

Wireless Power Transmission for Electric Vehicles – WPT(EV)

A brief overview

Topics

- **What is the amateur service?**
- **What is WPT(EV)?**
- **What plans are there for WPT(EV)?**
- **What are the technical characteristics of WPT(EV)**
- **What problems could this create?**
- **What action is needed?**

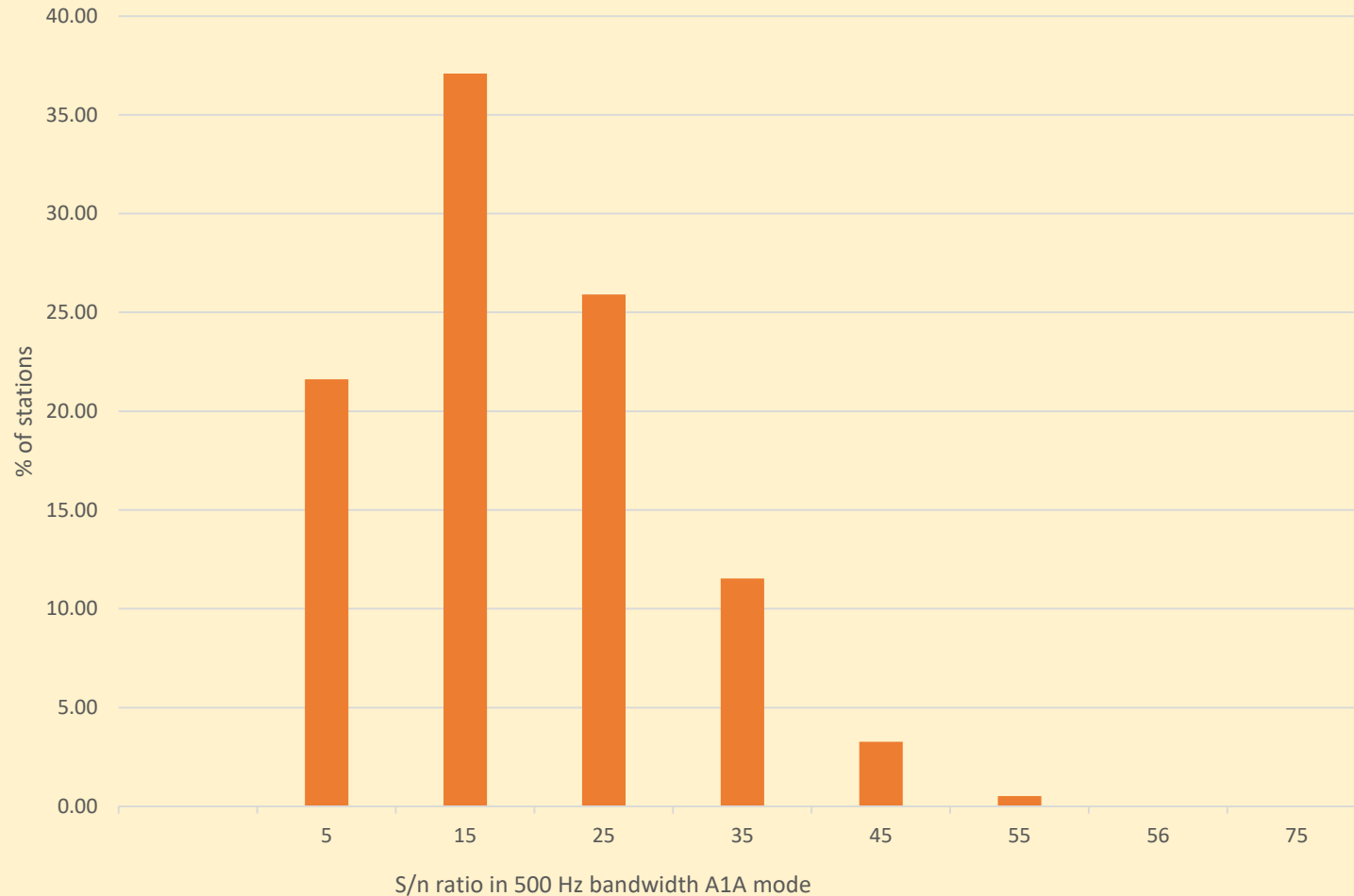
The Amateur Service

- **Defined in Radio Regulations:**
 - *A radiocommunication service for the purpose of self-training, intercommunication and technical investigations carried out by amateurs, that is, by duly authorized persons interested in radio technique solely with a personal aim and without pecuniary interest.*
- **Up to 3 million licensed radio amateurs world-wide**
- **Most operate with antennas in their gardens**
- **Relatively low power service – low signal to noise ratio communications – operating close to the background noise levels**
- **Licensed to use a range of frequency bands**

Amateur LF/HF Frequency bands

Frequency range	Allocation status
135.7 - 137.8 kHz	Secondary allocation
472.0 - 479.0 kHz	Secondary allocation
1.8-2.0 MHz	Part primary, part secondary
3.5-4.0 MHz	Primary allocation
5,351.5-5,366.5 kHz	Secondary allocation
7.0-7.3 MHz	Primary allocation
10.1 - 10.15 MHz	Secondary allocation
14.0-14.35 MHz	Primary allocation
18.068-18.168 MHz	Primary allocation
21.0 - 21.45 MHz	Primary allocation
24.890 - 24.990 MHz	Primary allocation
28.0 - 29.7 MHz	Primary allocation

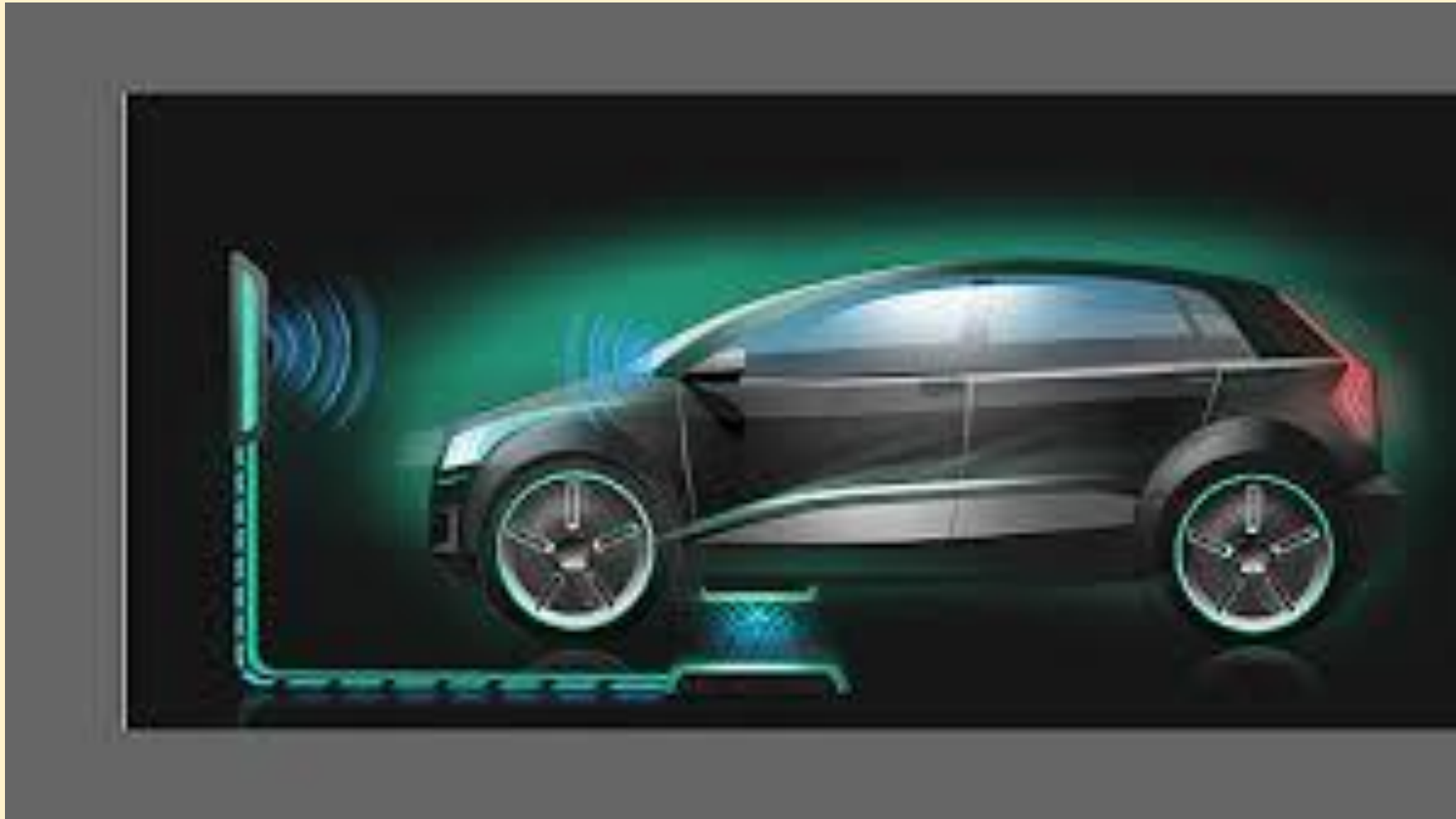
Signal-to-noise ratios in the amateur service



Based on 528,000 data points over a 2 x 24 hour period between 1.8-30 MHz

The amateur service is therefore highly susceptible to any increase in the background noise level.

What is WPT(EV)?



WPT(EV) in the home environment

- Charges the car through induction via a pad under the vehicle, rather than “plug-in”
- Power levels from 3.3 to 22 kW
- Likely to operate around 85 kHz. The harmonics could cause severe interference to local radio reception – both amateur and broadcast.
- Charge times of 3-12 hours
- 5 installations per hectare (=never more than 20m from one)
- Frequency stability and phase noise uncertain
- CEPT intends to classify as a “Short Range Device” (SRD)
- SRDs are not permitted to cause interference to radio services

A comparison of WPT and “Plug-in”

Dimension	Plug-in technology	WPT technology
Power Transfer Efficiency	100%	c 87.5% (note 1)
Power cost penalty	0	14%
Parking alignment requirement	To access the plug-in cable	+/- [xx cm] laterally and longitudinally (To be advised, but close alignment is necessary)
Installation cost premium (est) vs plug-in		Euro 1,000 (note 2)
Radio interference	Governed by EMC standards	Governed by radio standards
Human exposure issues	None	Care needed (note 3)
Suitability for on-street installation	OK	Unclear

Notes:

1 Based on draft CEPT report.

2 Estimate only

3 Projection of emission levels at 1m distance suggest that the ICNIRP Reference Levels will be reached or exceeded

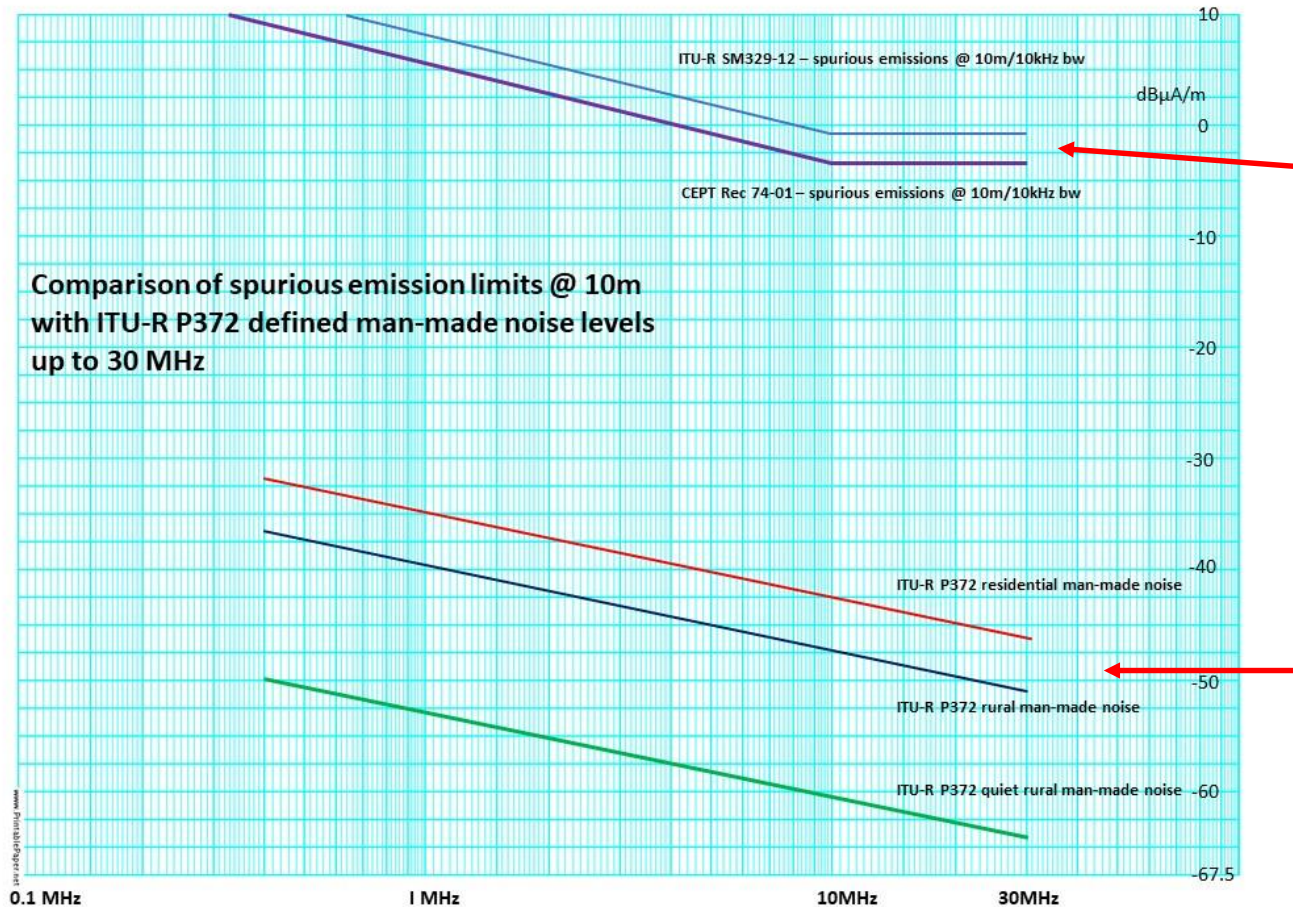
From this it will be seen that the “convenience” of WPT is potentially offset by issues of installation cost, the ongoing power cost premium and parking alignment

This information is drawn from reports in current circulation and is believed to be accurate

SRD

- **In the past, Short Range Devices in the home environment have been:**
 - Low power, and/or
 - Short duration transmission
- **WPT is neither**
- **Some discussions in CEPT suggest that the existing spurious emission limits for inductive SRDs are appropriate**
- **These were developed on a wholly different set of assumptions about duty cycle, location and whether victim and emitter share the same frequency, and are not appropriate for WPT(EV)**
- **WPT(EV) is high duty cycle, located in residential areas and its harmonics are likely to be spread across a band of frequencies**

The CEPT / ITU limits and the noise level



Note limits are some 40-60dB above noise level at 10m distance

Recent measurements in UK on noise levels and other reports submitted to ITU suggest that, with the exception of a few “hot spots”, the ITU-R P372 levels are still a reasonable assessment of the real world

WPT at these limits will severely impact radio reception

- EC Decision 2006/771/EC states: *Member States shall designate and make available, on a non-exclusive, non-interference and non-protected basis, the frequency bands for the categories of short-range devices. 'Non-interference and non-protected basis' means that **no harmful interference may be caused to any radio communications service***
- ITU RR 15.13 states *Administrations shall take all practicable and necessary steps to ensure that radiation from equipment used for industrial, scientific and medical applications is minimal and that, outside the bands designated for use by this equipment, radiation from such equipment is at a level that **does not cause harmful interference to a radiocommunication service** and, in particular, to a radionavigation or any other safety service operating in accordance with the provisions of these Regulations*
- **A very significant improvement is needed in emission limits to prevent extensive harmful interference to radio services**

Mitigation

- **The impact of WPT harmonics can be reduced if:**
 - **All WPT installations adopt a single highly accurate fundamental frequency – meaning all harmonics are on “spot frequencies” rather than spread across the spectrum**
 - **All WPT systems have a very good phase and sideband noise performance**
- **These need to be properly specified**

What radio users require

- **A similar situation existed with power line telecommunications and that this was resolved by a 40 dB improvement in the emission mask for all amateur bands and similar provisions for the SW broadcast bands**
- **We now seek appropriate limits to the levels of WPT(EV) spurious emissions to ensure that radio communications services – in particular amateur and broadcast – can operate as intended.**
- **We ask administrations to make their views known to CEPT and to become active in CEPT SE24 and the discussions there on appropriate limits**