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Low-power FM modulators in Europe

The need for efficient enforcement of the European Standard and Recommendation

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The EBU, considering that:

1. Low-power FM modulators are Short Range Devices (SRD) typically used for the purpose of listening to MP3/CD players on a home or car Band II (FM) radio receiver. As these devices transmit signals within a frequency band used for FM broadcasting (Band II, from 87.5 MHz to 108 MHz), they may cause interference to the reception of the FM broadcast signals. Further explanation on the risk of such interference is given in the **Annex** on the basis of studies and trials made in Europe and in the USA.
2. The work carried out on this subject by CEPT[1] has resulted in the specification of limits for the RF parameters of these devices. Consequently, an ERP[2] limit of 50 nW for such devices is now part of the ETSI[3] harmonised standard EN 301357, published in July 2006. The deadline for its transposition into National Standards has been set for April 2007. In the meanwhile, European National Regulatory Bodies should be examining the authorisation of the use of these devices in their countries.
3. A major concern is that such devices often do not comply with their corresponding product standard (see **Annex**). This is already the case in the USA and it could occur in Europe when the use of these devices becomes authorized in some European countries.

Recommends that **guidelines** should be produced for Regulatory and Trading Standards Bodies and for Market Surveillance Authorities in countries intending to allow the use of low-power FM modulators.

Suggested Guidelines

1. The radiated emission levels of the low-power FM modulators should be limited to the minimum necessary for the normal use of these devices (transmission to close proximity receivers) and in no case should they exceed the limit set by EN 301357 (50 nW ERP).
2. The enforcement of the emission limit should be strict enough to avoid the arrival on the market of devices exceeding the limit set by EN 301357.

[1] European Conference of Postal and Telecommunications Administrations

[2] Effective Radiated Power

[3] European Telecommunication Standards Institute

3. The frequency modulation of the transmitter output of these devices should be limited to a deviation of ±75 kHz, as applied to regular FM broadcast signals. Thus the devices must be equipped with an appropriate limiter.
4. Low-power FM modulators should have a full band tuning range (87.5 – 108 MHz) in order to prevent a concentration of the interference in some frequencies[1].
5. The direct connection of low-power FM modulators to external antennas, other than the antenna provided with the device, in a home or a car environment, should not be possible.
6. Low-power FM modulators without a CE Mark should be removed from the market immediately; in this case, no testing is required[2].

Annex: Risk of interference to broadcasting from low-power FM modulators

[1] One model of such a modulator has been found to use a unique carrier fixed at 107.7 MHz; this is particularly unfortunate in France as this is the frequency used across the country for a synchronous FM network covering highways for the purposes of providing traffic information.

[2] Many devices are designed for use in other markets that have different frequency bands allocated to broadcasting than those in Europe. These devices should not be allowed within the European Union.

Annex: Risk of interference to broadcasting from low-power FM modulators

Two cases of interference to the FM Broadcasting service by low-power FM modulators may be identified. The first corresponds to "normal use" of these low-power FM modulators. The second corresponds to "misuse" or faulty application of the devices when they are linked directly by cable to the radio's antenna input.

The interference caused by "normal" use of low-power FM modulators

Several tests and simulations have been carried out on the subject of interference from low-power FM modulators to regular FM reception. The details and the results are given in ECC[1] report 73 by a CEPT working group when the subject of the power limits of these devices was considered.

During discussions in the CEPT group, broadcasters pushed hard to set the power limit of these devices to 15 nW ERP. This is close to the limit set by the FCC[2] in the USA (the FCC limit is expressed as a field-strength of 250 uV/m at 3 m, which corresponds to an ERP of about 11 nW). Manufacturers argued that such a level was insufficient for normal operation of the devices. The final decision of the ECC was to set the maximum ERP level to 50 nW (effectively 5 dB higher than that requested by broadcasters). A compromise proposal of a 30 nW ERP limit was rejected.

According to trials led by a broadcasting operator:

- For in-car use of low-power FM modulators, co-channel interference may occur to FM broadcast reception in other vehicles located within a 10 m radius of the modulator. The interference was observed with ERPs as low as 15 nW. More interference cases were observed with higher ERPs such as 50 nW. The worst case scenarios correspond to interference between stationary cars (e.g. traffic jam, traffic lights);
- At least 200 kHz frequency separation of the low-power FM modulator from the wanted FM broadcast signal is required to prevent co-channel interference;
- With a 50 nW ERP, the FM modulator is usually correctly received inside a moving vehicle, even in the presence of a co-channel FM broadcast signal in the area. The reception of the FM modulator would be disturbed only in the presence of a high-level co-channel FM broadcast signal, thus prompting the user retune the modulator to a different channel. FM broadcast signals at low levels will not prompt the user to retune the modulator to a different channel but interference to the reception of the broadcast signal by nearby vehicles is more likely.

The 50 nW ERP limit is now part of **ERC[3] Recommendation 70-03** and of the harmonised ETSI standard **EN 301357**, published in July 2006, with a deadline for its transposition into national standards set for April 2007. Some European countries, including Switzerland and Germany, have already implemented the ERC Recommendation. The European national regulatory bodies should now be considering this subject. They have several options:

[1] Electronic Communications Committee

[2] Federal Communications Commission

[3] European Radiocommunications Committee

- Prohibiting the use of the devices in their countries.
- Authorizing the devices with the ERP limit proposed in the ETSI standard.
- Authorizing the devices with a lower ERP limit.

In the USA, where low-power FM modulators are authorized and regulated, it appears that the majority of commercially available devices are not compliant with the applicable FCC ERP limit.

A study ordered by the NAB[1] showed that 13 out of 17 devices tested (76%) were not compliant and that on average the limit was exceeded by 14 dB. One device exceeded the limit by 40 dB (10 000 times higher).

Another study made by NPR[2] labs showed that the proportion of non-compliant FM modulators actually used (by direct measurement of field strengths along roadways in Washington, DC) was around 40%. The excess in the signal level with regard to the FCC limit reached 20 dB (100 times higher) in some cases, despite the attenuation due to the car shielding estimated at 11 dB (the difference between the signal level generated inside the car and its level measured outside).

Such excessive ERPs are also very likely to be encountered in Europe. The tests carried out in the beginning of 2005 and reported in ECC report 73 showed that some devices were already in use throughout Europe (despite there being no national regulation at the time in many countries) and that they had ERP levels greater than the 50 nW limit. Out of 8 devices tested, 3 had an ERP lower than 50 nW and 5 had a higher ERP, some of these exceeding the 50 nW limit by 27 dB (500 times higher).

Whilst the regulatory ERP limit of 50 nW is itself of concern, the poor compliance with this limit by manufacturers and the inadequate checking of this compliance by regulators must be a major concern.

Another type of interference can occur with low-power FM modulators as a result of excessive deviation of the frequency modulation in these devices. Deviations up to 243 kHz (instead of the 75 kHz maximum deviation normally used in broadcast transmissions) were measured in some devices. Spectrum occupation of up to 800 kHz was also measured, which is four times the channel bandwidth for a broadcast FM signal. This would cause simultaneous co-channel interference to numerous adjacent broadcast channels.

Some low-power FM modulators have a single or a small number of pre-selected frequencies whereas others offer a tuning range throughout the FM Band II. Limiting the number of tuning frequencies may create a situation where interference is concentrated over a portion of the broadcast band and may therefore affect specific programmes, as is the case in the USA. There, the most commonly used frequencies for low-power FM modulators are in the lower part of the FM Band, which is used mainly by the Public Service Radio stations. A wide tuning range for these devices may be preferable in order to prevent a concentration of the interference.

[1] National Association of Broadcasters: (*http://www.nab.org/xert/corpcomm/NAB_Part15_Study.pdf*)

[2] National Public Radio: (*http://www.nprlabs.org/reports/FMModulatorUsage.pdf*)

The interference caused by a possible "misuse" of low-power FM modulators

A specific type of "wired" low-power FM modulator is also available. These devices are inserted between the car antenna and the antenna input of the car radio. In some cases, these devices are badly installed, resulting in the locally modulated FM signal being fed directly to the car antenna, which makes the car a mobile FM transmitter. This is explained in the following text adapted from an article published in the 'Radio World' journal[1]:

> *"In mobile settings, switching devices are commonly provided to disconnect the external FM receiving aerial when the short-range FM modulator is in use. Improper connection or omission of these switches can result in direct radiation of the short-range FM modulator emission through the vehicle's antenna system. This can result in audible detection or interference effects of the short-range modulator on nearby receivers for up to 100 meters or more."*
>
> *"The switch box, said Dave Wilson, director of technology and standards for the Consumer Electronics Association, is usually installed behind the car radio and has one output and two inputs: the car antenna and the audio output from an XM satellite tuner. If XM is turned on, for example, it will take the signal and modulate it onto a FM frequency; that signal is fed into the radio's FM antenna input. When the XM receiver is turned off, a switch in the box disconnects the FM circuit and reconnects the car antenna.*
>
> *NPR Vice President and Chief Technology Officer Mike Starling believes some consumers are installing the devices improperly and taking the output of the satellite receiver directly to the antenna input of the car. The problem with that, said Wilson, is when you turn on the FM radio, the satellite signal is fed into the car, but it's also sent back up the antenna and radiated out of the car antenna so the car is acting like a station. This situation doesn't mean the products themselves are not compliant with FCC's Part 15 rules specifying a power limit of 250 microvolts per meter."*

The number of interference cases caused by this misuse of low-power FM modulators in the USA is not known.

At the ITU-R[2], a Recommendation was recently issued on this subject under the reference **6/316(Rev.1)-E** dated 10 October 2006 (*http://www.itu.int/md/R03-SG06-C-0316/en*).

[1] The original text may be found at:
http://www.rwonline.com/reference-room/special-report/2006.07.19-04_rw_RF_mods_2.shtml

[2] International Telecommunications Union – Radiocommunications Sector