Test Report

Prepared for: MICRORISC s.r.o.

Model: TR-82G

Serial Number:

Project No: p2420010

Test Results: Pass

To

FCC Part 15.249: 2024
and
RSS-210: Issue 10 (December 2019)

Date of Issue: July 10, 2024

On the behalf of the applicant:	**MICRORISC s.r.o.** **Prumyslova 1275** **Valdicke Predmesti** **506 01 Czech Republic**
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Prepared By:	**Compliance Testing, LLC** **Mesa, AZ 85204** **(480) 926-3100 phone / (480) 926-3598 fax** **www.compliancetesting.com** **ANAB Cert#: AT-2901** **FCC Site Reg. #US2901** **ISED Site Reg. #2044A-2**

Reviewed / Authorized By:

John Michalowicz, Test Engineer

Test Results Summary

Test Date Range: May 1 – May 2, 2024

Specification		Test Name	Pass, Fail, N/A	Comments
FCC	**RSS**			
15.249(a)	Annex B.10	Field Strength of Fundamental	Pass	
15.249(a), 15.249(d), 15.209(a), 15.205	Annex B.10, Section 7.1, 7.2, 7.3 / RSS-GEN 8.9 and 8.10	General Field Strength Emissions, Spurious Harmonic Emission, Restricted Bands	Pass	
-	Section 5 / RSS-Gen 6.7	99% Occupied Bandwidth	Complete	
15.207	RSS-GEN Section 8.8	A/C Powerline Conducted Emissions	N/A	Battery Powered. No AC input
Method Deviations/Additions: No				

Statements of conformity are reported as:

- Pass - the measured value is below the acceptance limit, *acceptance limit = test limit*.
- Fail - the measured value is above the acceptance limit, *acceptance limit = test limit*.

References/Methods	Description
ANSI C63.4-2014	Method and Measurements of Radio-Noise Emissions from low-Voltage Electrical and Electronic Equipment in the range 9kHz to 40GHz.
ANSI C63.10:2020	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
558074 D01 15.247 Meas Guidance v05r02	Guidance for Compliance Measurements on DTS, FHSS, and Hybrid System Devices Operating Under Section 15.247 of the FCC Rules
RSS-GEN Issue 5: 2018	General Requirements for Compliance of Radio Apparatus
ISO/IEC 17025:2017	General requirements for the Competence of Testing and Calibrations Laboratories

Table of Contents

Description	Page
Test Results Summary	2
Test Report Revision History	4
EUT Description	5
Test and Measurement Data	7
Test Setup and Modes of Operation	8
Field Strength of Fundamental	10
General Field Strength Emissions / Spurious Harmonic Emissions / Restricted Bands	13
99% Occupied Bandwidth	27
Measurement Uncertainty	30

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	July 10, 2024	John Michalowicz	Original Document

Current revision of the test report replaces any prior versions. Only the current version of the test report is valid.

EUT Description

Model Tested:	**TR-82G**
Models Covered:	**TR-82GA, TR-85GA, TR-86GA, TR-86G**
Serial:	**NA**
Firmware:	**NA**
Software:	**4.1**
Description:	**900 MHz radio module**
Additional Information:	The models covered include packaging variations and models with integral antennas. The external antenna selection has a higher gain so it was chosen for testing. The conducted power remains the same whether integral antenna or external antenna models are used. Test level was set to -24 by the manufacturer. **Radio Frequency Range and Operational Info: 902-928MHz** **EUT is a module and operates off 3.3 V DC sourced from an evaluation board.** **Usage: Portable**
Receipt of Sample(s):	**May 31st 2024**
EUT Condition:	**Visual Damage** No **State of Development** Production/Production Equivalent

The applicant has been cautioned as to the following

15.21 - Information to User

The user's manual or instruction manual for an intentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

15.27(a) - Special Accessories

Equipment marked to a consumer must be capable of complying with the necessary regulations in the configuration in which the equipment is marketed. Where special accessories, such as shielded cables and/or special connectors are required to enable an unintentional or intentional radiator to comply with the emission limits in this part, the equipment must be marketed with, i.e. shipped and sold with, those special accessories. However, in lieu of shipping or packaging the special accessories with the unintentional or intentional radiator, the responsible party may employ other methods of ensuring that the special accessories are provided to the consumer without an additional charge.

Information detailing any alternative method used to supply the special accessories for a grant of equipment authorization or retained in the verification records, as appropriate. The party responsible for the equipment, as detailed in § 2.909 of this chapter, shall ensure that these special accessories are provided with the equipment. The instruction manual for such devices shall include appropriate instructions on the first page of text concerned with the installation of the device that these special accessories must be used with the device. It is the responsibility of the user to use the needed special accessories supplied with the equipment.

Authorization Requirements

Intentional Radios may require authorization covered under the following rule parts or standards:

-47 CFR Part 2 Subpart J

-RSS-Gen — General Requirements for Compliance of Radio Apparatus

Note: These notices are specific to the methods and standards related to the testing within this report. Customers should also consider and review additional legal regulations for import/export documentation and labeling for the countries and geographies under consideration by the manufacturer.

Test and Measurement Data

Subpart 2.1033(b)

All tests and measurement data shown were performed in accordance with FCC Rule Parts: 15.249.

All tests and measurement data shown are deemed satisfactory evidence of compliance with Industry Canada Radio Standards Specification RSS-Gen and RSS-210.

Standard Engineering Practices

Unless otherwise indicated, the procedures contained in ANSI C63.10 and ANSI C63.4 were observed during testing.

Prior to testing, the EUT was tuned up in accordance with the manufacturer's alignment procedures. All external gain controls were maintained at the position of maximum and/or optimum gain throughout the testing. Measurement results, unless otherwise noted, are worst case measurement.

Standard Test Conditions and Engineering Practices

Unless otherwise indicated in the specific measurement results, the ambient temperature was maintained within the range of 10º to 40ºC (50º to 104ºF) and the relative humidity levels were in the range of 10% to 90%.

Environmental Conditions		
Temperature (ºC)	**Humidity (%)**	**Barometric Pressure (mbar)**
26.1 – 27.2	31 - 41	967.8 – 969.7

Test Setup and Modes of Operation

EUT Operation during Tests

EUT was tested by using radio test modes pre-programmed into the firmware of the EUT that allowed continuous >98% duty cycle at the low, mid and high channel frequencies. The EUT is powered by an evaluation board

Accessories:

Qty	Description	Manufacturer	Model	S/N
1	Evaluation Board	MICRORISC	DK-EVAL-04a	NA
1	AC/DC adaptor	Sunny	SYS1561-1105	NA

Cables: N/A

Modifications to EUT(s) (Y/N): N

15.203: Antenna Requirement:

	The antenna is permanently attached to the EUT
X	The antenna uses a unique coupling
	The EUT must be professionally installed
	The antenna requirement does not apply

The antenna gain stated by the manufacturer is 2.15 dBi

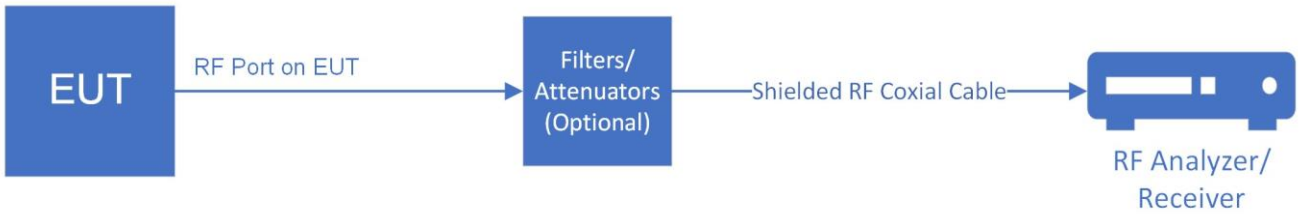
Field Strength of Fundamental

Engineer: John Michalowicz
Test Date: June 5th 2024

Test Procedure

CONDUCTED METHOD
A spectrum analyzer was directly connected to the EUT's RF port. The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. A reference level offset was added to convert conducted power to 3m field strength measurements using ANSI C63.10. A spectrum analyzer was used to verify that the EUT met the requirements for Output Power.

Test Setup



The Spectrum Analyzer was set to the following:

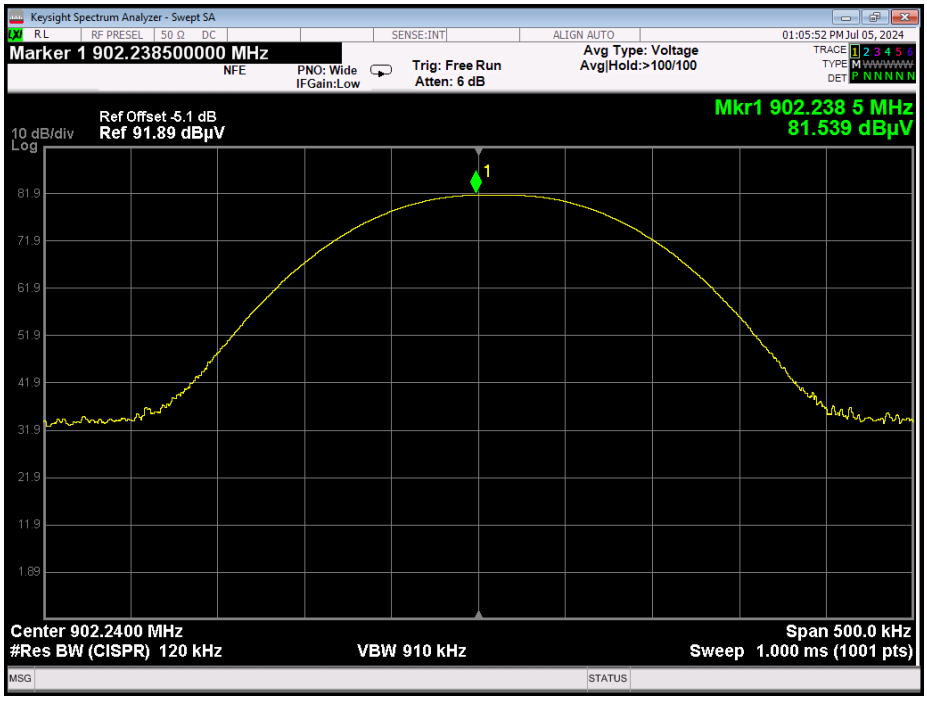
RBW ≥ DTS Bandwidth
VBW ≥ 3 x RBW
Span ≥ 3 x RBW
Sweep time = auto couple

Field Strength of Fundamental Summary Table (worse case axis and polarity)

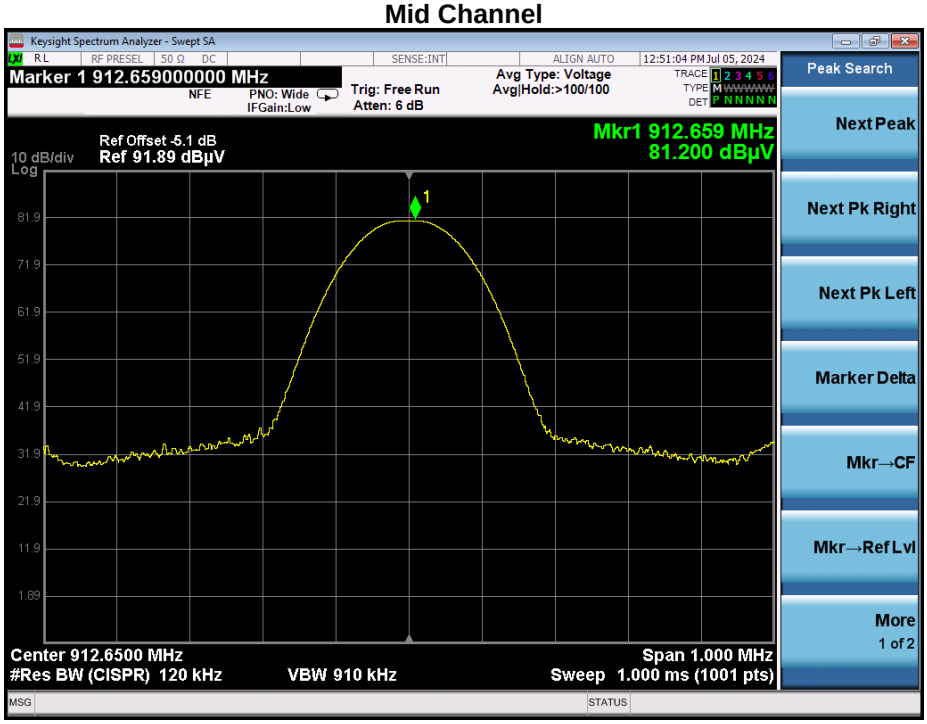
Tuned Frequency (MHz)	Mode of Operation	PK Measured Value (dBuV/m)	Antenna Gain (dB)	PK Field Strength (dBuV)	AVG /Specification Limit (dBuV/m)	Result
902.24	Continuous TX Low Ch	81.54	2.15	83.69	94	Pass
912.65	Continuous TX Mid Ch	81.2	2.15	83.35	94	Pass
927.74	Continuous TX High Ch	81.0	2.15	83.15	94	Pass

Field Strength of Fundamental Plots

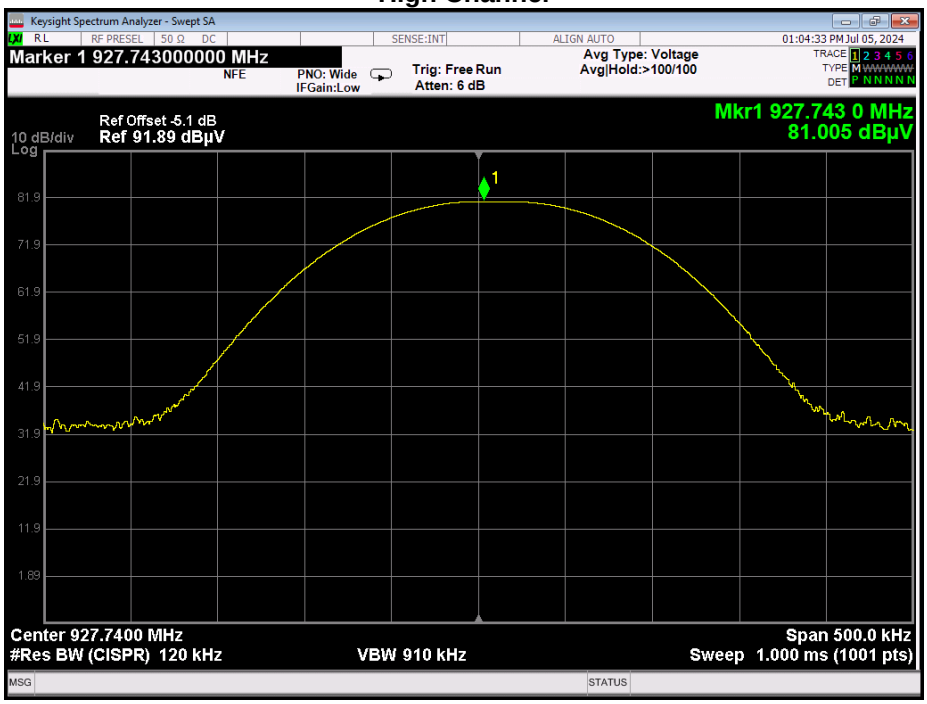
Low Channel



Mid Channel



High Channel



General Field Strength Emissions / Spurious Harmonic Emissions / Restricted Bands

Engineer: John Michalowicz

Test Date: June 5, 2024

Test Procedure

Antenna-port conducted measurements were performed as an alternative to radiated measurements for demonstrating compliance in the restricted frequency bands for 15.209.

The following offsets were added to the measurements:
The maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level
A maximum ground reflection factor to the EIRP level, 6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000MHz.

The following equations were used to determine the field strength from the conducted values.
E[dBµV/m] = EIRP[dBm] - 20 log(d[meters]) + 104.77, where E = field strength and d = 3m
E[dBµV/m] = EIRP[dBm] + 95.2, for d = 3 meters.

The Spectrum Analyzer was set to the following:

The Spectrum Analyzer was set to the following for emissions > 1000MHz:

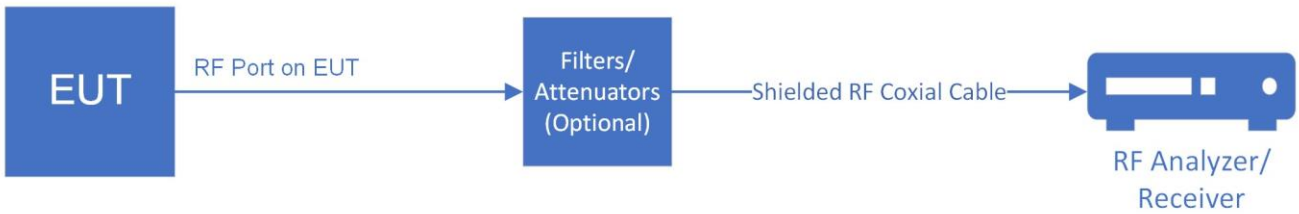
a. RBW = 1 MHz
b. VBW ≥ 3 MHz
c. Detector = Peak.
d. Sweep time = auto
e. Trace mode = max hold
    1. Note: For emissions where the peak exceeded that of the average 15.209 emission limit the following was performed.
f. RBW = 1 MHz
g. VBW ≤ RBW/100 (i.e., 10 kHz) but not less than 10 Hz

For emissions below 1000MHz the Spectrum Analyzer settings were as follows:

a. RBW = 100 kHz
b. VBW ≥ 300 kHz
c. Detector = Peak
d. Sweep time = auto
e. Trace mode = max hold

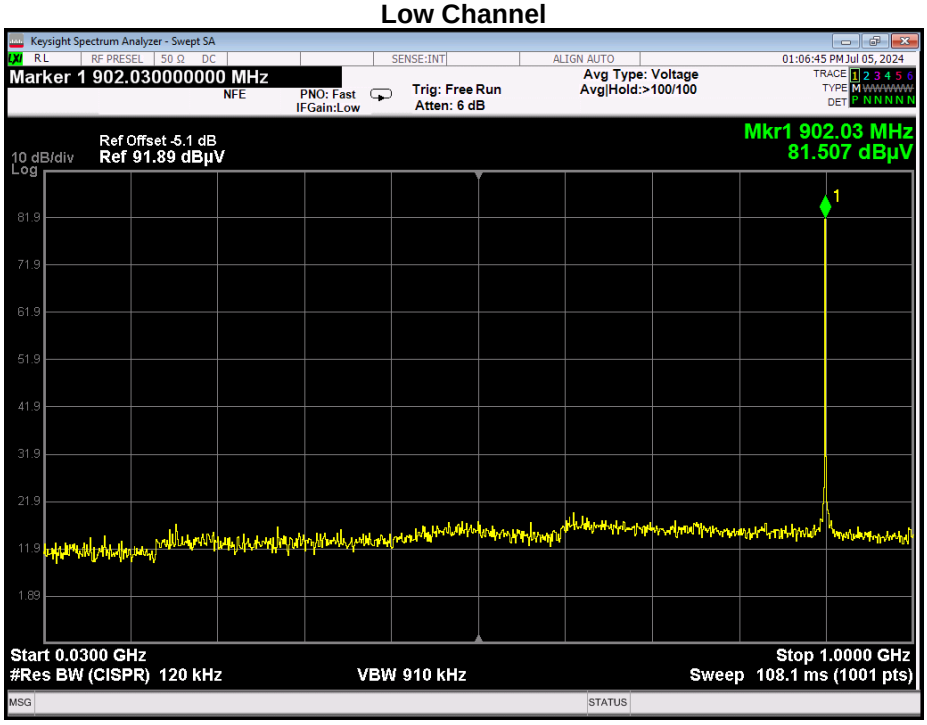
The EUT was connected to a spectrum analyzer to verify that the EUT met the requirements for spurious emissions. The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. The frequency range from 30 MHz to the 10th harmonic of the fundamental transmitter was investigated. required range were evaluated.

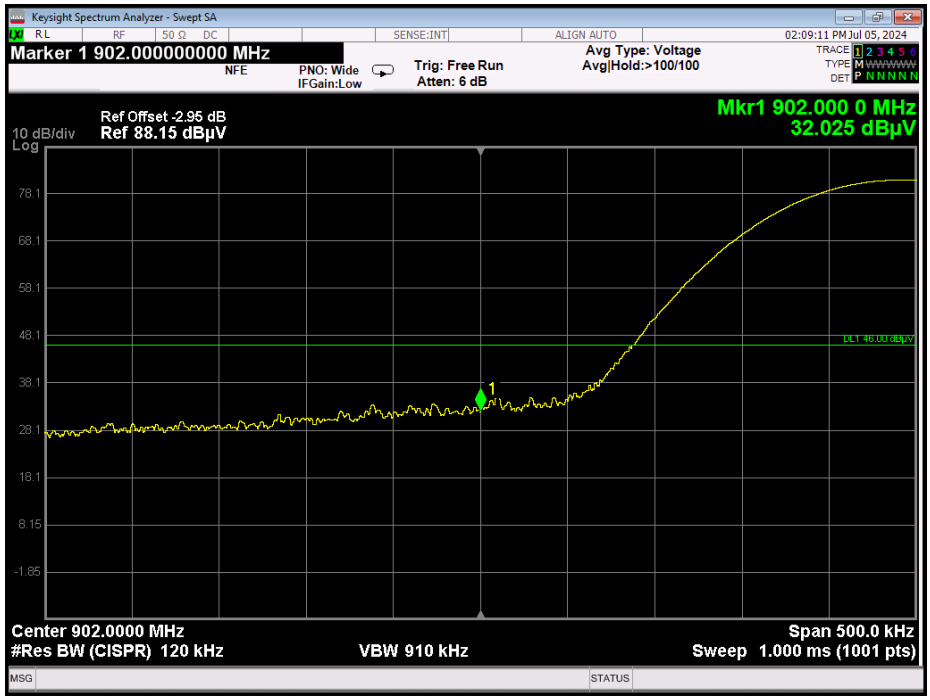
Basic Test Setup



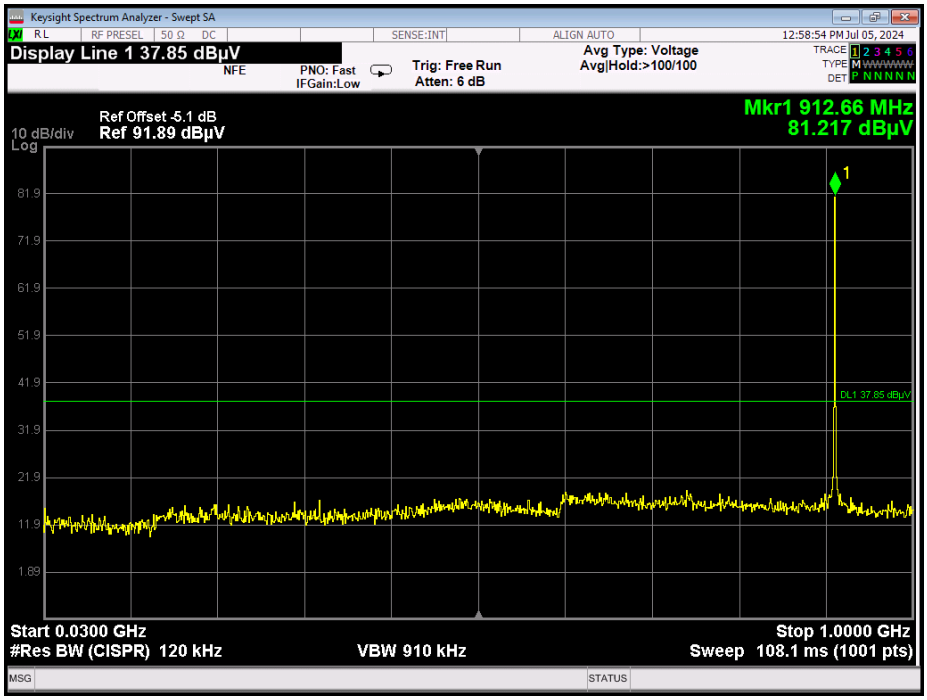
Radiated Emissions 30-1000MHz

Low Channel

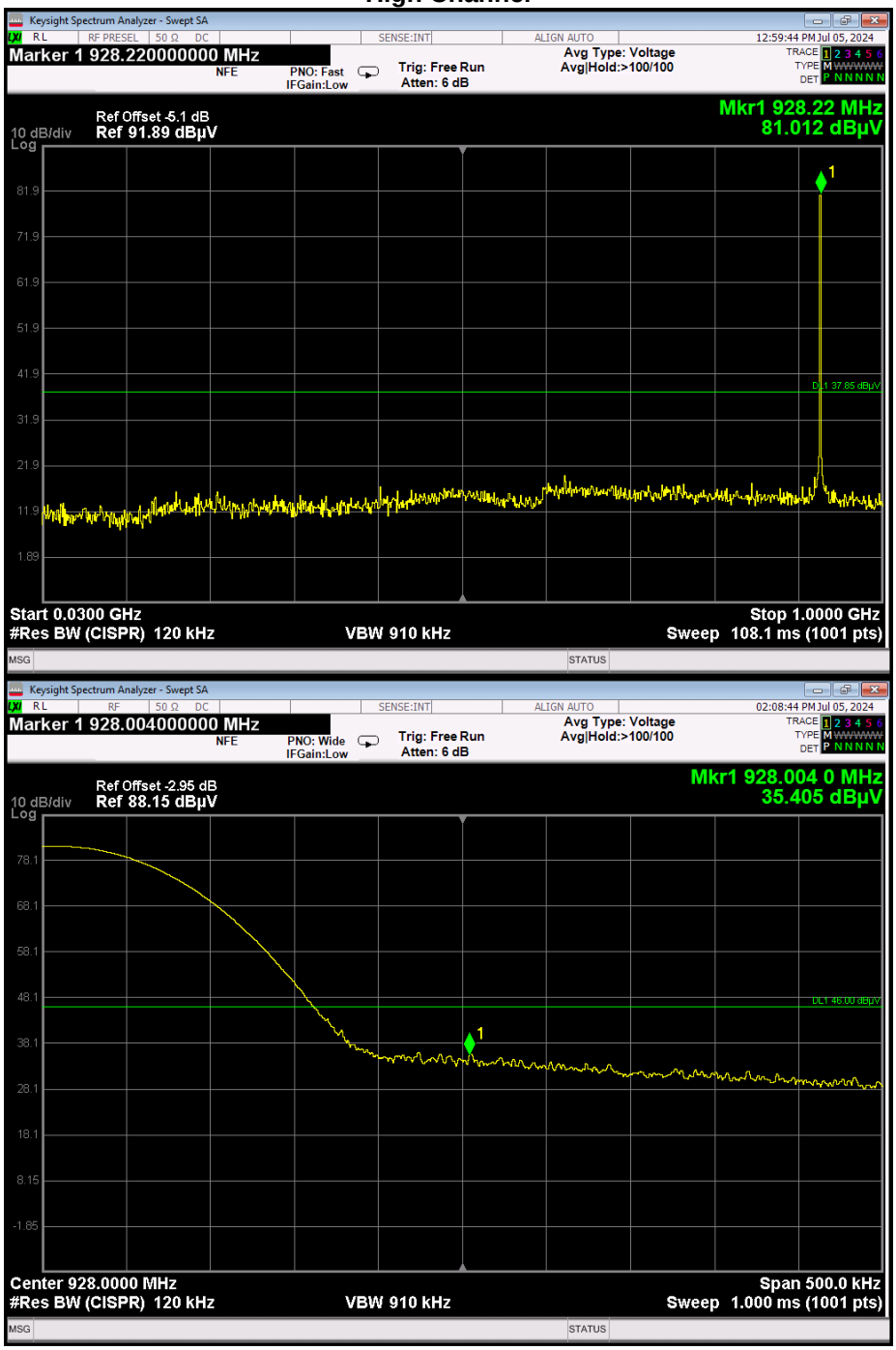




Mid Channel


Keysight Spectrum Analyzer - Swept SA
RL
RF PRESEL
50 Ω
DC
SENSE:INT
ALIGN AUTO
12:58:54 PM Jul 05, 2024
Display Line 1 37.85 dBµV
NFE
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 6 dB
Avg Type: Voltage
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Ref Offset -5.1 dB
10 dB/div
Log
Ref 91.89 dBµV
Mkr1 912.66 MHz
81.217 dBµV
81.9
71.9
61.9
51.9
41.9
31.9
21.9
11.9
1.89
1
DL1 37.85 dBµV
Start 0.0300 GHz
#Res BW (CISPR) 120 kHz
VBW 910 kHz
Stop 1.0000 GHz
Sweep 108.1 ms (1001 pts)
MSG
STATUS

High Channel

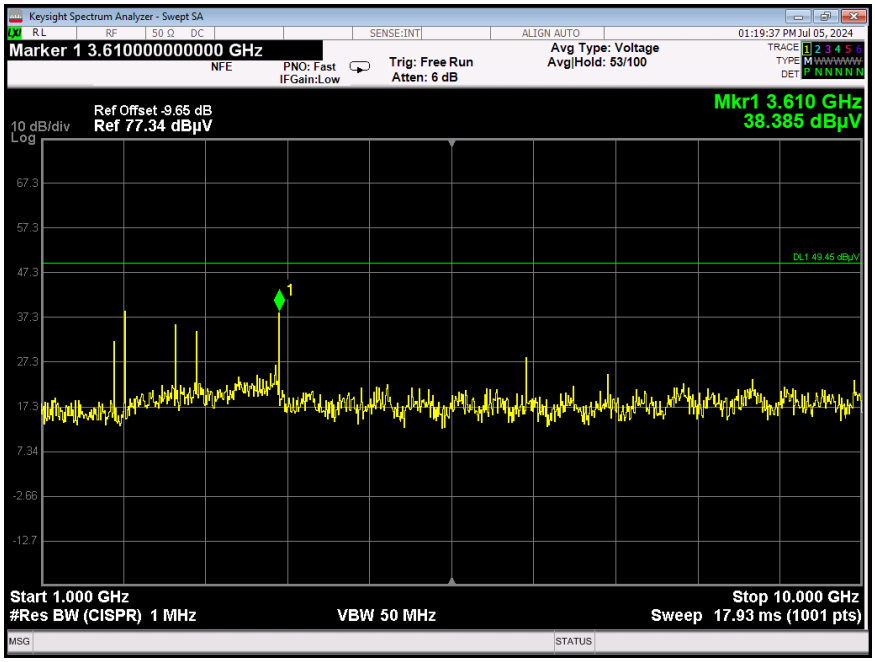


Band Edge Summary Table

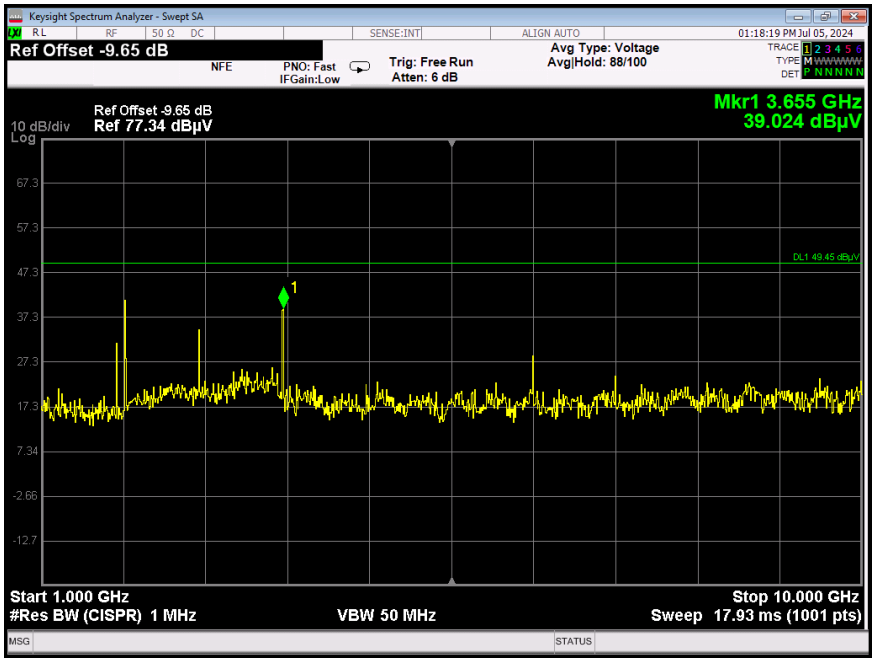
Tuned Frequency (MHz)	Mode of Operation	PK Measured Value (dBuV/m)	AVG Specification Limit (dBuV/m)	Result
902.24	Continuous TX Low Ch	32.0	54	Pass
927.74	Continuous TX High Ch	35.4	54	Pass

Radiated Emissions Above 1000MHz

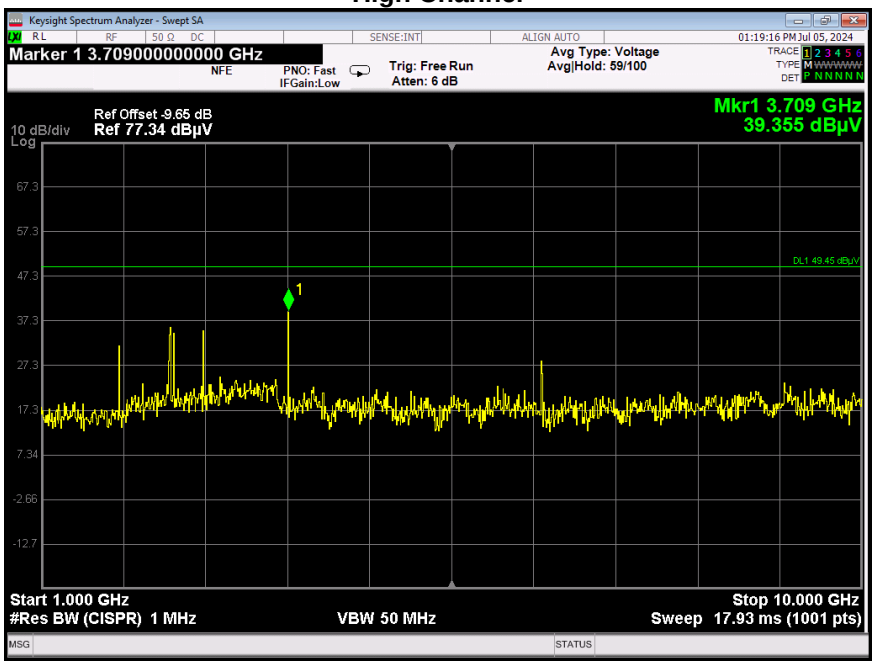
Low Channel



Mid Channel



High Channel



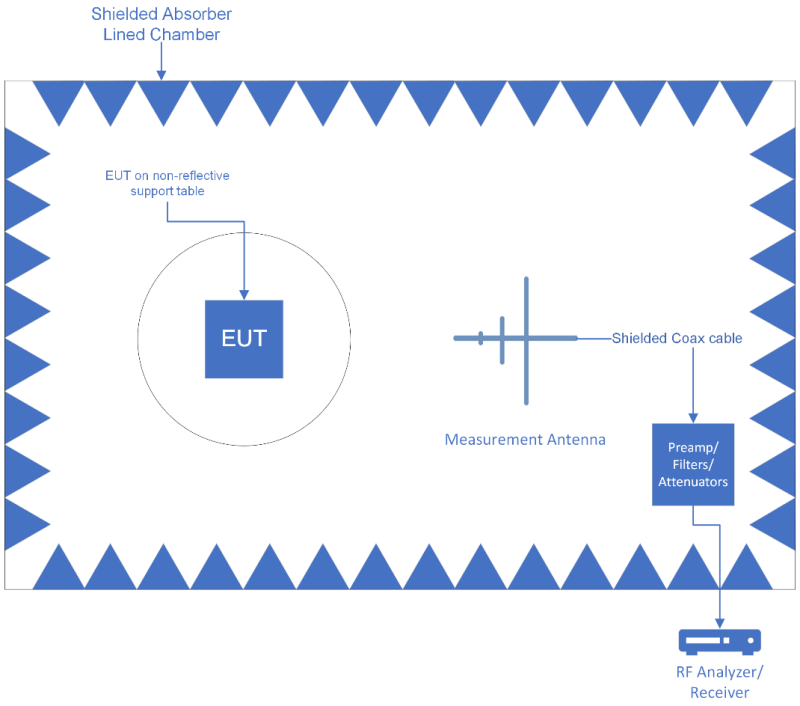
Radiated Spurious Emissions

Engineer: John Michalowicz
Test Date: June 5th 2024

Test Procedure
Radiated Spurious Emissions: 30 – 1000 MHz and Above 1GHz

The EUT was setup in a semi-anechoic test chamber set 3m from the receiving antenna. The EUT was set to transmit on the lowest, middle and highest frequency of operation at the maximum power level into a 50 ohm load. The EUT was tested, in 3 orthogonal axis, by rotating it 360° with the receive antenna in both the vertical and horizontal orientation while raised from 1 to 4 meters to ensure the TX signal levels were maximized. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Spurious Emissions. All emissions across the required range were evaluated.

Basic Test Setup



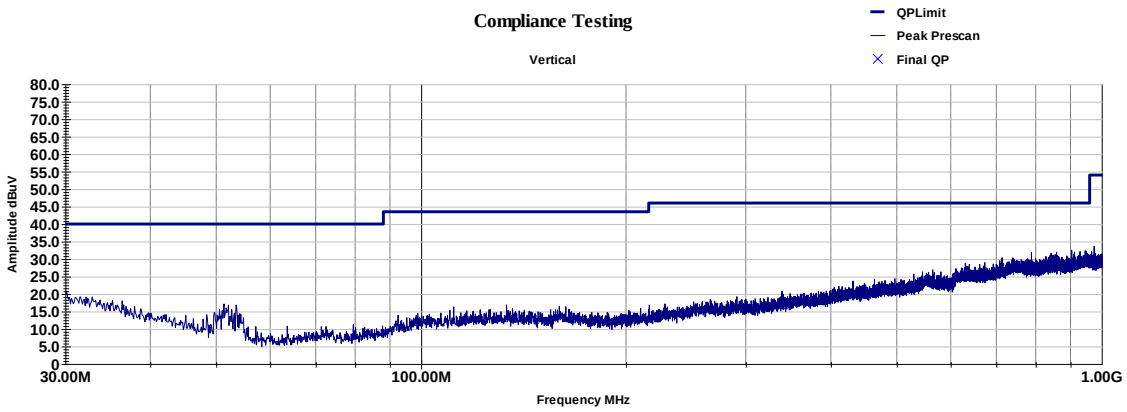
	Settings Below 1GHz	Settings Above 1GHz
RBW	120 kHz	1 MHz
VBW	300 kHz	3 MHz
Detector	Quasi Peak	Peak / Average

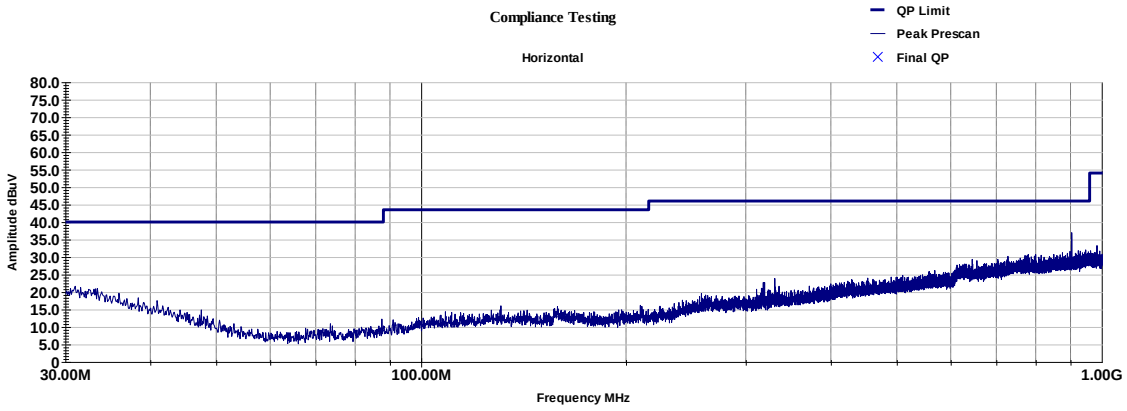
Sample Calculations

Corrected Value = Measured Value + Correction factor

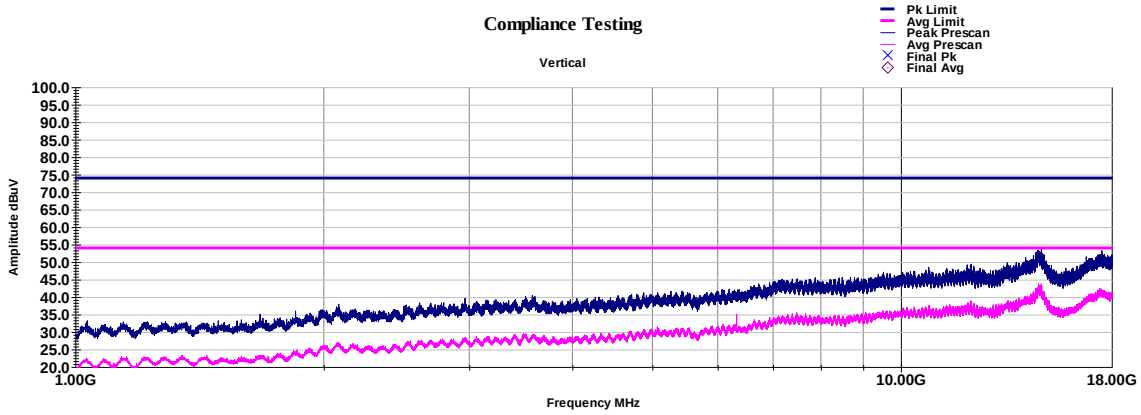
Correction factor = Antenna Correction Factor + Cable loss + Preamp/Attenuator Factor

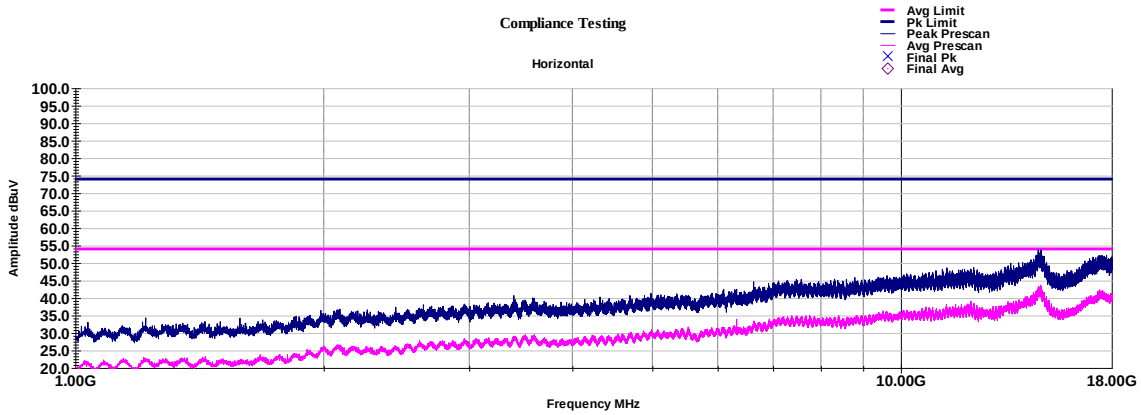
82G_Low Channel_30 - 1000 MHz



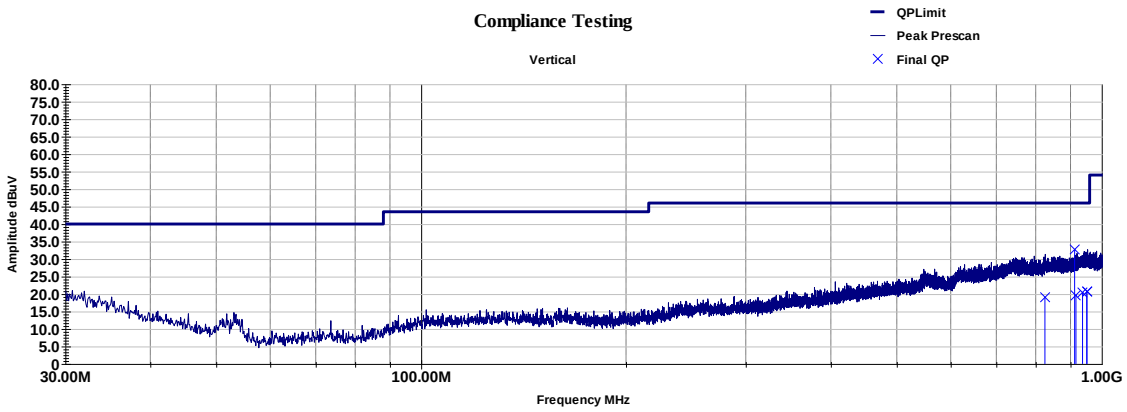


82G_Low channel_1 - 18 GHz

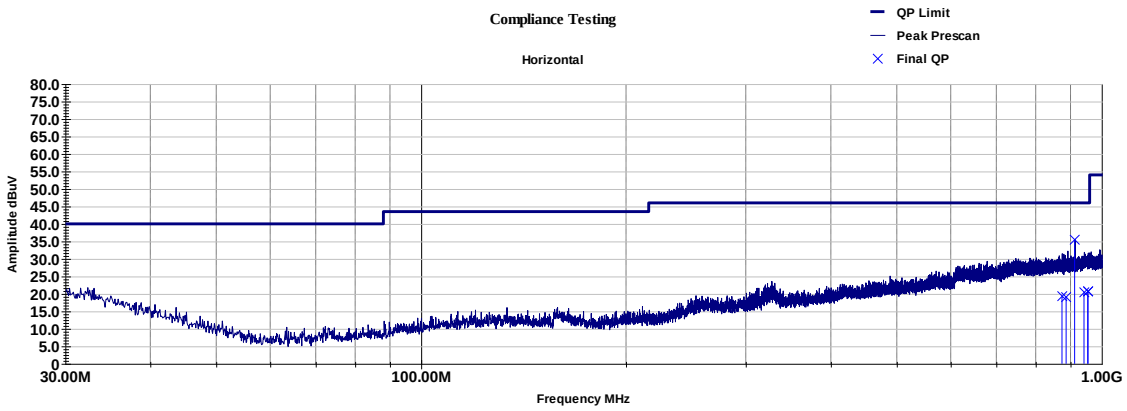




82G_Mid Channel_30 - 1000 MHz



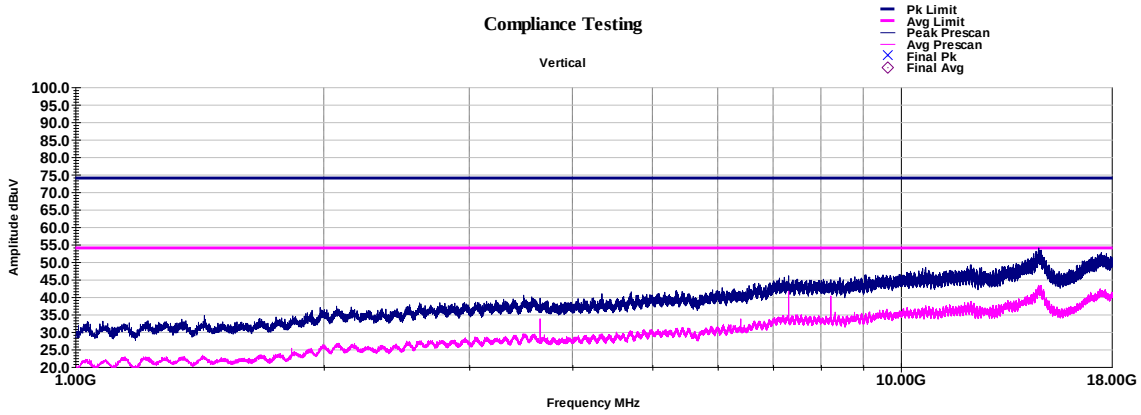
Frequency	Azimuth	Height	Raw QP	Correction	Final QP	Limit	QP Margin
MHz	deg	cm	dBuV	dB	dBuV/m	dBuV/m	dB
825.17	359.00	140.00	28.15	-9.08	19.10	46.00	-26.90
912.638	257.00	109.00	40.93	-8.24	32.70	46.00	-13.30
916.467	239.00	105.00	27.87	-8.15	19.70	46.00	-26.30
937.222	20.00	260.00	27.76	-7.26	20.50	46.00	-25.50
950.986	97.00	381.00	27.79	-7.07	20.70	46.00	-25.30
951.197	38.00	100.00	27.79	-7.09	20.70	46.00	-25.30
Final = Raw + Path Loss							
Margin = Final - Limit							

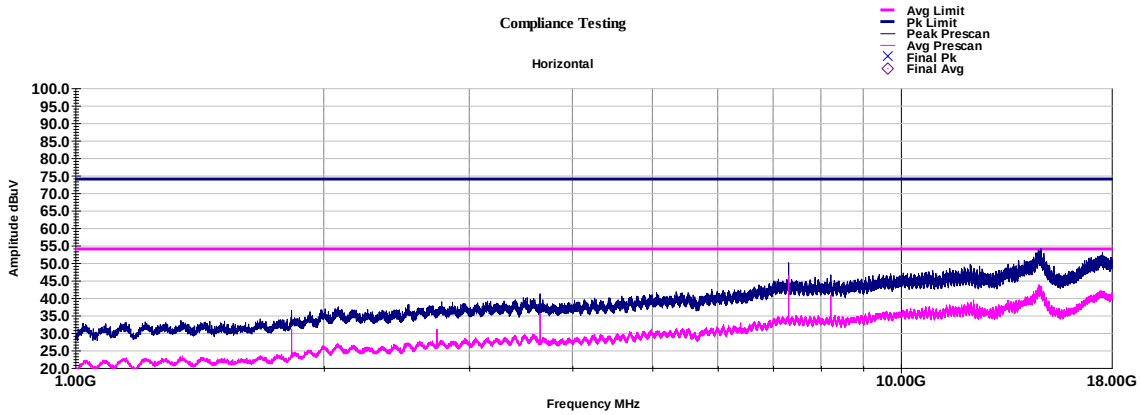


Frequency	Azimuth	Height	Raw QP	Correction	Final QP	Limit	QP Margin
MHz	deg	cm	dBuV	dB	dBuV/m	dBuV/m	dB
874.219	313.00	400.00	28.06	-8.87	19.20	46.00	-26.80
886.649	359.00	315.00	27.99	-8.85	19.10	46.00	-26.90
912.64	56.00	162.00	43.91	-8.34	35.60	46.00	-10.40
941.789	45.00	400.00	27.83	-7.39	20.40	46.00	-25.60
954.102	324.00	400.00	27.78	-7.17	20.60	46.00	-25.40
954.102	324.00	400.00	27.78	-7.17	20.60	46.00	-25.40
954.705	246.00	100.00	27.78	-7.17	20.60	46.00	-25.40
954.102	324.00	400.00	27.78	-7.17	20.60	46.00	-25.40
Final = Raw + Path Loss							

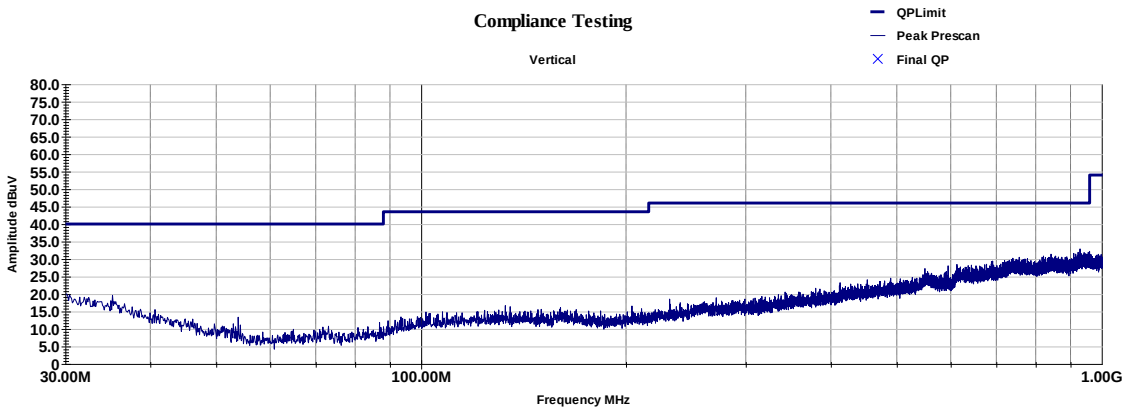
Margin = Final - Limit

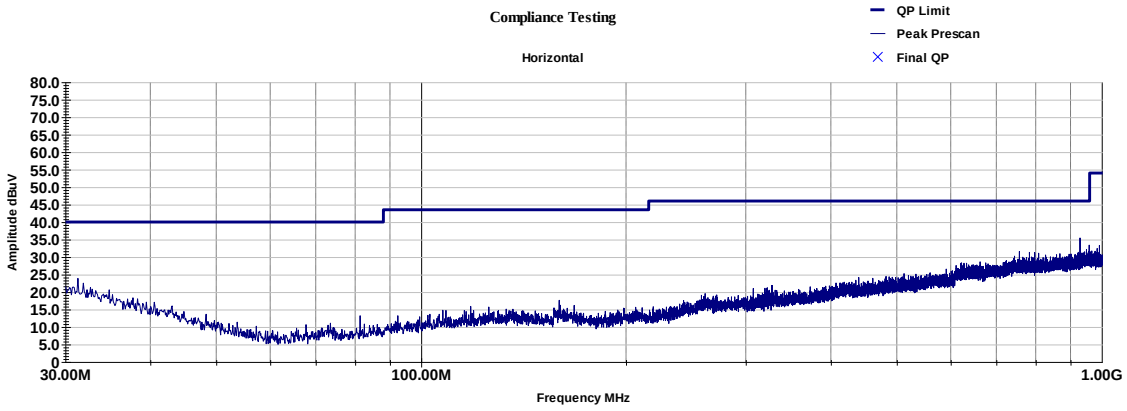
82G_Mid Channel_1 - 18 GHz



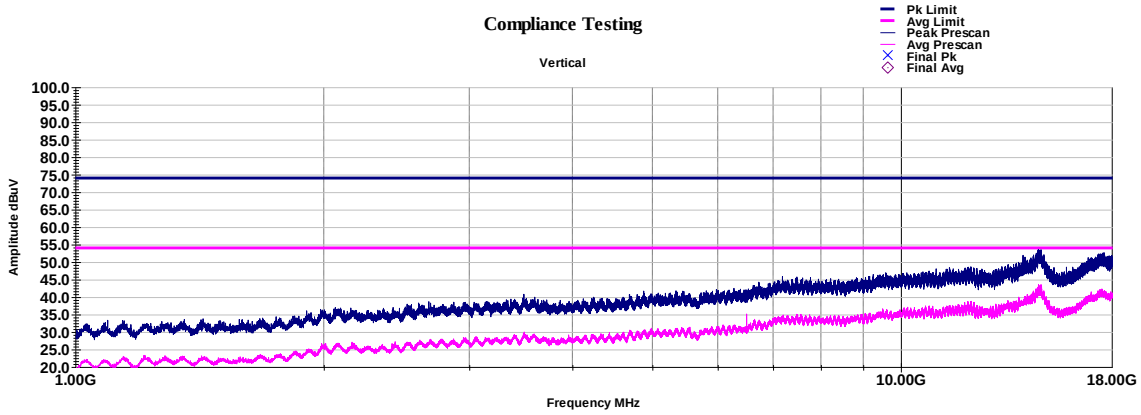


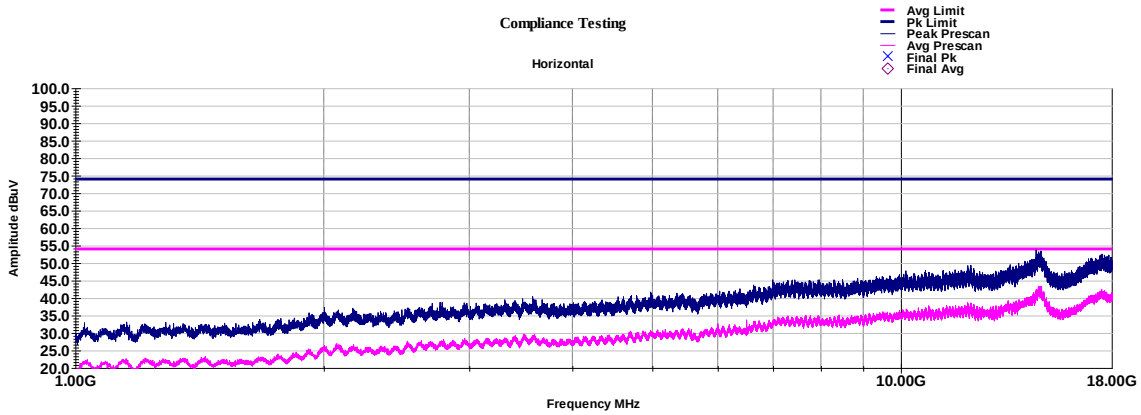
82G_High Channel_30 - 1000 MHz





82G_High channel_1 - 18 GHz





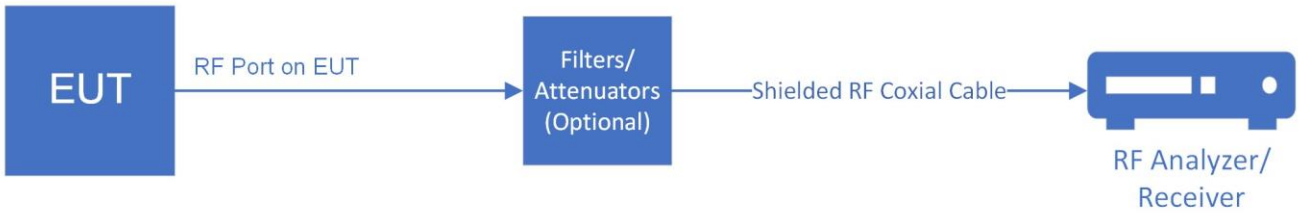
99% Occupied Bandwidth

Engineer: John Michalowicz
Test Date: June 5th 2024

Test Procedure

CONDUCTED METHOD
An antenna probe was placed next to the permanently attached antenna and then connected to a short shielded coax Cable. A spectrum analyzer was directly connected to this cable. The EUT was set to transmit on the low, mid and high frequencies at the maximum power level. The analyzer was offset to read the maximum power measured from radiated field strength measurements. A spectrum analyzer was used to verify that the EUT met the Bandwidth requirements.

Test Setup



The Spectrum Analyzer was set to the following:

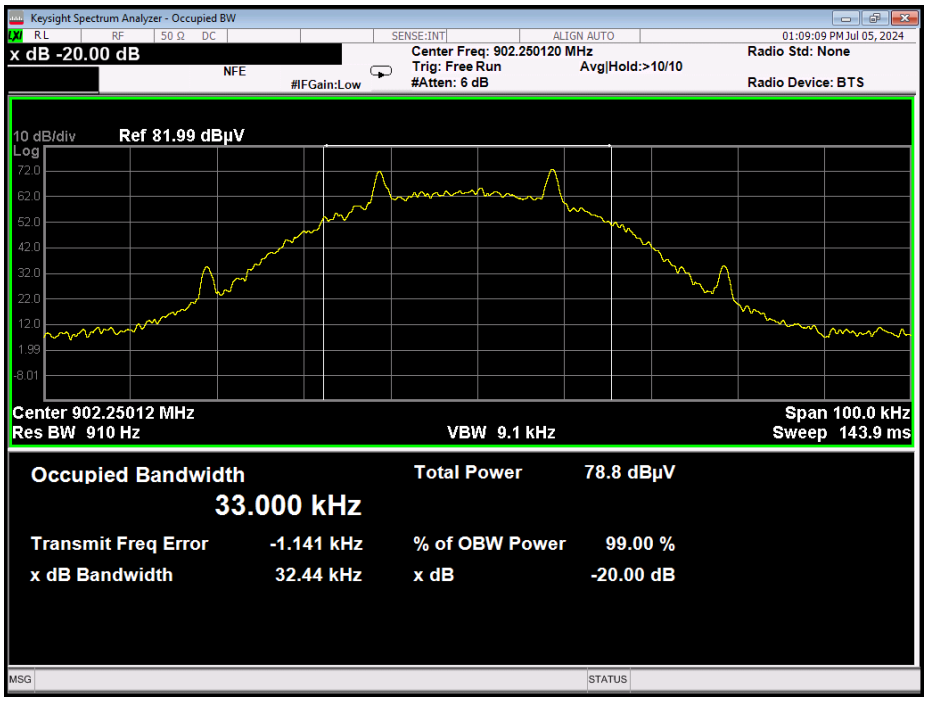
RBW = 1-3% of OBW
VBW ≥ 3 x RBW
Peak Detector
Trace mode = max hold
Sweep = auto couple
Span = 1.5 x EBW

99% Bandwidth Summary

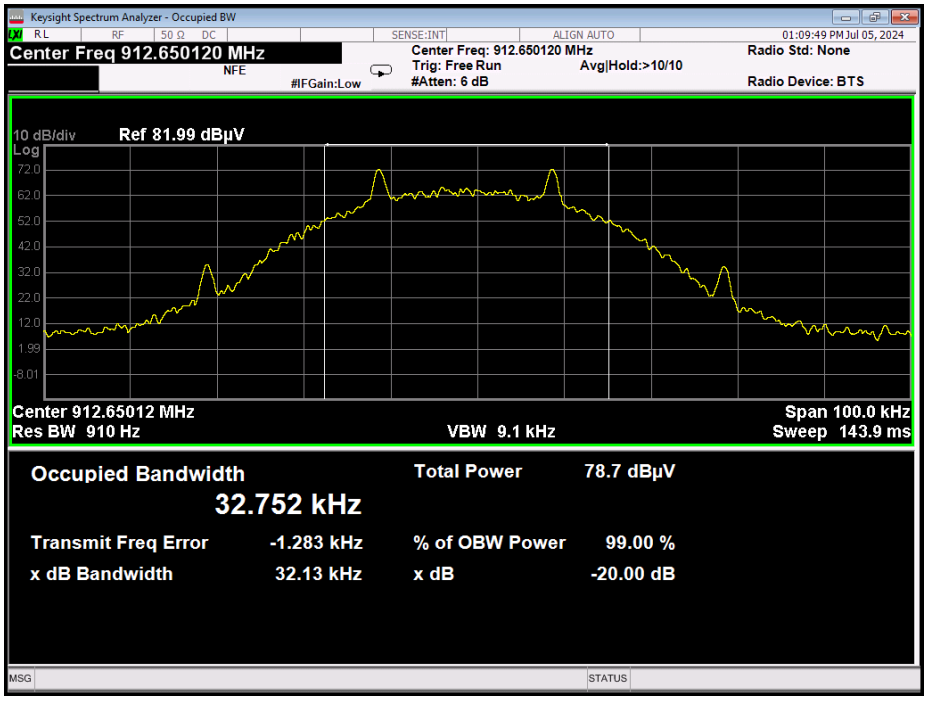
Frequency (MHz)	Mode of Operation	Measured Bandwidth (kHz)	Result
902.24	Continuous TX Low Ch	33.0	Complete
912.65	Continuous TX Mid Ch	32.7	Complete
927.74	Continuous TX High Ch	33.2	Complete

99% Bandwidth Plots

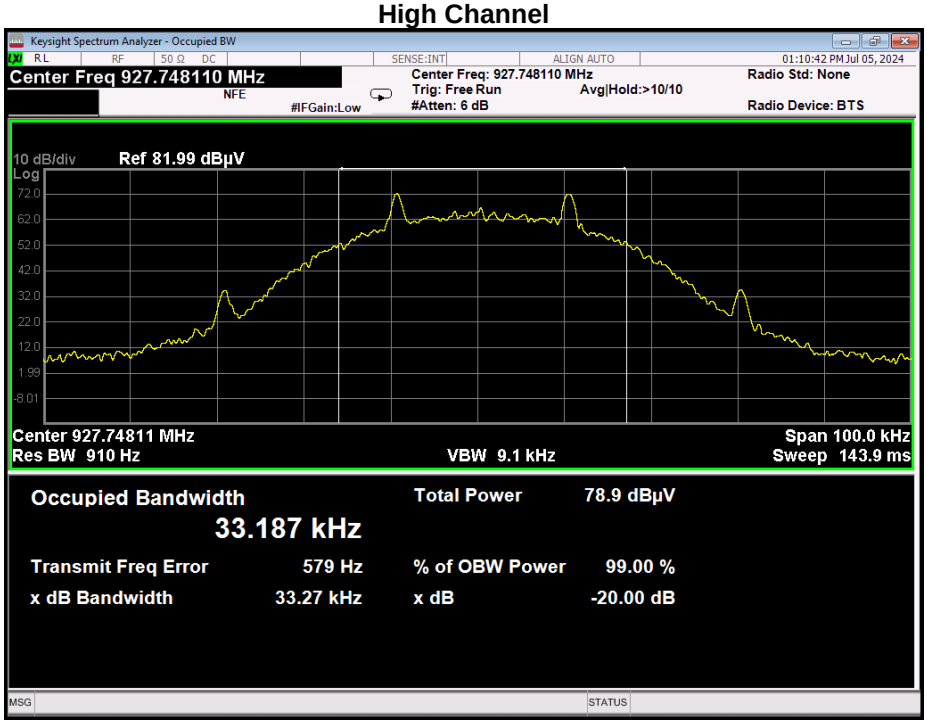
Low Channel



Mid Channel



High Channel



Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
Bilog Antenna 0.030-1.0GHz	Schaffner	CBL6111C	i00349	02/07/23	02/06/25
ultra wideband LNA 10MHz-45GHz	RF-Lambda USA	RLNA00M45GA	i00555	02/19/24	02/19/25
9kHz-44GHz CISPR comp. receiver	Keysight	N9038A	i00552	03/01/24	03/01/25
RF Amplifier 10MHz-50GHz, 40dB gain amp.	Eravant	SBB-0115034019-2F2F-E3	i00722	02/7/24	02/7/25
1-18GHz Horn Antenna	Antenna Research Assoc	DRG-118/A	i00271	08/11/22	08/10/24
Antenna, Horn 18-40GHz	EMCO	3116	I00085	03/14/23	03/13/25
temperature/humidity/pressure probe	Omega Engineering, Inc.	iBTHX-W-5	i00629	01/25/23	01/24/25
temperature/humidity/pressure probe	Omega Engineering, Inc.	iBTHX-W	i00686	01/25/23	01/24/25
Network analyzer	HP	8753D	i00505	11/03/23	11/02/24
Spectrum Analyzer 3Hz-13.2GHz	Agilent	E4445A	I00471	01/05/24	01/05/25

In addition to the above listed equipment standard RF connectors and cables were utilized in the testing of the described equipment. Prior to testing these components were tested to verify proper operation.

Measurement Uncertainty

Measurement Uncertainty for Compliance Testing is listed in the table below.

Measurement	U_{lab}
Radio Frequency	± 3.3 x 10^{-8}
RF Power, conducted	± 1.5 dB
RF Power Density, conducted	± 1.0 dB
Conducted Emissions	± 1.8 dB
Radiated Emissions 9kHz-30MHz	± 3.6 dB
Radiated Emissions 30MHz-1000MHz	± 4.25 dB
Radiated Emissions – 1GHz-18GHz	± 4.5 dB
Temperature	± 1.5 deg C
Humidity	± 4.3 %
DC voltage	± 0.20 VDC
AC Voltage	± 1.2 VAC

The reported expanded uncertainty +/- U_{lab}(dB) has been estimated at a 95% confidence level (k=2)
U_{lab} is less than or equal to U_{EMC} therefore;

- Compliance is deemed to occur if no measured disturbance exceeds the disturbance limit.
- Non-Compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

END OF TEST REPORT