Now and then. Current ASIC technology (left) employs literally thousands of transistors that enable self-monitoring, interconnection, and the ability for the battery to last more than a year. Early smoke alarms (right) had about one hundred components and a few transistors. Photo courtesy of Jarden Safety

Smoke Alarms—Phenomenal Life Safety Bargain

Isaac Papier, Vice President Industry Relations, Honeywell Life Safety

Today's smoke alarms are truly phenomenal life safety devices. For a modest investment of a few dollars, a homeowner is provided with years of lifesaving early fire detection and alarm notification to facilitate timely occupant evacuation in the event of a threatening fire. Statistics have shown (Reference to NFPA statistics) that the introduction of smoke alarms has reduced residential fire fatalities by 50 percent.

Today's smoke alarms are the product of many years of ongoing extensive research, development, and innovation that made possible a highly reliable, sophisticated, advanced technology device at a bargain price.

Smoke detector technology development can be traced back to the early 1920s. These early detectors were large contraptions intended for shipboard use in order to trigger the discharge of fire suppression in cargo holds. It was not until the early 1940s that the rudiments of today's ionization detectors first appeared. Unlike modern detectors that utilize a minuscule radioactive source, these detectors utilized a high voltage to ionize the air in the detection chamber. While these detectors were not suitable for a residential application, they quickly demonstrated their effectiveness in commercial and industrial application and their technology led the way for development of the modern smoke alarm.

The first major innovation in smoke detector development during the early 1960s was the replacement of the high voltage by a radioactive source known as Americium 241and the use of a transistor to monitor the detection chamber. This permitted operation at a low voltage (24V) and led directly to the development of the first smoke alarm in 1965.

Early Development of Smoke Alarms

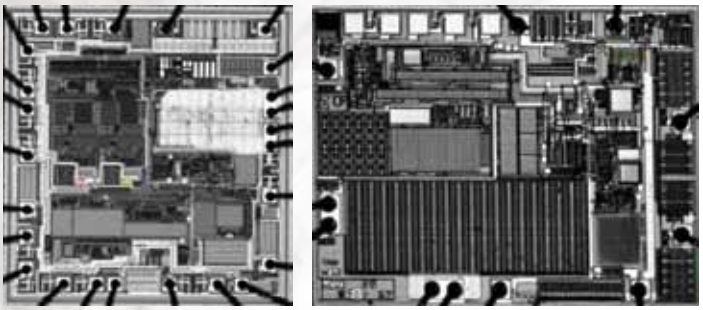
The first smoke alarm that made widespread installation in residences highly feasible appeared in the latter half of the 1960s. This was a photoelectric detector with an electromechanical sounder and an incandescent lamp for a light source. While a number of transistors were used to monitor the detection chamber and control the smoke alarm functions, the incandescent lamp light source and electromechanical sounder required considerable—a specialty, very expensive battery was required.

By today's standards, these first-generation detectors were crude electromechanical devices made up of a detection chamber and myriad of discrete electrical/electronic components. But their availability led to considerable research that concluded that smoke detectors had greater potential to improve life safety than heat detectors. This conclusion has been reaffirmed for ionization and photoelectric detectors numerous times over the years.

Early adoption of smoke alarms was a slow process partly because of the lack of public education and probably just as significant, the cost. Early smoke alarms were low-volume handmade devices made up of numerous discrete electronic components. The price hovered around $300—about $2,000 in today's dollars!

Numerous technology advances have been incorporated into smoke alarms over the years that have significantly enhanced performance, reliability, power consumption, and cost:

- Replacement of the incandescent light source in photoelectric smoke alarms provided several benefits including lowered power consumption, increased reliability and detector life, and the ability to "tune" the response to specific smoke particulate size distribution.
- Introduction of the field effect transistor in ionization smoke alarms significantly reduced the size of the radioactive source, enhanced stability, and reduced power consumption.
- Replacement of the electromechanical alarm sounder with a solid-state piezoelectric disc led to major power savings, enhanced reliability, and smaller smoke alarms.
- The power savings provided by the changes noted above permitted the use of a standard 9V battery in place of an expensive specialty battery.
- Development of application-specific integrated circuits (ASIC). This change was a major factor for cost reduction, functionality enhancement, reliability enhancement, and power consumption reduction. While the first smoke alarms had about one hundred components and a few transistors, ASICs contain literally thousands of transistors enabling self-monitoring, interconnection, and the ability for the battery to last more than a year.



Circuit board from the first generation chamber (left) and smoke alarm ASIC surface (right). Courtesy of Microchip

Current Technology

Research has shown that most homes in the U.S. are equipped with at least one smoke alarm. Unfortunately, this research has also revealed that many of these installed alarms are inoperative because of dead or missing batteries. The introduction of lithium ion batteries, coupled with technological advancement that significantly reduced power consumption, has resulted in the introduction of the 10-year sealed smoke alarm. The 10-year life specification, which was carefully chosen because that time span coincides with the National Fire Protection Association's recommendation, ensures that a highly reliable life safety alarm is always present in the home. Considering that these current technology alarms retail for $30 to $40 and last for 10 years, it becomes apparent how big a life-safety bargain they are.

Many fire safety specialists advocate the installation of both photoelectric and ionization smoke alarms because these have performance advantages in a smoldering versus a flaming fire. Because one never knows where a fire might start, the best protection is provided by installing one of each. The recent introduction of multi-sensor photo/ion detectors eliminates the need for two separate devices.

Carbon monoxide (CO), a colorless, odorless gas that is produced in fuel-burning appliances has been labeled the silent killer (see page xx). CO alarms share much of their technology with smoke detectors. Therefore, the introduction of combination smoke/CO alarms is a natural outgrowth. Here again, the consumer is provided a highly sophisticated life-safety device that is the product of many years of technological evolution at an economical price.

Looking to the Future

Research is underway to develop multi-criteria detectors that employ multiple sensors and computer logic to detect the very early attributes of a fire while providing enhanced resistance to phenomena that may trigger an unwanted alarm. While these devices are a number of years away, when they do arrive they will provide enhanced detection and resistance to unwanted alarms and, yes, they will continue to be a bargain.

Smoke alarms are wonderful low-cost life safety devices that have proven themselves to be an essential element of every occupancy. Since their introduction, they have saved countless lives. But in order for them to provide their essential service, it is critical that:

- they be properly installed
- they are properly maintained, including regular replacement of batteries
- the smoke alarm battery is never borrowed for another use

Smoke alarms are highly reliable devices with a limited life of 10 years and it is essential that these devices be replaced after 10 years of use. Many newer smoke alarms incorporate a non-replaceable 10-year battery. These devices will provide an end of life indication when it's time to replace. Be safe.

Mr. Papier serves on NFPA 72 Technical Committee, NFPA 101 Life Safety Code Correlating Committee, National Premise Security Code Committee NFPA 730/31, Air Conditioning Technical Committee NFPA 90A & B, The Security Industry Association Standards Council, U.S. TAG to ISO TC 21/SC3. He is also chairman of the NEMA 3SB Signaling Section Research Committee and NEMA C&S Committee.