



Commission for
Communications Regulation

Authorisation of Ground- and Wall-Probing Radar (GPR/WPR) Imaging Systems & Level Probing Radar (LPR) Devices in Ireland

Information Notice

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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

1 Introduction

1. Ultra Wideband Ground- and Wall- Probing Radar (GPR/WPR) imaging systems are used in several European countries in survey and detection applications. GPR/WPR imaging is commonly used to locate underground gas main leaks, sink-holes, survivors of avalanches and several other applications. These are large, expensive and professional systems and should not be confused with consumer equipment such as stud finders or pipe locators which work on the principle of metal detection and not radar.
2. Similarly, emerging industrial Level Probing Radar (LPR) devices are used in many industries concerned with process control to measure the amount of various substances (mostly liquids or granulates). LPR applications have many practical industrial uses including process control, custody transfer measurement (governmental legal measurements), water and other liquid monitoring, and spill prevention. The main function of LPR is to enhance reliability through the prevention of accidents, increase industrial and quality control, and improve environmental conditions in production processes. These are fixed installations usually in large manufacturing plants.
3. The CEPT Electronic Communications Committee (ECC) adopts decisions, recommendations and reports aimed at efficient spectrum utilisation and harmonisation. The implementation of ECC Decisions and Recommendations by national administrations, while voluntary, is a key tool in the harmonisation of the use of the radio spectrum and provides clear information to industry and operators concerning CEPT harmonisation actions.
4. In April 2011, in its draft strategy for managing the radio spectrum¹, among other things ComReg proposed to implement and monitor a number of CEPT Electronic Communications Committee (ECC) Decisions. These included ECC/DEC/ (06) 08² and ECC/DEC/ (11) 02³ which define harmonised conditions for the use of radio spectrum by GPR/WPR and LPR devices, respectively. No submissions were received from stakeholders in relation to the implementation of GPR/WPR and LPR in Ireland.

¹ ComReg Document 11/28 - Review of the Period 2008 – 2010 & Proposed Strategy for Managing the Radio Spectrum: 2011 – 2013 – 11 April 2011..

² <http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCDEC0608.PDF>

³ <http://www.erodocdb.dk/docs/doc98/official/pdf/ECCDec1102.pdf>

5. On the basis of the technical conditions set out in these ECC Decisions, ComReg has now published Exemption Orders (S.I. 111 of 2013⁴ & S.I. 112 of 2013⁵) which exempt GPR/WPR imaging systems and LPR devices respectively from licensing in Ireland⁶, provided usage complies with the conditions set out in the exemption orders which is also listed in Annex: 1 and Annex: 6 to this Information Notice.
6. In reaching its decision to exempt GPR/WPR imaging systems and LPR devices from licensing under certain conditions, ComReg has taken a number of factors into consideration:
 - ECC Decision ECC/DEC/(06)08 states that GPR/WPR imaging systems have been used for over 30 years in other European jurisdictions by small numbers of trained personnel in specialised industrial and commercial applications;
 - Similarly, ECC Decision ECC/DEC/ (11)02 assumes that all LPR devices will be installed and maintained by professionally trained personnel in order to meet the necessary installation requirements.
 - GPR/WPR radar applications are not used for telecommunications purposes and their intended usage excludes radiation into the free space. The density of usage and activity is expected to remain low, therefore considerably reducing the risk of interference with other services. Furthermore, no significant interference resulting from these applications has so far been reported by other spectrum users in jurisdictions where they have been operational for many years.
7. In order to ensure that the possibility of interference from current or future GPR/WPR imaging systems & LPR devices is minimised, ComReg has attached the following strict conditions to the exemption of these devices from licensing in Ireland:

Conditions for use of GPR/WPR Imaging Systems:

- Users of GPR/WPR imaging systems must register their equipment with ComReg prior to use by completing the registration form provided in Annex: 3 to this document;

⁴ http://www.comreg.ie/fileupload/publications/SI_111_of_2013.pdf

⁵ http://www.comreg.ie/fileupload/publications/SI_112_of_2013.pdf

⁶ Under section 3 of the Wireless Telegraphy Act 1926.

- GPR/WPR imaging systems shall operate on a non-interference, non-protected basis i.e. such use should neither cause interference to other services nor seek protection from interference by other users of the radio spectrum. Furthermore, GPR/WPR equipment is also required to comply with the essential requirements and other relevant provisions of the Radio and Telecommunications Terminal Equipment (R&TTE) Directive⁷ ;
- Users must keep a log recording of every occasion upon which the radar is used. The log file should include details of every location at which the radio equipment is used, the date and duration of operations and the frequency band used to operate the radio equipment. Ongoing records should be maintained for at least the previous 12 months. The format of the log file is provided in Annex: 5 to this document;
- Equipment and usage conditions must comply with the technical parameters which are set out in ECC/DEC/ (06)08 and repeated in Annex: 1 to this Information Notice; and
- In the vicinity of certain sensitive sites, including Radio Astronomy facilities, the use of GPR/WPR imaging systems will require special advance authorisation. A preliminary list of sites for which special authorisation is required is included in Annex: 2 of this document. ComReg retains the right to amend this list as and when required. The Notification form that must be completed prior to use of GPR/WPR imaging systems in the vicinity of sensitive sites is contained in Annex: 4 to this document.

Conditions for use of LPR devices operating in frequency bands 6 - 8.5 GHz, 24.05 - 26.5 GHz, 57-64 GHz and 75 - 85 GHz:

- LPR devices shall operate on a non-interference, non-protected basis i.e. such use should neither cause interference to other services nor seek protection from interference by other users of the radio spectrum. Furthermore, LPR equipment is also required to comply with the essential requirements and other relevant provisions of the Radio and Telecommunications Terminal Equipment (R&TTE) Directive⁷ ;
- Equipment and usage conditions must comply with the technical parameters which are set out in Annex 1 of CEPT ECC Decision ECC/DEC/(11)02 and repeated in Annex: 6 to this Information Notice;

⁷ Signed into Irish law on 5 June 2001 under Statutory Instrument 240 of 2001.

- Users of LPR devices should implement an Automatic Power Control mechanism with a dynamic range of at least 20 dB, or an equivalent mitigation technique. These techniques are described in the Harmonised European Standard EN 302 729 developed by ETSI⁸ for LPR devices.
 - In the vicinity of certain sensitive sites listed in Annex: 2 to this document, special authorisation should be sought from ComReg by users of these devices prior to use. In particular:
 - the use of LPR devices operating in the 6 – 8.5 GHz, 24.05 – 26.5 GHz and 75 - 85 GHz bands is not normally permitted within a radius of 4km around any Radio Astronomy stations.
 - The antenna height of an LPR installation of devices operating in the 6 – 8.5 GHz, 24.05 – 26.5 GHz and 75 - 85 GHz bands should not exceed 15 metres above ground level within a radius of 4 to 40 km around any Radio Astronomy station.
8. ComReg believes that the benefit of the exemption approach is that it balances:
- the need to ensure that potential users of GPR/WPR imaging systems and LPR devices in Ireland have clarity about the legal requirements and preconditions for use of these devices;
 - the need to minimise the potential for interference to existing users of Irish radio spectrum - especially airport radar and radioastronomy - as a result of the use of GPR/WPR imaging systems and LPR devices;
 - the desire to avoid the need for users of GPR/WPR imaging systems to obtain advance permission from ComReg before any instance of device usage (provided such usage is outside of certain sensitive areas);
 - the desire to avoid any unnecessary administrative burden on users of GPR/WPR imaging systems and LPR devices and on ComReg itself arising from the use of these devices.

⁸ European Telecommunications Standards Institute

Annex: 1

Technical Parameters for the operation of GPR/WPR imaging systems in Ireland

A 1.1 GPR/WPR equipment shall have a mechanism which deactivates the equipment when normal use is interrupted. This mechanism shall fulfil the following requirements:

- Manually operated GPR and WPR, which is intended to be used as handheld equipment, shall contain a manually operated non-locking switch (e.g., it may be a sensor for the presence of the operators hand or a movement sensor) which ensures that the equipment de-activates (i.e. the transmitter switches off) within 10 seconds of being released by the operator.
- In the case of remotely/computer controlled imaging equipment, the equipment is de-activated via the control system provided that de-activation takes place within 10 seconds of the control system being switched off or released by the operator.
- There are particular cases where the equipment is mounted in a vehicle for the collection of data where the deactivation time required is 60 seconds.

A 1.2 Maximum mean and peak power densities of any undesired emission emanating from GPR/WPR imaging systems are defined below. For pragmatic reasons and for taking the mitigation factors into account, the mean power density shall be determined by formula (1) or (2) below and the peak values shall be measured according to ETSI EN 302 066-1.

Note: GPR/WPRs operate across a wide range of spectrum where established radio services operate. These services have diverse bandwidths, some may be susceptible to peak signal levels and others to average signal levels. There are technical and practical issues, related to bandwidth, the effective loading of the GPR/WPRs radiation by earth materials and the limitations of instrumentation. It is acknowledged that peak signal levels will be measured and average signal levels calculated based upon the duty cycle of the GPR/WPR.

a) The mean power density of any undesired emission emanating from GPR/WPR imaging systems shall be kept to a minimum and shall not exceed the limits in Table 1, below:

Table 1

Frequency range (MHz)	Maximum mean e.i.r.p. density (dBm/MHz)
<230	-65
230-1000	-60
1000-1600	-65*
1600-3400	-51.3
3400-5000	-41.3
5000-6000	-51.3
>6000	-65

* In addition to the maximum mean e.i.r.p. density given in the table above, a maximum mean e.i.r.p. density of -75 dBm/kHz applies to spectral lines emitted by the GPR/WPR equipment in the frequency bands 1164-1215 MHz and 1559-1610 MHz allocated to the Radio Navigation Satellite Service (RNSS).

b) The measured radiated power density of any undesired emission emanating from GPR/WPR imaging systems shall not exceed the limits as given in Table 2 below:

Table 2

Frequency range (MHz)	Maximum peak power
30 to 230	-44,5dBm/120kHz (e.r.p.)
> 230 to 1 000	-37,5dBm/120kHz (e.r.p.)
> 1 000 to 18 000	-30dBm/MHz (e.i.r.p.)

The methods of measurement for peak power values are given by EN 302 066-1 V1.1.1, part 8.2.2.

c) The time domain architecture of GPR/WPRs and patterns of use imply that there is wide variation in the total power emitted in any time period. For pulsed systems this includes the duration of pulses compared to the time between pulses, the time between bursts of pulses when the system is being moved to the next measurement position and other operational factors. This should be taken into account when considering the mean power that may be incident upon a vulnerable radio service. In order to accommodate all of these factors a conversion factor is used to evaluate the mean power that should be compared to the limits in Table 1. This conversion factor has been established as a simple and practical way to assess mean power levels based on the measurement of peak power levels.

When determining mean power values, for pulsed systems, to be compared with the values in Table 1 the following formula shall be used:

$$(1) \quad \text{Power}_{\text{mean}} = \text{Power}_{\text{peak}} + \text{conversion_factor}$$

with: conversion factor = $10\log(\text{PRF} \times \tau)$

where

PRF is the pulse repetition frequency,

and

τ is the pulse width of the GPR transmitter measured at the 50% amplitude points of the envelope at boresight with an UWB probe and a suitable oscilloscope. When performing this measurement, care should be taken that the pulse is properly gated, i.e., no reflectors should be allowed to influence the pulse while travelling from the GPR transmitter to the UWB probe. The UWB probe/antenna should have a bandwidth wide enough to capture the UWB signal from the GPR/WPR properly.

For systems using step-frequency waveforms, the wideband signal is formed by transmitting a sequence of discrete frequencies each having a Dwell Time (DT). The length of the total sequence is referred to as the Scan Time (ST). The Scan Time is identical to the Cycle Time in frequency hopping systems, and it is the interval between each time the transmitter is hopping back to the first frequency in the sequence.

For calculating the mean power value for a step-frequency system, the following formula shall be used:

$$(2) \quad \text{Power}_{\text{mean}} = \text{Power}_{\text{peak}} + \text{conversion_factor}$$

with: conversion_factor = $10\log(\text{DT}/\text{ST})$

where:

DT is measured at the 50% amplitude points of the envelope at boresight with an UWB probe and a spectrum analyser in zero-span mode at a frequency near the maximum of the radiated spectrum using 1MHz resolution bandwidth. ST is measured in the same way using a spectrum analyser in zero-span mode and 1MHz resolution bandwidth.

Annex: 2 A Preliminary List of Sensitive Sites

A 2.1 As GPR/WPR equipment could interfere with the sensitive receiver equipment used at certain Radio Astronomy sites, users of GPR/WPR systems are required to seek special permission from ComReg prior to its use at these sites. ComReg has identified a list of these sensitive sites below. ComReg retains the right to amend this list as and when required.

Site Name	Co-ordinates
Birr, Offaly	E206049 N205269
Elfordstown, Cork	E187913 N077915

A 2.2 Users of GPR/WPR systems must complete the form below (also available on ComReg's website⁹), prior to using radio equipment within a 7 kilometre radius of the radio astronomy sites.

⁹ ComReg's website XYZXYZ

Annex: 3 The Registration form

GPR/WPR imaging systems	Operator registration form
Operator details	
Company Name	
Address:	
Telephone:	
Fax:	
Contact person for GPR/WPR operation activities (if any)	
Last name:	
First name:	
Telephone:	
Fax:	
E-mail:	

A 3.1 The completed Registration and the Notification forms where appropriate should be submitted via E-mail to licensing@comreg.ie or by post to address below:

*The Commission for Communications Regulation, Licensing Operations Division,
Abbey Court, Irish Life Centre, Lower Abbey Street, Dublin 1*

Annex: 4 The Notification form

GPR/WPR imaging systems	Notification form for use in the vicinity of sensitive sites	
Operator details		
Company / Organisation name:		
Address		
Contact person for GPR/WPR survey		
Last name:		
First name:		
Mobile:		
Survey area		
Geographical coordinates:	Eastings:	Northings:
Radius:		
General description & address:		
Time period		
Starting time and Date:		
Ending time and Date:		
Description of GPR/WPR equipment 1		
Brand:		
Model:		
Antenna type:		
Operating frequency range:		
Other:		

Annex: 5 Format of a log file to be maintained by users of GPR/WPR imaging systems

Date and Duration of Usage	Location of use	Frequency (MHz)	Type of Usage	Equipment Model Number

Annex: 6

Technical Parameters for the operation of LPR Devices in Ireland

A 6.1 Emissions of LPR devices shall comply with the mean e.i.r.p. spectral density and peak e.i.r.p. limits, specified in Table 3 (Columns A, B and D);

A 6.2 Strict (stable) downward orientation of LPR antennas under any operating conditions shall be ensured by appropriate installation;

Table 3: Essential technical requirements for LPR devices

Frequency band (GHz)	Maximum mean e.i.r.p. spectral density (dBm/MHz) (Notes 1 and 5)	Maximum peak e.i.r.p. (dBm measured in 50 MHz) (Notes 2 and 5)	Maximum antenna beamwidth (degrees) (Note 3)	Maximum mean e.i.r.p. spectral density on half-sphere (dBm/MHz) (Notes 4 and 5)
	A	B	C	D
6.0-8.5	-33	+7	12	-55
24.05-26.5	-14	+26	12	-41.3
57-64	-2	+35	8	-41.3
75-85	-3	+34	8	-41.3

Notes:

(1) Mean e.i.r.p. spectral density within an LPR antenna main beam is the average power per unit bandwidth radiated in the direction of the maximum level;

(2) Peak e.i.r.p. within the main beam is the power contained within a 50 MHz bandwidth at the frequency at which the highest mean radiated power occurs. If measured in a bandwidth of x MHz, this level is to be scaled down by a factor of $20\log(50/x)$ dB;

(3) Defined by -3 dB level, relative to maximum gain. Note that in EN 302 729 it is expressed as \pm HalfBeamWidth, whereas here it is expressed as the total opening angle. The LPR antenna gain in the elevation angles above 60 degrees from the main beam direction has to fulfil a maximum value of -10 dBi;

(4) The maximum mean e.i.r.p. spectral density limits on a half sphere around a LPR installation accounts for both the LPR antenna side-lobe emissions and any reflections from the measured material/object. Compliance with these limits is assumed in cases where the LPR devices comply with measured maximum mean e.i.r.p. spectral density and the maximum peak e.i.r.p. limits within the main beam (Table 3, Columns A and B) and use the prescribed antenna (see note 3);

(5) The related limits in the unwanted emissions domain radiated by a LPR are those as listed in Table 4 for LPR devices operating in the 6.0-8.5 GHz band. For LPR operating in the other bands, the limits for emissions in the unwanted emissions domain are at least 20 dB less than the in-band limits specified in Table 3. For LPR operating within the 24.05-26.5 GHz band, the unwanted emissions in the 23.6-24.0 GHz “passive band” are at least 30 dB less than the in-band limits specified in Table 3.

Table 4: Limits of unwanted emissions for LPR operated in 6.0-8.5 GHz band

Frequency range (GHz)	Max. mean e.i.r.p. spectral density limit (dBm/MHz) (Note 1)	Max. mean e.i.r.p. spectral density limit on half-sphere (dBm/MHz) (Note 4)
Below 1.73	-63	-85
1.73-2.7	-58	-80
2.7-5	-48	-70
5-6	-43	-65
8.5-10.6	-43	-65
Above 10.6	-63	-85