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Ministry of Economic Development
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Radio Spectrum

RADIO SPECTRUM POLICY

DEFINITION AND MEASUREMENT OF LICENSED POWER UNDER SPECTRUM LICENCES

1. Policy.

The licensed power as stated on the licence is defined as the maximum e.i.r.p. permitted in any direction and on any polarisation.

2. Specific Criteria.

To be compliant with the licence, the following conditions must be met.

(a) The maximum e.i.r.p. must not be exceeded.
(b) The plane of maximum radiation must align with the licensed polarisation.
(c) The horizontal radiation pattern defined by the licence must be complied with, in that the e.i.r.p. on any bearing must not exceed that specified.

Measurement of e.i.r.p. should be made with an antenna of matching polarisation. Alternatively, for other than linear polarisation, it can be done by summing the powers in the orthogonal planes, ensuring that one of the planes is the plane of maximum radiation.

3. General Technical Considerations.

E.i.r.p. is defined by the Radiocommunications Act 1989 as follows:

"E.i.r.p. means the equivalent isotropically radiated power, being the power supplied to the antenna, multiplied by the antenna gain in a given direction relative to an isotropic antenna."

This definition is consistent with that in the International Radio Regulations, which is as follows:

S1.161 *equivalent isotropically radiated power (e.i.r.p.):* The product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna *(absolute or isotropic gain)*.

Gain of an antenna is defined by the International Radio Regulations as follows:

S1.160 *gain of an antenna:* The ratio, usually expressed in decibels, of the power required at the input of a loss-free reference antenna to the power supplied to the input of the given antenna to produce, in a given direction, the same field strength or the same power flux-density at the same distance. When not specified otherwise, the gain refers to the direction of maximum *radiation*. The gain may be considered for a specified polarization.

Depending on the choice of the reference antenna a distinction is made between:

a) absolute or isotropic gain (*Gi*), when the reference antenna is an isotropic antenna isolated in space;

b) gain relative to a half-wave dipole (*Gd*), when the reference antenna is a half-wave dipole isolated in space whose equatorial plane contains the given direction;
c) gain relative to a short vertical antenna (*Gv*), when the reference antenna is a linear conductor, much shorter than one quarter of the wavelength, normal to the surface of a perfectly conducting plane which contains the given direction.

S1.137 *radiation:* The outward flow of energy from any source in the form of *radio waves*.

4. Background.

The need to define the terms and measurement methods relating to licensed power for services licensed under Management Rights has arisen because of differing interpretations by licensees. A reiteration of the definitions as contained in the national legislation and the international regulations is desirable to establish a common starting point for all concerned.

5. Explanatory notes

An isotropic radiator is a hypothetical point in space radiating equally in all directions. It has no polarisation itself and is concerned with the radiation of energy in all directions, rather than the position of the electric vector. All antennas can be referenced to e.i.r.p. which is why it was used in the Radiocommunications Act.

The radiated power in e.i.r.p. is the ratio of the sum of the powers radiated regardless of their polarisation to a point source. In the case of crossed dipoles, the power is the sum of the power radiated in each plane expressed relative to an isotropic radiator.

When a circularly polarised wave is received by a plane polarised antenna like a dipole, there is a loss as the antenna will not receive signals where the electric vector is in the orthogonal plane. This is a factor of the receiving antenna used rather than the power transmitted. If an antenna that was circular polarised and in the same direction of rotation as the incoming wave was used, the loss would not occur.

The loss therefore is a reception phenomenon and not a transmission effect. The maximum output power is set by the value on the licence, not by the receivers, and should be the transmitter power multiplied by the total antenna gain as expressed in e.i.r.p. less any feeder and coupling losses.

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