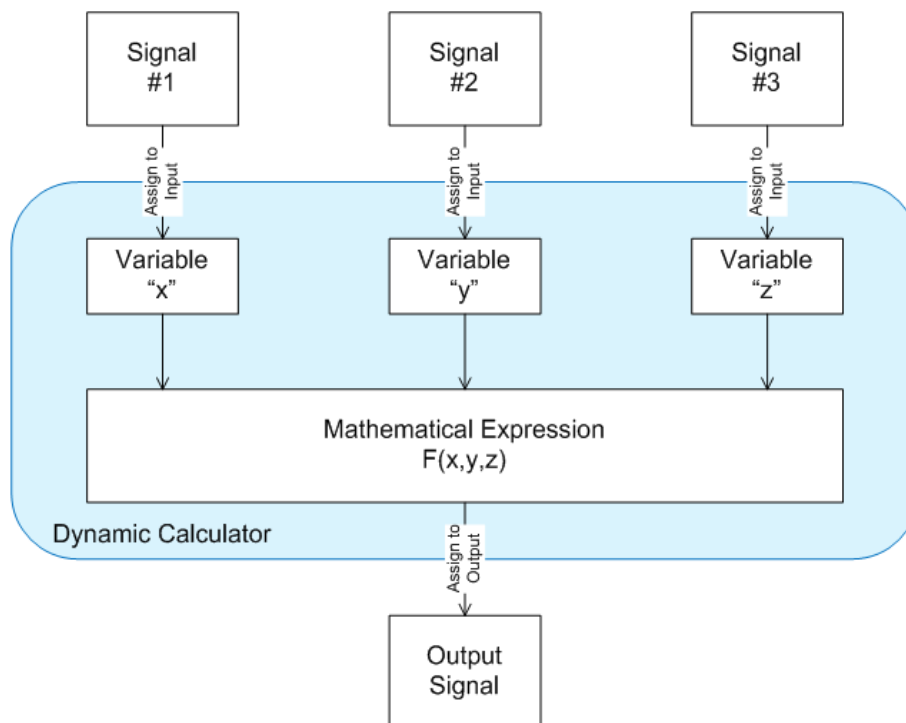


August 2012

Dynamic Calculator in openPDC and openPG

The Dynamic Calculator is an action adapter that can be used to create a calculated signal value. This calculated value is computed at the rate which is configurable and typically the rate of the incoming signals. It's not recommend that this adapter not be used for signals that span large difference in periodicity (e.g., a 4-second down-sampled value with 60 sample-per-second phasor data.)

The purpose of this action adapter is to compute a value that can be used in near-real time processes prior to data archival or other phasor data processing. The figure below shows how the dynamic calculator works for an example of three input values, or signals.



Dynamic Calculator Conceptual Data Flow

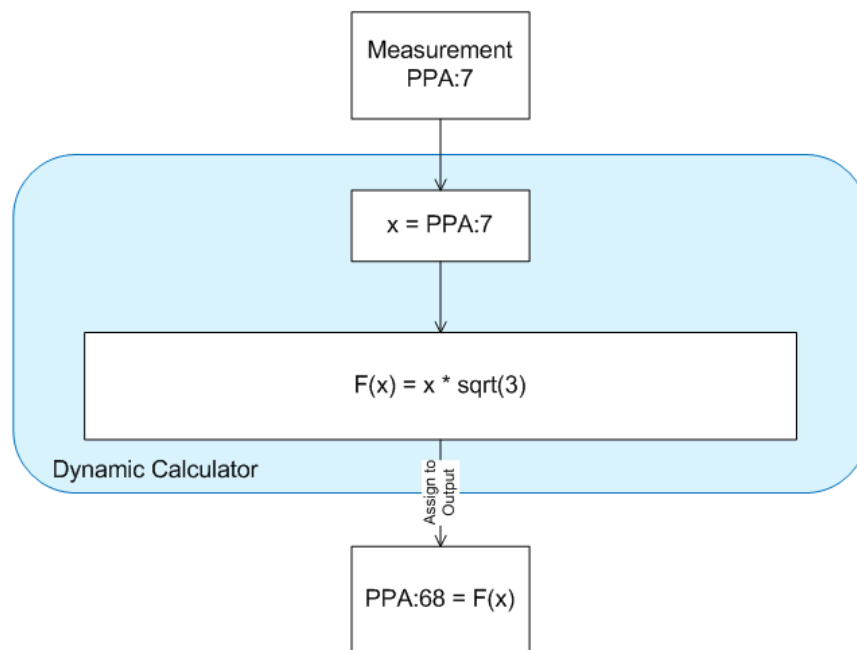
The Dynamic Calculator is configured through the "Manage Action Adapters" configuration screen where the "mathematical expression" is entered. This expression can include trigonometric and other functions as shown on page 16.

A description of how to use the Dynamic Calculator is provided through two examples, (1) The simple example of multiplying a signal by a scalar and (2) a more involved example of adding two phasors (in polar form) and returning a polar result.

Example 1 – Multiply a Voltage by $\sqrt{3}$

This is a simple mathematical function to demonstrate in detail how to set up a Dynamic Calculator as show by the data flow diagram below.

The input signal is shown below as referenced by the “Measurement Key” which is the preferred manner to reference a signal for this adapter. However, point tag or point GUID can both be used as well.



Example 1 – Data Flow

In general, the steps for configuration of the Dynamic Calculator are:

1. Create the output signal that will receive the results of this calculation (e.g., PPA:68)
2. Find the designed input signals (e.g., PPA:7)

3. Create the Action Adapter and build the mathematical expression in the connection string for this adapter. This expression can consist of standard operators, parenthesis, and functions as listed on Page 16.

Step 1 – Using the Manage – Measurements screen, create a new signal which will receive the results of the calculation. The Point Tag should be descriptive of this signal. Note that Internal and Enabled are both checked.



The “Measurement Key” for this new output signal is created by the openPDC. Go to menu Monitoring – Device Measurement to find the Measurement Key – e.g., PPA-68.



DIRECT CONNECTED		Devices Connected Directly		IEEE 1344-1995	ABB-521	
PPA:4	Shelby ABB-521 Frequency Delta (dF/dt)			19:19:08.966	-1.66	
PPA:3	Shelby ABB-521 Digital Value 1			19:19:08.966	0	
PPA:2	Shelby ABB-521 Frequency			19:19:08.966	59.97	Hz
PPA:6	Shelby ABB-521 500 kV Bus 1 Positive Sequence Voltage Phase Angle			19:19:08.966	-108.067	Degrees
PPA:8	Shelby ABB-521 500 kV Bus 2 Positive Sequence Voltage Phase Angle			19:19:08.966	-108.04	Degrees
PPA:10	Shelby ABB-521 Cordova Positive Sequence Current Phase Angle			19:19:08.966	61.705	Degrees
PPA:12	Shelby ABB-521 Dell Positive Sequence Current Phase Angle			19:19:08.966	-108.627	Degrees
PPA:14	Shelby ABB-521 Lagoon Creek Positive Sequence Current Phase Angle			19:19:08.966	-157.644	Degrees
PPA:5	Shelby ABB-521 500 kV Bus 1 Positive Sequence Voltage Magnitude			19:19:08.966	299972.906	Volts
PPA:7	Shelby ABB-521 500 kV Bus 2 Positive Sequence Voltage Magnitude			19:19:08.966	298967.469	Volts
PPA:9	Shelby ABB-521 Cordova Positive Sequence Current Magnitude			19:19:08.966	238.728	Amps
PPA:11	Shelby ABB-521 Dell Positive Sequence Current Magnitude			19:19:08.966	517.65	Amps
PPA:13	Shelby ABB-521 Lagoon Creek Positive Sequence Current Magnitude			19:19:08.966	210.853	Amps
PPA:1	Shelby ABB-521 Status Flags			19:19:08.966	8228	
CALCULATED		Calculated Measurements				
PPA:68	Dynamic Calculator Example 1			19:19:08.982	517826.844	

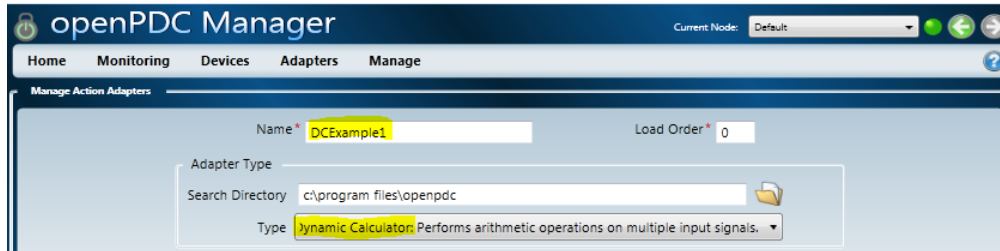
Step 2 – Find the Measurement Key or Point Tag of the input signal to be used in the calculation by browsing through PDC measurements. e.g., The Measurement Key is PPA:7 as shown below.



The screenshot shows the 'openPDC Manager' interface with the 'Monitoring' tab selected. The 'Real-time Device Measurements' section is active, displaying a table of measurements for the 'SHELBY' device. The table has columns for measurement key, description, IEEE 1344-1995 value, ABB-521 value, and units. The measurement key 'PPA:7' is highlighted in yellow, corresponding to 'Shelby ABB-521 500 kV Bus 2 Positive Sequence Voltage Magnitude'.

Measurement Key	Description	IEEE 1344-1995	ABB-521	Units
PPA:4	Shelby ABB-521 Frequency Delta (dF/dt)	18:47:26.333	-0.26	
PPA:3	Shelby ABB-521 Digital Value 1	18:47:26.333	0	
PPA:2	Shelby ABB-521 Frequency	18:47:26.333	59.964	Hz
PPA:6	Shelby ABB-521 500 kV Bus 1 Positive Sequence Voltage Phase Angle	18:47:26.333	-87.63	Degrees
PPA:8	Shelby ABB-521 500 kV Bus 2 Positive Sequence Voltage Phase Angle	18:47:26.333	-87.603	Degrees
PPA:10	Shelby ABB-521 Cordova Positive Sequence Current Phase Angle	18:47:26.333	84.538	Degrees
PPA:12	Shelby ABB-521 Dell Positive Sequence Current Phase Angle	18:47:26.333	-85.968	Degrees
PPA:14	Shelby ABB-521 Lagoon Creek Positive Sequence Current Phase Angle	18:47:26.333	-136.748	Degrees
PPA:5	Shelby ABB-521 500 kV Bus 1 Positive Sequence Voltage Magnitude	18:47:26.333	299426.75	Volts
PPA:7	Shelby ABB-521 500 kV Bus 2 Positive Sequence Voltage Magnitude	18:47:26.333	298420.281	Volts
PPA:9	Shelby ABB-521 Cordova Positive Sequence Current Magnitude	18:47:26.333	226.982	Amps
PPA:11	Shelby ABB-521 Dell Positive Sequence Current Magnitude	18:47:26.333	500.011	Amps
PPA:13	Shelby ABB-521 Lagoon Creek Positive Sequence Current Magnitude	18:47:26.333	216.451	Amps
PPA:1	Shelby ABB-521 Status Flags	18:47:26.333	8228	

Step 3 – Create Dynamic Calculator in menu Adapters - Action Adapters by dropping down to “Dynamic Calculation” under “Type” as shown below and entering in a unique name for this action adapter, e.g., “DCExample1”.



The screenshot shows the 'openPDC Manager' interface with the 'Adapters' tab selected. The 'Manage Action Adapters' section is active, displaying a form for creating a new adapter. The 'Name' field is set to 'DCExample1', 'Load Order' is 0, and 'Adapter Type' is 'Dynamic Calculator'. The 'Search Directory' is 'c:\program files\openpdc'.

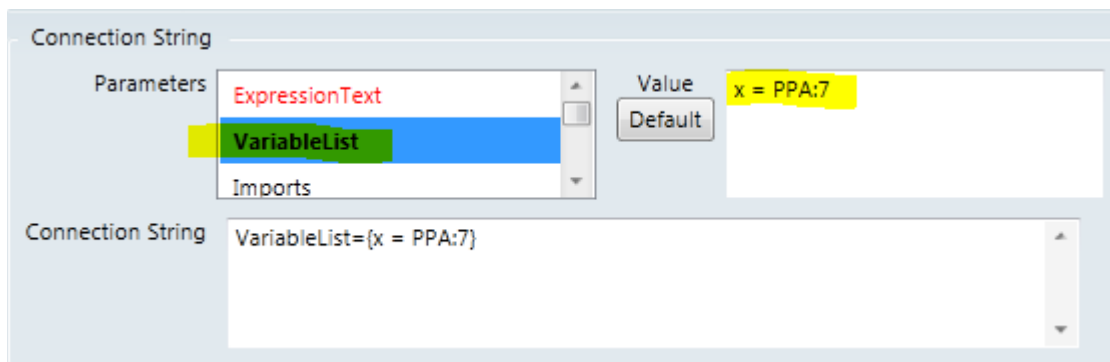
Field	Value
Name	DCExample1
Load Order	0
Adapter Type	Dynamic Calculator
Search Directory	c:\program files\openpdc
Type	Dynamic Calculator (Performs arithmetic operations on multiple input signals.)

Step 4 – Enter the required the connection string parameters, including the mathematical expression.

All the required parameters for the connection string are shown in red in the parameters list dialog box as shown in the figure below. These required parameters are:

- VariableList
- ExpressionText
- OutputMeasurements
- FramesPerSecond
- LagTime
- LeadTime

VariableList: First assign the input signal (PPA:7) to an arbitrary variable name, e.g., “x”. (The parameters in red in the parameters drop down are required and missing. The ones in bold have been set to values other than the default value.)

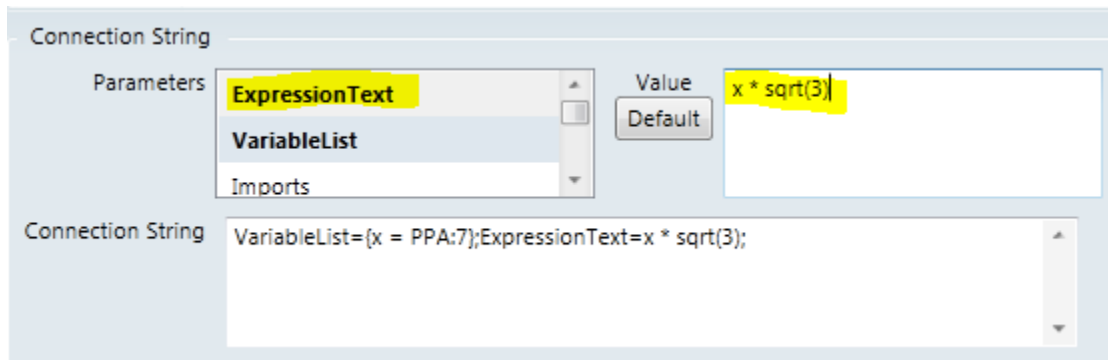


The screenshot shows a 'Connection String' dialog box. It has a 'Parameters' list on the left with three items: 'ExpressionText' (in red), 'VariableList' (in bold green), and 'Imports'. To the right of the list is a 'Value' field containing 'x = PPA:7' and a 'Default' button. Below the parameters list is a 'Connection String' text area containing the text 'VariableList={x = PPA:7}'.

Note: This step is required when using the Point Tag or GUID to assign a value to the variable. As seen below, Measurement Keys can be used directly in the calculation expression without an assignment to a variable.

ExpressionText: Enter the $f(x)$, in this case “x” times the square root of three. While value could have been entered as a constant (1.732), the SQRT function was applied.

This expression could also have been entered as “PPA:7*SQRT(3)” without the definition of “x”.



Connection String

Parameters

ExpressionText

VariableList

Imports

Value

Default

x * sqrt(3)

Connection String

VariableList={x = PPA:7};ExpressionText=x * sqrt(3);

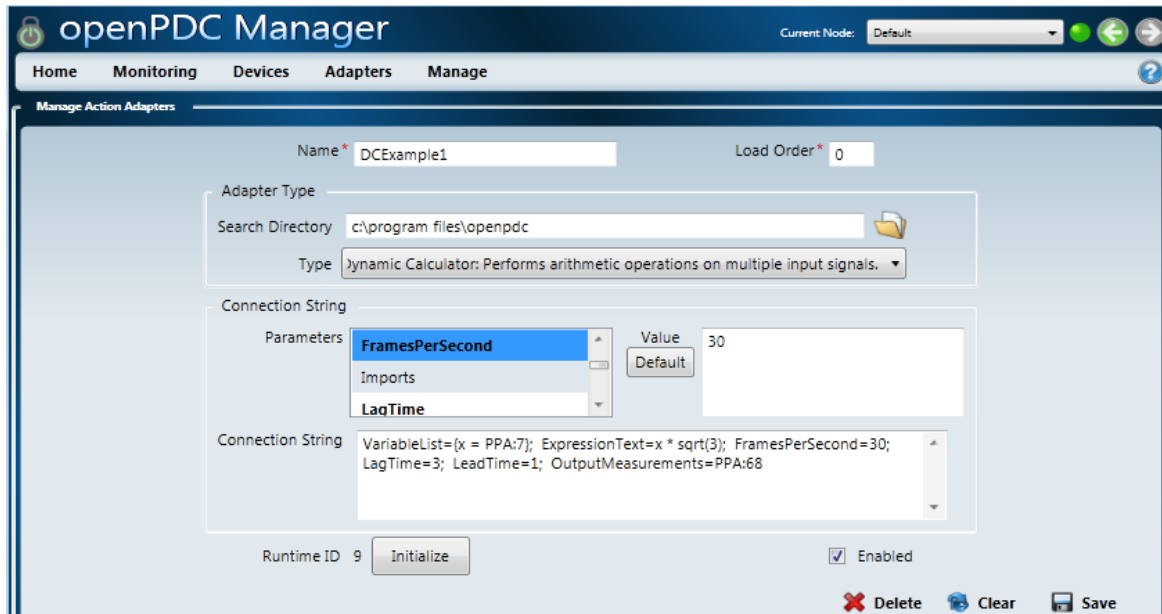
OutputMeasurements: Assign the created signal with Measurement Key = PPA:68 to the output.

FramesPerSecond: 30 – The calculation periodicity.

LagTime: 3.0 seconds (Wait for up to 3 seconds for all input variables to be initialized by a signal. The lag time for this adapter should be set to match other lag times in the system.)

LeadTime: 1.0 seconds (Since the calculation is always performed on signals with matching timestamps, setting the lead time to a high value allows for large amounts of local clock drift prior to discarding the calculation based on a bad “future” time. A lead time of 1 second is shown in this example. It could have been set to 10 seconds.)

This is the completed Dynamic Calculator for Example 1:



openPDC Manager

Current Node: Default

Home Monitoring Devices Adapters Manage

Manage Action Adapters

Name * DCExample1 Load Order * 0

Adapter Type

Search Directory c:\program files\openpdc

Type Dynamic Calculator: Performs arithmetic operations on multiple input signals.

Connection String

Parameters

FramesPerSecond

Imports

LagTime

Value

Default

30

Connection String

VariableList={x = PPA:7}; ExpressionText=x * sqrt(3); FramesPerSecond=30; LagTime=3; LeadTime=1; OutputMeasurements=PPA:68

Runtime ID 9 Initialize

Enabled

Delete Clear Save

Click the Initialize button to start the Calculations.

Confirm operation at menu Monitoring – Device Measurement:

openPDC Manager Current Node: Default

Home Monitoring Devices Adapters Manage

Real-time Device Measurements [Display Settings](#) Refresh Interval: 1 sec Last Refresh: 21:05:10.952

DIRECT CONNECTED		Devices Connected Directly		IEEE 1344-1995	ABB-521	Edit
▲	SHELBY	Shelby				
PPA:4	Shelby ABB-521 Frequency Delta (dF/dt)	21:05:10.933	0.31			
PPA:3	Shelby ABB-521 Digital Value 1	21:05:10.933	0			
PPA:2	Shelby ABB-521 Frequency	21:05:10.933	59.968		Hz	
PPA:6	Shelby ABB-521 500 kV Bus 1 Positive Sequence Voltage Phase Angle	21:05:10.933	-70.871		Degrees	
PPA:8	Shelby ABB-521 500 kV Bus 2 Positive Sequence Voltage Phase Angle	21:05:10.933	-70.845		Degrees	
PPA:10	Shelby ABB-521 Cordova Positive Sequence Current Phase Angle	21:05:10.933	100.457		Degrees	
PPA:12	Shelby ABB-521 Dell Positive Sequence Current Phase Angle	21:05:10.933	-69.693		Degrees	
PPA:14	Shelby ABB-521 Lagoon Creek Positive Sequence Current Phase Angle	21:05:10.933	-119.026		Degrees	
PPA:5	Shelby ABB-521 500 kV Bus 1 Positive Sequence Voltage Magnitude	21:05:10.933	299473.813		Volts	
PPA:7	Shelby ABB-521 500 kV Bus 2 Positive Sequence Voltage Magnitude	21:05:10.933	298476.875		Volts	
PPA:9	Shelby ABB-521 Cordova Positive Sequence Current Magnitude	21:05:10.933	221.947		Amps	
PPA:11	Shelby ABB-521 Dell Positive Sequence Current Magnitude	21:05:10.933	489.073		Amps	
PPA:13	Shelby ABB-521 Lagoon Creek Positive Sequence Current Magnitude	21:05:10.933	217.363		Amps	
PPA:1	Shelby ABB-521 Status Flags	21:05:10.933	8228			
▲	CALCULATED	Calculated Measurements				Edit
PPA:68	Dynamic Calculator Example 1	21:05:10.948	516977.125			

Example 2 – Addition of Two Phasor Values

This example is more involved. Using two phasor values in polar coordinates it computes a resulting phasor, also in polar coordinates.

For this example, Measurement Keys are used to refer to signals. This reference can also be the Point Tag or Point GUID.

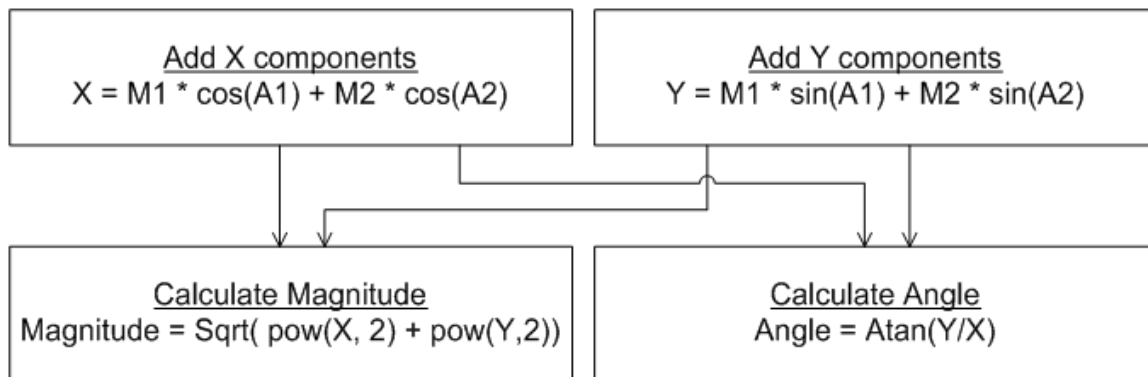
The inputs represent four (4) signals:

1. Magnitude and Angle (M1 and A1)
2. Magnitude and Angle (M2 and A2)

To perform this calculation, each phasor is converted to rectangular notation, added, then the result is converted to polar notation as shown below.

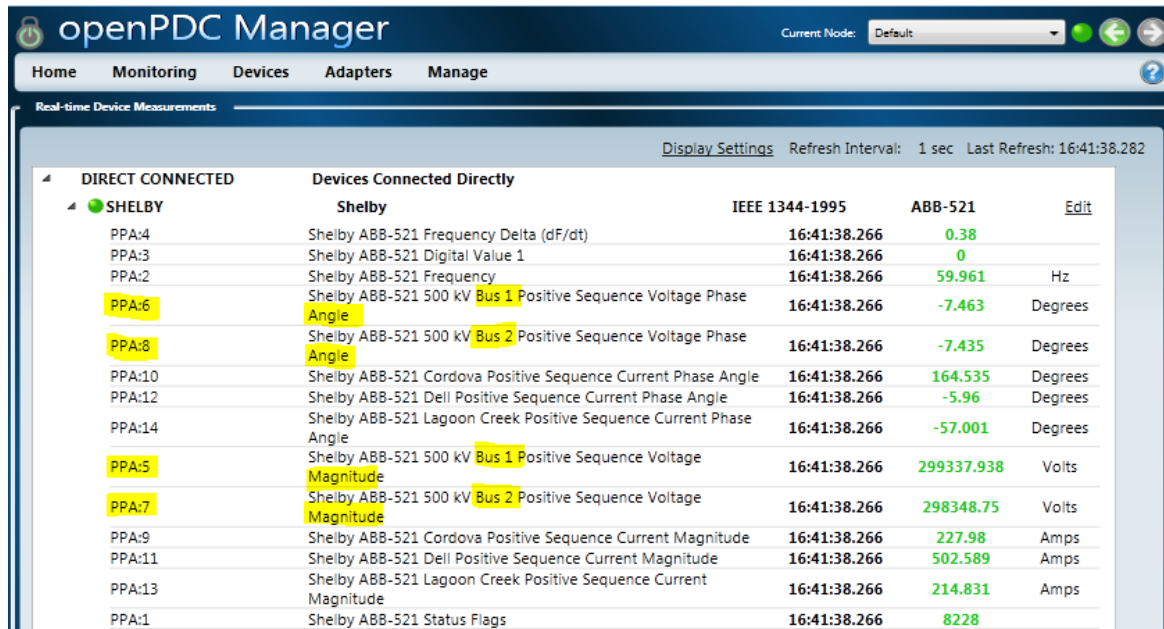
With the limitations of the Dynamic Calculator this requires four instances of the Dynamic Calculator adapter as represented by each box below.

1. Add X components
2. Add Y components
3. Compute magnitude of result
4. Compute angle of result



This requires

- Identifying four input adapters with Magnitudes and Phase Angles.
- Create two Dynamic Calculator Action Adapters for the X and Y components.
- Create two Dynamic Calculator Action Adapters for the resulting Magnitude and Phase Angle.

Step 1 - Identify Input Adapters


The screenshot shows the 'openPDC Manager' interface with the 'Adapters' tab selected. It displays a table of 'DIRECT CONNECTED' devices for 'SHELBY'. The table has columns for 'Device', 'IEEE 1344-1995', 'ABB-521', and 'Edit'. Several rows are highlighted in yellow, corresponding to the PPA values listed in the text below.

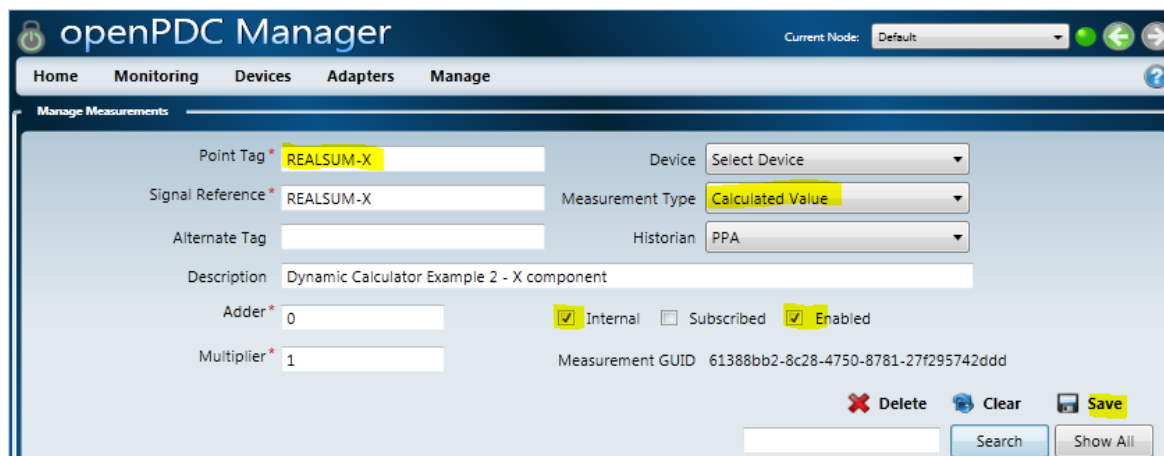
Device	IEEE 1344-1995	ABB-521	Edit
PPA:4	Shelby ABB-521 Frequency Delta (dF/dt)	16:41:38.266	0.38
PPA:3	Shelby ABB-521 Digital Value 1	16:41:38.266	0
PPA:2	Shelby ABB-521 Frequency	16:41:38.266	59.961 Hz
PPA:6	Shelby ABB-521 500 kV Bus 1 Positive Sequence Voltage Phase Angle	16:41:38.266	-7.463 Degrees
PPA:8	Shelby ABB-521 500 kV Bus 2 Positive Sequence Voltage Phase Angle	16:41:38.266	-7.435 Degrees
PPA:10	Shelby ABB-521 Cordova Positive Sequence Current Phase Angle	16:41:38.266	164.535 Degrees
PPA:12	Shelby ABB-521 Dell Positive Sequence Current Phase Angle	16:41:38.266	-5.96 Degrees
PPA:14	Shelby ABB-521 Lagoon Creek Positive Sequence Current Phase Angle	16:41:38.266	-57.001 Degrees
PPA:5	Shelby ABB-521 500 kV Bus 1 Positive Sequence Voltage Magnitude	16:41:38.266	299337.938 Volts
PPA:7	Shelby ABB-521 500 kV Bus 2 Positive Sequence Voltage Magnitude	16:41:38.266	298348.75 Volts
PPA:9	Shelby ABB-521 Cordova Positive Sequence Current Magnitude	16:41:38.266	227.98 Amps
PPA:11	Shelby ABB-521 Dell Positive Sequence Current Magnitude	16:41:38.266	502.589 Amps
PPA:13	Shelby ABB-521 Lagoon Creek Positive Sequence Current Magnitude	16:41:38.266	214.831 Amps
PPA:1	Shelby ABB-521 Status Flags	16:41:38.266	8228

PPA:5 – Bus 1 Magnitude

PPA:6 – Bus 1 Angle

PPA:7 – Bus 2 Magnitude

PPA:8 – Bus 2 Angle

Step 2 – Create an Output for the Dynamic Calculator results in menu Manage - Measurements:


The screenshot shows the 'Manage Measurements' form in the 'openPDC Manager' interface. The form contains several input fields and dropdown menus for configuring a measurement.

Point Tag *	REALSUM-X	Device	Select Device
Signal Reference *	REALSUM-X	Measurement Type	Calculated Value
Alternate Tag		Historian	PPA
Description	Dynamic Calculator Example 2 - X component		
Adder *	0	<input checked="" type="checkbox"/> Internal	<input type="checkbox"/> Subscribed <input checked="" type="checkbox"/> Enabled
Multiplier *	1	Measurement GUID 61388bb2-8c28-4750-8781-27f295742ddd	
<div> Delete Clear Save </div>			

openPDC Manager Current Node: Default

Home Monitoring Devices Adapters Manage

Manage Measurements

Point Tag * **REACTIVESUM-Y** Device Select Device

Signal Reference * REACTIVESUM-Y Measurement Type **Calculated Value**

Alternate Tag Historian PPA

Description Dynamic Calculator Example 2 - Y component

Adder * 0 ☒ Internal ☐ Subscribed ☒ Enabled

Multiplier * 1 Measurement GUID 65609e61-44ea-4321-a53d-c8c3ea4f0208

Delete Clear Save

Search Show All

openPDC Manager Current Node: Default

Home Monitoring Devices Adapters Manage

Manage Measurements

Point Tag * **RESULT-MAGNITUDE** Device Select Device

Signal Reference * RESULT-MAGNITUDE Measurement Type **Calculated Value**

Alternate Tag Historian PPA

Description Dynamic Calculator Example 2 - Magnitude

Adder * 0 ☒ Internal ☐ Subscribed ☒ Enabled

Multiplier * 1 Measurement GUID fb40c3ae-0d1d-4f4f-a64b-7cc800a3d76c

Delete Clear Save

Search Show All

openPDC Manager Current Node: Default

Home Monitoring Devices Adapters Manage

Manage Measurements

Point Tag * **RESULT-ANGLE** Device Select Device

Signal Reference * RESULT-ANGLE Measurement Type **Calculated Value**

Alternate Tag Historian PPA

Description Dynamic Calculator Example 2 - Angle

Adder * 0 ☒ Internal ☐ Subscribed ☒ Enabled

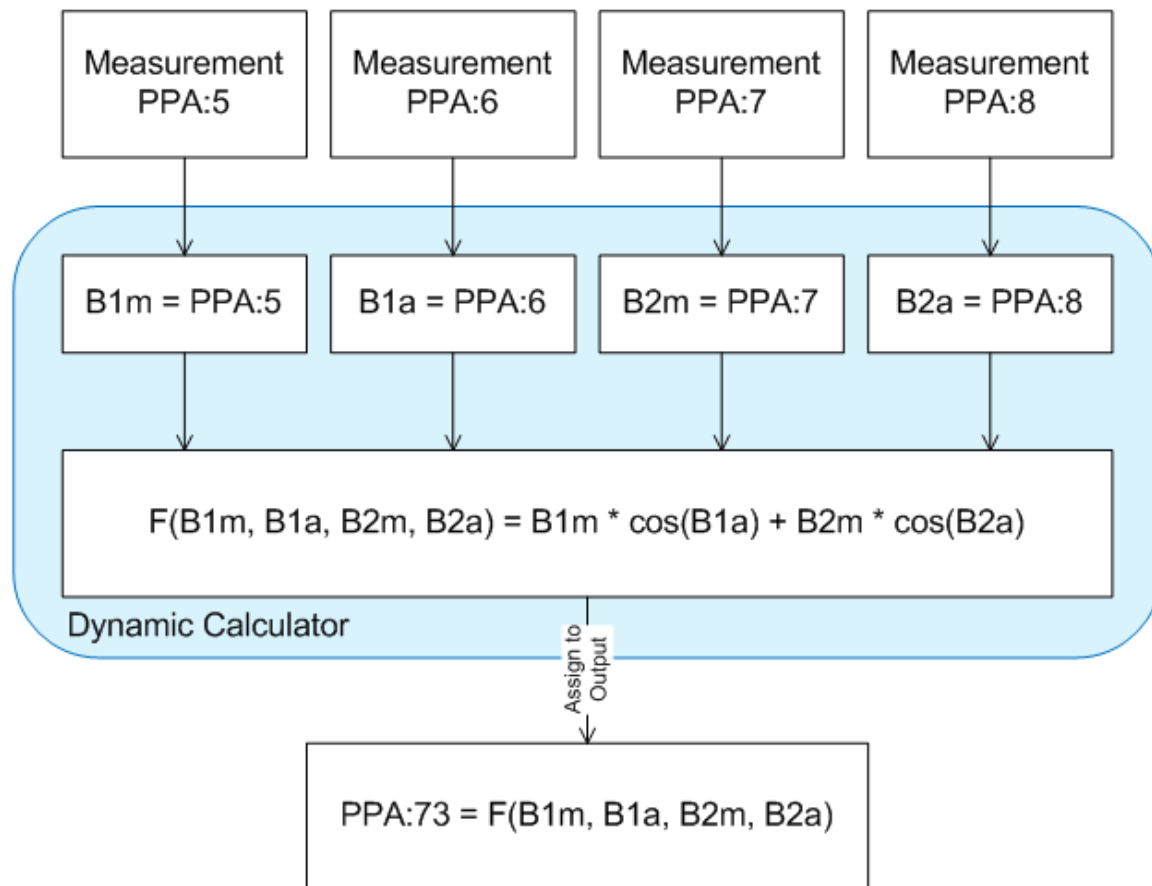
Multiplier * 1 Measurement GUID e4e93839-0204-4bef-b088-ee18e2d85c18

Delete Clear Save

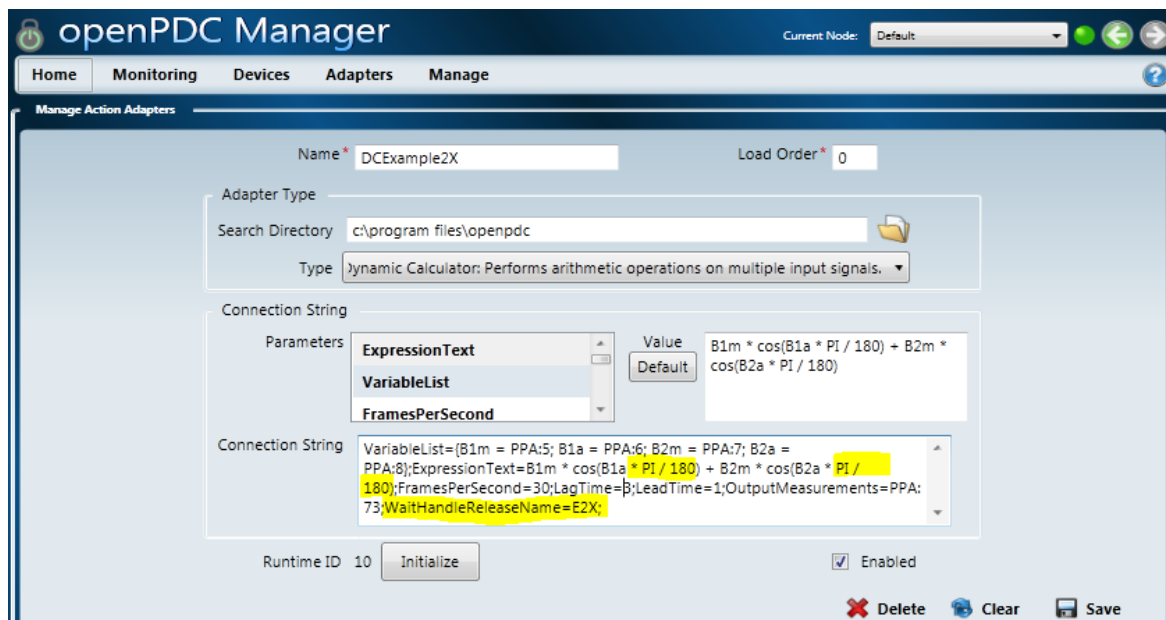
Search Show All

ID	Description	Internal	Subscribed	Enabled
PPA:74	Dynamic Calculator Example 2 - Y component	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
PPA:73	Dynamic Calculator Example 2 - X component	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
PPA:75	Dynamic Calculator Example 2 - Magnitude	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
PPA:76	Dynamic Calculator Example 2 - Angle	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Notice the list of ID's for each Output. This will be the IDs used to define where the calculated values will be saved.

Step 3 – Create Dynamic Calculator for X Components

This is the completed Dynamic Calculator for the X components:

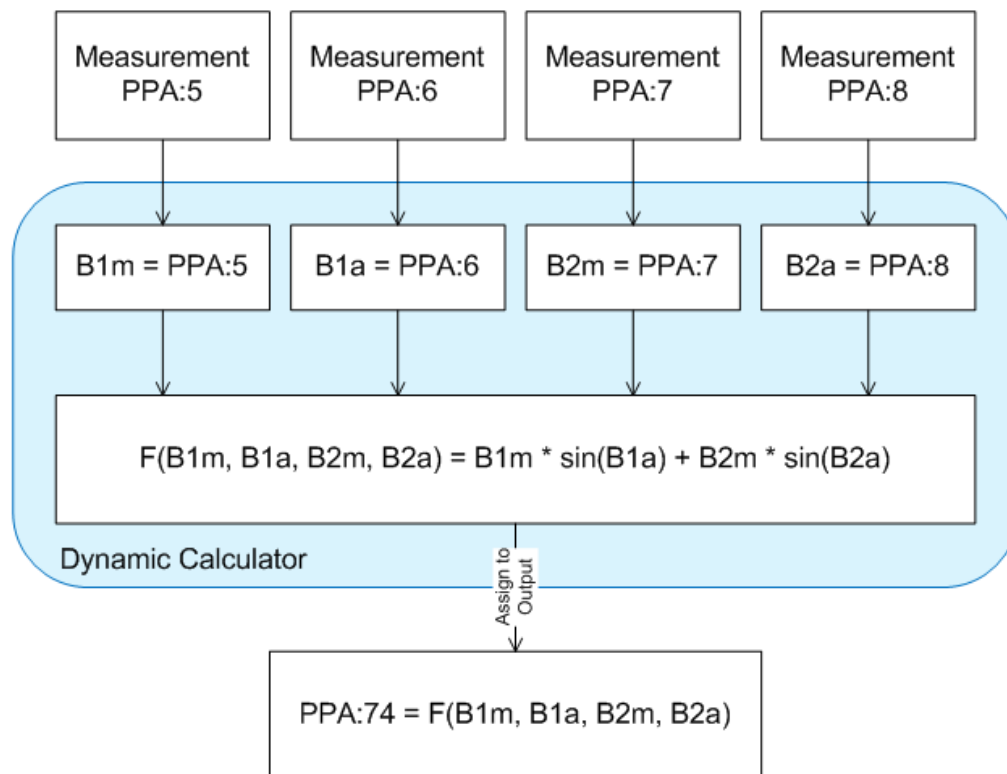


There are several things to note:

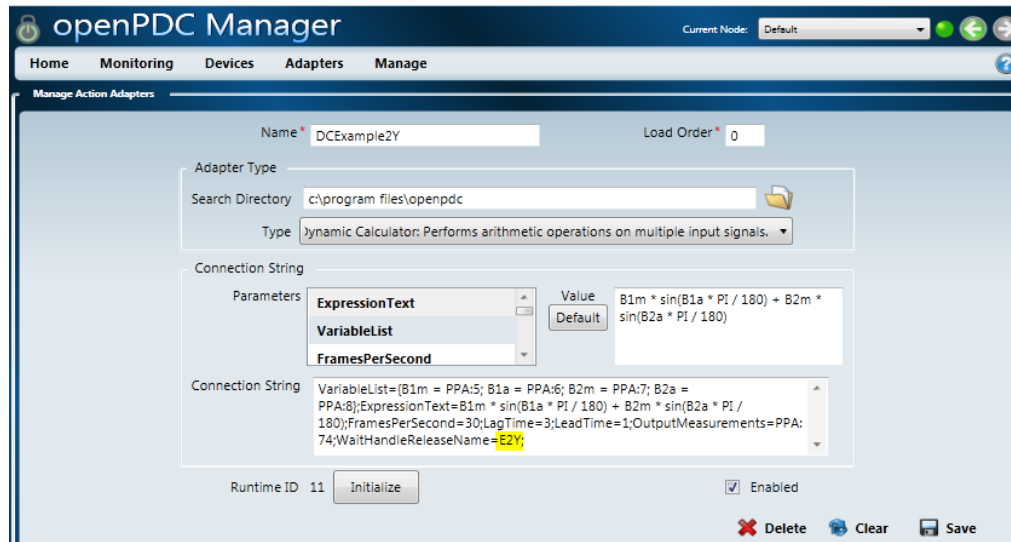
- The VariableList has four definitions and is contained in { } brackets in the Connection Stream. Between each definition is a semi-colon. This is the required syntax.
- The cosine (and sine) function expects the angle to be in radians. This requires the PI/180 conversion.
- There is a new parameter on the list – WaitHandleReleaseName. The Magnitude and Angle calculations are dependent on this calculation as well as the Y component calculation. In order to keep the dependent calculation in sync, the Wait Handle was created. When this calculation is completed, the dependent calculations are release to perform their calculations. 'WaitHandleReleaseName' is a parameter that is given a name – any non-standard or un-used name – to notify the dependent calculations.

Click the Initialize button to start the Calculations.

Step 4 – Create Dynamic Calculator for Y Components



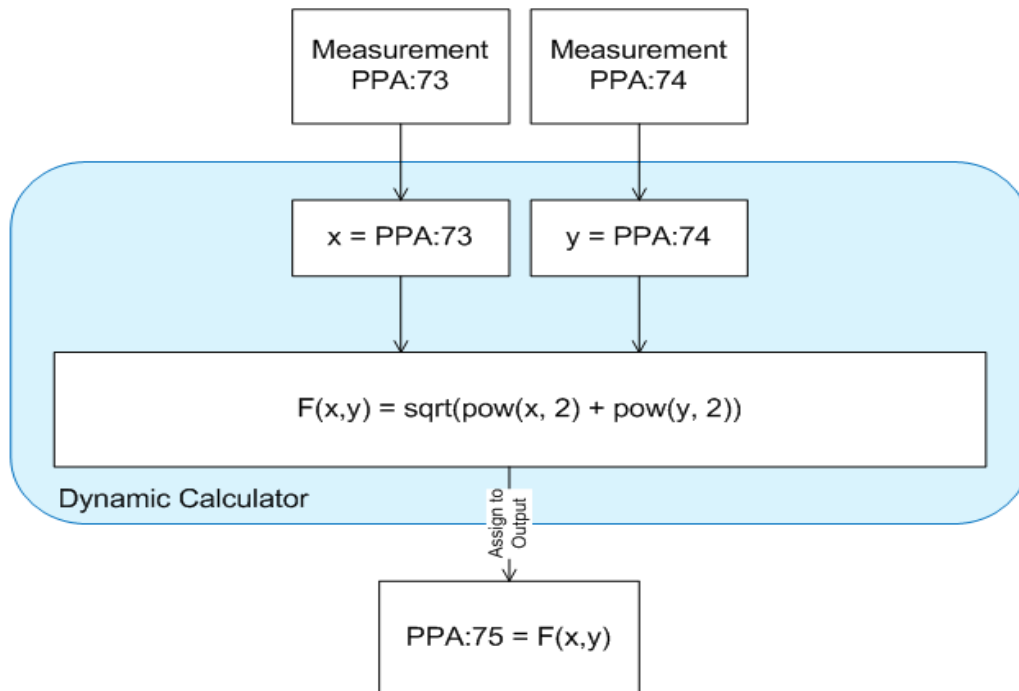
This is the completed Dynamic Calculator for the Y components:



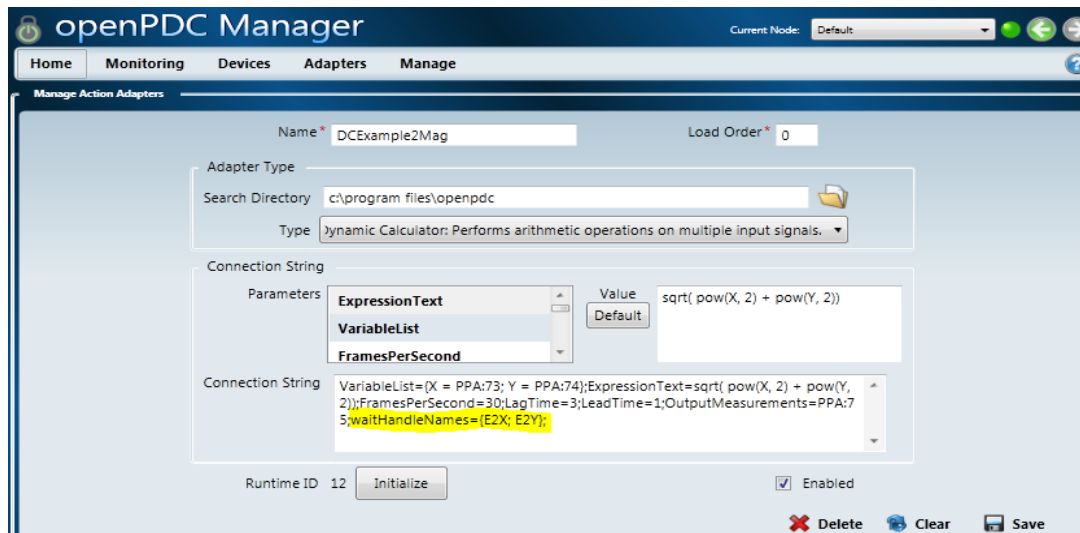
The screenshot shows the 'openPDC Manager' window with the 'Adapters' tab selected. The 'Manage Action Adapters' section displays the configuration for an adapter named 'DCExample2Y' with a 'Load Order' of 0. The 'Adapter Type' is set to 'Dynamic Calculator: Performs arithmetic operations on multiple input signals.'. The 'Search Directory' is 'c:\program files\openpdc'. The 'Type' is 'Dynamic Calculator: Performs arithmetic operations on multiple input signals.'. The 'Connection String' section shows the 'ExpressionText' as '81m * sin(B1a * PI / 180) + B2m * sin(B2a * PI / 180)' and the 'VariableList' as 'B1m = PPA:5; B1a = PPA:6; B2m = PPA:7; B2a = PPA:8; ExpressionText=81m * sin(B1a * PI / 180) + B2m * sin(B2a * PI / 180); FramesPerSecond=30; LagTime=3; LeadTime=1; OutputMeasurements=PPA:74; WaitHandleReleaseName=E2Y;'. The 'Runtime ID' is 11. The 'Initialize' button is visible, along with 'Delete', 'Clear', and 'Save' buttons.

Click the Initialize button to start the Calculations.

Step 5 - Create Dynamic Calculator for Magnitude Result



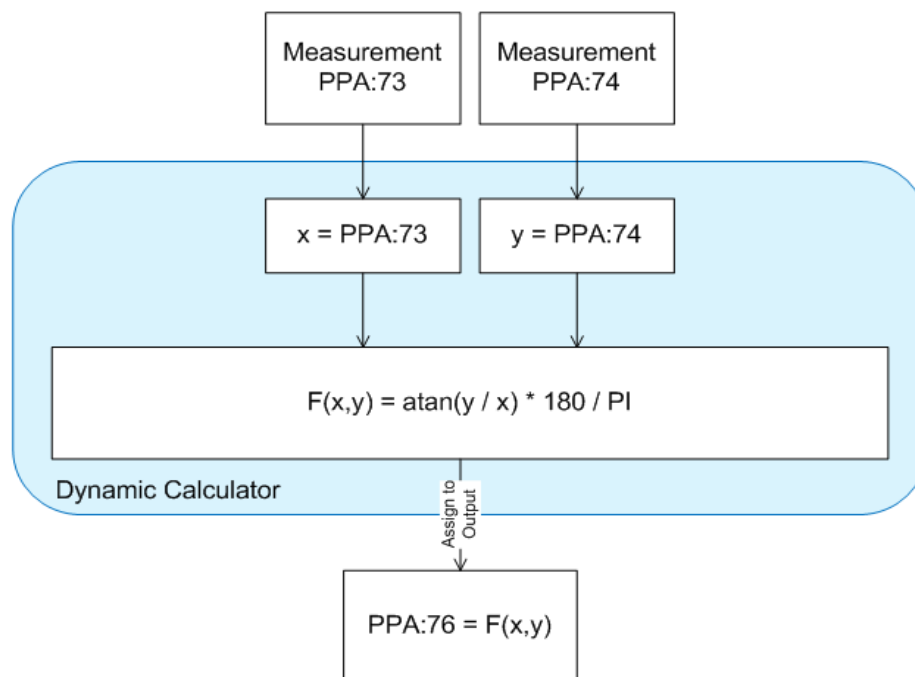
This is the completed Dynamic Calculator for the Magnitude results:

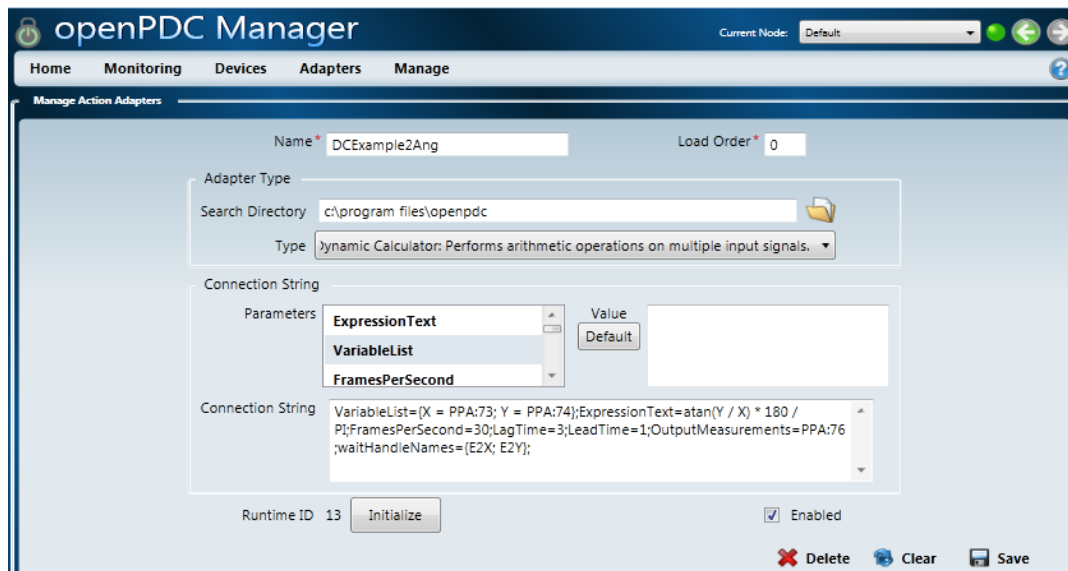


Note: Notice the 'waitHandleNames' parameter. This is how the 'WaitHandleReleaseName' is referred to for the required calculations. In usual standard method the required calculation names are separated by a semicolon and enclosed in { } brackets.

Click the Initialize button to start the Calculations.

Step 6 - Create Dynamic Calculator for Angle Result





openPDC Manager Current Node: Default

Home Monitoring Devices Adapters Manage

Manage Action Adapters

Name: Load Order:

Adapter Type:

Search Directory:

Parameters: Value:

VariableList: FramesPerSecond:

Connection String:

Runtime ID: 13 Initialize ☒ Enabled

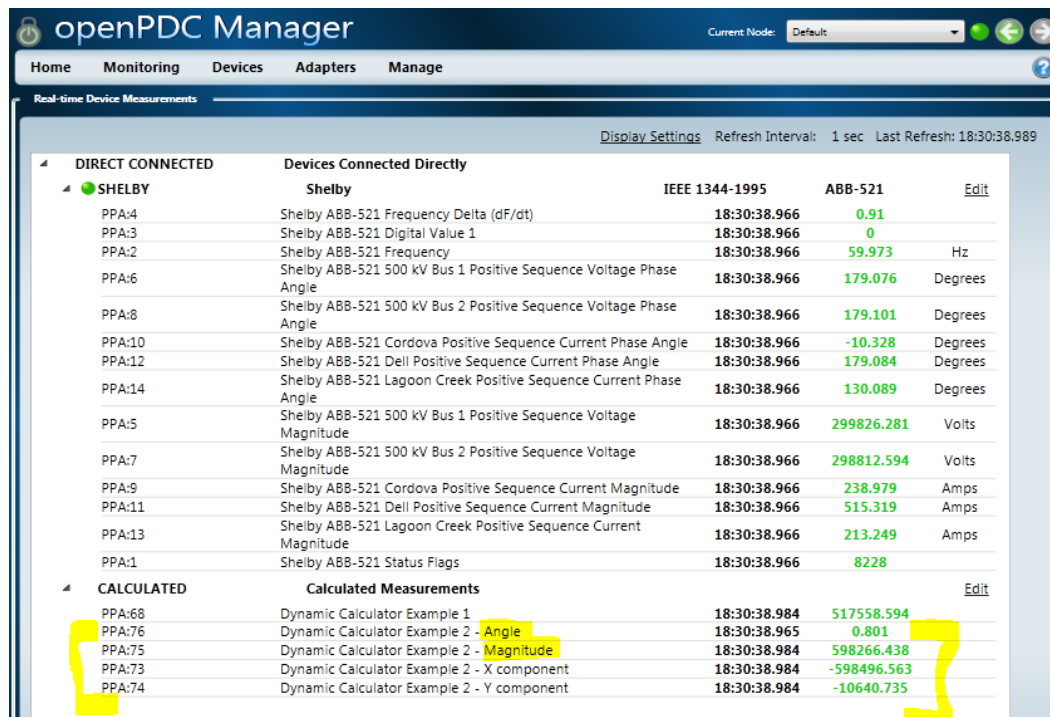
Delete Clear Save

NOTE: Just as Sin and Cos require radian degrees to properly return values, the aTan returns in radian and must be converted in order to display degrees.

Click the Initialize button to start the Calculations.

Final Results:

Confirm operation at menu Monitoring – Device Measurement:



openPDC Manager Current Node: Default

Home Monitoring Devices Adapters Manage

Real-time Device Measurements

Display Settings Refresh Interval: 1 sec Last Refresh: 18:30:38.989

DIRECT CONNECTED		Devices Connected Directly	IEEE 1344-1995	ABB-521	Edit
▲	SHELBY	Shelby			
PPA:4	Shelby ABB-521 Frequency Delta (dF/dt)	18:30:38.966	0.91		
PPA:3	Shelby ABB-521 Digital Value 1	18:30:38.966	0		
PPA:2	Shelby ABB-521 Frequency	18:30:38.966	59.973	Hz	
PPA:6	Shelby ABB-521 500 kV Bus 1 Positive Sequence Voltage Phase Angle	18:30:38.966	179.076	Degrees	
PPA:8	Shelby ABB-521 500 kV Bus 2 Positive Sequence Voltage Phase Angle	18:30:38.966	179.101	Degrees	
PPA:10	Shelby ABB-521 Cordova Positive Sequence Current Phase Angle	18:30:38.966	-10.328	Degrees	
PPA:12	Shelby ABB-521 Dell Positive Sequence Current Phase Angle	18:30:38.966	179.084	Degrees	
PPA:14	Shelby ABB-521 Lagoon Creek Positive Sequence Current Phase Angle	18:30:38.966	130.089	Degrees	
PPA:5	Shelby ABB-521 500 kV Bus 1 Positive Sequence Voltage Magnitude	18:30:38.966	299826.281	Volts	
PPA:7	Shelby ABB-521 500 kV Bus 2 Positive Sequence Voltage Magnitude	18:30:38.966	298812.594	Volts	
PPA:9	Shelby ABB-521 Cordova Positive Sequence Current Magnitude	18:30:38.966	238.979	Amps	
PPA:11	Shelby ABB-521 Dell Positive Sequence Current Magnitude	18:30:38.966	515.319	Amps	
PPA:13	Shelby ABB-521 Lagoon Creek Positive Sequence Current Magnitude	18:30:38.966	213.249	Amps	
PPA:1	Shelby ABB-521 Status Flags	18:30:38.966	8228		
▲	CALCULATED	Calculated Measurements			Edit
PPA:68	Dynamic Calculator Example 1	18:30:38.984	517558.594		
PPA:76	Dynamic Calculator Example 2 - Angle	18:30:38.965	0.801		
PPA:75	Dynamic Calculator Example 2 - Magnitude	18:30:38.984	598266.438		
PPA:73	Dynamic Calculator Example 2 - X component	18:30:38.984	-598496.563		
PPA:74	Dynamic Calculator Example 2 - Y component	18:30:38.984	-10640.735		

Available Functions

This is a listing of the functions available. This comes directly from the .NETv4 Math Class. Many functions are capable of accepting several number types (overloaded).

- **Abs(x)** - Returns the absolute value of the specified number, x.
- **Acos(x)** - Returns the angle whose cosine is x.
- **Asin(y)** - Returns the angle whose sine is y.
- **Atan(z)** - Returns the angle whose tangent is z
- **Atan2(y, x)** - Returns the angle whose tangent is the quotient of y / x
- **BigMul(x, y)** - Produces the full product of two numbers, x and y.
- **Ceiling(x)** - Returns the smallest integer value that is greater than or equal to the specified number, x.
- **Cos(a)** - Returns the cosine of the specified angle, a.
- **Cosh(a)** - Returns the hyperbolic cosine of the specified angle, a.
- **DivRem(x, y, r)** - Calculates the quotient of two specified number, x and y, and also returns the remainder in an output parameter, r.
- **E** - Returns the constant **e**
- **Exp(x)** - Returns **e** raised to the specified power, x.
- **Floor(x)** - Returns the largest integer less than or equal to the specified number, x.
- **IEEERemainder(x, y)** - Returns the remainder resulting from the division of a specified number, x, by another specified number, y.
- **Log(x)** - Returns the natural (base **e**) logarithm of a specified number, x.
- **Log(x, b)** - Returns the logarithm of a specified number, x, in a specified base, b.
- **Max(x, y)** - Returns the larger of two numbers.
- **Min(x, y)** - Returns the smaller of two numbers.
- **PI** - Returns the constant **π**
- **Pow(x, p)** - Returns a specified number, x, raised to the specified power, p.
- **Round(x)** - Rounds a specified number, x, to the nearest integer value.
- **Round(x, d)** - Rounds a specified number, x, to a specified number of fractional digits, d.
- **Sign(x)** - Returns a value indicating the sign of x. [-1, 0, 1]
- **Sin(a)** - Returns the sine of the specified angle, a.
- **Sinh(a)** - Returns the hyperbolic sine of the specified angle, a.
- **Sqrt(x)** - Returns the square root of a specified number, x.
- **Tan(a)** - Returns the tangent of the specified angle, a.
- **Tanh(a)** - Returns the hyperbolic tangent of the specified angle, a.
- **Truncate(x)** - Returns the integral part of a specified number, x.

ABOUT THE AUTHOR

Shawn Williams is a project manager at GPA with extensive experience within the process control industry.
