

# TRANSMISSION LINE TRANSFORMERS

by Jerry Sevick, W2FMI

2nd Edition



Published by \_\_\_\_\_  
the American Radio Relay League

225 Main Street  
Newington, CT 06111

*Copyright © 1990 by*

The American Radio Relay League, Inc

*Copyright secured under the Pan-American  
Convention*

This work is publication No. 75 of the Radio  
Amateur's Library, published by the League. All  
rights reserved. No part of this work may be  
reproduced in any form except by written  
permission of the publisher. All rights of  
translation are reserved.

Printed in USA

*Quedan reservados todos los derechos*

ISBN: 0-87259-296-0

\$20.00 in USA

Second Edition  
Second Printing, 1991

# Contents

## Preface

## About the Author

### Chapter 1 Analysis

- 1.1 Introduction
- 1.2 The Basic Building Block
- 1.3 The Guanella Analysis
- 1.4 The Ruthroff Analysis

### Chapter 2 Low-Frequency Characterization

- 2.1 Introduction
- 2.2 Low-Frequency Analyses of Ruthroff's 1:4 Transformers
- 2.3 Low-Frequency Analyses of Guanella's 1:4 Transformers
- 2.4 The Rod v the Toroid
- 2.5 Rod Parameters

### Chapter 3 High-Frequency Characterization

- 3.1 Introduction
- 3.2 Experiment v Theory
- 3.3 To Twist or Not to Twist
- 3.4 The Autotransformer v the Transmission Line Transformer
- 3.5 Ferrites and Frequency Response

### Chapter 4 Transformer Parameters for Low-Impedance Applications

- 4.1 Introduction
- 4.2 Stripline Transformers
- 4.3 Low-Impedance Coaxial Cable Transformers
- 4.4 The Third Winding

- Chapter 5 Transformer Parameters for High-Impedance Applications**
  - 5.1 Introduction
  - 5.2 High-Impedance Limitations
  - 5.3 Long Transmission Lines
  - 5.4 Variable Characteristic Impedance Lines
  - 5.5 Series Transformers
- Chapter 6 1:4 Unbalanced-to-Unbalanced Transformer Designs**
  - 6.1 Introduction
  - 6.2 Schematics and Pictorials
  - 6.3 12.5:50- $\Omega$  Ununs
  - 6.4 25:100- $\Omega$ , 50:200- $\Omega$  and 75:300- $\Omega$  Ununs
- Chapter 7 Unbalanced-to-Unbalanced Transformer Designs with Impedance Ratios Less Than 1:4**
  - 7.1 Introduction
  - 7.2 1:1.5 Ununs
    - 7.2.1 Tapped-Bifilar Transformers
    - 7.2.2 Quintufilar Transformers
  - 7.3 1:2 Ununs
  - 7.4 1:3 Ununs
- Chapter 8 Unbalanced-to-Unbalanced Transformer Designs with Impedance Ratios Greater Than 1:4**
  - 8.1 Introduction
  - 8.2 Guanella Transformers
    - 8.2.1 5.56:50- $\Omega$  Ununs
    - 8.2.2 50:300- $\Omega$  Ununs
    - 8.2.3 50:450- $\Omega$  Ununs
    - 8.2.4 50:600- $\Omega$  Ununs
    - 8.2.5 50:800- $\Omega$  Ununs
  - 8.3 Ruthroff-Type Transformers
    - 8.3.1 5.56:50- $\Omega$  Ununs
    - 8.3.2 50:450- $\Omega$  Ununs
    - 8.3.3 3.125:50- $\Omega$  Ununs
  - 8.4 Ruthroff-Guanella Transformers
  - 8.5 Coaxial Cable Transformers: Ruthroff-Type

## **Chapter 9 Baluns**

- 9.1 Introduction
- 9.2 The 1:1 Balun
  - 9.2.1 Rod v Toroidal Baluns
  - 9.2.2 Bifilar v Trifilar Baluns
  - 9.2.3 Air-Core v Ferrite-Core Baluns
- 9.3 The 1:4 Balun
  - 9.3.1 50:200- $\Omega$  Baluns
  - 9.3.2 75:300- $\Omega$  Baluns
  - 9.3.3 25:100- $\Omega$  Baluns
  - 9.3.4 12.5:50- $\Omega$  Baluns
- 9.4 The 1:9 Balun
- 9.5 Baluns for Yagi, Quad and Rhombic Antennas
  - 9.5.1 Yagi Beams
  - 9.5.2 Quad Antennas
  - 9.5.3 Rhombic Antennas

## **Chapter 10 Multimatch Transformers**

- 10.1 Introduction
- 10.2 Dual-Output Transformers
  - 10.2.1 1:1.5 and 1:3 Ratios
  - 10.2.2 1:2 and 1:4 Ratios
- 10.3 Parallel Transformers
- 10.4 Dual-Output, Parallel Transformers
- 10.5 8-Ratio Transformer

## **Chapter 11 Materials and Power Ratings**

- 11.1 Introduction
- 11.2 History of Ferrites
- 11.3 Experimental Results
- 11.4 Power Ratings
- 11.5 Suppliers of Materials

## **Chapter 12 Simple Test Equipment**

- 12.1 Introduction
- 12.2 The Wheatstone Bridge
- 12.3 A High-Frequency Resistive Bridge
- 12.4 Signal Generators
- 12.5 Efficiency Measurements—The Soak Test
- 12.6 Characteristic Impedance Measurements

# Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

## Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

## Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

## Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

## API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

## LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

## FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

## E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.