Commission for
Communications Regulation

Report

2010 Programme of Measurement of Non-Ionising Radiation Emissions

First Interim Report

Document No:	**10/36**
Date:	**23rd April 2010**

An Coimisiún um Rialáil Cumarsáide
Commission for Communications Regulation
Abbey Court Irish Life Centre Lower Abbey Street Dublin 1 Ireland
Telephone +353 1 804 9600 *Fax* +353 1 804 9680 *Email* info@comreg.ie *Web* www.comreg.ie

Contents

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 2010 programme.

The site surveys were conducted during January – March 2010 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 2010 Programme of Measurement of Non-Ionising Radiation emissions. The site surveys were conducted during January – March 2010 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.

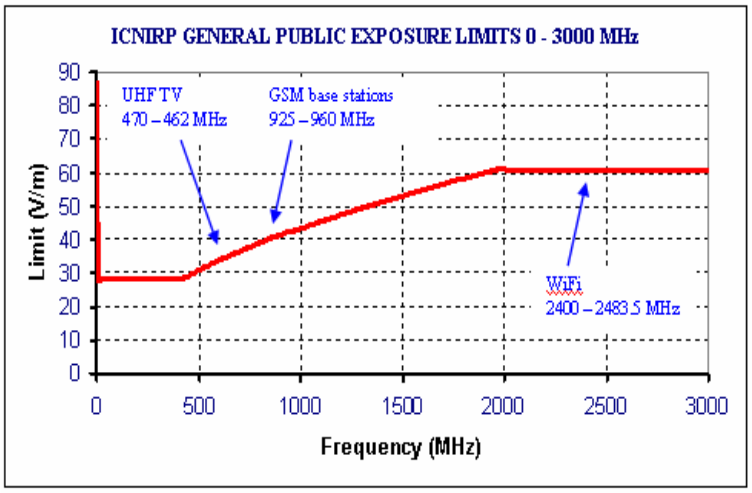
- to extrapolate to an estimate of the level under maximum traffic from the transmitter. For example, the base stations of mobile telephone networks produce emissions which vary according to the changing volume of calls or data traffic over the course of the day. The levels measured for the always-on 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: Carlow Shopping Centre

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	Not disclosed	0.004539	0.004539	28	6168
FM Radio	93.992	0.024016	0.024016	28	1166
FM Radio	89.550	0.006630	0.006630	28	4223
FM Radio	91.737	0.019679	0.019679	28	1423
FM Radio	99.185	0.016769	0.016769	28	1670
FM Radio	101.440	0.016558	0.016558	28	1691
FM Radio	97.340	0.015014	0.015014	28	1865
TV PAL	215.600	0.033037	0.041866	28	669
TV PAL	191.440	0.027925	0.035389	28	791
TETRA	Not disclosed	0.014142	0.024494	28	1143
TETRA	Not disclosed	0.013002	0.022520	28	1243
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	35398
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	60451
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	16490
TV PAL	487.083	0.019454	0.024653	30.3	1231
TV PAL	511.000	0.019231	0.024370	31.1	1275
TV PAL	603.933	0.007898	0.010008	33.8	3376
TV DVB-T	642.883	0.005383	0.014158	34.9	2462
TV DVB-T	666.800	0.004340	0.011416	35.5	3110
TV DVB-T	618.967	0.003990	0.010495	34.2	3259
TV DVB-T	699.973	0.005721	0.015049	36.4	2417
Wireless Audio Tx	853.273	0.002649	0.002649	40.2	15165
GSM	938.067	1.010416	2.020831	42.1	21
GSM	953.583	0.841395	1.682790	42.5	25
GSM	949.267	0.783430	1.566859	42.4	27
GSM	939.933	0.072111	0.144221	42.2	292
GSM	1842.750	0.885116	1.770231	59.0	33
GSM	1867.000	0.669885	1.339769	59.4	44
GSM	1831.250	0.076825	0.153649	58.8	383
UMTS FDD	2166.733	0.212324	1.373048	61	44
UMTS FDD	2146.200	0.108019	0.698531	61	87
UMTS FDD	2117.267	0.022156	0.143280	61	426
UMTS FDD	2113.533	0.016482	0.106582	61	572
UMTS FDD	2128.467	0.004656	0.030108	61	2026
UMTS FDD	2131.967	0.004592	0.029695	61	2054

Table continued overleaf →

....table continued from previous page

Emission Type	Frequency	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below Limit [adjusted Values]
WiFi	2467.913	0.023496	0.091166	61	669
WiFi	2460.398	0.018218	0.070686	61	863
WiFi	2404.453	0.006753	0.026202	61	2328
WiFi	2437.575	0.004651	0.018044	61	3381
FWALA	3597.667	0.001206	0.003043	61	20044
FWALA	3591.667	0.000717	0.001809	61	33727
FWALA	3525.333	0.000595	0.001501	61	40642
FWALA	3748.100	0.001834	0.004628	61	13182
FWALA	3764.300	0.001592	0.004017	61	15187
FWALA	3758.300	0.001535	0.003871	61	15757
FWALA	3743.000	0.001352	0.003411	61	17885
FWALA	3727.100	0.001046	0.002638	61	23119
WiFi	5649.350	0.006577	0.025517	61	2391
WiFi	5716.500	0.001074	0.004167	61	14638
FWALA	10237.707	0.002567	0.009159	61	6660
FWALA	10231.380	0.002486	0.008869	61	6878

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**	0.007328	1

3.2.2 Dublin: Ballybrack - Church Road

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	Not disclosed	0.004320	0.004320	28	6481
FM Radio	94.880	0.010447	0.010447	28	2680
FM Radio	192.192	0.009683	0.009683	28	2892
FM Radio	104.447	0.009322	0.009322	28	3004
FM Radio	106.018	0.009300	0.009300	28	3011
FM Radio	105.198	0.008851	0.008851	28	3163
FM Radio	88.457	0.008443	0.008443	28	3316
TETRA	Not disclosed	0.005735	0.009933	28	2819
TETRA	Not disclosed	0.005649	0.009785	28	2862
TETRA	Not disclosed	0.002304	0.003991	28	7016
TETRA	Not disclosed	0.001879	0.003255	28	8602
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	58664
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	51450
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	65432
TV PAL	567.347	0.007055	0.008941	32.8	3663
TV PAL	583.680	0.006958	0.008818	33.2	3767
TV PAL	535.333	0.005998	0.007601	31.8	4186
TV PAL	799.933	0.030867	0.039117	38.9	994
TV PAL	775.760	0.018772	0.023788	38.3	1610
TV PAL	743.093	0.010802	0.013689	37.5	2738
TV DVB-T	741.133	0.007925	0.020845	37.4	1796
TV DVB-T	794.053	0.006124	0.016106	38.7	2406
GSM	951.833	0.008620	0.017240	42.4	2461
GSM	940.517	0.007303	0.014606	42.2	2887
GSM	954.750	0.007261	0.014522	42.5	2926
GSM	947.400	0.006427	0.012854	42.3	3293
GSM	1864.000	0.007396	0.014792	59.4	4013
UMTS	2153.200	0.302343	1.955175	61	31
UMTS	2146.200	0.296825	1.919489	61	32
UMTS	2112.833	0.135831	0.878386	61	69
UMTS	2118.900	0.133352	0.862354	61	71
UMTS	2168.833	0.010864	0.070256	61	868
WiFi	2447.038	0.005781	0.022430	61	2720
FWALA	3561.000	0.098175	0.247658	61	246
FWALA	3568.667	0.018072	0.045588	61	1338
FWALA	3550.333	0.001180	0.002978	61	20487
FWALA	3501.000	0.000735	0.001853	61	32921

Quotient calculated overleaf →

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**	0.002447	1

3.2.3 Dublin: Citywest Business Park

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	Not disclosed	0.004656	0.004656	28	6014
PMR	Not disclosed	0.004983	0.004983	28	5619
FM Radio	95.495	0.018260	0.018260	28	1533
FM Radio	104.447	0.010617	0.010617	28	2637
FM Radio	88.457	0.008872	0.008872	28	3156
FM Radio	103.832	0.008356	0.008356	28	3351
T-DAB	227.413	0.007023	0.008298	28	3374
TETRA	Not disclosed	0.002799	0.004848	28	5776
TETRA	Not disclosed	0.002486	0.004306	28	6503
TETRA	Not disclosed	0.001928	0.003339	28	8387
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	14104
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	57930
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	46552
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	59750
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	53549
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	60187
TV PAL	567.347	0.008166	0.010348	32.8	3165
TV PAL	535.333	0.007727	0.009792	31.8	3249
TV PAL	583.680	0.006982	0.008848	33.2	3754
TV PAL	775.760	0.005018	0.006359	38.3	6023
TV PAL	743.093	0.004960	0.006286	37.5	5963
TV DVB-T	738.520	0.002767	0.007278	37.4	5134
TV DVB-T	792.747	0.002360	0.006209	38.7	6236
GSM	949.150	1.847141	3.694282	42.4	11
GSM	940.400	1.776233	3.552467	42.2	12
GSM	947.283	0.350348	0.700697	42.3	60
GSM	947.283	0.350348	0.700697	42.3	60
GSM	938.300	0.098401	0.196802	42.1	214
GSM	951.367	0.047044	0.094087	42.4	451
GSM	1862.750	2.463202	4.926404	59.3	12
GSM	1842.250	0.489215	0.978431	59.0	60
GSM	1838.750	0.425598	0.851197	59.0	69
GSM	1846.750	0.093433	0.186866	59.1	316
GSM	1861.150	0.070795	0.141589	59.3	419
GSM	1836.000	0.051345	0.102690	58.9	574

Table continued overleaf →

....table continued from previous page

Emission Type	Frequency	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below Limit [adjusted Values]
UMTS TDD	1900.267	0.003763	0.013755	59.9	4358
UMTS FDD	2153.667	0.365174	2.361487	61	26
UMTS FDD	2133.833	0.323594	2.092597	61	29
UMTS FDD	2126.133	0.316592	2.047320	61	30
UMTS FDD	2147.367	0.301301	1.948434	61	31
UMTS FDD	2116.567	0.114551	0.740774	61	82
UMTS FDD	2111.433	0.088716	0.573701	61	106
FWALA	3522.667	0.000618	0.001559	61	39127
FWALA	3752.300	0.015470	0.039026	61	1563
FWALA	3761.000	0.007161	0.018066	61	3377
FWALA	3743.600	0.006561	0.016552	61	3685
FWALA	3725.600	0.003255	0.008210	61	7430
FWALA	3731.900	0.002679	0.006759	61	9026
WiFi	5513.350	0.001157	0.004491	61	13583
WiFi	5588.150	0.001117	0.004333	61	14077

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**	0.027732	1

3.2.4 Dublin: Donabate - Main Street

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	Not disclosed	0.004202	0.004202	28	6663
TETRA	Not disclosed	0.002396	0.004150	28	6747
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	58743
TV DVB-T	737.213	0.001272	0.003346	37.3	11158
GSM	948.683	1.091440	2.182881	42.4	19
GSM	940.983	0.215278	0.430556	42.2	98
GSM	939.000	0.130317	0.260633	42.1	162
GSM	945.533	0.095609	0.191219	42.3	221
GSM	954.050	0.042170	0.084339	42.5	504
GSM	1844.000	1.148154	2.296307	59.0	26
GSM	1831.500	0.743019	1.486038	58.8	40
GSM	1834.000	0.379752	0.759504	58.9	78
GSM	1857.500	0.046291	0.092583	59.3	640
UMTS FDD	2153.900	0.131371	0.849544	61	72
UMTS FDD	2146.200	0.101625	0.657182	61	93
UMTS FDD	2113.767	0.025148	0.162624	61	375
UMTS FDD	2177.267	0.023796	0.153881	61	396
UMTS FDD	2167.900	0.012897	0.083404	61	731
UMTS FDD	2131.033	0.012374	0.080018	61	762
FWALA	3739.700	0.000903	0.004303	61	14176
WiFi	5472.550	0.001096	0.004254	61	14338

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**	0.00547	1

3.2.5 Dublin: Dun Laoghaire - Rochestown Lodge Hotel

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	Not disclosed	0.004365	0.004365	28	6414
PMR	Not disclosed	0.006419	0.006419	28	4362
FM Radio	101.782	0.052602	0.052602	28	532
FM Radio	88.457	0.023933	0.023933	28	1170
FM Radio	92.898	0.022594	0.022594	28	1239
FM Radio	102.260	0.022465	0.022465	28	1246
FM Radio	90.712	0.021404	0.021404	28	1308
FM Radio	96.725	0.019588	0.019588	28	1429
TV PAL	183.440	0.037411	0.047409	28	591
TV PAL	207.600	0.029580	0.037486	28	747
TETRA	Not disclosed	0.006209	0.010754	28	2604
TETRA	Not disclosed	0.004107	0.007113	28	3936
TETRA	Not disclosed	0.003487	0.006040	28	4636
TETRA	Not disclosed	0.003105	0.005377	28	5207
TETRA	Not disclosed	0.001782	0.003087	28	9070
TETRA	Not disclosed	0.001673	0.002898	28	9663
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	6372
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	33969
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	63599
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	64102
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	51573
TV PAL	567.347	0.013521	0.017134	32.8	1911
TV PAL	535.333	0.010316	0.013073	31.8	2434
TV PAL	583.027	0.009152	0.011597	33.2	2863
TV PAL	775.760	0.009931	0.012585	38.3	3043
TV PAL	751.587	0.009343	0.011840	37.7	3184
TV PAL	719.573	0.006615	0.008382	36.9	4400
TV PAL	799.933	0.005047	0.006395	38.9	6081
TV PAL	847.627	0.004023	0.005098	40.0	7853
TV PAL	831.947	0.003859	0.004891	39.7	8109
TV DVB-T	792.093	0.003846	0.010116	38.7	3826
TV DVB-T	739.827	0.003720	0.009784	37.4	3823

Table continued overleaf →

....table continued from previous page

Emission Type	Frequency	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below Limit [adjusted Values]
GSM	937.950	3.423734	6.847468	42.1	6
GSM	948.217	1.671091	3.342181	42.3	13
GSM	954.050	0.882064	1.764128	42.5	24
GSM	946.000	0.213304	0.426609	42.3	99
GSM	954.983	0.112590	0.225180	42.5	189
GSM	940.283	0.074046	0.148091	42.2	285
GSM	1833.500	0.750758	1.501516	58.9	39
GSM	1857.750	0.566239	1.132479	59.3	52
GSM	1844.000	0.103753	0.207506	59.0	285
GSM	1840.750	0.086099	0.172199	59.0	343
GSM	1842.250	0.056754	0.113509	59.0	520
GSM	1876.250	0.032584	0.065167	59.6	914
UMTS TDD	1902.400	0.004390	0.016050	60.0	3737
UMTS FDD	2126.833	0.463447	2.996992	61	20
UMTS FDD	2131.733	0.457088	2.955872	61	21
UMTS FDD	2113.300	0.250035	1.616909	61	38
UMTS FDD	2117.733	0.225944	1.461119	61	42
UMTS FDD	2153.433	0.122744	0.793753	61	77
UMTS FDD	2146.433	0.087902	0.568441	61	107
FWALA	3563.333	0.121899	0.307505	61	198
FWALA	3558.000	0.007998	0.020177	61	3023
FWALA	3572.333	0.002239	0.005647	61	10801
FWALA	3578.667	0.001455	0.003672	61	16614
FWALA	3719.900	0.011885	0.029981	61	2035
FWALA	3744.200	0.010715	0.027030	61	2257
FWALA	3734.000	0.008045	0.020293	61	3006
FWALA	3730.100	0.008082	0.020387	61	2992
FWALA	3749.900	0.005630	0.014202	61	4295
FWALA	3725.600	0.005212	0.013148	61	4640
WiFi	5594.100	0.001226	0.004757	61	12823

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**	0.041914	1

3.2.6 Dublin 5: Raheny Shopping Centre

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	Not disclosed	0.004699	0.004699	28	5959
PMR	Not disclosed	0.003548	0.003548	28	7891
TV PAL	183.280	0.023823	0.030190	28	927
TV PAL	207.440	0.022208	0.028143	28	995
T-DAB	227.093	0.010839	0.012809	28	2186
TETRA	Not disclosed	0.305492	0.529128	28	53
TETRA	Not disclosed	0.301301	0.521868	28	54
TETRA	Not disclosed	0.002664	0.004614	28	6069
TETRA	Not disclosed	0.002541	0.004401	28	6362
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	31514
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	59966
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	62268
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	66509
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	54759
TV PAL	583.680	0.010162	0.012878	33.2	2579
TV PAL	567.347	0.009795	0.012413	32.8	2639
TV PAL	535.333	0.009528	0.012074	31.8	2635
TV PAL	775.107	0.007456	0.009449	38.3	4052
TV PAL	743.093	0.008892	0.011268	37.5	3326
TV DVB-T	792.093	0.005339	0.014044	38.7	2755
TV DVB-T	739.827	0.004487	0.011803	37.4	3169
GSM	940.050	0.486968	0.973935	42.2	43
GSM	952.533	0.357684	0.715369	42.4	59
GSM	946.000	0.137562	0.275125	42.3	154
GSM	938.417	0.056234	0.112468	42.1	375
GSM	951.717	0.079159	0.158318	42.4	268
GSM	1854.500	0.377138	0.754275	59.2	79
GSM	1867.250	0.256448	0.512897	59.4	116
GSM	1834.750	0.172584	0.345168	58.9	171
GSM	1844.750	0.106292	0.212584	59.1	278
GSM	1842.250	0.047206	0.094413	59.0	625
GSM	1856.750	0.044361	0.088722	59.2	668
UMTS FDD	2131.967	0.552077	3.570143	61	17
UMTS FDD	2126.133	0.101274	0.654916	61	93
UMTS FDD	2148.767	0.101274	0.654916	61	93
UMTS FDD	2112.600	0.053889	0.348486	61	175
UMTS FDD	2119.133	0.053889	0.348486	61	175
UMTS FDD	2168.600	0.012720	0.082259	61	742

Table continued overleaf →

....table continued from previous page

Emission Type	Frequency	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below Limit [adjusted Values]
WiFi	2439.800	0.004524	0.017552	61	3475
FWALA	3570.000	0.192975	0.486802	61	125
FWALA	3563.000	0.007236	0.018254	61	3342
FWALA	3546.667	0.005781	0.014583	61	4183
FWALA	3544.333	0.001057	0.002666	61	22881

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**	0.005665	1

3.2.7 Dublin 9: Santry - Omni Park Shopping Centre

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	Not disclosed	0.004775	0.004775	28	5864
PMR	Not disclosed	0.007861	0.007861	28	3562
PMR	Not disclosed	0.003618	0.003618	28	7739
FM Radio	94.880	0.007916	0.007916	28	3537
FM Radio	702.260	0.006839	0.006839	36	5328
PMR	Not disclosed	0.001892	0.001892	28	14796
TV PAL	207.280	0.018923	0.023981	28	1168
T-DAB	227.653	0.013693	0.016181	28	1730
TETRA	Not disclosed	0.085408	0.147931	28	189
TETRA	Not disclosed	0.053951	0.093446	28	300
TETRA	Not disclosed	0.001830	0.002588	28	10818
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	59348
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	45389
TV DVB-T	794.707	0.002396	0.006302	38.8	6150
TV DVB-T	737.213	0.002094	0.005508	37.3	6778
GSM	939.233	3.392345	6.784690	42.1	6
GSM	940.633	0.143054	0.286108	42.2	147
GSM	946.817	0.032026	0.064052	42.3	661
GSM	953.933	0.028412	0.056824	42.5	747
GSM	1836.250	0.307256	0.614511	58.9	96
GSM	1862.500	0.154703	0.309407	59.3	192
UMTS FDD	2126.133	0.234153	1.514208	61	40
UMTS FDD	2131.500	0.198609	1.284357	61	47
UMTS FDD	2166.967	0.075076	0.485496	61	126
UMTS FDD	2152.500	0.074817	0.483822	61	126
UMTS FDD	2148.533	0.066145	0.427746	61	143
UMTS FDD	2112.133	0.016904	0.109316	61	558
FWALA	3553.000	0.155060	0.391158	61	156
FWALA	3501.000	0.075683	0.190921	61	320
FWALA	3596.000	0.001600	0.004035	61	15117
FWALA	3571.000	0.001357	0.003423	61	17823
FWALA	3588.000	0.000861	0.002172	61	28085
FWALA	3744.200	0.002075	0.007402	61	8241
FWALA	3719.600	0.001799	0.006418	61	9505
WiFi	5482.750	0.001119	0.004343	61	14044
WiFi	5541.400	0.000902	0.003498	61	17438

Quotient calculated overleaf →

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**	0.027438	1

3.2.8 Dublin 12: Ballymount Ind Estate - Ballymount Drive

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	Not disclosed	0.004656	0.004656	28	6014
FM Radio	89.072	0.014223	0.014223	28	1969
FM Radio	104.447	0.012882	0.012882	28	2173
FM Radio	100.893	0.011429	0.011429	28	2450
FM Radio	83.513	0.011130	0.011130	28	2516
FM Radio	98.707	0.010593	0.010593	28	2643
FM Radio	94.880	0.009672	0.009672	28	2895
PMR	Not disclosed	0.003065	0.003065	28	9134
PMR	Not disclosed	0.002688	0.002688	28	10415
TV PAL	207.760	0.059979	0.076009	28	368
TV PAL	183.440	0.059566	0.075486	28	371
T-DAB	227.680	0.009397	0.011105	28	2521
TETRA	Not disclosed	0.008740	0.015138	28	1850
TETRA	Not disclosed	0.008185	0.014176	28	1975
TETRA	Not disclosed	0.003400	0.004809	28	5823
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	2114
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	5932
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	14551
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	20598
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	23599
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	39996
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	37365
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	99
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	30936
TV PAL	567.347	0.017140	0.021720	32.8	1508
TV PAL	535.333	0.014622	0.018530	31.8	1717
TV PAL	583.027	0.008800	0.011152	33.2	2977
TV PAL	775.760	0.038282	0.048514	38.3	789
TV PAL	799.933	0.027893	0.035348	38.9	1100
TV PAL	743.747	0.014109	0.017880	37.5	2097
TV DVB-T	739.827	0.014421	0.037931	37.4	986
TV DVB-T	796.013	0.013122	0.034514	38.8	1124

Table continued overleaf →

....table continued from previous page

Emission Type	Frequency	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below Limit [adjusted Values]
GSM	945.650	0.643428	1.286856	42.3	33
GSM	938.767	0.504081	1.008161	42.1	42
GSM	937.833	0.171593	0.343186	42.1	123
GSM	953.583	0.081846	0.163693	42.5	259
GSM	949.033	0.032885	0.065770	42.4	644
GSM	1845.000	0.518203	1.036406	59.1	57
GSM	1855.500	0.060604	0.121208	59.2	489
GSM	1839.250	0.056494	0.112987	59.0	522
GSM	1831.750	0.033420	0.066839	58.8	880
GSM	1864.250	0.020869	0.041738	59.4	1422
UMTS FDD	2147.833	0.237137	1.533507	61	40
UMTS FDD	2118.900	0.090365	0.584367	61	104
UMTS FDD	2111.433	0.063900	0.413224	61	148
UMTS FDD	2128.933	0.044978	0.290861	61	210
UMTS FDD	2166.267	0.012677	0.081976	61	744
UMTS FDD	2151.100	0.007464	0.048271	61	1264
WiFi	2417.813	0.005470	0.021224	61	2874
FWALA	3541.667	0.016672	0.042058	61	1450
FWALA	3566.000	0.005610	0.014153	61	4310
FWALA	3571.000	0.005502	0.013879	61	4395
FWALA	3729.200	0.000890	0.002246	61	27163
FWALA	3715.400	0.000749	0.001890	61	32283

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**	0.00282	1

3.2.9 Dublin 12: Bluebell – Naas Road Business Park

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	Not disclosed	0.009131	0.009131	28	3067
PMR	Not disclosed	0.006095	0.006095	28	4594
PMR	Not disclosed	0.005364	0.005364	28	5220
PMR	Not disclosed	0.004853	0.004853	28	5770
FM Radio	94.880	0.014876	0.014876	28	1882
FM Radio	92.898	0.012162	0.012162	28	2302
FM Radio	104.378	0.011926	0.011926	28	2348
FM Radio	96.725	0.010399	0.010399	28	2693
FM Radio	101.850	0.010351	0.010351	28	2705
FM Radio	106.018	0.009183	0.009183	28	3049
PMR	Not disclosed	0.002234	0.002234	28	12536
Noise	142.950 - 144.3	0.018201	0.018201	28	1538
Noise	144.300 - 150.600	0.039206	0.039206	28	714
Spurious Emission	198.000	0.028931	0.034892	28	802
TV PAL	183.280	0.025586	0.032424	28	864
Noise	199 - 210	0.104256	0.104256	28	269
T-DAB	227.067	0.018621	0.022004	28	1273
TETRA	Not disclosed	0.007286	0.012620	28	2219
TETRA	Not disclosed	0.006950	0.012038	28	2326
TETRA	Not disclosed	0.003338	0.005782	28	4843
TETRA	Not disclosed	0.002466	0.004271	28	6555
TETRA	Not disclosed	0.002404	0.004164	28	6724
TETRA	Not disclosed	0.002216	0.003838	28	7296
TETRA	Not disclosed	0.005321	0.007525	28	3721
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	11563
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	20987
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	20984
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	36798
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	43135
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	45477
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	21745
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	22583
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	47746
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	54009
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	67045
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	54488
TV PAL	567.347	0.213304	0.270311	32.8	121
TV PAL	535.333	0.178443	0.226133	31.8	141
TV PAL	583.680	0.172187	0.218205	33.2	152

Table continued overleaf →

....table continued from previous page

Emission Type	Frequency	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below Limit [adjusted Values]
TV PAL	743.747	0.189234	0.239808	37.5	156
TV PAL	775.107	0.015740	0.019946	38.3	1919
TV DVB-T	739.827	0.123880	0.325834	37.4	115
TV DVB-T	794.707	0.123880	0.325834	38.8	119
GSM	940.750	4.111497	8.222994	42.2	5
GSM	938.417	0.108768	0.217535	42.1	194
GSM	955.100	0.066834	0.133669	42.5	318
GSM	952.650	0.035686	0.071372	42.4	595
GSM	946.700	0.036183	0.072365	42.3	585
GSM	948.567	0.034475	0.068949	42.3	614
GSM	1838.000	0.089125	0.178250	58.9	331
GSM	1840.000	0.037068	0.074136	59.0	796
GSM	1863.500	0.025734	0.051467	59.4	1153
GSM	1857.000	0.025852	0.051705	59.3	1146
UMTS TDD	1906.867	0.003006	0.010989	60.0	5464
UMTS FDD	2132.433	0.452898	2.928773	61	21
UMTS FDD	2128.700	0.375405	2.427648	61	25
UMTS FDD	2111.200	0.209170	1.352651	61	45
UMTS FDD	2116.333	0.166725	1.078166	61	57
UMTS FDD	2153.433	0.034954	0.226040	61	270
UMTS FDD	2148.767	0.034754	0.224743	61	271
WiFi	2415.865	0.005188	0.020130	61	3030
WiFi	2463.182	0.004467	0.017331	61	3520
FWALA	3501.000	0.047479	0.119771	61	509
FWALA	3549.667	0.002315	0.005839	61	10447
FWALA	3764.600	0.016368	0.041291	61	1477
FWALA	3772.700	0.011285	0.028468	61	2143
FWALA	3779.300	0.007112	0.017941	61	3400
FWALA	3724.100	0.001180	0.002978	61	20487
FWALA	3716.300	0.000955	0.002409	61	25321
WiFi	5597.500	0.001219	0.004730	61	12897

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**	0.043171	1

3.2.10 Dublin 13: Baldoyle - Main Street

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	Not disclosed	0.004212	0.004212	28	6647
PMR	Not disclosed	0.005093	0.005093	28	5497
PMR	Not disclosed	0.002441	0.002441	28	11472
TV PAL	207.600	0.041543	0.052646	28	532
TV PAL	183.440	0.041115	0.052103	28	537
T-DAB	227.120	0.007269	0.008590	28	3260
TETRA	Not disclosed	0.006273	0.010866	28	2577
TETRA	Not disclosed	0.005774	0.010001	28	2800
TETRA	Not disclosed	0.002472	0.004281	28	6540
TETRA	Not disclosed	0.002058	0.003565	28	7854
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	39400
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	45233
TV PAL	535.333	0.016577	0.021007	31.8	1514
TV PAL	567.347	0.015686	0.019878	32.8	1648
TV PAL	583.027	0.008954	0.011347	33.2	2926
TV PAL	799.333	0.021135	0.026783	38.9	1451
TV PAL	775.760	0.017398	0.022048	38.3	1737
TV PAL	743.747	0.016293	0.020647	37.5	1816
TV DVB-T	739.173	0.012176	0.032026	37.4	1167
TV DVB-T	791.440	0.008166	0.021478	38.7	1801
GSM	939.583	1.896706	3.793412	42.1	11
GSM	940.750	0.184714	0.369428	42.2	114
GSM	937.833	0.165386	0.330773	42.1	127
GSM	955.333	0.009473	0.018947	42.5	2243
GSM	1840.750	1.283808	2.567616	59.0	23
GSM	1843.250	0.150314	0.300628	59.0	196
UMTS FDD	2133.600	0.397649	2.571495	61	24
UMTS FDD	2128.467	0.374542	2.422064	61	25
UMTS FDD	2147.833	0.305844	1.977815	61	31
UMTS FDD	2111.433	0.005585	0.036115	61	1689
UMTS FDD	2116.567	0.005129	0.033165	61	1839

Table continued overleaf →

....table continued from previous page

Emission Type	Frequency	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below Limit [adjusted Values]
WiFi	2433.400	0.008385	0.032534	61	1875
WiFi	2439.245	0.006331	0.024566	61	2483
FWALA	3549.333	0.001554	0.003921	61	15559
FWALA	3572.333	0.000883	0.002228	61	27383
FWALA	3588.667	0.000689	0.001737	61	35114
FWALA	3719.900	0.002140	0.005399	61	11297
WiFi	5640.850	0.001113	0.004319	61	14125

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**	0.014576	1

3.2.11 Dublin 13: Donaghmede Shopping Centre

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	Not disclosed	0.004576	0.004576	28	6119
PMR	Not disclosed	0.004915	0.004915	28	5697
PMR	Not disclosed	0.004276	0.004276	28	6549
PMR	Not disclosed	0.004036	0.004036	28	6937
PMR	Not disclosed	0.004018	0.004018	28	6969
PMR	Not disclosed	0.003908	0.003908	28	7164
PMR	Not disclosed	0.003895	0.003895	28	7189
TV PAL	183.440	0.024917	0.031577	28	887
T-DAB	227.067	0.006699	0.007916	28	3537
TETRA	Not disclosed	0.010340	0.017909	28	1563
TETRA	Not disclosed	0.009750	0.016887	28	1658
TETRA	Not disclosed	0.003065	0.005310	28	5273
TETRA	Not disclosed	0.003048	0.005279	28	5304
TETRA	Not disclosed	0.002716	0.004705	28	5951
TETRA	Not disclosed	0.002443	0.004232	28	6616
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	8700
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	36751
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	57997
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	28372
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	51113
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	56039
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	25436
TV PAL	535.333	0.013017	0.016495	31.8	1929
TV PAL	583.680	0.012677	0.016064	33.2	2068
TV PAL	567.347	0.009099	0.011531	32.8	2840
TV PAL	743.093	0.016769	0.021250	37.5	1764
TV PAL	799.933	0.016069	0.020364	38.9	1910
TV PAL	775.760	0.008008	0.010148	38.3	3774
TV PAL	719.357	0.004694	0.005948	36.9	6200
TV PAL	831.293	0.003922	0.004970	39.6	7977
TV PAL	847.627	0.003819	0.004840	40.0	8271
TV DVB-T	739.827	0.011790	0.031010	37.4	1206
TV DVB-T	791.440	0.006531	0.017179	38.7	2252
GSM	955.800	2.854303	5.708605	42.5	7
GSM	938.183	1.211993	2.423985	42.1	17
GSM	951.833	0.514636	1.029272	42.4	41
GSM	940.633	0.366438	0.732875	42.2	58

Table continued overleaf →

....table continued from previous page

Emission Type	Frequency	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below Limit [adjusted Values]
GSM	947.050	0.117085	0.234169	42.3	181
GSM	939.933	0.144877	0.289754	42.2	145
GSM	1864.250	1.125900	2.251801	59.4	26
GSM	1855.500	0.522998	1.045996	59.2	57
GSM	1836.250	0.424131	0.848262	58.9	69
GSM	1861.150	0.224647	0.449293	59.3	132
GSM	1844.750	0.162368	0.324736	59.1	182
GSM	1840.050	0.035975	0.071950	59.0	820
UMTS TDD	1911.467	0.009120	0.033340	60.1	1803
UMTS TDD	1900.067	0.007551	0.027604	59.9	2171
UMTS TDD	1907.733	0.005278	0.019296	60.1	3112
UMTS FDD	2128.700	0.263937	1.706812	61	36
UMTS FDD	2133.600	0.255564	1.652668	61	37
UMTS FDD	2167.200	0.225944	1.461119	61	42
UMTS FDD	2146.667	0.009705	0.062760	61	972
UMTS FDD	2112.133	0.007311	0.047281	61	1290
UMTS FDD	2117.268	0.006397	0.041370	61	1474
WiFi	2414.473	0.007063	0.027405	61	2226
FWALA	3599.667	0.060884	0.153586	61	397
FWALA	3581.333	0.035400	0.089300	61	683
FWALA	3592.000	0.012897	0.032535	61	1875
FWALA	3562.667	0.002173	0.005481	61	11130
FWALA	3547.000	0.001578	0.003980	61	15328
FWALA	3558.667	0.001388	0.003502	61	17417
FWALA	3749.600	0.010174	0.025666	61	2377
FWALA	3767.300	0.010081	0.025430	61	2399
FWALA 3	3735.500	0.009026	0.022769	61	2679
FWALA	3755.000	0.008404	0.021201	61	2877
FWALA	3718.400	0.003361	0.008479	61	7194
FWALA	3712.700	0.002427	0.006121	61	9965
WiFi	5666.350	0.008851	0.034343	61	1776

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**	0.02647	1

3.2.12 Kildare: Athy - Leinster St

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	Not disclosed	0.004932	0.004932	28	5678
TETRA	Not disclosed	0.079524	0.137740	28	203
TETRA	Not disclosed	0.007870	0.013632	28	2054
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	4909
TV PAL	667.307	0.005489	0.006956	35.5	5106
GSM	941.217	1.729816	3.459633	42.2	12
GSM	954.983	1.417425	2.834849	42.5	15
GSM	939.700	0.359749	0.719499	42.1	59
GSM	938.417	0.148936	0.297872	42.1	141
GSM	951.483	0.031514	0.063027	42.4	673
GSM	1831.500	0.114948	0.229895	58.8	256
GSM	1866.500	0.063314	0.126628	59.4	469
GSM	1863.750	0.011143	0.022286	59.4	2664
UMTS TDD	1909.933	0.003784	0.013835	60.1	4344
UMTS FDD	2126.600	0.093648	0.605600	61	101
UMTS FDD	2134.433	0.079159	0.511901	61	119
UMTS FDD	2167.433	0.009817	0.063487	61	961
UMTS FDD	2117.967	0.009183	0.059386	61	1027
UMTS FDD	2112.133	0.007718	0.049910	61	1222
UMTS FDD	2146.200	0.007354	0.047554	61	1283
WiFi	2464.852	0.008194	0.031793	61	1919
FWALA	3549.667	0.008730	0.022022	61	2770
FWALA	3544.333	0.007490	0.018895	61	3228
FWALA	3557.667	0.006397	0.016138	61	3780
FWALA	3554.667	0.000916	0.002311	61	26392
FWALA	3798.800	0.001512	0.007207	61	8464
FWALA	3727.400	0.000990	0.002497	61	24433
FWALA	3713.900	0.000865	0.002182	61	27956

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**	0.011738	1

3.2.13 Kildare: Clane - Main Street

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	Not disclosed	0.004375	0.004375	28	6400
PMR	Not disclosed	0.006494	0.006494	28	4312
TV PAL	183.280	0.023174	0.029367	28	953
TETRA	Not disclosed	1.078947	1.868791	28	15
TV PAL	544.480	0.006524	0.008267	32.1	3881
TV PAL	799.933	0.016444	0.020838	38.9	1866
TV PAL	775.760	0.008260	0.010468	38.3	3658
GSM	939.467	2.077304	4.154607	42.1	10
GSM	949.850	0.622300	1.244601	42.4	34
GSM	937.833	0.372821	0.745641	42.1	56
GSM	946.817	0.425109	0.850217	42.3	50
GSM	1835.000	0.235776	0.471552	58.9	125
GSM	1855.500	0.010483	0.020967	59.2	2825
GSM	1879.000	0.010221	0.020442	59.6	2916
UMTS FDD	2131.000	0.325462	2.104678	61	29
UMTS FDD	2127.533	0.311889	2.016906	61	30
UMTS FDD	2119.133	0.004566	0.029525	61	2066
UMTS FDD	2111.667	0.004325	0.027970	61	2181
UMTS FDD	2168.133	0.004159	0.026896	61	2268
FWALA	3724.100	0.000587	0.001480	61	41208
FWALA	3713.900	0.000552	0.001393	61	43800
WiFi	5515.050	0.002745	0.010650	61	5728
WiFi	5609.940	0.001607	0.006235	61	9784
WiFi	5491.250	0.001589	0.006164	61	9897
WiFi	5540.550	0.001204	0.004670	61	13062

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**	0.018103	1

3.2.14 Kilkenny: Castlecomer - Barrack Hill

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	Not disclosed	0.004529	0.004529	28	6182
FM Radio	96.588	0.014438	0.014438	28	1939
TETRA	Not disclosed	0.013305	0.023044	28	1215
TETRA	Not disclosed	0.011899	0.020609	28	1359
TV PAL	486.987	0.008063	0.010218	30.3	2970
TV PAL	511.160	0.007798	0.009882	31.1	3146
TV DVB-T	667.307	0.001374	0.003614	35.5	9828
TV DVB-T	698.013	0.001291	0.003396	36.3	10696
GSM	949.267	0.340800	0.681601	42.4	62
GSM	952.767	0.009583	0.019166	42.4	2214
UMTS FDD	2146.433	0.004937	0.031929	61	1910

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**	0.000261	1

3.2.15 Laois: Portlaoise - Dublin Rd - Killeshin Hotel

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	Not disclosed	0.004102	0.004102	28	6826
TETRA	Not disclosed	0.002150	0.003724	28	7518
TETRA	Not disclosed	0.001897	0.003285	28	8523
TETRA	Not disclosed	0.001698	0.002941	28	9519
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	45029
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	58466
GSM	945.417	0.526017	1.052035	42.3	40
GSM	951.250	0.044617	0.089234	42.4	475
GSM	952.300	0.036771	0.073541	42.4	577
GSM	953.700	0.035934	0.071867	42.5	591
GSM	1854.750	0.010081	0.020162	59.2	2937
GSM	1850.750	0.008740	0.017480	59.2	3384
GSM	1848.250	0.008443	0.016886	59.1	3501
GSM	1846.750	0.007665	0.015330	59.1	3855
GSM	1849.250	0.006324	0.012648	59.1	4675
UMTS FDD	2147.133	0.047698	0.308451	61	198
UMTS FDD	2152.733	0.045499	0.294229	61	207
UMTS FDD	2166.967	0.007525	0.048662	61	1254
UMTS FDD	2168.600	0.005433	0.035131	61	1736
UMTS FDD	2111.433	0.004792	0.030987	61	1969
FWALA	3730.100	0.001700	0.004289	61	14223

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**	0.00068	1

3.2.16 Louth: Drogheda - Rathmullan Rd - FM Radio Transmitter

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	Not disclosed	0.004624	0.004624	28	6056
PMR	Not disclosed	0.003720	0.003720	28	7528
FM Radio	96.520	0.904690	0.904690	28	31
FM Radio	107.658	0.126328	0.126328	28	222
FM Radio	105.062	0.012402	0.012402	28	2258
PMR	Not disclosed	0.004169	0.004169	28	6717
PMR	Not disclosed	0.002301	0.002301	28	12166
TETRA	Not disclosed	0.007345	0.012722	28	2201
TETRA	Not disclosed	0.005868	0.010164	28	2755
TETRA	Not disclosed	0.002965	0.005135	28	5453
TETRA	Not disclosed	0.002688	0.004657	28	6013
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	59897
TV PAL	751.587	0.006816	0.008637	37.7	4364
TV PAL	719.573	0.006375	0.008079	36.9	4565
TV PAL	847.626	0.005339	0.006767	40.0	5916
TV PAL	831.293	0.004915	0.006228	39.6	6365
GSM	954.867	0.031769	0.063537	42.5	669
GSM	953.817	0.026182	0.052364	42.5	811
GSM	950.900	0.020654	0.041308	42.4	1026
GSM	953.116	0.019209	0.038418	42.4	1105
GSM	938.300	0.011749	0.023498	42.1	1792
GSM	947.750	0.010789	0.021579	42.3	1962
GSM	1835.250	0.030304	0.060608	58.9	972
GSM	1839.000	0.028675	0.057350	59.0	1028
GSM	1856.750	0.020630	0.041260	59.2	1436
GSM	1840.250	0.016885	0.033770	59.0	1747
GSM	1832.250	0.014028	0.028056	58.9	2098
GSM	1855.000	0.012218	0.024436	59.2	2424
UMTS FDD	2147.600	0.010593	0.068499	61	891
UMTS FDD	2131.967	0.008700	0.056258	61	1084
UMTS FDD	2167.433	0.008670	0.056064	61	1088
UMTS FDD	2126.833	0.007656	0.049509	61	1232
UMTS FDD	2119.133	0.006653	0.043022	61	1418
UMTS FDD	2162.766	0.006331	0.040944	61	1490
WiFi	2439.245	0.004295	0.016666	61	3660

Table continued overleaf →

....table continued from previous page

Emission Type	Frequency	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below Limit [adjusted Values]
FWALA	3505.333	0.007889	0.019900	61	3065
FWALA	3565.000	0.003694	0.009319	61	6546
FWALA	3547.667	0.002228	0.005622	61	10851
FWALA	3582.667	0.001656	0.004177	61	14604
FWALA	3572.000	0.001607	0.004054	61	15048
FWALA	3541.333	0.001457	0.003676	61	16595
WiFi	5696.950	0.001569	0.006086	61	10023

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**	0.001079	1

3.2.17 Meath: Ashbourne Industrial Estate

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	Not disclosed	0.004797	0.004797	28	5837
FM Radio	100.893	0.008650	0.008650	28	3237
FM Radio	89.140	0.007952	0.007952	28	3521
FM Radio	98.707	0.007665	0.007665	28	3653
FM Radio	104.447	0.007269	0.007269	28	3852
TV PAL	183.600	0.023550	0.029844	28	938
TV PAL	207.120	0.019387	0.024568	28	1140
T-DAB	227.813	0.007088	0.008375	28	3343
TETRA	Not disclosed	0.004545	0.007872	28	3557
TETRA	Not disclosed	0.003648	0.006318	28	4432
TETRA	Not disclosed	0.002642	0.004577	28	6118
TETRA	Not disclosed	0.002429	0.004208	28	6654
TETRA	Not disclosed	0.002054	0.003557	28	7872
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	59691
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	54466
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	59839
TV PAL	799.280	0.005702	0.007225	38.9	5380
TV PAL	775.760	0.004207	0.005332	38.3	7183
TV DVB-T	735.253	0.002183	0.005741	37.3	6494
TV DVB-T	792.093	0.001326	0.003487	38.7	11097
GSM	953.000	0.753356	1.506711	42.4	28
GSM	948.567	0.734514	1.469028	42.3	29
GSM	946.000	0.630231	1.260463	42.3	34
GSM	950.900	0.608135	1.216270	42.4	35
GSM	1841.500	0.006375	0.012751	59.0	4628
UMTS FDD	2146.200	0.058210	0.376431	61	162
UMTS FDD	2166.267	0.013852	0.089575	61	681
WiFi	2405.288	0.009806	0.038048	61	1603

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**	0.004218	1

3.2.18 Meath: Bellewstown

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	Not disclosed	0.004770	0.004770	28	5870
PMR	Not disclosed	0.003585	0.003585	28	7810
FM Radio	105.540	0.009806	0.009806	28	2855
FM Radio	95.837	0.009727	0.009727	28	2878
FM Radio	102.738	0.008851	0.008851	28	3163
FM Radio	105.062	0.008561	0.008561	28	3271
FM Radio	96.999	0.007236	0.007236	28	3870
FM Radio	87.773	0.007145	0.007145	28	3919
TV PAL	183.440	0.026122	0.033103	28	846
T-DAB	227.173	0.006950	0.008213	28	3409
TETRA	Not disclosed	0.004217	0.007304	28	3834
TETRA	Not disclosed	0.002996	0.005189	28	5396
TETRA	Not disclosed	0.002688	0.004657	28	6013
TETRA	Not disclosed	0.002415	0.004184	28	6693
TETRA	Not disclosed	0.002140	0.003707	28	7553
TETRA	Not disclosed	0.001892	0.003278	28	8543
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	56820
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	58601
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	52317
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	63531
TV PAL	535.333	0.011015	0.013959	31.8	2279
TV PAL	567.347	0.010151	0.012864	32.8	2546
TV PAL	583.027	0.008054	0.010206	33.2	3253
TV PAL	831.947	0.016425	0.020814	39.7	1905
TV PAL	718.920	0.016125	0.020435	36.9	1804
TV PAL	751.587	0.012374	0.015681	37.7	2404
TV PAL	847.627	0.008750	0.011088	40.0	3610
TV PAL	743.747	0.006331	0.008024	37.5	4674
TV PAL	775.760	0.004550	0.005766	38.3	6642
TV DVB-T	741.133	0.003192	0.008395	37.4	4459
TV DVB-T	791.440	0.002639	0.006942	38.7	5572

Table continued overleaf →

....table continued from previous page

Emission Type	Frequency	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below Limit [adjusted Values]
GSM	951.833	2.480276	4.960552	42.4	9
GSM	945.533	0.019320	0.038639	42.3	1094
GSM	940.137	0.009528	0.019056	42.2	2212
GSM	1833.250	0.241824	0.483649	58.9	122
UMTS TDD	1900.467	0.019055	0.069657	59.9	861
UMTS TDD	1903.800	0.012374	0.045234	60.0	1326
UMTS FDD	2168.133	0.012691	0.082070	61	743
UMTS FDD	2148.533	0.004320	0.027937	61	2183
FWALA	3515.333	0.000594	0.001497	61	40736
FWALA	3797.900	0.011682	0.055690	61	1095
FWALA	3733.400	0.006561	0.031280	61	1950
WiFi	5532.900	0.001467	0.005693	61	10715

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**	0.013751	1

3.2.19 Westmeath: Moate - Dublin Road - Eircom Site

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	Not disclosed	0.004759	0.004759	28	5884
TETRA	Not disclosed	1.022116	1.770356	28	16
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	53627
TV PAL	623.533	0.006831	0.008657	34.3	3966
TV PAL	647.707	0.006266	0.007941	35.0	4407
TV PAL	703.240	0.008091	0.010253	36.5	3556
TV PAL	671.227	0.006124	0.007760	35.6	4591
TV PAL	847.627	0.004145	0.005252	40.0	7622
TV PAL	831.293	0.003581	0.004538	39.6	8736
TV DVB-T	679.720	0.001547	0.004069	35.8	8810
GSM	949.733	0.102683	0.205367	42.4	206
GSM	946.000	0.101742	0.203484	42.3	208
GSM	946.700	0.091096	0.182192	42.3	232
GSM	941.100	0.012134	0.024268	42.2	1738
GSM	953.467	0.010520	0.021039	42.5	2018
UMTS FDD	2117.500	0.006714	0.043420	61	1405
UMTS FDD	2148.067	0.005741	0.037127	61	1643
UMTS FDD	2114.000	0.005735	0.037084	61	1645
UMTS FDD	2168.367	0.004426	0.028621	61	2131
UMTS FDD	2117.500	0.006714	0.043420	61	1405

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**	0.004066	1

3.2.20 Wicklow: Blessington

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	Not disclosed	0.004613	0.004613	28	6070
PMR	Not disclosed	0.004305	0.004305	28	6504
PMR	Not disclosed	0.003846	0.003846	28	7280
FM Radio	89.072	0.017803	0.017803	28	1573
FM Radio	91.258	0.016274	0.016274	28	1721
FM Radio	93.513	0.012064	0.012064	28	2321
FM Radio	98.707	0.010864	0.010864	28	2577
FM Radio	100.893	0.008318	0.008318	28	3366
TV PAL	183.280	0.023768	0.030121	28	930
TV PAL	207.600	0.020797	0.026355	28	1062
T-DAB	227.173	0.006464	0.007638	28	3666
TETRA	Not disclosed	0.656901	1.137786	28	25
TETRA	Not disclosed	0.003199	0.005541	28	5054
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	35815
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	65979
TV PAL	775.760	0.038327	0.048570	38.3	789
TV PAL	799.933	0.034995	0.044347	38.9	877
TV PAL	703.893	0.007063	0.008951	36.5	4076
TV PAL	679.067	0.006871	0.008707	35.8	4115
TV DVB-T	791.440	0.008720	0.022935	38.7	1687
TV DVB-T	740.480	0.012274	0.032285	37.4	1159
GSM	939.000	1.650061	3.300122	42.1	13
GSM	953.817	0.448229	0.896458	42.5	47
GSM	948.683	0.275423	0.550846	42.4	77
GSM	952.883	0.103872	0.207745	42.4	204
GSM	950.550	0.010069	0.020139	42.4	2105
GSM	1878.250	0.009173	0.018346	59.6	3248
UMTS FDD	2112.833	0.294442	1.904082	61	32
UMTS FDD	2116.567	0.252930	1.635632	61	37
UMTS FDD	2128.000	0.137721	0.890606	61	68
UMTS FDD	2133.600	0.117761	0.761528	61	80
UMTS FDD	2166.267	0.049602	0.320764	61	190
UMTS FDD	2146.200	0.018302	0.118355	61	515
WiFi	2450.100	0.004325	0.016782	61	3635

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**	0.010526	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 2010 as part of the 2010 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.

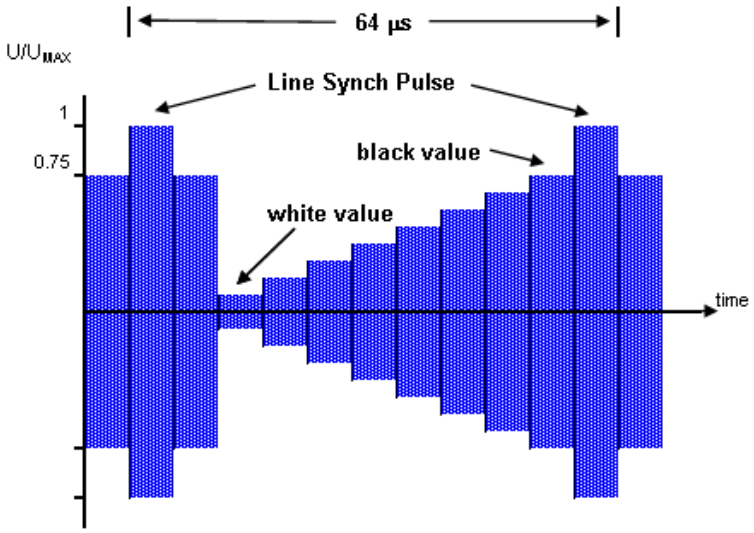


Figure 1: Luminance Signal in the Time Domain

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.