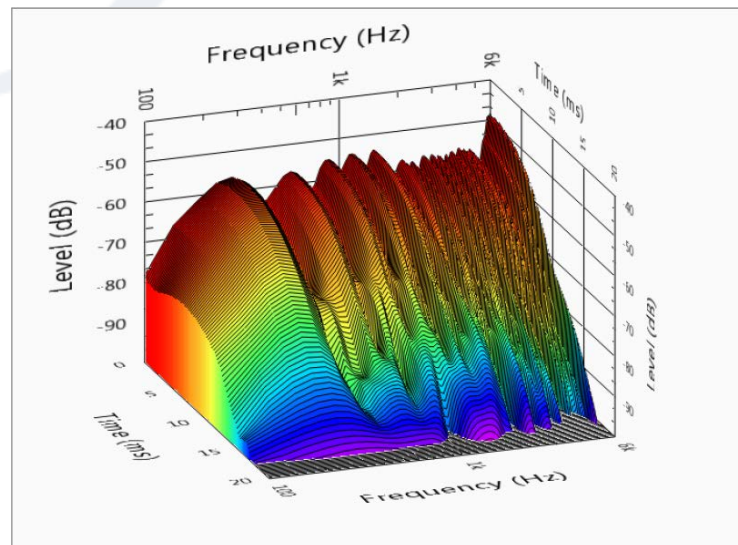






APx Polar Plot  
Utility

APx CSD Utility



Numeric

↑ Search Customize

Add  
 Subtract  
 Multiply  
 Divide  
 Quotient & Remainder  
 Conversion  
 Increment  
 Decrement  
 Add Array Element  
 Multiply Array  
 Compound Interest  
 Data Manipulation  
 Absolute Value  
 Round To Nearest  
 Round Towards Zero  
 Round Towards Positive Infinity  
 Scale By Power  
 Complex  
 Square Root  
 Square  
 Negate  
 Reciprocal  
 Sign  
 Scaling  
 Numeric Constant  
 Enum Constant  
 Ring Constant  
 Random Number  
 Expression Node  
 Fixed-Point  
 DBL Numerical Constant  
 +Inf  
 -Inf  
 Machine Epsilon  
 Math Constants

Array

↑ Search Customize

Array Size  
 Index Array  
 Replace Subarray  
 Insert Into Array  
 Delete From Array  
 Initialize Array  
 Build Array  
 Array Subset  
 Max & Min  
 Reshape Array  
 Sort 1D Array  
 Search 1D Array  
 Split 1D Array  
 Reverse 1D Array  
 Rotate 1D Array  
 Interpolate 1D Array  
 Threshold 1D Array  
 Interleave 1D Array  
 Decimate 1D Array  
 Transpose 2D Array  
 Array Constant  
 Array To Cluster  
 Cluster To Array  
 Array to Matrix  
 Matrix to Array

Mathematics

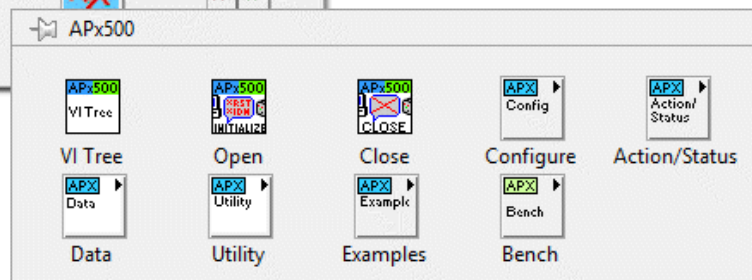
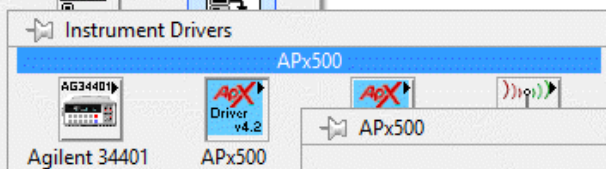
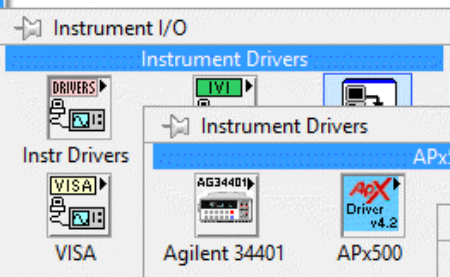
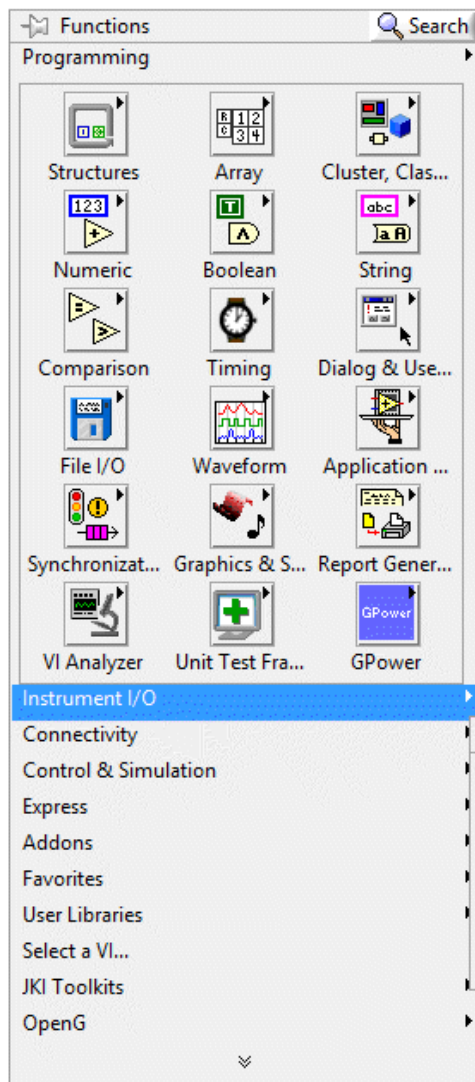
↑ Search Customize

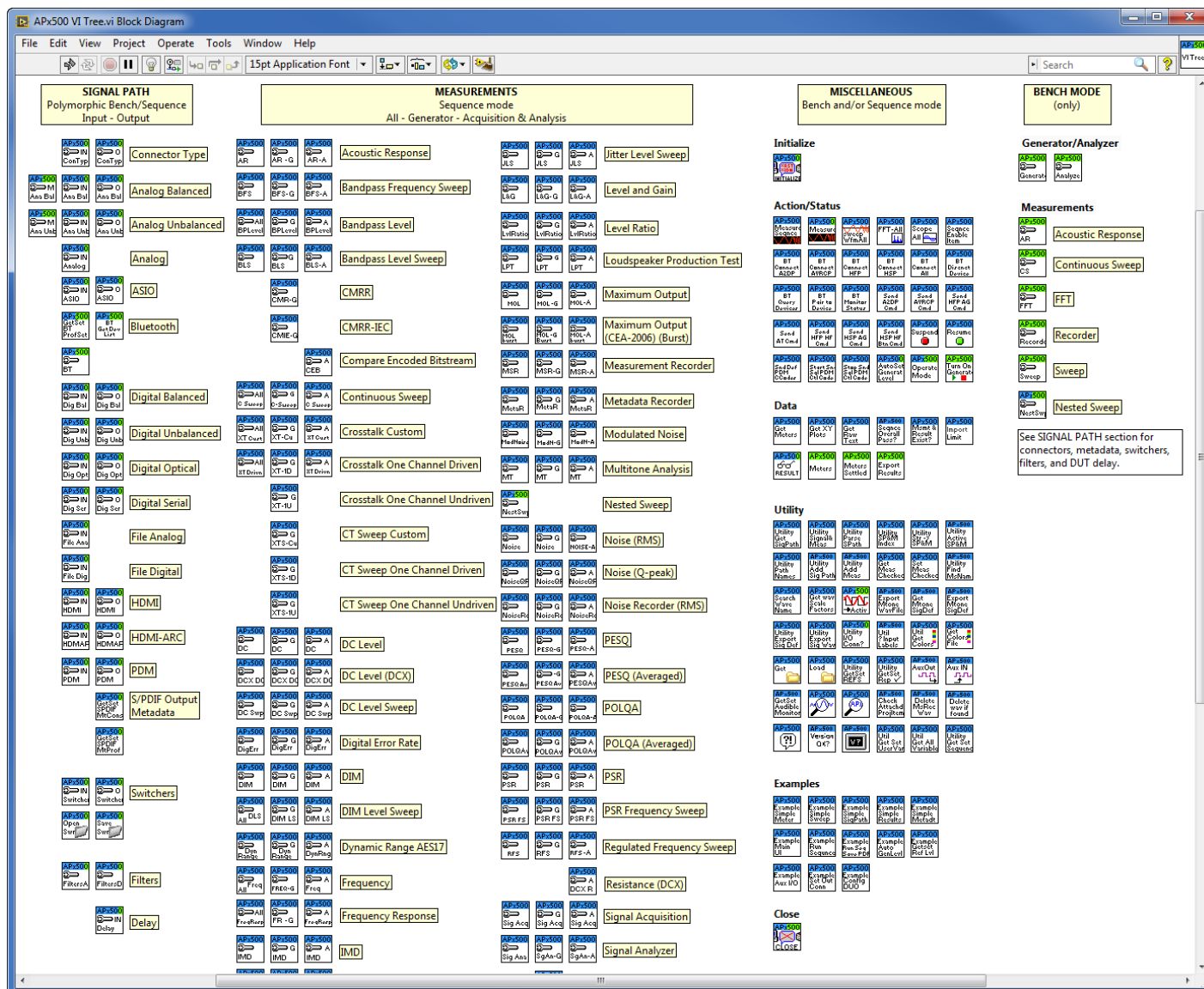
Numeric  
 Elementary  
 Linear Algebra  
 Fitting  
 Interp & Extrapolation  
 Integ & Diff  
 Prob & Stat  
 Optimization  
 Differential Equations  
 Geometry  
 Polynomial  
 Script & For Loop

Matrix

# APx LabVIEW .NET Driver

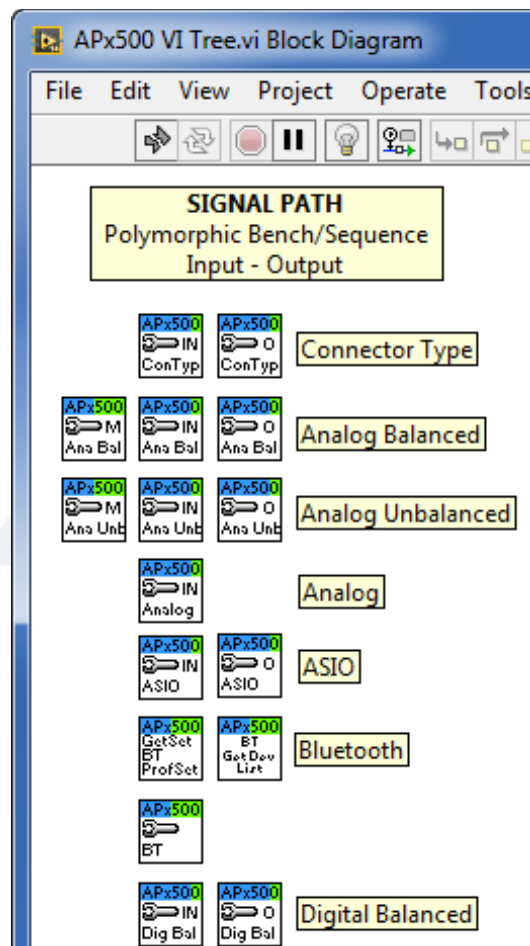
1. Why LabVIEW
2. **Driver Structure**
3. Signal Path
4. Measurements
5. Other VIs
6. Examples
7. Constructing LV Projects
8. Constructing LV VIs





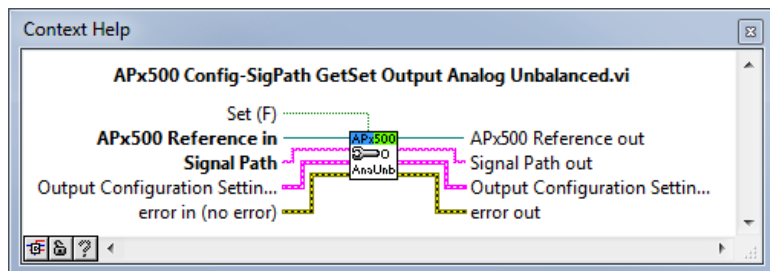
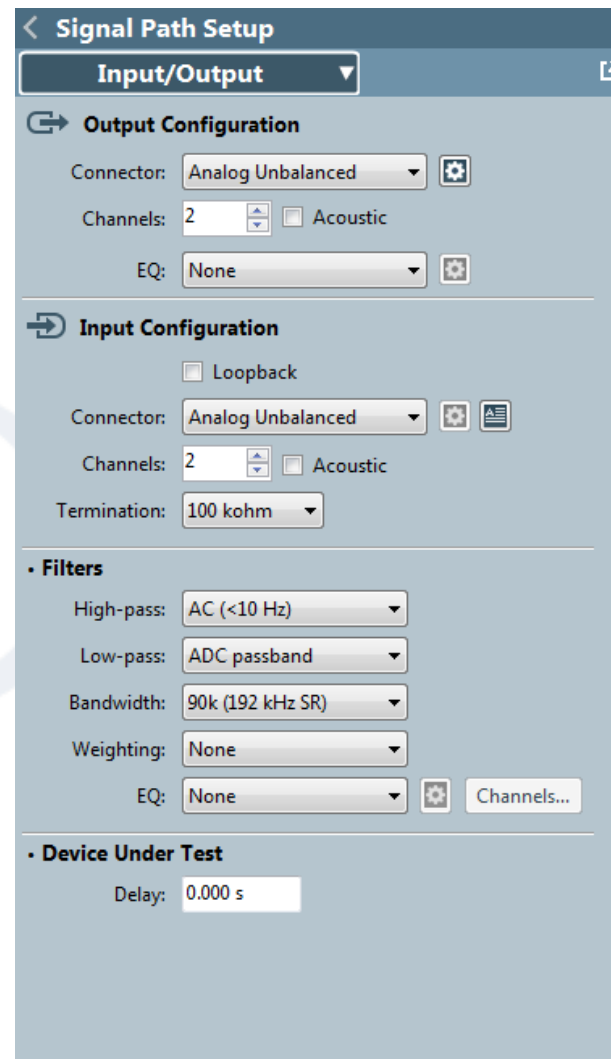
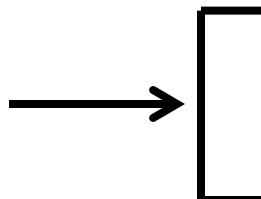
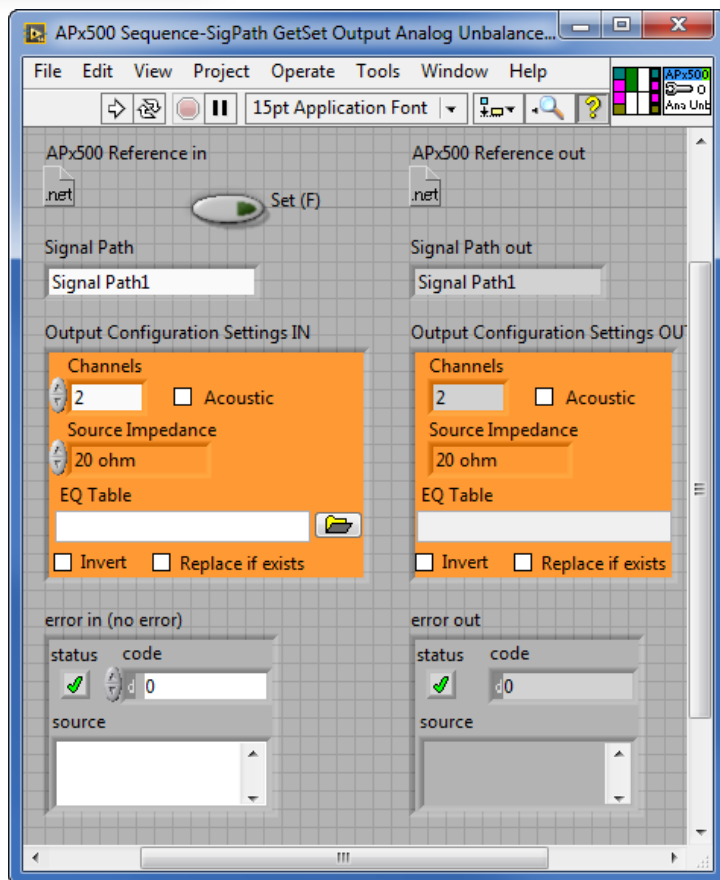
# APx LabVIEW .NET Driver

1. Why LabVIEW
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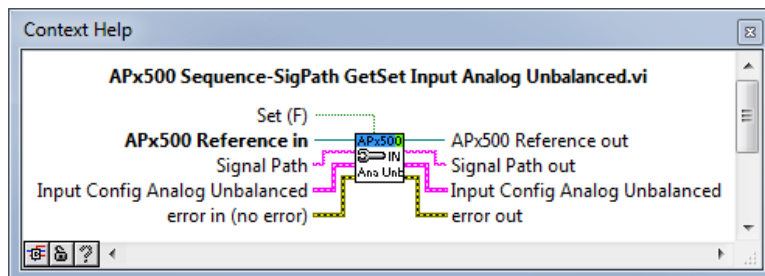
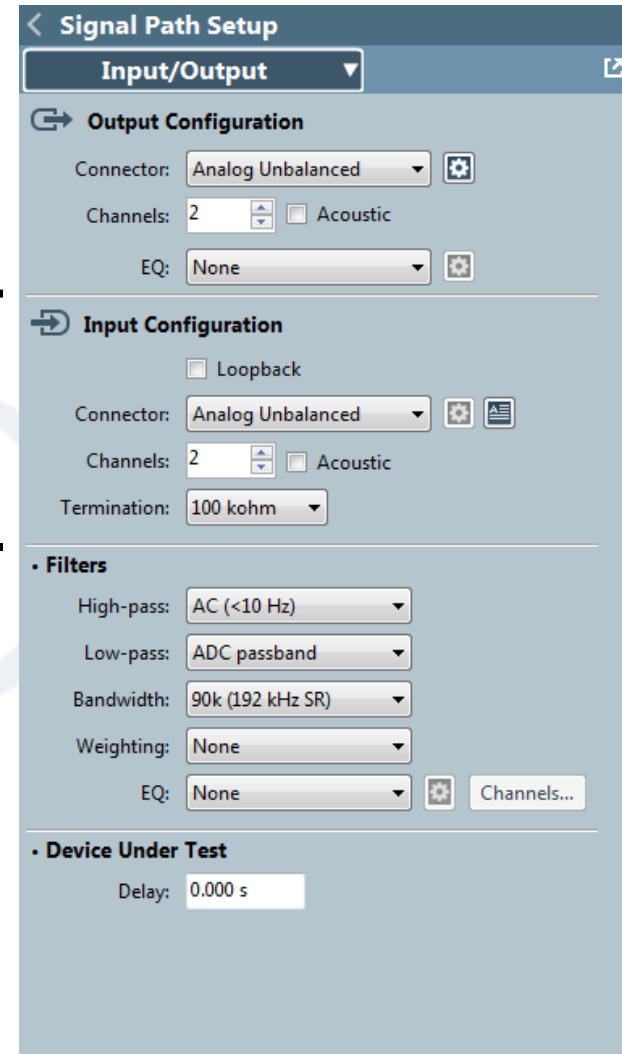
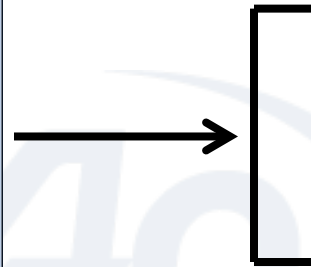
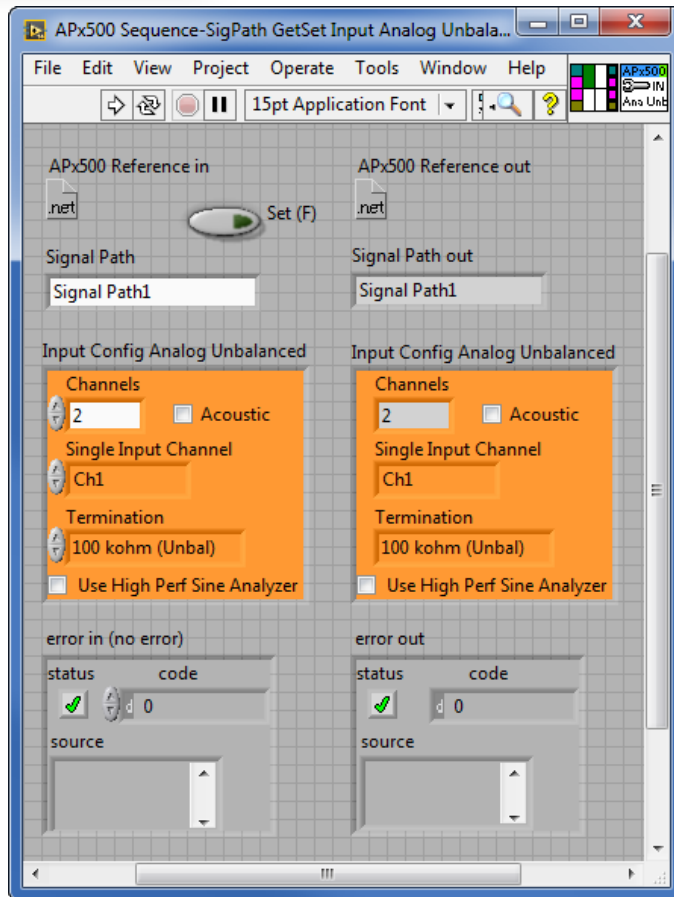


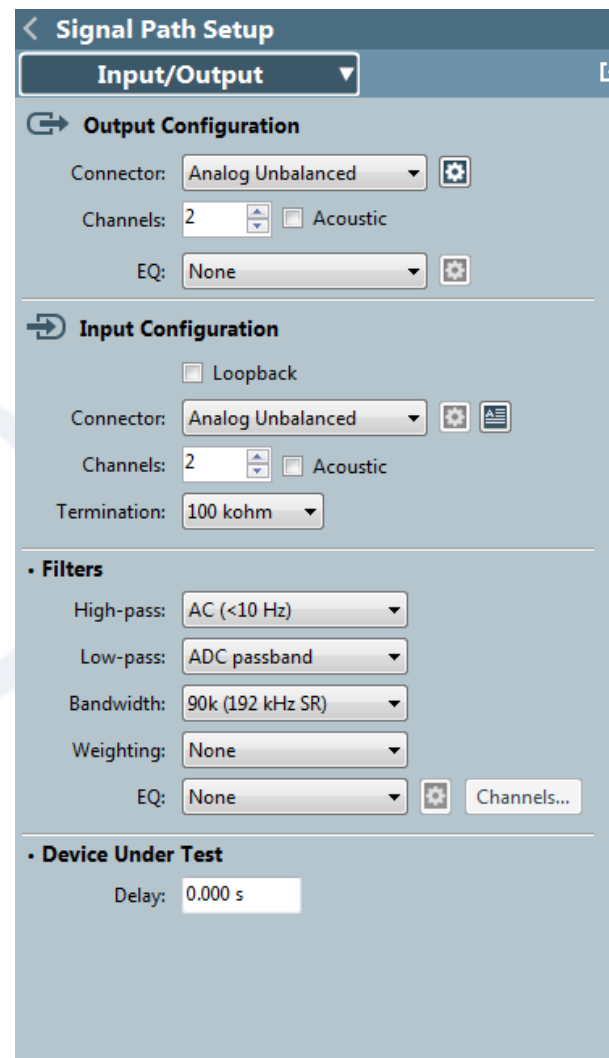
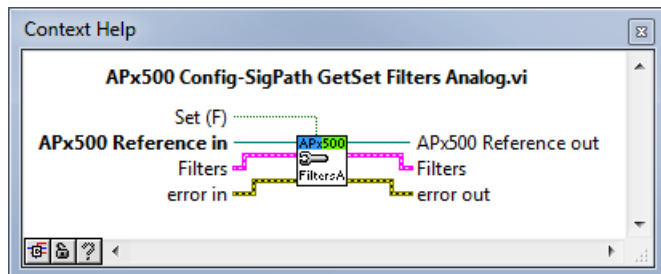
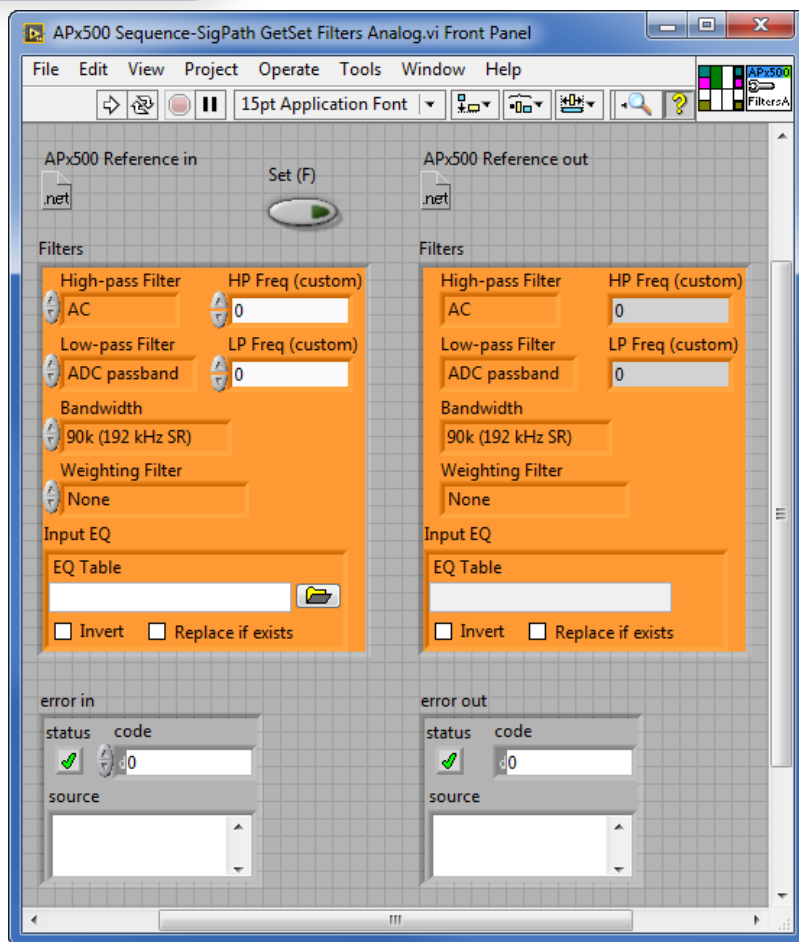
# SPS – Output Config

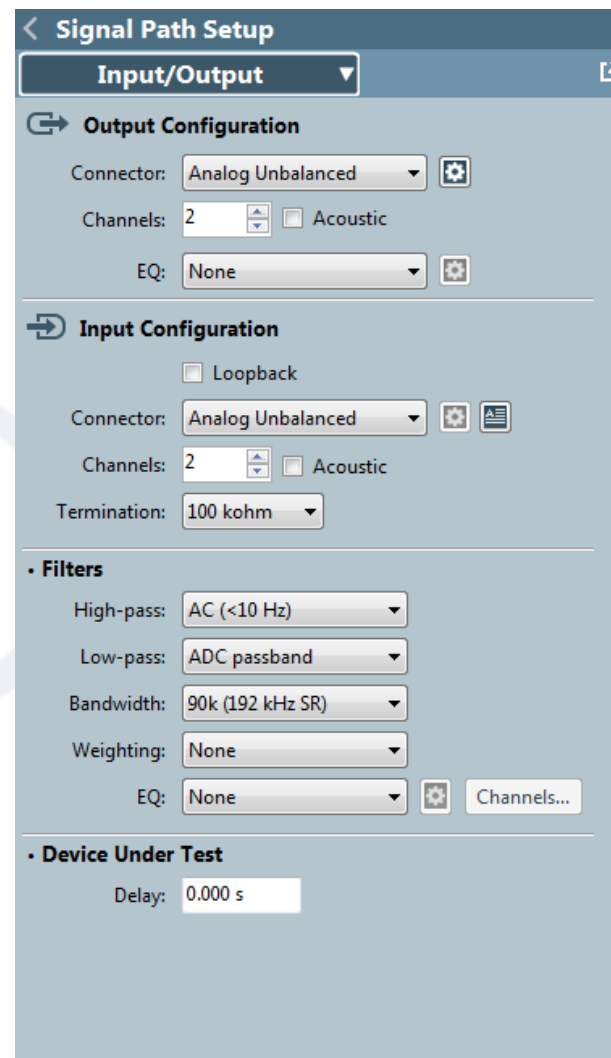
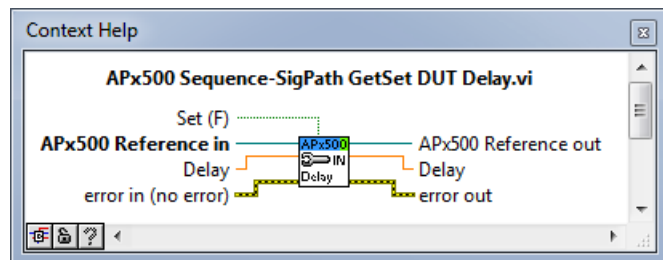
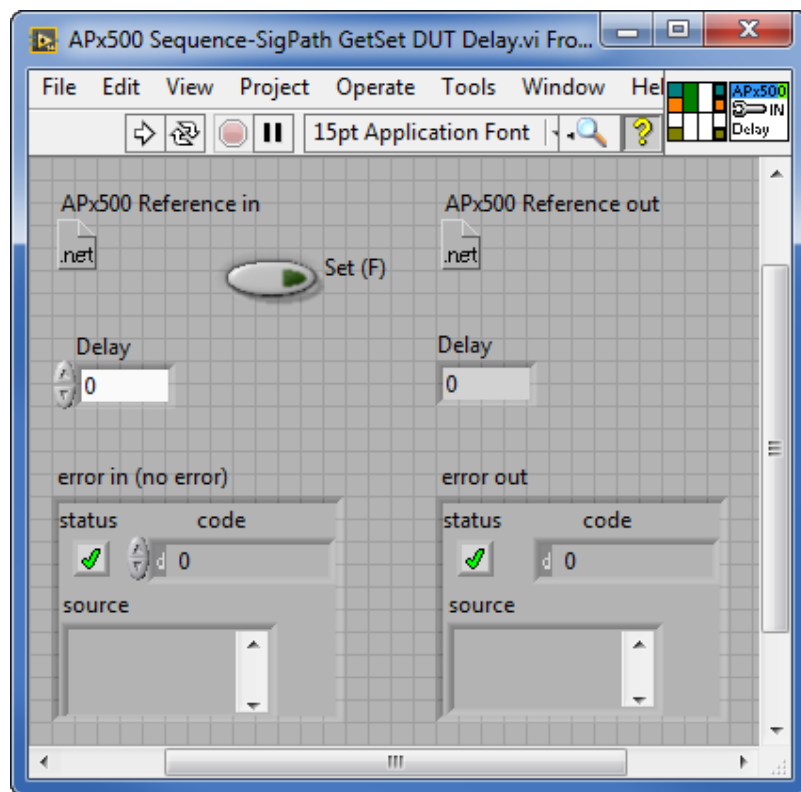




# SPS – Input Config

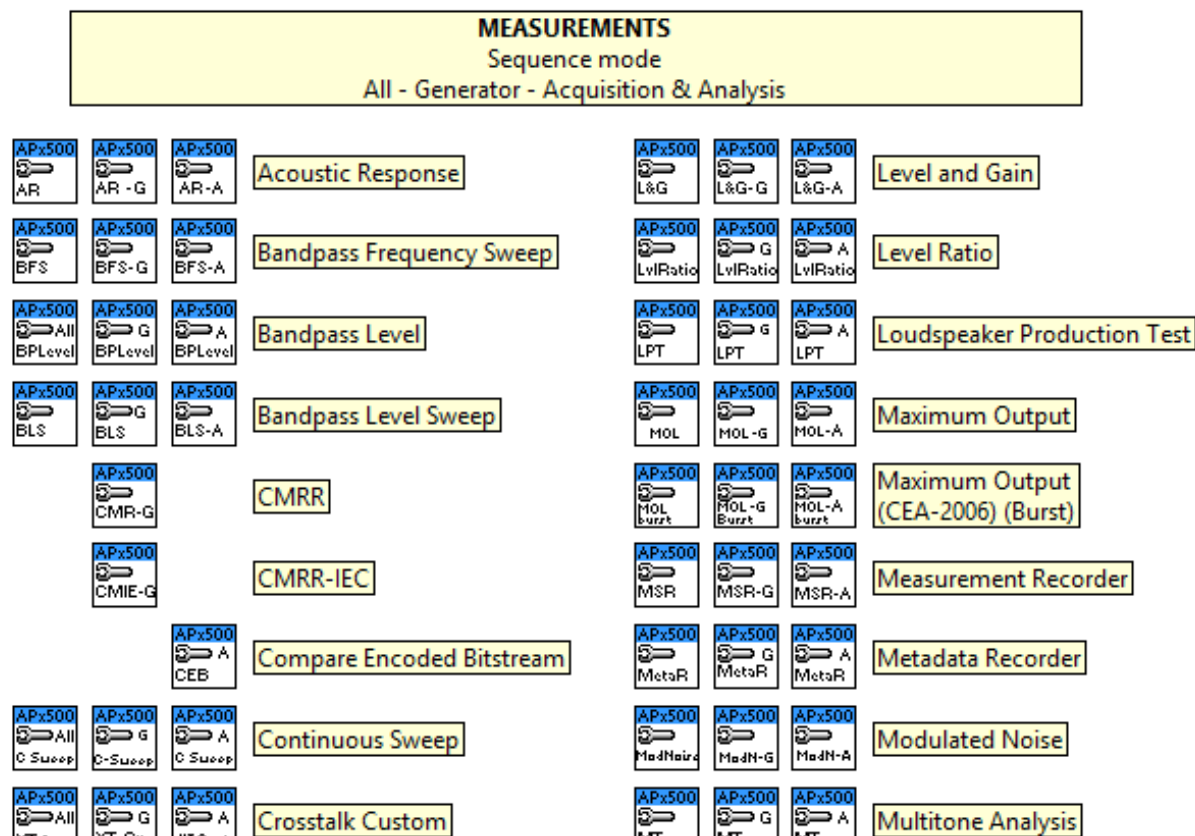


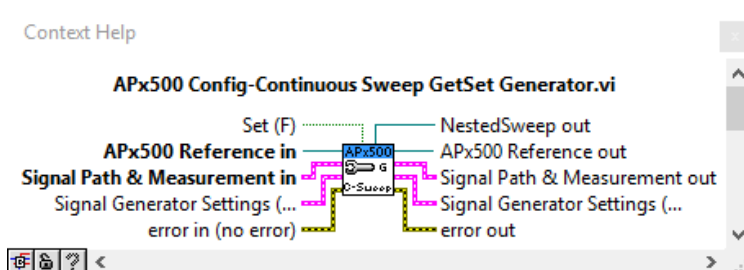
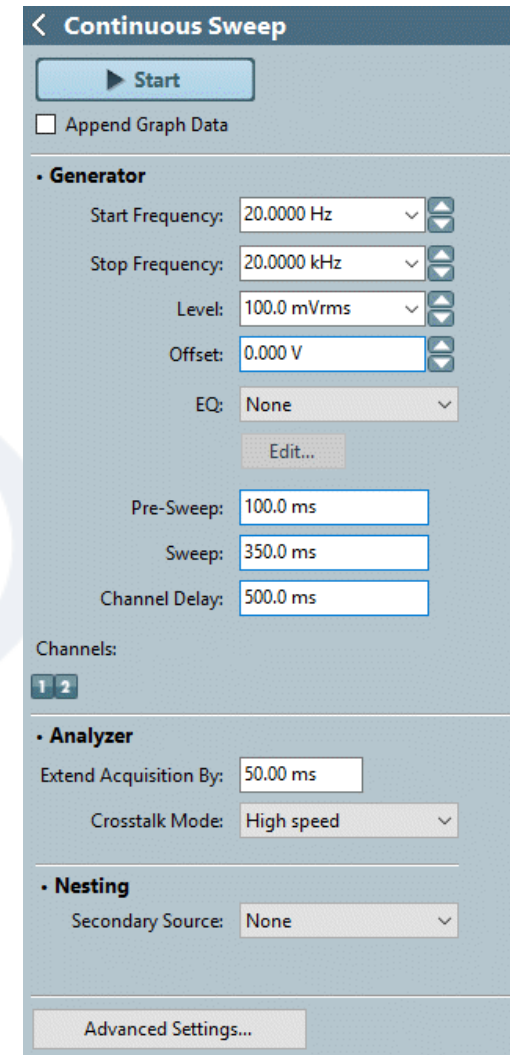
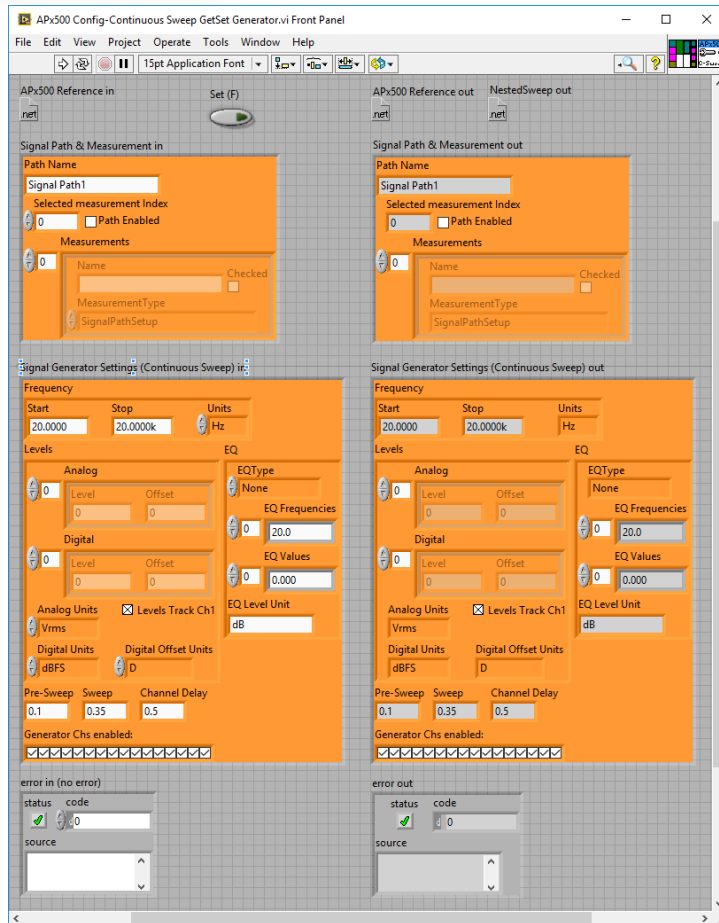




# APx LabVIEW .NET Driver

1. Why LabVIEW
2. Driver Structure
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- 4. Measurements**
5. Other VIs
6. Examples
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8. Constructing LV VIs





Continuous Sweep

▶ Start

☐ Append Graph Data

• Generator

Start Frequency:

20.0000 Hz

▼▲

Stop Frequency:

20.0000 kHz

▼▲

Level:

100.0 mVrms

▼▲

Offset:

0.000 V

▼▲

EQ:

None

▼

Edit...

Pre-Sweep:

100.0 ms

Sweep:

350.0 ms

Channel Delay:

500.0 ms

Channels:

12

• Analyzer

Extend Acquisition By:

50.00 ms

Crosstalk Mode:

High speed

▼

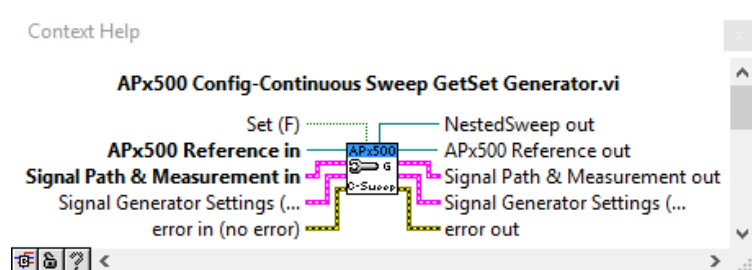
• Nesting

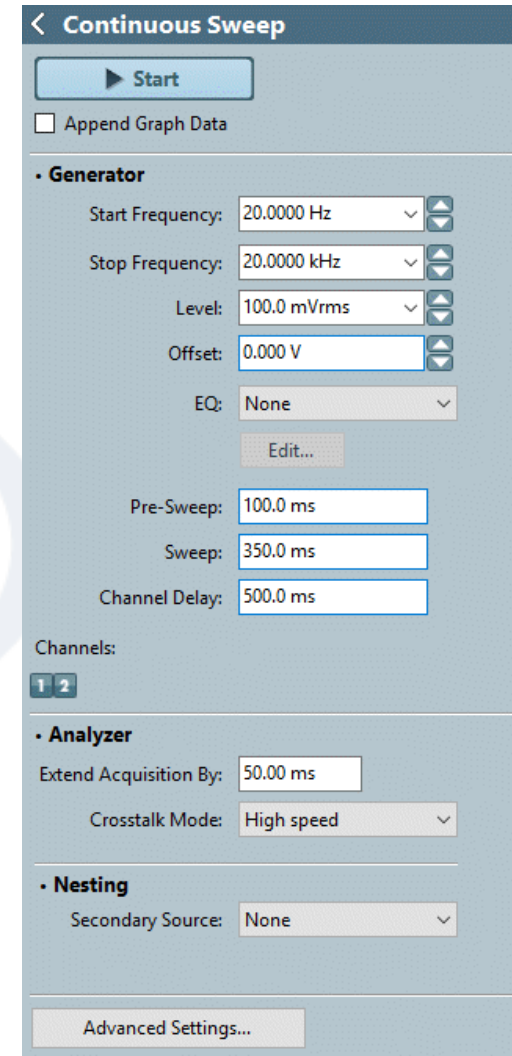
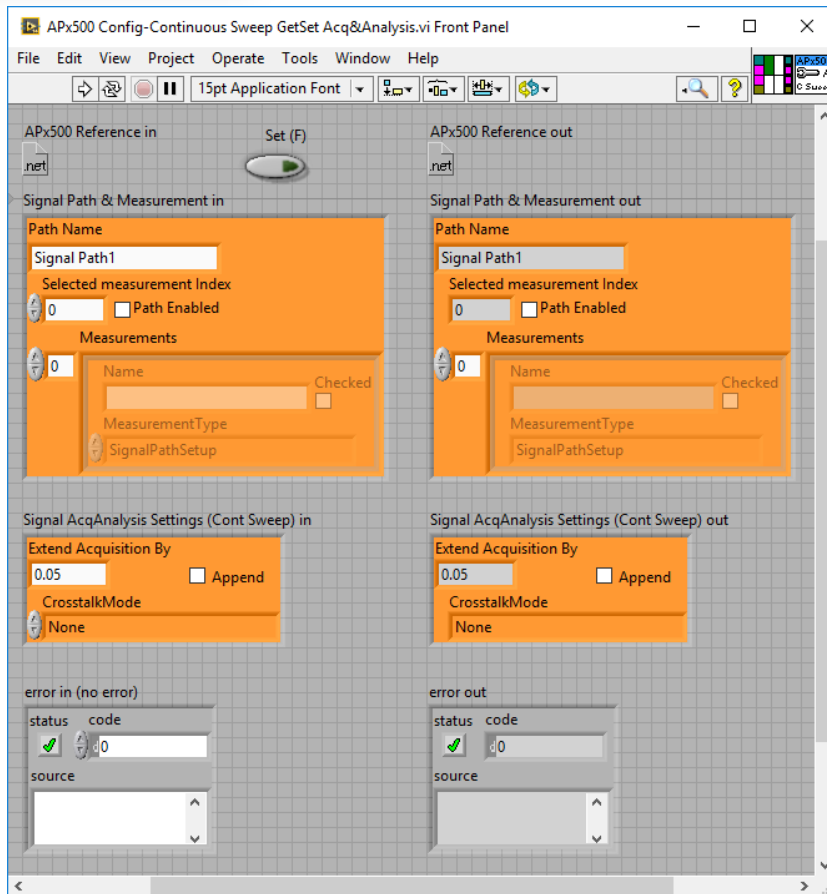
Secondary Source:

None

▼

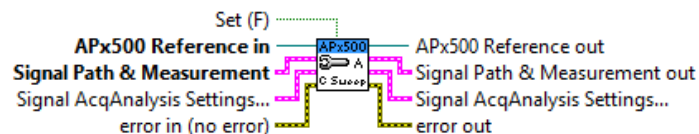
Advanced Settings...



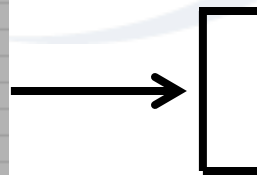
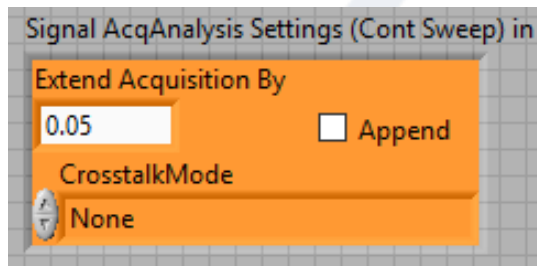


## Context Help

### APx500 Config-Continuous Sweep GetSet Acq&Analysis.vi







### < Continuous Sweep

**Start**

☐ Append Graph Data

**• Generator**

Start Frequency: 20.0000 Hz

Stop Frequency: 20.0000 kHz

Level: 100.0 mVrms

Offset: 0.000 V

EQ: None

Edit...

Pre-Sweep: 100.0 ms

Sweep: 350.0 ms

Channel Delay: 500.0 ms

Channels: 1 2

**• Analyzer**

Extend Acquisition By: 50.00 ms

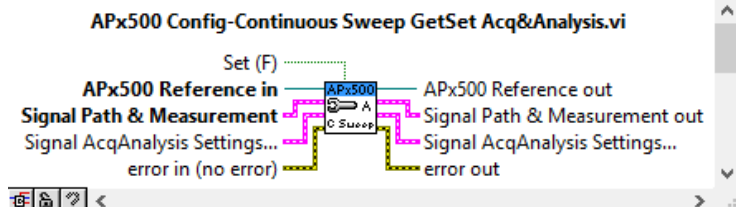
Crosstalk Mode: High speed

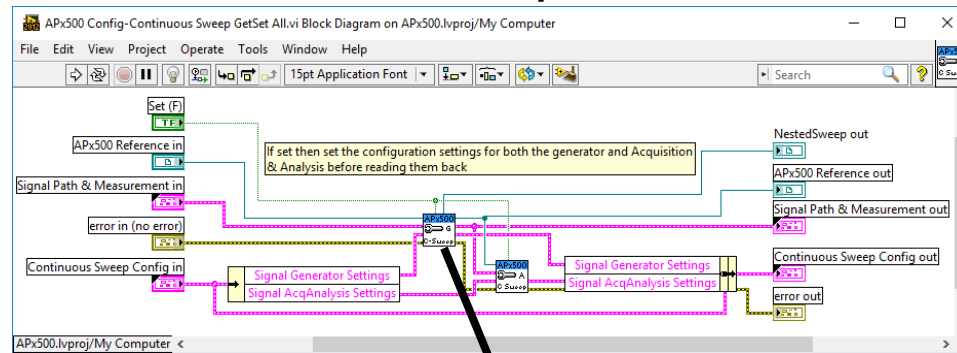
**• Nesting**

Secondary Source: None

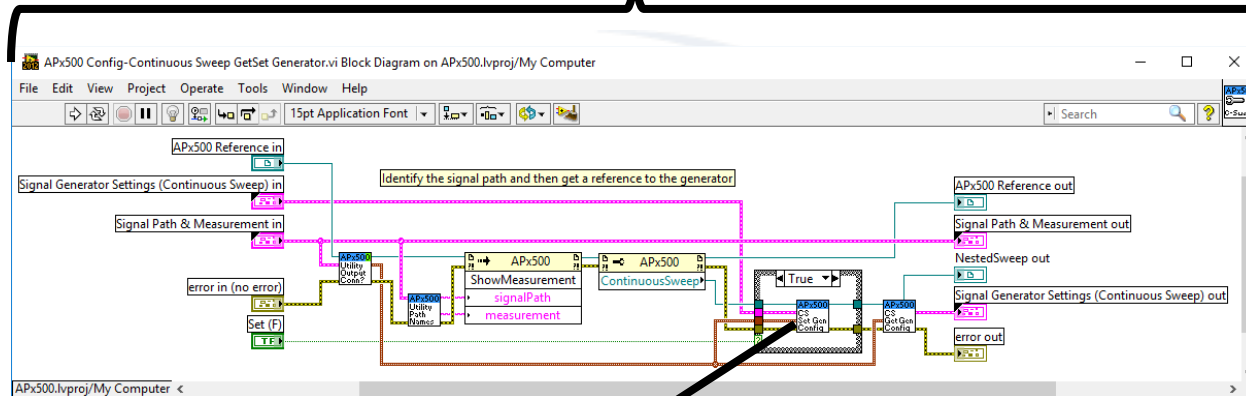
Advanced Settings...

Context Help

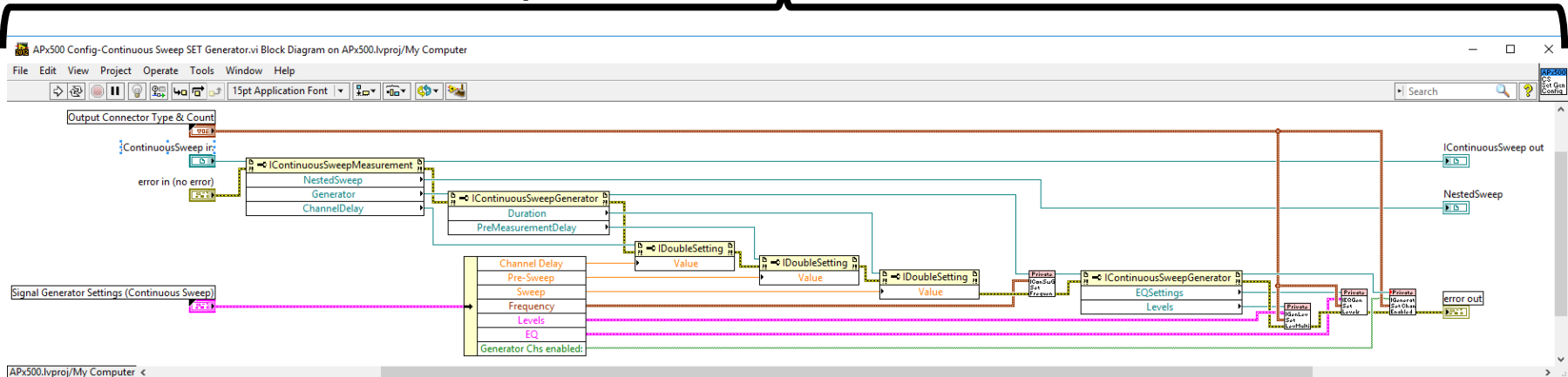




## Continuous Sweep GetSet Generator



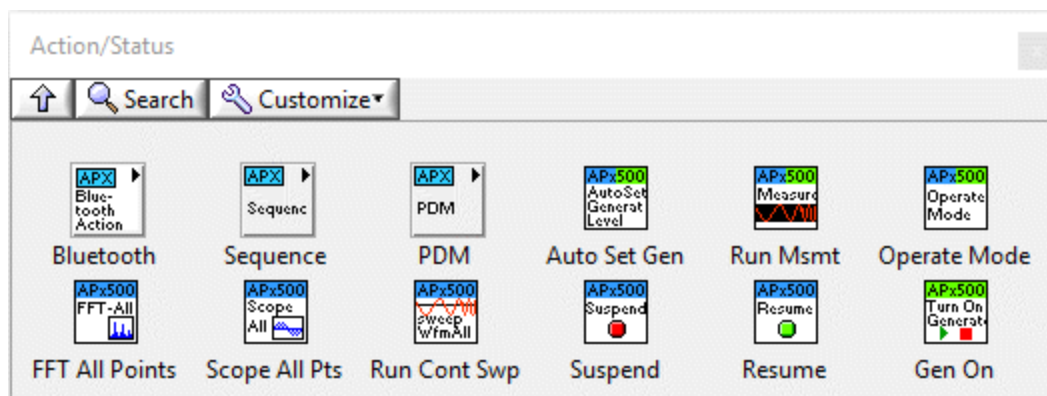
## Continuous Sweep Set Generator



# APx LabVIEW .NET Driver

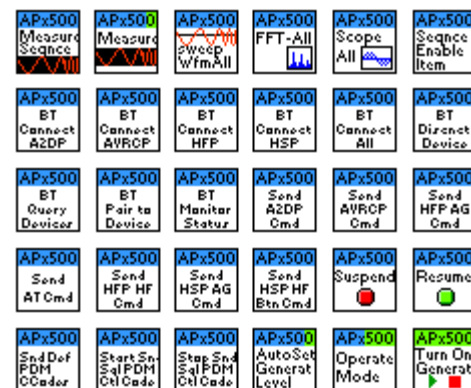
1. Why LabVIEW
2. Driver Structure
3. Signal Path
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- 5. Other VIs**
6. Examples
7. Constructing LV Projects
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Palette:

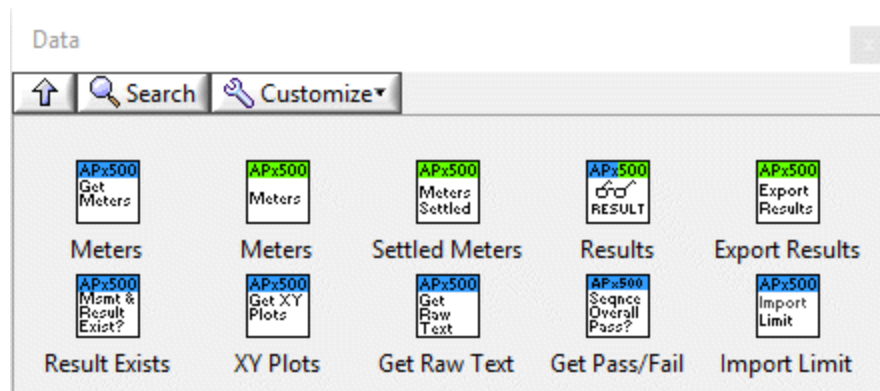


Tree:

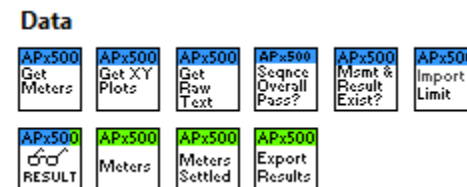
Action/Status

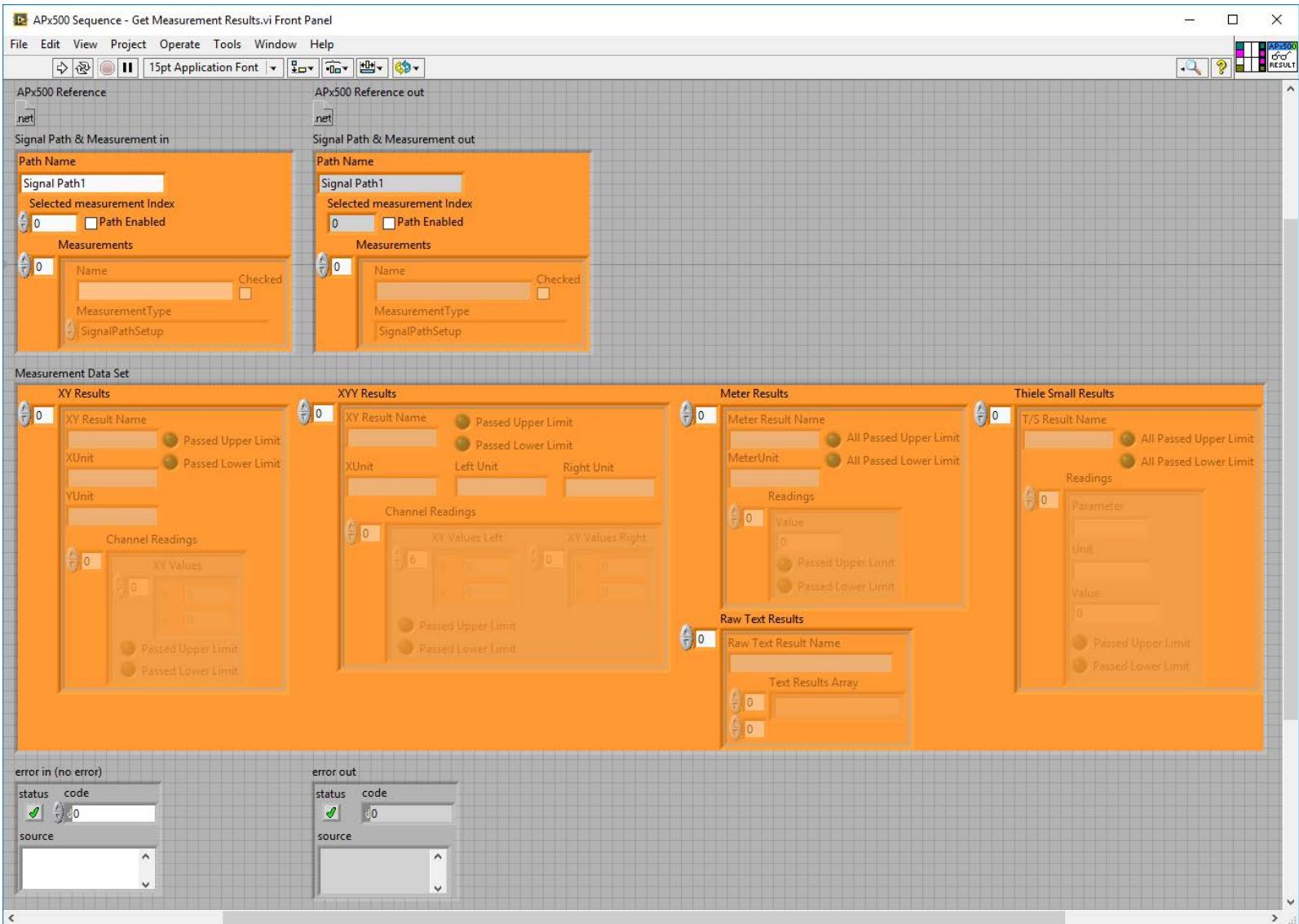


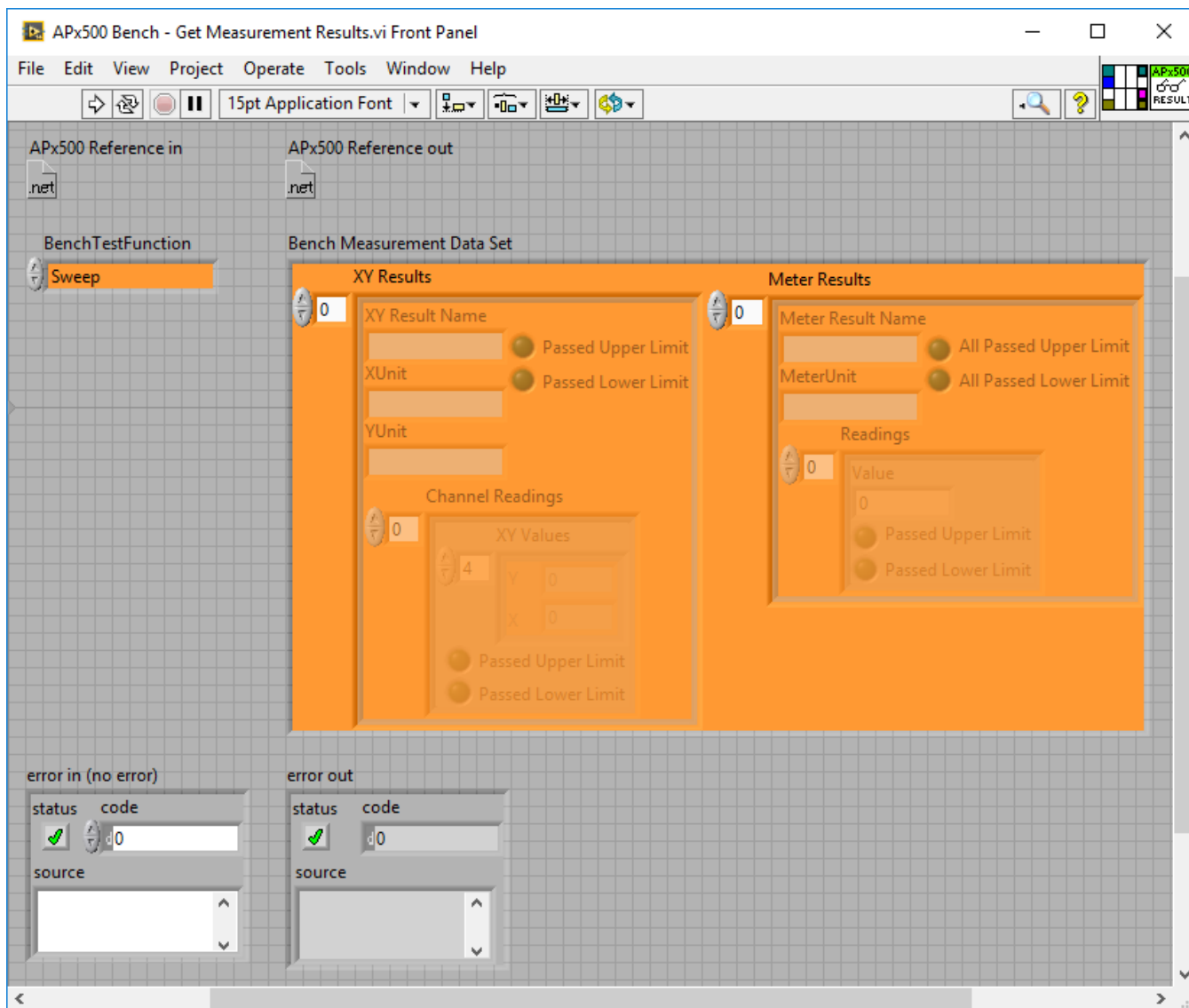
Palette:



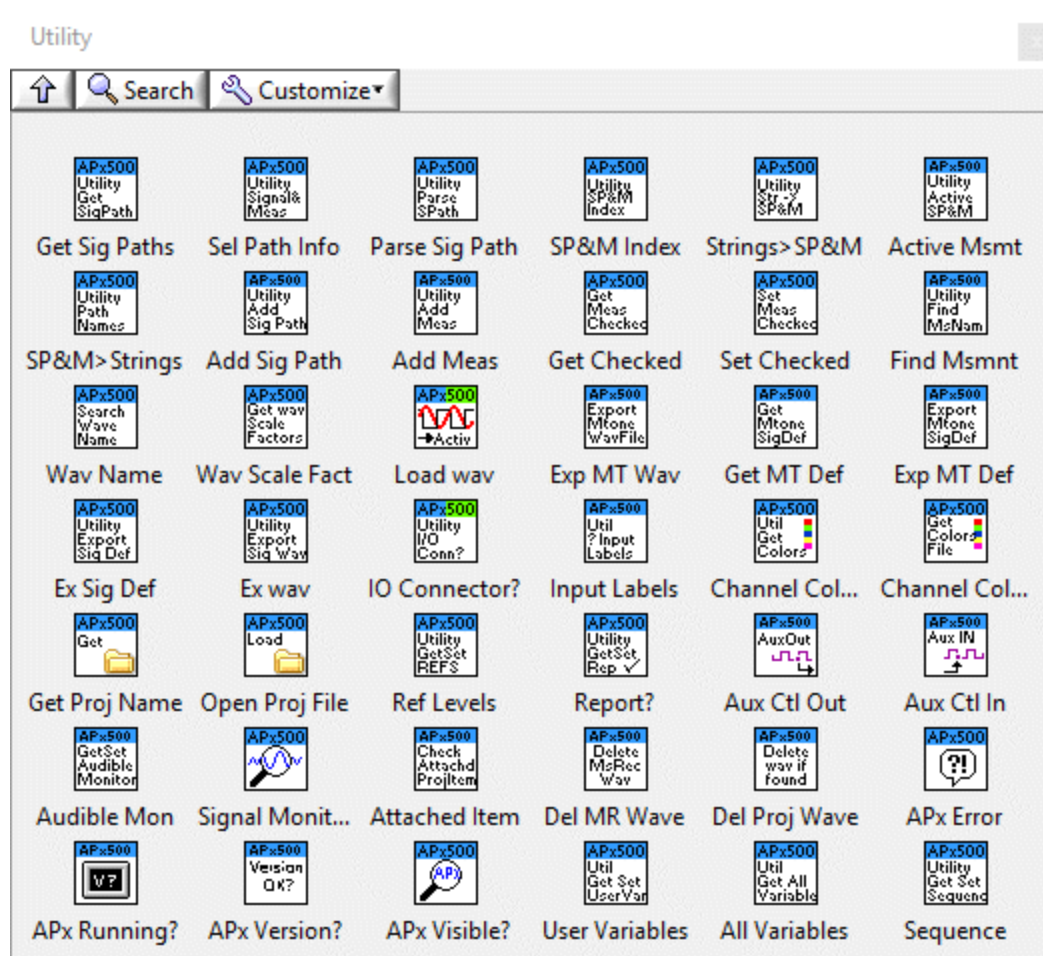
Tree:







## Palette:

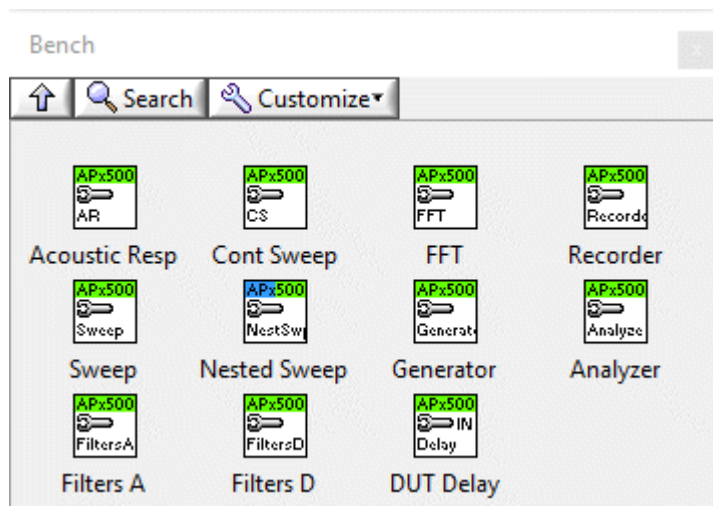


## Tree:

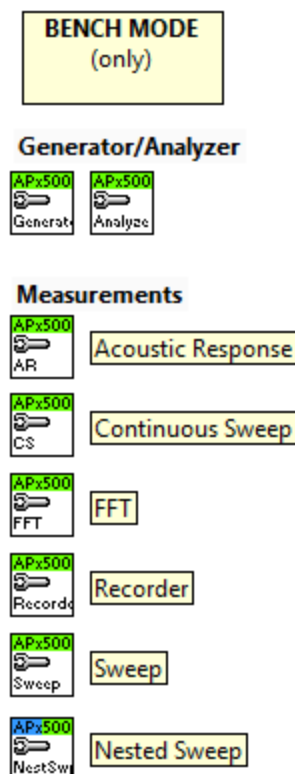




## Palette:



## Tree:

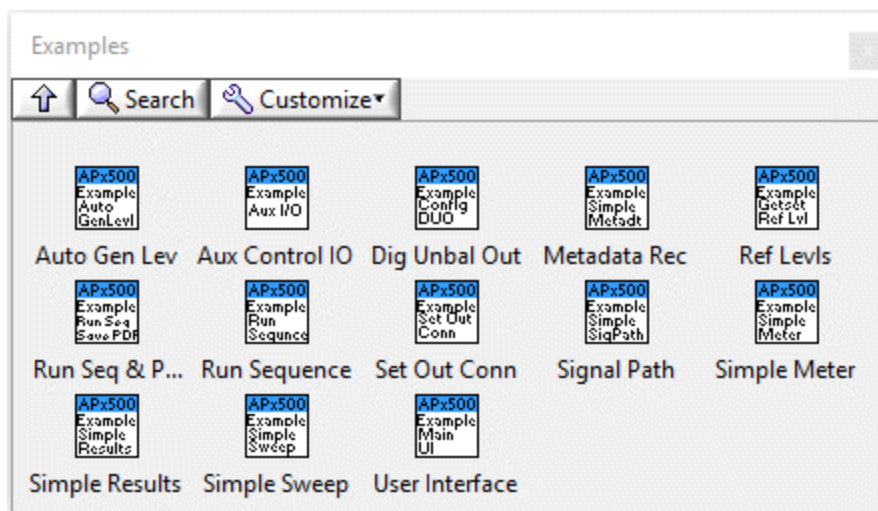


See SIGNAL PATH section for connectors, metadata, switchers, filters, and DUT delay.

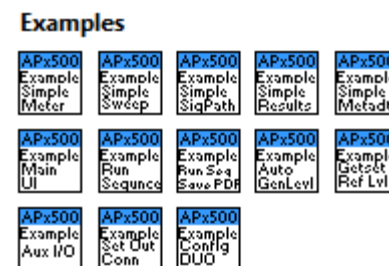
# APx LabVIEW .NET Driver

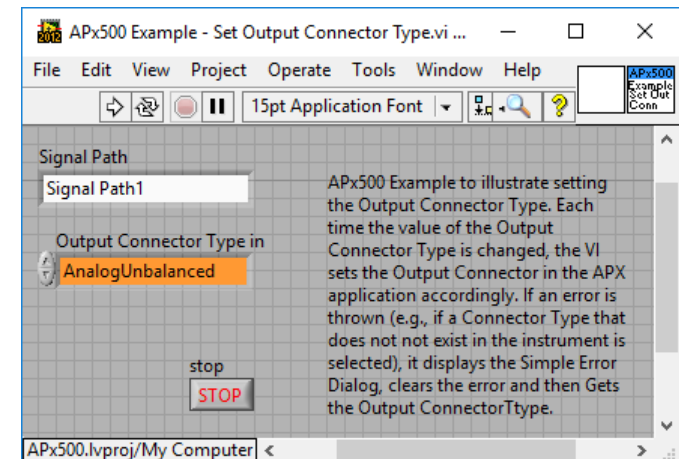
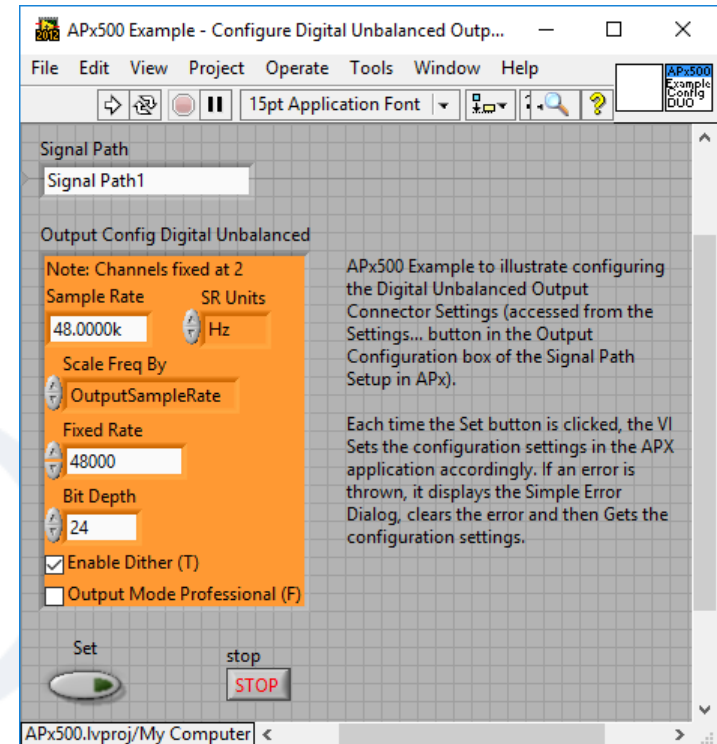
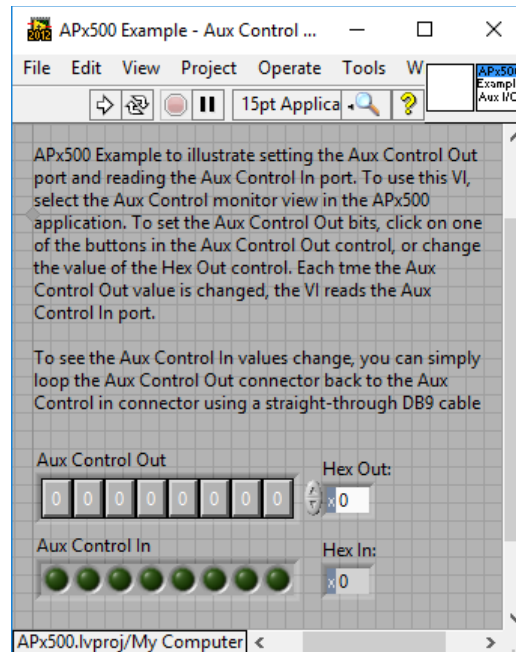
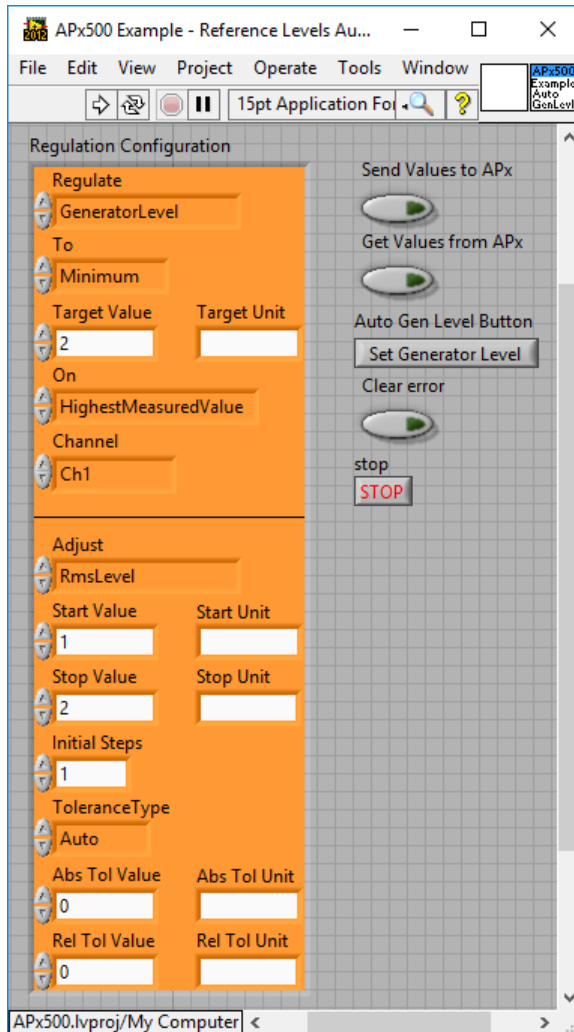
1. Why LabVIEW
2. Driver Structure
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- 6. Examples**
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Palette:



Tree:





# APx LabVIEW .NET Driver

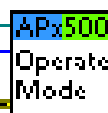
1. Why LabVIEW
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3. Signal Path
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8. Constructing LV VIs



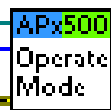
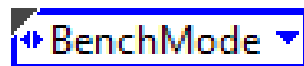
Sequence mode



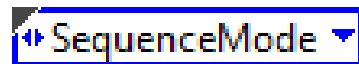
Bench mode



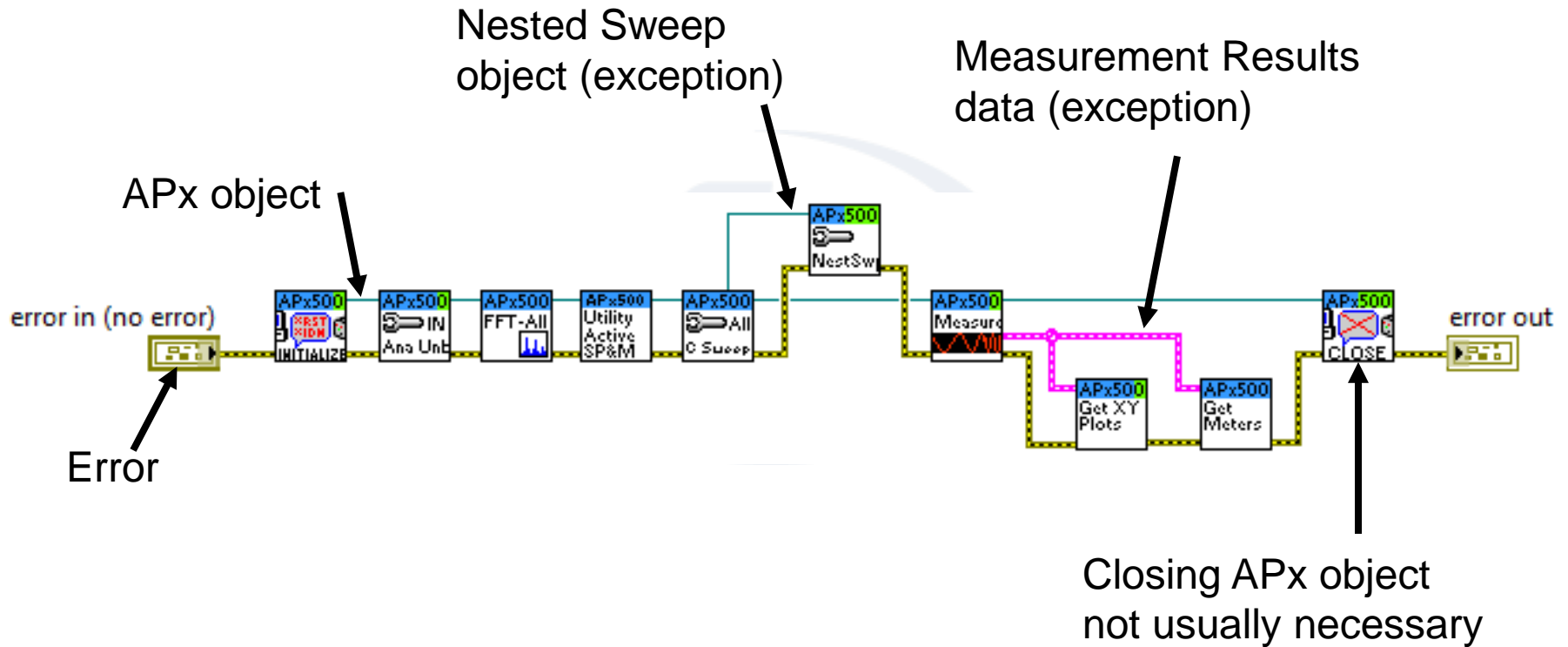
Sequence mode,  
switch to Bench mode



Bench mode, switch  
to Sequence mode



# Passing APx Object

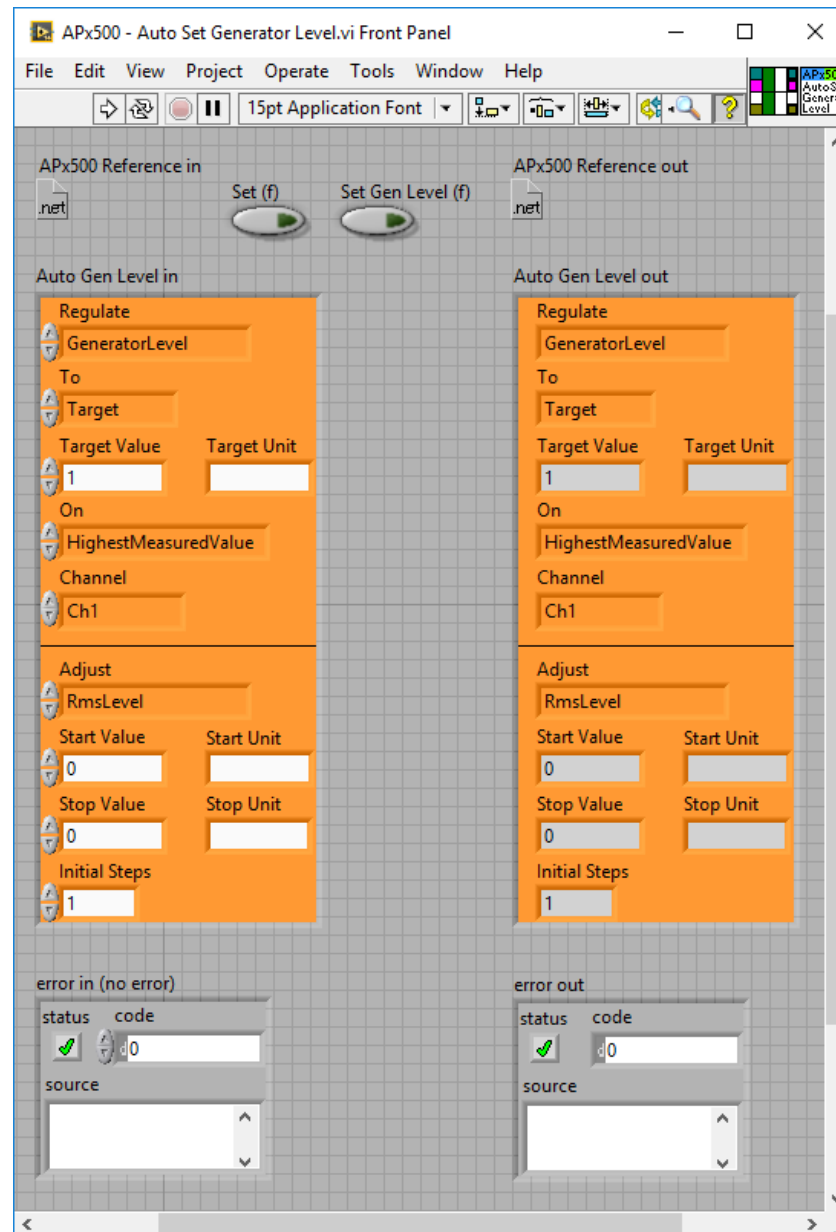


# APx LabVIEW .NET Driver

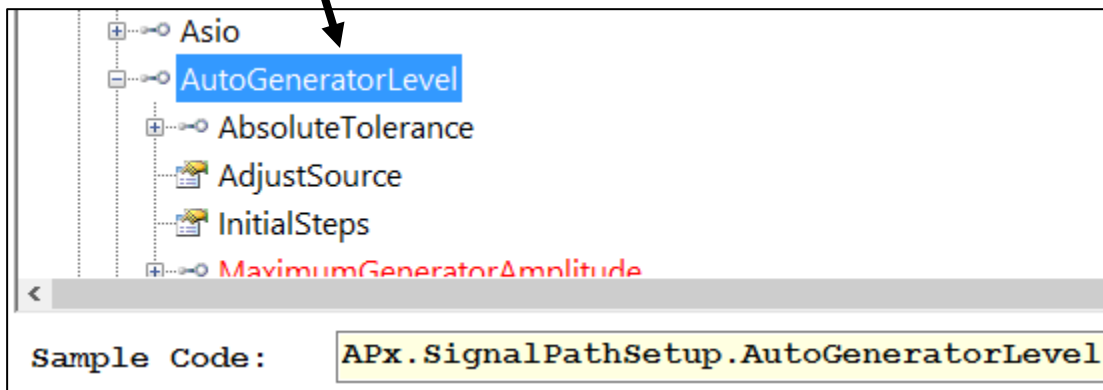
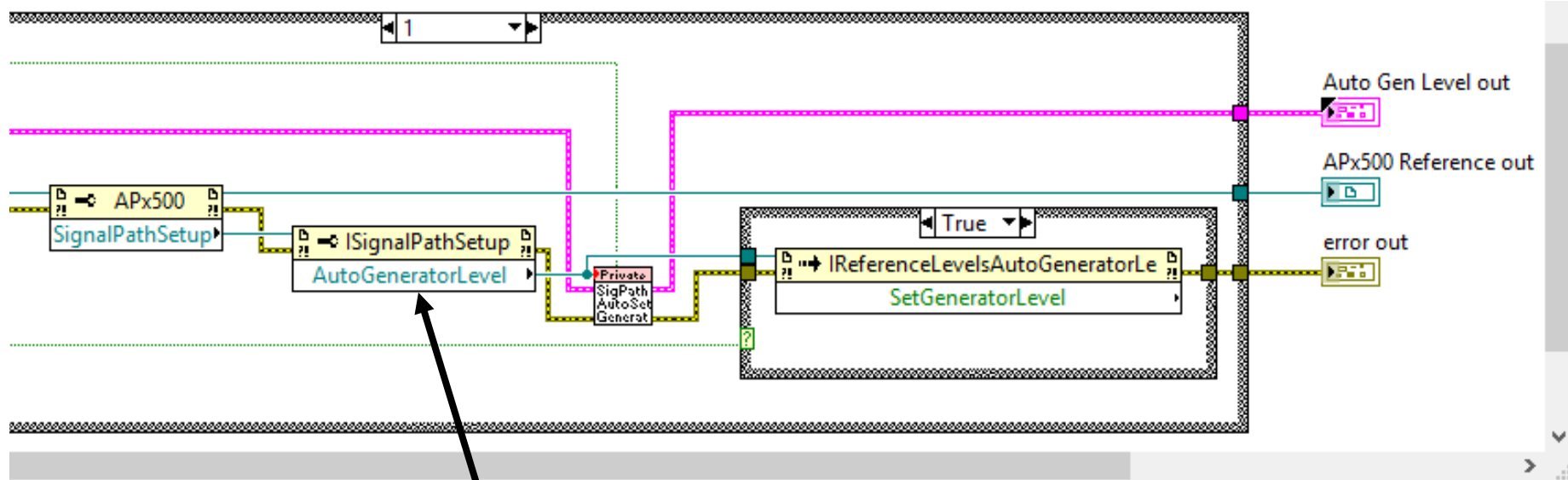
1. Why LabVIEW
2. Driver Structure
3. Signal Path
4. Measurements
5. Other VIs
6. Examples
7. Constructing LV Projects
8. **Constructing LV VIs**



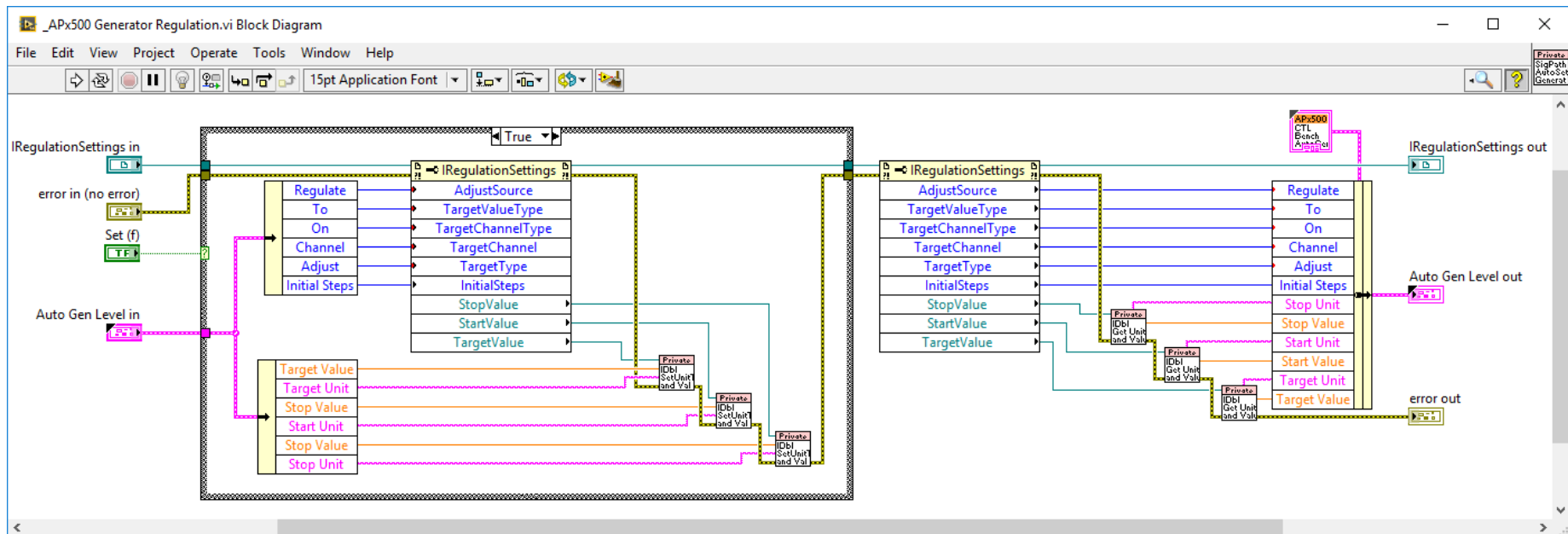
# VI Structure – Auto Set Gen Panel



# VI Structure – Auto Set Gen Block



APx API Browser



# VI Structure – Write Settings

Front panel control cluster

Auto Gen Level in

Regulate

GeneratorLevel

To

Target

Target Value

1

Target Unit

On

HighestMeasuredValue

Channel

Ch1

Adjust

RmsLevel

Start Value

0

Start Unit

Stop Value

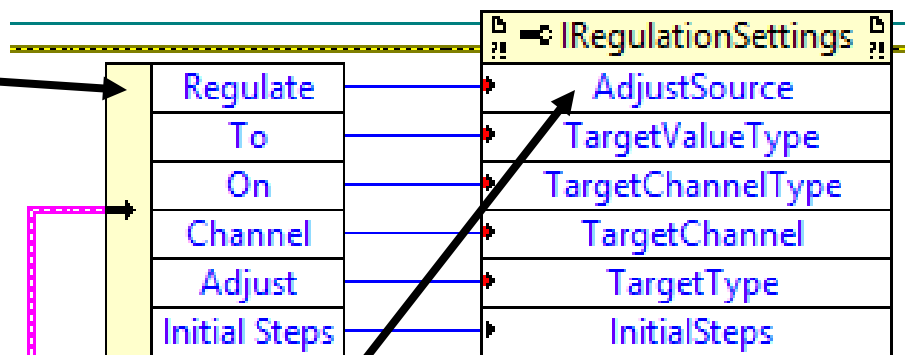
0

Stop Unit

Initial Steps

1

Unbundle cluster .NET property node (write)



The screenshot shows the APx API Browser with the following hierarchy: `Asio` > `AutoGeneratorLevel` > `AdjustSource` > `InitialSteps`. The `AdjustSource` node is highlighted. Below the hierarchy, the sample code is displayed: `APx.SignalPathSetup.AutoGeneratorLevel.AdjustSource`.

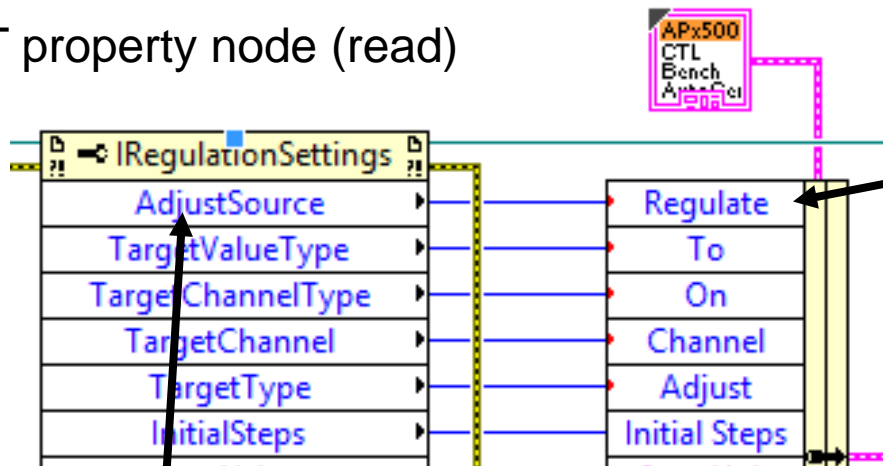
APx API Browser

# VI Structure – Read Settings

Front panel indicator cluster

Unbundle cluster

.NET property node (read)



Auto Gen Level out

Regulate

GeneratorLevel

To

Target

Target Value Target Unit

1

On

HighestMeasuredValue

Channel

Ch1

Adjust

RmsLevel

Start Value Start Unit

0

Stop Value Stop Unit

0

Initial Steps

1

Asio

AutoGeneratorLevel

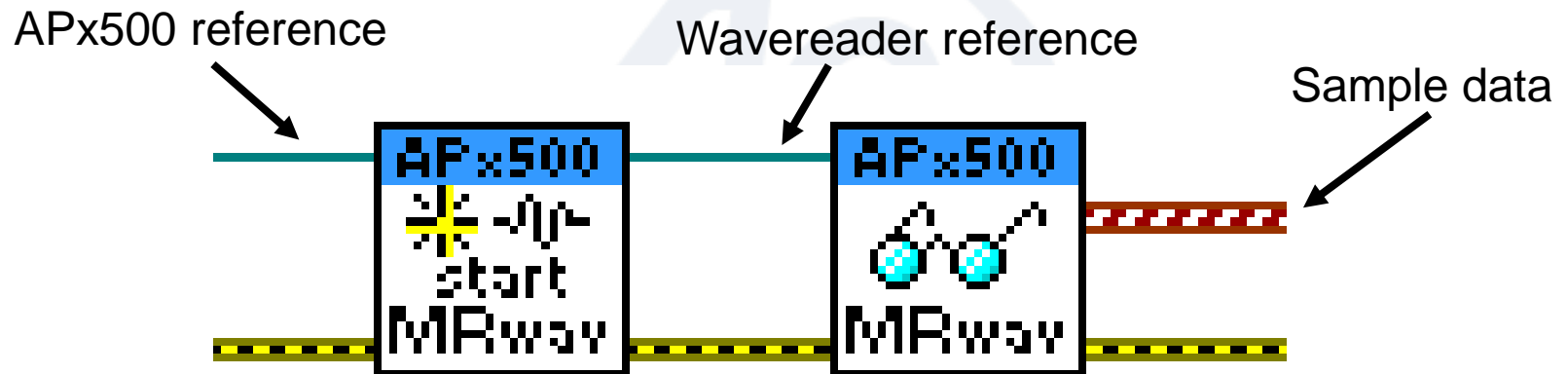
AdjustSource

InitialSteps

MaximumGeneratorAmplitude

Sample Code: `APx.SignalPathSetup.AutoGeneratorLevel.AdjustSource`

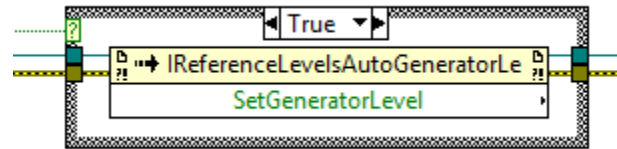
APx API Browser



Front panel control



.NET invoke node (method)



Asio

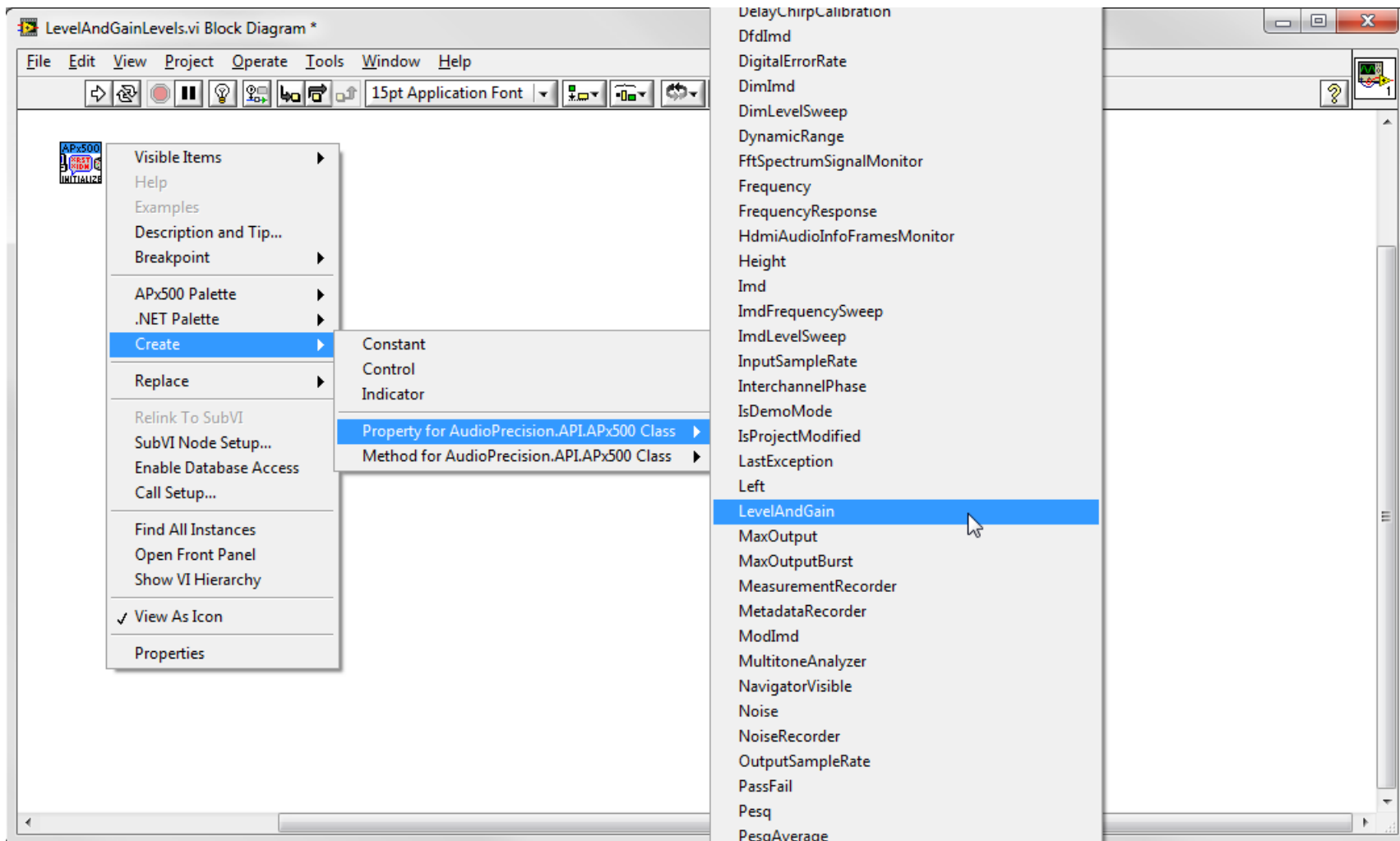
AutoGeneratorLevel

- AdjustSource
- InitialSteps
- MaximumGeneratorAmplitude
- MeasuredChannel
- MeasureWorstChannel
- SetGeneratorLevel()**
- SourceMaxValue

Sample Code: `APx.SignalPathSetup.AutoGeneratorLevel.SetGeneratorLevel()`

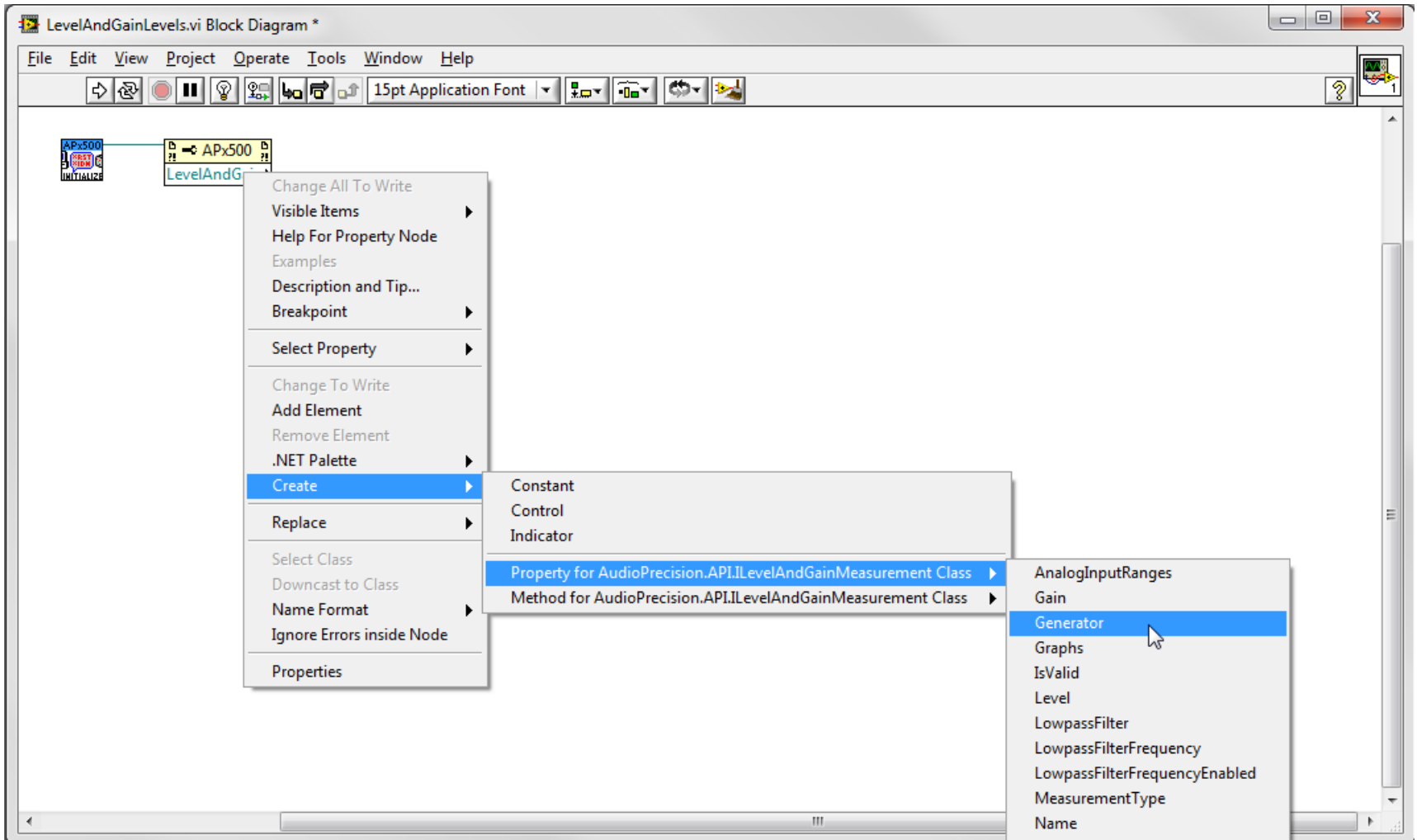
APx API Browser

# Adding Properties and Methods

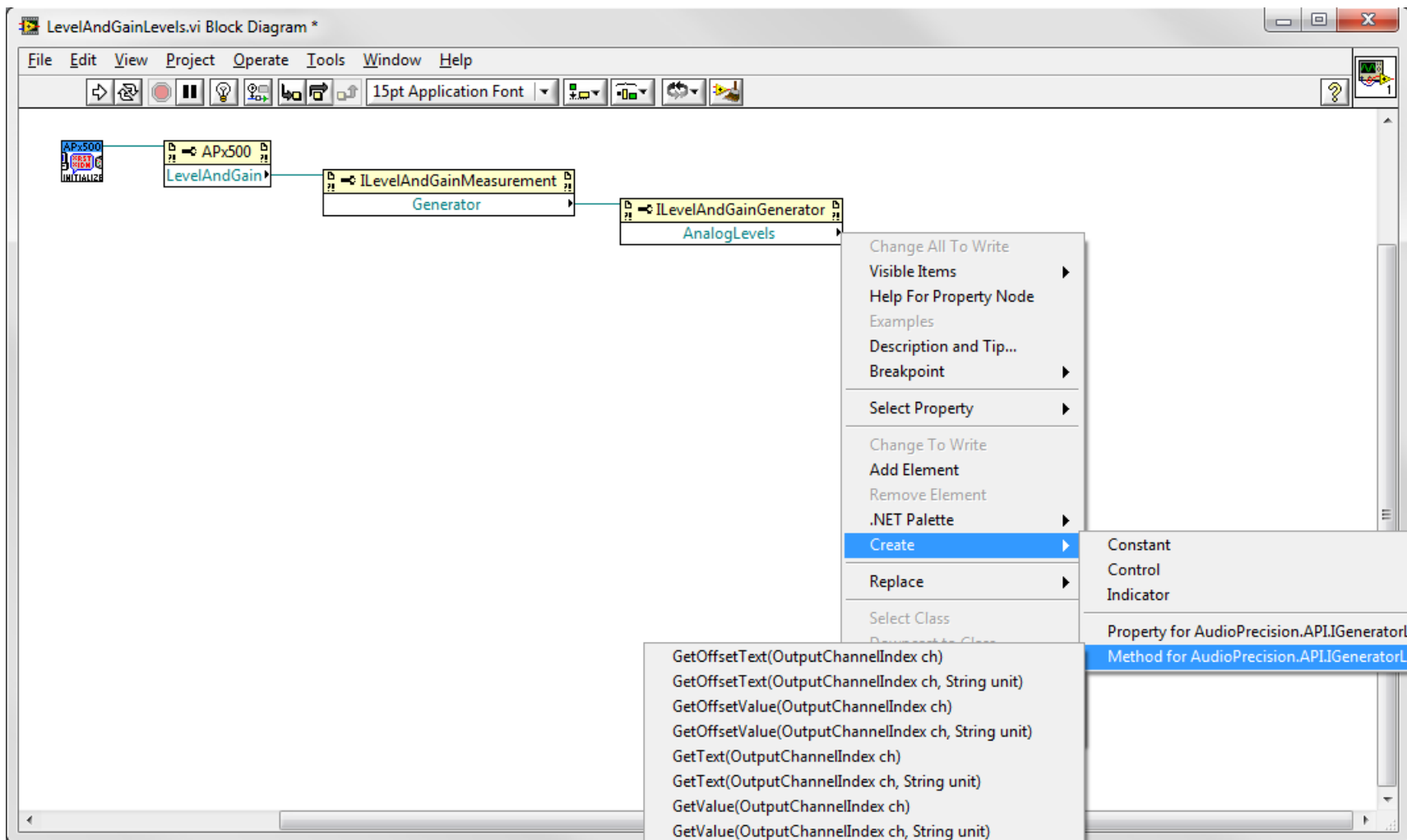




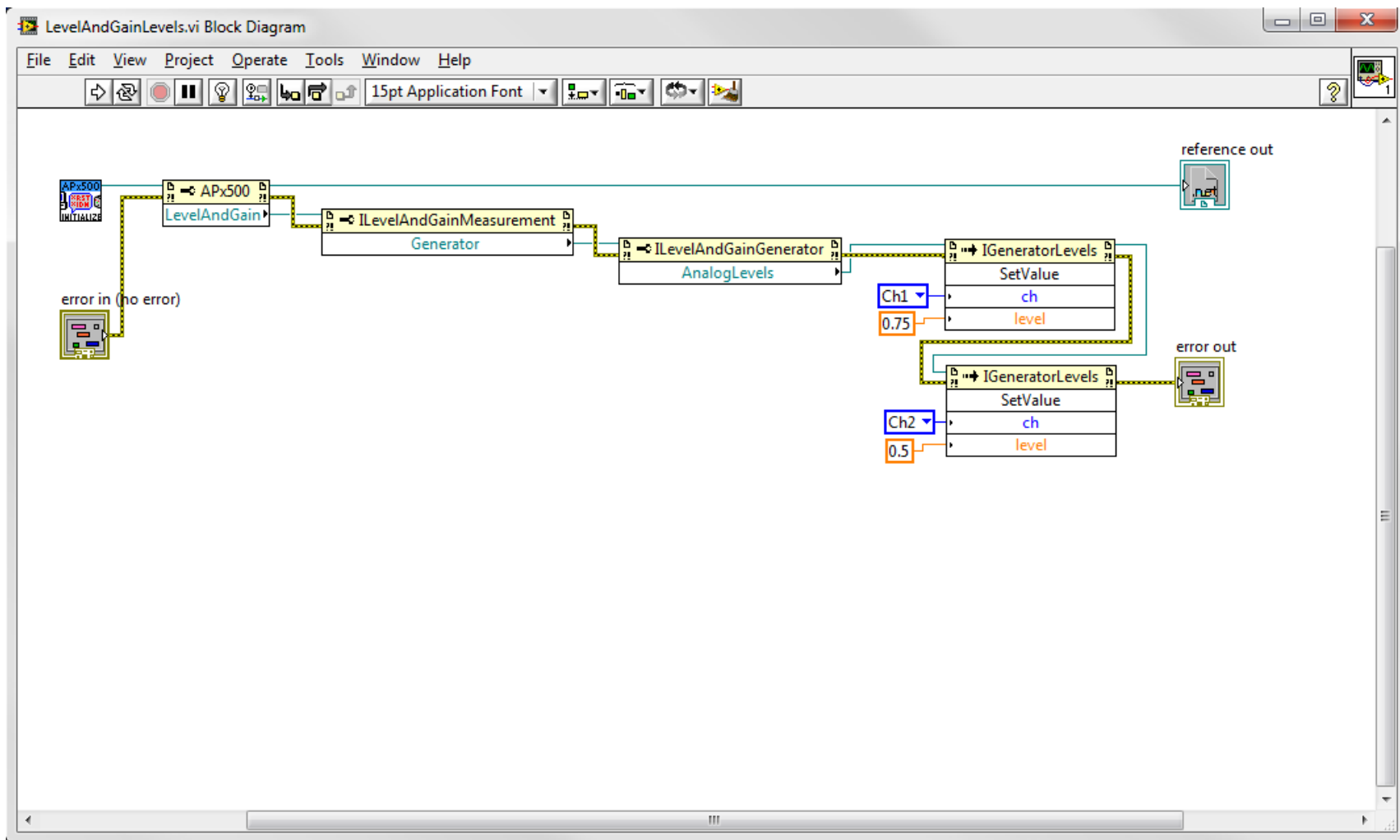
# Adding Properties and Methods



# Adding Properties and Methods

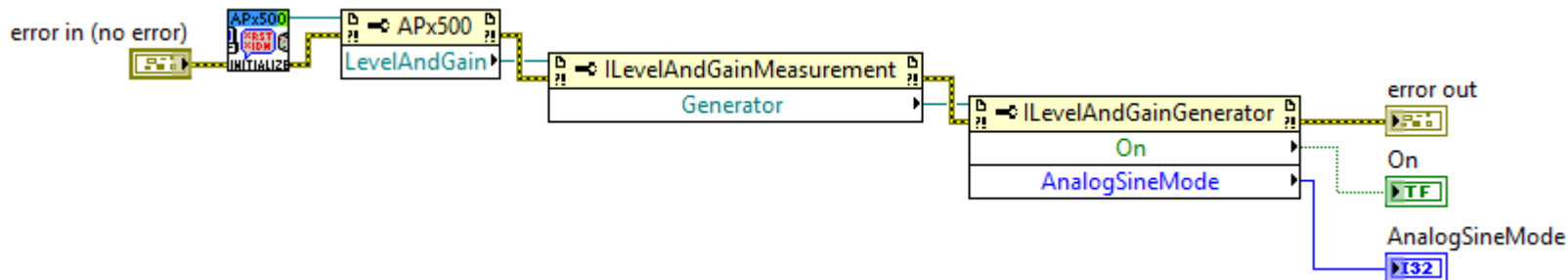


# Adding Properties and Methods

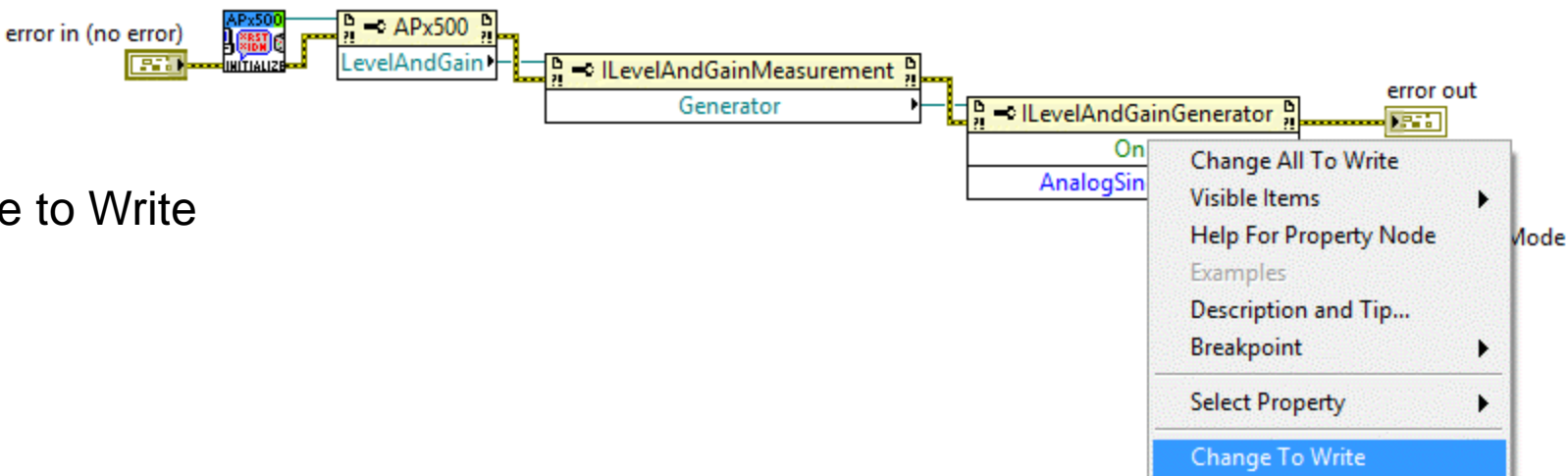


# Changing Property from Read to Write

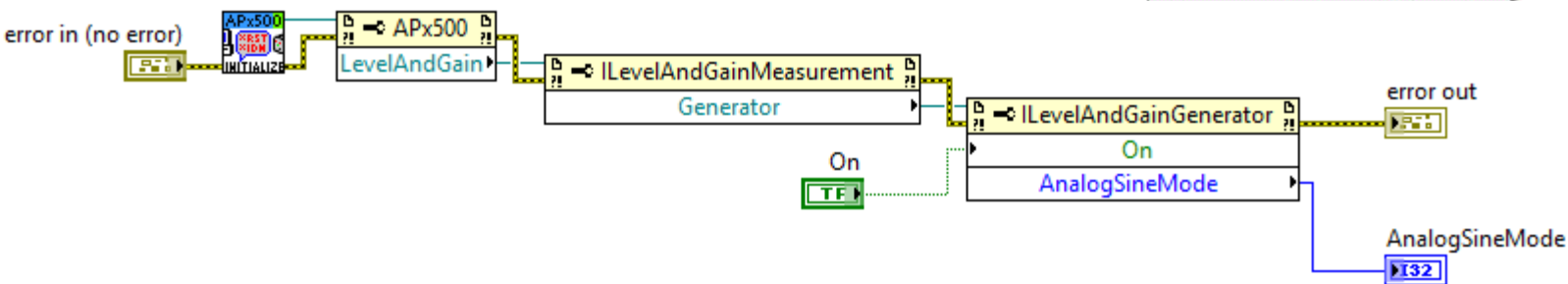
Read



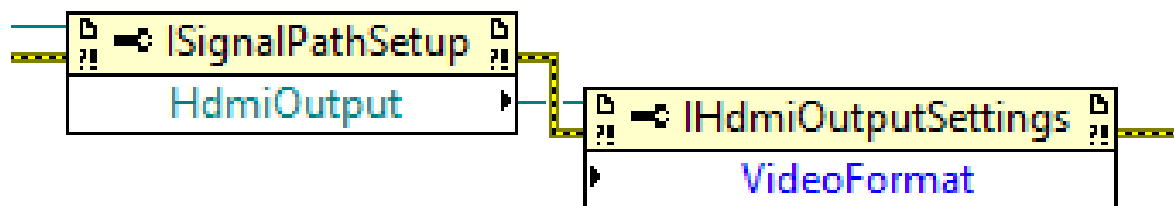
Change to Write



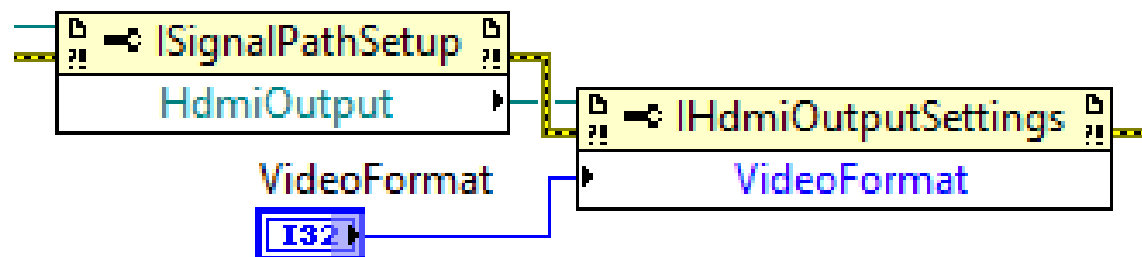
Write



Add the property.

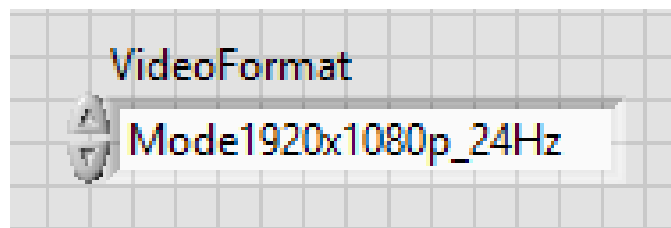


Add a control.



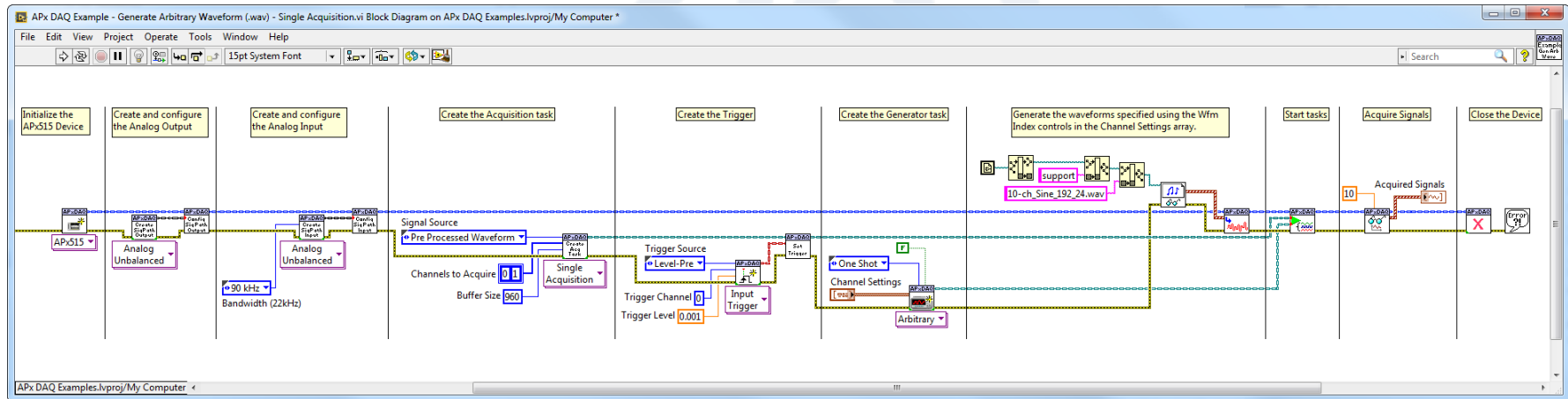
Replace the Ring with an Enum.

Save as a Type Def if desired.

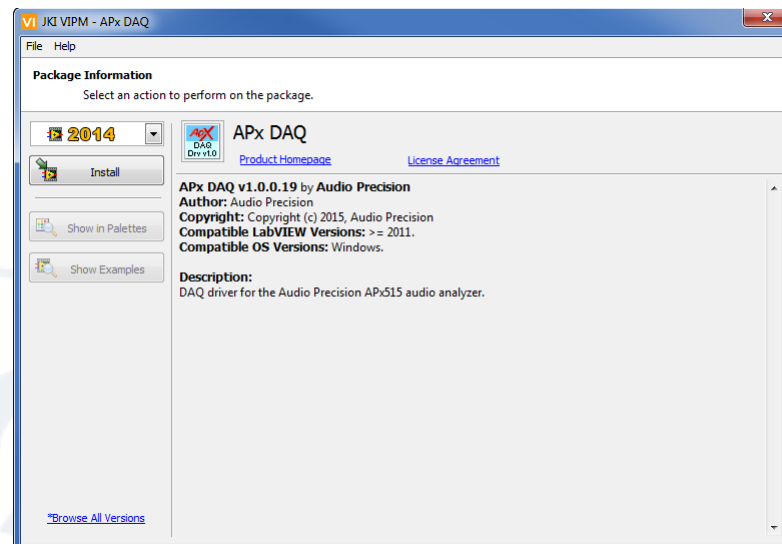
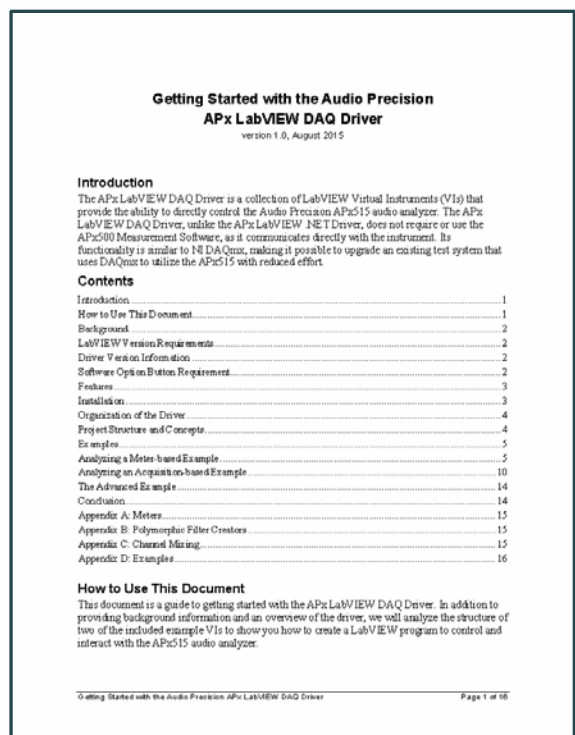


# APx LabVIEW DAQ Driver

- **LabVIEW Data Acquisition (DAQ) Driver for the APx515 Audio Analyzer**
- **Similar to NI DAQmx™**
  - Easy conversion of LabVIEW VIs from DAQmx



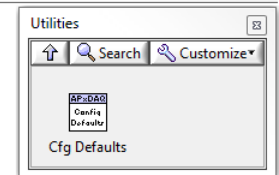
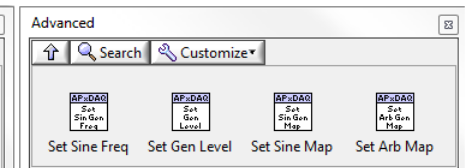
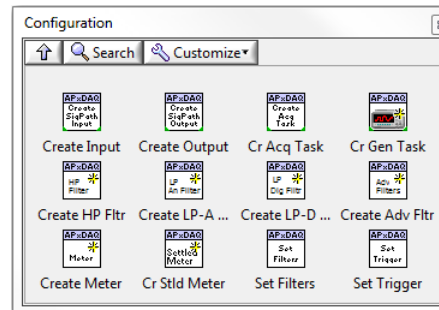
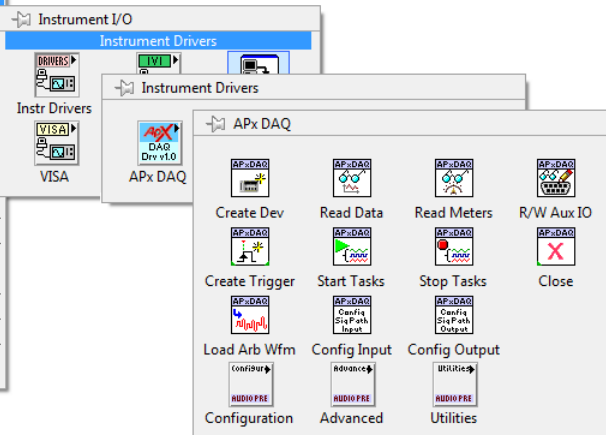
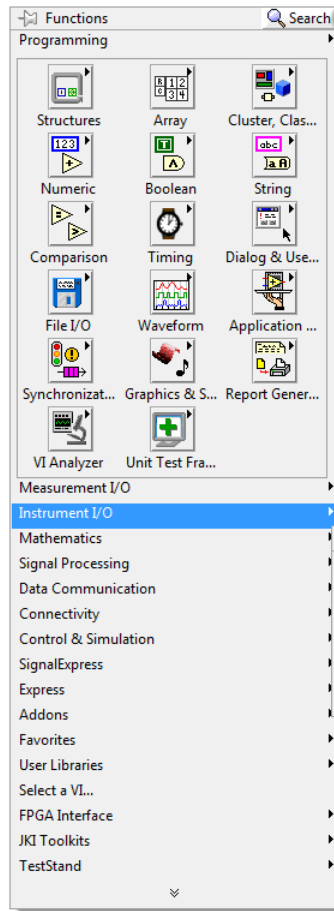
- **DAQ Driver package available for download from AP.com includes:**
  - VI Package file
  - User Guide



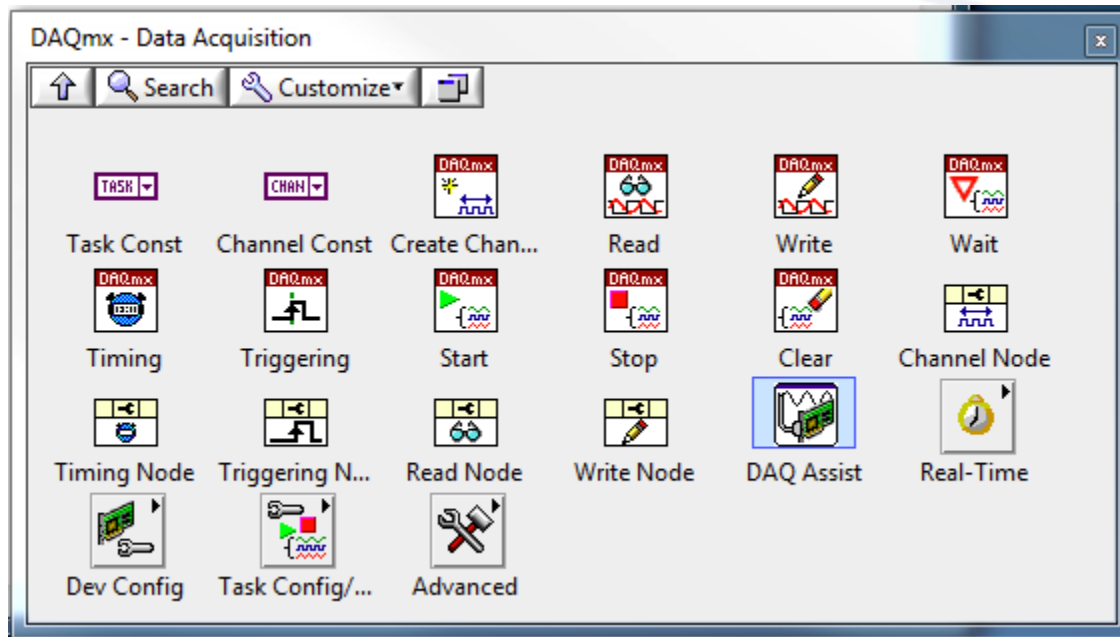
- **Uses VI Package Manager from JKI**
  - Free download
- **Can be installed in LabVIEW 2012 or later.**



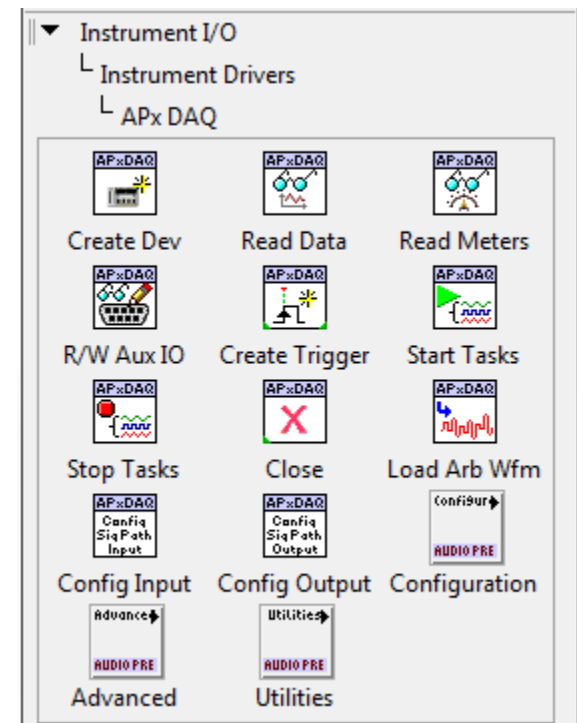
- Installs a set of menu palettes on the Instrument Drivers palette, under Instrument I/O



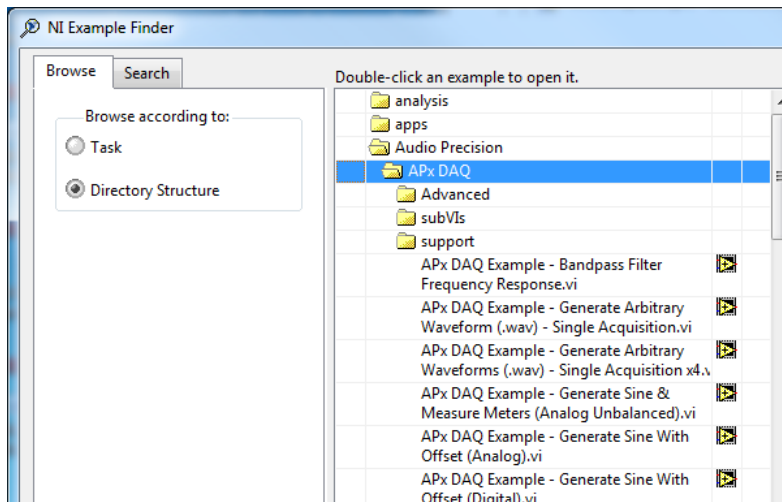
## NI-DAQmx



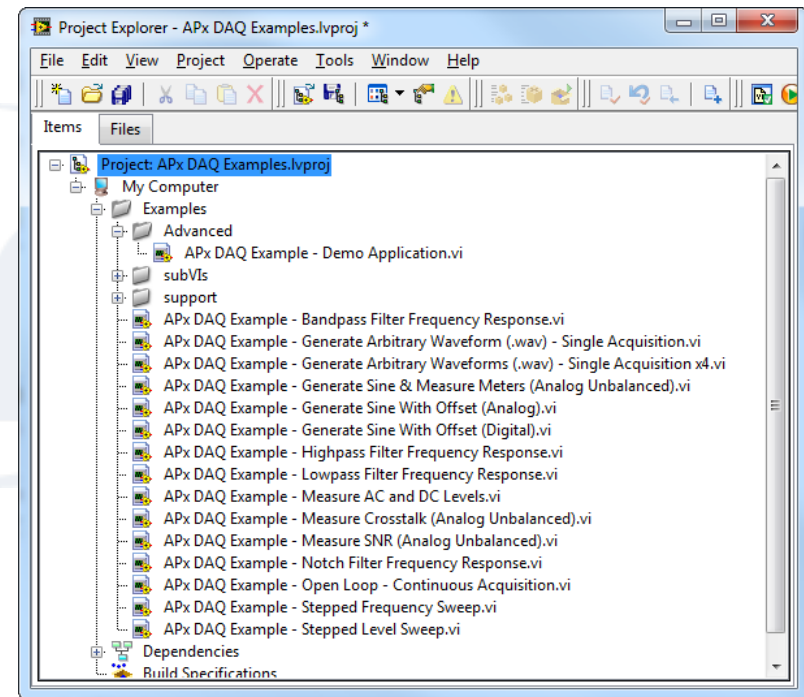
## APx DAQ



## NI Example Finder



## Examples Project



## **All Instrument Drivers have:**

- **Arbitrary Waveform Generator**
- **Waveform Acquisition**
- **LabVIEW waveform data type**

- **Built-in sine wave generator**

- 2 independent channels
- Dither (optional)

- **Input Filters**

- High Pass
- Low Pass
  - Butterworth & Elliptic
  - User specified corner frequencies
- Weighting Filters
  - A, B, C, CCIR, C-Message, ... etc.

- **Built-in meters for audio metrics**

- RMS Level
- Peak Level
- DC Level
- Frequency
- Phase
- THD+N Ratio
- THD+N Level
- SINAD
- Bandpass Level
- DC Level
- Input Sample Rate

## Generator Performance

- Sine Frequency Range: 2 Hz to 80.1 kHz
- Frequency Accuracy: 3 ppm
- Maximum Amplitude (balanced): 16.00 Vrms
- Amplitude Accuracy:  $\pm 0.05$  dB
- Flatness (5 Hz–20 kHz):  $\pm 0.010$  dB
- Digital Output Sampling Rate: 22 – 216 kHz

## Analyzer Performance

- Maximum Rated Input Voltage: 125 Vpk
- Residual Input Noise (20 kHz BW):  $\leq 1.4$   $\mu$ V
- Maximum Bandwidth: > 90 kHz
- Amplitude Accuracy (1 kHz):  $\pm 0.05$  dB
- Amplitude Flatness (10 Hz - 20 kHz):  $\pm 0.010$  dB
- DC Voltage Measurement: Yes

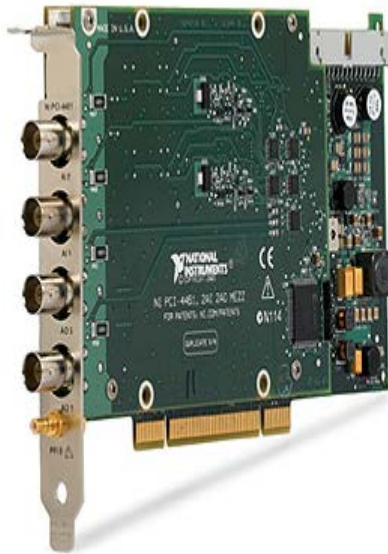


## System Performance

- Residual THD+N (20 kHz BW): -102 dB + 1.4  $\mu$ V
- Typical: < -106 dB (1 kHz, 2.0 V)

**Base Price: \$6,450**  
(including APx500 SW)

# Closest NI DAQ module



**NI PCI-4461**      **\$4,300**  
PCI card



**NI PXI-4461**      **\$4,200**  
**NI PXIe-4463 + NI PXIe-4464 \$6,000**

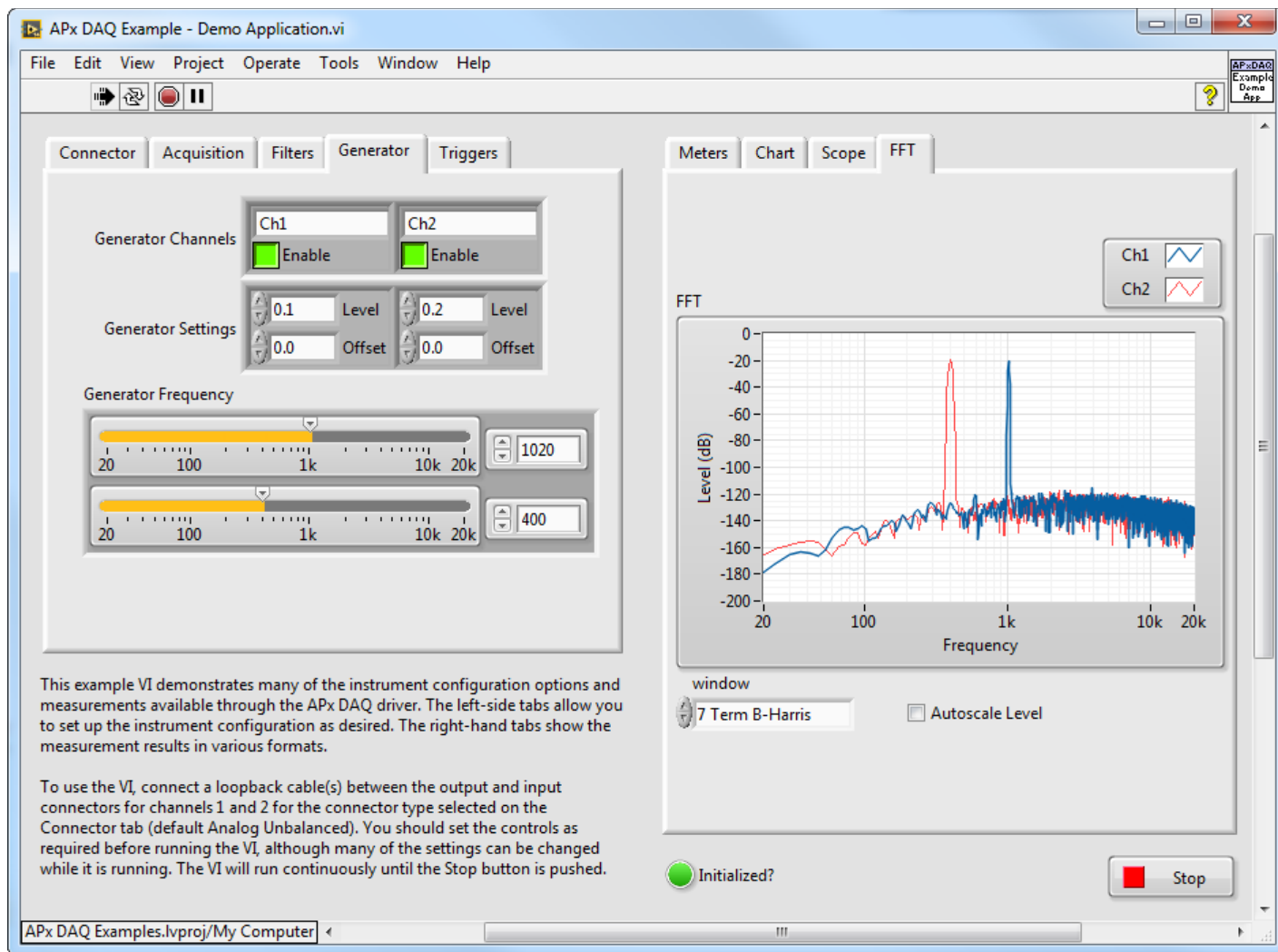
PXI Chassis + controller extra (> \$5k)



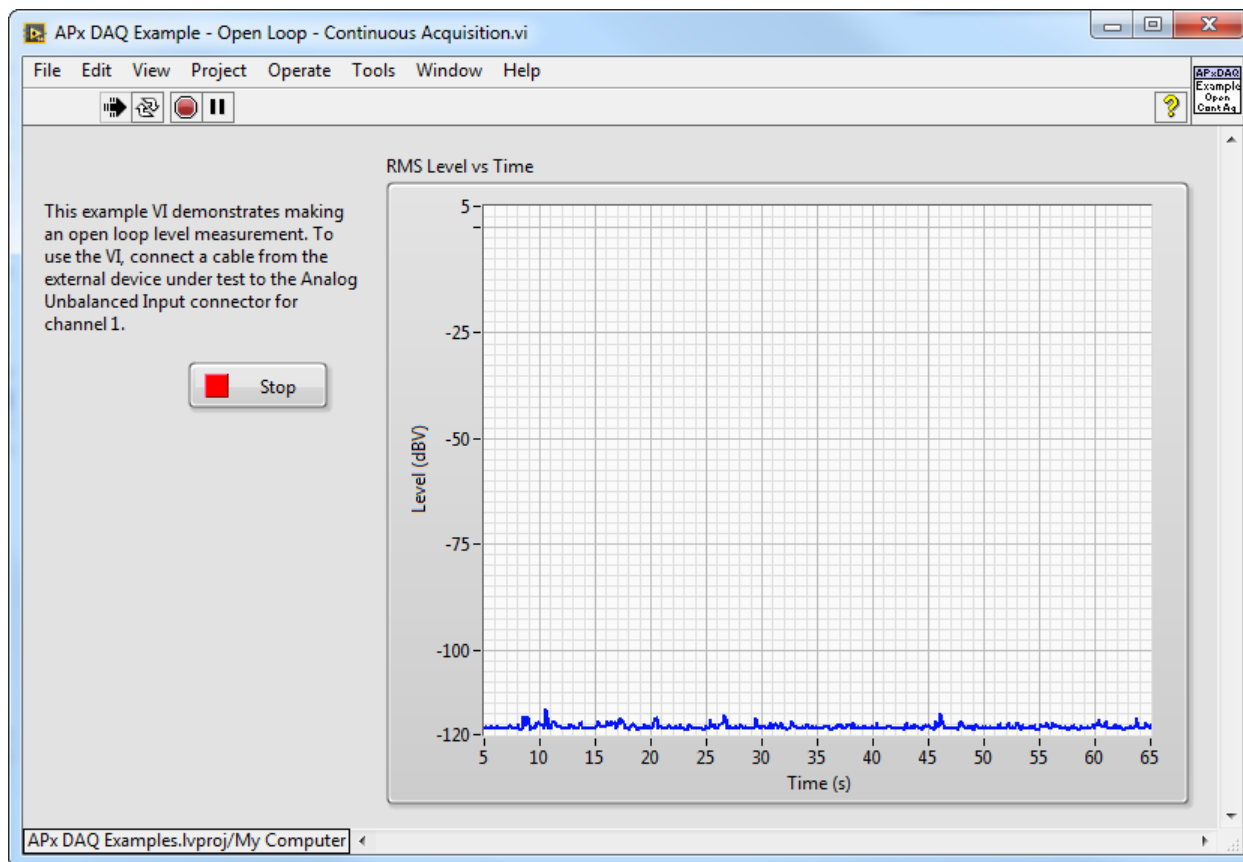
# Quick Comparison APx515 versus NI 4461

	APx515	NI 4461
Analog I/O channels	2 In / 2 Out, 24 bit	2 In / 2 Out, 24 bit
Maximum Sample Rate (2 channels)	192 kHz	102 kHz <i>(204 kHz on 1 channel)</i>
Maximum Input Voltage	125 Vp	42 Vp
Maximum Output Voltage	22.6 Vp (16 Vrms)	10 Vp
Output THD (typical)	-110 dB*	-95 dB
Input THD (typical)	-110 dB*	-107 dB
Digital I/O	AES3, S/PDIF, TOSLINK	None
Warranty	3 years	1 year
Additional Features	<ul style="list-style-type: none"> <li>Built in weighting, high-pass &amp; low-pass filters and audio meters</li> <li>APx500 SW available free</li> </ul>	<ul style="list-style-type: none"> <li>Inputs support IEPE (CCP)</li> </ul>
* Measured on an APx515 demo unit (AP specifies THD+N, not THD).		

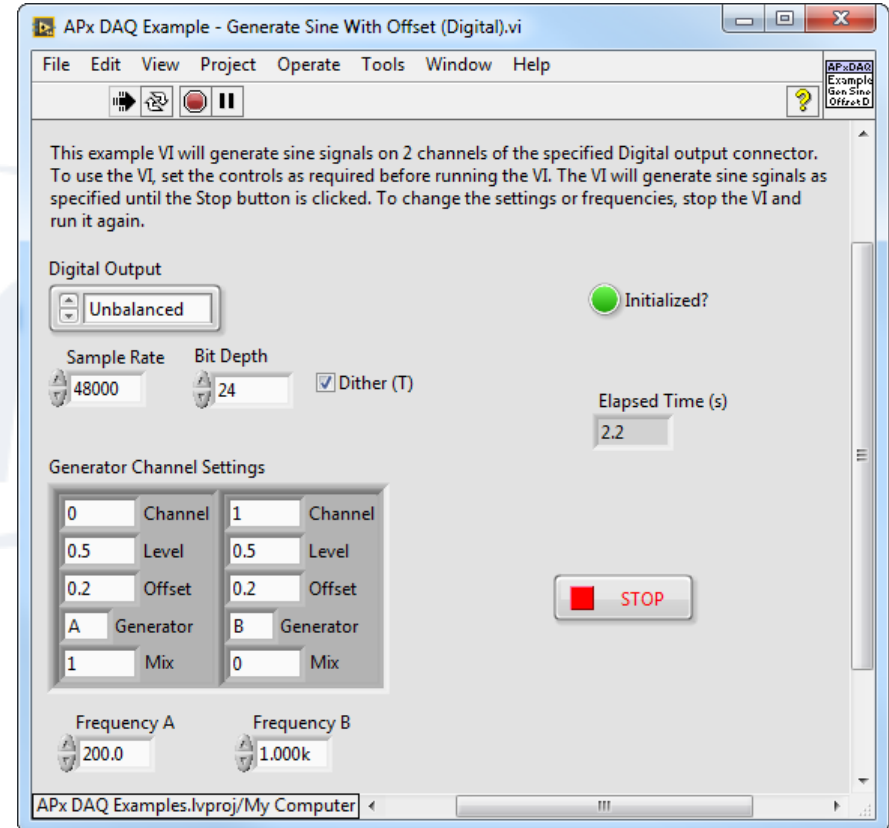
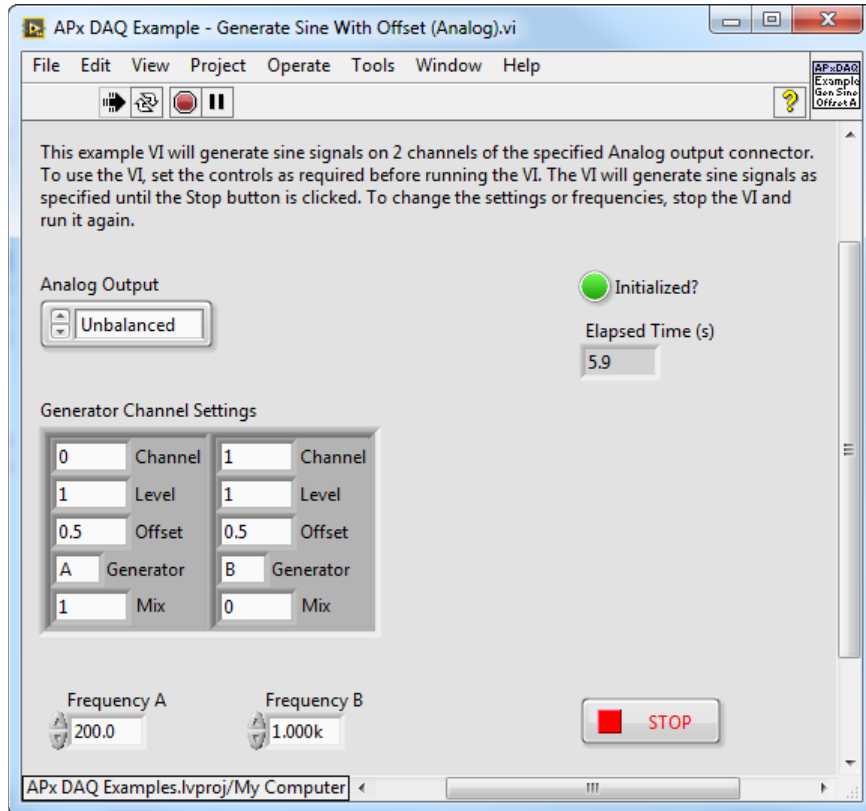




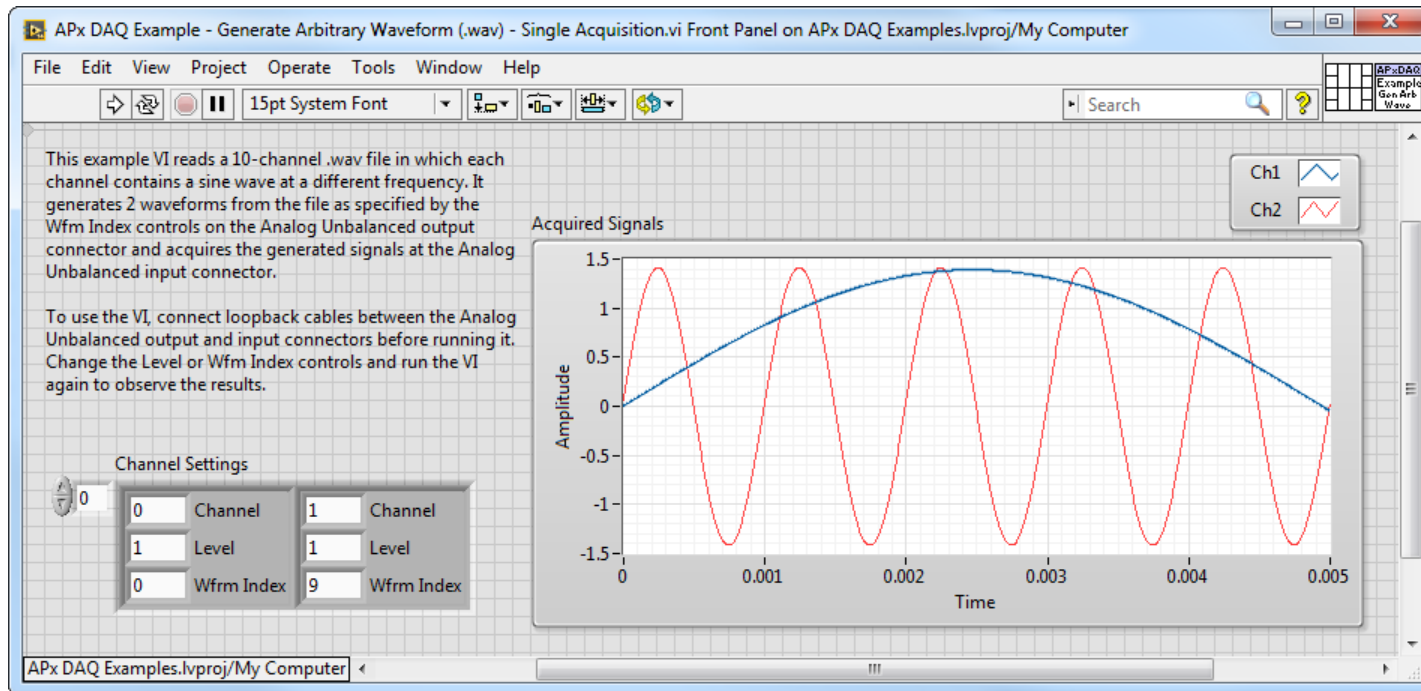
# Example – Acquisition only



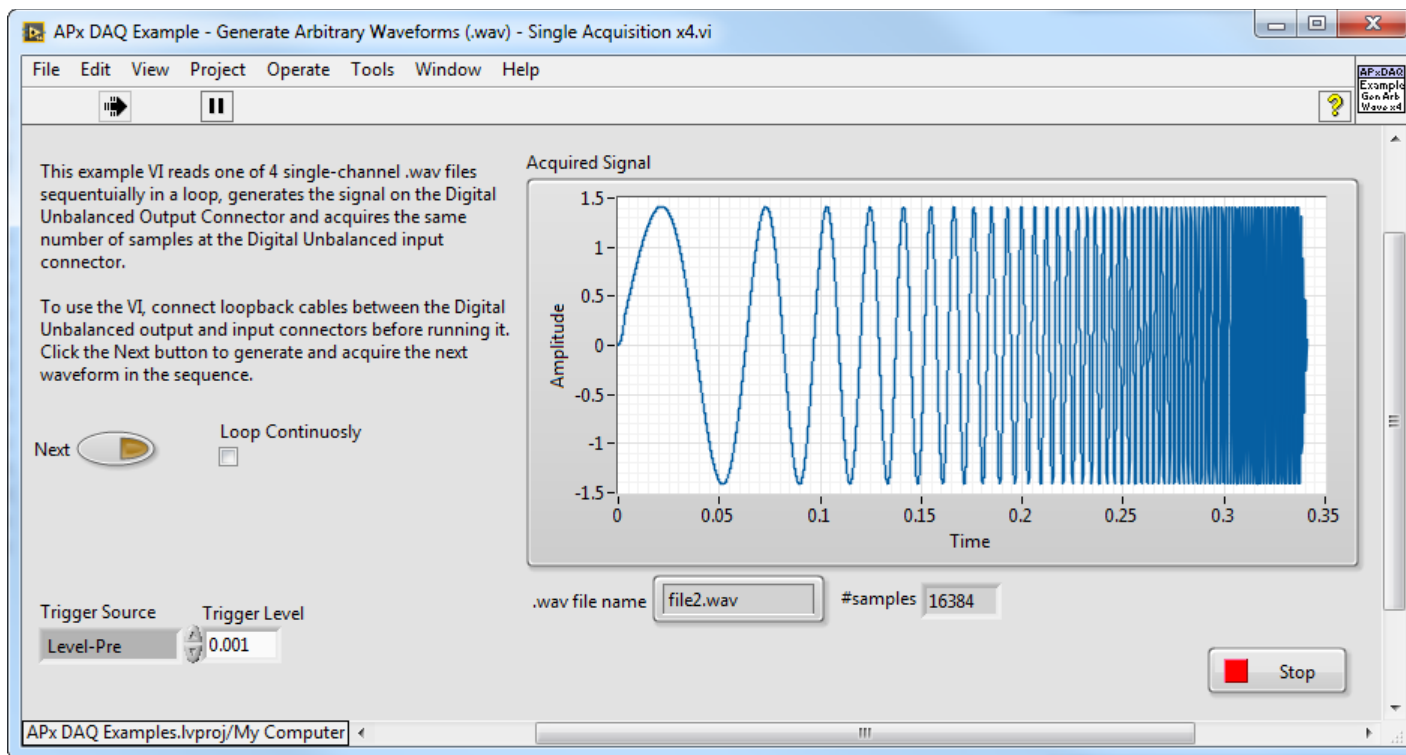
# Examples – Generation only (Analog & Digital)



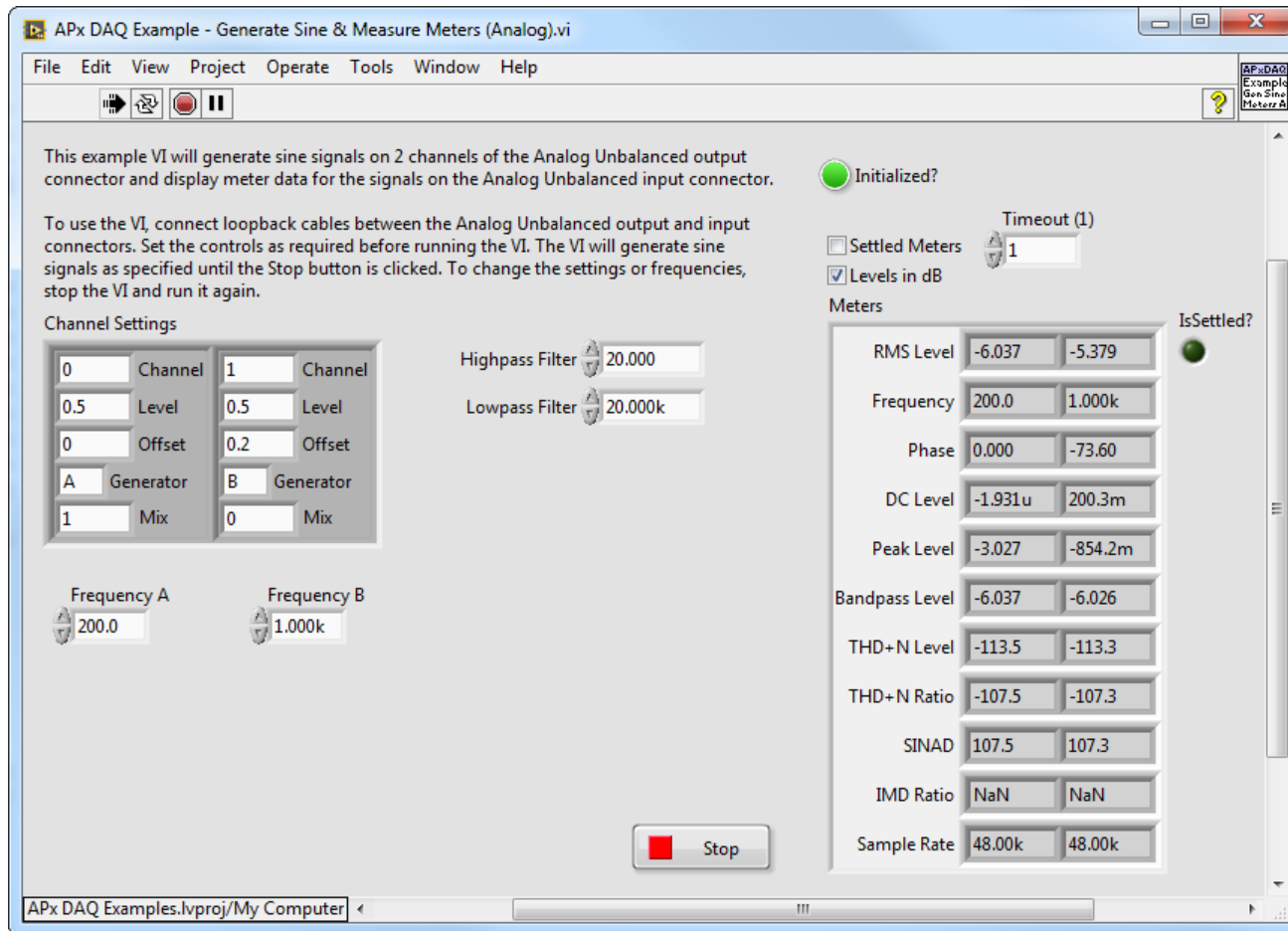
# Example – Waveform Generation & Acquisition (multi-channel wav)



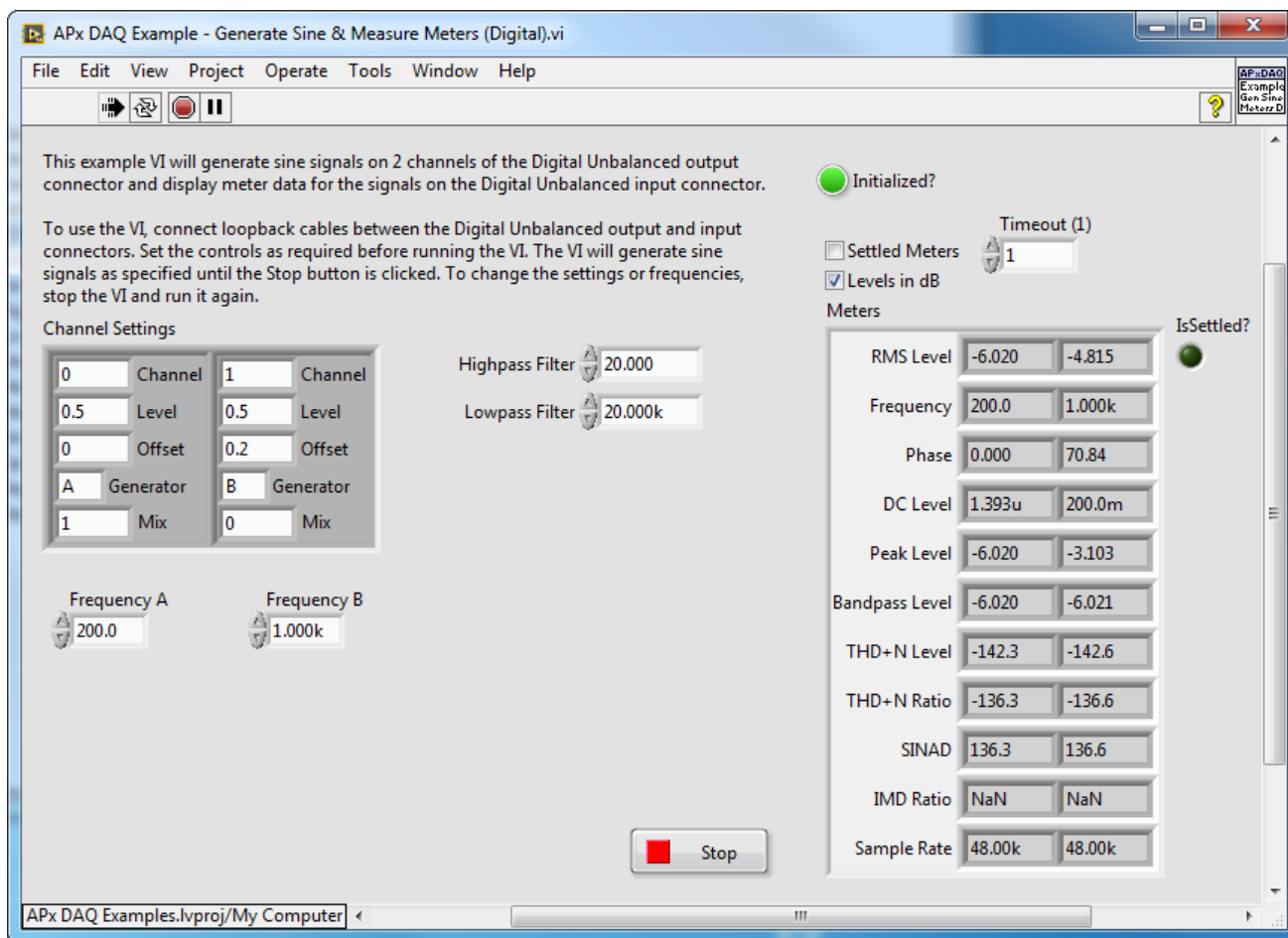
# Example – Waveform Generation & Acquisition (multiple files)



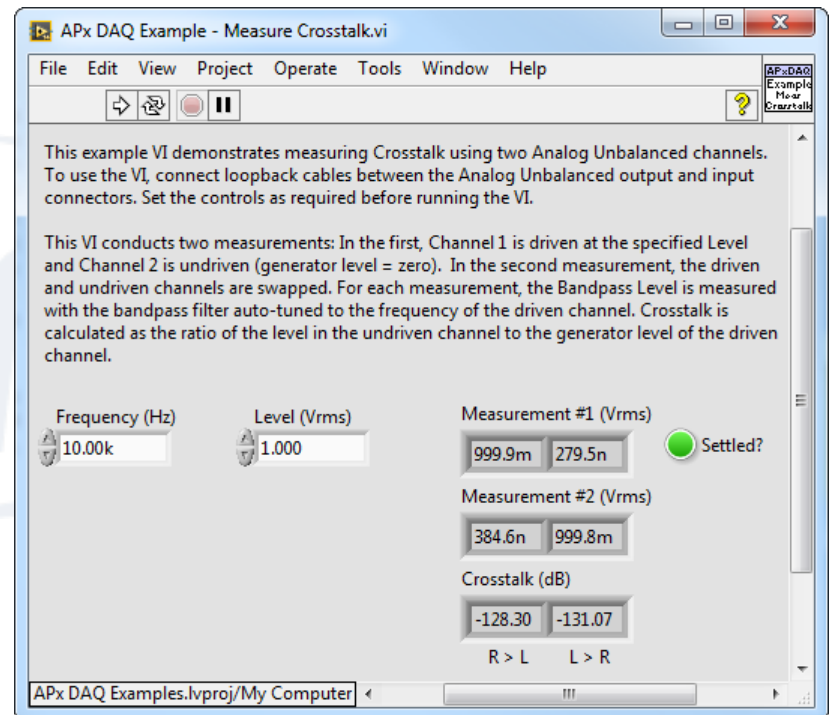
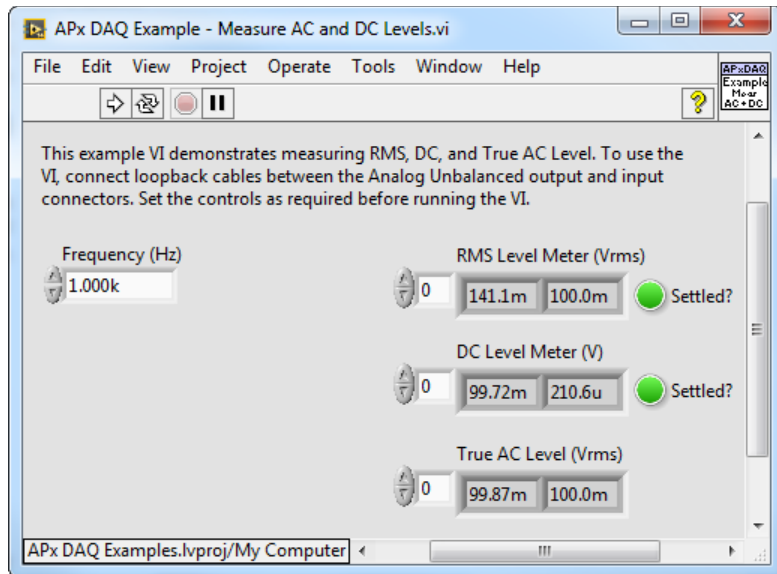
# Example – Generate Sine & Measure Meters (Analog)



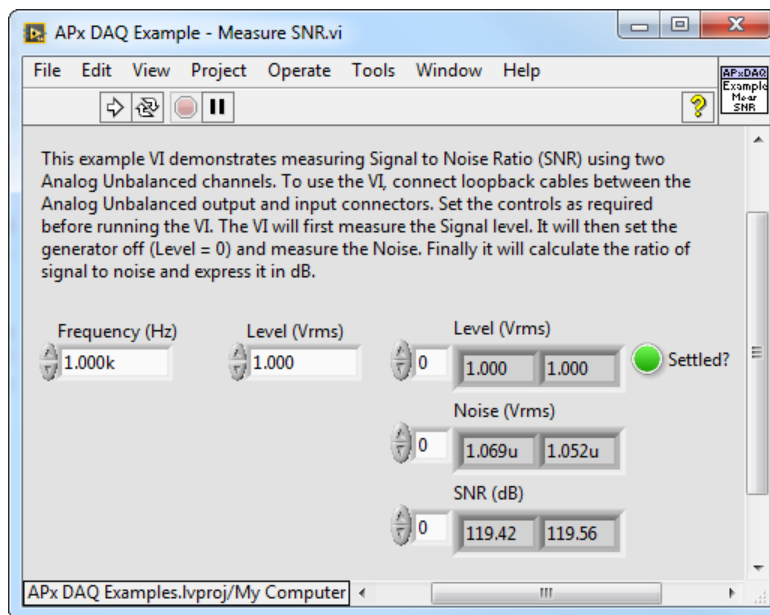
# Example – Generate Sine & Measure Meters (Digital)



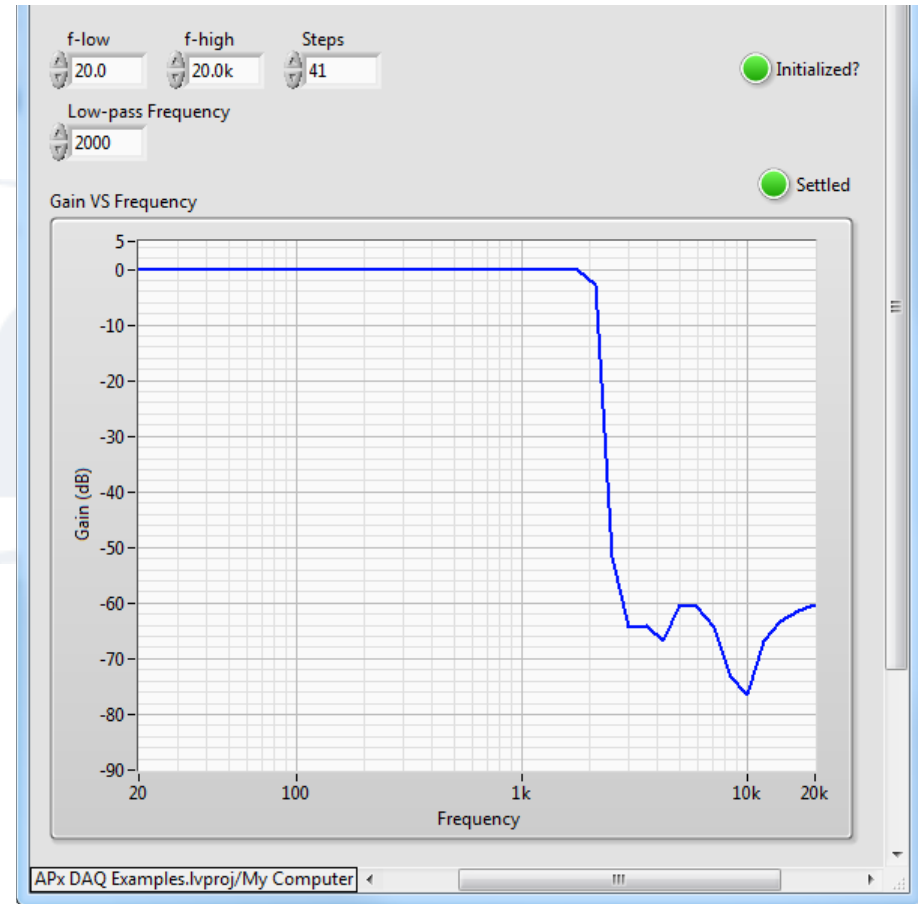
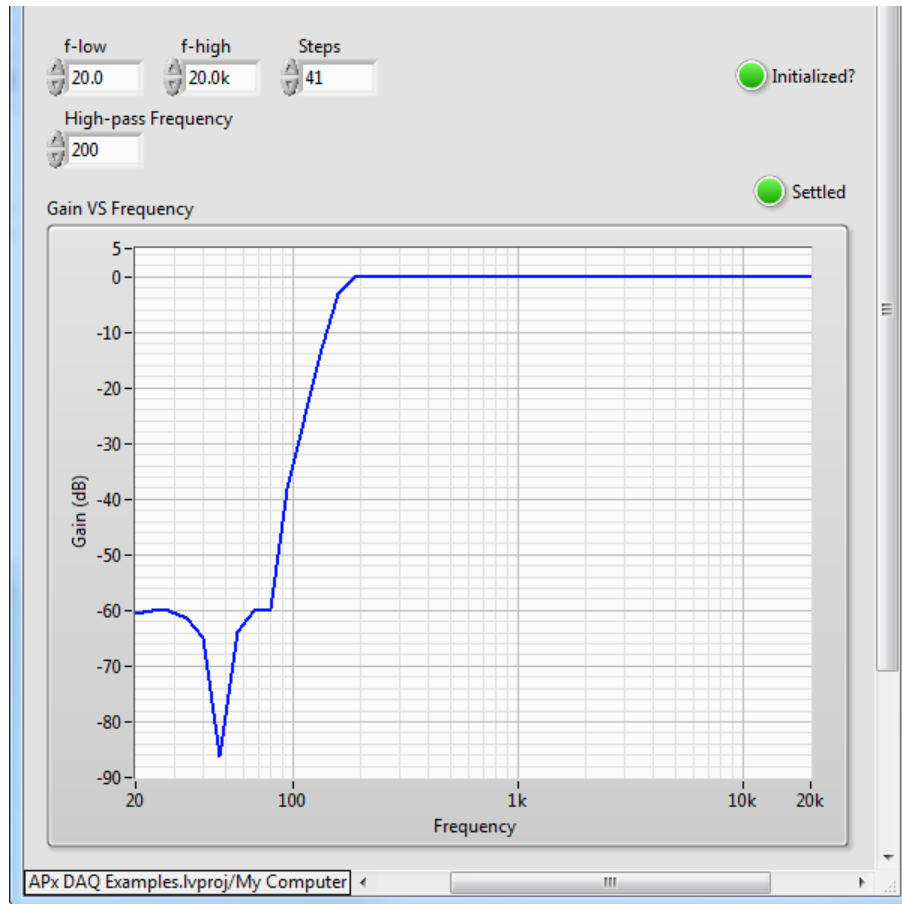
# Examples – AC & DC Level + Crosstalk



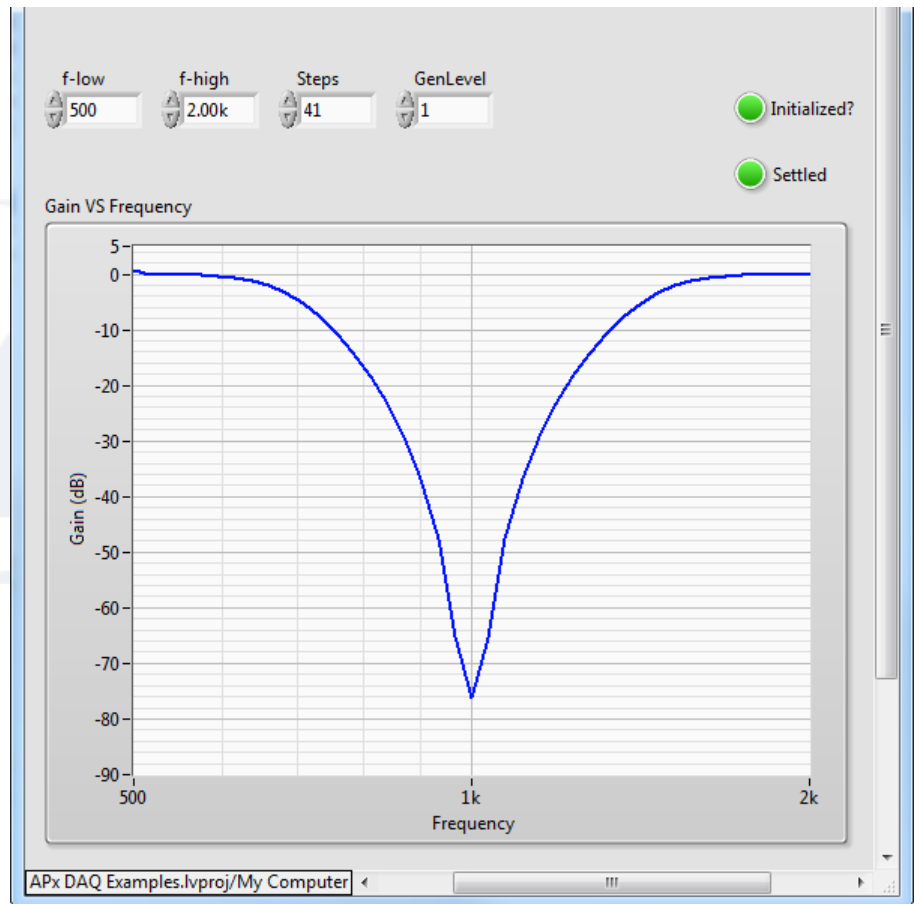
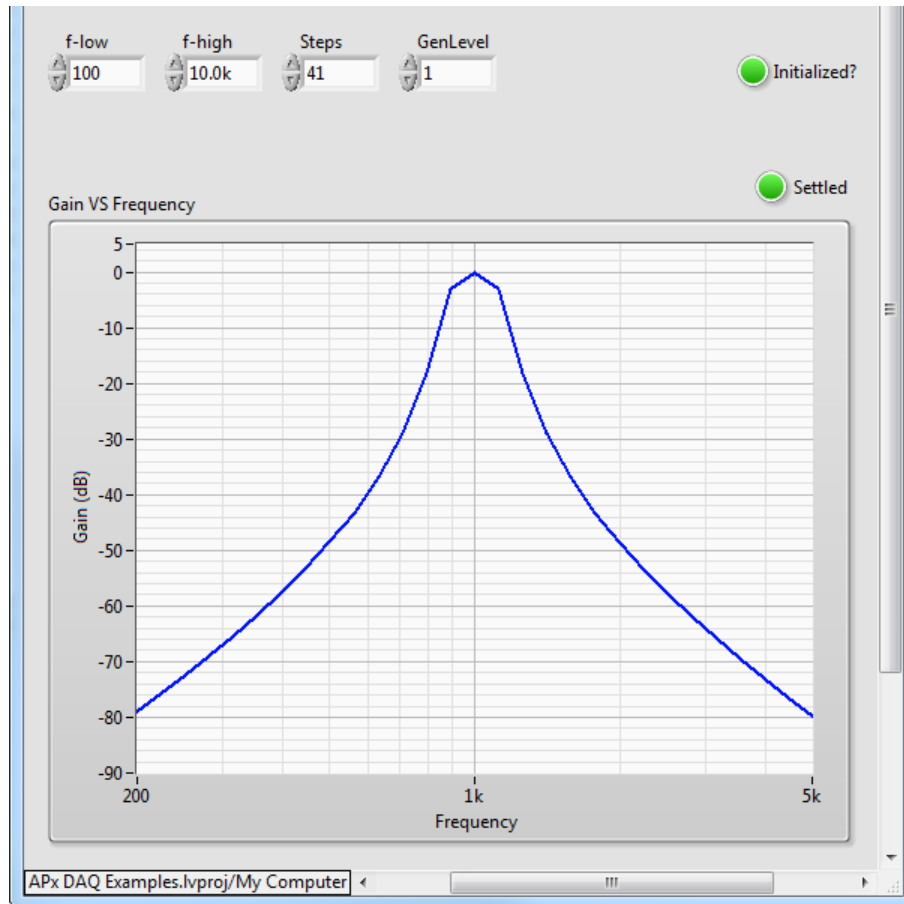




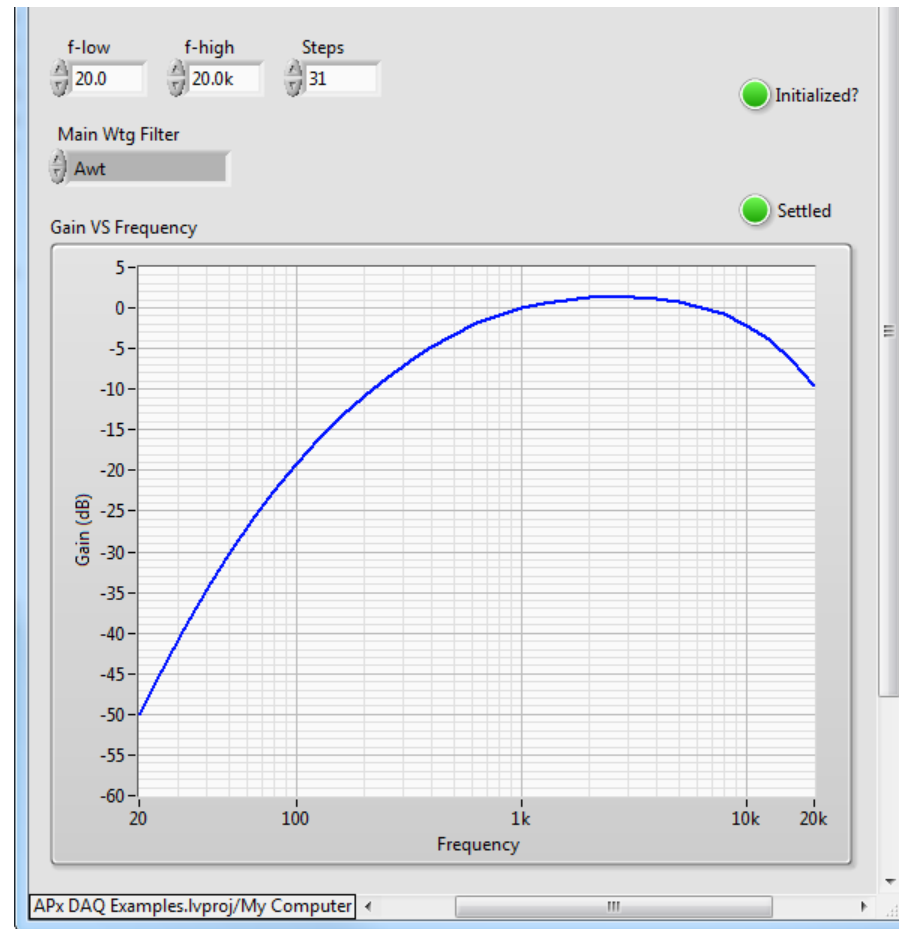
# Examples - High-pass & Low-pass filters



# Examples – Bandpass & Notch Filters



# Example – Weighting Filter



# Example – Stepped Level Sweep

