

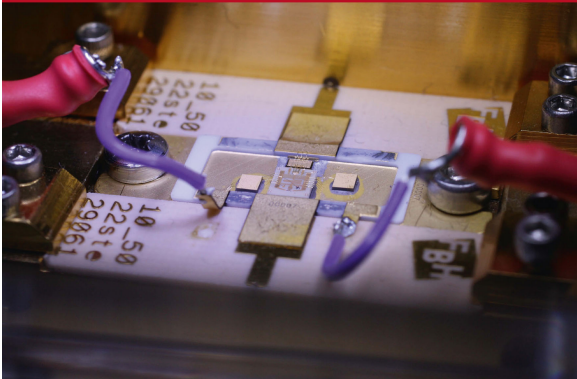


Alex Wiens (Autor)

Tunable Ferroelectric Matching Networks implemented into High Power RF Amplifiers for High Dynamic and Wideband Efficiency

Alex Wiens

**Tunable Ferroelectric Matching Networks
implemented into High Power RF
Amplifiers for High Dynamic and
Wideband Efficiency**



Cuvillier Verlag Göttingen
Internationaler wissenschaftlicher Fachverlag

<https://cuvillier.de/de/shop/publications/7505>

Copyright:

Cuvillier Verlag, Inhaberin Annette Jentsch-Cuvillier, Nonnenstieg 8, 37075 Göttingen, Germany
Telefon: +49 (0)551 54724-0, E-Mail: info@cuvillier.de, Website: <https://cuvillier.de>



Contents

1	Introduction	11
2	Fundamentals of Nonlinear Dielectrics	15
2.1	Electric Polarization	15
2.2	Perovskite Ferroelectrics	17
2.3	Barium Strontium Titanate	20
2.3.1	Modeling of Electric Tunability	24
2.3.2	Process Technology for Tunable Components	26
3	Ferroelectric Composite Material and Varactor Optimization	31
3.1	Multi Dielectric Composites	31
3.1.1	Modeling of Dielectric Properties	32
3.1.2	Processing and Characterization	47
3.1.3	Comparison of Models and Measurement Results	51
3.2	Varactor Topologies: Design and Optimization	56
3.2.1	Uiplanar Thick Film Varactors	57
3.2.2	Multilayer Thick- and Thin Film Varactors	65
3.2.3	External Biasing Concepts: Resistive and Inductive Decoupling	67
4	Large Signal Characteristics of Ferroelectric Varactors	75
4.1	Thermal Conductivity of Barium Strontium Titanate	76
4.2	RF-induced Self Heating	78
4.2.1	Modelling of Thermal Behaviour	79
4.2.2	Large Signal Measurements	82
4.3	Non-linear Characteristics	89
4.3.1	Models	89
4.3.2	Intermodulation Measurements and Comparison	93



Contents

5	Integration of Tunable Matching Networks into RF Power Amplifiers	95
5.1	Transistor Characterization for Impedance Matching	99
5.2	Filter-based Matching Network Synthesis	102
5.2.1	Thick Film Implementation	112
5.2.2	Thin Film Implementation	116
5.3	CAD-aided Impedance Space Matching Network Synthesis	118
5.4	Hybrid Implementation into a GaN HEMT	125
6	Conclusion and Outlook	135
A	Mathematical Appendix	139
B	Characterization Appendix	143
C	Figure Appendix	151
D	Table Appendix	153
E	Lithography Appendix	155
F	Measurement equipment	157
	Symbols and Abbreviations	157
	Bibliography	163
	Curriculum Vitae	183