ONE WORLD ○ OUR APPROVAL

Wireless test report 368918–1R1TRFWL

Applicant:

Deere & Company

Product:

RTK Radio 450

Model:

SR54

FCC ID:

OV5-RTK450

Specifications:

- FCC 47 CFR Part 90

  Private Land Mobile Radio Services

Date of issue: May 10, 2019

Test engineer(s): Kevin Rose, Wireless/EMC Specialist Signature: 

Reviewed by: Tom Tidwell, Director Nemko Direct for Telecom Signature: 

Test location

Company name	Nemko Canada Inc.			
Facilities	Ottawa site: 303 River Road Ottawa, Ontario Canada K1V 1H2 Tel: +1 613 737 9680 Fax: +1 613 737 9691	Montréal site: 292 Labrosse Avenue Pointe-Claire, Québec Canada H9R 5L8 Tel: +1 514 694 2684 Fax: +1 514 694 3528	**Cambridge site:** **1-130 Saltsman Drive** **Cambridge, Ontario** **Canada** **N3E 0B2** **Tel: +1 519 650 4811**	Almonte site: 1500 Peter Robinson Road West Carleton, Ontario Canada K0A 1L0 Tel: +1 613 256-9117 Fax: +1 613 256-8848
Test site registration	**Organization**	**Recognition numbers and location**		
	FCC/ISED	CA2040 (Ottawa/Almonte); CA2041 (Montreal); CA0101 (Cambridge)		
Website	www.nemko.com			

Tested by	Kevin Rose, Wireless/EMC Specialist
Reviewed by	Andrey Adelberg, Senior Wireless/EMC Specialist
Date	May 9, 2019
Signature of reviewer	

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

Copyright notification

Table of contents

Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Deere & Company
Address	One John Deere Place, Moline, IL 61265 USA

1.2 Test specifications

FCC 47 CFR Part 90	Private Land Mobile Radio Services

1.3 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See “Summary of test results” for full details.

1.4 Exclusions

None

1.5 Test report revision history

Revision #	Details of changes made to test report
TRF	Original report issued

Section 2. Summary of test results

2.1 FCC Part 90 test results

Part	Test description	Verdict
§2.1046 & 90.205	Output power	Pass
§2.1049 & 90.210	Occupied bandwidth	Pass
§2.1051 & 90.210	Spurious emissions at the antenna terminal	Pass
§2.1053 & 90.210	Field strength of spurious radiation	Pass
§2.1055 & 90.213	Frequency stability	Pass
90.214	Transient Frequency Behavior	Reported

Notes: None

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	February 28, 2019
Nemko sample ID number	1

3.2 EUT information

Product name	RTK 450 Radio
Model	SR54
Serial number	PCSR54C590601

3.3 Technical information

Frequency band	421–512 MHz
Frequency Min	440.00125 MHz
Frequency Max	449.99875 MHz
RF power Max	1.67 W at antenna input
Rated Power	2.0 W
Field strength, Units @ distance	N/A
Measured BW (99 %)	7.49 kHz
Type of modulation	F3D
Emission classification (F1D, G1D, D1D)	7K49F3D
Power requirements	12–24 V_{DC},
Antenna information	Various types of antennas with different gain may be used with this licensed device, depending on the implementation. The antenna type and gain is included in the licensing process. RF exposure is determined at the time of licensing.

3.4 Product description and theory of operation

The RTK450 increases the range and reliability of the 450 MHz Starfire RTK radio link by transmitting at a higher power in a licensed radio band.

3.5 EUT exercise details

Method used is hyperterminal to send transmit parameters to EUT and verify connection during test.

3.6 EUT setup diagram

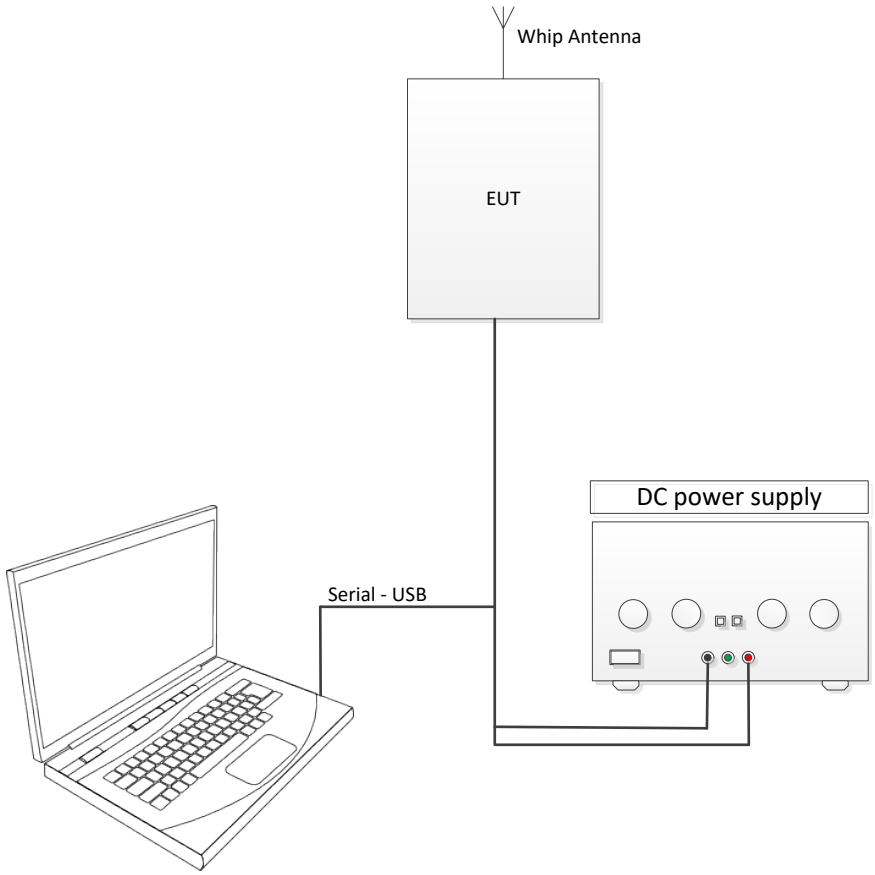


Figure 3.6-1: *Setup diagram*

Table 3.6-1: *EUT sub assemblies*

Description	Brand name	Model, Part number, Serial number, Revision level
RTK 450 Radio	John Deere	PN: PFA10095, SN: PCSR54B561903
Whip Antenna	John Deere	PN: PFP10612

Table 3.6-2: *Support equipment*

Description	Brand name	Model, Part number, Serial number, Revision level
Laptop Computer	Dell	latitude
DC Power Supply	Ametek	FA003005

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	860–1060 mbar

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.

Section 6. Measurement uncertainty

6.1 Uncertainty of measurement

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of K = 2 with 95% certainty.

Test name	Measurement uncertainty, dB
All antenna port measurements	0.55
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78
AC power line conducted emissions	3.55

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: *Equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA003012	1 year	August 22, 2019
Flush mount turntable	SUNAR	FM2022	FA003006	—	NCR
Controller	SUNAR	SC110V	FA002976	—	NCR
Antenna mast	SUNAR	TLT2	FA003007	—	NCR
AC Power source	Chroma	0	FA003020	—	NCR
Receiver/spectrum analyzer	Rohde & Schwarz	ESR26	FA002969	1 year	June 1, 2019
Spectrum analyzer	Rohde & Schwarz	FSW43	FA002971	1 year	June 1, 2019
Horn antenna (1–18 GHz)	ETS Lindgren	3117	FA002911	1 year	August 16, 2019
Preamp (1–18 GHz)	ETS Lindgren	124334	FA002956	1 year	September 18, 2019
Temperature chamber	Espec	EPX-4H	FA003033	1 year	September 18, 2019

Note: NCR - no calibration required

Section 8. Testing data

8.1 FCC Part 90, FCC 2.1046 Output power

8.1.1 Definitions and limits

§90.205 (s) The output power shall not exceed by more than 20 percent either the output power shown in the Radio Equipment List [available in accordance with §90.203(a)(1)] for transmitters included in this list or when not so listed, the manufacturer's rated output power for the particular transmitter specifically listed on the authorization.

8.1.2 Test summary

Test date	March 22, 2019	Temperature:	21 °C
Test engineer	Kevin Rose	Air pressure:	1002 mbar
Verdict	Pass	Relative humidity:	31 %

8.1.3 Observations, settings and special notes

The test was performed using peak detector of the spectrum analyzer with RBW of 10 MHz and VBW of 10 MHz.
EUT rated output power = 2.0 W

"Conducted power was measured at 2W nominal. Power to demonstrate compliance with a 0 dbd antenna. Antenna cable loss is the loss in the coaxial cable installed between the transmitter output and the antenna."

8.1.4 Test data

Table 8.1-1: Transmit Power

Frequency, MHz	Output power, dBm	Antenna cable loss (dB)	Power at input to antenna (dBm)	Output power, Watts	Rated Output power + 20%, Watts	Margin, W
440.00125	32.86	1.1	31.76	1.50	2.40	0.90
445.00000	33.33	1.1	32.23	1.67	2.40	0.73
449.99875	33.21	1.1	32.11	1.63	2.40	0.77

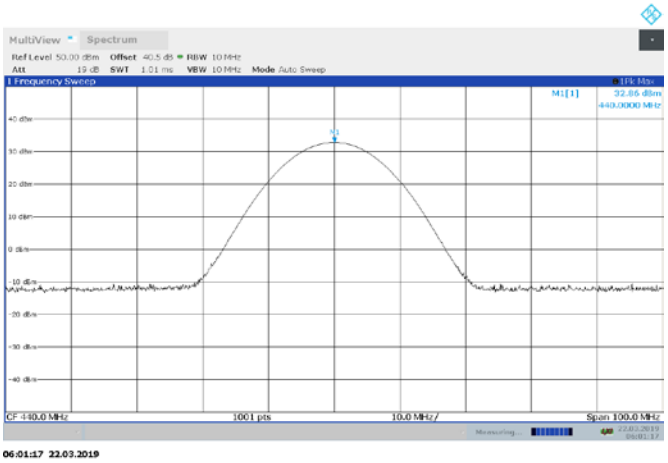


Figure 8.1-1: Low channel output power

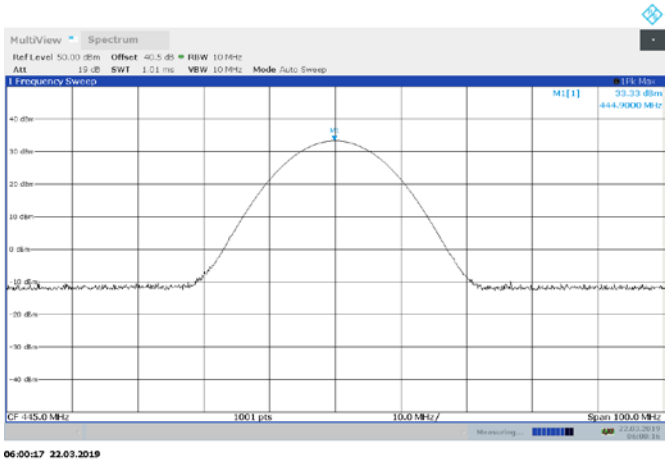


Figure 8.1-2: Mid channel output power

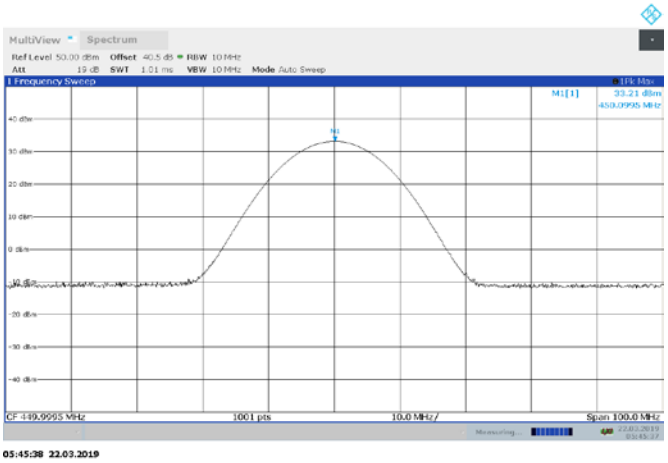


Figure 8.1-3: High channel output power

8.2 FCC Part 90, FCC 2.1049 Occupied bandwidth with Emission mask

8.2.1 Definitions and limits

(d) Emission Mask D—12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f0 to 5.625 kHz removed from f0: Zero dB.

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27(fd−2.88 kHz) dB.

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation

8.2.2 Test summary

Test date	March 22, 2019	Temperature:	21 °C
Test engineer	Kevin Rose	Air pressure:	1002 mbar
Verdict	Pass	Relative humidity:	31 %

8.2.3 Observations, settings and special notes

Spectrum analyser settings for measurements with scanning turned on:

Resolution bandwidth	100 Hz
Video bandwidth	100 Hz
Detector mode	Peak
Trace mode	Max Hold

8.2.4 Test data

Table 8.2-1: 99% Occupied Bandwidth

Frequency, MHz	99% OBW, kHz
440.00125	7.49
445.00000	7.60
449.99875	7.49

Note:20% of rated Power is 0.40 Watts.

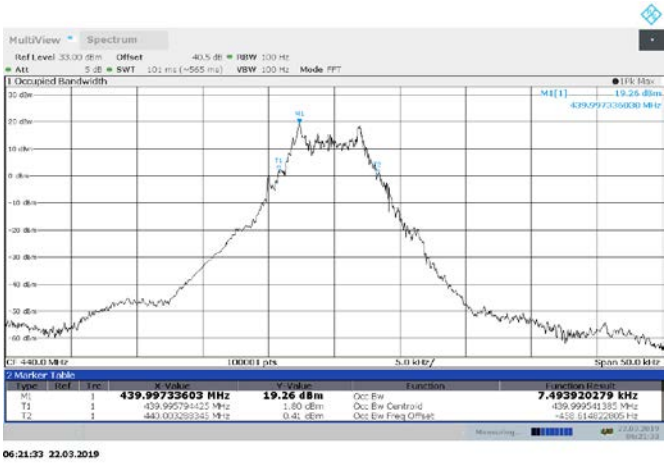


Figure 8.2-1: Low channel OBW

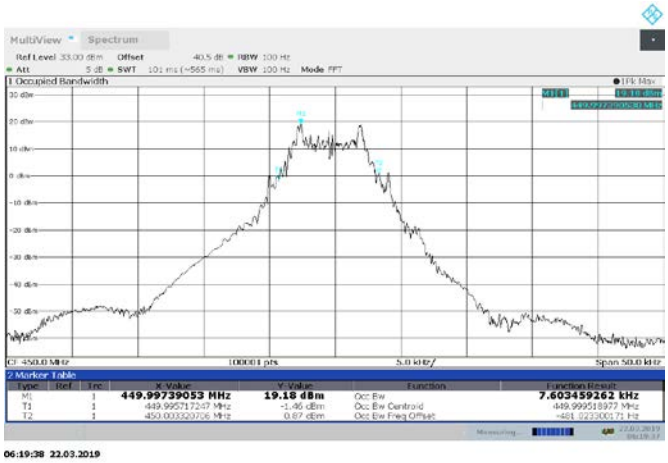


Figure 8.2-2: Mid channel OBW

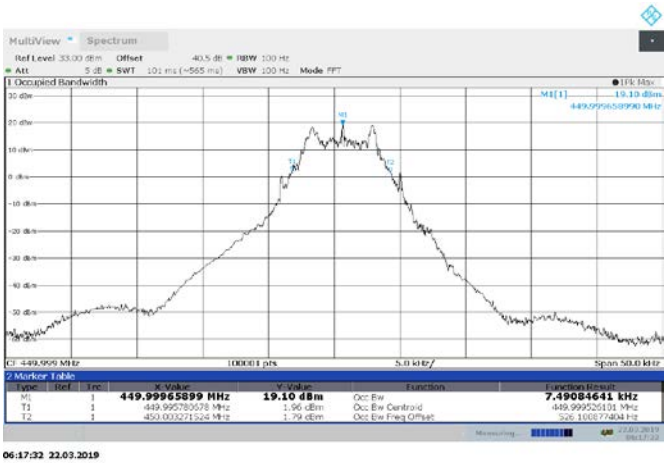


Figure 8.2-3: High channel OBW

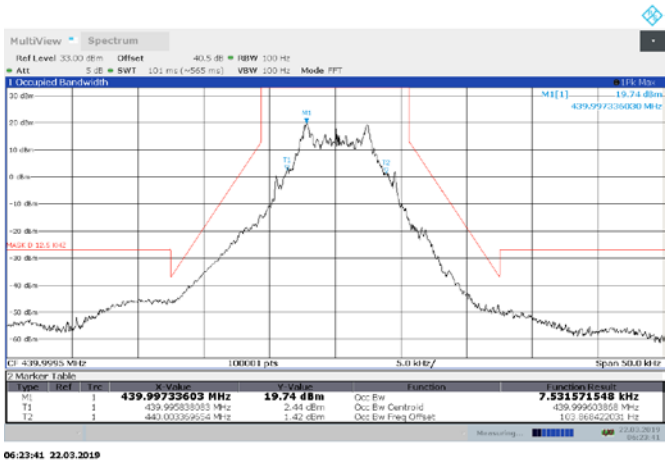


Figure 8.2-4: Low channel Mask D

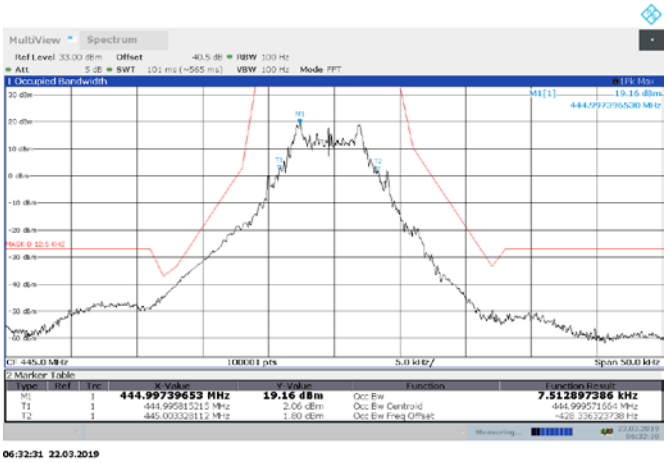


Figure 8.2-5: Mid channel Mask D

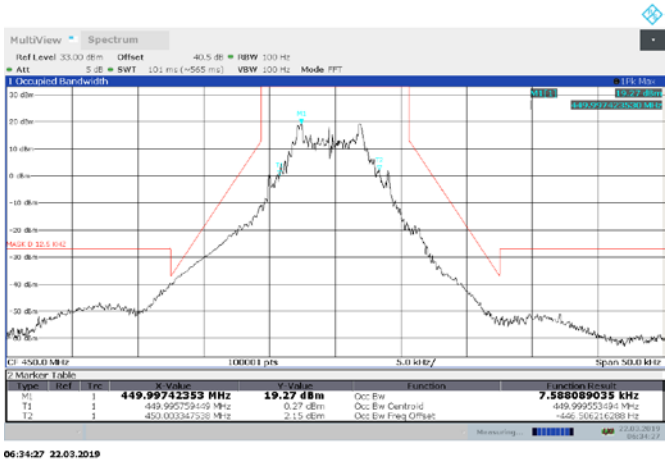


Figure 8.2-6: High channel Mask D

8.3 FCC Part 90, 2.1051 Spurious emissions at antenna terminal

8.3.1 Definitions and limits

(d) Emission Mask D—12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f0 to 5.625 kHz removed from f0: Zero dB.

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27(fd−2.88 kHz) dB.

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation

Table 8.3-1: *Spurious emissions limit*

Frequency range, MHz	Attenuation below carrier, dBc	Absolute spurious emission, dBm
30–5,000	50 + 10 Log_{10} (P)	−20

8.3.2 Test summary

Test date	March 22, 2019	Temperature:	21 °C
Test engineer	Kevin Rose	Air pressure:	1002 mbar
Verdict	Pass	Relative humidity:	31 %

8.3.3 Observations, settings and special notes

EUT was scanned within 30 MHz to 5 GHz

Resolution bandwidth	1 MHz
Video bandwidth	1 MHz
Detector mode	Peak
Trace mode	Max Hold

8.3.4 Test data

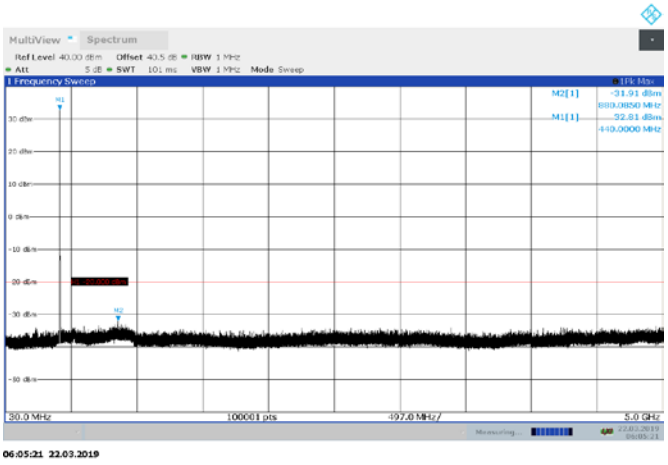


Figure 8.3-1: Conducted Spurious Low channel

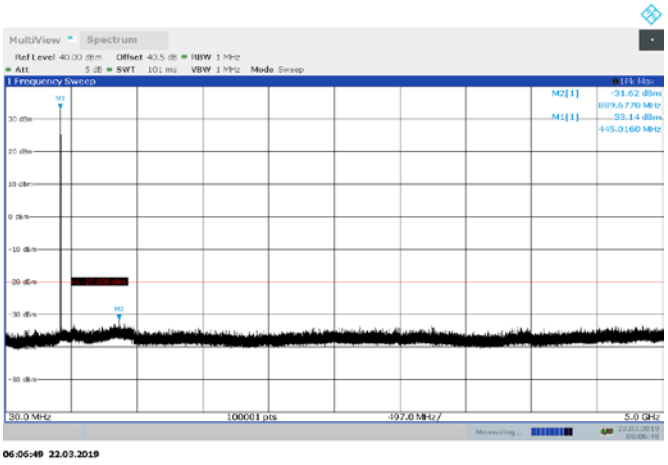


Figure 8.3-2: Conducted Spurious Mid channel

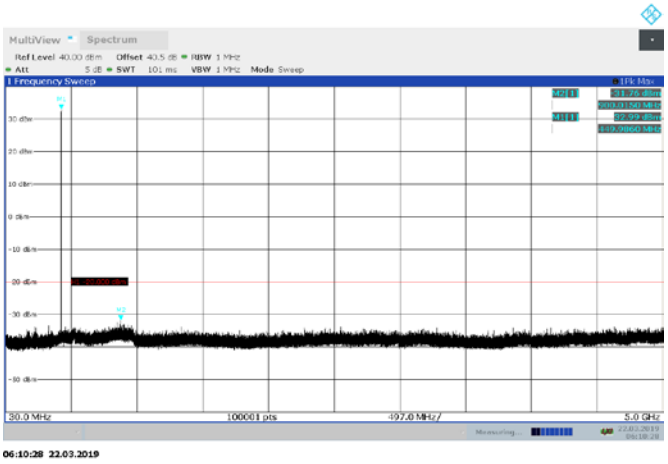


Figure 8.3-3: Conducted Spurious High channel

8.4 FCC Part 90, FCC 2.1053 Field strength of spurious radiation

8.4.1 Definitions and limits

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation

Table 8.4-1: *Spurious emissions limit*

Frequency range, MHz	Attenuation below carrier, dBc	Spurious emissions, dBm	Field strength of spurious radiation* at 3 m, dBµV/m
30–5,000	50 + 10 Log_{10} (P)	−20	75.23

Note: Theoretical conversion is for the preliminary results only.
Limit conversion calculation at 3 meters: dBµV/m = dBm + 95.23

8.4.2 Test summary

Test date	March 22, 2019	Temperature:	21 °C
Test engineer	Kevin Rose	Air pressure:	1002 mbar
Verdict	Pass	Relative humidity:	31 %

8.4.3 Observations, settings and special notes

No Emission within 10 dB of the limit were detected.

Resolution bandwidth	100 kHz
Video bandwidth	300 kHz
Detector mode	Peak
Trace mode	Max Hold

Spectrum analyser settings for measurements above 1 GHz:

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	Peak
Trace mode	Max Hold

8.4.4 Test data

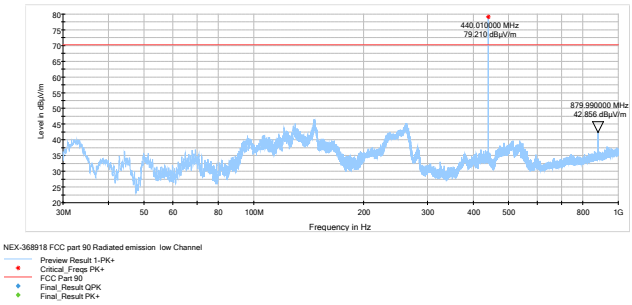


Figure 8.4-1: Radiated Low channel 30-1000 MHz

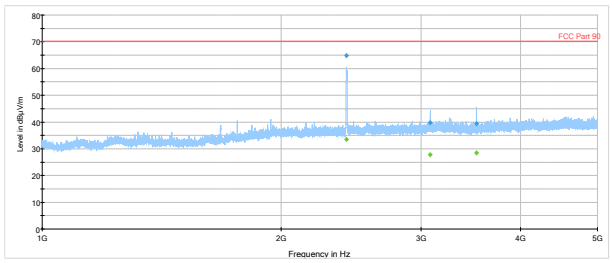


Figure 8.4-2: Radiated Low channel 1-5 GHz

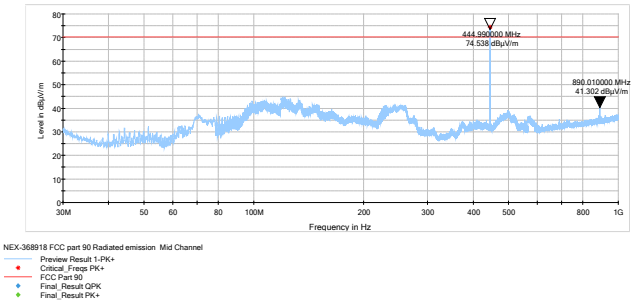


Figure 8.4-3: Radiated Mid channel 30-1000 MHz

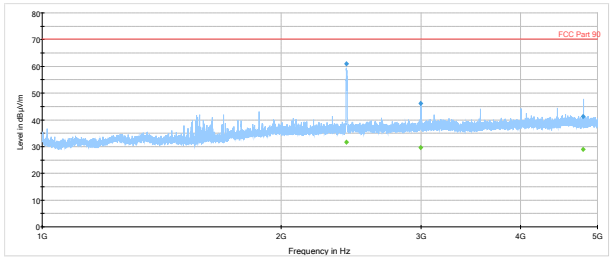


Figure 8.4-4: Radiated Mid channel 1-5 GHz

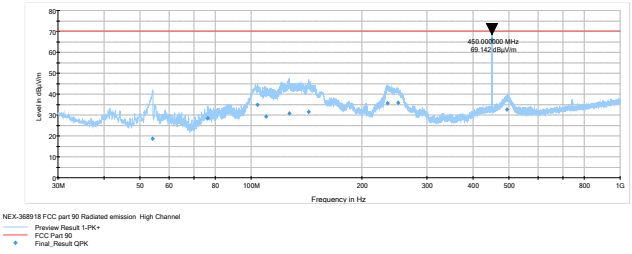


Figure 8.4-5: Radiated High channel 30-1000 MHz

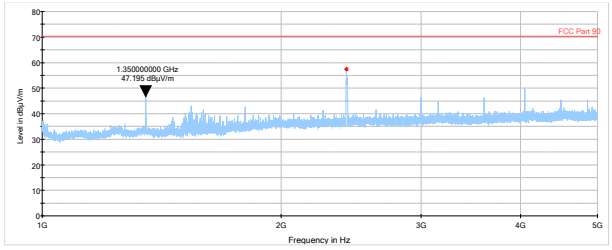


Figure 8.4-6: Radiated High channel 1-5 GHz

8.5 FCC Part 90, FCC 2.1055 Frequency stability

8.5.1 Definitions and limits

(a) The frequency stability shall be measured with variation of ambient temperature as follows:
(1) From −30 °C to +50 °C for all equipment except that specified in paragraphs (a)(2) and (3) of this section
(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° C through the range.
(d) The frequency stability shall be measured with variation of primary supply voltage as follows:
(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.
In the 421–512 MHz band, fixed and base stations with a 12.5 kHz channel bandwidth must have a frequency stability of 1.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 0.5 ppm.

8.5.2 Test summary

Test date	March 22, 2019	Temperature:	21 °C
Test engineer	Kevin Rose	Air pressure:	1002 mbar
Verdict	Pass	Relative humidity:	31 %

8.5.3 Observations, settings and special notes

EUT was not able to Transmit CW. The 26 dBc points were measured to establish compliance

No Frequency drift was observed

Resolution bandwidth	100 Hz
Video bandwidth	300 Hz
Detector mode	Peak

8.5.4 Test data

Table 8.5-1: *Frequency drift measurement results*

Test conditions	Frequency, MHz Low	Drift, ppm	Limit, 1.5 ppm	Drift Margin, ppm
+50 °C, Nominal	449.999550	-0.22	1.50	1.28
+40 °C, Nominal	449.999550	-0.22	1.50	1.28
+30 °C, Nominal	449.999600	-0.11	1.50	1.39
+20 °C, +15 %	449.999650	0.00	1.50	1.50
+20 °C, Nominal	449.999650		Reference	
+20 °C, -15 %	449.999650	0.00	1.50	1.50
+10 °C, Nominal	449.999550	-0.22	1.50	1.28
0 °C, Nominal	449.999500	-0.33	1.50	1.17
−10 °C, Nominal	449.999550	-0.22	1.50	1.28
−20 °C, Nominal	449.999650	0.00	1.50	1.50
−30 °C, Nominal	449.999750	0.22	1.50	1.28

$$\frac{F_{Measured} - F_{reference}}{F_{reference}} \times 1 \cdot 10^{6}$$

8.6 FCC 90.214 Transient frequency behavior

8.6.1 Definitions and limits

If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

8.6.2 Test summary

Test date	March 22, 2019	Temperature:	21 °C
Test engineer	Kevin Rose	Air pressure:	1002 mbar
Verdict	Measured	Relative humidity:	31 %

8.6.3 Observations, settings and special notes

EUT is less than 6 Watts therefore we have reported the results

FCC Publication 465557 Rule Part: 90 Publication Date 03/26/2007

Answer: The general technical requirements for a transmitter operating in the Private Land Mobile Radio Service Transient Frequency Behavior are contained in 47 CFR Subpart I of Part 90. The requirements for transient frequency behavior are given in 47 CFR 90.214. All units that operate in the frequency bands 150–174 and 421–512 MHz must be tested and reported, but the time interval (T1 and T3) limits of 47 CFR 90.214 do not apply to units with 6 W or less output power.

8.6.4 Test data

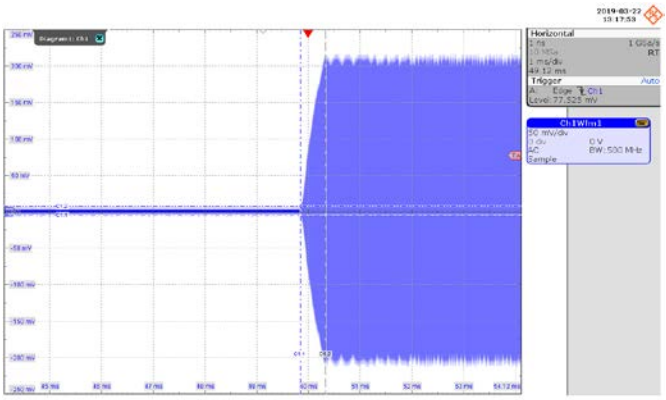


Figure 8.6-1: TX ON

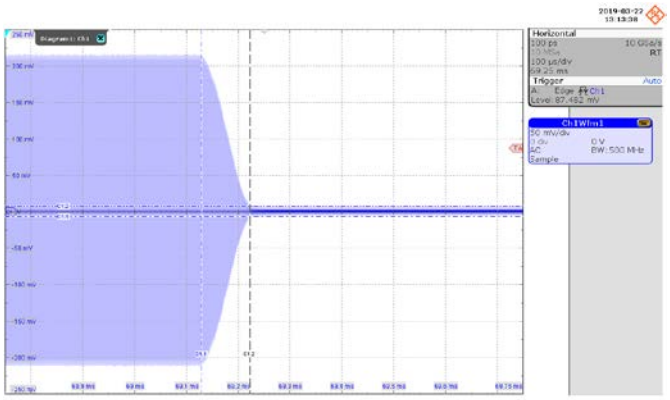
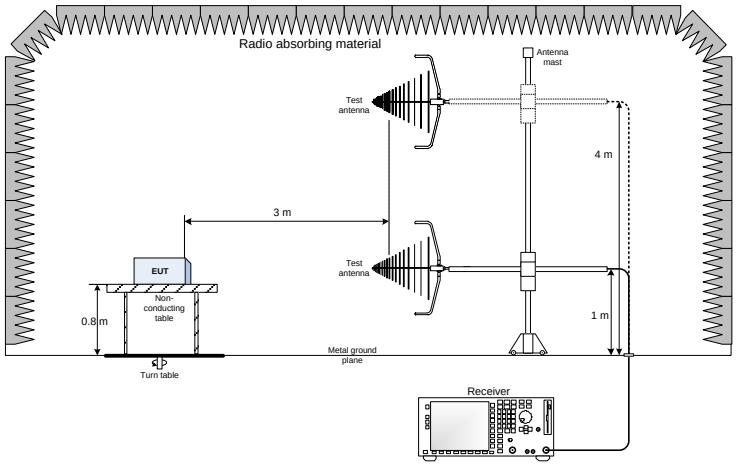


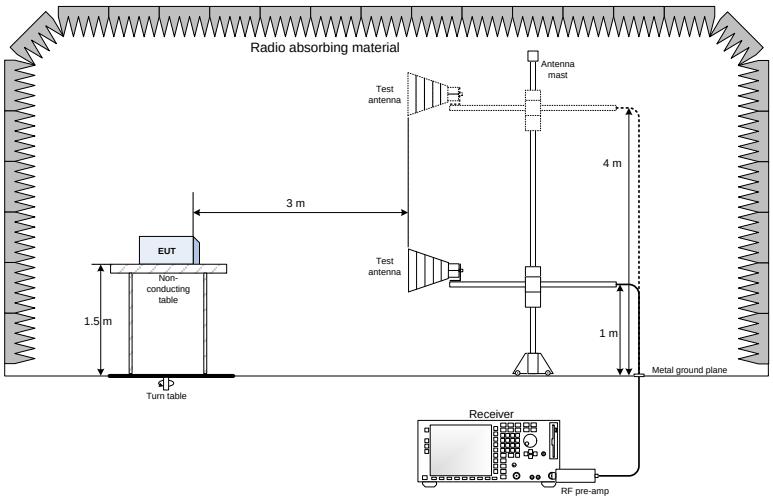
Figure 8.6-2: TX OFF

Section 9. Block diagrams of test set-ups

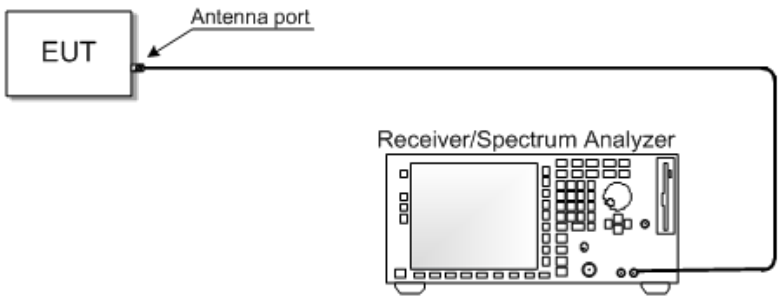
9.1 Radiated emissions set-up for frequencies below 1 GHz



9.2 Radiated emissions set-up for frequencies above 1 GHz



9.3 Conducted port measurements



9.4 Transient Frequency behavior