Application Note AN2009-60

Create a Virtual Phasor Measurement Unit

Andrew Swinghamer

INTRODUCTION

The SEL-3378 Synchrophasor Vector Processor (SVP) provides a platform to perform mathematical operations on incoming phasor data using built-in functional blocks and user-defined logic to build custom applications. In order to monitor and archive the calculated or derived data, the SVP provides a programmable virtual phasor measurement unit (PMU). This application note highlights the built-in functions and virtual PMU capabilities.

APPLICATION

The SVP contains an internal, programmable IEEE C37.118 server that operates similarly to an external PMU. The virtual PMU in the SVP can receive data from a combination of external PMU values and calculated quantities from the built-in or custom functions of the SVP. Map the output of the following easy-to-set-up functions to the outputs of the SVP virtual PMU:

- Real and reactive power calculator using positive-sequence and phase voltages and currents.
- Angle difference calculator between two phasors.

SEL SOLUTION

Power Calculation

Because the standard synchrophasor packet (per IEEE C37.118) does not contain power quantities, the user can calculate real and reactive power in the SVP using the power calculation functional block (PWRC).

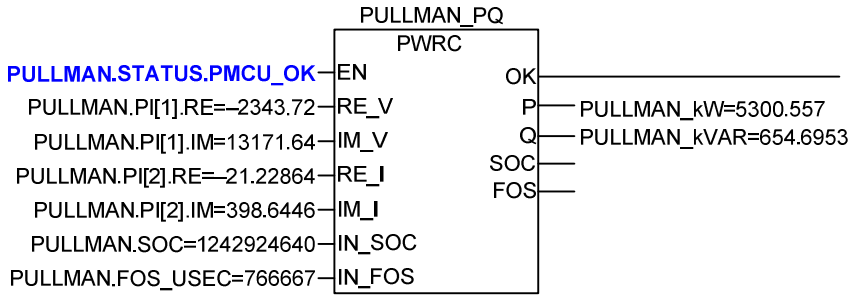

Figure 1 Positive-Sequence Real and Reactive Power

Provide real and imaginary voltage and current inputs to the PWRC to calculate single-phase real and reactive power. Use a combination of three (one for each power system phase), and sum the outputs together to calculate three-phase power.

Angle Difference

Calculate the angle difference between remote substations by supplying two phasor angle signals to the phase angle difference monitor functional block (PADM). The user can even set two alarm thresholds in degrees with corresponding pickup timers for added security before performing any real-time control actions at either substation.

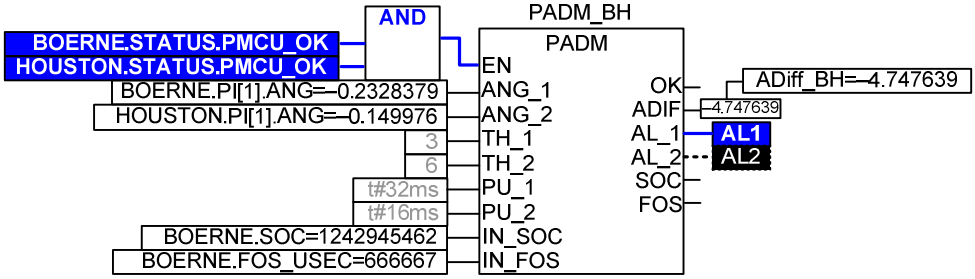

Figure 2 Angle Difference Between Two PMUs in Degrees

Assign the Derived Quantities From Power Calculation and Angle Difference

The SVP provides a PMCU_OUT (virtual PMU) functional block to send the derived quantities to external IEEE C37.118 clients for archiving and visualization. Figure 3 shows the configuration and data settings associated with the virtual PMU.

Output the data from the local client of the SVP as analog, digital, or phasor variables, which can be viewed in SEL-5078 SYNCHROWAVE® Console Software or archived for analysis with SEL-5076 SYNCHROWAVE Archiver Software.

```
(* Output Configuration *)
out_cfg_pmcu.PDC_IDCODE:=33782;
out_cfg_pmcu.STN_NAME:='SEL_3378_LocalClient';
out_cfg_pmcu.CLIENT_IP:='10.25.0.150';
out_cfg_pmcu.CLIENT_DATA_PORT:=3378;
out_cfg_pmcu.SERVER_IP:='192.168.1.5';
out_cfg_pmcu.SERVER_CMD_PORT:=3379;
out_cfg_pmcu.MRATE:=30;
out_cfg_pmcu.NFREQ:=60;
out_cfg_pmcu.NUM_PO:=2;
out_cfg_pmcu.NUM_AO:=3;
out_cfg_pmcu.NUM_DWO:=1;
out_cfg_pmcu.PH_RECT_FMT;=TRUE;
out_cfg_pmcu.CFG_CNT:=1;
```

```
(* Output Data *)
out_dat_pmcu.SOC:=BOERNE.SOC;
out_dat_pmcu.FOS_USEC:=BOERNE.FOS_USEC;
out_dat_pmcu.PO[1].RE:=BOERNE.PI[1].RE;
out_dat_pmcu.PO[1].IM:=BOERNE.PI[1].IM;
out_dat_pmcu.PO[2].RE:=HOUSTON.PI[1].RE;
out_dat_pmcu.PO[2].IM:=HOUSTON.PI[1].IM;
out_dat_pmcu.AO[1]:=PULLMAN_PQ.P;
out_dat_pmcu.AO[2]:=PULLMAN_PQ.Q;
out_dat_pmcu.AO[3]:=PADM_BH.ADIF;
out_dat_pmcu.DWO[1].BIT01:=PADM_BH.AL_A;
```

Figure 3 Virtual PMU Configuration and Data Settings

LAN2009-60

SCHWEITZER ENGINEERING LABORATORIES, INC.
2350 NE Hopkins Court • Pullman, WA 99163-5603 USA
Tel: +1.509.332.1890 • Fax: +1.509.332.7990
www.selinc.com • info@selinc.com