Power System Time, Frequency, and Phase Monitor

Available for Models 1084, 1088, and 1093

The Arbiter Systems®, Inc. Model 1084A/B/C, Model 1088B or Model 1093A/B/C GPS Satellite Controlled Clocks, equipped with Power System Time, Frequency, and Phase Monitor, measure the instantaneous phase angle and frequency of an applied 50 Hz or 60 Hz signal. Based on these measurements and a user-specified initial time offset, the Power System Monitor integrates total time deviation, which is system time minus GPS time. The Power System Monitor rejects the effects of harmonics, noise, dc offsets (external or internal), dropouts and surges to make true fundamental phase, frequency and time measurements with real-world input signals.

Applications for the Power System Monitor include frequency or time deviation monitoring to control daily time variations, system stability, load flow, and state prediction based on phase or frequency measurements across the grid. The Power System Monitor offers outstanding accuracy for phase and frequency measurements at a very economical price.

The measurement process of the board implements a hybrid digital/analog phase-locked loop with automatic level control. A digital synthesizer generates inphase and quadrature sine wave components and loop compensating signals. The action of the loops forces the frequency and phase of these internally-generated signals to accurately track the incoming signal's fundamental component, while rejecting interfering signals. The digital synthesizer also has a precise 10 PPS output, locked to the phase of the fundamental signal. This signal is measured by an on-board event timer with 100 ns resolution, and the resulting times are converted into absolute phase, frequency, and system time relative to 1 PPS-GPS.

To determine phase shift across a transmission line, the measured phase from two units, placed at the ends of the line, is subtracted and normalized into the range of 0 to 360° (or ±180°). By subtracting the two measurements of absolute phase, which are measured using the same (GPS time) reference, the reference cancels, leaving the phase angle between the two units: A-B=(A-R)-(B-R). This method works as long as the two time references are the same, within the error limits required by the application. For GPS time, which provides synchronization of 200 ns (99.99% confidence), the additional error due to reference synchronization is less than 0.004°. This is well below the residual measurement uncertainty limit of 0.1°.

Power System Time, Frequency and Phase Monitor Specifications

Input

Signal

Frequency	50 Hz nominal 60 Hz nominal
Range	±10 Hz minimum, from nominal
Voltage	30 to 300 Vrms
Impedance	400 kohm, balanced differential
Connector	Mating connector (twin-BNC) and 6 m (20 ft) cable provided

Outputs

Digital

Standard	Front-panel display or RS-232
Phase Angle	0 to 360°, absolute
Reference	1 PPS-GPS
Accuracy	0.1° [1]
Resolution	0.01° [1]
Frequency	±10 Hz of nominal
Accuracy	0.0001 Hz[1]
Resolution	0.0001 Hz[1]
System Time	Unlimited time error accumulation
Accuracy	5 microseconds + 1 ppm of peak accumulated time error[1]
Resolution	1 microsecond; 6 digits maximum[1]
Update Rate	10/second maximum

[1] Displayed or serial data output.