Ladybug VEE Power Meter Code

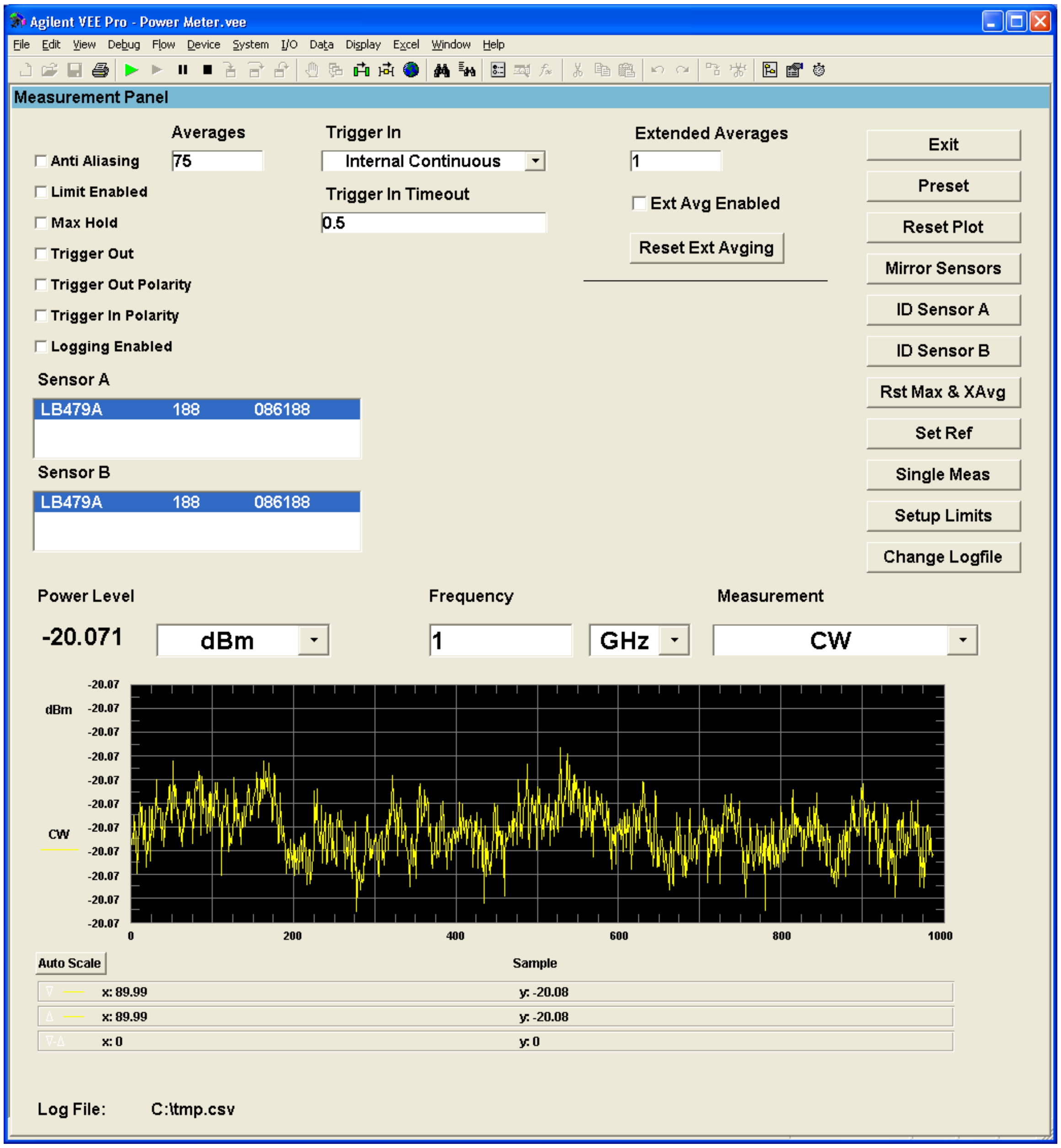
Overview

This document introduces the user to using Ladybug power sensors in a VEE environment. It assumes familiarity with VEE but does not require expertise. It demonstrates key functions including:

- Sensor Initialization
- Sensor Setup (Frequency, Averages, Measurement Units)
- CW Measurements
- Pulse Measurements
- Ratio Measurements

An example power meter application (with source code) is included. The user interface is shown in figure 1. It is designed to be easy to understand and uses many of the most common functions. It will work with one or more sensors.

Note: All VEE software is written in VEE 7.5.



Agilent VEE Pro - Power Meter.vee

Measurement Panel

- Anti Aliasing: unchecked
- Limit Enabled: unchecked
- Max Hold: unchecked
- Trigger Out: unchecked
- Trigger Out Polarity: unchecked
- Trigger In Polarity: unchecked
- Logging Enabled: unchecked
- Averages: 75
- Trigger In: Internal Continuous
- Trigger In Timeout: 0.5
- Extended Averages: 1
- Ext Avg Enabled: unchecked

Sensor A

LB479A	188	086188

Sensor B

LB479A	188	086188

Power Level: -20.071 dBm

Frequency: 1 GHz

Measurement: CW

x: 89.99	y: -20.08
x: 89.99	y: -20.08
x: 0	y: 0

Log File: C:\tmp.csv

Figure 1: VEE Power Meter Interface. Note that changes may be incorporated for cosmetic reasons or as new functionality is added. The interface may also change depending on some selections.

Exercising the VEE Power Meter Application

The VEE Power Meter is an interactive application designed to be similar to the front panel of more traditional power meters. Extra features, such as the plot, were added to emphasize some of the benefits of the Ladybug Sensor.

The software has many capabilities and is easy to use. A few of the settings and techniques are shown here to assist you in getting started.

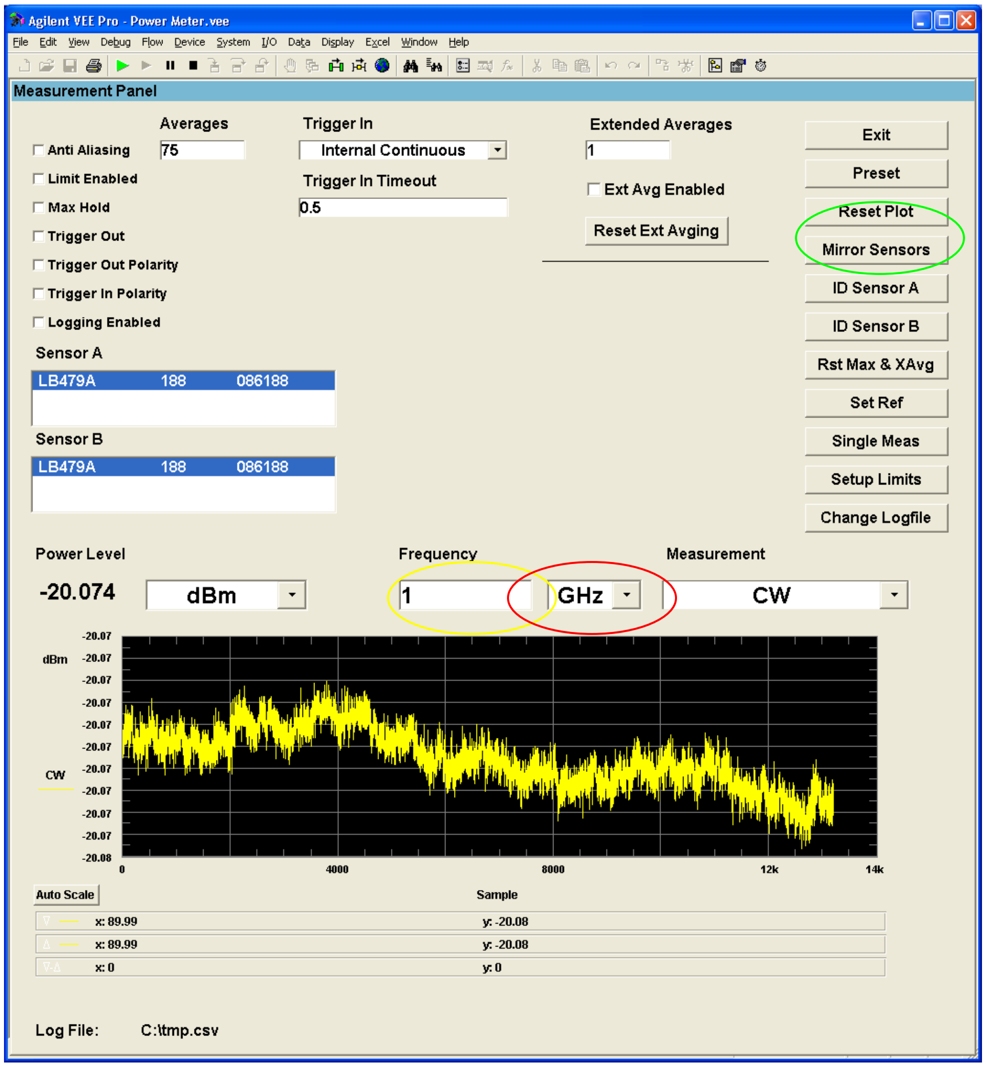
Software Installation

To install the software, simply unzip all of the files in the appropriate folder. Note that all files should remain in the same folder. This is especially true of the .DLL and .H files. If you wish to create your own VEE application, the location of these files is critical.

Setting the Frequency

To set the frequency, change the value in the frequency control (shown below in yellow). You may also change the units (shown in red) as necessary. These changes will take effect immediately.

Note that this will only change the frequency for the active sensor. If more than one sensor is connected, the others will not change. If you are performing ratio measurements, the settings for Sensor A can be copied to Sensor B by pressing the Mirror Sensor button.



Averages: 75
Trigger In: Internal Continuous
Trigger In Timeout: 0.5
Extended Averages: 1

☐ Anti Aliasing
☐ Limit Enabled
☐ Max Hold
☐ Trigger Out
☐ Trigger Out Polarity
☐ Trigger In Polarity
☐ Logging Enabled
☐ Ext Avg Enabled

Sensor A: LB479A 188 086188

Sensor B: LB479A 188 086188

Power Level: -20.074 dBm

Frequency: 1 GHz

Measurement: CW

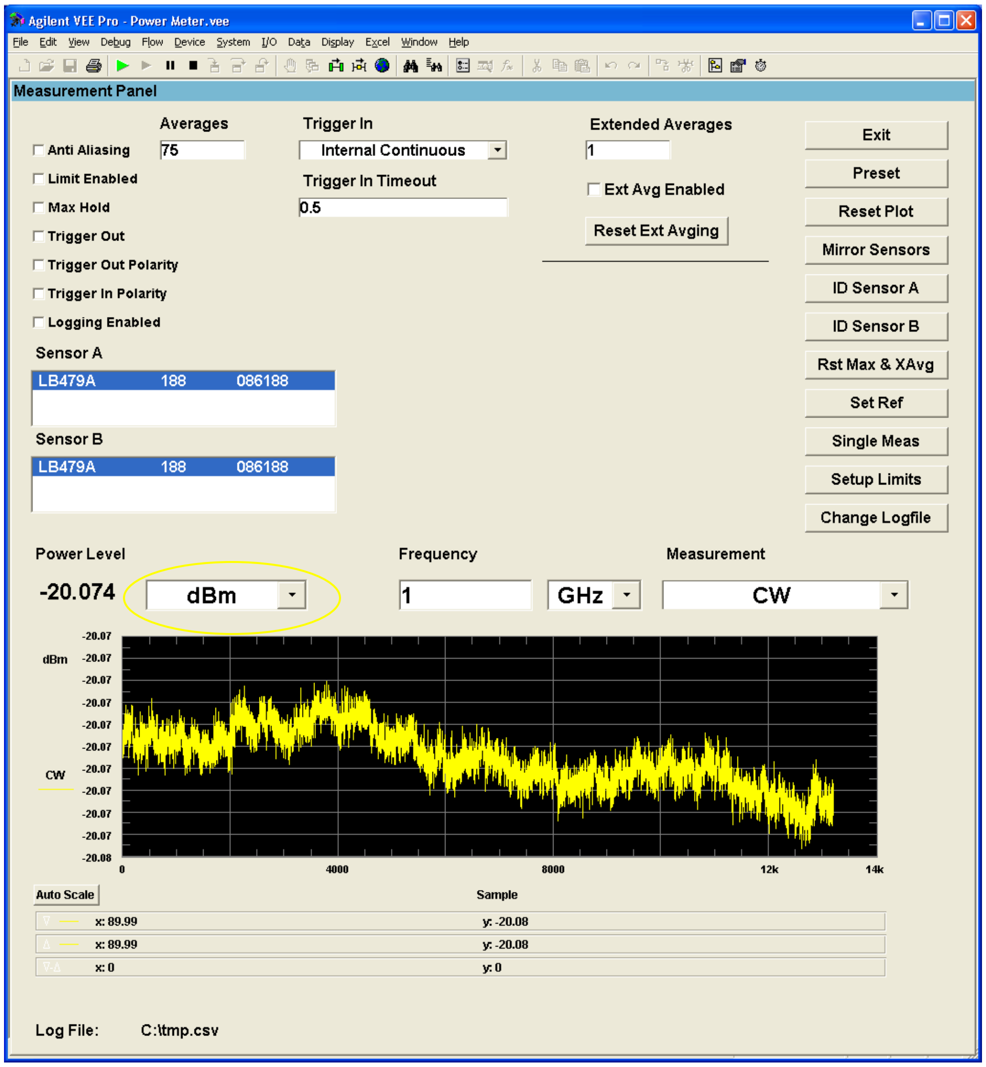
x: 89.99 y: -20.08
x: 89.99 y: -20.08
x: 0 y: 0

Log File: C:\tmp.csv

Figure 2: The frequency may be changed by any combination of the frequency value (shown in yellow) and the units (shown in red). Note that the Mirror Sensors button (shown in green) is only visible during ratio measurements.

Setting the Power Units

To set the power units, simply select the units from the drop-down list (shown in yellow). Note that the power units display shows the units for an individual sensor during ratio measurements.



Averages: 75

Trigger In: Internal Continuous

Trigger In Timeout: 0.5

Extended Averages: 1

☐ Ext Avg Enabled

☐ Anti Aliasing
☐ Limit Enabled
☐ Max Hold
☐ Trigger Out
☐ Trigger Out Polarity
☐ Trigger In Polarity
☐ Logging Enabled

Sensor A

LB479A	188	086188

Sensor B

LB479A	188	086188

Power Level: -20.074 dBm

Frequency: 1 GHz

Measurement: CW

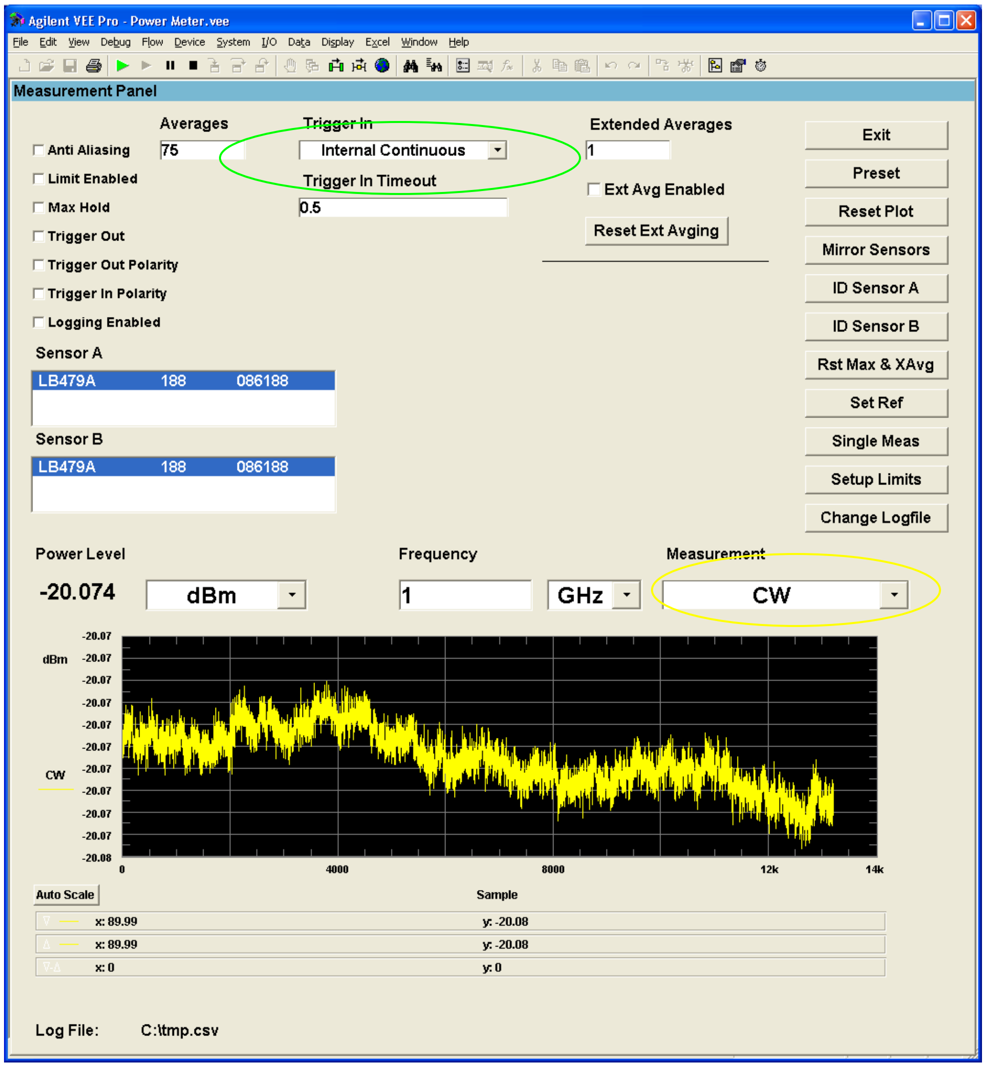
▽	x: 89.99	y: -20.08
△	x: 89.99	y: -20.08
▽-△	x: 0	y: 0

Log File: C:\tmp.csv

Figure 3: The power units control only controls sensor A. It also displays the current setting for Sensor A.

Making a CW Measurement

The default measurement when the system starts is CW. Generally speaking, this can be performed without any difficulty. To switch back to CW from another measurement, simply select CW from the drop-down list (shown below in yellow).



Measurement Panel

☐ Anti Aliasing
☐ Limit Enabled
☐ Max Hold
☐ Trigger Out
☐ Trigger Out Polarity
☐ Trigger In Polarity
☐ Logging Enabled

Averages: 75

Trigger In: Internal Continuous

Trigger In Timeout: 0.5

Extended Averages: 1

☐ Ext Avg Enabled

Sensor A: LB479A 188 086188

Sensor B: LB479A 188 086188

Power Level: -20.074 dBm

Frequency: 1 GHz

Measurement: CW

x: 89.99 y: -20.08

x: 89.99 y: -20.08

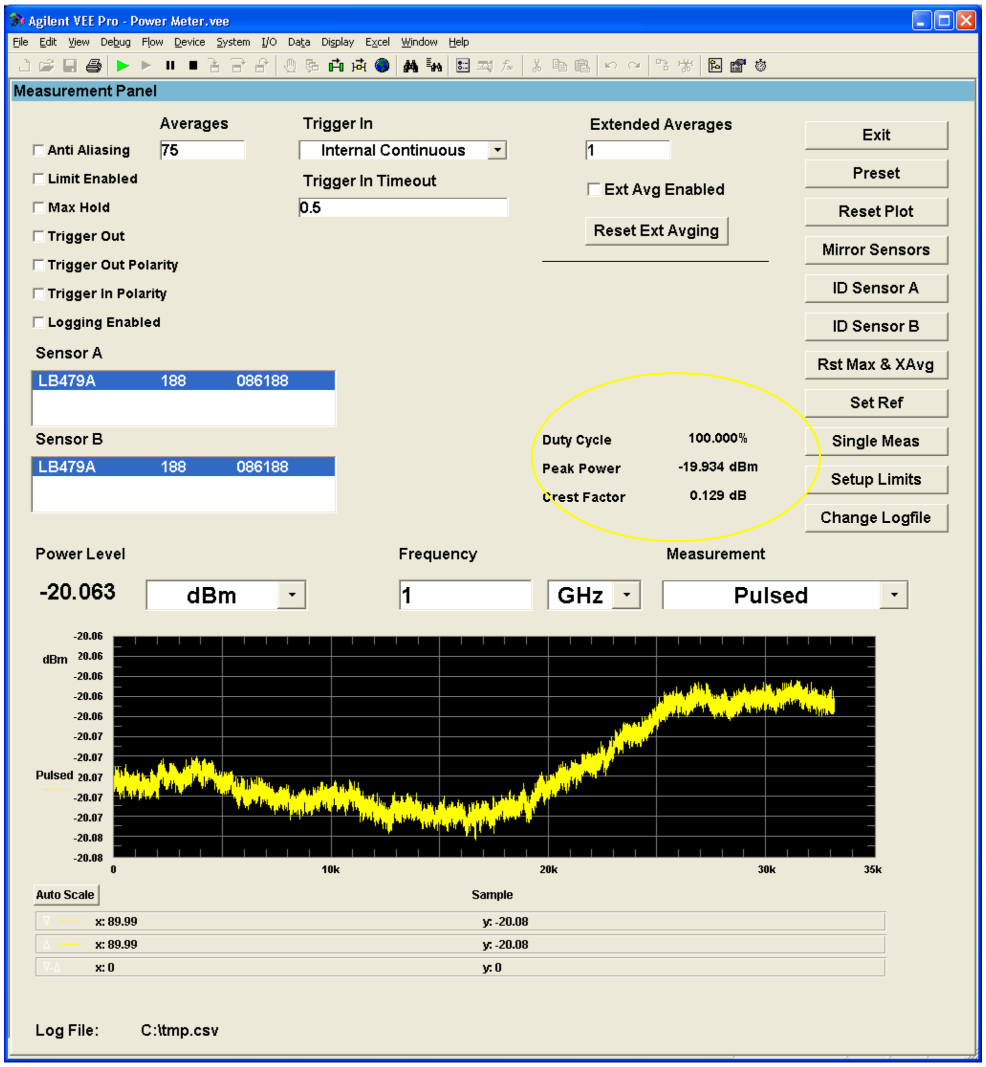
x: 0 y: 0

Log File: C:\tmp.csv

Figure 4: The default measurement type is CW. Measurements will be made continuously unless the Trigger In control (in green) is set to something other than "Internal Continuous".

Making a Pulse Measurement

Similarly, pulse measurements are made by selecting the Pulsed value from the drop-down list. Note that the additional quantities Duty Cycle, Peak Power, and Crest Factor (all shown in yellow) appear after this selection is made. Also, note that 5xx series sensors cannot make pulse measurements even though this option may be selected.



Averages: 75
Trigger In: Internal Continuous
Extended Averages: 1
☐ Anti Aliasing
☐ Limit Enabled
☐ Max Hold
☐ Trigger Out
☐ Trigger Out Polarity
☐ Trigger In Polarity
☐ Logging Enabled
Trigger In Timeout: 0.5
☐ Ext Avg Enabled

Sensor A

LB479A	188	086188

Sensor B

LB479A	188	086188

Duty Cycle	100.000%
Peak Power	-19.934 dBm
Crest Factor	0.129 dB

Power Level: -20.063 dBm
Frequency: 1 GHz
Measurement: Pulsed

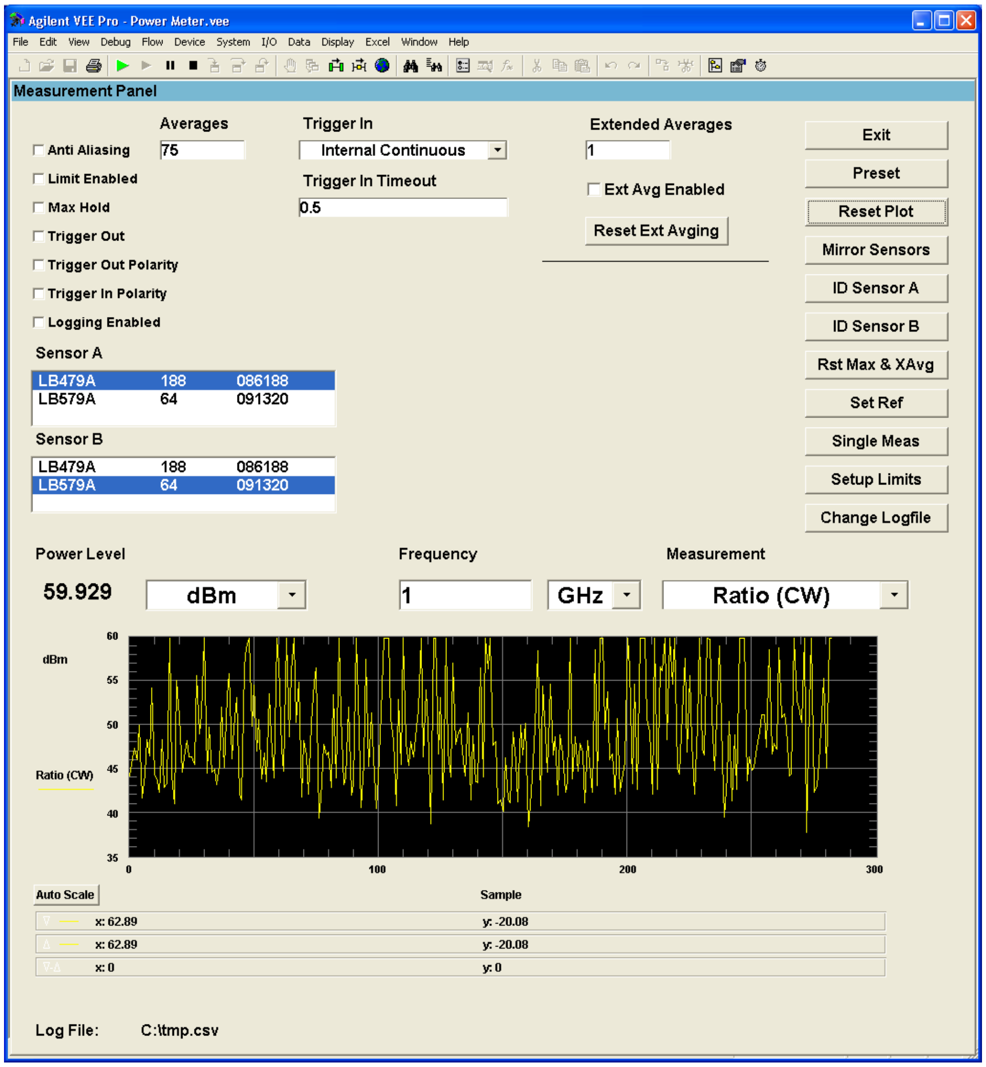
x: 89.99 y: -20.08
x: 89.99 y: -20.08
x: 0 y: 0

Log File: C:\tmp.csv

Figure 5: The additional pulse measurements are shown on the right. The units for duty cycle are alway percent and the units for crest factor are always dB. The units for the other parameters are always the same as the power units (except for pulse ratio).

Making a Ratio Measurement

Ratio measurements are made by selecting either of the Ratio options (CW or pulsed). CW is shown here. Not surprisingly, ratio measurements require two sensors for the results to make sense.



Averages: 75
Trigger In: Internal Continuous
Extended Averages: 1
Trigger In Timeout: 0.5
Ext Avg Enabled: ☐

☐ Anti Aliasing
☐ Limit Enabled
☐ Max Hold
☐ Trigger Out
☐ Trigger Out Polarity
☐ Trigger In Polarity
☐ Logging Enabled

Sensor A

LB479A	188	086188
LB579A	64	091320

Sensor B

LB479A	188	086188
LB579A	64	091320

Power Level: 59.929 dBm
Frequency: 1 GHz
Measurement: Ratio (CW)

x: 62.89 y: -20.08
x: 62.89 y: -20.08
x: 0 y: 0

Log File: C:\tmp.csv

Figure 6: Note that the ratio measurements are always A-B (or A/B for linear units). To display B-A, simply switch the selected sensors.

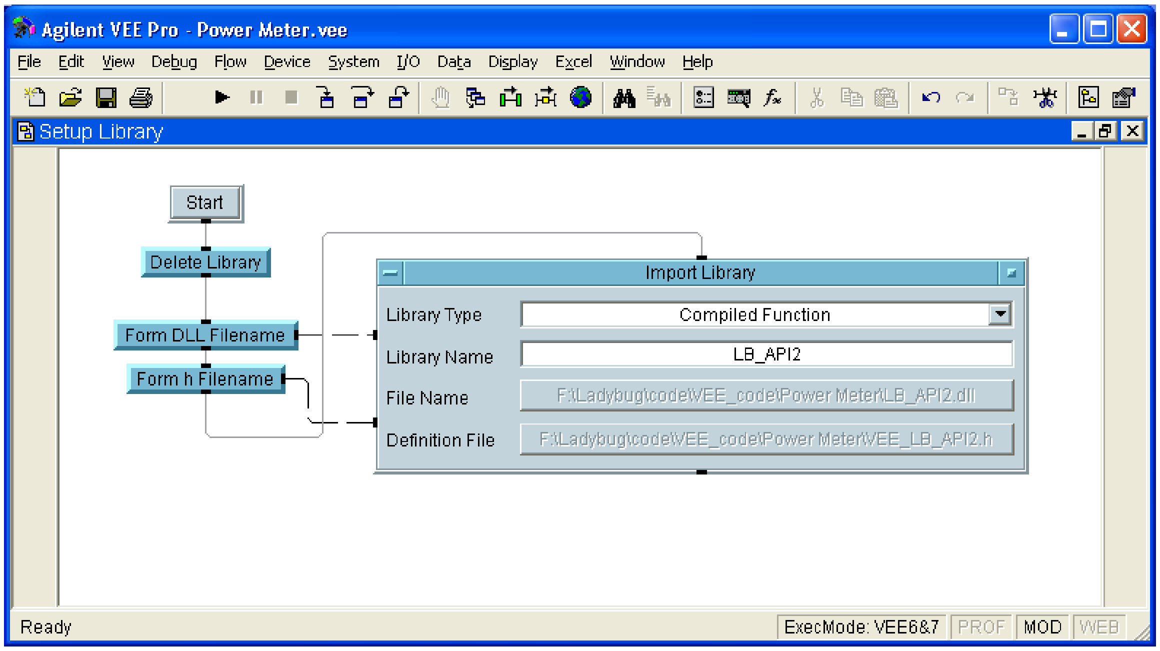
Using and Modifying the Code

Sensor Communication

Communication with LadyBug power sensors is done through the index, the serial number, or the address of the sensor. In this example code, all communication is done through the address. This is because the address covers more functionality than the others and because it makes the code more flexible. For example, the user cannot change the serial number of a sensor but they can change the address.

Library Setup

Since all calls to the power sensor are done with DLL function calls, the library must be imported prior to calling any of the routines. This is a fairly simple process with an example of the VEE code shown in the following figure.



Library Type	Compiled Function
Library Name	LB_API2
File Name	F:\Ladybug\code\VEE_code\Power Meter\LB_API2.dll
Definition File	F:\Ladybug\code\VEE_code\Power Meter\VEE_LB_API2.h

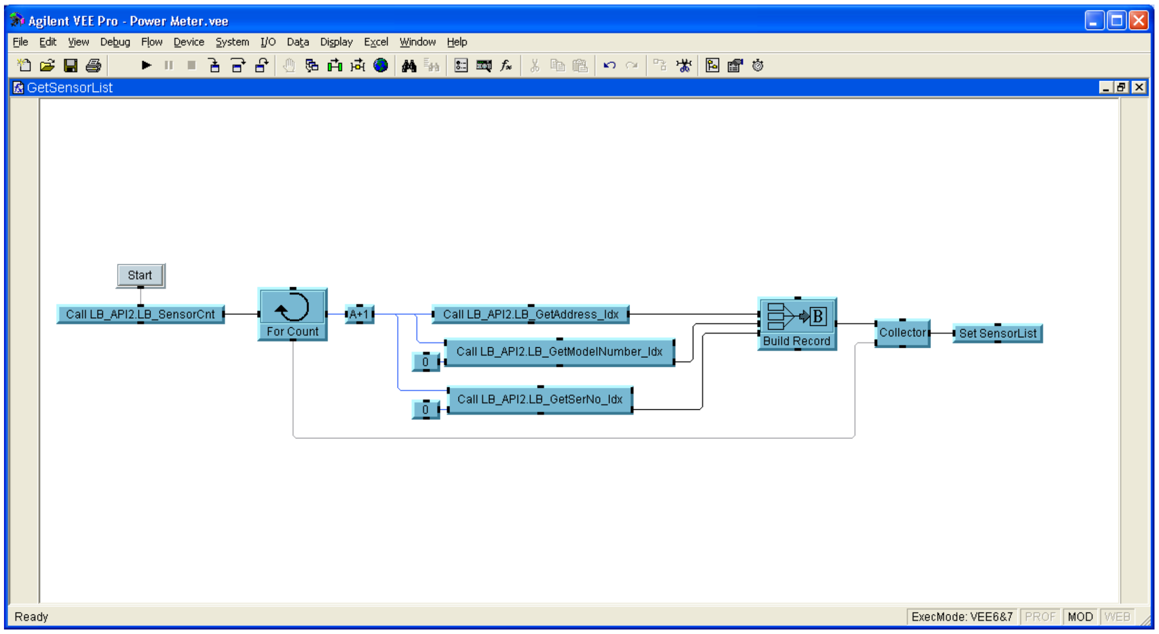
Figure 7: The crucial setting for an imported library is setting the Library Type to "Compiled Function". It is also good practice to delete the library prior to importing it.

Initializing the Sensors

Before the sensors can be used, they must be initialized. The code performs additional steps as well, but we will focus on the steps necessary for any application. You may need the additional steps depending upon your application.

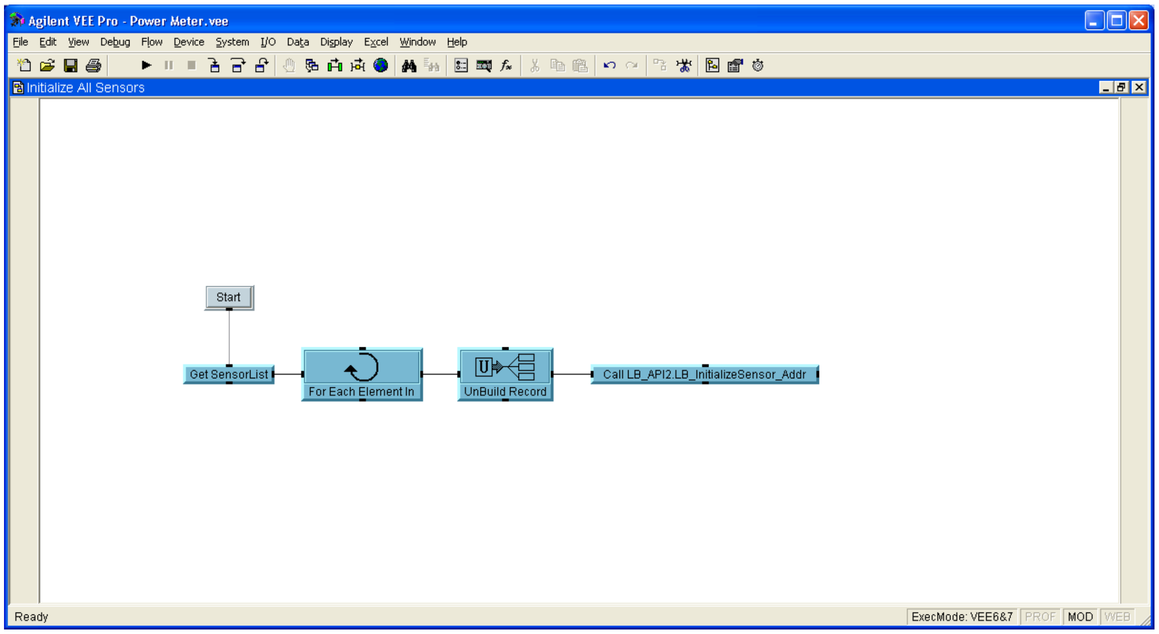
The first step in this process is to obtain the sensor list. This is followed by initializing each sensor. This initialization only needs to be done once.

In the power meter code, these steps are performed as shown in the following figures.



Agilent VEE Pro - Power Meter.vee
File Edit View Debug Flow Device System I/O Data Display Excel Window Help
GetSensorList
Start
Call LB_API2.LB_SensorCnt
For Count
A+1
Call LB_API2.LB_GetAddress_Idx
Call LB_API2.LB_GetModelNumber_Idx
Call LB_API2.LB_GetSerNo_Idx
0
0
Build Record
Collector
Set SensorList
Ready
ExecMode: VEE6&7
PROF
MOD
WEB

Figure 8: "Get Sensor List" userFunction. Note that the SensorList is an array of records.



Agilent VEE Pro - Power Meter.vee
File Edit View Debug Flow Device System I/O Data Display Excel Window Help
Initialize All Sensors
Start
Get SensorList
For Each Element In
UnBuild Record
Call LB_API2.LB_InitializeSensor_Addr
Ready
ExecMode: VEE6&7
PROF
MOD
WEB

Figure 9: "Initialize All Sensors" uses the address fields of each record in the array.

An easy way to initialize all sensors is shown below:

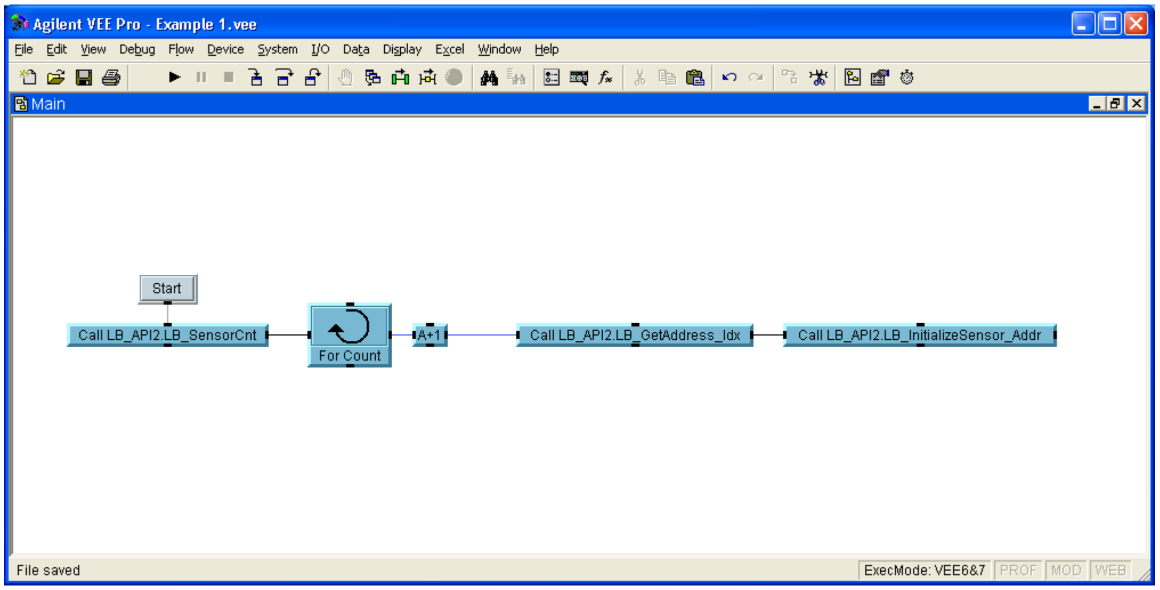

Agilent VEE Pro - Example 1.vee
File Edit View Debug Flow Device System I/O Data Display Excel Window Help
Main
Start
Call LB_API2.LB_SensorCnt
For Count
A+1
Call LB_API2.LB_GetAddress_Idx
Call LB_API2.LB_InitializeSensor_Addr
File saved
ExecMode: VEE6&7
PROF
MOD
WEB

Figure 10: Easy Initialization example (Example 1.vee). This example may be found in the examples folder. Note that it does not include the library import.

Sensor Identification

To make the LED on the current power sensor blink several times, use the LB_BlinkLED_Addr function.

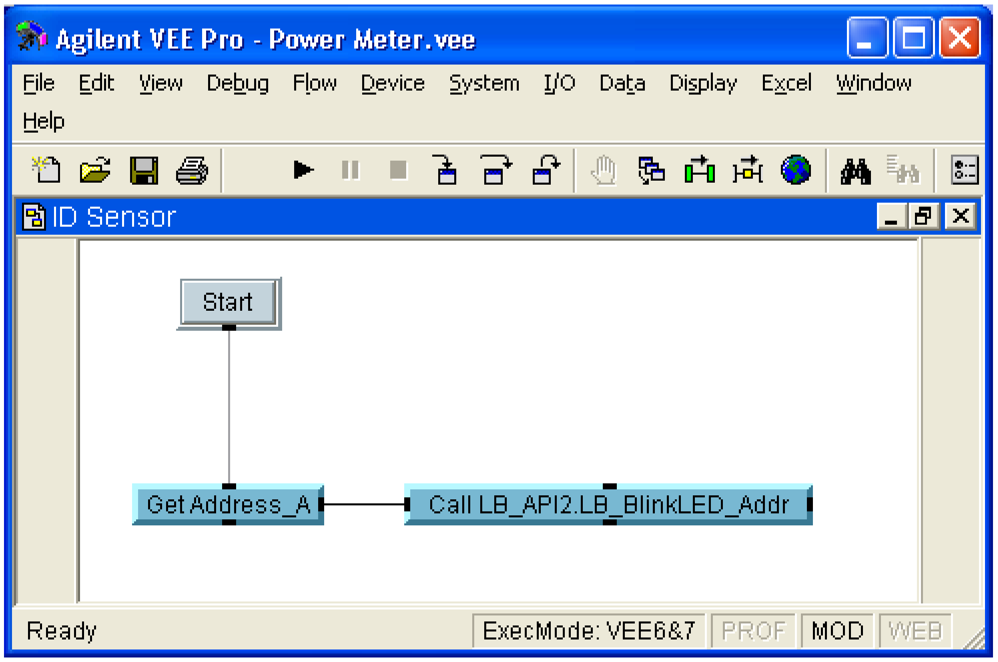

Agilent VEE Pro - Power Meter.vee
File Edit View Debug Flow Device System I/O Data Display Excel Window
Help
ID Sensor
Start
Get Address_A
Call LB_API2.LB_BlinkLED_Addr
Ready
ExecMode: VEE6&7
PROF
MOD
WEB

Figure 11: This function is used to physically identify the sensor at the given address.

Setting the Frequency

To set the power sensor frequency, use the LB_Set_Frequency function. Note that the frequency must be in Hertz. You will need to account for this before calling this function (as was done in the power meter code).

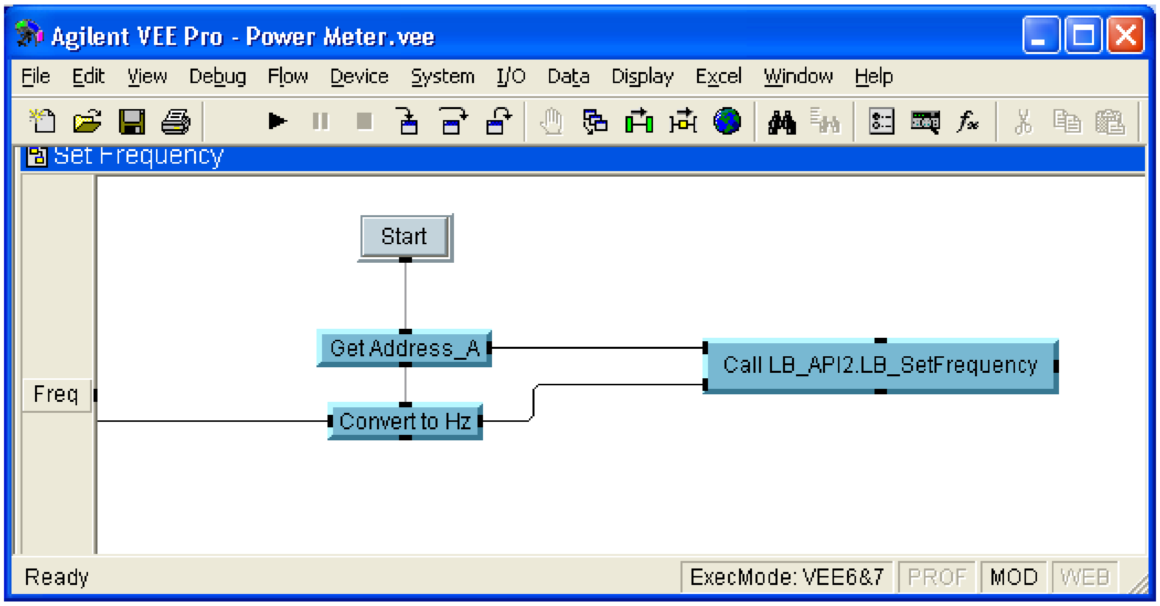

Agilent VEE Pro - Power Meter.vee
File Edit View Debug Flow Device System I/O Data Display Excel Window Help
Set Frequency
Start
Get Address_A
Call LB_API2.LB_SetFrequency
Freq
Convert to Hz
Ready
ExecMode: VEE6&7
PROF
MOD
WEB

Figure 12: With these parameters, the power sensor at address A would be set to the frequency of the Freq pin.

Setting the Power Units

To set the power units, use the LB_SetMeasurementPowerUnits function as shown in the figure. Possible units include dBm, dBW, dBkW, dBuV, dBmV, dBV, Watts, Volts, and dB Relative.

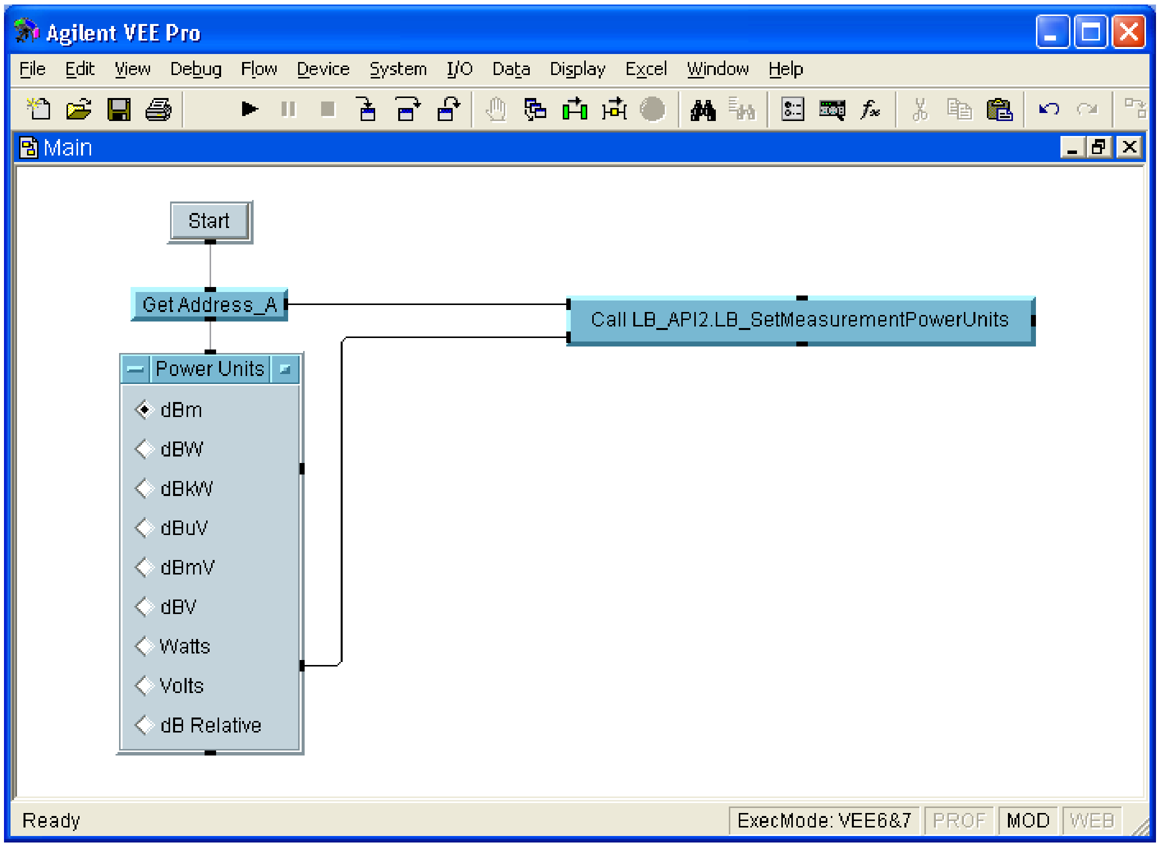


Figure 13: With these parameters, the LB_SetMeasurementPowerUnits will set the power sensor to dBm. Note that the ordinal output of the radio button control is used (not the enum). Also, the order of the units in the radio buttons control is critical.

Making a CW Measurement

The Get CW Measurement (Address).vee example will measure the CW power for the sensor at the given address in the selected units of the sensor. This example shows the minimum required to make this measurement, including importing the library, initializing the sensor, setting the frequency, setting the power units, and making the measurements.

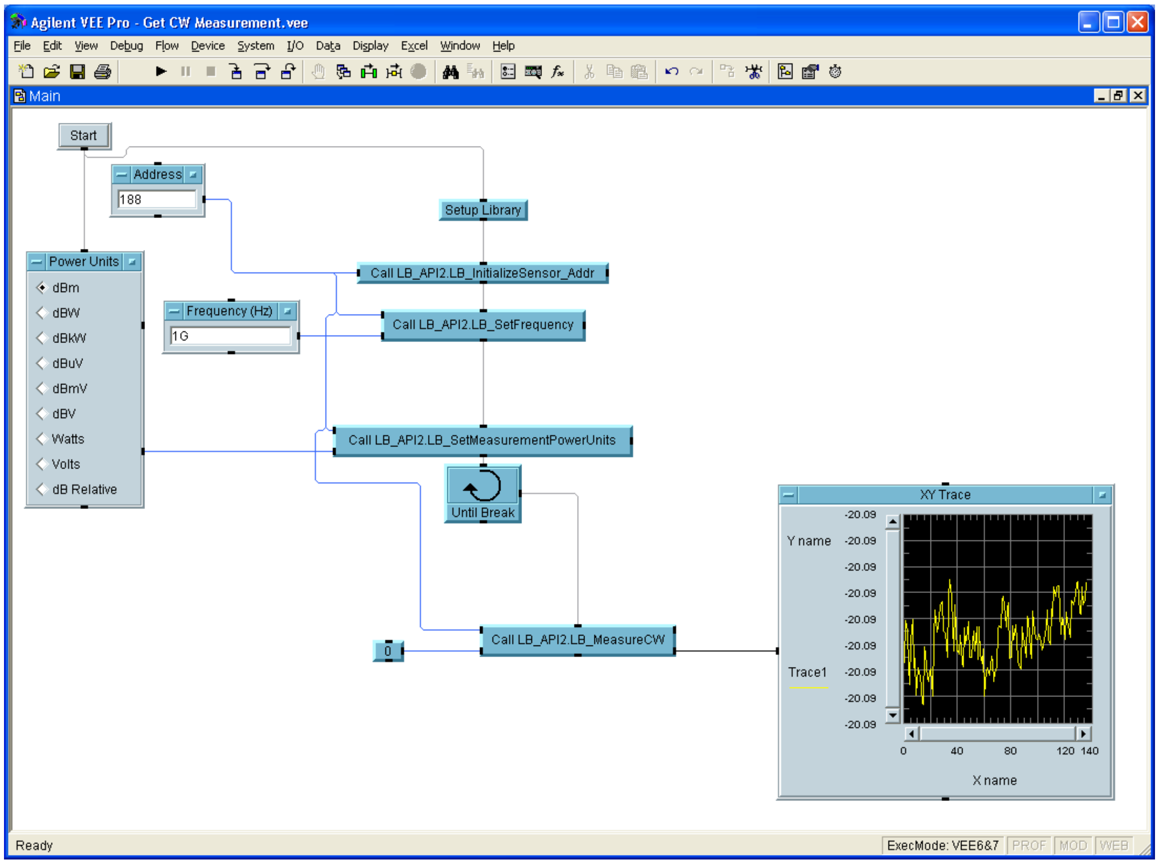

Agilent VEE Pro - Get CW Measurement.vee
File Edit View Debug Flow Device System I/O Data Display Excel Window Help
Main
Start
Address
188
Setup Library
Power Units
dBm
dBW
dBkW
dBuV
dBmV
dBV
Watts
Volts
dB Relative
Call LB_API2.LB_InitializeSensor_Addr
Frequency (Hz)
1G
Call LB_API2.LB_SetFrequency
Call LB_API2.LB_SetMeasurementPowerUnits
Until Break
XY Trace
Y name
-20.09
Trace1
0
40
80
120
140
X name
Call LB_API2.LB_MeasureCW
0
Ready
ExecMode: VEE6&7
PROF
MOD
WEB

Figure 14: The CW Measurement Example shows how to take continuous CW measurements. Note that the address (188) will probably have to be modified for your needs.

Making a Pulse Measurement

Similarly, the Get Pulse Measurement.vee example will measure the pulse power for the selected sensor.

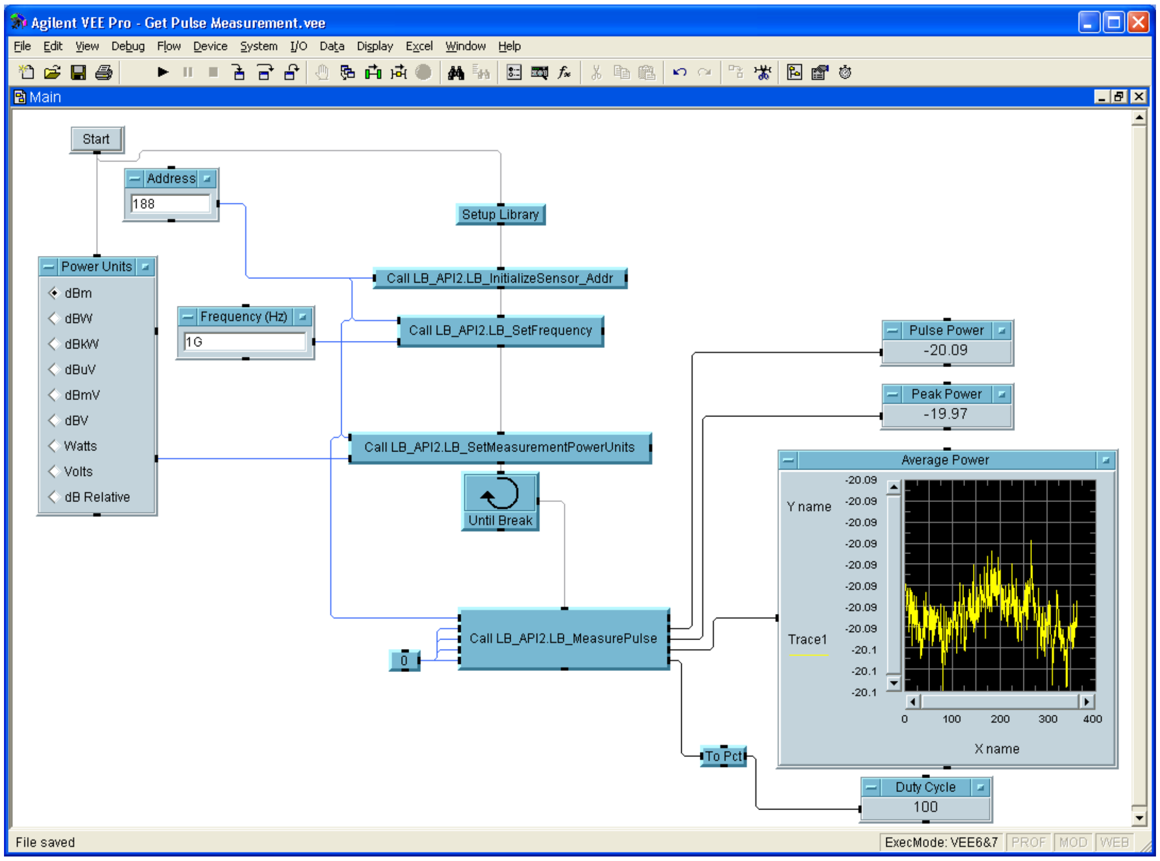

Agilent VEE Pro - Get Pulse Measurement.vee
File Edit View Debug Flow Device System I/O Data Display Excel Window Help
Main
Start
Address
188
Setup Library
Power Units
dBm
dBW
dBkW
dBuV
dBmV
dBV
Watts
Volts
dB Relative
Call LB_API2.LB_InitializeSensor_Addr
Frequency (Hz)
1G
Call LB_API2.LB_SetFrequency
Call LB_API2.LB_SetMeasurementPowerUnits
Until Break
Call LB_API2.LB_MeasurePulse
0
Pulse Power
-20.09
Peak Power
-19.97
Average Power
Y name
Trace1
X name
To Pct
Duty Cycle
100
File saved
ExecMode: VEE6&7
PROF
MOD
WEB

Figure 15: The Pulse Measurement example is similar in format to the CW Measurement example but note that it has four outputs.

Making a Ratio Measurement

Ratio measurements simply involve setting up and measuring power levels from two sensors. There is no single function that performs this measurement.

The Ratio Measurement.vee example demonstrates how to perform these measurements. Note that ratio measurements are subtracted for logarithmic units (such as dBm) and divided for linear units.

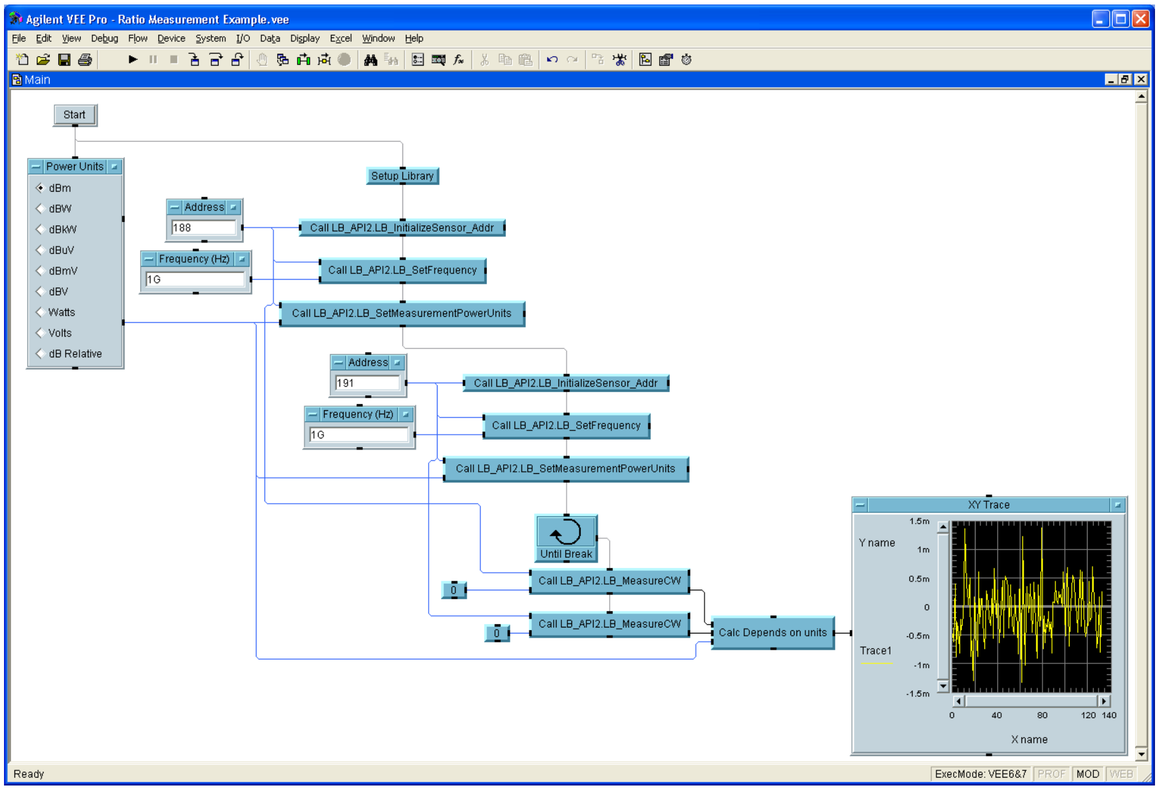

Agilent VEE Pro - Ratio Measurement Example.vee
File Edit View Debug Flow Device System I/O Data Display Excel Window Help
Main
Start
Power Units
dBm
dBW
dBkW
dBuV
dBmV
dBV
Watts
Volts
dB Relative
Setup Library
Address
188
Call LB_API2.LB_InitializeSensor_Addr
Frequency (Hz)
1G
Call LB_API2.LB_SetFrequency
Call LB_API2.LB_SetMeasurementPowerUnits
Address
191
Call LB_API2.LB_InitializeSensor_Addr
Frequency (Hz)
1G
Call LB_API2.LB_SetFrequency
Call LB_API2.LB_SetMeasurementPowerUnits
Until Break
0
Call LB_API2.LB_MeasureCW
0
Call LB_API2.LB_MeasureCW
Calc Depends on units
XY Trace
Y name
Trace1
1.5m
1m
0.5m
0
-0.5m
-1m
-1.5m
0
40
80
120
140
X name
Ready
ExecMode: VEE6&7
PROF
MOD
WEB

Figure 16: This example shows a CW ratio measurement of two sensors at 1 GHz. Note that units are treated differently in ratio measurements.

Adding to Existing Projects

The VEE files distributed with this code can be added directly to any existing project. It is recommended that you check to ensure that the DLL functions are imported correctly at the beginning of the program. This may require modification to the folders specified by the import DLL function.