

## 1. Survey Summary

<b>Address of Transmitter Site Surveyed:</b>	Hayfield Manor Hotel, Perrott Ave, College Rd, The Lough, Cork
<b>Site Type:</b>	GSM, UMTS, LTE
<b>Survey Date:</b>	13/06/2019

<b>Measurement Location:</b> (at point of maximum non-ionising radiation near site)	At junction of College View and Horgan's Buildings, opposite transmitter location
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<b>Measurement Location Coordinates:</b>	<b>LAT</b>	<i>deg</i>	<i>min</i>	<i>sec</i>	<b>LONG</b>	<i>deg</i>	<i>min</i>	<i>sec</i>
	N	51	53	28.9	W	8	29	27.2

### Purpose and Conduct of Survey:

The purpose of this survey was to assess compliance with the limits for general public exposure to non-ionising radiation (**NIR**) set by the International Commission on Non-Ionising Radiation Protection (**ICNIRP**) ("**ICNIRP Public Exposure Limits**").

Compliance with the ICNIRP Public Exposure Limits is a condition of a General Authorisation for an electronic communications network/service as well as of various Wireless Telegraphy licences issued by the Commission for Communications Regulation (**ComReg**).

The survey was conducted by:

- measuring the overall electromagnetic field (**EMF**) present at the point of highest exposure in a public area associated with the designated transmitter site;
- identifying the frequency of the principal emissions contributing to the EMF; and
- measuring the intensity (or level) of same.

### Overall Conclusions of the Survey

<b>Frequency Selective Measurements:</b> (Individual emissions measured at specific frequencies)	<b>Below ICNIRP Public Limits (Compliant)</b>
<b>Total Exposure Quotient:</b> (Assessment of cumulative emissions from multiple transmitters)	<b>Below ICNIRP Public Limits (Compliant)</b>

## 2. Surveyors

<b>Survey conducted for ComReg by:</b>	Compliance Engineering Ireland Ltd.	
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<b>Survey Engineer(s):</b>	<b>Report Writer:</b>	<b>Report Reviewer:</b>
Michael Reilly, BEng	Michael Reilly, BEng	John McAuley, MEng

### 3. Survey Location Details

#### Designated Transmitter Site Photo



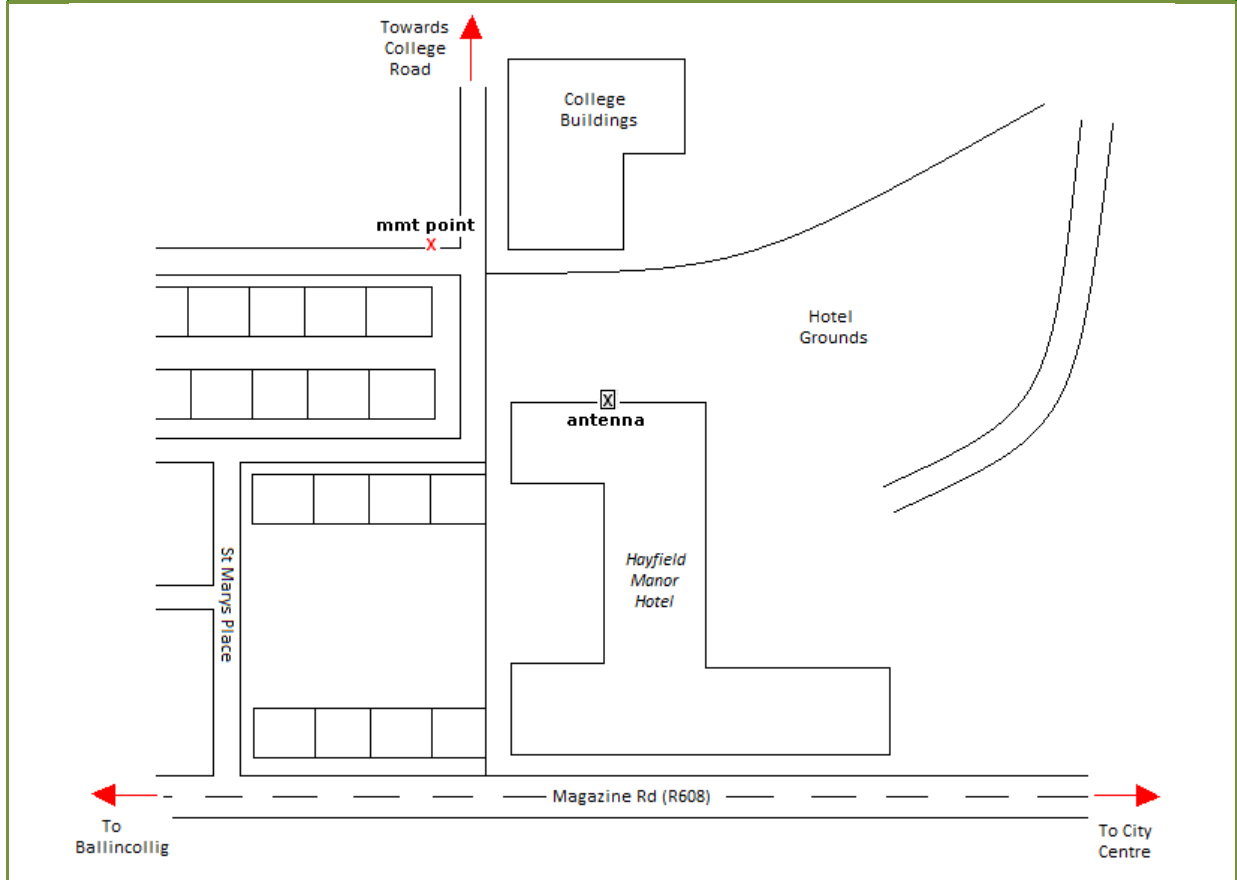
#### Survey Weather

**Sky:** Cloudy

**Temperature:**  
13° C

**Relative Humidity:**  
50 %

#### Map of Designated Transmitter Site and Measurement Location



## 4. Introductory Note

### Purpose of Survey

The survey of the designated transmitter site (“**Designated Site**”) was commissioned by ComReg as part of its Programme of Measurement of Non-Ionising Radiation. The purpose of the survey was to assess whether NIR (occurring within the radio frequency part of the electromagnetic spectrum) from the Designated Site complied with the limits for general public exposure specified in the guidelines published by ICNIRP (“**ICNIRP Public Exposure Limits**”).<sup>1</sup>

Compliance with the ICNIRP Public Exposure Limits is a condition of a General Authorisation for the provision of an electronic communications network/service (e.g. mobile phone and broadcasting networks) as well as of various Wireless Telegraphy licences (in respect of transmitting stations) issued by ComReg.

### Survey Methodology

Measurements of the NIR from the Designated Site were conducted in accordance with the methodology outlined in ComReg Document 08/51R3<sup>2</sup>. This methodology incorporates many of the measurement methods and procedures outlined in:

- European Electronic Communications Committee (**ECC**) Recommendation (02)04<sup>3</sup>;
- European Committee for Electrotechnical Standardisation (**CENELEC**) measurement standard EN 50492:2008<sup>4</sup>, and
- measurement techniques developed by the Institut für Mobil- und Satellitenfunktechnik (**IMST**) and the EM-Institut on behalf of the German Federal Office for Radiation Protection.<sup>5</sup>

### Note re this Report Version

If you have downloaded this report from [www.siteviewer.ie](http://www.siteviewer.ie) or from [www.comreg.ie](http://www.comreg.ie), you are reading an abbreviated version. In addition to sections 1 to 8, the full extended technical version of this report contains a comprehensive technical record of the measurements and any calculations performed, a list of equipment used, as well as a technical appendix. A copy of the extended report is available on request from ComReg.

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<sup>1</sup> Current ICNIRP guidelines:

- “Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz)”, ICNIRP, published in ‘Health Physics’, April 1998, Volume 74, No. 4: <http://www.icnirp.org/documents/emfgdl.pdf>
- “Guidelines for Limiting Exposure to Time-Varying Electric and Magnetic Fields (1 Hz to 100 kHz)”, ICNIRP, published in ‘Health Physics’, December 2010, Volume 99, No. 6: <http://www.icnirp.org/documents/LFgdl.pdf>

<sup>2</sup> <https://www.comreg.ie/publication-download/programme-of-measurement-of-non-ionising-radiation-emissions-methodology-for-the-conduct-of-surveys-to-measure-non-ionising-electromagnetic-radiation-from-transmitter-sites-2>

<sup>3</sup> ECC RECOMMENDATION (02)04, “Measuring Non-Ionising Electromagnetic Radiation (9 kHz – 300 GHz)”, ECC, (revised Bratislava 2003, Helsinki 2007): <http://www.erdocdb.dk/Docs/doc98/official/pdf/REC0204.PDF>

<sup>4</sup> EN 50492:2008, “Basic standard for the in-situ measurement of electromagnetic field strength related to human exposure in the vicinity of base stations”, CENELEC, November 2008: <http://www.cenelec.eu>

<sup>5</sup> See: <http://www.bfs.de> .

## 5. Survey Overview

### Survey Stages

In accordance with the methodology outlined in ComReg Document 08/51R3, this survey was conducted in three stages:

- 1 Initial Site Survey
- 2 Full Survey – Broadband Measurements
- 3 Full Survey – Frequency Selective Measurements

An outline of each stage, along with the results and conclusions of the measurements, are presented in the following three sections.

### Measurement of Electromagnetic Fields

Electromagnetic fields (**EMFs**) can be sub-divided into two components:

- Electric field (**E-field**) (measured in volts per metre or “V/m”); and
- Magnetic field (**H-field**) (measured in amperes per metre or “A/m”).

The E-field and the H-field are mathematically interdependent<sup>6</sup> in the **radiating near-field**<sup>7</sup> and the **far-field**<sup>8</sup>, which is located beyond a distance of at least the wavelength of the radiated EMF. The measurement locations for most transmitter installations lie well within the far-field, as the wavelengths of the transmitted signals are relatively short and the antennas are typically located many metres from any public area.

The following table identifies wavelengths for commonly transmitted signals:

Transmitter Type	Frequency	Wavelength
PMR Low Band VHF	68 MHz	4.41 m
UHF TV	470 MHz	0.64 m
GSM 900 (mobile phone base)	925 MHz	0.32 m
GSM 1800 (mobile phone base)	1805 MHz	0.17 m
UMTS (mobile phone base)	2110 MHz	0.14 m

In the radiating near-field and far-field, only one component needs to be measured, as the other component can be readily derived from it. Normally, it is the E-field which is measured.

In the case of transmitters of very long wavelength signals, such as long wave radio (1.19 km wavelength), the H-field and E-field must be measured separately as the point of measurement will most likely lie within the **reactive near-field**<sup>9</sup> region. In this region, located within a distance of at least the wavelength of the

<sup>6</sup>  $E \approx H \times Z_0$  (Radiating Near Field) and  $E = H \times Z_0$  (Far Field), where  $Z_0$  (characteristic impedance of free space)  $\approx 377 \Omega$

<sup>7</sup> Beyond a distance of  $\max(\lambda, D, D^2/4\lambda)$ , where  $\lambda$  is the wavelength and  $D$  is the antenna's largest dimension

<sup>8</sup> Beyond a distance of  $\max(5\lambda, 5D, 0.6D^2/\lambda)$


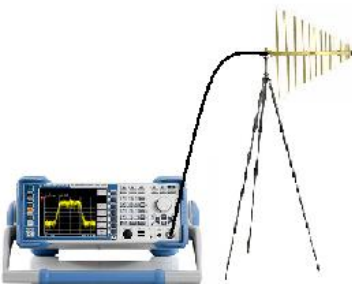

<sup>9</sup> Within a distance of  $\max(\lambda, D, D^2/4\lambda)$

radiated EMF, the relationship between E and H becomes very complex and there is no direct correlation between both components of the EMF.

**Measurement Equipment**

The measurement of EMFs is a complex process which involves the use of various meters, spectrum analysers, probes and antennas, appropriate to the frequencies of the emissions being measured.

The table below shows examples of equipment typically used to measure EMFs in NIR surveys.

Initial Site Survey and Broadband Measurements	Frequency Selective Measurements	
 <p data-bbox="352 831 480 880">ISOTROPIC PROBE</p> <p data-bbox="368 1077 496 1149">FIELD STRENGTH METER</p> <p data-bbox="220 1234 576 1406">Used to measure the overall electric or magnetic field present over a range of frequencies (e.g. 100kHz to 3GHz).</p>	<p data-bbox="603 685 970 734">SPECTRUM ANALYSER WITH TRIPOD MOUNTED ANTENNA CONNECTED</p>  <p data-bbox="603 1234 1439 1440">Spectrum analysers are used to measure individual emissions at specific frequencies. Individual emissions contribute to the overall EMF. Examples of individual emissions are a TV signal, and a mobile phone signal for a particular mobile operator. There may be a number of emissions from different transmitters contributing to the overall EMF at a particular location.</p>	<p data-bbox="1038 685 1374 763">PORTABLE SPECTRUM ANALYSER WITH ANTENNA DIRECTLY CONNECTED</p> 

## 6. Initial Site Survey

An initial survey was carried out in the area around the Designated Site in order to determine the point of maximum NIR. This is the location at which the overall E-field strength level measured was somewhat higher than that measured in other areas around the site and represents the highest level of exposure to which a member of the general public might be subjected in the vicinity of the transmitter.

For this initial survey a calibrated **field strength meter** fitted with a **3 GHz isotropic probe** was used. The meter and probe were used to measure the sum of all electrical fields present at **all frequencies from 100 kHz up to 3 GHz**.

Once the point of maximum NIR was determined, broadband and frequency-selective measurements were conducted at that location (see following two sections).

For the duration of all measurements, the various instruments, antennas and probes used were mounted on non-metallic supports.

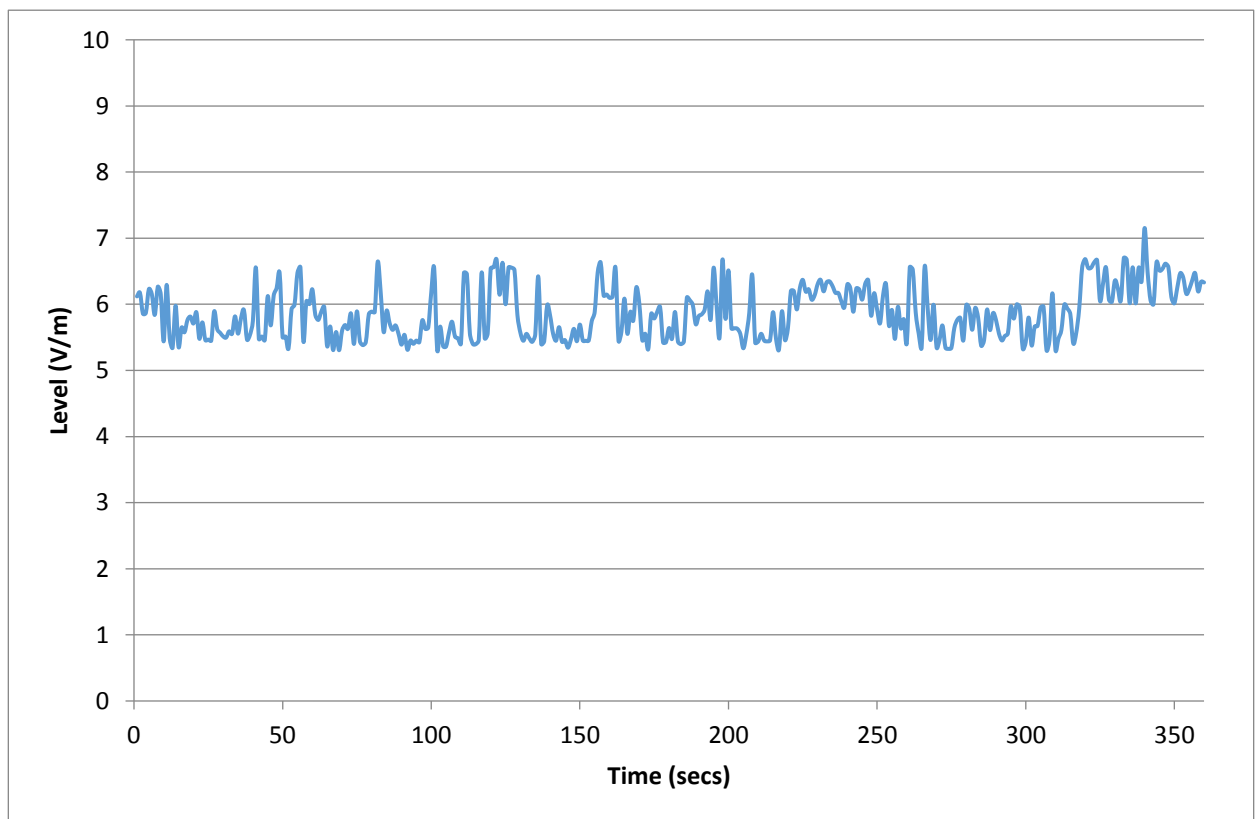
## 7. Full Survey – Broadband Measurements

The purpose of these measurements was to get an overview of the intensity of the electromagnetic field present at the point of maximum NIR near the site. There, the field strength meter was mounted on a tripod and, fitted with a **3GHz isotropic probe**, was set to record, over a six minute period, simultaneous measurements of the sum of all received signals within the frequency range of the probe. This measurement was then repeated using a **60 GHz isotropic probe**.

The broadband measurement results presented below show the levels in volts per metre (V/m) recorded during the six minute period. The average and maximum levels can be compared to the lowest maximum ICNIRP Public Exposure Limits which is 28 V/m.

If a broadband measurement is higher than 28 V/m, it does not necessarily follow that the ICNIRP Public Exposure Limits have been exceeded because the limits are frequency dependent. For example, if the emissions are in the 2100 MHz (mobile phone) frequency band, then the limit which applies is higher at 61 V/m. A more detailed investigation involving frequency selective measurement is necessary to assess compliance with the ICNIRP Public Exposure Limits (see following section).

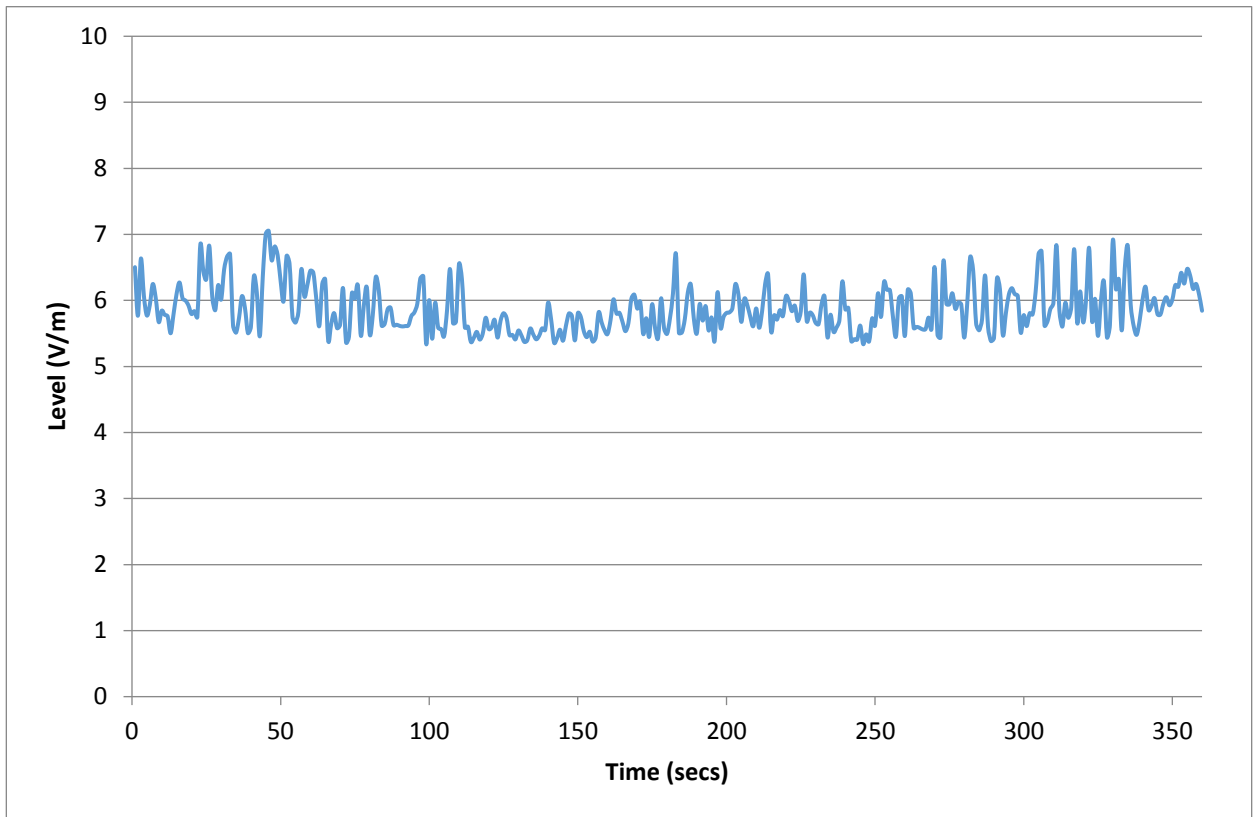
Electric field strengths recorded over 6 minute period using 3 GHz probe at point of maximum NIR



Acquisition Mode: 1 Sec. Sampling

<b>Mean Measurement V/m:</b>	5.87 V/m	<b>Peak Measurement V/m:</b>	7.15 V/m
<b>Date:</b>	13/06/2019	<b>Start Time:</b>	12:53
<b>Meter:</b>	NBM-550	<b>Probe:</b>	EF3091
<b>Frequency Range:</b>	100 kHz – 3 GHz		

Electric field strengths recorded over 6 min period using 60 GHz probe at point of maximum NIR



Acquisition Mode: 1 Sec. Sampling

<b>Mean Measurement V/m:</b>	5.88 V/m	<b>Peak Measurement V/m:</b>	7.05 V/m
<b>Date:</b>	13/06/2019	<b>Start Time:</b>	13:01
<b>Meter:</b>	NBM-550	<b>Probe:</b>	EF 6091
<b>Frequency Range:</b>	100 MHz – 60 GHz		

Conclusion of the Broadband Measurements

The mean and peak measurements were below the lowest ICNIRP guideline limit of 28 V/m.



## 8. Full Survey – Frequency Selective Measurements

### Basic Measurement Procedure

A more detailed survey was performed at the point of maximum NIR near the Designated Site to identify the individual transmit frequencies and field strengths of each type of emission (e.g. mobile phone (GSM, UMTS and LTE), wireless broadband, TV, radio signals etc.) and their contribution to the total EMF.

The measurements were performed using spectrum analyser equipment and a range of antennas to match the frequency bands in which emissions were measured.

### Table of Measurement Results

A list of the measurements made is presented in the table on the following page. For each emission measured, the table shows:

- **Emission Type** (e.g. GSM or UMTS mobile phone, TV etc);
- Transmission **frequency** of the signal;
- **Measured Level** (in volts per metre (V/m));
- **Adjusted Level** (if applicable to account for the characteristics of certain signal types or to compensate for limitations of measurement equipment or to estimate emissions for maximum call or data traffic); and
- **ICNIRP Public Limit.**

Further details of Adjusted Level/s and ICNIRP Public Exposure Limits are in the explanatory notes which follow the table of measurement results.

### Assessment of ICNIRP Compliance of Individual Emissions

The levels for each measure (as adjusted where necessary) are compared to the relevant ICNIRP Public Exposure Limit which applies for the particular frequency of the emission. It should be again noted that the ICNIRP Public Exposure Limit varies according to frequency - the limits for the different measurements presented in the tables will vary as the measurements have been performed at different frequencies.

### Assessment of ICNIRP Compliance of Cumulative Emissions

The levels measured for individual emissions are used to calculate **Total Exposure Quotients** to assess the cumulative effect of individual emissions from multiple transmitters. Further details of these quotients are in the explanatory notes which follow the table of measurement results.

The calculated values of the Total Exposure Quotients must be  $\leq 1$  in order for the aggregate of multiple measurements to satisfy the criteria of the ICNIRP Public Exposure Limit.

Table of Frequency Selective Measurement Results

Emission Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Exposure Limit (V/m)	Times below Limit [adjusted Values]
FM Radio	106.100	0.14640	0.14640	28.0	191.257
FM Radio	96.380	0.06184	0.06184	28.0	452.781
FM Radio	102.590	0.05784	0.05784	28.0	484.094
FM Radio	94.780	0.03455	0.03455	28.0	810.420
FM Radio	93.080	0.02762	0.02762	28.0	1013.758
FM Radio	90.880	0.01530	0.01530	28.0	1830.065
FM Radio	101.490	0.01155	0.01155	28.0	2424.242
FM Radio	100.980	0.01095	0.01095	28.0	2557.078
FM Radio	91.360	0.01055	0.01055	28.0	2654.028
FM Radio	89.710	0.01053	0.01053	28.0	2659.069
FM Radio	91.990	0.00979	0.00979	28.0	2859.769
FM Radio	89.200	0.00907	0.00907	28.0	3088.803
FM Radio	94.090	0.00836	0.00836	28.0	3351.287
FM Radio	98.780	0.00634	0.00634	28.0	4414.315
FM Radio	99.320	0.00616	0.00616	28.0	4545.455
FM Radio	100.390	0.00480	0.00480	28.0	5833.333
FM Radio	98.300	0.00478	0.00478	28.0	5852.843
FM Radio	88.330	0.00473	0.00473	28.0	5919.662
PMR	REDACTED	0.00578	0.00578	28.0	4845.967
T-DAB	217.020	0.01817	0.01817	28.0	1541.002
T-DAB	227.230	0.00902	0.00902	28.0	3104.213
TETRA	REDACTED	0.03796	0.06575	28.0	425.864
TETRA	REDACTED	0.03409	0.05905	28.0	474.210
TETRA	REDACTED	0.03092	0.05356	28.0	522.827
TETRA	REDACTED	0.01803	0.03123	28.0	896.606
TETRA	REDACTED	0.00364	0.00631	28.0	4437.499
TETRA	REDACTED	0.00348	0.00602	28.0	4652.031
TETRA	REDACTED	0.00210	0.00363	28.0	7716.376
TETRA	REDACTED	0.00206	0.00357	28.0	7851.291
TETRA	REDACTED	0.00159	0.00275	28.0	10186.394
TETRA	REDACTED	0.00150	0.00260	28.0	10770.025
TETRA	REDACTED	0.00115	0.00200	28.0	14032.819
TETRA	REDACTED	0.00112	0.00193	28.0	14472.522
TETRA	REDACTED	0.00106	0.00184	28.0	15236.388
PMR	REDACTED	REDACTED	REDACTED	REDACTED	4107.264
PMR	REDACTED	REDACTED	REDACTED	REDACTED	13251.835
PMR	REDACTED	REDACTED	REDACTED	REDACTED	35057.267
PMR	REDACTED	REDACTED	REDACTED	REDACTED	37491.942
DVB-T	706.450	0.02737	0.03230	36.5	1131.584
DVB-T	616.870	0.02290	0.02702	34.2	1263.811
DVB-T	695.850	0.01687	0.01991	36.3	1822.063
DVB-T	561.080	0.01364	0.01610	32.6	2023.572

DVB-T	578.930	0.01295	0.01528	33.1	2165.030
DVB-T	666.830	0.01266	0.01494	35.5	2376.810
DVB-T	627.500	0.01147	0.01353	34.4	2544.861
LTE	816.000	0.77840	2.22622	39.3	17.643
LTE	806.000	0.40100	1.14686	39.0	34.038
LTE	796.000	0.01530	0.04376	38.8	886.547
GSM	949.188	3.00400	6.00800	42.4	7.051
GSM	926.406	0.06942	0.13884	41.9	301.432
GSM	956.781	0.01947	0.03894	42.5	1092.227
UMTS FDD	953.500	2.35500	8.79433	42.5	4.828
UMTS FDD	943.000	0.67370	2.51581	42.2	16.783
UMTS FDD	937.000	0.33700	1.25847	42.1	33.445
UMTS FDD	932.500	0.07857	0.29341	42.0	143.106
GSM	1841.190	0.00651	0.01302	59.0	4532.186
LTE	1815.000	0.26510	0.92871	58.6	63.076
LTE	1830.000	0.23840	0.96438	58.8	60.993
LTE	1855.000	0.12130	0.49068	59.2	120.691
LTE	1875.000	0.03080	0.10790	59.5	551.800
DECT <sup>10</sup>	1903.890	0.01287	0.02458	61.0	2481.521
UMTS FDD	2122.500	0.21300	0.67357	61.0	90.562
UMTS FDD	2147.500	0.17150	0.54233	61.0	112.477
UMTS FDD	2152.500	0.10140	0.32066	61.0	190.234
UMTS FDD	2117.500	0.09120	0.28840	61.0	211.510
UMTS FDD	2112.500	0.08535	0.26990	61.0	226.008
UMTS FDD	2157.500	0.06856	0.21681	61.0	281.356
UMTS FDD	2127.500	0.05302	0.16767	61.0	363.820
UMTS FDD	2132.500	0.03555	0.11242	61.0	542.609
UMTS FDD	2162.500	0.02177	0.06884	61.0	886.071
UMTS FDD	2167.500	0.00700	0.02213	61.0	2756.467
LTE	3462.000	0.00715	0.04310	61.0	1415.426
LTE	3535.667	0.04105	0.24751	61.0	246.455
LTE	3593.857	0.00726	0.04379	61.0	1392.972

#### Total Exposure Quotients [calculated from Adjusted Levels]

Quotient	Frequency Range	Calculated Quotient Value	Limit
Electrical Stimulation Effects	1 Hz to 10 MHz	n/a	1
Thermal Effects	100 kHz and above	0.072562	1

#### Overall Conclusions of the Survey

<b>Frequency Selective Measurements:</b> (Individual emissions measured at specific frequencies)	<b>Below ICNIRP Public Limits (Compliant)</b>
<b>Total Exposure Quotient:</b> (Assessment of cumulative emissions from multiple transmitters)	<b>Below ICNIRP Public Limits (Compliant)</b>

<sup>10</sup> This DECT device has since been removed, as it was non-compliant with Radio Frequency Plan for Ireland.

## Explanatory Notes

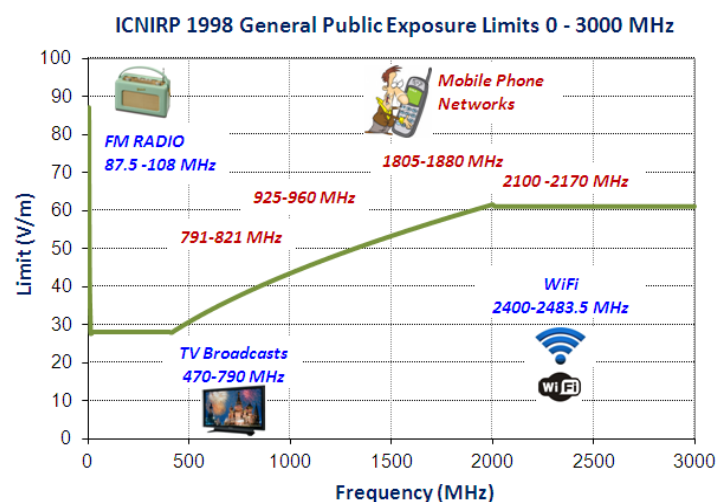
### Adjusted Levels

For some emissions, an adjusted level may be required to be derived from the measured level:

- (1) to compensate for the limited measurement resolution of the spectrum analyser.** For example, a measurement of a DVB-T (digital TV) signal performed with a resolution of 5 MHz needs to be adjusted upwards using a correction factor to account for the energy present within the full 7.61 MHz bandwidth of the signal; and/or
- (2) to extrapolate to an estimate of the level under maximum traffic or duty cycle from the transmitter.** For example, the base stations of mobile phone networks produce emissions which vary according to the changing volume of calls or data traffic over the course of the day.

### ICNIRP Public Exposure Limits

These are set out in the ICNIRP Guidelines as reference levels for the practical assessment of exposure to electric and magnetic fields, as experienced by the general public (excluding occupational exposure and exposure during medical procedures). The limits vary according to the frequency of the emissions as illustrated in the adjacent diagram. For example, the limits for Wi-Fi in the 2400-2483.5 MHz frequency band are higher than those for FM Radio transmissions in the much lower 87.5-108 MHz frequency band.



### Total Exposure Quotients

The Total Exposure Quotients (which must be  $\leq 1$ ) are calculated in accordance with mathematical formulas specified in the ICNIRP Guidelines to assess the cumulative effect of emissions from multiple transmitters. The quotients in this report are calculated from the Adjusted Levels rather than from the Measured Levels to account for total potential public exposure under maximum traffic conditions.

The two quotients are as follows:

#### (1) Quotient for Electrical Stimulation Effects (1 Hz to 10 MHz)

This quotient is calculated only in a small number of cases where strong emissions in the frequency range between 1 Hz and 10 MHz are present at the survey location (e.g. near a long wave radio transmitter site). This essentially involves summing the ratios (measured field strength/applicable limit) for each emission.

#### (2) Quotient for Thermal Effects (100 kHz and above)

The measurements of any emissions above 100 kHz are used to calculate a quotient to assess any thermal (heat) effects. This essentially involves summing the squares of the ratios (measured field strength/applicable limit) for each emission.