Radio Technology SIG

‘Power Amplifier Techniques Workshop’

22 May 2018

Sponsored by Rohde & Schwarz

This SIG is championed byMark Beach, **University of Bristol**, Brian Collins, **BSC Associates**,

Diego Giancola, **PA Consulting Group** and Peter Topham, **Qualcomm Technologies International**

**Venue: Jesus College, Cambridge, CB5 8BL**

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| **AGENDA** | **WiFi Username: Jesus College guest / No password required** |
| **9:45** | Registration and networking with refreshments |
| **10:30** | Introduction to Radio Technology SIG from **Peter Topham,** **Qualcomm Technologies International****Morning sessions chaired by Peter Topham,** **Qualcomm Technologies International** |
| **10:40** | Welcome from sponsor, **Lindsay Harris,** **Rohde & Schwarz** |
| **10:50** | **An introduction to RF Power Amplifier Design****Chris Potter, CambridgeRF**Almost no two power amplifiers are the same, many design decisions need to be made in choosing the correct device and circuit topology. This presentation introduces the considerations that need to be taken into account to meet the requirements of power, frequency, linearity, efficiency etc. Some of the key specs and corresponding measurements will be described. |
| **11:30** | Q&A |
| **11:50** | **High Efficiency Modes****Steve Cripps, University of Cardiff**This talk will focus on some more recent developments in PA modes, including Class J and so-called “continuous” modes, and the more controversial subject of switch modes and their relevance at GHz frequencies. The universally ignored effect of soft device IV characteristics will also be discussed. |
| **12:30** | Q&A |
| **12:50** | **Lunch and networking** |
| **13:50** | **Afternoon sessions chaired by Brian Collins,** **BSC Associates****Envelope Tracking****Gerard Wimpenny, Qualcomm Technologies International**This talk will introduce Envelope Tracking as a PA efficiency enhancement technique and will cover the advantages and challenges of ET compared with fixed supply, Average Power Tracking (APT) and Envelope Elimination and Restoration (EER) PAs. It will go on to consider 3 port ‘surface’ characterization of ET PAs and the influence of the choice of envelope shaping function on PA efficiency and system linearity. |
| **14:30** | Q&A |
| **14:50** | **Digital Predistortion and Correction Techniques****Kevin Morris, University of Bristol**This talk will cover a number of digital correction techniques, including digital predistortion, adaptive distortion and Cartesian loop. These will be considered in terms of operating bandwidth, amount of improvement possible and effects of adjacent channel performance. |
| **15:30** | Q&A |
| **15:50** | **Refreshments and networking**  |
| **16:30** | **Architectural Enhancements to Power Amplifiers & Transmitters****Gareth Lloyd, Rohde & Schwarz**The energy efficiency and signal integrity of an amplifier, or transmitter, may be significantly enhanced by implementing architectural concepts. Historically, much research effort has been dedicated to such techniques. This presentation provides a quick hierarchical overview of the concepts, before discussing and demonstrating variants of one of the most popular classifications. |
|  **17:10** | Q&A |
| **17:45** | **Event close** |
| **With the permission of the speakers, presentations will be loaded to the CW website following the event** |

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| **Profile of organisers** |

**Cambridge Wireless (CW)**

CW is the leading international community for companies involved in the research, development and application of wireless and mobile, internet, semiconductor and software technologies. With over 400 members from major network operators and device manufacturers to innovative start-ups and universities, CW stimulates debate and collaboration, harnesses and shares knowledge, and helps to build connections between academia and industry. CW's 20 Special Interest Groups (SIGs) provide its members with a dynamic forum where they can network with their peers, track the latest technology trends and business developments and position their organisations in key market sectors. CW also organises major conferences and start-up competitions along with other high-quality industry networking events and dinners. With headquarters at the heart of Cambridge, UK, CW partners with other international industry clusters and organisations to extend its reach and remain at the forefront of global developments and business opportunities. [**www.cambridgewireless.co.uk**](http://www.cambridgewireless.co.uk)

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| **Profile of Host** |

**Jesus College, Cambridge**

Jesus College is on a single large site on a quiet side street in the centre of Cambridge. It was established between 1496 and 1516 on the site of the twelfth-century Benedictine nunnery of St Mary and St Radegund whose buildings, which included a huge church, were adapted to house it. These buildings remain at the College’s centre, and beyond them there are 24 acres of sports fields and gardens. [**https://www.jesus.cam.ac.uk/**](https://www.jesus.cam.ac.uk/)

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| **Profile of sponsor** |

**Rohde & Schwarz**

Rohde & Schwarz UK Ltd has been the UK subsidiary of Rohde & Schwarz GmBH for 40 years. Based in Fleet, RSUK employs 105 people to provide dedicated sales, services and support to customers across the UK and Ireland. Rohde & Schwarz has designed and manufactured the highest-quality specialist products in Germany for 77 years across a wide range of technologies and industries, including wireless, broadcast, aerospace, defence and security markets. [**www.rohde-schwarz.com**](https://www.rohde-schwarz.com/uk/home_48230.html)

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| **Profile of SIG Champions** |

**Mark Beach, University of Bristol**

Mark Beach received his PhD for research addressing the application of Smart Antenna techniques to GPS from the University of Bristol in 1989, where he subsequently joined as a member of academic staff. He was promoted to Senior Lecturer in 1996, Reader in 1998 and Professor in 2003. He was Head of the Department of Electrical & Electronic Engineering from 2006 to 2010, and then spearheaded Bristol’s hosting of the EPSRC Centre for Doctoral Training (CDT) in Communications. He currently manages the delivery of the CDT in Communications, leads research in the field of enabling technologies for the delivery of 5G and beyond wireless connectivity, as well as his role as the School Research Impact Director. Mark’s current research activities are delivered through the Communication Systems and Networks Group, forming a key component within Bristol’s Smart Internet Lab. He has over 25 years of physical layer wireless research embracing the application of Spread Spectrum technology for cellular systems, adaptive or smart antenna for capacity and range extension in wireless networks, MIMO aided connectivity for through-put enhancement, Millimetre Wave technologies as well as flexible RF technologies for SDR modems underpins his current research portfolio. [**www.bristol.ac.uk**](http://www.bristol.ac.uk/)

**Brian Collins, BSC Associates**

Brian has designed antennas for applications including radio and TV broadcasting, base stations, handsets and consumer products, and has operated his own consultancy firm for the last 12 years. He has published more than 70 papers on antenna topics and contributed chapters to several recent textbooks. He operates a small consultancy company, chairs the Antenna Interface Standards Group and is an Honorary Visiting Professor in the School of Electronic Engineering and Computer Science at Queen Mary, University of London. [**www.bscassociates.co.uk**](http://www.bscassociates.co.uk/)

**Diego Giancola, PA Consulting Group**

Diego has spent his career in radio systems R&D and modem design in the wireless communication sector, from 2G to the latest 4G evolutions. His research interests lie in multi-antenna systems and novel signal processing and architectures for radio signals. He currently co-runs PA’s signal processing team and leads the research activities in LTE evolution and 5G landscaping. Diego has a first degree in telecommunication engineering and a doctorate in electronics and communication engineering from Politecnico di Milano. [**www.paconsulting.com**](http://www.paconsulting.com/)

**Peter Topham, Qualcomm Technologies Inc.**

Peter has more than 30 years’ experience of RF and high-speed circuit design, taking chips into production ranging from FM Band II through cellular, Bluetooth and on to UWB at 10GHz. He has been with Qualcomm for 7 years, specialising in low-power RF design for portable and wearable products. [**www.qualcomm.com**](https://www.qualcomm.com/)

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| **Profile of speakers** |

**Steve Cripps, University of Cardiff**

Prof. Cripps graduated from Cambridge University, England, with a Masters and Ph.D. in the mid 1970’s, and then spent many years working in the microwave electronics industry, both in the UK and California. This included spells as designer, manager, company founder (Celeritek), and independent consultant. He has written several books on RF Power Amplifiers and was the recipient of both 2008 IEEE Microwave Applications Award and the 2015 Microwave Prize for his work in RFPA design. Prof. Cripps is currently a Distinguished Research Professor at Cardiff University, Wales, UK and a Life Fellow of the IEEE. [**www.cardiff.ac.uk**](http://www.cardiff.ac.uk)

**Gareth Lloyd, Rhode & Schwartz**

Gareth Lloyd graduated from the University of Leeds in 1994 with a degree in Electronic & Electrical Engineering. Gareth has worked in various engineering and management roles, in different industries, for major companies including Ericsson, Huawei, ZTE, TriQuint and Andrew Corporation. Gareth joined Rohde & Schwarz in 2015, as a Senior Expert. His primary work focus is performance differentiated radio front-ends (RFFE). [**www.rohde-schwarz.com**](http://www.rohde-schwarz.com)

**Kevin Morris, University of Bristol**

Kevin Morris received the B.Eng. and Ph.D. degrees in electronics and communications engineering from the University of Bristol, Bristol, U.K., in 1995 and 2000, respectively. He is currently a Reader of RF engineering and Head of the Department of Electrical and Electronic Engineering, University of Bristol. He has authored or co-authored over 90 academic papers and he holds five patents. His research interests principally concern looking at methods of reducing power consumption in communications systems including the area of RF hardware design with a specific interest in the design of efficient linear broadband power amplifiers for use within future communications systems. Dr. Morris is currently involved with a number of the Engineering and Physical Sciences Research Council (EPSRC) research programmes including FARAD and SENSE and industry funded research programmes within the U.K. He is a member of the UK Electronic Skills Foundation (UK-ESF) Strategic Advisory board. [**www.bristol.ac.uk**](http://www.bristol.ac.uk)

**Chris Potter, Cambridge RF**

Chris Potter is presently a consultant and director with Cambridge RF Ltd. in Cambridge UK, working on circuit-level design and product integration and approvals. Diverse projects for clients include the fields of GPS receivers, Bluetooth testers, Envelope Tracking PAs, Security tag readers, Zigbee consumer products, Microwave radios, and DVB over fibre. Previously, he was Principal Engineer at Marconi Instruments, where he designed a variety of microwave and RF test equipment including signal generators and network analyzers. Later he held the post of Chief RF Technologist at Tality UK (formerly Symbionics), working on RF architectures and product designs for GSM, EDGE, Bluetooth, 802.11a/b and W-CDMA. His research interests include adaptive linearization of PAs. He also runs Aphena Ltd, a software company that produces tools for RF engineers to help with measurement automation during the design process. Chris Potter received his Ph.D. degree on the subject of Microwave Network Analysers in 1987 from the University of London, England. [**www.cambridgerf.com**](http://www.cambridgerf.com/)

**Gerard Wimpenny, Qualcomm Technologies Inc.**

Gerard Wimpenny graduated from Cambridge University in 1983 with a degree in Electrical Sciences. He worked on a wide variety of RF and PAs developments at BBC R&D and subsequently as Technical Director at Symbionics/Tality. He joined Cambridge startup Nujira as CTO in 2004 and worked on Envelope Tracking modulators with output powers spanning 1W to >1000W. Nujira was acquired by Qualcomm in 2015 and Gerard now works at Qualcomm UK as a Senior Director of Technology focusing on Envelope Tracking.

Biography to follow. [**www.qualcomm.com**](http://www.qualcomm.com)