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TEST OF NUCLEAR-PULSE SHAPERS USING OSCILLATION-BASED TEST

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***Abstract*— This paper addresses the problem of testing continuous-time nuclear-pulse shapers using Oscillation-Based Test (OBT). The proposal is to convert the whole systems into non-linear oscillators, avoiding the partition in low-order sections. The design of the oscillators is very simple because the non-linear elements are mathematically modeled using the describing function approach, and the study of the oscillators is made using techniques of linear systems. The test strategy presents high fault coverage and requires only one test session. The last characteristic allows reducing the time required for executing the test and the complexity of the test controller. The OBT schemes are validated using deviation and catastrophic fault models.**

***Keywords*— Oscillation-based test, nuclear pulse shaper, testing**

I. INTRODUCTION

Nuclear pulse shapers are used for ionizing radiation spectroscopy usually associated with Multi-Channel Analyzers (MCA) in order to obtain the spectra of the radiation field under study.

The block diagram of a typical radiation spectroscopy system is presented in Fig. 1. In the figure, a preamplifier amplifies the charge signal, Qδ(t), delivered by the detector. The shaper processes the preamplifier output and an Analog to Digital Converter (ADC) converts the shaped signal to the digital domain. Finally, the MCA obtains an energy histogram.

Convenient conditions for spectroscopy applications are achieved when the pulse delivered by the shaper is Gaussian or semi-Gaussian (Knoll, 2000). There are several ways for implementing Gaussian shapers, but an extended and very simple alternative is by means of connecting a differentiator in cascade with several integrators. For this kind of topologies, the approximation to the Gaussian pulse-shape improves as the number of integrators in the cascade increases. In practice, configurations with two up to six integrators are employed.

Despite the fact that nuclear pulse shapers are widely used in the nuclear industry and in basic and applied research, the problem of testing them remains unexplored. In this paper, a simple and efficient test solution is proposed for continuous-time pulse shapers, using a particular test strategy named Oscillation-Based Test (OBT).

OBT has been proposed for the first time by Arabi and Kaminska (1996) as a test strategy able to detect commonly observed defects in the manufacturing process. However, the circuit resources added to the original system for testing can be re-used for implementing periodic test during the in-field operation. This kind of test is particularly important for portable and critical applications demanding a high degree of confidence in the circuit.

II. PREVIOUS WORK ON OBT

The core idea in OBT is the conversion of the Circuit under Test (CUT) into an oscillator, adding some extra components to force the circuit to oscillate. It is assumed that a fault in the CUT will produce deviations in the frequency or in the amplitude and consequently it will become observable (Arabi and Kaminska, 1996). Some of the reasons that make this approach very at-

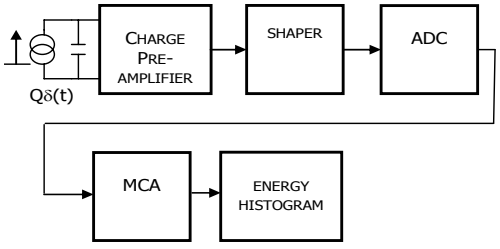

Figure1 1. Radiation spectroscopy system. Block diagram.