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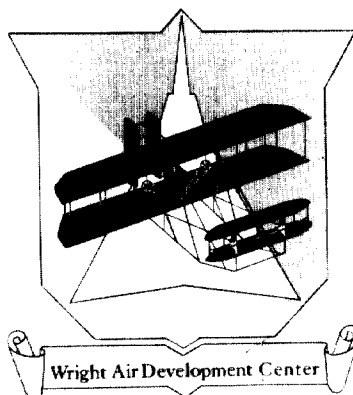
HANDBOOK OF PIEZOELECTRIC CRYSTALS FOR RADIO EQUIPMENT DESIGNERS

This Report Supersedes WADC TR 54-248, Dated December 1954

John P. Buchanan

Philco Corporation

OCTOBER 1956



WRIGHT AIR DEVELOPMENT CENTER

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Communications and Navigation Laboratory

Contract No. AF 33(616)—2453

ARDC PROJECT 4155, TASK No. 43033

**Wright Air Development Center
Air Research and Development Command
United States Air Force
Wright-Patterson Air Force Base, Ohio**

FOREWORD

This handbook was prepared by the Technical Publications Department, TechRep Division, Philco Corporation under Contract AF33 (616)-2453. Mr. F. W. Wojcicki served as project director, with Mr. M. W. Nachman assuming these duties during the final processing stage. Mr. J. P. Buchanan was project engineer and author. Credit for assembling the data on specific crystal units and holders in Sections II and III belongs to Mr. C. W. Henry.

This Task No. 43033, titled Handbook of Piezoelectric Crystals for Radio Equipment Designers, ARDC Project 4155 was administered under Mr. V. J. Carpantier as chief of the Specialties Section, Communication Branch of the Communications and Navigation Laboratory, Wright Air Development Center.

Appreciation is extended to Gentile Air Force Depot, Squier Signal Laboratory, Armour Research Foundation at Illinois Institute of Technology, New York University College of Engineering, and to the many individuals and other organizations whose generous cooperation has proved so important during the preparation of the handbook. In particular, the successful conclusion of the project is heavily indebted to the interest, administrative assistance, and many valuable suggestions of Mr. E. H. Borgelt of the Frequency Control Group, Wright Air Development Center, and to Mr. R. A. Sykes and assistants at Bell Telephone Laboratories for freely giving of their time and knowledge in reviewing the text and contributing important corrective comments for improving the usefulness and accuracy of the text.

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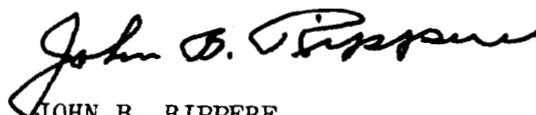
ABSTRACT

A comprehensive manual of piezoelectric control of radio frequencies is offered. It is directed toward the design of oscillator circuits having optimum operating conditions when employing Military Standard crystal units. Included is a survey of the development of the piezoelectric crystal art; descriptions and characteristics of all crystal elements and mounting methods that have found commercial application; a detailed study of the equivalent circuit characteristics of crystal units; analyses of basic piezoelectric oscillator principles and of the effects of changes in various circuit parameters, using the Pierce oscillator as a reference circuit; analyses and recommended design procedures for all types of piezoelectric oscillator circuits used, or tested for use, in USAF equipments; schematic diagrams and tables giving actual circuit parameters of all available nonclassified piezoelectric oscillators now being used in USAF equipments; descriptions of all crystal units and crystal holders now being used in USAF equipments, containing references and schematics of circuits employing those crystal units recommended for equipments of new design; a brief discussion of crystal ovens and descriptions of ovens currently available for use with Military Standard crystal units; and a comprehensive index to increase the utility of the handbook as a reference manual. Circuit analyses, derivations of equations, and suggestions for design innovations whose sources are not directly acknowledged have originated with the author and so far as is known have not been specifically confirmed in practice.

PUBLICATION REVIEW

This report has been reviewed and is approved.

FOR THE COMMANDER:



JOHN B. RIPPERS
Colonel, USAF
Chief, Comm & Nav Laboratory
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Wright Air Development Center