A Vector Network Analyzer-Based Near Field Scanner for MM-Wave and THz Receivers

Kristina Davis¹, Chris Groppi¹, Hamdi Mani¹, Caleb Wheeler¹, Chris Walker²
¹ Arizona State University, Tempe, AZ 85287 USA
² University of Arizona, Tuscon, AZ 85721 USA

Abstract- Here we present the methodology and initial results for a new near-field antenna measurement system for sub-millimeter and terahertz receivers. The system is based on a 4-port VNA with two internal sources, which offers reduced complexity and cost when compared to previous systems.

I. INTRODUCTION

We present the design, characterization and initial results from a novel mm-wave and terahertz near field scanner based on a 4-port Vector Network Analyzer (VNA). This method uses a planar near-field to far-field transformation, described by [1]. Similar near-field systems have been developed for a variety of other applications ([2], [3], and others), but the system presented here is significantly simpler and less expensive if a 4-port VNA with two sources is available.

II. METHODS

Traditional systems have used a vector voltmeter and phase locked signal generator [4]. Our system uses a Rohde & Schwarz ZVA24 VNA to supply two phase locked sources. Figure 1 shows a block diagram of the experiment apparatus. The first VNA source supplies the LO signal to the RUT and the second source drives an even harmonic comb generator located on a vertical XY scanning stage. A high precision motion stage with 8 micron positioning accuracy and a 150mmx150mm motion range is used to scan the high frequency source across the near field of the receiver under test. Some external circuitry is needed to supply the reference signal to the VNA. A power divider splits each source signal before reaching the CG and LO. The two offset signals are mixed together then divided down in frequency. The receiver IF is also divided down to match the reference tone. The VNA internally performs all phase and amplitude comparison duties.

III. SUMMARY

Typical radio astronomy receivers are sensitive enough to perform well with the low power from a comb generator. When combined with a 4 port, two source VNA, a near field scanning system can be constructed which dramatically decreases the cost and complexity of the measurement setup. The number of external mixers, dividers, and amplifiers necessary for this experimental method is fewer than similar techniques used in this frequency regime. No external source signals are necessary eliminating problems that arise from imperfect phase locking. This system is capable of operating at any frequency where a suitable comb generator exists, and with virtually any heterodyne array receiver.

REFERENCES


Fig 1. System configuration for the near field antenna measurement system. Two of four VNA ports are used as source signals. The measurement and reference signals are input to a third port.