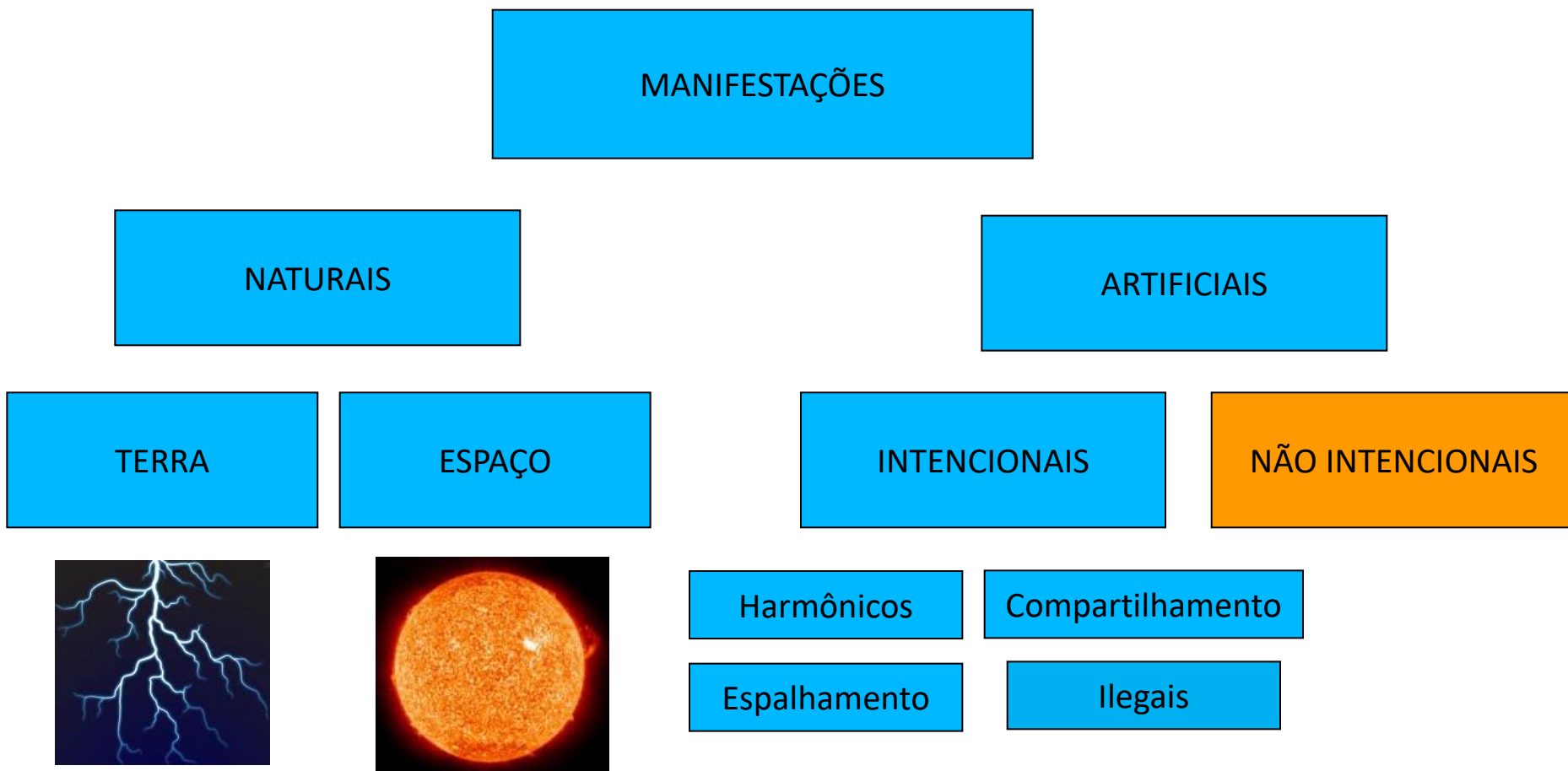


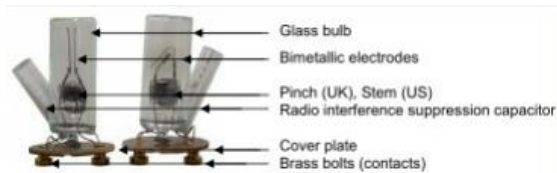
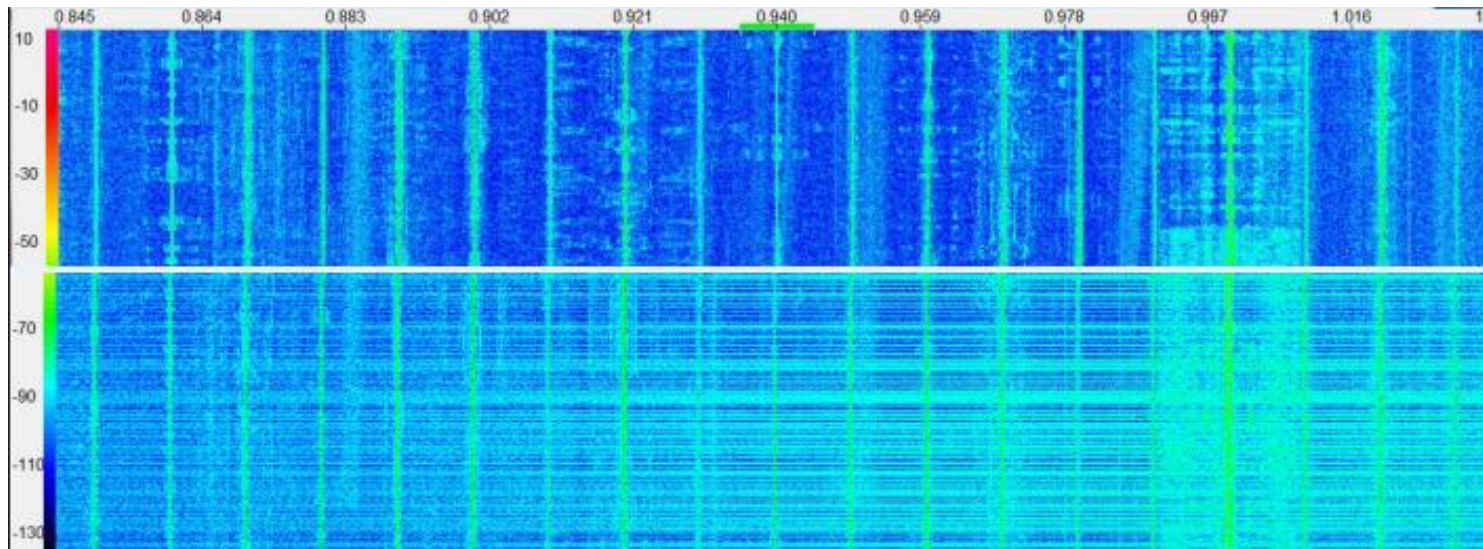
# Interferências de fontes não intencionais

Flávio A. B. Archangelo

# Tipos de Interferências

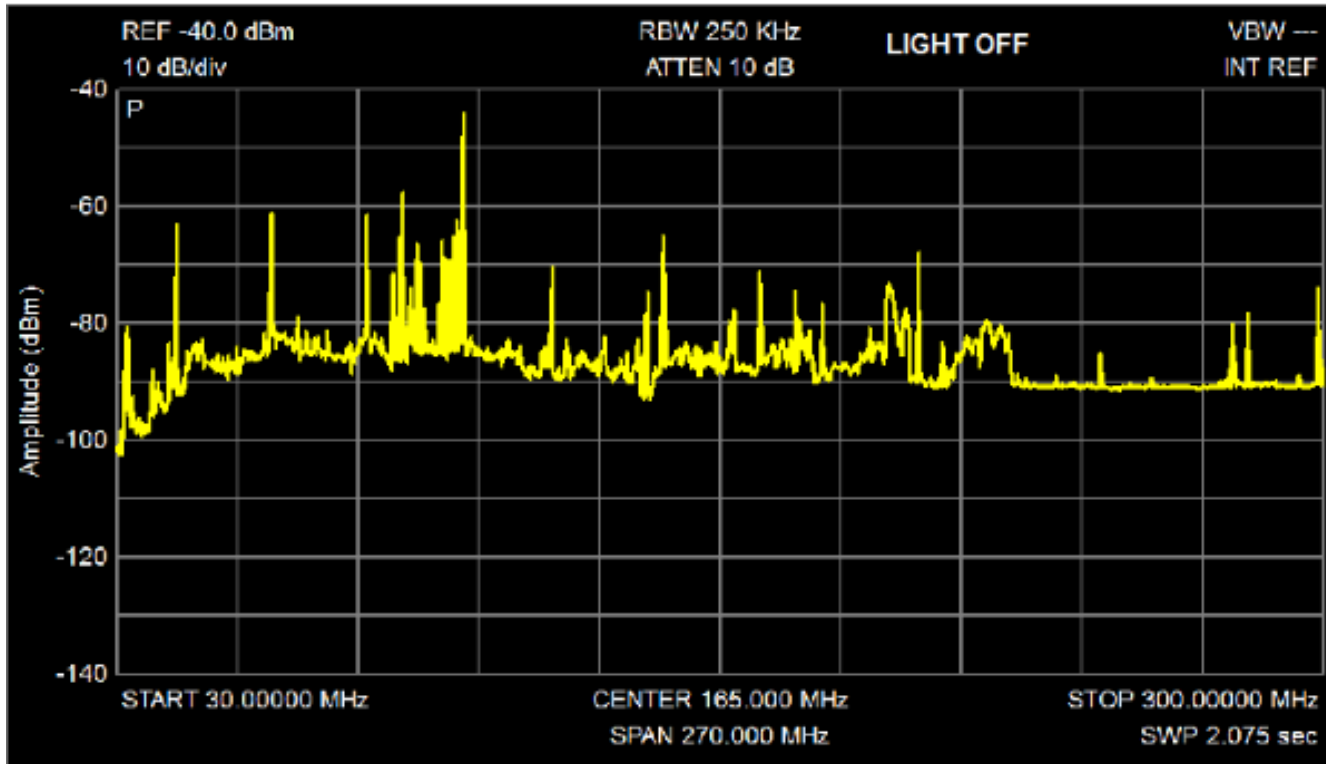


# Iluminação: Fluorescentes



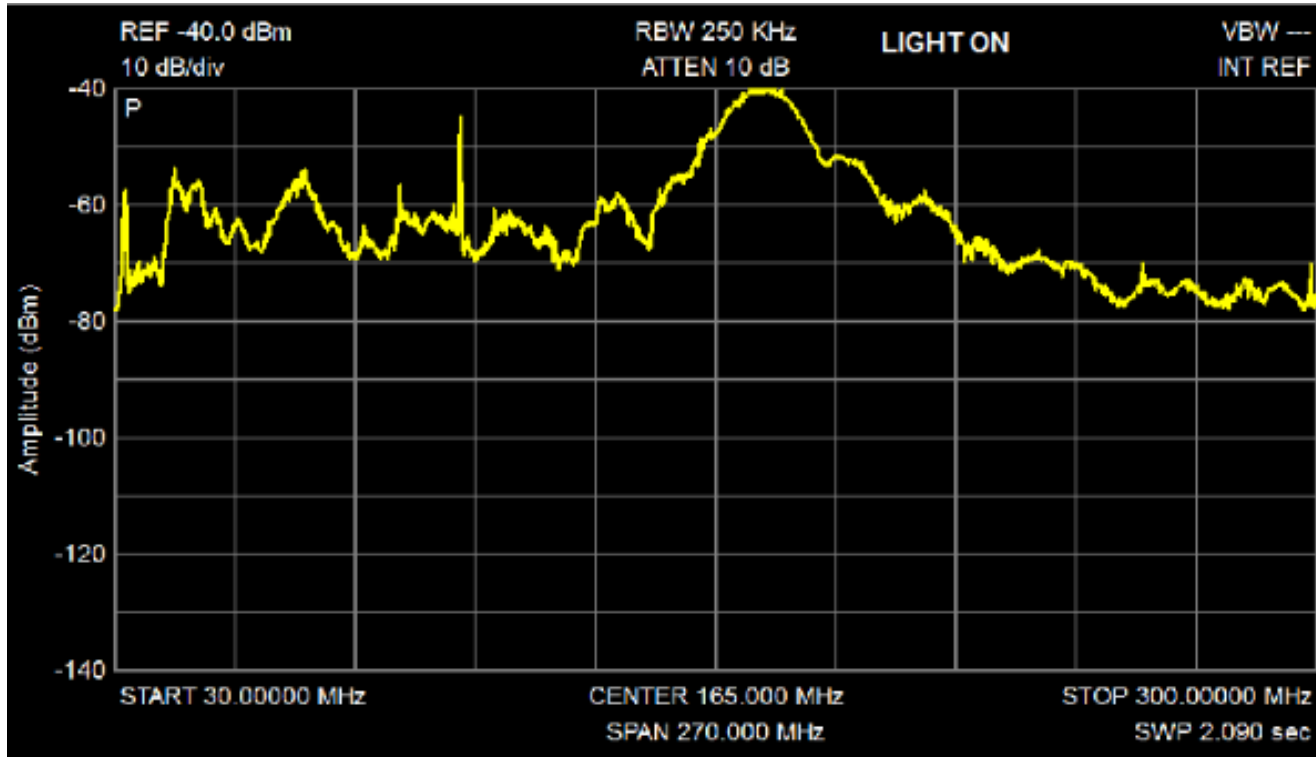
Reatores eletrônicos e starters

# Iluminação LED em VHF



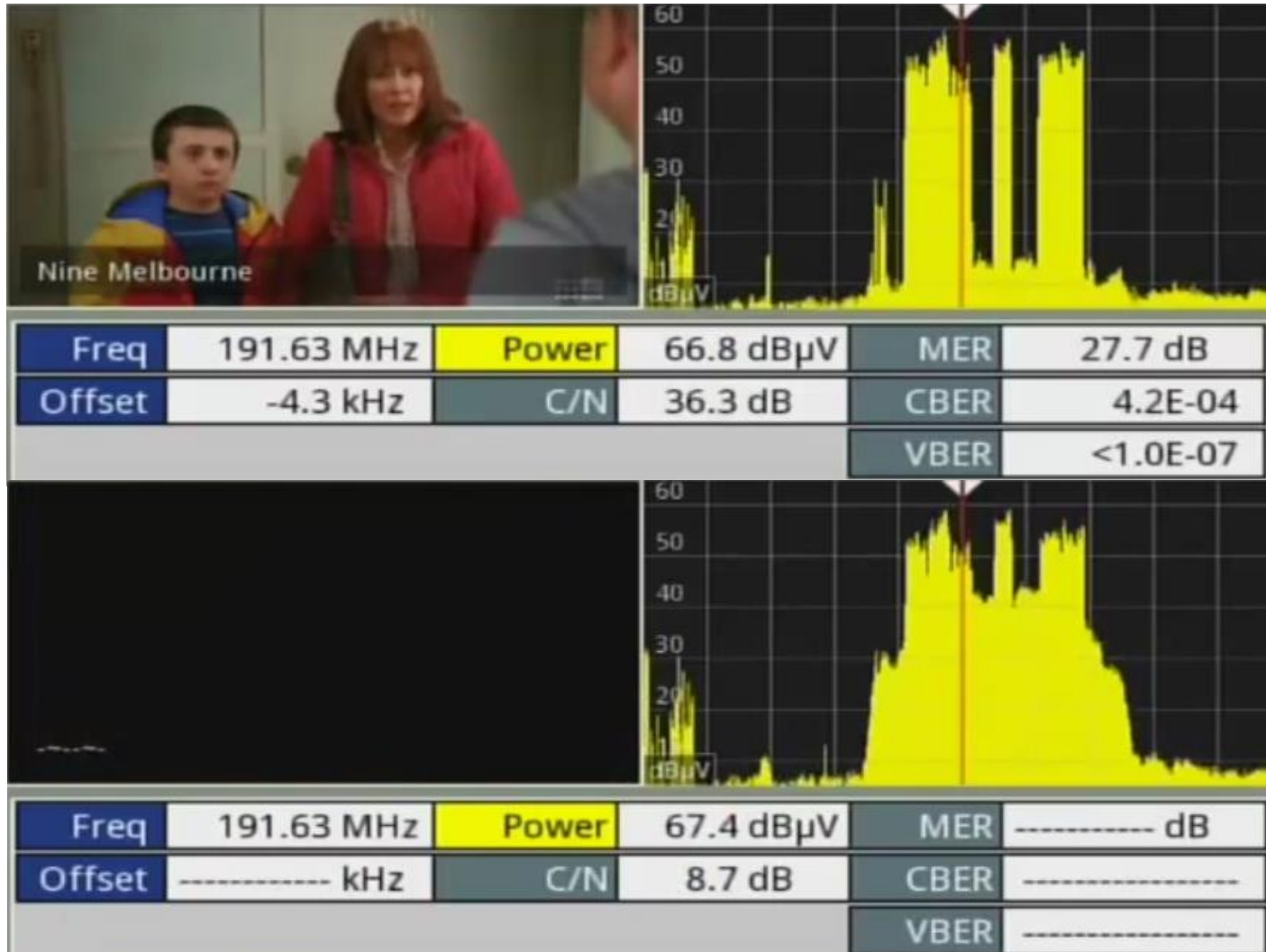
LEDBenchmark

# Iluminação LED em VHF

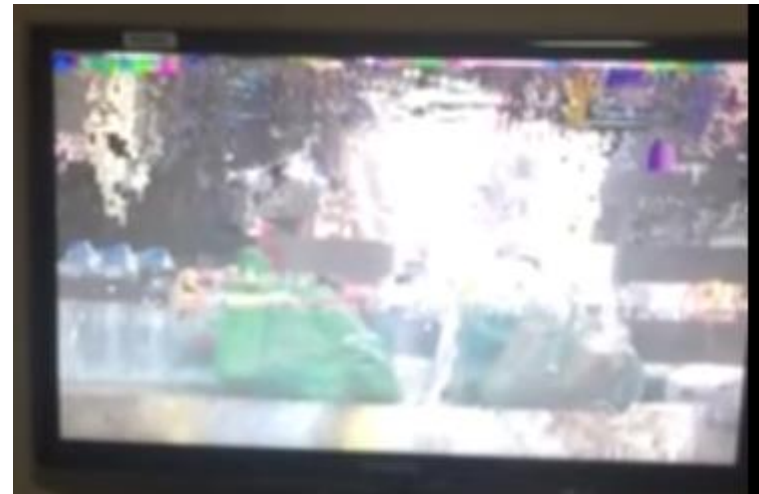


“Severe case of digital TV/DAB signal disruption...The product has been reported by users to completely cut out digital TV and radio reception even affecting neighbor houses”

# LED em VHF




# LED x TVD (UHF)



# “Impact of unwanted RF energy generated by non-radiocommunication equipment to radiocommunication services”

**Radiocommunication Study Groups**  
**WP 1A Rapporteur Group on Co-existence issues (Period: November 2016 to June 2017)**



Received: 24 May 2017

**Document**  
**JA-RG-CO-EX(16-17)/13**  
**Document 1A/171-E**  
**24 May 2017**  
**English only**

**International Civil Aviation Organization**


**RESPONSE TO LIAISON STATEMENT FROM WORKING PARTY 1A, TITLED:**

**ASSESSMENT OF THE IMPACT OF UNWANTED RADIO FREQUENCY ENERGY GENERATED BY NON RADIOCOMMUNICATION EQUIPMENT TO RADIOCOMMUNICATION SERVICES (QUESTIONS ITU-R 221-2/1 & ITU-R 236/1)**

ICAO thanks Working Party 1A (WP 1A) for its Liaison Statement titled: Assessment of the impact of Unwanted Radio Frequency energy generated by non-radiocommunication equipment to radiocommunication services. In that document, WP 1A requested information from ICAO on (a) details of instances of disturbances and degradation within their experience caused by electrical/electronic equipment and telecommunication distribution systems operating over metallic conductors, and (b) the noise floor they anticipate in order to satisfy their planned operational requirements, especially where there are precise expectations on the noise floor.

The Frequency Spectrum Management Panel (FSMP) of the ICAO Air Navigation Commission is responsible for managing aeronautical frequency spectrum on a global basis, in order to ensure sufficient access to the resource for the provision of aeronautical communication, navigation and surveillance services (CNS) in an efficient and safe manner. FSMP held its 4th working group meeting from the 29th March to the 7th April 2017. During this meeting, the Panel reviewed the Liaison from WP 1A and assigned a correspondence action to the meeting to provide the FSMP Rapporteur with the requested information. Information as received is detailed below.

- ICAO provided input to the WP 5B reply liaison to WP 1A (1A/187) (10 November, 2014) from last study cycle, and that material is still valid. In addition, the following websites could provide useful information:
  - <https://www.fcc.gov/general/cable-signal-leakage-enforcement>
  - [https://eurocontrol.int/sites/default/files/Field\\_tabs/content/documents/communication/15032001-briefing-cats8.pdf](https://eurocontrol.int/sites/default/files/Field_tabs/content/documents/communication/15032001-briefing-cats8.pdf)
  - [https://www.ntia.doc.gov/files/ntia/publications/ntia\\_bpl\\_report\\_04\\_413\\_volume\\_ii.pdf](https://www.ntia.doc.gov/files/ntia/publications/ntia_bpl_report_04_413_volume_ii.pdf)
- ICAO has also been receiving information regarding interference to aeronautical frequencies from the operation of light emitting diode (LED) lighting systems. One example can be found at:



International Civil Aviation Organization  
WORKING PAPER

FSMP-WG4-WP22  
2017-05-23

**FREQUENCY SPECTRUM MANAGEMENT PANEL (FSMP)**  
**FOURTH MEETING OF THE WORKING GROUP**  
**ICAO Regional Office, Bangkok, Thailand, 27 March – 7 April 2017**

**Agenda Item 9: Interference from non-aeronautical sources**

**Case Study: LED lighting interference to aviation VHF communication**

Presented by Mike Biggs (USA)

**SUMMARY**

This paper provides information on a recent case of interference to aviation VHF communications in the United States. After considerable investigation, the source was determined to be LED-based lights that were used to replace fluorescent tube lighting in a maintenance shelter.

**1. INTRODUCTION**

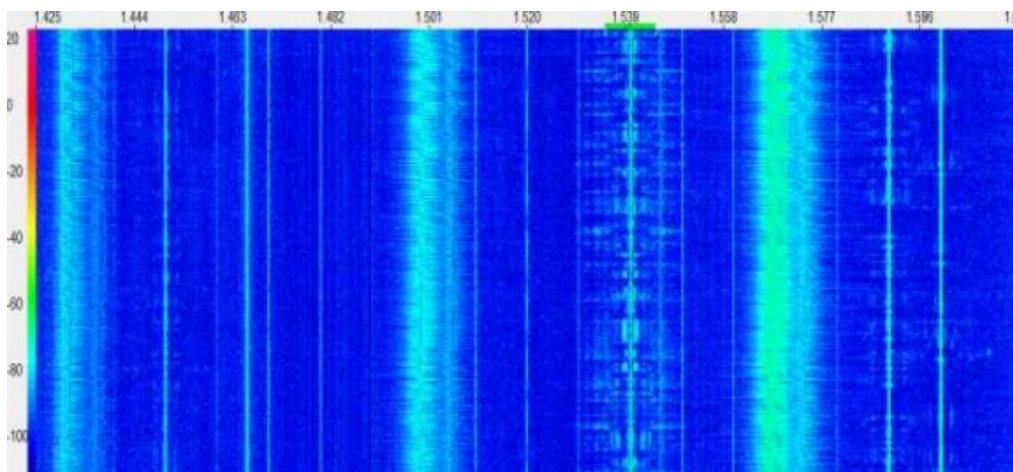
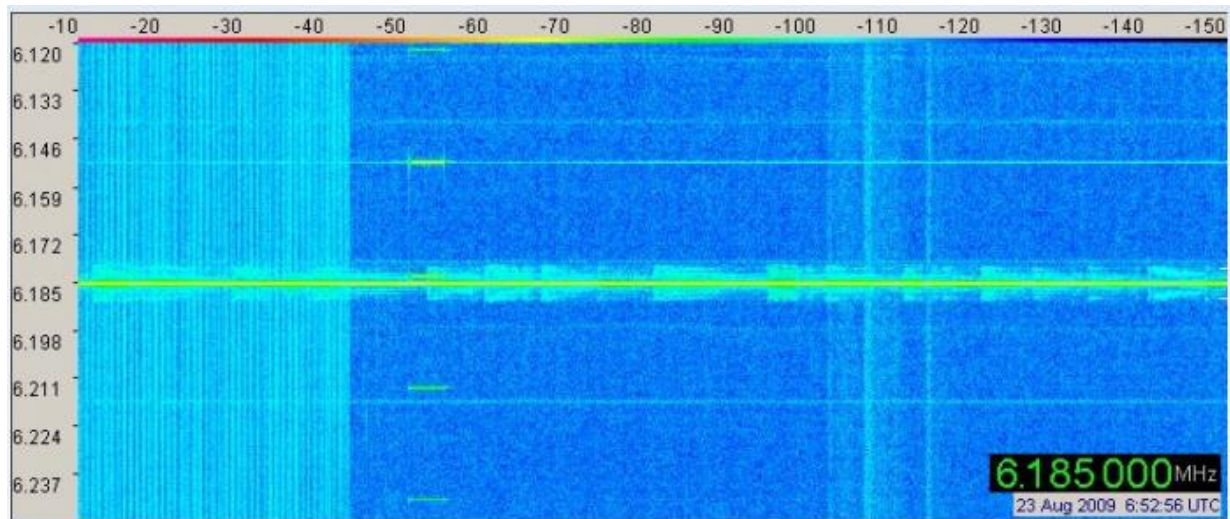
1.1 Like many countries, the United States Federal Aviation Administration (FAA) utilizes remote communications air-ground (RCAG) sites to extend VHF aeronautical communications coverage. Recently one of those RCAG sites in California was experiencing intermittent/seemingly random occurrences of interference. After considerable investigation, the source was determined to be LED lighting from a maintenance shelter approximately 2.5 kilometers away.

**2. DISCUSSION**

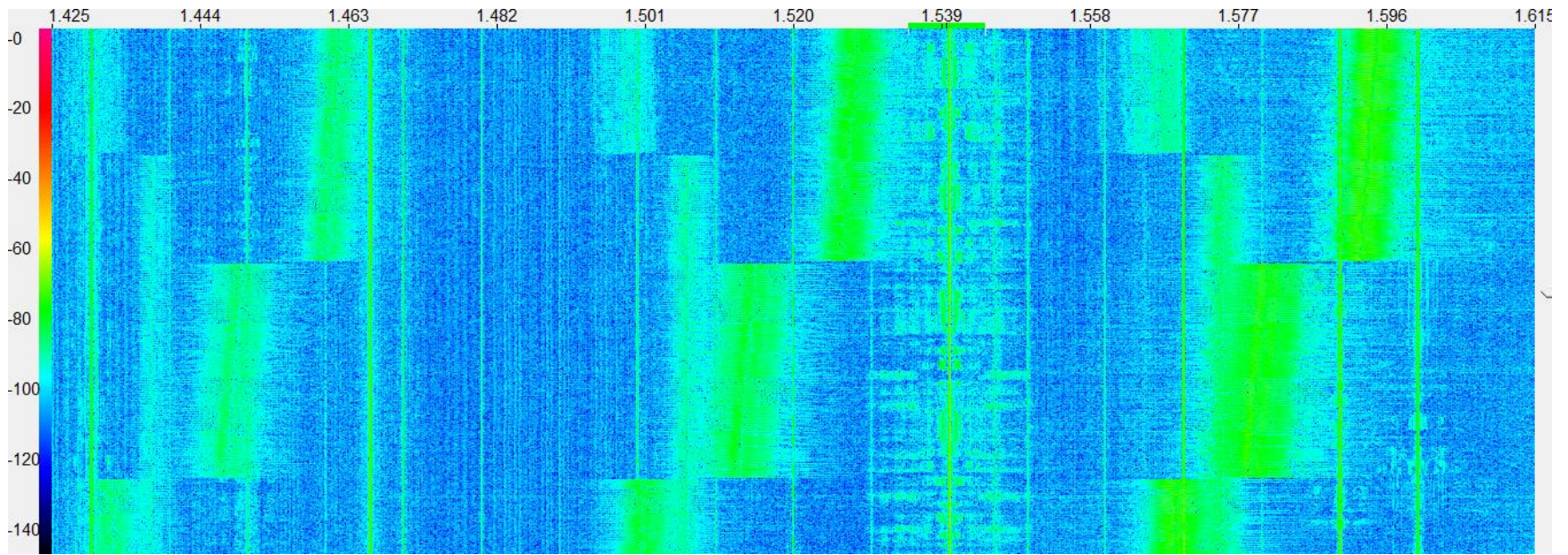
2.1 In early March 2017, an FAA RCAG in California began receiving intermittent radio frequency interference (RFI). Due to the mountainous terrain in the vicinity, the RFI could not be seen on the ground, so it was difficult to get a line of bearing toward the source. When however spectrum analyzers were connected to spare VHF antennas on the RCAG antenna towers, the



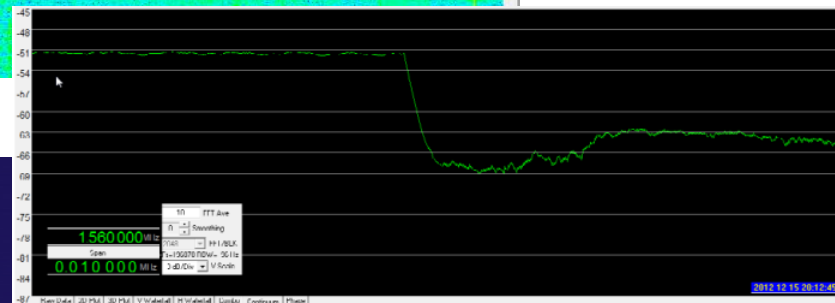
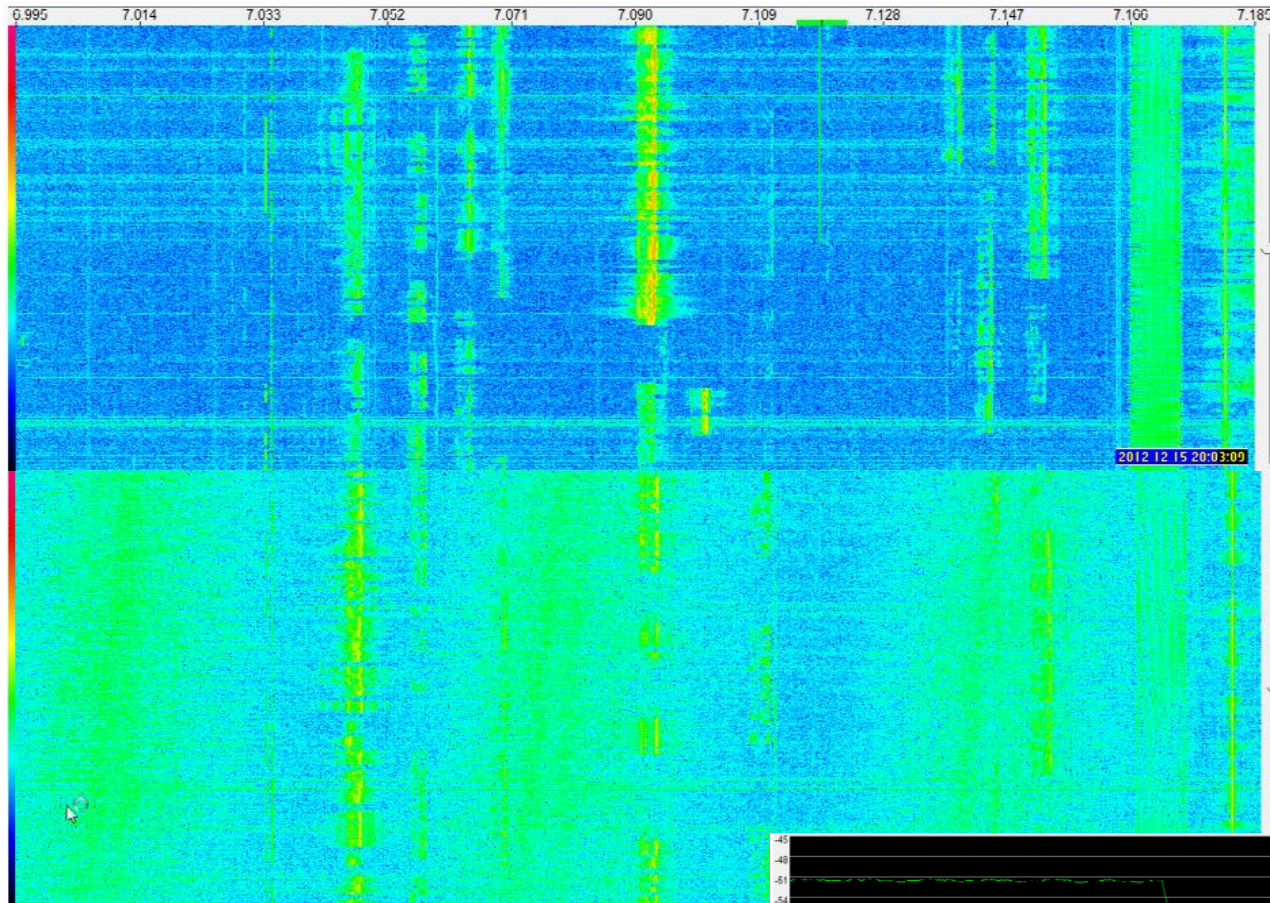
# Iluminação Pública e Semáforos



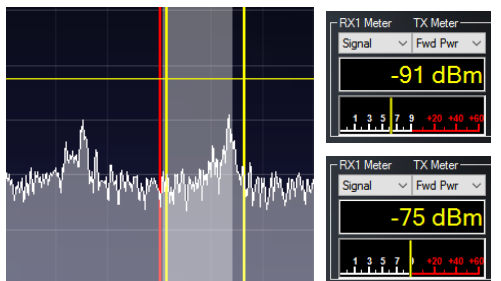
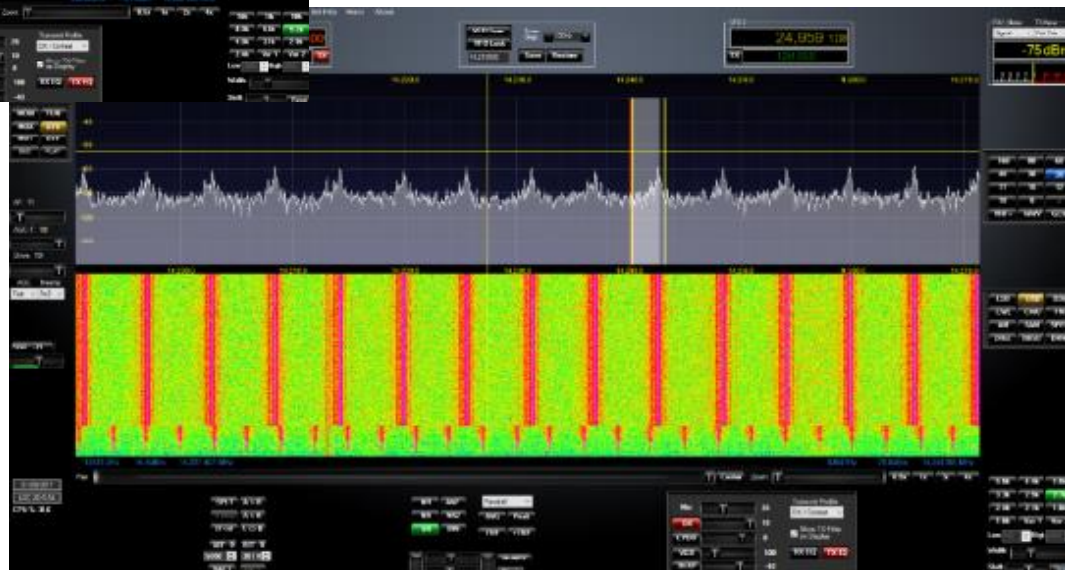
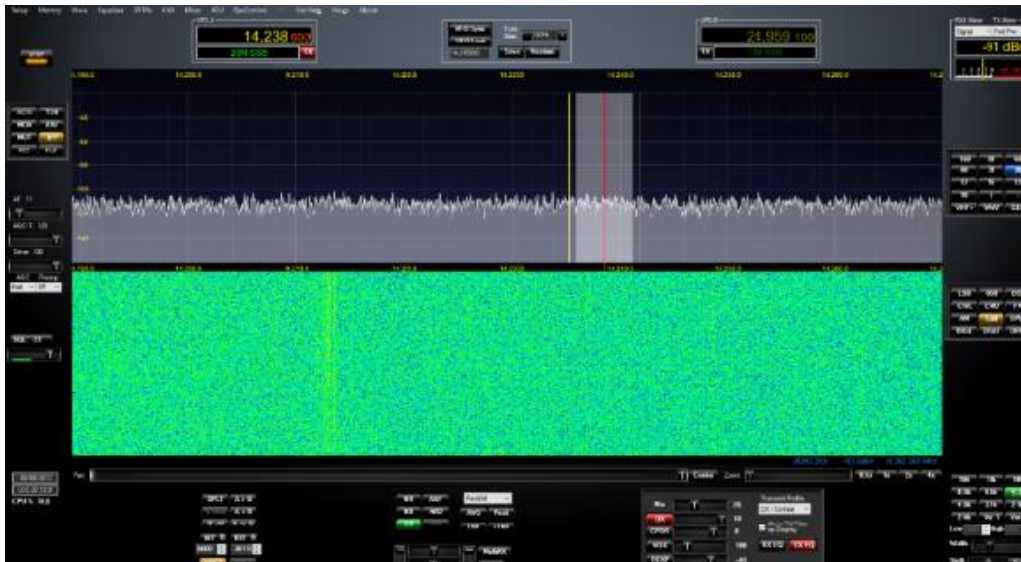
# Semáforos



# Degradação SNR

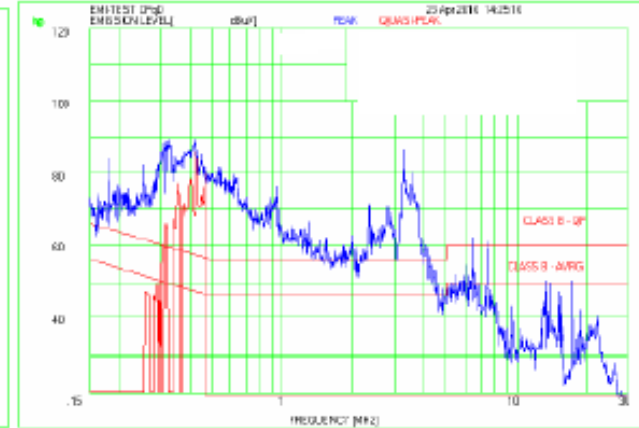
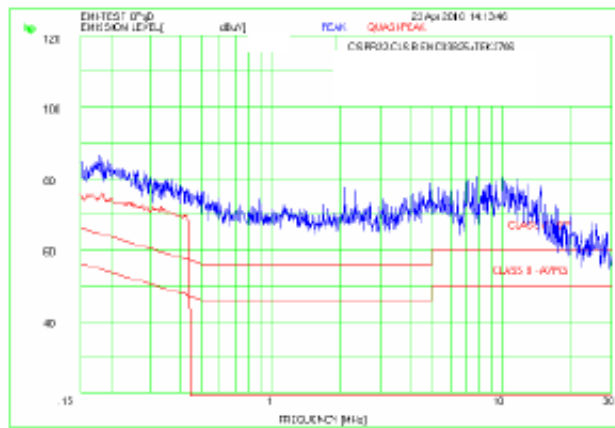
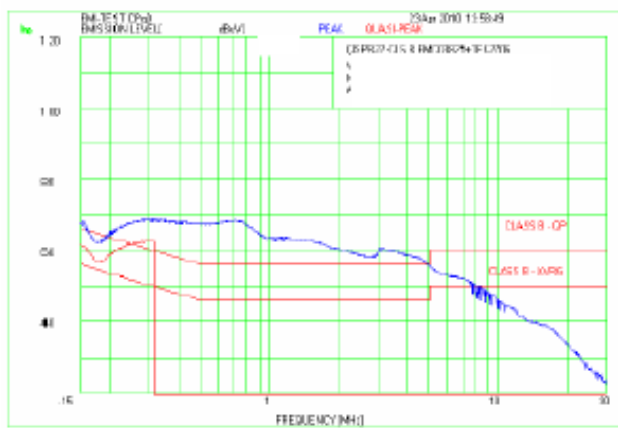
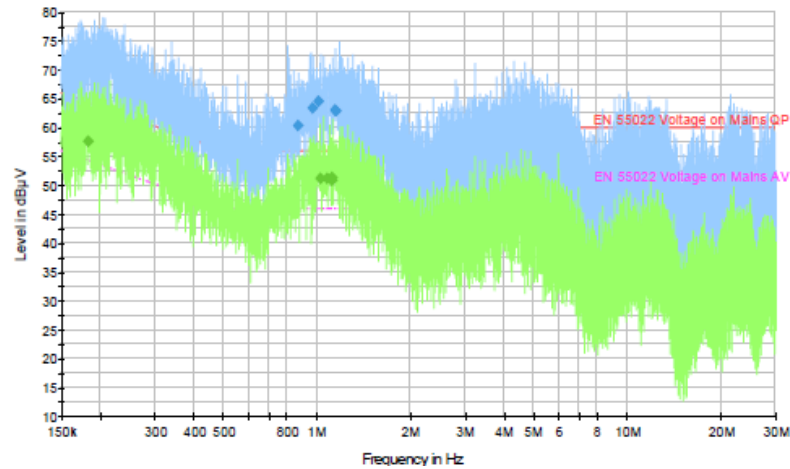


# Eletrodomésticos

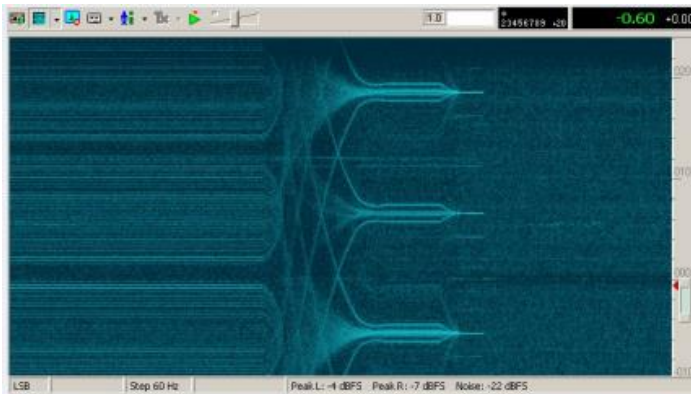


Smart Inverter Compressor

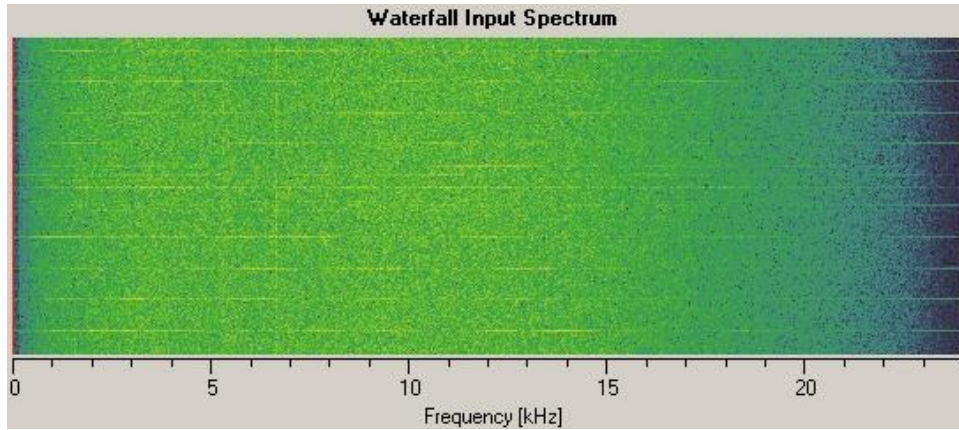
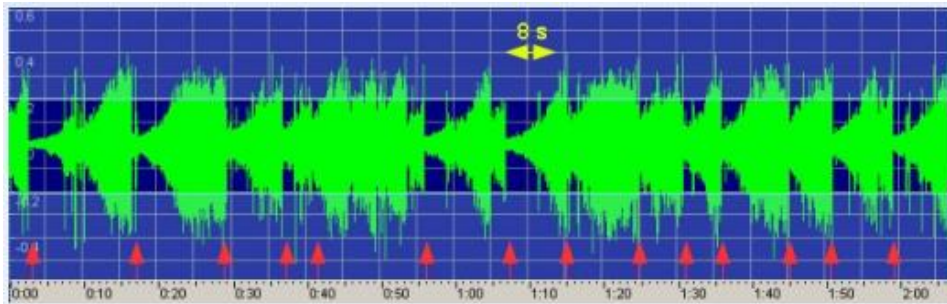
# Eletrodomésticos



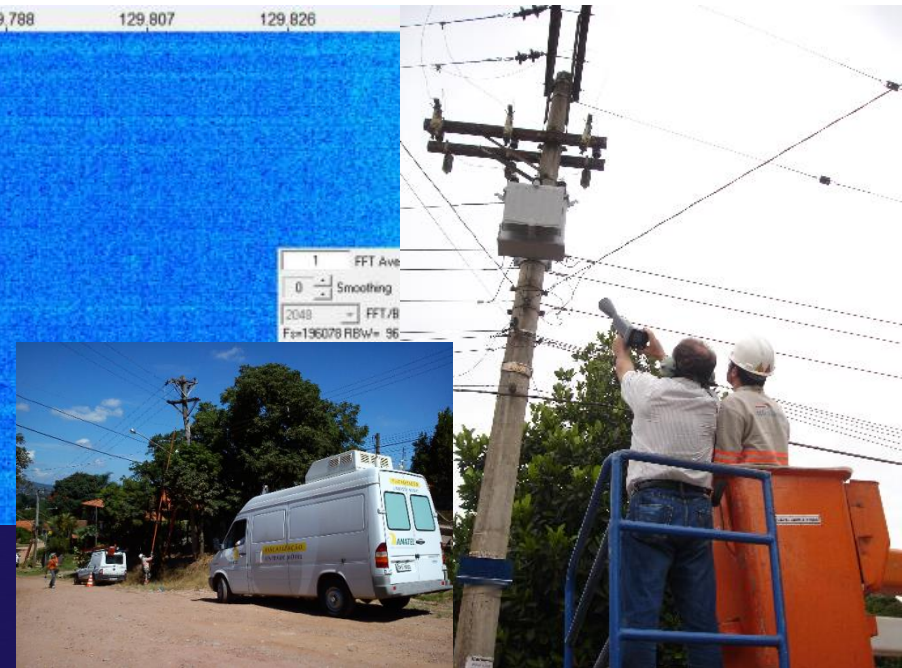
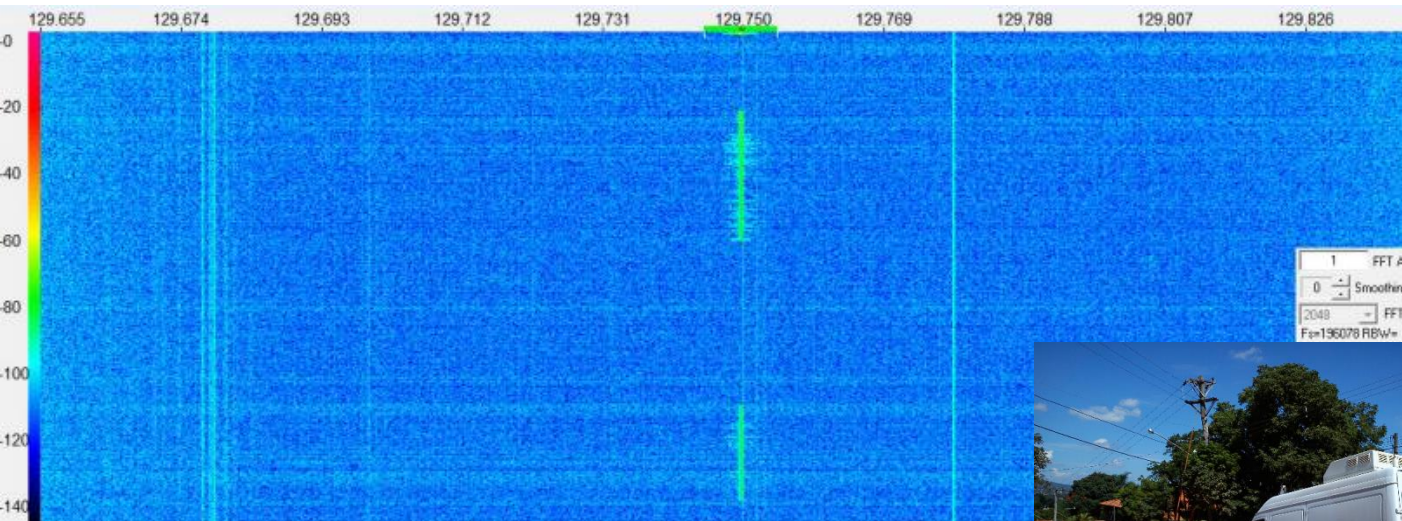
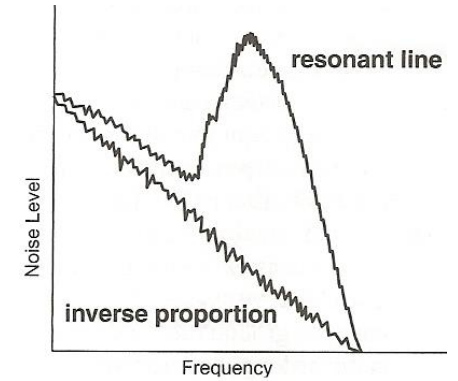
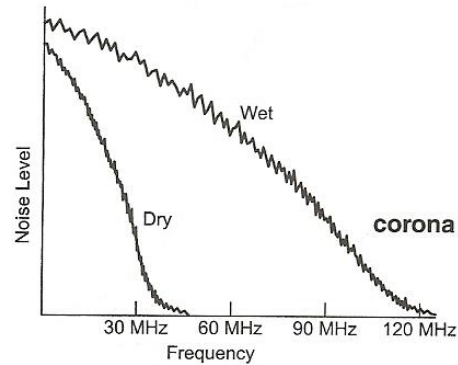
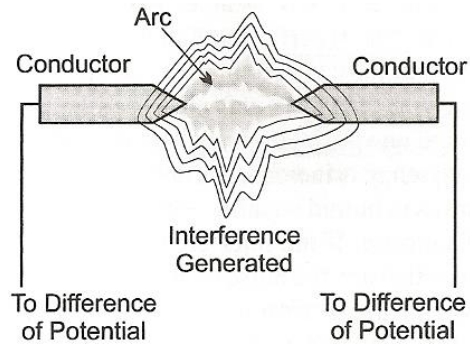
# Elevadores (PWM)



# Cercas Eléctricas



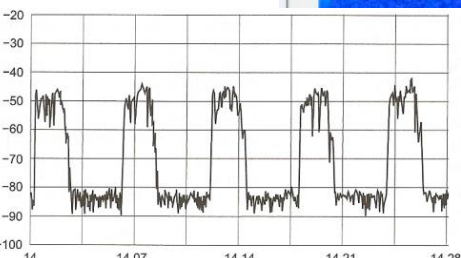
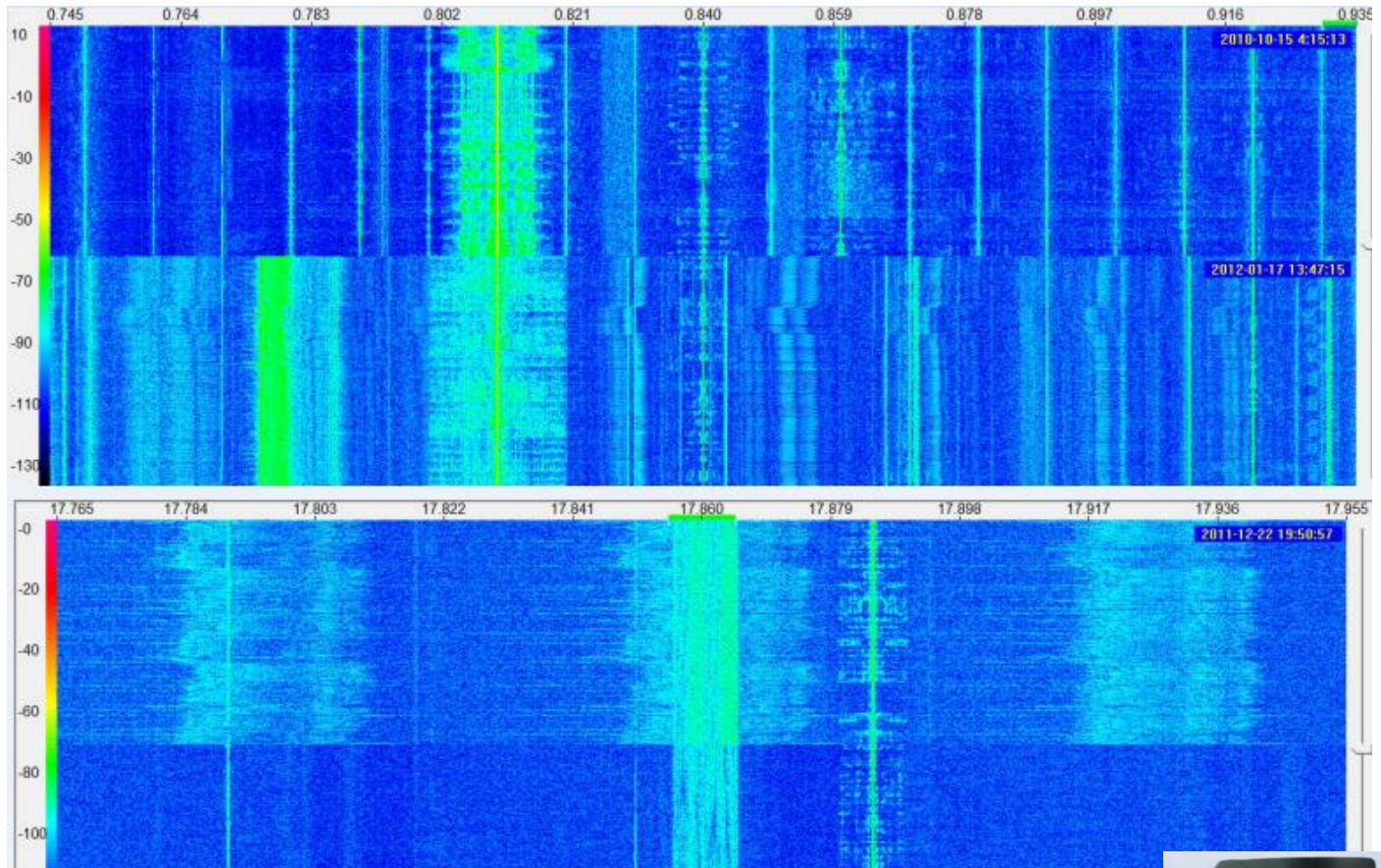
# Rede Elétrica



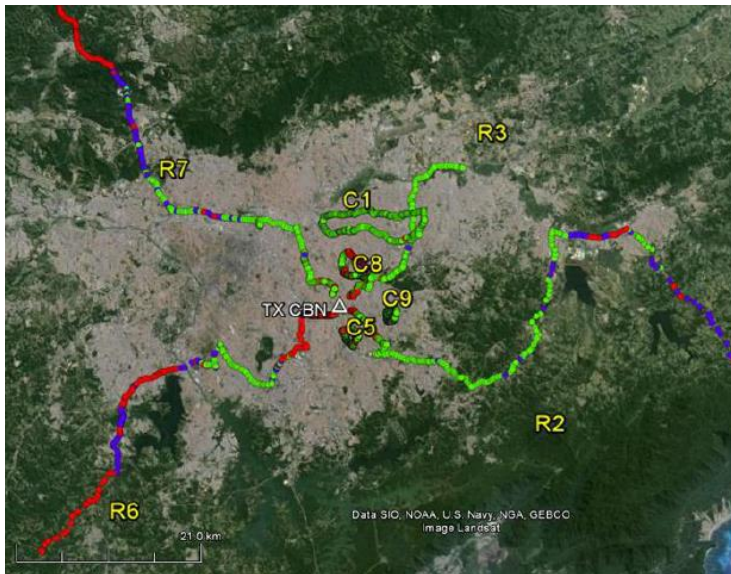




# Fontes Chaveadas



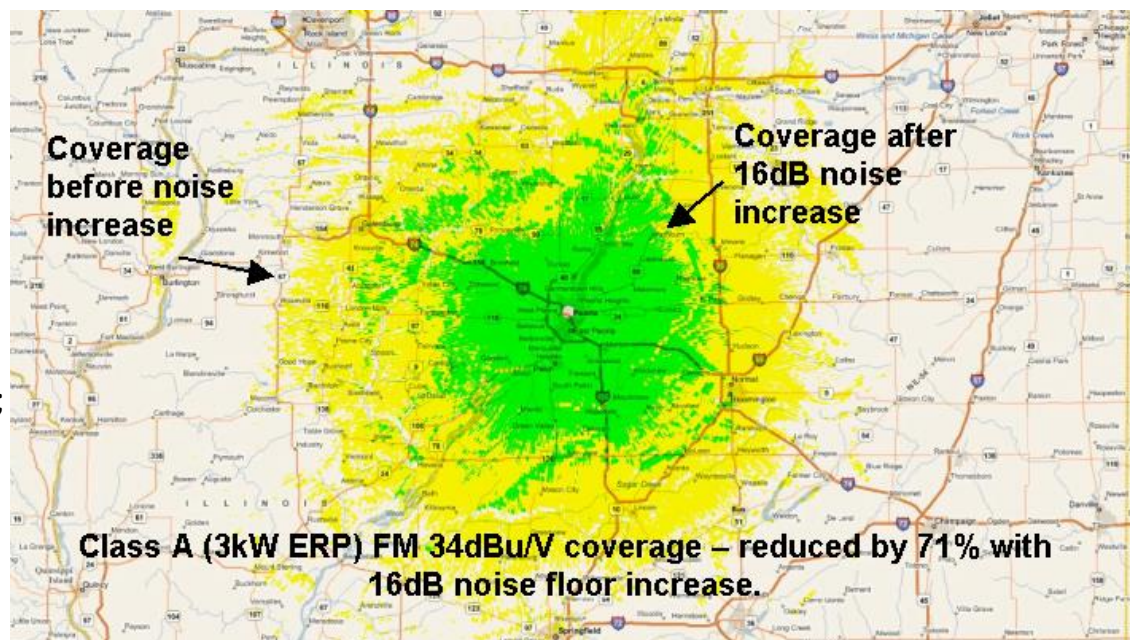
# Rádio Digital



“For distances up to about 20 km, digital reception was achieved at 90% of the points in three of the four routes. Only on the Northwest route this figure drops to about 50%. This is due to the fact that, as illustrated in Fig. 9, the first portion of this route runs through an industrial area that also has dense aerial power lines, that raises the noise floor making digital decoding difficult”. (Measurements...)

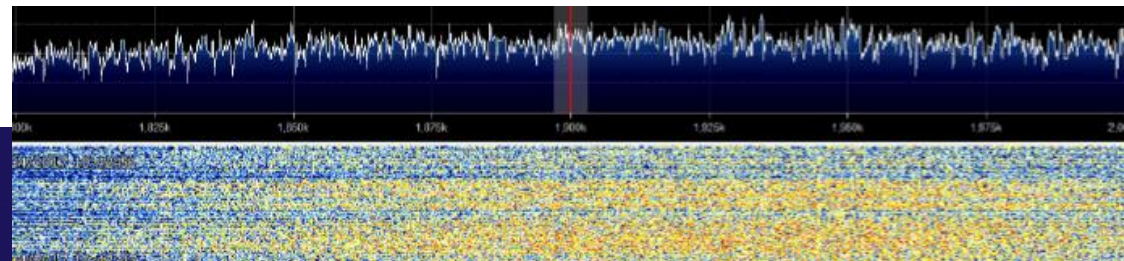
# Consequências dos ruídos

- Perda de cobertura;
- Redução da qualidade do sinal;
- Perda de audiência;
- Imagem de ineficiência tec. tradicionais;
- Dificuldades para adotar novas tec;
- Relativização esforços da digitalização;
- Aumento de potência, consumo de energia;
- Gap Fillers;
- Sucateamento e supervalorização de faixas;
- Subaproveitamento recurso espectral.

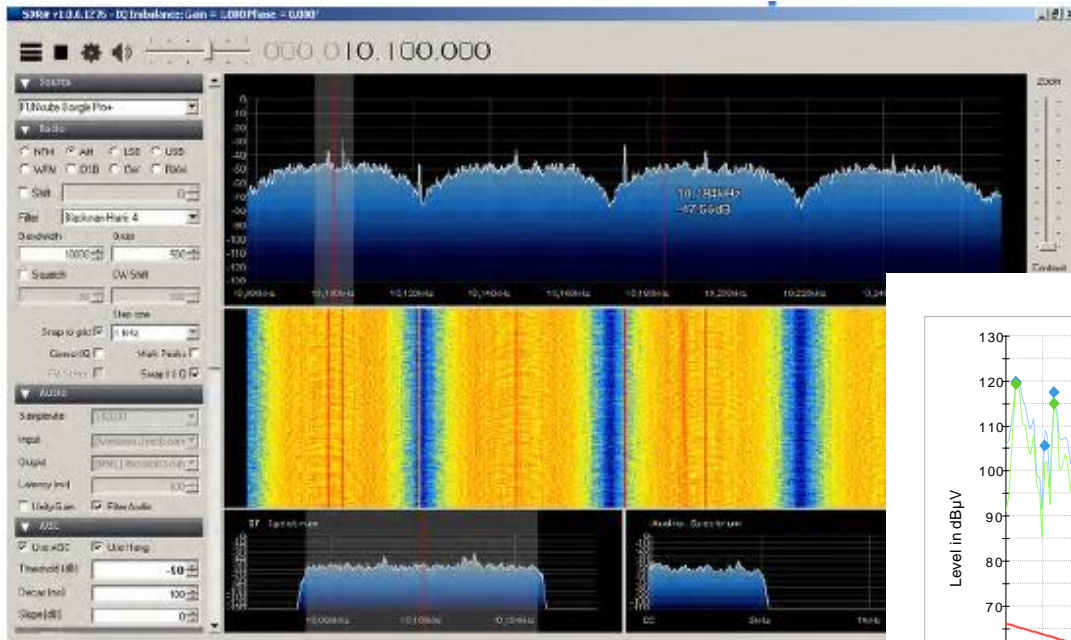


# Tecnologias promissoras

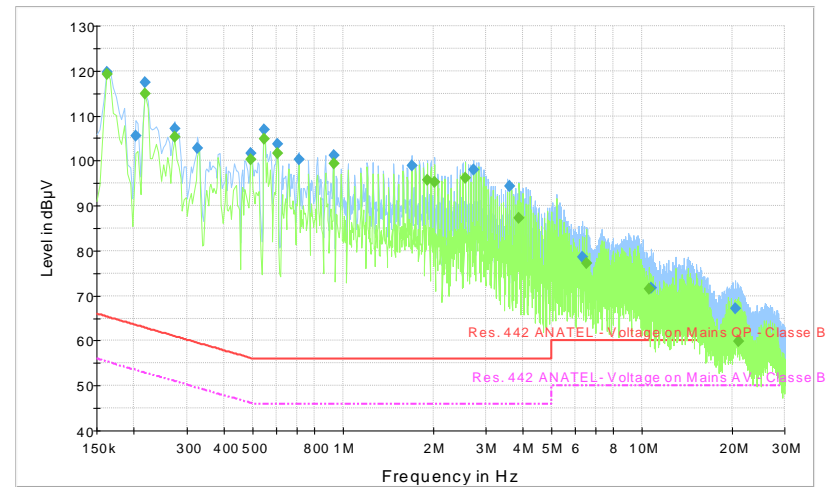
- Energia Solar;
- Energia Eólica;
- IoT;
- Smart Cities;
- WPT;
- Carros elétricos;
- Como sem EMC?



# Sistemas Fotovoltaicos



CE Single Phase SN 457 Auto Test

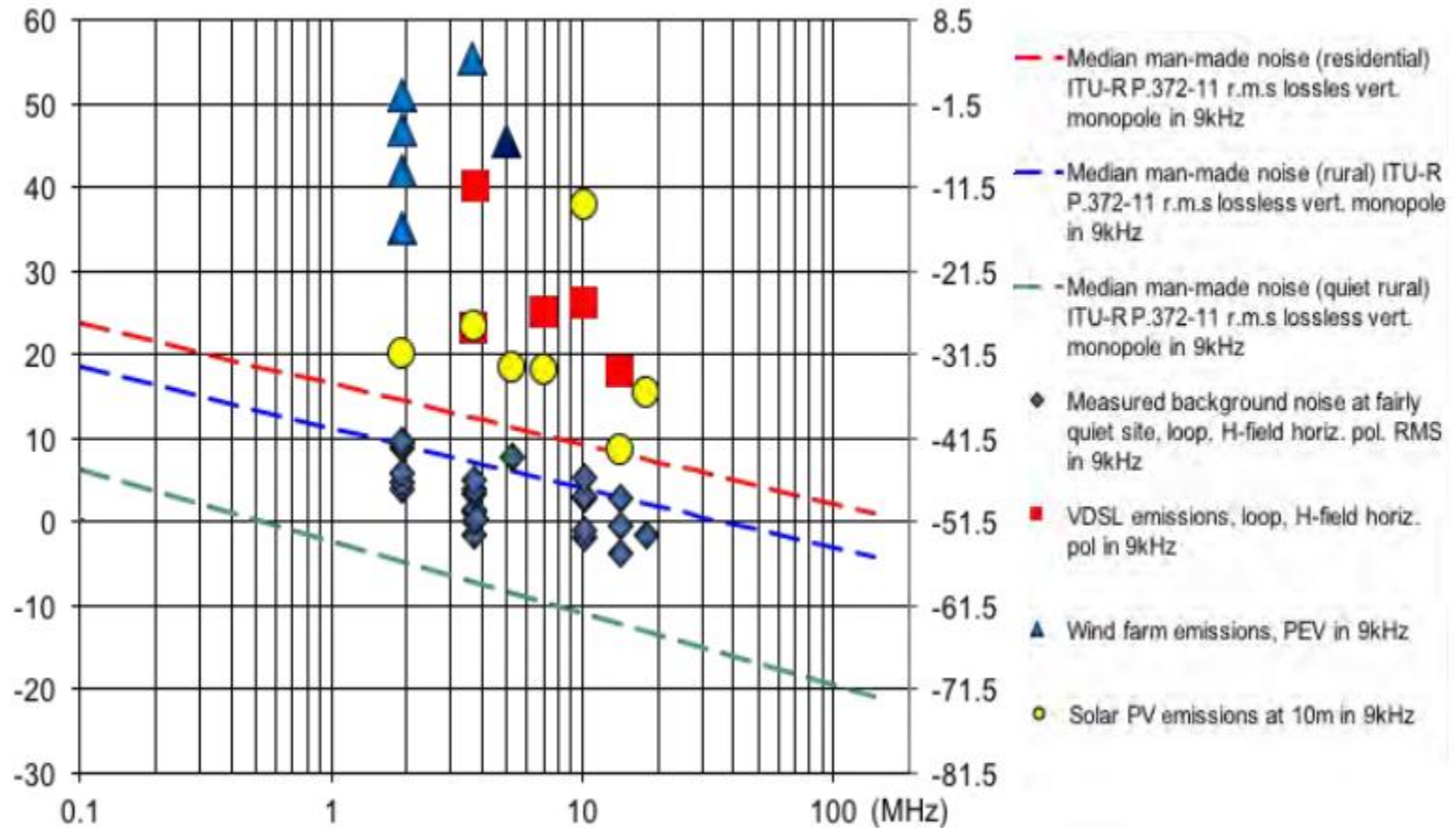


- Res. 442 ANATEL - Voltage on Mains QP - Classe B
- Res. 442 ANATEL - Voltage on Mains AV - Classe B
- ◆ Preview Result 1-PK+
- ◆ Preview Result 2-AVG
- ◆ Final Result 1-QPK
- ◆ Final Result 2-AVG

Até 40 dB

'E' field  
dB( $\mu$ V/m)

## EMCC Interference Measurements



## Diagnosing interference: TV reception



## What's wrong with my radio reception?



## Interference from electric fences



Report or complain about interference

Mobile broadband & TV reception: The link

Do I have the right antenna system?

Devices prohibited by the ACMA

Interference to remote-operated devices

Resolving reception issues from amateur & CB radio

Radio licensing & interference FAQ

TV & radio interference

What's wrong with my radio reception?

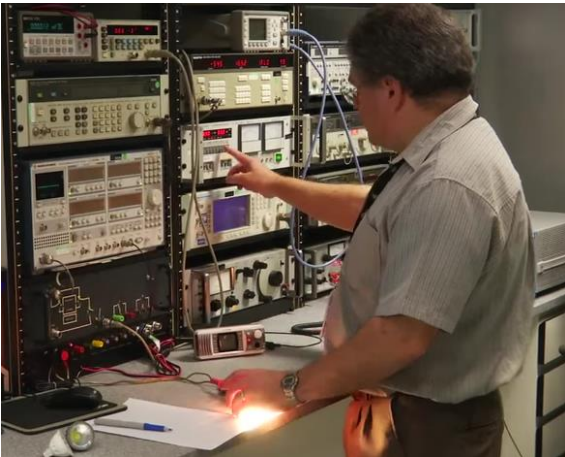
What's wrong with my TV reception?

Discover more in Telco compl... | Telco complaints | Interference and r... | Equipment and ca... | Telemarketing co...

## LED lights & TV Interference







[https://www.youtube.com/watch?v=jWdu9US\\_7MY](https://www.youtube.com/watch?v=jWdu9US_7MY)

# Referências

- ACMA: <https://www.acma.gov.au/Citizen/Complaints/Telco-complaints-2/Interference-and-reception-complaints>
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- TVD UHF x LED: <https://youtu.be/1JgOh4CriTA>
- Vellano Neto, Victor. Estrutura Técnico Normativa para Promoção da Compatibilidade Eletromagnética. Seminário de Defesa Espectral. <http://www.radioamadores.org/biblio/apres/CNR2014/Victor-LABRE-SDE-CNR-2014.pdf>
- Vilas Boas Magalhães, Gilberto. Rede Sibratec Compamagnet. Seminário de Defesa Espectral. <http://www.radioamadores.org/biblio/apres/CNR2014/Gilberto-LABRE-SDE-CNR-2014.pdf>

# Obrigado!



Flávio A. B. Archangelo

[flavio.archangelo@labre.org.br](mailto:flavio.archangelo@labre.org.br)