Test report for

47 CFR Part 15 Subpart B

ICES-Gen, ICES-003

Product name	: Jlink Pro Plus
Applicant	: JOZ B.V
FCC ID	: 2BGQ2JLINK
IC	: 32602-JLINK

Test report No. : P000394690 001 Ver 2.0

Laboratory information

Accreditation

Kiwa Nederland B.V. complies with the accreditation criteria for test laboratories as laid down in ISO/IEC 17025:2017. The accreditation covers the quality system of the laboratory as well as the specific activities as described in the authorized annex bearing the accreditation number L248 and is granted by the Dutch Council For Accreditation (RvA: Raad voor Accreditatie).

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Documentation

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Testing Location

Test Site	Kiwa Nederland B.V.
Test Site location	Wilmersdorf 50 7327 AC Apeldoorn The Netherlands Tel. +31 88998 3393
Test Site FCC	NL0001
CABID	NL0001

Revision History

Version	Date	Remarks	By
v0.50	13-09-2024	First draft	TK
v1.00	18-09-2024	Final release	TK
V2.00	20-11-2024	Adjustments based on assessor comments	TK

Table of Contents

Summary of Test results

FCC	ISED	Description	Section in report	Verdict
15.109 (a)	ICES-003 Table 2	Radiated spurious emissions < 1GHz	3.1	Pass
15.109 (a)	ICES-003 Table 4	Radiated spurious emissions > 1GHz	3.2	Pass
15.107 (c)	ICES-003 Table 1	AC power-line conducted emissions	3.3	Pass

Decision rule: Pass/Fail decisions are based on measurement results without taking into account measurement uncertainty.

1 General Description

1.1 Applicant

Client name:	JOZ B.V.
Address:	Industrieweg 5, Westwoud
Zip code:	1617 KK
Country:	The Netherlands
Telephone:	+31 228566500
E-mail:	barath.kumar@joz.nl

1.2 Manufacturer

Manufacturer name:	JOZ B.V.
Address:	Industrieweg 5, Westwoud
Zip code:	1617 KK
Country:	The Netherlands
Telephone:	+31 228566500
E-mail:	barath.kumar@joz.nl

1.3 Tested Equipment Under Test (EUT)

Product name:	Jlink Pro Plus
Brand name:	JOZ B.V.
FCC ID:	2BGQ2JLINK
IC:	32602-JLINK
Product type:	Access point
Model(s):	N.A.
Batch and/or serial No.	20900643
Software version:	3.7.11
Hardware version:	A
Date of receipt	17-04-2024
Tests started:	29-07-2024
Testing ended:	31-07-2024

Auxiliary items

AUX1

Product name:	Power supply for EUT
Brand name:	MEAN WELL
Product type:	AC/DC switching adapter
Model(s):	GST40A24-TI
Batch and/or serial No.	SC33430536
Remarks:	Connects to EUT

AUX2

Product name:	Notebook
Brand name:	Lenovo
Product type:	Laptop
Model(s):	Thinkbook 15 G2 ITL
Batch and/or serial No.	--
Remarks:	Connects to EUT Ethernet port, property test lab

1.4 Product specifications of Equipment under test

Zigbee	DIGI	XB3-24Z8UM-J
WiFi	Murata	LBEE5KL1DX-883

Disclaimer: above info is declared by the applicant

The EUT is considered as a Class B device.
Highest internal frequency is 2480MHz.

1.5 Environmental conditions

Test date	29-07-2024	30-07-2024	31-07-2024
Ambient temperature	21.4°C	22.4°C	22.9°C
Humidity	59%	60%	59.3%

1.6 Measurement standards

- ANSI C63.4:2014

1.7 Applicable standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart B
- ICES-003 Issue 7
- ICES-Gen Issue 2

1.8 Observation and remarks

The worst case orientation for spurious emissions of the EUT was used, this is with the back of the EUT on the table. A link from the notebook to the EUT was established using the ethernet cable. This ethernet cable went into the semi anechoic room via optic fibre.

1.9 Conclusions

The sample of the product showed **NO NON-COMPLIANCES** to the specifications stated in paragraph 1.8 of this report.

The results of the test as stated in this report, are exclusively applicable to the product items as identified in this report. Kiwa Nederland B.V. accepts no responsibility for any properties of product items in this test report, which are not supported by the tests as specified in paragraph 1.8 *"Applicable standards".*

All tests are performed by:

Name : Paul van Wanrooij, BASc

Review of test methods and report by:

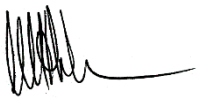
Name : ing. R. van Barneveld

The above conclusions have been verified by the following signatory:

Date : 03-12-2024

Name : ing. M.H. Khan

Function : Test Engineer

Signature : 

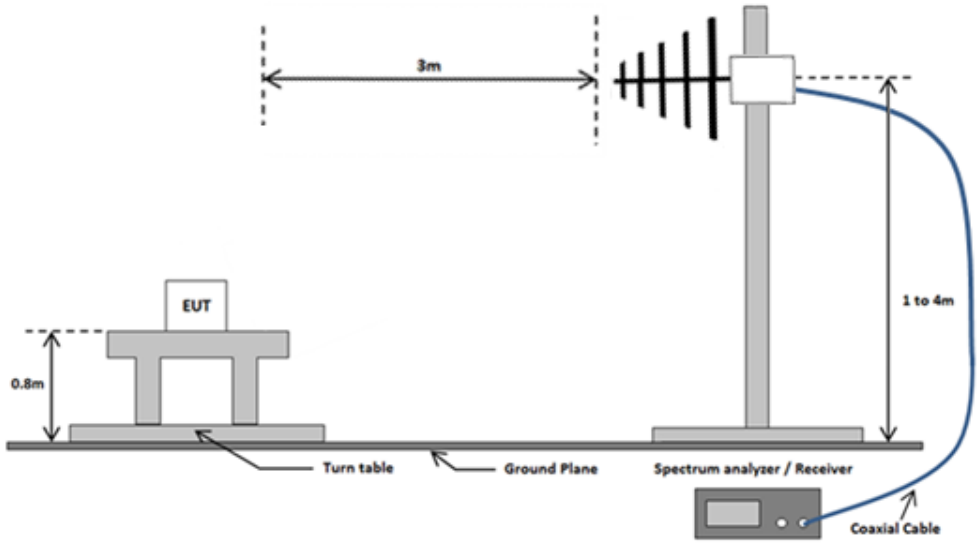
2 Test configuration of the Equipment Under Test

2.1 Test mode

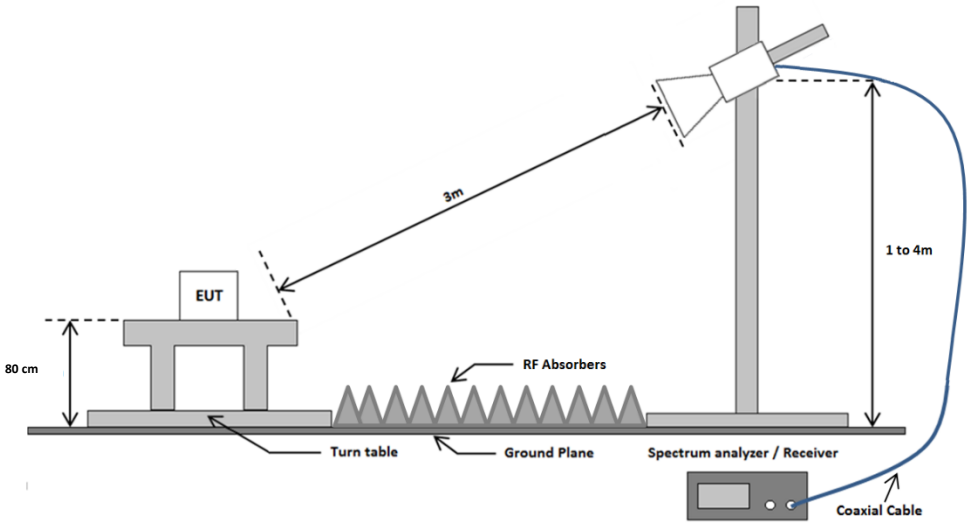
The EUT was plugged into a 110V 60Hz AC power plug, running the control board. The Zigbee and Wlan modules on the device were turned off.

2.2 Test setups

2.2.1 Radiated emissions test setup 30 MHz - 1 GHz

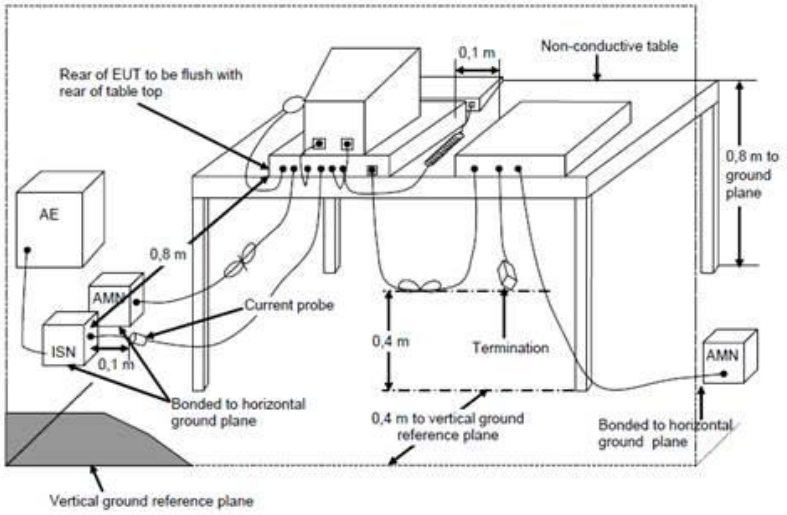


2.2.2 Radiated emissions test setup above 1 GHz



2.2.3 AC Power line conducted emissions test setup

Emissions test at AC mains



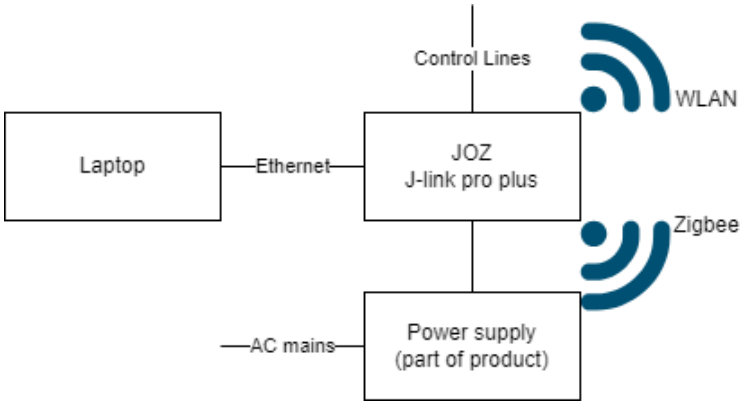


Figure 1. EUT and auxiliary setup

List of used cables					
Number	**Function**	**From**	**To**	**Length**	**Remarks**
1	AC Power	mains 120Vac 60 Hz	AUX1 & AUX2	< 3m	-
2	Ethernet	EUT	AUX2	<3m	-

2.3 Test methodology.

The test methodology used is based on the requirements of 47 CFR Part 15, sections 15.31, 15.107 and 15.109, ICES-003 and ICES-Gen. The test methods, which have been used, are based on ANSI C63.4-2014.

2.4 Equipment modifications.

No modifications have been made to the equipment.

2.5 Equipment used in the test configuration

Description	Manufacturer	Model	ID	Cal. Done date	Cal. due date	Used at Par.
EMI Receiver	Rohde & Schwarz	ESR7	114870	09-2022	09-2024	3.3
EMI Receiver	Rohde & Schwarz	ESR7	114605	07-2022	31-07-2024	3.1
Spectrum Analyzer	Rohde & Schwarz	FSV3044	114923	10-2023	10-2025	3.2
Biconical antenna + 6dB attenuator	EMCO	3146	107818	06-2022	06-2025	3.1
Cable 1-40GHz	--	--	114691	--	--	3.2
Cable 30-1000MHz	--	--	114928	--	--	3.1
Logperiodic antenna	EMCO	3147	114385	02-2021	02-2026	3.1
Horn antenna	EMCO	3115	114607	01-2021	01-2025	3.2
Preamplifier 1-18 GHz	µComp Nordic	MCNA-40-0010800-25-10P	114690	08-2024	08-2026	3.2
Test software	Raditeq	Radimation Version 2023.2.3	--	--	--	3.1, 3.2, 3.3
Semi-Anechoic Chamber	ETS Lindgren	SAR	114624	03-2023	03-2026	3.1, 3.2
LISN /Two line V-network	Rohde & Schwarz	ENV 216	114379	11-2023	11-2025	3.3

*Note: Standard gain horn antennas do not need calibration
Conformance of the used measurement and test equipment with the requirements of ISO/IEC 17025:2017 has been confirmed before testing.
NA= Not Applicable

2.6 Sample calculations

All formulas for data conversions and conversion factors are reported in chapter 4 of this test report.

3 Test results

3.1 Radiated spurious emissions

3.1.1 Limit

Except for Class A digital devices, the field strength of radiated emissions from an unintentional radiator shall not exceed the field strength levels specified in the following tables.
On any frequency or frequencies below or equal to 1000 MHz, the limits shown are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths, unless otherwise specified.
Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function.
When average radiated emission measurements are specified in this part, there is also a limit on the peak level of the emissions. Unless otherwise specified, the limit on peak emissions is 20 dB above the average limit.
The product under test shall comply with both the average and the peak limits.

ICES-003 Issue 7 section 3.2.2
The quasi-peak limits for the electric component of the radiated field strength emitted from ITE or digital apparatus, within 30 MHz to 1 GHz, for a measurement distance of 3m are presented in table below.
At and above 1 GHz, except for outdoor units of home satellite receiving systems, the ITE or digital apparatus shall comply with the limits specified in table below up to the frequency F_M, which shall be determined. The product under test shall comply with both the average and the peak limits.

FCC 15.109(a)

Frequency (MHz)	Field strength (µV/meter)	Field strength (dBµV/m)	Measurement distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

ICES-003 tables 2, 4

Frequency (MHz)	Field strength (dBµV/m)	Measurement distance (meters)
30-88	40.0	3
88-216	43.5	3
216-230	46.0	3
230 -960	47.0	3
Above 960	54.0	3

3.1.2 Measurement instruments

The measurement instruments are listed in chapter 2.5 of this report.

3.1.3 Test setup

The test setup is as shown in chapter 2.2.1 and 2.2.2 of this report.

3.1.4 Test procedure

30 MHz to 18 GHz: According to ANSI C63.4-2014, section 8.3

30 MHz to 1 GHz: IRN 441 – Method 1
1 GHz to 18 GHz: IRN 441 – Method 2

In case of handheld and/or body-worn equipment, the EUT's orientation (X, Y, Z) was varied in order to ensure that maximum emission amplitudes were attained. In all other cases the associated cabling and the EUT orientation was varied for maximum emissions.

The spectrum was examined from 30MHz to the highest measurement frequency according to the table below. Final radiated emission measurements were made at 3m distance.

Highest internal frequency (F_X) [i]	Highest measurement frequency (F_M)
$F_X \leq 108$ MHz	1 GHz
108 MHz < $F_X \leq 500$ MHz	2 GHz
500 MHz < $F_X \leq 1$ GHz	5 GHz
$F_X > 1$ GHz	5 x F_X up to a maximum of 40 GHz
i. F_X is the highest fundamental frequency generated and/or used in the ITE or digital apparatus under test.	

The 6 highest emission amplitudes relative to the appropriate limit were recorded in this report. Field strength values of radiated emissions at frequencies not listed in the tables are more than 20 dB below the applicable limit.

3.1.5 Measurement Uncertainty

Frequency range	Polarization	Uncertainty
30 – 200 MHz	Horizontal	±4.5 dB
	Vertical	±5.4 dB
200 -1000 MHz	Horizontal	±3.6 dB
	Vertical	±4.6 dB
1 – 18 GHz	Horizontal	±5.7 dB
	Vertical	±5.7 dB

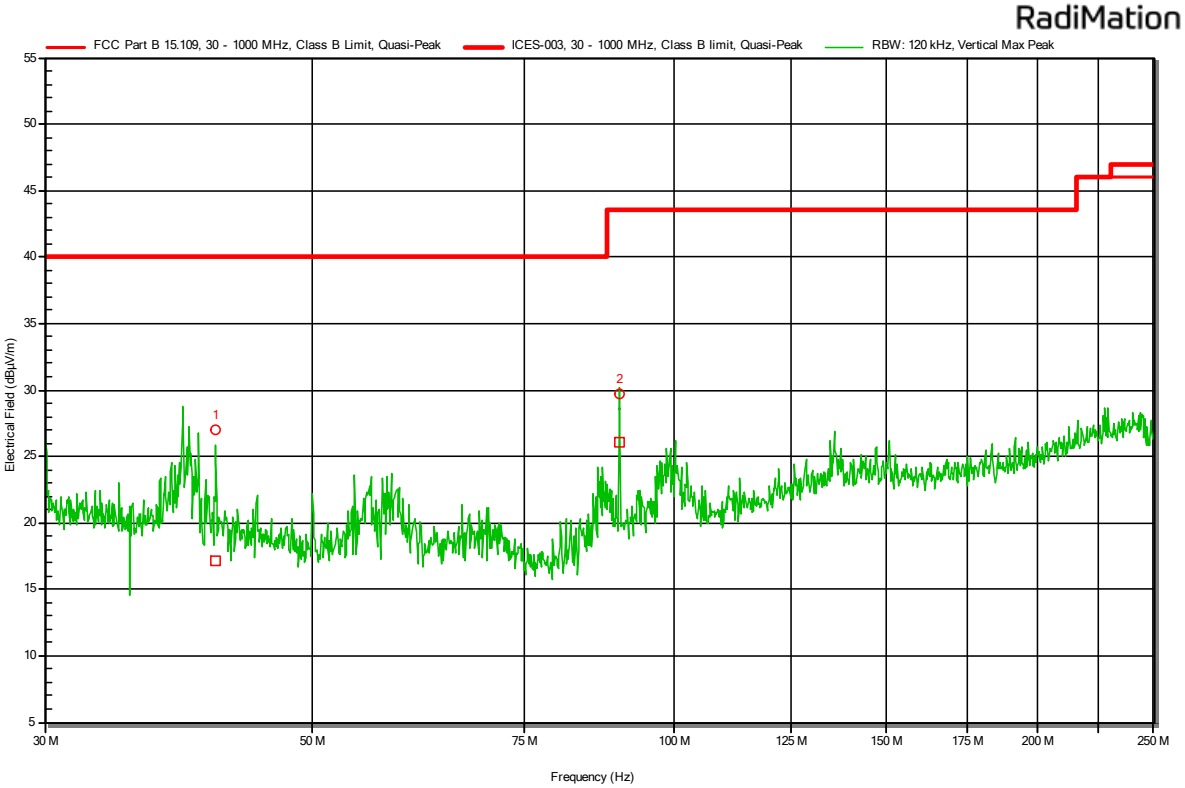
3.1.6 Test results

Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Limit	Status	Height	Polarization
1	41.598 MHz	27 dBµV/m	17.2 dBµV/m	40 dBµV/m	Pass	1 m	Vertical
2	90.002 MHz	29.8 dBµV/m	26.1 dBµV/m	43.5 dBµV/m	Pass	1.5 m	Vertical
3	544.488 MHz	44.4 dBµV/m	40.1 dBµV/m	46 dBµV/m	Pass	1 m	Vertical
4	296.994 MHz	32.5 dBµV/m	26.7 dBµV/m	46 dBµV/m	Pass	1 m	Horizontal
5	544.534 MHz	41.4 dBµV/m	35.3 dBµV/m	46 dBµV/m	Pass	1.5 m	Horizontal
6	544.481 MHz	44.1 dBµV/m	40.2 dBµV/m	46 dBµV/m	Pass	1 m	Vertical

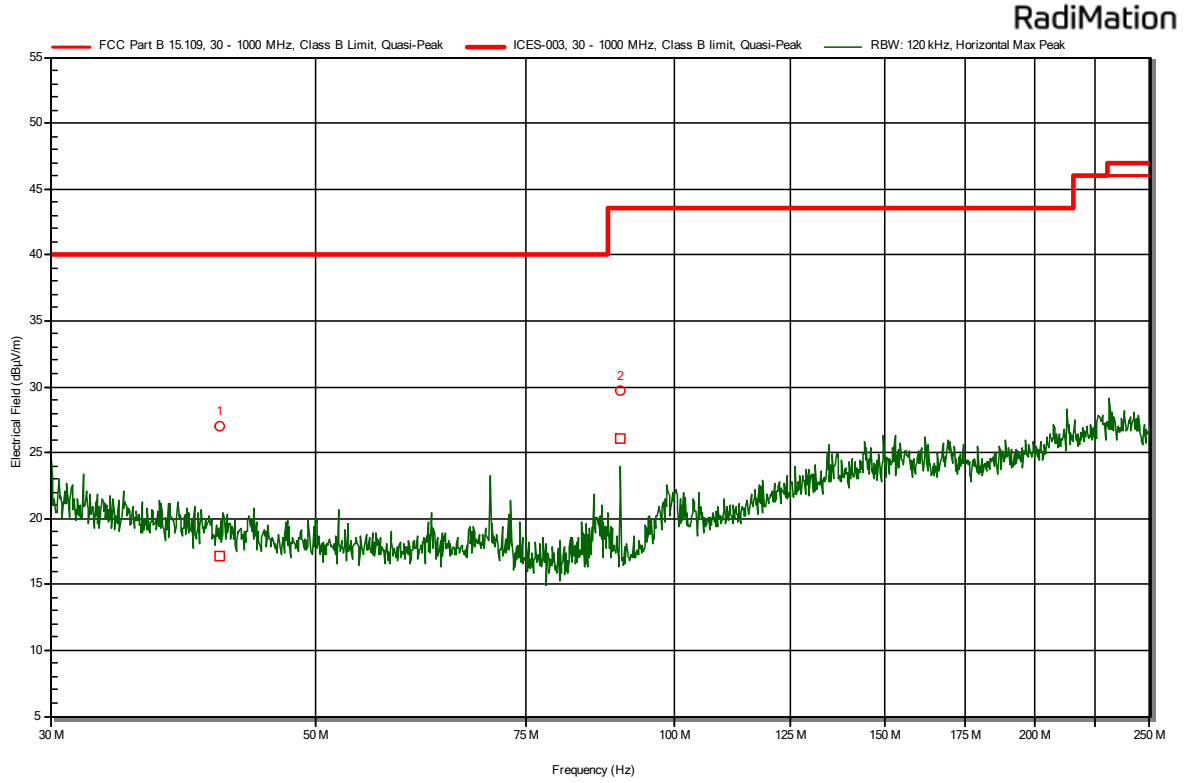
The results of the radiated emission tests are depicted in the table above. A selection of plots is provided on the next pages.

3.1.7 Plots of the Radiated Spurious Emissions Measurement

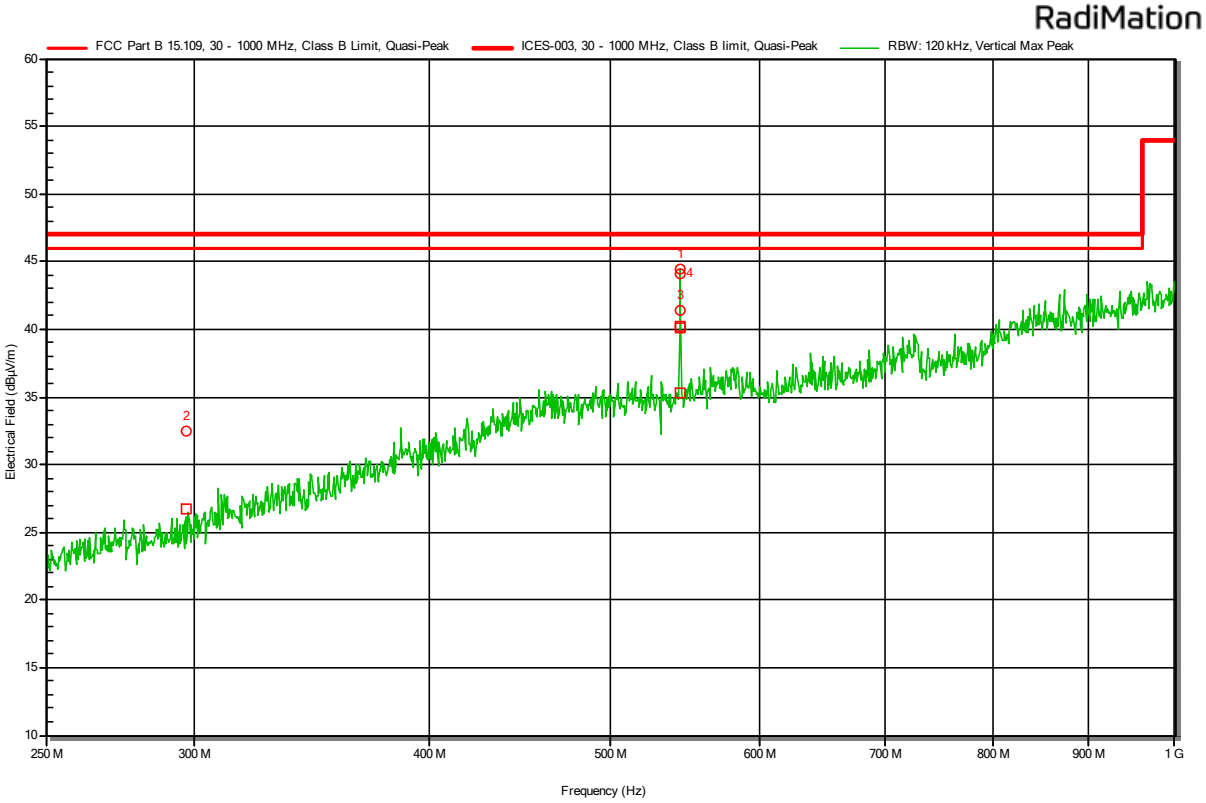
Plot 1a: radiated emissions of the EUT, Antenna vertical, in the range 30 – 250 MHz
(pre-scan peak values shown)



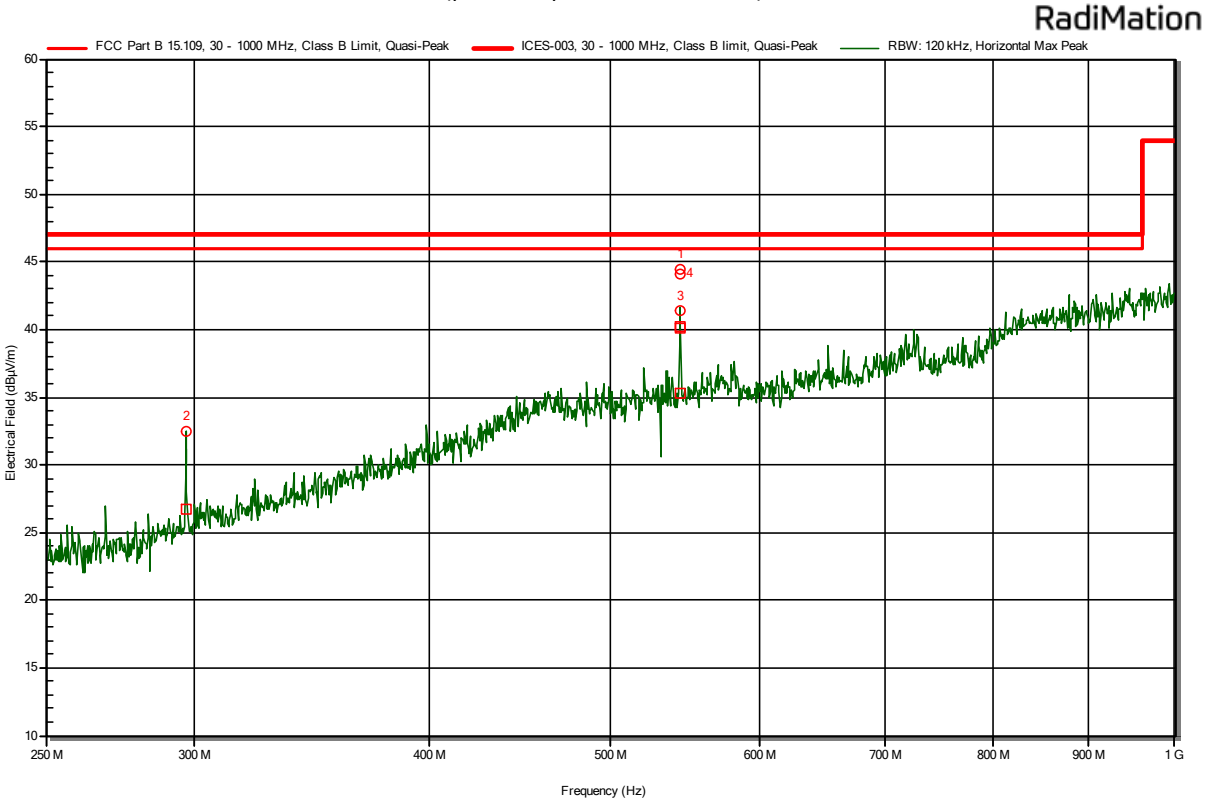
Plot 1b: radiated emissions of the EUT, Antenna horizontal, in the range 30 – 250 MHz
(pre-scan peak values shown)



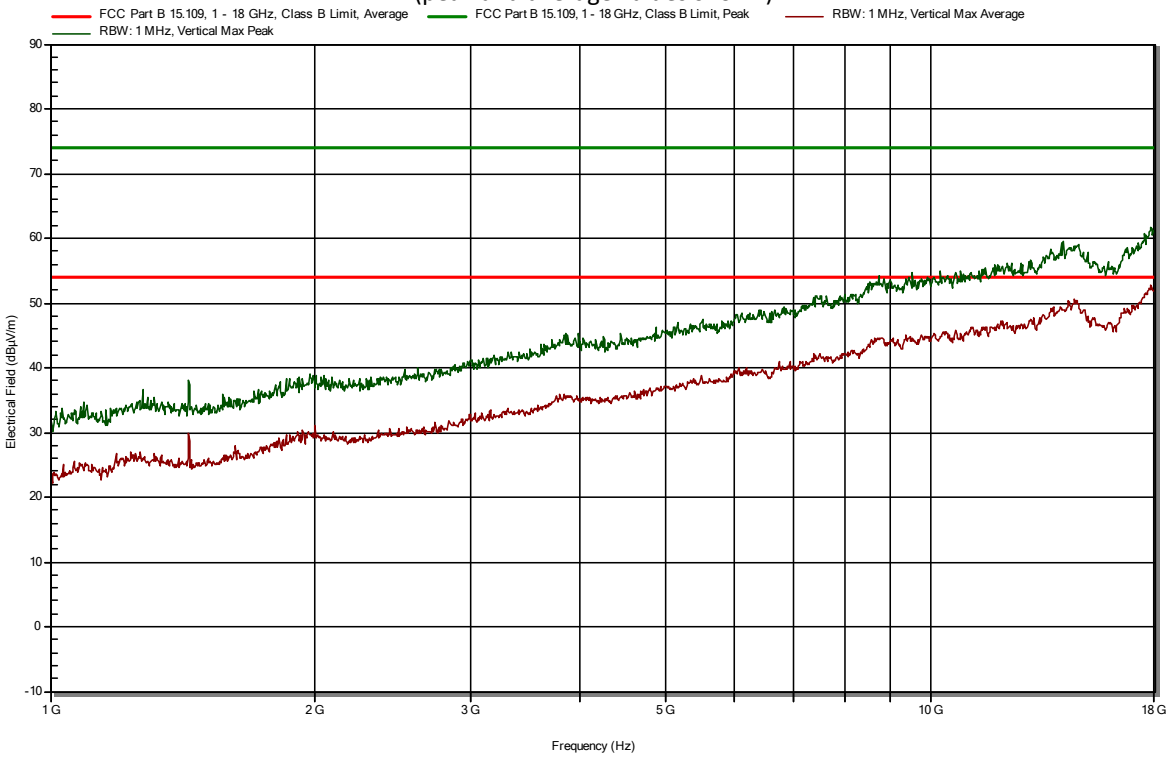
Plot 2a: radiated emissions of the EUT, Antenna vertical, in the range 250-1000 MHz
(pre-scan peak values shown)



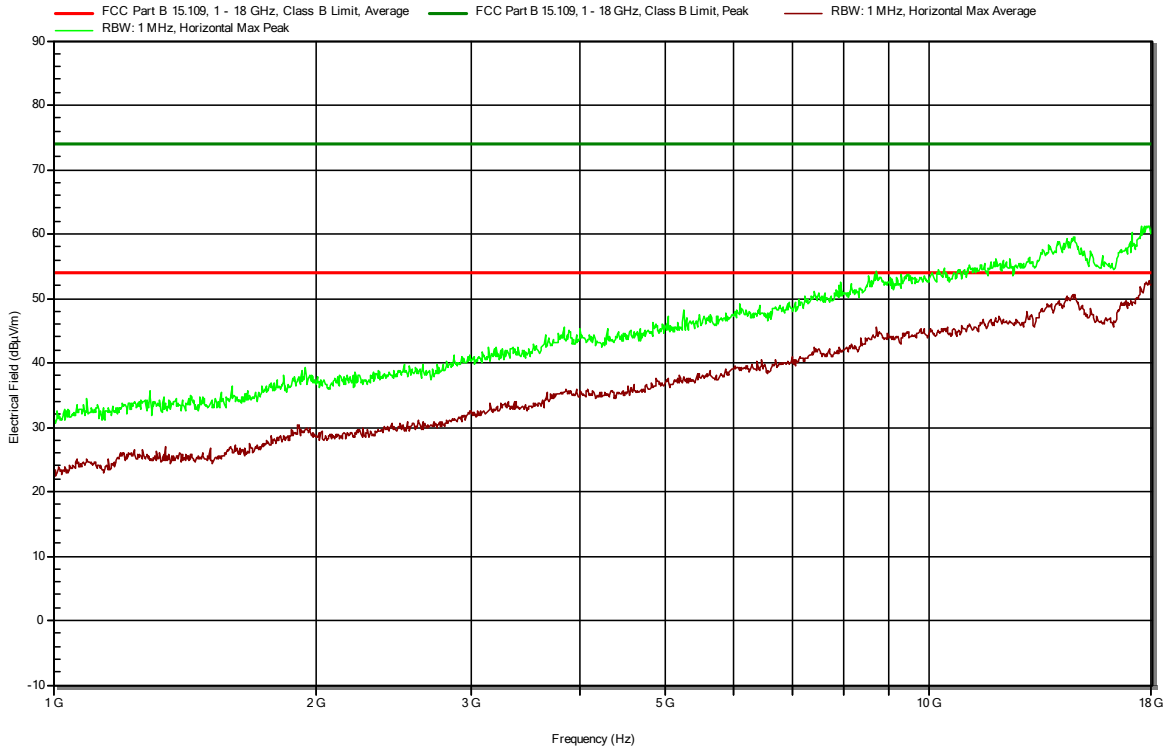
Plot 2b: radiated emissions of the EUT, Antenna horizontal, in the range 250-1000 MHz
(pre-scan peak values shown)



Plot 3a: radiated emissions of the EUT, Antenna vertical, in the range 1-18 GHz
(peak and average values shown)



Plot 3b: radiated emissions of the EUT, Antenna horizontal, in the range 1-18 GHz
(peak and average values shown)



Note: Limit for ICES-003 and FCC part B 15.109 are the same at this frequency, only the FCC Limits are included but the product passes both tests.

3.2 AC Power-line conducted emissions

3.2.1 Limit

§ 15.107 (a)
Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN).

ICES-003 Issue 7 section 3.2.1

The ITE or digital apparatus shall comply with the conducted emission limits specified in table below at its AC mains power terminals. The product under test shall comply with both the quasi-peak and the average limits.

Where the product under test is powered through an external device (for example, through an external power supply, or by means of a device providing power over Ethernet to the product under test), the conducted emission limits apply at the AC mains power terminals of the external device, while this is powering the product under test: see ICES-Gen.

Frequency of Emission (MHz)	Conducted Limit (dBµV) Quasi-Peak	Conducted Limit (dBµV) Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 - 30	46	50

*Decreases with the logarithm of the frequency.

3.2.2 Measurement instruments

The measurement instruments are listed in chapter 2.5 of this report.

3.2.3 Test setup

The test setup is as shown in chapter 2.2.3 of this report.

3.2.4 Test procedure

According to ANSI C63.4: 2014, section 13.3

IRN 439 – Method 1

3.2.5 Measurement uncertainty

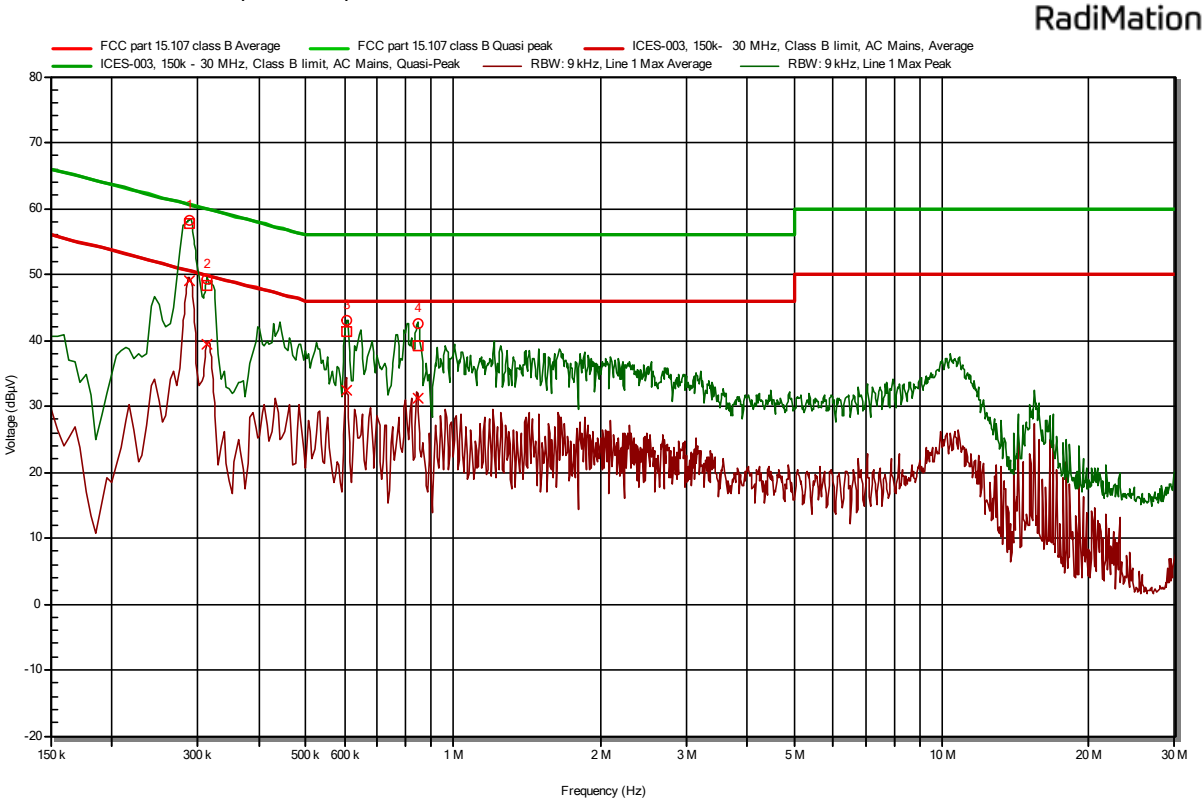
+/- 3.6 dB

3.2.6 AC Power Line Conducted emission data of the EUT, results

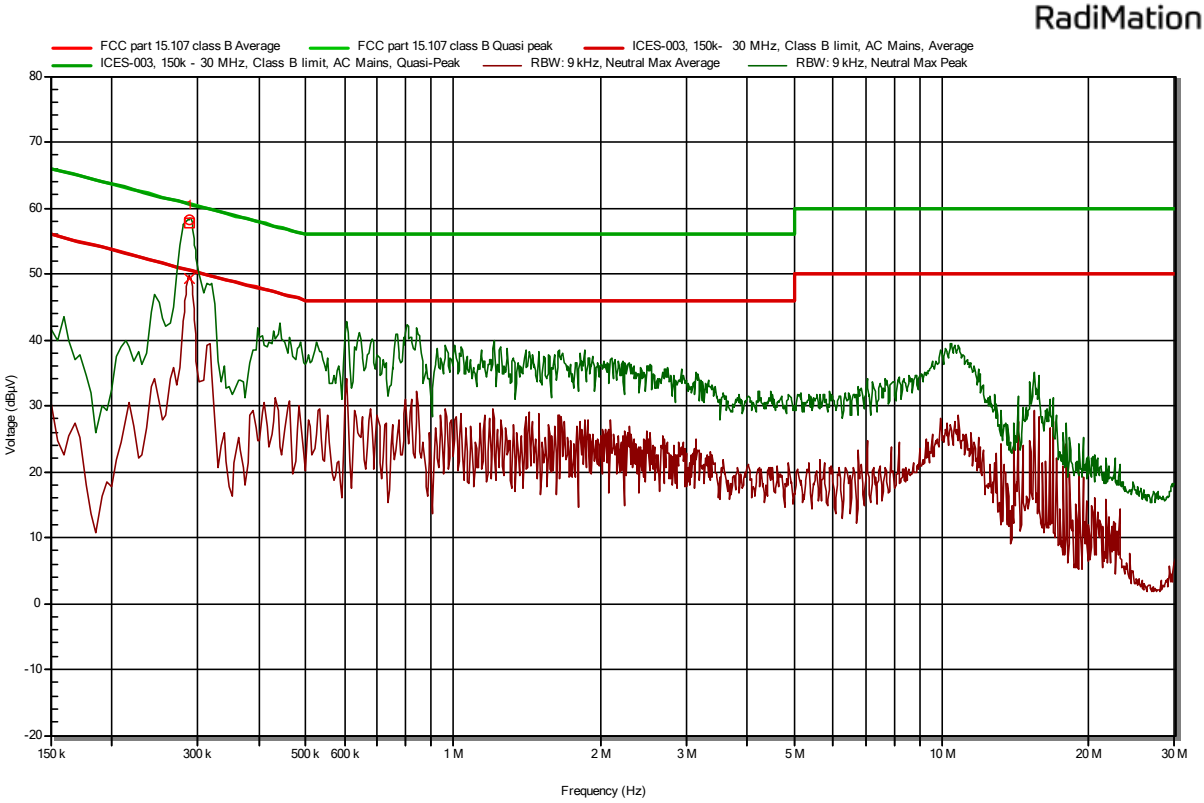
Peak Number	Frequency	Peak	Average	Average Limit	Quasi-Peak	Quasi-Peak Limit	Status	LISN
1	289.05 kHz	58.2 dBµV	49.1 dBµV	50.6 dBµV	57.7 dBµV	60.6 dBµV	Pass	Line 1
2	313.35 kHz	49.4 dBµV	39.4 dBµV	49.9 dBµV	48.3 dBµV	59.9 dBµV	Pass	Line 1
3	605.85 kHz	43 dBµV	32.4 dBµV	46 dBµV	41.3 dBµV	56 dBµV	Pass	Line 1
4	845.7 kHz	42.6 dBµV	31.2 dBµV	46 dBµV	39.2 dBµV	56 dBµV	Pass	Line 1
5	289.05 kHz	58.3 dBµV	49.2 dBµV	50.6 dBµV	57.8 dBµV	60.6 dBµV	Pass	Neutral

3.2.7 Plots of the AC mains conducted spurious measurement

Pre-scan plot with peak detector of the AC Power-line Conducted emissions on **Phase**



Pre-scan plot with peak detector of the AC Power-line Conducted emissions on **Neutral**



4 Sample calculations

All formulas for data conversions and conversion factors are reported in this chapter.

Conducted emission Measurement:

U_{lisn} (dBµV) = U (dBµV) + Corr. (dB)

Where:
U = Measuring receiver voltage
LISN insertion loss = Voltage division factor of LISN
Corr. = sum of single correction factors of used LISN, cables and pulse limiter.
Linear interpolation will be used for frequencies in between the values in the table.

Frequency (MHz)	**Voltage division LISN (db)**	**Cable loss (dB)**	**Corr. (dB)**
	114379 SN: 230000813 Rohde & Schwarz ENV 216	**TE 11134**	
0,15	9.7	0.02	9.72
0,2	9.68	0.03	9.71
0,3	9.68	0.03	9.71
0,5	9.69	0.08	9.77
0,7	9.69	0.25	9.94
0,8	9.69	0.25	9.94
1	9.68	0.11	9.79
2	9.7	0.15	9.85
3	9.71	0.21	9.92
5	9.72	0.21	9.93
7	9.76	0.25	10.01
8	9.77	0.25	10.02
10	9.77	0.29	10.06
15	9.84	0.34	10.18
20	9.88	0.37	10.25
25	9.97	0.43	10.4
30	10.08	0.45	10.53

Field Strength Measurement:

E (dBµV/m) = U(dBµV) + AF (dB/m) + Corr. (dB)

Where:
E = Electric field strength
U = Measuring receiver voltage
AF = Antenna factor
CL = Cable loss

Corr. = sum of single correction factors of used cable and amplifier (if applicable).
Linear interpolation will be used for frequencies in between the values in the table.
Tables shows an extract of the values.

Frequency (MHz)	AF 114515 EMCO 6505 S/N:9112-2710	300m to 3m and 30m to 3m correction	CL (dB) SAR cable	Corr. (dB)
0,009	18.49	104.956	0.7	-85.8
0,01	17.64	104.041	0.05	-86.4
0,02	13.23	98.02	0.07	-84.7
0,03	11.65	94.498	0.1	-82.7
0,04	10.97	91.999	0.1	-80.9
0,1	10.14	84.041	0.1	-73.8
0,2	10.01	78.02	0.1	-67.9
0,5	9.95	50.061	0.1	-40
1	9.91	44.041	0.2	-33.9
3	9.93	34.498	0.2	-24.4
5	9.93	30.061	0.3	-19.8
10	9.75	24.041	0.6	-13.7
15	9.29	20.519	0.9	-10.3
20	8.57	18.02	1	-8.5
25	7.55	16.082	0.7	-7.8
27	7.01	15.413	1.2	-7.2
30	6.03	14.498	1	-7.5

Frequency (MHz)	AF (dB/m) ID: 107818 EMCO 3109	Cable loss (dB) Id: 114928	Attenuator ID:114525 Hewlett Packet	Corr. (dB)
30	13.5	1.8	6	21.3
100	9.2	2.7	6	17.9
150	12.6	3.2	6	21.8
200	13.6	3.6	6	23.2
250	15.2	4.3	6	25.5

Frequency (MHz)	AF (dB/m) ID: 114385 EMCO LPDA	Cable loss (dB) Id: 114928	Corr. (dB)
250	11.8	4.3	16.1
300	13	5.1	18.1
350	14.2	5.8	20
400	15.6	7.3	22.9
450	17.1	7.9	25
500	17.3	8	25.3
550	17.7	8	25.7
600	18.4	7.7	26.1
650	19.2	7.5	26.7
700	19.7	7.7	27.4
750	20.3	7.9	28.2
800	21.4	8.2	29.6
850	22.0	8.7	30.7
900	22.1	8.9	31
950	22.6	9.2	31.8
1000	22.5	9.6	32.1

Frequency (MHz)	AF (dB/m) 114607 Emco 3115 SN: 9412-4377	Gain (dB) 114690 µComp Nordic MCNA-40-0010800-25-10P	Cable loss (dB) 114691	Corr. (dB)
1000	23.6	45.1	2.1	-19.4
2000	27.1	44.7	3.3	-14.3
3000	30.5	44.2	4.2	-9.5
4000	32.7	43.5	4.9	-5.9
5000	33.2	43.1	5.6	-4.3
6000	34.6	43	6.3	-2.1
7000	35.2	42.9	6.4	-1.3
8000	37.0	43.3	7.2	0.9
9000	38.1	43.3	7.9	2.7
10000	38.2	43	8.2	3.4
11000	38.3	42.9	8.7	4.1
12000	39.1	42.6	9	5.5
13000	39.2	43.6	9.8	5.4
14000	41.1	44.3	9.7	6.5
15000	40.2	44.4	10.4	6.2
16000	37.5	44.3	10.8	4
17000	41.1	44.5	11.4	8
18000	44.0	44.9	11.4	10.5

<<END OF REPORT>>