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Test report

284168-3TRFWL

Date of issue: December 1, 2018

Applicant:

Deltanode Solutions AB

Product:

AWS

Model:

DHR820

FCC ID: V5FDHR002 IC: 11014A-DHR002

Specifications:

FCC Part 27, RSS-131 Issue 3, RSS-139 Issue 3

Test location

Company name	Nemko Canada Inc.
Address	303 River Road
City	Ottawa
Province	Ontario
Postal code	K1V 1H2
Country	Canada
Telephone	+1 613 737 9680
Facsimile	+1 613 737 9691
Toll free	+1 800 563 6336
Website	www.nemko.com
Site number	FCC test site registration number: 175281, IC: 2040A-4 (3 m semi anechoic chamber)

Tested by	Kevin Rose, Wireless/EMC Specialist
Reviewed by	Russell Grant, Senior Technical Assessor
Date	December 1, 2018
Signature	Russell Grant

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.

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Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Deltanode Solutions AB
Address	Hammarby Fabriksvag 61
City	Stockholm
Province/State	
Postal/Zip code	SE-120 30
Country	Sweden

1.2 Test specifications

FCC Part 27	MISCELLANEOUS WIRELESS COMMUNICATIONS SERVICES
935210 D05 Indus Booster Basic Meas v01r02	MEASUREMENTS GUIDANCE FOR INDUSTRIAL AND NON-CONSUMER SIGNAL BOOSTER, REPEATER, AND AMPLIFIER DEVICES
RSS-131 Issue 3 RSS-139 Issue 3	Zone Enhancers Advanced Wireless Services (AWS) Equipment Operating in the Bands 1710-1780 MHz and 2110-2180 MHz

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 27, RSS-131 Issue 3, RSS-139 Issue 3

KDB 935210 D05 3.2	Measuring AGC threshold level	Reported
RSS-131 5.2.1, KDB 935210 D05 3.3	Out-of-band-rejection	Reported
RSS-131 5.2.2, KDB 935210 D05 3.4	Input-versus-output signal comparison	Pass
FCC 27.50(d), RSS-131 5.2.3, RSS-139 6.5, KDB 935210 D05 3.5	Mean output power and amplifier/booster gain	Pass
FCC 27.53(h), RSS-139 6.6, KDB 935210 D05 3.6.2,	Out-of-band/out-of-block emissions conducted measurements	Pass
FCC 27.53(h), RSS-139 6.6, KDB 935210 D05 3.6.3	Spurious emissions conducted measurements	Pass
FCC 27.54, RSS-131 5.2.4, RSS-139 6.4, KDB 935210 D05 3.7	Frequency stability measurements	N/A[1]
FCC 27.53(h), RSS-139 6.6, KDB 935210 D05 3.8	Spurious emissions radiated measurements	Pass

Notes: [1]The signal booster does not alter the input signal in any way.

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	November 8, 2018
Nemko sample ID number	13300321

3.2 EUT information

Product name	AWS
Model	DHR820
Serial number	10189

3.3 Technical information

Operating band	1710 – 1755 / 2110 – 2155 MHz
Modulation type	CDMA, WCDMA, LTE: 1.4, 3, 5, 10, 15, 20 MHz
Channel Spacing	Standard
Power requirements	110 V_{AC}, ~3 A for entire system tested
Emission designator	CDMA: F9W LTE: D7W 1M25F9W, 5M00F9W, 1M40D7W, 3M00D7W, 5M00D7W, 10M0D7W, 15M0D7W, 20M0D7W
Gain	80 dB
Antenna information	External Antenna is not provided EUT used a 50 Ω termination.

3.4 Product description and theory of operation

Off air high power repeater – 33dBm of output power on DL, 25dBm of output power on UL, 80dB gain in both DL and UL

3.5 EUT exercise details

The EUT was controlled via a Laptop interface with GUI to configure the system. The EUT uses set channels Bandwidths user settable to a maximum of 15 MHz.

3.6 EUT setup diagram

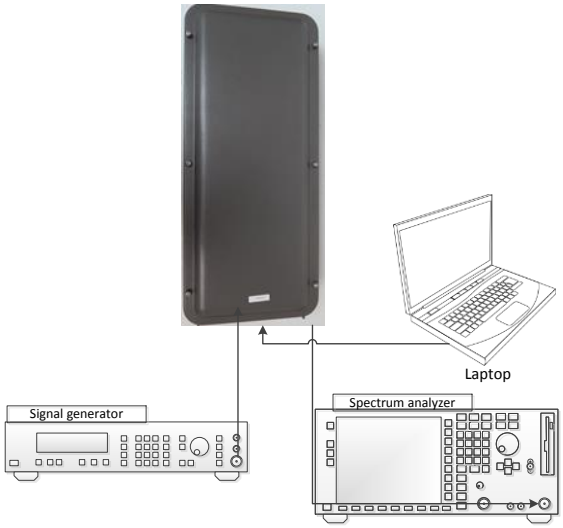

Figure 3.6-1: *Setup diagram*

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

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: *Equipment list*

Equipment	Manufacturer	Model no.	Serial no.	Asset no.	Cal./Ver. cycle	Next cal./ver.
3 m EMI test chamber	TDK	SAC-3		FA003012	1 year	Aug. 22/19
Flush mount turntable	SUNAR	FM2022		FA003006	—	NCR
Controller	SUNAR	SC110V	050118-1	FA002976	—	NCR
Antenna mast	SUNAR	TLT2	042418-5	FA003007	—	NCR
AC Power source	Chroma			FA003020	—	NCR
Receiver/spectrum analyzer	Rohde & Schwarz	ESR26	101367	FA002969	1 year	Jan. 30/19
Spectrum analyzer	Rohde & Schwarz	FSW43	104437	FA002971	1 year	Mar. 16/19
Horn antenna (1–18 GHz)	ETS-Lindgren	3117	00052793	FA002911	1 year	Aug. 16/19
Preamp (1–18 GHz)	ETS-Lindgren	124334	00224880	FA002956	1 year	Sept 18/19
Bilog antenna (30–2000 MHz)	SUNAR	JB1	A053018-1	FA003009	1 year	Sept. 6/19
Vector Signal Generator	Rohde & Schwarz	SMW200A	101857	FA002970	1 year	Feb. 2/19

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

Section 8. Testing data

8.1 KDB 935210 D05 3.2, Measuring AGC threshold level

8.1.1 Definitions and limits

The AGC threshold is the input power at which a 1 dB increase in the input signal power no longer causes a 1 dB increase in the output power.

8.1.2 Test summary

Test date	November 7, 2018	Temperature	22 °C
Test engineer	Kevin Rose	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	33 %

8.1.3 Observations, settings and special notes

Test receiver settings:

Detector mode	RMS (for average), Peak (for peak)
Resolution bandwidth	20 kHz
Integration bandwidth	>OBW
Video bandwidth	>RBW
Trace mode	Power Average (for average), Max Hold (for peak)
Measurement time	Auto

8.1.4 Test data

Table 8.1-1: *AGC Threshold*

Modulation	Frequency, MHz	RF input power AVG, dBm
AWGN	1732.5	-55.48
AWGN	2132.5	-48.76

8.2 RSS-131 5.2.1, KDB 935210 D05 3.3, Out-of-band-rejection

8.2.1 Definitions and limits

The gain-versus-frequency response and the 20 dB bandwidth of the zone enhancer shall be reported. The zone enhancer shall reject amplification of other signals outside the passband of the zone enhancer.

8.2.2 Test summary

Test date	November 7, 2018	Temperature	21 °C
Test engineer	Kevin Rose	Air pressure	1000 mbar
Verdict	Pass	Relative humidity	42 %

8.2.3 Observations, settings and special notes

Frequency range	30 MHz to 10th harmonic
Detector mode	Peak
Resolution bandwidth sweep	100 kHz (below 1 GHz), 1000 kHz (above 1 GHz)
Video bandwidth	>RBW
Trace mode	Max Hold
Measurement time	Auto

8.2.4 Test data

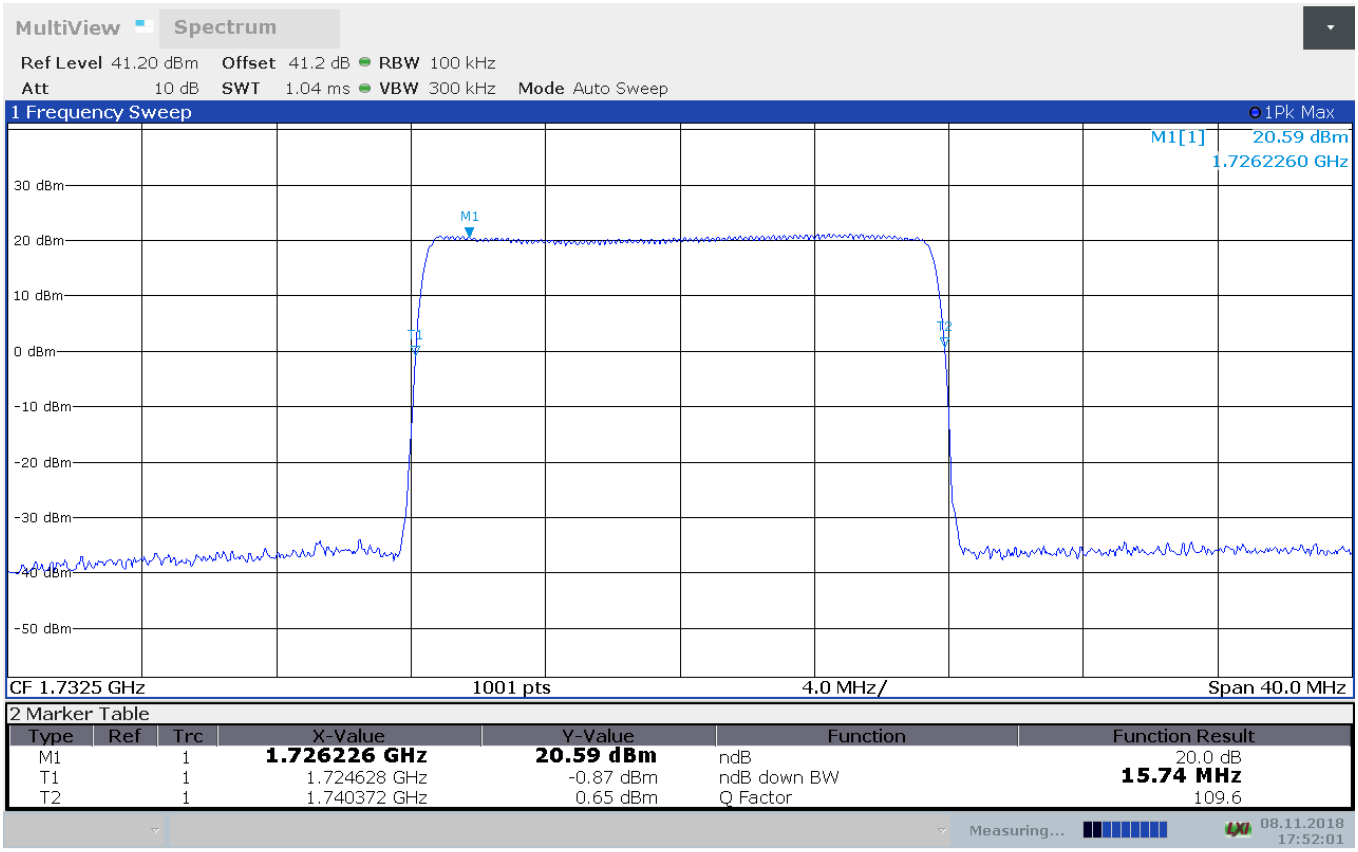

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Figure 8.2-1: *Passband UL*

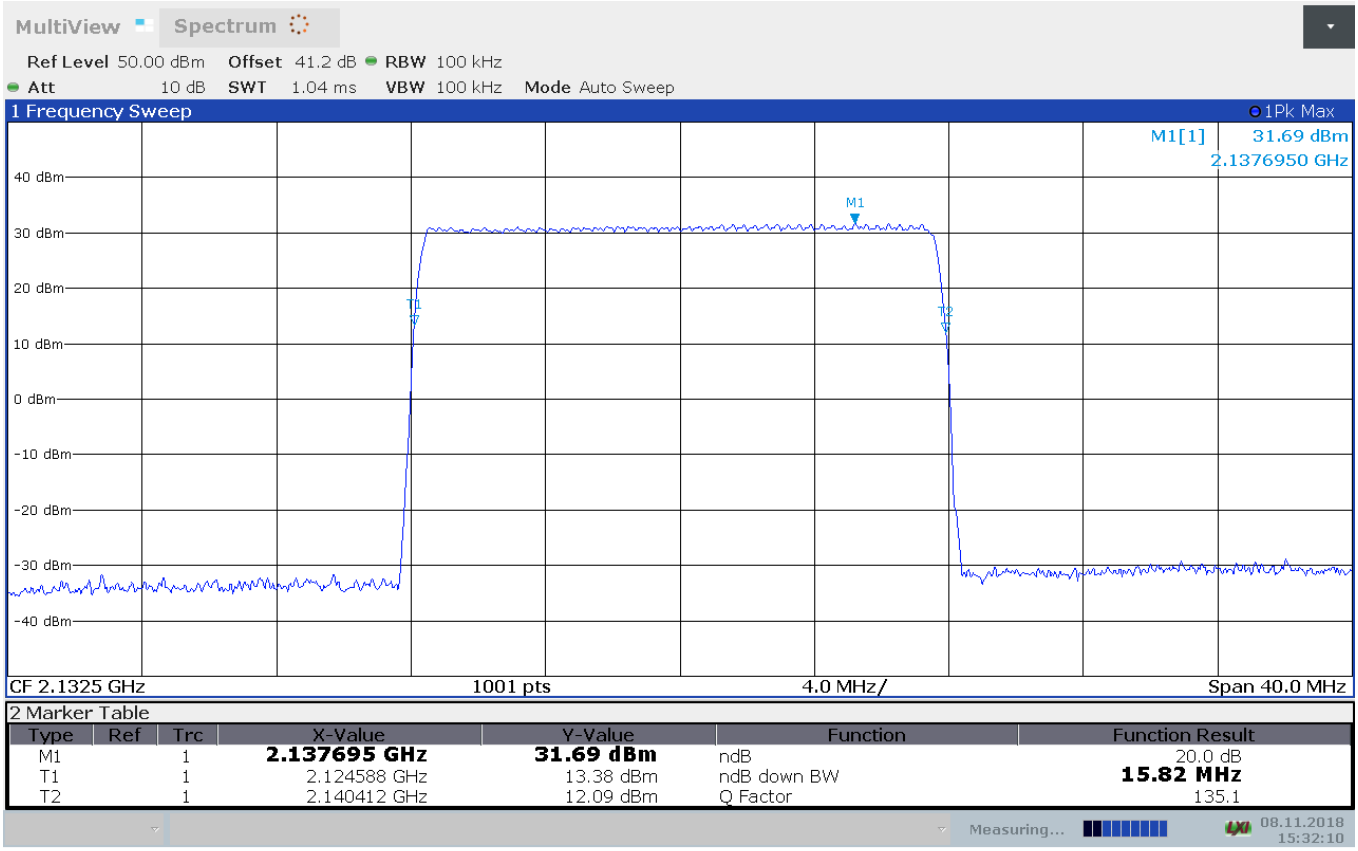

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Figure 8.2-2: *Passband DL*

8.3 RSS-131 5.2.2, KDB 935210 D05 3.4, Input-versus-output signal comparison

8.3.1 Definitions and limits

The spectral growth of the 26 dB bandwidth of the output signal shall be less than 5% of the input signal spectrum.

A 26 dB bandwidth measurement shall be performed on the input signal and the output signal; alternatively, the 99% OBW can be measured and used. See KDB Publication 971168 [R8] for more information on measuring OBW

8.3.2 Test summary

Test date	October 29, 2018	Temperature	22 °C
Test engineer	Kevin Rose	Air pressure	1001 mbar
Verdict	Pass	Relative humidity	32 %

8.3.3 Observations, settings and special notes

Frequency range	250% of OBW
Detector mode	Peak
Resolution bandwidth	1 % to 5 % of the anticipated OBW
Video bandwidth	>RBW
Trace mode	Max Hold

8.3.4 Test data

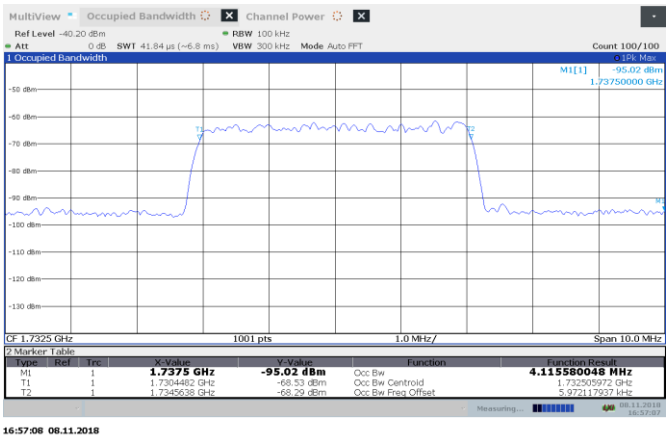

Figure 8.3-1: *AWGN AGC -0.5 dB 1732.5 MHz input 99% BW UL*

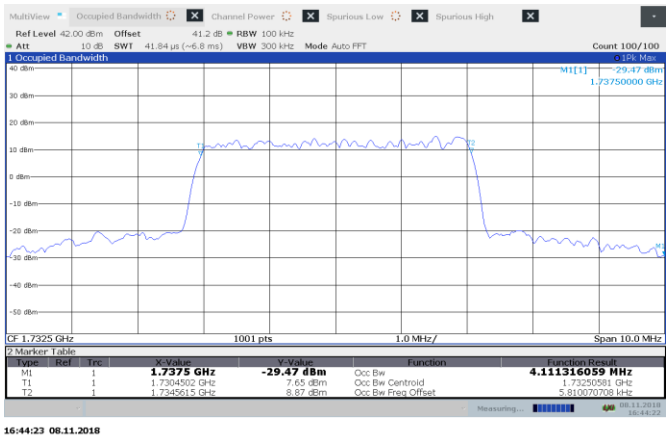

Figure 8.3-2: *AWGN AGC -0.5 dB 1732.5 MHz output 99% BW UL*

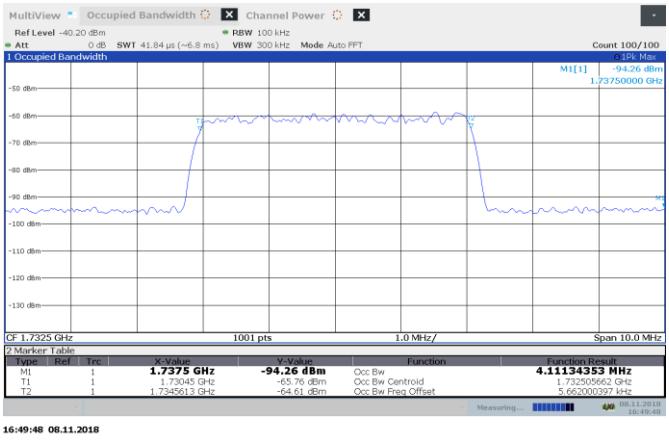

Figure 8.3-3: *AWGN AGC+3 dB 1732.5 MHz input 99% BW UL*

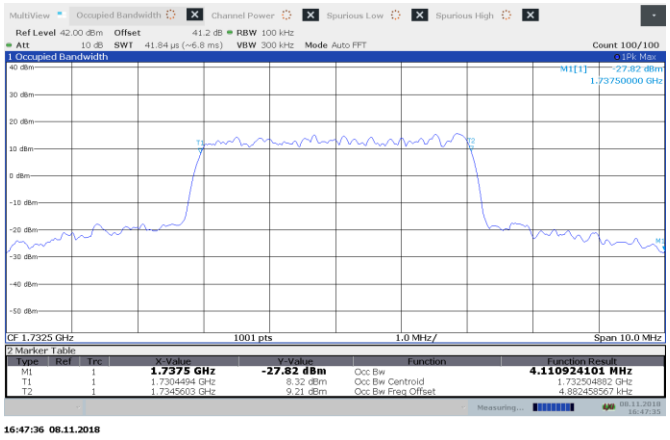

Figure 8.3-4: *AWGN AGC+-3 dB 1732.5 MHz output 99% BW UL*

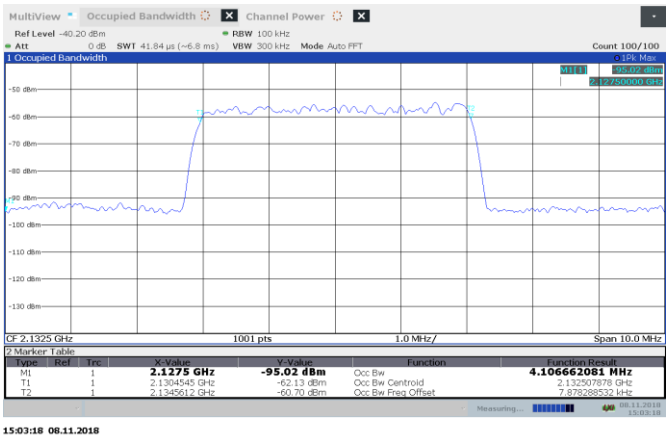

Figure 8.3-5: *AWGN AGC -0.5 dB 2132.5 MHz input 99% BW DL*

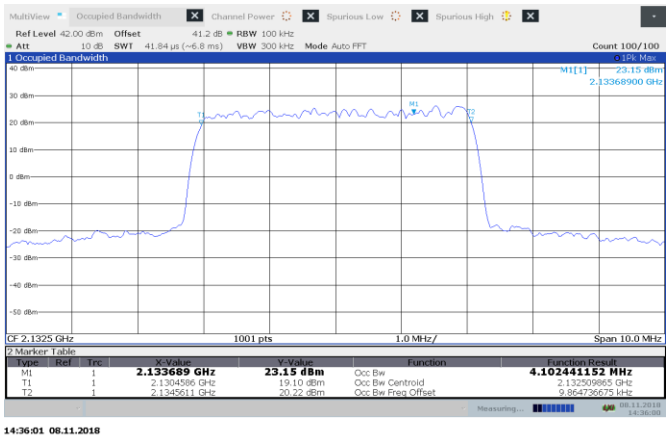

Figure 8.3-6: *AWGN AGC -0.5 dB 2132.5 MHz output 99% BW DL*

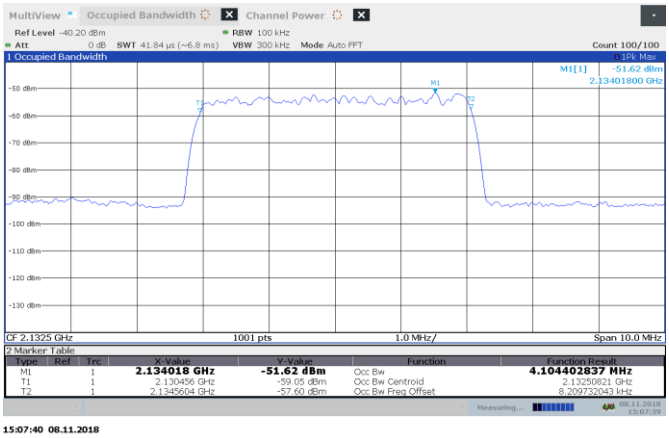

Figure 8.3-7: *AWGN AGC + 3dB 2132.5 MHz input 99% BW DL*

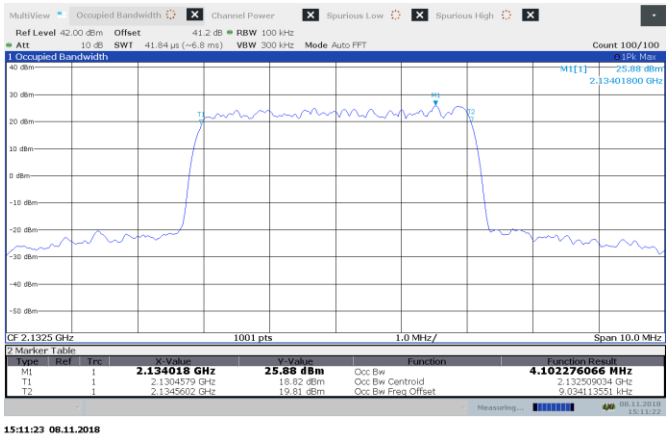

Figure 8.3-8: *AWGN AGC+-3 dB 2132.5 MHz output 99% BW DL*

8.4 FCC 27.50(d), RSS-131 5.2.3, RSS-139 6.5, KDB 935210 D05 3.5, Mean output power and amplifier/booster gain

8.4.1 Definitions and limits

FCC 27.50(d)
(1) 2110 – 2155 MHz, Low Density, 3280 W EIRP or 3280 W/MHz with an emission bandwidth > 1 MHz
(2) 2110 – 2155 MHz, High Density, 1640 W EIRP or 1640 W/MHz with an emission bandwidth > 1 MHz
(4) 1710 – 1755 MHz, 1 W EIRP
(5) The peak-to-average ratio (PAR) of the transmission may not exceed 13 dB

RSS-131 5.2.3
The zone enhancer gain shall not exceed the nominal gain by more than 1.0 dB. Outside of the 20 dB bandwidth, the gain shall not exceed the gain at the 20 dB point

RSS-139 6.5 refer to SRSP-513. In addition, the peak to average power ratio (PAPR) of the equipment shall not exceed 13 dB for more than 0.1% of the time, using a signal that corresponds to the highest PAPR during periods of continuous transmission.

8.4.2 Test summary

Test date	November 8, 2018	Temperature	22 °C
Test engineer	Kevin Rose	Air pressure	1001 mbar
Verdict	Pass	Relative humidity	32 %

8.4.3 Observations, settings and special notes

Detector mode	RMS (for average), Peak (for peak)
Resolution bandwidth	100 kHz
Integration bandwidth	>OBW
Video bandwidth	>RBW
Trace mode	Power Average (for average), Max Hold (for peak)
Measurement time	Auto

Table 8.4-1: *Output power results*

Frequency, MHz	RF output power Peak, dBm
1732.5	23.47
Gain = 84.68dB	PAR = 6.56
2132.5	31.62
Gain = 81.39dB	PAR = 6.56

8.5 FCC 27.53(h), RSS-139 6.6, KDB 935210 D05 3.6.2, Out-of-band/out-of-block emissions conducted measurements

8.5.1 Definitions and limits

FCC 27.53(h) / RSS-139 6.6 (1) The power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 log10 (P) dB.

8.5.2 Test summary

Test date	October 29, 2018	Temperature	22 °C
Test engineer	Kevin Rose	Air pressure	1001 mbar
Verdict	Pass	Relative humidity	32 %

8.5.3 Observations, settings and special notes

Test receiver settings:

Detector mode	RMS
Resolution bandwidth	3 kHz
Integration bandwidth	>OBW
Video bandwidth	>RBW
Trace mode	Power Average (100 sweeps)
Measurement time	Auto

8.5.4 Test data

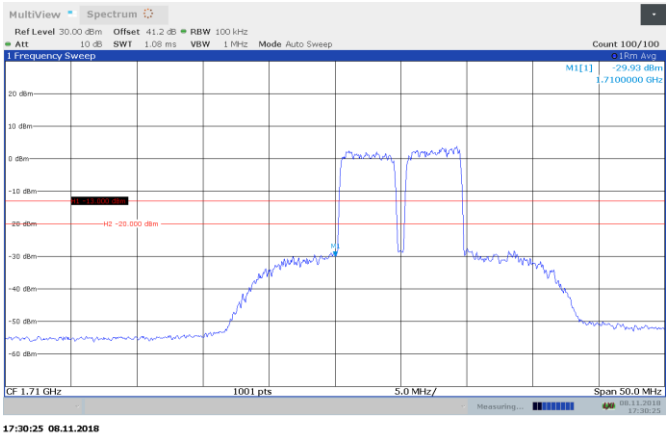

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Figure 8.5-1: *AWGN 1712.5 and1717.5 MHz AGC - 0.5dB Out-of-block UL*

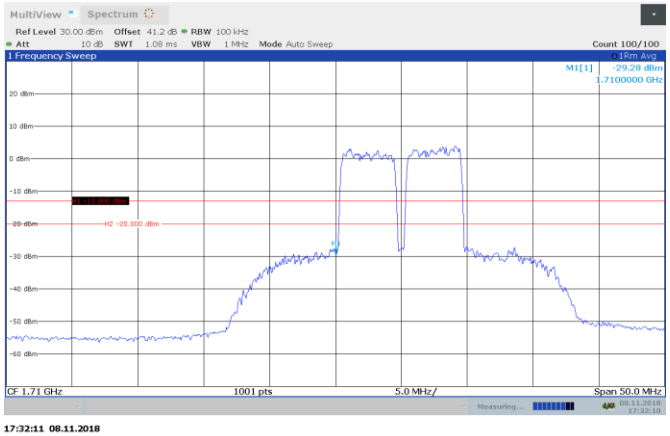

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Figure 8.5-2: *AWGN 1712.5 and1717.5 MHz AGC + 3dB Out-of-block UL*

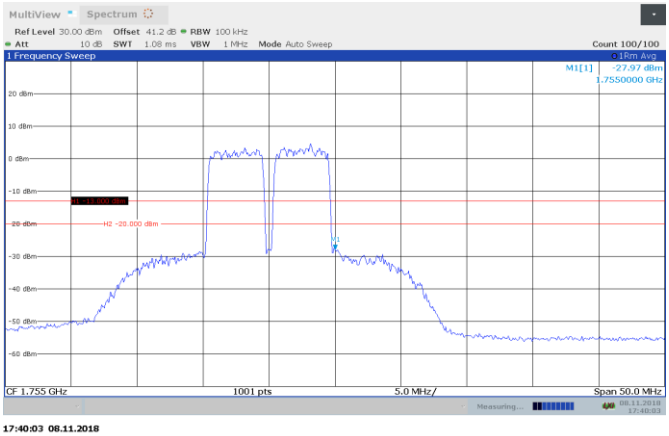

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Figure 8.5-3: *AWGN 1747.5 and 1752.5 MHz AGC – 0.5dB Out-of-block UL*

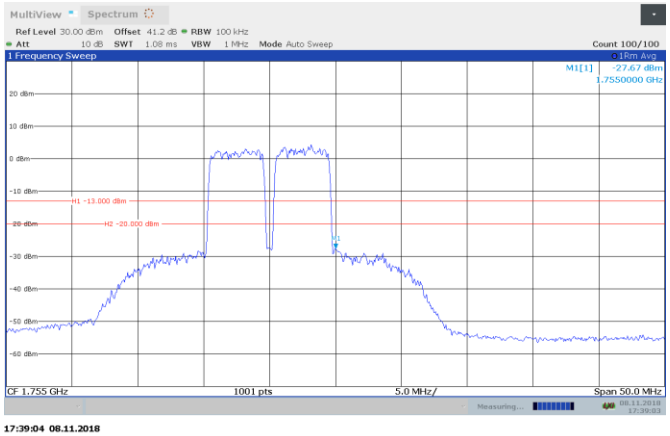

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Figure 8.5-4: *AWGN 1747.5 and 1752.5 MHz AGC + 3dB Out-of-block UL*

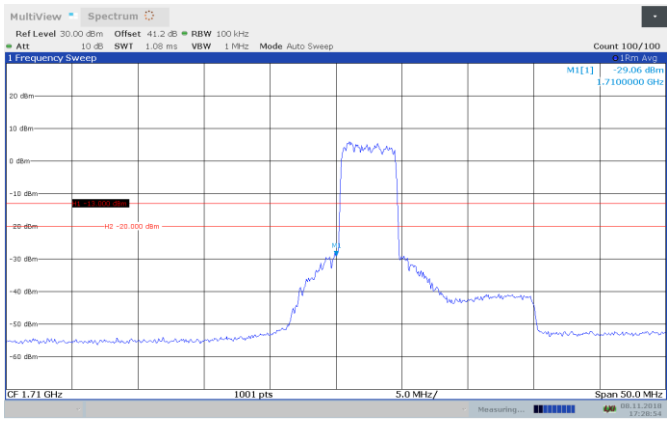

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Figure 8.5-5: *AWGN 1712.5 MHz AGC - 0.5dB Out-of-block UL*

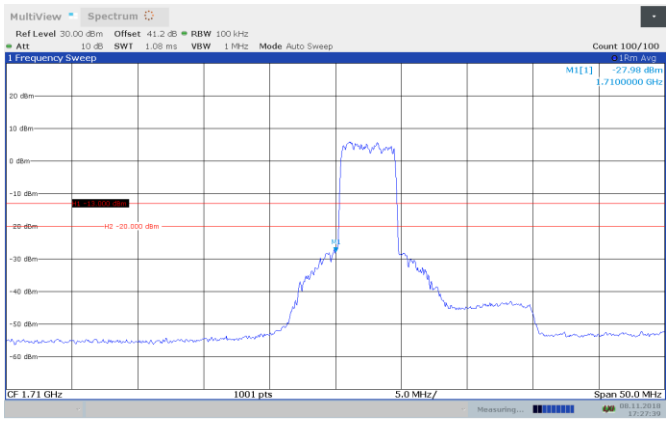

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Figure 8.5-6: *AWGN 1712.5 MHz AGC + 3dB Out-of-block UL*

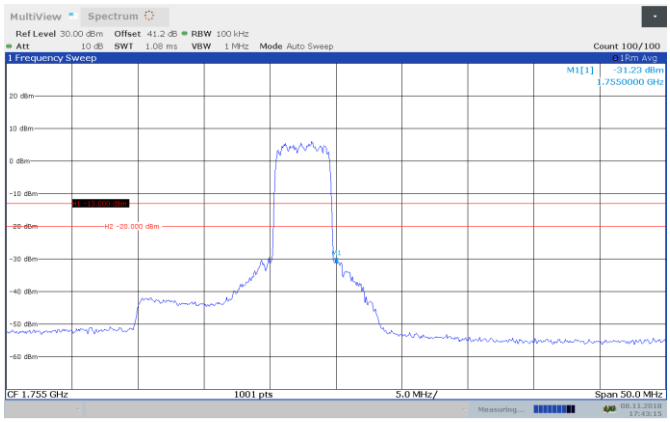

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Figure 8.5-7: *AWGN 1752.5 MHz AGC – 0.5dB Out-of-block UL*

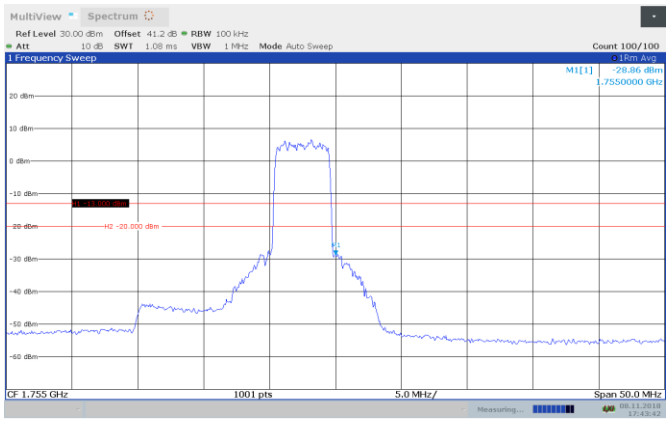

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Figure 8.5-8: *AWGN 1752.5 MHz AGC + 3dB Out-of-block UL*

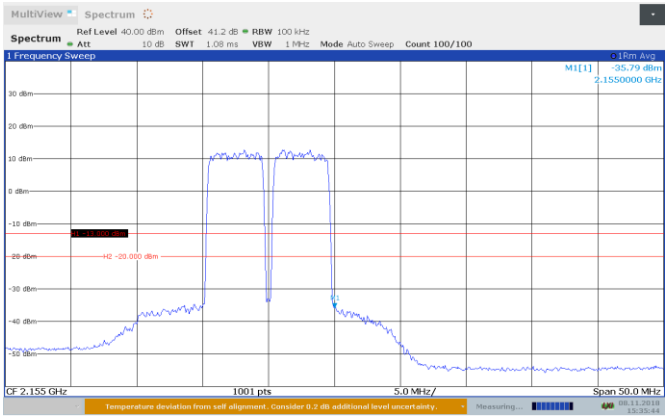

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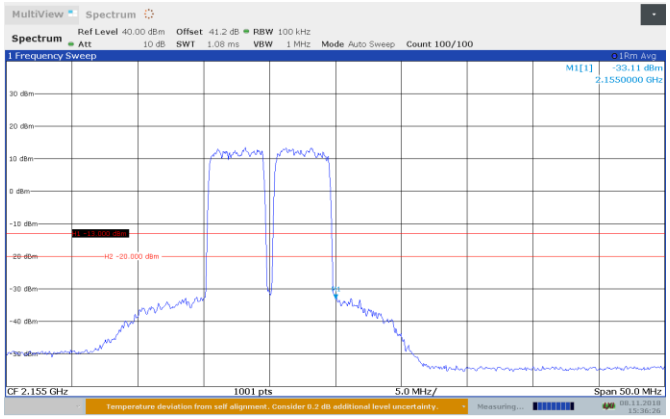
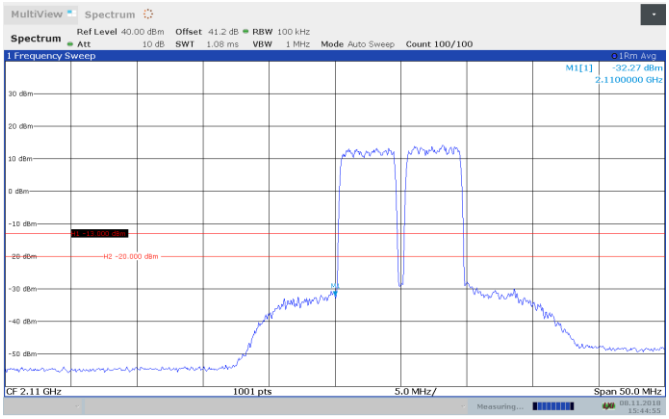
Figure 8.5-9: *AWGN 2147.5 and2152.5 MHz AGC - 0.5dB Out-of-block DL*



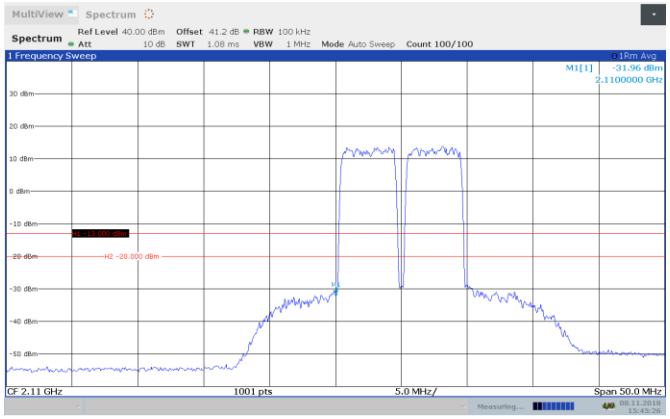
15:36:27 08.11.2018

Figure 8.5-10: *AWGN 1987.5 and1992.5 MHz AGC + 3dB Out-of-block DL*



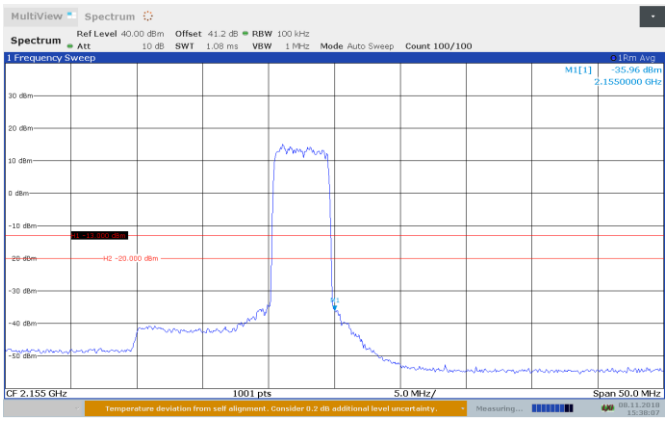
15:44:56 08.11.2018

Figure 8.5-11: *AWGN 2112.5 and 2117.5 MHz AGC – 0.5dB Out-of-block DL*



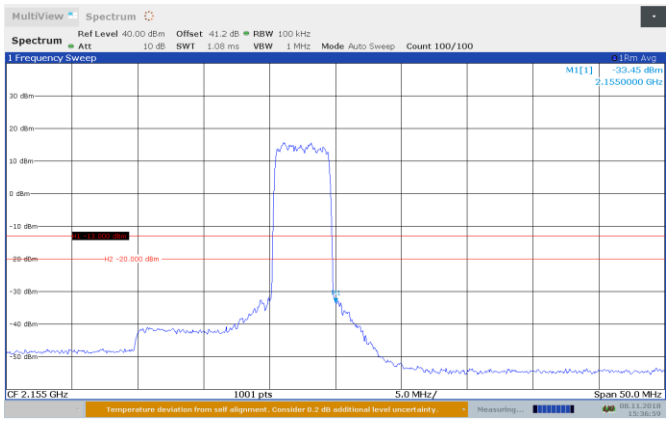
15:45:26 08.11.2018

Figure 8.5-12: *AWGN 2112.5 and 2117.5 MHz AGC + 3dB Out-of-block DL*



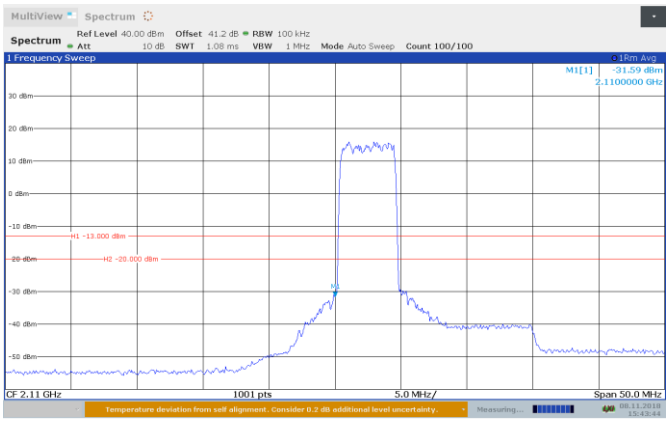
15:38:07 08.11.2018

Figure 8.5-13: *AWGN 2152.5 MHz AGC - 0.5dB Out-of-block DL*



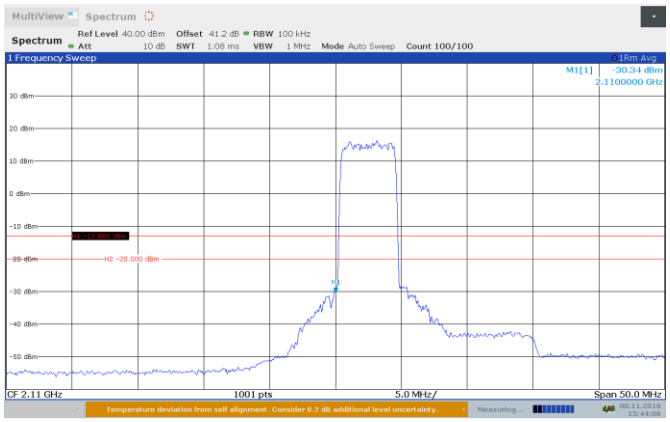
15:37:00 08.11.2018

Figure 8.5-14: *AWGN 2152.5 MHz AGC+ 3dB Out-of-block DL*



15:43:45 08.11.2018

Figure 8.5-15: *AWGN 2112.5 MHz AGC – 0.5dB Out-of-block DL*



15:44:08 08.11.2018

Figure 8.5-16: *AWGN 2112.5 MHz AGC + 3dB Out-of-block DL*

8.6 FCC 27.53(h), RSS-139 6.6, KDB 935210 D05 3.6.3, Spurious emissions conducted measurements

FCC 27.53(h) / RSS-139 6.6 (1) The power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 log10 (P) dB.

8.6.1 Test summary

Test date	November 8, 2018	Temperature	21 °C
Test engineer	Kevin Rose	Air pressure	1000 mbar
Verdict	Pass	Relative humidity	42 %

8.6.2 Observations, settings and special notes

Frequency range	30 MHz to 10th harmonic
Detector mode	Peak
Resolution bandwidth sweep	100 kHz (below 1 GHz), 1000 kHz (above 1 GHz)
Video bandwidth	>RBW
Trace mode	Max Hold
Measurement time	Auto

8.6.3 Test data

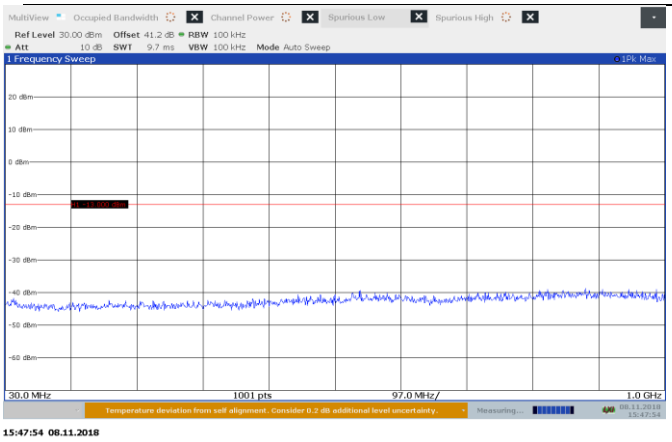


Figure 8.6-1: *AWGN 2112.5 MHz conducted emission DL 30 – 1000MHz*

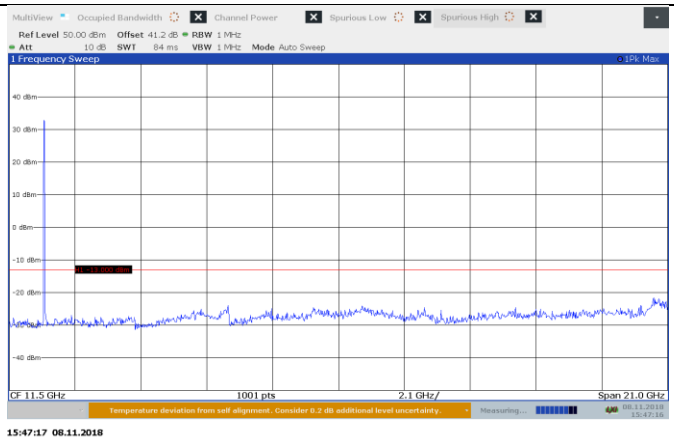


Figure 8.6-2: *AWGN 2112.5 MHz conducted emission DL 1-22GHz*

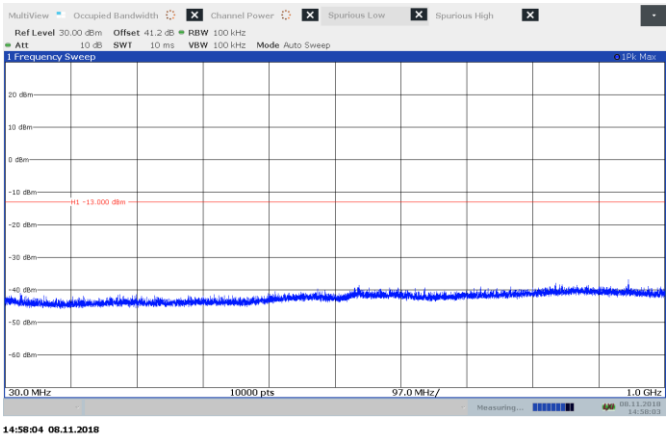


Figure 8.6-3: *AWGN 2132.5 MHz conducted emission DL 30 – 1000MHz*

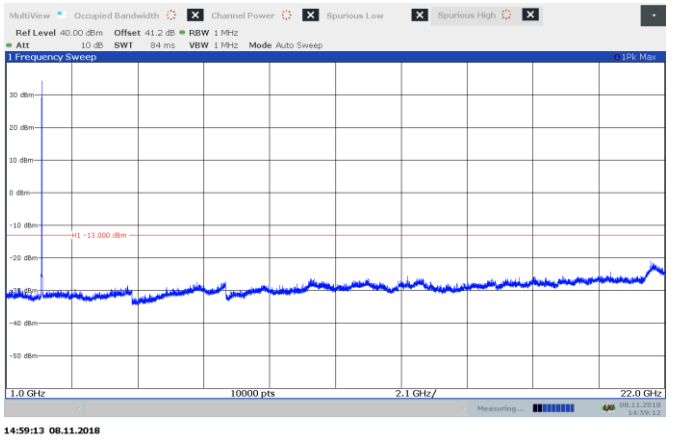


Figure 8.6-4: *AWGN 2132.5 MHz conducted emission DL 1-22GHz*

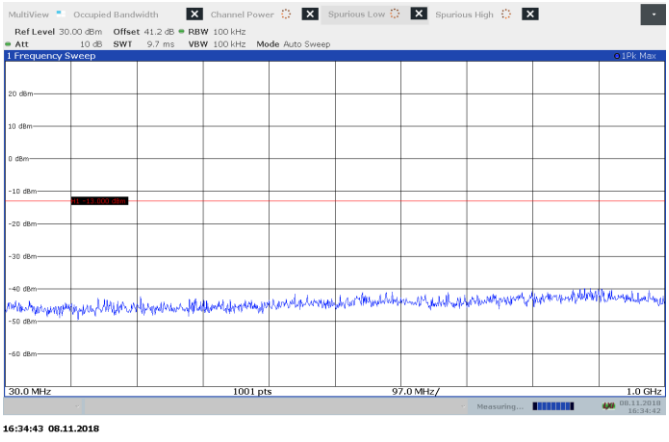


Figure 8.6-5: *AWGN 2152.5 MHz conducted emission DL 30 – 1000MHz*

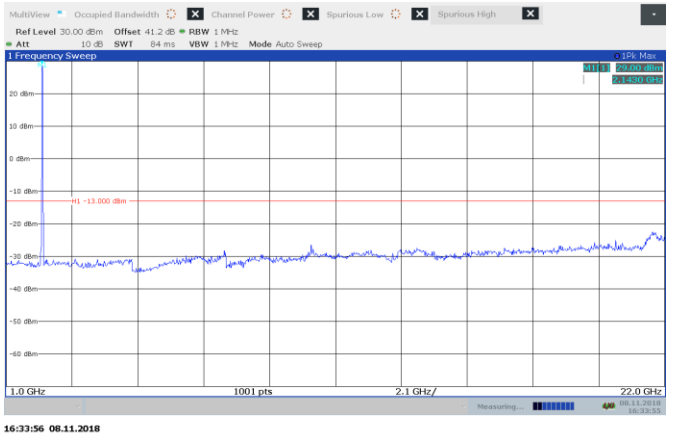


Figure 8.6-6: *AWGN 2152.5 MHz conducted emission DL 1-22GHz*

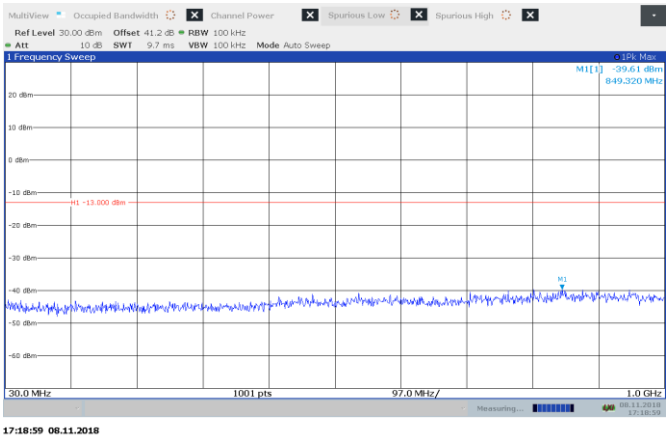


Figure 8.6-7: *AWGN 1712.5 MHz conducted emission UL 30 – 1000MHz*

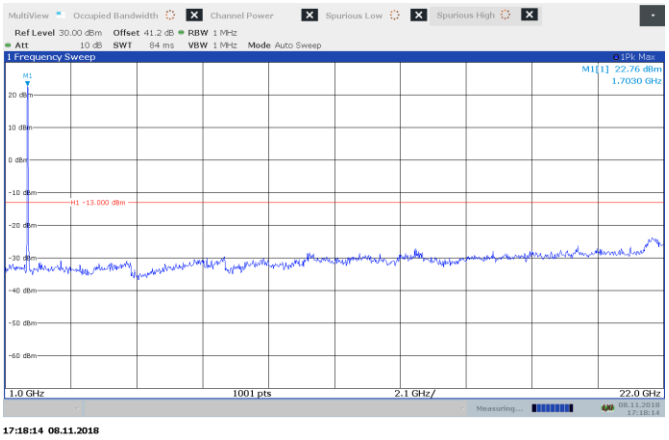


Figure 8.6-8: *AWGN 1712.5 MHz conducted emission UL 1-22GHz*

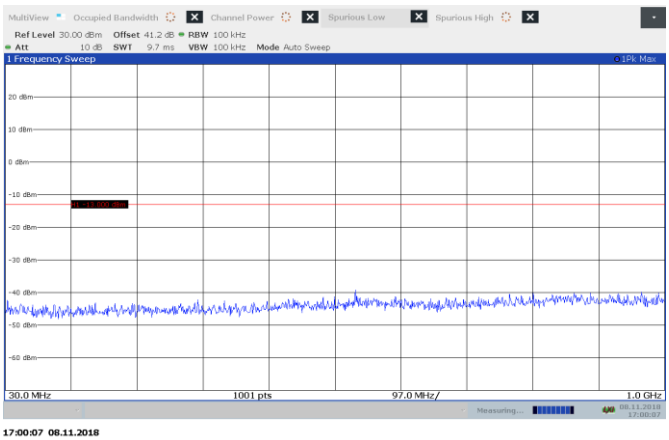


Figure 8.6-9: *AWGN 1732.5 MHz conducted emission UL 30 – 1000MHz*

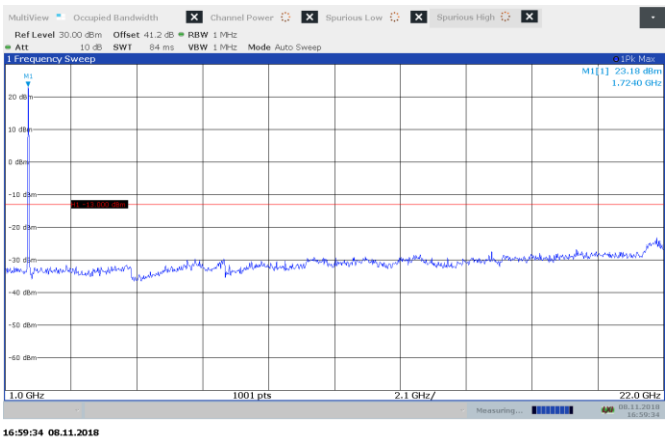


Figure 8.6-10: *AWGN 1732.5 MHz conducted emission UL 1-22GHz*

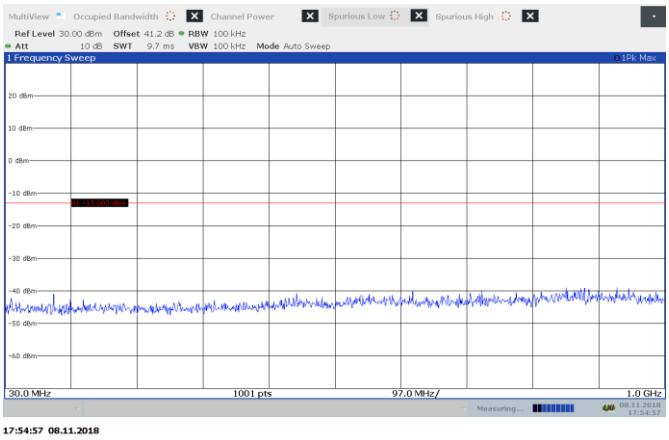


Figure 8.6-11: *AWGN 1752.5 MHz conducted emission UL 30 – 1000MHz*

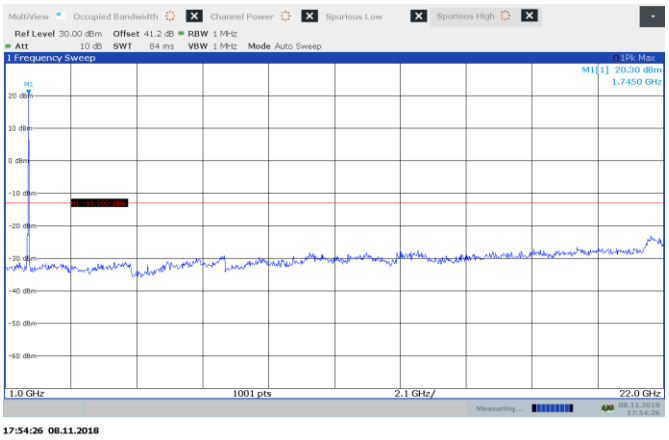


Figure 8.6-12: *AWGN 1752.5 MHz conducted emission UL 1-22GHz*

8.7 FCC 27.53(h), RSS-139 6.6, KDB 935210 D05 3.8, Spurious emissions radiated measurements

8.7.1 Definitions and limits

FCC 27.53(h) / RSS-139 6.6 (1) The power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 log10 (P) dB.

8.7.2 Test summary

Test date	June 27, 2018	Temperature	21 °C
Test engineer	Kevin Rose	Air pressure	1000 mbar
Verdict	Pass	Relative humidity	42 %

8.7.3 Observations, settings and special notes

Worst case examples are provided. No emssions within 20 dB of the limit were detected.

Receiver settings were:

Frequency range	30 MHz to 10th harmonic
Detector mode	Peak
Resolution bandwidth	100 kHz (below 1 GHz), 1000 kHz (above 1 GHz)
Video bandwidth	>RBW
Trace mode	Max Hold

8.7.4 Test data

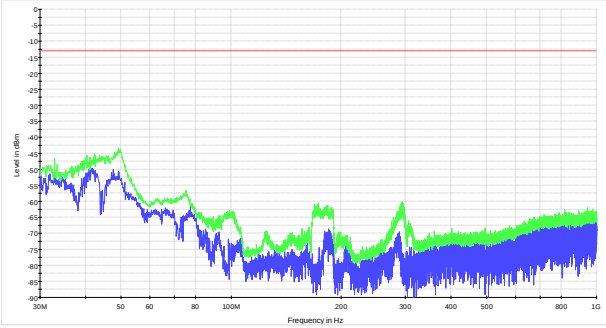


Figure 8.7-1: *30 MHz to 1 GHz Radiated*

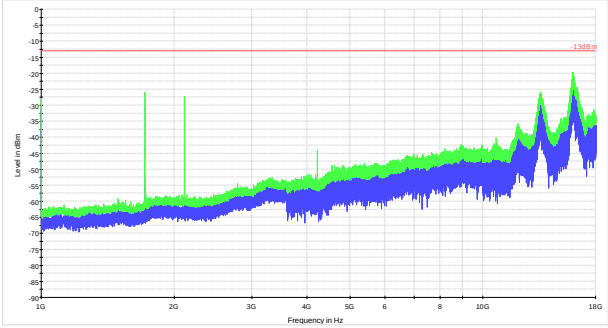


Figure 8.7-2: *1GHz to 18 GHz Radiated*

Section 9. Setup Photos

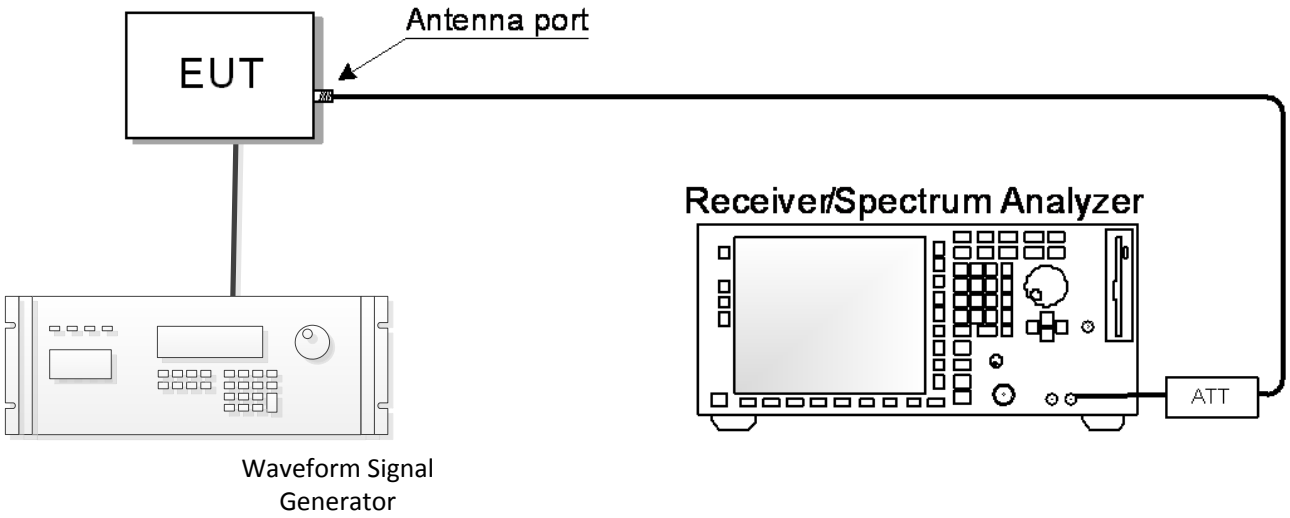
9.1 Set-up

Figure 9.1-1: *Radiated setup photo*

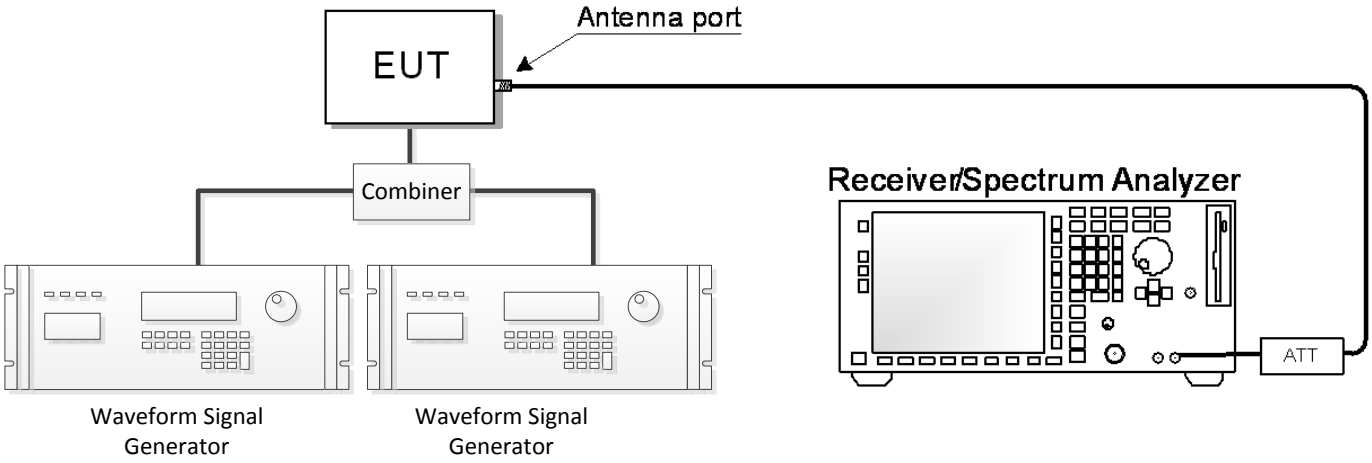
Figure 9.1-2: *Conducted setup photo*

Section 10. Block diagrams of test set-ups

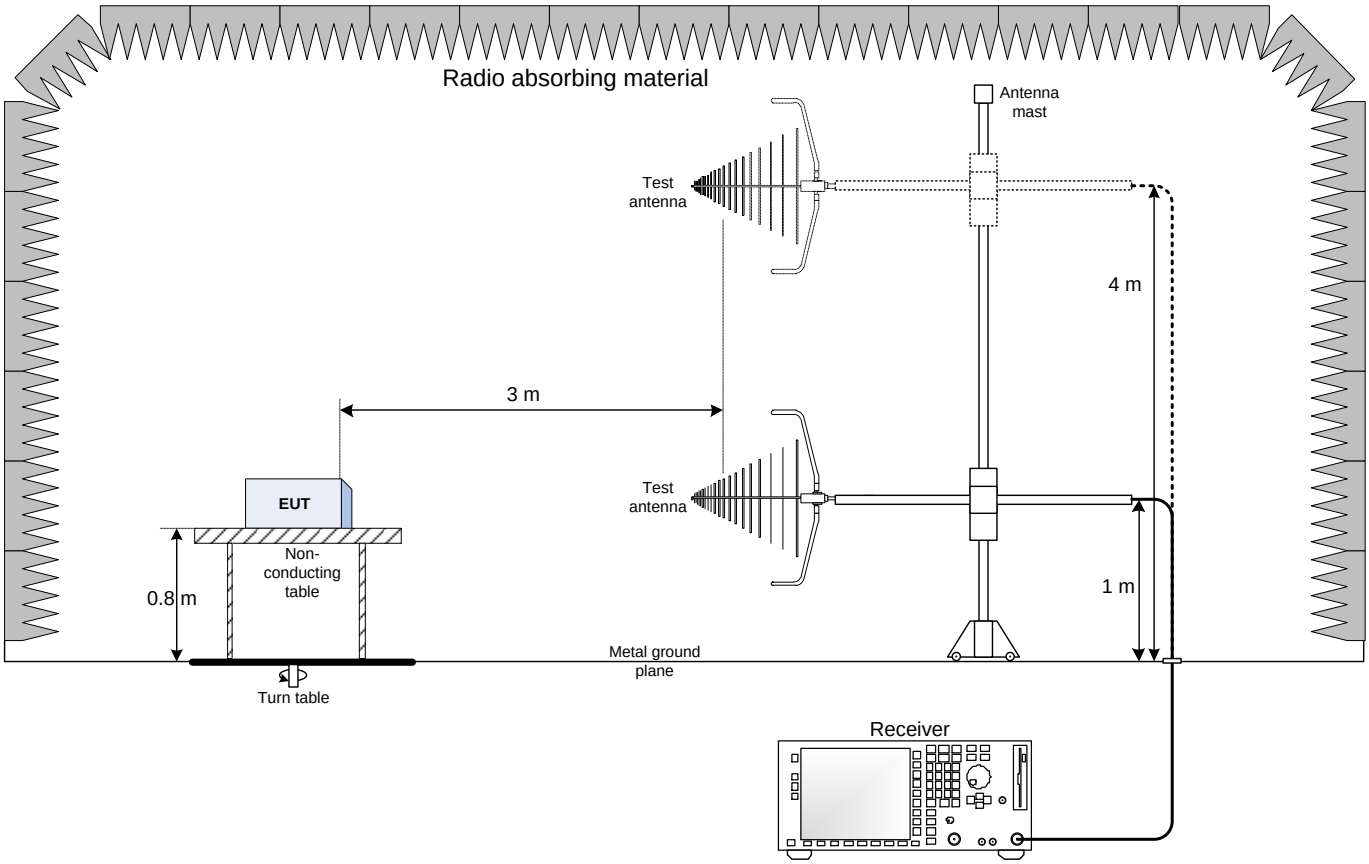
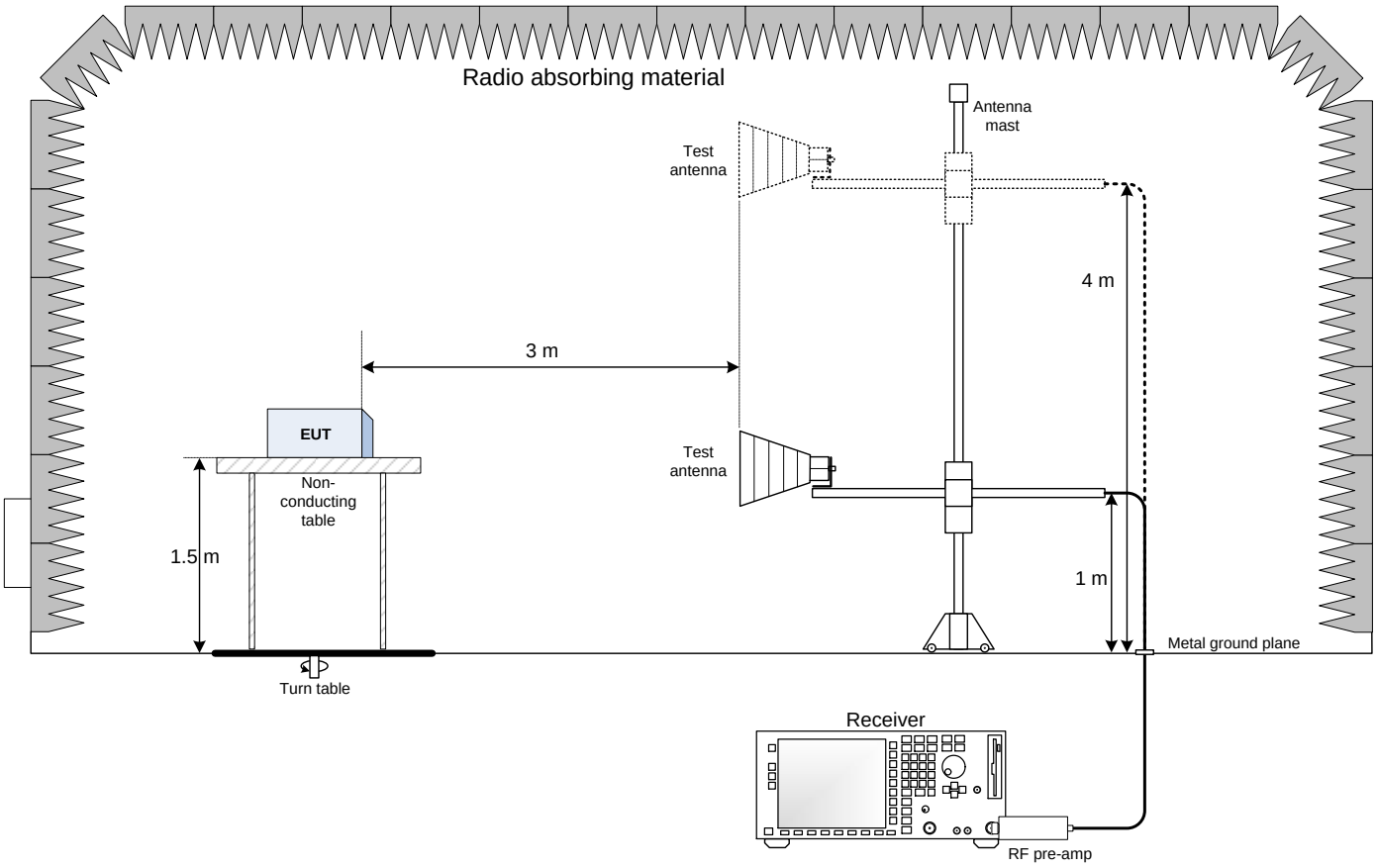
10.1 Measuring AGC threshold level, Out-of-band-rejection, Input-versus-output signal comparison, Mean output power and amplifier/booster gain, Spurious emissions conducted measurements



10.2 Out-of-band/out-of-block emissions conducted measurements (intermodulation test)



10.3 Spurious emissions radiated measurements



10.4 Spurious emissions radiated measurements (above 1GHz)