Commission for
Communications Regulation

Report

2009 Programme of Measurement of Non-Ionising Radiation Emissions

First Interim Report

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1. Executive Summary

The Commission for Communications Regulation (ComReg) currently arranges for Non-Ionising Radiation (NIR) surveys to be conducted near a sample number of licensed transmitter sites nationwide. Each survey involves measurement of NIR emission levels at the point of highest emissions (in a public area), associated with the transmitter. Sites are surveyed in order to assess compliance on the part of transmitter operators with their licence conditions relating to NIR emissions.

This report forms part of an ongoing series of interim reports which outline ComReg's programme of measurements, and presents the results of the first set of site surveys (20 sites) undertaken during the 2009 programme.

The site surveys were conducted by engineers of Vilicom Engineering Ltd which was contracted by ComReg to assist it with the programme.

On the basis of this work, ComReg has concluded that the NIR emissions measured from all of the 20 sites were below the relevant ICNIRP guideline limits for general public exposure[1]. The results of the measurements taken at all the sites are presented in this report.

[1] See Annex 2

2. Introduction

The Commission for Communications Regulation (ComReg) is the licensing authority for the use of the radio frequency spectrum in Ireland. The frequency spectrum is a valuable national resource which has been used for communications purposes for over 100 years. Applications which make use of the radio spectrum include a wide range of services such as radio and television broadcasting, mobile telephony and other telecommunications services such as internet connection.

It is a condition of various licences[2] issued by ComReg that licensees must ensure that non-ionising radiation[3] (NIR) emissions from each transmitter operated under the licence must be within the limits set down in the guidelines published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP)[4]. Levels of NIR emissions from a licensed transmitter must not exceed the ICNIRP limits in any part of the site or surrounding area to which the general public has access.

In order to assess compliance on the part of transmitter operators with their licence conditions relating to NIR, ComReg currently arranges for NIR surveys to be conducted near a sample number of licensed transmitter sites nationwide. Each survey involves measurement of NIR emission levels at the point of highest emissions (in a public area), associated with the transmitter.

This report presents the results of measurements taken at the first set of 20 sites chosen as part of the 2009 Programme of Measurement of Non-Ionising Radiation emissions. The site surveys were conducted by engineers of Vilicom Engineering Ltd which was contracted by ComReg to assist it with the programme.

[2] Issued pursuant to the Wireless Telegraphy Act, 1926 (No. 45 of 1926) e.g. for services such as GSM & UMTS Mobile Telephony, Radio & TV Broadcasting, MMDS, Wireless Broadband etc.

[3] Non-ionising radiation is that part of the electromagnetic spectrum below 3 x 10^{15} Hz (3000 million MHz). Radio waves, infrared radiation and visible light are examples of NIR. (see Annex 1)

[4] See Annexes 1& 2 for further details.

Abbreviated versions of the individual site survey reports are available on the ComReg website[5] as well as on Siteviewer[6], an on-line facility provided by ComReg, which allows the public to view details of GSM and 3G mobile telephony base stations throughout Ireland. Copies of the full site reports are available on request.

[5] www.comreg.ie
[6] www.siteviewer.ie

3. Measurement Results

3.1 Explanatory Note

At the point of highest emissions[7] associated with each site, the engineers measured the electric field strength (or electric field voltage)[8] of emissions in the relevant radio frequency bands.

The tables which follow in the next sub-section present the levels measured at each site. The sites are listed in order by county.

The tables show the measured levels alongside the relevant ICNIRP limits for general public exposure. They include levels measured in respect of emissions from the transmitter site, along with the levels for emissions from nearby sites, if particularly high at the location.

The tables present the measurements for each site under the following headings:

1. Signal Type
2. Frequency
3. Measured Level V/m
4. Adjusted Level V/m
5. ICNIRP guideline limit
6. Total Exposure Quotient

A brief explanation of each of the headings follows:-

[7] See Annex 3 for an outline of the site survey methodology.

[8] See Annex 4 for an outline of how electromagnetic fields are measured.

Signal Type

The type of signal to which an emission on a particular frequency relates e.g. **GSM** (2nd generation mobile phone system), **UMTS** (3rd generation mobile phone system), **FM Radio**, **TV PAL** (analogue television), **FWALA** (wireless broadband) etc.

Frequency (MHz)

Various radio services are transmitted in predefined frequency ranges. For example 3G (or UMTS) mobile telephony base stations transmit signals on a frequency somewhere in the range 2110 – 2170 MHz. At each site transmitting a 3G signal, measurements were taken in that frequency range and the results of those measurements are presented in the tables. Other services such as GSM 900, GSM 1800, TETRA, Television etc. are presented in similar manner in the tables, if applicable. The frequencies of emissions associated with some services (e.g. emergency services) are not shown in the interests of confidentiality and security.

Measured Level V/m

The tables show the electric field strength levels measured for each emission (signal) type from the designated site, along with the levels for emissions from nearby sites, if particularly high. In many instances more than one measured level is shown for each emission type. This is due to the fact that different mobile operators often transmit signals from the same site on different frequency channels.

Adjusted Level V/m

For some emission types an adjusted level has been calculated from the measured level for any or all of the following reasons:

- to compensate for the limited measurement resolution of the spectrum analyser[9]. For example, a measurement of a digital television signal performed with at a resolution of 5 MHz needs to be adjusted upwards

[9] Spectrum analysers are used to measure individual emissions at specific frequencies (see Annex 4).

using a correction factor in order to account for the energy present within the full 7.6 MHz bandwidth of the signal.

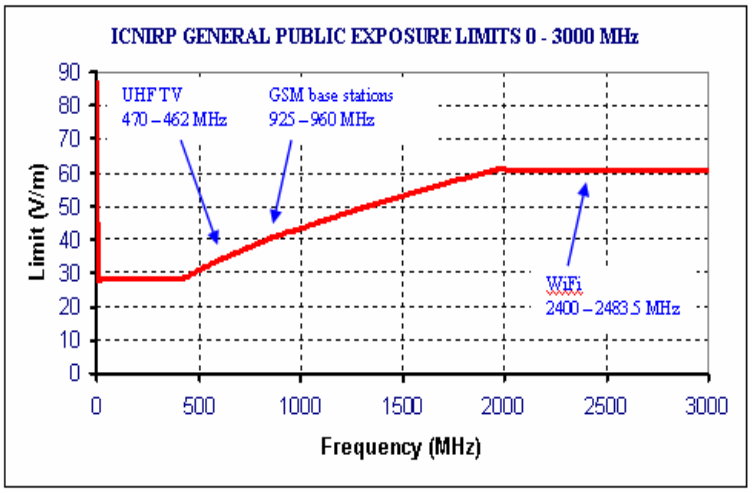
- to extrapolate to an estimate of the level under maximum traffic from the transmitter. For example, the base stations of mobile telephone networks produce emissions which vary according to the changing volume of calls or data traffic over the course of the day. The levels measured for the always-on pilot channels of the base stations can be used to extrapolate to a level which would be expected if all voice and data channels were in operation.

- to account for the characteristics of certain complex signal types (e.g. analogue PAL TV).

For further details concerning the calculation of Adjusted Levels, please refer to Annex 5.

ICNIRP guideline limit

For each site the table shows the measured and adjusted electric field strength levels in Volts per metre (V/m) alongside the relevant ICNIRP general public guideline limits. It should be noted that the ICNIRP guideline limits vary according to frequency as illustrated:



For example, for a GSM mobile signal on a frequency of 940.050 MHz, the relevant limit is 42.158 V/m, while for a 3G mobile signal on a frequency of 2147.2 MHz the relevant limit is 61 V/m. Thus the limits for the different measurements presented in the tables will vary as the measurements have been performed at different frequencies.

For further details concerning the ICNIRP Limits, please refer to Annex 2.

Total Exposure Quotient

For each site, Total Exposure Quotients are calculated, in accordance with mathematical formulas specified in the ICNIRP Guidelines in order 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, in order to account for total potential public exposure under maximum traffic conditions.

In order to satisfy the criteria of the ICNIRP Guidelines, the Quotients must be less than or equal to 1.

The two quotients are as follows:

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).

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.

Please refer to Annex 2 for further information concerning the calculation of the Quotients.

3.2 Measurement Results by Site

3.2.1 Carlow: Muine Bheag / Bagenalstown - Kilcarrig Street

Measurements

Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of Adjusted Level)
PMR	Not disclosed	0.004699	0.004699	28.0	5959
FM Radio	89.618	0.007490	0.007490	28.0	3738
TV PAL	215.760	0.021852	0.027693	28.0	1011
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	2231
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	12486
TV PAL	486.987	0.015524	0.019673	30.3	1542
TV PAL	511.160	0.008872	0.011243	31.1	2765
TV PAL	804.507	0.005176	0.006559	39.0	5946
TV DVB-T	666.653	0.004989	0.013122	35.5	2706
GSM 900	955.683	0.676083	1.352166	42.5	31
GSM 900	947.750	0.023632	0.047264	42.3	896
GSM 900	940.517	0.021014	0.042027	42.2	1003
UMTS	2113.767	0.006910	0.044687	61.0	1365
UMTS	2146.667	0.004088	0.026435	61.0	2308
WiFi	2412.803	0.004534	0.017593	61.0	3467

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	0.001017	1

3.2.2 Dublin: Deansgrange Business Park

Measurements

Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of Adjusted Level)
PMR	Not disclosed	0.004819	0.004819	28.0	5810
FM Radio	104.447	0.019611	0.019611	28.0	1428
FM Radio	88.457	0.017681	0.017681	28.0	1584
FM Radio	94.880	0.015812	0.015812	28.0	1771
FM Radio	106.018	0.015668	0.015668	28.0	1787
T-DAB	227.547	0.006419	0.007586	28.0	3691
TETRA	Not disclosed	0.002155	0.003733	28.0	7501
TETRA	Not disclosed	0.001801	0.003119	28.0	8976
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	20310
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	23610
TV PAL	535.333	0.012531	0.015881	31.8	2003
TV PAL	583.680	0.010151	0.012864	33.2	2582
TV PAL	567.347	0.009874	0.012513	32.8	2617
TV PAL	743.093	0.011311	0.014334	37.5	2615
TV PAL	773.147	0.001932	0.005082	38.2	7524
TV DVB-T	741.133	0.001866	0.004909	37.4	7625
TV DVB-T	816.267	0.001635	0.004300	39.3	9135
GSM 900	949.267	0.613056	1.226112	42.4	35
GSM 900	938.417	0.435011	0.870022	42.1	48
GSM 900	954.867	0.040504	0.081008	42.5	524
GSM 1800	1835.000	0.179267	0.358534	58.9	164
GSM 1800	1845.000	0.158855	0.317709	59.1	186
UMTS	2132.900	0.147911	0.956501	61.0	64
UMTS	2126.613	0.123169	0.796500	61.0	77
UMTS	2147.367	0.086796	0.561288	61.0	109
UMTS	2114.233	0.021677	0.140180	61.0	435
WiFi	2437.853	0.007595	0.029467	61.0	2070
WiFi	2433.400	0.001122	0.006902	61.0	8838
WiFi	2440.800	0.001122	0.006005	61.0	10159
WiFi	2435.348	0.001122	0.005352	61.0	11398
FWALA	3570.000	0.017278	0.043587	61.0	1400

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	0.001843	1

3.2.3 Dublin: Hill of Howth

Measurements

Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of Adjusted Level)
PMR	Not disclosed	0.204409	0.204409	28.0	137
PMR	Not disclosed	0.085408	0.085408	28.0	328
PMR	Not disclosed	0.197925	0.197925	28.0	141
PMR	Not disclosed	0.149108	0.149108	28.0	188
PMR	Not disclosed	0.142069	0.142069	28.0	197
PMR	Not disclosed	0.122180	0.122180	28.0	229
PMR	Not disclosed	0.120365	0.120365	28.0	233
PMR	Not disclosed	0.107523	0.107523	28.0	260
FM Radio	87.500	0.040411	0.040411	28.0	693
FM Radio	101.850	0.015867	0.015867	28.0	1765
FM Radio	104.447	0.015049	0.015049	28.0	1861
FM Radio	106.018	0.013599	0.013599	28.0	2059
PMR	Not disclosed	0.179061	0.179061	28.0	156
PMR	Not disclosed	0.147571	0.147571	28.0	190
PMR	Not disclosed	0.128825	0.128825	28.0	217
PMR	Not disclosed	0.104232	0.104232	28.0	269
PMR	Not disclosed	0.053580	0.053580	28.0	523
TV PAL	183.120	0.029957	0.037963	28.0	738
TV PAL	207.280	0.028184	0.035716	28.0	784
TV PAL	189.200	0.022439	0.028436	28.0	985
TV PAL	213.200	0.019838	0.025140	28.0	1114
T-DAB	227.653	0.006776	0.008008	28.0	3497
TETRA	Not disclosed	0.202768	0.351205	28.0	80
TETRA	Not disclosed	0.149108	0.258262	28.0	108
TETRA	Not disclosed	0.144877	0.250935	28.0	112
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	11693
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	14175
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	257
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	882
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	6397
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	190
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	193
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	217
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	381
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	390
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	424
TV PAL	535.333	0.019454	0.024653	31.8	1290
TV PAL	567.347	0.018728	0.023734	32.8	1380
TV PAL	583.680	0.011350	0.014383	33.2	2310

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Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of Adjusted Level)
TV PAL	775.760	0.036644	0.046437	38.3	825
TV PAL	799.280	0.034914	0.044245	38.9	879
TV PAL	831.947	0.020630	0.026144	39.7	1517
TV PAL	719.573	0.017885	0.022665	36.9	1627
TV PAL	751.587	0.016788	0.021275	37.7	1772
TV PAL	847.627	0.013521	0.017134	40.0	2336
TV DVB-T	740.480	0.008521	0.022413	37.4	1669
GSM 900	952.883	2.330773	4.661546	42.4	9
GSM 900	940.750	0.956093	1.912185	42.2	22
GSM 900	948.333	0.699842	1.399684	42.3	30
GSM 1800	1856.750	0.945148	1.890297	59.2	31
UMTS	1910.800	0.017338	0.112121	60.1	536
UMTS	1905.800	0.011682	0.075542	60.0	795
UMTS	2147.600	0.015311	0.099012	61.0	616
UMTS	2113.300	0.013305	0.086037	61.0	709
UMTS	2167.200	0.009311	0.060212	61.0	1013
UMTS	2132.200	0.008790	0.056844	61.0	1073
UMTS	2127.800	0.008790	0.056844	61.0	1073
FWALA	3543.300	0.002497	0.006300	61.0	9682
FWALA	3552.000	0.001122	0.004105	61.0	14859
FWALA	3558.900	0.001122	0.003796	61.0	16069
FWALA	3528.600	0.001122	0.002795	61.0	21826
FWALA	3563.400	0.001122	0.002814	61.0	21676
FWALA	3580.200	0.001122	0.002390	61.0	25526
FWALA	3765.500	0.007595	0.019158	61.0	3184
FWALA	3761.600	0.001122	0.018128	61.0	3365
FWALA	3770.900	0.001122	0.009383	61.0	6501
FWALA	3750.500	0.001122	0.011691	61.0	5218
WiFi	5640.000	0.001488	0.005772	61.0	10568

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	0.017015	1

3.2.4 Dublin: Swords - Swords Manor Avenue

Measurements

Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of Adjusted Level)
PMR	Not disclosed	0.004651	0.004651	28.0	6021
TV PAL	207.600	0.034041	0.043138	28.0	649
TV PAL	183.440	0.032810	0.041578	28.0	673
T-DAB	227.680	0.006942	0.008204	28.0	3413
TETRA	Not disclosed	0.003240	0.005611	28.0	4990
TETRA	Not disclosed	0.003112	0.005390	28.0	5195
TETRA	Not disclosed	0.003034	0.005255	28.0	5328
TETRA	Not disclosed	0.002881	0.004990	28.0	5612
TETRA	Not disclosed	0.002835	0.004910	28.0	5703
TETRA	Not disclosed	0.002720	0.004710	28.0	5944
TV PAL	567.347	0.025061	0.031759	32.8	1031
TV PAL	583.680	0.016088	0.020388	33.2	1629
TV PAL	775.760	0.010990	0.013927	38.3	2750
TV PAL	799.280	0.010116	0.012819	38.9	3032
TV PAL	743.747	0.009954	0.012614	37.5	2973
TV DVB-T	739.827	0.006863	0.018051	37.4	2072
GSM 900	954.750	1.883649	3.767298	42.5	11
GSM 900	945.300	0.022988	0.045976	42.3	920
GSM 900	937.833	0.008424	0.016847	42.1	2499
GSM 1800	1856.500	0.195434	0.390868	59.2	152
UMTS	1914.467	0.013804	0.089266	60.2	674
UMTS	1918.733	0.008251	0.053356	60.2	1129
UMTS	2166.967	0.006412	0.041465	61.0	1471
UMTS	2114.000	0.005669	0.036659	61.0	1664
UMTS	2147.367	0.004513	0.029187	61.0	2090
UMTS	2127.767	0.004217	0.027270	61.0	2237
WiFi	2416.143	0.005352	0.020765	61.0	2938
WiFi	2418.370	0.001122	0.004629	61.0	13177
FWALA	3555.000	0.000584	0.001474	61.0	41398
FWALA	3564.300	0.001122	0.001332	61.0	45812
FWALA	3770.600	0.000872	0.002200	61.0	27732
FWALA	3766.100	0.001122	0.001976	61.0	30866

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	0.007919	1

3.2.5 Dublin 2: Christchurch Place - Jury's Inn

Measurements

Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of Adjusted Level)
PMR	Not disclosed	0.004753	0.004753	28.0	5891
PMR	Not disclosed	0.003833	0.003833	28.0	7306
PMR	Not disclosed	0.462381	0.462381	28.0	61
PMR	Not disclosed	0.022699	0.022699	28.0	1234
PMR	Not disclosed	0.004864	0.004864	28.0	5756
PMR	Not disclosed	0.004088	0.004088	28.0	6849
T-DAB	Not disclosed	0.007120	0.008414	28.0	3328
TETRA	Not disclosed	0.020725	0.035897	28.0	780
TETRA	Not disclosed	0.020370	0.035283	28.0	794
TETRA	Not disclosed	0.018642	0.032289	28.0	867
TETRA	Not disclosed	0.004672	0.006607	28.0	4238
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	5024
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	11408
TV PAL	567.347	0.015470	0.019605	32.8	1671
TV PAL	535.333	0.015205	0.019269	31.8	1651
TV PAL	583.027	0.010889	0.013800	33.2	2406
TV PAL	743.747	0.007998	0.010136	37.5	3700
TV DVB-T	740.480	0.006088	0.016014	37.4	2336
TV DVB	791.440	0.003931	0.010339	38.7	3741
TV DVB	817.573	0.003639	0.009572	39.3	4107
TV DVB	773.147	0.003532	0.009290	38.2	4116
GSM 900	953.000	1.102808	2.205616	42.4	19
GSM 900	947.750	0.250611	0.501222	42.3	84
GSM 900	939.700	0.017358	0.034716	42.1	1214
GSM 1800	1854.500	0.640472	1.280944	59.2	46
GSM 1800	1864.000	0.291407	0.582814	59.4	102
GSM 1800	1837.000	0.160879	0.321758	58.9	183
UMTS	1905.733	0.004004	0.025893	60.0	2318
UMTS	2166.733	0.027511	0.177904	61.0	343
UMTS	2147.833	0.008433	0.054536	61.0	1119
UMTS	2114.000	0.006863	0.044380	61.0	1374
UMTS	2128.467	0.004411	0.028522	61.0	2139
WiFi	2463.738	0.008337	0.032347	61.0	1886
WiFi	2421.153	0.001122	0.007834	61.0	7786
FWALA	3589.800	0.065088	0.164192	61.0	372
FWALA	3595.200	0.001122	0.020481	61.0	2978
FWALA	3555.300	0.001122	0.002491	61.0	24489
FWALA	3760.400	0.001034	0.002608	61.0	23387

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**	0.003732	1

3.2.6 Dublin 7: Phibsboro Shopping Centre

Measurements

Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of Adjusted Level)
PMR	Not disclosed	0.004847	0.004847	28.0	5776
PMR	Not disclosed	0.004013	0.004013	28.0	6977
PMR	Not disclosed	0.002231	0.002231	28.0	12550
TV PAL	182.960	0.026577	0.033679	28.0	831
TV PAL	207.120	0.023741	0.030086	28.0	931
T-DAB	227.173	0.006683	0.007898	28.0	3545
TETRA	Not disclosed	0.018471	0.031993	28.0	875
TETRA	Not disclosed	0.017803	0.030836	28.0	908
TETRA	Not disclosed	0.016255	0.028155	28.0	994
TETRA	Not disclosed	0.009152	0.015851	28.0	1766
TETRA	Not disclosed	0.008933	0.015473	28.0	1810
TETRA	Not disclosed	0.008414	0.014573	28.0	1921
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	658
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	3501
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	8396
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	13598
TV PAL	535.333	0.010198	0.012923	31.8	2462
TV PAL	567.347	0.010162	0.012878	32.8	2543
TV PAL	747.013	0.021827	0.027661	37.6	1359
TV PAL	799.933	0.015101	0.019137	38.9	2032
TV PAL	775.760	0.014911	0.018896	38.3	2027
TV DVB-T	818.227	0.008995	0.023659	39.3	1662
TV DVB	772.493	0.008954	0.023550	38.2	1623
TV DVB	792.747	0.007736	0.020347	38.7	1903
TV DVB	739.827	0.006317	0.016615	37.4	2251
GSM 900	954.400	2.964831	5.929663	42.5	7
GSM 900	952.767	0.341979	0.683959	42.4	62
GSM 900	938.767	0.273527	0.547054	42.1	77
GSM 900	946.467	0.131220	0.262440	42.3	161
GSM 1800	1854.500	0.299916	0.599833	59.2	99
GSM 1800	1865.750	0.285430	0.570861	59.4	104
GSM 1800	1856.650	0.279576	0.559152	59.2	106
GSM 1800	1834.500	0.216521	0.433042	58.9	136
UMTS	1909.066	0.019187	0.124075	60.1	484
UMTS	1912.667	0.011776	0.076153	60.1	790
UMTS	2168.833	0.090991	0.588418	61.0	104
UMTS	2113.300	0.061802	0.399655	61.0	153
UMTS	2126.833	0.034316	0.221914	61.0	275
UMTS	2147.833	0.022935	0.148315	61.0	411
UMTS	2132.667	0.006095	0.039417	61.0	1548

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Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of Adjusted Level)
WiFi	2461.233	0.007055	0.027374	61.0	2228
WiFi	2419.761	0.001122	0.005848	61.0	10431
FWALA	3541.200	0.041020	0.103479	61.0	589
FWALA	3577.800	0.001122	0.066889	61.0	912
FWALA	3595.800	0.001122	0.011178	61.0	5457
FWALA	3554.400	0.001122	0.005839	61.0	10447
FWALA	3765.500	0.003972	0.010020	61.0	6088
FWALA	3774.500	0.001122	0.008154	61.0	7481
FWALA	3743.300	0.001122	0.004622	61.0	13197

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**	0.020469	1

3.2.7 Dublin 8: Meath Street

Measurements

Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of Adjusted Level)
PMR	Not disclosed	0.004493	0.004493	28.0	6232
FM Radio	92.898	0.010081	0.010081	28.0	2778
FM Radio	100.893	0.008600	0.008600	28.0	3256
FM Radio	106.018	0.007916	0.007916	28.0	3537
FM Radio	94.880	0.007907	0.007907	28.0	3541
PMR	Not disclosed	0.016769	0.016769	28.0	1670
PMR	Not disclosed	0.012764	0.012764	28.0	2194
PMR	Not disclosed	0.011482	0.011482	28.0	2439
PMR	Not disclosed	0.006194	0.006194	28.0	4520
TV PAL	207.600	0.022029	0.027917	28.0	1003
TV PAL	183.120	0.021979	0.027853	28.0	1005
T-DAB	227.707	0.021627	0.025556	28.0	1096
TETRA	Not disclosed	0.004955	0.008581	28.0	3263
TETRA	Not disclosed	0.004164	0.007212	28.0	3882
TETRA	Not disclosed	0.003677	0.006369	28.0	4396
TETRA	Not disclosed	0.003416	0.005916	28.0	4733
TETRA	Not disclosed	0.001738	0.002458	28.0	11393
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	4685
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	5225
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	6199
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	7270
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	7349
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	9216
TV PAL	567.347	0.136458	0.172928	32.8	189
TV PAL	583.680	0.105560	0.133772	33.2	248
TV PAL	535.333	0.102329	0.129677	31.8	245
TV PAL	743.747	0.064565	0.081821	37.5	458
TV DVB-T	734.600	0.035156	0.092469	37.3	403
GSM 900	955.683	4.513360	9.026721	42.5	5
GSM 1800	1856.750	1.890166	3.780332	59.2	16
GSM 1800	1866.250	0.263633	0.527266	59.4	113
UMTS	1911.267	0.034874	0.225520	60.1	267
UMTS	2127.533	0.022516	0.145608	61.0	419
UMTS	2132.200	0.021953	0.141966	61.0	430
UMTS	2114.000	0.013552	0.087637	61.0	696
UMTS	2168.367	0.010023	0.064817	61.0	941
UMTS	2147.133	0.006237	0.040335	61.0	1512
WiFi	2438.410	0.012764	0.049526	61.0	1232

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Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of Adjusted Level)
WiFi	2459.850	0.001122	0.012331	61.0	4947
WiFi	2462.900	0.001122	0.010740	61.0	5680
FWALA	3565.800	0.003440	0.008677	61.0	7030
FWALA	3529.200	0.001122	0.005832	61.0	10459
FWALA	3548.100	0.001122	0.004829	61.0	12632
FWALA	3599.100	0.001122	0.003672	61.0	16614
FWALA	3585.900	0.001122	0.001497	61.0	40736
FWALA	3768.200	0.032359	0.115443	61.0	528
FWALA	3761.300	0.001122	0.030156	61.0	2023
FWALA	3713.300	0.001122	0.004120	61.0	14807
FWALA	10241.337	0.002506	0.008941	61.0	6823

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	0.049356	1

3.2.8 Dublin 11: Finglas Garda Station

Measurements

Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of Adjusted Level)
PMR	Not disclosed	0.004995	0.004995	28.0	5606
FM Radio	104.447	0.013047	0.013047	28.0	2146
FM Radio	98.092	0.011246	0.011246	28.0	2490
FM Radio	106.018	0.010198	0.010198	28.0	2746
FM Radio	94.880	0.009462	0.009462	28.0	2959
TV PAL	207.440	0.035156	0.044552	28.0	628
TV PAL	182.960	0.032584	0.041292	28.0	678
T-DAB	227.147	0.006990	0.008260	28.0	3390
TETRA	Not disclosed	0.298882	0.517679	28.0	54
TETRA	Not disclosed	0.295461	0.511753	28.0	55
TETRA	Not disclosed	0.001921	0.002717	28.0	10307
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	12695
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	20842
TV PAL	535.333	0.023659	0.029982	31.8	1061
TV PAL	567.347	0.018239	0.023113	32.8	1417
TV PAL	583.680	0.011885	0.015061	33.2	2206
TV PAL	743.747	0.046026	0.058326	37.5	643
TV PAL	799.280	0.010483	0.013285	38.9	2926
TV PAL	775.760	0.009886	0.012527	38.3	3057
TV DVB-T	740.480	0.025615	0.067375	37.4	555
GSM 900	953.817	0.899498	1.798995	42.5	24
GSM 900	946.817	0.081003	0.162006	42.3	261
GSM 900	938.883	0.025586	0.051172	42.1	823
GSM 1800	1845.500	1.310690	2.621380	59.1	23
GSM 1800	1856.250	0.129271	0.258541	59.2	229
GSM 1800	1865.750	0.013521	0.027041	59.4	2196
GSM 1800	1837.000	0.014655	0.029311	58.9	2011
UMTS	1912.067	0.004188	0.027082	60.1	2220
UMTS	2147.833	0.017278	0.111734	61.0	546
UMTS	2112.133	0.008700	0.056258	61.0	1084
UMTS	2132.900	0.004949	0.032003	61.0	1906
UMTS	2128.000	0.004699	0.030387	61.0	2007
UMTS	2168.600	0.004236	0.027396	61.0	2227
FWALA	3566.700	0.001654	0.004172	61.0	14621
FWALA	3548.400	0.001122	0.002593	61.0	23522
FWALA	3580.200	0.001122	0.001922	61.0	31731
FWALA	3530.100	0.001122	0.001842	61.0	33111
FWALA	3768.200	0.001921	0.006853	61.0	8901

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**	0.004494	1

3.2.9 Dublin 14: Rathfarnham - Nutgrove Shopping Centre

Measurements

Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of Adjusted Level)
PMR	Not disclosed	0.008082	0.008082	28.0	3465
FM Radio	104.447	0.049488	0.049488	28.0	566
FM Radio	106.018	0.038949	0.038949	28.0	719
FM Radio	94.880	0.036433	0.036433	28.0	769
FM Radio	105.198	0.022725	0.022725	28.0	1232
FM Radio	92.898	0.014471	0.014471	28.0	1935
FM Radio	103.832	0.018578	0.018578	28.0	1507
T-DAB	227.067	0.041687	0.049261	28.0	568
TETRA	Not disclosed	0.035892	0.062167	28.0	450
TETRA	Not disclosed	0.035604	0.061668	28.0	454
TETRA	Not disclosed	0.008943	0.015490	28.0	1808
TETRA	Not disclosed	0.007047	0.012206	28.0	2294
TETRA	Not disclosed	0.005998	0.010389	28.0	2695
TETRA	Not disclosed	0.008026	0.011351	28.0	2467
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	6505
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	13866
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	17634
TV PAL	567.347	0.158672	0.201078	32.8	163
TV PAL	535.333	0.144046	0.182543	31.8	174
TV PAL	583.680	0.127791	0.161944	33.2	205
TV PAL	749.627	0.033690	0.042694	37.6	882
TV PAL	799.933	0.006152	0.007796	38.9	4988
TV DVB-T	735.907	0.027797	0.073113	37.3	510
GSM 900	940.867	2.506109	5.012219	42.2	8
GSM 900	948.100	0.260016	0.520032	42.3	81
GSM 900	954.400	0.390391	0.780782	42.5	54
GSM 1800	1864.250	0.760326	1.520653	59.4	39
GSM 1800	1857.500	0.406443	0.812887	59.3	73
GSM 1800	1743.500	0.253221	0.506442	57.4	113
UMTS	2166.267	0.139959	0.905077	61.0	67
UMTS	2112.600	0.085507	0.552950	61.0	110
UMTS	2147.600	0.027733	0.179344	61.0	340
FWALA	3555.600	0.043102	0.108731	61.0	561
FWALA	3563.100	0.001122	0.047245	61.0	1291
FWALA	3528.300	0.001122	0.007250	61.0	8414
FWALA	3541.200	0.001122	0.001972	61.0	30937
FWALA	3739.100	0.002133	0.005381	61.0	11336
FWALA	3733.400	0.001122	0.003718	61.0	16405
FWALA	3746.000	0.001122	0.003510	61.0	17377

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Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of Adjusted Level)
FWALA	3722.600	0.001122	0.003306	61.0	18449
WiFi	5518.450	0.001596	0.006192	61.0	9851
FWALA	10240.450	0.002618	0.009340	61.0	6531
FWALA	10213.850	0.001122	0.008788	61.0	6942
FWALA	10269.710	0.001122	0.008431	61.0	7235
FWALA	10190.353	0.001122	0.008163	61.0	7472

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	0.01597	1

3.2.10 Dublin 17: Coolock - Colaiste Dhúlaigh – FM Radio Transmitter

Measurements

Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of Adjusted Level)
PMR	Not disclosed	0.004748	0.004748	28.0	5897
FM Radio	90.302	0.100346	0.100346	28.0	279
T-DAB	227.893	0.006273	0.007413	28.0	3777
TETRA	Not disclosed	0.002723	0.004716	28.0	5937
TETRA	Not disclosed	0.002600	0.004504	28.0	6217
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	583
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	4786
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	21328
TV PAL	583.680	0.012691	0.016083	33.2	2066
TV PAL	535.333	0.011614	0.014719	31.8	2161
TV PAL	567.347	0.007962	0.010089	32.8	3246
TV PAL	799.933	0.030130	0.038182	38.9	1019
TV PAL	775.760	0.027542	0.034903	38.3	1097
TV DVB-T	735.253	0.003217	0.008462	37.3	4406
GSM 900	953.583	0.935406	1.870811	42.5	23
GSM 900	956.033	0.820352	1.640703	42.5	26
GSM 900	937.833	0.784332	1.568664	42.1	27
GSM 1800	1857.250	0.878011	1.756022	59.3	34
GSM 1800	1843.250	0.733669	1.467337	59.0	40
GSM 1800	1867.000	0.612350	1.224701	59.4	49
UMTS	1907.467	0.003051	0.019733	60.1	3043
UMTS	2168.133	0.287740	1.860740	61.0	33
UMTS	2113.533	0.157398	1.017854	61.0	60
UMTS	2131.267	0.150141	0.970925	61.0	63
UMTS	2127.533	0.131522	0.850522	61.0	72
UMTS	2146.667	0.109396	0.707434	61.0	86
FWALA	3544.500	0.076648	0.193354	61.0	315
FWALA	3547.200	0.001122	0.167052	61.0	365
FWALA	3600.000	0.001122	0.027438	61.0	2223
FWALA	3565.800	0.001122	0.004930	61.0	12373
FWALA	3558.600	0.001122	0.001997	61.0	30548
FWALA	3748.700	0.001091	0.002753	61.0	22155
FWALA	3764.600	0.001122	0.002238	61.0	27257
WiFi	5566.900	0.002254	0.008746	61.0	6974

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**	0.008567	1

3.2.11 Dublin 20: Palmerstown - Kennelsfort Road Upper

Measurements

Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of Adjusted Level)
PMR	Not disclosed	0.004613	0.004613	28.0	6070
FM Radio	104.447	0.018967	0.018967	28.0	1476
FM Radio	89.072	0.016827	0.016827	28.0	1664
FM Radio	98.707	0.014521	0.014521	28.0	1928
FM Radio	91.327	0.014504	0.014504	28.0	1930
FM Radio	101.850	0.014060	0.014060	28.0	1991
FM Radio	106.018	0.013804	0.013804	28.0	2028
TV PAL	207.600	0.043652	0.055318	28.0	506
TV PAL	183.600	0.042218	0.053501	28.0	523
TV PAL	213.680	0.025380	0.032164	28.0	871
TV PAL	189.040	0.024266	0.030751	28.0	911
T-DAB	227.280	0.007603	0.008985	28.0	3116
TETRA	Not disclosed	0.021702	0.037589	28.0	745
TETRA	Not disclosed	0.021478	0.037202	28.0	753
TETRA	Not disclosed	0.016368	0.028350	28.0	988
TETRA	Not disclosed	0.001742	0.002463	28.0	11367
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	12429
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	19084
TV PAL	567.347	0.021577	0.027344	32.8	1198
TV PAL	583.680	0.018599	0.023570	33.2	1409
TV PAL	799.933	0.016051	0.020341	38.9	1912
TV PAL	743.093	0.014689	0.018615	37.5	2014
TV PAL	775.760	0.011092	0.014056	38.3	2725
TV DVB-T	740.480	0.011508	0.030269	37.4	1236
GSM 900	953.000	2.030019	4.060037	42.4	10
GSM 1800	1855.500	0.416390	0.832779	59.2	71
GSM 1800	1841.000	0.025468	0.050937	59.0	1158
GSM 1800	1861.500	0.014740	0.029480	59.3	2012
UMTS	1909.667	0.008035	0.051962	60.1	1156
UMTS	1906.200	0.007656	0.049509	60.0	1213
UMTS	2166.500	0.121060	0.782863	61.0	78
UMTS	2113.067	0.008063	0.052142	61.0	1170
UMTS	2146.433	0.006346	0.041038	61.0	1486
UMTS	2127.767	0.004013	0.025953	61.0	2350
WiFi	2423.658	0.005200	0.020176	61.0	3023
FWALA	3549.000	0.000808	0.002039	61.0	29921
FWALA	3593.400	0.001122	0.001601	61.0	38105
FWALA	3766.700	0.001637	0.004129	61.0	14773
FWALA	3761.600	0.001122	0.004096	61.0	14893
FWALA	3755.900	0.001122	0.002494	61.0	24461
FWALA	3773.900	0.001122	0.002362	61.0	25821

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**	0.009534	1

3.2.12 Kildare: Dunmurry Hill

Measurements

Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of Adjusted Level)
PMR	Not disclosed	0.004858	0.004858	28.0	5763
PMR	Not disclosed	0.004395	0.004395	28.0	6370
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	17118
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	24261
TV PAL	702.587	0.004126	0.005228	36.4	6971
TV PAL	831.947	0.004023	0.005098	39.7	7780
TV DVB-T	657.507	0.001437	0.003780	35.3	9327
TV DVB-T	681.680	0.001780	0.004683	35.9	7666
TV DVB-T	713.040	0.001297	0.003412	36.7	10761
GSM 900	937.950	0.026699	0.053399	42.1	789
GSM 900	955.217	0.014240	0.028479	42.5	1492
GSM 900	949.033	0.011207	0.022415	42.4	1890
GSM 1800	1845.750	0.048922	0.097843	59.1	604
GSM 1800	1831.750	0.048809	0.097618	58.8	603
UMTS	2113.767	0.005284	0.034173	61.0	1785
UMTS	2147.833	0.004441	0.028720	61.0	2124
MMDS PAL	2532.860	0.020300	0.025726	61.0	2371
MMDS PAL	2548.980	0.001122	0.021795	61.0	2799
FWALA	3512.100	0.001245	0.003139	61.0	19430

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	0.0000088	1

3.2.13 Kildare: Kildare Town Market Sq / Claregate St

Measurements

Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of Adjusted Level)
PMR	Not disclosed	0.004842	0.004842	28.0	5783
FM Radio	93.513	0.012531	0.012531	28.0	2234
FM Radio	98.707	0.008872	0.008872	28.0	3156
TV PAL	191.280	0.026152	0.033141	28.0	845
TV PAL	215.600	0.021429	0.027156	28.0	1031
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	12500
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	18408
TV PAL	487.640	0.015488	0.019627	30.4	1547
TV PAL	511.160	0.007621	0.009657	31.1	3219
TV PAL	775.760	0.016444	0.020838	38.3	1838
TV PAL	799.933	0.009761	0.012370	38.9	3144
GSM 900	940.633	0.410677	0.821353	42.2	51
GSM 900	954.050	0.618728	1.237457	42.5	34
GSM 900	939.350	0.345541	0.691083	42.1	61
GSM 900	948.567	0.022491	0.044981	42.3	941
GSM 1800	1835.000	0.535180	1.070360	58.9	55
GSM 1800	1855.250	0.335738	0.671475	59.2	88
GSM 1800	1857.250	0.094624	0.189247	59.3	313
UMTS	2147.600	0.144378	0.933653	61.0	65
UMTS	2114.000	0.103039	0.666324	61.0	92
UMTS	2167.667	0.076384	0.493953	61.0	123
FWALA	3718.400	0.003027	0.007636	61.0	7989
FWALA	3764.300	0.001122	0.004299	61.0	14190
FWALA	3732.200	0.001122	0.002060	61.0	29613

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	0.00239	1

3.2.14 Laois: Abbeyleix Road - Portlaoise Garda Station

Measurements

Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of Adjusted Level)
PMR	Not disclosed	0.004102	0.004102	28.0	6826
FM Radio	96.178	0.009528	0.009528	28.0	2939
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	1288
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	1268
GSM 900	954.983	0.825087	1.650175	42.5	26
GSM 900	953.583	0.227248	0.454496	42.5	93
GSM 900	938.183	0.028249	0.056498	42.1	745
GSM 1800	1854.500	0.254683	0.509366	59.2	116
GSM 1800	1856.250	0.138835	0.277671	59.2	213
GSM 1800	1857.750	0.131978	0.263955	59.3	225
UMTS	2148.767	0.014689	0.094992	61.0	642
UMTS	2111.200	0.010035	0.064891	61.0	940
WiFi	2450.657	0.011885	0.046114	61.0	1323
WiFi	2452.327	0.001122	0.011858	61.0	5144
FWALA	3552.300	0.002968	0.007488	61.0	8147
FWALA	3544.500	0.001122	0.004491	61.0	13582
FWALA	3525.000	0.001122	0.003701	61.0	16481
FWALA	3597.600	0.001122	0.002927	61.0	20844
FWALA	3549.000	0.001122	0.002731	61.0	22335
FWALA	3557.700	0.001122	0.002195	61.0	27796
WiFi	5537.150	0.001925	0.007470	61.0	8166
WiFi	5717.350	0.001122	0.007085	61.0	8610
FWA (Lic-exempt)	5728.000	0.027765	0.070041	61.0	871
FWA (Lic-exempt)	2735.500	0.001122	0.007706	61.0	7915
FWA (Lic-exempt)	5756.500	0.001122	0.006121	61.0	9965

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**	0.001747	1

3.2.15 Louth: Castlebellingham – Dundalk Road

Measurements

Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of Adjusted Level)
PMR	Not disclosed	0.004667	0.004667	28.0	6000
PMR	Not disclosed	0.003715	0.003715	28.0	7536
FM Radio	102.738	0.008511	0.008511	28.0	3290
FM Radio	105.540	0.007771	0.007771	28.0	3603
T-DAB	227.520	0.011508	0.013599	28.0	2059
TV PAL	751.587	0.065088	0.082483	37.7	457
TV PAL	719.573	0.051701	0.065519	36.9	563
TV PAL	831.947	0.051464	0.065218	39.7	608
TV PAL	847.627	0.039765	0.050392	40.0	794
TV DVB-T	729.373	0.008008	0.021062	37.1	1763
GSM 900	945.650	0.542001	1.084002	42.3	39
GSM 900	953.233	0.011899	0.023797	42.5	1784
GSM 900	938.300	0.011548	0.023096	42.1	1824
GSM 1800	1857.750	0.008194	0.016388	59.3	3616
GSM 1800	1847.500	0.006187	0.012375	59.1	4776
UMTS	2148.767	0.309386	2.000717	61.0	30
UMTS	2113.533	0.004222	0.027301	61.0	2234

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	0.001747	1

3.2.16 Meath: Athboy - Old Darnley Hotel

Measurements

Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of Adjusted Level)
PMR	Not disclosed	0.004977	0.004977	28.0	5625
FM Radio	96.520	0.191426	0.191426	28.0	146
GSM 900	952.767	0.006012	0.012023	42.4	3530
GSM 900	947.167	0.004281	0.008561	42.3	4943
GSM 900	937.950	0.003443	0.006887	42.1	6115
GSM 1800	1843.000	1.123311	2.246622	59.0	26
GSM 1800	1844.000	0.625893	1.251786	59.0	47
GSM 1800	1832.000	0.152230	0.304460	58.9	193
UMTS	2147.600	0.171989	1.112207	61.0	55

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	0.002304	1

3.2.17 Meath: Navan Shopping Centre

Measurements

N.B.: Electromagnetic noise emissions were measured in several bands. The noise may be attributable to spurious emissions from nearby emitters and electrical machinery. The noise levels measured are tabulated here along with the levels measured for the various signals present and are included in the calculations for the Total Exposure Quotient.

Emission / Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of Adjusted Level)
PMR	Not disclosed	0.002118	0.002118	28.0	13218
PMR	Not disclosed	0.004078	0.004078	28.0	6865
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	14559
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	22361
TV PAL	529.453	0.007568	0.009591	31.6	3299
TV PAL	751.587	0.005420	0.006869	37.7	5488
GSM 900	955.100	5.122713	10.245425	42.5	4
GSM 900	949.033	3.254618	6.509236	42.4	7
GSM 900	941.100	1.394762	2.789523	42.2	15
GSM 900	939.000	0.759451	1.518903	42.1	28
GSM 1800	1856.250	1.680738	3.361476	59.2	18
GSM 1800	1832.250	1.075227	2.150453	58.9	27
GSM 1800	1862.000	0.872971	1.745943	59.3	34
UMTS	1904.000	0.06308	0.2298237	60.00	261
UMTS	1910.000	0.05499	0.2003488	59.99	299
UMTS	2149.000	0.438026	2.832603	61.0	22
UMTS	2114.233	0.050466	0.326352	61.0	187
UMTS	2166.500	0.013900	0.089885	61.0	679
WiFi	2410.020	0.006569	0.025488	61.0	2393
WiFi	2430.060	0.001122	0.006531	61.0	9340
FWALA	10227.593	0.005559	0.019832	61.0	3076
Noise + PMR Signals	68 – 74.8	0.2047436	0.2047436	28	137
Noise	75.2 - 81.35	0.2756680	0.2756680	28	102
Noise	81.35 - 87.5	0.0842886	0.0842886	28	332
Noise	1900 – 1920	0.1951868	0.1951868	59.9 – 60.2	308
Noise + FWALA Signals	3510 – 3600	0.0188094	0.0188094	61	3243
Noise	3710 – 3800	0.2964113	0.2964113	61	206
Noise	5470 – 5725	0.0772692	0.0772692	61	789
Noise	5725 – 5875	0.0605770	0.0605770	61	1007

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**	0.095187	1

3.2.18 Offaly: Edenderry Watertower

Measurements

Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of Adjusted Level)
PMR	Not disclosed	0.004198	0.004198	28.0	6670
FM Radio	98.707	0.010023	0.010023	28.0	2794
FM Radio	89.072	0.008720	0.008720	28.0	3211
TV PAL	207.600	0.024660	0.031251	28.0	896
TV PAL	183.120	0.023227	0.029435	28.0	951
TV PAL	486.987	0.011708	0.014838	30.3	2045
TV PAL	511.160	0.009661	0.012242	31.1	2539
TV PAL	647.707	0.009462	0.011991	35.0	2918
TV PAL	799.933	0.010666	0.013517	38.9	2877
TV PAL	703.240	0.010198	0.012923	36.5	2822
TV PAL	775.760	0.006630	0.008402	38.3	4558
TV DVB-T	658.813	0.003350	0.008810	35.3	4006
TV DVB	636.600	0.002692	0.007079	34.7	4900
TV DVB	711.733	0.002339	0.006152	36.7	5963
TV DVB	678.413	0.002175	0.005721	35.8	6260
GSM 900	939.933	0.476980	0.953960	42.2	44
GSM 900	954.867	0.400405	0.800811	42.5	53
GSM 900	950.783	0.010069	0.020139	42.4	2105
GSM 1800	1837.500	0.376704	0.753408	58.9	78
GSM 1800	1860.750	0.356451	0.712902	59.3	83
GSM 1800	1856.750	0.237137	0.474275	59.2	125
UMTS	2147.600	0.114551	0.740774	61.0	82
UMTS	2166.500	0.111173	0.718928	61.0	85
UMTS	2111.900	0.005224	0.033782	61.0	1806
FWALA	3519.300	0.000512	0.001292	61.0	47204
FWALA	3745.100	0.004645	0.011718	61.0	5206

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	0.00153	1

3.2.19 Wexford: Courtown Garda Station

Measurements

Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of Adjusted Level)
PMR	Not disclosed	0.004385	0.004385	28.0	6385
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	18990
TV PAL	511.160	0.008750	0.011088	31.1	2804
TV PAL	486.987	0.008590	0.010886	30.3	2787
GSM 900	946.933	0.539511	1.079021	42.3	39
GSM 900	953.817	0.316957	0.633913	42.5	67
GSM 900	938.767	0.041020	0.082041	42.1	514
UMTS	2145.967	0.039719	0.256854	61.0	237
UMTS	2167.200	0.015470	0.100043	61.0	610
UMTS	2111.433	0.007586	0.049055	61.0	1243
FWA (Lic-exempt)	5835.500	0.001406	0.003547	61.0	17198
FWA (Lic-exempt)	5845.000	0.001122	0.003458	61.0	17639

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**	0.000898	1

3.2.20 Wicklow: Bellevue-Greystones – Broadcast Transmitter Site

Measurements

Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of Adjusted Level)
PMR	Not disclosed	0.004529	0.004529	28.0	6182
FM Radio	96.247	0.033690	0.033690	28.0	831
FM Radio	89.482	0.009920	0.009920	28.0	2823
TETRA	Not disclosed	0.005164	0.008945	28.0	3130
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	10255
TV PAL	759.427	0.024266	0.030751	37.9	1232
TV PAL	727.413	0.023041	0.029199	37.1	1270
TV PAL	807.773	0.018218	0.023087	39.1	1693
TV DVB-T	722.840	0.008453	0.022233	37.0	1663
GSM 900	955.683	0.148594	0.297187	42.5	143
GSM 900	946.350	0.115345	0.230691	42.3	183
GSM 900	939.583	0.081190	0.162379	42.1	260
GSM 1800	1838.000	0.133660	0.267319	58.9	221
GSM 1800	1835.000	0.120504	0.241007	58.9	244
GSM 1800	1831.500	0.120365	0.240730	58.8	244
GSM 1800	1833.250	0.116547	0.233093	58.9	253
GSM 1800	1855.000	0.082130	0.164259	59.2	361
UMTS	2147.133	0.025439	0.164507	61.0	371
UMTS	2113.767	0.023578	0.152470	61.0	400
UMTS	2133.367	0.012345	0.079834	61.0	764
UMTS	2126.133	0.010423	0.067404	61.0	905
UMTS	2168.133	0.005565	0.035990	61.0	1695
FWALA	3577.800	0.010678	0.026937	61.0	2265
FWALA	3587.100	0.001122	0.023488	61.0	2597
FWALA	10163.375	0.002761	0.009848	61.0	6194

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	0.000192	1

4. Conclusion

The conclusion of this report is that at all 20 licensed transmitter sites surveyed on behalf of ComReg during the period January - March 2009 as part of the 2009 Programme of Measurement of Non-Ionising Radiation Emissions:

(1) Measurements undertaken of non-ionising radiation emission levels on individual frequencies were found to fall below the international ICNIRP reference levels for general public exposure.

(2) The levels measured were not found to cause the aggregate of non-ionising radiation emissions to exceed the criteria for simultaneous exposure to multiple frequency fields specified in the guidelines published by ICNIRP.

Annex 1 - NIR and Emissions Standards

Definition

Non-ionising radiation (NIR) is that part of the electromagnetic spectrum below 3000 million MHz (3 x 10^{15} Hz). Non-ionising radiation includes all radiations and fields of the electromagnetic spectrum that do not normally have sufficient energy to produce ionisation in matter and is characterised by energy per photon of less than about 12 eV and wavelengths greater than 100 nm. Radio waves, infrared radiation and visible light are examples of NIR. Electromagnetic waves at frequencies above 3000 million MHz are known as ionising radiation and this includes X-rays and Gamma rays as well as some Ultraviolet radiation.

Standards for limiting exposure to non-ionising radiation

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) is an independent, scientific organisation established in 1992. The ICNIRP was established for the purpose of advancing Non-Ionising Radiation Protection and in particular to provide guidance and recommendations on protection from NIR exposure. ICNIRP operates in co-operation with the Environmental Health Division of the World Health Organisation and the United Nations Environment Programme.

In 1998 ICNIRP published guidelines[10] for limiting exposure to NIR (up to 300 GHz). Many countries have adopted the 1998 ICNIRP document as the reference for setting emissions limits. It should be noted that in 1999 the Council of the European Union issued a recommendation[11] to limit exposure of the general public to electromagnetic fields 0Hz - 300GHz

[10] "Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz)", Health Physics, vol 74, no. 4, April 1998

Available on the Web at www.icnirp.de.

[11] Recommendation of the European Council 1999/519/EC of July 12, 1999

based on a set of basic restrictions and reference levels developed internationally under the advice of the International Commission on Non-Ionizing Radiation Protection. In relation to emissions within the radio spectrum, these limits are equivalent to the ICNIRP guideline limits. An outline of the ICNIRP Guidelines is presented in Annex 2.

Non-ionising radiation licence conditions

It is a condition of various licences[12] issued by ComReg pursuant to the Wireless Telegraphy Act, 1926 (No. 45 of 1926) that licensees must ensure that NIR emissions from each radio installation operated thereunder must be within the limits specified in the guidelines published by ICNIRP.

[12] e.g. GSM, 3G Mobile, Radio and TV Broadcasting, MMDS, FWA (Wireless Broadband), among others.

Annex 2 – The ICNIRP Guidelines

SUMMARY OF THE ICNIRP GUIDELINES FOR LIMITING EXPOSURE TO TIME-VARYING ELECTRIC, MAGNETIC, AND ELECTROMAGNETIC FIELDS (UP TO 300 GHz)

In 1974, the International Radiation Protection Association (IRPA) formed a working group on non-ionising radiation (NIR), which examined the problems arising in the field of protection against the various types of NIR. In 1977, this working group became the International Non-Ionizing Radiation Committee (INIRC).

In cooperation with the Environmental Health Division of the World Health Organization (WHO), the IRPA/INIRC developed a number of health criteria documents on NIR as part of WHO's Environmental Health Criteria Program, sponsored by the United Nations Environment Program (UNEP). Each document includes an overview of the physical characteristics, measurement and instrumentation, sources, and applications of NIR, a thorough review of the literature on biological effects, and an evaluation of the health risks of exposure to NIR. These health criteria have provided the scientific database for the subsequent development of exposure limits and codes of practice relating to NIR.

At the Eighth International Congress of the IRPA, a new, independent scientific organization—the International Commission on Non-Ionizing Radiation Protection (ICNIRP)—was established as a successor to the IRPA/INIRC. The functions of the Commission are to investigate the hazards that may be associated with the different forms of NIR, develop international guidelines on NIR exposure limits, and deal with all aspects of NIR protection.

ICNIRP has defined two guideline exposure limits, one for members of the general public and one for people classified as occupational (e.g. telecommunication engineers). The occupationally exposed population consists of adults who are generally exposed under known conditions and are trained to be aware of potential risk and to take appropriate precautions. By contrast, the general public comprises individuals of all ages and of varying health status, and may include particularly susceptible groups or individuals. In many cases, members of the public are unaware of their exposure to EMF. Moreover, individual members of the public cannot reasonably be expected to take precautions to minimize or avoid exposure. It is these considerations that underlie the adoption of more stringent exposure restrictions for the public than for the occupationally exposed population.

ICNIRP has defined basic restrictions and reference levels. Depending on frequency, the physical quantities used to specify the basic restrictions on exposure to electromagnetic fields (EMF) are current density, specific absorption rate (SAR), and power density. SAR is not easily measurable in living people therefore reference levels have been obtained from the basic restrictions by mathematical modelling and by extrapolation from the results of laboratory investigations at specific frequencies.

The reference levels are provided for comparison with measured values of physical quantities; compliance with all reference levels given in these guidelines will ensure

compliance with basic restrictions. If measured values are higher than reference levels, it does not necessarily follow that the basic restrictions have been exceeded, but a more detailed analysis is necessary to assess compliance with the basic restrictions.

Frequency Range	E – Field Strength (Vm^{-1})	H – Field (Am^{-1})	B – Field (μT)	Equivalent plane wave power S (Wm^{-2})
up to 1 Hz	-	1.63×10^5	2×10^5	-
1 – 8 Hz	20,000	$1.63 \times 10^5/f^2$	$2.5 \times 10^5/f^2$	-
8 – 25 Hz	20,000	$1.63 \times 10^5/f$	$2.5 \times 10^4/f$	-
0.025 – 0.82 kHz	$500/f$	$20/f$	$25/f$	-
0.82 – 65 kHz	610	24.4	30.7	-
0.065 – 1 MHz	610	$1.6/f$	$2.0/f$	-
1 – 10 MHz	$610/f$	$1.6/f$	$2.0/f$	-
10 – 400 MHz	61	0.16	0.2	10
400 – 2000 MHz	$3f^{1/2}$	$0.008f^{1/2}$	$0.01f^{1/2}$	$f/40$
2 – 300 GHz	137	0.36	0.45	50

Table 1: Reference levels for <u>occupational exposure</u> to time-varying electric and magnetic fields (unperturbed rms values). f in units as indicated in the Frequency Range column.

Frequency Range	E – Field Strength (Vm^{-1})	H – Field (Am^{-1})	B – Field (μT)	Equivalent plane wave power S (Wm^{-2})
up to 1 Hz	-	3.2×10^4	4×10^4	-
1 – 8 Hz	10,000	$3.2 \times 10^4/f^2$	$4 \times 104/f^2$	-
8 – 25 Hz	10,000	$4{,}000/f$	$5000/f$	-
0.025 – 0.8 kHz	$250/f$	$4/f$	$5/f$	-
0.8 – 3 kHz	$250/f$	5	6.25	-
3 – 150 kHz	87	5	6.25	-
0.15 - 1 MHz	87	$0.73/f$	$0.092/f$	
1 – 10 MHz	$87/f^2$	$0.73/f$	$0.092/f$	-
10 – 400 MHz	28	0.16	0.092	2
400 – 2000 MHz	$1.375f^{1/2}$	$0.0037f^{1/2}$	$0.0046f^{1/2}$	$f/200$
2 – 300 GHz	61	0.16	0.20	10

Table 2: Reference levels for <u>general public exposure</u> to time-varying electric and magnetic fields (unperturbed rms values). f in units as indicated in the Frequency Range column.

Simultaneous Exposure to Multiple Frequency Fields (Total Exposure Quotients)

ICNIRP has specified a means of assessing additivity of exposures in situations of simultaneous exposure to fields of different frequencies. Additivity is examined separately for the effects of electrical and thermal stimulation, and ICNIRP has set out basic restrictions which should be met for both considerations.

For practical application of the basic restrictions, ICNIRP has advised that the following criteria[13] regarding reference levels of field strengths should be applied:

Induced Current Density and Electrical Stimulation

For induced current density and electrical stimulation effects, relevant up to 10 MHz, the following two requirements should be applied to the field levels:

$$\sum_{i=1\ \mathrm{Hz}}^{1\ \mathrm{MHz}} \frac{E_i}{E_{L,i}} + \sum_{i>1\ \mathrm{MHz}}^{10\ \mathrm{MHz}} \frac{E_i}{a} \leq 1,$$

and

$$\sum_{j=1\ \mathrm{Hz}}^{65\ \mathrm{kHz}} \frac{H_j}{H_{L,j}} + \sum_{j>65\ \mathrm{kHz}}^{10\ \mathrm{MHz}} \frac{H_j}{b} \leq 1,$$

where

E_i = the electric field strength at frequency i;

$E_{L,i}$ = the electric field reference level from Tables 1 and 2;

Hj = the magnetic field strength at frequency j;

$H_{L,j}$ = the magnetic field reference level from Tables 1 and 2;

a = 610 V m^{-1} for occupational exposure and 87 V m^{-1} for general public exposure; and

b = 24.4 A m^{-1} (30.7 μT) for occupational exposure and 5 A m^{-1} (6.25 μT) for general public exposure.

[13] The calculated values are referred to as '**Total Exposure Quotients**' elsewhere in this report.

Thermal Considerations

For thermal considerations, relevant above 100 kHz, the following two requirements should be applied to the field levels:

$$\sum_{i=100\ \mathrm{kHz}}^{1\ \mathrm{MHz}} \left(\frac{E_i}{c}\right)^2 + \sum_{i>1\ \mathrm{MHz}}^{300\ \mathrm{GHz}} \left(\frac{E_i}{E_{L,i}}\right)^2 \leq 1,$$

and

$$\sum_{j=100\ \mathrm{kHz}}^{1\ \mathrm{MHz}} \left(\frac{H_j}{d}\right)^2 + \sum_{j>1\ \mathrm{MHz}}^{300\ \mathrm{GHz}} \left(\frac{H_j}{H_{L,j}}\right)^2 \leq 1,$$

where

E_i = the electric field strength at frequency i;

$E_{L,i}$ = the electric field reference level from Tables 1 and 2;

Hj = the magnetic field strength at frequency j;

$H_{L,j}$ = the magnetic field reference level from Tables 1 and 2;

c = $610/f$ V m^{-1} (f in MHz) for occupational exposure and $87/f^{1/2}$ V m^{-1} for general public exposure; and

d = $1.6/f$ A m^{-1} (f in MHz) for occupational exposure and $0.73/f$ for general public exposure.

Annex 3 – Survey Methodology

The purpose of the surveys was to quantify the electromagnetic field (EMF) present at each area and to identify the frequency and intensity (or level) of the principal emissions contributing to the field. The locations of the survey were chosen by ComReg.

Some of the typical emission types encountered when measuring EMF are AM and FM broadcast radio, broadcast television signals, wireless CCTV, mobile radio, emergency services radios, pager base station radios, taxi base station radios, mobile phone base station signals and wireless broadband signals.

Measurements of the non-ionising radiation emissions from the site were conducted in accordance with the methodology outlined in document ComReg 08/51[14], which incorporates many of the measurement methods and procedures outlined in ECC Recommendation (02)04[15].

Surveys were, in most cases, conducted in three stages as follows:

1 Initial Site Survey

At all sites surveyed, initial investigations were carried out using a field strength meter and a broadband probe to find the position of the maximum field strength. The probe used for the initial investigation measured and summed all emissions present in a broad frequency range (typically 100 kHz to 3 GHz).

2 Broadband Measurements

Once the location was identified, the field strength meter and broadband probe were mounted on a non-conductive tripod and the aggregate field strength in Volts per meter was recorded over a period exceeding six minutes.

[14] http://www.comreg.ie/_fileupload/publications/ComReg0851.pdf

[15] ECC REC (02)04 (revised Bratislava 2003, Helsinki 2007), "Measuring Non-Ionising Electromagnetic Radiation (9 kHz – 300 GHz), published by the European Communications Committee on www.ero.dk.

3 Frequency Selective Measurements

Measurements of emissions at specific frequencies were then carried out at the same location using a spectrum analyser and a range of antennas matched to the frequencies being measured. The spectrum analyser was set to sweep a frequency range continuously for a period of up to six minutes and the results were stored in the spectrum analyser.

This procedure was repeated at different frequency ranges until the electromagnetic fields at all relevant frequencies were recorded. The results were later transferred to a computer for analysis and comparison with the ICNIRP general public guideline levels.

Annex 4 – Measurement of Electromagnetic Fields

Electromagnetic fields can be sub-divided into two components:

(1) Electric field **E** [measured in Volts per metre or V/m]

(2) Magnetic field **H** [measured in Amperes per metre or A/m]

The E-field and the H-field are mathematically interdependent[16] in the **far-field** which is the region[17] where the distance from the radiating antenna exceeds the wavelength of the radiated electromagnetic field. 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 shows 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 far-field only one component needs to be measured, as the other component can be easily derived from it. Normally it is only the electric field which is measured in this region.

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** region. This is the region located less than one wavelength from the radiating antenna. Here, the

[16] $E = H \times Z_0$ where Z_0 (characteristic impedance of free space) $\approx 377\ \Omega$

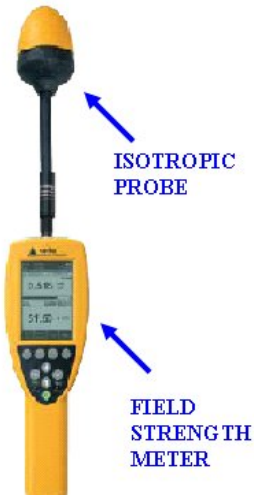
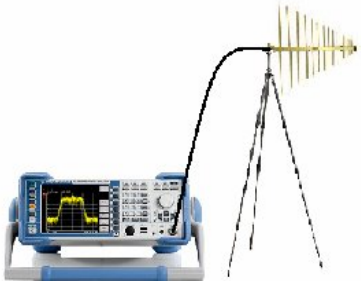
[17] Beyond a distance of $\lambda + 2D^2/\lambda$ where λ is the wavelength and D is the antenna's largest dimension

relationship between E and H becomes very complex and there is no direct correlation between both components of the electromagnetic field.

Measurement Equipment

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

The table below shows examples of equipment typically used to measure electromagnetic fields in non-ionising radiation surveys.

<table>
<tr><th>Initial Site Survey and Broadband Measurements</th><th colspan="2">Frequency Selective Measurements</th></tr>
<tr><td> 
</td><td>SPECTRUM ANALYSER WITH TRIPOD MOUNTED ANTENNA CONNECTED
  </td><td>PORTABLE SPECTRUM ANALYSER WITH ANTENNA DIRECTLY CONNECTED
  </td></tr>
<tr><td>Used to measure the overall electric or magnetic field present over a range of frequencies. (e.g. 100kHz to 3GHz)</td><td colspan="2">Spectrum analysers are used to measure individual emissions at specific frequencies. The individual emissions contribute to the overall electromagnetic field. 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 electromagnetic field at a particular location.</td></tr>
</table>

Annex 5 – Derivation of Adjusted Levels

In the case of some services an adjusted level is calculated from the measured electric field level and is presented in the relevant frequency selective measurement table for comparison with the applicable emission limit. For a particular measurement, the adjustment may be performed for any or all of the following reasons

(a) to compensate for when the bandwidth of the emission exceeds the maximum resolution bandwidth (RBW) of the spectrum analyser used.

(b) to extrapolate to an estimate of the level of emissions from a transmitter under maximum traffic conditions (e.g. when a mobile phone base station is serving its maximum number of calls and data clients).

(c) to account for the characteristics of emissions with complex signal structures (e.g. PAL TV)

Compensating for the limited measurement resolution of the spectrum analyser

In many cases it is necessary to compensate for the limited measurement resolution of the spectrum analyser, as the bandwidth of the signal measured may be greater than the resolution bandwidth (RBW) of the analyser. For example, a measurement of a digital television signal performed with at an RBW setting of 5 MHz needs to be adjusted upwards by multiplying it by a correction factor in order to account for the energy present within the full 7.61 MHz bandwidth of the signal.

The correction factor is derived as follows:

RBW CORRECTION FACTOR: $K_{RBW} = 10 \times \log_{10} (B_{Signal} / B_N)$

Where B_{Signal} is the signal/emission bandwidth

B_N is the noise bandwidth of the analyser filter

(for a Gaussian Filter: $B_N \approx 1.1 \times B_{3dB}$)

Example: Measuring a 7.61 MHz DVB-T signal with 5 MHz RBW:

B_{Signal} = 7.61 MHz

B_{3dB} = RBW = 5 MHz => $B_N = 1.1 \times 5 = 5.1$

$K_{RBW} = 10 \times \log_{10} (7.61 / 5.1) = 1.74$ dB

Extrapolation to Max Traffic Signal Level

In the case of some networks it is necessary to extrapolate to an estimate of the level under maximum traffic from the transmitter. For example, the base stations of mobile telephone networks produce emissions which vary according to the changing volume of calls or data traffic over the course of the day.

In the cases of GSM, TETRA and UMTS (3G), the estimated electric field levels for maximum traffic conditions are extrapolated from the constant pilot channels (BCCH for GSM and TETRA and P-CPICH for UMTS) as follows:

GSM and TETRA:

V/m Calculation	dB Calculation
$\mathbf{E_{MAX}} = E_{BCCH} \times \sqrt{n_{channels}}$	$\mathbf{E_{MAX}} = E_{BCCH} + 10\mathrm{Log}_{10}(n_{channels})$
$n_{channels}$ includes the BCCH plus the number of traffic channels. If the Number of traffic channels per BCCH is not known, $n_{channels}$ is taken as: **GSM:** 4 **TETRA (Emergency):** 3 **TETRA (Civil):** 2	

UMTS:

V/m Calculation	dB Calculation
$\mathbf{E_{MAX}} = E_{UMTS} \times \sqrt{R_{P\text{-}CPICH}}$	$\mathbf{E_{MAX}} = E_{UMTS} + R_{P\text{-}CPICH}$
$R_{P\text{-}CPICH} = P_{MAX} / P_{P\text{-}CPICH}$ The P-CPICH transmits with a constant power typically 10 dB below the maximum possible power (P_{MAX}) for a UMTS signal. Therefore $R_{P\text{-}CPICH}$ = 10 dB $\sqrt{R_{P\text{-}CPICH}} = \sqrt{10} = 3.1623$	

If necessary, as in the case of GSM and TETRA, the frequencies of the pilot channels present have been identified prior to recording the standard frequency selective scan of the band.

Accounting for characteristics of certain complex signals:

In the case of some signals with a complex structure, such as analogue PAL television, it is necessary to apply a correction factor for reasons such as the following:

- to take into account characteristics of the signal shape, which make it difficult to measure an RMS level directly, which is indicative of worst case exposure.

- to derive a level more indicative of the aggregate of emissions attributable to the individual signal components.

Analogue PAL TV

The peak field strength caused by the synch pulses of the picture (luminance) carrier is measured. The field strength from the picture signal is at its highest when a synch pulse is being transmitted.

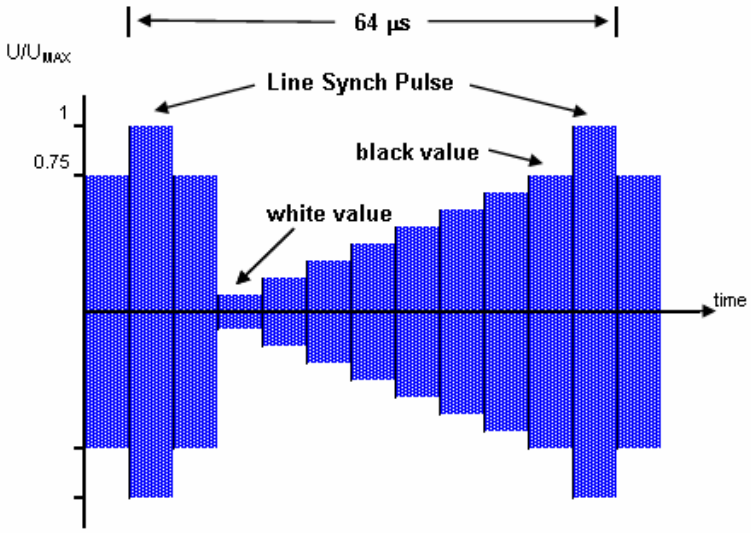


Figure 1: Luminance Signal in the Time Domain

For a black picture, the mean power is 2.5 dB below the peak power (i.e. for a synch pulse). It is assumed that 100% black picture is transmitted permanently for worst case exposure evaluation. The mean (RMS) level for a black picture is then calculated from the peak synch pulse level by applying a correction factor to the peak synch pulse level. The value of this **correction factor** is **-2.3 dB** rather than -2.5 dB, in

order to take into consideration the small contributions of the FM and NICAM sound signal components.

The level for the full PAL signal is thus derived by applying the correction factor to the measurement for the peak luminance signal:

$$\mathbf{E_{PAL}} = E_{LUM} \times k \qquad \text{corr factor } k = -2.3 \text{ dB} = 0.767$$

Annex 6 – Glossary

Antenna: - A conductive structure specifically designed to couple or to radiate electromagnetic energy.

BCCH: - Broadcast control channel. BCCH is a constant carrier on GSM base stations. Essentially it is the 'always on' pilot channel. The constant signal level of the BCCH allows for extrapolation to a maximum traffic signal level for a base station.

Broadband Measurement: - A measurement carried out using a meter and probe combination that simultaneously measures and sums all received signals within the frequency range of the probe. Generally this meter and probe combination is not as sensitive as the equipment used for narrowband measurements but is useful for getting an overall picture of the level of electromagnetic fields present at a site.

ComReg: - The Commission for Communications Regulation. ComReg is the statutory body responsible for the regulation of the electronic communications sector (telecommunications, radiocommunications and broadcasting transmission) and the postal sector in Ireland.

Electric Field Strength: - Electric field strength is a quantitative expression of the intensity of an electric field at a particular location. The standard unit is the Volt per meter (V/m). A field strength of 1 V/m represents a potential difference of one volt between points separated by one meter.

Electromagnetic Field (EMF): - Combined electric and magnetic fields, in this case radiating from an antenna.

Electromagnetic Spectrum: - The complete range of the wavelengths of electromagnetic radiation, beginning with the radio waves and extending through microwaves and visible light (a very small part of the spectrum) all the way to the extremely short gamma rays that are a product of radioactive atoms. The electromagnetic spectrum contains both non-ionizing and ionizing radiation

Frequency: - The number of cycles completed in one second by an electromagnetic wave. It is expressed in Hertz (Hz) or a multiple of Hertz, e.g. kHz (kilohertz, 1,000 Hertz), MHz (MegaHertz, 1,000,000 Hertz) and GHz (GigaHertz, 1,000,000,000 Hertz).

Frequency Range: - A group of frequencies between a selected start and stop frequency. E.g. the frequency range of the FM broadcast band includes all frequencies between 88 and 108 MHz.

Frequency Selective Measurement: - A measurement carried out using a receiver and an antenna which measures the received signal strength at specific frequencies. A spectrum analyser is usually used as the receiver, and a range of antennas is used which are suitable for reception of all the frequencies to be measured.

ICNIRP: - The International Commission on Non-Ionizing Radiation Protection.

Ionising radiation: - Ionising radiation, also called radioactivity, is electromagnetic (EM) radiation whose waves contain energy sufficient to overcome the binding energy of electrons in atoms or molecules, thus creating ions. It occurs at frequencies higher than ultraviolet light and includes x-rays and gamma rays. The sources of electromagnetic fields measured in this survey do not produce any ionising radiation.

Isotropic probe: Receives electromagnetic signals regardless of polarisation or direction of travel. An isotropic probe is designed to give the same reading, no matter which way it is pointed.

Non-ionising radiation (NIR): - Includes all radiations and fields of the electromagnetic spectrum that do not normally have sufficient energy to produce ionization in matter; characterized by energy per photon less than approximately 12 electron Volts, wavelengths greater than 100 nm, and frequencies lower than 3×10^{15} Hz.

Occupational Exposure: - All exposure to EMF experienced by individuals who are exposed under known conditions in the course of performing their work and who are trained to be aware of potential risk and to take appropriate precautions.

Public Exposure: - All exposure to EMF experienced by members of the general public, excluding occupational exposure and exposure during medical procedures.

P-CPICH: - Primary Common Pilot channel. P-CPICH is a downlink channel broadcast by UMTS Node-Bs (i.e. 3G base stations) with constant power. It allows extrapolation to a maximum traffic signal level for a UMTS channel.

Radiofrequency (RF): - For this survey any radio signals between the frequencies 100 kHz to 40 GHz.

Spectrum analyser: - An instrument that displays signal amplitude (strength) as it varies by signal frequency. The frequency appears on the horizontal axis, and the amplitude is displayed on the vertical axis. It can be set to sweep a frequency band where the amplitude of the received signals show up as spikes on the recorded trace.