The Royal Academy of Engineering

Research Fellowship

Distributed Passive Intermodulation Phenomena in Microwave Circuits

Co-funded by EPSRC

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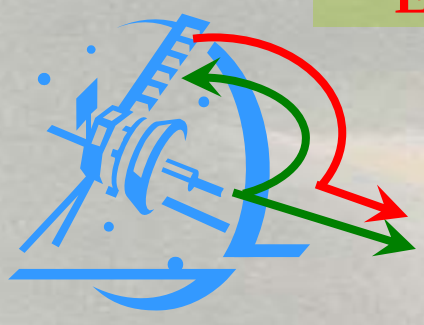
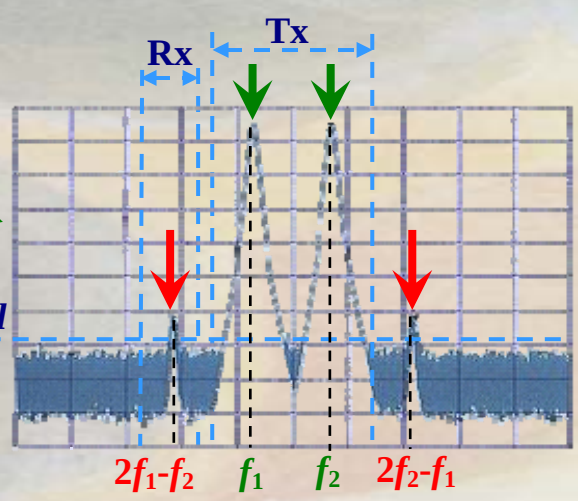
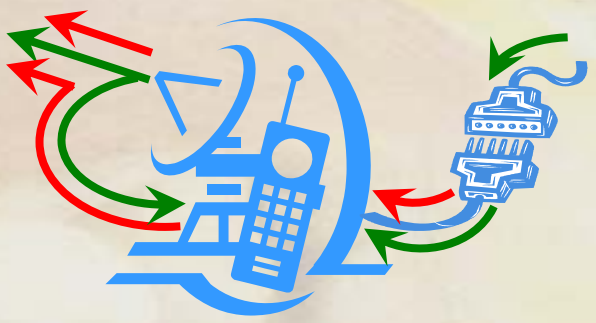
Effect of Passive Intermodulation Distortion





Tx - transmit band
Rx - receive band

Passive Intermodulation (PIM) is the generation of mixing frequencies $nf_1 \pm mf_2$ (n,m=0, ±1, ±2,…) due to nonlinear (disproportional) response of passive components (cable assemblies, printed circuit boards, metallic waveguides, reflectors)

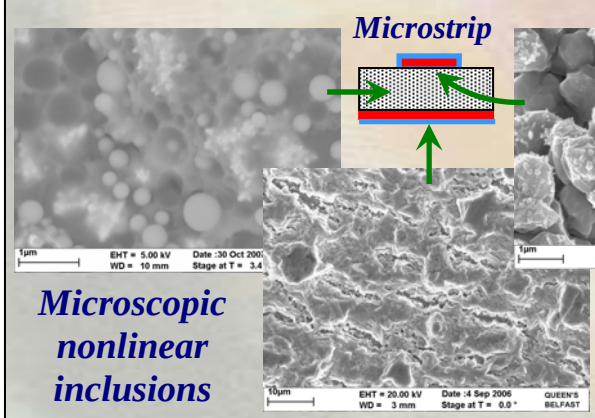


Co-factors of vulnerability:

- Higher Tx power
- Higher Rx sensitivity
- Denser band population
- Shared antennas
- Multi-channelling
- Colocation

Corrupted & Distorted Information Due to Unwanted Signals at Receiver End

Distributed Generation of Passive Intermodulation

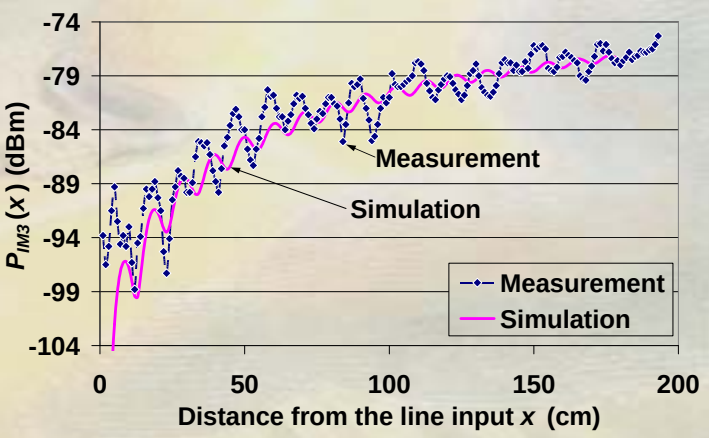


Microscopic nonlinear inclusions

Microscopic roughness

Nonlinear coatings

Distributed PIM generation is collective response of ensemble of microscopic nonlinearities resulting in cumulative intensification of forward propagating PIM products on the nonlinear transmission line due to their phase synchronism



Research Framework

Distributed PIM Phenomena in Printed Circuits & Metallic Waveguide Components

- **Phenomenology**
  - **Nonlinear Transmission Line**
  - **Rigorous Electromagnetic Analysis**
- **Experimental Characterisation**
  - **Two-port Transmission/Reflection Measurements**
  - **Field Mapping of PIM Product Distribution**

Modelling and Prediction of PIM Distortion in RF Components

PIM Characterisation: Standardisation of Methodology & Production Quality

New Low-PIM Materials and Technologies for 3G/4G Wireless Communications

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