Development and characterization of a multi-platform Data Acquisition System for Power Quality metrological certification

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Abstract. A Data Acquisition USB Device has been designed, developed, realized and characterized to be used in Power Quality monitoring activities. The system simultaneously manage 8 data acquisition channels to allow acquisition on tri-phases plus neutral lines working at 499 samples per 50 Hz period. It can get external certified time and voltage references to warranty certified measurements. The system is directly powered by USB interface and use a multiplatform FTDI Virtual ComPort drivers to yield a simple-to-use and scalable device able to send and receive data over High Speed RS232 virtual interfaces, without requiring any advanced programming skill. The virtual serial communication makes data acquisition software portable over many platforms, regardless development environment and programming language. The proposed device has been tested with custom software written in C# and VB6, than in LabView and MatLab environment, moreover it has been characterized applying the most common ADC performing test to verify its behaviour.

Key words

Power Quality, Acquisition Card, MAX1320, Multi-platform System.

1. Introduction

The constant grow up of non linear loads connected to the electric network is the principal cause of the necessity to measure the electrical energy quality. These loads produce a series of variations on ideal current and voltage waveform that have to be studied and monitored to preserve the network, the generators and the loads by possible breakings. Power Quality is the branch of the science that analyzes these alterations[1] covering a multitude of types of power system disturbances and studying the interactions that can appear in a generic electric network between generators and loads. The CEI EN 50160 and subsequent are the norm that defines all the characteristics of the electricity supplied by public distribution systems [2].

In order to study the Power Quality it is necessary to measure the normed parameters using proper instrumentation, as suggested in CEI IEC 61000-4-7 [3].

In the market there are many instruments that measure Power Quality[4] but they have several order of problems as, for e.g.:

1) to obtain high accuracy measurements the instruments' costs are high[5];
2) often, the sensors are not adequate to PQ needs, as, e.g. the use of ferromagnetic core sensors with pass band too small that don't allow to correctly measure the harmonic and interharmonic content;
3) normally, the market instruments are not designed to obtain automatic measurements for long time cause the little memory deep;
4) multiple channels acquisition cards use a multiplexed management for the input channels, this produce an incorrect registration of the electric phases under analysis[6,7,8];
5) the acquisition trigger is not connected to a metrological time reference making the metrological approach toward the measurements fruitless, or, where it is verified, the multiplexing is managed by a local quartz that has a poor time accuracy [6,7,8];
6) devices designed for automatic stand alone measurements have not yet a high reliability[6,7,9].

These lasts three problems have been directly found on instrument realized by ourselves, partially solved with a complex uncertainty determination (problem 4) [6] or with suitable recovery remote control system (problem 6)[8,9].

To face part of these problems it has been developed an "ad hoc" Data Acquisition System (DAS).

We improved performances of the previous measurement instrumentation, widely described in [6,7,8], developing a custom acquisition board based on high speed USB 2.0 interface, capable to acquire simultaneously 8 channels working at 24.976 kHz, 14 bit word depth, that guarantees 499 samples per AC cycle, over the lower boundaries of 256 samples, recommended by emerging standards like IEC 61850[10].

The DAS system is equipped with the versatile FT2232HQ USB interface whose drivers are available for Windows©, Linux and MacOSX operating systems and represents a wide range of opportunities for DAS to interface with existing platforms, both hardware and software.

The board has its own time and voltage reference on; when available, it's possible to set up external references for metrological purposes. In fact, the board has designed to be connected directly to a certified 2,048 kHz timing signal provided by Telecom Italia and synchronized with atomic clock of INRIM institute, holder of national legal time counting.

System control is quite easy via Virtual Com Port (VCP) driver with a very simple command set over a bidirectional 9,600 bps null modem channel. A second VCP high speed one-way channel is dedicated to transmit captured data over USB connection. The software driver