

Preface

Piezoelectric (PE) accelerometers with integral electronics, also called Integrated Electronics Piezoelectric (IEPE) accelerometers or Integrated Circuit Piezoelectric (ICP) accelerometers, are vibration sensors designed for measurement of dynamic vibration signals at frequencies ranging from very low (near-dc) to 10 kHz. Their advantages include low noise; wide dynamic, frequency, and temperature range; low-output impedance; high sensitivity; and the availability of miniature design.

IEPE accelerometers are used in many applications, such as aircraft, automobile, and spacecraft measurements; structure monitoring; homeland security, oil exploration; seismic isolation and stabilization platforms; seismology and earthquake measurements; and active seismic isolators for gravitational wave detectors.

This book presents IEPE accelerometer information from leading industry experts, working on development of IEPE sensors with Meggitt—Orange County (formerly Endevco Corporation).

This book fills in the gaps of IEPE sensor literature. Most of the existing IEPE accelerometer literature sources are a few journal articles and conference presentations. There are few, if any, books on this subject.

Chapter 1 introduces the field of IEPE accelerometers, their principle, construction, block and schematic diagrams, and types. The next two Chaps. 2 and 3 describe the two basic parts of an IEPE accelerometer, PE transducer, and FET-input amplifier, respectively. A PE transducer is also the main part of well-known PE accelerometers used without electronics. Therefore, subsequent chapters focus mainly on IEPE accelerometer electronics, which is probably less familiar to most readers. FET-input amplifier is in most cases the main noise source of an IEPE accelerometer. Chapter 4 contains noise analysis of a common-source silicon FET amplifier, which forms the basis of the FET-input charge and voltage amplifiers used in IEPE sensors. Chapter 5 presents noise measurement results of different JFET and MOSFETs, the basic active parts for the FET-input amplifier. Chapter 6 discusses the fundamental noise limit of IEPE accelerometers determined by the PE transducer used. Chapter 7 presents noise analysis and expression for an IEPE accelerometer noise floor showing the main noise sources contributed by both the

FET-input amplifier and the PE transducer. Chapter 8 describes the design of ultra-low noise seismic IEPE accelerometers featuring perhaps the lowest noise floor (for their size and weight) combined with the lowest (near-dc) operating frequencies perhaps ever reported to date among the IEPE sensors. Chapter 9 presents high-temperature, up to 175 °C, miniature triaxial and single axis IEPE accelerometers with silicon-based electronics recently designed. This chapter also includes comparison between the designed accelerometers and the state-of-the art high-temperature accelerometers and discussion about key factors providing high-temperature operation.

This book is a valuable information source on IEPE accelerometers and their electronics for engineering, manufacturing, industry, and science professionals working in the field of IEPE accelerometers, and also for undergraduate and graduate students working in this area.

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