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RADIO TEST REPORT

Report ID:
REP015997

Project ID:
PRJ0041479

Type of assessment:
Class II Permissive Change

Applicant:
Summation Research Inc.

Type of Radio Equipment:
Land-Mobile Transmitter and Receiver

Product Marketing Name (PMN):
UHF Non-Broadcast Radio

Models (HVINs):
STR-1821B, STR-1821B-L

FCC ID:
OQW-STR1800

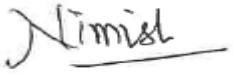
ISED Certification number:
9110A-STR1800

Specifications:

- FCC 47 CFR Part 90, Subpart I
- RSS-119 Issue 12, May 2015

Date of issue: September 25, 2023

Nimish Kapoor, EMC/RF Specialist
Tested by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Kevin Rose, EMC/RF Specialist
Reviewed by


Signature

Lab locations

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	FCC: CA2040; IC: 2040A-4 (Ottawa/Almonte); FCC: CA2041; IC: 2040G-5 (Montreal); CA0101 (Cambridge)		
Website	www.nemko.com			

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 contained in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

Copyright notification

Table of Contents

Section 1 Report summary

1.1 Test specifications

FCC 47 CFR Part 90, Subpart I	Private land mobile radio services. General technical standards
RSS-119 Issue 12, May 2015	Land Mobile and Fixed Equipment Operating in the Frequency Range 27.41–960 MHz

1.2 Test methods

ANSI C63.26-2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
RSS-102, Issue 5, March 19, 2015	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
SRSP-501, Issue 5, October 2004	Technical Requirements for Land Mobile and Fixed Radio Services Operating in the Bands 406.1–430 MHz and 450–470 MHz
FCC 47 CFR Part 2, Subpart J	Equipment authorization procedures
RSS-Gen Issue 5, March 2019	General Requirements for Compliance of Radio Apparatus

1.3 Exclusions

Partial testing was performed on the product with the transmitter operating to confirm that after the change in the product it still meets the FCC and ISED requirements. This investigation of the final product was done by spot checking emissions, output power and spectral density from the device while operating the host as a composite system. This testing was performed with the host product configured in typical operational modes to check the spurious emissions and output power for compliance with all the applicable rules.

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was performed against all relevant requirements of the test standard except as noted in section 1.3 above. 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.

1.5 Test report revision history

Table 1.5-1: *Test report revision history*

Report ID	Date of issue	Details of changes made to test report
REP015997	September 25, 2023	Original report issued

Section 2 Engineering considerations

2.1 Modifications incorporated in the EUT for compliance

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

2.2 Technical judgment

This test report covers only partial testing of unit for C2PC change in reference to original report “393579-1TRFWL” FCC ID: OQW-STR1800 and IC: 9110A-STR1800.
The C2PC was to add two new models to the family of Series STR-1800. The difference in the model STR-1800B and STR-1800B-L The STR-1821B and STR-1821B-L had 2 components replaced to change the high-pass filter characteristics on the Receive section only. The STR-1821B-L had an additional component change to a lower gain LNA on the Receive section only

2.3 Model variant declaration

There were no model variants declared by the applicant..

2.4 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 3 Test conditions

3.1 Atmospheric conditions

Temperature	15 °C – 35 °C
Relative humidity	20 % – 75 %
Air pressure	86 kPa (860 mbar) – 106 kPa (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.

3.2 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 4 Information provided by the applicant

4.1 Disclaimer

This section contains information provided by the applicant and has been utilized to support the test plan. Inaccurate information provided by the applicant can affect the validity of the results contained within this test report. Nemko accepts no responsibility for the information contained within this section and the impact it may have on the test plan and resulting measurements.

4.2 Applicant/Manufacture

Name	Summation Research Inc.
Address	305 East Dr. Suite D, Melbourne FL, 32904, USA

4.3 EUT information

Product name (PMN)	UHF Non-Broadcast Radio
Series	STR-1800
Models (HVINs)	STR-1821B and STR-1821B-L
Serial number	STR-1821B: 5501060 STR-1821B-L: 5501059
WABTEC Part number	STR-1821B: 1003144-214 STR-1821B-L: 1003144-216
Power supply requirements	DC: 13.6 V (Tx: max 9 A, Rx: 0.7 A)
Product description and theory of operation	UHF Land Mobile Data Radio, simplex operation, modulates user analog and digital data to and from a 12.5 kHz or 6.25 kHz carrier between the frequencies of 400 MHz and 470 MHz, approved for operation with external antenna with a gain of up to 0 dBd, with an output power up to 30 W maximum measured at the output of the transceiver
Software details	Version for Testing: 4.99 Production firmware version: 4.10

4.4 Technical information

System type	☒ Mobile system ☐ Base/Fixed point-to-point system
Frequency band (FCC)	400–470 MHz
Frequency band (ISED)	452.925 – 457.95 MHz
Type of modulation	SOQPSK, FSK and FFSK
Emission classification	11K2F2D, 11K2F1D, 4K00F1D
Antenna information	Sinclair, MN: ST321-SF9SNF, Gain: 0 dBd (2.15 dBi) Kathrein, MN: K 70 20 21, Gain: 0 dBd (2.15 dBi)

4.5 EUT setup details

4.5.1 Radio exercise details

Operating conditions	The EUT is running a modification to the production firmware that was done to bypass the PTT time out time and that allows it to be commanded via RS-422 interface to the computer with executable test software: FCC-Bert.exe The EUT was set to transmit at 457.9375 MHz in Tx Test Mode with Modulation Tone being set to FM 1.8 kHz
Transmitter state	EUT was specially programmed for Transmitter to transmit at 100% duty cycle for 72 seconds and then it needs to be re-transmit again

4.5.2 EUT setup configuration

Table 4.5-1: *EUT interface ports*

Description	Qty.
Primary power connector	1
DB-9 Front panel connector	1
DB-25 Front panel connector	1
UHF PL-259 Type (F) RF 50 Ω antenna connector	1

Table 4.5-2: *Support equipment*

Description	Brand name	Model, Part number, Serial number, Revision level
Laptop	Dell	MN: Latitude E7470, SN: FHV3NC2

Table 4.5-3: *Inter-connection cables*

Cable description	From	To	Length (m)
Power	Nemko DC power supply	STR-1800 Radio	1.5
USB to RS422	Laptop	USB to RS422 Connector	0.5
RS422 to DB25	USB to RS422 Connector	STR-1800 Radio	0.5

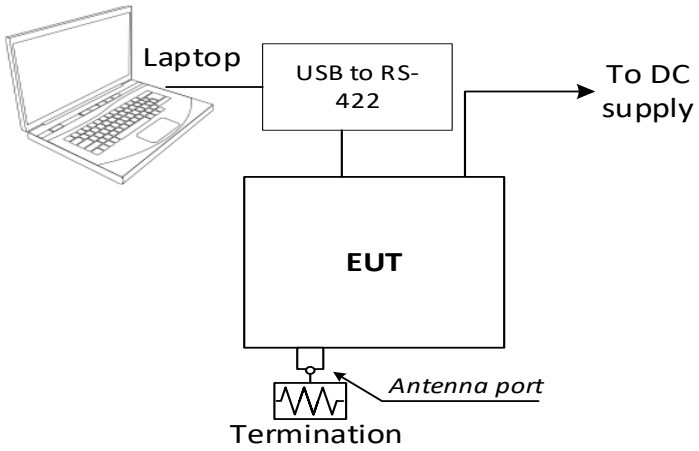

Figure 4.5-1: *Radiated testing block diagram*

Section 5 Summary of test results

5.1 Testing location

Test location (s)	Ottawa

5.2 Testing period

Test start date	August 31, 2023	Test end date	September 5, 2023

5.3 Sample information

Receipt date	August 18, 2023	Nemko sample ID number(s)	PRJ00414790001, PRJ00414790002

5.4 FCC Part 2 and 90 Subpart J test requirements results

Table 5.4-1: *FCC requirements results*

Part	Test description	Verdict
§90.210	Spectrum mask and spurious emissions	Pass

Notes: Only radiated spurious emissions assessment was performed. Therefore, all other tests are excluded from the table.

5.5 ISED RSS-119, Issue 12 and RSS-Gen, Issue 5 test requirements results

Table 5.5-1: *ISED requirements results*

Section	Test description	Verdict
RSS-119, 5.5	Spectrum mask and spurious emissions	Pass

Notes: Only radiated spurious emissions assessment was performed. Therefore, all other tests are excluded from the table.

Section 6 Test equipment

6.1 Test equipment list

Table 6.1-1: *Equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	January 19, 2024
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
61505 AC source	Chroma	61509	FA003036	—	VOU
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 40	FA002071	1 year	March 2, 2024
Horn (1–18 GHz)	ETS Lindgren	3117	FA002840	1 year	March 7, 2024
Preamp (1–18 GHz)	ETS Lindgren	124334	FA002873	1 year	November 18, 2023
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	March 7, 2024
50 Ω coax cable	Carlisle	WHU18-1818-072	FA002391	1 year	October 17, 2023

Notes: NCR - no calibration required, VOU - verify on use

Table 6.1-2: *Automation software details*

Test description	Manufacturer of Software	Details
Radiated spurious emissions	Rohde & Schwarz	EMC32, Software for EMC Measurements, Version 11.20.00

6.2 Measurement uncertainty

Table 6.2-1: *Measurement uncertainty calculations based on equipment list*

Measurement	Standard uncertainty, ±dB	Measurement uncertainty, ±dB
Radiated spurious emissions (30 MHz to 1 GHz)	6.3	5.8
Radiated spurious emissions (1 GHz to 6 GHz)	5.2	4.7

Notes: UKAS Lab 34, TIA-603 and ETSI TR 100 028-1&2 have been used as guidance for measurement uncertainty reasonable estimations with regards to previous experience and validation of data. Nemko Canada Inc. follows these test methods in order to satisfy ISO/IEC 17025 requirements for estimation of uncertainty of measurement for wireless products. Measurement uncertainty calculations assume a coverage factor of K = 2 with 95% certainty.

Section 7 Testing data

7.1 Spectrum mask and spurious emissions

7.1.1 References, definitions and limits

FCC §90.210:

Except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (o) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating under this part.

Table 7.1-1: *Applicable Emission Masks*

Frequency band, MHz	Mask for equipment with audio low pass filter	Mask for equipment with audio low pass filter
421–512[1,2]	B, D, or E	C, D, or E

Notes: [1]Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D, and equipment designed to operate with a 6.25 kHz channel bandwidth must meet the requirements of Emission Mask E.
[2]Equipment designed to operate on 25 kilohertz bandwidth channels must meet the requirements of either Emission Mask B or G, whichever is applicable, while equipment designed to operate on 12.5 kilohertz bandwidth channels must meet the requirements of Emission Mask D. Equipment designed to operate on 25 kilohertz bandwidth channels may alternatively meet the Adjacent Channel Power limits of §90.221.

(b) **Emission Mask B.** For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.

(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

(c) **Emission Mask C.** For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier output power (P) as follows:

(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5 kHz, but not more than 10 kHz: At least 83 log (f_d/5) dB;

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 10 kHz, but not more than 250 percent of the authorized bandwidth: At least 29 log (f_d^2/11) dB or 50 dB, whichever is the lesser attenuation;

(3) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

(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 f_0 to 5.625 kHz removed from f_0: Zero dB.

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

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

(4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. To show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to ensure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

References, definitions and limits, continued

FCC §90.210:

(e) **Emission Mask E**—6.25 kHz or less channel bandwidth equipment. For transmitters designed to operate with a 6.25 kHz or less 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 f_0 to 3.0 kHz removed from f_0: Zero dB.

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 3.0 kHz but no more than 4.6 kHz: At least 30 + 16.67(f_d−3 kHz) or 55 + 10 log (P) or 65 dB, whichever is the lesser attenuation.

(3) On any frequency removed from the center of the authorized bandwidth by more than 4.6 kHz: At least 55 + 10 log (P) or 65 dB, whichever is the lesser attenuation.

(4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

RSS-119, Clause 5.5:

The authorized bandwidth is defined as the maximum width of the band of frequencies used to derive spectrum masks and is not necessarily equivalent to the bandwidth found on radio and spectrum licences.

Table 7.1-2: *Spectrum Masks*

Frequency band, MHz	Channel Bandwidth (kHz)	Authorized Bandwidth (kHz)	Mask for equipment with audio low pass filter	Mask for equipment with audio low pass filter
450–470	25.00	20.00	B	C
	12.50	11.25	D	D
	6.25	6.00	E	E

Notes: The spectrum masks are given in the table for equipment having an output power greater than 120 mW. For equipment with an output power that does not exceed 120 mW, Section 5.10 applies.

RSS-119, Clause 5.8:

The spectrum plots of the unwanted emissions shall comply with the masks specified in tables below.

The term *displacement frequency, f_d,* used in these sections refers to the difference between the channel frequency and the emission component frequency expressed in kilohertz, and *p* is the transmitter output power in Watts.

5.8.1 **Emission Mask B** for Transmitters Equipped With an Audio Low-Pass Filter

The power of any emission shall be attenuated below the transmitter output power P (dBW) as specified in Table below:

Table 7.1-3: *Emission Mask B*

Displacement Frequency, f_d (kHz)	Minimum Attenuation (dB)	Resolution Bandwidth (Hz)
$10 < f_d \leq 20$	25	300
$20 < f_d \leq 50$	35	300
$f_d > 50$	$43 + 10 \times \text{Log}_{10}(p)$	Specified in Section 4.2.1

5.8.2 **Emission Mask C** for Transmitters not Equipped With an Audio Low-Pass Filter

The power of any emission shall be attenuated below the transmitter output power P (dBW) as specified in Table below:

Table 7.1-4: *Emission Mask C*

Displacement Frequency, f_d (kHz)	Minimum Attenuation (dB)	Resolution Bandwidth (Hz)
$5 < f_d \leq 10$	$83 \times \text{Log}_{10}(f_d / 5)$	300
$10 < f_d \leq 50$	Whichever is the lesser: 50 *or* $29 \times \text{Log}_{10}(f_d^2 / 11)$	300
$f_d > 50$	$43 + 10 \times \text{Log}_{10}(p)$	Specified in Section 4.2.1

References, definitions and limits, continued

RSS-119, Clause 5.8:

5.8.3 **Emission Mask D** for Transmitters Equipped With or Without an Audio Low-Pass Filter

The power of any emission shall be attenuated below the transmitter output power P (dBW) as specified in Table below:

Table 7.1-5: *Emission Mask D*

Displacement Frequency, f_d (kHz)	Minimum Attenuation (dB)	Resolution Bandwidth (Hz)
$5.625 < f_d \leq 12.5$	$83 \times \text{Log}_{10}(f_d / 5)$	Specified in Section 4.2.2
$f_d > 12.5$	Whichever is the lesser: 70 *or* $50 \times \text{Log}_{10}(p)$	Specified in Section 4.2.2

5.8.4 **Emission Mask E** for Transmitters Equipped With or Without an Audio Low-Pass Filter

The power of any emission shall be attenuated below the transmitter output power P (dBW) as specified in Table below:

Table 7.1-6: *Emission Mask E*

Displacement Frequency, f_d (kHz)	Minimum Attenuation (dB)	Resolution Bandwidth (Hz)
$3 < f_d \leq 4.6$	Whichever is the lesser: $30 + 16.67 (f_d - 3)$ *or* $55 + 10 \times \text{Log}_{10}(p)$	Specified in Section 4.2.2
$f_d > 4.6$	Whichever is the lesser: 57 *or* $55 \times \text{Log}_{10}(p)$	Specified in Section 4.2.2

RSS-119, Clause 4.2:

When the transmitter unwanted emissions are being measured, a sufficient number of sweeps must be measured to ensure that the emission profile is developed. The video bandwidth shall be at least three times the width of the instrument resolution bandwidth.

For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated carrier power refers to the total output power contained in the occupied bandwidth when the transmitter is modulated with signals representative of those encountered in a real system operation.

4.2.1 Emission Masks B, C, G, I and J

Unwanted emission measurements can be in peak or averaging mode, provided that the same parameter, peak power or average power, used for the transmitter's output power measurement is also used for the unwanted emission measurements.

Except where otherwise stated, on any frequency removed from the carrier frequency by more than 250% of the authorized bandwidth, a resolution bandwidth of at least 100 kHz must be used for frequencies to be measured at or below 1 GHz, and a resolution bandwidth of at least 1 MHz must be used for frequencies to be measured above 1 GHz. If a narrower resolution bandwidth is used, power integration shall be applied.

4.2.2 Emission Masks D, E, F and Y

In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak mode. For emissions beyond 50 kHz from the edge of the authorized bandwidth, the resolution bandwidth shall be 100 kHz for frequencies at or below 1 GHz, and 1 MHz for frequencies above 1 GHz. However, for emission mask F, at a displacement frequency of less than 3.75 kHz, the resolution bandwidth shall be 30 Hz.

7.1.2 Test summary

Verdict	Pass		
Test date	September 5, 2023	Temperature	21 and 28 °C
Tested by	Nimish Kapoor	Air pressure	995 and 1002 mbar
Test location	Ottawa	Relative humidity	54 and 61 %

7.1.3 Observations, settings and special notes

Spectrum analyser settings for spurious emissions:

Resolution bandwidth:	100 kHz (below 1 GHz); 1 MHz (above 1 GHz)
Video bandwidth:	> RBW
Detector mode:	Peak
Trace mode:	Max Hold

7.1.4 Test data

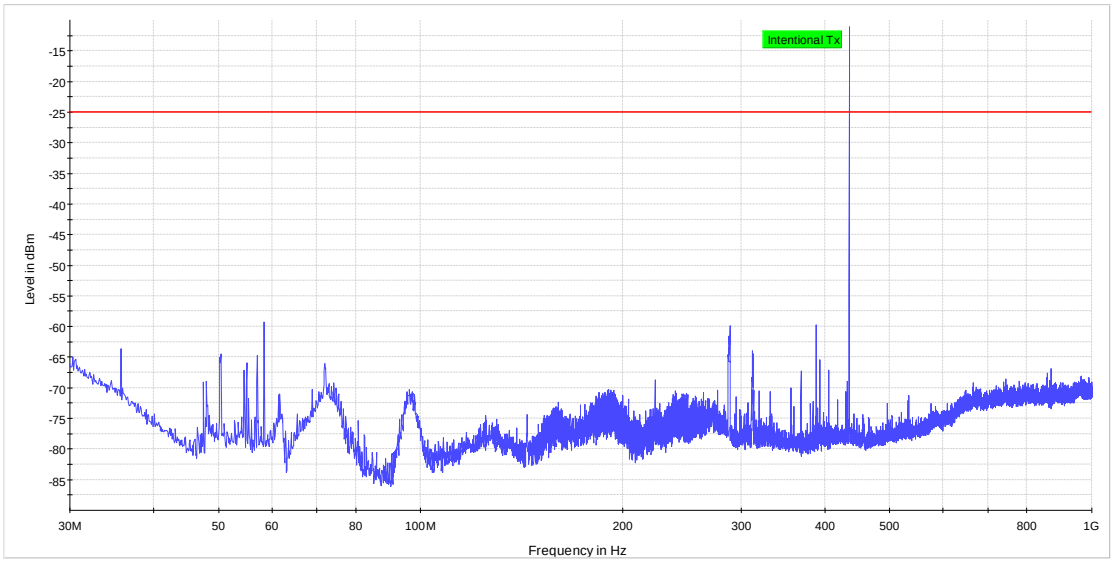

Figure 7.1-1: *Radiated spurious emissions from 30 MHz to 1000 MHz [STR-1821B]*

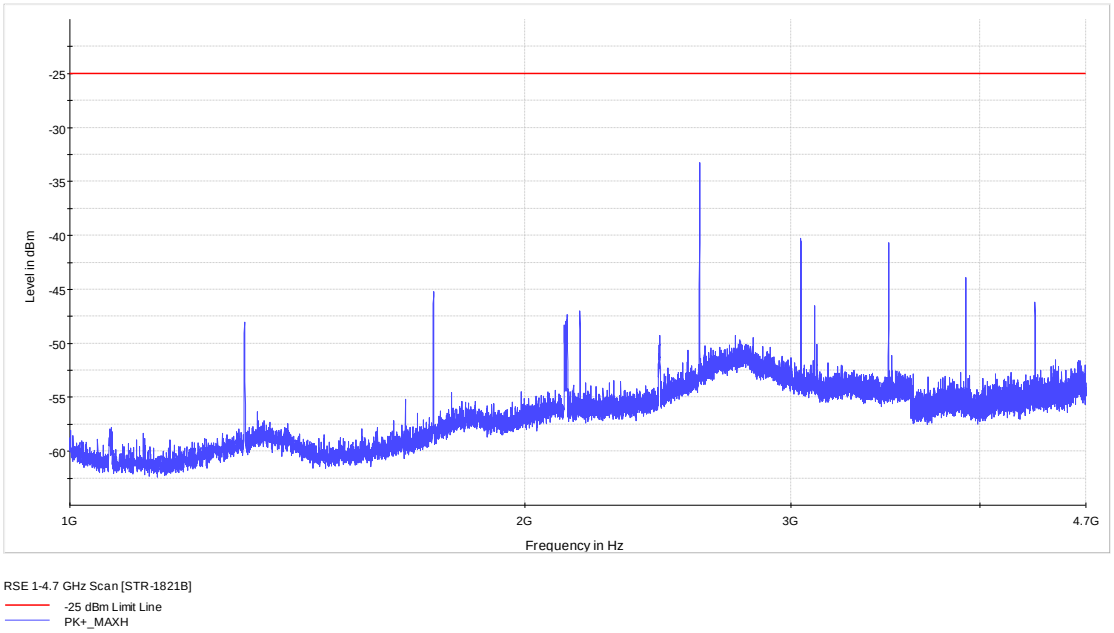

Figure 7.1-2: *Radiated spurious emissions from 1000 MHz to 4700 MHz [STR-1821B]*

Test data, continued

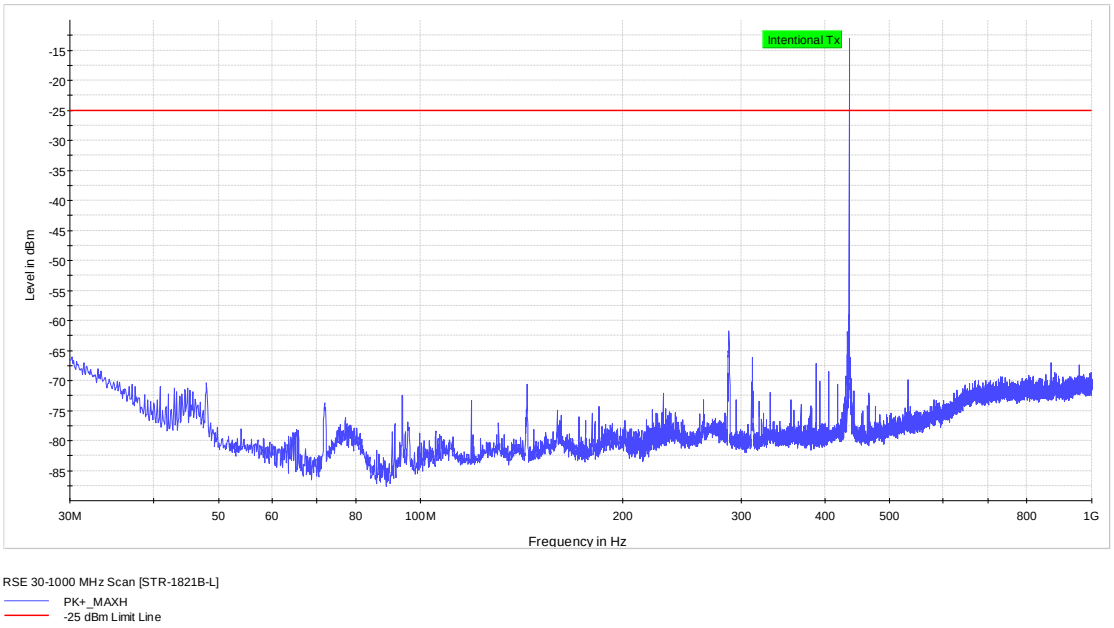

Figure 7.1-3: *Radiated spurious emissions from 30 MHz to 1000 MHz [STR-1821B-L]*

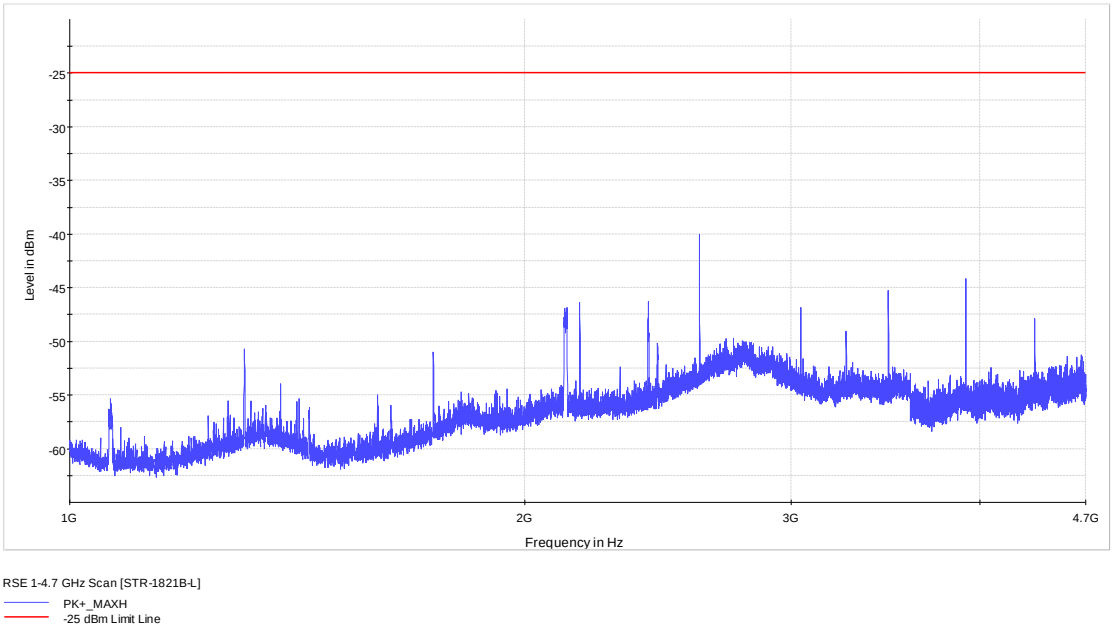

Figure 7.1-4: *Radiated spurious emissions from 1000 MHz to 4700 MHz [STR-1821B-L]*

Section 8 EUT photos

8.1 External photos

Figure 8.1-1: *Front view photo*

Figure 8.1-2: *Rear view photo*

External photos, continued

Figure 8.1-3: *Side view photo*

Figure 8.1-4: *Side view photo*

External photos, continued

Figure 8.1-5: *Top view photo*

External photos, continued

Figure 8.1-6: *Bottom view photo [STR-1821B]*

Notes: The two units are identical. The label is different on the bottom side; Hence, bottom side is shown separately.

External photos, continued

Figure 8.1-7: *Bottom view photo [STR-1821B-L]*

Notes: The two units are identical. The label is different on the bottom side; Hence, bottom side is shown separately.

End of the test report