Commission for Communications Regulation
An Coimisiún um Rialáil Cumarsáide

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Programme of Measurement of Non-Ionising Radiation Emissions

Site Survey Report 09/82_8

1. Survey Summary

Address of Transmitter Site Surveyed:	Tallaght Garda Station, Dublin 24
Site Type:	GSM UMTS, PMR, TETRA
Survey Date:	18/09/2009

Measurement Location: (at point of maximum non-ionising radiation near site)	On the grass verge of the McDonalds drive through

Measurement Location Coordinates:			deg	min	sec
	Latitude:	N	53	17	14.6
	Longitude:	W	6	22	02.9

Purpose and Conduct of Survey:

Non-ionising electromagnetic radiation levels were measured at the point of highest emissions which was determined near the site, in order to **assess compliance with** the international **ICNIRP Limits** for general public exposure to non-ionising radiation.

Compliance with the ICNIRP Limits is a **condition** of various wireless transmission **licences** issued by the **Commission for Communications Regulation (ComReg)**.

Overall Conclusions of the Survey	
Frequency Selective Measurements: (Individual emissions measured at specific frequencies)	**Below ICNIRP Public Limits (Compliant)**
Total Exposure Quotient: (Assessment of cumulative emissions from multiple transmitters)	**Below ICNIRP Public Limits (Compliant)**

2. Surveyors

Survey conducted on behalf of ComReg by:

Vilicom Vilicom Engineering Ltd, 14 Joyce Way, Park West Business Park, D12

Survey Engineer(s):	**Report Writer:**	**Report Reviewer:**
John Ryan, BSc	John Ryan, BSc	Sean Keating, BEng

3. Survey Location Details

Transmitter Site Photo

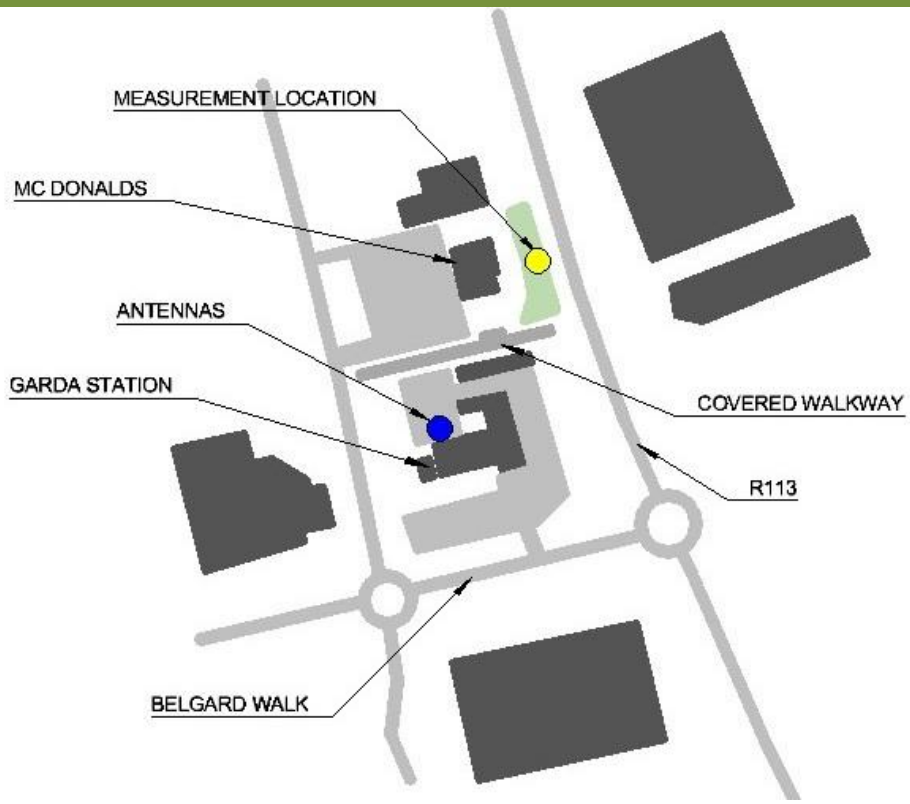
Survey Weather Conditions

Sky:
Overcast

Temperature:
19° C

Relative Humidity:
40%

Map of Transmitter Site and Measurement Location



4. Introductory Note

Purpose of Survey

The survey of the designated transmitter site was commissioned by the Commission for Communications Regulation (ComReg) as part of its Programme of Measurement of Non-Ionising Radiation Emissions. The purpose of the survey was to assess whether non-ionising electromagnetic radiation emissions from the site were compliant with the limits specified in the guidelines[1] published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). Compliance with the ICNIRP limits is a condition of various Wireless Telegraphy licences (e.g. GSM and UMTS Mobile telephony, wireless broadband, broadcasting etc.) issued by ComReg.

Survey Methodology

Measurements of the non-ionising radiation emissions from the site were conducted in accordance with the methodology outlined in document ComReg 08/51R[2], which incorporates many of the measurement methods and procedures outlined in ECC Recommendation (02)04[3].

Note re this Report Version

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

[1] "Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz)", International Commission on Non-Ionizing Radiation Protection, Published in 'Health Physics', April 1998, Volume 74, Number 4. www.icnirp.de

[2] http://www.comreg.ie/_fileupload/publications/ComReg0851R.pdf

[3] 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.

5. Survey Overview

Survey Stages

In accordance with the methodology outlined in document ComReg 08/51R, the survey was conducted in three stages as follows:

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

Brief outlines of each stage, along with results and conclusions of the measurements are presented in the three sections which follow.

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[4] in the **far-field** which is the region[5] 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 relationship between E and H becomes very complex and there is no direct correlation between both components of the electromagnetic field.

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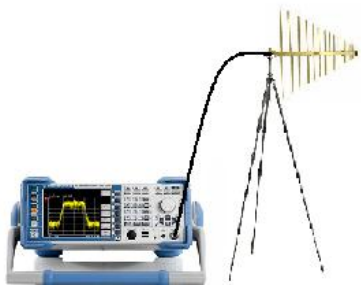
[4] $E = H \times Z_0$ where Z_0 (characteristic impedance of free space) $\approx 377\ \Omega$

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

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 colspan="2">SPECTRUM ANALYSER WITH TRIPOD MOUNTED ANTENNA CONNECTED
 
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>

6. Initial Site Survey

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

For this initial survey a calibrated **field strength meter** fitted with an **18 GHz isotropic probe** was used. The meter and probe were used to measure the sum of all electrical fields present at **all frequencies from 3 MHz up to 18 GHz**.

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

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

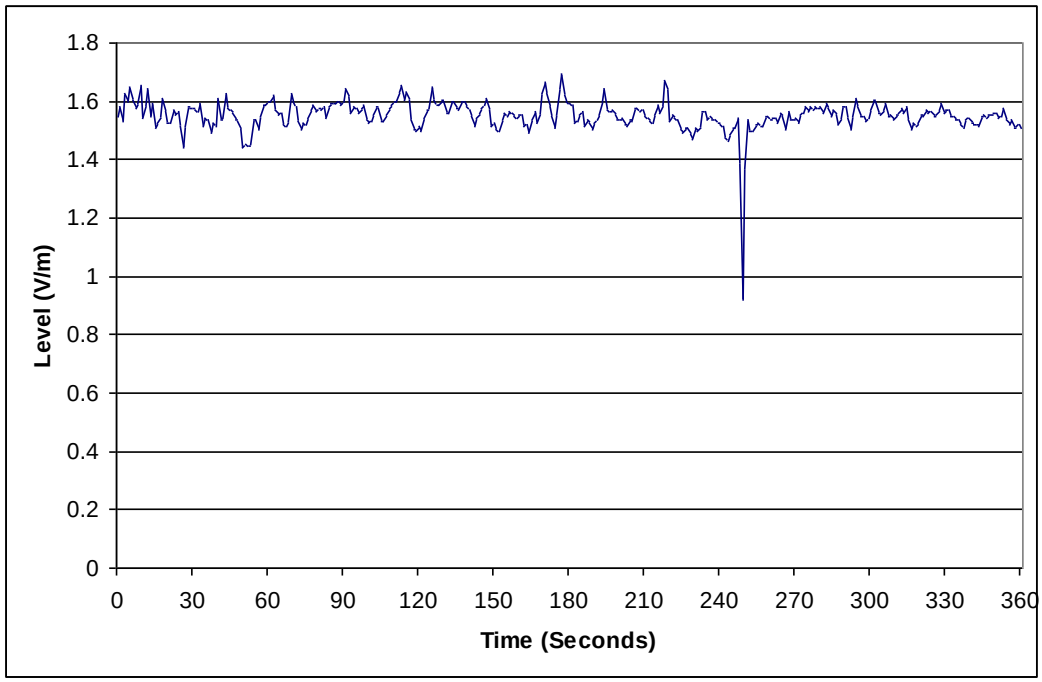
7. Full Survey – Broadband Measurements

The purpose of these measurements was to get an overview of the intensity of the electromagnetic field present at the point of maximum NIR near the site. There, the field strength meter and probe combination were mounted on a tripod and were set to record, over a six minute period, simultaneous measurements of the sum of all received signals within the frequency range of the probe.

The broadband measurement results presented in the graph and table below show the levels in Volts per metre (V/m) recorded in the course of the six minute measurement. The average and maximum levels can be compared to the lowest maximum ICNIRP general public guideline limit which is 28 V/m.

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

Electric field strengths recorded over 6 min period using 18 GHz probe at point of max NIR:



Acquisition Mode: 1 Sec. Sampling

Mean Measurement:	1.55V/m	**Peak Measurement:**	1.7V/m
Date:	18/09/2009	**Start Time:**	10:36
Meter:	Narda NBM 550	**Probe:**	EF 1891 (3 MHz - 18 GHz)

Conclusion of the Broadband Measurements

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

8. Full Survey – Frequency Selective Measurements

Basic Measurement Procedure

A more detailed survey was performed at the point of maximum NIR near the site in order to identify the individual transmit frequencies and field strengths of each type of emission (e.g. mobile telephone GSM and UMTS, wireless broadband, TV, radio signals etc) and their contribution to the total electromagnetic field. The measurements were performed using spectrum analyser equipment and a range of antennas to match the frequency bands in which emissions were measured.

Table of Measurement Results

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

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

For further details of Adjusted Levels and ICNIRP Limits, please see the explanatory notes which follow the table of measurement results.

Assessment of ICNIRP Compliance of Individual Emissions

The levels for each emission measured, which have been adjusted where necessary, are compared to the relevant ICNIRP general public guideline limit which applies at the particular frequency of the emission. It should be noted that the ICNIRP guideline limits vary according to frequency. The limits for the different measurements presented in the tables will vary as the measurements have been performed at different frequencies.

Assessment of ICNIRP Compliance of Cumulative Emissions

The levels measured for individual emissions are used to calculate two **Total Exposure Quotients** in order assess the cumulative effect of emissions from multiple transmitters. For further details of the quotients, please see the explanatory notes which follow the tables of measurement results.

The calculated values of the quotients must be ≤ 1 in order for the aggregate of NIR emissions to satisfy the criteria of the ICNIRP Guidelines.

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	74.528	0.004335	0.004335	28.0	6459
PMR	86.926	0.006769	0.006769	28.0	4137
FM Radio	93.513	0.042121	0.042121	28.0	665
FM Radio	89.072	0.032999	0.032999	28.0	849
FM Radio	91.258	0.028907	0.028907	28.0	969
FM Radio	100.893	0.023254	0.023254	28.0	1204
FM Radio	98.707	0.021257	0.021257	28.0	1317
FM Radio	92.898	0.017358	0.017358	28.0	1613
TV PAL	183.440	0.039765	0.050392	28.0	556
TV PAL	207.760	0.024462	0.031000	28.0	903
T-DAB	227.653	0.009572	0.011311	28.0	2475
T-DAB	224.400	0.007745	0.009152	28.0	3060
TETRA	390.200	0.217520	0.376756	28.0	74
TETRA	390.450	0.197015	0.341241	28.0	82
TETRA	394.583	0.155776	0.269812	28.0	104
TETRA	390.800	0.118713	0.205618	28.0	136
PMR	451.988	0.075509	0.075509	29.2	387
PMR	456.700	0.001877	0.001877	29.4	15654
PMR	453.015	0.001712	0.001712	29.3	17095
PMR	458.755	0.025852	0.025852	29.5	1139
PMR	459.514	0.005218	0.005218	29.5	5649
PMR	457.169	0.000999	0.000999	29.4	29433
PMR	457.370	0.000905	0.000905	29.4	32504
PMR	465.996	0.034995	0.034995	29.7	848
PMR	463.818	0.008110	0.008110	29.6	3652
PMR	464.874	0.005433	0.005433	29.6	5457
PMR	466.964	0.000773	0.000773	29.7	38454
TV PAL	567.347	0.041543	0.052646	32.8	622
TV PAL	583.680	0.025793	0.032686	33.2	1016
TV PAL	535.333	0.014538	0.018423	31.8	1727
TV PAL	743.747	0.032322	0.040960	37.5	915
TV PAL	775.760	0.012868	0.016307	38.3	2349
TV DVB-T	739.827	0.014997	0.039445	37.4	948
TV DVB-T	796.667	0.010691	0.028119	38.8	1380

Table continued overleaf….

Emission Type	Frequency	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below Limit [adjusted Values]
GSM	952.533	0.126911	0.253822	42.4	167
GSM	953.467	0.103276	0.206552	42.5	206
GSM	946.467	0.068549	0.137098	42.3	309
GSM	950.200	0.061589	0.123177	42.4	344
GSM	955.333	0.030549	0.061098	42.5	696
GSM	938.067	0.023578	0.047155	42.1	893
GSM	1857.000	0.941890	1.883779	59.3	31
GSM	1854.750	0.265461	0.530921	59.2	112
GSM	1831.250	0.081470	0.162941	58.8	361
GSM	1835.500	0.079983	0.159967	58.9	368
GSM	1834.000	0.050408	0.100816	58.9	584
GSM	1865.250	0.021528	0.043056	59.4	1379
UMTS FDD	2118.667	0.122039	0.789197	61.0	77
UMTS FDD	2146.200	0.113501	0.733982	61.0	83
UMTS FDD	2113.533	0.110790	0.716450	61.0	85
UMTS FDD	2166.733	0.025003	0.161691	61.0	377
WiFi	2410.855	0.018945	0.073508	61.0	830
FWALA	3549.333	0.004457	0.011242	61.0	5426
FWALA	3560.333	0.001122	0.002081	61.0	29307
FWALA	3542.667	0.001122	0.002039	61.0	29921
FWALA	3713.900	0.001263	0.003187	61.0	19142
FWALA	3711.800	0.001122	0.001881	61.0	32432
FWA (Lic-exempt)	5778.000	0.028543	0.072003	61.0	847
FWA (Lic-exempt)	5774.500	0.001122	0.006114	61.0	9976
FWA (Lic-exempt)	5834.000	0.001122	0.003179	61.0	19186

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**	0.002155	1

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

Explanatory Notes

Adjusted Levels[6]

For some emissions 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. For example, a measurement of a digital television signal performed with at a resolution of 5 MHz needs to be adjusted upwards using a correction factor in order to account for the energy present within the full 7.6 MHz bandwidth of the signal.

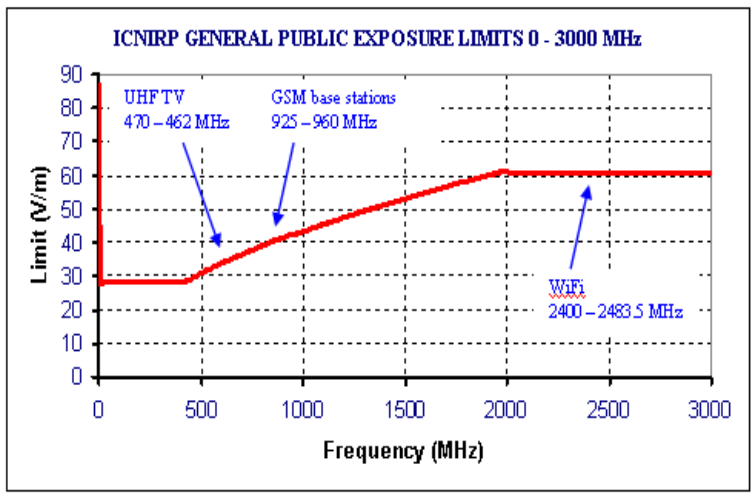
- to extrapolate to an estimate of the level under maximum traffic from the transmitter. For example, the base stations of mobile telephone networks produce emissions which vary according to the changing volume of calls or data traffic over the course of the day.

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

The ICNIRP Public Exposure Limit

The ICNIRP Limits vary according to the frequency of the emissions, as illustrated here.

It can be seen that the limits applicable to GSM 900 mobile phone transmissions are higher than those applicable to UHF TV transmissions.



Total Exposure Quotients

The Total Exposure Quotients (which must be ≤ 1) 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. 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.

[6] See appendices to the extended technical version of this report for further details re calculation of adjusted levels.