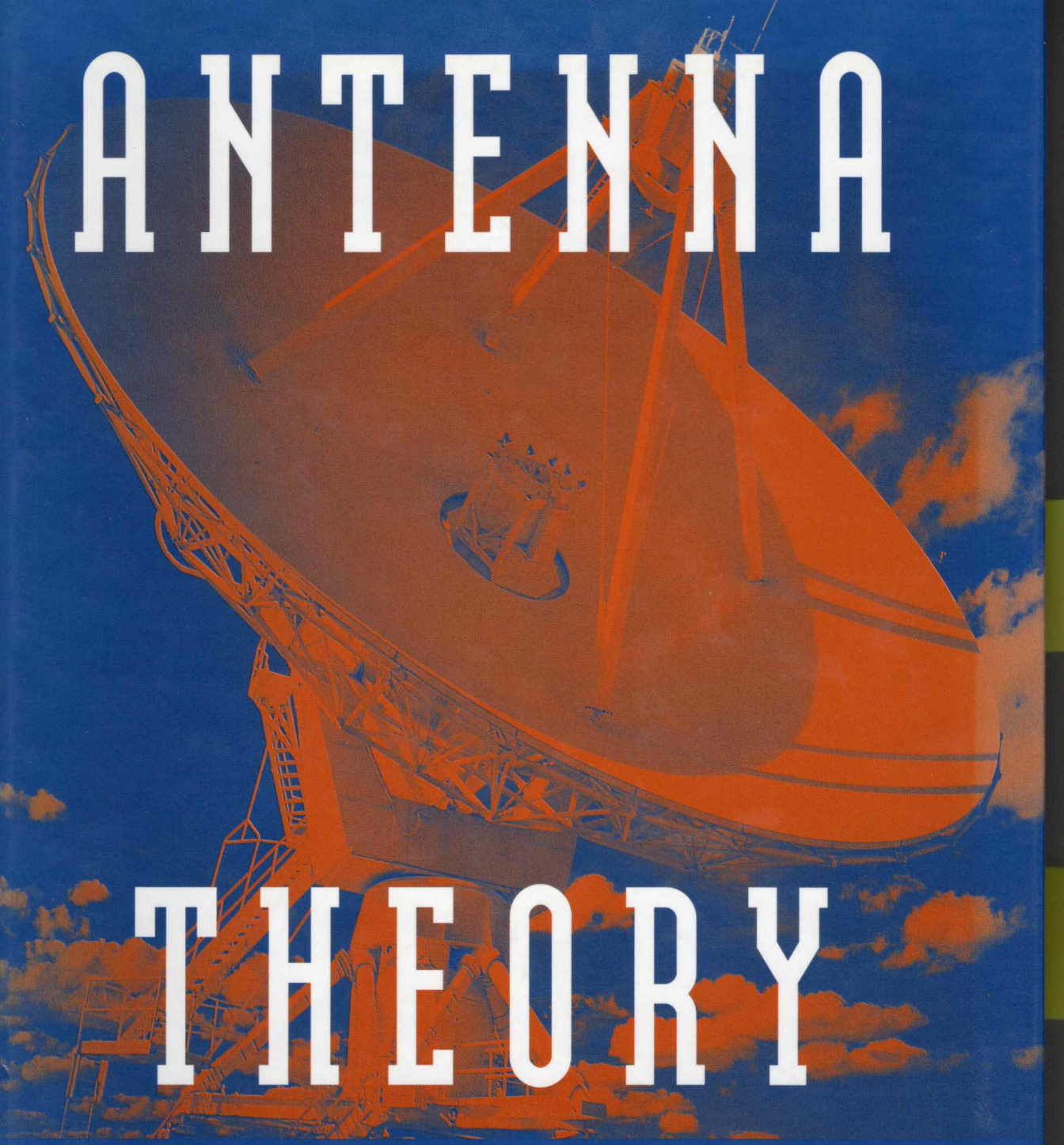




ANTENNA

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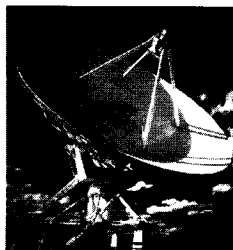
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JOHN WILEY & SONS, INC.

New York • Chichester • Brisbane • Toronto • Singapore

FRONT COVER PHOTO: Parabolic reflector (25-m diameter) of 27-element Very Large Array (VLA) radio telescope. National Radio Astronomy Observatory (NRAO), Socorro, New Mexico.

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COVER PHOTOGRAPH Socorro Mexico, Telegraph Colour Library FPG. ©

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Library of Congress Cataloging in Publication Data:

Balanis, Constantine A., 1938—

Antenna theory : analysis and design / Constantine A. Balanis. —
2nd ed.

p. cm.

Includes index.

ISBN 0-471-59268-4 (cloth : alk. paper)

1. Antennas (Electronics) I. Title.

TK7871.6.B353 1997

621.382'4—dc20

96-12134
CIP

Printed in the United States of America

10 9 8

CHAPTER

1

ANTENNAS

1.1 INTRODUCTION

An antenna is defined by Webster's Dictionary as "a usually metallic device (as a rod or wire) for radiating or receiving radio waves." The *IEEE Standard Definitions of Terms for Antennas* (IEEE Std 145-1983)* defines the antenna or aerial as "a means for radiating or receiving radio waves." In other words the antenna is the transitional structure between free-space and a guiding device, as shown in Figure 1.1. The guiding device or transmission line may take the form of a coaxial line or a hollow pipe (waveguide), and it is used to transport electromagnetic energy from the transmitting source to the antenna, or from the antenna to the receiver. In the former case we have a transmitting antenna and in the latter a receiving antenna.

A transmission-line Thevenin equivalent of the antenna system of Figure 1.1 in the transmitting mode is shown in Figure 1.2 where the source is represented by an ideal generator, the transmission line is represented by a line with characteristic impedance Z_c , and the antenna is represented by a load Z_A [$Z_A = (R_L + R_r) + jX_A$] connected to the transmission line. The Thevenin and Norton circuit equivalents of the antenna are also shown in Figure 2.21. The load resistance R_L is used to represent the conduction and dielectric losses associated with the antenna structure while R_r , referred to as the *radiation resistance*, is used to represent radiation by the antenna. The reactance X_A is used to represent the imaginary part of the impedance associated with radiation by the antenna. This is discussed more in detail in Sections 2.13 and 2.14. Under ideal conditions, energy generated by the source should be totally transferred to the radiation resistance R_r , which is used to represent radiation by the antenna. However, in a practical system there are conduction-dielectric losses due to the lossy nature of the transmission line and the antenna, as well as the due to reflections (mismatch) losses at the interface between the line and the antenna. Taking into account the internal impedance of the source and neglecting line and reflection (mismatch) losses, maximum power is delivered to the antenna under *conjugate matching*. This is discussed in Section 2.13.

*IEEE Transactions on Antennas and Propagation, vols. AP-17, No. 3, May 1969; AP-22, No. 1, January 1974; and AP-31, No. 6, Part II, November 1983.