



International Amateur Radio Union Region 1

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Subject	HID street lighting poses a severe EMI threat to Amateur Radio		
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1. Introduction

Utility companies are replacing at a fast pace traditional orange sodium-vapour lamps with more efficient, white light, metal-halide high intensity discharge (HID) street lighting fixtures. Unlike sodium-vapour lamps, HID lamps require a high voltage power supply —called electrical ballast— that is switched at 100–400 Hz with a square wave pattern.

2. Background

In many European countries, utility companies are replacing at a fast pace traditional orange sodium-vapour lamps with more efficient, white light, metal-halide high intensity discharge (HID) street lighting fixtures.

Unlike sodium-vapour lamps, metal-halide HID gas discharge lamps require a high voltage power supply¹ —called electronic ballast— that is typically a couple of kilovolt switched at 100–400 Hz with a square wave pattern.² Unlike fluorescent lamps, high-frequency operation does not increase metal-halide HID lamp efficiency.¹ Metal-halide HID lamps could operate equally well from a 50 Hz inductive ballast. However, because of higher resistive losses, an inductive ballast is most often discarded in favour of an electronic ballast.¹



Metal-halide HID street lights can take on many appearances. Sources: Philips Indal & Wikipedia

HID street lighting may produce electromagnetic interference (EMI) in several ways. In most HID EMI cases, the electrical ballast is mounted next to the lamp, but suffers poor input filtering/line conditioning. This allows for harmonics of the switched square wave to propagate as a common mode signal along the mains power line. The mains network will radiate this RF energy wherever the mains power cable is not deeply buried into the ground or not shielded by a conductive lighting post. By consequence, direction finding techniques may often fail at pointing out the HID electrical ballast as the interference source. However, when the noise coincides with the period when the street lights are on, little doubt will remain about the true origin of the QRM.

Street lights may also be retrofitted with an electrical ballast mounted at the foot of the lighting post, several meters below the actual HID lamp.³ If this is the case, the load lines towards the HID lamp will couple common mode harmonic RF energy onto the conductive lighting post. The conductive lighting post will radiate this RF energy by acting as a vertical antenna of almost ideal length for HF.

At least one electrical ballast manufacturer prides itself for making grounding of its electrical ballasts optional.³ This of course, renders any attempt at common mode input filtering futile.

Whereas LED light bulbs with noisy switched power supplies involve at most a couple of watts of switched power, the switched power levels of HID street lights are typically several hundred watts up to a few kilowatts. If EMI problems occur with HID electrical ballasts, these tend to be far more serious than the typical switched LED bulb interference.

Several European radio amateur operators —including the author of this proposal— have experienced severe cases of EMI over the entirety of the LF, MF and HF bands caused by metal-halide HID street light electrical ballasts.

A particularly well documented case⁴ that includes video and audio material⁵ is that of David Gregory, G0SLV, from Blackpool; first reported in May 2016. David's HID EMI issue has not been resolved, mainly because the UK's regulatory telecommunications authority *Ofcom* does not have any adequate enforcement strategy in place.⁶

Such is the December 2016 case of the author of this proposal, which involves occasional tapping during festivities of the mains, from wall outlets mounted on top of the lighting posts. This resulted in a continuous 59+15 dB burst noise on 80 and 40 m.

Strikingly ironic is the case of Dutch utility provider *Liander* that failed in using power line signalling to switch its new HID street lights. According to the news report, hundreds of power line signalling boards had to be replaced with real time clocks. Even worse, the utility provider never happened to understand that the electrical ballasts of its new HID lamps were interfering with the power line signalling circuitry.⁷ In such, utility provider *Liander* is not an isolated case. The author's utility provider *Infrax* is also hard-pressed to understand that HID electrical ballasts may cause radio interference when installed improperly.

The fast-paced adoption of HID street light technology by utility providers all over Europe, may well be the number one contributing factor to raising background noise levels on the HF band; even more so than switched power supply consumer electronics.

3. Key points and proposal

A number of factors contribute to the potential for EMI issues with metal-halide HID street lights:

1. Metal-halide HID lighting was first applied in industrial settings. HID electrical ballasts appear to be designed mainly according to American National Standards Institute (ANSI) standards.¹ These standards may be insufficient to warrant interference free operation in residential street lighting scenarios.
2. HID electrical ballast typically switch a couple of kilovolt at 100–400 Hz with a square wave pattern.
3. HID electrical ballast input filtering/line conditioning may be poor, allowing for harmonics of the switched square wave to propagate as a common mode signal along the mains power line. The mains power line will radiate this RF energy as an antenna wherever possible.
4. Consequently, EMI direction finding techniques may often fail at pointing out the HID electrical ballast as the interference source.
5. CE marking is by large a self-certification scheme and manufacturers or importers are responsible for identify the applicable Directive(s) and assessing the product's conformity.⁸
6. This may result in cases of unlawful CE marking misuse whereby only a selected set of CE EMC norms (e.g. EN 61000-3-2:2006⁹) are tested for, whereas other pertinent EMC norms (e.g. EN 55015:2013¹⁰) are completely neglected.³
7. Performing EMC conformance tests in unrealistic product settings (e.g. with unusual short mains power lines) equally results in unlawful CE marking misuse.
8. Utility companies are completely oblivious to HID electrical ballasts potentially causing EMI.
9. National regulatory telecommunications authorities are lacking the means for adequate EMC product inspection and law enforcement.
10. HID street lighting involves switched power levels of several hundred watts up to a few kilowatts. Consequently, when EMI issues occur, these will be far more serious compared to the issues with switched LED lightning.
11. The fast-paced adoption of HID street light technology by utility providers all over Europe, may well be the number one contributing factor to the raising background noise levels on the HF band.

4. Recommendations

The following recommendations are proposed:

1. IARU Region 1 formally recognises high intensity discharge (HID) electrical ballasts as a substantial EMI threat to amateur radio.
2. IARU Region 1, through its member societies' publications, will inform amateur radio operators about the potential EMI issues involved with HID street lighting.

3. IARU Region 1, through its member societies, will organise a survey among amateur radio operators, in an attempt to measure the prevalence of this EMI issue. (See also the UBA open access EMI database proposal.)
4. IARU Region 1, through its member societies, will organise a measuring campaign both in the field and in the lab to professionally document a number of these HID EMI cases.
5. IARU Region 1, will produce a professional technical report for the attention of utility companies and HID ballast manufacturers alike, detailing above measurements.
6. IARU Region 1, either directly or through the national regulatory telecommunications authorities, will request compliance test reports from HID ballast manufacturers.
7. IARU Region 1 will press national regulatory telecommunications authorities to step up EMC inspection and law enforcement concerning HID electrical ballasts used in residential street lighting.
8. IARU Region 1 will coerce European Economic Area member states into recalling, repairing or replacing noncompliant HID electrical ballasts and banning the import of these.
9. IARU Region 1 will set up and document a court litigation strategy should amicable EMI resolution strategies fail.

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