

Workshop EMC em Sistemas Fotovoltaicos

Inmetro/Instituto Eldorado

Compatibilidade e Interferência Eletromagnética *Casos Práticos*

João Saad Júnior

Eng. Eletrônico (UFRJ-1978)

M.Sc. Sistemas (COPPE-UFRJ-1984)

Ex-pesquisador do CEPEL/Eletronbras (1978-2013)

Ex-Membro da Gestão da Ass. Bras. Comp. Elet. -ABRICEM-(1995)

Assessor Técnico da LABRE

Membro Comitê Técnico PBE Fotovoltaicos

A **Compatibilidade Eletromagnética**

é a capacidade de sistemas eletrônicos operarem seguramente sem se interferirem.



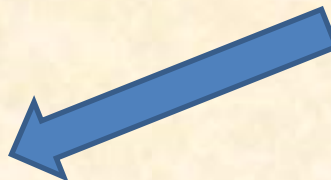
Início das radiocomunicações

Crescimento da tecnologia eletrônica/Digitalização

Ampliação das normas de EMC (diretivas europeias, FCC, normas para equipamentos eletromédicos etc)

Começam as preocupações com a EMC

aumento no caso de interferências



ORGANIZAÇÕES QUE TRATAM DE REQUISITOS DE EMC



Comité Européen de Normalisation

Comité Européen de Normalisation Electrotechnique

European Telecommunications Standards Institute (10 TR, TS)

International Electrotechnical Commission (CISPR22-102)

Eletromédicos -> EMC (ANVISA e INMETRO)



emi solutions

The Educational Source of Electronics Professionals

Master RFI
in four days!

Another
EMI Incident?
(see page 3)

PC's now employed
to design out EMI.
See page 21.

New handbooks
solve your toughest
interference problems
guaranteed!
See page 18.

EMC TECHNOLOGY—
Now Free.
See page 3.

ORGANIZAÇÕES QUE TRATAM DE REQUISITOS DE EMC



(Amendment Part 15)



(Certificação de Equip)



(Project 1675)
(Project 1901)



Comité Européen
de Normalisation



Comité Européen
de Normalisation
Electrotechnique



European
Telecommunications
Standards Institute
(10 TR, TS)

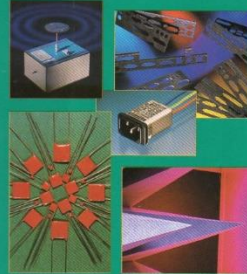


International
Electrotechnical
Commission
(CISPR22-102)

Interference Technology Engineers' Master

ITEM 1999

The International Journal of EMC™



ROBAM INDUSTRIES, INC.
3 UNION HILL ROAD
WEST CONSHOHOCKEN, PA 19382-0758
ADDRESS CORRECTION REQUESTED

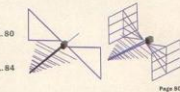
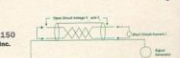

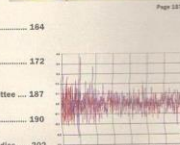
DIRECTORY
AND
DESIGN
GUIDE
FOR THE
CONTROL OF
EMI & E

In This Issue

- ANTENNAS ... 79
- BUSINESS CARDS ... 224
- CABLES & CONNECTORS ... 150
- CONDUCTIVE COATINGS ... 125
- EMC DESIGN & SOFTWARE ... 157
- EMC REGULATIONS ... 164
- EMPLOYMENT SERVICES ... 201
- FERRITES ... 55
- FILTERS ... 17
- GOVERNMENT DIRECTORY ... 374
- LIGHTNING, TRANSIENTS & ESD ... 88
- MAGNETIC SHIELDING ... 84
- MEDICAL ELECTRONICS ... 123
- MILITARY EMC ... 115
- PRODUCTS & SERVICES INDEX ... 283
- PROFESSIONAL SOCIETIES ... 118
- SALES OFFICE DIRECTORY ... 280
- SERVICES ... 287
- SHIELDING ROOMS ... 120
- SHIELDING AIDS ... 48
- SUSCEPTIBILITY ... 89
- TEST INSTRUMENTATION ... 70
- WEBSITE DIRECTORY ... 222

ITEM 1999

CONTENTS

- 79 ANTENNAS**
Understanding the Measurement Uncertainties of the Bi-conical Loop Hybrid Antenna 80
Zhang Chen, EMC Test Systems
Introduction to Measurement Uncertainty for Antenna Calibration 84
Mike Howard, Liberty Labs, Inc.  Page 80
- 150 CABLES & CONNECTORS**
Impedance Termination of Cable Shields to Reduce EMI Coupling 150
Richard Montgomerie and Robert Booth, CMAR Services, Inc.  Page 150
- 125 CONDUCTIVE COATINGS**
Performance Characterization of Conductive Coatings for EMI Control 125
Brian C. Jackson and Thomas W. Steaks, Enthouse OMI
- 157 EMC DESIGN & SOFTWARE**
EMC Management in the Railway Industry: Concept to Completion 157
Alwyn Flannery, SRA Technology Ltd  Page 157
- 164 EMC REGULATIONS**
Interpreting EMI Receiver Specifications 164
Warner Schaefers, Hewlett-Packard Company
Reducing Measurement Uncertainty in EMC Test Laboratories 172
Bruce Antkowiak, IBM, and
Cedric G. Branch, Computer Development Corporation
CES: The Electromagnetic Compatibility Committee 187
Daniel D. Houston, TV Product Service, Inc.
SLIM: Efforts to Simplify the EMC Directive 190
Gary Finkels, Instrument Specialties Co., Inc.
The Proliferation of Conformity Assessment Bodies 202
Daniel D. Houston, President, IEEE EMC Society
Regulatory Issues with Motor-driven Appliances, Inc. 208
Dwayne R. Eggleston, International Certification Services, Inc.
Evaluating the Differences Between FCC Part 15.247 and RSS-139 212
David A. Case, Alameda Wireless Communications  Page 212

Continued on page 6

ITEM 1999

RECEIVERS



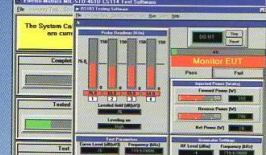
ANTENNAS



ACCESSORIES



SOFTWARE



AMPLI-SYSTEM



SYSTEMS



Electro-Metrics, Incorporated
231 Enterprise Road
Johnstown, New York 12095

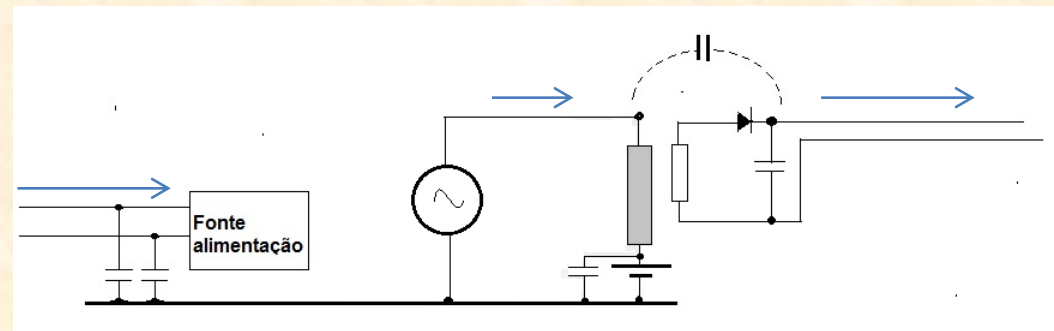
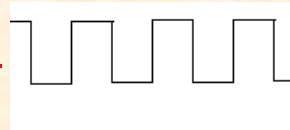
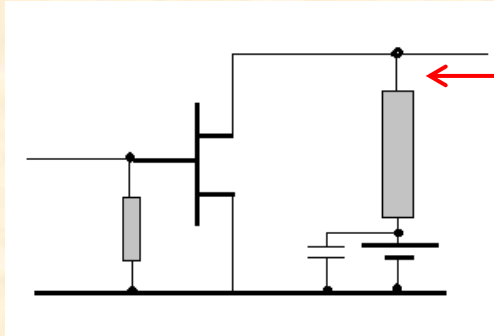
Circle Inquiry No. 82

Web: www.electro-metrics.com

Telephone: 518-762-2600
Fax: 518-762-2812
Email: info@emhq.com

Alimentação elétrica moderna -> Dispositivos de Chaveamento

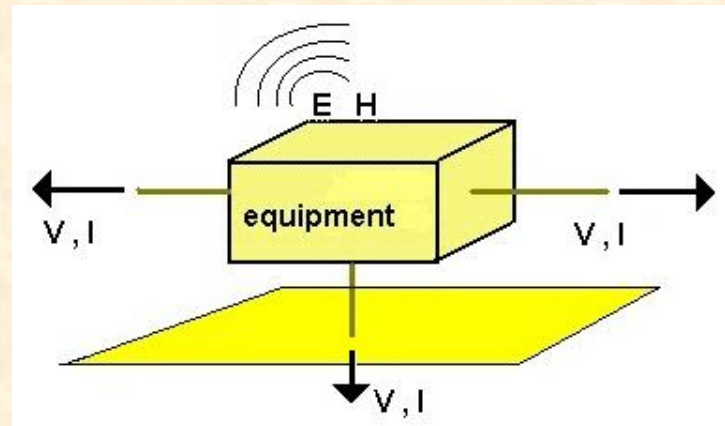
Fontes chaveadas → de poucos Watts a vários kW



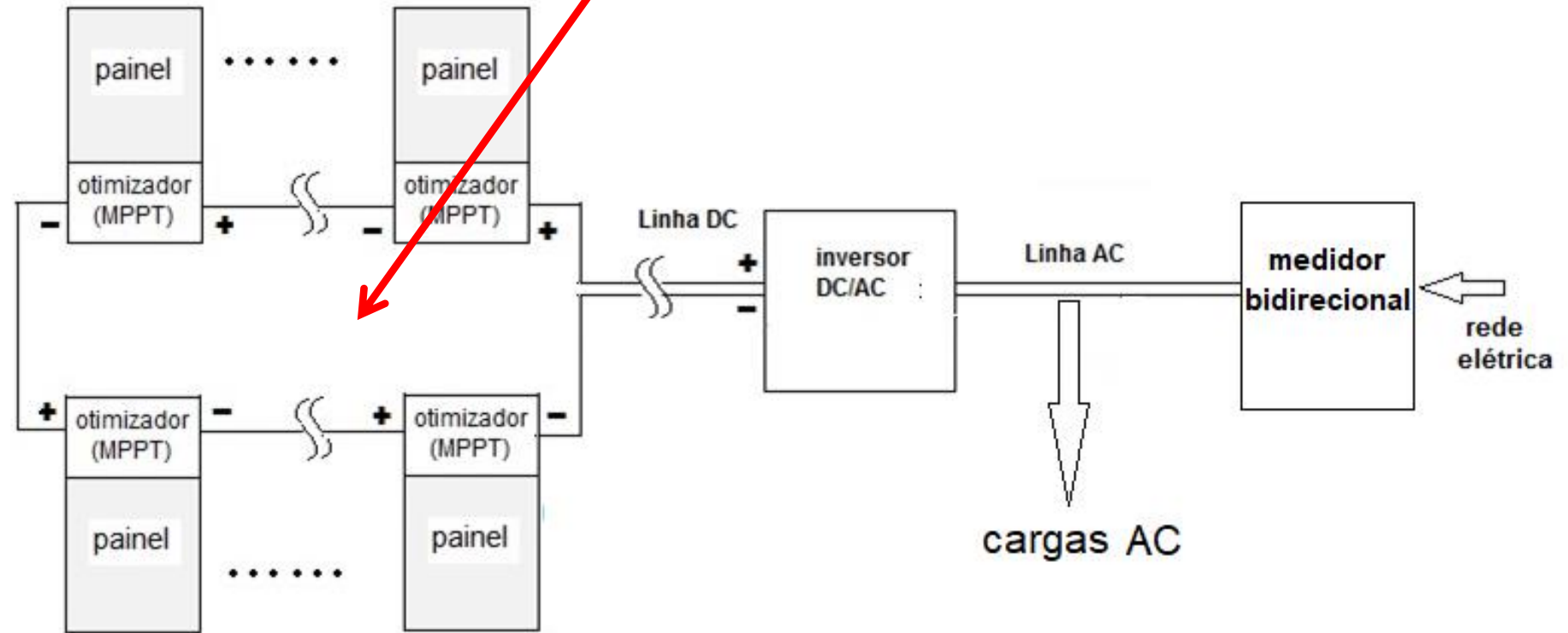
A falta de controle das radiações intencionais ou não intencionais são equivalentes e igualmente ruins



- Emissividade:**
- ambiente EM conduzido (até 30MHz)
 - ambiente EM radiado (acima de 30MHz)



Antena tipo "loop" para o ruído em Modo Diferencial



Agência Sueca de Pesquisas em Defesa

Interference Impact from Solar-Panel Systems on Air Traffic Control Communications

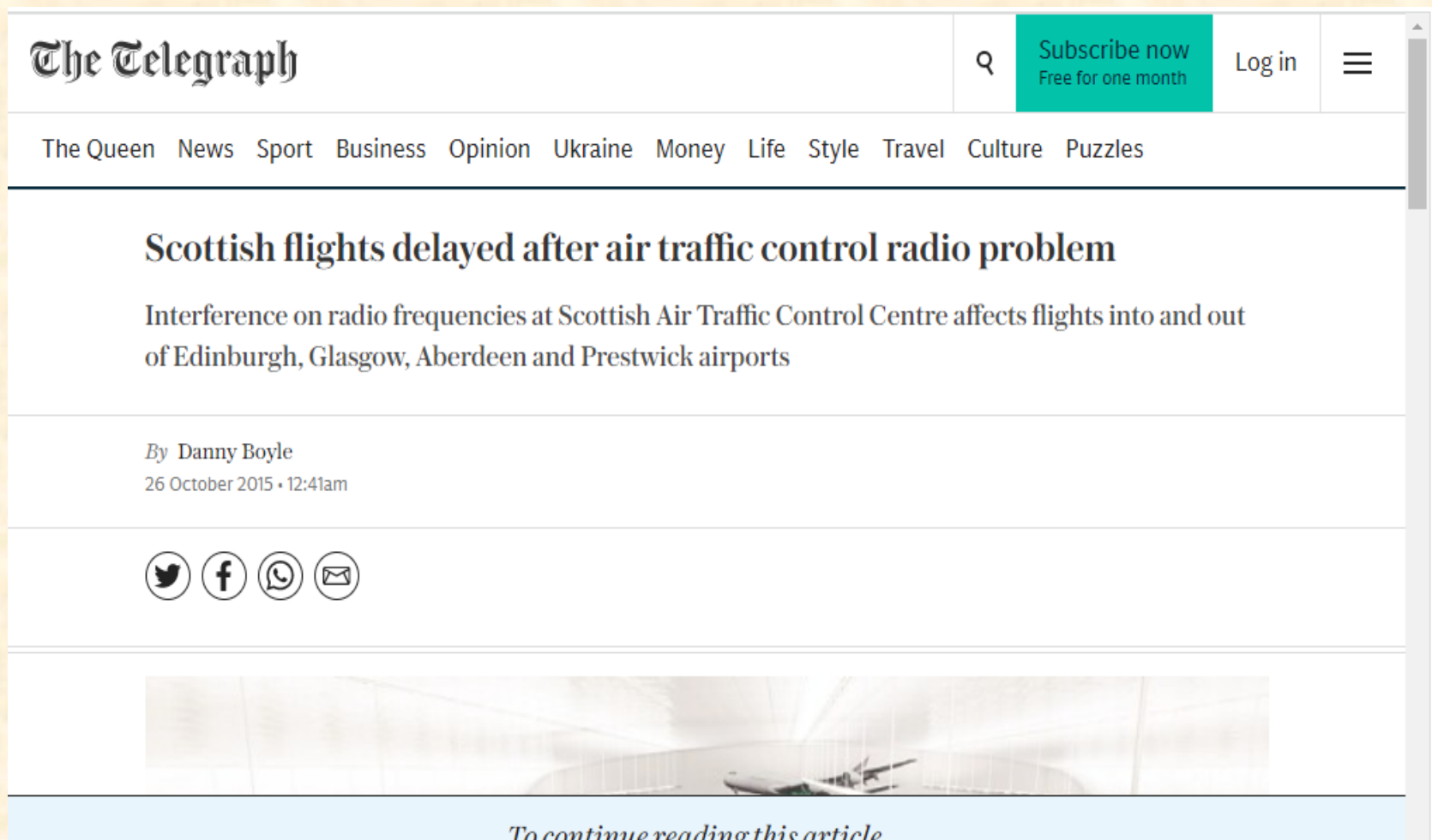
<https://ieeexplore.ieee.org/document/8871512>

Casos reais citados no trabalho:

- ***Interrupção da comunicação de controle de tráfego aéreo em aeroporto da Suécia devido a um outdoor eletrônico*** (Report 11EV4910 do The National Electric Safety Board 16-12-2011)



- **Interferência na frequência de controle de tráfego aéreo na Escócia atrasa vôos.**
<https://www.telegraph.co.uk/news/aviation/11954446/Scotland-air-traffic-control-problem-delays-flights.html>



The Telegraph

Subscribe now
Free for one month

Log in


The Queen News Sport Business Opinion Ukraine Money Life Style Travel Culture Puzzles

Scottish flights delayed after air traffic control radio problem

Interference on radio frequencies at Scottish Air Traffic Control Centre affects flights into and out of Edinburgh, Glasgow, Aberdeen and Prestwick airports

By Danny Boyle
26 October 2015 • 12:41am

Twitter Facebook WhatsApp Email



To continue reading this article...



Aviso da Guarda Costeira Americana sobre interferências geradas por lâmpadas LED:

<https://www.dco.uscg.mil/Portals/9/DCO%20Documents/5p/CG-5PC/INV/Alerts/1318.pdf?ver=2018-08-16-091109-630>



UNITED STATES COAST GUARD
U.S. Department of Homeland Security

MARINE SAFETY ALERT

Inspections and Compliance Directorate

August 15, 2018
Washington, DC

Safety Alert 13-18

Let us enlighten you about LED lighting!

Potential interference of VHF-FM Radio and AIS Reception.

The U.S. Coast Guard has received reports from crews, ship owners, inspectors and other mariners regarding poor reception on VHF frequencies used for radiotelephone, digital selective calling (DSC) and automatic identification systems (AIS) when in the vicinity of light emitting diode (LED) lighting on-board ships (e.g., navigation lights, searchlights and floodlights, interior and exterior lights, adornment).

Radio frequency interference caused by these LED lamps were found to create potential safety hazards. For example, the maritime rescue coordination center in one port was unable to contact a ship involved in a traffic separation scheme incident by VHF radio. That ship also experienced very poor AIS reception. Other ships in different ports have experienced degradation of the VHF receivers, including AIS, caused by their LED navigation lights. LED lighting installed near VHF antennas has also shown to compound the reception.





WORKING PAPER

FREQUENCY SPECTRUM MANGEMENT 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 communications

Presented by Mike Biggs (USA)

SUMMARY

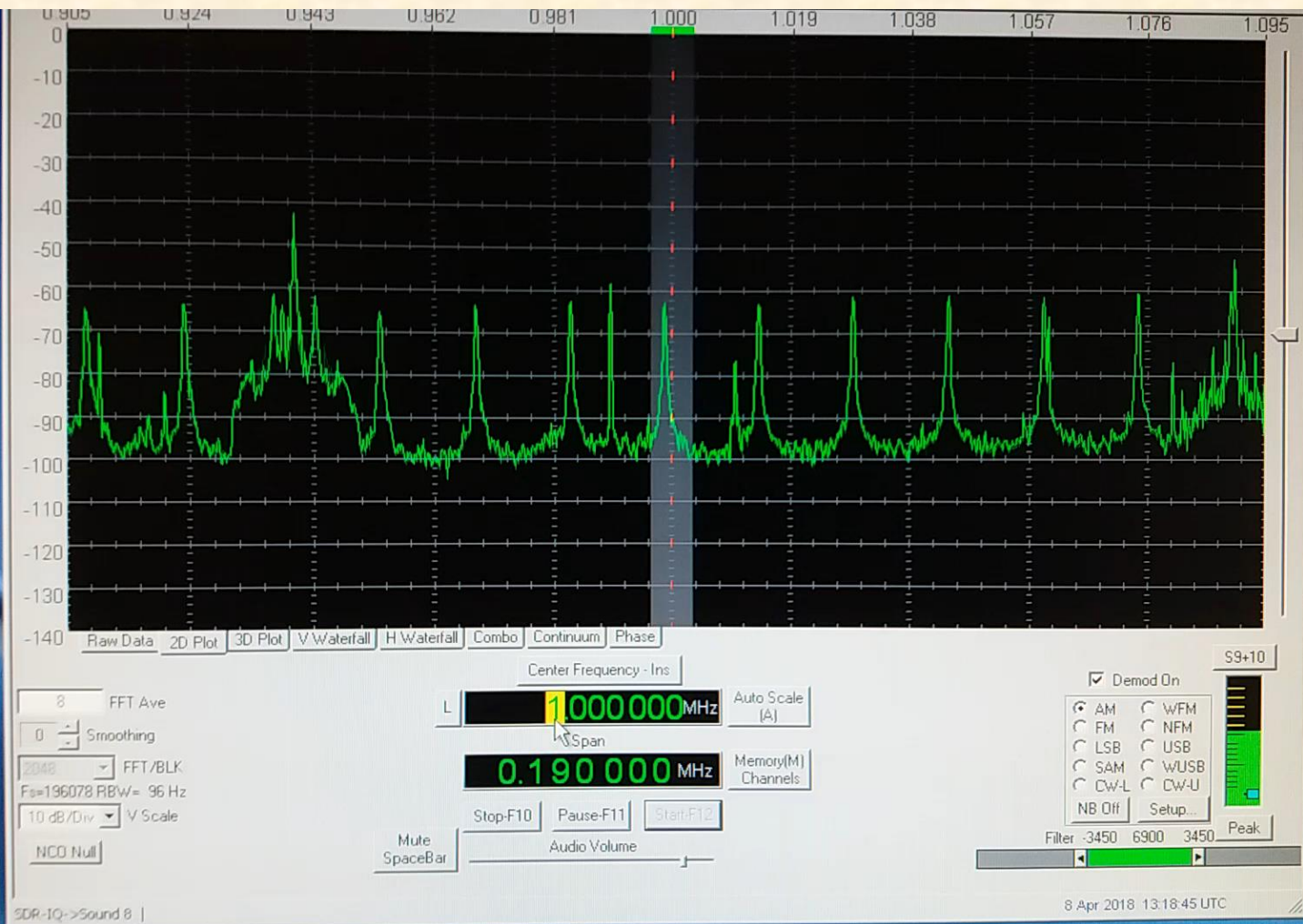
This paper provides information on a re-aviation VHF communications in the Unit-ation, the source was determined to replace fluorescent tube lighti-

2.2 After considerable review of potential transmitter sites with direct line of sight (LOS) to the RCAG antenna, the RFI was localized with a bearing toward a microwave site on a mountain approximately 2.5 kilometers away (see Figure 1). As a result, a visit was arranged to that site.

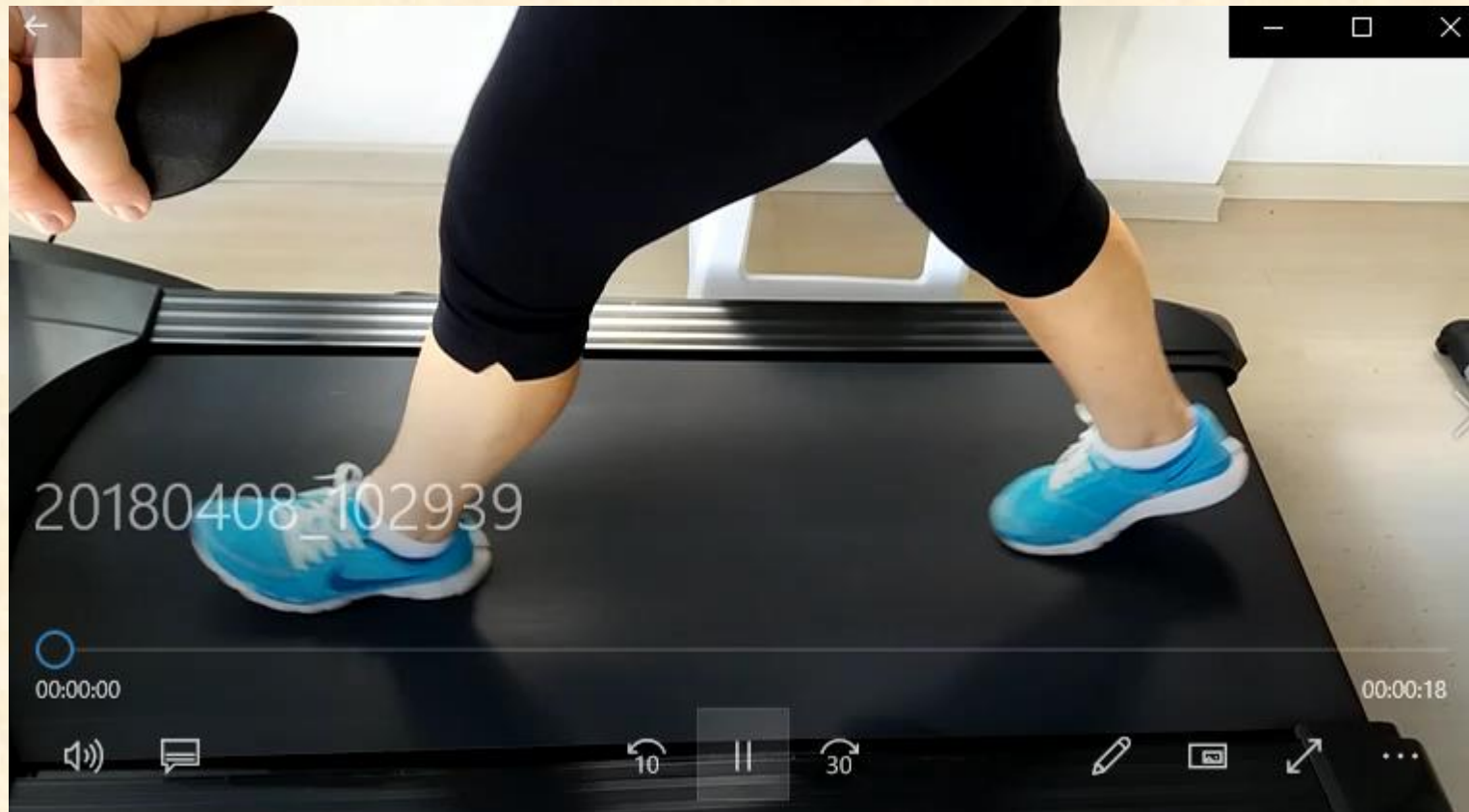


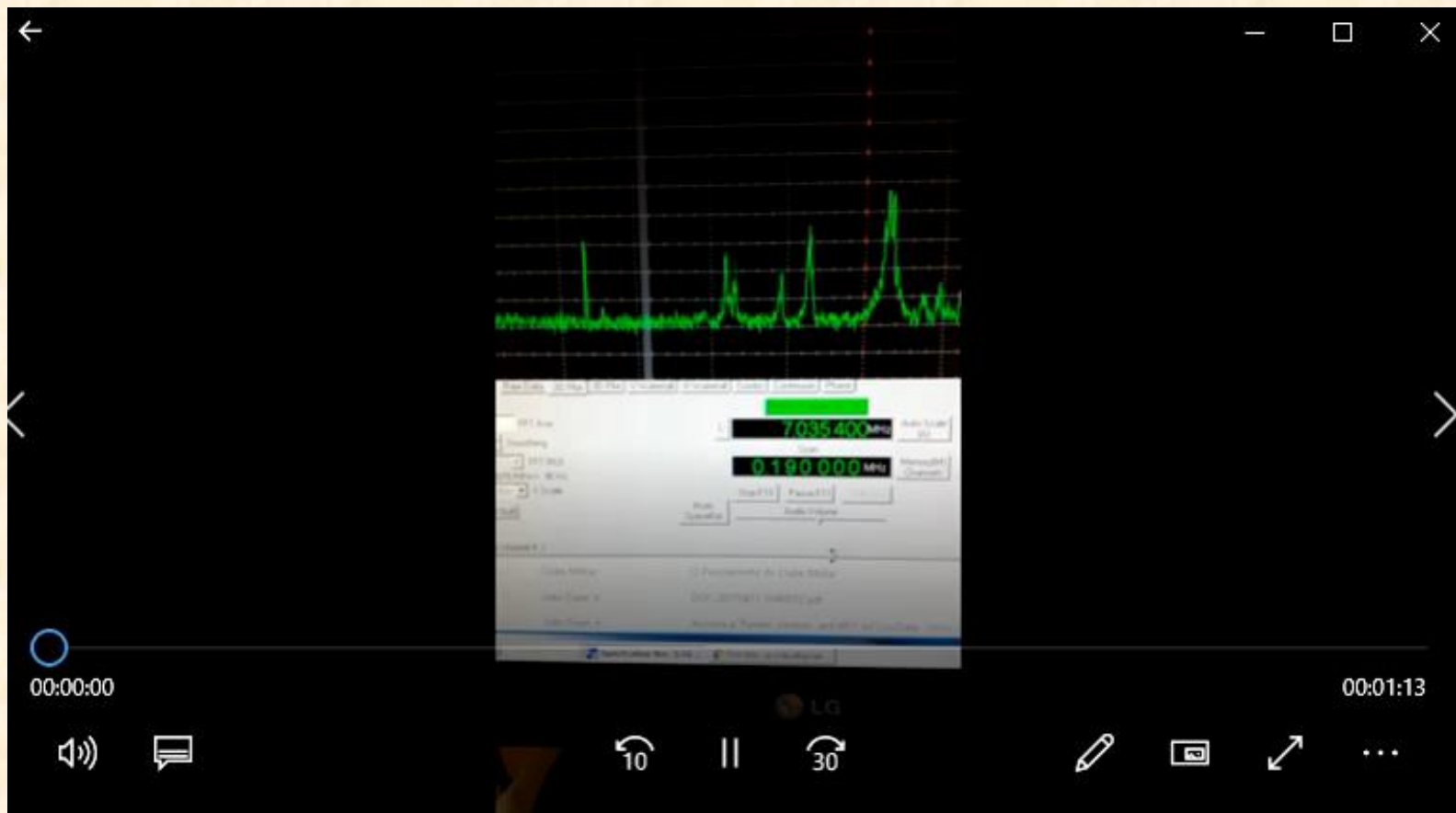
EXEMPLOS DE INTERFERÊNCIAS NAS TELECOMUNICAÇÕES





Foi relativamente fácil descobrir a fonte de interferência...







**Australian
Communications
and Media Authority**

Making media
and communications
work for all Australians

Contact the ACMA



ACMA → Agência Australiana de Telecomunicações



Australian Government

LED-ACMA_Australia



00:00:19

00:03:11



Conclusão:

Estamos no caminho certo em tratar com a devida atenção os requisitos de EMC para os fotovoltaicos



Uma vez poluído o espectro, não haverá para onde fugir!

A photograph of a forest path. The path is made of dirt and grass, leading into a dense forest of tall, leafy trees. Sunlight filters through the canopy, creating a dappled light effect on the ground. The overall color palette is dominated by various shades of green.

Muito Obrigado!

João Saad Júnior

LABRE

jsaad.emc@gmail.com