

Figure 12 - Hopping - Measured Frequency 880.92 MHz

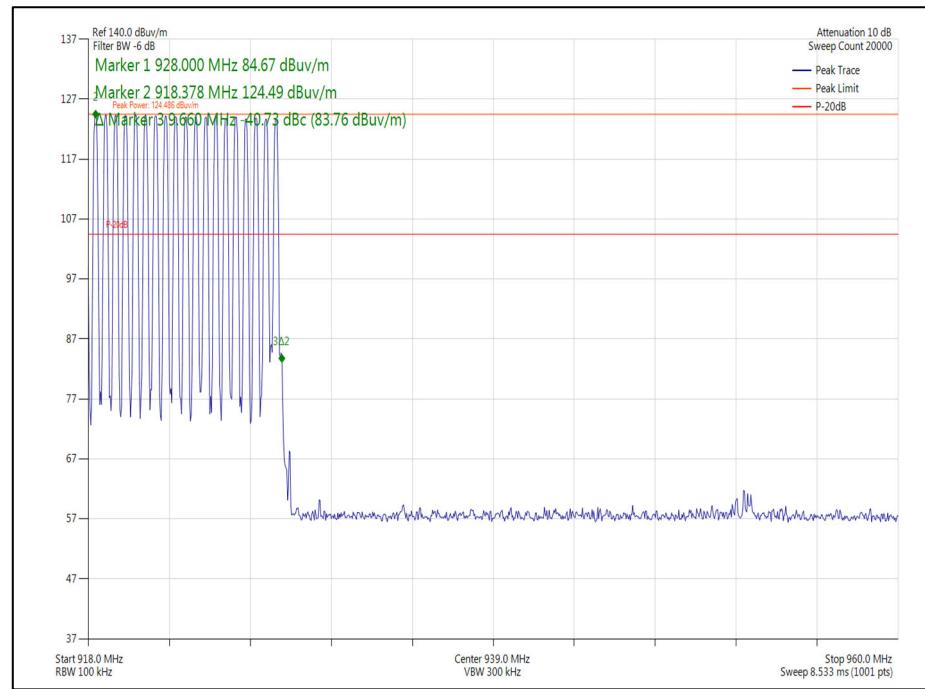


Figure 13 - Hopping - Measured Frequency 928.038 MHz



FCC 47 CFR Part 15, Limit Clause 15.247 (d)

20 dB below the fundamental measured in a 100 kHz bandwidth using a peak detector. If the transmitter complies with the conducted power limits, based on the use of RMS averaging over a time interval, the attenuation required shall be 30 dB below the fundamental instead of 20 dB.

ISEDC RSS-247, Limit Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

2.6.7 Test Location and Test Equipment Used

This test was carried out in Bearley EMC Chamber 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Hygrometer	Rotronic	A2	1698	12	18-Nov-2021
Bilog Antenna	Schaffner	CBL6143	1858	24	10-Nov-2022
EMC 3m Semi Anechoic Chamber	Rainford	Hybrid	4160	36	16-Dec-2021
7m N-Type Cable	Teledyne Storm	SA90-195-7MTR	4168	6	10-Mar-2021
EMC Mast controller	Innco Systems	CONTROLLER CO3000	4728	-	TU
EMI Receiver	Keysight Technologies	N9038A MXE	4974	12	27-Jan-2022
EmX Emissions Software	TUV SUD	V2.1.7	5125	-	Software
Cable (18GHz N Type 3m)	Rosenberger	LU7-036-3000	5163	12	10-Dec-2021
Turntable Controller	Maturo	Maturo NCD	5275	-	TU
4dB Attenuator	Pasternack	PE7047-4	5647	24	10-Nov-2022

Table 17

TU - Traceability Unscheduled



2.7 Spurious Radiated Emissions

2.7.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247(d) and 15.205
ISED RSS-247, Clause 5.5
ISED RSS-GEN, Clause 6.13

2.7.2 Equipment Under Test and Modification State

CE4, S/N: 153000220 - Modification State 0

2.7.3 Date of Test

21-May-2021 to 24-May-2021

2.7.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 6.3, 6.5 and 6.6.

The EUT was placed on the non-conducting platform in a manner typical of a normal installation. For frequencies > 1 GHz, plots for average measurements were taken in accordance with ANSI C63.10, clause 4.1.4.2.5 to characterize the EUT. Where emissions were detected, final average measurements were taken in accordance with ANSI C63.10, clause 4.1.4.2.2.

The plots shown are the characterisation of the EUT. The limits on the plots represent the most stringent case for restricted bands, (74/54 dB μ V/m) when compared to 20 dBc outside restricted bands. The limits shown have been used as a threshold to determine where further measurements are necessary. Where results are within 10 dB of the limits within the restricted bands, shown on the plots, further investigation was carried out and reported in results tables.

The following conversion can be applied to convert from dB μ V/m to μ V/m:
 $10^{(Field\ Strength\ in\ dB\mu\text{V}/m)/20}$.

To determine the emission characteristic of the EUT above 18 GHz, the test antenna was swept over all faces of the EUT whilst observing a spectral display. The frequency of any emissions of interest was noted for formal measurement at the correct measurement distance of 1m. This procedure was repeated for all relevant transmit operating channels.

At a measurement distance of 1 meter the limit line was increased by $20 * \text{LOG}(3/1) = 9.54$ dB.

Where formal measurements have been necessary, the results have been presented in the emissions table.

2.7.5 Example Test Setup Diagram

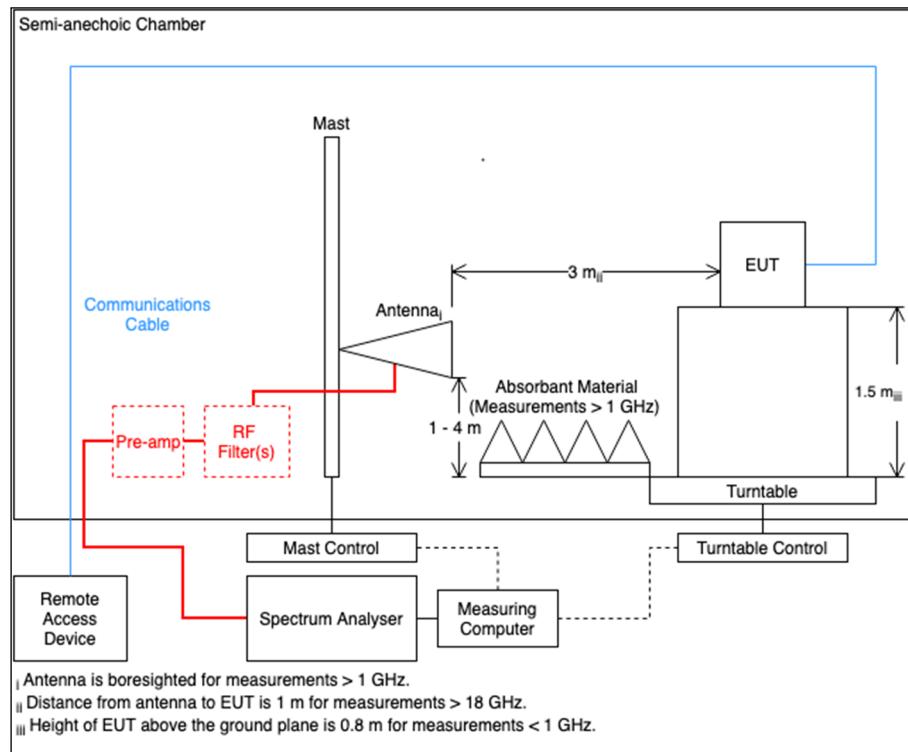


Figure 14

2.7.6 Environmental Conditions

Ambient Temperature 18.4 - 20.0 °C
Relative Humidity 36.4 - 44.6 %

2.7.7 Test Results

Commander - Battery powered - 915 MHz transmitter

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
168.005	38.54	43.52	-4.98	Q-Peak	11	110	Vertical	-
120.044	25.19	43.52	-18.33	Q-Peak	213	391	Vertical	-
168.038	31.47	43.52	-12.05	Q-Peak	27	395	Vertical	-
264.007	40.87	46.02	-5.15	Q-Peak	276	112	Horizontal	-
168.003	32.8	43.52	-10.72	Q-Peak	47	324	Horizontal	-
237.714	29.96	46.02	-16.06	Q-Peak	297	186	Horizontal	-

Table 18 - 902.26 MHz, 30 MHz to 1 GHz - Emission Results

No other emissions were detected within 6 dB of the limit.

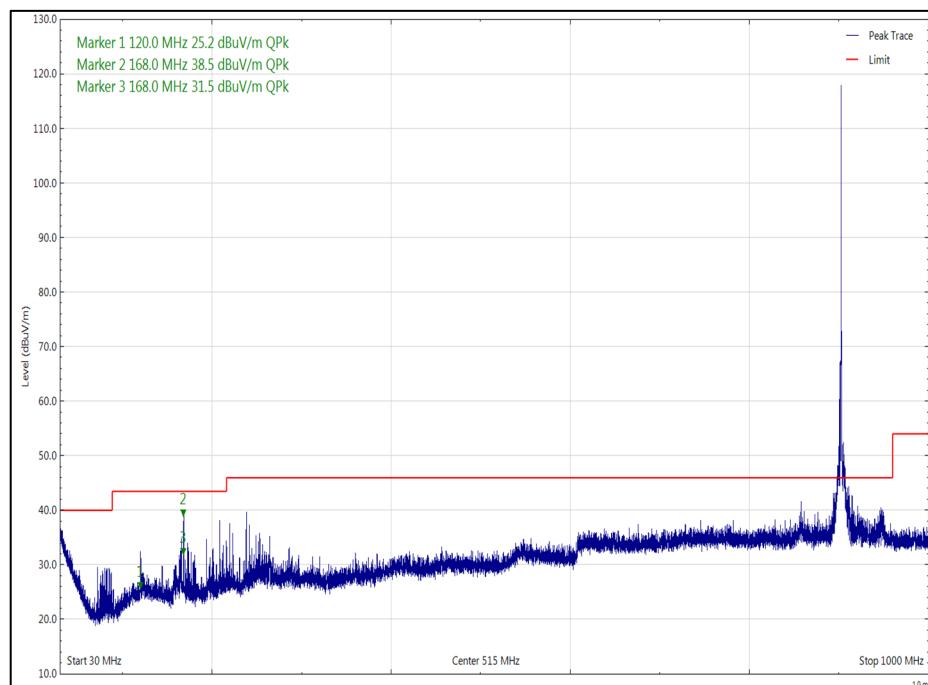


Figure 15 - 902.26 MHz, 30 MHz to 1 GHz, Vertical,

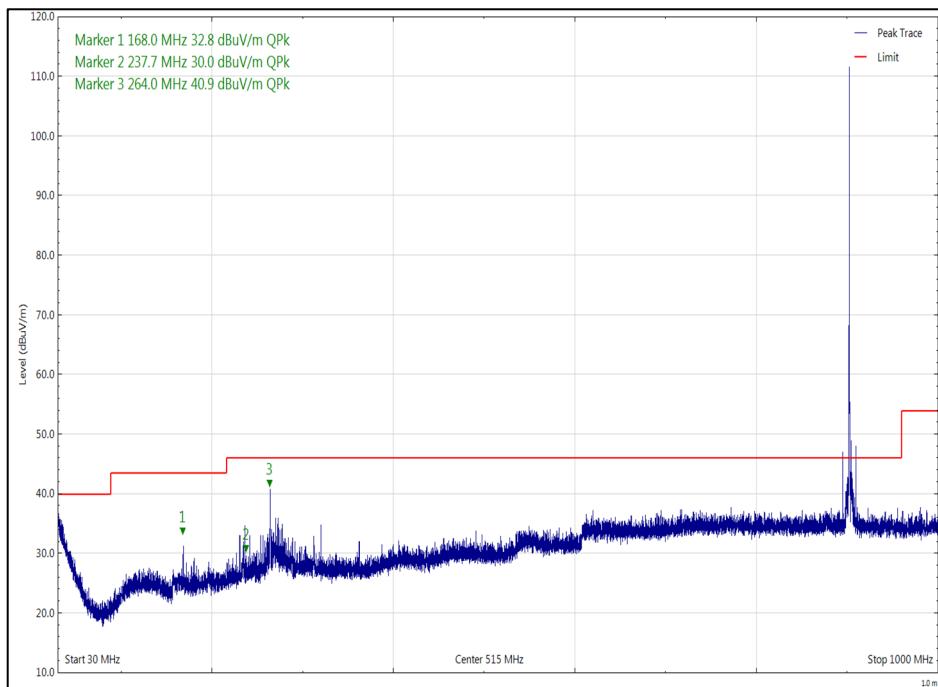


Figure 16 - 902.26 MHz, 30 MHz to 1 GHz, Horizontal

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
2706.814	33.2	54.0	-20.8	CISPR Avg	24	398	Vertical	-
3608.923	32.5	54.0	-21.5	CISPR Avg	311	175	Vertical	-
4511.384	30.6	54.0	-23.4	CISPR Avg	110	215	Vertical	-
17938.229	36.6	54.0	-17.4	CISPR Avg	250	244	Vertical	-
17950.905	36.4	54.0	-17.6	CISPR Avg	350	206	Vertical	-
1002.991	35.4	54.0	-18.6	CISPR Avg	138	400	Horizontal	-
2706.769	37.7	54.0	-16.3	CISPR Avg	178	106	Horizontal	-
3609.118	31.5	54.0	-22.5	CISPR Avg	176	128	Horizontal	-
4511.264	30.2	54.0	-23.8	CISPR Avg	92	104	Horizontal	-
5413.409	27.3	54.0	-26.7	CISPR Avg	123	118	Horizontal	-
17630.009	35.1	54.0	-18.9	CISPR Avg	249	100	Horizontal	-
17953.415	36.0	54.0	-18.0	CISPR Avg	243	279	Horizontal	-
17991.415	36.5	54.0	-17.5	CISPR Avg	350	100	Horizontal	-

Table 19 - 902.26 MHz, 1 GHz to 25GHz Emissions Results

No other emissions were detected within 6 dB of the limit.

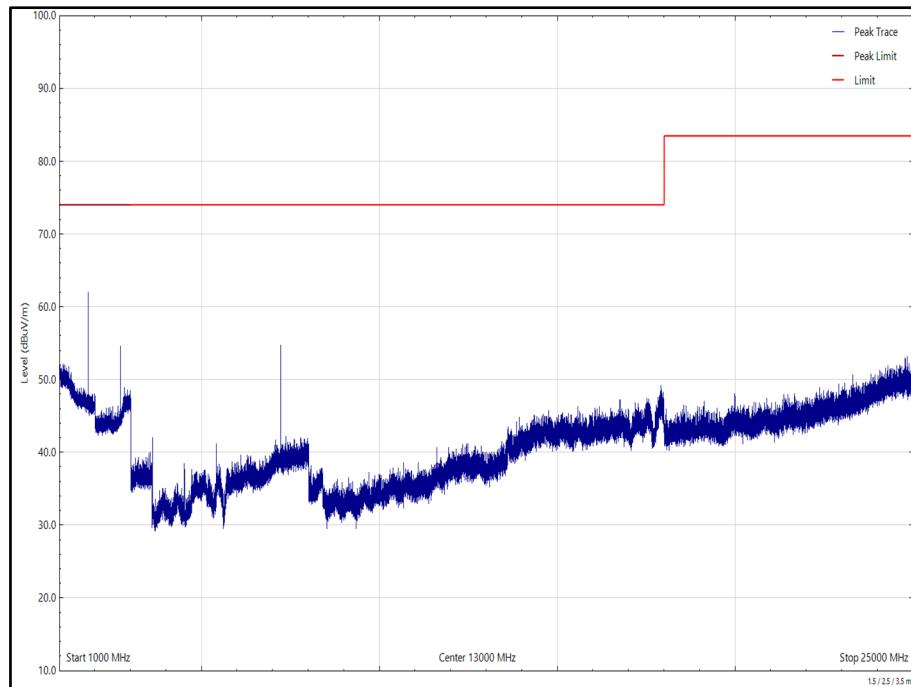


Figure 17 - 902.26 MHz, 1 GHz to 25 GHz, Vertical - Peak

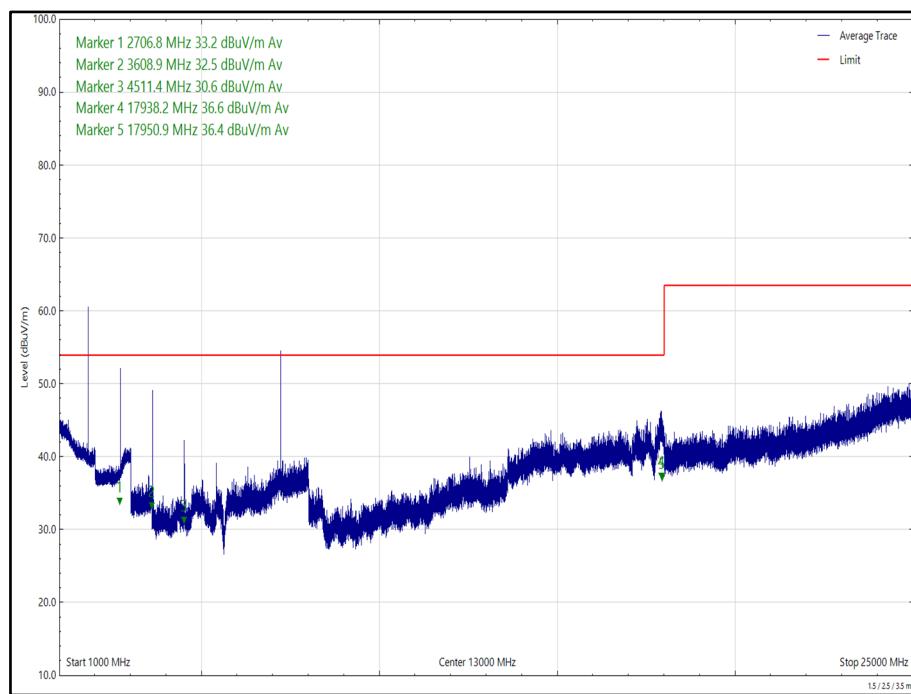


Figure 18 - 902.26 MHz, 1 GHz to 25 GHz, Vertical - Average

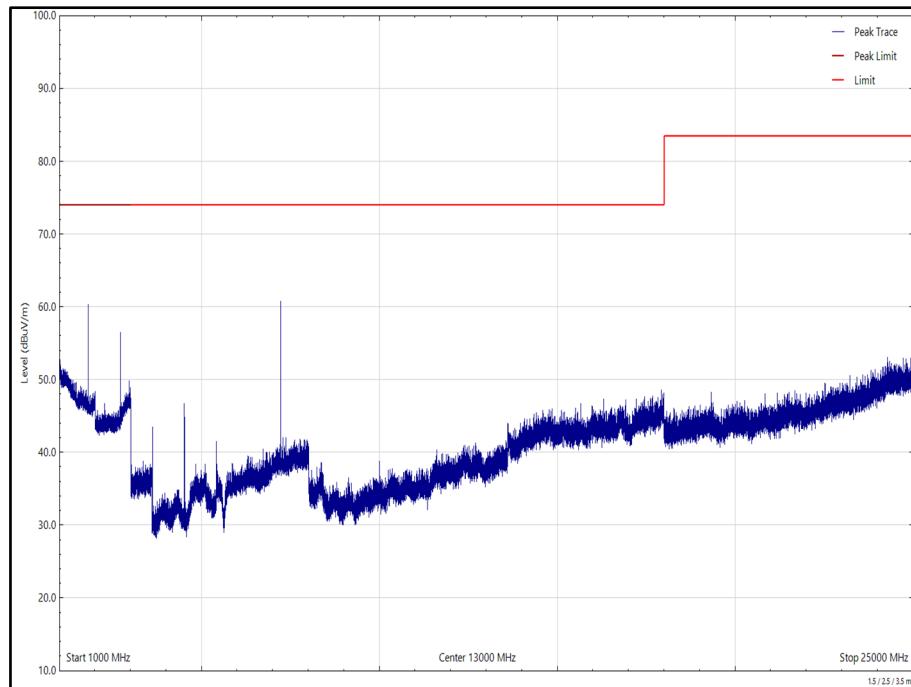


Figure 19 - 902.26 MHz, 1 GHz to 25 GHz, Horizontal - Peak

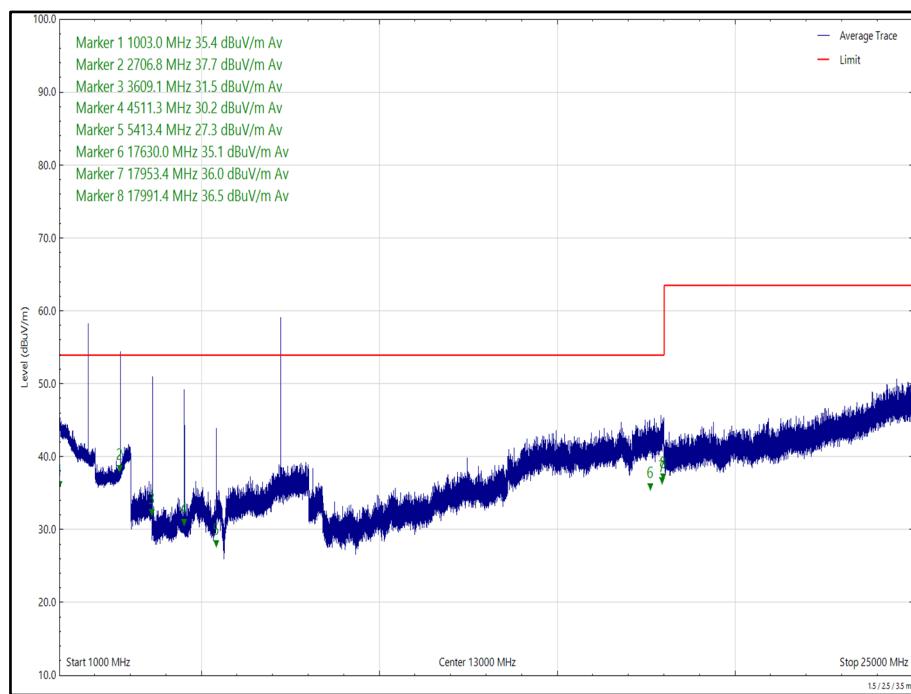


Figure 20 - 902.26 MHz, 1 GHz to 25 GHz, Horizontal - Average

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
79.825	26.36	40	-13.64	Q-Peak	149	354	Vertical	-
168.035	37.91	43.52	-5.61	Q-Peak	0	100	Vertical	-
248.917	33.65	46.02	-12.37	Q-Peak	3	303	Vertical	-
961.966	41.84	53.98	-12.14	Q-Peak	17	125	Vertical	-
264.018	33.56	46.02	-12.46	Q-Peak	273	378	Horizontal	-
961.152	34.84	53.98	-19.14	Q-Peak	67	100	Horizontal	-
264.062	38.73	46.02	-7.29	Q-Peak	274	100	Horizontal	-

Table 20 - 914.74 MHz, 30 MHz to 1 GHz - Emission Results

No other emissions were detected within 6 dB of the limit.

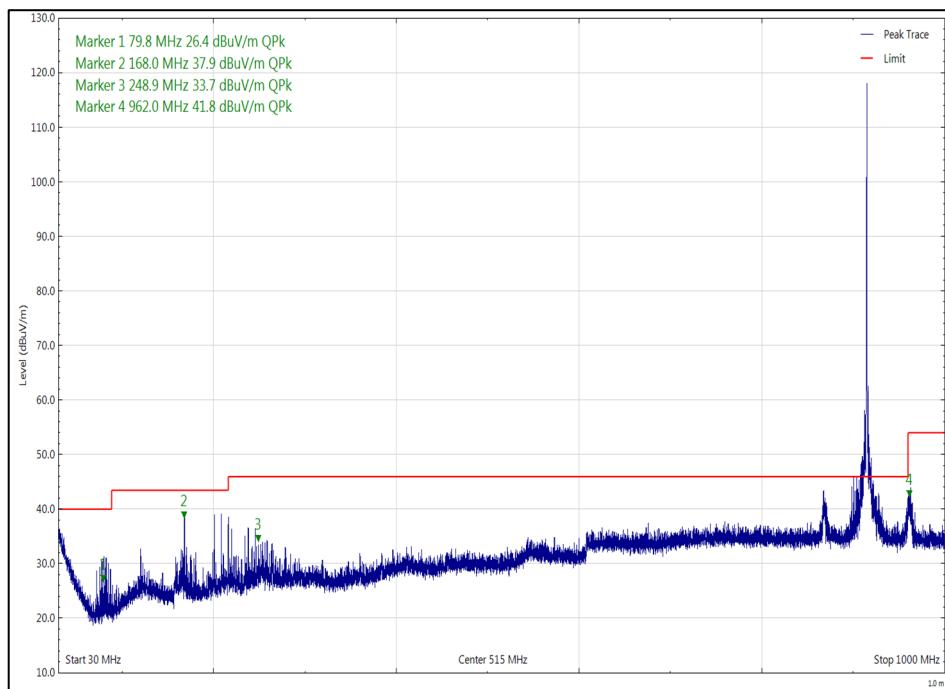


Figure 21 - 914.74 MHz, 30 MHz to 1 GHz, Vertical,

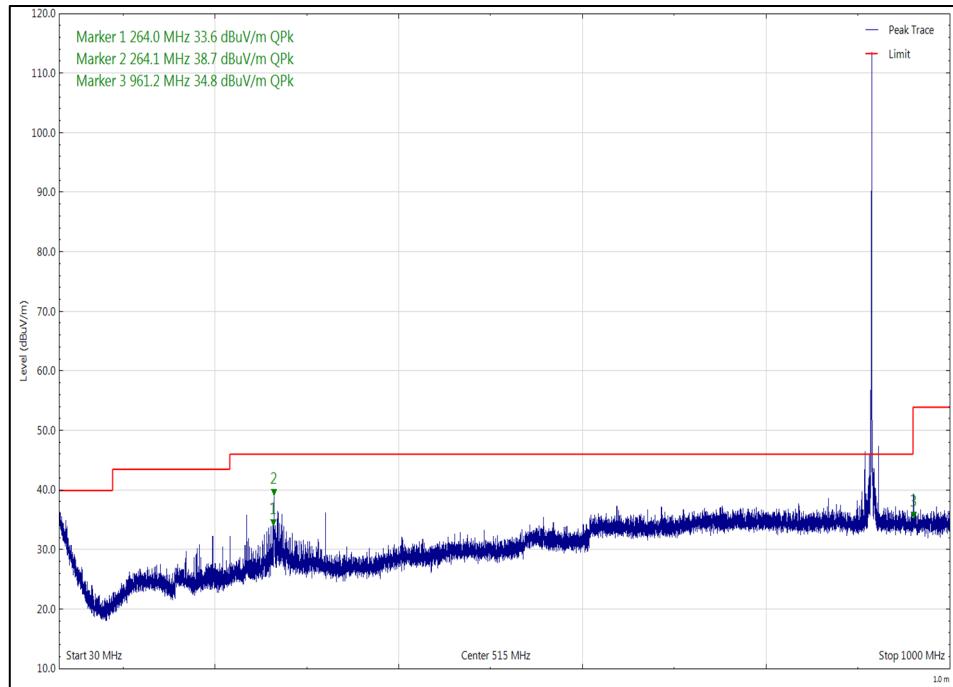


Figure 22 - 914.74 MHz, 30 MHz to 1 GHz, Horizontal

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
1190.305	38.4	54.0	-15.6	CISPR Avg	224	310	Vertical	-
2744.159	37.6	54.0	-16.4	CISPR Avg	137	104	Vertical	-
3658.778	31.6	54.0	-22.4	CISPR Avg	102	187	Vertical	-
7317.779	36.4	54.0	-17.7	CISPR Avg	255	262	Vertical	-
17923.879	36.7	54.0	-17.3	CISPR Avg	34	274	Vertical	-
1006.074	35.3	54.0	-18.7	CISPR Avg	358	264	Horizontal	-
1195.976	38.4	54.0	-15.6	CISPR Avg	96	239	Horizontal	-
2744.214	36.1	54.0	-17.9	CISPR Avg	149	266	Horizontal	-
3658.943	35.7	54.0	-18.3	CISPR Avg	115	183	Horizontal	-
4573.435	26.0	54.0	-28.0	CISPR Avg	267	310	Horizontal	-
7317.864	39.6	54.0	-14.4	CISPR Avg	178	146	Horizontal	-

Table 21 - 914.74 MHz, 1 GHz to 25 GHz - Emissions Results

No other emissions were detected within 6 dB of the limit.

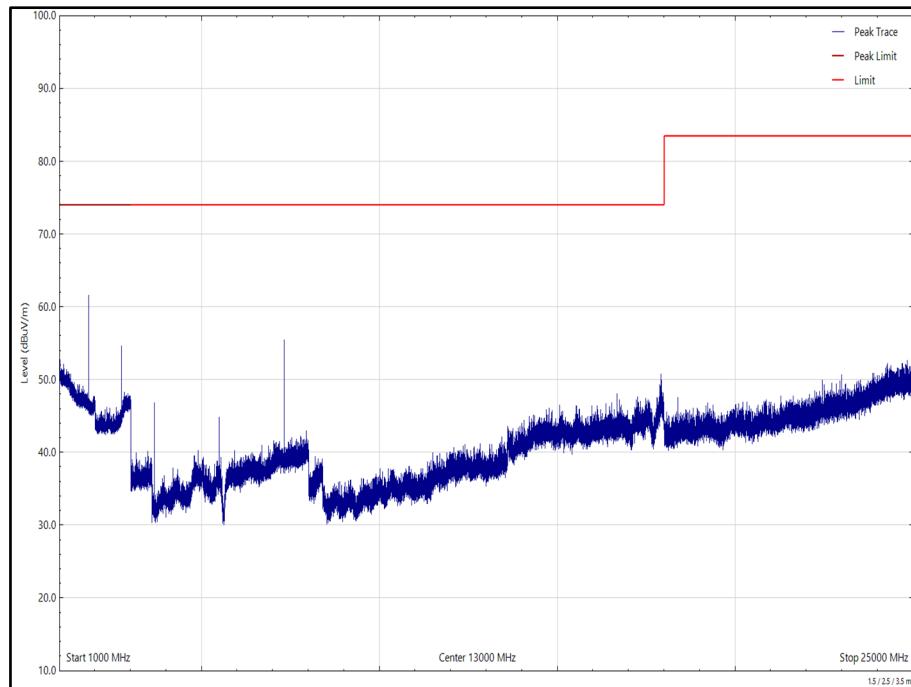


Figure 23 - 914.74 MHz, 1 GHz to 25 GHz, Vertical - Peak

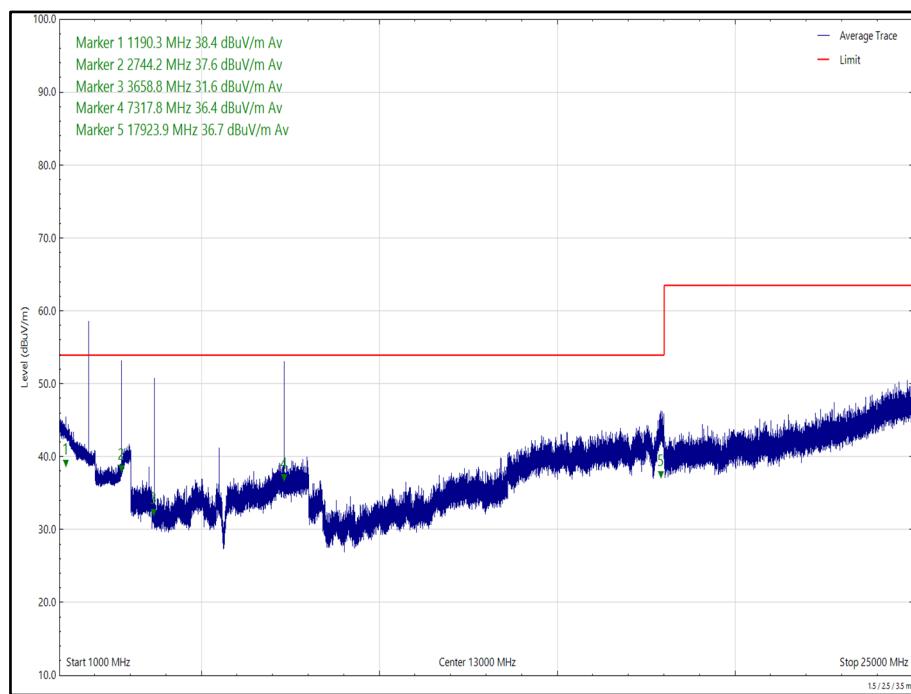


Figure 24 - 914.74 MHz, 1 GHz to 25 GHz, Vertical - Average

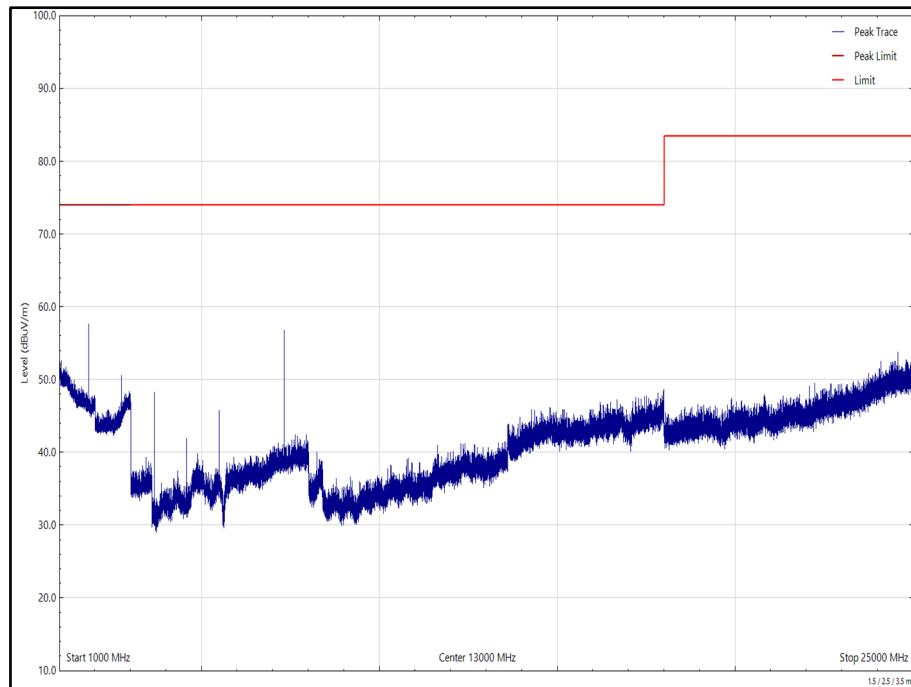


Figure 25 - 914.74 MHz, 1 GHz to 25 GHz, Horizontal - Peak

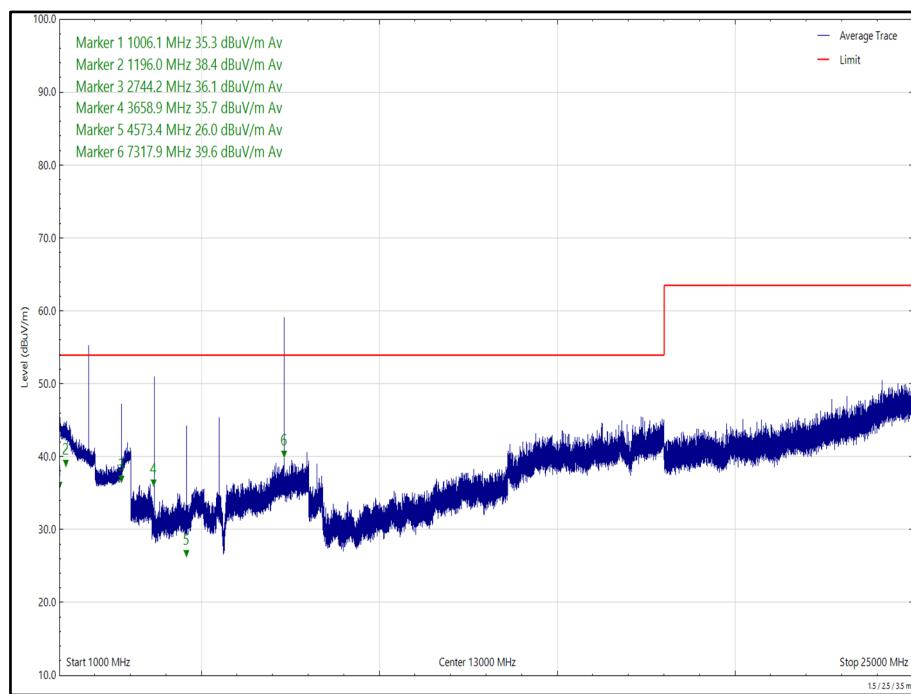


Figure 26 - 914.74 MHz, 1 GHz to 25 GHz, Horizontal: - Average

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
168.007	38.19	43.52	-5.33	Q-Peak	17	116	Vertical	-
168.004	37.5	43.52	-6.02	Q-Peak	4	129	Vertical	-
79.844	31.58	40	-8.42	Q-Peak	227	100	Vertical	-
245.159	36.04	46.02	-9.98	Q-Peak	0	176	Vertical	-
245.172	27.08	46.02	-18.94	Q-Peak	19	390	Vertical	-
248.909	36.25	46.02	-9.77	Q-Peak	347	229	Vertical	-
264.004	40.39	46.02	-5.63	Q-Peak	277	119	Horizontal	-
272.362	34.48	46.02	-11.54	Q-Peak	182	177	Horizontal	-

Table 22 - 927.74 MHz, 30 MHz to 1 GHz - Emission Results

No other emissions were detected within 6 dB of the limit.

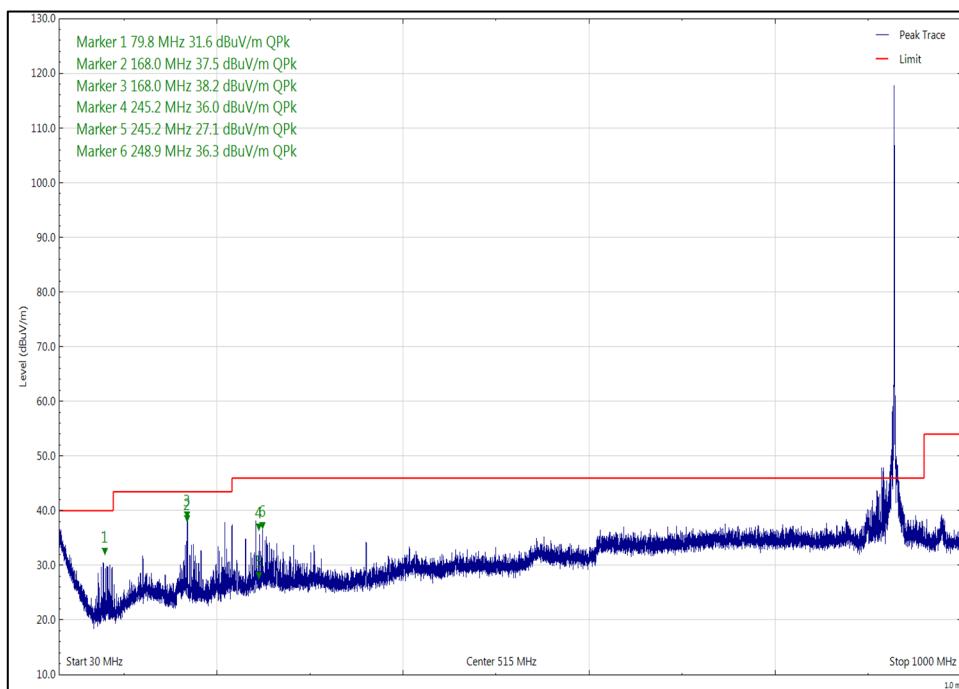


Figure 27 - 927.74 MHz 30 MHz to 1 GHz, Vertical,

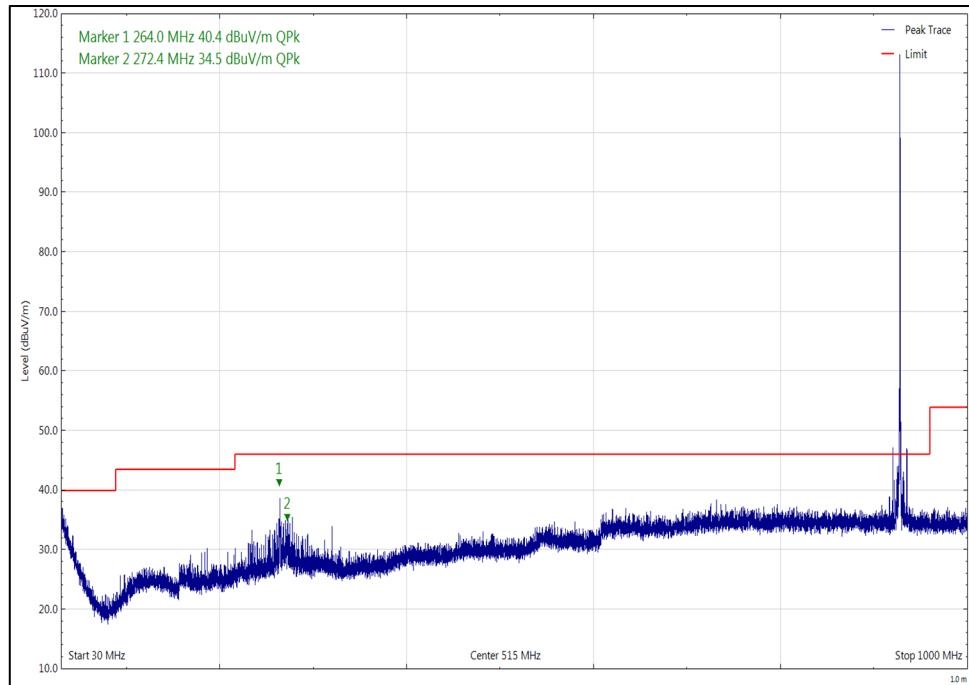


Figure 28 - 927.74 MHz, 30 MHz to 1 GHz, Horizontal

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
1001.825	35.4	54.0	-18.6	CISPR Avg	261	362	Vertical	-
2783.178	39.3	54.0	-14.7	CISPR Avg	140	106	Vertical	-
3710.914	32.3	54.0	-21.7	CISPR Avg	230	302	Vertical	-
7421.900	33.1	54.0	-20.9	CISPR Avg	134	264	Vertical	-
17881.652	36.5	54.0	-17.5	CISPR Avg	302	398	Vertical	-
1002.249	35.5	54.0	-18.5	CISPR Avg	119	388	Horizontal	-
1148.005	38.5	54.0	-15.5	CISPR Avg	350	241	Horizontal	-
1190.055	38.4	54.0	-15.6	CISPR Avg	171	325	Horizontal	-
2783.288	37.6	54.0	-16.4	CISPR Avg	182	110	Horizontal	-
3710.909	36.8	54.0	-17.2	CISPR Avg	126	160	Horizontal	-
7421.940	33.9	54.0	-20.1	CISPR Avg	244	143	Horizontal	-
15593.437	33.2	54.0	-20.8	CISPR Avg	132	196	Horizontal	-
17968.558	36.2	54.0	-17.8	CISPR Avg	151	300	Horizontal	-

Table 23 - 914.74 MHz, 1 GHz to 25GHz Emissions Results

No other emissions were detected within 6 dB of the limit.

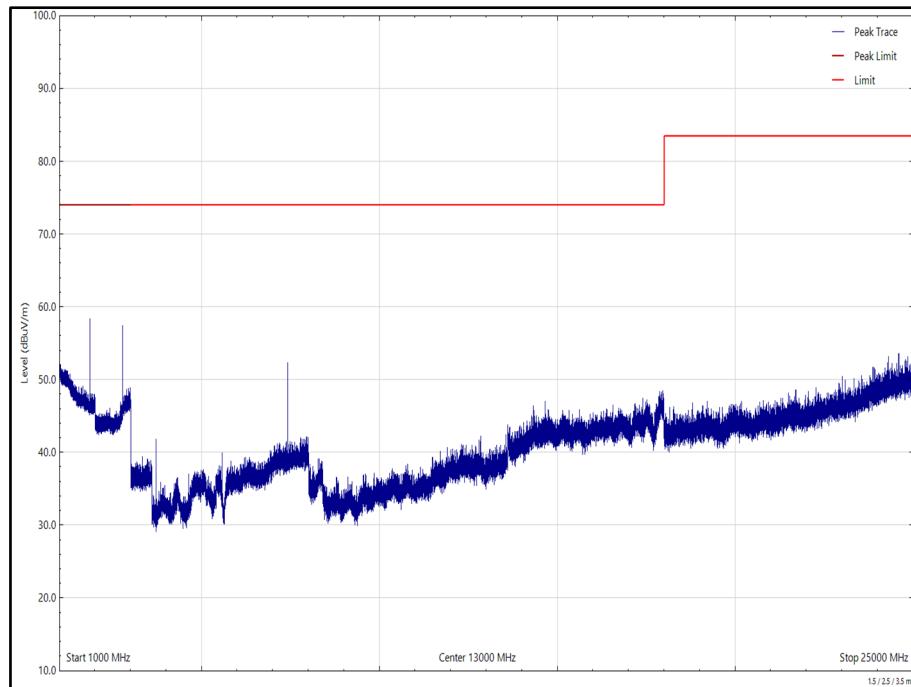


Figure 29 - 927.74 MHz, 1 GHz to 25 GHz, Vertical - Peak

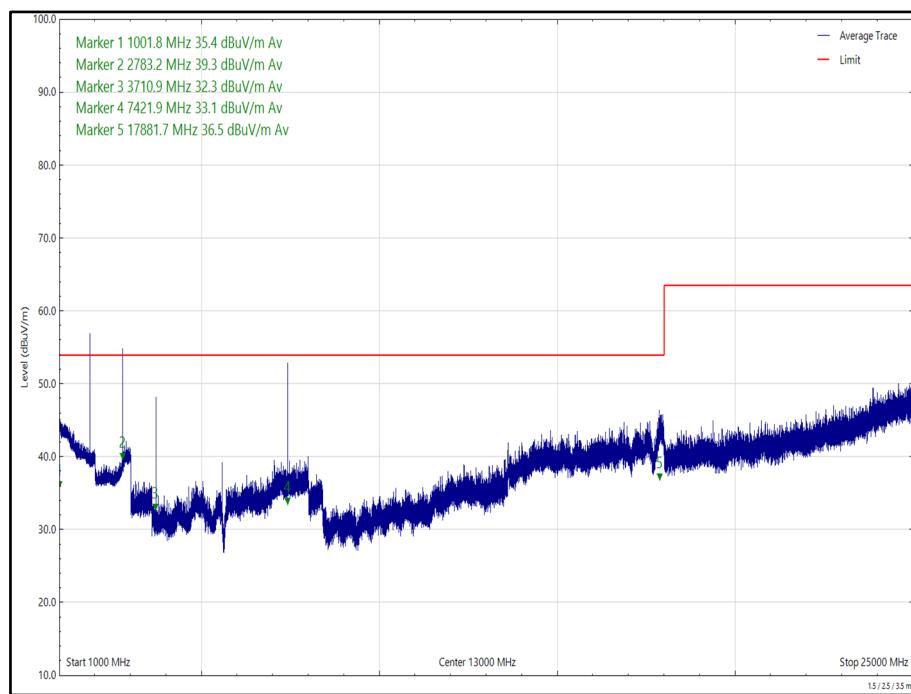


Figure 30 - 927.74 MHz, 1 GHz to 25 GHz, Vertical - Average

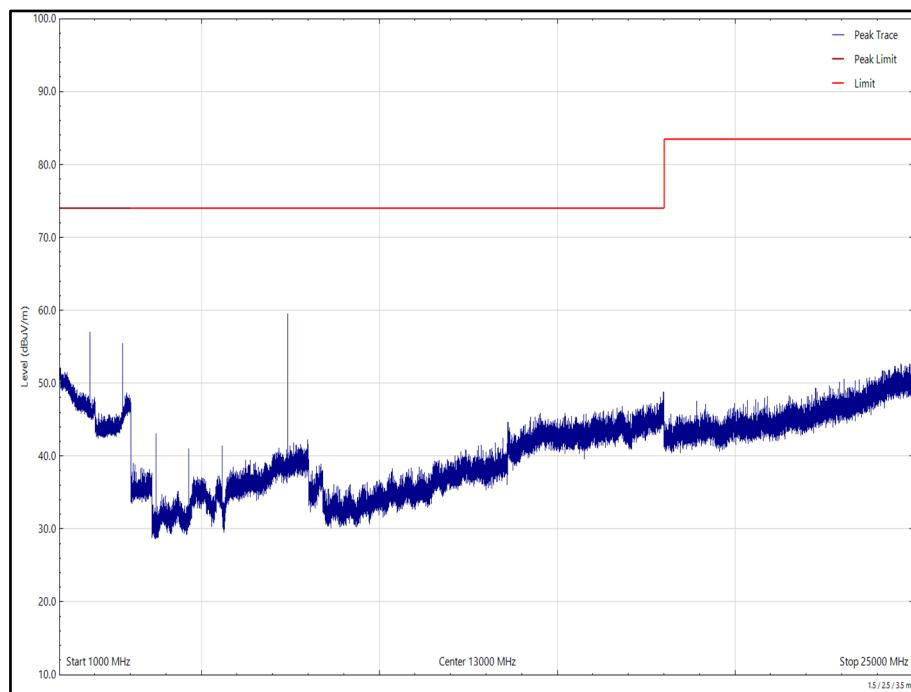


Figure 31 - 927.74 MHz, 1 GHz to 25 GHz, Horizontal - Peak

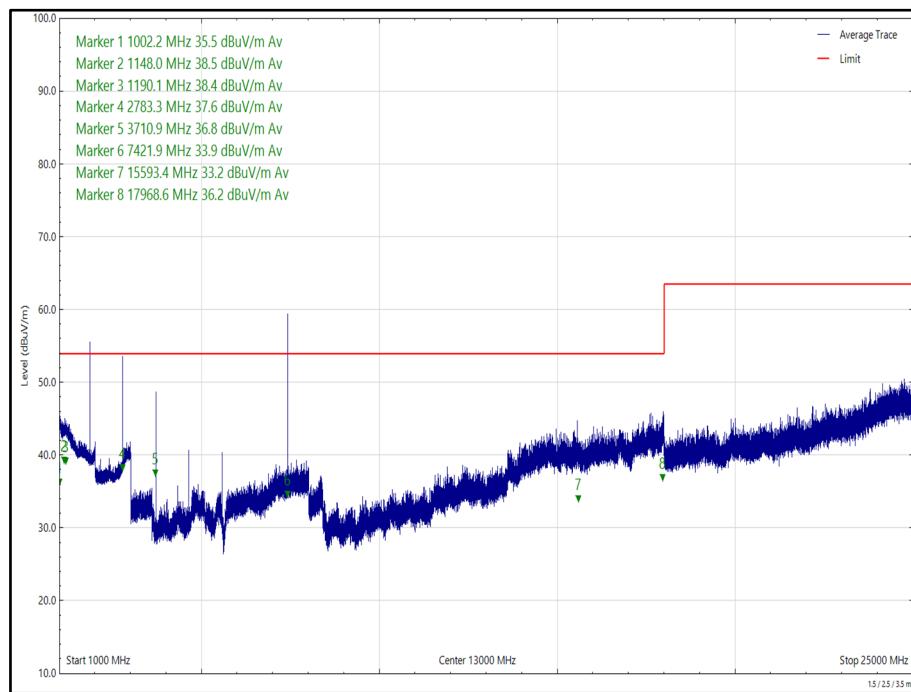


Figure 32 - 927.74 MHz, 1 GHz to 25 GHz, Horizontal: - Average

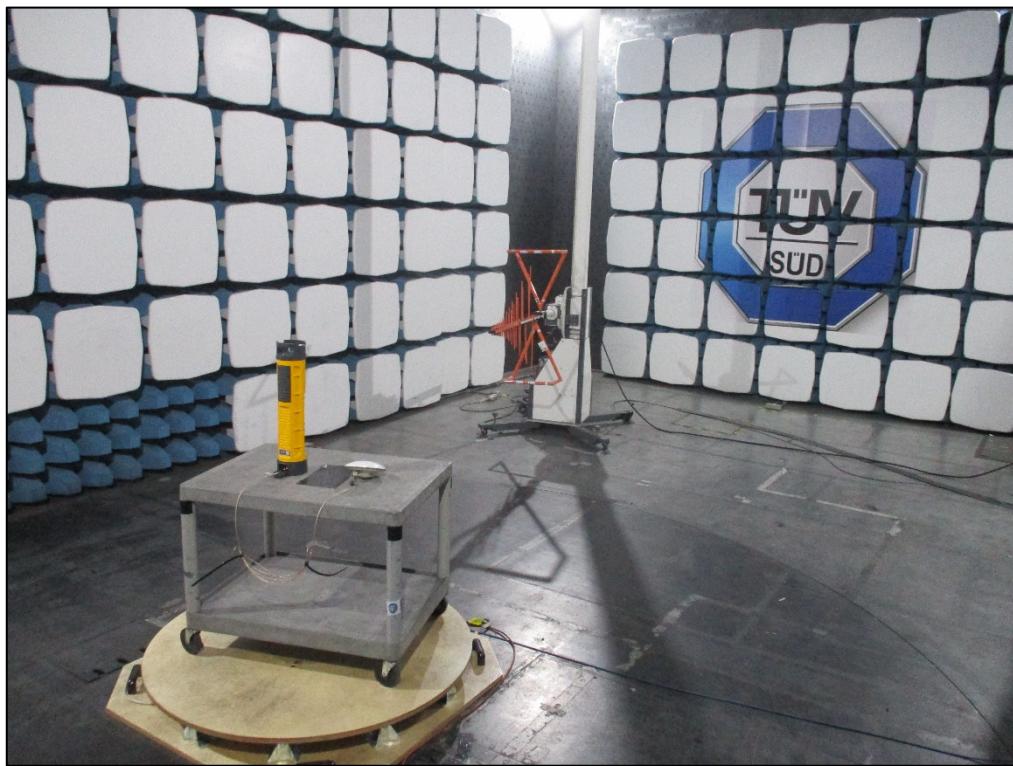


Figure 33 – Test Setup- 30 MHz to 1 GHz



Figure 34 - Test Setup - 1 GHz to 18 GHz



Figure 35 - Test Setup - 18 GHz to 25 GHz

FCC 47 CFR Part 15, Limit Clause 15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in 15.209(a)

ISEDC RSS-247, Limit Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

2.7.8 Test Location and Test Equipment Used

This test was carried out in Bearley EMC Chamber 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Power Supply Unit	Farnell	H60-25	1709	-	TU
Bilog Antenna	Schaffner	CBL6143	1858	24	10-Nov-2022
EMC 3m Semi Anechoic Chamber	Rainford	Hybrid	4160	36	16-Dec-2021
7m N-Type Cable	Teledyne Storm	SA90-195-7MTR	4168	6	10-Mar-2021
1-8 GHz Amplifier	Wright Technologies	APS04-0085	4674	12	18-Aug-2021
8-18 GHz Amplifier	Wright Technologies	APS04-0086	4675	12	18-Aug-2021
EMC Mast controller	Innco Systems	CONTROLLER CO3000	4728	-	TU
1 - 18GHz DRG Horn	ETS-Lindgren	3117	4737	24	28-Jul-2021
EMI Receiver	Keysight Technologies	N9038A MXE	4974	12	27-Jan-2022
EmX Emissions Software	TUV SUD	V2.1.7	5125	-	Software
Cable (18GHz N Type 3m)	Rosenberger	LU7-036-3000	5163	12	10-Dec-2021
3 GHz High Pass Filter	RLC Electronics	F-100-3000-5-R	5229	12	07-Jul-2021
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	5232	12	10-Mar-2021
Turntable Controller	Maturo	Maturo NCD	5275	-	TU
3m 40 GHz RF Cable	Scott Cables	KPS-1501-3000-KPS	5408	12	10-Dec-2021
7m K Type Cable	IntelliConnect Limited	I23398	5622	12	15-Sep-2021
4dB Attenuator	Pasternack	PE7047-4	5647	24	10-Nov-2022
Scientific Ambient Monitor	Testo	622	5698	12	17-Feb-2022
Broad-Band Horn Antenna 15-26.5(40)GHz	Schwarzbeck	BBHA 9170	5233	12	14-Oct-2021
18-40GHz Pre-Amplifier	Schwarzbeck	BBV9721	5241	12	14-Oct-2021
Turntable	Maturo	TT 1.2WF Turntable Model TT1.2WF 1011 3110.01	5780	-	TU

Table 24

TU - Traceability Unscheduled

3 Photographs

3.1 Test Setup Photographs



Figure 36 - Front View - DGPS Commander



Figure 37 - Rear View - DGPS Commander

4 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

Test Name	Measurement Uncertainty
Maximum Conducted Output Power	± 3.2 dB
Frequency Hopping Systems - Average Time of Occupancy	-
Frequency Hopping Systems - Channel Separation	± 1.87 kHz
Frequency Hopping Systems - Number of Hopping Channels	-
Frequency Hopping Systems - 20 dB Bandwidth	± 1.87 kHz
Authorised Band Edges	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Spurious Radiated Emissions	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB

Table 25

Measurement Uncertainty Decision Rule

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115: 2007, clause 4.4.3 and 4.5.1.