

# 1. Introduction

Just as radio and the movies were supposedly killed off by television, the vacuum tube, as we all know, was done in by the transistor. Like the "death" of Mark Twain, however, reports of the death of the vacuum tube have been "greatly exaggerated." Where large amounts of power must be converted from one form to another—especially if the end form is microwaves (that is, frequencies ranging from 1 GHz to 100 GHz approximately)—vacuum tubes still represent viable technology.

The operative word here is "large." What constitutes a large amount of power is related to the square of the wavelength of the end form of converted power. Whereas millions of watts may be required to satisfy such a criterion at the low-frequency end of the microwave spectrum, kilowatts—or even watts!—may be more than adequate to satisfy it at the upper end of the that spectrum.

Despite the earnest efforts of the developers of solid-state devices to make the vacuum tube obsolete, it still rules the realm of high-power microwave. (This is notwithstanding the solid-state designer's "modular" approach to high-power, exemplified by the dictum: "If you can get one watt from a single transistor, you can get a megawatt from a million of them.") High-power vacuum tubes come in many forms, from that hoary workhorse known as the multi-cavity klystron to the most sophisticated wide-band, high-gain, coupled-cavity traveling-wave tube—or even the high-efficiency crossed-field amplifier. These devices still have a role to play in technology.

What follows, then, is dedicated to those technologists who, at some point in their careers, may have to deal with a microwave vacuum tube in order to power a radar system or a particle accelerator, to transmit information or to cure plywood, to kill cancer or even to kill weed seeds before planting. But this book assumes that the reader already possesses a knowledge of microwave tubes themselves. Instead, it focuses on the types of transmitters, or "life-support systems," that use them. To these transmitters, the microwave tubes themselves are the ultimate load.

Although the term "transmitter" will be used throughout this book to identify an overall system whose useful output is high-frequency power, bear in mind that more and more the term is becoming a misnomer; the output of such devices is more frequently being "transmitted" nowhere. Instead, their output is being used internally by an even larger system.