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MOS Equipment

2002-277ED-5

Shielding Effectiveness Test Report 2002-277ED-5 Rev. N/C

Test Standards: IEEE 299-2006

For

MOS Equipment

201 W Montecito Street
Santa Barbara, CA 93101

On

TitanRF Flex 1 Layer

Model Number: N/A; Part Number: N/A; Serial Number: N/A

Performed By: **Keystone Compliance, LLC.**
131 Columbus Inner Belt
New Castle, PA 16101

Keystone Compliance, LLC. does hereby certify that all inspections and tests have been performed in accordance with the documents referenced herein with exceptions as noted in this report. The results in this report pertain to the specified equipment tested, as received. This report shall not be reproduced, except in full, without the written authorization of Keystone Compliance, LLC.

Prepared By: **Maria Rodgers**, Technical Writer — **Date:** 10/7/2020

Approved By: **Tony Masone Jr.**, Lab Manager — **Date:** 10/7/2020

Approved By: **Joey Sullivan**, Quality Manager — **Date:** 10/7/2020

Document History

Revision	Issue Date	Description of Modifications	Revised By	Approved By
N/C	10/7/2020	Initial release	N/A	T.M.

Client Information

Purchase Order	2002-277EA
Quote Number	2002-277ED-5
EUT Arrival Date	8/13/2020 -- Received in good condition
Company Name	MOS Equipment
Address	201 W Montecito Street
City, State Zip	Santa Barbara, CA 93101
Contact Name	Amanda Benenati
Email	amanda@mosequipment.com

Test Facility Information

Test Laboratory	Keystone Compliance, LLC.
Address	131 Columbus Inner Belt
City, State, Zip Code	New Castle, PA 16101
Phone	(724) 657-9940
Fax	724-657-9920
Web Site	www.keystonecompliance.com
Contact Name	Tony Masone Jr.
Title	Lab Manager
E-Mail Address	Tonyjr@keystonecompliance.com

Test Program Information

Test Personnel	Travis Gennaro – EMC Test Technician
Test Title & Test Dates	Shielding Effectiveness – September 11, 2020 to September 15, 2020

TABLE OF CONTENTS

LIST OF TABLES

Introduction

This report documents the results of the EMC tests performed on the TitanRF Flex 1 Layer, Model Number: N/A; Part Number: N/A; Serial Number: N/A, submitted by MOS Equipment

The EMC test programs described herein were performed in accordance with the applicable requirements of IEEE 299-2006.

All test data is included in Section 3 of this document.

All tests performed at Keystone Compliance New Castle, PA EMC test facility. All tests were performed using the test set-ups of the relevant standard for tests performed in laboratory conditions.

Acronyms and Abbreviations

EMC – Electromagnetic Compatibility

EMI – Electromagnetic Interference

EUT – Equipment Under Test

M/N – Model Number

P/N – Part Number

S/N – Serial Number

Vac – Voltage Alternating Current

DC – Direct Current

AM – Amplitude Modulation

dB – Decibel

deg – Degree

H/V – Horizontal or Vertical Polarity

m – Meters

cm – Centimeter

V/m – Volts per meter

dBuV/m – Decibel microvolts per meter

kV – Kilovolt

Hz – Hertz

kHz – Kilohertz

MHz – Megahertz

GHz – Gigahertz

pF – Picofarad

Ω – Ohm

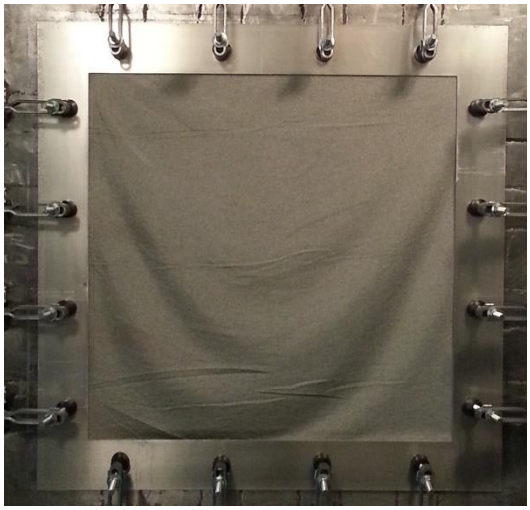
QP – Quasi-Peak

N/A – Not Applicable

Configuration

Testing performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations, and settings used to complete the evaluation. The actual test parameters specified in the test data; this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation, indicated in the test data.

EUT		
Description	Manufacturer	
TitanRF Flex 1 Layer	**MOS Equipment**	
Model Number	Part Number	Serial Number
N/A	**N/A**	**N/A**



EUT
TitanRF Flex 1 Layer

Summary of Tests Performed & Results

Table 1 Tests Performed & Results

Report Paragraph	Test Description	Specification	Notes	Results
IEEE 299-2006				
3.1	Shielding Effectiveness	IEEE 299-2006	1.5-40GHz	Determined by Customer

Section 1 – Test Conditions and Equipment

1.1 Instrumentation and Equipment

Measuring and test equipment, utilized in the performance of these tests, was calibrated in accordance with ANSI/NCSL Z540-3-2006, by Keystone Compliance, LLC or a commercial facility, utilizing reference standards (or interim standards) whose calibrations have been certified as being traceable to the National Institute of Standards & Technology (NIST). All reference standards utilized in the above calibration system are supported by certificates, reports, or data sheets attesting to the date, accuracy, and conditions under which the results furnished were obtained. All subordinate standards, measuring and test equipment are supported by like data when such information is essential to achieve the accuracy control required by the procedure.

Keystone Compliance, LLC attests that the commercial sources providing calibration services on the above-referenced equipment, other than the NIST Standards are in fact capable of performing the required services to the satisfaction of Keystone Compliance, LLC Quality Assurance. Certifications of all calibrations performed are retained on file in the Keystone Compliance, LLC Quality Assurance Department, and are available for inspection upon request by customer representatives.

The test equipment utilized during this test program is listed on individual Test Equipment Logs located in Section 3 of this document.

1.2 Tolerances

All test conditions were maintained within all applicable specified tolerances.

Section 2 – References

2.1 Applicable Specifications

Reference Specification Title	**IEEE 299-2006** **Method for Measuring the Effectiveness of Electromagnetic Shielding Enclosures**
Calibration Information	**ANSI/NCSL Z540-3-2006** **Calibration Laboratories and Measuring Test Equipment— General Requirements**

Section 3 – Test Descriptions, Test Equipment, Test Data, & Test Setup Photographs

3.1 Shielding Effectiveness Test

a) The Shielding Effectiveness test requirements for the TitanRF Flex 1 Layer are specified in IEEE 299-2006.

b) The Shielding Effectiveness test description for the TitanRF Flex 1 Layer is located in Paragraph 3.1.1 of this document.

c) The Shielding Effectiveness test equipment used to test the TitanRF Flex 1 Layer is located in Paragraph 3.1.2 of this document.

d) All recorded test data for the Shielding Effectiveness test on the TitanRF Flex 1 Layer is located in Paragraph 3.1.3 of this document.

e) The Shielding Effectiveness test setup photographs for the TitanRF Flex 1 Layer are located in Paragraph 3.1.4 of this document.

3.1.1 Shielding Effectiveness Test Description

Test Description
Using the configuration(s) noted within this report, multiple shielding effectiveness tests were performed. The frequency range investigated is also noted in this report.

Sample Calculation
Shielding Effectiveness: "Open Bulkhead" measurement – Test Screen Measurement

Measurement Bandwidths					
Start Frequency:	1.5GHz	Stop Frequency:	40GHz	Step Size:	10/decade

3.1.2 Shielding Effectiveness Test Equipment Log

Equipment Log	
Customer:	**MOS Equipment**
Date:	**9/11/20**
Test Engineer:	**T. Gennaro**

Test Equipment					
Asset No.	Description	Manufacturer	Model	Serial No.	Cal. Due
EF058	Signal Generator	Rohde & Schwarz	SMR20	100742	12/20/2020
EG007	RF Amplifier	Hewlett Packard	8349B	2644A01939	UWCE
EG066	RF Amplifier	Exodus Advanced Communications	AMP4037	10005	UWCE
EE039	DRG Antenna	Rohde & Schwarz	HF906	100066	UWCE
EE051	DRG Antenna	EMCO	3115	2434	10/16/2021
EE017	DRG Antenna	ETS Lindgren	3116	00026390	2/19/2022
EE071	Horn Antenna (18-26.5GHz)	Exodus Advanced Communications	EHA42-300-24	None	UWCE
EE072	Horn Antenna (26.5-31.5GHz)	Exodus Advanced Communications	EHA34-300-24	None	UWCE
EE073	Horn Antenna (31.5-40GHz)	Exodus Advanced Communications	EHA28-300-24	None	UWCE

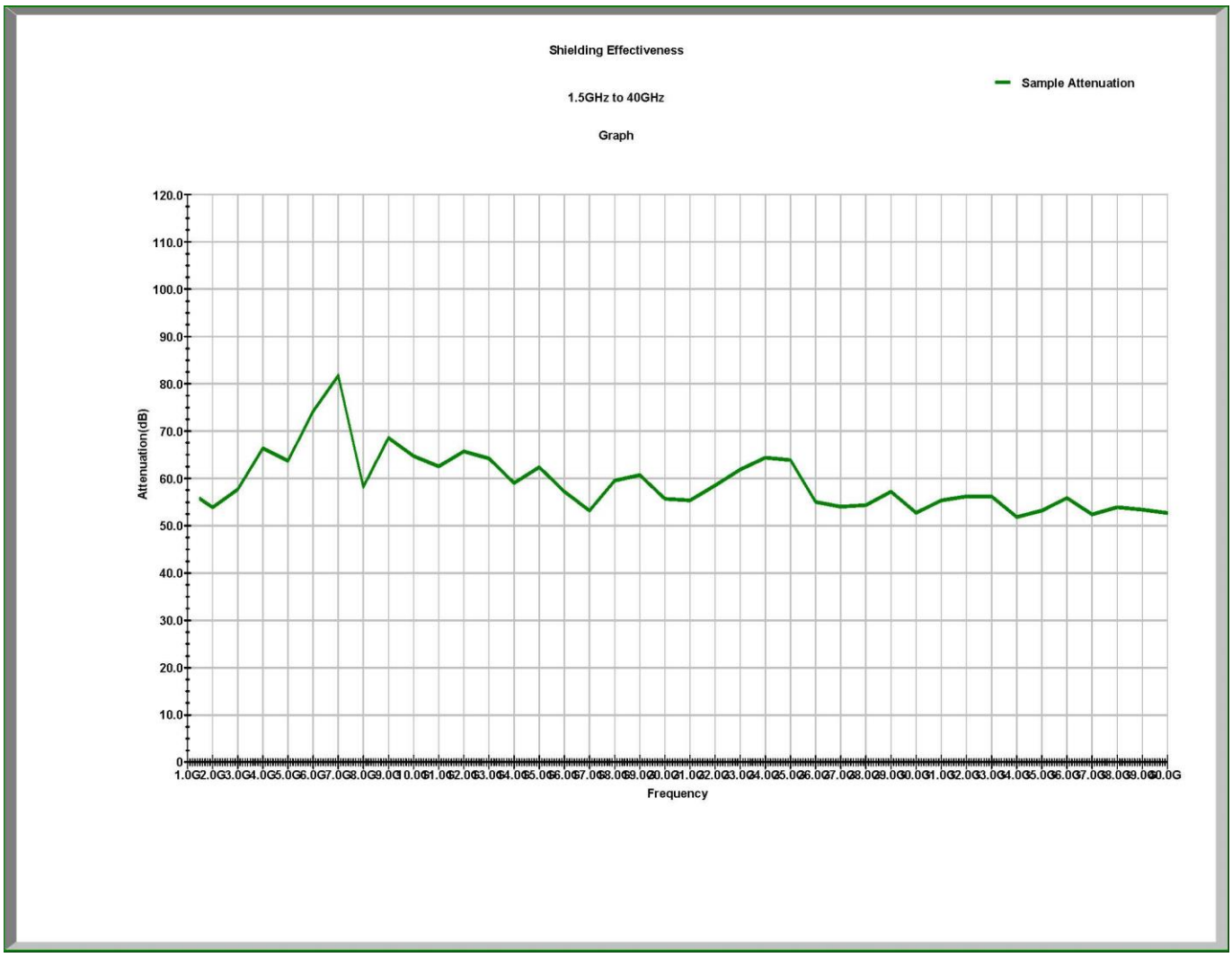
UWCE: Used with Calibrated Equipment

3.1.3 Shielding Effectiveness Test Data

Shielding Effectiveness Data Sheet					
Customer:	**MOS Equipment**				
Date:	**9/11/20**			Test Engineer:	**T. Gennaro**
Config. #:	**1**	Power:	**N/A**	Job Site:	**Keystone Compliance**
Test Specifications					
Test Spec.:	**IEEE 299-2006**				

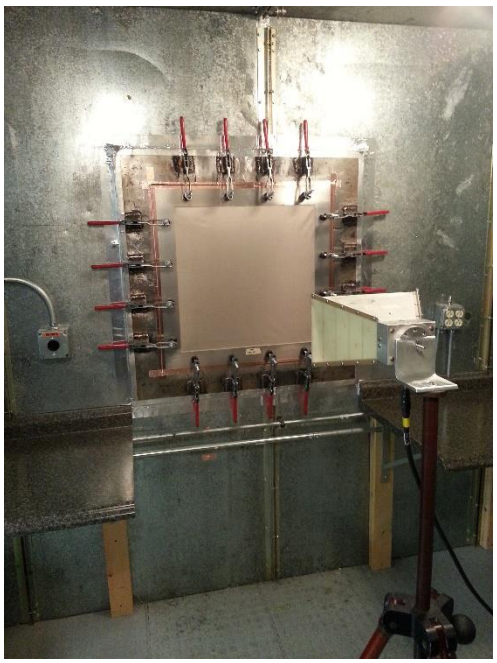
Test Data

Test Parameters					
Start Frequency:	**1.5GHz**	Stop Frequency:	**40GHz**	Test Distance:	**2 meters**
EUT Operating Modes					
N/A					
Comments					
None					
Deviations From Test Standard					
None					
Results					
N/A					

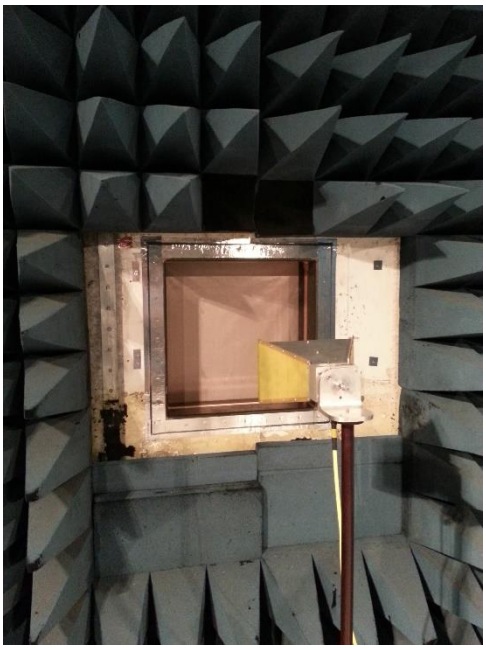

Shielding Effectiveness
1.5GHz to 40GHz
Graph
Sample Attenuation
Attenuation(dB)
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
Frequency

Shielding Effectiveness – TitanRF Flex 1 Layer	
Frequency	**Attenuation (dB)**
1.5GHz	55.66
2GHz	53.83
3GHz	57.66
4GHz	66.34
5GHz	63.66
6GHz	74.17
7GHz	81.67
8GHz	58.17
9GHz	68.50
10GHz	64.66
11GHz	62.50
12GHz	65.66
13GHz	64.17
14GHz	59.00
15GHz	62.34
16GHz	57.16
17GHz	53.17
18GHz	59.50
19GHz	60.67
20GHz	55.67
21GHz	55.34
22GHz	58.50
23GHz	61.84
24GHz	64.33
25GHz	63.84
26GHz	55.00
27GHz	54.00
28GHz	54.33
29GHz	57.17
30GHz	52.67
31GHz	55.34
32GHz	56.17
33GHz	56.17
34GHz	51.83
35GHz	53.16
36GHz	55.83
37GHz	52.34
38GHz	53.84
39GHz	53.34
40GHz	52.66

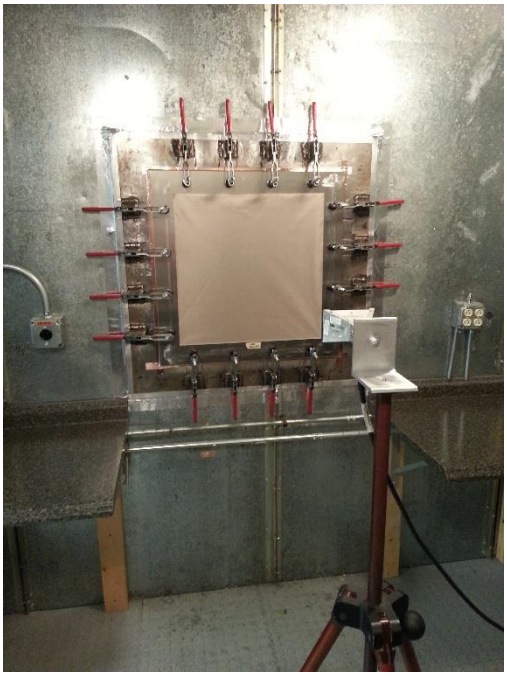
3.1.4 Shielding Effectiveness Test Setup Photographs



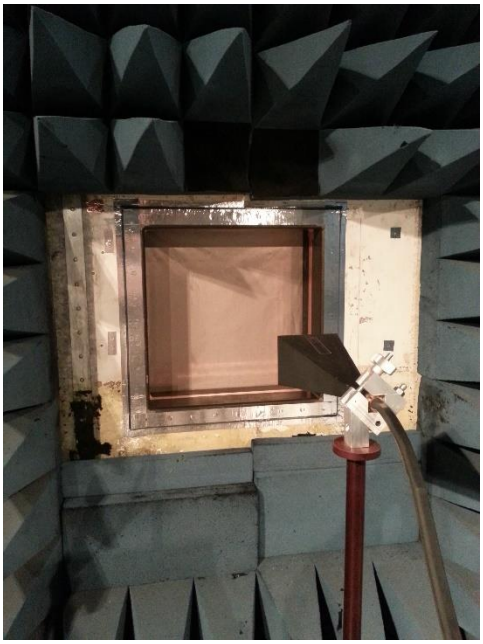
Shielding Effectiveness
1.5GHz to 17GHz Receive



Shielding Effectiveness
1.5GHz to 17GHz Transmit



Shielding Effectiveness
18GHz to 40GHz Receive



Shielding Effectiveness
18GHz to 40GHz Transmit

Section 4 – Conclusion

a) The TitanRF Flex 1 Layer, Model Number: N/A; Part Number: N/A; Serial Number: N/A, was subjected to the following EMC Tests in accordance with IEEE 299-2006 and the specifications as shown in Table 2:

Table 2 Tests Performed & Results

Test Description	Specification	Results
IEEE 299-2006		
Shielding Effectiveness	**IEEE 299-2006**	**Determined by Customer**

b) The TitanRF Flex 1 Layer was returned to MOS Equipment after completion of the Shielding Effectiveness Test.