Certification Test Report

FCC ID: QZC-UFTR1
IC: 4557A-UFTR1

FCC Rule Part: Part 90 Subpart I
ISED Canada Radio Standards Specification: RSS-119

TÜV SÜD Report Number: 17-3005.W06.2A

Manufacturer: Elster Solutions, LLC
Model: UFTR1

Test Begin Date: January 25, 2017
Test End Date: May 7, 2017

Report Issue Date: May 16, 2017

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code AT-1921

This report must not be used by the client to claim product certification, approval, or endorsement by ANAB, ANSI, or any agency of the Federal Government.

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This report contains 21 pages

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1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate continued compliance with Part 90 Subpart I of the FCC's Code of Federal Regulations, and Innovation, Science and Economic Development, Canada Radio Standards Specifications RSS-119.

1.2 Product Description

The UFT is housed in a 3.67" x 4.25" x 1.35" plastic enclosure. This enclosure is then mounted to a rotating plastic clip used to attach the device to the user's waist/belt

A 3.7V (nominal voltage) 6600 mAh Lithium battery is mounted inside the plastic enclosure with the PCBA and serves as the main power source for the system.

The battery is charged via a micro-usb port (5V) located at the top of the enclosure, and is charged via a battery controller IC which prevents over/under voltage and provides the appropriate charging current of 0.2C.

The output of the battery controller is fed to a buck-boost regulator which provides a 3.3V source to all other ICs on the PCBA

The 450 MHz antenna is an external dipole antenna with rubber insulation, and the antenna is mounted externally via an SMA connector at the top of the enclosure. The 900MHz antenna is a chip antenna mounted onto the PCBA. The Bluetooth module has an on-board chip antenna as well.

The 900 and 450 MHz radio subsystems are both operated by one Si4467 transceiver. The 900 MHz and 450 MHz transmit path is selected via an RF switch IC. The Bluetooth operation of the device is controlled by a separate preapproved module (FCCID: PI4411B) and operates independently.

The 450 MHz radio only has a transmit mode operation, while the 900 MHz radio (FCCID: (FCCID: QZC-UFTR1) is bi-directional. The 450 MHz radio can be transmitting while the 900 MHz radio is in receive mode, and the Bluetooth module can be in transmit or receive mode at any given time, regardless of other radio modes.

Technical Information:

Detail	Description
Frequency Range	451.35 MHz
Number of Channels	1
Modulation Format	2GFSK
Channel Bandwidth	12.5kHz
Data Rates	3.125kHz
Number of Inputs/Outputs	0/1
Operating Voltage	3.7VDC
Antenna Type / Gain	Dipole / 4dBi

Manufacturer Information:
Elster Solutions, LLC
208 S. Rogers Lane
Raleigh, NC 27610

EUT Serial Numbers: 0009
Test Sample Condition: The test samples were provided in good working order with no visible defects.

1.3 Test Methodology and Considerations

1.3.1 Configurations and Justification

The unit was powered using a battery for testing. For the radiated emissions, the EUT was evaluated in the three orthogonal planes. The worst-case orientation was Y polarization.

The EUT is capable of simultaneous transmission with respect to the 451.35 MHz transmitter and the Bluetooth transmitter. Therefore, an evaluation was performed with both transmitters transmitting simultaneous with passing results.

1.3.2 In-Band Testing Methodology

The EUT band of operation is provided in the table below.

CFR Title 47 Rule Part	Frequency Band of Operation (MHz)
90	451.35

1.4 Emission Designators

The UFTR1 transmitter produces one distinct modulation format. The emissions designator for the modulation type used by the UFTR1 transmitter is F1D

2 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

TÜV SÜD America Inc.
2320 Presidential Drive, Suite 101
Durham, NC 27703
Phone: (919) 381-4235

2.2 Laboratory Accreditations/Recognitions/Certifications

TÜV SÜD America Inc. is accredited to ISO/IEC 17025 by ANSI-ASQ National Accreditation Board under their ANAB program and has been issued certificate number AT-1921 in recognition of this accreditation. Unless otherwise specified, all test methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

FCC Registered Test Site Number: 637011
ISED Canada Test Site Registration Number: 20446

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 18' x 28' x 18' shielded enclosure. The chamber is lined with Samwha Electronics Co. LTD Ferrite Absorber, model number SFA300 (HSN-1). The ferrite tile is 10cm x 10 cm and weighs approximately 1.4lbs. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber. On top of the ferrite tiles is DMAS HT-45 (Dutch Microwave Absorber Solutions) hybrid absorber on all walls except the wall behind the antenna mast which has a shorter DMAS HT-25 absorber.

The turntable is 1.50m in diameter and is located 150cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using short #6 copper wire. The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the turntable. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane.

Behind the turntable is a 2' x 6' x 1.5' deep shielded pit used for support equipment if necessary. The pit is equipped with 2 - 4" PVC chase from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

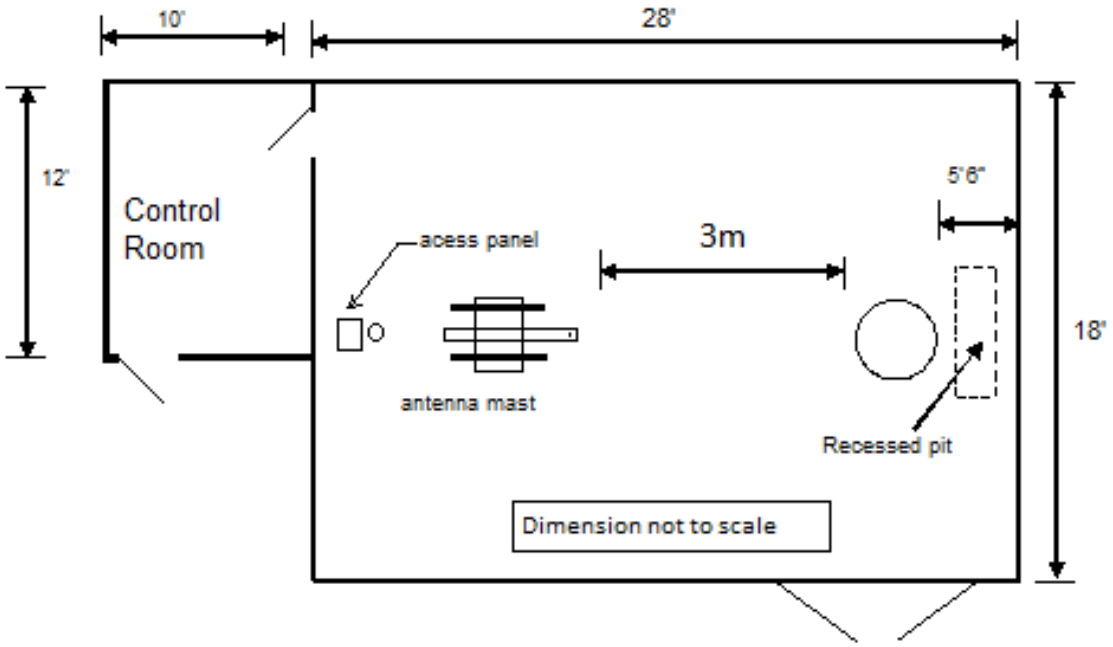

Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2014: American National Standard for Methods of Measurement of Radio-Noise Emissions from low-voltage electrical and electronic equipment in the range of 9kHz to 40 GHz.
- ANSI C63.26-2015: American National Standard of Procedures for Compliance Testing of Transmitters Used in Licensed Radio Services
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2017
- US Code of Federal Regulations (CFR): Title 47, Part 90, Subpart I: Private Land Mobile Radio Services, 2017
- TIA-603-C: Land Mobile FM or PM - Communications Equipment - Measurement and Performance Standards, 2004
- ISED Canada Radio Standards Specification: RSS-119 - Radio Transmitters and Receivers Operating in the Land Mobile and Fixed Services in the Frequency Range 27.41-960 MHz, Issue 12, May 2015
- ISED Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 4, Nov 2014

4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment

Asset ID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
277	EMCO	93146	Antennas	9904-5199	9/12/2016	9/12/2018
499*	EMCO	3146	Antennas	1108	5/4/2015	5/4/2017
3002	Rohde & Schwarz	ESU40	Receiver	100346	1/12/2017	1/12/2018
3006	Rohde & Schwarz	TS-PR18	Amplifiers	122006	1/11/2017	1/11/2018
3008*	Rohde & Schwarz	NRP2	Meter	103131	1/28/2016	1/28/2017
3009*	Rohde & Schwarz	NRP-Z81	Meter	102397	1/28/2016	1/28/2017
3011	Rohde & Schwarz	ENV216	LISN	3011	1/12/2017	1/12/2018
3012	Rohde & Schwarz	EMC32-EB	Software	100731	NCR	NCR
3014*	EMCO	3115	Antennas	9901-5653	2/10/2015	2/10/2017
3016	Fei Teng Wireless Technology	HA-07M18G-NF	Antennas	2013120203	1/26/2016	1/26/2018
3020	Rohde & Schwarz	SMB100A	Signal Generators	175943	1/10/2017	1/10/2018
3029	Micro-Tronics	HPM50108	Filter	134	1/13/2017	1/13/2018
3031	Hasco, Inc.	HLL335-S1-S1-96	Cables	3074	9/20/2016	9/20/2017
3036	Hasco, Inc.	HLL142-S1-S1-24	Cables	2450	1/11/2017	1/11/2018
3038	Florida RF Labs	NMSE-290AW-60.0-NMSE	Cable Set	1448	1/3/2017	1/3/2018
3039	Florida RF Labs	NMSE-290AW-396.0-NMSE	Cable Set	1447	1/3/2017	1/3/2018
3049	Aeroflex Inmet	26AH-20	Attenuator	1443	1/11/2017	1/11/2018
3051	Mountain View Cable	BMS-RG400-264.0-BMS	Cables	3051	1/3/2017	1/3/2018
3055	Rohde & Schwarz	3005	Cables	3055	1/3/2017	1/3/2018
3085	Rohde & Schwarz	FSW43	Spectrum Analyzer	103997	8/9/2016	8/9/2017

Note: *The testing was performed prior to the calibration due date.
NCR = No Calibration Required
Asset 3002: Firmware Version: ESU40 is 4.73 SP4
Asset 3012: Software Version: EMC32-B is 9.15
Asset 3020: Firmware Rev: 2.20.382.113
Asset 3085: Instrument Firmware 2.41 SP1

5 SUPPORT EQUIPMENT

Table 5-1: EUT and Support Equipment Description

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Elster Solutions, LLC	Belt Clip Radio	0009
2	50 Ohm Termination	N/A	N/A	N/A

Table 5-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
	None			

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

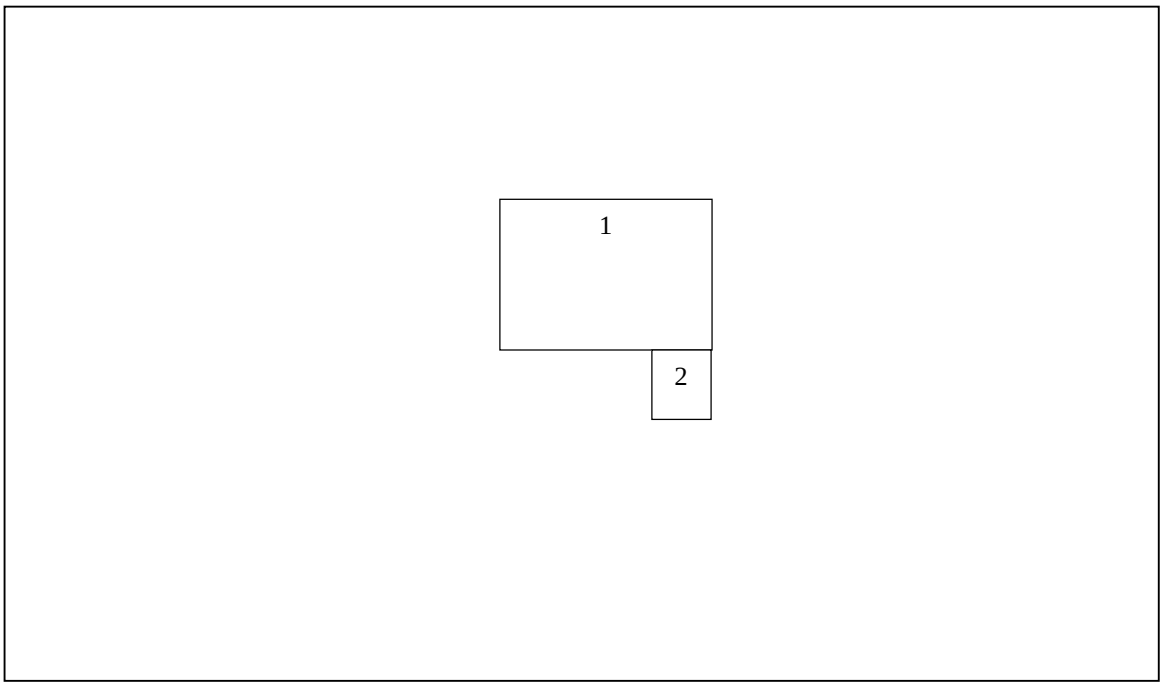

Figure 6-1: Test Setup Block Diagram

7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

Table 7-1: Test Results Summary

Test Parameter	Test Site	Test Summary
RF Power Output	1	Pass
Occupied Bandwidth (Emissions Limits)	1	Pass
99 Percent Bandwidth	1	Pass
Spurious Emissions at Antenna Terminals	1	Pass
Field Strength of Spurious Emissions	1	Pass
Transient Frequency Behavior	1	Pass
Frequency Stability	1	Pass

7.1 RF Power Output

7.1.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of a wide band RF power meter through 20 dB of passive attenuation. The results are shown below.

7.1.2 Measurement Results

FCC Part 90.205; ISED Canada RSS-119 5.4

Table 7.1.2-1: Peak Output Power

Frequency (MHz)	FCC Rule Part	Output Power (dBm)
451.35	90	26.95

7.2 Occupied Bandwidth (Emission Limits)

7.2.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer through 20 dB of passive attenuation. The spectrum analyzer resolution and video bandwidths were set to 100 Hz and 300 Hz respectively. The internal correction factors of the spectrum analyzer were employed to correct for any cable or attenuator losses. Results of the test are shown below for all modes of operation.

7.2.2 Measurement Results

Part 90.210(d)

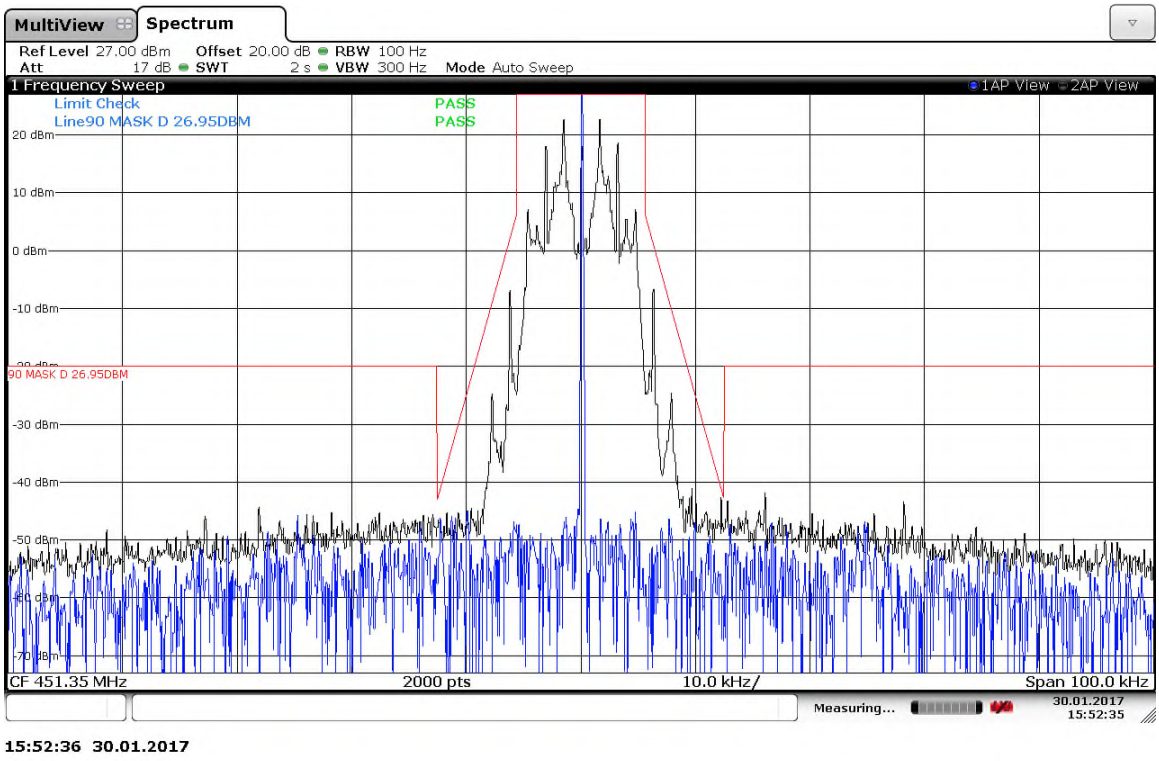

Figure 7.2.2-1: 451.35MHz – 2GFSK

7.3 99% Bandwidth

7.3.1 Measurement Procedure (ANSI 63.26: 2015 Section 5.4.4)

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer through 20 dB of passive attenuation. The internal correction factors of the spectrum analyzer were employed to correct for any cable and attenuator losses.

The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts. The nominal IF filter 3 dB bandwidth (RBW) is in the range of 1% to 5% of the OBW, and the VBW was set ≥ 3 × RBW. The reference level was set to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation. The measurements were made using the spectrum analyzer's 99% BW function.

7.3.2 Measurement Results

Frequency (MHz)	ISED Canada Rule Part	Mode of Operation	99% Bandwidth (kHz)
451.35	RSS-119	2GFSK	9.05

ISED Canada RSS-GEN 6.6, ISED Canada RSS-119

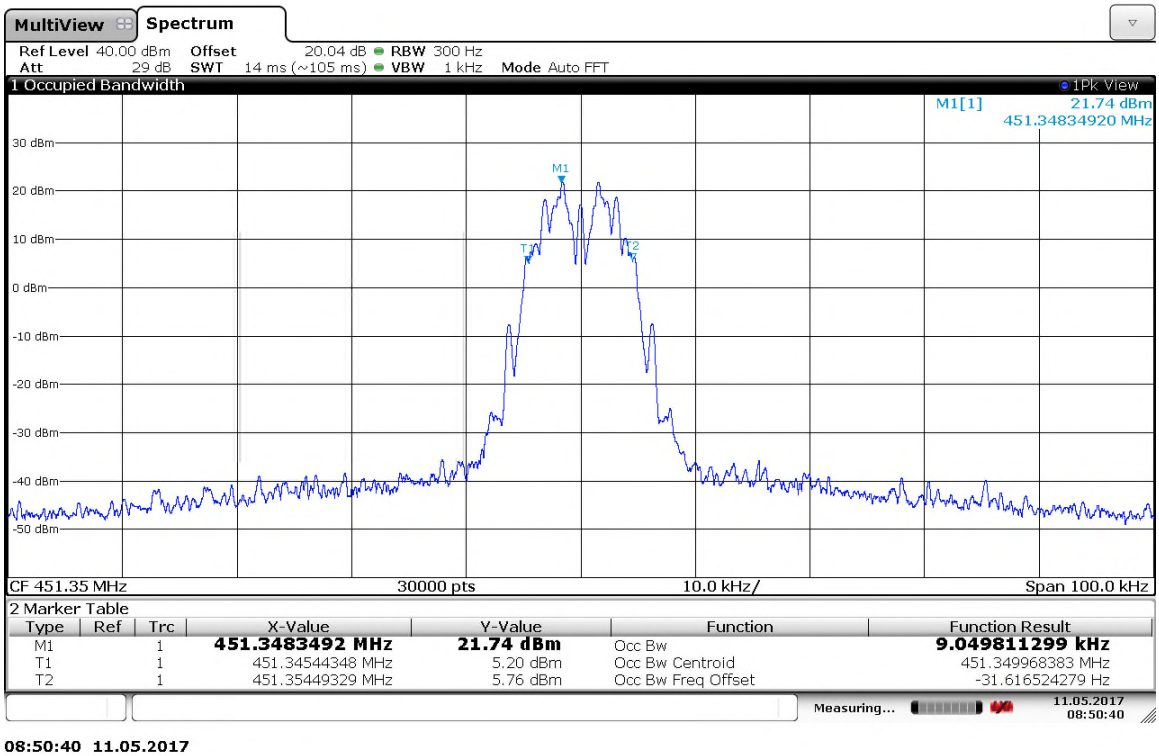

Figure 7.3.2-1: 451.35MHz – 2GFSK

7.4 Spurious Emissions at Antenna Terminals

7.4.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer through 20 dB of passive attenuation. The spectrum analyzer resolution bandwidth was set to 100 kHz below 1000 MHz and 1 MHz above 1000 MHz. The internal correction factors of the spectrum analyzer were employed to correct for any cable, attenuator or filter losses. The spectrum was investigated in accordance to CFR 47 Part 2.1057. Results are shown below.

7.4.2 Measurement Results

FCC Part 90.210(d); ISED Canada RSS-119 5.8.3

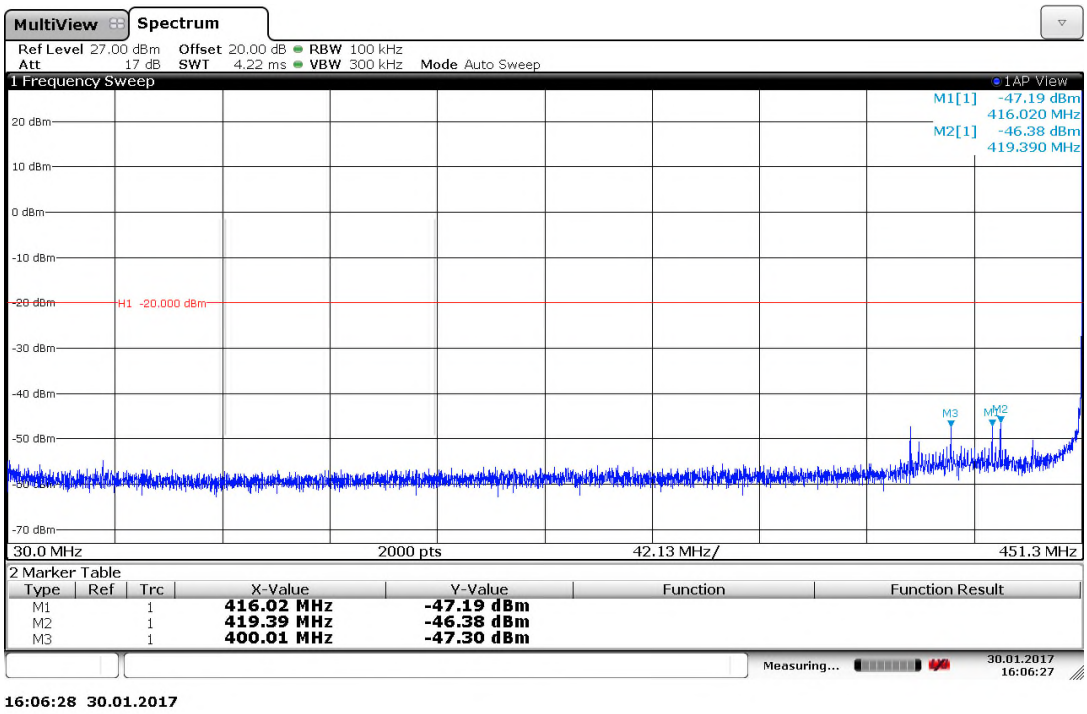

Figure 7.4.2-1: 451.35 MHz – 30MHz to Fundamental

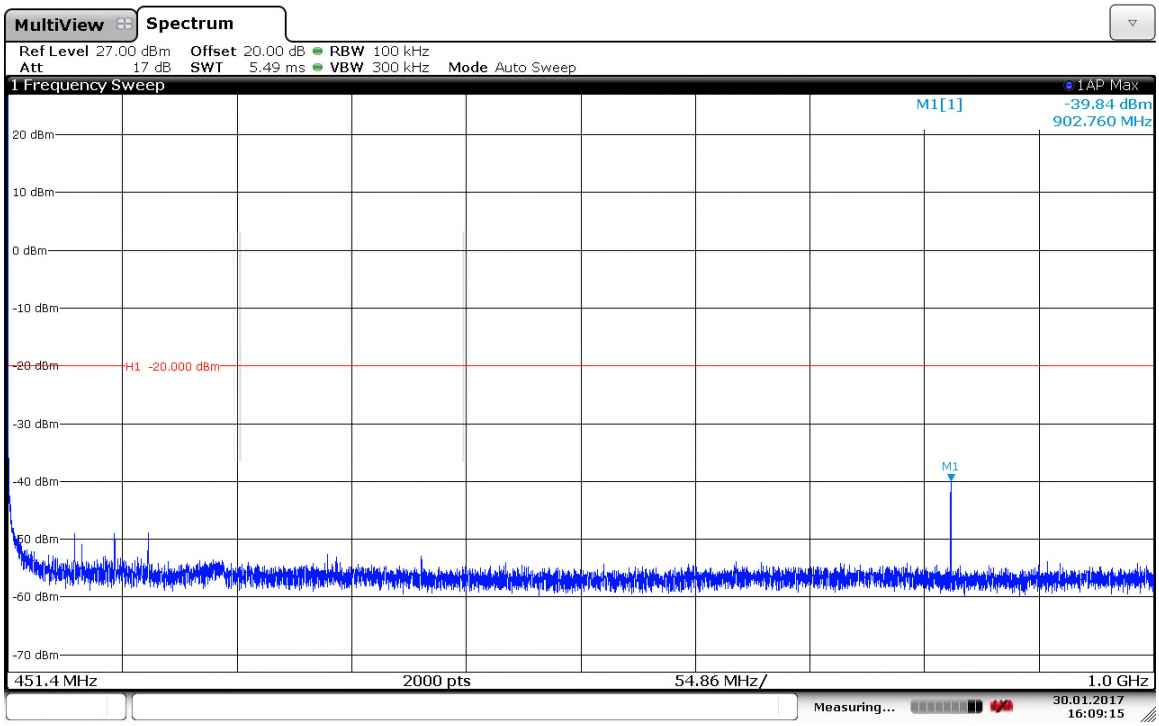

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Figure 7.4.2-2: 451.35 MHz – Fundamental to 1GHz

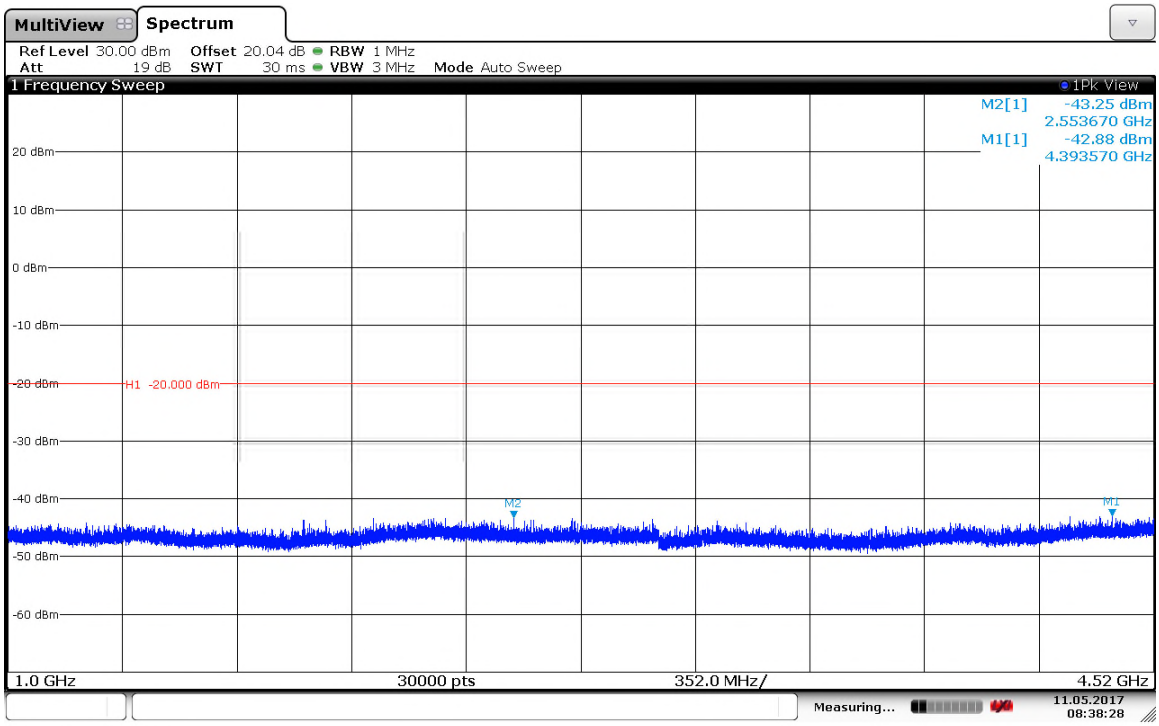

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Figure 7.4.2-3: 451.35 MHz – 1GHz to 4.52GHz

7.5 Field Strength of Spurious Emissions

7.5.1 Measurement Procedure

The equipment under test is placed in the Semi-Anechoic Chamber (described in section 2.3.1) on a wooden table at the turntable center. For each spurious emission, the antenna mast is raised and lowered from one (1) to four (4) meters and the turntable is rotated 360º and the maximum reading on the spectrum analyzer is recorded. This was repeated for both horizontal and vertical polarizations of the receive antenna.

The equipment under test is then replaced with a substitution antenna fed by a signal generator. The signal generator's frequency is set to that of the spurious emission recorded from the equipment under test. The antenna mast is raised and lowered from one (1) to four (4) meters to obtain a maximum reading on the spectrum analyzer. The output of the signal generator is then adjusted until the reading on the spectrum analyzer matches that obtained from the equipment under test. The signal generator level is recorded. The power in dBm of each spurious emission is calculated by correcting the signal generator level for the cable loss and gain of the substitution antenna referenced to a dipole. The spectrum was investigated in accordance to CFR 47 Part 2.1057.

The magnitude of all spurious emissions not reported were attenuated below the noise floor of the measurement system and therefore not specified in this report. Results are shown below.

7.5.2 Measurement Results

FCC Part 90.210(d); ISED Canada RSS-119 5.8.3

Table 7.5.2-1: Field Strength of Spurious Emissions

Frequency (MHz)	Spectrum Analyzer Level (dBµV/m)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
902.7	29.00	H	-52.99	-20.00	32.99
902.7	28.8	V	-53.89	-20.00	33.89
1354.05	54	H	-53.16	-20.00	33.16
1354.05	53.1	V	-54.59	-20.00	34.59
1805.4	49.6	H	-55.99	-20.00	35.99
1805.4	46.1	V	-60.29	-20.00	40.29
2256.75	46.1	H	-60.49	-20.00	40.49
2256.75	43.7	V	-65.19	-20.00	45.19
2708.1	42.1	H	-67.22	-20.00	47.22
2708.1	42.1	V	-66.82	-20.00	46.82
3610.8	45.2	H	-59.44	-20.00	39.44
3610.8	44.6	V	-61.44	-20.00	41.44

NOTE: All frequencies not listed were below the noise floor of the spectrum analyzer.

7.6 Frequency Stability

7.6.1 Measurement Procedure

The equipment under test is placed inside an environmental chamber. The RF output is directly coupled to the input of the measurement equipment and a power supply is attached to the primary supply voltage.

Frequency measurements were made at the extremes of the of temperature range -30º C to +50º C and at intervals of 10º C at normal supply voltage. A period of time sufficient to stabilize all components of the equipment was allowed at each frequency measurement. At a temperature 20º C the measurements were performed with a new battery and at the battery end point. The maximum variation of frequency was recorded.

7.6.2 Measurement Results

FCC Part 90.213; ISED Canada RSS-119 5.3

Frequency Stability

Frequency (MHz): 451.35
Deviation Limit (PPM): 2.5ppm

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VDC)
-30 C	**451.349798**	**-0.448**	0%	3.70
-20 C	**451.349866**	**-0.297**	0%	3.70
-10 C	**451.349951**	**-0.109**	0%	3.70
0 C	**451.350012**	**0.027**	0%	3.70
10 C	**451.350042**	**0.093**	0%	3.70
20 C	**451.349999**	**-0.002**	0%	3.70
30 C	**451.350000**	**0.000**	0%	3.70
40 C	**451.350045**	**0.100**	0%	3.70
50 C	**451.350067**	**0.148**	0%	3.70
20 C	**451.350012**	**0.027**	Battery End Point	2.80

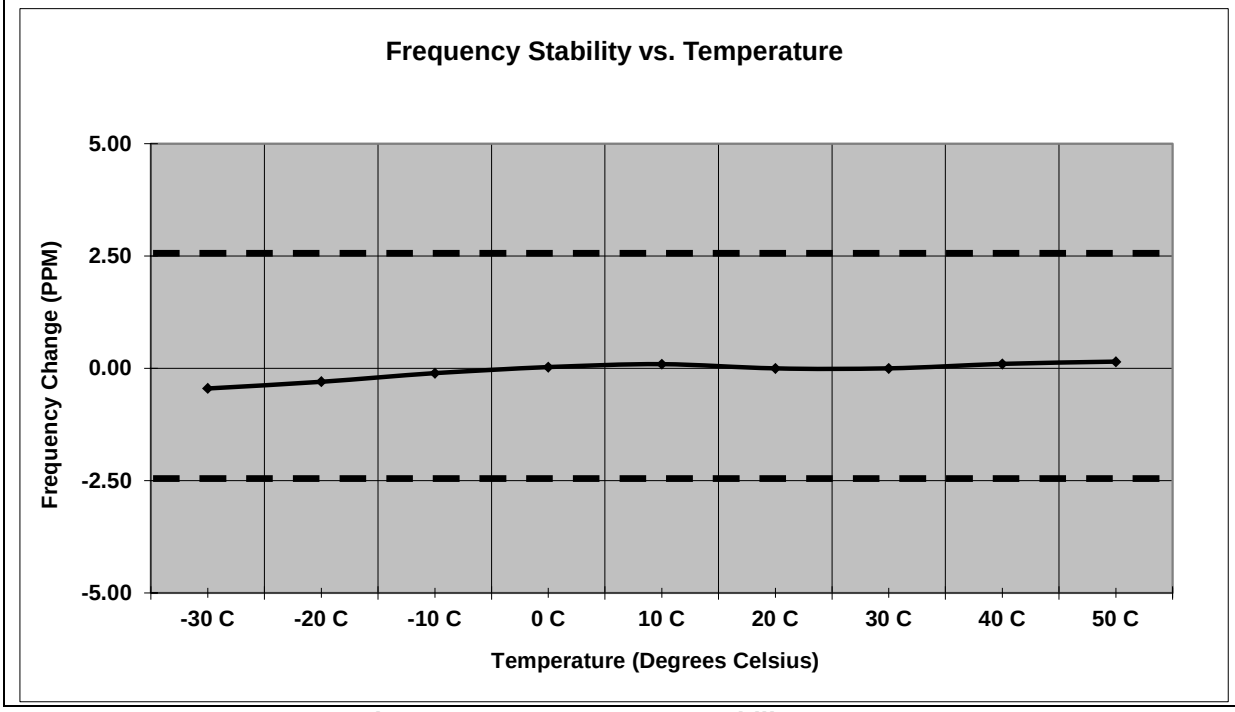

Figure 7.6.2-1: Frequency Stability

7.7 Transient Frequency Behavior

7.7.1 Measurement Procedure

The measurements were performed using a test receiver. The EUT was connected using the variable attenuator and two power splitters. The transmitter level was set to 40 dB below the test receivers maximum input level, and then the transmitter was turned off. With the transmitter off the signal generator was set to a level equal to that previously recorded from the transmitter and maintained at the same amplitude through-out the test. Then, the attenuation between the transmitter and the RF detector was reduced by 30 dB. The Transient Frequency Behavior is reported below.

7.7.2 Measurement Results

Part 90.214; ISED Canada RSS-119 5.9

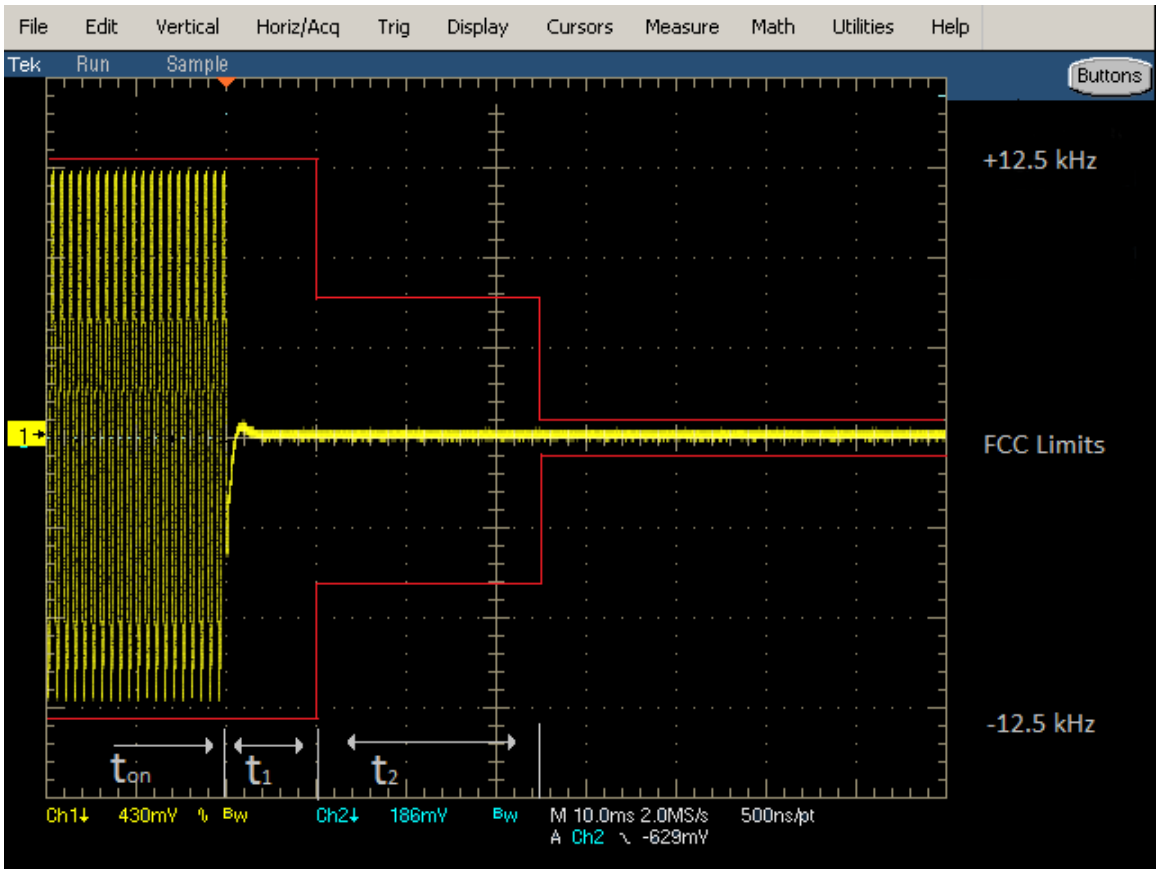

Figure 7.7.2-1: Transient Frequency Behavior – Transmitter On

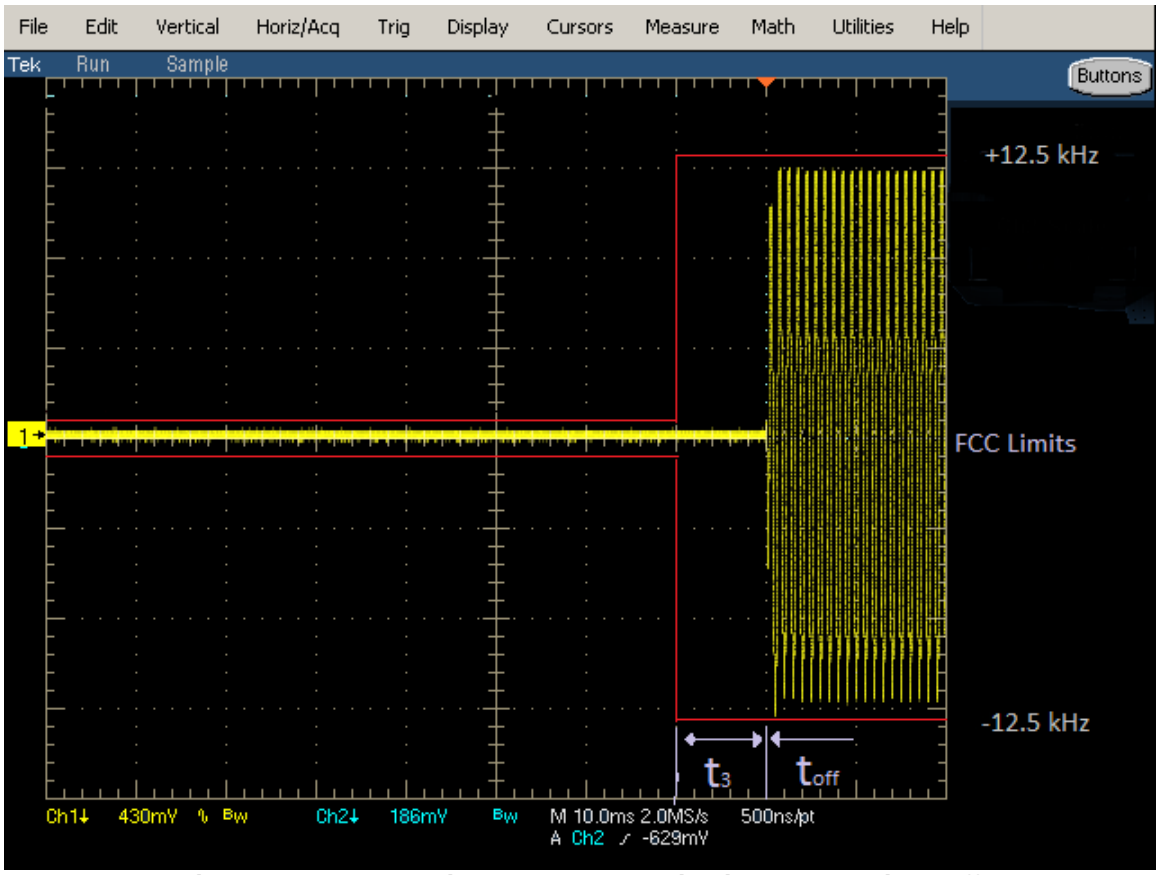

Figure 7.7.2-2: Transient Frequency Behavior – Transmitter Off

8 CONCLUSION

In the opinion of TÜV SÜD America Inc. the UFTR1, manufactured by Elster Solutions, LLC meets the requirements of FCC Part 90 Subpart I and ISED Canada Radio Standards Specification: RSS-119 for the tests documented herein.

END REPORT