

A Review on Design of Microcontroller Based PMU With or Without GPS System

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ABSTRACT: Day by day complexity in power system increased because of expansion of transmission and distribution. To avoid such complexity PMU i.e. phasor measurement unit is used, which provides estimate phasor, frequency and the magnitude of supply voltage. PMU shows actual status of power system by measuring the electrical waves on an electricity grid using a common time source for synchronization. This paper provides the theoretical review on microcontroller based PMU with or without GPS system.

KEYWORDS: PMU, estimate phasor, frequency, magnitude, electricity grid, microcontroller, GPS system

I. INTRODUCTION

In today's era electrical power is very important for us. But due to increasing demand the power is not sufficient to transfer or customer will not satisfy. Increase in demand of electricity there is increase in expansion of supply electricity and hence transmission and distribution system are become more complex but due to use of power electronic devices we can make power system reliable and efficient. With recent technology of phasor measurement unit we can provide accurate frequency information to power system and also provide time stamped phasor to the power system [1, 2].

II. BASIC PMU STRUCTURE

PMU is basically used for checking the power condition in a power system by measuring voltage and current phasor along with frequency at a particular node. Figure 1 shows the basic components of PMU structure namely Synchronization Unit (it consists of GPS receivers and phase-locked oscillators for providing the sampling clock to the Measurement Unit), Measurement Unit (it has three components i.e. Anti-aliasing filters, Analog-to-Digital Converter and Phasor measurement Unit/ Processor) and Data Transmission Unit (data received from Measurement Unit with the help of a MODEM). [4]

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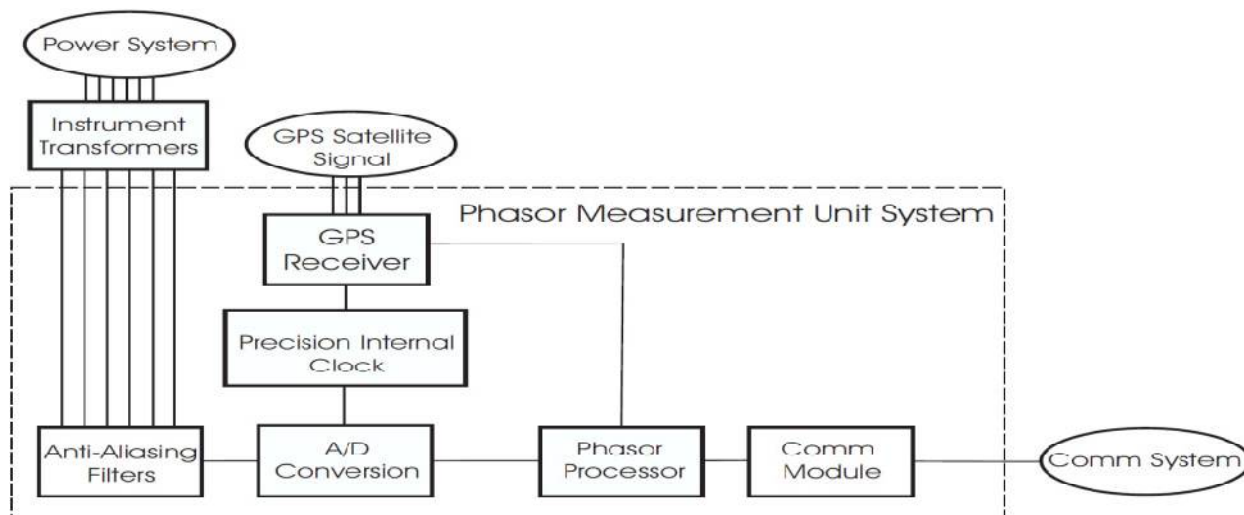


Figure 1 shows the basic PMU structure

III. DIFFERENCE BETWEEN THE SCADA AND PMU

Table 1 shows the Difference between the SCADA and PMU with different factors [3]

Factors	SCADA	PMU
Measurement	Analog	Digital
Resolution	2-4 samples per cycle	Up to 60 samples per cycle
Phasor Angle Measurement	No	Yes
Monitoring	Local	Wide-area
Observability	Steady state	Dynamic/Transient state
Time Synchronization	No	Yes

IV. METHODS FOR PHASOR ESTIMATION

There are Different phasor estimation methods like Zero Crossing (it is methods enabling to evaluate the delay time of propagating waves. In this method some threshold level the half period of the signal exceeding this level is determined), Discrete Fourier Transform (DFT; it is the equivalent of the continuous Fourier Transform for signals known only at N instants separated by sample times T i.e. a finite sequence of data), Sliding Discrete Fourier Transform (SDFT; provides frequency domain updates on a per sample basis with significantly fewer computations than the DFT or FFT for each update), Least Error Squares (it is a method of regression analysis to approximate solution of the over determined systems i.e. number of equations are more than unknowns), Kalman Filters (is an optimal estimator which chooses the best solution from indirect, inaccurate and uncertain observations data), Demodulation (is the extraction of original information from a modulated carrier wave) and Phasor measurement angle changing (is based on the approximation that only positive sequence is used for phasor estimation). Mostly Zero crossing, DFT and Sliding DFT are used [4].

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V. EXISTING WORK

Rohini P. Haridas [3] presents the GPS based phasor measurement techniques in power system. In the proposed system analog inputs are the voltages and currents, taken from the secondary winding of the three phase voltage and current transformers and the Anti aliasing filter limit the bandwidth to satisfy the Nyquist criterion, also used to filter out the input frequencies that are higher than the Nyquist rate.

Vikram S. Rajput et al. [5] presents a microcontroller-based phasor measurement system with Controller Area Network (CAN) bus communication capability for control of a distributed generator (DG). Proposed system implemented using inexpensive microcontroller ICs that integrate many of the required functions on a single chip. This system demonstrates the ability for an 8-bit microcontroller running at 20 Mhz to calculate 60 Hz phasors for three channels with little external circuitry.

David. M. Laverty et al. [6] provides open source phasor measurement unit project, OpenPMU (it was as a low cost alternative to commercial products), developed by Queen’s University Belfast. Compliance testing of the proposed system was taken under both nominal and dynamic conditions and it was found that the OpenPMU complies with IEEE Standard for TVE under 99% of measurements during nominal conditions

Daniel Dotta et al [9] presents the a PMU MATLAB simulator and the aim of this software is to aid in the understanding of the behaviour of algorithms internal to the PMU and to grasp key factors affecting their performance under off-nominal frequency operation.

Saeed Hassan Khan et al. [10] proposed system aimed at designing a cost-effective PMU device as per IEEE standard C37.118.1-2011. This proposed system worked in two step; in first step Balanced 3-phase voltage wave-forms were first simulated in MATLAB and parameters specified by the standard were computed using the recursive DFT algorithm and in second stage the whole algorithm was ported to C language which was used to program Arduino Due – the micro-controller platform used.

1. Comparison between with GPS and without using GPS system in PMU

Sr.no	PMU WITH USING GPS SYSTEM	PMU WITHOUT USING GPS SYSTEM
1.	Frequency measurement is accurate with time samples	Frequency measurement is inaccurate as compare to PMU device which uses GPS system
2.	Fault Location finding is easy , and also easy to calculate frequency at particular location	Location finding is somewhat difficult
3.	Bandwidth requirement is high as the use of global positioning system	No bandwidth requirement
4.	Is there is any Network problem then this system doesn’t use properly	There is no any network issue because no use of GPS system
5.	Cost of this system is very high	As compared to PMU with using GPS system, cost is less.

2. APPLICATION OF PMU IN POWER SYSTEMS

The major applications of the PMU in the Power System are given below [7, 8]

- State Estimation
- Oscillation Detection and Control
- Voltage Stability Monitoring and Control
- Protection of Power Systems
- Power system Real Time Monitoring, Recording & Control
- PMU assisted state estimator
- Post- Disturbance Analysis
- Power System Restoration
- Protection and control application for Distributed Generation (DG)

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- Overload monitoring
- Adaptive Protection
- Phase Angle Monitoring

VI. CONCLUSION

PMU provides innovative solution to traditional utility problems it is also very facilitates to improved protection and effective control of power system network. This paper provides the overall introduction to the phasor measurement unit, also provides the comparisen between SCADA and PMU and major applications of the PMU in the Power System.

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