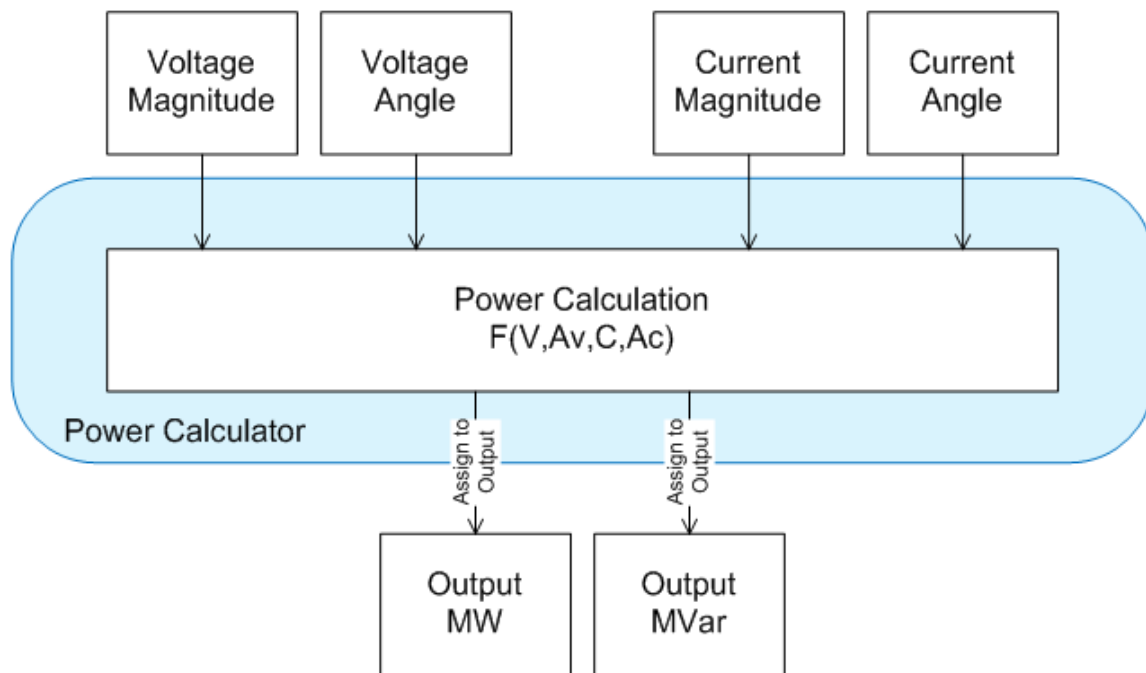


August 2012

Power Calculations in the openPDC and openPG

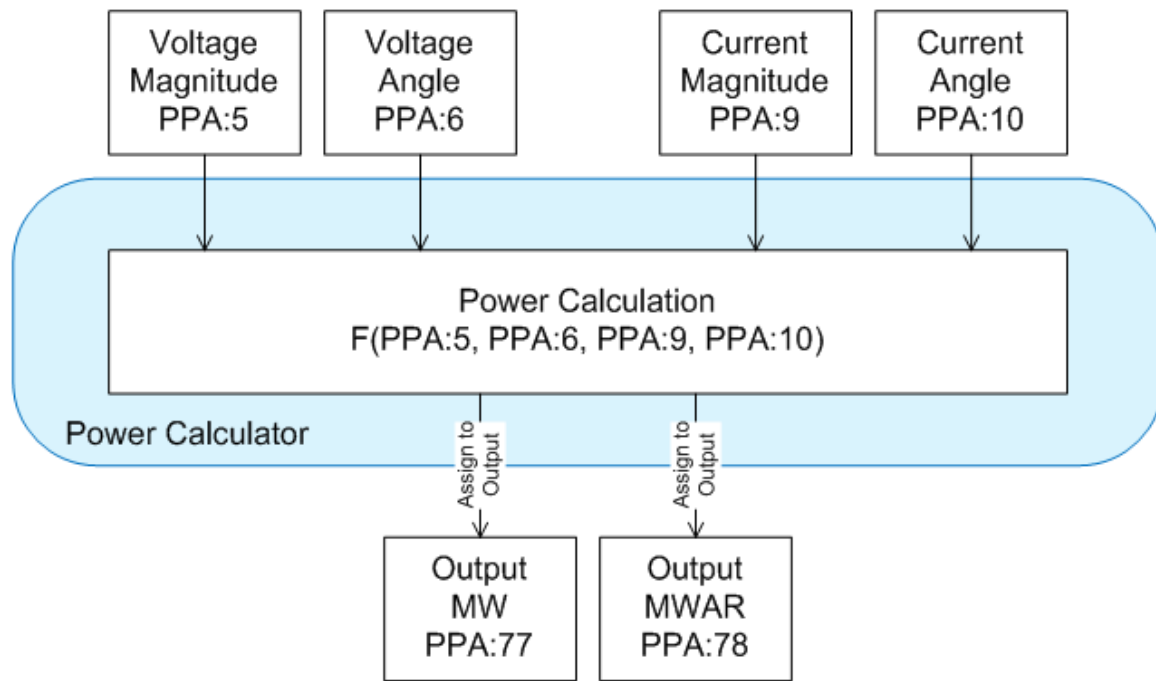
The Power Calculator is an action adapter that is used to compute real and reactive power from a Voltage phasor and a Current phasor. Inputs are the positive sequence values from the PMU.

Below is a graphical representation of how the Power Calculator is constructed.



Example


The example below shows how to set up the Power Calculator adapter. Here is the data flow diagram below. In this example, "Measurement Keys" are used to refer to specific input signals rather than Point Tags. However, Point Tags can be used as the reference to input voltage and current phasors.



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:77; PPA:78)
2. Find the designed input signals (e.g., PPA:5; PPA:6; PPA:9; PPA:10)
3. Create the Action Adapter of type "Power Calculator"

Step 1 – Create a Real Power (MW) output for the Power Calculator results in menu Manage - Measurements:

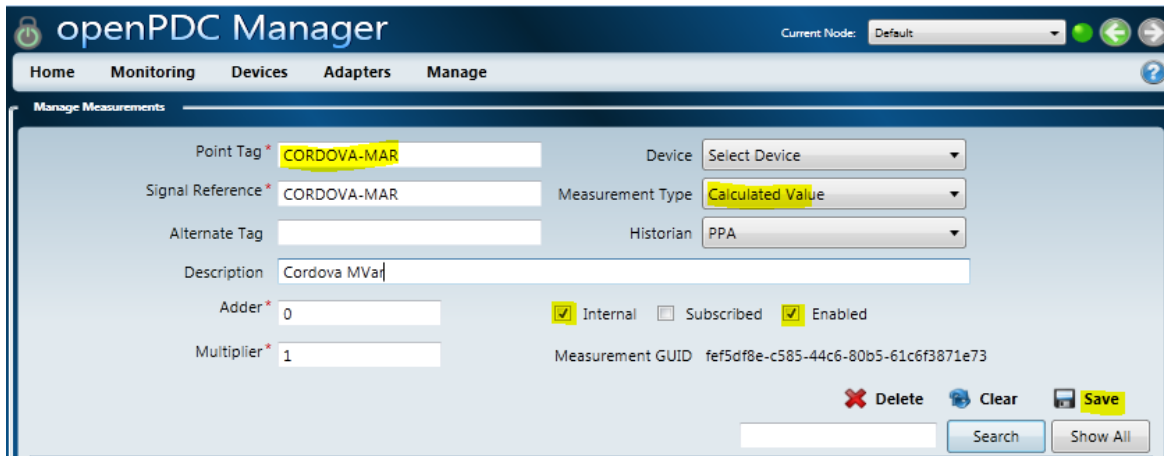


The screenshot shows the 'openPDC Manager' interface with the 'Manage Measurements' tab selected. The form contains the following fields and values:

- Point Tag*: CORDOVA-MW
- Signal Reference*: CORDOVA-MW
- Alternate Tag: (empty)
- Description: Cordova MW
- Adder*: 0
- Multiplier*: 1
- Device: Select Device
- Measurement Type: Calculated Value
- Historian: PPA
- Internal: ☒ Internal
- Subscribed: ☐ Subscribed
- Enabled: ☒ Enabled
- Measurement GUID: fef5df8e-c585-44c6-80b5-61c6f3871e73

At the bottom right, there are buttons for 'Delete', 'Clear', 'Save', 'Search', and 'Show All'.

Step 2 – Create a Reactive Power (MVAR) output for the Power Calculator results in menu Manage - Measurements:

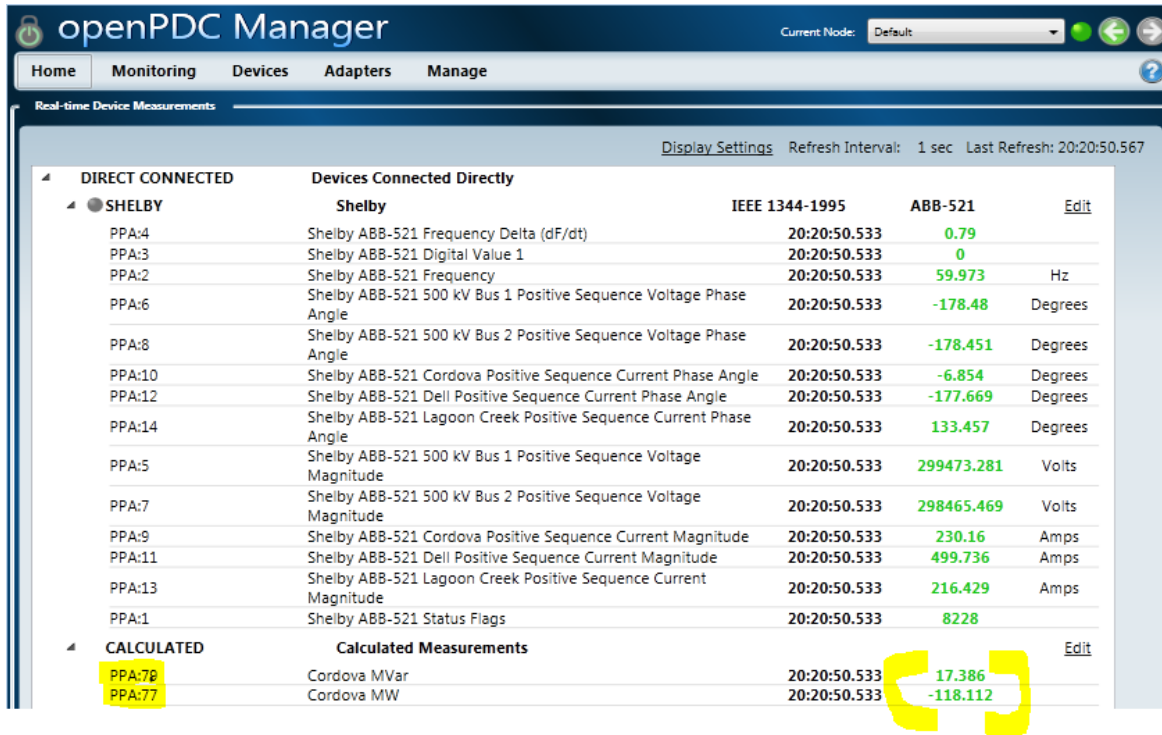


The screenshot shows the 'openPDC Manager' interface with the 'Manage Measurements' tab selected. The form contains the following fields and values:

- Point Tag*: CORDOVA-MAR
- Signal Reference*: CORDOVA-MAR
- Alternate Tag: (empty)
- Description: Cordova MVar
- Adder*: 0
- Multiplier*: 1
- Device: Select Device
- Measurement Type: Calculated Value
- Historian: PPA
- Internal: ☒ Internal
- Subscribed: ☐ Subscribed
- Enabled: ☒ Enabled
- Measurement GUID: fef5df8e-c585-44c6-80b5-61c6f3871e73

At the bottom right, there are buttons for 'Delete', 'Clear', 'Save', 'Search', and 'Show All'.

At this point you do not know the reference ID for this output. Go to menu Monitoring – Device Measurement to find the ID:



DIRECT CONNECTED		Devices Connected Directly		IEEE 1344-1995	ABB-521	
▲ SHELBY		Shelby				Edit
PPA:4		Shelby ABB-521 Frequency Delta (dF/dt)		20:20:50.533	0.79	
PPA:3		Shelby ABB-521 Digital Value 1		20:20:50.533	0	
PPA:2		Shelby ABB-521 Frequency		20:20:50.533	59.973	Hz
PPA:6		Shelby ABB-521 500 kV Bus 1 Positive Sequence Voltage Phase Angle		20:20:50.533	-178.48	Degrees
PPA:8		Shelby ABB-521 500 kV Bus 2 Positive Sequence Voltage Phase Angle		20:20:50.533	-178.451	Degrees
PPA:10		Shelby ABB-521 Cordova Positive Sequence Current Phase Angle		20:20:50.533	-6.854	Degrees
PPA:12		Shelby ABB-521 Dell Positive Sequence Current Phase Angle		20:20:50.533	-177.669	Degrees
PPA:14		Shelby ABB-521 Lagoon Creek Positive Sequence Current Phase Angle		20:20:50.533	133.457	Degrees
PPA:5		Shelby ABB-521 500 kV Bus 1 Positive Sequence Voltage Magnitude		20:20:50.533	299473.281	Volts
PPA:7		Shelby ABB-521 500 kV Bus 2 Positive Sequence Voltage Magnitude		20:20:50.533	298465.469	Volts
PPA:9		Shelby ABB-521 Cordova Positive Sequence Current Magnitude		20:20:50.533	230.16	Amps
PPA:11		Shelby ABB-521 Dell Positive Sequence Current Magnitude		20:20:50.533	499.736	Amps
PPA:13		Shelby ABB-521 Lagoon Creek Positive Sequence Current Magnitude		20:20:50.533	216.429	Amps
PPA:1		Shelby ABB-521 Status Flags		20:20:50.533	8228	
▲ CALCULATED		Calculated Measurements				Edit
PPA:78		Cordova MVar		20:20:50.533	17.386	
PPA:77		Cordova MW		20:20:50.533	-118.112	

PPA:77 – MW Calculation; Point Tag = “CORDOVA_MW”

PPA:78 – MVAR Calculation; Point Tag = “CORDOVA_MVAR”

Step 3 – Determine the input. For this example, it will be:

DIRECT CONNECTED		Devices Connected Directly			
▲	● SHELBY	Shelby	IEEE 1344-1995	ABB-521	Edit
	PPA:4	Shelby ABB-521 Frequency Delta (dF/dt)	13:19:47.433	-0.54	
	PPA:3	Shelby ABB-521 Digital Value 1	13:19:47.433	0	
	PPA:2	Shelby ABB-521 Frequency	13:19:47.433	59.959	Hz
	PPA:6	Shelby ABB-521 500 kV Bus 1 Positive Sequence Voltage Phase Angle	13:19:47.433	61.313	Degrees
	PPA:8	Shelby ABB-521 500 kV Bus 2 Positive Sequence Voltage Phase Angle	13:19:47.433	61.338	Degrees
	PPA:10	Shelby ABB-521 Cordova Positive Sequence Current Phase Angle	13:19:47.433	-128.009	Degrees
	PPA:12	Shelby ABB-521 Dell Positive Sequence Current Phase Angle	13:19:47.433	61.413	Degrees
	PPA:14	Shelby ABB-521 Lagoon Creek Positive Sequence Current Phase Angle	13:19:47.433	10.812	Degrees
	PPA:5	Shelby ABB-521 500 kV Bus 1 Positive Sequence Voltage Magnitude	13:19:47.433	299775.5	Volts
	PPA:7	Shelby ABB-521 500 kV Bus 2 Positive Sequence Voltage Magnitude	13:19:47.433	298777.125	Volts
	PPA:9	Shelby ABB-521 Cordova Positive Sequence Current Magnitude	13:19:47.433	246.801	Amps
	PPA:11	Shelby ABB-521 Dell Positive Sequence Current Magnitude	13:19:47.433	529.233	Amps
	PPA:13	Shelby ABB-521 Lagoon Creek Positive Sequence Current Magnitude	13:19:47.433	210.833	Amps
	PPA:1	Shelby ABB-521 Status Flags	13:19:47.433	8228	
▲	CALCULATED	Calculated Measurements			Edit

PPA:5 – Voltage Magnitude

PPA:6 – Voltage Angle

PPA:9 – Current Magnitude

PPA:10 – Current Angle

Step 4 – Create Power Calculator in menu Adapters - Action Adapters:

Start by giving it a name and defining the type as 'Power Calculator'. Here is the full connection string for this example:

```
inputMeasurementKeys={PPA:5; PPA:6; PPA:9;PA:10};
```

```
outputMeasurements={PPA:77;PPA:78};
```

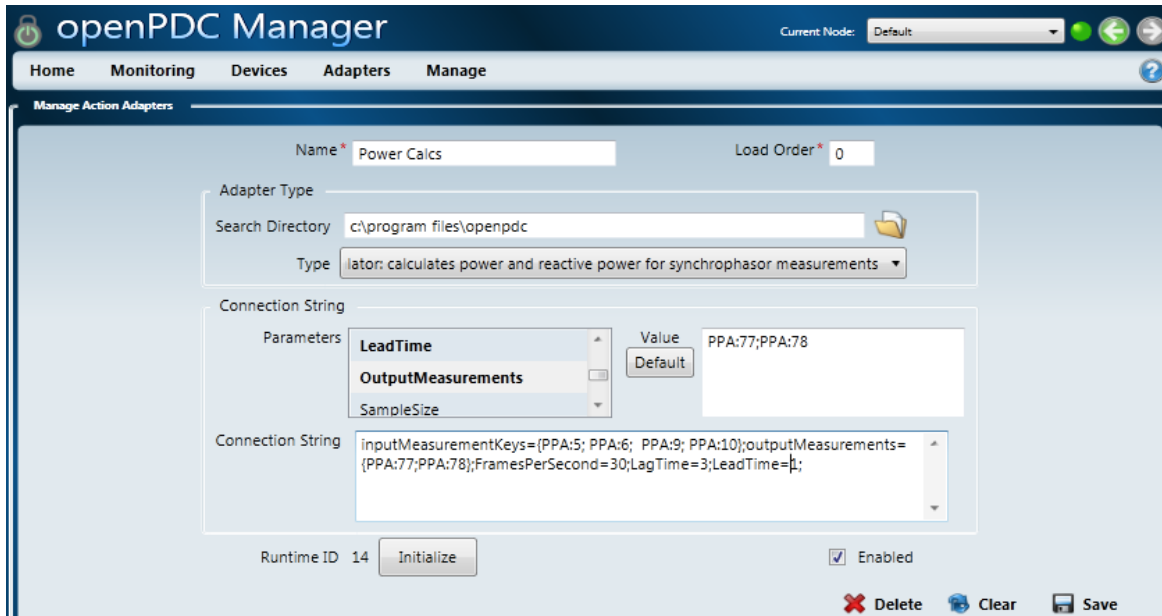
```
FramesPerSecond=30;
```

```
LagTime=3.0 Seconds;
```

```
LeadTime=1.0 Seconds;
```

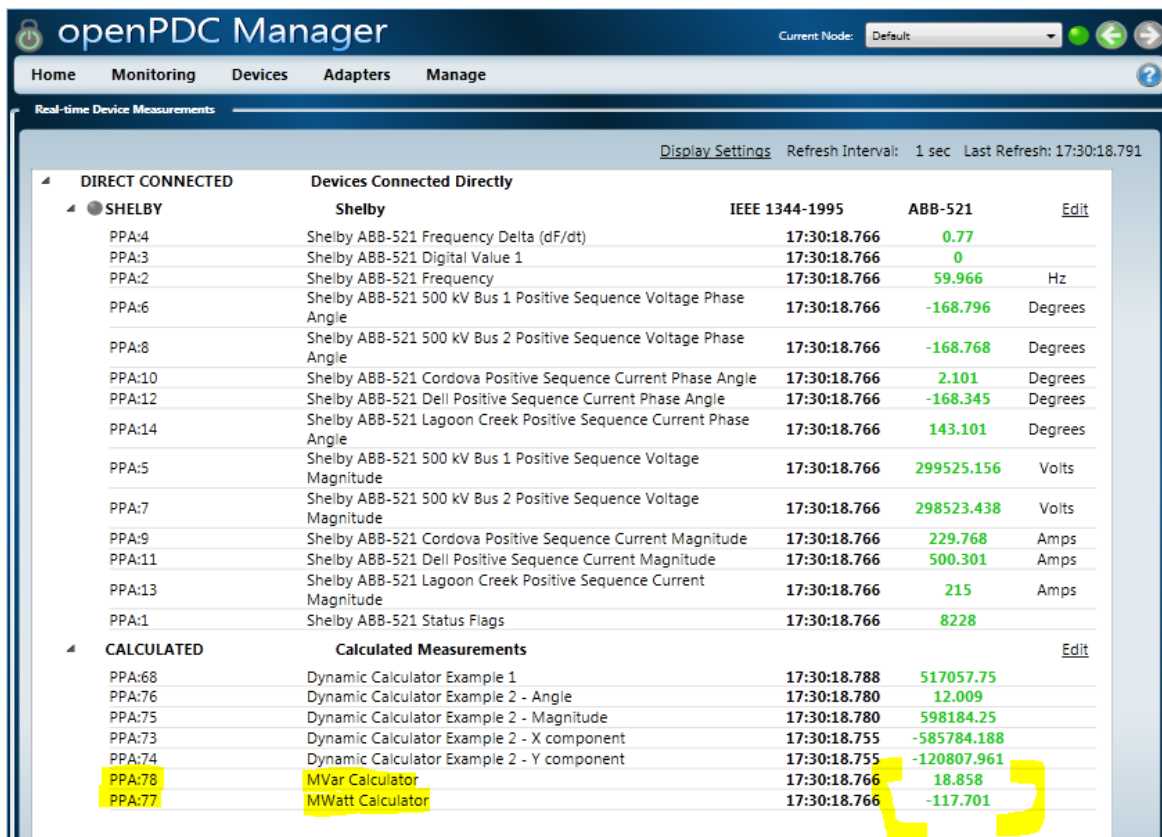
Note: None of these connection parameters are initially available in the list box. You must type them in the connection parameter box before they will be available in the list box. At that point you may modify them using the list box and the value box.

Here is a screen shot of the completed Power Calculator Example:



Click the Initialize button to start the Calculations.

Confirm operation at menu Monitoring – Device Measurement:



DIRECT CONNECTED		Devices Connected Directly		IEEE 1344-1995	ABB-521	Edit
PPA:4	Shelby ABB-521 Frequency Delta (dF/dt)	17:30:18.766	0.77			
PPA:3	Shelby ABB-521 Digital Value 1	17:30:18.766	0			
PPA:2	Shelby ABB-521 Frequency	17:30:18.766	59.966		Hz	
PPA:6	Shelby ABB-521 500 kV Bus 1 Positive Sequence Voltage Phase Angle	17:30:18.766	-168.796		Degrees	
PPA:8	Shelby ABB-521 500 kV Bus 2 Positive Sequence Voltage Phase Angle	17:30:18.766	-168.768		Degrees	
PPA:10	Shelby ABB-521 Cordova Positive Sequence Current Phase Angle	17:30:18.766	2.101		Degrees	
PPA:12	Shelby ABB-521 Dell Positive Sequence Current Phase Angle	17:30:18.766	-168.345		Degrees	
PPA:14	Shelby ABB-521 Lagoon Creek Positive Sequence Current Phase Angle	17:30:18.766	143.101		Degrees	
PPA:5	Shelby ABB-521 500 kV Bus 1 Positive Sequence Voltage Magnitude	17:30:18.766	299525.156		Volts	
PPA:7	Shelby ABB-521 500 kV Bus 2 Positive Sequence Voltage Magnitude	17:30:18.766	298523.438		Volts	
PPA:9	Shelby ABB-521 Cordova Positive Sequence Current Magnitude	17:30:18.766	229.768		Amps	
PPA:11	Shelby ABB-521 Dell Positive Sequence Current Magnitude	17:30:18.766	500.301		Amps	
PPA:13	Shelby ABB-521 Lagoon Creek Positive Sequence Current Magnitude	17:30:18.766	215		Amps	
PPA:1	Shelby ABB-521 Status Flags	17:30:18.766	8228			
CALCULATED		Calculated Measurements				Edit
PPA:68	Dynamic Calculator Example 1	17:30:18.788	517057.75			
PPA:76	Dynamic Calculator Example 2 - Angle	17:30:18.780	12.009			
PPA:75	Dynamic Calculator Example 2 - Magnitude	17:30:18.780	598184.25			
PPA:73	Dynamic Calculator Example 2 - X component	17:30:18.755	-585784.188			
PPA:74	Dynamic Calculator Example 2 - Y component	17:30:18.755	-120807.961			
PPA:78	MVar Calculator	17:30:18.766	18.858			
PPA:77	MWatt Calculator	17:30:18.766	-117.701			

Power Calculator Example is complete.

ABOUT THE AUTHOR

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