INTRODUCTION

This document summarizes the antenna gain measurements performed at MVG Inc. The purpose of this document is to provide a summary of the measurement procedure, traceability information, expanded uncertainties and the calibration data for the Antenna Under Test (AUT).

MEASUREMENT SYSTEM INFORMATION

GENERAL INFORMATION

The antenna calibration is performed in a MVG SG-64 system with 63 probe antennas mounted with equal spacing on a circular arch. Electronic switching of the probe antennas provides outstanding measurement speed. The geometry of the setup, with only a Styrofoam column within 1.6 meters of the AUT, ensures minimum interference and low ripple on the measured radiation patterns.



Figure 1 – *The SG-64. The AUT is placed on top of the pedestal, in the center of the system.*

LIST OF EQUIPMENT

Equipment Summary Sheet					
Equipment Description	Manufacturer	Identification No.	Current Calibration Date	Next Calibration Date	
SG-64 Probe Array	MVG	1102320-0002	3/2019	3/2020	
RF Transmitter/ Receiver Unit (NPAC)	MVG	1102156-1828	characterized prior to test and in annual calibration	characterized prior to test and in annual calibration	
Reference Horn Antenna	MVG	SH400 sn# 0017	08/2004	Verified in monthly checks. No cal required.	
Reference Horn Antenna	MVG	SH800 sn# 0025	08/2004	Verified in monthly checks. No cal required.	

GAIN CALIBRATION

GAIN DEFINITION

The reported boresight antenna *gain* is 4π times the ratio of the power radiated per unit solid angle in that direction to the net power delivered to the antenna by a 50 Ω generator. This definition is also referred to as *realized antenna gain* which is less than the IEEE definition [IEEE Standard Test Procedures for Antennas, ANSI/IEEE Std 149-2021] by the value of the return loss.

CALIBRATION STANDARD

The calibrated substitution antenna is a dual ridge horn as shown in Figure 2 below. This horn has been calibrated at NIST (Boulder, CO) which ensures direct traceability to a National Metrology Institute.



Figure 2 – MVG SH400-SN0017 and SH800-SN0025 horns.

Page: 2/6









Figure 3 – NIST calibrated boresight gain vs. frequency plot of the MVG SH400-SN0017



Realized Boresight Gain vs. Frequency for SH800-SN0025 from NIST

Figure 4 – NIST calibrated boresight gain vs. frequency plot of the MVG SH800-SN0025



nvg





MEASUREMENT UNCERTAINTY

The following uncertainties apply to the gain measurement:

Frequency band	Expanded Uncertainty on Gain
400-800 MHz	0.89 dB
800-1000 MHz	0.84 dB
1000-6000 MHz	0.69 dB

These uncertainties represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2 traceable to the Internationally Accepted Guide to Measurement Uncertainty.

MEASUREMENT SETUP

The AUT is mounted on a Styrofoam column as shown in the picture below.



Figure 5 – *Photograph illustrating an antenna mounted in the test range. For clarity, a coordinate system has been superimposed on the picture.*



Page: 4/6



COORDINATE SYSTEM



The system coordinate system is shown in Figure 6.

Figure 6: Coordinate System







- 1. Setup SATIMO SG-64 chamber for passive measurements.
- 2. Chamber should be power on for 24 hours before actual testing
- 3. PRETESTING
- 4. Attach the reference gain antenna to the coax sma connector in center of chamber
- 5. Measure the gain of reference antenna with antenna pointing vertical. Confirm gain measures the horn gain +/- tolerance typically +/- 5%
- 6. CUSTOMER ANTENNA MODULE TESTING
- 7. Configure test modules with a u.fl compatible RF coax which allows SATIMO chamber to drive the module antennas
- 8. Tape modified WIFI module with coax feed in the SG-64 chamber mounted on the Styrofoam support
- 9. Take pictures of the module for each SATIMO test
- 10. Attach u.fl connector to u.fl adapter on the sma feedline in center of chamber
- 11. Run the SATIMO test chamber to sweep 2400-2500 MHz in 20 MHz steps
- 12. Run the SATIMO test program to sweep 5000-6000 MHZ in 100 MHz steps
- **13. EXPORT TO CUSTOMER**
- 14. Tester generates the report
- 15. Export the HTML report to customer to view using a web browser
- 16. Export the raw data to customer
- 17. Email zip package to customer
- 18. Return modules to customer via mail
- 19. Test SW: Satenv (c) METRAWARE & SATIMO 2001.
- 20. Test Engineer: Kémi Sule



