

ZOYA POPOVIĆ

Distinguished Professor and Lockheed Martin Endowed Chair
Department of Electrical, Computer and Energy Engineering
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EDUCATION

Ph.D., Electrical Engineering, Caltech, 1990. Thesis advisor: Prof. David Rutledge.
Dipl.Ing. (B.S.), Electrical Engineering, University of Belgrade, Serbia, Yugoslavia, 1985.

Zoya Popović received her Dipl. Ing. degree from the University of Belgrade, Serbia, in 1985, and the M.S. and Ph.D. degrees from Caltech, Pasadena, California, in 1986 and 1990, respectively. Her doctoral thesis was on large-scale quasi-optical microwave power combining. She joined the faculty of the University of Colorado in Boulder in August 1990, where she became a full professor in 1998, and received the Hudson Moore Jr. endowed professorship in 2006. She was named Distinguished Professor in 2010 and Lockheed Martin Endowed Chair in 2017. She has developed five undergraduate and graduate electromagnetics and microwave laboratory courses and co-authored (with her late father) *Introductory Electromagnetics* for the junior-level core course for electrical and computer engineering students, translated to several foreign languages. Her research interests include high-efficiency linear microwave power amplifiers, low-loss broadband microwave and millimeter-wave circuits, medical applications of microwaves, intelligent RF circuits, active antenna arrays, cryogenic circuits, microwave radiometry, and wireless powering for low-power sensors. She was a Visiting Professor at the Technische Universitat Muenchen, Munich, Germany, in 2001 and 2003, and at Supaero (ISAE), Toulouse, in 2014 and a Chair of Excellence at Carlos III University in Madrid, Spain, in 2018/19.

RECOGNITION

- Elected as Member of the National Academy of Engineering, 2022
- *Doktora Honoris Causa* (Honorary PhD), Carlos III Univ. of Madrid, Spain, 2022
- Chair of Excellence, Carlos III University of Madrid, Spain, 2018-2019
- Carnegie Mellon Judith Resnik Distinguished Lecture, 2017
- University of Colorado Distinguished Research Lecturer, 2015
- University of Utah Distinguished Judd Lecturer, 2015
- IEEE Rudy Henning Distinguished Mentoring award, 2015
- IEEE MTT Distinguished Educator Award, 2013
- Holland Teaching Award, University of Colorado, 2011 and 2013
- Distinguished Professor, University of Colorado, 2010
- Coleman Research Fellow, Coleman Institute, 2008
- Faculty Research Award, College of Engineering and Applied Science, 2007
- Elected Foreign Member of Serbian Academy of Sciences and Arts, 2006
- Microwave Prize, IEEE MTT Society, 2005, best journal paper award and
- Microwave Prize, IEEE MTT Society, 1993, best journal paper award
- Fellow, IEEE, 2002
- ASEE HP/Terman Award 2001, for combined teaching and research excellence
- Humboldt Research Award for Senior Scientists, German Humboldt Foundation, 2000/2001
- Margaret Willard Award, University of Colorado, 1997, as female role model
- Eta Kappa Nu professor of the year award, 1997, by student vote
- URSI Issac Koga Gold Medal, Lille, France, 1996, awarded once every three years
- White House NSF Presidential Faculty Fellow Award, 1993
- URSI Young Scientist, Kyoto, Japan, 1993
- City of Belgrade October Award for the Diploma Thesis in 1985

FUNDING SUMMARY

- Current funding sources: NSF, DARPA, ONR, Navy CRANE, AFOSR, Lockheed Martin, Qorvo, Analog Devices, ColdQuanta, National Instruments, MIT Lincoln Laboratory, HRL Laboratories, CEI, NIST, LumenAstra, OEDIT.
- Average expenditures >\$1.2M/year since 1995.

GRADUATE STUDENTS

- 70 Ph.D. students graduated and happily employed.
- 18 students currently doing their Ph.D. dissertations, 8 are women.
- Over 85% of the graduated and current graduate students are U.S. citizens.
- Former students contributing at MIT Lincoln Lab (10), Sandia (5), Keysight (2), Infineon/Wolfspeed (3), Lockheed (5), Qorvo (3), NIST, NI, ARL, NASA, TI, Qualcomm, Raytheon, various other companies and in academia (e.g. Notre Dame, Univ. of Hawaii).

Personal tidbit: wife of physics professor and JILA Fellow Dana Anderson and mother of three daughters (ages 21 to 30) who can all solder. The oldest has a PhD in electrical engineering (my contribution to diversity – 33% of my female children are EE PhDs, and 67% will have PhDs in STEM fields).

TOTAL CITATIONS (Google Scholar, July 2023): 15,999; h-index: 57

BOOKS, EDITED BOOKS AND BOOK CHAPTERS

Introductory Electromagnetics, Zoya Popovic and Branko Popovic, Prentice Hall, 2000.

Introductory Electromagnetics, Practice Problems and Labs, Zoya Popovic and Branko Popovic, Prentice Hall, 2000, *Student workbook*.

Active and Quasi-Optical Arrays for Solid-State Power Combining, eds. Robert A. York and Zoya B. Popovic, John Wiley and Sons, 1997.

- “Quasi-optical antenna array amplifiers,” Zoya Popovic, Robert York, Emilio Sovero, Jon Schoenberg, Chapter 5, pp. 187-244.
- “Grid oscillators,” Zoya Popovic, Wayne Shiroma, Robert M. Weikle, II, Chapter 8, pp. 293-330.
- “Quasi-optical subsystems,” Zoya Popovic and Gerald Johnson, Chapter, pp. 455-484.
- “Analysis and design of oscillator grids and arrays,” W. Shiroma, E. Bryerton, Z. Popovic, chapter in *Analysis and Design of Integrated Circuit/Antenna Modules*, eds. K.C. Gupta and P. Hall, Wiley and Sons, 2000, pp 301-332
- “Power amplifier approaches for high-efficiency and linearity,” with Peter Asbeck, Larry Larson and Tatsuo Itoh, Chapter in “*RF Technologies for Low-Power Wireless Communications*,” Eds. T. Itoh, G. Haddad, Wiley and Sons, pp.189-228, Wiley, 2001.
- “Magnetostatics”, with B. Popovic and M. Popovic, Chapter 3 in *Handbook of Engineering Electromagnetics*, ed. Rajeev Bansal, Marcel Dekker, 2004, pp 89-122
- “Electromagnetic induction,” with B. Popovic and M. Popovic, Chapter 4 in *Handbook of Engineering Electromagnetics*, ed. Rajeev Bansal, Marcel Dekker, 2004, pp 122-162
- “Active Antennas,” with S. Rondineau and N. Lopez, in *Antenna Engineering Handbook*, ed. John Volakis, 2007 (30 pages).
- “Active Antennas,” in *Antenna Engineering Handbook*, ed. John Volakis, 2018 (30 pages).

JOURNAL ARTICLES

1. Z. Popovic, A. Markovic, "The THD Characteristics of the Phase Detector," *IEEE Trans. on Consumer Electronics*, CE-32, No.1, pp. 20-25, Feb. 1986.
2. R. C. Compton, R. C. McPhedran, Z. Popovic, G. M. Rebeiz, P. P. Tong, D. B. Rutledge, "Bow-tie antennas on a dielectric half-space: Theory and Experiment," *IEEE Trans. on Antennas and Propagation*, AP-35, pp. 622-631, June, 1987.
3. Z. Popovic, M. Kim, D. B. Rutledge, "Grid Oscillators," *International Journal for Infrared and Millimeter Waves* 9, pp. 647-654, 1988.
4. Z. Popovic, R. M. Wickle, M. Kim, K. A. Potter, D. B. Rutledge, "Bar-Grid Oscillators," *IEEE Transactions on Microwave Theory and Techniques*, MTT-38, No.3, March 1990.
5. R. J. Hwu, C. F. Jou, N. C. Luhmann Jr., M. Kim, W. W. Lam, Z. Popovic, D. B. Rutledge, "Array Concepts for Solid-State and Vacuum Microelectronics Millimeter-Wave Generation," *IEEE Transactions on Electron Devices*, Vol. 36, No. 11, Nov. 1989.
6. Z. Popovic, R. M. Wickle, M. Kim, D. B. Rutledge, "A 100-MESFET Planar Grid Oscillator," *IEEE Transactions on Microwave Theory and Techniques*, Vol. MTT-39, No. 2, pp. 193-200, Feb. 1991. **(Winner of IEEE Microwave Prize for best paper of the year)**
7. R.M. Weikle, II, M. Kim, J.B. Hacker, M.P. DeLisio, Z. Popovic, D.B. Rutledge, "Transistor Oscillator and Amplifier Grids," *Invited paper, Proc. IEEE*, Vol. 80, No. 11, pp 1800-1809, Nov. 1992.
8. S. Bundy, T. Mader, Z. Popovic, "Quasi-Optical VCOs," *IEEE Transactions on Microwave Theory and Techniques*, Special Issue, Vol. 41, No. 10, pp 1775-1781, October 1993.
9. V. Radisic, D. Hjelme, A.R. Mickelson, Z. Popovic, "Experimentally Variable Modeling of Coplanar Waveguide Discontinuities," *IEEE Transactions on Microwave Theory and Techniques*, Special Issue, Vol 41, No. 9, pp 1524-1533, September 1993.
10. V. Radisic, V. Jevremovic, Z. Popovic, "CPW Oscillator Conjugation for an Electro-Optic Modulator," *IEEE Transactions on Microwave Theory and Techniques*, Special Issue, Vol 41, No. 9, pp 1645-1647, September 1993.
11. T. Mader, J. Schoenberg, L. Harmon, Z. Popovic, "Planar MESFET Transmission Wave Amplifier," *IEE Electronic Letters*, Vol. 28, No. 19, pp. 1699-1701, September 1993.
12. Z. Popovic, B. D. Popovic, "Time-efficient modeling of the effect of metal packages on electrical circuits," *IEEE Transactions on Microwave Theory and Techniques*, Special Issue on Packaging and Interconnects, Vol.42, No.9, pp. 1820-1826, September 1994.
13. W. A. Shiroma, B. L. Shaw, Z. Popovic, "A 100-transistor quadruple grid oscillator," *IEEE MTT Microwave and Guided Wave Letters*, Vol.4, No.10, pp. 350-352, October 1994.
14. J. S. H. Schoenberg, S. C. Bundy, Z. Popovic, "Two-level power combining using a lens amplifier," *IEEE Transactions on Microwave Theory and Techniques*, Vol.42, No.12, pp. 2480 -2485, December 1994.
15. S. C. Bundy, Z. B. Popovic, "A generalized analysis for grid oscillator design," *IEEE Transactions on Microwave Theory and Techniques*, Vol.42, No.12, pp. 2486-2491, December 1994.
16. T.B. Mader, Z. B. Popovic, "The transmission-line high-efficiency class-E amplifier," *IEEE MTT Microwave and Guided Wave Letters*, Vol.5, No.10, pp. 290-293, October 1995.
17. B.D. Popovic, J. Schoenberg, Z.B. Popovic "Broadband Quasi-Microstrip Antenna," *IEEE Trans. on Antennas and Propagation*, Vol.43, No.10, pp.1148-1152, October 1995.
18. W. Shiroma, S. Bundy, S. Hollung, B. Bauernfiend, Z.B. Popovic, "Cascaded active and passive quasi-optical grids," *W IEEE Trans. on Microwave Theory and Techniques*, Vol.43, No.12, pp. 2904-2909, December 1995.
19. S. Hollung, M. Markovic, W. Shiroma, Z.B. Popovic, "A quasi-optical isolator," *IEEE Microwave and Guided Wave Lett.*, pp. 205-207, April 1996.
20. E. Bryerton, W. Shiroma, Z.B. Popovic, "A 5-GHz high-efficiency class-E oscillator," *IEEE Microwave and Guided Wave Lett.*, Vol.6, No.12, pp. 441-443, December 1996.

21. S. Hollung, A. Cox, Z. Popovic, "A bi-directional quasi-optical lens amplifier," *IEEE Trans. on Microwave Theory and Techniques*, Vol.45, No.12, pp. 2352-2357, December 1997.
22. W.A. Shiroma, Z. Popovic, "Analysis and optimization of grid oscillators," *IEEE Trans. on Microwave Theory and Techniques*, Vol.45, No.12, pp. 2380-2386, December 1997.
23. T. Mader, E. Bryerton, M. Markovic, M. Forman, Z.B. Popovic, "Switched-mode high-efficiency microwave power amplifiers in a free-space power combining array," *IEEE Trans. on Microwave Theory and Techniques*, Vol.48, No.10, pp. 1391-1398, October 1998.
24. Z. Popovic, A. Mortazawi, "Quasi-optical transmit/receive front ends," *invited paper, IEEE Trans. on Microwave Theory and Techniques*, Vol. 48, No. 11, pp. 1964-1975, November 1998.
25. M. Markovic, A. Kain, Z. Popovic, "Nonlinear modeling of class-E microwave power amplifiers," *Journal of the RF and Microwave Computer-Aided Engineering*, Vol.9, Issue 2, pp 93-103, March/April 1999.
26. S. Djukic, D. Maksimovic, Z. Popovic, "A planar 4.5-GHz DC to DC power converter," *Special Issue on Low-Power/Low-Noise Circuits of the IEEE Trans. Microwave Theory Techn.*, pp.1457-1460, July 1999.
27. E. Bryerton, M. Weiss, Z. Popovic, "Efficiency of chip-level versus external power combining," *Special Issue on Low-Power/Low-Noise Circuits of the IEEE Trans. Microwave Theory Techn.*, pp.1482-1485, July 1999.
28. J. Mix, J. Dixon, Z. Popovic, M. Piket-May, "Incorporating non-linear lumped elements in FDTD: the equivalent source method," *International Journal of Numerical Modeling: Electronic networks, devices and fields*, *Int. J. Numer. Model.* 12 , pp.157-170, 1999.
29. M. Forman, T. Marshall, Z. Popovic, "Two Ka-band quasi-optical amplifier arrays," *IEEE Trans. on Microwave Theory and Techniques*, Vol.47, No.12, pp.2568-2573, December 1999.
30. M. Weiss, M. Crites, E. Bryerton, J. Whitacker, Z. Popovic, "Time domain optical sampling of nonlinear microwave amplifiers and multipliers," *IEEE Trans. on Microwave Theory and Techniques*, Vol.47, No.12, pp. 2599-2604, December 1999.
31. M. McDonald, R. A. York, E. Grossman, Z. Popovic, "Spectral transmittance of lossy printed resonant-grid terahertz bandpass filters," *IEEE Trans. on Microwave Theory and Techniques*, *Special Issue on Terahertz Electronics*, Vol 48, No. 4, pp 712-718, April 2000.
32. B. Notaros, B. Popovic, J. Peeters Weem, R. Brown, Z. Popovic, "Efficient large-domain MOM solutions to electrically large practical EM problems," *IEEE Trans. on Microwave Theory and Techniques*, Vol. 49, No. 1, pp 151-159, Jan 2001.
33. J. Vian, Z. Popovic, "A transmit/receive active antenna with fast low-power optical switching," *IEEE Trans. on Microwave Theory and Techniques* Vol 48, No. 12, pp 2686-2691, Dec. 2000.
34. K. Yang, T. Marshall, M. Forman, Z. Popovic, J. Hubert, L. Mirth, L.P.B. Katehi, J.F. Whitaker, "Active-amplifier-array diagnostics using high-resolution electrooptic field mapping," *IEEE Trans. on Microwave Theory and Techniques*, Vol 49, No. 5, pp 849-857, May 2001.
35. M. Weiss, Z. Popovic, F. H. Raab, "Linearity of X-band class-F power amplifiers in high-efficiency transmitters," *IEEE Trans. on Microwave Theory and Techniques* Vol 49, No. 6, pp 1174-1179, June 2001.
36. D.Z Anderson, V Damiao, D. Popovic, Z. Popovic, S. Romisch, A. Sullivan, "-70dB optical carrier suppression by two-beam coupling in photorefractive media," *Applied Physics B*, 72, pp 743-748, 2001.
37. D. Popovic, Z. Popovic, "Multibeam antennas with polarization and angle diversity," *IEEE Trans. Antennas and Propagation*, *Special Issue on Wireless Communications*, pp. 651-657, May 2002.
38. D. Anderson, E. Fotheringham, S. Romisch, P. Smith, Z. Popovic, "A lens antenna array with adaptive optical processing," *IEEE Trans. Antennas and Propagation*, *Special Issue on Wireless Communications*, pp. 607-617, May 2002.
39. F. H. Raab, P. Asbeck, S. Cripps, P.B. Kenington, Z. Popovic, N. Potheary, J. F. Sevic, N. O. Sokal, "Power amplifiers and transmitters for RF and microwave," *IEEE Trans. Microwave Theory and Techn.*, Vol. 50, No. 3, pp. 814-826, Mar 2002.

40. S. Pajic, Z. Popovic, "An efficient 16-element X-band spatial combiner of switched-mode power amplifiers," *IEEE Trans. Microwave Theory and Techn.*, Vol. 51, No.73, July 2003.
41. H. Loui, J. Peeters Weem, Z. Popovic, "A dual-band dual-polarized nested Vivaldi slot array with multilevel ground plane," *IEEE Trans. Antennas and Propagation*, Sept. 2003.
42. J.A. Hagerty, F. Helmbrecht, W. McCalpin, R. Zane, Z. Popovic, "Recycling ambient microwave energy with broadband antenna arrays," *IEEE Trans. Microwave Theory and Techn.*, pp. 1014-1024, March 2004. (**Winner of IEEE Microwave Prize for best paper of the year**)
43. N. Wang, V. Yousefzadeh, S. Pajic, D. Maksimovic, Z. Popovic, "60-% efficient 10-GHz power amplifier with dynamic drain bias control," *IEEE Trans. Microwave Theory and Techn*, 2004, Vol 52(3) pp 1077 - 1081, March 2004.
44. N. Wang, X. Peng, V. Yousefzadeh, D. Maksimovic, S. Pajic, Z. Popovic, "Linearity of X-Band Class-E Power Amplifiers in EER Operation," *Microwave Theory and Techniques, IEEE Transactions on*, Vol 53 (3), March 2005 Page(s):1096 – 1102
45. S. Pajic, N. Wang, P.M. Watson, T. K. Quatch, Z. Popovic, "X-band Two-Stage High-Efficiency Switched-Mode Power Amplifiers," *Microwave Theory and Techniques, IEEE Transactions on*, Vol 53 (9), Sept. 2005 Page(s):2899 – 2908
46. Y. Zhou, S. Rondineau, D. Popovic, A. Sayeed, Z. Popovic, "Virtual Channel Space-Time with Dual-Polarization Discrete Lens Antenna Arrays," *IEEE Trans. Antennas and Propagation*, Vol. 53 (8), Aug. 2005, Page(s): 2444-2455
47. V. Yousefzadeh, N. Wang, Z. Popović, D. Maksimović, "A digitally controlled DC-DC converter for an RF power amplifier," *IEEE Transactions on Power Electronics*, Vol.21, No.1, January 2006, pp. 164-172.
48. M. Lukic, S. Rondineau, Z. Popovic, D. Filipovic, "Modeling of realistic rectangular micro-coaxial lines," *IEEE Trans. Microw. Theory Techn.*, vol. 54, no. 5, pp. 2068-2076, May 2006.
49. K. Vanhille, D. Fontaine, C. Nichols, D. Filipovic, Z. Popovic, "Quasi-planar high-Q millimeter wave resonators," *IEEE Trans. Microw. Theory Techn.*, vol.54, no.6, pp.2439-2446, June 2006.
50. P. Bell, N. Hoivik, R. Saravanan, N. Ehsan, V. Bright, Z. Popovic, "Flip-chip assembled air-suspended inductors," *IEEE Trans. On Advanced Packaging*, Vol. 30, No. 1, Feb. 2007.
51. K. Vanhille, D. Fontaine, C. Nichols, Z. Popovic, D. Filipovic, "Ka-band Miniaturized Quasi-Planar High-Q Resonators," *IEEE Trans. Microw. Theory Techn.*, vol.55, no.6, pp. 1272-1279, June 2007.
52. X. Zhao, T. Qian, G. Mei, C. Kwan, R. Zane, C. Walsh, T. Paing, Z. Popovic, "Active health monitoring of an aircraft wing with an embedded piezoelectric sensor/actuator network: II. Wireless approaches," *Smart Materials and Structures*, 16(2007), pp. 1218-1225, June 2007.
53. C. Dietlein, A. Luukanen, Z. Popovic, E. Grossman, "A W-band polarization converter and isolator," *IEEE Trans. Antennas and Prop.*, vol.55, No.6, pp. 1804-1809, June 2007.
54. D. Skigin, H. Loui, E. Kuester, Z. Popovic, "Bandwidth control of forbidden transmission gaps in compound structures with subwavelength slits," *Phys. Rev. E* 76, 016604, 2007.
55. M. Jankovic, J. Breitbarth, A. Brannon, Z. Popovic, "Measuring transistor large-signal noise figure for low-power and low phase-noise oscillator design," *IEEE Trans. Microw. Theory Techn.*, vol. 56, no. 7, pp. 1511-1515, June 2007.
56. C. Dietlein, Z. Popovic, E. N. Grossman, "Aqueous blackbody calibration source for millimeter-wave/terahertz metrology," *Applied Optics*, Vol. 47, No. 30, pp. 5604-5615, Oct. 2008.
57. X. Shen, C. Dietlein, E. Grossman, Z. Popovic, F. Meyer, "Detection and Segmentation of Concealed Objects in Terahertz Images," *IEEE Trans. Image Processing*, vol. 17, no. 12, pp. 2465-2475, Dec. 2008.
58. T. Paing, J. Shin, R. Zane, Z. Popovic, "Resistor Emulator Approach to Low-Power RF Energy Harvesting," *IEEE Trans. Power Electronics*, vol. 23, no. 3, pp. 1494-1501, May 2008.
59. L. Ranzani, P. Boffi, R. Siano, S. Rondineau, Z. Popovic, M. Martinelli, "Microwave-domain analog predistortion based on chirped delay lines for dispersion compensation of 10-Gb/s optical communication signals," *Journal of Lightwave Techn.*, vol.26, no.15, pp. 2641-2646, Aug. 2008.

60. M. Elsbury, C. Burroughs, P. Dresselhaus, Z. Popovic, S. Benz, "Microwave packaging for applied voltage standard applications," *IEEE Trans. Superconductivity*, vol. 19, no. 3, pp. 1012-1015, June 2009.
61. M. Elsbury, P. Dresselhaus, N. Bergen, C. Burroughs, S. Benz, Z. Popovic, "Broadband lumped-element integrated N-way power dividers for voltage standards," *IEEE Trans. Microw. Theory Techn.*, vol. 57, no. 8, pp. 2055-2063, Aug. 2009.
62. N. Ehsan, K. Vanhille, S. Rondineau, E. Cullens, Z. Popovic, "Broadband micro-coaxial Wilkinson dividers," *IEEE Trans. Microw. Theory Techn.*, vol. 57, no. 11, pp. 2783-2789, Nov. 2009.
63. R. Paul, L. Sankey, L. Corradini, Z. Popovic, D. Maksimovic, "Power Management of Wideband Code Division Multiple Access RF Power Amplifiers With Antenna Mismatch," *IEEE Trans. Power Electronics*, vol. 25, No. 4, pp. 981-991, Apr. 2010.
64. Q. Mu, J. Coleman, S. Scholnik, Z. Popovic, "Circuit approaches to nonlinear IDI mitigation in noise shaped bandpass D/A conversion," *IEEE Trans. Circuits and Systems I*, vol.57, issue 7, pp. 1559 – 1572, 2010.
65. N. Ehsan, KJ. Vanhille, S. Rondineau, Z. Popovic, "Micro-coaxial Impedance Transformers," *Microwave Theory and Techniques, IEEE Transactions on*, Vol 58 (11), Nov.2010 Page(s):2908 - 2914
66. A. Dolgov, R. Zane, Z. Popovic, "Power Management System for Online Low Power RF Energy Harvesting Optimization," *IEEE Transactions on Circuits and Systems -I*, pp. 1802-1811, 2010.
67. T. Paing, E. A. Falkenstein, R. Zane and Z. Popovic, "Custom IC for Ultralow Power RF Energy Scavenging," *IEEE Transactions on Power Electronics*, vol. 26, no. 6, pp. 1620-1626, June 2011.
68. J. Chisum, E. Grossman, Z. Popovic, "A General Approach to Low Noise Readout of Terahertz Imaging Arrays," *Review of Scientific Instruments*, Vol. 82, 065106-01 to 08, June 2011.
69. M. Roberg, Z. Popovic, "Analysis of High Efficiency Power Amplifiers with Arbitrary Output Harmonic Terminations" *IEEE Trans. Microwave Theory Techn.*, pp. 2037-2048, Aug. 2011.
70. Z. Popovic, E. Grossman, "THz Metrology and Instrumentation," *Invited Paper, Inaugural issue of the IEEE Transactions on THz Science and Technology*, pp. 133-144, Sept. 2011.
71. D. Costinett, E. Falkenstein, R. Zane, Z. Popovic, "Far-field RF-powered variable duty cycle wireless sensor platform," *IEEE Trans. Circuits and Systems*, , pp.822-827, Vol. 58, Dec. 2011.
72. D.G. Kuester, D.R. Novotny, J.R. Guerrieri, A. Ibrahim, Z. Popović, "Simple Test and Modeling of RFID Tag Backscatter", *IEEE Trans. Microwave Theory Techn.*, Vol.60, No.7, pp. 2248-2258, July 2012.
73. J. D. Chisum, Z. Popovic, "Performance Limitations and Measurement Analysis of a Near-Field Microwave Microscope for Nondestructive and Subsurface Detection," *IEEE Trans. Microwave Theory Techn.*, Vol. 60, pp. 2037-2048, Aug. 2012.
74. Cullens, E.D., Ranzani, L., Vanhille, K. J. ; Grossman, E. N. ; Ehsan, N. ; Popovic, Z., "Micro-Fabricated 130–180 GHz Frequency Scanning Waveguide Arrays," *IEEE Trans. Antennas and Prop*, vol.60, no.8, pp. 3647 – 3653, Aug.2012.
75. Ranzani, L. Spietz, Z. Popovic, J. Aumentado, "A 4:1 Transmission-Line Impedance Transformer for Broadband Superconducting Circuits," *L. IEEE Trans. Applied Superconductivity*, Vol.22, No.5, 15000606, Oct.2012.
76. M. Roberg, M. Rodríguez, D. Maksimovic, Z. Popovic, "Efficient and Linear Amplification of Spectrally Confined Pulsed AM Radar Signals," *IEEE Microwave and Wireless Component Letters*, Vol. 22, No.6, pp. 279-282, June 2012.
77. J. Hoversten, S. Schafer, M. Roberg, M. Norris, D. Maksimović, Z. Popović, "Co-design of PA, Supply, and Signal Processing for Linear Supply-Modulated RF Transmitters," *IEEE Trans. Microwave Theory Techn.*, Vol. 60, No.6, pp.2010-2020, June 2012.
78. M. Roberg, T. Reveyrand, I. Ramos, E.A. Falkenstein, Z. Popović, "High-Efficiency Harmonically Terminated Diode and Transistor Rectifiers," *IEEE Trans. Microwave Theory Techn.*, Vol. 60, No.12, pp.4043-4052, Dec. 2012.

79. Falkenstein, E.; Roberg, M.; Popovic, Z.; , "Low-Power Wireless Power Delivery," *Microwave Theory and Techniques, IEEE Transactions on* , vol.60, no.7, pp.2277-2286, July 2012
80. T. Reveyrand, I. Ramos, Z. Popovic, "Time-reversal duality of high-efficiency RF power amplifiers," *IET Electronics Lett*, Vol.48, No.25, Dec. 6, 2012
81. A. Dani, M. Roberg, Z. Popovic, "PA Efficiency and Linearity Enhancement using External Harmonic Injection," *IEEE Trans. Microwave Theory Techn.*, Vol. 60, No.12, pp.4097-4106, Dec. 2012.
82. Ranzani, Leonardo; Spietz, Lafe; Popovic, Zoya; Aumentado, Jose, "Two-port microwave calibration at millikelvin temperatures," *Review of Scientific Instruments* , vol.84, no.3, pp.034704,034704-9, Mar 2013
83. Ranzani, L.; Cullens, E.D.; Kuester, D.; Vanhille, K.J.; Grossman, E.; Popovic, Z., "W-Band Micro-Fabricated Coaxially-Fed Frequency Scanned Slot Arrays," *Antennas and Propagation, IEEE Transactions on* , vol.61, no.4, pp.2324,2328, April 2013
84. Z. Popovic, "Cut the Cord: Low-Power Far-Field Wireless Powering," *Microwave Magazine, IEEE* , vol.14, no.2, pp.55,62, March-April 2013
85. Trang, F.; Rogalla, H.; Popovic, Z., "Resonant Response of High-Temperature Superconducting Split-Ring Resonators," *Applied Superconductivity, IEEE Transactions on* , vol.23, no.3, pp.1300405,1300405, June 2013
86. Kuester, D.; Popovic, "How Good Is Your Tag?: RFID Backscatter Metrics and Measurements," *Z., Microwave Magazine, IEEE* , vol.14, no.5, pp.47,55, July-Aug. 2013
87. Ranzani, L.; Kuester, D.; Vanhille, K.J.; Boryssenko, A.; Grossman, E.; Popovic, Z., "G-Band Micro-Fabricated Frequency-Steered Arrays With 2 °/GHz Beam Steering," *Terahertz Science and Technology, IEEE Transactions on* , vol.3, no.5, pp.566,573, Sept. 2013
88. Z. Popovic, E. Falkenstein, D. Constinet, R. Zane, "Low-power far-field wireless powering for wireless sensors," *Proceedings of the IEEE, Special Issue on Wireless Powering, Vol.101*, No. 6, pp. 1397 – 1409, June 2013.
89. B. Lindseth, W. Brown, T. Hock, A. Cohn, Z. Popovic, "Wind profiler radar antenna sidelobe reduction," *IEEE Trans. Antennas and Propagation, Vol. 62*, No.1, pp. 56-63, Jan. 2014.
90. M. Rodriguez, M. Roberg, A. Zai, A. Alarcon, Z. Popovic, D. Maksimovic, "Resonant pulse-shaping power supply for radar transmitters," *IEEE Trans. Power Electronics, Vol. 29*, No.2, pp.707-718 , Feb.2014
91. R. Scheeler, E. Kuester, Z. Popovic, "Sensing depth of microwave radiation for internal body temperature measurements," *IEEE Trans. Antennas and Propagation, Vol. 62*, pp.1-12, 2014
92. S. Korhummel, A. Rosen, Z. Popovic, "Over-moded cavity for multiple-electronic device wireless charging," *IEEE Trans. Microwave Theory Techn.*, Vol. 62, No.4, pp. 1074-1079, Apr. 2014
93. Z. Popović *et al.*, "Scalable RF Energy Harvesting," in *IEEE Transactions on Microwave Theory and Techniques*, vol. 62, no. 4, pp. 1046-1056, April 2014.
94. Del Prete, M.; Costanzo, A.; Georgiadis, A.; Collado, A.; Masotti, D.; Popovic, Z., "A 2.45-GHz Energy-Autonomous Wireless Power Relay Node," in *Microwave Theory and Techniques, IEEE Transactions on* , vol.63, no.12, pp.4511-4520, Dec. 2015
95. Schafer, S.; Popovic, Z., "Multi-Frequency Measurements for Supply Modulated Transmitters," in *Microwave Theory and Techniques, IEEE Transactions on* , vol.63, no.9, pp.2931-2941, Sept. 2015
96. Litchfield, M.; Reveyrand, T.; Popovic, Z., "Load Modulation Measurements of X-Band Outphasing Power Amplifiers," in *Microwave Theory and Techniques, IEEE Transactions on* , vol.63, no.12, pp.4119-4129, Dec. 2015
97. Zai, A.; Pinto, M.; Coffey, M.; Popovic, Z., "Supply-Modulated Radar Transmitters With Amplitude-Modulated Pulses," in *Microwave Theory and Techniques, IEEE Transactions on* , vol.63, no.9, pp.2953-2964, Sept. 2015

98. Ramos, I.; Ruiz Lavin, M.N.; Garcia, J.A.; Maksimovic, D.; Popovic, Z., "GaN Microwave DC–DC Converters," in *Microwave Theory and Techniques, IEEE Transactions on* , vol.63, no.12, pp.4473-4482, Dec. 2015
99. G. Lasser, L. W. Mayer, Z. Popović and C. F. Mecklenbräuker, "Low-Profile Switched-Beam Antenna Backed by an Artificial Magnetic Conductor for Efficient Close-to-Metal Operation," in *IEEE Transactions on Antennas and Propagation*, vol. 64, no. 4, pp. 1307-1316, April 2016.
100. P. Asbeck and Z. Popovic, "ET Comes of Age: Envelope Tracking for Higher-Efficiency Power Amplifiers," in *IEEE Microwave Magazine*, vol. 17, no. 3, pp. 16-25, March 2016.
101. C. Florian, T. Cappello, D. Niessen, R. P. Paganelli, S. Schafer and Z. Popović, "Efficient Programmable Pulse Shaping for X-Band GaN MMIC Radar Power Amplifiers," in *IEEE Transactions on Microwave Theory and Techniques*, vol. 65, no. 3, pp. 881-891, March 2017.
102. Z. Popovic, "Amping Up the PA for 5G: Efficient GaN Power Amplifiers with Dynamic Supplies," in *IEEE Microwave Magazine*, vol. 18, no. 3, pp. 137-149, May 2017.
103. P. Bluem, A. Kiruluta, P. F. Van de Moortele, A. Duh, G. Adriany and Z. Popović, "Patch-Probe Excitation for Ultrahigh Magnetic Field Wide-Bore MRI," in *IEEE Transactions on Microwave Theory and Techniques*, vol. 65, no. 7, pp. 2547-2557, July 2017.
104. F. J. Martinez-Rodriguez, P. Roblin, Z. Popovic and J. I. Martinez-Lopez, "Optimal Definition of Class F for Realistic Transistor Models," in *IEEE Transactions on Microwave Theory and Techniques*, vol. 65, no. 10, pp. 3585-3595, Oct. 2017.
105. S. Verploegh, M. Coffey, E. Grossman and Z. Popović, "Properties of 50–110-GHz Waveguide Components Fabricated by Metal Additive Manufacturing," in *IEEE Transactions on Microwave Theory and Techniques*, vol. 65, no. 12, pp. 5144-5153, Dec. 2017.
106. T. Cappello, T. W. Barton, C. Florian, M. Litchfield and Z. Popovic, "Multilevel Supply-Modulated Chireix Outphasing With Continuous Input Modulation," in *IEEE Transactions on Microwave Theory and Techniques*, vol. 65, no. 12, pp. 5231-5243, Dec. 2017.
107. C. Florian, T. Cappello, A. Santarelli, D. Niessen, F. Filicori and Z. Popović, "A Prepulping Technique for the Characterization of GaN Power Amplifiers With Dynamic Supply Under Controlled Thermal and Trapping States," in *IEEE Transactions on Microwave Theory and Techniques*, vol. 65, no. 12, pp. 5046-5062, Dec. 2017.
108. P. Momenroodaki, W. Haines, M. Fromandi and Z. Popovic, "Noninvasive Internal Body Temperature Tracking With Near-Field Microwave Radiometry," in *IEEE Transactions on Microwave Theory and Techniques*, vol. 66, no. 5, pp. 2535-2545, May 2018.
109. J. A. Garcia and Z. Popović, "Class-E Rectifiers and Power Converters: The Operation of the Class-E Topology as a Power Amplifier and a Rectifier with Very High Conversion Efficiencies," in *IEEE Microwave Magazine*, vol. 19, no. 5, pp. 67-78, July-Aug. 2018.
110. Z. Popovic and J. A. Garcia, "Microwave Class-E Power Amplifiers: A Brief Review of Essential Concepts in High-Frequency Class-E PAs and Related Circuits," in *IEEE Microwave Magazine*, vol. 19, no. 5, pp. 54-66, July-Aug. 2018.
111. G. P. Gibiino, C. Florian, A. Santarelli, T. Cappello and Z. Popović, "Isotrap Pulsed I-V Characterization of GaN HEMTs for PA Design," in *IEEE Microwave and Wireless Components Letters*, vol. 28, no. 8, pp. 672-674, Aug. 2018.
112. M. R. Duffy, G. Lasser, M. Olavsbråten, E. Berry and Z. Popović, "Efficient Multisignal 2-4-GHz Power Amplifier With Power Tracking," in *IEEE Transactions on Microwave Theory and Techniques*, vol. 66, no. 12, pp. 5652-5663, Dec. 2018.
113. P. Bluem, P. Van de Moortele, G. Adriany and Z. Popović, "Excitation and RF Field Control of a Human-Size 10.5-T MRI System," in *IEEE Transactions on Microwave Theory and Techniques*, vol. 67, no. 3, pp. 1184-1196, March 2019.
114. T. Cappello, C. Florian, D. Niessen, R. P. Paganelli, S. Schafer and Z. Popovic, "Efficient X-Band Transmitter With Integrated GaN Power Amplifier and Supply Modulator," in *IEEE Transactions on Microwave Theory and Techniques*, vol. 67, no. 4, pp. 1601-1614, April 2019.

115. T. Cappello, A. Duh, T. W. Barton and Z. Popovic, "A Dual-Band Dual-Output Power Amplifier for Carrier Aggregation," in *IEEE Transactions on Microwave Theory and Techniques*, early access, 2019.
116. G. Lasser, M. R. Duffy and Z. Popović, "Dynamic Dual-Gate Bias Modulation for Linearization of a High-Efficiency Multistage PA," in *IEEE Transactions on Microwave Theory and Techniques*, vol. 67, no. 7, pp. 2483-2494, July 2019.
117. C. Liang, P. Roblin, Y. Hahn, Z. Popovic and H. Chang, "Novel Outphasing Power Amplifiers Designed With an Analytic Generalized Doherty-Chireix Continuum Theory," in *IEEE Transactions on Circuits and Systems I: Regular Papers*, early access, 2019.
118. J. A. Estrada, G. Lasser, M. Pinto, F. Herrault and Z. Popović, "Metal-Embedded Chip Assembly Processing for Enhanced RF Circuit Performance," in *IEEE Transactions on Microwave Theory and Techniques*, vol. 67, no. 9, pp. 3537-3546, Sept. 2019.
119. M. R. Duffy, G. Lasser, G. Nevett, M. Roberg and Z. Popović, "A Three-Stage 18.5–24-GHz GaN-on-SiC 4 W 40% Efficient MMIC PA," in *IEEE Journal of Solid-State Circuits*, vol. 54, no. 9, pp. 2402-2410, Sept. 2019.
120. Z. Popovic, G. Artner, G. Lasser and C. F. Mecklenbraeuer, "Electromagnetic-Wave Fun Using Simple Take-Home Experiments," in *IEEE Antennas and Propagation Magazine*, vol. 62, no. 2, pp. 100-106, April 2020.
121. Santamaría-Botello, G., Zoya, P., Abdalmalak, K.A., Segovia-Vargas, D., Brown, E.R. & García Muñoz, L.E. 2020, "Sensitivity and noise in THz electro-optic upconversion radiometers", *Scientific Reports (Nature Publisher Group)*, vol. 10, no. 1.
122. J. R. Montejo-Garai, L. Marzall and Z. Popović, "Octave Bandwidth High-Performance Microstrip-to-Double-Ridge-Waveguide Transition," in *IEEE Microwave and Wireless Components Letters*, vol. 30, no. 7, pp. 637-640, July 2020.
123. J. Antonio Estrada, E. Kwiatkowski, A. Lopez, M. Borgonos, D. Segovia, T. Barton, Z. Popovic, "RF-Harvesting Tightly Coupled Rectenna Array Tee-Shirt With Greater Than Octave Bandwidth," in *IEEE Transactions on Microwave Theory and Techniques*, vol. 68, no. 9, pp. 3908-3919, Sept. 2020.
124. P. Zurek, T. Cappello and Z. Popovic, "Broadband Diplexed Power Amplifier," in *IEEE Microwave and Wireless Components Letters*, vol. 30, no. 11, pp. 1073-1076, Nov. 2020.
125. A. Estrada, S. Johannes, D. Psychogiou and Z. Popović, "Tunable Impedance-Matching Filters," in *IEEE Microwave and Wireless Components Letters*, 2021.
126. S. Verploegh, M. Pinto, L. Marzall, D. Martin, G. Lasser and Z. Popović, "Analysis of Process Variations in W-Band GaN MMIC PAs Using Nonparametric Statistics," in *IEEE Transactions on Microwave Theory and Techniques*, vol. 69, no. 4, pp. 2304-2318, April 2021.
127. J. A. Estrada, J. R. Montejo-Garai, P. de Paco, D. Psychogiou and Z. Popović, "Power Amplifiers With Frequency-Selective Matching Networks," in *IEEE Transactions on Microwave Theory and Techniques*, vol. 69, no. 1, pp. 697-708, Jan. 2021.
128. D. Fishler, Z. Popović and T. Barton, "Supply Modulation Behavior of a Doherty Power Amplifier," in *IEEE Journal of Microwaves*, vol. 1 (inaugural), no. 1, pp. 508-512, winter 2021.
129. L. Marzall, D. Psychogiou and Z. Popović, "Microstrip Ferrite Circulator Design With Control of Magnetization Distribution," in *IEEE Transactions on Microwave Theory and Techniques*, vol. 69, no. 2, pp. 1217-1226, Feb. 2021.
130. T. Cappello, Z. Popovic, K. Morris and A. Cappello, "Gaussian Pulse Characterization of RF Power Amplifiers," *IEEE Microwave and Wireless Comp. Lett.*, vol. 31, no. 4, pp. 417-420, April 2021.

131. L. Marzall, P. Danielson, G. Lasser and Z. Popović, "Broadband Small-Aperture High-Gain Ridge Horn Antenna Array Element," in *IEEE Antennas and Wireless Propagation Letters*, vol. 20, no. 5, pp. 708-712, May 2021.
132. J. A. Estrada, S. Johannes, D. Psychogiou and Z. Popović, "Tunable Impedance-Matching Filters," in *IEEE Microwave and Wireless Components Letters*, vol. 31, no. 8, pp. 993-996, Aug. 2021.
133. R. Alsulami, P. Roblin, J. I. Martinez-Lopez, Y. Hahn, C. Liang, Z. Popovic, V. Chen, "A Novel 3-Way Dual-Band Doherty Power Amplifier for Enhanced Concurrent Operation," in *IEEE Transactions on Microwave Theory and Techniques*, vol. 69, no. 9, pp. 4041-4058, Sept. 2021.
134. A. A. Babenko, G. Lasser and Z. Popović, "0.01–22-GHz Feedback-Stabilized Single-Supply GaAs Cascode Distributed Amplifiers," in *IEEE Microwave and Wireless Components Letters*, vol. 31, no. 12, pp. 1291-1294, Dec. 2021.
135. A. Babenko, N. Flowers-Jacobs, G. Lasser, J. Brevik, A. Fox, P. Dresselhaus, Z. Popovic, S. Benz, "A Microwave Quantum-Defined Millivolt Source," in *IEEE Transactions on Microwave Theory and Techniques*, Vol.69, no.12, Dec. 2021.
136. R. Streeter, G. S. Botello, K. Hall and Z. Popović, "Correlation Radiometry for Subcutaneous Temperature Measurements," in *IEEE Journal of Electromagnetics, RF and Microwaves in Medicine and Biology*, vol. 6, no. 2, pp. 230-237, Jan 2022.
137. M. Robinson, P. Danielson and Z. Popović, "Continuous Broadband GaAs and GaN MMIC Phase Shifters," in *IEEE Microwave and Wireless Components Letters*, vol. 32, no. 1, pp. 56-59, Jan. 2022.
138. E. Kwiatkowski, J. A. Estrada, A. López-Yela and Z. Popović, "Broadband RF Energy-Harvesting Arrays," in *Proceedings of the IEEE*, vol. 110, no. 1, pp. 74-88, Jan. 2022.
139. L. Marzall, M. Robinson, P. Danielson, A. Robinson, N. Ehsan and Z. Popović, "Active and Passive Components for Broadband Transmit Phased Arrays: Broadband Transmit Front-End Components," in *IEEE Microwave Magazine*, vol. 23, no. 2, pp. 56-74, Feb. 2022.
140. R. Streeter, G. S. Botello, K. Hall and Z. Popović, "Correlation Radiometry for Subcutaneous Temperature Measurements," in *IEEE Journal of Electromagnetics, RF and Microwaves in Medicine and Biology*, vol. 6, no. 2, pp. 230-237, June 2022.
141. A. A. Babenko *et al.*, "RF Josephson Arbitrary Waveform Synthesizer With Integrated Superconducting Diplexers," in *IEEE Transactions on Applied Superconductivity*, vol. 32, no. 8, pp. 1-9, Nov. 2022.
142. L. Marzall, C. Nogales, S. Schafer, G. Lasser and Z. Popović, "Nonlinear and Load-Pulling Effects in an Octave-Bandwidth Transmit Array," in *IEEE Transactions on Microwave Theory and Techniques*, vol. 71, no. 1, pp. 350-359, Jan. 2023.
143. T. Sonnenberg, A. Romano, S. Verploegh, M. Pinto and Z. Popović, "V- and W-Band Millimeter-Wave GaN MMICs," in *IEEE Journal of Microwaves*, vol. 3, no. 1, pp. 453-465, Jan. 2023.
144. C. Nogales, Z. Popović and G. Lasser, "An 800-W Four-Level Supply Modulator for Efficient Envelope Tracking of RF Transmitters," in *IEEE Journal of Emerging and Selected Topics in Power Electronics*, vol. 11, no. 3, pp. 3251-3260, June 2023.
145. J. Lee, G. S. Botello, R. Streeter and Z. Popović, "Noninvasive Internal Body Thermometry With On-Chip GaAs Dicke Radiometer," in *IEEE Microwave and Wireless Technology Letters*, vol. 33, no. 6, pp. 927-930, June 2023.
146. M. C. Robinson, J. A. Molles, V. V. Yakovlev and Z. Popović, "Solid-State Power Combining for Heating Small Volumes of Mixed Waste Materials," in *IEEE Journal of Microwaves*, vol. 3, no. 3, pp. 881-893, July 2023.
147. C. Nogales, Z. Popović and G. Lasser, "Gate Pulsing as a Transient Ringing Reduction Method for Multilevel Supply Modulators," in *IEEE Transactions on Power Electronics*, vol. 38, no. 8, pp. 9358-9361, Aug. 2023.
148. T. Sonnenberg, S. Verploegh, M. Pinto and Z. Popović, "W-Band GaN HEMT Frequency Multipliers," in *IEEE Transactions on Microwave Theory and Techniques*, 2023.

PATENTS AND PATENT APPLICATIONS

Zane, R., Popovic, Z., Sharp, A. and Restrepo, D., University of Colorado Boulder, 2011. *Systems and methods for receiving and managing power in wireless devices*. U.S. Patent 7,956,572. **(was licensed by Cymbet Corp.)**

Rodenbeck, C.T., Pankonin, J., Heintzleman, R.E., Kinzie, N.J. and Popovic, Z.P., National Technology and Engineering Solutions of Sandia LLC, 2014. *Ultra-wideband short-pulse radar with range accuracy for short range detection*. U.S. Patent 8,854,254.

Popovic, Z., Scheeler, R., Momenroodaki, P. and Haines, W.D., University of Colorado Boulder, *Microwave thermometer for internal body temperature retrieval*, U.S. Patent 10,506,930, Issued Dec. 17, 2019. **(Licensing agreement with LumenAstra Corp.)**

Afridi, K., Chang, C-K., Da Silva, G., Kumar, A., Maksimovic, D., Pervaiz, S., Popovic, Z., *Wireless Power Transfer*, U.S. Patent 10,298,058, Issued May 21, 2019. **(Licensing agreement with ExoPower.)**

Lasser, G., Popovic, Z., U.S. Patent application 16/191,053, *Gain stabilization for supply modulated RF and microwave integrated circuits*, filed November 14, 2018

Cappello, T., Florian, C., Popovic, Z., U.S. Patent Application No. 62/668,028, *Single-Supply Multi-Level Envelope Tracker for RF Power Amplifier Efficiency Enhancement*, March 2019

Zurek, P., Popovic, Z., U.S. Provisional Patent Application No., 63/027,889, *Broadband Multiplexed Power Amplifier*, filed May 20, 2020

M. Robinson, Popovic, Z., Provisional Patent Application No. 63/090,460, *Microwave-Based Pyrolysis Reactor and Associated Methods*, filed October 12, 2020. **(Potential licensing agreement with RegynBio.)**

SELECTED CONFERENCE PUBLICATIONS (TOTAL NUMBER OVER 350)

1. R. C. Compton, R. McPhedran, Z. Popovic, G. M. Rebeiz, and D. B. Rutledge, "The bow-tie antenna on a dielectric - theory versus experiment," *11th Int. Conference on Infrared and Millimeter Waves*, Pisa, Italy, October 1986.
2. Z. B. Popovic, and D. B. Rutledge, "Diode-grid Oscillators," *1988 IEEE AP-S International Antenna Symposium*, Syracuse, New York, June 1988.
3. T. Mader, S. Bundy, Z. B. Popovic, "Quasi-Optical Array VCOs," *1992 IEEE International Microwave Symposium Digest*, pp. 1539-1543.
4. K.Y. Chen, P.D. Biernacki, A.R. Mickelson, Z.B. Popovic, "Optical Measurements of Microwave Grid Oscillator Power Combiners," *IEEE MTT International Symposium Digest*, pp.313-316, Atlanta, June 1993.
5. W. A. Shiroma, B. L. Shaw, Z. B. Popovic, "Three-dimensional power combiners," *IEEE MTT International Symposium Digest*, pp. 831-834, San Diego, May 1994.
6. J. Hubert, J. Schoenberg, Z. B. Popovic, "A Ka-band quasi-optical amplifier," *1995 IEEE MTT-S Int. Symp. Dig.* (Orlando, FL), pp. 585-588, May 1995.
7. T. Mader, M. Markovic, Z.B. Popovic, "High-efficiency amplifiers for portable handsets," *6th International Symposium on Personal, Indoor and Mobile Radio Communications, PMIRC 95 Digest*, pp.1242-1243, September 1995, Toronto.

8. R. Brown, B.D. Popovic, Z.B. Popovic, "A low-profile broadband antenna for wireless communications," *6th International Symposium on Personal, Indoor and Mobile Radio Communications, PMIRC 95 Digest*, pp.135-139, September 1995, Toronto.
9. W. Shiroma, E. Bryerton, S. Hollung, Z.B. Popovic, "A quasi-optical receiver with angle diversity," *IEEE MTT-S International Symposium Digest*, pp. 1131-1135, June 1996, San Francisco.
10. S. Hollung, J. Vian, Z. Popovic, "A bi-directional quasi-optical lens amplifier," *IEEE MTT-S International Microwave Symposium Digest*, pp. 675-678, June 1997, Denver.
11. E. W. Bryerton, M. D. Weiss, Z. Popovic, "A 10-GHz high-efficiency lens amplifier array," *IEEE MTT-S International Microwave Symposium Digest*, pp. 1461-1464, June 1998, Baltimore.
12. M. Weiss, Z. Popovic, "A 10-GHz high-efficiency active antenna," *1999 IEEE IMS Symposium Digest*, pp.663-666, Anaheim, CA, June 1999.
13. B. Notaros, B. Popovic, R. Brown, Z. Popovic, "Large domain MOM solution of complex electromagnetic problems," *1999 IEEE IMS Symposium Digest*, pp.1665-1668, Anaheim, CA, June 1999.
14. S. Djukic, D. Maksimovic, Z. Popovic, "A planar C-band DC-DC converter," *1999 IEEE IMS Symposium Digest*, pp.827-830, Anaheim, CA, June 1999.
15. D. Anderson, V. Damiao, E. Fotheringham, D. Popovic, S. Romisch and Z. Popovic, "Optically Smart Active Antenna Arrays" *2000 IEEE IMS Symposium Digest*, pp 843-846, Boston, June 2000.
16. J. Vian and Z. Popovic, "A Transmit/Receive Active Antenna with Fast Low-Power Optical Switching" *2000 IEEE IMS Symposium Digest*, pp 847-850, Boston, June 2000. **[Received 2nd prize in the Student Paper Competition]**
17. J. Peeters Weem and Z. Popovic, "Vivaldi Antenna Arrays for SKA", *APS-2000 Conference Digest*, Salt Lake City, Utah, July 2000.
18. J. Peeters Weem, Z. Popovic "A method for determining noise coupling in a phased array antenna," *2001 IEEE International Microwave Symposium Digest*, pp.271-274, Phoenix, Arizona, May 2001.
19. J. Vian, Z. Popovic, "Smart lens antenna arrays," *2001 IEEE International Microwave Symposium Digest*, pp.129-132, Phoenix, Arizona, May 2001.
20. M. Forman, J. Vian, Z. Popovic, "A Ka-band full-duplex transmit-receive lens array," *2001 IEEE International Microwave Symposium Digest*, pp.1831-1834, Phoenix, Arizona, May 2001
21. J. A. Hagerty, Z. Popovic, "An experimental and theoretical characterization of a broadband arbitrarily polarized rectenna array," *2001 IEEE International Microwave Symposium Digest*, pp.1855-1858, Phoenix, Arizona, May 2001
22. J. Hagerty, Z. Popovic, "Passive millimeter-wave ranging using discrete lenses with wave-front coding," *2001 European Microwave Conference Digest*, pp. 421-424, London, October 2001.
23. B. Montrose, D. Popovic, B. Popovic, Z. Popovic, "Dual-polarized star microstrip antennas," *2001 European Microwave Conference Digest*, pp. 137-140, London, October 2001.
24. M. Weiss, Z. Popovic, "An X-band class-E high-efficiency frequency doubler," *2001 European Microwave Conference Digest*, pp. 225-229, London, October 2001.
25. S. Pajic, Z. Popovic, "A 10-GHz High-efficiency Active Antenna Sub-Array," *IEEE International Microwave Symposium Digest*, pp.1527-1530, Seattle, June 2002.
26. Oswald, M.T.; Hagness, S.C.; Van Veen, B.D.; Popovic, Z.; "Reconfigurable single-feed antennas for diversity wireless communications," *Antennas and Propagation Society International Symposium, 2002. IEEE , Volume: 1 , 2002 Page(s): 469 -472*
27. Hagerty, J.A.; Popovic, Z.; "A 10 GHz integrated class-E oscillating annular ring element for high-efficiency transmitting arrays," *Microwave Symposium Digest, 2002 IEEE MTT-S International , Volume: 2 , 2002 Page(s): 1317 -1320*
28. Shino, N.; Popovic, Z.; "Radiation from ground plane photonic bandgap microstrip waveguides," *Microwave Symposium Digest, 2002 IEEE MTT-S International , Vol: 2, pp: 1079 -1082*
29. Hagerty, J.A.; Popovic, Z.; "A 10 GHz active annular ring antenna," *Antennas and Propagation Society International Symposium, 2002. IEEE , Volume: 2 , 2002 Page(s): 284 -287*

30. Anderson, D.Z.; Fotheringham, E.; Romisch, S.; Smith, P.C.; Popovic, Z.; "A compact prototype optical processor for X-band arrays," *Microwave Photonics, 2001. MWP '01. 2001 International Topical Meeting on* , 2002 Page(s): 227 -230
31. Pajic, S.; Popovic, Z.; "A 10-GHz high-efficiency active antenna sub-array," *Microwave Symposium Digest, 2002 IEEE MTT-S International , Volume: 3* , 2002 Page(s): 1527 -1530
32. Romisch, S., Bell, P., Popovic, D., Shino, N., Popovic, Z., "Multibeam planar discrete millimeter-wave lens for fixed-formation satellites," *Digest of 27th URSI General Assembly, Maastricht, Amsterdam, Aug 2002. – Young Scientist Award (S. Romisch)*
33. Do-Hong, Tuan; Hagerty, Joseph A.; Popovic, Zoya; Russer, Peter: "Spatial Processing with Lens Antenna Arrays for Direction-of-Arrival Estimation," *Digest of 27th General Assembly of the International Union of Radio Science (2002) Aug.*
34. Z. Popovic, "Active and Smart Antenna Arrays," *Invited plenary talk at the Annual Meeting of the Argentine Physical Association, Cordoba, Argentina, Sept 2002*
35. Bell, P., Hoivik, N., Bright, V., Popovic, Z., "A Frequency Tunable Half-Wave Resonator using a MEMS Variable Capacitor," *35th International Symposium on Microelectronics – IMAPS 2002, Denver, CO, Sept 2002 [Received 2nd Best Student Paper Prize]*
36. D. Popovic, S. Romisch, N. Shino, Z. Popovic, "Multibeam planar lens antenna arrays," *GOMAC 2003 – lens2003 GOMAC Digest*, pp. , Tampa, Apr 2003.
37. E. Fotheringham, D. Anderson, P. Smith, Z. Popovic, "Adaptive optical signal processing for microwave-carrier broadband signals," *2003 GOMAC Digest*, Tampa, Apr 2003.
38. S. Pajic, P. Bell, N. Hoivik, V. Bright, Z. Popovic, "High-efficiency X-band amplifiers and spatial combiners with impedance tuners using MEM inductors and variable capacitors," *2003 GOMAC Digest*, Tampa, Apr 2003.
39. P. Bell, N. Hoivik, V. Bright, Z. Popovic, "Micro-bias Tees using micromachined flip-chip inductors," *IEEE 2003 Intern. Microwave Symp. Digest*, Philadelphia, June 2003.
40. S. Römisch, D. Popović, N. Shino, R. Lee, Z. Popović, "Multibeam lens antenna arrays with amplitude controlled steering," *IEEE 2003 Intern. Microwave Symp. Digest*, Philadelphia, June 2003.
41. J. A. Hagerty, Z. Popovic, "Rectenna arrays for recycling statistical broadband radiation," *2003 Antennas Application Symp. Diges.*, Allerton, Sept 2003.
42. S. Rondineau, S. Romisch, D. Popovic, Z. Popovic, "Multibeam spatially-fed antenna arrays with amplitude-controlled beam steering," *2003 Antennas Application Symp. Diges.*, pp. , Allerton, Sept 2003.
43. Z. Popovic, S. Pajic, N. Wang, P. Bell, "70% efficient switched-mode microwave power amplifiers," *Invited paper, IEEE GaAs IC Symposium Digest*, pp. 125-129, San Diego, Nov 2003.
44. P. Smith, E. Fotheringham, D. Anderson, Z. Popovic, "Smart antennas with optical processing for broadband blind source separation," *IEEE Topical Conf. Wireless Comm. Techn. Digest*, Honolulu, Oct 2003.
45. D. Anderson, E. Fotheringham, D. Popovic, Z. Popovic, S. Romisch, P. Smith, "Smart and multibeam diversity antenna arrays with high-bandwidth analog signal processing," *IEEE Topical Conf. Wireless Comm. Techn. Digest*, Honolulu, Oct 2003.
46. Smith, P.C.; Popovic, Z.; Baylor, M.-E.; Anderson, D.Z.; "Holographic blind signal separation," *Lasers and Electro-Optics (CLEO). Conference on Vo 1*, 16-21 May 2004 Page(s):2 pp. vol.1
47. Zheng, G.; Kirby, P.L.; Pajic, S.; Pothier, A.; Blondy, P.; Papapolymerou, J.; Popovic, Z.; "A monolithic reconfigurable tuner with ohmic contact MEMS switches for efficiency optimization of X-band power amplifiers," *Silicon Monolithic Integrated Circuits in RF Systems, 2004. Digest of Papers. 2004 Topical Meeting on* 8-10 Sept. 2004, pp:159 – 162
48. Loui, H.; Kuester, E.F.; Lalezari, F.; Popovic, Z.; "Thick FSSs for large scan angle applications," *Antennas and Propagation Society Symposium*, 20-25 June 2004 pp:2171 - 2174 Vol.2
49. Rondineau, S.; Perotoni, M.B.; Lopez, N.; Popovic, Z.; "Packaging of multibeam spatially-fed antenna arrays," *Antennas and Propagation Society Symposium*, 20-25 June 2004, pp:1435 - 1438

50. Popovic, Z.; Walsh, C.; Matyas, P.; Dietlein, C.; Anderson, D.Z.; "High-resolution small-aperture angle of arrival detection using nonlinear analog processing," *Microwave Symposium Digest, 2004 IEEE MTT-S International*, 6-11 June 2004 pp:1749 - 1752 Vol.3
51. Yousefzadeh, V.; Wang, N.; Maksimovic, D.; Popovic, Z.; "Digitally controlled DC-DC converter for RF power amplifier," *Applied Power Electronics Conference and Exposition, 2004. APEC '04. Nineteenth Annual IEEE*, pp:81 - 87 Vol.1
52. S. Pajic, W. McCalpin, Z. Popovic, "Load-Pull Based Design of Ultra-Linear W-CDMA Base-Station Power Amplifiers," *IEEE MTT Power Amplifier Topical Symp. Digest*, San Diego, 2004, pp.
53. A. Brannon, J. Breitbarth, Z. Popovic, "A Low-Power Low Phase Noise Local Oscillator for Chip-Scale Atomic Clocks," *IEEE 2005 IMS Digest*, Long Beach, June '05, pp.
54. C. Walsh, S. Rondineau, M. Jankovic, G. Zhao, Z. Popovic, "A Conformal 10-GHz Rectenna for Wireless Powering of Piezoelectric Sensor Electronics," *IEEE 2005 IMS Digest*, Long Beach, June '05, pp. 143-146.
55. P. Bell, C. Dyck, Z. Popovic, "MEMS Switched Class A-to-E Reconfigurable Power Amplifier," *2006 IEEE MTT Radio and Wireless Symposium Digest*, San Diego, 2006, pp.243-246.
56. J. Breitbarth, S. Pajic, N. Wang, Z. Popovic, "Additive Phase Noise in Linear and High-Efficiency X-band Power Amplifiers," *J IEEE 2006 IMS Digest*, San Francisco, June '06, pp. 1871-1874.
57. D. Filipovic, Z. Popovic, K. Vanhille, M. Lukic, S. Rondineau, M. Buck, G. Potvin, D. Fontain, C. Nichols, D. Sherrer, S. Zhou, W. Houck, D. Fleming, E. Daniel, D. Wilkins, V. Sokolov, J. Evans, "Modeling, Design, Fabrication and Performance of Rectangular micro-Coaxial Lines and Components," *IEEE 2006 IMS Digest*, San Francisco, June '06, pp. 1393-1396.
58. T. Paing, J. Morroni, A. Dolgov, J. shin, J. Brannan, R. Zane, Z. Popovic, "Wirelessly powered wireless sensor platform," *2007 European Microwave Conference Digest*, Munich, Germany, Oct. 2007.
59. K. Vanhille, J. O'Brien, D. Sherrer, W. Hogan, C. Gaebe, Z. Popovic, "Electromagnetic modeling of wafer-level silicon electro-optical packages for 10 & 40 Gb/s communications," *2007 European Microwave Conference Digest*, Munich, Germany, Oct. 2007.
60. N. Wang, N. Lopez, V. Yousefzadeh, J. Hoversten, D. Maksimovic, Z. Popovic, "Linearity of X-band class-E power amplifiers in a digital polar transmitter," *IEEE 2007 IMS Digest*, Honolulu, Hawaii, June '07, pp. 1083-1086.
61. N. Ehsan, H. Loui, Z. Popovic, "Dual-polarization large scan angle broadband thick metallic FSS," *IEEE AP Intern. Symp. Digest*, June 2007, pp. 4537 – 4540.
62. Lee, R.Q.; Popovic, Z.; Rondineau, S.; Miranda, F.A.; "Steerable space fed lens array for low-cost adaptive ground station applications," *IEEE AP Intern. Symp. Digest*, June 2007 Page(s):2136 – 2139
63. Kitching, J.; Knappe, S.; Moreland, J.; Liew, L.-A.; Shah, V.; Gerginov, V.; Schwindt, P.D.D.; Hollberg, L.; Brannon, A.; Lindseth, B.; Popovic, Z.; "Chip-Scale Atomic Devices Based on Microfabricated Alkali Vapor Cells," *Lasers and Electro-Optics and Intern. Quantum Electron. Conference Digest, CLEOE-IQEC 2007*, June 2007.
64. Brannon, A.; Shah, V.; Popovic, Z.; Gerginov, V.; Knappe, S.; Hollberg, L.; Kitching, J.; "Self-Injection Locking of a Microwave Oscillator by Use of Four-Wave Mixing in an Atomic Vapor," *IEEE Intern. Frequency Control Symp., 2007 and 21st European Frequency and Time Forum*, May 2007, Page(s):275 – 278
65. Dietlein, C.; Chisum, J.D.; Ramirez, M.D.; Luukanen, A.; Grossman, E.N.; Popovic, "Integrated Microbolometer Antenna Characterization from 95-650 GHz," *Z.; IEEE IMS Digest*, June 2007, Honolulu, Page(s):1165 – 1168
66. N. Lopez, X. Jiang, D. Maksimovic, Z. Popovic, "A high-efficiency linear polar transmitter for EDGE," *2008 IEEE RWS Conference Digest*, Orlando, pp. 199-202.
67. Immorlica, A.A.; Actis, R.; Nair, D.; Vanhille, K.; Nichols, C.; Rollin, J.-M.; Fleming, D.; Varghese, R.; Sherrer, D.; Filipovic, D.; Cullens, E.; Ehsan, N.; Popovic, Z.; "Miniature 3D micro-machined solid state power amplifiers," *COMCAS 2008 IEEE International Conference*, pp.1-7, Tel Aviv, Israel, May 2008.

68. T. Paing, E. Falkenstein, R. Zane, Z. Popovic, "Custom IC for Ultra-low Power RF Energy Harvesting," *24th Annual IEEE Applied Power Electronics Conference and Exposition, APEC 2009*, 15-19 Feb. 2009 Page(s):1239 – 1245
69. M. Elsbury, P. Dresselhaus, S. Benz, Z. Popovic, "Integrated broadband lumped-element symmetrical hybrid N-way power dividers," *IEEE IMS Digest*, June 2009, Boston, Page(s):997-1000.
70. L. Sankey, Z. Popovic, "Adaptive tuning for handheld transmitters," *IEEE IMS Digest*, June 2009, Boston, Page(s):225-228.
71. N. Ehsan, K. Vanhille, E. Cullens, D. Frey, S. Rondineau, R. Actis, S. Jessup, R. Lender, A. Immorlica, D. Nair, D. Filipovic, Z. Popovic, "Micro-coaxial lines for active hybrid-monolithic circuits," *IEEE IMS Digest*, June 2009, Boston, Page(s):465-468.
72. Lorena Cabria1, José A. García, Teophile Aballo, Zoya Popovic, "Polar Phase-Conjugating Active Arrays for Spectrally-Efficient Linear Wireless Links," *IEEE MTT International Microwave Symposium Digest*, May 2010, Anaheim, CA, pp.77-80.
73. J. Hoversten, M. Roberg, Z. Popovic, "Harmonic Load Pull of High-Power Microwave Devices using Fundamental-Only Load Pull Tuners," *IEEE ARFTG conference digest*, Anaheim, CA, May 2010.
74. Z. Popovic, "Micro-coaxial micro-fabricated feeds for phased array antennas," *Plenary talk, IEEE Phased Array Systems and Technology (ARRAY) Symposium*, 2010.
75. A. Dani, M. Roberg, Z. Popovic, "Efficiency and Linearity of Power Amplifiers with External Harmonic Injection", *IEEE MTT International Microwave Symp. Digest*, June 2012, Montreal.
76. M. Roberg, E. Falkenstein, Z. Popovic, "High-Efficiency Harmonically-Terminated Rectifier for Wireless Powering Applications," *IEEE MTT International Microwave Symp. Digest*, June 2012, Montreal.
77. C. Sanchez-Perez, D. Sardin, M. Roberg, J. de Mingo, Z. Popovic, "Tunable Outphasing for Power Amplifier Efficiency Improvement under Load Mismatch," *IEEE MTT International Microwave Symp. Digest*, June 2012, Montreal.
78. R. Scheeler, Z. Popovic, "GaAs MMIC Tunable Directional Coupler," *IEEE MTT International Microwave Symp. Digest*, June 2012, Montreal.
79. B. Lindseth, T. Kelly, W.O. Brown, T. Hock, S.A. Cohn, Z. Popovic, "Low-Cost 63% Efficient 2.5-kW UHF Power Amplifier for a Wind Profiler Radar," *IEEE MTT International Microwave Symp. Digest*, June 2012, Montreal.
80. T. Reveyrand, Z. Popovic, "A new method to measure pulsed RF time domain waveforms with a sub-sampling system," *IEEE MTT International Microwave Symp. Digest*, June 2012, Montreal.
81. Scott Schafer, Michael Litchfield, Andrew Zai, Zoya Popovic, Chuck Campbell, "X-Band MMIC GaN Power Amplifiers Designed for High-Efficiency Supply-Modulated Transmitters," *IEEE MTT International Microwave Symp. Digest*, June 2013, Seattle.
82. H. Jang, A. Zai, T. Reveyrand, P. Roblin, Z. Popovic, and D. E. Root, "Simulation and Measurement-based X-parameter Models for Power Amplifiers with Envelope Tracking," *IEEE MTT International Microwave Symp. Digest*, June 2013, Seattle.
83. D. Sardin, Z. Popovic, "Decade Bandwidth High-Efficiency GaN VHF/UHF Power Amplifier," *IEEE MTT International Microwave Symp. Digest*, June 2013, Seattle.
84. Popovic, Z.; Falkenstein, E.; Zane, R., "Low-power density wireless powering for battery-less sensors," *Radio and Wireless Symposium (RWS), 2013 IEEE* , vol., no., pp.31,33, 20-23 Jan. 2013
85. Dani, A.; Popovic, Z., "Linearization of efficient harmonically-injected PAs," *Power Amplifiers for Wireless and Radio Applications (PAWR), 2013 IEEE Topical Conference on* , vol., no., pp.31,33, 20-20 Jan. 2013
86. Korhummel, S.; Kuester, D.G.; Popovic, Z., "A harmonically-terminated two-gram low-power rectenna on a flexible substrate," *Wireless Power Transfer (WPT), 2013 IEEE* , vol., no., pp.119,122, 15-16 May 2013
87. Rahimizadeh, S.; Korhummel, S.; Kaslon, B.; Popovic, Z., "Scalable adaptive wireless powering of multiple electronic devices in an over-moded cavity," *Wireless Power Transfer (WPT), 2013 IEEE* , vol., no., pp.84,87, 15-16 May 2013

88. Popovic, Z., "Far-field wireless power delivery and power management for low-power sensors," *Wireless Power Transfer (WPT), 2013 IEEE*, vol., no., pp.1,4, 15-16 May 2013
89. Schafer, Scott; Litchfield, Michael; Zai, Andrew; Popovic, Zoya; Campbell, Chuck, "X-band MMIC GaN power amplifiers designed for high-efficiency supply-modulated transmitters," *Microwave Symposium Digest (IMS), 2013 IEEE MTT-S International*, vol., no., pp.1,3, 2-7 June 2013
90. Sardin, David; Popovic, Zoya, "Decade bandwidth high-efficiency GaN VHF/UHF power amplifier," *Microwave Symposium Digest (IMS), 2013 IEEE MTT-S International*, vol., no., pp.1,3, 2-7 June 2013
91. Jang, Haedong; Zai, Andrew; Reveyrand, Tibault; Roblin, Patrick; Popovic, Zoya; Root, David E., "Simulation and measurement-based X-parameter models for power amplifiers with envelope tracking," *Microwave Symposium Digest (IMS), 2013 IEEE MTT-S International*, vol., no., pp.1,4, 2-7 June 2013
92. Dongxue Li; Rodriguez, M.; Zai, A.; Sardin, D.; Maksimovic, D.; Popovic, Z., "RFPA supply modulator using wide-bandwidth linear amplifier with a GaN HEMT output stage," *Control and Modeling for Power Electronics (COMPEL), 2013 IEEE 14th Workshop on*, vol., no., pp.1,6, 23-26 June 2013
93. Dani, A.; Coffey, M.; Popovic, Z., "Efficient linear supply-modulated PA with harmonic injection," *Microwave Conference (EuMC), 2013 European*, vol., no., pp.541,544, 6-10 Oct. 2013
94. Scheeler, R.; Popovic, Z., "A 1.4 GHz MMIC Active Cold Noise Source," *Compound Semiconductor Integrated Circuit Symposium (CSICS), 2013 IEEE*, pp.1,4, 13-16 Oct. 2013
95. Popovic, Z., "Far-field low-power wireless powering for unattended sensors," *IEEE 16th Wireless and Microwave Technology Conference (WAMICON), 2015*, pp.1-4, 13-15 April 2015
96. Basta, N.P.; Falkenstein, E.A.; Popovic, Z., "Bow-tie rectenna arrays," in *Wireless Power Transfer Conference (WPTC), 2015 IEEE*, vol., no., pp.1-4, 13-15 May 2015
97. Ramos, I.; Popovic, Z., "A compact 2.45 GHz, low power wireless energy harvester with a reflector-backed folded dipole rectenna," in *Wireless Power Transfer Conference (WPTC), 2015 IEEE*, vol., no., pp.1-3, 13-15 May 2015
98. Schafer, S.; Coffey, M.; Popovic, Z., "X-band wireless power transfer with two-stage high-efficiency GaN PA/ rectifier," in *Wireless Power Transfer Conference (WPTC), 2015 IEEE*, vol., no., pp.1-3, 13-15 May 2015
99. Coffey, M.; Schafer, S.; Popovic, Z., "Two-stage high-efficiency X-Band GaN MMIC PA/ rectifier," in *Microwave Symposium (IMS), 2015 IEEE MTT-S International*, pp.1-4, 17-22 May 2015
100. Bluem, P.; Tonyushkin, A.; Deelchand, D.; Adriany, G.; Van de Moortele, P.-F.; Kiruluta, A.J.M.; Popovic, Z., "Travelling-wave excitation for 16.4T small-bore MRI," in *Microwave Symposium (IMS), 2015 IEEE MTT-S International*, pp.1-4, 17-22 May 2015
101. Schafer, S.; Popovic, Z., "GaN transistor large-signal characterization under multi-frequency excitation," in *Microwave Symposium (IMS), 2015 IEEE MTT-S International*, pp.1-4, 17-22 May 2015
102. Dunbar, S.; Wenzl, F.; Hack, C.; Hafeza, R.; Esfeer, H.; Defay, F.; Prothin, S.; Bajon, D.; Popovic, Z., "Wireless far-field charging of a micro-UAV," in *Wireless Power Transfer Conference (WPTC), 2015 IEEE*, pp.1-4, 13-15 May 2015
103. Popovic, Z., "GaN power amplifiers with supply modulation," in *Microwave Symposium (IMS), 2015 IEEE MTT-S International*, pp.1-4, 17-22 May 2015. **Invited**
104. C. Florian, D. Niessen, T. Cappello, A. Santarelli, F. Filicori and Z. Popovic, "Pre-pulsing characterization of GaN PAs with dynamic supply," *2016 IEEE MTT-S International Microwave Symposium (IMS)*, San Francisco, CA, 2016, pp. 1-4.
105. P. Momenroodaki, R. D. Fernandes and Z. Popović, "Air-substrate compact high gain rectennas for low RF power harvesting," *2016 10th European Conference on Antennas and Propagation (EuCAP)*, Davos, 2016, pp. 1-4.
106. I. Ramos and Z. Popović, "A fully monolithically integrated 4.6 GHz DC-DC converter," *2016 IEEE MTT-S International Microwave Symposium (IMS)*, San Francisco, CA, 2016, pp. 1-4.

107. A. Zai, C. Florian, T. Cappello and Z. Popovic, "Efficient power amplifiers for amplitude-tapered pulses with improved spectral confinement," *2016 IEEE MTT-S International Microwave Symposium (IMS)*, San Francisco, CA, 2016, pp. 1-4.
108. S. Rahimizadeh, J. Chéron, Qianli Mu and Z. Popović, "In-package harmonic termination design for improving active device efficiency," *2016 IEEE MTT-S International Microwave Symposium (IMS)*, San Francisco, CA, 2016, pp. 1-4.
109. Z. Popovic, I. Ramos, T. Reveyrand and M. Litchfield, "Microwave Transistor Power Rectifiers and Applications," *2016 IEEE Compound Semiconductor Integrated Circuit Symposium (CSICS)*, Austin, TX, 2016, pp. 1-4.
110. J. Estrada, I. Ramos, A. Narayan, A. Keith, Z. Popovic, "RF energy harvester in the proximity of an aircraft radar altimeter," *2016 IEEE Wireless Power Transfer Conf. (WPTC)*, Aveiro, 2016, pp. 1-4.
111. S. Schafer and Z. Popović, "Multi-frequency large-signal analysis using describing functions," *2016 IEEE MTT-S International Microwave Symposium (IMS)*, San Francisco, CA, 2016, pp. 1-4.
112. I. Ramos, K. Afridi, J. A. Estrada and Z. Popović, "Near-field capacitive wireless power transfer array with external field cancellation," *2016 IEEE Wireless Power Transfer Conference (WPTC)*, Aveiro, 2016, pp. 1-4.
113. M. Litchfield, T. Cappello, C. Florian and Z. Popovic, "X-Band GaN Multi-Level Chireix Outphasing PA with a Discrete Supply Modulator MMIC," *2016 IEEE Compound Semiconductor Integrated Circuit Symposium (CSICS)*, Austin, TX, 2016, pp. 1-4.
114. C. Florian, D. Niessen, T. Cappello, A. Santarelli, F. Filicori and Z. Popovic, "Pre-pulsing characterization of GaN PAs with dynamic supply," *2016 IEEE MTT-S International Microwave Symposium (IMS)*, San Francisco, CA, 2016, pp. 1-4.
115. A. Sepahvand, P. Momenroodaki, Y. Zhang, Z. Popović and D. Maksimović, "Monolithic multilevel GaN converter for envelope tracking in RF power amplifiers," *2016 IEEE Energy Conversion Congress and Exposition (ECCE)*, Milwaukee, WI, 2016, pp. 1-7.
116. G. Lasser, M. Duffy, M. Olavsbråten and Z. Popović, "Gate control of a two-stage GaN MMIC amplifier for amplitude and phase linearization," *2017 IEEE 18th Wireless and Microwave Technology Conference (WAMICON)*, Cocoa Beach, FL, 2017, pp. 1-5. **Received Best Paper Award**
117. M. Coffey, S. Verploegh, S. Edstaller, S. Armstrong, E. Grossman and Z. Popovic, "Additive manufactured W-band waveguide components," *2017 IEEE MTT-S International Microwave Symposium (IMS)*, Honolulu, HI, 2017, pp. 52-55.
118. W. Haines, P. Momenroodaki, E. Berry, M. Fromandi and Z. Popovic, "Wireless system for continuous monitoring of core body temperature," *2017 IEEE MTT-S International Microwave Symposium (IMS)*, Honolulu, HI, 2017, pp. 541-543.
119. M. R. Duffy, G. Lasser, J. Vance, M. Olavsbråten, T. Barton and Z. Popovic, "Bandwidth-reduced supply modulation of a high-efficiency X-band GaN MMIC PA for multiple wideband signals," *2017 IEEE MTT-S International Microwave Symposium (IMS)*, Honolulu, HI, 2017, pp. 1850-185
120. B. Regensburger *et al.*, "High-performance large air-gap capacitive wireless power transfer system for electric vehicle charging," *2017 IEEE Transportation Electrification Conference and Expo (ITEC)*, Chicago, IL, 2017, pp. 638-643.
121. J. A. García and Z. Popović, "Class-E rectifiers and power converters," *2017 IEEE MTT-S International Microwave Symposium (IMS)*, Honolulu, HI, 2017, pp. 1327-1330.
122. P. Momenroodaki, Z. Popović and M. Fallahpour, "Antenna probes for power reception from deep tissues for wearable microwave thermometry," *2017 IEEE International Symp.on Antennas and Propagation & USNC/URSI National Radio Science Meeting*, San Diego, CA, 2017, pp. 573-574.
123. P. Momenroodaki, W. Haines and Z. Popović, "Non-invasive microwave thermometry of multilayer human tissues," *2017 IEEE MTT-S International Microwave Symposium (IMS)*, Honolulu, HI, 2017, pp. 1387-1390.
124. T. Cappello, C. Florian, T. W. Barton, M. Litchfield and Z. Popovic, "Multi-level supply-modulated Chireix outphasing for LTE signals," *2017 IEEE MTT-S International Microwave Symposium (IMS)*, Honolulu, HI, 2017, pp. 1846-1849.

125. Z. Popovic, "Near- and far-field wireless power transfer," *2017 13th International Conf.on Advanced Technologies, Systems and Services in Telecommunications (TELSIKS)*, Nis, 2017, **Invited**.
126. Z. Popović and J. A. García, "Microwave class-E power amplifiers," *2017 IEEE MTT-S International Microwave Symposium (IMS)*, Honolulu, HI, 2017, pp. 1323-1326.
127. P. Bluem and Z. Popovic, "10.5-T MRI volume excitation using traveling-wave microstrip probes," *2017 IEEE MTT-S Intern. Microwave Symp. (IMS)*, Honolulu, HI, 2017, pp. 1396-1399.
128. J. Breitbarth and Z. Popović, "Spectral performance and noise theory of nonlinear transmission line frequency multipliers," *2017 Joint Conference of the European Frequency and Time Forum and IEEE International Frequency Control Symp. (EFTF/IFCS)*, Besancon, France, 2017, pp. 261-264.
129. Z. Popovic, "High-performance transceiver components for defense communications and sensing," *2017 IEEE MTT-S International Microwave Symposium (IMS)*, Honolulu, HI, 2017, pp. 336-339. **Invited**.
130. K. Doubleday *et al.*, "Multi-objective optimization of capacitive wireless power transfer systems for electric vehicle charging," *2017 IEEE 18th Workshop on Control and Modeling for Power Electronics (COMPEL)*, Stanford, CA, 2017, pp. 1-8.
131. G. Lasser, M. Duffy, J. Vance and Z. Popović, "Discrete-level envelope tracking for broadband noise-like signals," *2017 IEEE MTT-S International Microwave Symposium (IMS)*, Honolulu, HI, 2017, pp. 1942-1945.
132. M. Olavsbråten, D. Gecan, M. R. Duffy, G. Lasser and Z. Popovic, "Efficiency enhancement and linearization of GaN PAs using reduced-bandwidth supply modulation," *2017 47th European Microwave Conference (EuMC)*, Nuremberg, 2017, pp. 456-459.
133. J. Estrada, S. Sinha, B. Regensburger, K. Afridi and Z. Popović, "Capacitive wireless powering for electric vehicles with near-field phased arrays," *2017 47th European Microwave Conference (EuMC)*, Nuremberg, 2017, pp. 196-199.
134. W. Hallberg, P. E. de Falco, M. Özen, C. Fager, Z. Popovic and T. Barton, "Characterization of linear power amplifiers for LTE applications," *2018 IEEE Topical Conference on RF/Microwave Power Amplifiers for Radio and Wireless Applications (PAWR)*, Anaheim, CA, 2018, pp. 32-34.
135. A. Duh, S. Rahimizadeh, T. Barton and Z. Popović, "A 3.5/5.9-GHz dual-band output matching network for an efficiency-optimized multiband power amplifier," *2018 IEEE Topical Conference on RF/Microwave Power Amplifiers for Radio and Wireless Applications (PAWR)*, Anaheim, CA, 2018, pp. 75-78.
136. B. Regensburger, S. Sinha, A. Kumar, J. Vance, Z. Popovic and K. K. Afridi, "Kilowatt-scale large air-gap multi-modular capacitive wireless power transfer system for electric vehicle charging," *2018 IEEE Applied Power Electronics Conference and Exposition (APEC)*, San Antonio, TX, 2018, pp. 666-671.
137. S. Rahimizadeh and Z. Popović, "In-package matching network validation for improving power amplifier performance," *2018 IEEE 19th Wireless and Microwave Technology Conference (WAMICON)*, Sand Key, FL, 2018, pp. 1-4. **Won Best Student Paper Award**
138. M. Pinto, L. F. Marzall, A. Ashley, D. Psychogiou and Z. Popović, "A design approach for monolithically integrated broadband circulators," *2018 International Applied Computational Electromagnetics Society Symposium (ACES)*, Denver, CO, 2018, pp. 1-2.
139. A. Ashley, L. F. Marzall, M. Pinto, Z. Popovic and D. Psychogiou, "Bandwidth design of ferrite-based circulators," *2018 International Applied Computational Electromagnetics Society Symposium (ACES)*, Denver, CO, 2018, pp. 1-2.
140. J. Estrada, P. Zurek and Z. Popović, "Harvesting of aircraft radar altimeter sidelobes for low-power sensors," *2018 International Applied Computational Electromagnetics Society Symposium (ACES)*, Denver, CO, 2018, pp. 1-2.
141. P. Zurek, M. Foreman, R. Johnson, C. Galbraith, J. Estrada and Z. Popovic, "Design of ungrounded CPW GaN-on-Si MMICs," *2018 International Applied Computational Electromagnetics Society Symposium (ACES)*, Denver, CO, 2018, pp. 1-2.

142. L. F. Marzall, M. Pinto, A. Ashley, D. Psychogiou and Z. Popović, "Co-simulations of DC magnetic bias fields and RF performance for microwave ferrite circulators," *2018 International Applied Computational Electromagnetics Society Symposium (ACES)*, Denver, CO, 2018, pp. 1-2.
143. G. Lasser, M. Duffy and Z. Popović, "Independent Dynamic Gate Bias for a Two-Stage Amplifier for Amplitude and Phase Linearization," *2018 International Workshop on Integrated Nonlinear Microwave and Millimetre-wave Circuits (INMMIC)*, Brive La Gaillarde, 2018, pp. 1-3.
144. M. R. Duffy, E. Berry, G. Lasser and Z. Popović, "An Efficient Linearized Octave-Bandwidth Power Amplifier for Carrier Aggregation," *2018 IEEE/MTT-S International Microwave Symposium - IMS*, Philadelphia, PA, 2018, pp. 473-476.
145. T. Cappello, P. H. Pednekar, C. Florian, Z. Popovic and T. W. Barton, "Supply Modulation of a Broadband Load Modulated Balanced Amplifier," *2018 IEEE/MTT-S International Microwave Symposium - IMS*, Philadelphia, PA, 2018, pp. 304-307.
146. S. Manafi, M. Pinto, M. Al-Tarifi, G. Lasser, Z. Popovic and D. S. Filipovic, "Enabling Passive Components for High-Power Wideband Millimeter Wave Repeater Applications," *2018 11th Global Symposium on Millimeter Waves (GSMM)*, Boulder, CO, USA, 2018, pp. 1-3.
147. D. Fishler, T. Cappello, W. Hallberg, T. W. Barton and Z. Popovic, "Supply Modulation of a Linear Doherty Power Amplifier," *2018 48th European Microwave Conference (EuMC)*, Madrid, Spain, 2018, pp. 519-522.
148. A. Ashley, L. F. Marzall, Z. Popovic and D. Psychogiou, "Frequency Selective Ferrite Circulators with Quasi-Elliptic Transmission Response," *2018 48th European Microwave Conference (EuMC)*, Madrid, Spain, 2018, pp. 211-214. **Won Best Student Paper Award**
149. M. Pinto, L. Marzall, A. Ashley, D. Psychogiou and Z. Popović, "Design-Oriented Modelling of Microstrip Ferrite Circulators," *2018 48th European Microwave Conference (EuMC)*, Madrid, Spain, 2018, pp. 215-218.
150. M. R. Duffy, G. Lasser, T. Cappello and Z. Popović, "Dual Gate and Drain Supply Modulation of an X-Band PA," *2019 IEEE MTT-S International Microwave Symposium (IMS)*, Boston, MA, USA, 2019, pp. 979-982.
151. T. Cappello, C. Florian, A. Santarelli and Z. Popovic, "Linearization of a 500-W L-band GaN Doherty Power Amplifier by Dual-Pulse Trap Characterization," *2019 IEEE MTT-S International Microwave Symposium (IMS)*, Boston, MA, USA, 2019, pp. 905-908.
152. T. Cappello, S. Verploegh, C. Florian and Z. Popovic, "Single-DC-Input Multi-Level Envelope Tracking of a High-Efficiency X-band Power Amplifier," *2019 IEEE MTT-S International Microwave Symposium (IMS)*, Boston, MA, USA, 2019, pp. 464-467.
153. D. Martin, M. Roberg, Z. Popovic and T. Barton, "A 6–12 GHz Reconfigurable Transformer-Based Outphasing Combiner in 250-nm GaAs," *2019 IEEE BiCMOS and Compound semiconductor Integrated Circuits and Technology Symposium (BCICTS)*, Nashville, TN, USA, 2019, pp. 1-4.
154. A. Duh, M. Duffy, W. Hallberg, M. Pinto, T. Barton and Z. Popović, "A 10.8-GHz GaN MMIC Load-Modulated Amplifier," *2019 49th European Microwave Conference (EuMC)*, Paris, France, 2019, pp. 408-411.
155. M. R. Duffy, G. Lasser and Z. Popović, "Discrete Supply Modulation of a Three-Stage K-Band PA," *2019 49th European Microwave Conference (EuMC)*, Paris, France, 2019, pp. 698-701. **Won Young Engineer Award**
156. Megan Robinson, Zoya Popovic. "Scalable microwave waste-to-fuel conversion." In *AMPERE 2019. 17th International Conference on Microwave and High Frequency Heating*, pp. 210-216. Editorial Universitat Politècnica de València, 2019.
157. D. T. Donahue, M. Roberg, Z. Popovic and T. W. Barton, "An X-Band Sampled-Line Impedance Sensor in 250-nm GaAs," *2020 IEEE Topical Conference on RF/Microwave Power Amplifiers for Radio and Wireless Applications (PAWR)*, San Antonio, TX, USA, 2020, pp. 1-4.
158. P. Zurek and Z. Popović, "Two-Stage Concurrent X/Ku Dual-Band GaAs MMIC Power Amplifier," *2020 IEEE/MTT-S International Microwave Symposium (IMS)*, Los Angeles, CA, USA, 2020, pp. 269-272.

159. J. A. Estrada, P. de Paco, S. Johannes, D. Psychogiou and Z. Popović, "Co-Designed High-Efficiency GaN Filter Power Amplifier," *2020 IEEE/MTT-S International Microwave Symposium (IMS)*, Los Angeles, CA, USA, 2020, pp. 115-118.
160. A. Babenko *et al.*, "Characterization of a Josephson Junction Comb Generator," *2020 IEEE/MTT-S International Microwave Symposium (IMS)*, Los Angeles, CA, USA, 2020, pp. 936-939.
161. E. Kwiatkowski, C. T. Rodenbeck, T. Barton and Z. Popović, "Power-Combined Rectenna Array for X-Band Wireless Power Transfer," *2020 IEEE/MTT-S International Microwave Symposium (IMS)*, Los Angeles, CA, USA, 2020, pp. 992-995.
162. L. Marzall, S. Verploegh, T. Cappello, M. Roberg and Z. Popović, "Active MMIC Circulator Performance in a Phased-Array-Like Environment," *2020 50th European Microwave Conference (EuMC)*, 2021, pp. 1186-1189.
163. Der, W. Sear, Z. Popovic, G. Lasser and T. Barton, "A S-C- / K-band Reconfigurable GaAs MMIC Power Amplifier for 5G Applications," *2021 IEEE MTT-S International Microwave Symposium (IMS)*, 2021, pp. 873-876.
164. J. Lee, G. S. Botello, R. Streeter, K. Hall and Z. Popović, "A Hybrid Correlation-Dicke Radiometer for Internal Body Thermometry," *2022 52nd European Microwave Conference (EuMC)*, pp. 464-467, Feb. 2022, London.
165. J. Molles, M. Robinson, E. Kwiatkowski and Z. Popović, "A 10-GHz Single-Supply GaAs MMIC Self-Synchronous Rectifier," *2022 17th European Microwave Integrated Circuits Conference (EuMIC)*, Feb. 2022, London.
166. C. Nogales, Z. Popović and G. Lasser, "A 10-W6-12GHz GaN MMIC Supply Modulated Power Amplifier," *2022 52nd European Microwave Conference (EuMC)*, 2022, pp. 436-439
167. S. Stroessner, R. Lucero, J. Kravits, A. Russell, S. Johannes, K. Baker, J. Kasprzyk, Z. Popovic, "Power Amplifier Design Using Interactive Multi-Objective Visualization," *2022 52nd European Microwave Conference (EuMC)*, pp. 500-503, Feb. 2022, London.
168. S. Verploegh, T. Sonnenberg, M. Pinto, A. Babenko and Z. Popović, "On-chip Power Combining with 3-Stage 75–110 GHz GaN MMIC Power Amplifiers," *2021 51st European Microwave Conference (EuMC)*, 2022, pp. 890-893, **Received Tom Brazil paper award**
169. A. Romano, T. Sonnenberg, S. Verploegh, T. Barton and Z. Popovic, "A W-Band GaN MMIC Continuous 90° Reflective Phase Shifter," *2022 IEEE 22nd Annual Wireless and Microwave Technology Conference (WAMICON)*, 2022. **Received best student paper award**
170. A. A. Babenko *et al.*, "Cryogenic Decade-Passband Superconducting Integrated Diplexer," *2022 IEEE/MTT-S International Microwave Symposium - IMS 2022*, pp. 156-159, Denver, June 2022.

Hardware photographs and main results, along with pdf versions of the papers can be seen or downloaded from <https://www.colorado.edu/faculty/popovic-zoya/>

RESEARCH OVERVIEW

Graduated 70 Ph.D. students over the past 33 years, with 18 Ph.D. students, 2 MS students, and 4 undergraduate research students and 1 post-doctoral fellow currently working in the following areas of microwave/millimeter-wave engineering: (1) high-efficiency PAs and adaptive PAs for radar and communications; (2) three-dimensional heterogeneously integrated microwave circuits; (3) multibeam active antenna arrays for radar and communications; (4) wireless powering for batteryless sensors; (5) microwave radiometry for medical applications; (6) microwave waste management; (7) millimeter-wave circuits and quasi-optical techniques; and (8) atomic quantum sensors.

Research interests statement

I am interested in continued work in reducing power consumption in analog front ends with new circuit topologies that give higher efficiency. Our first publications in this area were in 1995, with the first demonstrated microwave-frequency class-E power amplifier. Our results for X-band and UHF power amplifiers had record published efficiencies, and we are continuing a strong effort in this direction with MMIC PAs implemented in GaN with integrated dynamic supplies and with increased power levels at higher frequencies. A new direction that we are expanding in is in maintaining linearity with high efficiency at high power levels, and this work has gained a lot of industry attention. We are also working on broadband and low additive phase noise power amplifiers. My ultimate long-term goal is to address efficiency, linearity and bandwidth in a single transmitter component. Another related area is intelligent transmitters, which involves sensing, control algorithms, and dynamic adaptation to varying loads.

An area in which we have a best paper award and licensed patent is in RF energy harvesting and wireless powering of wireless sensors. The applications are for low-maintenance batteryless sensors for manufacturing environments, structural monitoring, green buildings and healthcare. We have shown that broadband statistically varying randomly polarized background microwave radiation can be efficiently rectified and the stray energy stored over time for useful electronic applications. We have also shown that FCC-compliant low-power transmitters can be strategically placed to enable constant very low power density energy delivery and storage. My goals related to this research are to improve the integration of our current hybrid demonstrations, and to expand the circuit-antenna library so that we can address many concrete applications with an optimized architecture. This work is mostly industry funded with a small NSF component and a new project in low-power large-area microwave rectenna arrays for space power beaming for NRL.

Another area of increasing interest is in microwave radiometry for internal body temperature measurements (funded by NSF, state of Colorado, LumenAstra). This approach provides a solution to a problem that has not yet been solved. We use a very sensitive receiver and near-field probe placed on the skin to measure the total radiometric power received from a stack of tissues, and then estimate the power emitted (and therefore temperature) of a buried tissue layer, based on electromagnetic simulations of the tissues. Our patent in this technology resulted in a Colorado start-up LumenAstra founded by Mr. Jim Pollock, currently an early-stage technology company. My group at CU Boulder continues research in this area to improve temperature resolution and spatial resolution.

I am interested in continuing the work in multibeam arrays for communication and radar systems, especially taking advantage of the increase in dynamic range, increase in transmitter power with simultaneous increase in reliability, and decrease in sensitivity to multipath fading. The group has demonstrated multibeam antenna arrays with greatly reduced cost and increased reliability as compared to standard phased arrays, funded by NASA. We are continuing this work for electronic warfare transmit phased array.

Two new areas of interest are in microwave quantum engineering and microwave pyrolysis for converting waste to useable fuel. Areas of quantum engineering include Josephson Junction dc and AC voltage standards (with NIST) and room-temperature and laser-cooled Rydberg atom microwave and millimeter-wave electrometry (ColdQuanta, DARPA, Lockheed Martin).

TEACHING

Radio-Frequency Undergraduate Sequence:

Students who complete this sequence graduate in the “RF track” and can immediately get a job in the RF industry. An example is the *RF Academy* which I have helped institute with Lockheed Martin (as Lockheed

Martin Endowed Chair), in which students can start an internship after the first sophomore course and continue with summer internships and/or part-time work that fits their academic schedule during the year, with a guaranteed job after graduation. Since 2016, over 70 students have passed through this program and a large fraction are now working at Lockheed Martin Space Systems in Denver.

ECCE 2420, *Electronics for Wireless Communications*, sophomore elective for electrical and computer engineering majors. Developed in 2011, offered every Spring semester, 40 students maximum, usually there is a long wait list and I let more students into the course. The course has an extensive laboratory component and follows the textbook “The Electronics of Radio” by Prof. David Rutledge which is designed around the NorCal40A superheterodyne transceiver. The course was revised at CU Boulder for easier de-bugging by replacing the single >200 component radio board with 9 sub-boards which students can test one at a time and finally assemble a working radio. The goal of the course is to motivate later courses in circuits, electromagnetic and communications, while teaching some basic practical and lab skills. The students spend the semester learning about analog electronics through the building of a pcb-based 7-MHz radio. As a part of the final exam, they take the Technician and General Amateur Radio test and get their licenses. In 2016, for example, all students (over 50) received their amateur radio licenses. Presented at IMS workshop, 2017.

ECEN 3400, *Electromagnetic Fields and Waves*, 1st semester junior course, was taught for many years as a 5-credit class (lectures, labs, recitations) core course. Currently it is a 3-credit core class for all EE and most ECE majors, with an annual enrolment of about 100. I wrote a textbook (about 450 pages) and workbook (about 200 pages) for the course published by Prentice Hall in 2000. The book was translated to Korean and Portuguese. After the death of my co-author (also my father), I have negotiated to own the copyright and the text is distributed free to students. I developed a series of 12 labs, which are used as practical homework projects and demos. Over the years, partnerships with Texas Instruments, SpectraLink, Keysight, Rhode and Schwartz and Qorvo have enabled equipment, parts and student project awards.

ECEN 3410, *Electromagnetic Waves*, 2nd semester junior course, developed the theoretical background and a set of practical problems and laboratory exercises that cover EM wave topics in the radio and optical parts of the spectrum, as pre-requisite for the microwave lab. Class projects, which are in part theoretical and in part self-paced experimental (requiring only equipment in our standard undergraduate circuits lab) start and end with uniform plane waves, closing the circle through nonuniform waves in a coaxial line, quasi-TEM waves in microstrip, TE/TM waves in metal waveguides, evanescent waves in dielectric waveguides including fibers, Gaussian beams, antennas and propagation. The experiments are designed to be in-part open ended with a significant practical design component.

ECEN 4363/5634, *Microwave Lab*, senior/beginning graduate level lab, annual enrolment over 40. Developed most of the labs, wrote the lab manual and notes, obtained equipment donations from HP/Agilent, Qorvo, FIRST RF and Rhode and Schwartz over the years (over \$2M). Labs include artificial transmission lines in time and frequency domain, power measurements in X-band waveguide, network analysis and calibration (6GHz), multi-port networks (waveguide and microstrip), Gunn diode oscillators in waveguide, linear and power amplifiers, antenna measurements, superheterodyne link with voice (FM, single upconversion) and digital data (including SDRs), and radar (FMCW and Doppler).

Courses developed for the graduate program in microwave engineering

ECEN 5104, *CAD of Microstrip Circuits*, Re-designed completely an existing course in Fall 2003. Typical enrolment is 15-20 graduate students who completed 6 design projects using commercial CAD tools (Agilent ADS, Ansoft Advanced Designer, AWR Microwave Office): matching circuits, couplers, filters, resonators, bias networks and a final larger project in an area of the student’s choice.

ECEN 5014, *Active Microwave Circuits*, graduate class with strong design component, taught every other year, enrolment about 25/semester. Wrote a lab manual and lecture notes. Class includes six two-week design projects using industry-standard software, circuits are fabricated and measured. Obtained software

donations for class from AWR. Each student also does an independent MMIC design final project which can be fabricated in the TriQuint GaAs pHEMT TQPED process. The design and final projects from several semesters available electronically in IEEE publication format.

ECEN 5004, *MMIC design and measurements*, graduate class with strong design component, taught every other year, enrolment about 25/semester. Obtained free MMIC TriQuint GaAs foundry fabrication (a \$35,000 value per run, since 2006) and WIN Semiconductor GaAs and GaN fabrication (\$100k/year for 2018-2021). Students spend the semester designing a MMIC in the 10-30GHz range, the MMIC is fabricated during the summer and they test it in the fall semester. Several papers have been published as a result of this class at IMS and EuMW.

ECEN 5024, *Advanced Electromagnetics*, developed in Fall 2020, with 20 graduate students. The class does not follow a textbook, but is rather focused on theoretical topics that the students will need in their research. It is centered on electromagnetic theorems, starting from equivalence, duality and reciprocity and including compensation and electrodynamic similitude. Through the theorems, various types of EM waves are studied: uniform and non-uniform plane waves in lossless and lossy media, quasi-TEM, TE and TM in metallic waveguides, waves in dielectric waveguides including optical fibers, and Gaussian beams.

Other undergraduate course development

ECEE 1500, *Sustainable energy*, for non-engineering majors. The class has been taught since 2010 and is approved as the Arts and Sciences QRMS (quantitative reasoning math and science) elective. The course material was shared with and is currently being used at the University of Washington (Prof. Peyman Arabashahi) and Ohio State University (Prof. Betty Lise Anderson). The course includes experimental group projects focused on energy issues related to engineering.

ECEN 2010, *Electrical Engineering in Biology and Medicine*, sophomore elective seminar course. Developed course with Prof. Meyer, including lectures, homeworks, practical design problems and about 10 visits from local companies during the semester. The course covers three components: electrical processes in the body (signaling), electrical engineering diagnostics and treatment (including MRI, EEG), and effects of electromagnetic fields on the body (e.g. heating).

Other graduate course development

- *Special topic, Practical antenna design*, graduate lab, taught irregularly, enrolment about 20/semester. The students use pc-based CAD to design about 15 different kinds of wire and printed antennas that they fabricate and measure. A part of this course is a field trip to the Very Large Array (VLA), the radio telescope in Socorro, New Mexico.

- *Special topic, RF/optical techniques*, graduate course, taught irregularly. Covers some common methods and components used at both RF and optical frequencies (wavelengths). The objective of the course is to present two different views of the same electromagnetic technique, phenomenon, or circuit component. Examples of methods that are compared include: Fourier optics and antenna analysis; Gaussian beams at optical and millimeter waves; diffraction theory; and basic field theorems. Examples of components that are compared include polarizers, lenses, waveguides, directional couplers, retro reflectors, phase conjugators, and soliton transmission structures. The course concludes with a conference at which students present projects they have worked on during the last month of the course. Colleagues from industry judged the presentations, and Best Paper Award was given. A digest of this mini conference was published for assessment purposes.

Fellowships obtained for my students at CU Boulder

- "Radio Frequency Research Fellowship", to fund one graduate student (Jacques Hung Loui) for a year, funded by FIRST RF, Fall 2003-Fall 2004, \$32,202
- Sandia National Laboratory, "Excellence in Science," Fellowship to support graduate student, Nicola Kinzie, 8/04 - 8/05, \$25,000
- MIT Lincoln Laboratories Fellowship - \$15K per year for support of exceptional graduate student, yearly for 5 years (2005-2010)
- Rohm and Haas Electronics, 1-year graduate fellowship, John O'Brien, \$33,500, 2006 - 2007
- NSF Graduate Fellowship for Alan Brannon, 2005-2008
- NIST PREP for Ph.D. advisee Alan Brannon, \$50,000/year for 3 years, 2006 – 2008
- NIST PREP fellowship for PhD advisee Jonathan Chisum, August 2006 - June 2007
- NIST-PREP for Michael Elsbury, Voltage standards, 2007-2010, \$50,000/year
- NIST-PREP, Bryan Babcock, 2009-2010, \$50,000
- NSF, International supplement (with Finland and Argentina), \$20k, 2008-2009
- NSF, REUs totaling over \$150,000
- NSF AGEP Minority Fellowship for PhD advisee Mabel Ramirez Velez, August 2006 - June 2007
- NIST/CU MSE Graduate Fellowship for Robert Scheeler, 2011 and 2012
- NIST PREP graduate fellowship for PhD advisee Dan Kuester, 2008-2012
- NSF, International supplement (with Switzerland), William Haines and Patrick Bluem, \$20k, 2016
- NIST PREP graduate fellowship for PhD advisee Akim Babenko, quantum electronics, 2018-2022
- NIST PREP graduate fellowship for PhD advisee Amy Robinson, quantum electronics, 2019-2023
- NDSEG Fellowship for PhD advisee Paige Danielson, phased array, 2018-2023
- NSF Graduate Fellowship for PhD advisee Kaitlin Hall, microwave thermometry, 2021-2024

International Teaching

I believe it is very important to expose my students in Colorado to a variety of cultures and have worked hard on enabling many visiting students from Europe (Italy, Spain, France, Germany, Finland, the Netherlands, Sweden, Norway, Serbia), Asia (Korea, Japan), South America (Argentina, Brazil, Venezuela) to work and spend extended visits in my group.

As visiting professor at the Technische Universitat Muenchen, Munich, Germany, I taught a version of the *RF Optics* graduate course in Spring 2001, and *Active Microwave Circuits* in Summer 2003, to a total of 30 graduate students. In the years following 2001, a total of 11 students from Germany spent at least 3 months each in my group, which resulted in about 10 joint papers (one of them is the 2004 winner of the IEEE MTT Microwave Prize).

As a visiting professor at ISAE (Supaero) in Toulouse, France, I taught a seminar course on antennas in Spring 2014 to approximately 40 students. This course was taught in French. I had 5 students from France (Limoges and Toulouse) spend at least 6 months each in my group, with a number of resulting joint publications.

As a Chair of Excellence professor at Carlos III University in Madrid, Spain, in Fall 2018, I taught a seminar course *Selected topics in active microwave circuits* to approximately 15 graduate students. We just got a paper accepted and two of the Spanish students will be spending time in my group this summer, finishing a joint journal paper. I have hosted 4 other graduate students from Spain in the past.

Outreach activities

- K-12 students know little about what engineering is and it is important to get this information out to both students and parents. I helped in many science fairs as coach (project advisor), as well as judge, in local elementary, middle and high-schools.

- I have created lab kits for high-school physics classes, in collaboration with Dr. Helen Petach, the Fairview high school physics teacher, Fairview High School, Boulder.
- I have worked with Jay Donegy and Dr. Helen Petach, the high-school instructors for the senior/junior class “Research Seminar in Science”. This all-year class teaches students how to approach a research problem and places them in research labs around Boulder. I hosted several students in the past few years, and they have all received prizes at the State science fairs and all are currently doing PhDs. The students working with me spent regular weekly times in the lab.
- I organize “a day in the lab” for elementary and middle-school students, where up to 100 students come to visit electrical engineering laboratories with 10-12 hands-on experiments. This is a yearly effort and has so far involved Eisenhower elementary school (3rd and 4th grades), Summit middle school (7th grade), and High-Peaks elementary school (4th grade), all in Boulder.

SELECTED SERVICE

- Member of Editorial Board, *Proceedings of the IEEE*, January 1, 2019 – present
- Steering Committee and Technical Program Committee, *2022 IEEE International Microwave Symposium*, Denver, CO, June 2022
- Technical Program Committee, *2022 IEEE International Microwave Symposium*, 2020 – present
- Member of External Advisory Board, *Southwest Research Institute*, Houston, Texas, 2018 - present
- Member of Technical Program Committee, *IEEE MTT-S International Symposium*, 1994 to present.
- General Chair for *IEEE Wireless Power Transfer Conference*, held in Boulder, May 2015.
- Member, *IEEE MTT Microwave Prize committee*, 2008 to 2018.
- Member, *IEEE Electromagnetics Award committee*, 2014-2018, chair 2016-2018.
- Member, IEEE MTT-5 and MTT-26 technical committees, 2010 to present. MTT-5 Vice chair 2014-2016, Chair 2017-2019.
- Associate Editor, *IEEE Trans. on Microwave Theory and Techniques*, January 2005 – December 2010.
- Technical Program Co-Chair (with the late K.C. Gupta) for the *IEEE MTT-S International Microwave Symposium* in Denver, June 1997 (about 8000 attendees).
- Chair, Commission D or URSI (2015-2017), Member at Large of URSI, 2009 -2018.
- Member of National Academies panel on ARL, Sensors and Electronics, 2006 and 2007.
- Member of Sandia National Laboratories Microsystems (Division 1700) review panel, 2007-2015.
- Organizer of workshops: WARC '95, Denver; 1997 ARO/DARPA Workshop on Quasi- Optical Combiners, Santa Barbara; Optical and Microwave Packaging Workshop, Estes Park, 1993.
- Organized numerous URSI, IMS, AP conference sessions.
- University of Colorado Chancellor's Committee on Conflict of Interest, 1996 to 2009, Chair in 1999.
- University of Colorado Distinguished Professor selection committee, 2015-present.
- College of Engineering Dean’s FLAG (Future Leaders) committee, 2002-2005.
- ECEE Department Chair Search, 2019-2020.
- ECEE department Executive Committee, 1995 to 2000, and 2002-present. Various hiring committees 2001-present. Department Chair search committee chair, 2018-2019.
- College of Engineering First Level Review Committee, 2020- present.
- College of Engineering Diversity, Equity and Inclusion Faculty search, 2020 – 2021.
- Department Graduate Committee, 2020 – present