

**Results of the Post-Energisation
Electromagnetic Field
Site Survey at the Fairfax Buildings
(Uncontrolled Electronic Copy)
for
RG Group**

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CHANGE HISTORY SHEET

Date	Issue	Section	Description
15.08.2025	1	-	First issue

EXECUTIVE SUMMARY

Swept-frequency electromagnetic (EM) field emissions measurements were made at the site of the newly built Fairfax Buildings in Manchester on Wednesday 13th August 2025. The Fairfax buildings are located approximately 20m from the adjacent 750V DC Manchester tram line.

The results were compared to the requirements of UK Designated standard EN50121-2: 2006 (emissions of the whole railway to the outside world) for DC tram systems (Class C).

All exceedances of the Class C limit of EN 50121-2: 2006 were attributed to bona-fide broadcast/communication services. No exceedances were attributable to the Fairfax Buildings.

The measured field strengths are consistent with the measurement location adjacent to a working tram system, and do not give credible cause for concern.

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LIST OF TERMS AND ABBREVIATIONS

AM	Amplitude Modulation
ARA	Active Receive Antenna
DAB	Digital Audio Broadcasting
DC	Direct Current
EM	Electromagnetic
EMC	Electromagnetic Compatibility
EMF	Electromagnetic Field
EMI	Electromagnetic Interference
FM	Frequency Modulation
3G, 4G, 5G	Third, fourth, fifth Generation
GSM	Global System for Mobile communications (2G mobile)
LTE	Long-Term Evolution (4G mobile telecoms)
LW	Long Wave (Radio)
MW	Medium Wave (Radio)
PFM	Power Frequency Magnetic field
PMR/PBR	Private Mobile Radio/Private Business Radio
PMSE	Programme Making and Special Events
POCSAG	Post Office Code Standardization Advisory Group
RF	Radio Frequency
SW	Short Wave (Radio)
TETRA	Terrestrial Trunked Radio (emergency services digital telecoms)
TV	Television
UK	United Kingdom
UMTS	Universal Mobile Telecommunications System (3G mobile)

1 INTRODUCTION

This report presents the results of radio frequency electromagnetic (EM) measurements made on Wednesday 13th August 2025 at the site of the new Fairfax Buildings in Manchester, with address:

The Fairfax,
Portugal St East,
Manchester,
M1 2WL.

Measurements were taken at ground level, following energisation of the building electrical systems. The measurements are described in an associated Test Plan, Y6009CR1 [1] and Method Statement, Y6143CR1 [2].

The purpose of these measurements is to benchmark the existing, post-energisation electromagnetic environment and compare it with the limits of EN 50121-2:2006 [3], and with the previous measurement results [4].

The overarching aim is to demonstrate that the energised Fairfax Buildings are not a credible source of interference to the adjacent tram system, in line with the requirements on Fixed Installations within the EMC Regulations [5] as amended.

Section 2 describes the measurement method and measurement locations. Section 3 summarises the results of the measurements. Section 4 presents analysis and conclusions for the project.

2 MEASUREMENT DETAILS

2.1 Test locations

Figure 1 shows the three locations used for measurements for the pre-energisation survey undertaken in June 2025. These points were re-used for the post-energisation survey.

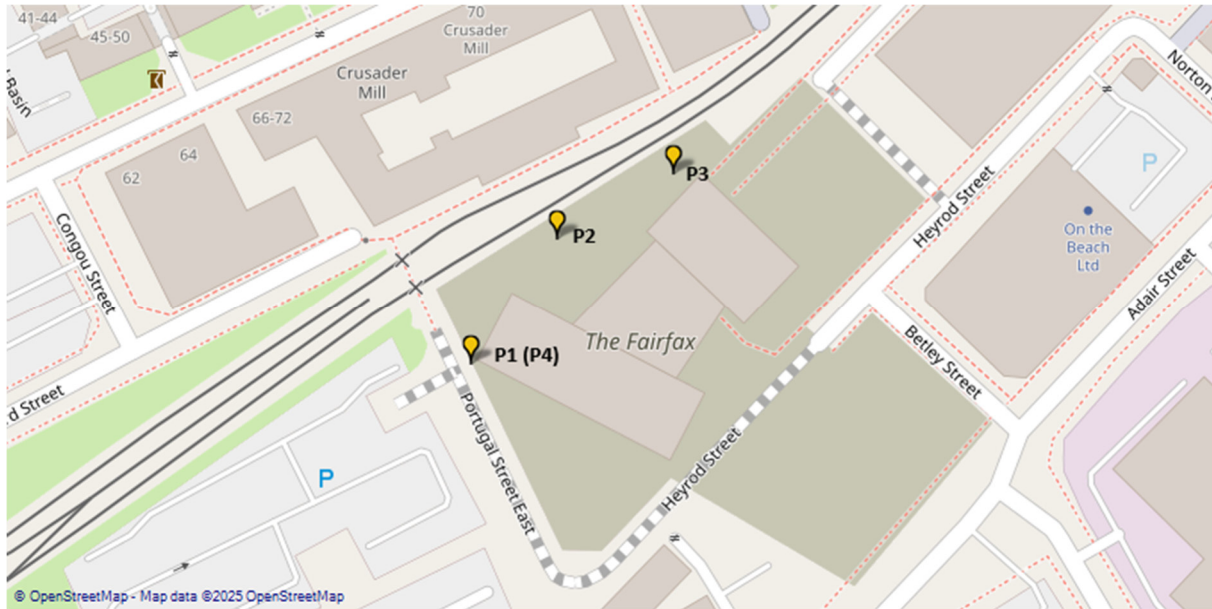


Figure 1: Measurement locations used for the pre- and post-energisation measurements.

Originally, four test points had been planned, but access to points 1 and 4 was not possible; the point labelled “P1 (P4)” lies between the two points.

Points P2 and P3 are 10m from the centre-line of the nearest track.

2.2 Electromagnetic field measurement method

Measurements were made in line with the EN 50121-2:2006 standard, with a spectrum analyser and appropriate magnetic and electric field antennas as specified in EN 50121-3-1:2006 [6]. Due to moving trains, EN 50121-3-1:2006 specifies measurement sub-ranges to reduce spectrum analyser sweep times below 1 second. The frequency ranges chosen for these measurements preserve that overall aim (while reducing the time required).

It is noted that EN 50121-2:2006 sets limits on EM emissions only in the frequency range 9kHz – 1GHz. However, since many modern computing and communication devices also use frequencies above 1GHz, the measurement frequency range has been extended up to a highest frequency of 6GHz, as indicated in Table 1. Note that in the frequency range below 150kHz, the recommended measurement bandwidth of 200Hz in EN 50121-2:2006

has been substituted (as permitted by EN 50121-2) for the value of 1kHz (see Table 1), in order to complete measurements in a manageable time frame.

The sub-ranges measured at each test location are summarised below in Table 1.

	Sub-range (Hz)	Measurement Bandwidth (Hz)	Sweep time (ms)	Antenna	Measurement Instrument
Requirement of EN 50121-2: 2006	9k – 150k	1k	286	EMCO 6511	Agilent MXE N9038A
	150k – 15M	9k	362	EMCO 6512	
	15M – 30M	9k	366		
	30M – 1G	120k	111	ARA+	
	1G – 3.6G	1M	35	Horn	
	3.6G – 6G	1M	5		

Table 1: Sub-ranges measured at each location.

+ The ARA01 is an active antenna with performance comparable to a BiLog antenna, but which is very much smaller. Saturation does not occur for fields less than 130 dB μ V/m.

Appendix 1 presents a list of the measurement equipment used, with asset numbers.

2.2.1 Antenna mounting heights

The antennas were mounted on a tripod at heights above ground level of:

1. 1.5m to the antenna centre for magnetic antennas.
2. 1.5m to the antenna centre for the ARA antenna.
3. 1.5m to the antenna centre for the horn antenna.

These heights are largely in line with the requirements of EN 50121-2: 2006 [3]. The ARA antenna has been used in place of a normally used BiLog antenna for convenience. The BiLog antenna is normally positioned at a height of 3m, partially on account of its large size. The much smaller size of the ARA antenna enabled a smaller antenna height to be used.

2.2.2 Antenna polarisations

At each measurement position, two polarisations of each antenna were measured. For electric antennas both horizontal and vertical polarisations were measured. For magnetic antennas, loop facing (“parallel”) and loop perpendicular polarisations were measured. Appendix 2 presents the definitions used.

2.2.3 Measurement display

For magnetic fields, measurements made with the loop antenna facing the building are shown in blue, and with the antenna perpendicular, in red. For electric fields, vertically polarised measurements are shown in blue, and horizontally polarised measurements in red.

Limits on emissions from the railway infrastructure to the outside world are set out in EN 50121-2: 2006, between 9 kHz and 1 GHz. The Class C limit (for < 750 Vdc railways) is shown in green. Both these limit lines are specified for a 10m separation; where the measurement antennas were not at this distance, the displayed limits have been adjusted in accordance with EN 50121-2: 2006, Clause 5.1.6.

Below 150 kHz, the change in measurement bandwidth (from 200 Hz to 1 kHz) results in a potential over-reporting of impulsive noise by a factor of 5 (14 dB). The limit line has been adjusted in the presented figures to account for this.

2.3 Locations, Dates, Times and Weather Conditions

Details of the measurement locations are shown in Table 2. The locations are marked in Figure 1.

ID	Location	Date/Time	Weather
1 (4)	Side of building, away from tramway	13/08/2025 09:00-12:00	Sunny dry, 29 C, light wind (8km/h N)
2	Between building and tramway	13/08/2025 13:00-17:00	
3	Between building and tramway	13/08/2025 14:30-17:45	

Table 2: Summary of measurement locations.

For full details of the test points, see the Test Plan [1].

3 MEASUREMENT RESULTS

3.1 Test Position 1 (4)

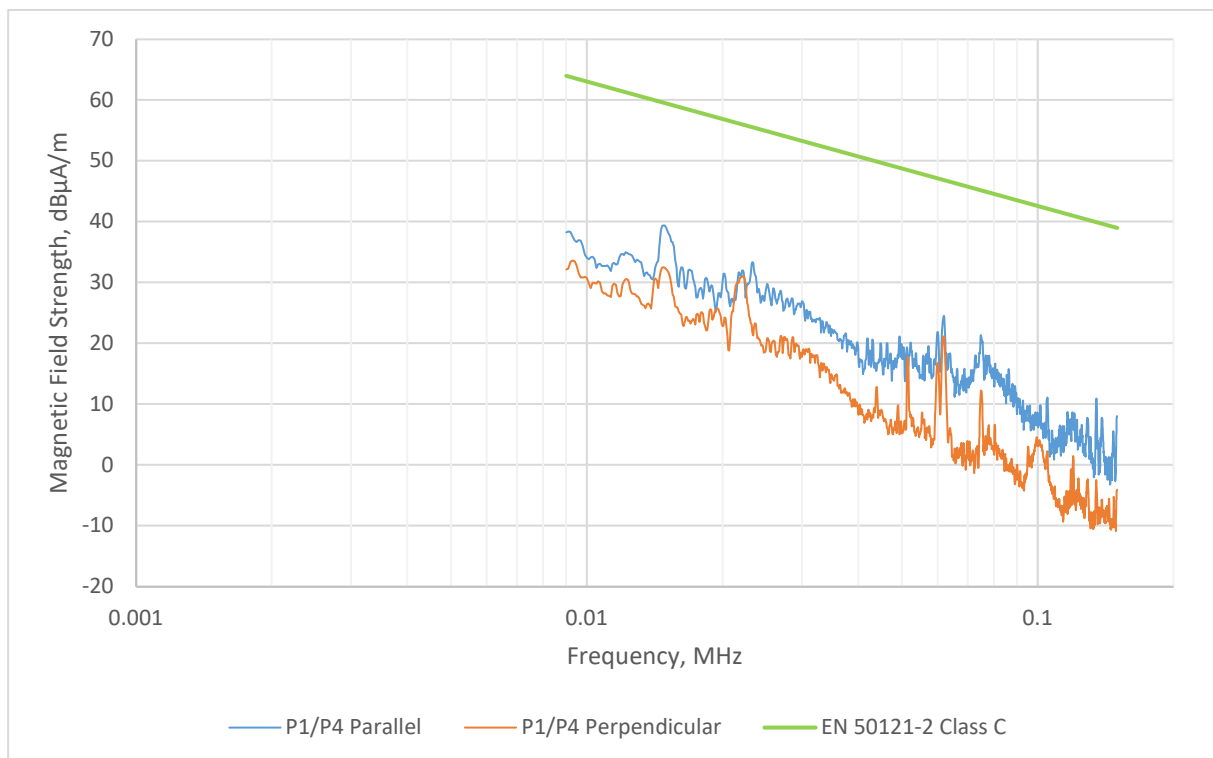


Figure 2: Maximum measured magnetic field strength at TP1 (TP4) from 9 kHz to 150 kHz. (Limit adjusted for 1kHz bandwidth).

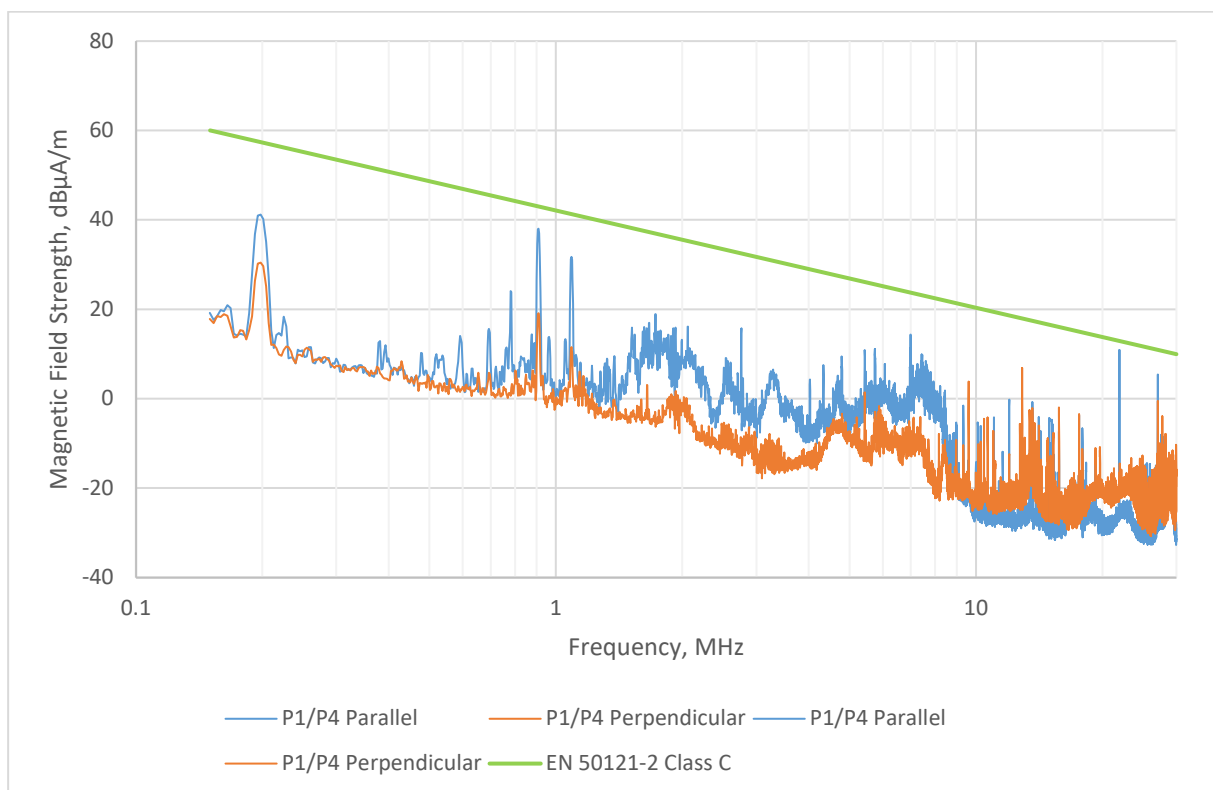


Figure 3: Maximum measured magnetic field strength at TP1 (TP4) from 150 kHz to 30 MHz.

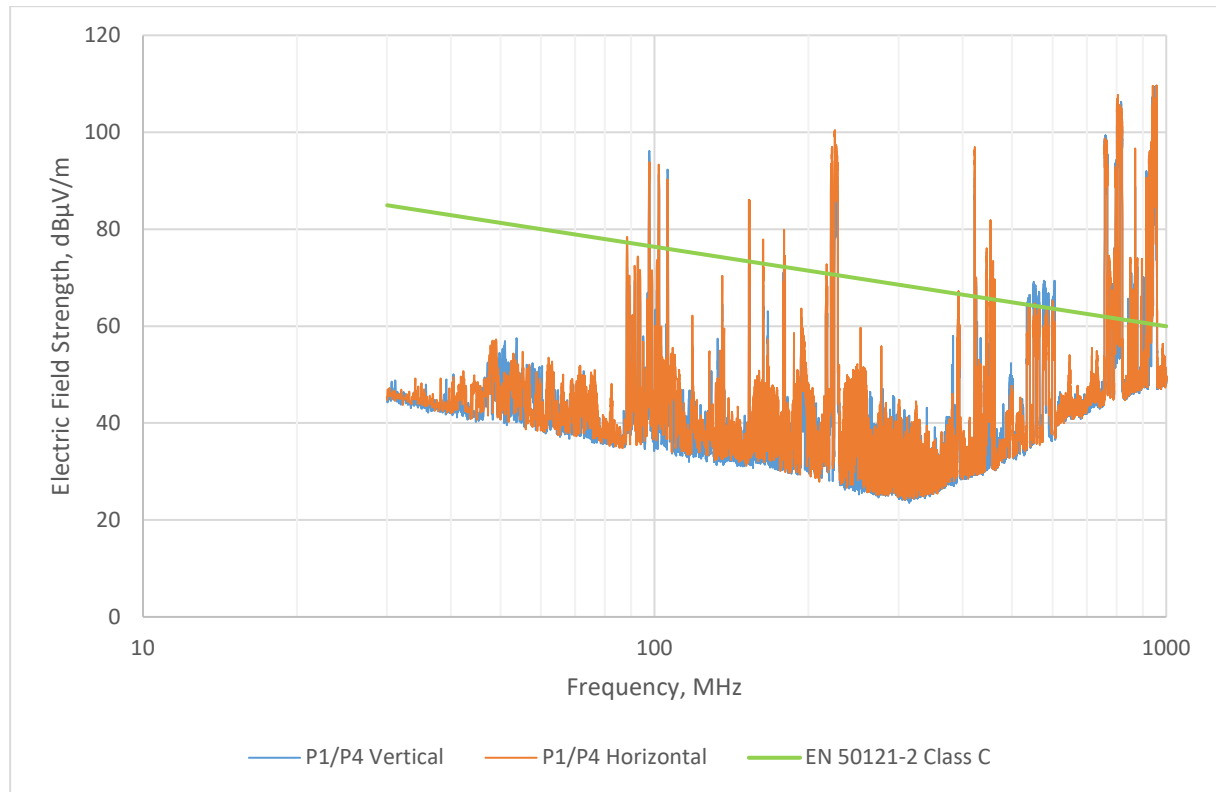


Figure 4: Maximum measured electric field strength at TP1 (TP4) from 30 MHz to 1 GHz.

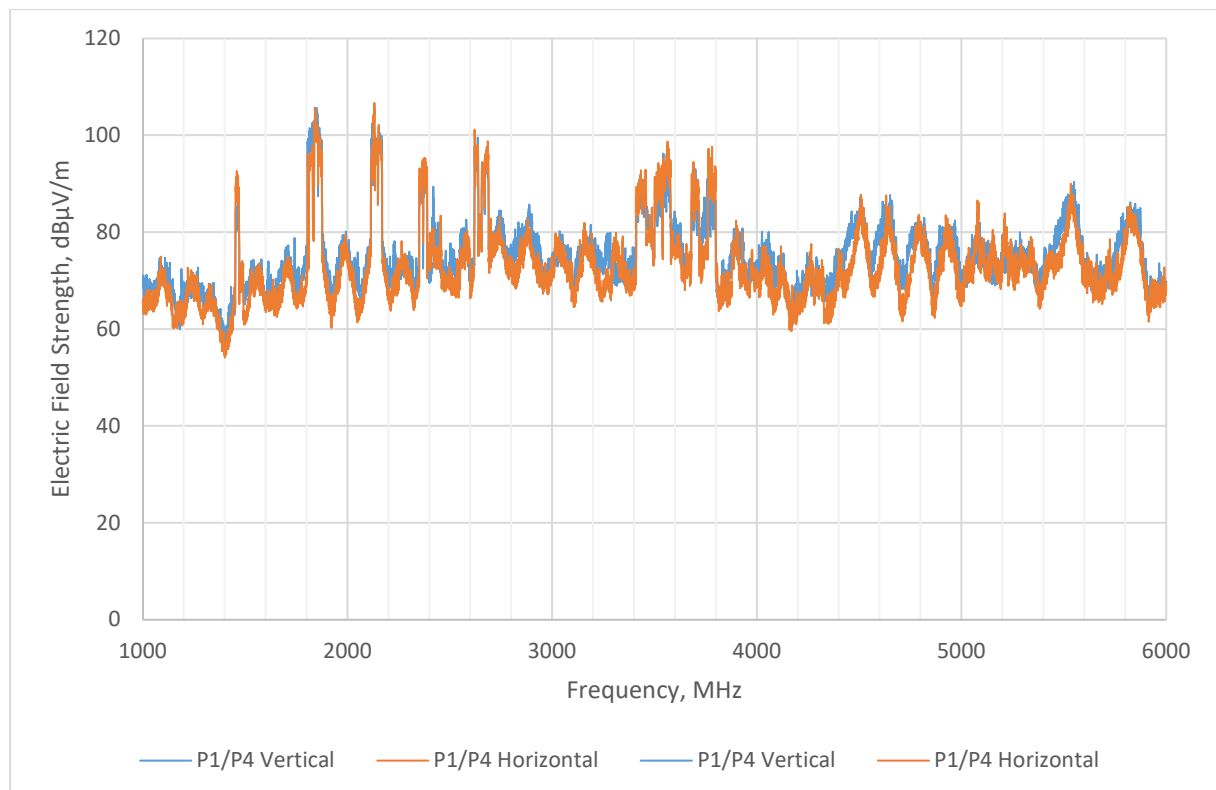


Figure 5: Maximum measured electric field strength at TP1 (TP4) from 1 GHz to 6 GHz.

3.2 Test Position 2

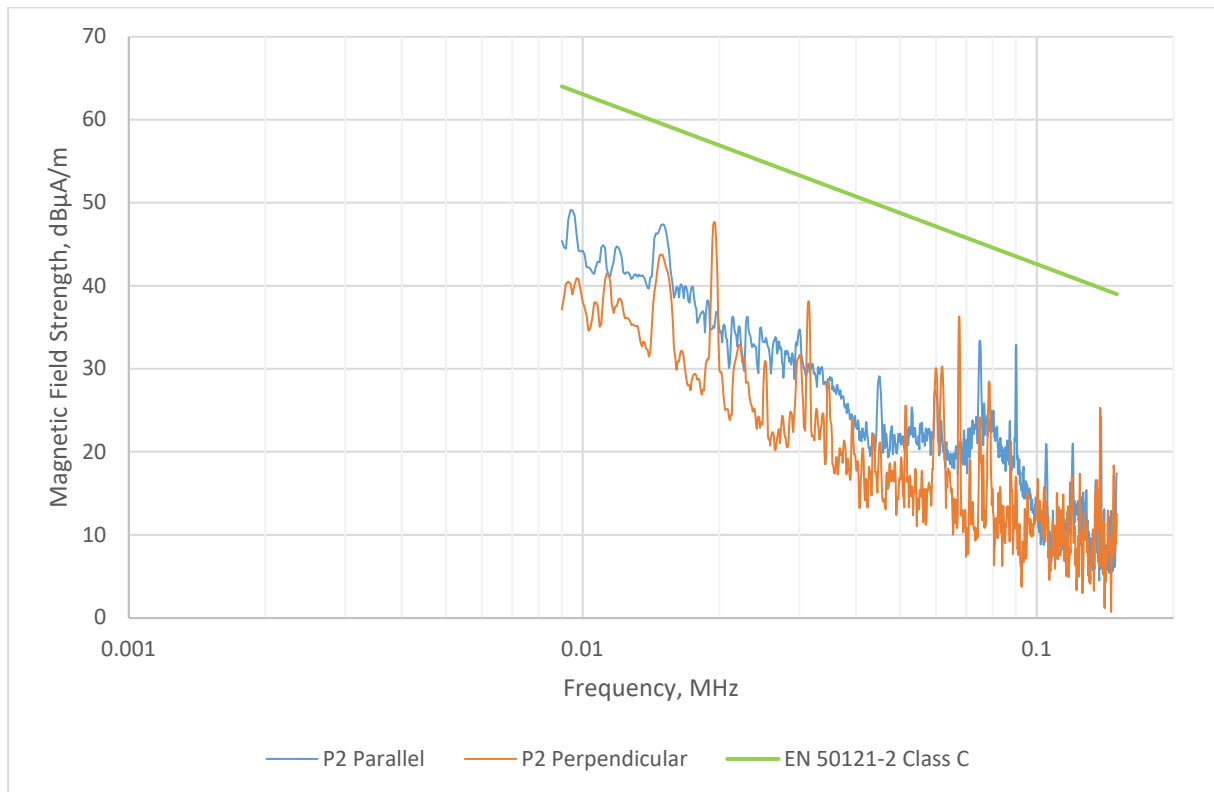


Figure 6: Maximum measured magnetic field strength at TP2 from 9 kHz to 150 kHz. (Limit adjusted for 1kHz bandwidth).

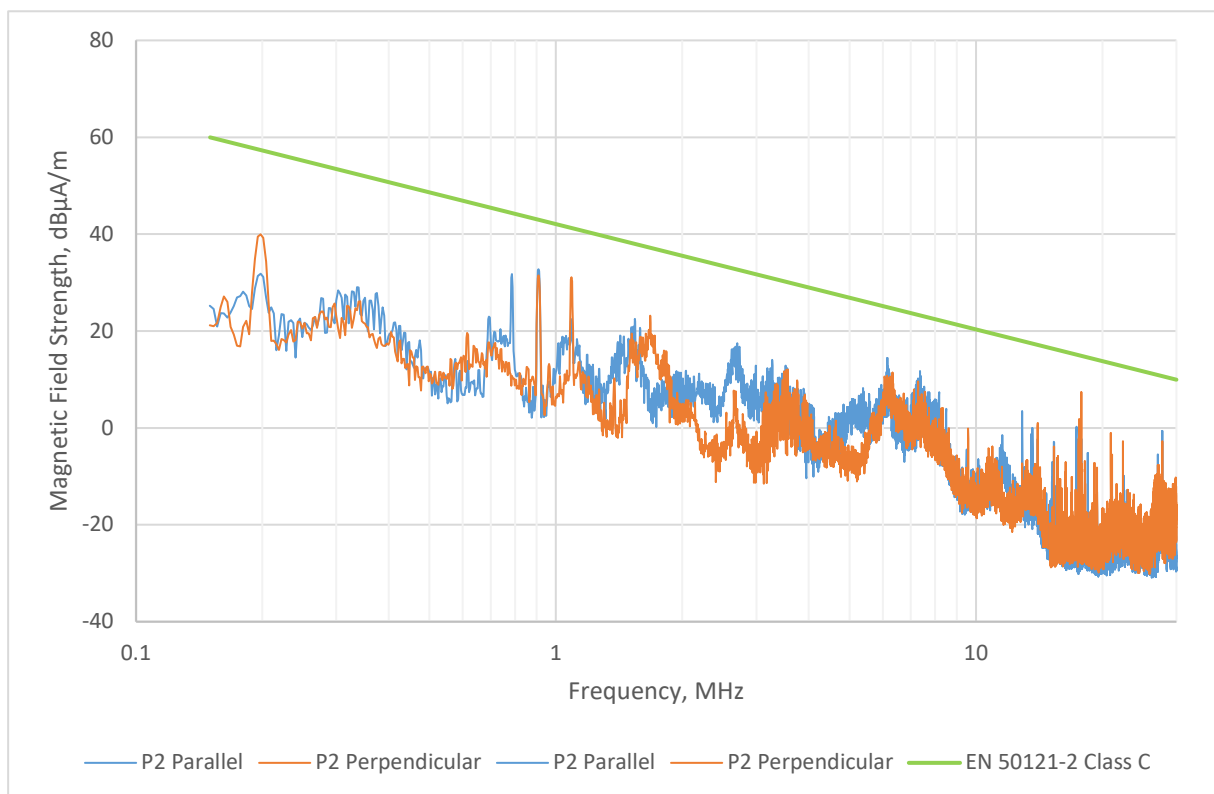


Figure 7: Maximum measured magnetic field strength at TP2 from 150 kHz to 30 MHz.

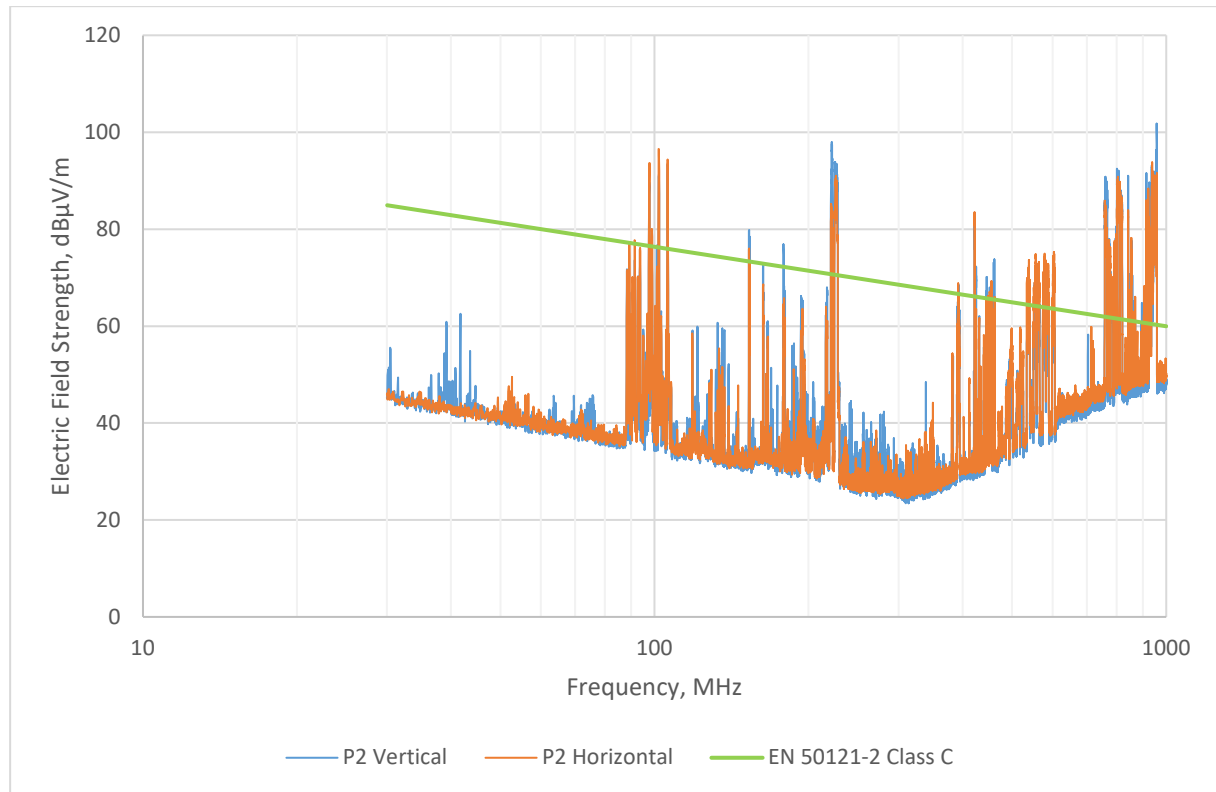


Figure 8: Maximum measured electric field strength at TP2 from 30 MHz to 1 GHz.

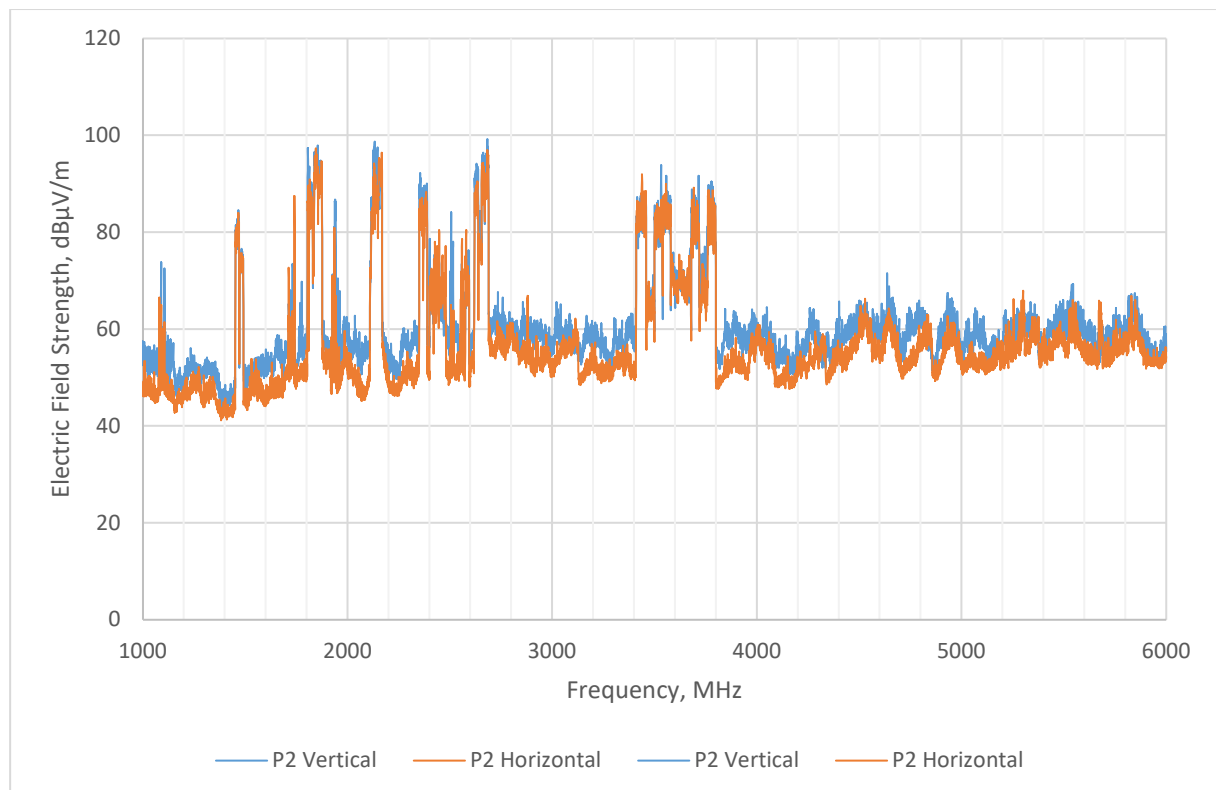


Figure 9 : Maximum measured electric field strength at TP2 from 1 GHz to 6 GHz.

3.3 Test Position 3

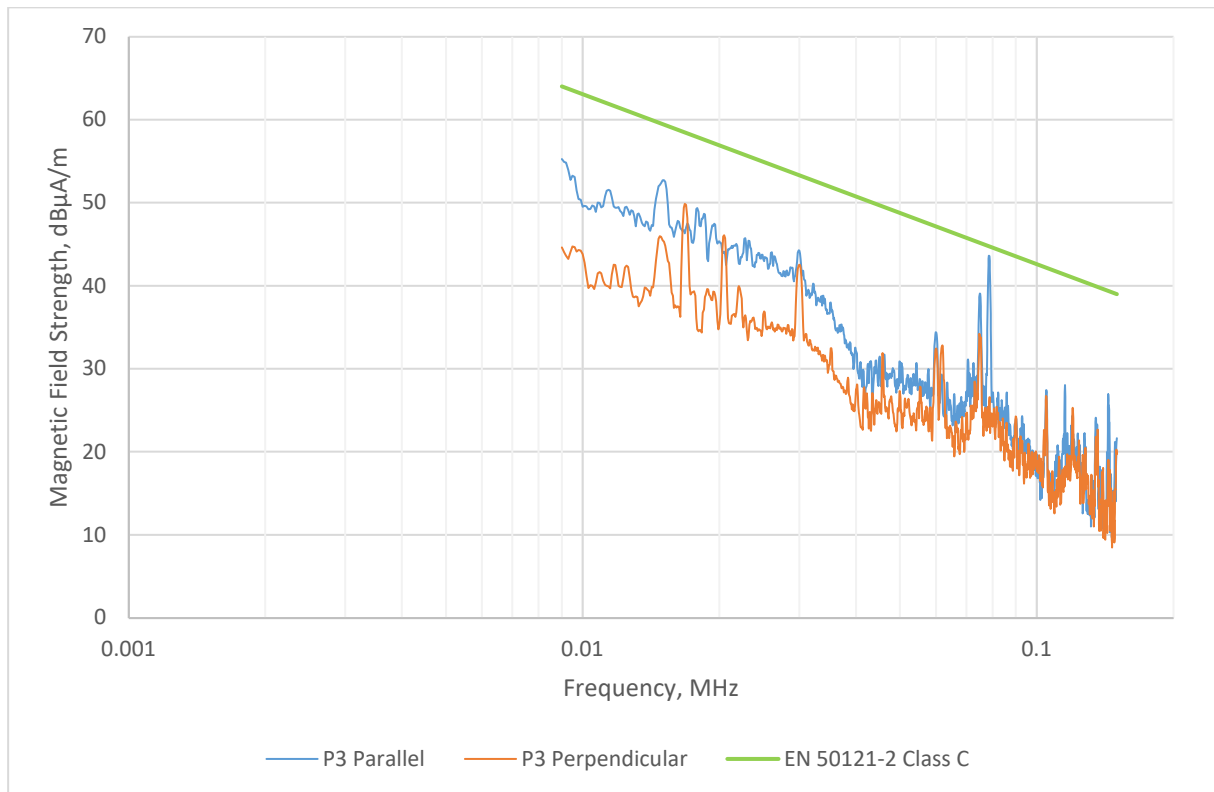


Figure 10: Maximum measured magnetic field strength at TP3 from 9 kHz to 150 kHz. (Limit adjusted for 1kHz bandwidth).

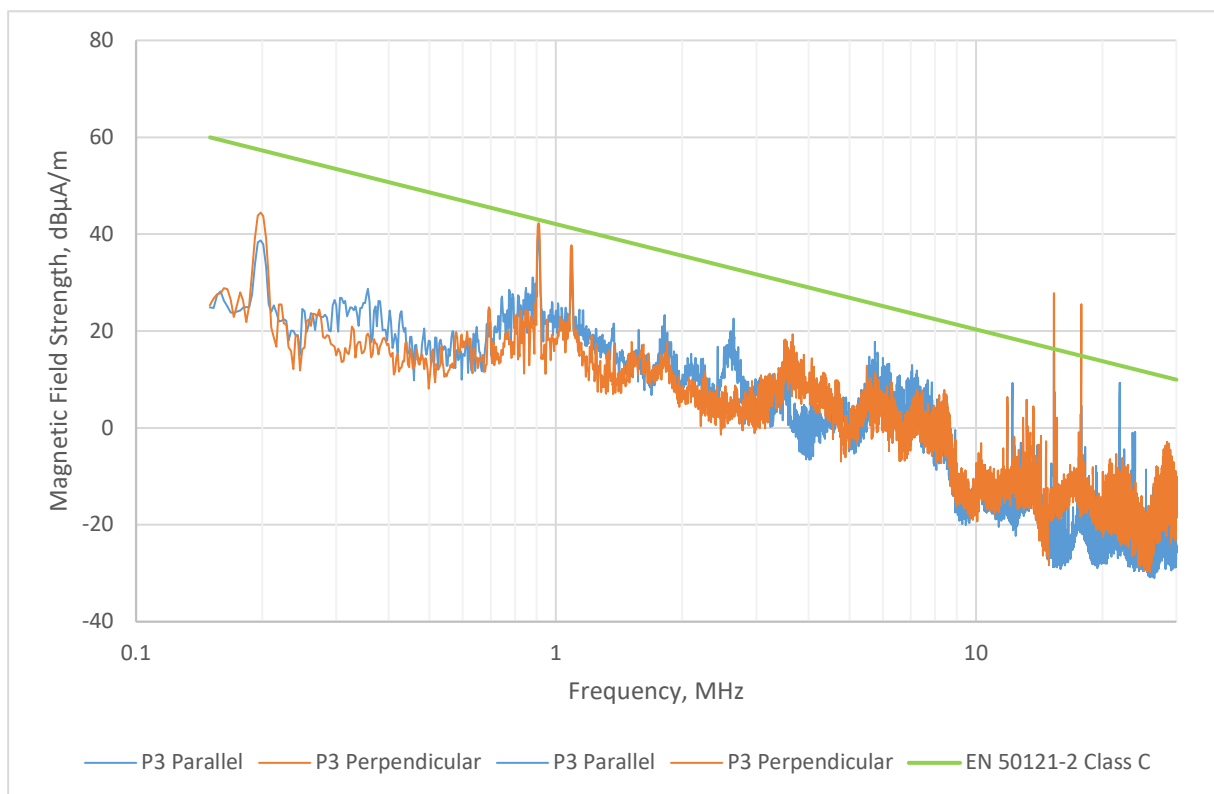


Figure 11: Maximum measured magnetic field strength at TP3 from 150 kHz to 30 MHz.

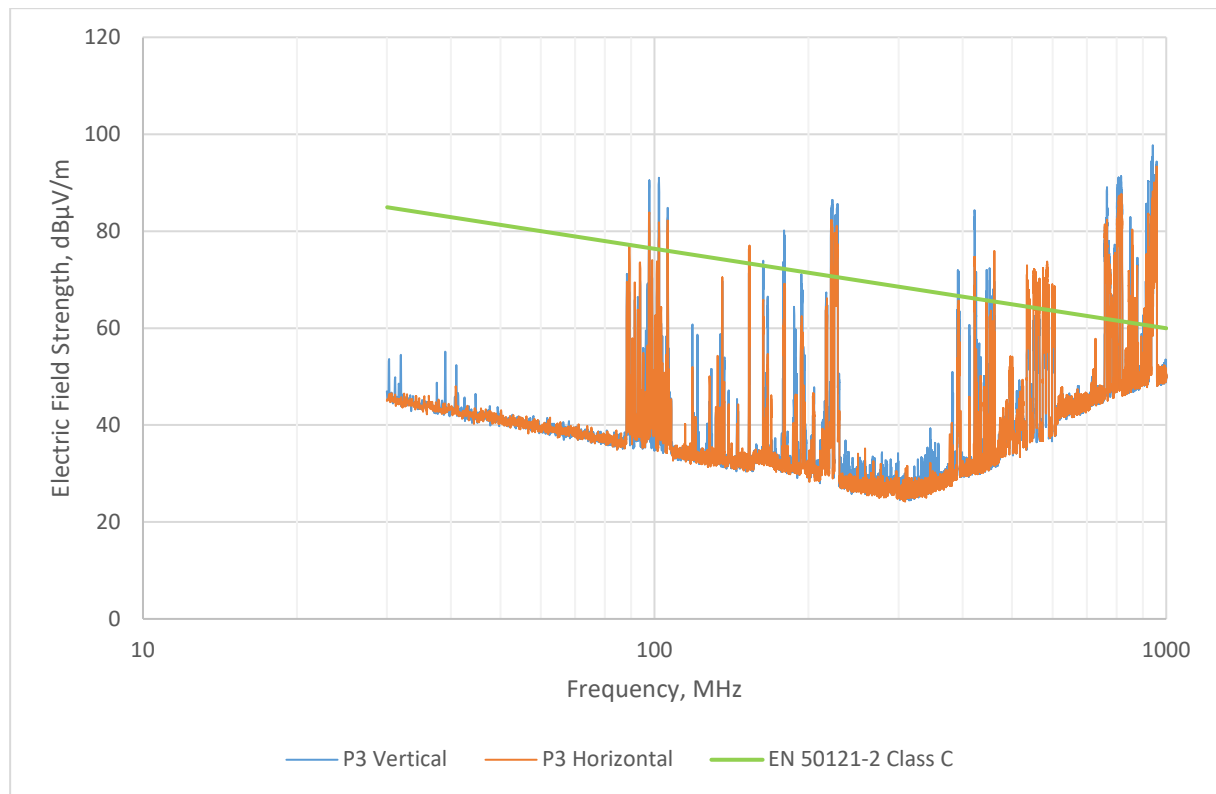


Figure 12: Maximum measured electric field strength at TP3 from 30 MHz to 1 GHz.

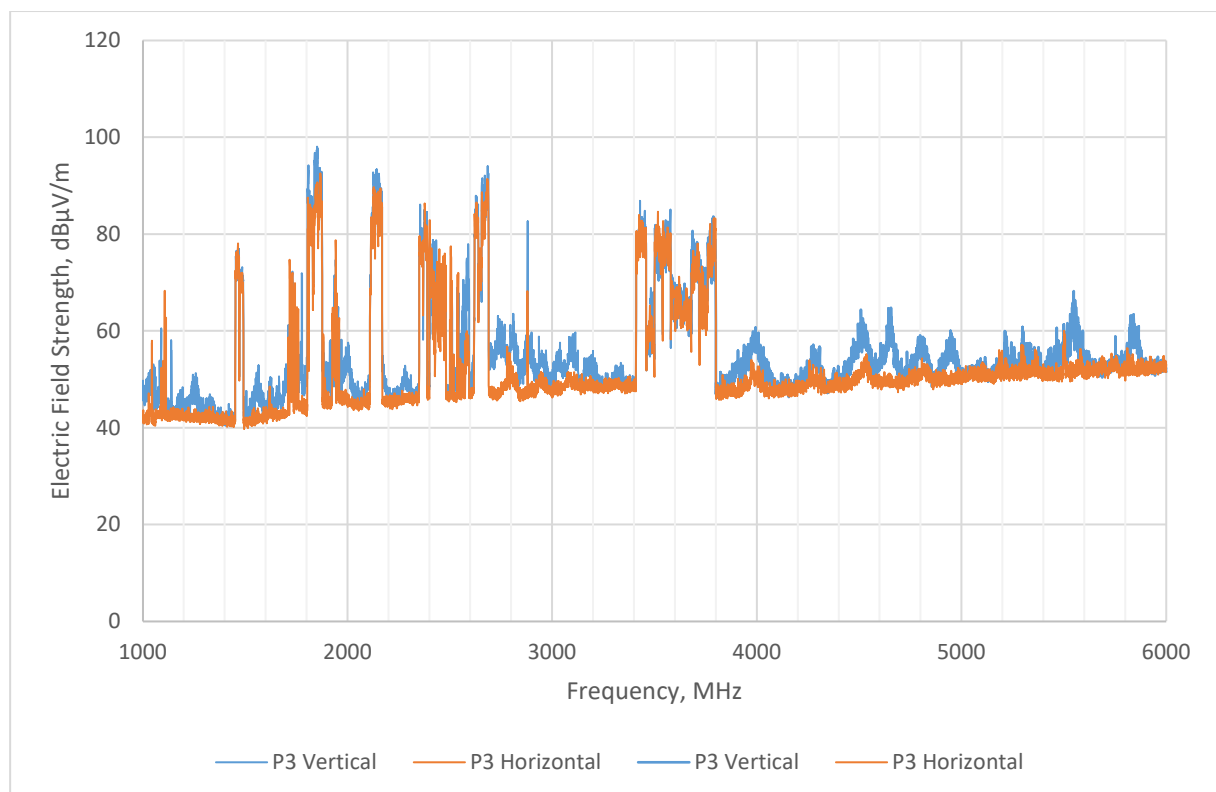


Figure 13 Maximum measured electric field strength at TP3 from 1 GHz to 6 GHz.

4 ANALYSIS AND CONCLUSIONS

4.1 Below 150 kHz

There were no exceedances of the Class C limit (as adjusted to account for the wider measurement bandwidth) below 150 kHz.

4.2 From 150 kHz to 30 MHz

There were two exceedances of the Class C limit. These were at TP3. One exceedance, at 17.81 MHz, was previously observed in June. The second exceedance, at 15.34 MHz, was not previously observed. Both signals are in bands for use by short-wave radio broadcasts, and are therefore attributed to such services.

4.3 From 30 MHz to 1 GHz

Exceedances of the limits above 30 MHz were seen at all three test points. These are at frequencies of bona fide broadcast and communications services (private mobile radio, TETRA, broadcast TV, mobile phone up & down-links (GSM/3G/4G/5G)) and are thus attributed to such services.

Exceedances at less common frequencies for PMR and similar services are listed in Table 3.

Frequency (MHz)	Exceedance (dB)			Note
	TP1 (TP4)	TP2	TP3	
153.05	13	7	4	Emergency Services emissions (POCSAG radio pager)
163.1	5		1	PMR transmission (Bus inspectors, parking enforcement)
179.2	8	5	8	Programme Making and Special Events (PMSE) transmission
422.7	31	17	18	Emergency Services, PMSE, Business Radio (PMR) or Defence related emissions
425.25	4	6	5	
445.7	10	4	6	
453.55	16		7	
458.7	8		2	
462.3	4	8	10	

Table 3: Exceedances at less common frequencies.

4.4 Above 1 GHz

EN 50121-2: 2006 does not limit emissions above 1 GHz; the measurements show field levels that are not unusually high.

REFERENCES

- 1 T. Konefal, "Plan for electromagnetic field measurements at The Fairfax," Doc. No. Y6009CR1, Eurofins E&E UK, May 2025.
- 2 C Greenfield, "Method statement for electromagnetic field measurements at The Fairfax," Doc. No. Y6143CR1, Eurofins E&E UK, August 2025.
- 3 EN 50121-2: 2006, "Railway applications - Electromagnetic compatibility Part 2: Emission of the whole railway system to the outside world", CENELEC, July 2006.
- 4 T Konefal, "Results of the Electromagnetic Field Site Survey at the Fairfax Buildings", Doc. No. Y6036CR1, Eurofins E&E UK, July 2025.
- 5 Statutory Instrument 2016 No. 1091, Electromagnetic Compatibility, The Electromagnetic Compatibility Regulations 2016.
- 6 EN 50121-3-1:2006, "Railway applications. Electromagnetic compatibility -Rolling stock -Train and complete vehicle", CENELEC, July 2006

APPENDIX 1 - LIST OF EQUIPMENT USED

Item	Model	Identifier
Spectrum Analyser	Keysight MXE 9038A	C0339
Loop Antenna	ETS 6511	C0227
Loop Antenna	ETS 6512	C0226
Active Receive Antenna	York EMC Services ARA01	s/n 1186
Horn Antenna	EMCO 3117	C0509
Pre-amp	Hewlett Packard 8447F OPT H64	C0620
	Bonn BLMA 0118A	Y0145

APPENDIX 2 - PARALLEL & PERPENDICULAR ORIENTATIONS

Figure 14 presents the antenna orientations referred to as “facing” (“parallel” below) and “perpendicular” in this document.

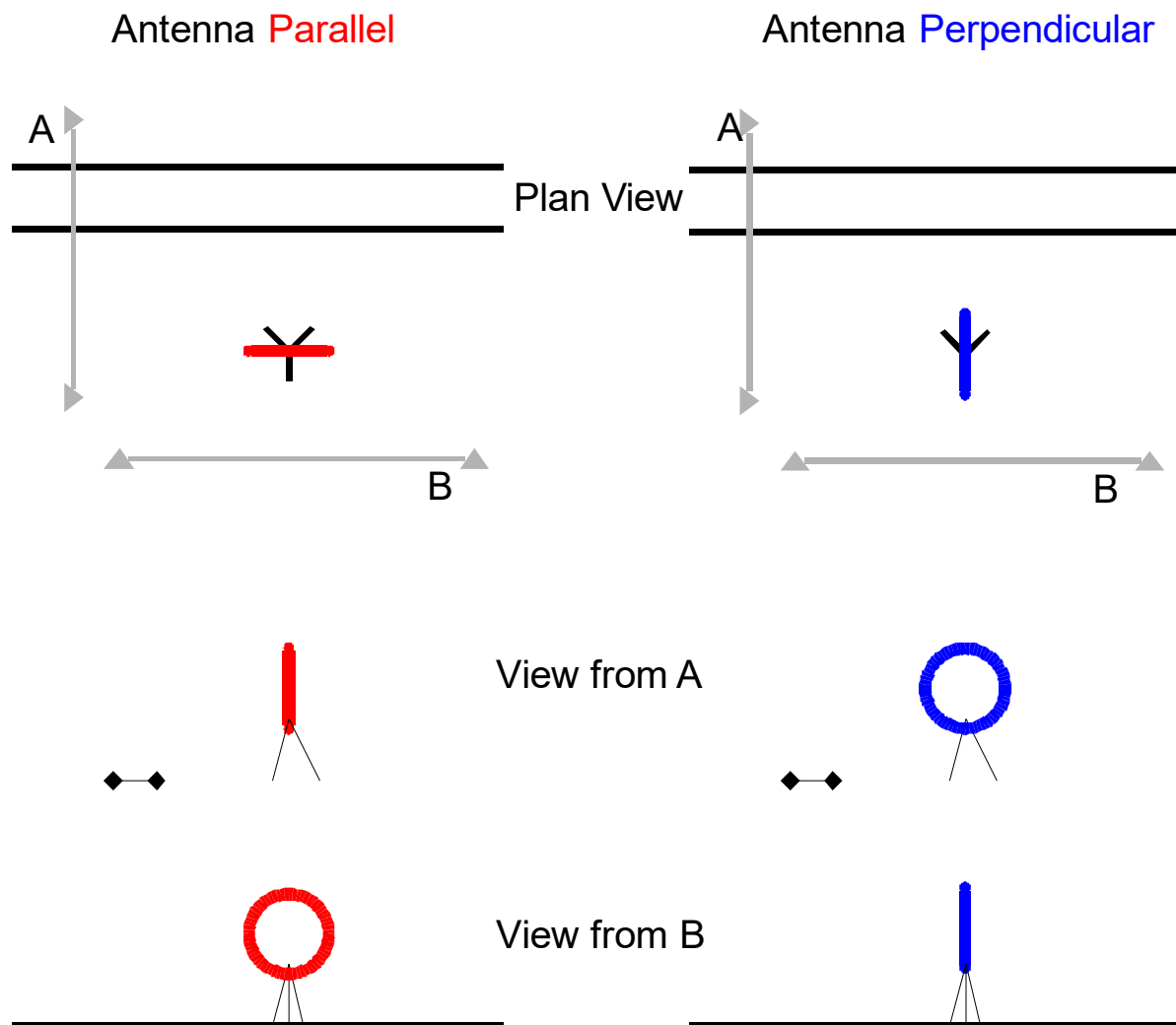


Figure 14: Definitions of facing/parallel and perpendicular antenna facings used in this document.

APPENDIX 3 – MEASUREMENT PHOTOGRAPHS



Test Point 1 (4).



Test Point 2.



Test Point 3