Preface

The primary intent of this book is to put into plain words how to determine whether a suspect electronic appliance control is the cause of a fire or the result of a fire. It is distinctive in two ways: first, in its evaluation of low voltage, low power (0.6 V, $\leq$5 W) fires and second, in its intent to disseminate valuable information that should not be hidden for personal gain.

The author has been asked multiple times during depositions if what he had just said was "*common knowledge*." It pained him to respond that it was not. This did not change the facts of the case but certainly changed what evidence was harvested and examined in pursuit of the truth. The judge and/or jury was saddled with the unenviable task of determining someone's guilt or innocence without all of the evidence being recognized and therefore not examined.

This book is also somewhat unique in its intended audience of those technically responsible for design, manufacturing, and forensic responsibilities. Its direction is to link the design, manufacturing, and forensic technical communities together as much as possible, thereby allowing each to ensure a final product that will not end up in litigation or at least not be found guilty during litigation. Empirical data provided will prove invaluable in determining the guilt or innocence of an electronic control. Solutions are also suggested when appropriate.

It is very unusual for design or manufacturing organizations to be familiar with NFPA 921. The NFPA, Guide for Fire and Explosion Investigation, is referenced since it provides invaluable forensic technical insight for both the design and manufacturing groups. This insight will allow the designer to know "how robust" their product must be to allow for a good night's sleep and yet not add crippling costs. The two best friends any electronic control can have are a well-documented FMEA (failure mode effect analysis) and an audited risk mitigation plan that encompasses the issues laid out in of this book.

It is a number game. The electronic control arena can be especially risky from a life safety and/or product liability standpoint for low-volume production (1000 per year). The good news is that a one-in-a-million problem is not likely to happen. The bad news is that the product may not have the financial backing to insure against reasonably expected failures, poor design, supplier component variation,

unanticipated shipping issues or customer misuse, etc. A product can have a problem that occurs only in one out of every ten thousand households. With over 133 million households in the USA alone in 2014, it is reasonable to expect at least 13,300 homes to experience an unlikely event as defined in Chap. 1.

The other end of the spectrum that is typically much more difficult to deal with is when hundreds of thousands or millions of "identical" products have been produced within a five-year period or so. The more individual the parts and processes from which the final product exists and the more varied its environment, the more complex any potential product forensic investigation will be.

Any product that startles someone by smelling hot, smelling like smoke or arcs and sparks presents a serious issue for those financially and emotionally responsible for its existence. It is not necessary for a unit to erupt into flames, destroy property, and potentially take innocent lives to create a product nightmare. Just the fear of this due to an overlooked new product introduction failure generating smoke or sparks in a home or in shipment can be disastrous if the issue is not dealt with quickly and rationally.

As with all things in life, it is very difficult, if not impossible, to prove something cannot possibly happen. It is much easier to prove something can happen. It is important to note that a level (voltage, current, power, or energy) below which a product fire cannot exist is never claimed. The bench experiments presented in Chap. 14 can be cited to prove levels and conditions at which a fire can exist but not a level at which a fire cannot exist. The experiments in Chap. 14 are designed to demonstrate how little voltage, power, and energy are actually necessary to allow an event to occur.

The author has been intrigued with electronics since he first watched the slowly building glow of tubes in his Hammarlund shortwave amateur radio receiver in the early 1960s. He was awestruck at the conversations he heard magically coming from around the world. Electronics technology was at that time beginning its rapid rise that has touched virtually every aspect of humanity. As with any advance in knowledge, boundaries are always being tested. We always want more for less and that translates into more discrete conductive material in smaller areas. This also translates into higher energy densities. One limiting factor of increasing energy densities is that of the all-too-well-known event that is the focus of this book.

The information that follows is either referenced, is demonstrated through experimentation, or has been learned through many years of new product designs, development, and production cycles.

To the excited, curious and fearless engineer a word about change. In the exciting worlds of research, new product design, and development, embrace change and embrace the associated risks. However, once you "pull the trigger" for a new high-volume product, restrain your urge to make it better when time is too late for adequate testing. It is entirely possible to make a seemingly minor change to eliminate a problem with very minor consequences, while creating a much less likely problem, however with horrible consequences.

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