EMF measurements around a monopole base station: Hatfield

At various distances and heights from the antenna

Report

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Overview

Monopoles are a type of telecommunications mast used to transmit mobile phone signals. Unlike traditional mobile phone towers, monopoles have a slim profile and compact design, requiring less ground space to install. This means they can be especially helpful for providing coverage in urban or space-limited environments.

The transmitting antennas are located towards the top of the monopole and in general the monopole will be taller than surrounding buildings (although not in all cases). In recent months we have received queries from members of the public expressing concerns about the electromagnetic field (EMF) levels produced by such masts, especially where they are relatively close to residential buildings.

Ofcom already carries out measurements around mobile phone masts (including monopole masts) and publishes these on our website – these tend to be taken just above ground level (at around 1.5 metres in height). This report is one of a small series of more detailed measurements that we are taking around monopole masts with measurements taken at multiple heights and distances.

What we have found – in brief

This report presents the results of our EMF measurements around a monopole mobile phone mast in Hatfield, Hertfordshire (see image of mast below). Measurements were taken using an EMF probe at a variety of heights and distances around the mast.

The highest EMF level we recorded from this monopole mast was **1.34%** of the ICNIRP general public level at a height of 16 metres above ground level and 5 metres from the mast. This indicates that the EMF levels in close proximity to this mast are well within those agreed internationally for general public exposure.

Summary of measurement results

This report presents the results of measurements of electromagnetic field (EMF) emission levels around a monopole base station in Hatfield, Hertfordshire. The height of the top of the monopole was 20 metres above ground level.

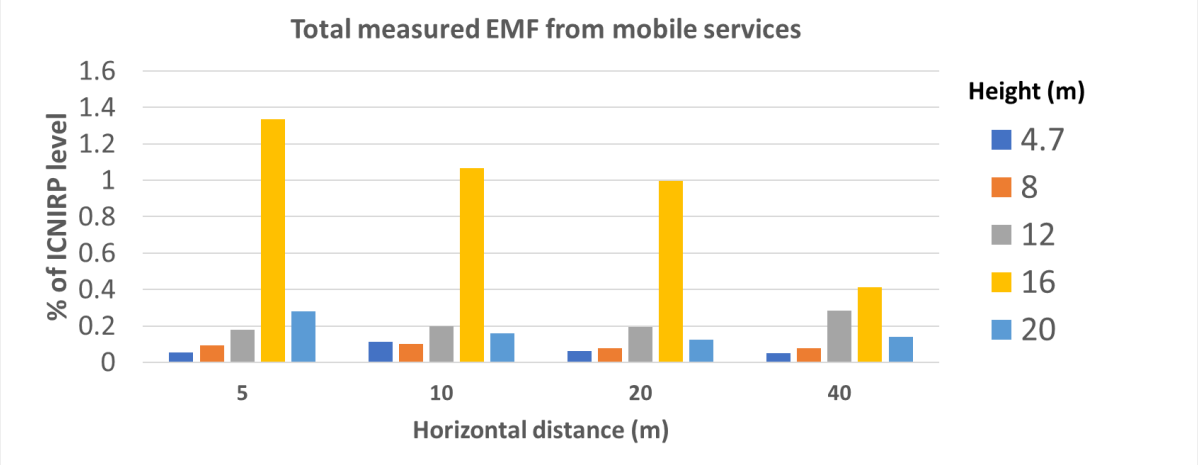
Measurements were taken at a range of heights and distances from the monopole, across all frequencies used for mobile base station transmissions between 420 MHz and 6 GHz.

The results are presented as percentages of the power density reference levels for general public exposure in the 1998 edition of ICNIRP Guidelines.

Table 1: EMF levels recorded at each measurement point

		Horizontal distance from the monopole			
		5m	**10m**	**20m**	**40m**
Height above ground level	**20m**	0.28%	0.16%	0.12%	0.14%
	16m	**1.34%**	1.07%	1.00%	0.41%
	12m	0.18%	0.20%	0.19%	0.28%
	8m	0.09%	0.10%	0.08%	0.08%
	4.7m	0.05%	0.11%	0.06%	0.05%

Figure 1: EMF levels chart



As can be seen from the table and chart above, the highest EMF level recorded was 1.34% of the ICNIRP reference level for general public exposure at a height of 16 metres above ground level and 5 metres from the monopole. This is to be expected, as the 16-metre measurement height broadly aligned with the height of the antenna panels on the monopole mast.

Measurement details, setup and location

Measurement details

Table 2: Measurement date, time and location

Date of measurement	16/01/2025
Measurement location	Hatfield, Hertfordshire
Time of measurement	10am - 3pm

Table 3: Measurement equipment

Measurement equipment	Model
Spectrum analyser	Keysight Fieldfox N9915A
Probe	AGOS Aria-6000
Cable	1 meter
Measurement vehicle	MAN van with 20m mast

Table 4: Frequency bands covered by this report

Frequency band (MHz)	Frequency range (MHz)	Technology[1]
700	738-788	4G, 5G
800	791-821	4G
900	925-960	4G
1400	1452-1492	4G (Supplementary downlink)
1800	1805-1880	4G
1900	1900-1920	4G
2100	2110-2170	4G
2300	2350-2390	4G
2600 TDD	2570-2620	4G
2600 FDD	2620-2690	4G
3400	3410-3680	4G, 5G
3800	3680-4200	4G, 5G

Measurement set-up

Measurements were taken using an EMF measurement probe connected to a spectrum analyser and mounted on a measurement vehicle with a pump-up mast, as illustrated in **Figure 2**.

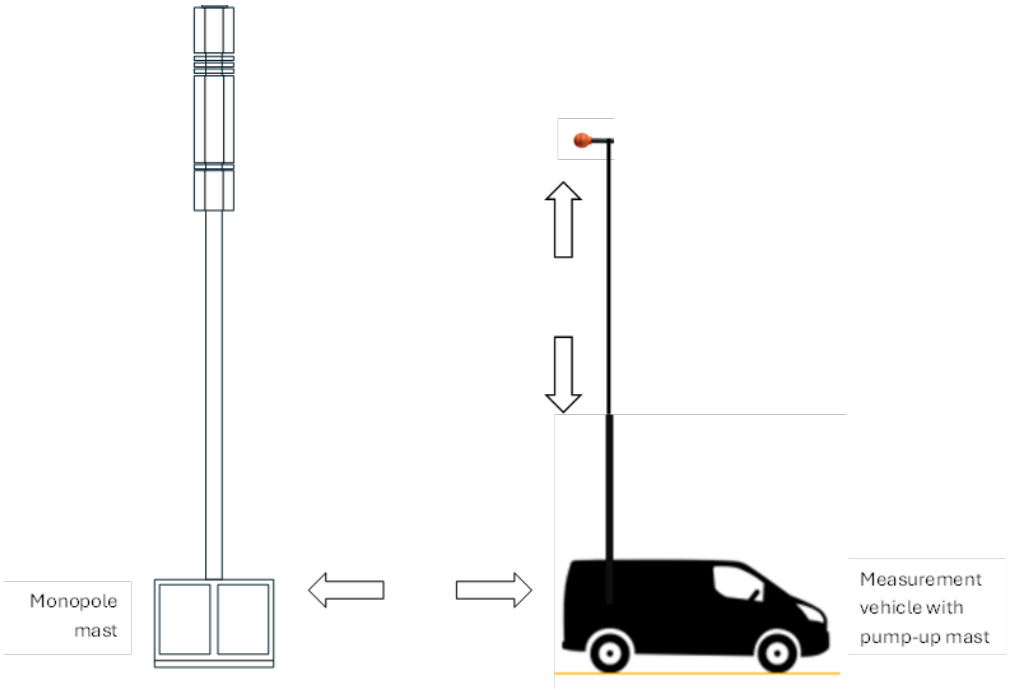
The measurement vehicle was then positioned so that the pump-up mast was at a fixed distance from the monopole, with the probe on the pump-up mast aligned with the vertical axis of the monopole. Measurements were then taken at each of the heights set out in this report. The

[1] This is an indication of the type of technologies typically deployed in these bands; not all frequency bands and technologies may be in use at all locations.

measurement vehicle was then moved to a different fixed distance away from the mast and the process was repeated.

At each measurement point (combination of height and distance), the spectrum analyser was set to conduct a Full-Audit EMF scan, measuring the average E-field strength over a six-minute period.

Figure 2: EMF measurement set-up



Measurement location

The measurement was conducted at the point shown in the map below.

Figure 3: Measurement location

Detailed measurement results

The following tables present the detailed results for each combination of height, distance and frequency.

We measured the average E-field strength over a six-minute period at distances of 5m, 10m, 20m and 40m from the monopole mast and at heights of 4.7m, 8m, 12m, 16m and 20m above ground level.

We have applied a measurement threshold of 3dB above the system noise floor[2] of the measurement equipment, below which any E-field strength levels measured are deemed not sufficiently above the system noise floor to be valid.

In the tables below, results are presented as percentages of the power density reference levels for general public exposure in the 1998 edition of ICNIRP Guidelines[3] and are shown to a precision of five decimal places. Results which are not sufficiently above the system noise floor to record as a valid measurement are shown as a dash (-). Results which are too small to register to five decimal places are shown as 0.0000%.

Distance 5m from the monopole

	% of the ICNIRP reference levels for general public exposure at different heights				
Frequency Band	**20m**	**16m**	**12m**	**8m**	**4.7m**
700 MHz	0.00672	0.09368	0.00280	0.00162	0.00131
800 MHz	0.04487	0.32403	0.01916	0.00584	0.00330
900 MHz	0.01573	0.01233	0.00522	0.00081	0.00073
1400 MHz	0.01727	0.13925	0.01358	0.00834	0.01456
1800 MHz	0.10543	0.63232	0.09203	0.04779	0.01443
1900 MHz	0.00014	0.00015	0.00015	0.00016	0.00016
2100 MHz	0.05711	0.10101	0.02950	0.01580	0.00862
2300 MHz	0.00236	0.00181	0.00080	0.00053	0.00040
2600 MHz TDD	0.00023	0.00025	0.00026	0.00027	0.00028
2600 MHz FDD	0.00044	0.00032	0.00024	0.00020	0.00021
3.4 GHz	0.02744	0.02652	0.00998	0.00544	0.00591
3.8 GHz	0.00384	0.00410	0.00421	0.00434	0.00450
Total	**0.28158**	**1.33577**	**0.17793**	**0.09114**	**0.05441**

[2] The noise floor of the measurement equipment is the level of background noise that is present before detecting any external signals. In other words, it indicates the absolute minimum level of detectable signals.

[3] Published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The power density reference levels in the ICNIRP Guidelines are the root mean square (rms) values averaged over six minutes.

Distance 10m from the monopole

	% of the ICNIRP reference levels for general public exposure at different heights				
Frequency Band	**20m**	**16m**	**12m**	**8m**	**4.7m**
700 MHz	0.00251	0.03407	0.00246	0.00144	0.00172
800 MHz	0.01741	0.14591	0.03569	0.00467	0.00484
900 MHz	0.00957	0.01034	0.00480	0.00117	0.00086
1400 MHz	0.00765	0.13123	0.02195	0.00479	0.01439
1800 MHz	0.05588	0.56568	0.06507	0.03797	0.06570
1900 MHz	0.00017	0.00018	0.00018	0.00018	0.00018
2100 MHz	0.01660	0.12532	0.01186	0.03416	0.01258
2300 MHz	0.00189	0.00202	0.00081	0.00046	0.00046
2600 MHz TDD	0.00029	0.00030	0.00030	0.00030	0.00031
2600 MHz FDD	0.00042	0.00034	0.00024	0.00021	0.00021
3.4 GHz	0.04148	0.04787	0.04983	0.00951	0.00725
3.8 GHz	0.00493	0.00503	0.00508	0.00501	0.00511
Total	**0.15880**	**1.06829**	**0.19827**	**0.09987**	**0.11361**

Distance 20m from the monopole

	% of the ICNIRP reference levels for general public exposure at different heights				
Frequency Band	**20m**	**16m**	**12m**	**8m**	**4.7m**
700 MHz	0.00344	0.01674	0.00637	0.00169	0.00180
800 MHz	0.01526	0.07273	0.04984	0.00410	0.00489
900 MHz	0.01024	0.01233	0.00663	0.00135	0.00109
1400 MHz	0.00288	0.12580	0.01243	0.00443	0.00394
1800 MHz	0.04454	0.55176	0.07401	0.02457	0.01979
1900 MHz	0.00019	0.00018	0.00019	0.00019	0.00019
2100 MHz	0.01688	0.17038	0.01525	0.00792	0.01262
2300 MHz	0.00223	0.00262	0.00062	0.00052	0.00051
2600 MHz TDD	0.00032	0.00032	0.00032	0.00032	0.00032
2600 MHz FDD	0.00047	0.00038	0.00023	0.00022	0.00023
3.4 GHz	0.02307	0.03669	0.02137	0.02745	0.01065
3.8 GHz	0.00538	0.00541	0.00545	0.00546	0.00538
Total	**0.12490**	**0.99534**	**0.19271**	**0.07822**	**0.06141**

Distance 40m from the monopole

	% of the ICNIRP reference levels for general public exposure at different heights				
Frequency Band	**20m**	**16m**	**12m**	**8m**	**4.7m**
700 MHz	0.00366	0.00459	0.00445	0.00317	0.00219
800 MHz	0.01740	0.03198	0.02767	0.01580	0.00733
900 MHz	0.01413	0.01477	0.01322	0.00348	0.00133
1400 MHz	0.00952	0.02856	0.01898	0.00208	0.00208
1800 MHz	0.03344	0.19587	0.13569	0.01991	0.00726
1900 MHz	0.00019	0.00020	0.00020	0.00020	0.00020
2100 MHz	0.01734	0.07036	0.05080	0.00639	0.00560
2300 MHz	0.00231	0.00246	0.00304	0.00081	0.00058
2600 MHz TDD	0.00033	0.00033	0.00033	0.00033	0.00034
2600 MHz FDD	0.00110	0.00072	0.00043	0.00025	0.00025
3.4 GHz	0.03536	0.05609	0.02351	0.01987	0.01708
3.8 GHz	0.00575	0.00576	0.00570	0.00563	0.00575
Total	**0.14053**	**0.41169**	**0.28402**	**0.07792**	**0.04999**