

88th ARFTG Short Course

Introduction to Power Amplifier Design

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Description

This is an introductory course on RF/microwave power amplifier (PA) design. It will cover the fundamentals of PA design, using simple models and load-pull methods to derive the basic PA. The amplifier classes A, AB, B, C, D, E, F, J, and S will be presented and compared, illustrating the use of harmonic loading to improve efficiency. Modern digital communications signals, such as those used in cellular wireless, are characterized by high peak-to-average-power ratios (PAPR), and there are several PA architectures that have been developed to accommodate such signals while still providing high efficiency: Doherty, Polar modulation/envelope tracking (ET), and Outphasing systems will be described, and design procedures for these PAs will be presented. Measurement techniques for PAs will be described, including scalar, vector, and nonlinear techniques. Some approaches to PA linearization will also be outlined.

Introduction:

- Small-signal amplifiers and power amplifiers.

Straightforward PA design using a simple model and load-pull data.

Amplifier Classes: A, AB, B, C, D, E, F, J...

- harmonic loading, efficiency enhancement, large-signal waveforms.

Modern Communications signals: PAPR, PA efficiency, linearity.

Load Modulation:

- Doherty PA
- Outphasing

Supply Modulation:

- Polar modulation
- Envelope Tracking (ET)

Measurement Techniques

- Small-signal, frequency response;
- Load-pull measurements.
- Large-signal nonlinear measurements, X-parameters

Linearization

- Analog Methods: feedforward
- Digital Pre-Distortion (DPD)

Learning Objectives and Outcomes

The students on this course will:

- gain an appreciation of the design principles of a RF/microwave power amplifier;
- understand some of the trade-offs in PA design;
- gain an awareness of the different high-efficiency PA architectures currently being used in the industry, and the design requirements and process;
- get an introduction to high-power measurement techniques;
- get an appreciation of linearization of the PA.

The overall learning outcomes will be a better understanding of how a PA design should be approached, and some of the basic questions will be answered.