Test Report Serial Number:	45461445R3.0
Test Report Date:	24 July 2018
Project Number:	1410

EMC Test Report - New Filing

Applicant:

Nestronics Research Inc.
Box 1886 Unit 1 - 309 1st Street West
Warman, SK S0K 4S0
Canada

Nestronics Research Inc.
Box 1886
Warman, SK S0K 4S0
Canada

FCC ID:	IC Registration Number
2AP75TXRX	**23764-TXRX**
Product Model Number / HVIN	Product Name / PMN
TXRX	**TXRX**

In Accordance With:

CFR Title 47, Part 15 Subpart C (§15.247), Part 15 Subpart B
Digital Transmission System (DTS)

RSS-Gen, RSS-247 Issue 2
Digital Transmission Systems (DTSs)

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-1** **FCC Registration: CA3874**

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1.0 DOCUMENT CONTROL

Revision History				
Samples Tested By:	Art Voss, P.Eng.	**Date(s) of Evaluation:**		26 June - 5 July, 2018
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	6 July 2018
2.0	Revised Exhibit List	Exh	Art Voss	17 July 2018
3.0	Revised Client Address	Cover, 2.0	Art Voss	24 July 2018
	Revised Conducted Power w/ Voltage Supply Voltage Range	7.0		
	Revised DTS Bandwith w/ Supply Voltage Range	8.0		
	Revised Power Spectral Density w/ Supply Voltage Range	10.0		
	Revised Band Edge Measurements	11.0		
	Revised Equipment List and Calibration	App. A		

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2.0 CLIENT AND DUT INFORMATION

Client Information		
Applicant Name	Nestronics Research Inc.	
Applicant Address	(FCC) Box 1886 Unit 1 - 309 1st Street West	
	(ISED) Box 1886	
	Warman, SK, S0K 4S0	
	Canada	
DUT Information		
Device Identifier(s):	FCC ID:	2AP75TXRX
	ISED ID:	23764-TXRX
Device Type:	Digital Transceiver Module	
Type of Equipment:	Digital FSK Transceiver Module	
Device Model(s) / HVIN:	TXRX	
Device Marketing Name / PMN:	TXRX	
Firmware Version ID Number / FVIN:	-	
Host Marketing Name / HMN:	-	
Test Sample Serial No.:	T/A Sample - Identical Prototype	
Transmit Frequency Range:	902 - 928MHz	
Test Channels:	24 Channel Programmable	
Manuf. Max. Rated Output Power:	24 dBm, 0.25W	
Manuf. Max. Rated BW/Data Rate:	250kbps	
Antenna Make and Model:	1/4 Wavelenght Whip	
Antenna Type and Gain:	1.5dBi Nominal, 6dBi Max	
Modulation:	4FSK	
Mode:	Simplex	
Emission Designator:	764KF1D	
DUT Power Source:	3VDC Alkaline	
DUT Dimensions [HxWxD] (mm)	H x W x D: 8mm x 30mm x 38mm	
Deviation(s) from standard/procedure:	None	
Modification of DUT:	None	

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3.0 SCOPE

This Certification Report was prepared on behalf of:

Nestronics Research Inc.

,(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.

As per FCC CFR 47 Part §2.1091 and §2.1093 and Health Canada Safety Code 6, an RF Exposure evaluation report is required for this *Equipment* and the results of the RF Exposure evaluation appear in a separate exhibit from this report.

This *Equipment* is subject to FCC Declaration of Conformity (DoC). DoC evaluations were performed on this *Equipment* and the results of the DoC evaluation appear in a separate exhibit from this report.

Application:
This application is for a new certification of a modular transmitter, as per FCC 47 CFR §15.212(a)(1) and ISED RSP-100 (5.3.2), as a **Limited Modular Approval**. The associated modular transmitter checklists accompany this report as a separate exhibit.

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4.0 TEST SUMMARY

TEST SUMMARY						
Section	**Description of Test**	**Procedure Reference**	**Applicable Rule Part(s) FCC**	**Applicable Rule Part(s) ISED**	**Test Date**	**Result**
7.0	Conducted Pow er (Fundemental)	ANSI C63.10-2013 KDB 558074 D01v04	§2.1046 §15.247(b)(3)	RSS-Gen RSS-247 (5.4)(d)	27 June 2018	Pass
8.0	6dB Bandw idth	ANSI C63.10-2013 KDB 558074 D01v04	§2.1049 §15.247(a)(2)	RSS-Gen RSS-247 (5.2)(a)	26 June 2018	Pass
9.0	Occupied Bandw idth	ANSI C63.10-2013 KDB 558074 D01v04	§2.1049 §15.247(a)(2)	RSS-Gen RSS-247 (5.2)(a)	26 June 2018	Pass
10.0	Pow er Spectral Density	ANSI C63.10-2013 KDB 558074 D01v04	§15.247(e)	RSS-247 (5.2)(b)	27 June 2018	Pass
11.0	Conducted TX Spurious Emissions	ANSI C63.10-2013 KDB 558074 D01v04	§2.1051 §15.247(d)	RSS-Gen RSS-247 (5.5)	27 June 2018	Pass
12.0	Radiated TX Spurious Emissions Restricted Bands	ANSI C63.10-2013 KDB 558074 D01v04	§15.247(d)	n/a	4 July 2018	Pass

I attest that the data reported herein is true and accurate w ithin the tolerance of the Measurement Instrument Uncertainty; that all tests and measurements w ere performed in accordance w ith accepted practices or procedures; and that all tests and measurements w ere 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 w hich w ere not adjusted, modified or altered in any manner w hatsoever, except as required to carry out specific tests or measurements. This test report has been completed in accordance w ith ISO/IEC 17025.	Art Voss, P.Eng. Technical Manager Celltech Labs Inc. 6 July 2018 Date

PROFESSIONAL PROVINCE OF A. F. VOSS # 31327 BRITISH COLUMBIA ENGINEER

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5.0 NORMATIVE REFERENCES

Normative References	
ISO/IEC 17025:2017	General requirements for the competence of testing and calibration laboratories
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: Sub Part C (15.247)	Code of Federal Regulations Telecommunication Radio Frequency Devices Intentional Radiators
CFR Title 47: Part 15: Subpart B:	Code of Federal Regulations Telecommunication Radio Frequency Devices Unintentional Radiators
ISED RSS-Gen Issue 5:	Innovation, Science and Economic Development Canada Spectrum Management and Telecommunications Radio Standards Specification General Requirements and Information for the Certification of Radiocommunication Equipment
ISED RSS-247 Issue 2:	Innovation, Science and Economic Development Canada Spectrum Management and Telecommunications Radio Standards Specification Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licensed-Exempt Local Area Network (LE_LAN) Devices
FCC KDB 558074 D01v04	OET Major Guidance Publications, Knowledge Data Base Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under Section 15.247

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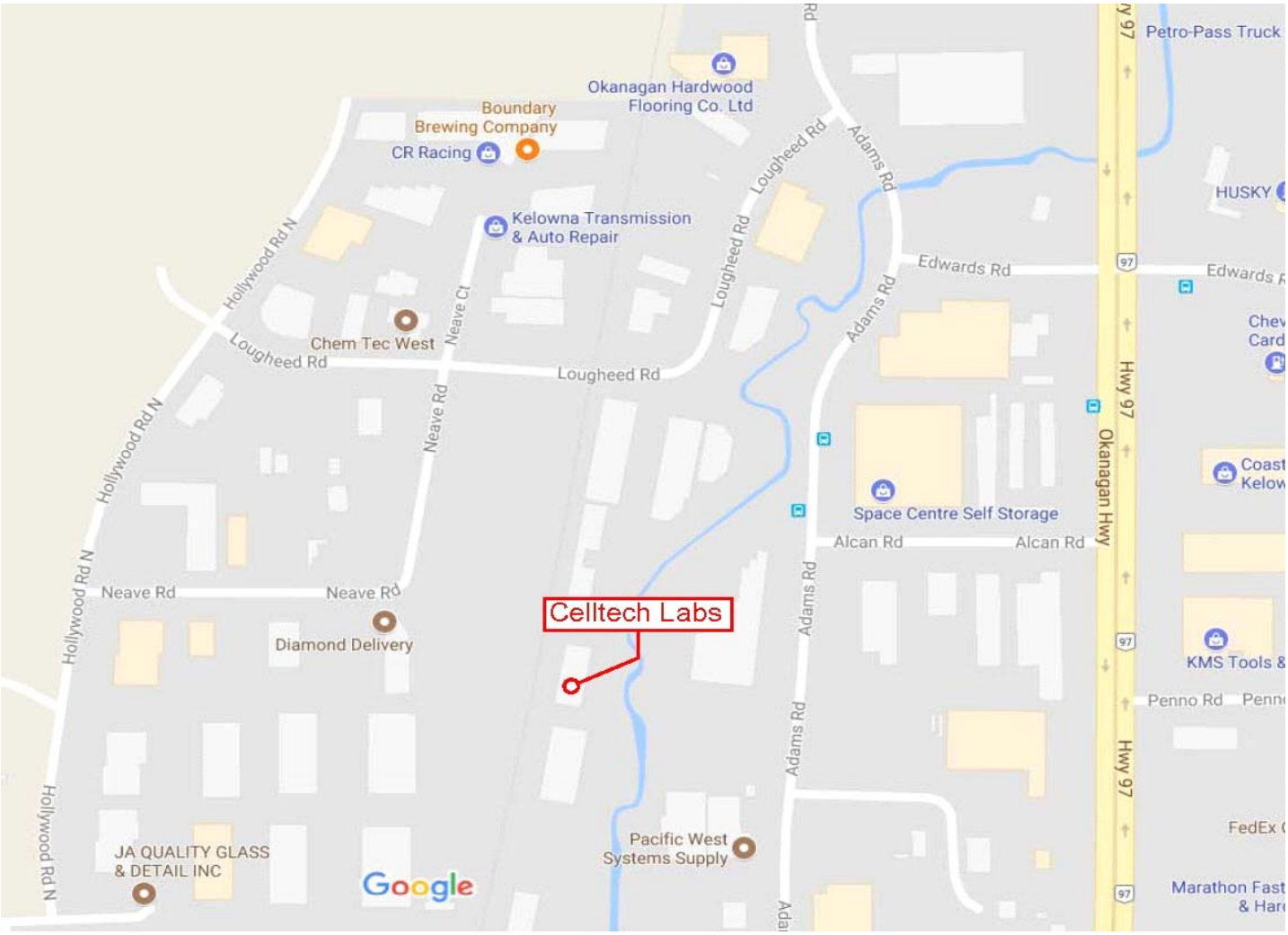
6.0 FACILITIES AND ACCREDITATIONS

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-1. Celltech is accredited to ISO 17025, through accrediting body A2LA and with certificate 2470.01.



7.0 CONDUCTED 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 (9.2.2.2), 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.) requirements 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.
KDB 558074 (9.2.1)	9.2.1 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.
KDB 558074 (9.2.2.2) C63.10 (11.9.2.2.2)	**Method AVGSA-1** (trace averaging with the EUT transmitting at full power throughout each sweep) 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. Comparative measurements were made at 1.8 and 4.0VDC supply voltage.

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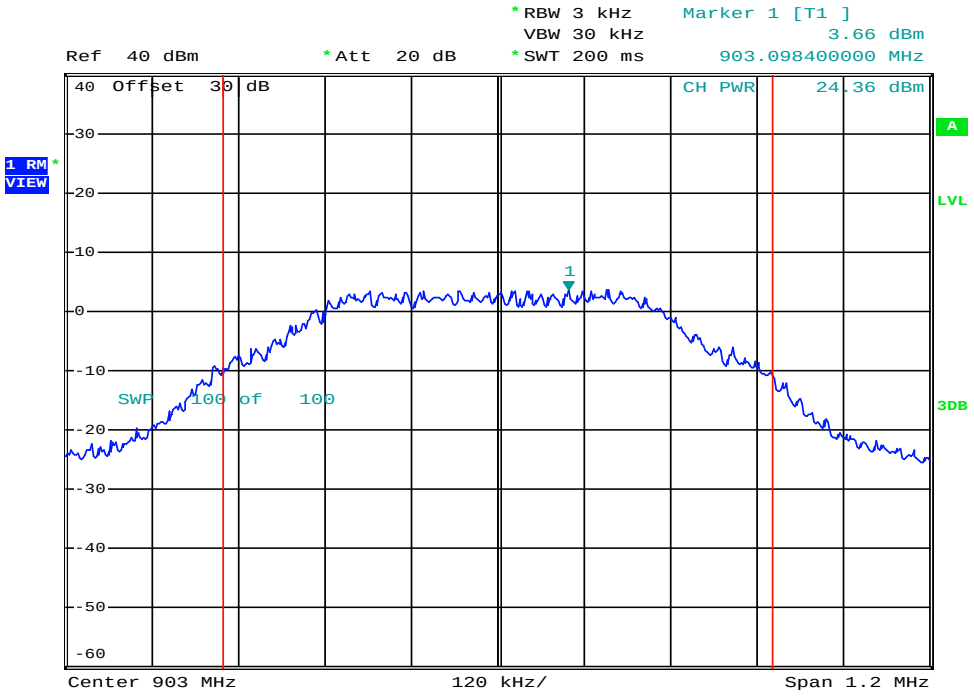
Plot 7.1 – Conducted Power 903MHz

Conducted Power (RMS)



Date: 24.JUL.2018 09:56:43

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
903.00 MHz	**764.00** kHz	**100** %
Modulation Setting:	Channel Power Setting:	Nominal Input Voltage:
4FSK	**Max** dBm	**3.0** VDC
		Measured Channel Power:
		24.36 dBm

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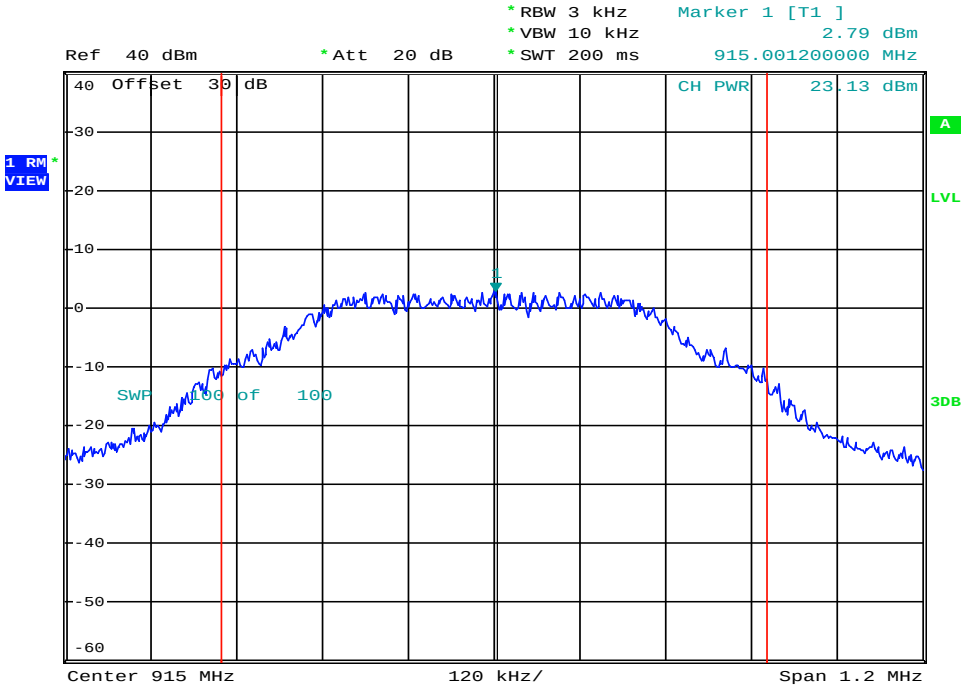
Plot 7.2 – Conducted Power 915MHz

Conducted Power (RMS)



Date: 27.JUN.2018 11:40:42

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
915.00 MHz	**764.00** kHz	**100** %
Modulation Setting:	Channel Power Setting:	Nominal Input Voltage:
4FSK	**Max** dBm	**3.0** VDC
		Measured Channel Power:
		23.13 dBm

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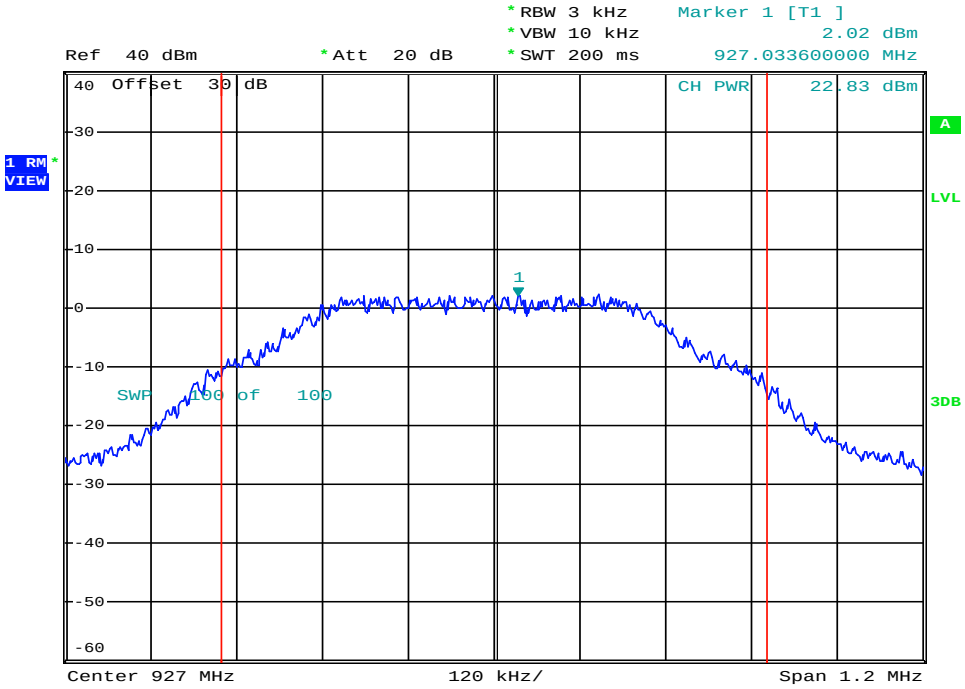
Plot 7.3 – Conducted Power 927MHz

Conducted Power (RMS)



Date: 27.JUN.2018 11:36:55

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
927.00 MHz	**764.00** kHz	**100** %
Modulation Setting:	Channel Power Setting:	Nominal Input Voltage:
4FSK	**Max** dBm	**3.0** VDC
		Measured Channel Power:
		22.83 dBm

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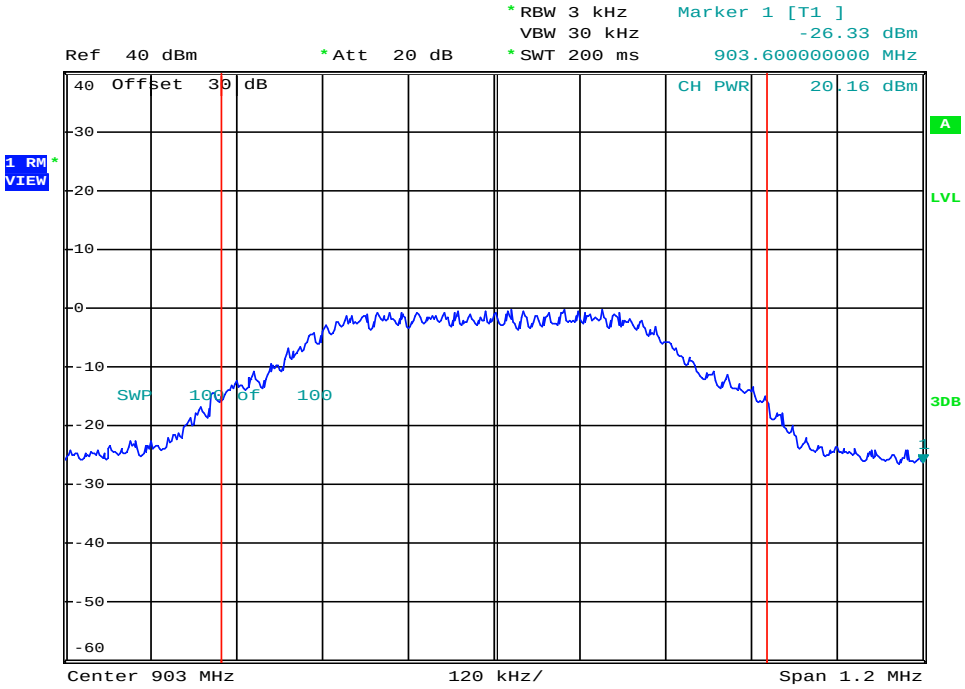
Plot 7.4 – Conducted Power 903MHz, 1.8VDC Supply Voltage

Conducted Power (RMS)



Date: 24.JUL.2018 09:54:56

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
903.00 MHz	**764.00** kHz	**100** %
Modulation Setting:	Channel Power Setting:	Nominal Input Voltage:
4FSK	**Max** dBm	**1.8** VDC
		Measured Channel Power:
		20.16 dBm

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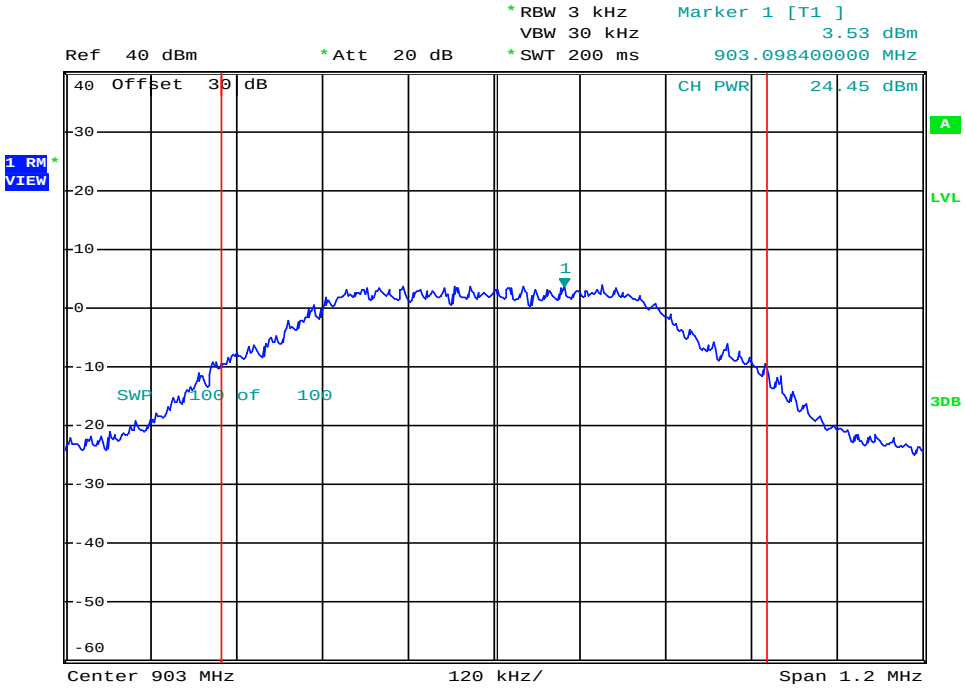
Plot 7.5 – Conducted Power 903MHz, 4.0VDC Supply Voltage

Conducted Power (RMS)



Date: 24.JUL.2018 09:58:45

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
903.00 MHz	**764.00** kHz	**100** %
Modulation Setting:	Channel Power Setting:	Nominal Input Voltage:
4FSK	**Max** dBm	**4.0** VDC
		Measured Channel Power:
		24.45 dBm

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Table 7.1 – Summary of Conducted Power Measurements

§15.247(b)(3), RSS-247 (5.4)(d) Channel Output Power (RMS)								
Frequency (MHz)	BW (kHz)	Modulation	Power Setting(1) (dBm)	Supply Voltage (VDC)	Measured Power [E_{Meas}] (dBm)	Measured Power [E_{Meas}] (W)	Limit (W)	Margin (dB)
903.0	764	4FSK	Max	3.0	24.36	0.27	1.0	**5.6**
915.0				3.0	23.13	0.21		**6.9**
927.0				3.0	22.83	0.19		**7.2**
903.0				1.8	20.16	0.10		**9.8**
903.0				4.0	24.45	0.28		**5.6**
							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)	BW (kHz)	Modulation	Power Setting(1) (dBm)	Supply Voltage (VDC)	Measured Power [E_{Meas}] (dBm)	Antenna Gain(2) [G_T] (dBi)	Cable Loss [L_C] (dB)	EIRP (dBm)	EIRP (W)	Limit (W)	Margin (dB)
903.0	764	4FSK	Max	3.0	24.36	1.5	0.5	26.36	0.43	4.0	**9.7**
915.0				3.0	23.13			25.13	0.33		**10.9**
927.0				3.0	22.83			24.83	0.30		**11.2**
903.0				1.8	20.16			22.16	0.16		**13.9**
903.0				4.0	24.45			26.45	0.44		**9.6**
										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

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8.0 DTS BANDWIDTH

Test Procedure	
Normative Reference	FCC 47 CFR §2.1049, §15.247(a)(2), RSS-Gen (6.7), RSS-247 (5.2)(a),
	KDB 558074 (8.2), ANSI C63.10 (11.8.2)

Limits	
47 CFR §15.247(a)(2)	(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions: (2) Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.
RSS-247 (5.2)(a)	5.2 Digital transmission systems DTSs include systems that employ digital modulation techniques resulting in spectral characteristics similar to direct sequence systems. The following applies to the bands 902-928 MHz and 2400 - 2483.5 MHz: a) The minimum 6 dB bandwidth shall be 500 kHz.
KDB 558074 (8.2) C63.10 (11.8.2)	**8.2 Option 2** The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW ≥ 3 X RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.
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 above using the Automatic 6dB Cursor Bandwidth measurement. 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. Comparative measurements were made at 1.8 and 4.0VDC supply voltage.

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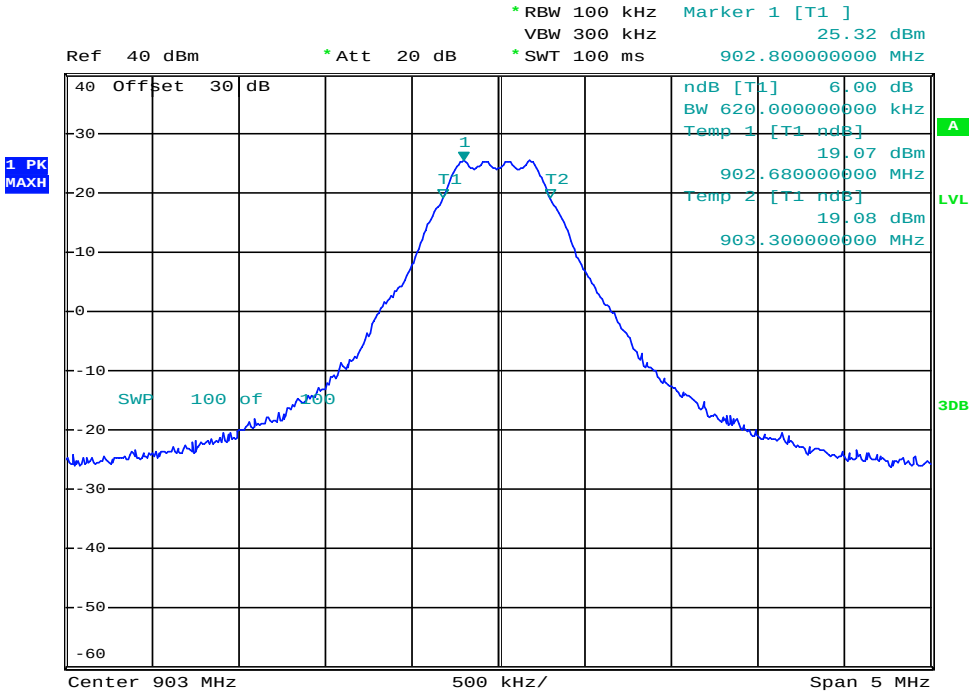
Plot 8.1 – 6dB DTS Bandwidth 903MHz

6dB *DTS* Bandwidth



Date: 24.JUL.2018 10:11:18

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
903.00 MHz	**Max** kHz	**100** %
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
4FSK	**Max** dBm	**3.0** VDC
		Measured DTS Bandwidth:
		620.00 kHz

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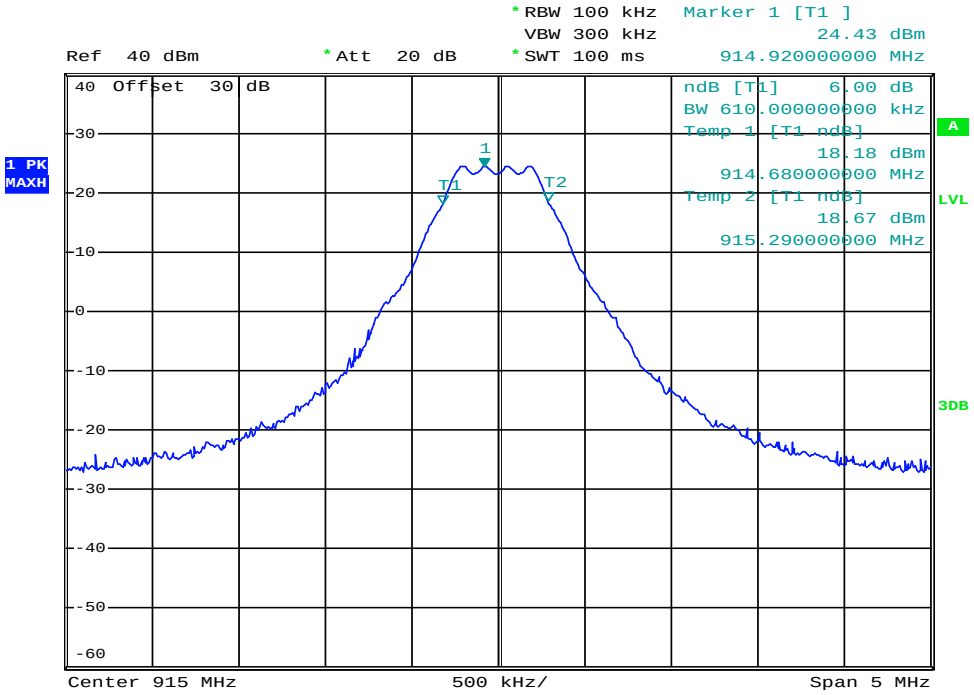
Plot 8.2 – 6dB DTS Bandwidth 915MHz

6dB *DST* Bandwidth



Date: 26.JUN.2018 16:55:56

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
915.00 MHz	**Max** kHz	**100** %
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
4FSK	**Max** dBm	**3.0** VDC
		Measured DTS Bandwidth:
		610.00 kHz

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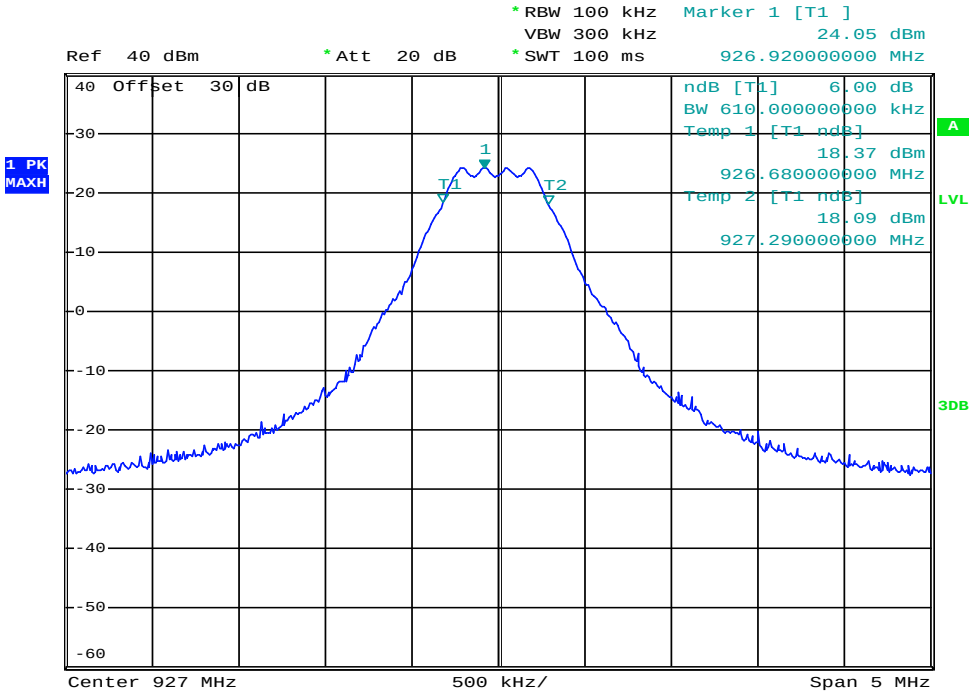
Plot 8.3 – 6dB DTS Bandwidth 927MHz

6dB *DTS* Bandwidth



Date: 26.JUN.2018 16:54:57

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
927.00 MHz	**Max** kHz	**100** %
Modulation Setting:	Channel Power Setting:	Nominal Input Voltage:
4FSK	**Max** dBm	**3.0** VDC
		Measured DTS Bandwidth:
		610.00 kHz

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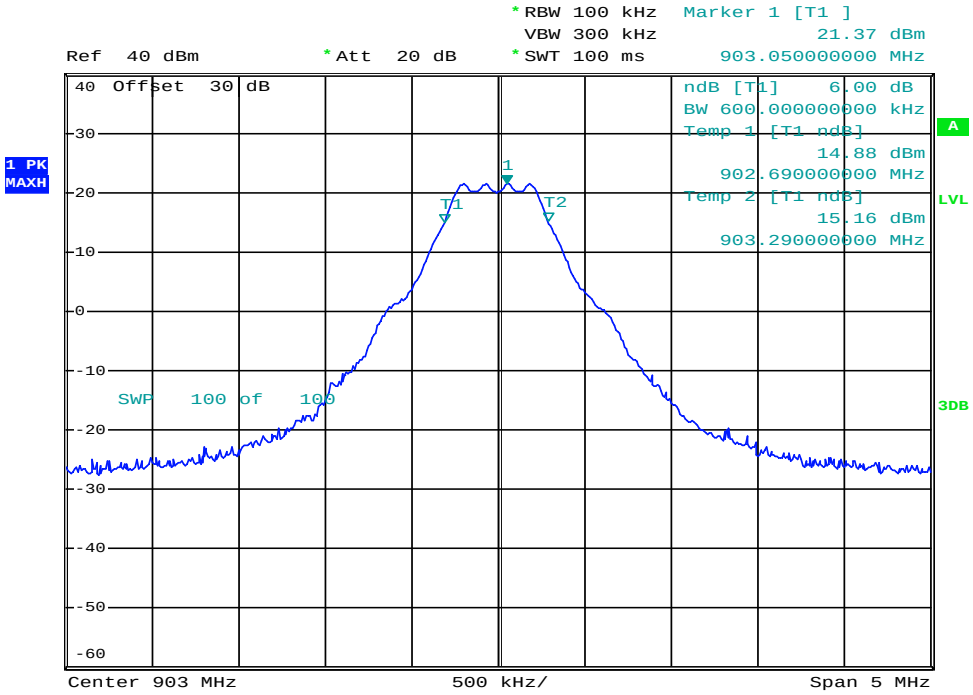
Plot 8.4 – 6dB DTS Bandwidth 903MHz, 1.8VDC Supply Voltage

6dB *DTS* Bandwidth



Date: 24.JUL.2018 10:10:20

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
903.00 MHz	**Max** kHz	**100** %
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
4FSK	**Max** dBm	**1.8** VDC
		Measured DTS Bandwidth:
		600.00 kHz

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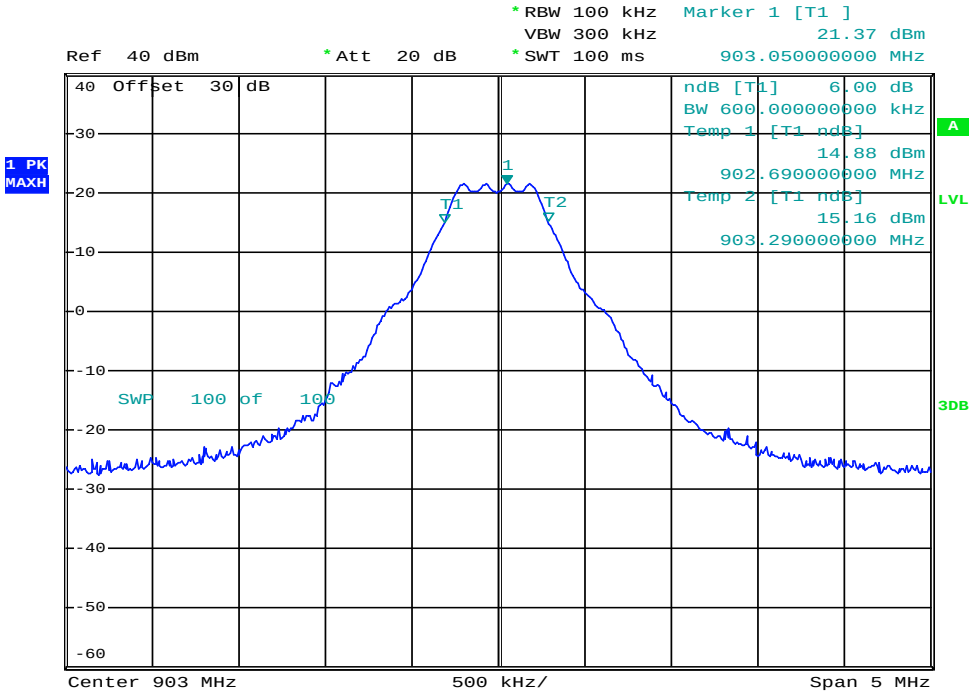
Plot 8.5 – 6dB DTS Bandwidth 903MHz, 4.0VDC Supply Voltage

6dB *DTS* Bandwidth



Date: 24.JUL.2018 10:10:20

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
903.00 MHz	**Max** kHz	**100** %
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
4FSK	**Max** dBm	**1.8** VDC
		Measured DTS Bandwidth:
		600.00 kHz

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Table 8.1 – Summary of 6dB DTS Bandwidth Measurements

6dB *DTS* Bandwidth Measurement Results						
Freqency (MHz)	Bandwidth Setting (kHz)	Modulation	Supply Voltage (VDC)	Measured 6dB BW [BW] (kHz)	Minimum 6dB BW [MBW] (kHz)	Margin (kHz)
903.00	Max	4FSK	3.0	620.00	500	**120.00**
915.00			3.0	610.00		**110.00**
927.00			3.0	610.00		**110.00**
903.00			1.8	610.00		**110.00**
903.00			4.0	610.00		**110.00**
					Result:	**Complies**

Margin = BW - MBW

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9.0 OCCUPIED BANDWIDTH

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 (9.2.1), ANSI C63.10 (6.9.3)

Limits	
KDB 558074 (9.2.1)	9.2.1 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 (6.9.3)	6.9.3 Occupied bandwidth—power bandwidth (99%) measurement procedure The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring 99% power bandwidth: a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW. b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement. c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2. d) Step a) through step c) might require iteration to adjust within the specified range. e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used. f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.
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 using the 99% Occupied Bandwidth function. 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 99% Occupied Bandwidth was measured and recorded and used for the basis for measuring the Conducted Output Power (See Section 7.0) and Power Spectral Density (See Section 10.0).

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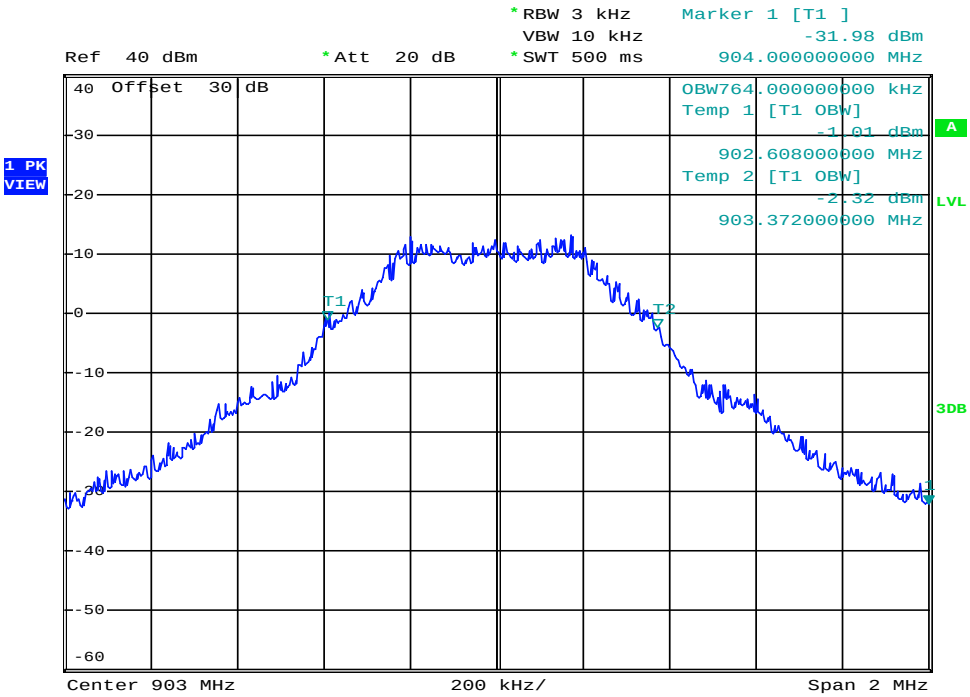
Plot 9.1 – Occupied Bandwidth 903MHz

Occupied Bandwidth



Date: 27.JUN.2018 10:37:54

Channel Frequency:	Channel Bandwidth Setting:	Transmit Duty Cycle:
903.00 MHz	**Max** kHz	**100** %
Modulation Setting:	Channel Power Setting:	Measured OBW:
4FSK	**Max** dBm	**764.00** kHz

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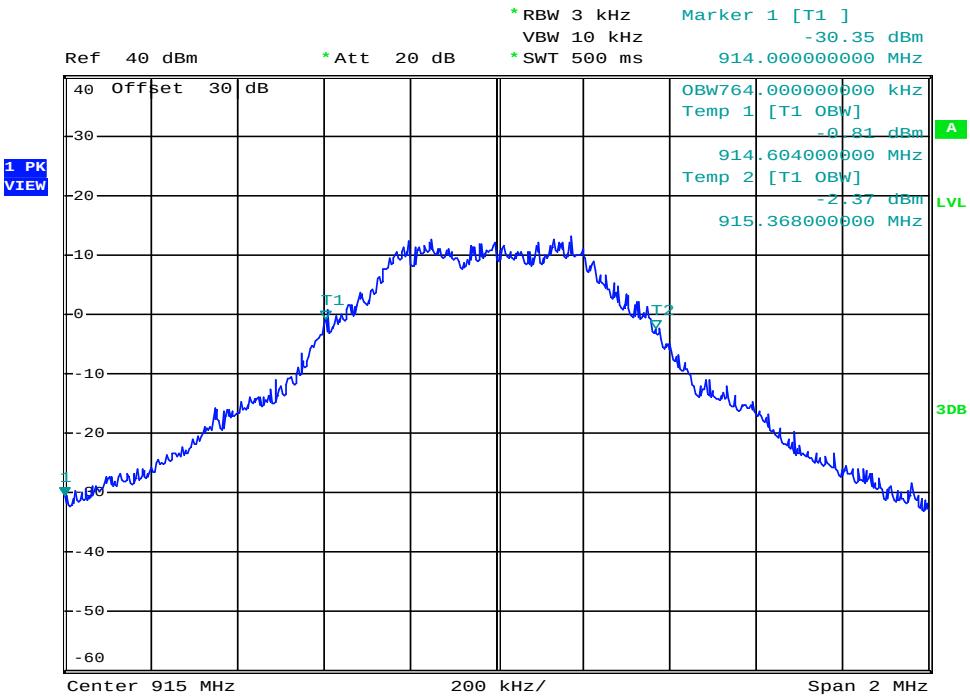
Plot 9.2 – Occupied Bandwidth 915MHz

Occupied Bandwidth



Date: 27.JUN.2018 10:35:37

Channel Frequency:	Channel Bandwidth Setting:	Transmit Duty Cycle:
915.00 MHz	**Max** kHz	**100** %
Modulation Setting:	Channel Power Setting:	Measured OBW:
4FSK	**Max** dBm	**764.00** kHz

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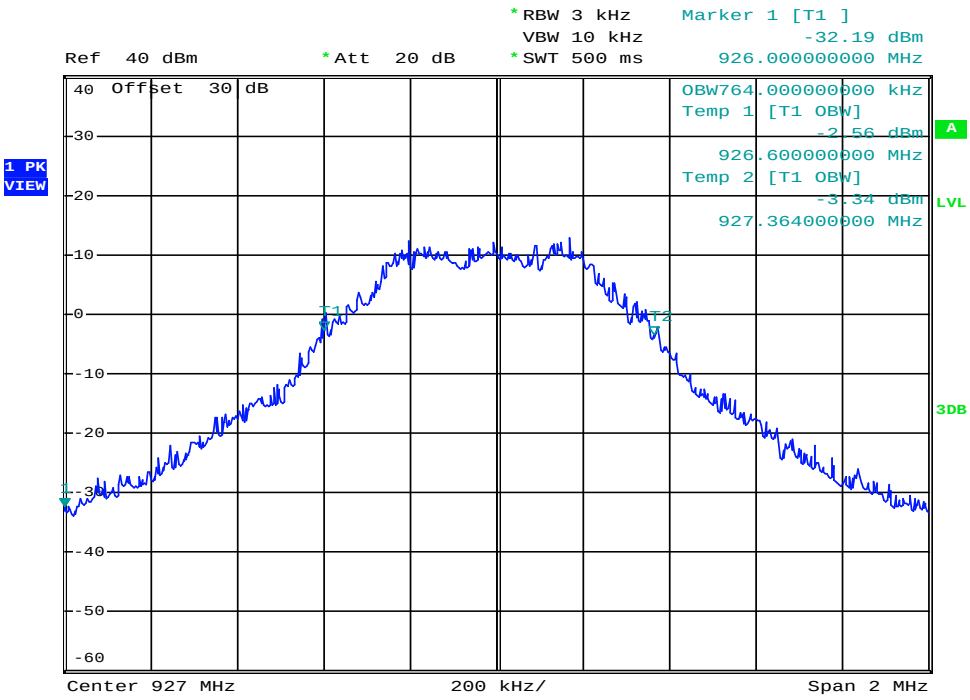
Plot 9.3 – Occupied Bandwidth 927MHz

Occupied Bandwidth



Date: 27.JUN.2018 10:36:59

Channel Frequency:	Channel Bandwidth Setting:	Transmit Duty Cycle:
927.00 MHz	**Max** kHz	**100** %
Modulation Setting:	Channel Power Setting:	Measured OBW:
4FSK	**Max** dBm	**764.00** kHz

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Table 9.1 – Summary of Occupied Bandwidth Measurements

Occupied Bandwidth Measurements			
Freqency (MHz)	Bandwidth Setting (kHz)	Modulation	Measured Occupied (kHz)
903.00	Max	4FSK	764.00
915.00			764.00
927.00			764.00

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10.0 POWER SPECTRAL DENSITY

Test Procedure	
Normative Reference	FCC 47 CFR §15.247(e), RSS-247 (5.2)(b),
	KDB 558074 (10.3), ANSI C63.10 (11.10.3)

Limits	
47 CFR §15.247(e)	(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.
RSS-247 (5.2)(b)	b) The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).
KDB 558074 (10.3) C63.10 (11.10.3)	**Method AVGPSD-1** (trace averaging with EUT transmitting at full power throughout each sweep) This procedure may be used when the maximum (average) conducted output power was used to demonstrate compliance to the output power limit. This is the baseline method for determining the maximum (average) conducted PSD level. If the instrument has an RMS power averaging detector, it must be used; otherwise, use the sample detector. The EUT must be configured to transmit continuously (duty cycle ≥ 98 %); otherwise sweep triggering/signal gating must be implemented to ensure that measurements are made only when the EUT is transmitting at its maximum power control level (no transmitter off time is to be considered). a) Set instrument center frequency to DTS channel center frequency. b) Set span to at least 1.5 X OBW. c) Set RBW to: 3 kHz ≤ RBW ≤ 100 kHz. . d) Set VBW ≥ 3 X RBW. e) Detector = RMS f) Ensure that the number of measurement points in the sweep ≥ 2 X span/RBW. g) Sweep time = auto couple. h) Employ trace averaging (RMS) mode over a minimum of 100 traces. i) Use the peak marker function to determine the maximum amplitude level. j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span in order to meet the minimum measurement point requirement as the RBW is reduced).
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 (1.5MHz / 3kHz) = 1000, 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 Power Spectral Density was measured and recorded. Comparative measurements were made at 1.8 and 4.0VDC supply voltage.

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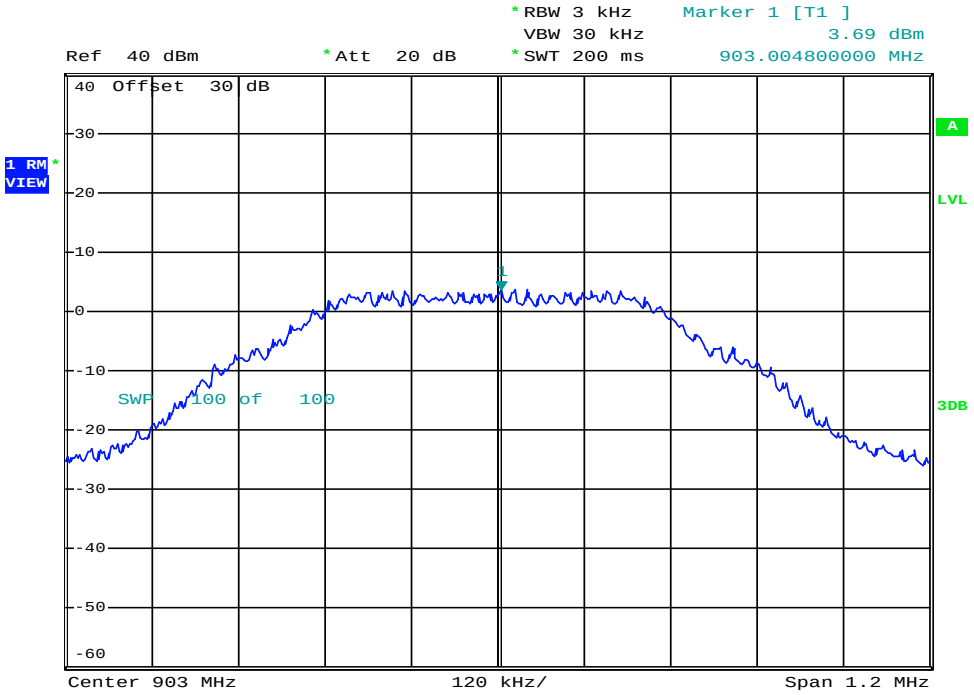
Plot 10.1 – Power Spectral Density 903 MHz

Power Spectral Density



Date: 24.JUL.2018 10:21:44

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
903.00 MHz	**764.00** kHz	**100** %
Modulation Setting:	Channel Power Setting:	Nominal Input Voltage:
4FSK	**Max** dBm	**3.0** VDC
		Measured PSD:
		3.69 dBm

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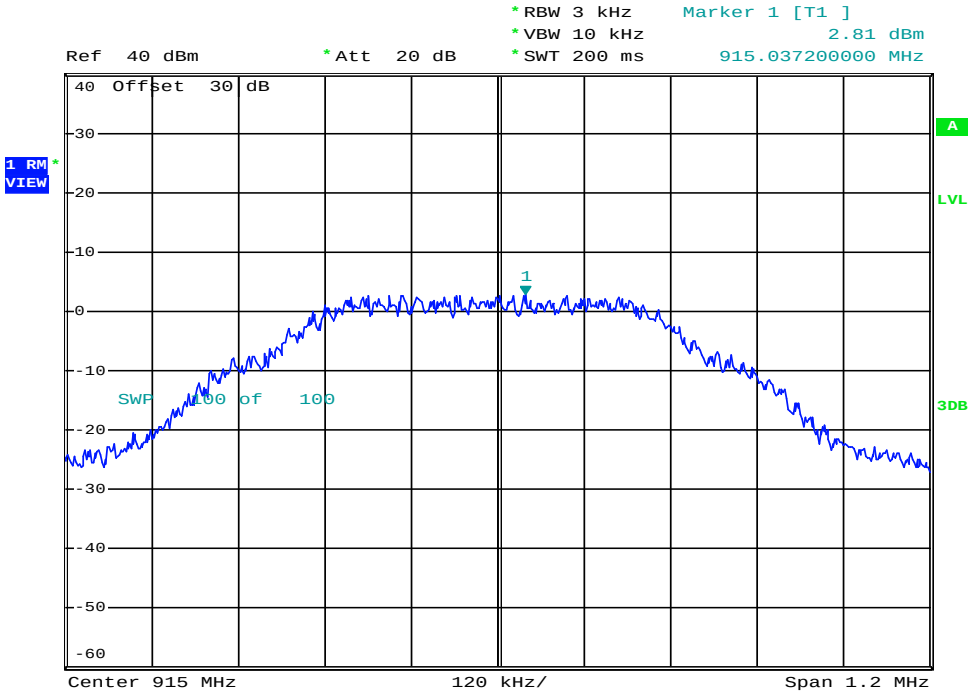
Plot 10.2 – Power Spectral Density 915 MHz

Power Spectral Density



Date: 27.JUN.2018 11:14:33

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
915.00 MHz	**764.00** kHz	**100** %
Modulation Setting:	Channel Power Setting:	Nominal Input Voltage:
4FSK	**Max** dBm	**3.0** VDC
		Measured PSD:
		2.81 dBm

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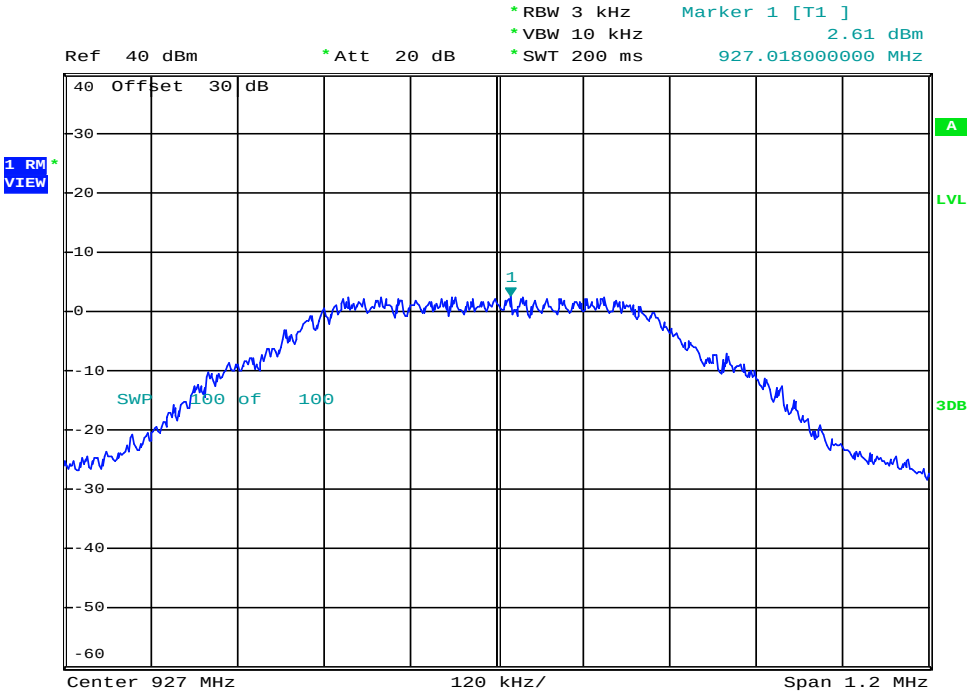
Plot 10.3 – Power Spectral Density 927 MHz

Power Spectral Density



Date: 27.JUN.2018 11:11:19

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
927.00 MHz	**764.00** kHz	**100** %
Modulation Setting:	Channel Power Setting:	Nominal Input Voltage:
4FSK	**Max** dBm	**3.0** VDC
		Measured PSD:
		2.61 dBm

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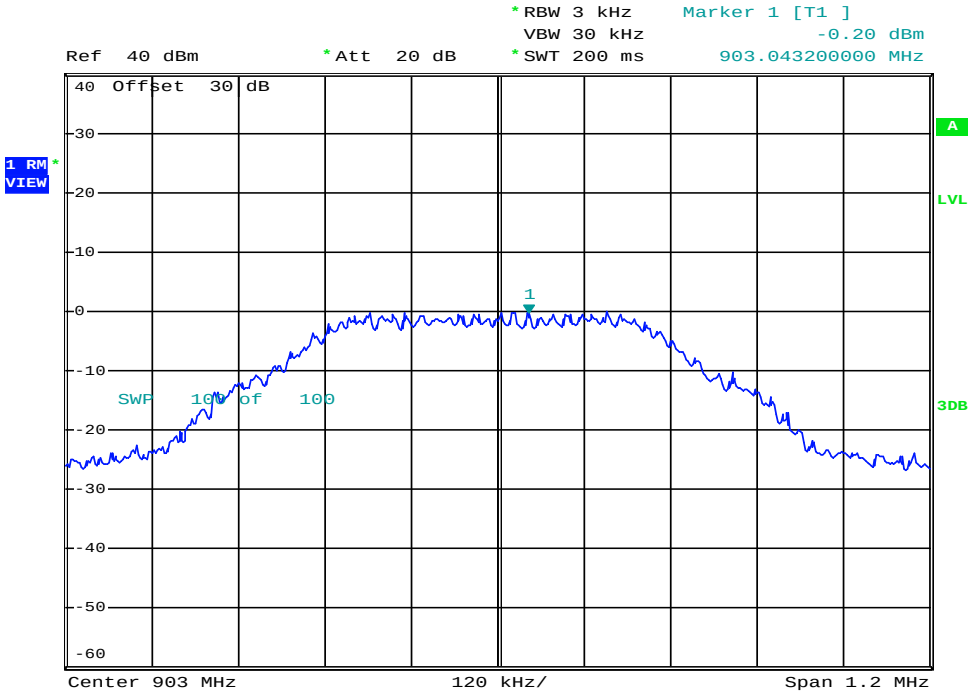
Plot 10.4 – Power Spectral Density 927 MHz, 1.8VDC Supply Voltage

Power Spectral Density



Date: 24.JUL.2018 10:16:44

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
903.00 MHz	**764.00** kHz	**100** %
Modulation Setting:	Channel Power Setting:	Nominal Input Voltage:
4FSK	**Max** dBm	**1.8** VDC
		Measured PSD:
		-0.20 dBm

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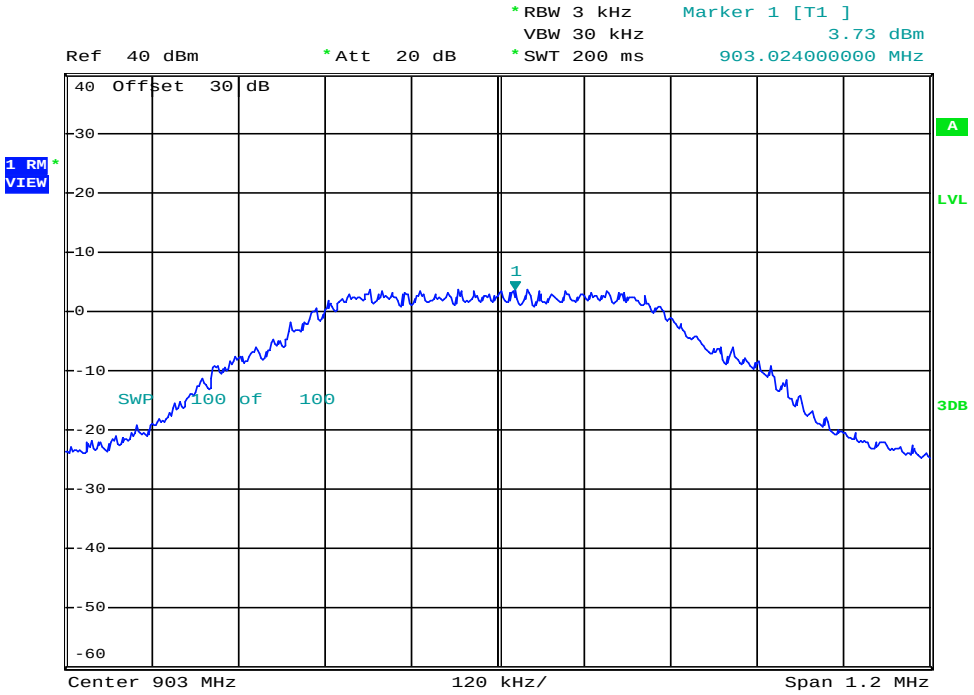
Plot 10.5 – Power Spectral Density 927 MHz, 4.0VDC Supply Voltage

Power Spectral Density



Date: 24.JUL.2018 10:22:42

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
903.00 MHz	**764.00** kHz	**100** %
Modulation Setting:	Channel Power Setting:	Nominal Input Voltage:
4FSK	**Max** dBm	**4.0** VDC
		Measured PSD:
		3.73 dBm

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Table 10.1 – Summary of Power Spectral Density Measurements

Power Spectral Density Measurement Results								
Frequency (MHz)	BW (kHz)	Modulation	Power Setting(1) (dBm)	Supply Voltage (VDC)	Transmit Duty Cycle (%)	Measured PSD [PSD_{Meas}] (dBm)	Limit (dBm)	Margin (dB)
903.0	764	4FSK	Max	3.0	100	3.69	8.0	**4.3**
915.0				3.0		2.81		**5.2**
927.0				3.0		2.61		**5.4**
903.0				1.8		-0.20		**8.2**
903.0				4.0		3.73		**4.3**
						Results:	**Complies**	

(1) The output power is factory set to maximum

Margin = Limit - PSD_{meas}

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11.0 CONDUCTED SPURIOUS EMISSIONS & BAND EDGE

Test Procedure	
Normative Reference	FCC 47 CFR §2.1051, §15.247(d), RSS-Gen (6.13), RSS-247 (5.5),
	KDB 558074 (11.3), ANSI C63.10 (11.11.3)

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.
KDB 558074 (11.3) C63.10 (11.11.3)	**11.1 General** The DTS rules specify that in any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions: b) If maximum conducted (average) output power was used to demonstrate compliance as described in 9.2, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 30 dBc). **11.2 Reference level measurement** a) Set instrument center frequency to DTS channel center frequency. b) Set the span to ≥ 1.5 X *DTS bandwidth.* c) Set the RBW = 100 kHz. d) Set the VBW ≥ 3 X RBW. e) Detector = peak. f) Sweep time = auto couple. g) Trace mode = max hold. h) Allow trace to fully stabilize. i) Use the peak marker function to determine the maximum PSD level. Note that the channel found to contain the maximum PSD level can be used to establish the reference

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Test Procedure (Cont.)	
Normative Reference	FCC 47 CFR §2.1051, §15.247(d), RSS-Gen (6.13), RSS-247 (5.5),
	KDB 558074 (11.3), ANSI C63.10 (11.11.3)

Limits	
KDB 558074 (11.3) C63.10 (11.11.3)	**11.3 Emission level measurement** a) Set the center frequency and span to encompass frequency range to be measured. b) Set the RBW = 100 kHz. c) Set the VBW ≥ 3 X RBW. d) Detector = peak. e) Sweep time = auto couple. f) Trace mode = max hold. g) Allow trace to fully stabilize. h) Use the peak marker function to determine the maximum amplitude level.
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. The Reference Level Measurement was 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 unwanted emissions were measured and recorded. The highest Reference Level Measurement was to determine the attenuation of the unwanted emissions. Comparative measurements were made at 1.8 and 4.0VDC supply voltage.

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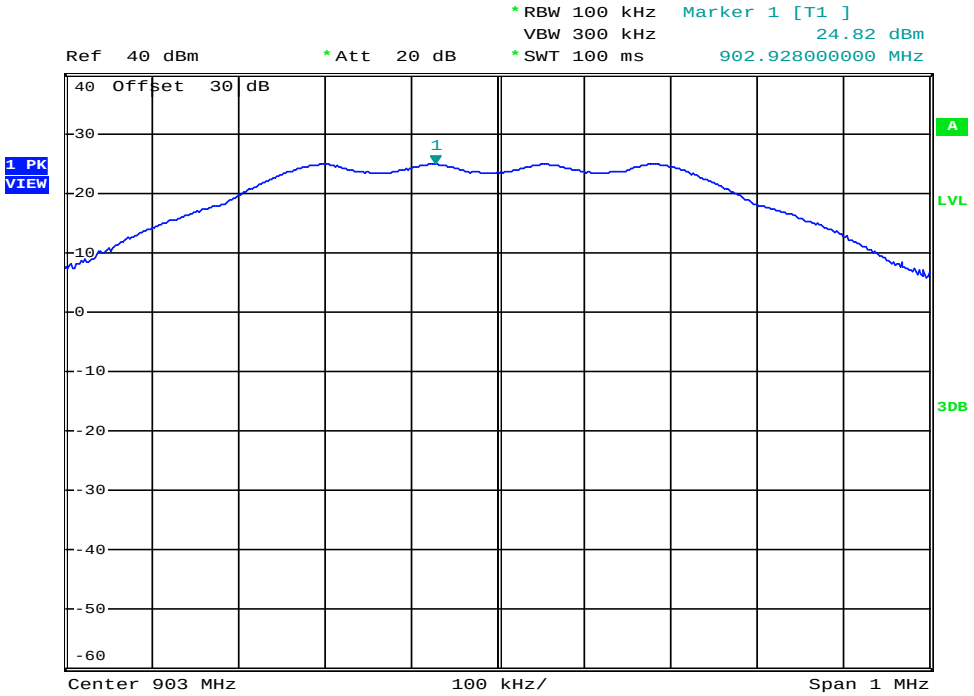
Plot 11.1 – Reference Level Measurement 903MHz

Reference Level Measurement



Date: 27.JUN.2018 12:11:29

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
903.00 MHz	**610.00** kHz	**100** %
Modulation Setting:	Channel Power Setting:	Measured PSD:
4FSK	**Max** dBm	**24.82** dBm

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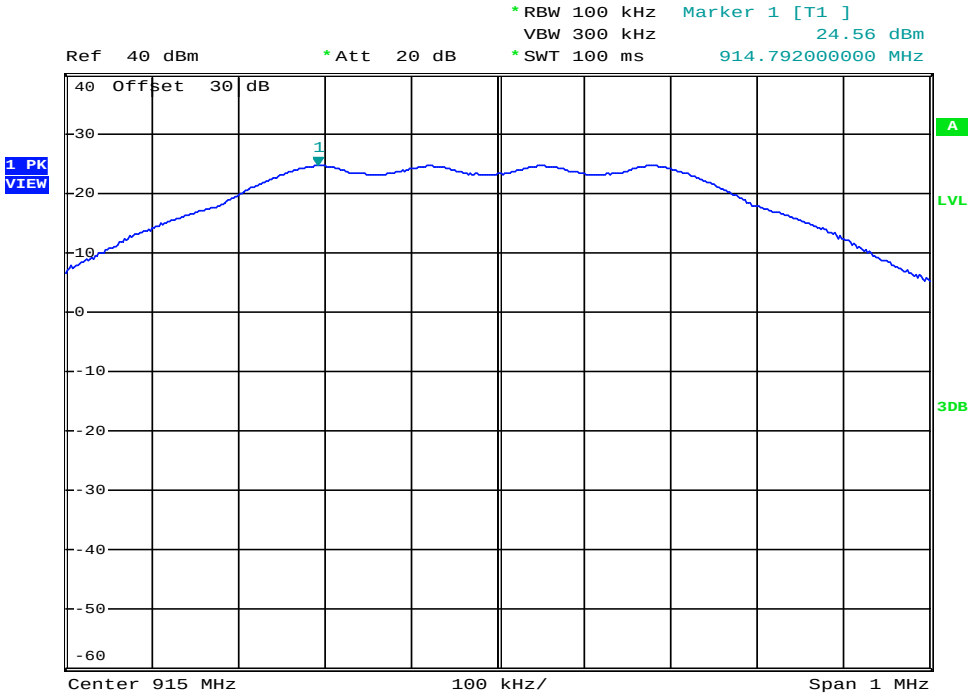
Plot 11.2 – Reference Level Measurement 915MHz

Reference Level Measurement



Date: 27.JUN.2018 12:12:50

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
915.00 MHz	**610.00** kHz	**100** %
Modulation Setting:	Channel Power Setting:	Measured PSD:
4FSK	**Max** dBm	**24.56** dBm

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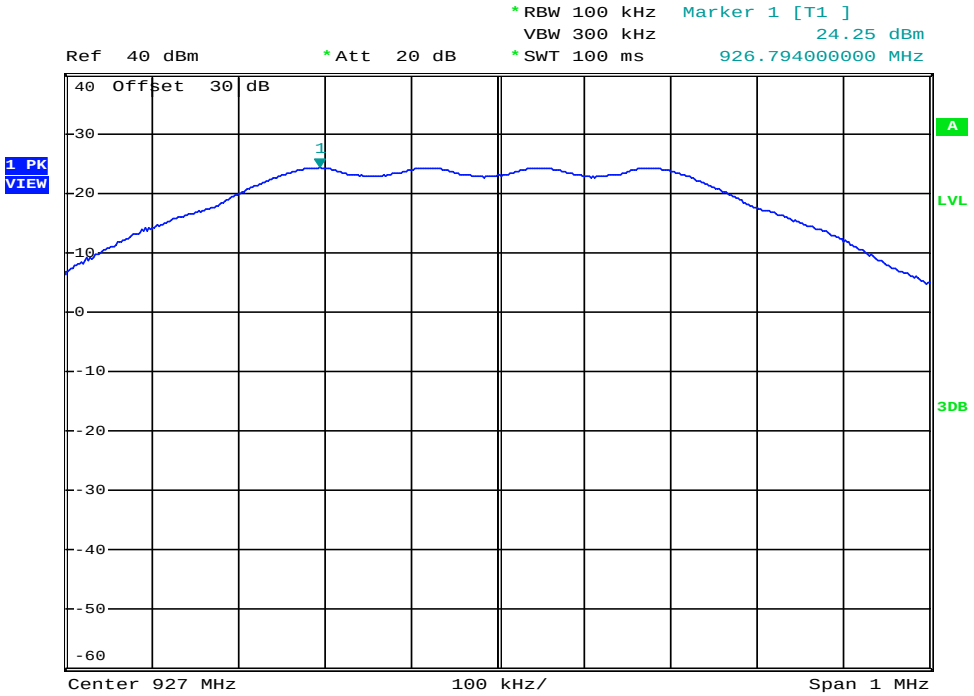
Plot 11.3 – Reference Level Measurement 927MHz

Reference Level Measurement



Date: 27.JUN.2018 12:10:25

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
927.00 MHz	**610.00** kHz	**100** %
Modulation Setting:	Channel Power Setting:	Measured PSD:
4FSK	**Max** dBm	**24.25** dBm

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Table 11.1 – Reference Level Measurements

Reference Level Measurement							
Frequency (MHz)	BW (kHz)	Modulation	Power Setting(1) (dBm)	Transmit Duty Cycle (%)	Measured PSD [PSD_{Meas}] (dBm)	Required Attenuation(2) [A_A] (dBc)	Limit Line [A_L] (dBm)
903.0	610	4FSK	Max	100	24.82*	30.00	-5.18
915.0					24.56		
927.0					24.25		

(1) The output power is factory set to maximum

(2) The Maximum Conducted (average) output power was used for compliance therefore the required attenuation is 30dBc.

* The highest 100kHz PSD is used to demonstrate compliance.

Limit Line (A_L) = A_A - PSD_{meas}

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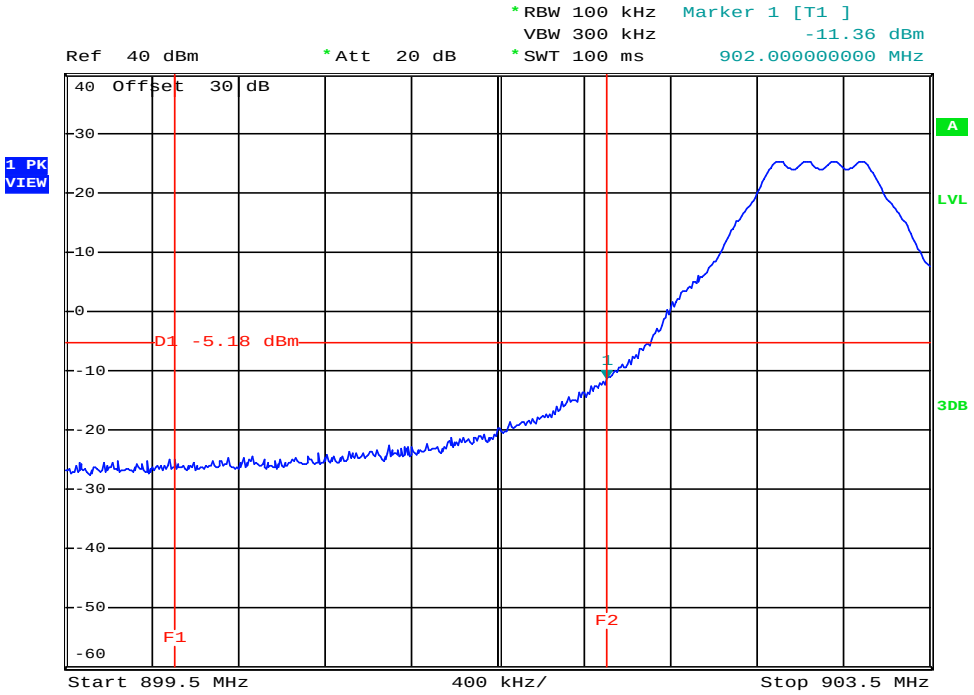
Plot 11.4 – Emission Level Measurement – Lower Band Edge 903 MHz

Lower Band Edge



Date: 23.JUL.2018 15:56:47

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
903.00 MHz	**620.00** kHz	**100** %
Modulation Setting:	Channel Power Setting:	Nominal Input Voltage:
4FSK	**Max** dBm	**3.0** VDC
		Measured Emission Level:
		-11.36 dBm

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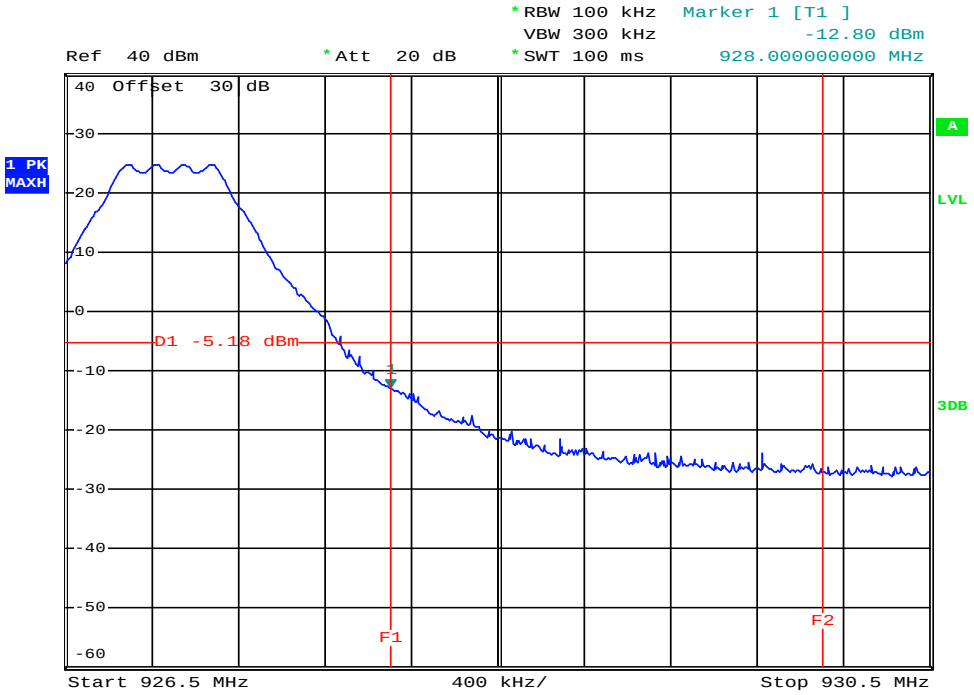
Plot 11.5 – Emission Level Measurement – Upper Band Edge 927 MHz

Upper Band Edge



Date: 23.JUL.2018 16:00:28

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
927.00 MHz	**610.00** kHz	**100** %
Modulation Setting:	Channel Power Setting:	Nominal Input Voltage:
4FSK	**Max** dBm	**3.0** VDC
		Measured Emission Level:
		-12.80 dBm

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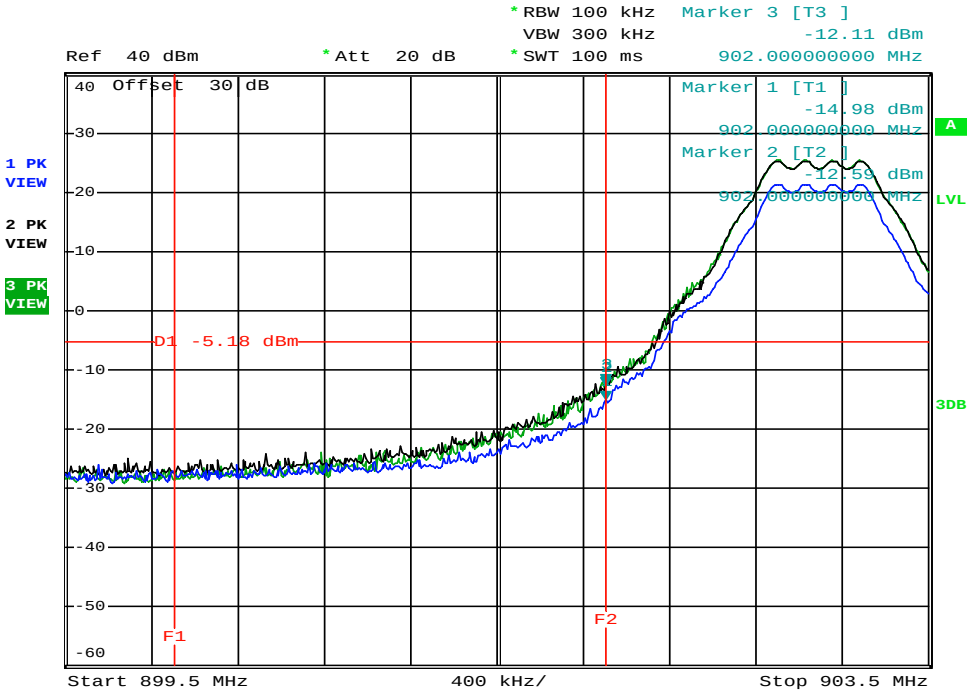
Plot 11.6 – Emission Level Measurement – Lower Band Edge - Supply Voltage Comparison

Lower Band Edge



Date: 24.JUL.2018 09:47:29

Channel Frequency: **903.00** MHz	Channel Bandwidth: **620.00** kHz	Transmit Duty Cycle: **100** %
Modulation Setting: **4FSK**	Channel Power Setting: **Max** dBm	
Nominal Input Voltage: **1.8** VDC	Nominal Input Voltage: **3.0** VDC	Nominal Input Voltage: **4.0** VDC
Measured Emission Level: **-14.98** dBm	Measured Emission Level: **-12.59** dBm	Measured Emission Level: **-12.11** dBm

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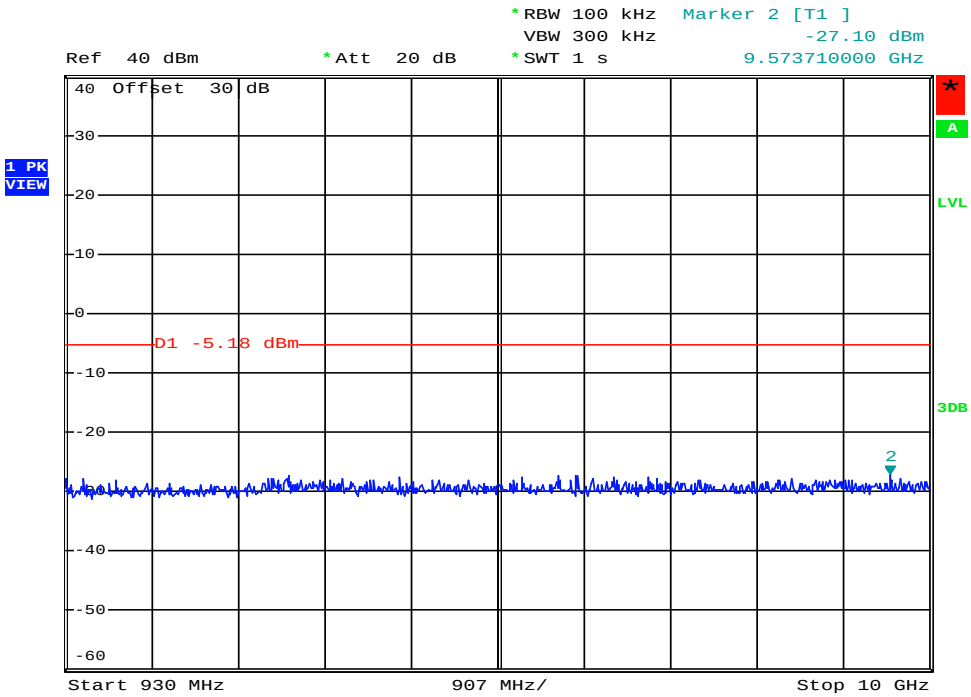
Plot 11.6 – Emission Level Measurement – to 10th Harmonic 927 MHz

Emissions to 10gHz



Date: 27.JUN.2018 12:56:21

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
927.00 MHz	**610.00** kHz	**100** %
Modulation Setting:	Channel Power Setting:	Nominal Input Voltage:
4FSK	**Max** dBm	**3.0** VDC
		Measured Emission Level:
		-27.10 dBm

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Table 11.2 – Emission Level Measurements Results

Emission Level Measurement								
Frequency Range (MHz)	BW (kHz)	Modulation	Power Setting(1) (dBm)	Supply Voltage (VDC)	Transmit Duty Cycle (%)	Measured Emission [E_{Meas}] (dBm)	Limit Line [A_L] (dBm)	Margin (dB)
900 - 902	610	4FSK	Max	3.0	100	-11.36	-5.2	**6.18**
900 - 902				1.8		-14.98		**9.80**
900 - 902				4.0		-12.11		**6.93**
928 - 930				3.0		-12.80		**7.62**
930 - 10GHz				3.0		-27.10		**21.92**
						Results:	**Complies**	

(1) The output power is factory set to maximum

Margin = A_L - E_{MEAS}

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12.0 RESTRICTED BAND EMISSIONS

Test Procedure	
Normative Reference	FCC 47 CFR §2.1051, §15.247(d), §15.205(a), §15.205(c), §15.209(a)
	ANSI C63.10 (5.9)

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)).
Test Setup	Appendix A Figure A.2, A.3, A.4

Measurement Procedure

The emissions from the DUT were measured on an OATS while the DUT was transmitting at 100% Duty Cycle. The output power of the DUT was set to the manufacturer's highest output power setting at the Low frequency channel as permitted by the device. The unwanted emissions were measured and recorded between 9kHz and 10GHz. Due to the form factor of this device, the DUT was tested in 3 "XYZ" orientations.

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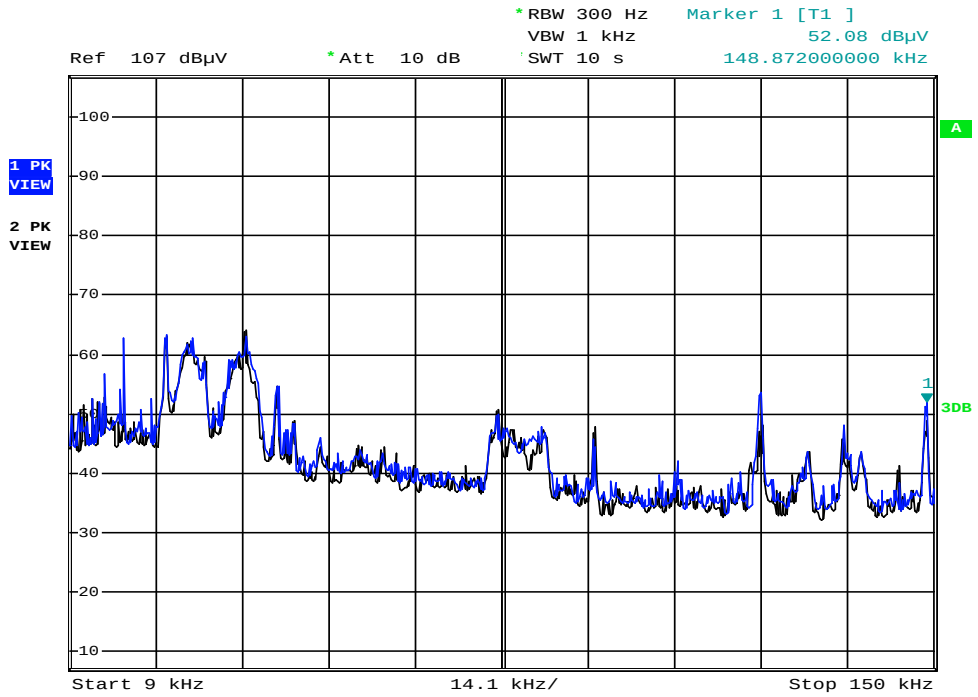
Plot 12.1 – Restricted Band Emissions 9kHz – 150kHz - Front

Restricted Band Emissions



Date: 4.JUL.2018 14:33:53

Trace 1 (Blue) = Ambient
Trace 2 (Black) = DUT Emission w/ Ambient

Channel Frequency: **903.00** MHz	Frequency Range: **9kHz - 150kHz**	Channel Bandwidth: **610.00** kHz
Transmit Duty Cycle: **100** %	Modulation Setting: **4FSK**	Channel Power Setting: **Max** dBm
Antenna Polarization: **Front**	Antenna Elevation: **Center: 1** m	Measured Emission: **None Detected** dBuV

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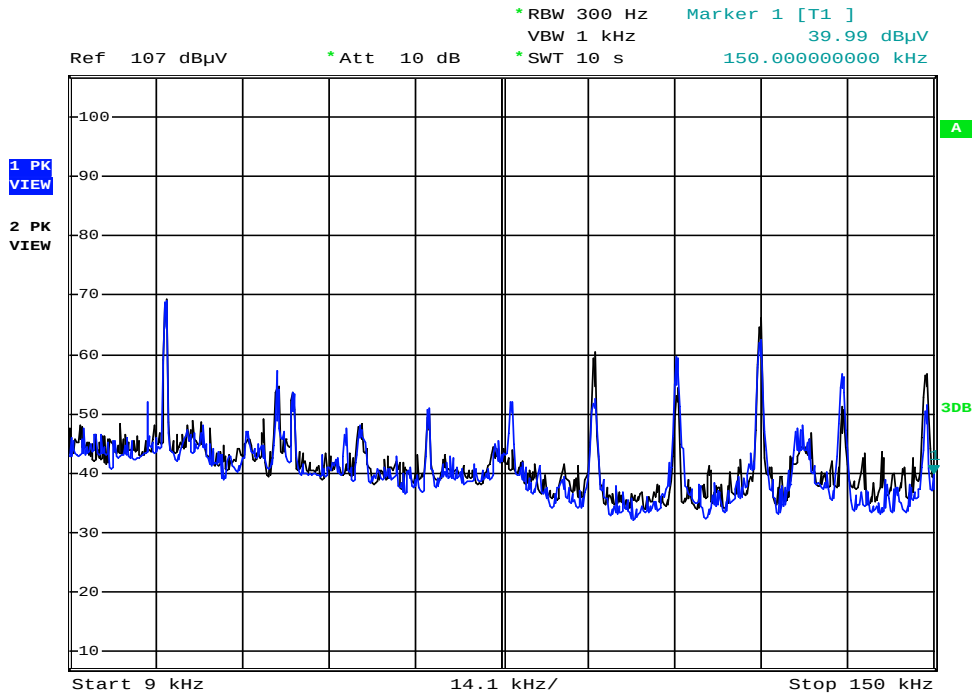
Plot 12.2 – Restricted Band Emissions 9kHz – 150kHz - Side

Restricted Band Emissions



Date: 4.JUL.2018 14:55:59

Trace 1 (Blue) = Ambient
Trace 2 (Black) = DUT Emission w/ Ambient

Channel Frequency: **903.00** MHz	Frequency Range: **9kHz - 150kHz**	Channel Bandwidth: **610.00** kHz
Transmit Duty Cycle: **100** %	Modulation Setting: **4FSK**	Channel Power Setting: **Max** dBm
Antenna Polarization: **Side**	Antenna Elevation: **Center: 1** m	Measured Emission: **None Detected** dBuV

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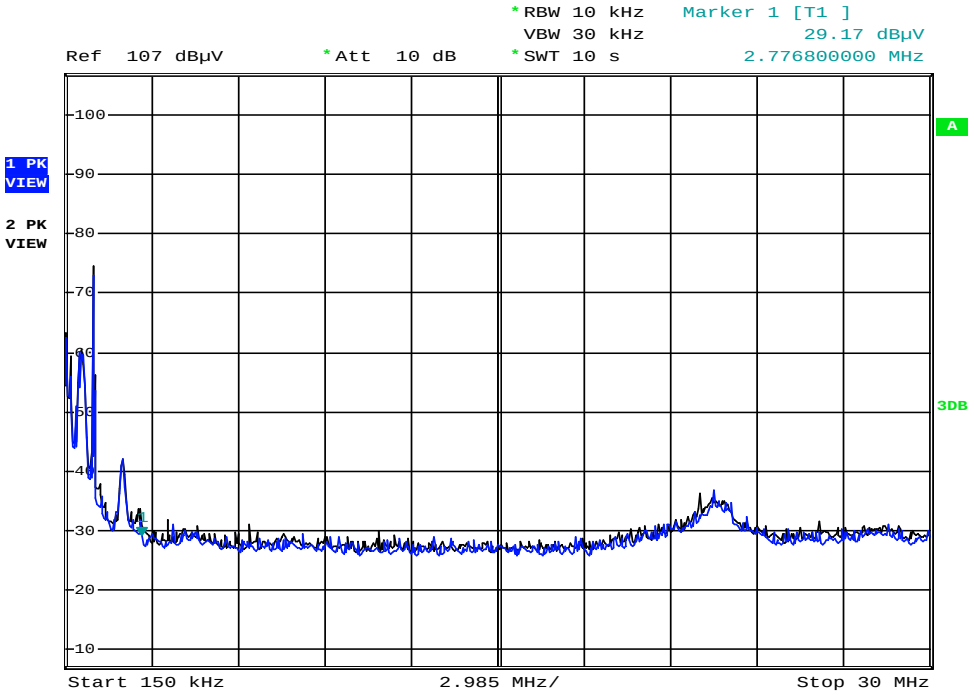
Plot 12.3 – Restricted Band Emissions 150kHz – 30MHz – 150kHz - Front

Restricted Band Emissions



Date: 4.JUL.2018 14:40:24

Trace 1 (Blue) = Ambient
Trace 2 (Black) = DUT Emission w/ Ambient

Channel Frequency: **903.00** MHz	Frequency Range: **150kHz - 30MHz**	Channel Bandwidth: **610.00** kHz
Transmit Duty Cycle: **100** %	Modulation Setting: **4FSK**	Channel Power Setting: **Max** dBm
Antenna Polarization: **Front**	Antenna Elevation: **Center: 1** m	Measured Emission: **None Detected** dBuV

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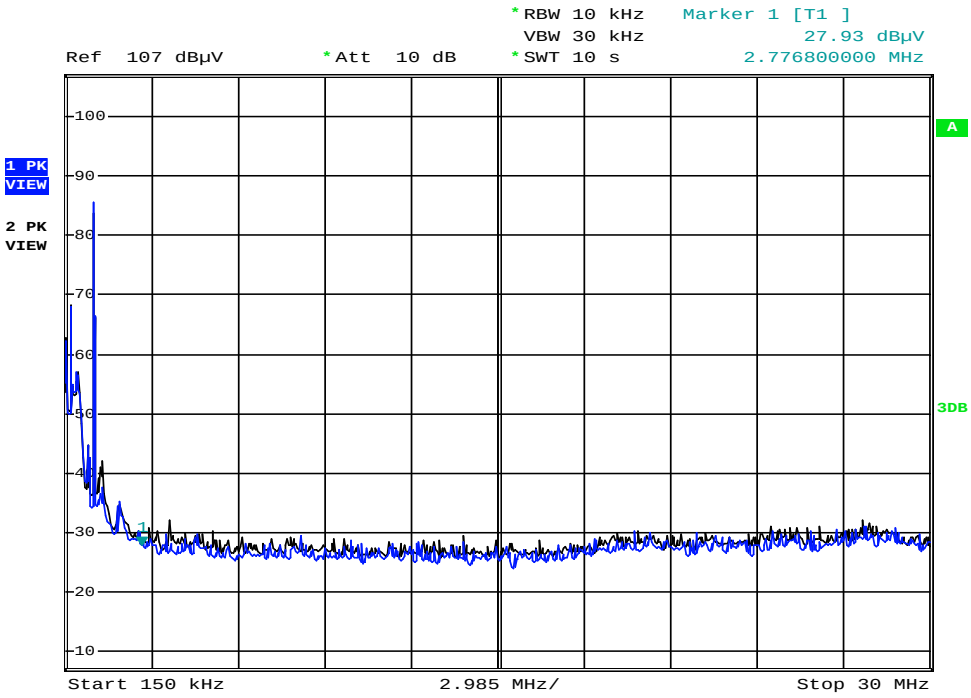
Plot 12.4 – Restricted Band Emissions 150kHz – 30MHz – 150kHz - Side



Date: 4.JUL.2018 14:49:16

Trace 1 (Blue) = Ambient
Trace 2 (Black) = DUT Emission w/ Ambient

Channel Frequency: **903.00** MHz	Frequency Range: **150kHz - 30MHz**	Channel Bandwidth: **610.00** kHz
Transmit Duty Cycle: **100** %	Modulation Setting: **4FSK**	Channel Power Setting: **Max** dBm
Antenna Polarization: **Side**	Antenna Elevation: **Center: 1** m	Measured Emission: **None Detected** dBuV

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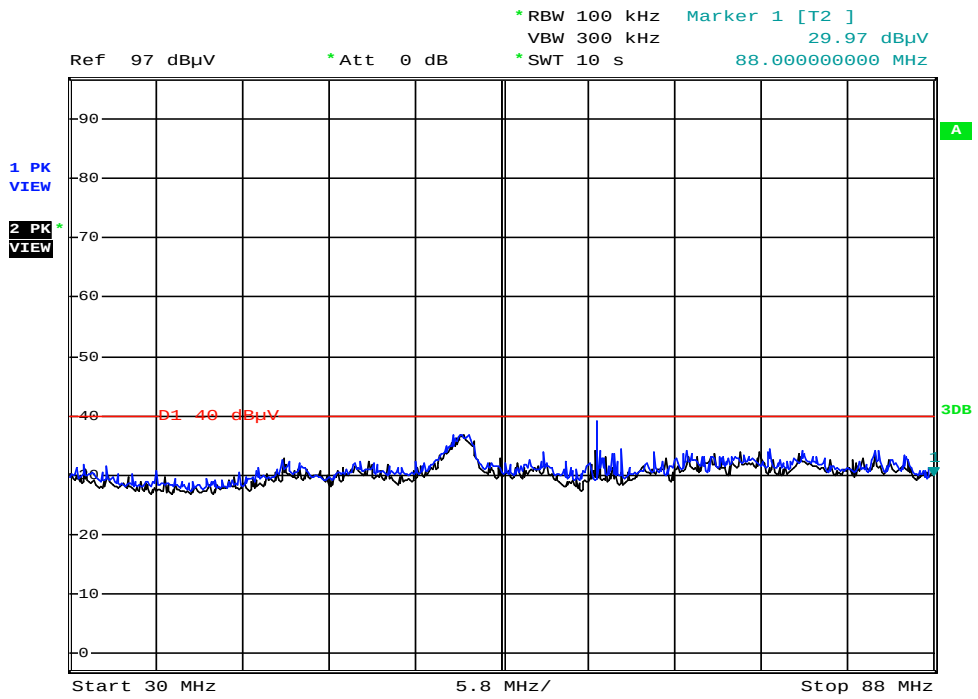
Plot 12.5 – Restricted Band Emissions 30MHz – 88MHz - Horizontal

Restricted Band Emissions



Date: 5.JUL.2018 12:52:31

Trace 1 (Blue) = Ambient
Trace 2 (Black) = DUT Emission w/ Ambient

Channel Frequency: **903.00** MHz	Frequency Range: **30MHz - 88MHz**	Channel Bandwidth: **610.00** kHz
Transmit Duty Cycle: **100** %	Modulation Setting: **4FSK**	Channel Power Setting: **Max** dBm
Antenna Polarization: **Horizontal**	Antenna Elevation: **1 - 4** m	Measured Emission: **None Detected** dBuV

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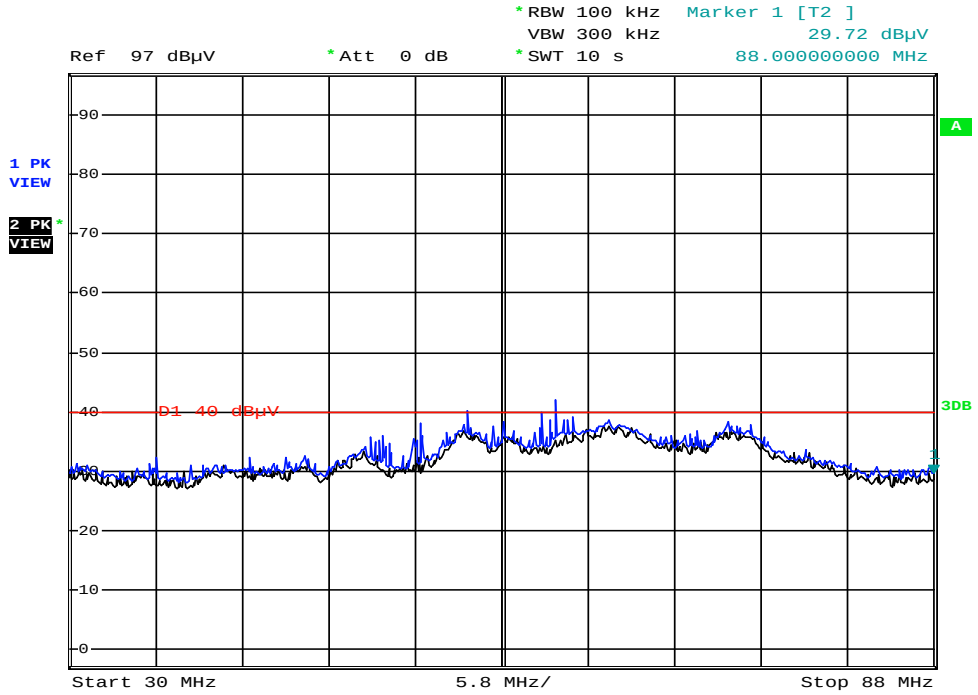
Plot 12.6 – Restricted Band Emissions 30MHz – 88MHz - Vertical

Restricted Band Emissions



Date: 5.JUL.2018 12:49:08

Trace 1 (Blue) = Ambient
Trace 2 (Black) = DUT Emission w/ Ambient

Channel Frequency: **903.00** MHz	Frequency Range: **30MHz - 88MHz**	Channel Bandwidth: **610.00** kHz
Transmit Duty Cycle: **100** %	Modulation Setting: **4FSK**	Channel Power Setting: **Max** dBm
Antenna Polarization: **Vertical**	Antenna Elevation: **1 - 4** m	Measured Emission: **None Detected** dBuV

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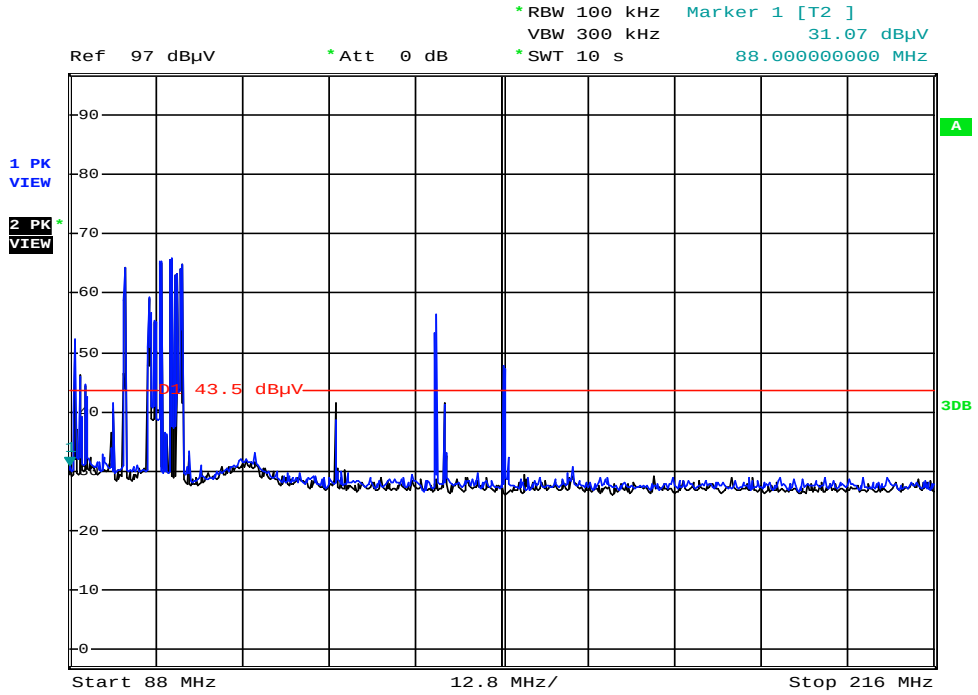
Plot 12.7 – Restricted Band Emissions 88MHz – 216MHz - Horizontal

Restricted Band Emissions



Date: 5.JUL.2018 12:56:23

Trace 1 (Blue) = Ambient
Trace 2 (Black) = DUT Emission w/ Ambient

Channel Frequency: **903.00** MHz	Frequency Range: **88MHz - 216MHz**	Channel Bandwidth: **610.00** kHz
Transmit Duty Cycle: **100** %	Modulation Setting: **4FSK**	Channel Power Setting: **Max** dBm
Antenna Polarization: **Horizontal**	Antenna Elevation: **1 - 4** m	Measured Emission: **None Detected** dBuV

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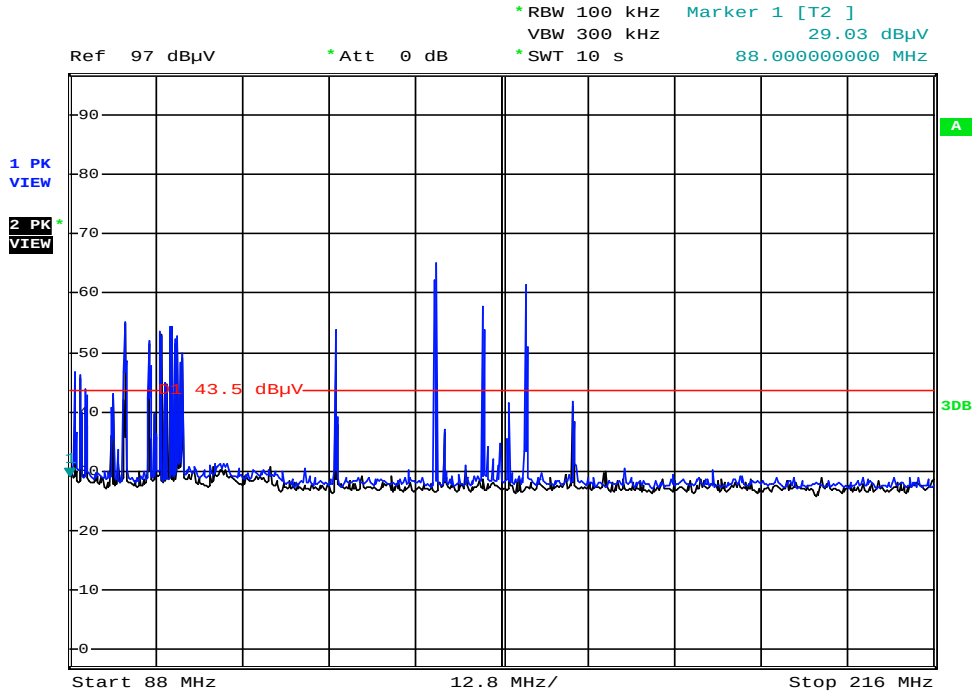
Plot 12.8 – Restricted Band Emissions 88MHz – 216MHz - Vertical

Restricted Band Emissions



Date: 5.JUL.2018 12:59:36

Trace 1 (Blue) = Ambient
Trace 2 (Black) = DUT Emission w/ Ambient

Channel Frequency: **903.00** MHz	Frequency Range: **88MHz - 216MHz**	Channel Bandwidth: **610.00** kHz
Transmit Duty Cycle: **100** %	Modulation Setting: **4FSK**	Channel Power Setting: **Max** dBm
Antenna Polarization: **Vertical**	Antenna Elevation: **1 - 4** m	Measured Emission: **None Detected** dBuV

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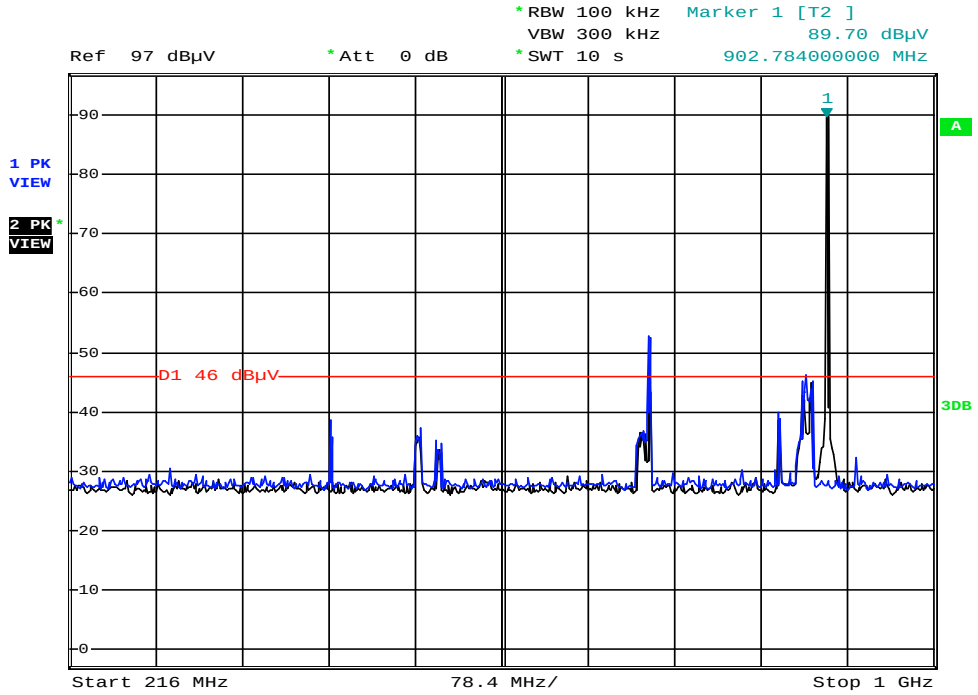
Plot 12.9 – Restricted Band Emissions 216MHz – 1000MHz - Horizontal

Restricted Band Emissions



Date: 5.JUL.2018 13:09:58

Trace 1 (Blue) = Ambient
Trace 2 (Black) = DUT Emission w/ Ambient

Channel Frequency: **903.00** MHz	Frequency Range: **216MHz - 1000MHz**	Channel Bandwidth: **610.00** kHz
Transmit Duty Cycle: **100** %	Modulation Setting: **4FSK**	Channel Power Setting: **Max** dBm
Antenna Polarization: **Horizontal**	Antenna Elevation: **1 - 4** m	Measured Emission: **Fundamental: 89.70** dBuV

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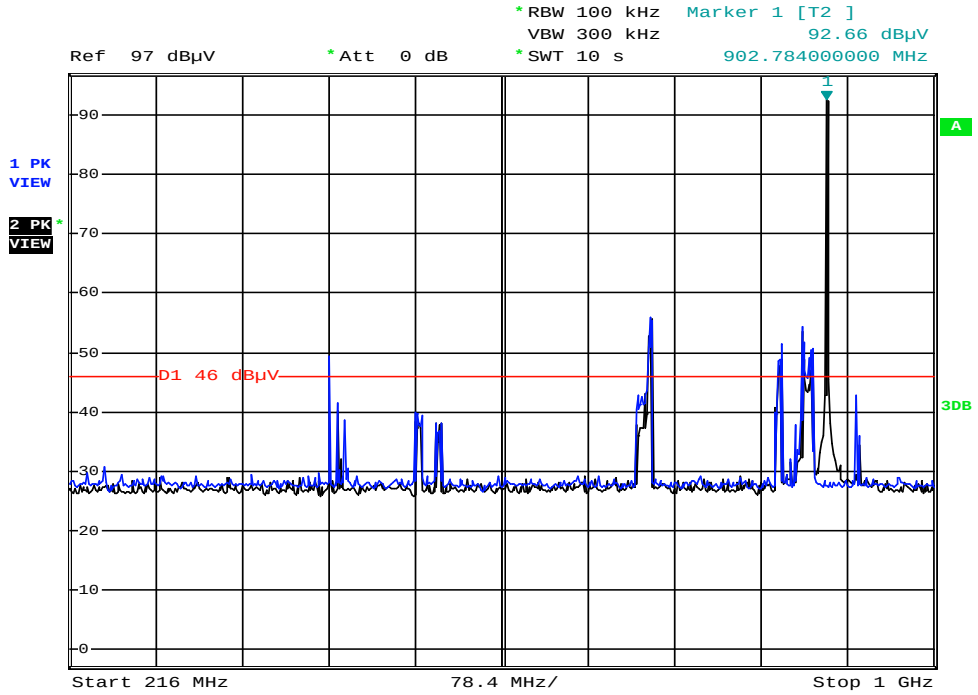
Plot 12.10 – Restricted Band Emissions 216MHz – 1000MHz - Vertical

Restricted Band Emissions



Date: 5.JUL.2018 13:05:34

Trace 1 (Blue) = Ambient
Trace 2 (Black) = DUT Emission w/ Ambient

Channel Frequency: **903.00** MHz	Frequency Range: **216MHz - 1000MHz**	Channel Bandwidth: **610.00** kHz
Transmit Duty Cycle: **100** %	Modulation Setting: **4FSK**	Channel Power Setting: **Max** dBm
Antenna Polarization: **Vertical**	Antenna Elevation: **1 - 4** m	Measured Emission: **Fundamental: 95.66** dBuV

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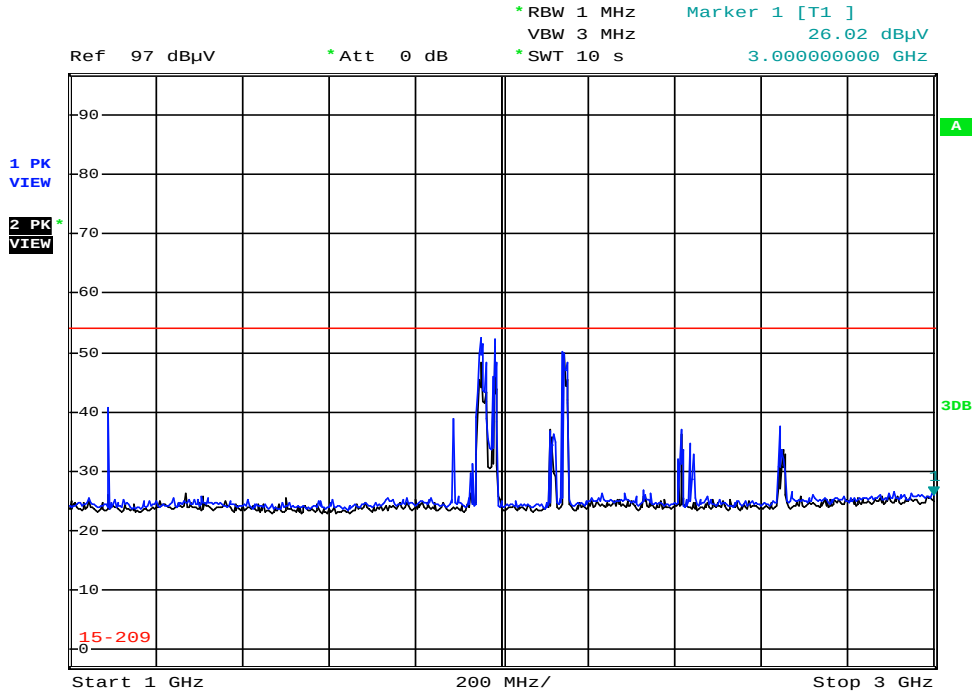
Plot 12.11 – Restricted Band Emissions 1GHz – 3GHz - Horizontal

Restricted Band Emissions



Date: 5.JUL.2018 15:00:14

Trace 1 (Blue) = Ambient
Trace 2 (Black) = DUT Emission w/ Ambient

Channel Frequency: **903.00** MHz	Frequency Range: **1GHz - 3GHz**	Channel Bandwidth: **610.00** kHz
Transmit Duty Cycle: **100** %	Modulation Setting: **4FSK**	Channel Power Setting: **Max** dBm
Antenna Polarization: **Horizontal**	Antenna Elevation: **1 - 4** m	Measured Emission: **None Detected** dBuV

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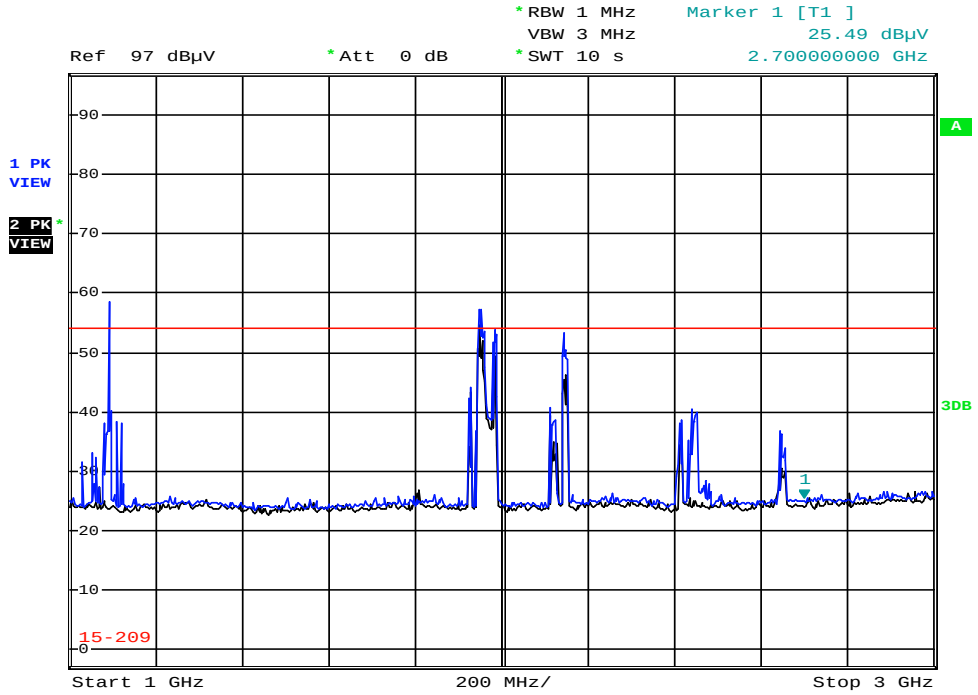
Plot 12.12 – Restricted Band Emissions 1GHz – 3GHz - Vertical

Restricted Band Emissions



Date: 5.JUL.2018 14:47:52

Trace 1 (Blue) = Ambient
Trace 2 (Black) = DUT Emission w/ Ambient

Channel Frequency: **903.00** MHz	Frequency Range: **1GHz - 3 GHz**	Channel Bandwidth: **610.00** kHz
Transmit Duty Cycle: **100** %	Modulation Setting: **4FSK**	Channel Power Setting: **Max** dBm
Antenna Polarization: **Vertical**	Antenna Elevation: **1 - 4** m	Measured Emission: **None Detected** dBuV

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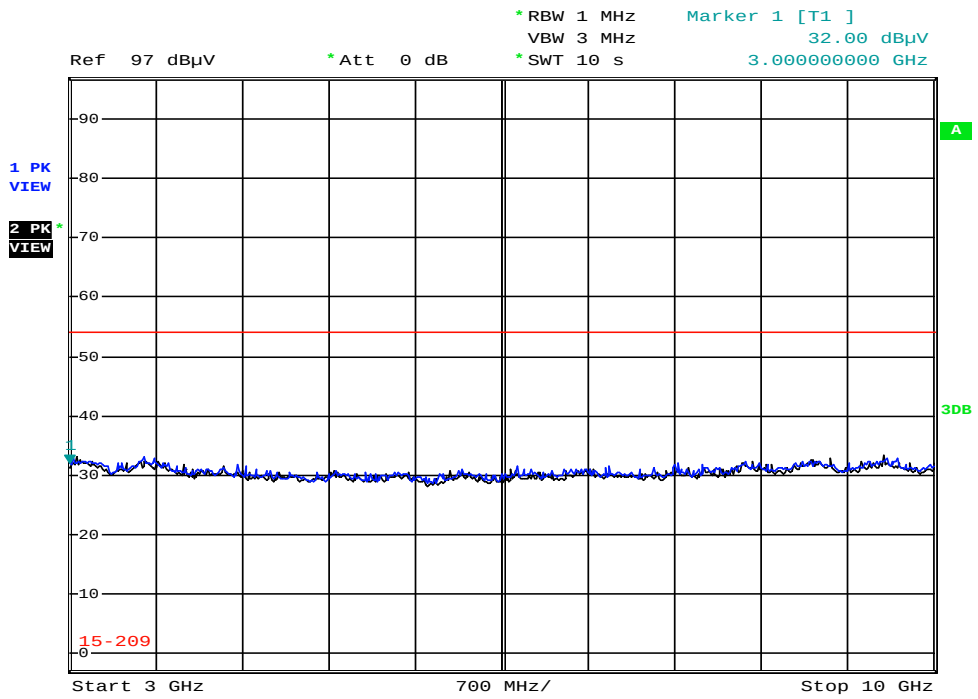
Plot 12.13 – Restricted Band Emissions 3GHz – 10GHz - Horizontal

Restricted Band Emissions



Date: 5.JUL.2018 14:56:16

Trace 1 (Blue) = Ambient
Trace 2 (Black) = DUT Emission w/ Ambient

Channel Frequency: **903.00** MHz	Frequency Range: **3GHz - 10GHz**	Channel Bandwidth: **610.00** kHz
Transmit Duty Cycle: **100** %	Modulation Setting: **4FSK**	Channel Power Setting: **Max** dBm
Antenna Polarization: **Horizontal**	Antenna Elevation: **1 - 4** m	Measured Emission: **None Detected** dBuV

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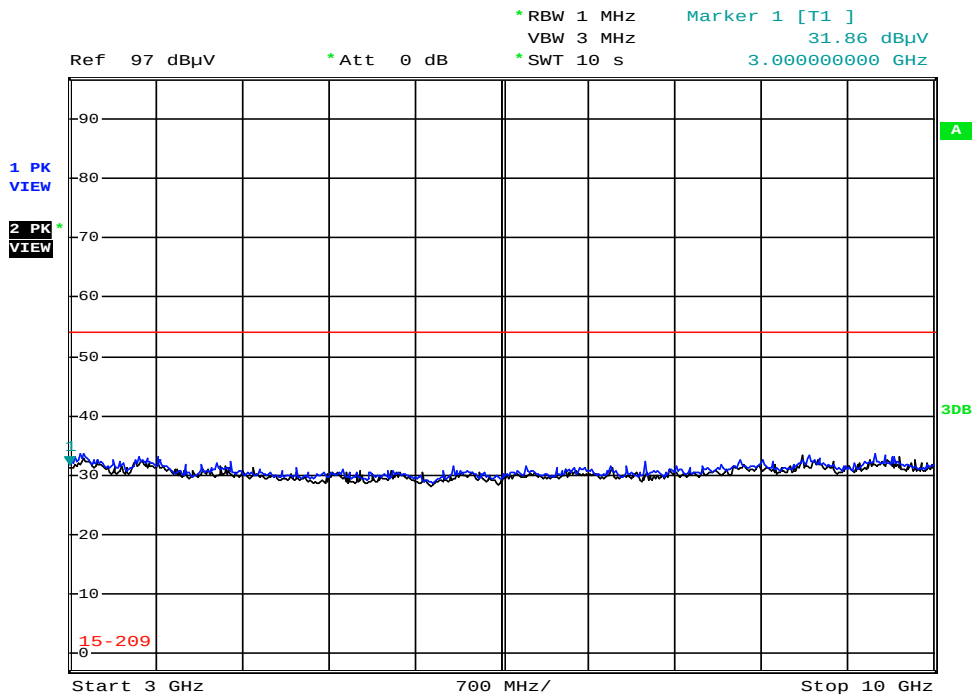
Plot 12.14 – Restricted Band Emissions 3GHz – 10GHz - Vertical

Restricted Band Emissions



Date: 5.JUL.2018 14:52:35

Trace 1 (Blue) = Ambient
Trace 2 (Black) = DUT Emission w/ Ambient

Channel Frequency: **903.00** MHz	Frequency Range: **3GHz - 10GHz**	Channel Bandwidth: **610.00** kHz
Transmit Duty Cycle: **100** %	Modulation Setting: **4FSK**	Channel Power Setting: **Max** dBm
Antenna Polarization: **Vertical**	Antenna Elevation: **1 - 4** m	Measured Emission: **None Detected** dBuV

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Table 12.1 – Summary of Restricted Band Emissions

Emission Level Measurement Results								
Frequency Range	BW (kHz)	Modulation	Power Setting(1) (dBm)	Transmit Duty Cycle (%)	Antenna Polarization	Measured Emission(2) [E_{Meas}] (dBuV @ 3m)	Worst Case Limit(3) [A_L] (dBuV @ 3m)	Margin (dB)
9kHz - 150kHz	610	4FSK	Max	100	Front	45.00	93.8	**48.80**
9kHz - 150kHz					Side	45.00		**48.80**
150kHz - 30MHz					Front	30.00	63.0	**33.00**
150kHz - 30MHz					Side	30.00		**33.00**
30MHz - 88MHz					Horizontal	30.00	40.0	**10.00**
30MHz - 88MHz					Vertical	30.00		**10.00**
88MHz - 216MHz					Horizontal	30.00	43.5	**13.50**
88MHz - 216MHz					Vertical	30.00		**13.50**
216MHz - 1000MHz					Horizontal	30.00	46.0	**16.00**
216MHz - 1000MHz					Vertical	30.00		**16.00**
1GHz - 3GHz					Horizontal	25.00	54.0	**29.00**
1GHz - 3GHz					Vertical	25.00		**29.00**
3GHz - 10GHz					Horizontal	30.00		**24.00**
3GHz - 10GHz					Vertical	30.00		**24.00**
						Results:	**Complies**	

(1) The output power is factory set to maximum

Limit between 9kHz and 490kHz = 2400/F (kHz) @300m = 266uV/m to 4.89uV/m
dBuV/m = 20Log (uV/m) = 48.5dBuV/m to 13.8dBuV/m
Distance Corrected: = 128.5dBuV/m to 93.8dBuV/m

Limit between 490kHz and 1705kHz = 24000/F (kHz) @30m = 160uV/m to 14uV/m
dBuV/m = 20Log (uV/m) = 44.1dBuV/m to 23dBuV/m
Distance Corrected: = 88.1dBuV/m to 63dBuV/m

Limit Between 1705kHz and 30MHz = 30uV/m @30m
dBuV/m = 20Log (uV/m) = 29.5dBuV/m
Distance Corrected: = 69.5dBuV/m

Limit between 30MHz and 88MHz = 100uV/m @ 3m
dBuV/m = 20Log (uV/m) = 40dBuV/m

Limit between 88MHz and 216MHz = 150uV/m @ 3m
dBuV/m = 20Log (uV/m) = 43.5dBuV/m

Limit between 216MHz and 960MHz = 200uV/m @3m
dBuV/m = 20Log (uV/m) = 46dBuV/m

Limit Above 960MHz = 500uV/m @3m
dBuV/m = 20Log (uV/m) = 54.0dBuV/m

Distance Correction: $40\text{Log}(D_{LIM}/D_{MEAS})$ + Limit
Below 30MHz Where D_{LIM} is the Limit Distance, D_{MEAS} is the Measurement Distance, Below
= 80dB + Limit @300m
= 40dB + Limit @30m

§15.31(f)(2) At frequencies below 30 MHz...when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor or by using thes quare of an inverse linear distance extrapolation factor (40 dB/decade).

(2) No emissions above the ambient were detected.

(3) The lowest limit within the test frequency range applied.

Worst case of all DUT orientations

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APPENDIX A – TEST SETUP DRAWINGS AND CONDITIONS

Table A.1 – Conducted Measurement Setup and Environmental

Environmental Conditions (Typical)	
Temperature	25°C
Humidity	<60%
Barometric Pressure	101 +/- 3kPa

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

Figure A.1 – Test Setup – Conducted Measurements

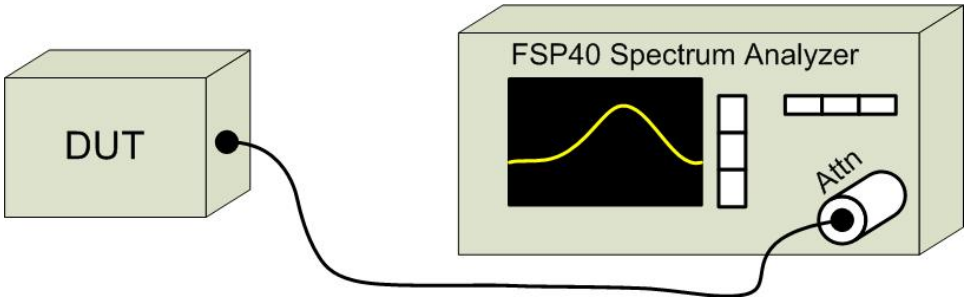

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Table A.2 – Radiated Emissions Measurement Equipment and Environmental

Environmental Conditions (Typical)	
Temperature	25°C
Humidity	<60%
Barometric Pressure	101 +/- 3kPa

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

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

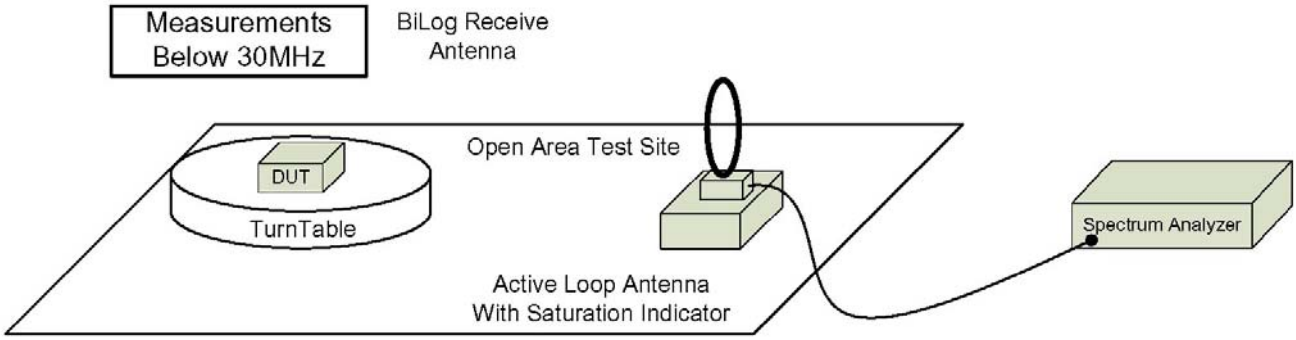


Figure A.3 – Test Setup Radiated Measurements 30MHz – 1GHz

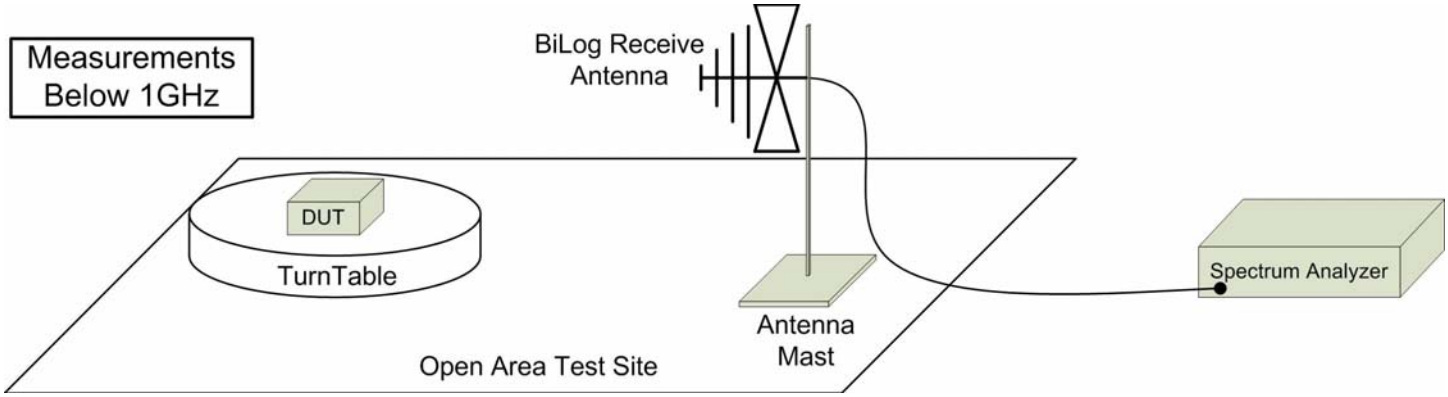
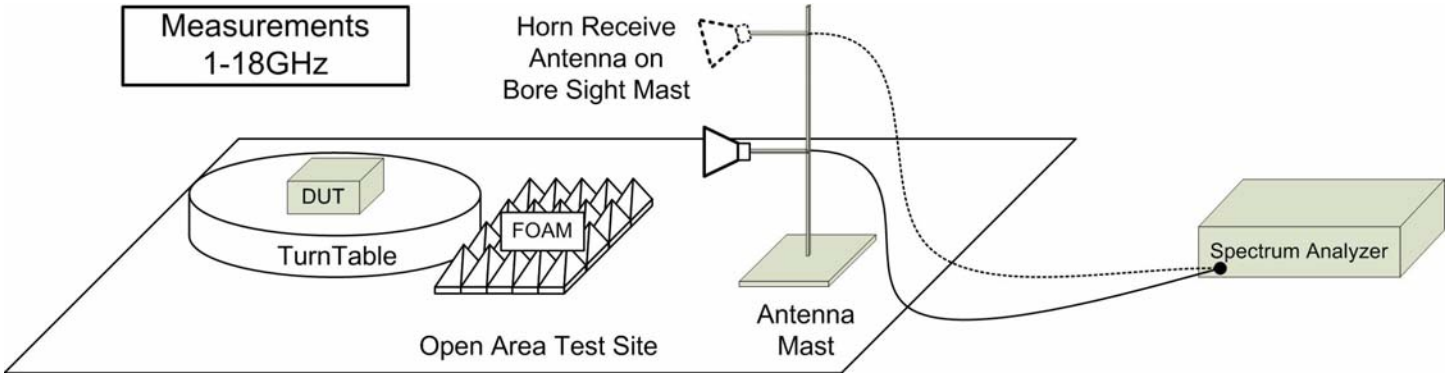


Figure A.4 – Test Setup Radiated Measurements Above 1GHz



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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	23 Jun 2017	Triennial	23 Jun 2020
*	00034	ETS	3115	6267	Double Ridged Guide Horn	2 Dec 2015	Triennial	2 Dec 2018
	00035	ETS	3115	6276	Double Ridged Guide Horn	2 Dec 2015	Triennial	2 Dec 2018
*	00085	EMCO	6502	9203-2724	Loop Antenna	8 Jun 2016	Triennial	8 Jun 2019
*	00047	HP	85685A	2837A00826	RF Preselector	23 Jun 2017	Triennial	23 Jun 2020
*	00049	HP	85650A	2043A00162	Quasi-peak Adapter	23 Jun 2017	Triennial	23 Jun 2020
*	00051	HP	8566B	2747A05510	Spectrum Analyzer	23 Jun 2017	Triennial	23 Jun 2020
	00223	HP	8901A	3749A07154	Modulation Analyzer	27 Dec 2017	Triennial	27 Dec 2020
	00224	HP	8903B	3729A18691	Audio Analyzer	28 Dec 2017	Triennial	28 Dec 2020
*	00241	R&S	FSU40	100500	Spectrum Analyzer	23 Apr 2015	Triennial	23 Apr 2018
*	00005	HP	8648D	3847A00611	Signal Generator	21 Jun 2017	Triennial	21 Jun 2020
	00006	R&S	SMR20	100104	Signal Generator	29 May 2017	Triennial	29 May 2020
	00243	Rigol	DS1102E	DS1ET150502164	Oscilloscope	7 Nov 2017	Triennial	7 Nov 2020
	00254	LeCroy	WM8600A	532	Oscilloscope	NCR	n/a	NCR
	00110	Gigatronics	8652A	1875801	Power Meter	29 Feb 2016	Triennial	29 Feb 2019
	00237	Gigatronics	80334A	1837001	Power Sensor	23 Jun 2014	Triennial	23 Jun 2017
	00232	ETS Lindgren	HI-6005	91440	Isotropic E-Field Probe	18 Dec 2017	Triennial	18 Dec 2020
	00003	HP	53181A	3736A05175	Frequency Counter	21 Jun 2017	Triennial	21 Jun 2020
	00257	Com-Power	LI-215A	191934	LISN	5 Jan 2018	Triennial	5 Jan 2021
	00041	AR	10W1000C	27887	Power Amplifier	NCR	n/a	NCR
	00106	AR	5SIG4	26235	Power Amplifier	NCR	n/a	NCR
	00280	AR	25A250AM6	22702	Power Amplifier	NCR	n/a	NCR
	00265	Miteq	JS32-00104000-58-5P	1939850	Microwave L/N Amplifier	COU	n/a	COU
	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
	00081	ESPEC	ECT-2	0510154-B	Environmental Chamber	CNR	n/a	CNR
	00234	VWR	61161-378	140320430	Temp/Humidity Meter	New	Triennial	New
	00236	Nokia	-	236	ESD Table	NCR	n/a	NCR
	00255	Expert ESD	A4001	A4001-155	ESD Target	COU	n/a	COU
	00064	NARDA	3020A	n/a	Bi-Directional Coupler	COU	n/a	COU
	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
*	00264	Koaxis	KP10-7.00M-TD	264	7m Armoured Cable	COU	n/a	COU
*	00275	TMS	LMR400	n/a	25m Cable	COU	n/a	COU
	00276	TMS	LMR400	n/a	4m Cable	COU	n/a	COU
	00277	TMS	LMR400	n/a	4m Cable	COU	n/a	COU
*	00278	TILE	34G3	n/a	TILE Test Software	NCR	n/a	NCR
Rented Equipment								

* Used during the course of this investigation
CNR: Calibration Not Required
COU: Calibrate On Use

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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	
30MHz - 200MHz	
U_{LAB} = 5.14dB U_{CISPR} = 6.3dB	
200MHz - 1000MHz	
U_{LAB} = 5.90dB U_{CISPR} = 6.3dB	
1GHz - 6GHz	
U_{LAB} = 4.80dB U_{CISPR} = 5.2dB	
6GHz - 18GHz	
U_{LAB} = 5.1dB U_{CISPR} = 5.5dB	
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

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