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# ASSESSMENT OF RESPONSE TIME OF SAR PROBE

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## Introduction

The GSM standard is a regular signal in the time domain with a TDMA frame of 4.615ms divided in 8 time slot of 577 $\mu$ s. Then from a CW calibration and a mean value measurement with a high sensitivity multimeter, it is possible to measure the SAR (Specific Absorption Ratio). Now, with the new standard, like WIFI 802.11, b,g,n , WIMAX, LTE, the signal in the time domain is irregular with random effect. Then a temporal measurement is required and the response time should be consistent with temporal specification of these new standards. Due to the high input impedance of the SAR probe, not only the probe contributes to the time response but all the acquisition system including the probe, cable, data acquisition module. Firstly, a test bench for the response time measurement is presented. Secondly, the simulation of the total acquisition system allows predicting the performance of the SAR measurement system according to the type and length of cable, the specification of the data acquisition module (Input impedance, capacity). Finally, the interest to implement a matching circuit near the probe is presented.

## Test bench

The first step is the assessment of the response time of the probe. A test bench has been developed with a signal generator (R&S SMJ100), a 6GHz digital scope to visualize the RF signal in the time domain, a waveguide to insert the probe under test and a data acquisition module (NI6259) with high input impedance (10GOhms). All the instruments are controlled by software developed with LABVIEW. The following figure shows the test bench.



Figure 1: Test bench

## Assessment of the response time of the SAR probe

Before predict the time response of the global SAR measurement system, it is necessary to assess the response time of the SAR probe alone. Due to the high input impedance probe and the effect of the capacity of cable, data acquisition, it is impossible to measure directly the time response. An equivalent electric model of the probe is a RC circuit (figure 2) is created. The resistance value is measured with an ohmmeter. Then from a simulation circuit with ADS software of different configurations by changing the length of the cable, the equivalent capacity is then assessed.

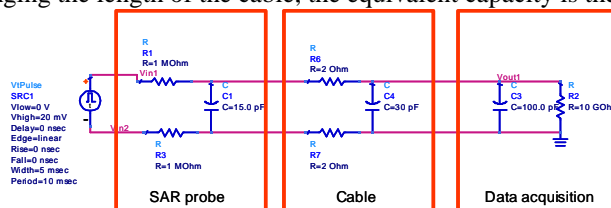


Figure 2: ADS simulation circuit

The following figure shows the measurement and the simulation of the response time for a SAR probe with an input impedance of 2MΩ, a coaxial cable of 30cm and a National Instrument data acquisition (NI6259). In this case the equivalent capacity of the probe is 15pF and the response time is 630μs.

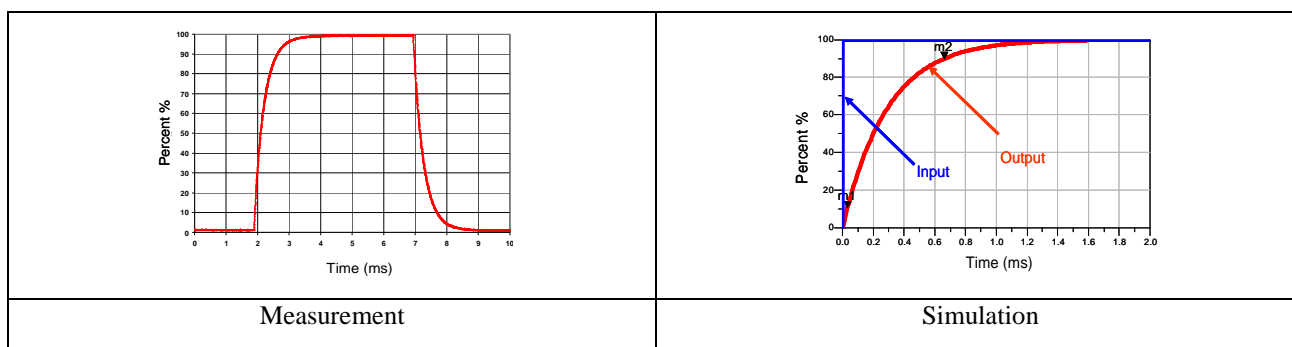


Figure 3: Comparison measurement and simulation

## Prediction of the time response of a SAR measurement system

By using the equivalent model of the probe, it is now possible to predict the time response of a SAR measurement system by taking account the type and the length of the cable, specification of the data acquisition module, the implementation or not of a matching circuit. The matching circuit is based on a non inverse operational amplifier. The model is loaded in ADS simulation (figure 4).

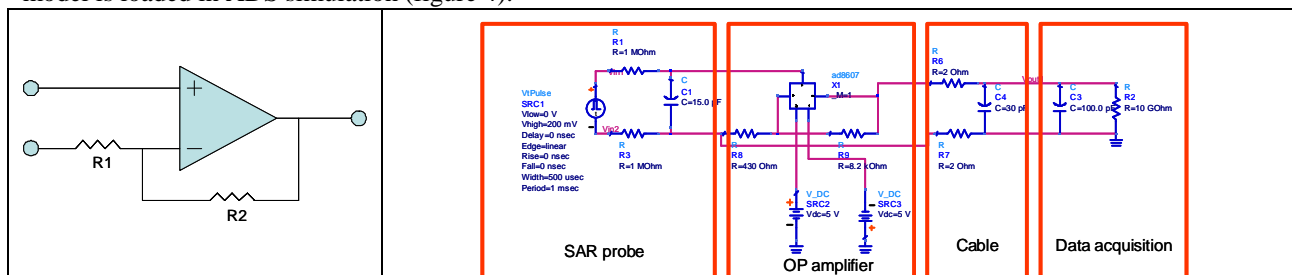


Figure 4: ADS Simulation including the matching circuit

For example, the table, below, shows the impact of the insertion of a matching circuit for two cables length.

	Without matching circuit	With matching circuit
Cable length of 30cm	630μs	68μs
Cable length of 130cm	1100μs	68μs

The matching circuit allows reducing significantly the time response and furthermore the modification of the cable length don't affect the response time of the global system.

## Conclusions

In this paper, a response time test bench of SAR probe is presented. From a circuit simulation, an equivalent electric model of the probe is computed. Then, it is now possible to predict the global performance of the SAR test bench according to a standard. The future work will be the conception of a .

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