Test Report Serial Number:	**45461883 R1.0**
Test Report Date:	**24 July 2023**
Project Number:	**1633**

EMC Test Report - Class II Permissive Change

Applicant:

THEDETECTIONGROUP®
Wireless Water Leak Detection

The Detection Group
440 N. Wolfe Rd. E126
Sunnyvale, CA, 94085
USA

The Detection Group
440 N. Wolfe Rd. E211
Sunnyvale, CA, 94085
USA

FCC ID: **2AK4V-DT-501**

IC Registration Number: **-**

Product Model Number / HVIN: **DT-501**

Product Name / PMN: **DT-501**

In Accordance With:

FCC 47 CFR §15.247, Part 15 Subpart B

Intentional Radiators - Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz, Unintentional Radiators

Approved By:

Ben Hewson, President
Celltech Labs Inc.
21-364 Lougheed Rd.
Kelowna, BC, V1X 7R8
Canada

Test Lab Certificate: 2470.01

IC Registration 3874A

FCC Registration: CA3874

Table of Contents

Table of Figures

Table of Plots

Table of Tables

1.0 REVISION HISTORY

Revision History					
Samples Tested By:	Art Voss, P.Eng.		**Date(s) of Evaluation:**	3 - 17 July 2023	
Report Prepared By:	Art Voss, P.Eng.		**Report Reviewed By:**	Ben Hewson	
Report Revision	**Description of Revision**		**Revised Section**	**Revised By**	**Revision Date**
1.0	Initial Release		n/a	Art Voss	24 july 2023

2.0 CLIENT AND DUT INFORMATION

Client Information	
Applicant Name (FCC)	**The Detection Group**
Applicant Address (FCC)	440 Wolfe Rd. E126
	Sunnyvale, CA, 94085
	USA
DUT Information	
Device Identifier(s):	**FCC ID:** **2AK4V-DT-501**
Device Type:	Industrial Digital Transceiver
Device Model(s) / HVIN:	DT-501
Device Marketing Name / PMN:	DT-501
Firmware Version ID Number / FVIN:	-
Host Marketing Name / HMN:	-
Test Sample Serial No.:	21105147
Equipment Class (FCC):	Digital Transmission System (DTS)
Transmit Frequency Range:	906 - 924MHz
Test Channels:	3 Channel
Manuf. Max. Rated Output Power:	24dBm
Manuf. Max. Rated BW/Data Rate:	n/a
Antenna Make and Model:	Whip
Antenna Type and Gain:	1.2dBi
Modulation:	BPSK-40
Mode:	Simplex
Emission Designator:	See Section 8.0
DUT Power Source:	3.7VDC Li-Ion Rechargeable
DUT Dimensions [LxWxD]	125mm x 95mm x 40mm
Deviation(s) from standard/procedure:	None
Modification of DUT:	None

3.0 SCOPE

Preface:

This Certification Report was prepared on behalf of:

The Detection Group

,(the '*Applicant*"), in accordance with the applicable Federal Communications Commission (FCC) CFR 47 and Innovation, Scientific and Economic Development (ISED) Canada rules parts and regulations (the '*Rules*'). The scope of this investigation was limited to only the equipment, devices and accessories (the '*Equipment*') supplied by the *Applicant*. The tests and measurements performed on this *Equipment* were only those set forth in the applicable *Rules* and/or the Test and Measurement Standards they reference. The *Rules* applied and the Test and Measurement Standards used during this evaluation appear in the Normative References section of this report. The limits set forth in the technical requirements of the applicable *Rules* were applied to the measurement results obtained during this evaluation and ,unless otherwise noted, these limits were used as the Pass/Fail criteria. The Pass/Fail statements made in this report apply to only the tests and measurements performed on only the *Equipment* tested during this evaluation. Where applicable and permissible, information including test and measurement data and/or results from previous evaluations of same or similar equipment, devices and/or accessories may be cited in this report.

Device Description:

The HVIN: DT-501 is a Class A Industrial remote hub controller with a low power 912MHz Transceiver. It is not made available to the general public and requires professional installation.

Application:

The *Applicant* wishes to remove the RF shielding to stream-line the manufacturing process. This is an application for a Class II Permissive Change.

Regulatory Requirement:

As per FCC 47 CFR 2 Subpart I , Equipment Authorization is require for this *Equipment* by means of Certification in accordance with FCC 47 CFR §15.247.

Scope of Work:

The scope of this investigation to the evaluation of the DT-501 to determine compliance to the *Rules* identified herein. It is limited to the evaluation of the Radiated Tx and Rx and antenna port Conducted emissions to ensure no degradation in the emissions exceeds those as previously filed.

RF Exposure:

As previously filed.

4.0 TEST SUMMARY

TEST SUMMARY					
Section	**Description of Test**	**Procedure Reference**	**Applicable Rule Part(s) FCC**	**Test Date**	**Result**
7.0	Conducted Pow er (Fundamental)	ANSI C63.10-2013 KDB 558074 D01v05	§2.1046 §15.247(b)(3)	5 Nov 2022	Pass
8.0	Conducted Tx Spurious Emissions	ANSI C63.10-2013 KDB 558074 D01v05	§2.1051 §15.247(d)	17 July 2023	Pass
9.0	Radiated Tx Spurious Emissions	ANSI C63.4-2014 KDB 558074 D01v05	§15.109 §15.247(d)	3 July 2023	Pass
10.0	Radiated Rx Spurious Emissions	ANSI C63.4-2014 KDB 558074 D01v05	§15.109	3 July 2023	Pass

Test Station Day Log

Date	Ambient Temp (°C)	Relative Humidity (%)	Barometric Pressure (kPa)	Test Station	Tests Performed Section(s)
3 July 2023	19.0	28	102.0	**OATS**	**9,10**
17 July 2023	26.0	16	101.9	**EMC**	**7,8**

EMC - EMC Test Bench
OATS - Open Area Test Site
LISN - LISN Test Area
IMM - Immunity Test Area
SAC - Semi-Anechoic Chamber
TC - Temperature Chamber
ESD - ESD Test Bench
RI - Radiated Immunity Chamber

I attest that the data reported herein is true and accurate within the tolerance of the Measurement Instrument Uncertainty; that all tests and measurements were performed in accordance with accepted practices or procedures; and that all tests and measurements were performed by me or by trained personnel under my direct supervision. The results of this investigation are based solely on the test sample(s) provided by the client which were not adjusted, modified or altered in any manner whatsoever, except as required to carry out specific tests or measurements. This test report has been completed in accordance with ISO/IEC 17025.

Art Voss, P.Eng.
Technical Manager
Celltech Labs Inc.

24 July 2023
Date

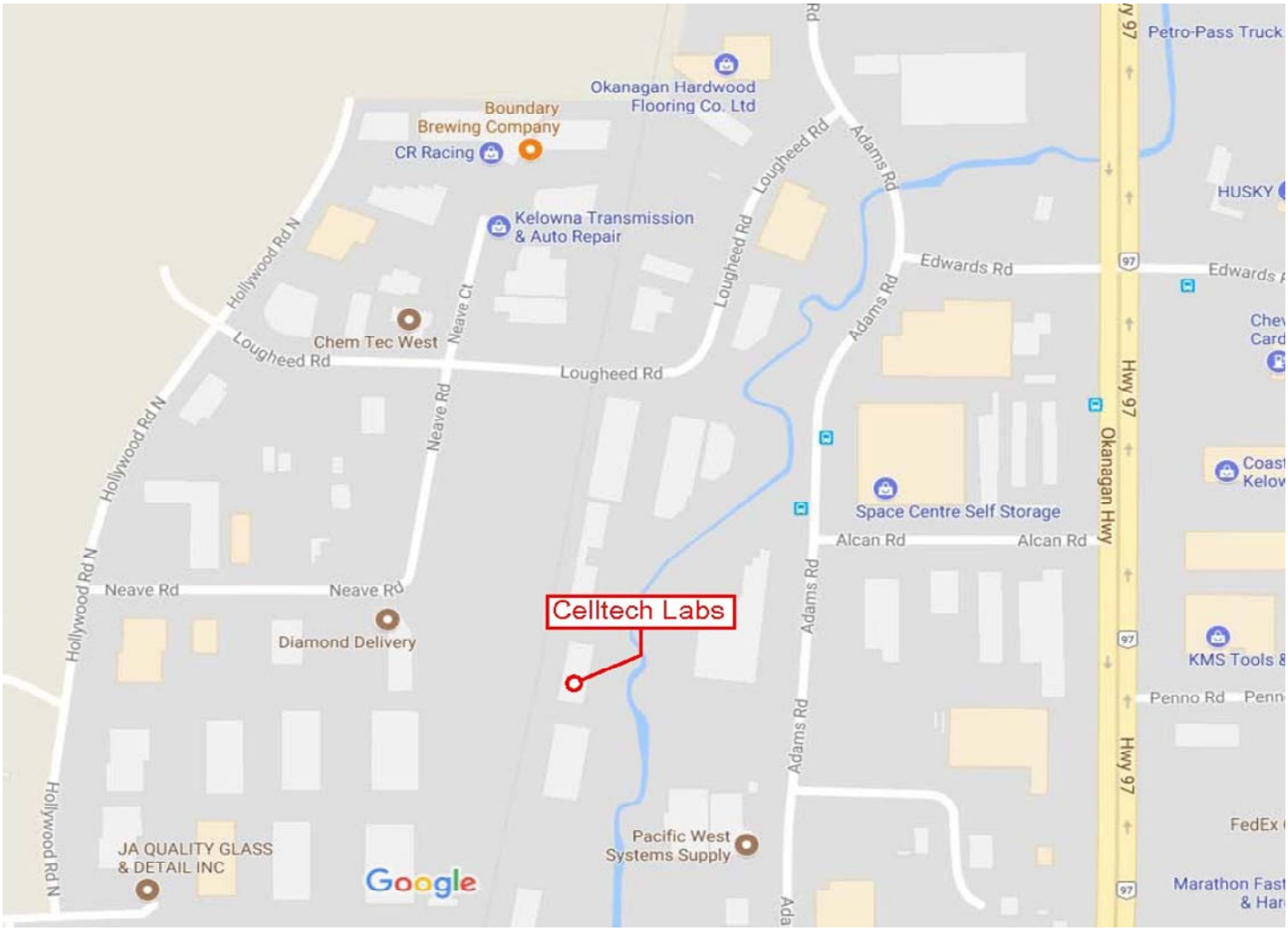
5.0 NORMATIVE REFERENCES

Normative References	
ISO/IEC 17025:2017	General requirements for the competence of testing and calibration laboratories
ANSI C63.4-2014	American National Standard of Procedures for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electric and Electronic Equipment in the Range of 9kHz to 40GHz
ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
CFR Title 47: Part 2:	Code of Federal Regulations Telecommunication Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
CFR Title 47: Part 15: Subpart B:	Code of Federal Regulations Telecommunication Radio Frequency Devices Unintentional Radiators
CFR Title 47: Part 15: Sub Part C (15.247)	Code of Federal Regulations Telecommunication Radio Frequency Devices Intentional Radiators
FCC KDB 558074 D01v05r02	OET Major Guidance Publications, Knowledge Data Base Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under Section 15.247

6.0 FACILITIES AND ACCREDITATIONS

Facility and Accreditation:

The facilities used to evaluate this device outlined in this report are located at 21-364 Lougheed Road, Kelowna, British Columbia, Canada V1X 7R8. The radiated emissions site (OATS) conforms to the requirements set forth in ANSI C63.4 and is filed and listed with the FCC under Test Firm Registration Number CA3874 and Innovation, Science and Economic Development Canada under Test Site File Number ISED 3874A. Celltech is accredited to ISO 17025, through accrediting body A2LA and with certificate 2470.01.



7.0 CONDUCTED CHANNEL POWER

Test Procedure	
Normative Reference	FCC 47 CFR §2.1046, §15.247(b)(3), RSS-Gen (6.1.2), RSS-247 (5.4)(d), KDB 558074 (8.3.2), ANSI C63.10 (11.9.2.2.2)

Limits	
47 CFR §15.247(b)(3)	(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power.
RSS-247 (5.4)(d)	**5.4 Transmitter output power and equivalent isotropically radiated power (e.i.r.p.)** Devices shall comply with the following requirements, where applicable: d) For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e). As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power.

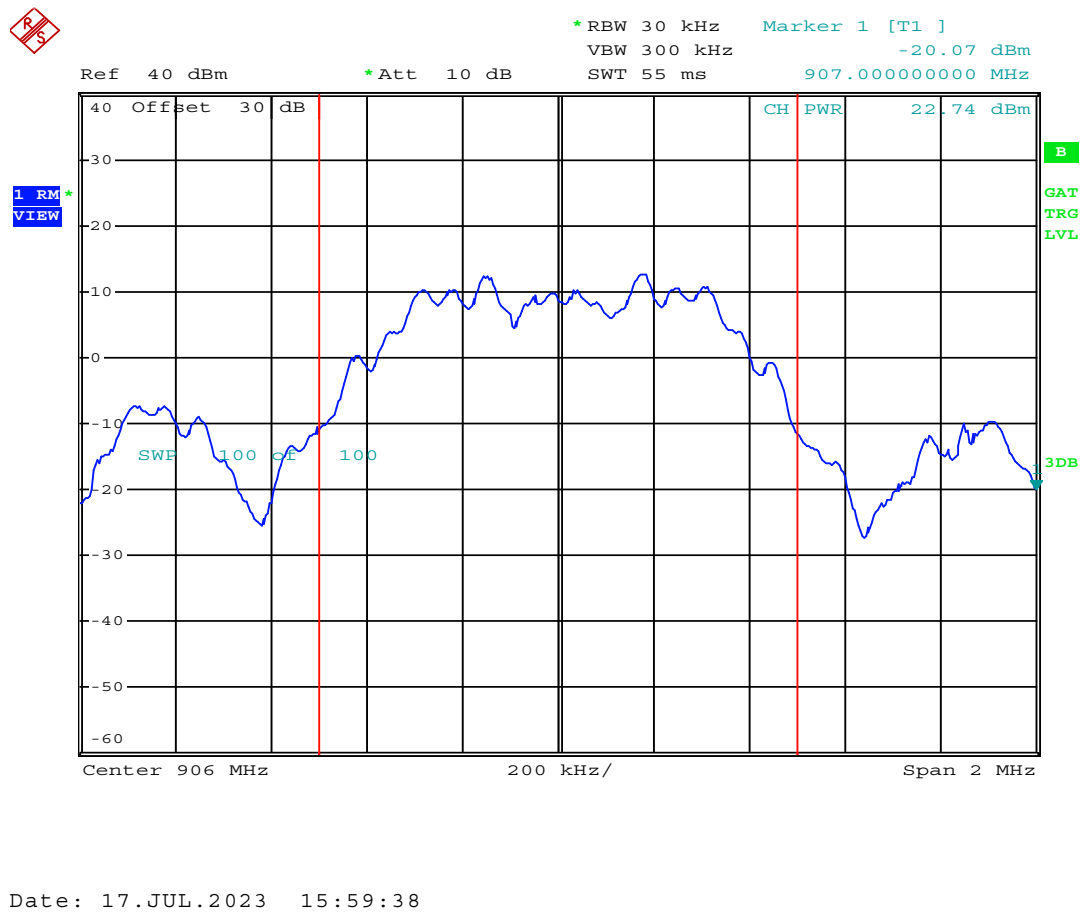
General Procedure	
KDB 558074 (8.3.2.1)	**8.3.2.1 General** Section 15.247 permits the maximum conducted (average) output power to be measured as an alternative to the maximum peak conducted output power for demonstrating compliance to the limit. When this option is exercised, the measured power is to be referenced to the OBW rather than the DTS bandwidth.
C63.10 (11.9.2.2.2)	**Method AVGSA-1** (trace averaging with the EUT transmitting at full power throughout each a) Set span to at least 1.5 X OBW. b) Set RBW = 1 % to 5 % of the OBW, not to exceed 1 MHz. c) Set VBW ≥ 3 X RBW. d) Number of points in sweep ≥ 2 X span / RBW. e) Sweep time = auto. f) Detector = RMS g) If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle ≥ 98 %, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to “free run”. h) Trace average at least 100 traces in power averaging i) Compute power by integrating the spectrum across the OBW of the signal using the instrument’s band power measurement function, with band limits set equal to the OBW band edges.

Test Setup	Appendix A - Figure A.1

Measurement Procedure
The DUT was connected to a Spectrum Analyzer (SA) via a 30dB attenuator connected to the DUT’s antenna port. The SA was configured as described above. Number of Sweep Points ≥ 2 X Span / RBW = 2 X (1.2MHz / 3kHz) = 800, the SA was configured for 1001 Points. The output power of the DUT was set to the manufacturer’s highest output power setting at the Low, Mid and High frequency channels as permitted by the device. The DUT was set to transmit at 100% Duty Cycle. The Channel Bandwidth was set to the measured 99% Occupied Bandwidth (See Section 9.0). The Band Channel Power was measured and recorded.

Plot 7.1 – Conducted Channel Power, 906 MHz

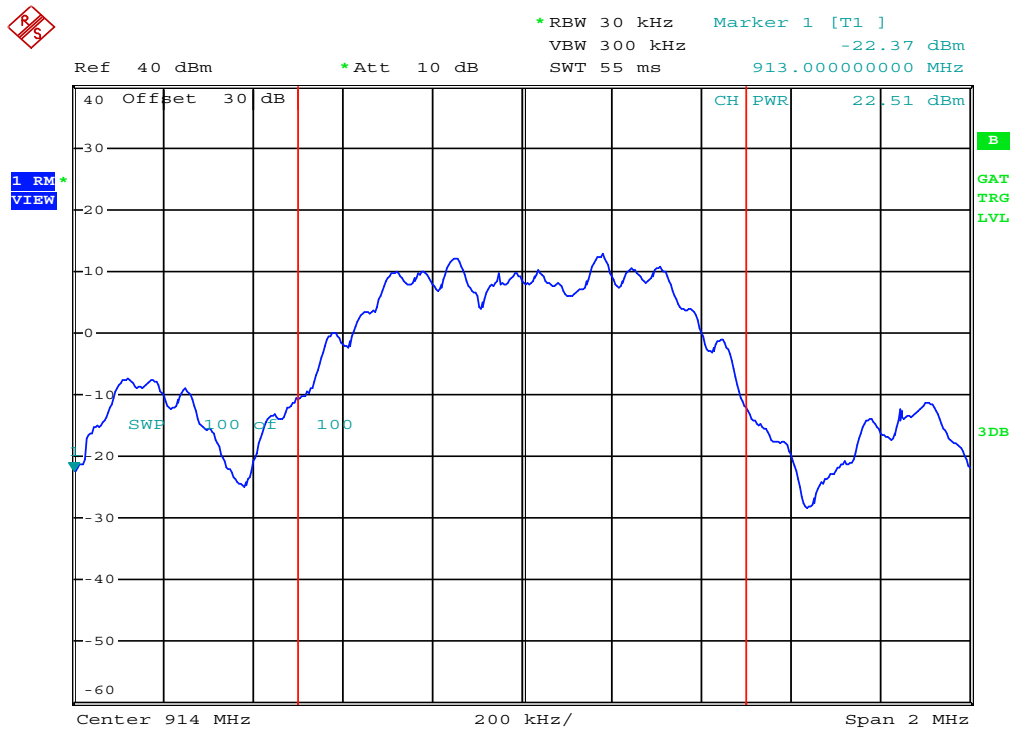
Conducted Power:



Channel:	1	**Channel Frequency:**	906 MHz
Mode:	-	**Modulation:**	BPSK
		Measured Channel Power:	22.75 dBm

Plot 7.2 – Conducted Channel Power, 914 MHz

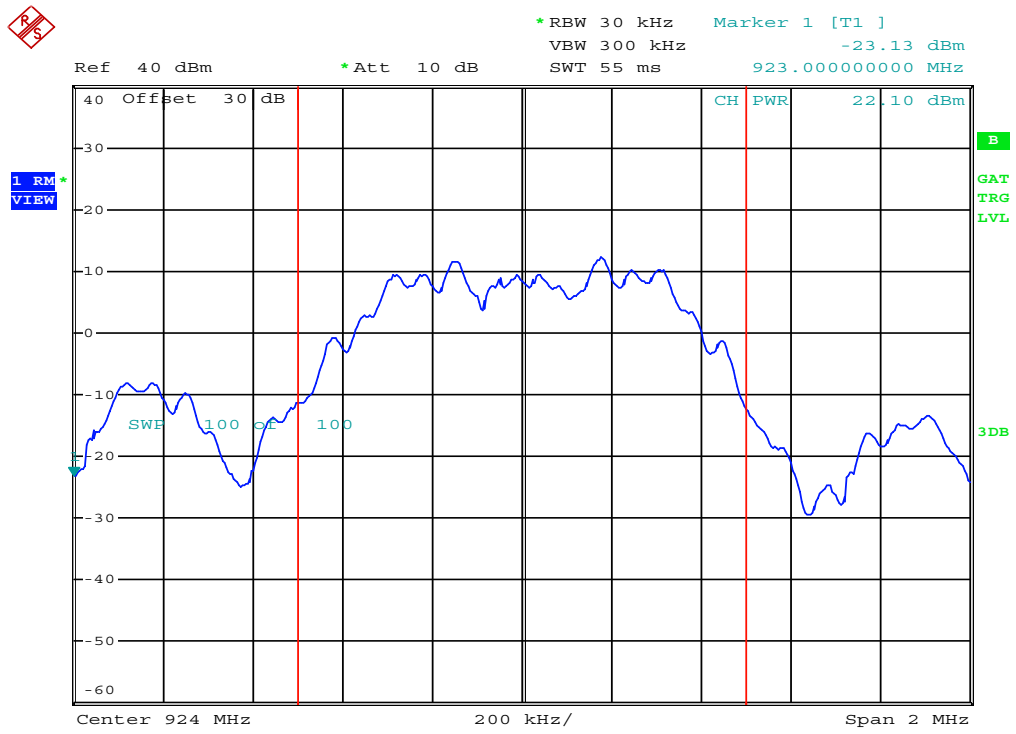
Conducted Power:



Channel:	**5**	**Channel Frequency:**	**914**	**MHz**
Mode:	**-**	**Modulation:**	**BPSK**	
		Measured Channel Power:	**22.51**	**dBm**

Plot 7.3 – Conducted Channel Power, 924 MHz

Conducted Power:



Channel:	**10**	**Channel Frequency:**	**924**	**MHz**
Mode:	**-**	**Modulation:**	**BPSK**	
		Measured Channel Power:	**22.10**	**dBm**

Table 7.1 – Summary of Conducted Channel Power Measurements

§15.247(b)(3), RSS-247 (5.4)(d) Channel Output Power (RMS)						
Frequency (MHz)	Modulation	Power Setting[1] (dBm)	Measured Power [E_{Meas}] (dBm)	Measured Power [E_{Meas}] (W)	Limit (W)	Margin (dB)
906.0	BPSK	Max	22.75	0.19	1.0	**7.3**
914.0	BPSK	Max	22.51	0.18	1.0	**7.5**
924.0	BPSK	Max	22.10	0.16	1.0	**7.9**
					Results:	**Complies**

(1) The output power is factory set to maximum

Margin = 10*Log(Limit / E_{meas})

RSS-247 (5.4)(d) Channel EIRP (RMS)									
Frequency (MHz)	Modulation	Power Setting[1] (dBm)	Measured Power [E_{Meas}] (dBm)	Antenna Gain[2] [G_T] (dBi)	Cable Loss [L_C] (dB)	EIRP (dBm)	EIRP (W)	Limit (W)	Margin (dB)
906.0	BPSK	Max	22.75	1.5	0.5	24.75	0.30	4.0	**11.3**
914.0			22.51			24.51	0.28		**11.5**
924.0			22.10			24.10	0.26		**11.9**
							Results:		**Complies**

EIRP (dBm) = E_{Meas} + G_T + L_C

Margin = Limit - EIRP in dB

(1) The output power is factory set to maximum

(2) Maximum permissible gain

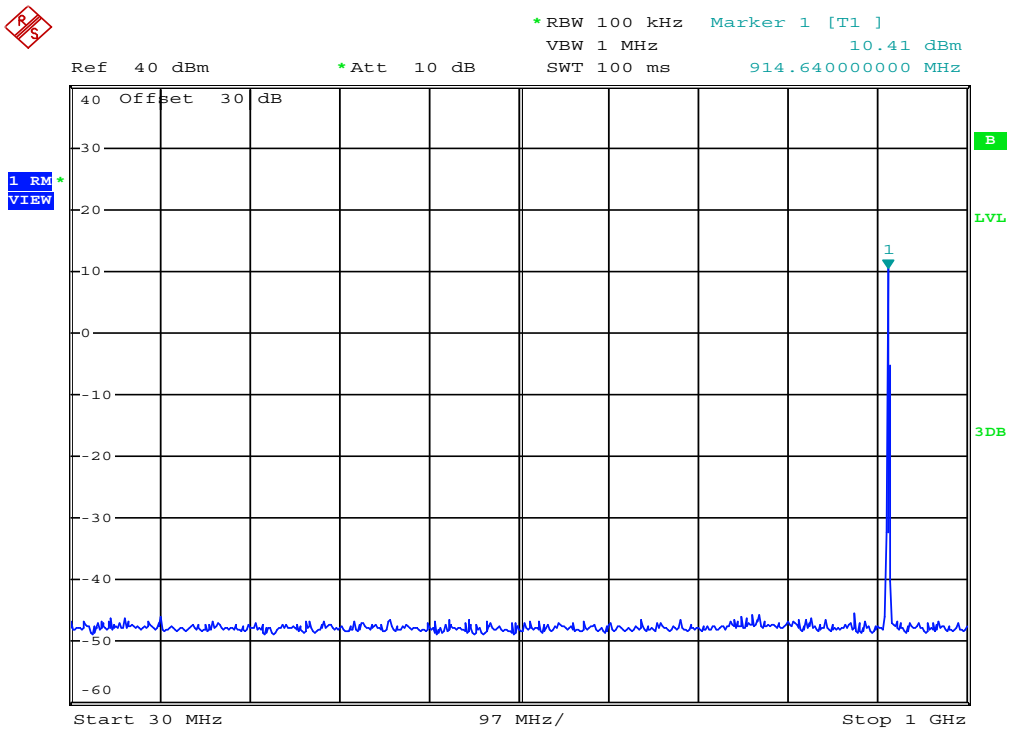
8.0 CONDUCTED SPURIOUS EMISSIONS

Test Procedure	
Normative Reference	FCC 47 CFR §2.1051, §15.247(d), RSS-Gen (6.13), RSS-247 (5.5),
	KDB 558074 (8.7), ANSI C63.10 (11.13.3.3)

Limits	
47 CFR §15.247(d)	(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.
RSS-247 (5.5)	**5.5 Unwanted emissions** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required. d) For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e). As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power.

Plot 8.1 – Conducted Spurious Emission Measurement

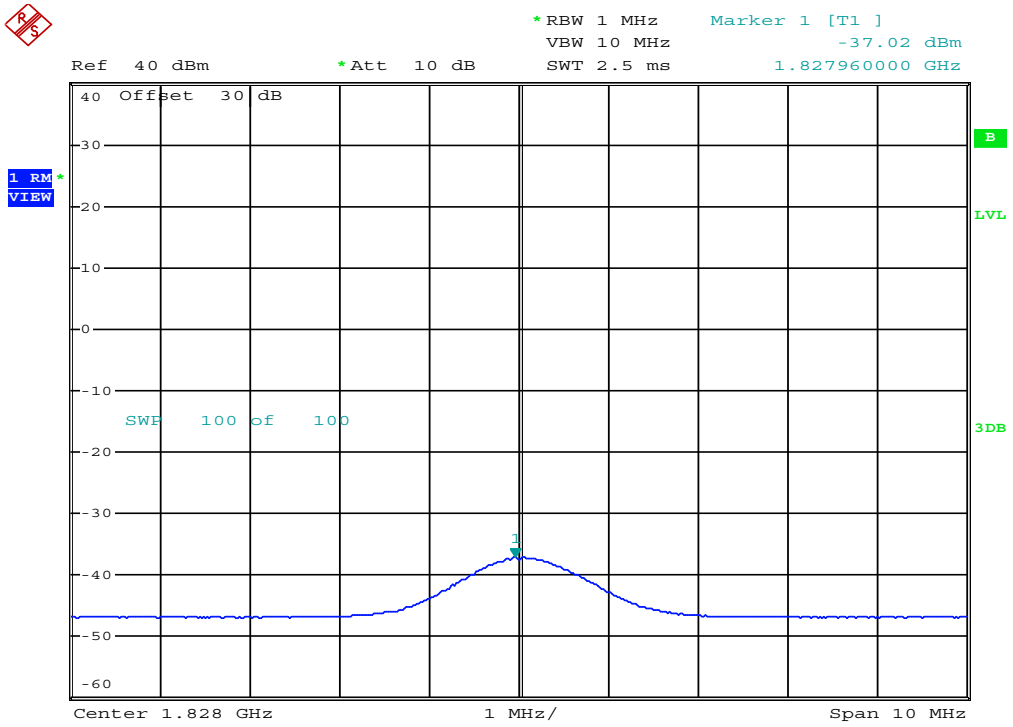
Conducted Spurious Emissions:



Channel:	**5**		**Channel Frequency:**	**914**	**MHz**
Mode:	**-**		**Modulation:**	**BPSK**	
Emission Frequency:	**Fundamental**	**MHz**	**Measured Emission:**	**Fundamental**	**dBm**

Plot 8.2 – Conducted Spurious Emission Measurement

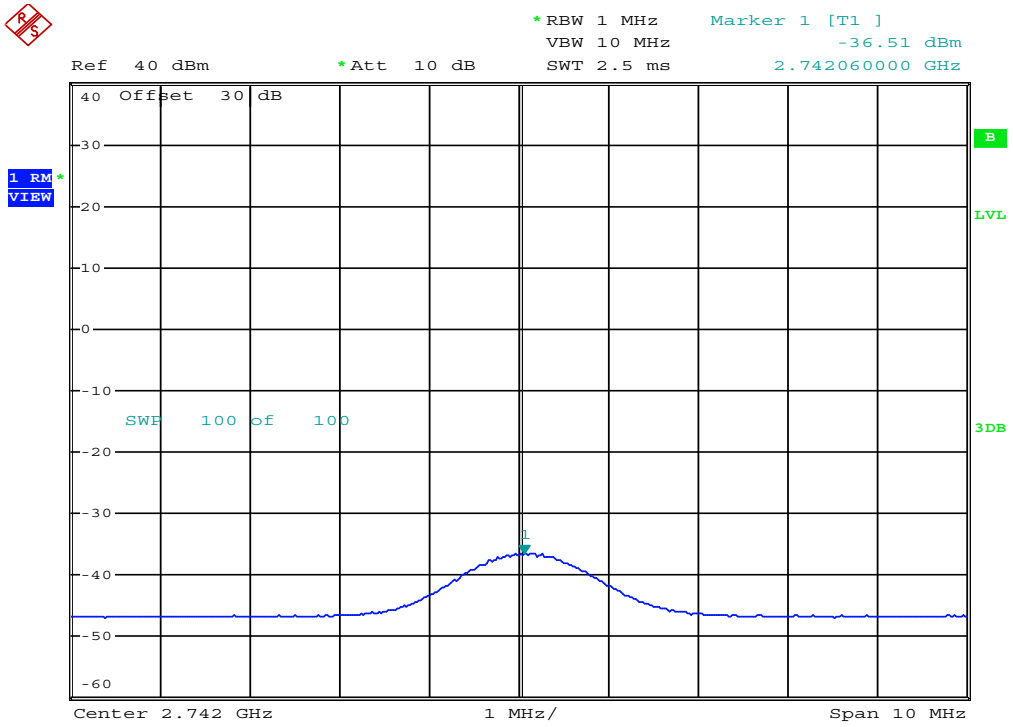
Conducted Spurious Emissions:



Channel:	**5**		**Channel Frequency:**	**914**	**MHz**
Mode:	**-**		**Modulation:**	**BPSK**	
Emission Frequency:	**1828**	**MHz**	**Measured Emission:**	**-37.02**	**dBm**

Plot 8.3 – Conducted Spurious Emission Measurement

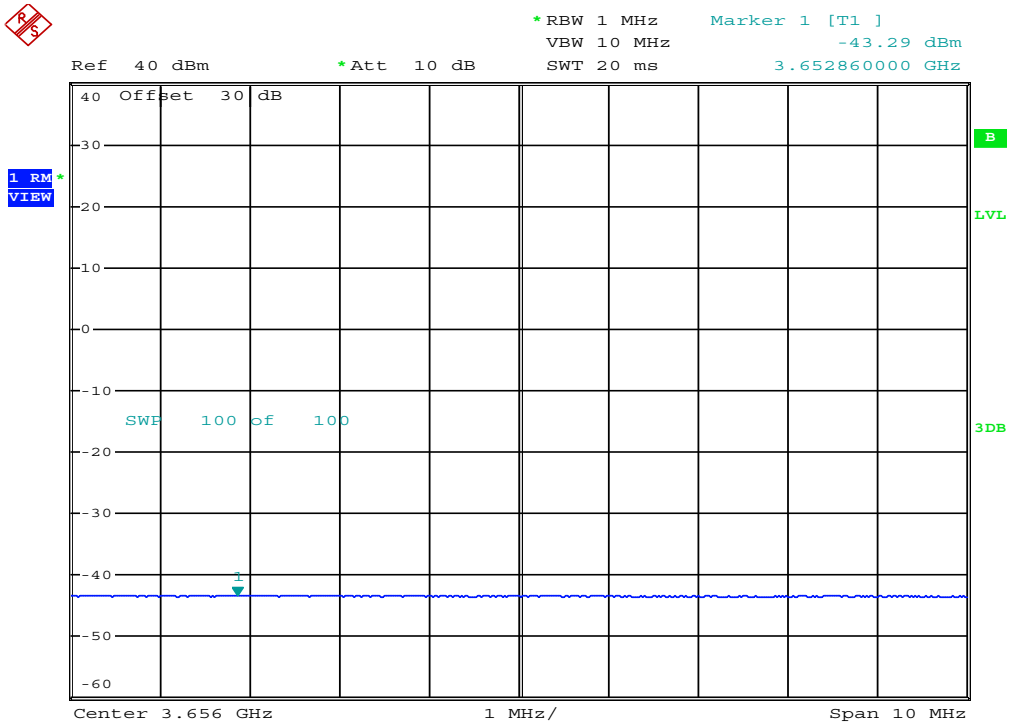
Conducted Spurious Emissions:



Channel:	**5**		**Channel Frequency:**	**914**	**MHz**
Mode:	**-**		**Modulation:**	**BPSK**	
Emission Frequency:	**2742**	**MHz**	**Measured Emission:**	**-36.51**	**dBm**

Plot 8.4 – Conducted Spurious Emission Measurement

Conducted Spurious Emissions:



Channel:	**5**		**Channel Frequency:**	**914**	**MHz**
Mode:	**-**		**Modulation:**	**BPSK**	
Emission Frequency:	**ND**	**MHz**	**Measured Emission:**	**ND**	**dBm**

Table 8.1 – Summary of Conducted Spurious Emissions Measurements

Conducted Spurious Emissions Measurement Results:								
Channel Number	Frequency (MHz)	Modulation	Emission Power [P_{Em}] (dBm)	Emission Frequency (MHz)	Fundamental Measurment [P_{Fund}] (dBm)	Attenuation [Atten] (dB)	Limit (dB)	Margin (dB)
5	914.00	BPSK	-37.02	1820	10.41	47.43	30	17.4
			-36.51	2742		46.92		16.9
								Complies

Attenuation [Atten] = [P_{Fund}] - [P_{Em}]
Margin = Attenuation - Limit
ND = None Detected

9.0 RADIATED TX EMISSIONS

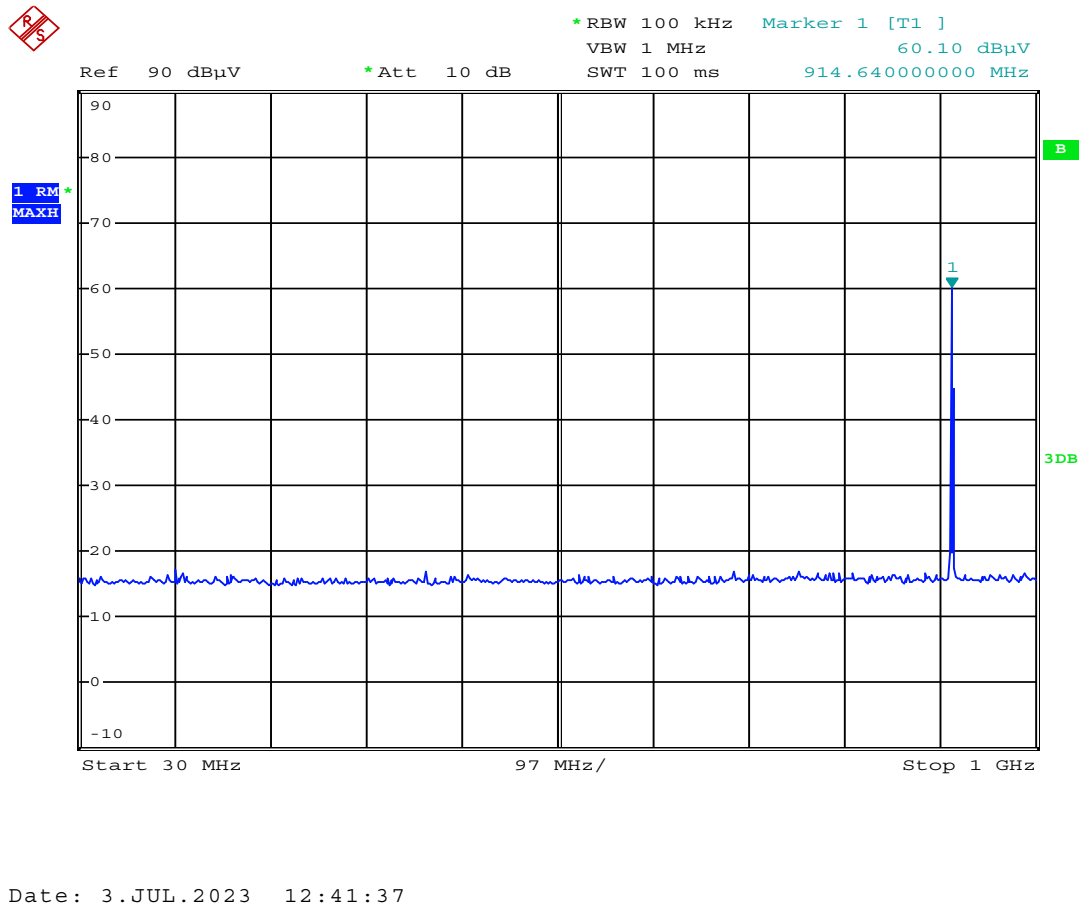
Test Procedure	
Normative Reference	FCC 47 CFR §2.1051, §15.247(d), §15.205(a), §15.205(c), §15.209(a)
	KDB 558074 (8.6), ANSI C63.10 (11.12)

Limits	
47 CFR §15.247(d)	(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).
47 CFR §15.209(a)	**§15.209 Radiated emission limits; general requirements.** (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvolts/meter)
0.009 - 0.490	2400/F (kHz) @300m
0.490 - 1.705	24000/F (kHz) @30m
1.705 - 30	30 @ 30m
30 - 88	100 @3m
88 - 216	150 @3m
216 - 960	200 @3m
Above 960	500 @3m

Plot 9.1 – Radiated Tx Emissions, 30 – 1000MHz, Horizontal

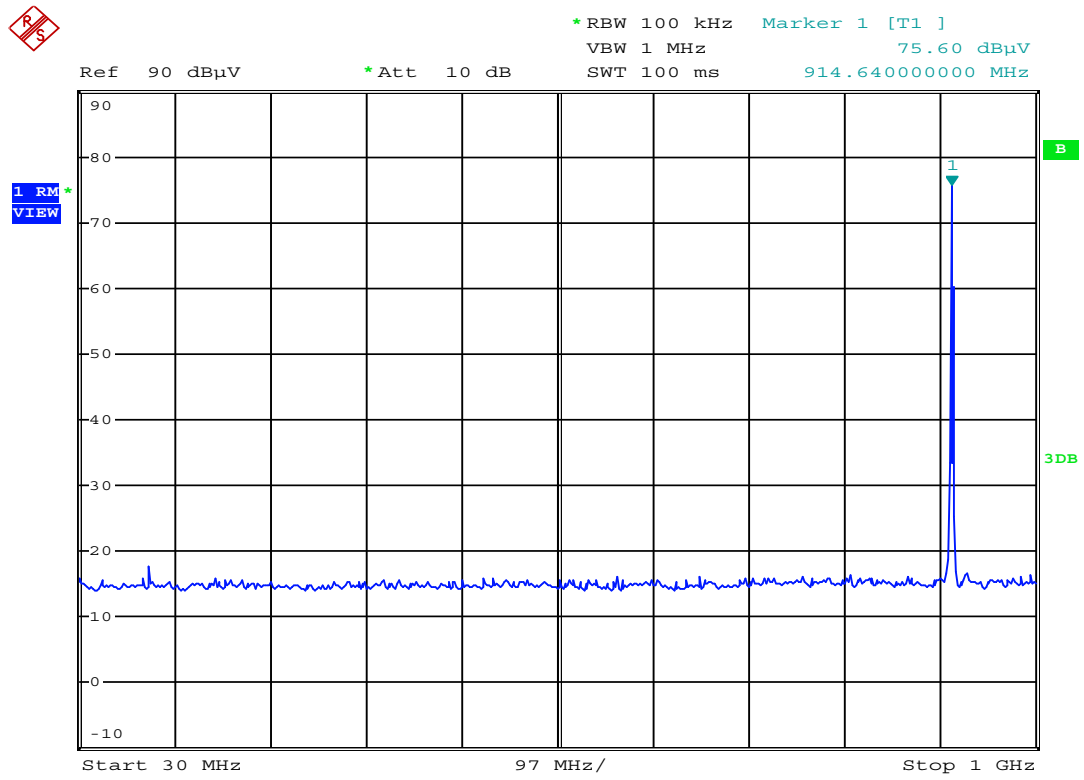
Radiated Tx Emissions:



Channel:	5		**Channel Frequency:**	914	MHz
Mode:	-		**Modulation:**	BPSK	
Polarization:	Horizontal		**Measured Channel Power(PK):**	-	dBm
Emission Frequency:	Fundamental	MHz	**Measured Channel Power(AV):**	-	dBm

Plot 9.2 – Radiated Tx Emissions, 30 – 1000MHz, Vertical

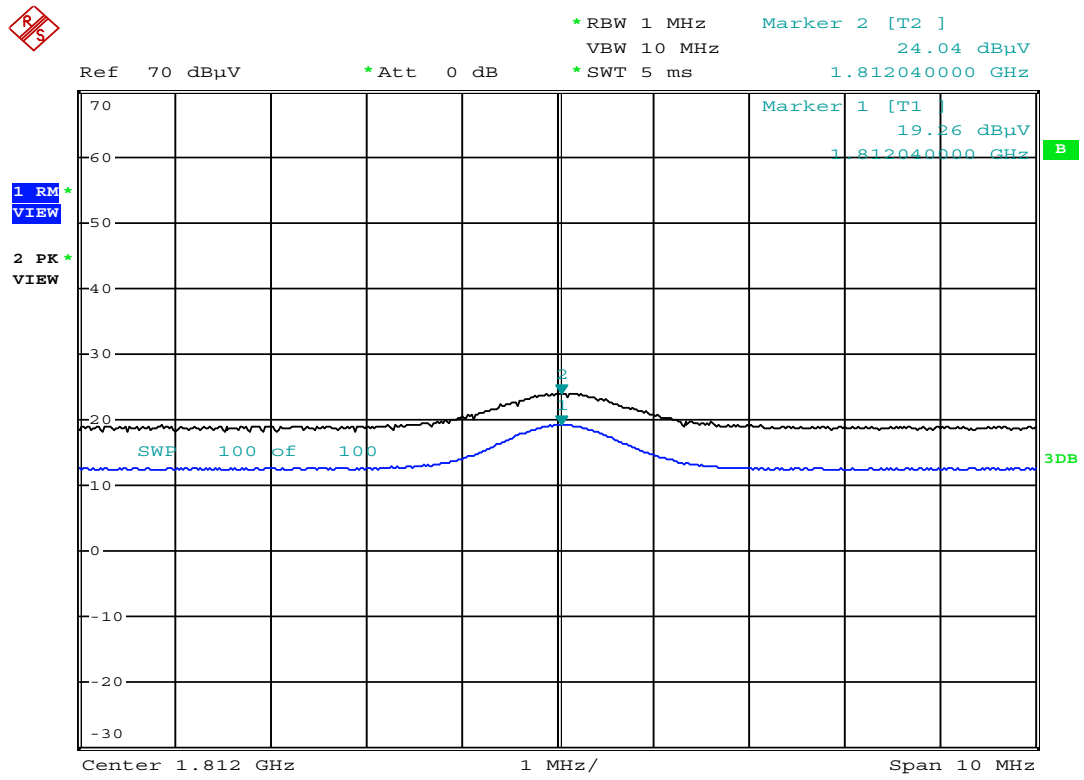
Radiated Tx Emissions:



Channel:	**5**		**Channel Frequency:**	**914**	**MHz**
Mode:	**-**		**Modulation:**	**BPSK**	
Polarization:	**Vertical**		**Measured Channel Power(PK):**	**-**	**dBm**
Emission Frequency:	**Fundamental**	**MHz**	**Measured Channel Power(AV):**	**-**	**dBm**

Plot 9.3 – Radiated Tx Emissions, Ch 1, 2nd Harmonic, Horizontal

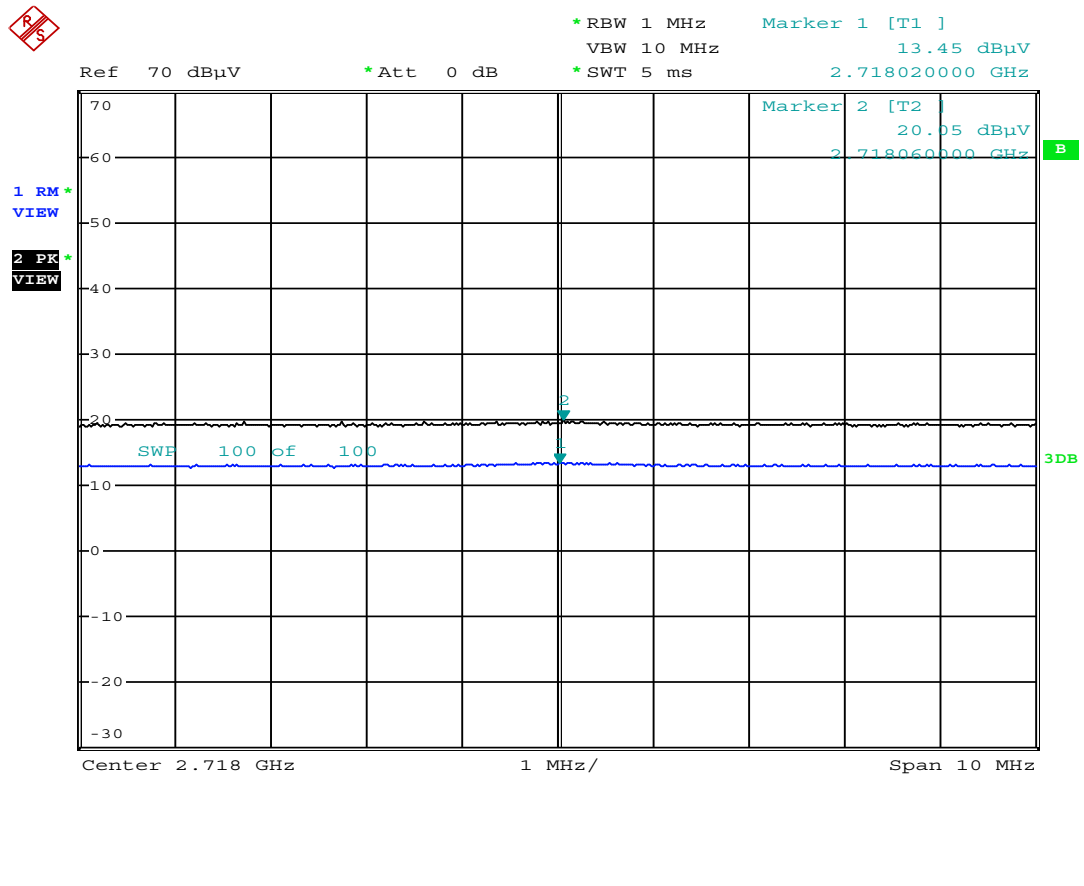
Radiated Tx Emissions:



Channel:	1		**Channel Frequency:**	906	MHz
Mode:	-		**Modulation:**	BPSK	
Polarization:	Horizontal		**Measured Channel Power(PK):**	24.04	dBm
Emission Frequency:	1812	MHz	**Measured Channel Power(AV):**	19.26	dBm

Plot 9.4 – Radiated Tx Emissions, Ch 1, 3rd Harmonic, Horizontal

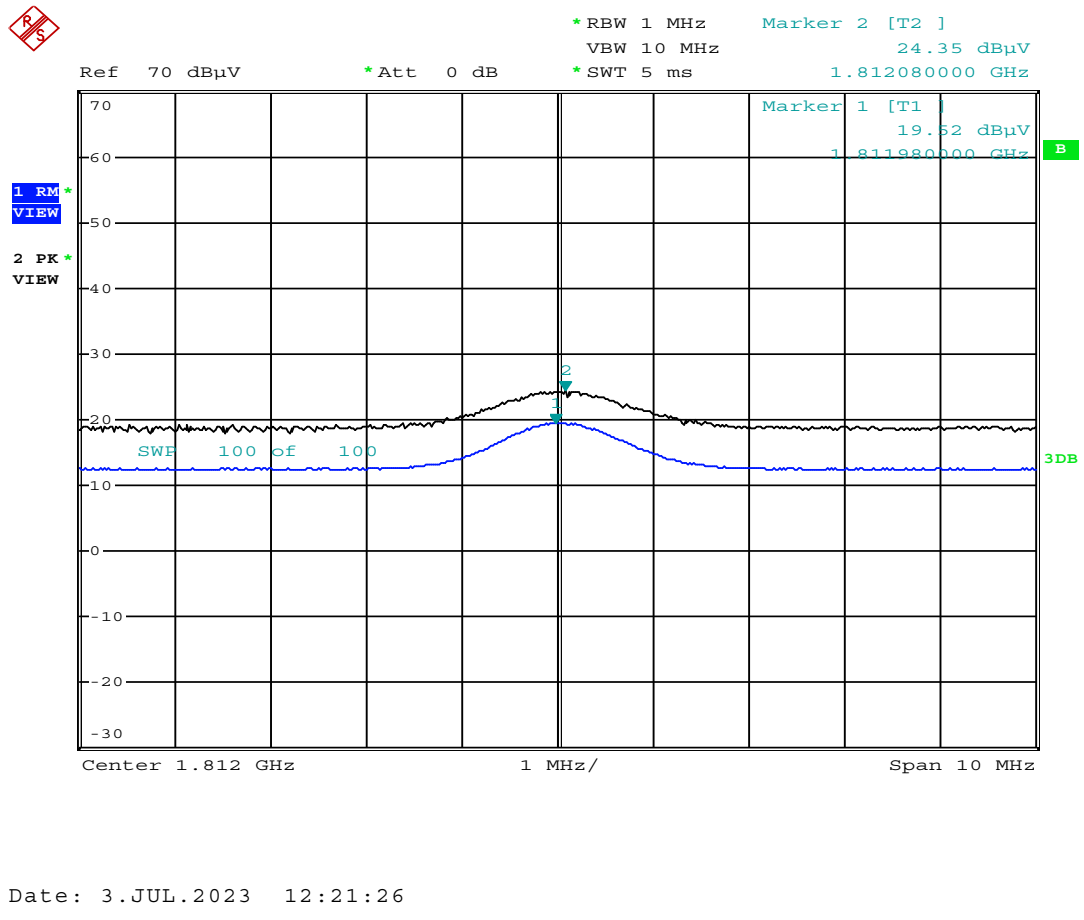
Radiated Tx Emissions:



Channel:	1	**Channel Frequency:**	906 MHz
Mode:	-	**Modulation:**	BPSK
Polarization:	Horizontal	**Measured Channel Power(PK):**	20.05 dBm
Emission Frequency:	2718 MHz	**Measured Channel Power(AV):**	13.45 dBm

Plot 9.5 – Radiated Tx Emissions, Ch 1, 2nd Harmonic, Vertical

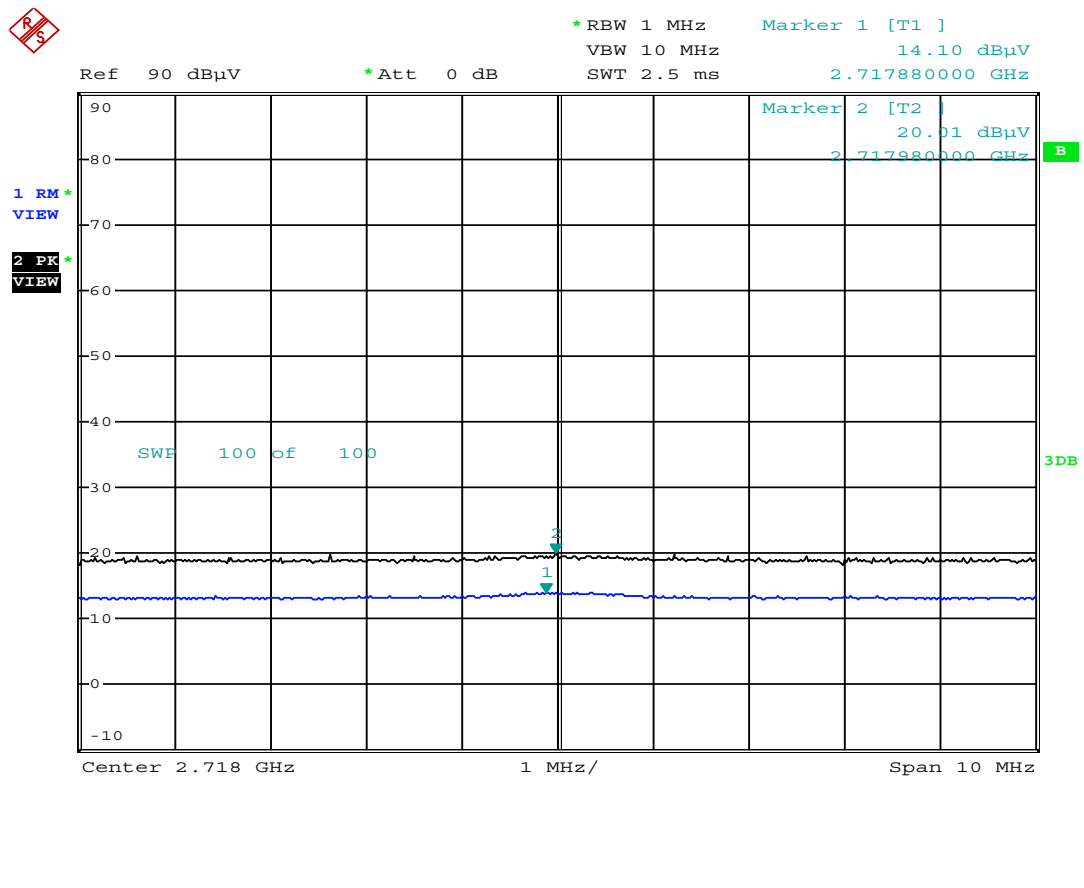
Radiated Tx Emissions:



Channel:	1	**Channel Frequency:**	906 MHz
Mode:	-	**Modulation:**	BPSK
Polarization:	Vertical	**Measured Channel Power(PK):**	24.35 dBm
Emission Frequency:	1812 MHz	**Measured Channel Power(AV):**	19.52 dBm

Plot 9.6 – Radiated Tx Emissions, Ch 1, 3rd Harmonic, Vertical

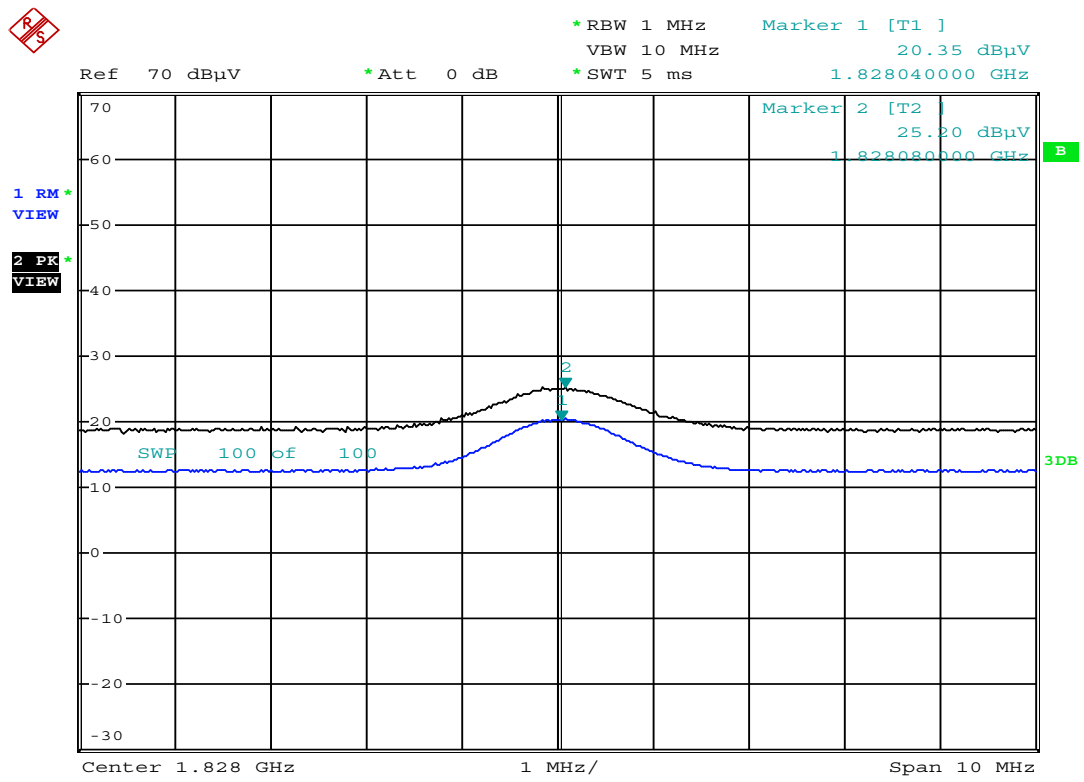
Radiated Tx Emissions:



Channel:	1	**Channel Frequency:**	906 MHz
Mode:	-	**Modulation:**	BPSK
Polarization:	Vertical	**Measured Channel Power(PK):**	20.01 dBm
Emission Frequency:	2718 MHz	**Measured Channel Power(AV):**	14.10 dBm

Plot 9.7 – Radiated Tx Emissions, Ch 5, 2nd Harmonic, Horizontal

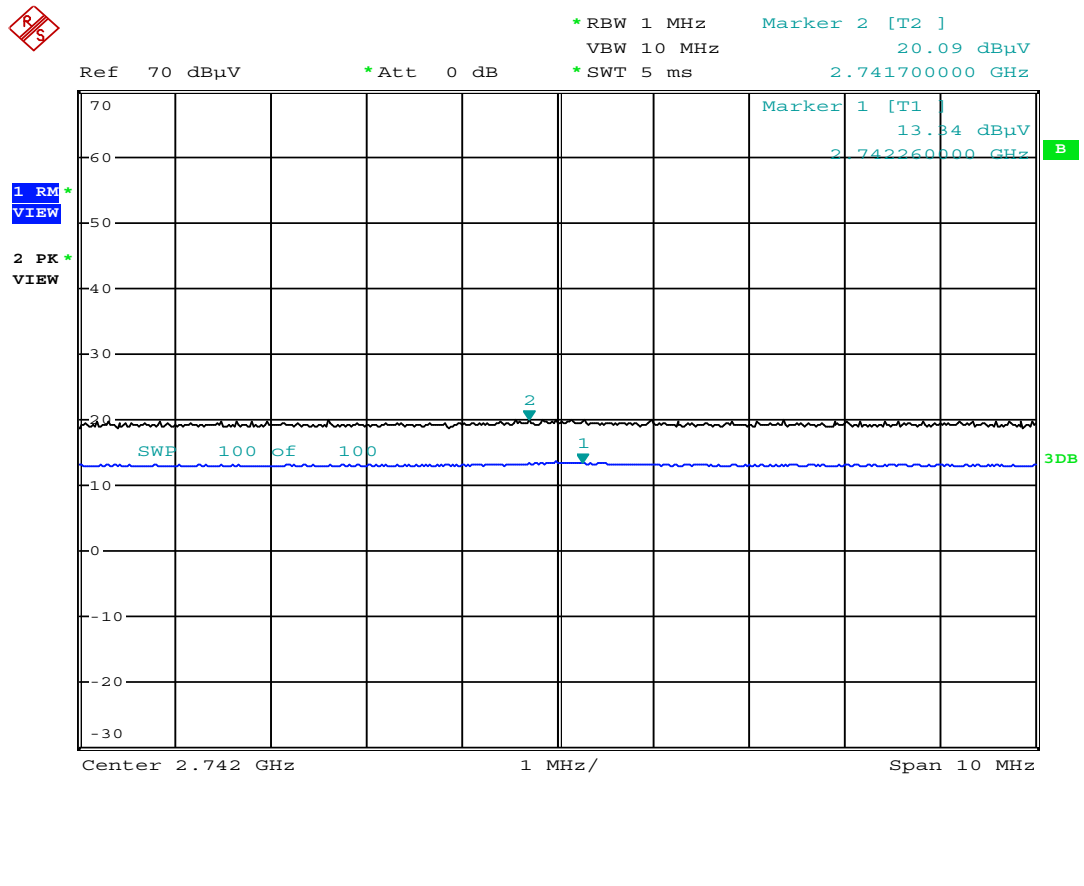
Radiated Tx Emissions:



Channel:	**5**		**Channel Frequency:**	**914**	**MHz**
Mode:	**-**		**Modulation:**	**BPSK**	
Polarization:	**Horizontal**		**Measured Channel Power(PK):**	**25.20**	**dBm**
Emission Frequency:	**1828**	**MHz**	**Measured Channel Power(AV):**	**20.35**	**dBm**

Plot 9.8 – Radiated Tx Emissions, Ch 5, 3rd Harmonic, Horizontal

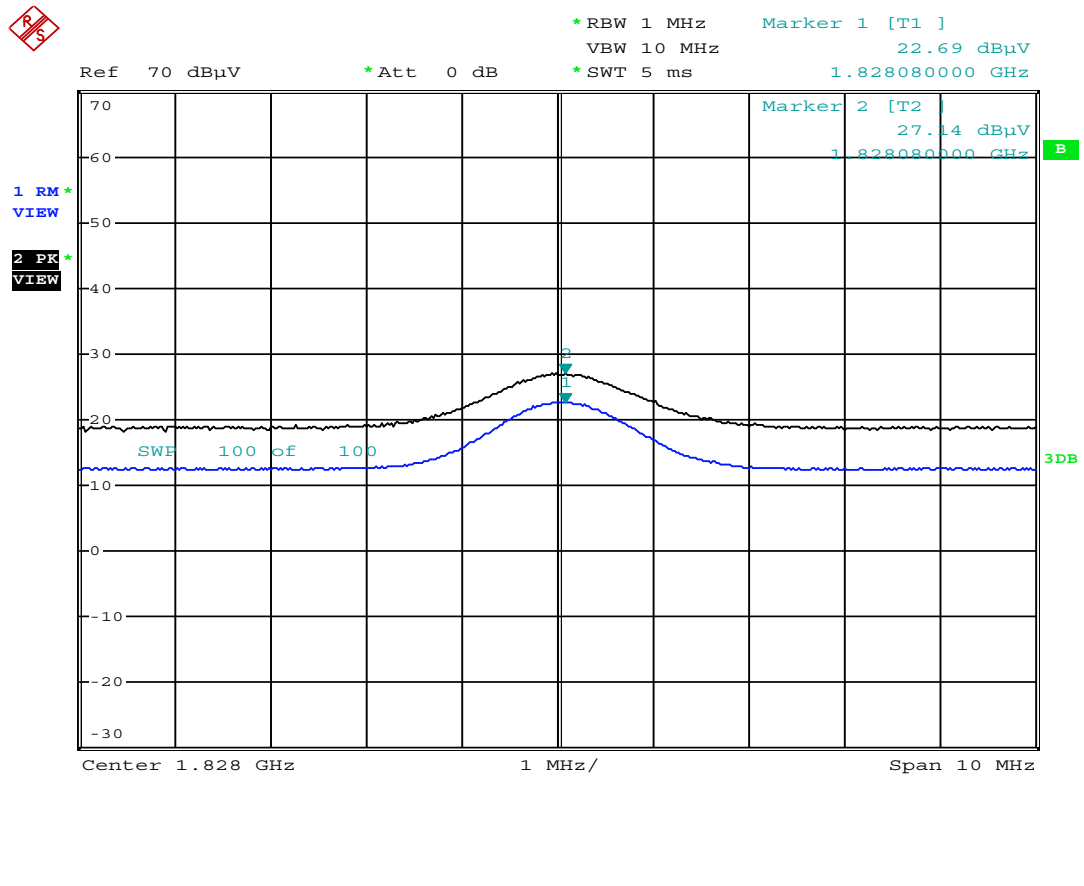
Radiated Tx Emissions:



Channel:	5		**Channel Frequency:**	914	MHz
Mode:	-		**Modulation:**	BPSK	
Polarization:	Horizontal		**Measured Channel Power(PK):**	20.09	dBm
Emission Frequency:	2742	MHz	**Measured Channel Power(AV):**	13.34	dBm

Plot 9.9 – Radiated Tx Emissions, Ch 5, 2nd Harmonic, Vertical

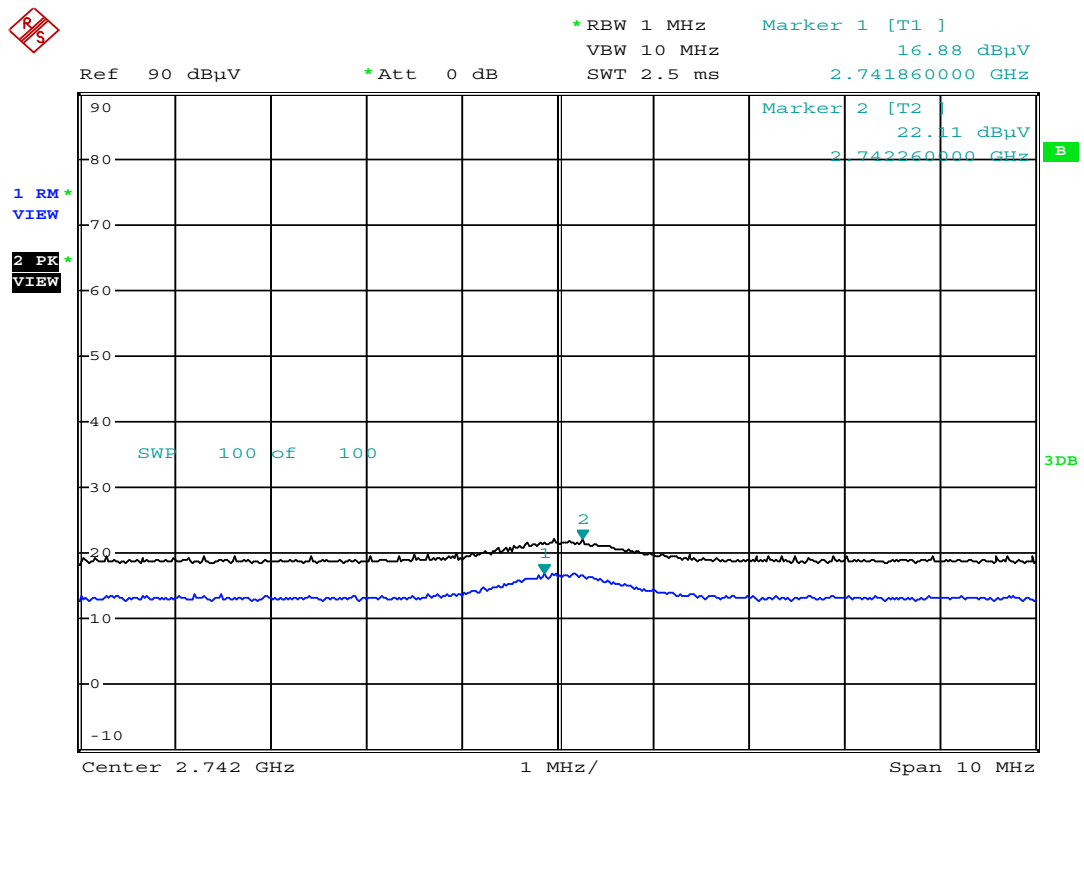
Radiated Tx Emissions:



Channel:	5		**Channel Frequency:**	914	MHz
Mode:	-		**Modulation:**	BPSK	
Polarization:	Vertical		**Measured Channel Power(PK):**	27.14	dBm
Emission Frequency:	1828	MHz	**Measured Channel Power(AV):**	22.69	dBm

Plot 9.10 – Radiated Tx Emissions, Ch 5, 3rd Harmonic, Vertical

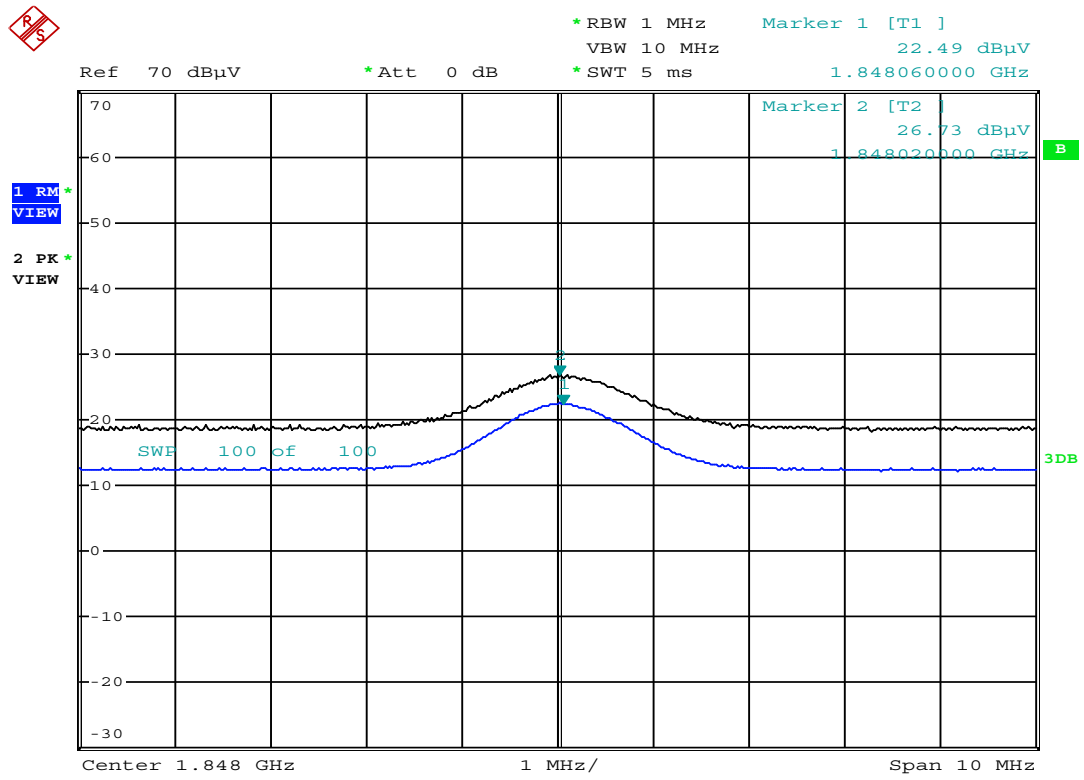
Radiated Tx Emissions:



Channel:	5	**Channel Frequency:**	914 MHz
Mode:	-	**Modulation:**	BPSK
Polarization:	Vertical	**Measured Channel Power(PK):**	22.11 dBm
Emission Frequency:	2742 MHz	**Measured Channel Power(AV):**	16.88 dBm

Plot 9.11 – Radiated Tx Emissions, Ch 10, 2nd Harmonic, Horizontal

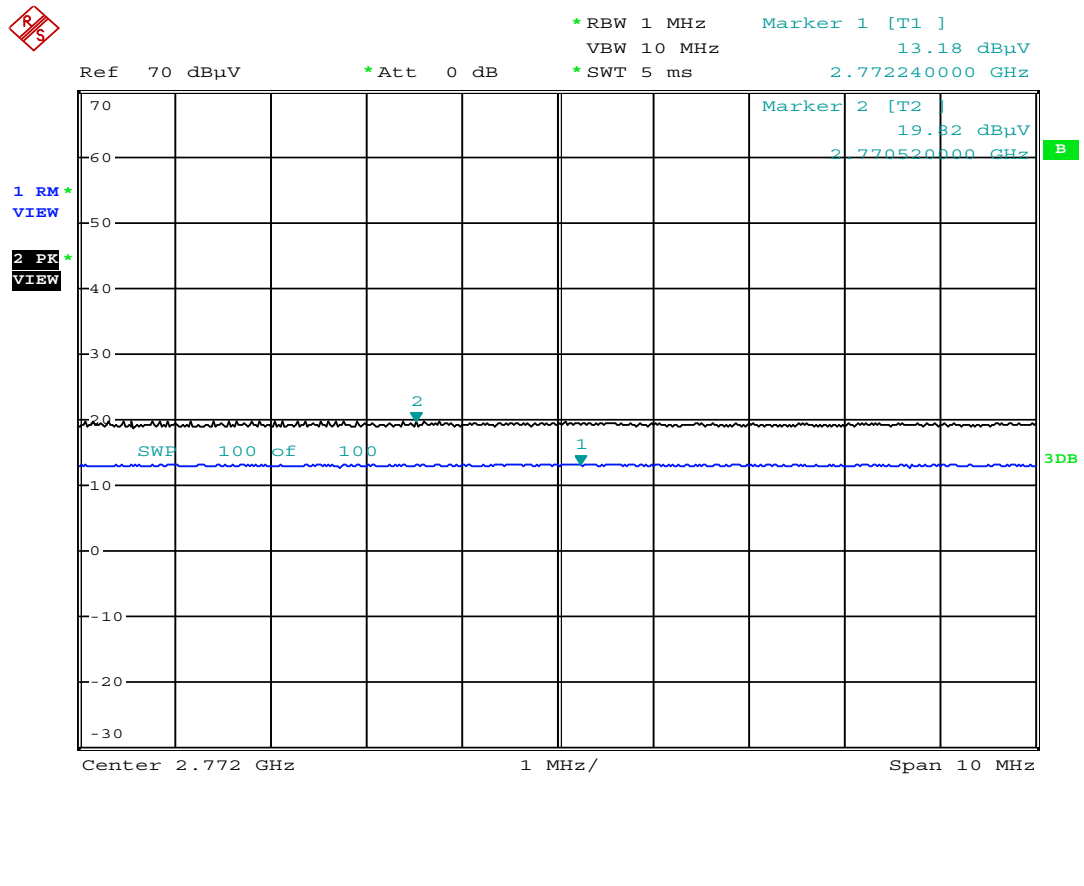
Radiated Tx Emissions:



Channel:	10	**Channel Frequency:**	924 MHz
Mode:	-	**Modulation:**	BPSK
Polarization:	Horizontal	**Measured Channel Power(PK):**	26.73 dBm
Emission Frequency:	1848 MHz	**Measured Channel Power(AV):**	22.49 dBm

Plot 9.12 – Radiated Tx Emissions, Ch 10, 3rd Harmonic, Horizontal

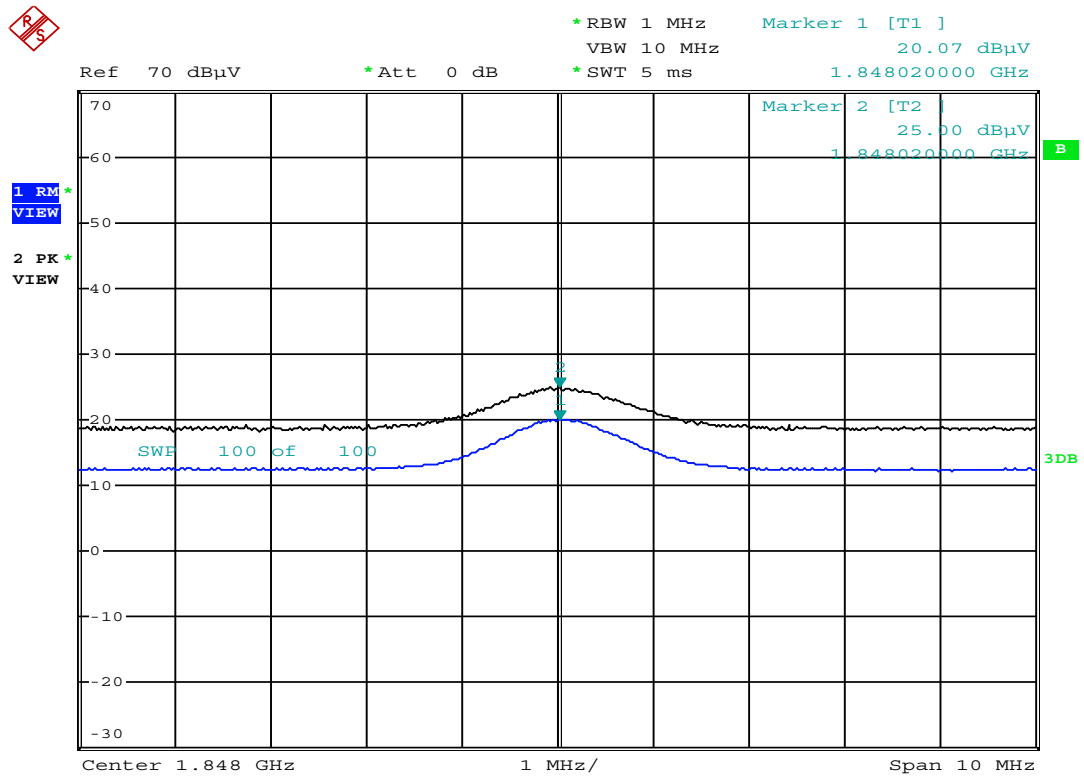
Radiated Tx Emissions:



Channel:	**10**		**Channel Frequency:**	**924**	**MHz**
Mode:	**-**		**Modulation:**	**BPSK**	
Polarization:	**Horizontal**		**Measured Channel Power(PK):**	**19.82**	**dBm**
Emission Frequency:	**2772**	**MHz**	**Measured Channel Power(AV):**	**13.18**	**dBm**

Plot 9.13 – Radiated Tx Emissions, Ch 10, 2nd Harmonic, Vertical

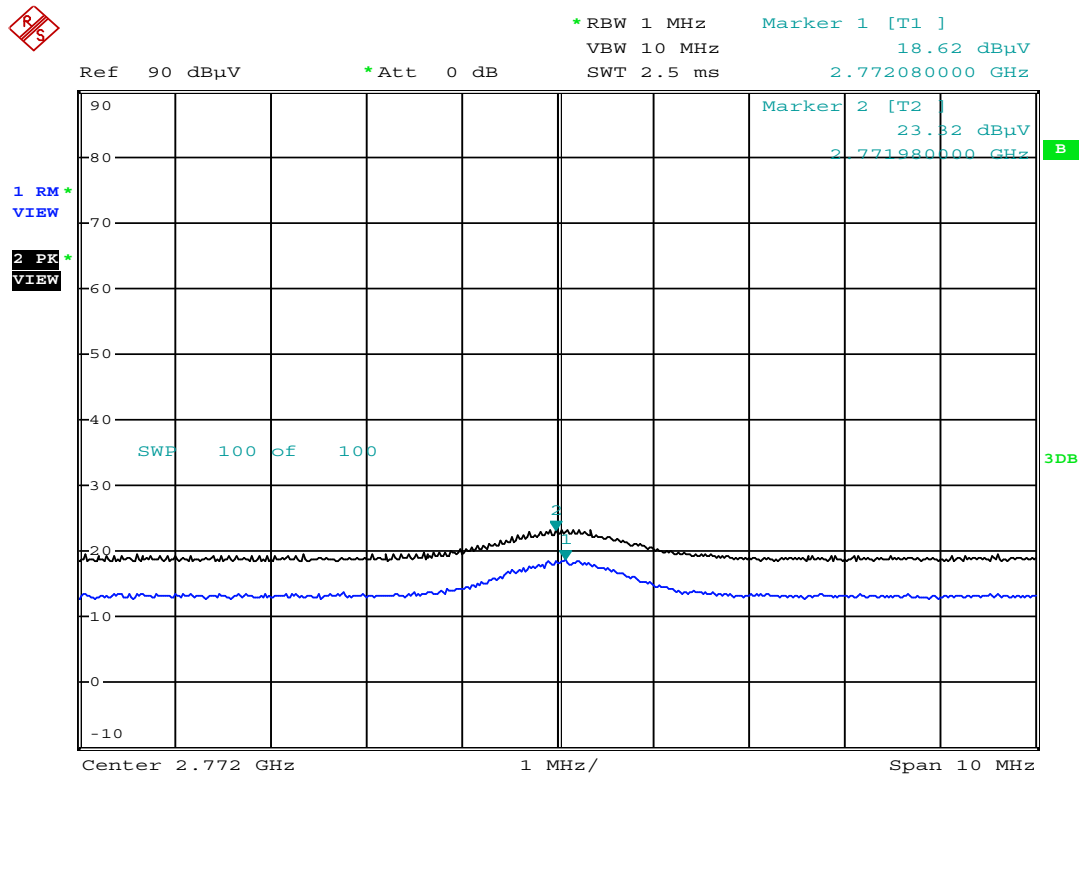
Radiated Tx Emissions:



Channel:	**10**		**Channel Frequency:**	**924**	**MHz**
Mode:	**-**		**Modulation:**	**BPSK**	
Polarization:	**Vertical**		**Measured Channel Power(PK):**	**25.00**	**dBm**
Emission Frequency:	**1848**	**MHz**	**Measured Channel Power(AV):**	**20.07**	**dBm**

Plot 9.14 – Radiated Tx Emissions, Ch 10, 3rd Harmonic, Vertical

Radiated Tx Emissions:



Channel:	**10**	**Channel Frequency:**	**924** **MHz**
Mode:	**-**	**Modulation:**	**BPSK**
Polarization:	**Vertical**	**Measured Channel Power(PK):**	**23.32** **dBm**
Emission Frequency:	**2772** **MHz**	**Measured Channel Power(AV):**	**18.62** **dBm**

Table 9.1 – Summary of Radiated Tx Emissions Measurements

Summary of Radiated Tx Emissions										
Measured Frequency Range (MHz)	Channel Frequency (MHz)	Antenna Polarization	Emission Frequency (MHz)	Measured Emission [E_{Meas}] (dBuV)	Antenna ACF [ACF] (dB)	Cable Loss [L_C] (dB)	Amplifier Gain [G_A] (dB)	Corrected Emission [E_{Corr}] (dBuV/m)	Limit (dBuV)	Margin (dB)
30-1000	914.0	Horizontal	914.0	(1) AV	29.40	2.92	0.00 (3)	31.3	46.0	**(1)**
30-1000	914.0	Vertical	914.0	(1) AV	29.40	2.92	0.00 (3)	31.3	46.0	**(1)**
1812.0	906.0	Horizontal	1812.0	19.26 AV	26.60	3.14	0.00 (3)	49.0	54.0	**5.0**
2718.0	906.0	Horizontal	2718.0	13.45 AV	28.66	4.58	0.00 (3)	46.7	54.0	**7.3**
1812.0	906.0	Vertical	1812.0	19.52 AV	26.60	3.14	0.00 (3)	49.3	54.0	**4.7**
2718.0	906.0	Vertical	2718.0	14.10 AV	28.66	4.58	0.00 (3)	47.3	54.0	**6.7**
1828.0	914.0	Horizontal	1828.0	20.35 AV	26.64	3.14	0.00 (3)	50.1	54.0	**3.9**
2742.0	914.0	Horizontal	2742.0	13.34 AV	28.66	4.58	0.00 (3)	46.6	54.0	**7.4**
1828.0	914.0	Vertical	1828.0	22.69 AV	26.64	3.14	0.00 (3)	52.5	54.0	**1.5**
2742.0	914.0	Vertical	2742.0	16.88 AV	28.66	4.58	0.00 (3)	50.1	54.0	**3.9**
1848.0	924.0	Horizontal	1848.0	22.49 AV	26.85	3.14	0.00 (3)	52.5	54.0	**1.5**
2772.0	924.0	Horizontal	2772.0	13.18 AV	28.69	4.58	0.00 (3)	46.4	54.0	**7.6**
1848.0	924.0	Vertical	1848.0	20.07 AV	26.85	3.14	0.00 (3)	50.1	54.0	**3.9**
2772.0	924.0	Vertical	2772.0	18.62 AV	28.69	4.58	0.00 (3)	51.9	54.0	**2.1**
1812.0	906.0	Horizontal	1812.0	24.04 PK	26.60	3.14	0.00 (3)	53.8	74.0	**20.2**
2718.0	906.0	Horizontal	2718.0	20.05 PK	28.66	4.58	0.00 (3)	53.3	74.0	**20.7**
1812.0	906.0	Vertical	1812.0	24.35 PK	26.60	3.14	0.00 (3)	54.1	74.0	**19.9**
2718.0	906.0	Vertical	2718.0	20.01 PK	28.66	4.58	0.00 (3)	53.3	74.0	**20.7**
1828.0	914.0	Horizontal	1828.0	25.20 PK	26.64	3.14	0.00 (3)	55.0	74.0	**19.0**
2742.0	914.0	Horizontal	2742.0	20.09 PK	28.66	4.58	0.00 (3)	53.3	74.0	**20.7**
1828.0	914.0	Vertical	1828.0	27.14 PK	26.64	3.14	0.00 (3)	56.9	74.0	**17.1**
2742.0	914.0	Vertical	2742.0	22.11 PK	28.66	4.58	0.00 (3)	55.3	74.0	**18.7**
1848.0	924.0	Horizontal	1848.0	26.73 PK	26.85	3.14	0.00 (3)	56.7	74.0	**17.3**
2772.0	924.0	Horizontal	2772.0	19.82 PK	28.69	4.58	0.00 (3)	53.1	74.0	**20.9**
1848.0	924.0	Vertical	1848.0	25.00 PK	26.85	3.14	0.00 (3)	55.0	74.0	**19.0**
2772.0	924.0	Vertical	2772.0	23.32 PK	28.69	4.58	0.00 (3)	56.6	74.0	**17.4**
								Results:	**Complies**	

(1) No Emissions Detected (ND) above ambient or within 20dB of the limit

(3) External Amplier not used

$E_{Corr} = E_{Meas} + ACF^E + L_C - G_A$

Where ACF^E is the Electric Antenna Correction Factor

10.0 RADIATED RX EMISSIONS

Test Procedure	
Normative Reference	**FCC 47 CFR §15.109, ICES-003(6.2)** **ANSI C63.4-2014**

Limits		
47 CFR §15.109	(b) The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the following:	
	30-88MHz: 39.1dBuV/m	30-88MHz: 49.6dBuV/m @ 3m
	88-216MHz: 43.5dBuV/m	88-216MHz: 54.0dBuV/m @ 3m
	216-960MHz: 46.4dBuV/m	216-960MHz: 56.9dBuV/m @ 3m
	> 960MHz: 49.5dBuV/m	> 960MHz: 60.0dBuV/m @ 3m
ICES-003(6.2.1)	6.2.1 - Radiated Emissions Limits Below 1 GHz Class A: ITE that meets the conditions for Class A operation defined in Section 2.2 shall comply with the Class A radiated limits set out in Table 4 determined at a distance of 10 metres.	
	30-88MHz: 39.1dBuV/m	30-88MHz: 49.6dBuV/m @ 3m
	88-216MHz: 43.5dBuV/m	88-216MHz: 54.0dBuV/m @ 3m
	216-960MHz: 46.4dBuV/m	216-960MHz: 56.9dBuV/m @ 3m
	> 960MHz: 49.5dBuV/m	> 960MHz: 60.0dBuV/m @ 3m

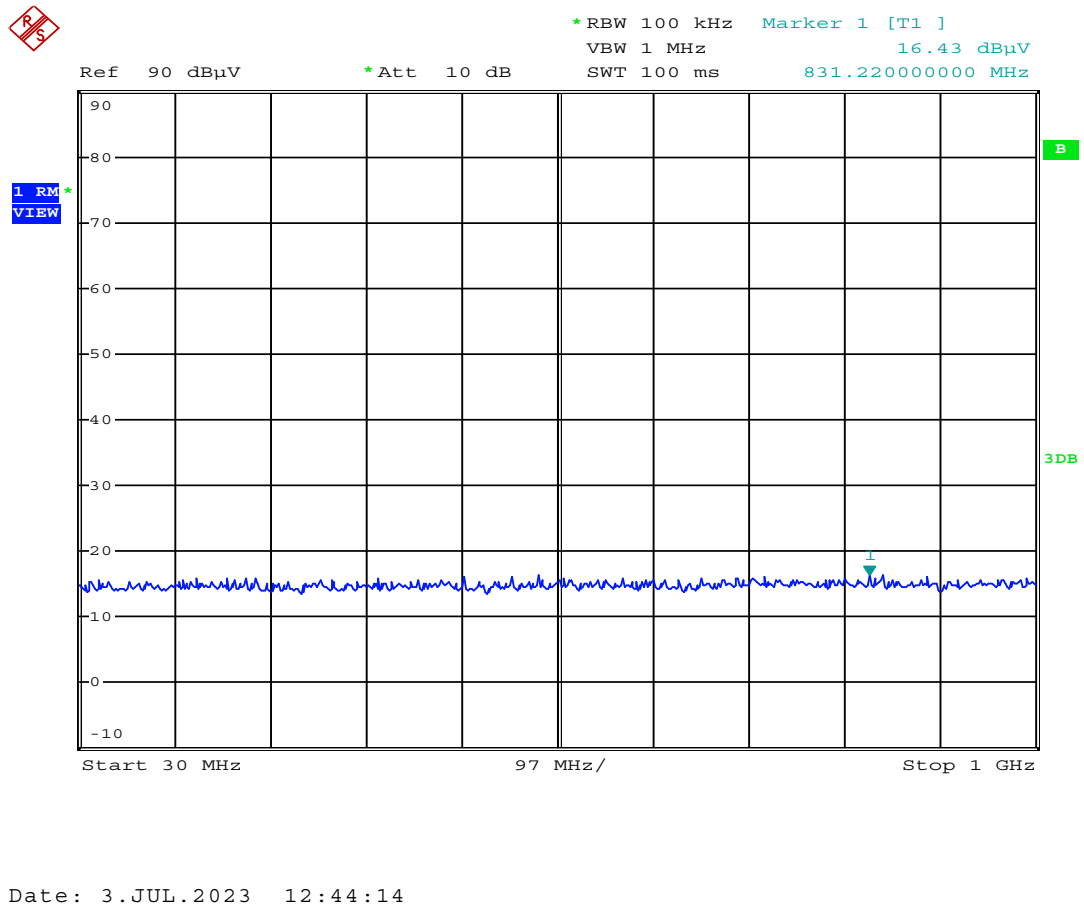
Test Setup	Appendix A	Figure A.1

Measurement Procedure

The DUT was set up as per ANSI C63.4:2014. Emissions were scanned between 30MHz and 1000MHz. The turntable was rotated 360 degrees and the antenna was elevated to 4m to optimize the measured emissions.

Plot 10.1 – Radiated Rx Emissions, 30-1000MHz, Horizontal

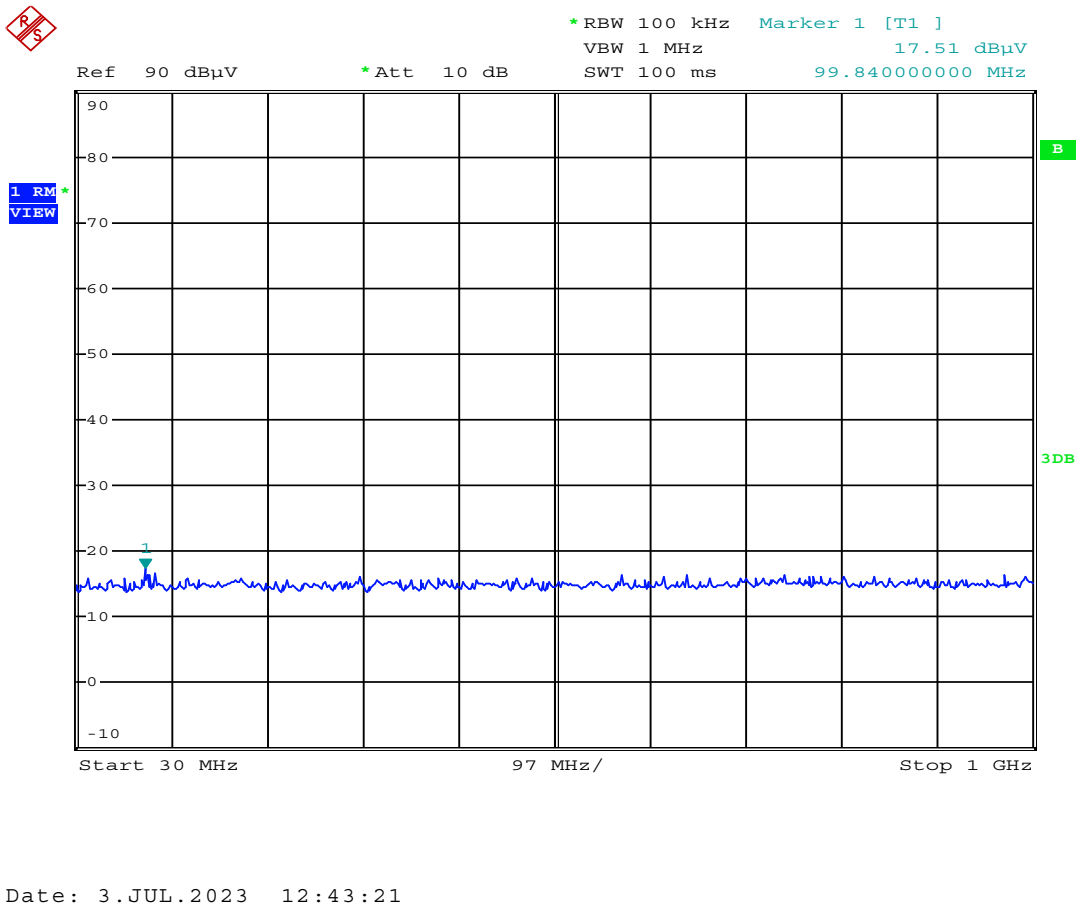
Radiated Rx Emissions:



Channel:	-		**Channel Frequency:**	-	MHz
Mode:	-		**Modulation:**	-	
Polarization:	Horizontal		**Measured Channel Power(PK):**	ND	dBm
Emission Frequency:	ND	MHz	**Measured Channel Power(AV):**	ND	dBm

Plot 10.2 – Radiated Rx Emissions, 30-1000MHz, Vertical

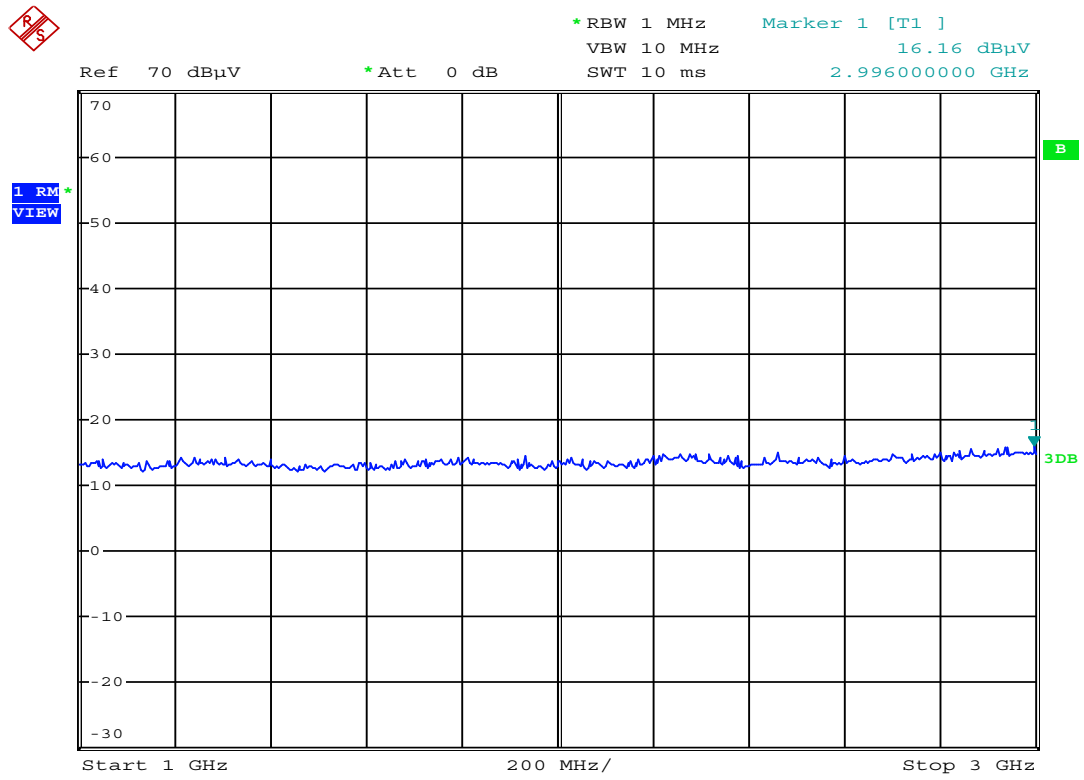
Radiated Rx Emissions:



Channel:	-		**Channel Frequency:**	-	**MHz**
Mode:	-		**Modulation:**	-	
Polarization:	Vertical		**Measured Channel Power(PK):**	ND	**dBm**
Emission Frequency:	ND	**MHz**	**Measured Channel Power(AV):**	ND	**dBm**

Plot 10.3 – Radiated Rx Emissions, 1-3GHz, Horizontal

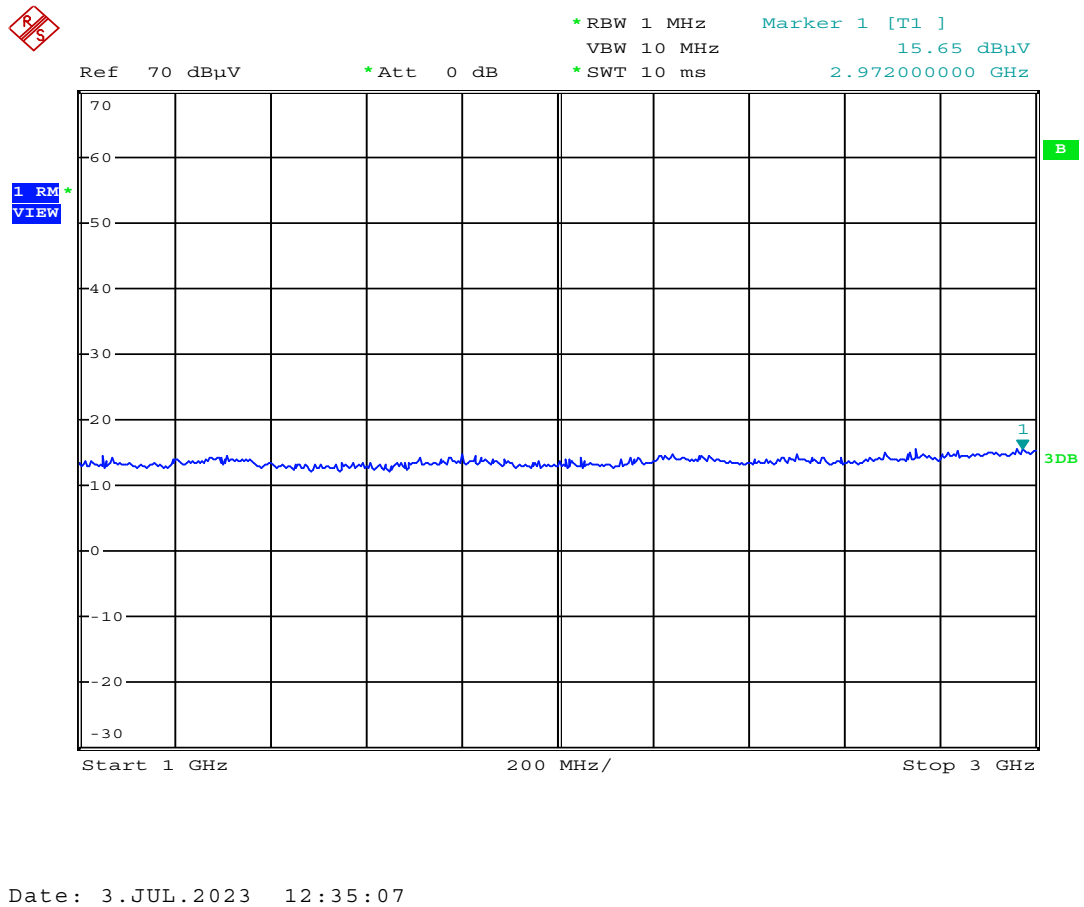
Radiated Rx Emissions:



Channel:	-		**Channel Frequency:**	-	MHz
Mode:	-		**Modulation:**	-	
Polarization:	Horizontal		**Measured Channel Power(PK):**	ND	dBm
Emission Frequency:	ND	MHz	**Measured Channel Power(AV):**	ND	dBm

Plot 10.4 – Radiated Rx Emissions, 1-3GHz, Vertical

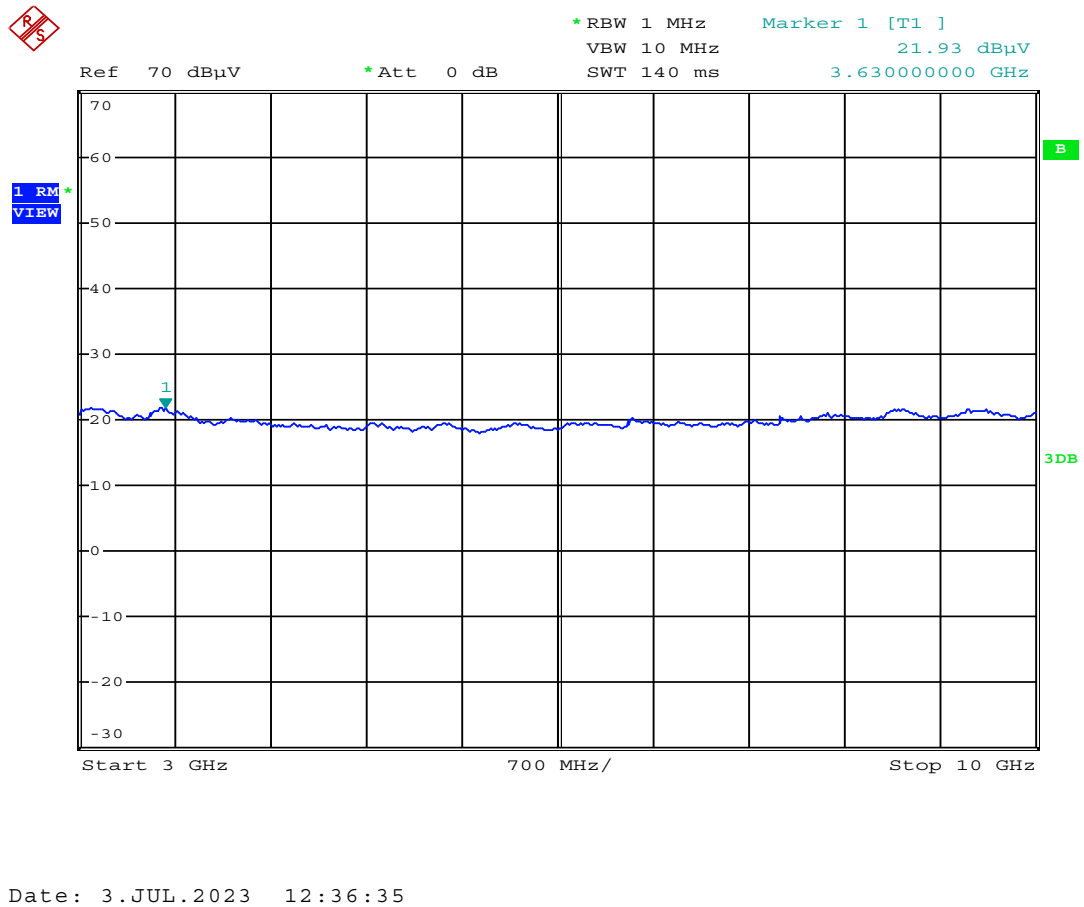
Radiated Rx Emissions:



Channel:	-		**Channel Frequency:**	-	MHz
Mode:	-		**Modulation:**	-	
Polarization:	Vertical		**Measured Channel Power(PK):**	ND	dBm
Emission Frequency:	ND	MHz	**Measured Channel Power(AV):**	ND	dBm

Plot 10.5 – Radiated Rx Emissions, 3-10GHz, Horizontal

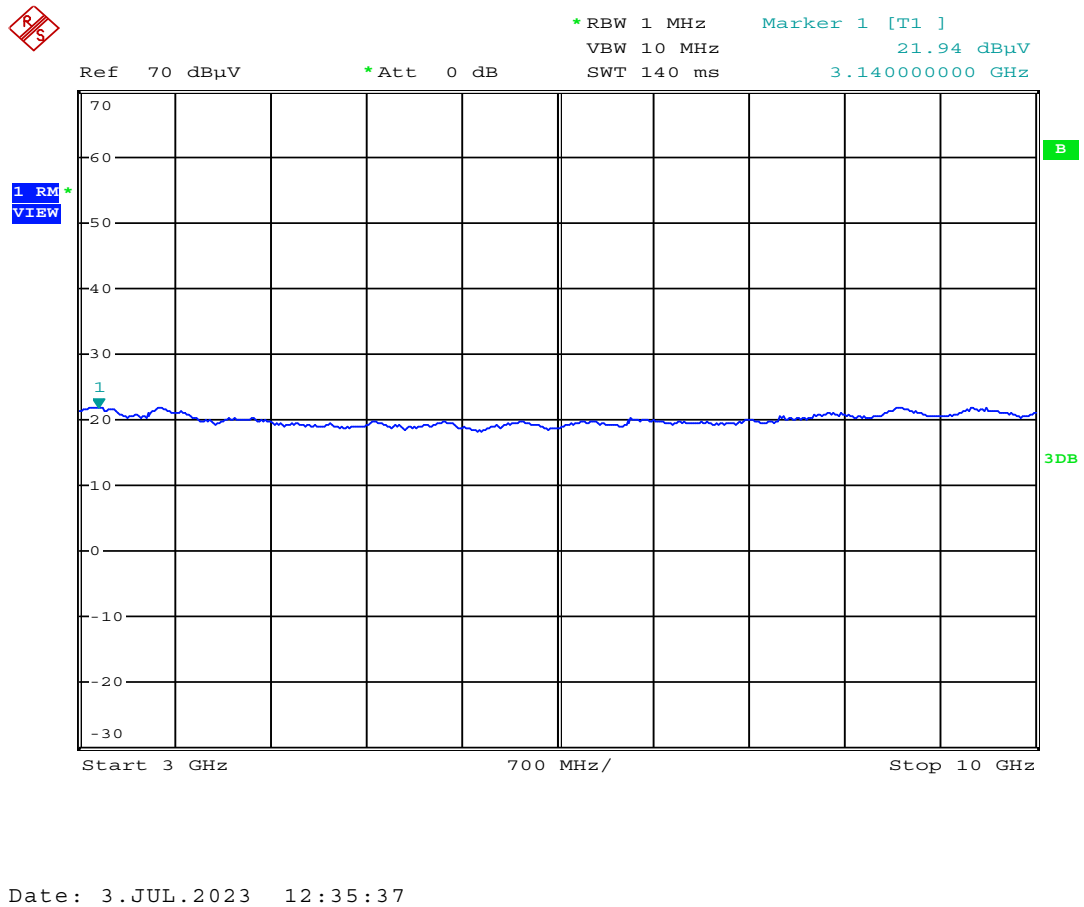
Radiated Rx Emissions:



Channel:	-		**Channel Frequency:**	-	MHz
Mode:	-		**Modulation:**	-	
Polarization:	Horizontal		**Measured Channel Power(PK):**	ND	dBm
Emission Frequency:	ND	MHz	**Measured Channel Power(AV):**	ND	dBm

Plot 10.6 – Radiated Rx Emissions, 3-10GHz, Vertical

Radiated Rx Emissions:



Channel:	-		**Channel Frequency:**	-	MHz
Mode:	-		**Modulation:**	-	
Polarization:	Vertical		**Measured Channel Power(PK):**	ND	dBm
Emission Frequency:	ND	MHz	**Measured Channel Power(AV):**	ND	dBm

Table 10.1 – Summary of Radiated Rx Measurements

Summary of Radiated Rx Emissions										
Measured Frequency Range (MHz)	Channel Frequency (MHz)	Antenna Polarization	Emission Frequency (MHz)	Measured Emission [E_{Meas}] (dBuV)	Antenna ACF [ACF] (dB)	Cable Loss [L_C] (dB)	Amplifier Gain [G_A] (dB)	Corrected Emission [E_{Corr}] (dBuV/m)	Limit (dBuV)	Margin (dB)
30-1000	-	Horizontal	**(1)**	(1) AV	-	-	0.00 (3)	**(1)**	-	**(1)**
30-1000	-	Vertical	**(1)**	(1) AV	-	-	0.00 (3)	**(1)**	-	**(1)**
1000-3000	-	Horizontal	**(1)**	(1) AV	-	-	0.00 (3)	**(1)**	54.0	**(1)**
1000-3000	-	Vertical	**(1)**	(1) AV	-	-	0.00 (3)	**(1)**	54.0	**(1)**
3000-1000	-	Horizontal	**(1)**	(1) AV	-	-	0.00 (3)	**(1)**	54.0	**(1)**
3000-1000	-	Vertical	**(1)**	(1) AV	-	-	0.00 (3)	**(1)**	54.0	**(1)**
								Results:	**Complies**	

(1) No Emissions Detected (ND) above ambient or within 20dB of the limit

(3) External Amplier not used

$E_{Corr} = E_{Meas} + ACF^E + L_C - G_A$

Where ACF^E is the Electric Antenna Correction Factor

APPENDIX A – TEST SETUP DRAWINGS

Table A.1 – Conducted Measurement Setup

Equipment List			
Asset Number	**Manufacturer**	**Model Number**	**Description**
00241	R&S	FSU40	Spectrum Analyzer

Figure A.1 – Test Setup – Conducted Measurements

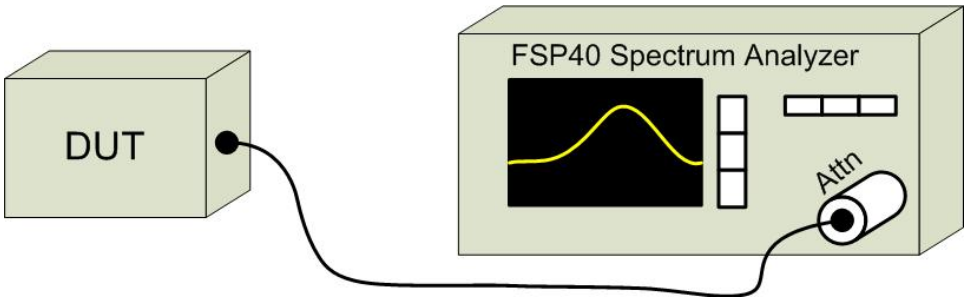


Table A.2 – Radiated Emissions Measurement Equipment

Equipment List			
Asset Number	**Manufacturer**	**Model Number**	**Description**
00051	HP	8566B	Spectrum Analyzer
00049	HP	85650A	Quasi-peak Adapter
00047	HP	85685A	RF Preselector
00072	EMCO	2075	Mini-mast
00073	EMCO	2080	Turn Table
00071	EMCO	2090	Multi-Device Controller
00265	Miteq	JS32-00104000-58-5P	Microwave L/N Amplifier
00241	R&S	FSU40	Spectrum Analyzer
00050	Chase	CBL-6111A	Bilog Antenna
00275	Coaxis	LMR400	25m Cable
00276	Coaxis	LMR400	4m Cable
00278	TILE	34G3	TILE Test Software
00034	ETS	3115	Double Ridged Guide Horn
00085	EMCO	6502	Loop Antenna

Figure A.2 – Test Setup Radiated Measurements 9kHzMHz – 30MHz

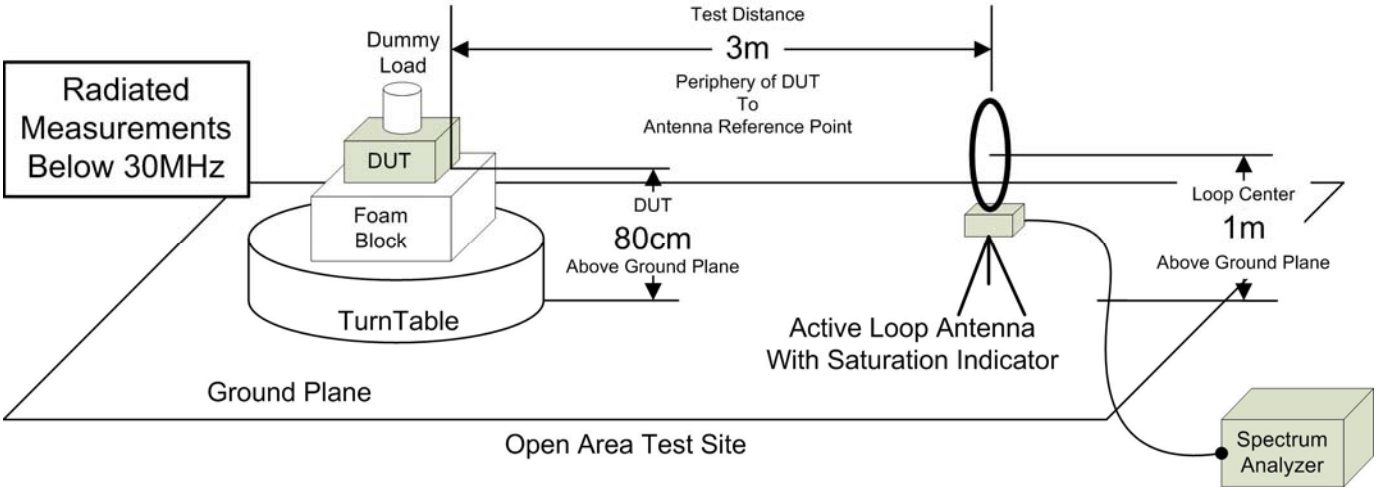


Figure A.3 – Test Setup Radiated Measurements 30MHz – 1GHz

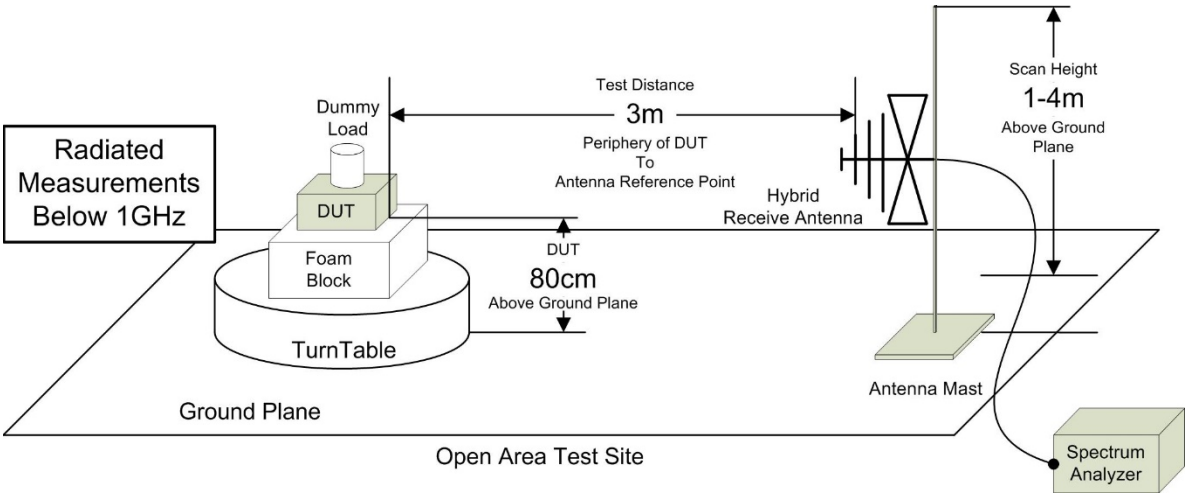


Figure A.4 – Test Setup Radiated Measurements 30MHz – 1GHz, Signal Substitution

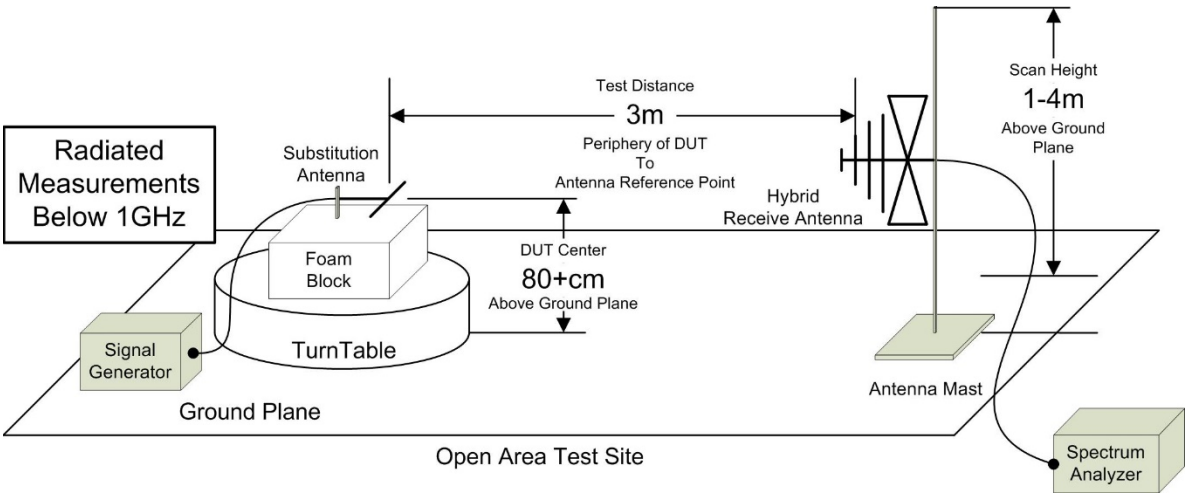
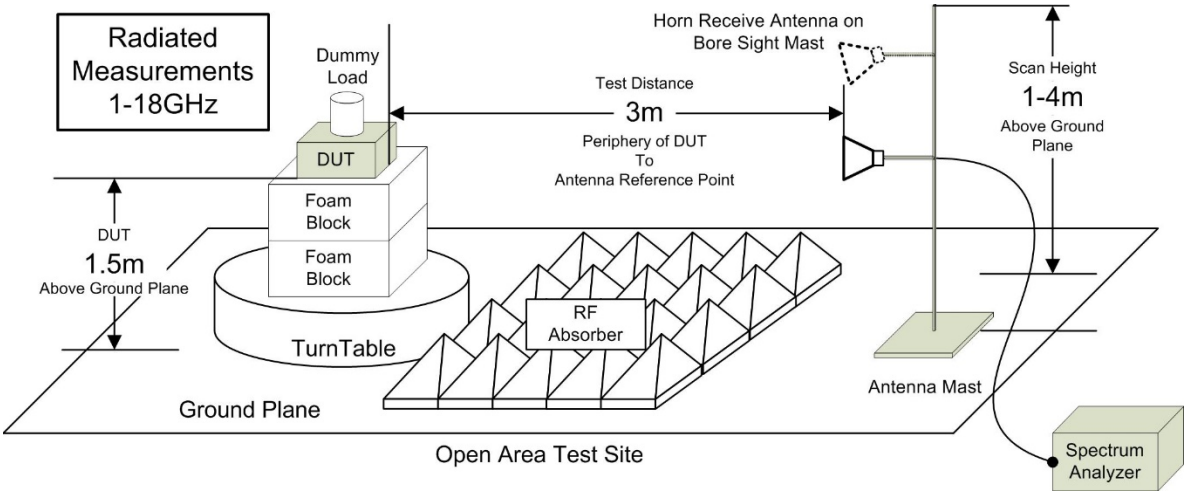


Figure A.5 – Test Setup Radiated Measurements 1 – 18GHz



APPENDIX B – EQUIPMENT LIST AND CALIBRATION

Equipment List							
Asset Number	Manufacturer	Model Number	Serial Number	Description	Last Calibrated	Calibration Interval	Calibration Due
00050	Chase	CBL-6111A	1607	Bilog Antenna	16 Nov 2020	Triennial	16 Nov 2023
00035	ETS	3115	6276	Double Ridged Guide Horn	4 Mar 2022	Triennial	4 Mar 2025
00241	R&S	FSU40	100500	Spectrum Analyzer	10 Aug 2021	Triennial	10 Aug 2024
00005	HP	8648D	3847A00611	Signal Generator	23 Jun 2020	Triennial	23 Jun 2023
00071	EMCO	2090	9912-1484	Multi-Device Controller	n/a	n/a	n/a
00072	EMCO	2075	0001-2277	Mini-mast	n/a	n/a	n/a
00073	EMCO	2080	0002-1002	Turn Table	n/a	n/a	n/a
00263	Koaxis	KP10-1.00M-TD	263	1m Armoured Cable	COU	n/a	COU
00263B	Koaxis	KP10-1.00M-TD	263B	1m Armoured Cable	COU	n/a	COU
00275	TMS	LMR400	n/a	25m Cable	COU	n/a	COU
00278	TILE	34G3	n/a	TILE Test Software	NCR	n/a	NCR

NCR: No Calibration Required
COU: Calibrate On Use

APPENDIX C – MEASUREMENT INSTRUMENT UNCERTAINTY

CISPR 16-4 Measurement Uncertainty (U_{LAB})	
This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence interval using a coverage factor of k=2	
Radiated Emissions 30MHz - 200MHz	
U_{LAB} = 5.14dB U_{CISPR} = 6.3dB	
Radiated Emissions 200MHz - 1000MHz	
U_{LAB} = 5.90dB U_{CISPR} = 6.3dB	
Radiated Emissions 1GHz - 6GHz	
U_{LAB} = 4.80dB U_{CISPR} = 5.2dB	
Radiated Emissions 6GHz - 18GHz	
U_{LAB} = 5.1dB U_{CISPR} = 5.5dB	
Power Line Conducted Emissions 9kHz to 150kHz	
U_{LAB} = 2.96dB U_{CISPR} = 3.8dB	
Power Line Conducted Emissions 150kHz to 30MHz	
U_{LAB} = 3.12dB U_{CISPR} = 3.4dB	
If the calculated uncertainty U_{lab} is **less** than U_{CISPR} then:	
1	Compliance is deemed to occur if **NO** measured disturbance exceeds the disturbance limit
2	Non-Compliance is deemed to occur if **ANY** measured disturbance **EXCEEDS** the disturbance limit
If the calculated uncertainty U_{lab} is **greater** than U_{CISPR} then:	
3	Compliance is deemed to occur if **NO** measured disturbance, increased by (U_{lab} - U_{CISPR}), exceeds the disturbance limit
4	Non-Compliance is deemed to occur if **ANY** measured disturbance, increased by (U_{lab} - U_{CISPR}), **EXCEEDS** the disturbance limit

Other Measurement Uncertainties (U_{LAB})
RF Conducted Emissions 9kHz - 40GHz
U_{LAB} = 1.0dB U_{CISPR} = n/a
Frequency/Bandwidth 9kHz - 40GHz
U_{LAB} = 0.1ppm U_{CISPR} = n/a
Temperature
U_{LAB} = 1^{O}C U_{CISPR} = n/a

END OF REPORT

