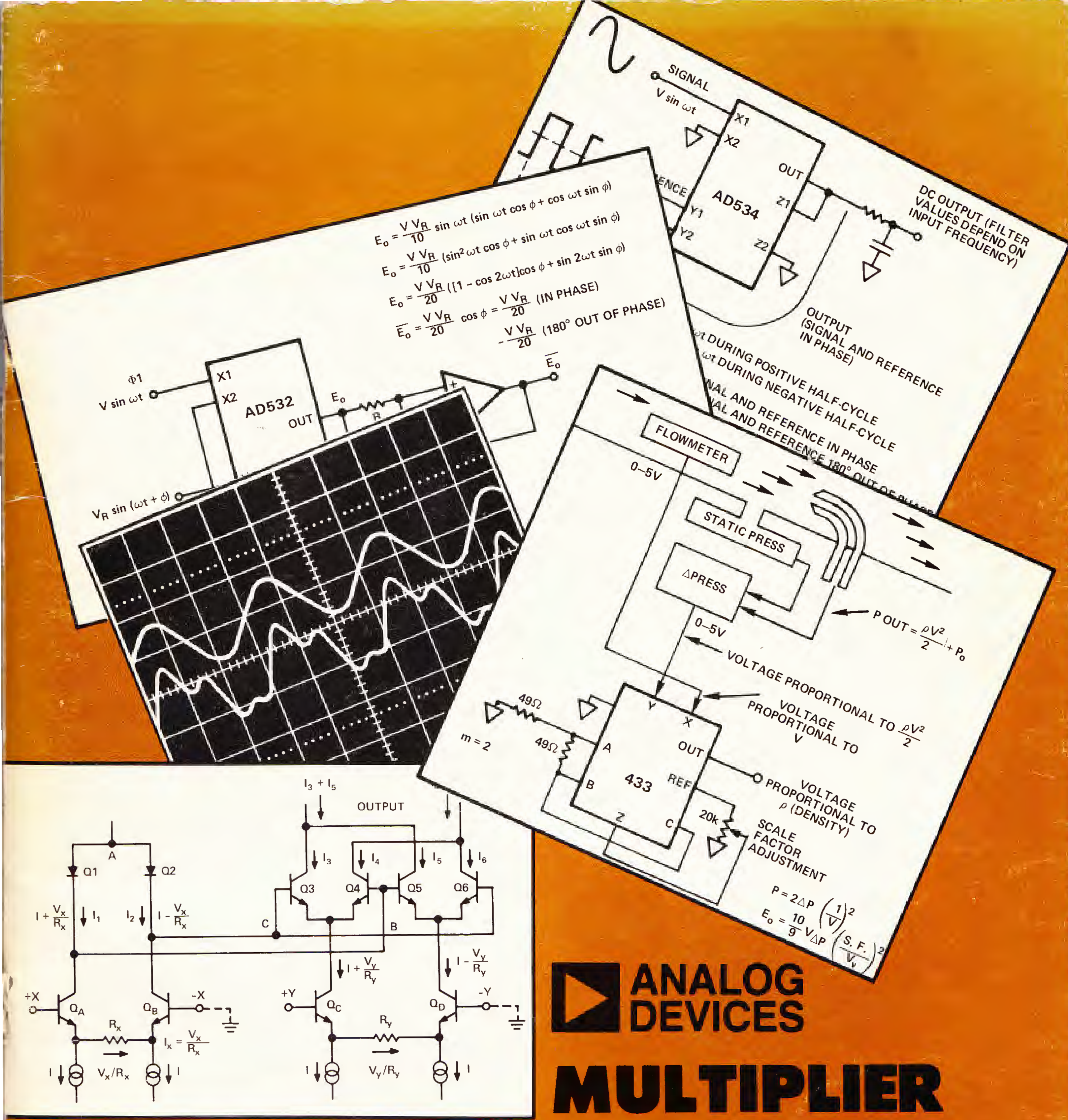

ANALOG DEVICES

MULTIPLIER APPLICATION GUIDE

We are pleased to acknowledge the invaluable contributions of James Williams and Barrie Gilbert, who have contributed to the design, testing, and/or documentation of many of these circuits.

Edited by D. H. Sheingold.

PREFACE

Closeted in Product Guides between "Operational Amplifiers" and "Data Converters" is usually a section called "Special" or "Function" circuits. Within this eclectic family of devices, there lives the analog multiplier. Multipliers are perhaps the most generally useful member of the group, but they are scarcely ever recognized as solutions-in-waiting, as op amps have become.

Ask an engineer what can be done with operational amplifiers or with systems using data converters, and the response will be lengthy, fluid, and enthusiastic. The same query with regard to multipliers is liable to yield (particularly in the worst case) a blank stare, a long (thoughtful) pause, and the barely audible response . . . "multiply (?)" Others may mention general cases, like amplitude modulators or function synthesis, but the detailed, inspired torrents of applications that discussions of op amps evoke simply aren't there.

Why not?

Two reasons suggest themselves. First, multipliers are admittedly not as broadly applicable as are op amps – which dominate the analog world because of the ability of even the neophyte designer (fresh from an undergraduate op-amp course) to see their relevance and immediate applicability to measurement and control problems. With the advent of digital computers and minicomputers, digital instruments, and microprocessors, data converters have assumed a readily identifiable functionality. Multipliers – and other analog functional components – conceived originally to perform circumscribed tasks in analog computing, simply appear to have been born without charisma.

Second, high-performance, easy-to-implement, low-cost multipliers (on-a-chip) have only been available for a few years. Op amps and data converters have been mature products for much longer. It's interesting to note that even the now-ubiquitous op amp was around for quite a while before its capabilities were widely recognized and exploited. It might also be noted that the market for data converters wasn't just created, it was demanded by the digital revolution of the '60's, as the only rational way of interfacing digital systems to the Real (analog) World.

The availability of good multipliers in profusion evokes the need for applications literature. The present effort complements earlier publications[1] in documenting the spreading uses of analog multiplication, but there is a difference of approach. Here, the bulk of the effort has gone into the section on Applications, although there is some review of basics and generalities. The objective here is to create awareness in the reader that the analog multiplier is a universally applicable problem solver. That is, multipliers don't "just multiply" in the same way the op amps don't "just amplify". These devices make possible analog solutions to analog problems with simplicity, sophistication, and low cost.

The depth of detail in the treatment of many of the applications is intended to attract the engineer-at-the bench, who is painfully aware of the gulf between concepts and circuits-that-work in the cold, cruel world. Those who are charged (or will be) with designing a production instrument, a test fixture, or a fully instrumented system, are the intended beneficiaries of this book. No reader can fail to be impressed by the fact that, in many of the applications, the multiplying function, which is the key to performing the overall function of the system, comprises but a small part of the overall circuit; there's plenty of room for the reader to exercise his own engineering creativity and judgment over the actual implementation of the rest of it. We hope, then, that the present publication will serve both novice and veteran as a generator of ideas.

" . . . Be fruitful and multiply . . ." (Genesis 1-22)

[1] For example, the Analog Devices NONLINEAR CIRCUITS HANDBOOK, edited by D. H. Sheingold, available for $5.95 from P.O. Box 796, Norwood MA 02062.

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