

Mixed-Signal and Mixed-Domain Instrumentation for Emerging Technology Device Characterization

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Abstract

This paper deals with new and emerging instrumentation for characterization of emerging technologies including RF-to-DC and Analog-to-Digital Conversion. These new emerging technologies will impose measurement in a mixture of domains, including RF and DC simultaneously, case of RF-DC converters that are used heavily in Wireless Power Transmission and RFID circuits, and Analog and Digital, normally called mixed-signal that are used in Software Defined Radio (SDR) and Cognitive Radio (CR) transceivers.

The paper presents the main limitations present in necessary measurement test benches and then discusses specific approaches for instrumentation that is able to realize those measurement procedures. Finally, the characterization and modelling aspects will also be addressed.

1. Summary

Emerging technologies are bringing signal processing algorithms and digital signals to operate directly at RF frequencies, some of those examples include SDR solutions [1-2]. These radios operate directly in a sampled version of the analog counterpart signal that runs at Gbps, and thus they can really be considered digital radio signals. Nevertheless, the same approaches for analog RF front-ends continue to be true, that is VSWR, sensitivity, dynamic range, third order intercept points, among others continue to be of high importance to evaluate and design the complete link budget of respective receivers and transmitters. Unfortunately, most of the instrumentation available in the market is focused on analog transceivers, and not much relevant equipment exists for digital RF signals. This can be overcome by proposing a new instrument called mixed-signal analyzer [3-4], Fig. 1, which actually combines both analog and digital signals in the same framework, and allows the implementation of characterization solutions in an integrated and straightforward form. The main problem of these systems is the precise synchronization of the analog and digital ports, so that precise amplitude and phase measurements can be done.

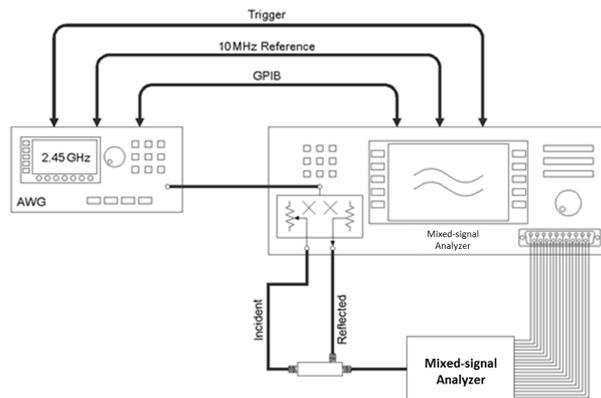


Fig. 1 - Mixed-signal instrumentation

This synchronization is actually a strong source of debate and will be discussed deeply in section 2. Using this new instrumentation approach and with a strong calibration solution several modelling and characterization operations can be implemented with the described instrument, that will be the focus of section 4.

Despite this, other emerging technologies as Wireless Power Transmission and RFID solutions are also giving their first steps in the RF and engineering science journals. Once again these new technologies are very cumbersome for characterization mainly because the input is an analog signal at RF and the output is a DC voltage value. Novel testing

schemes as the one presented in [5-6] can be explored for this new characterization approaches. In section 3 we will be addressing these problems discussing characterization and modelling aspects for RF-DC converters. This paper will then be divided into the following sections: in section 2 mixed-signal (analog-digital) instrumentation will be discussed, and in section 3, RF-DC instrumentation will be addressed, finally in section 4 some practical examples will be given. The paper finishes with some conclusions been drawn.

2. References

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