A System For The Characterization Of The Micro-Controllers

Bruno Andò, Salvatore Baglio, Vito Caruso, Nicola Pitrone

Engineering Faculty, D.I.E.E.S., Viale A. Doria, 6, 95125 Catania, Italy,
phone: +390957382309, fax: +39095330793, E-mail: nicola.pitrone@diees.unict.it

Abstract – The characterization of complex electronic devices is very important for technical as well as didactic reasons. The characterization of the micro-controllers involves the investigation on its peripheral devices, mainly the ADCs, the PWMs, the timer signals, sometimes the DACs. A testing platform has been realised, with reference to the ST52X430 micro-controller. Moreover, it has been improved in order to test the peripheral devices of the ST52X440 micro-controller. It consists of a board and some programmable instruments connected to a PC, on which the implemented software can run. The user can choice the test to be performed on the basis of the IEEE standard 1241-2001. Some results of the ADC characterization made by using this platform have been presented last year. In this work the use of the realised system for the characterization of the other peripheral devices is presented.

I. Introduction

The characterization of a micro-controller involves the characterization of its peripheral devices, mainly the ADCs, the PWMs, the timer signals, sometimes the DACs.

Researchers devoted particular attention to the characterization of the ADC, and a standard terminology and a testing methodology have been developed [1].

ADC modelling and testing have been widely investigated, with different aims [2, 3]:

- to optimise the test procedure;
- to develop an accurate model which takes into account non-linearities;
- to minimize the test effort;
- to on-line test the validity of the model.

Measurement procedures and methods for static and quasi-static test of ADCs have been implemented mainly for reducing the experimental burden [4, 5].

The FFT test has been used in order to derive the integral non-linearity of ADCs, because in some cases it is faster than histogram test and static non-linearity test [6].

ADC testing with IEEE standard 1241-2001 relies on frequency domain techniques, which can produce a robust characterization of the ADC. Analysis based on these techniques can yield the various testing parameters [7].

On account of the previous considerations, in order to simplify the procedures to be carried out for the characterization of the micro-controllers, a testing platform has been realised, with reference to the ST52X430 micro-controller.

This platform has been already used with reference to the ADC and the satisfactory results obtained have been recently presented [8].

The features of the measurement system are outlined in the next section. The characterization of some components of the micro-controller has been carried out and the results are presented in the third section and in the last section some conclusions are drawn.

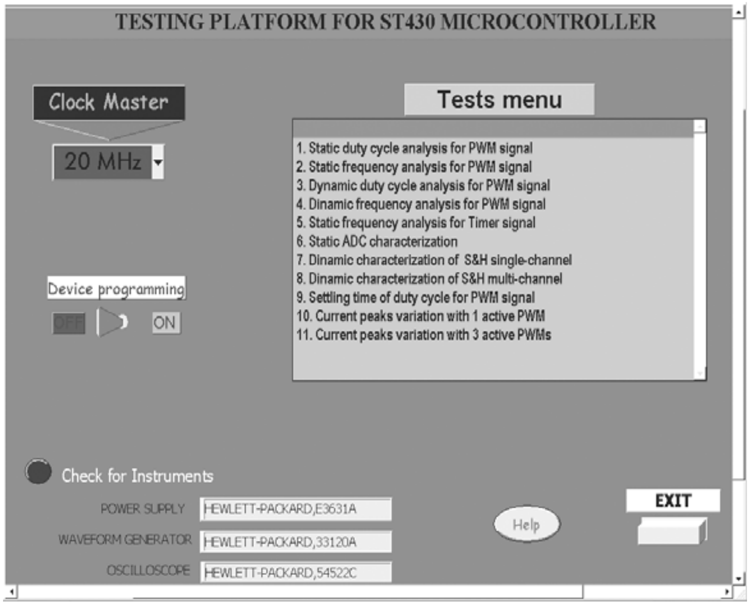
II. The developed testing platform

The testing system consists of a board and some programmable instruments connected to a PC, on which the implemented software can run. The device under test can be inserted on the board and each pin of the device can be properly connected. Also the voltage supply can be properly connected to the correct pins.

An interface between the serial port of the device and the serial port of the PC has been implemented.

The used hardware includes a PC, a function generator, a digital oscilloscope, a multimeter and a dc-power supply: they are interconnected by the standard IEEE-488 and the RS232.

A flexible software has been implemented. Figure 1represents the user interface, displayed on the monitor of the PC.



TESTING PLATFORM FOR ST430 MICROCONTROLLER

Clock Master: 20 MHz

POWER SUPPLY: HEWLETT-PACKARD,E3631A
WAVEFORM GENERATOR: HEWLETT-PACKARD,33120A
OSCILLOSCOPE: HEWLETT-PACKARD,54522C

Figure 1. The realised testing platform.

As it is shown, various choices can be made by the user: the various items of the test menu, the clock, the instruments, the programming of the devise under test. A routine has been implemented that performs downloading of the assembler code on the devise.

There is also shown the menu of the tests that can be carried out; various test procedures have been realized: in addition to the static characterization of the ADC, also the characterization of the comparator and the stability of the PWM signal.

The software stores the data in a suitable way: the management of the data files is performed carefully.

An on-line help for simplifying the testing operation has been implemented. It shows the board and the hardware connections.

Particular attention has been devoted to the implementation of the software for the presentation of the results. The results obtained in a single test are directly shown on the display. Moreover, other choices can be made on the files already stored.

Some results of the characterization procedures using the realised platform, performed on both the ST52x430 and the ST52x440 micro-controllers, are presented in the next section.

III. Characterization of digital devices

Various sections of the micro-controller can be tested, as it is emphasized in Figure 1. Among the tests performed in this work, the following ones will be presented in the next subsections:

1. static ADC characterization;
2. static frequency analysis for PWM signals;
3. static duty cycle analysis for PWM signals;
4. dynamic characterization of S&H single-channel.

In the graphic environment arranged for this test, the parameters related to the number of measurements to be performed and to the step variation of the voltage must be defined, the test will be activated and the results will be obtained, as it is shown in the following Figures. In particular, Figure 2 shows the static characterization of the ADC (on the left side of the figure) and the trend of both the differential error and the offset with reference to the ideal case (computed in the labVIEW™ environment).

Figure 3 shows the results of the frequency analysis and the evaluation (in labVIEW™) of the mean trend of the residual and the experimental variance of the residual with respect to the reference value.

Figure 4 shows the results of the duty cycle analysis and the evaluation (in labVIEW™) of the mean trend of the residual and the experimental variance of the residual with respect to the reference value.

In Figure 5 the results of the computation of the trend of the mean of the sampling time and that of the mean of the sampled values are presented.

In Figure 6 the mean value of the current amplitude peaks when one PWM signal is active is presented.

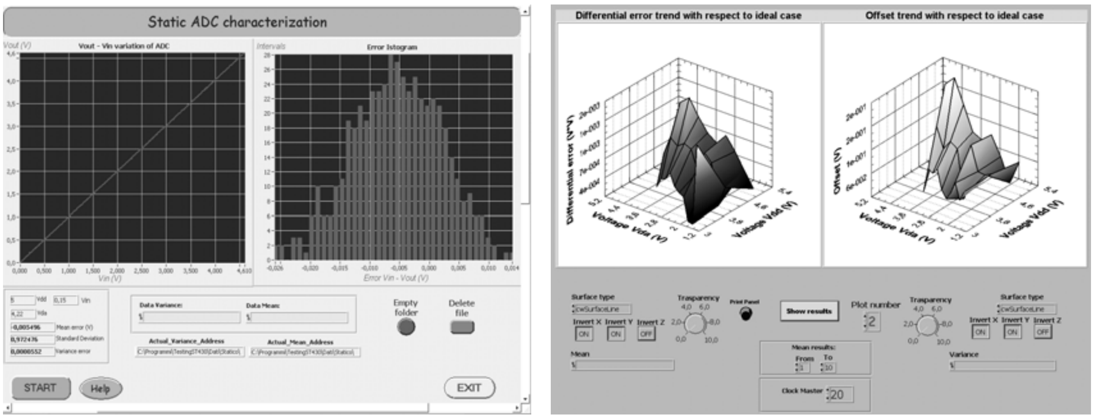


Figure 2. Static characterization of the ADC.

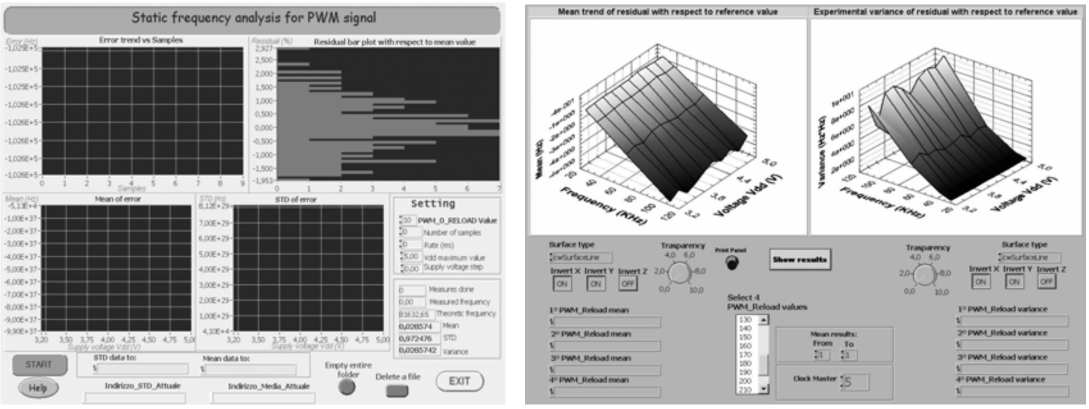


Figure 3. Static frequency analysis for PWM signals.

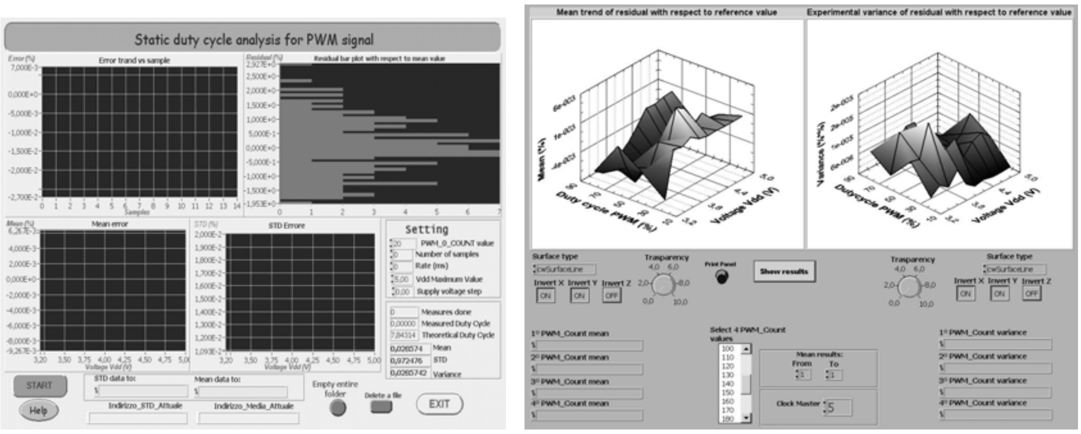
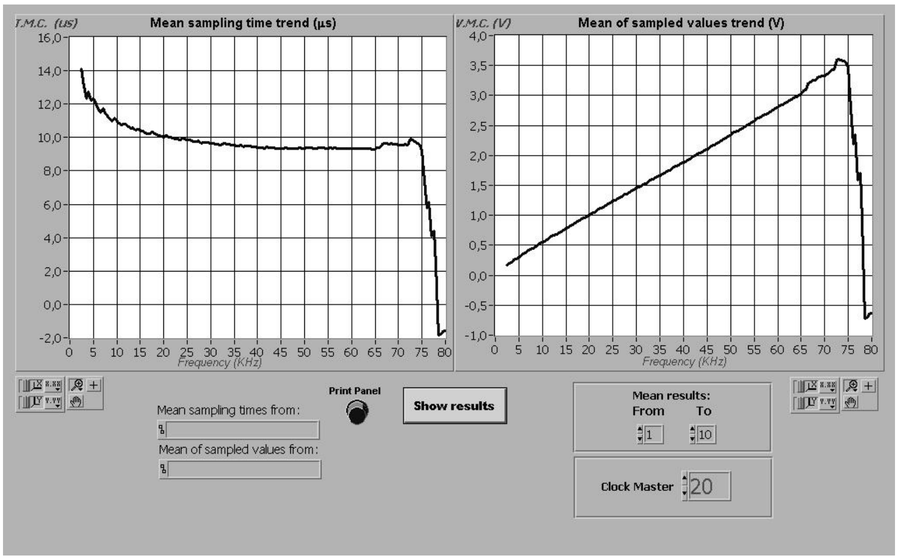


Figure 4. Static duty cycle analysis for PWM signals.

IV. Conclusions

A platform for the characterization of micro-controllers has been presented. It is proposed as a standard procedure for testing industrial devices, as the ST52XXX family.

To drive the various pieces of the used hardware a suitable software has been implemented. The system allows the user carrying out some tests. Examples have been synthetically presented. The hardware as well as the software can be easily modified in order to test other micro-controllers. The realized platform is didactically valuable and can be used for modern vocational training.



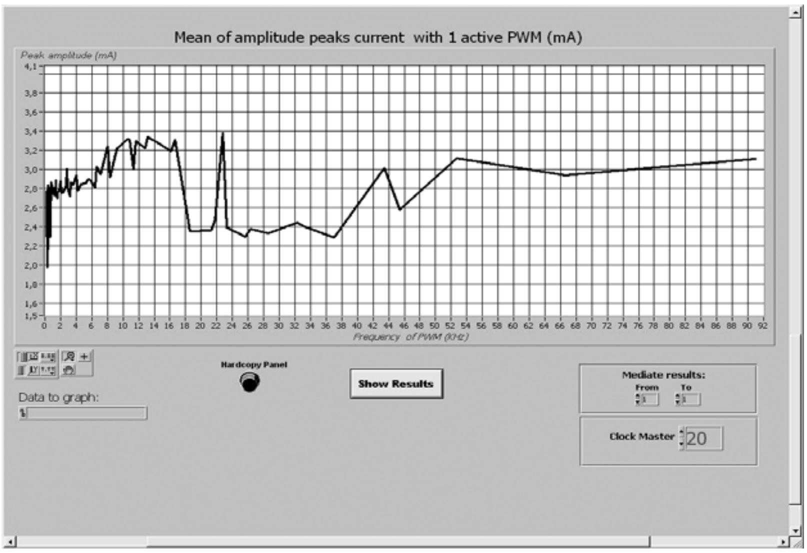
Mean sampling times from:

Mean of sampled values from:

Mean results:
From 1 To 10

Clock Master 20

Figure 5. Dynamic characterization of S&H single-channel.



Data to graph:

Mediate results:
From 1 To 1

Clock Master 20

Figure 6. Mean value of the current amplitude peaks.

References

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