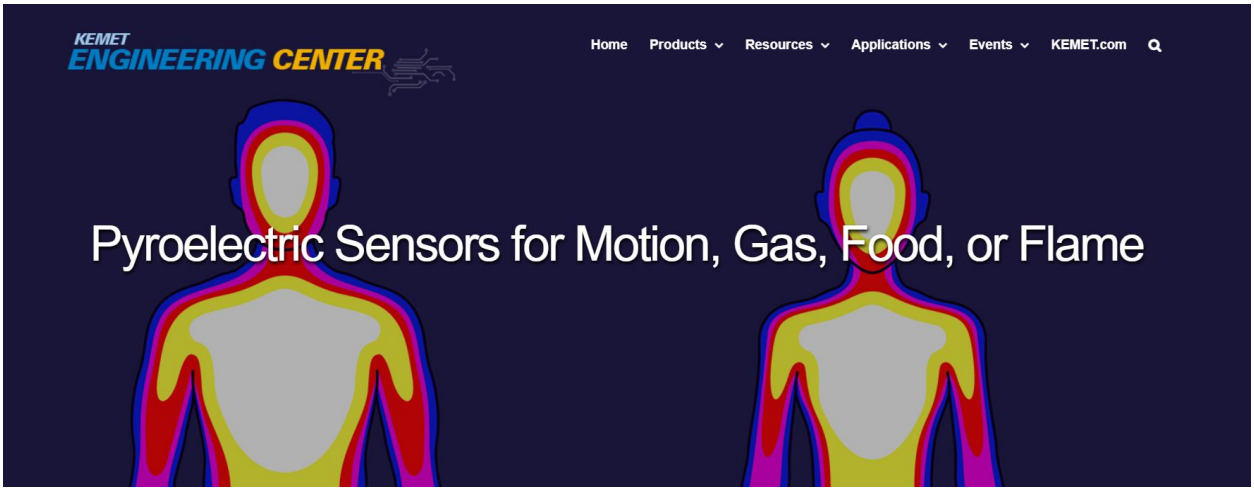


As electronic devices become increasingly automated, reliability and safety are of utmost importance. Ensuring those devices work properly is often done through the use of pyroelectric sensors, which indicate a change that requires a specific type of reaction. Sensors help bring peace-of-mind to many small, but important, operations that impact our daily lives. Whether they are being used in garage doors or fire detectors, pyroelectric sensors help guarantee trustworthy devices at home. They can be used in a host of applications utilizing the same basic, underlying technology that relies on the pyroelectric effect.

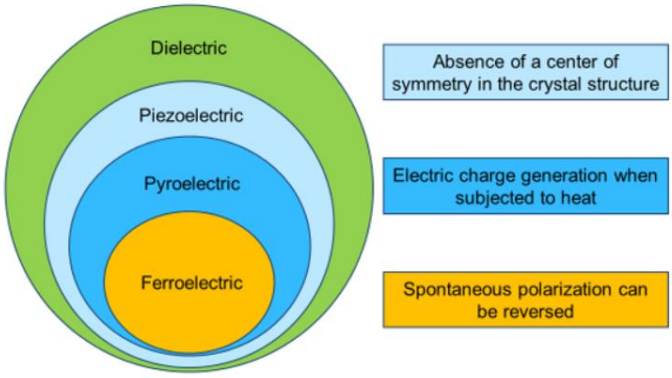
KEMET's Pyroelectric Infrared (IR) Sensors take advantage of the pyroelectric effect of ceramic materials that absorb infrared rays and generate an electrical signal response to them. KEMET's sensors are highly sensitive and suited for a vast number of applications.

The Pyroelectric Effect (and others)

Pyroelectricity is the property of certain crystalline materials that are electrically polarized to experience a change in their polarization proportionally to a change in heat. This change in the net polarization of the crystal temporarily generates a detectable voltage across the crystal. Different materials have different pyroelectric coefficients that describe how sensitive they are.

The pyroelectric effect is related to, but different from, a number of other effects: the thermoelectric effect, the piezoelectric effect, and the ferroelectric effect.

- **The thermoelectric effect** is the property of certain materials to generate an electric field proportionally to a change in temperature across the material, positionally. This is distinguished from the pyroelectric effect, which generates an electric field according to a change in temperature over time.
- **The piezoelectric effect** is the property of certain materials to generate an electric field proportionally to a pressure applied to the material. Interestingly, all known pyroelectric materials are also piezoelectric.
- **The ferroelectric effect** is the property of certain materials to reverse their electrical polarization when exposed to a reversed electrical field. All ferroelectric materials are also pyroelectric, but not all pyroelectric materials are ferroelectric.



The pyroelectric effect can be used to detect infrared radiation. Infrared radiation is absorbed by chemicals or materials at specific wavelengths, so a pyroelectric sensor can be used to detect the presence of a specific chemical or material that is blocking a specific wavelength of IR.

Sensing the Pyroelectric Effect

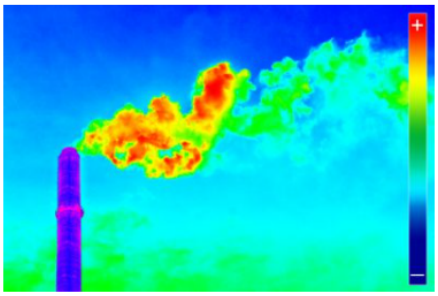
Infrared radiation heats pyroelectric ceramic crystals, generating a detectable voltage that can be measured. Passive infrared sensors measure or detect the infrared rays generated by an object that is, itself, an IR emitter. Active infrared sensors require an infrared emitter to be the source of the radiation, and then the sensor detects what wavelengths were absorbed by something between the emitter and the sensor. Below are some examples of sensors that take advantage of the pyroelectric effect to detect infrared for specific applications.

Motion Sensors

Infrared motion sensors can be either active or passive. Active infrared sensors can work over a very long distance because the infrared emitter and sensor can be far apart. A common example of this is a garage door safety sensor. As soon as anything blocks the infrared beam across the opening of the garage door, a signal tells the garage door to stop. Passive infrared sensors can also be used to detect motion, using very sensitive sensors configured to sense the infrared radiation heat from a source directly. Such sensors are capable of detecting the presence, or absence, of any object that emits enough IR, even a human body.

KEMET's QMS series pyroelectric motion sensors are highly sensitive surface mount devices. They are offered in either a single-pixel configuration or in a 2×2 pixel configuration that allows users to also determine the direction of the detected motion. A high dynamic range and fast response times ensure rapid and accurate motion detection.

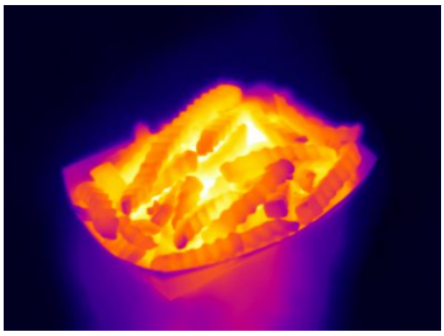
Gas Sensors



One of the most popular applications of infrared pyroelectric sensors is to detect and monitor gasses. These sensors operate by employing an IR emitter to direct infrared radiation through a sample of gas, and then detecting if a certain IR wavelength is received on the other side. If it is not received, the gas that absorbs that wavelength must be present in the sample. Sensors are tuned to specific wavelengths using optical IR filters at the sensor that permit only the desired wavelength through to the sensing element.

KEMET's QGS series pyroelectric gas sensors are in a small SMD package with a digital I2C output, while their QGC series are in a TO39 package with analog outputs. Both series offer high sensitivity and extremely fast response times. The QGS series enables very low power consumption when coupled with low duty cycle IR-emitters. The QGC series offers many optical filters for sensing different gasses and is capable of housing up to four sensing elements in a single TO39 package.

Food Sensors

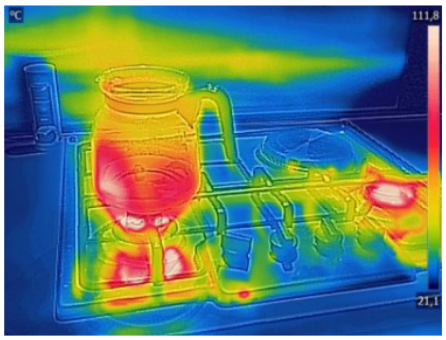


From photographer Brea Souders, an assortment of food photographed using a thermal camera.

Similar to gas sensors, food sensors are calibrated to detect food-related substances such as fat, lactose, or sugar. These are general IR spectroscopy sensors that can be used for monitoring all kinds of commercial, industrial, or medical substances or processes, depending on the configuration and infrared optical filters used.

KEMET's QDC series of pyroelectric food sensors house two sensing elements in one TO39 package, and can be specified to detect a variety of commonly monitored food substances. KEMET's QDA series of pyroelectric IR sensors is a more general series of sensors designed for IR spectroscopy. These sensors can measure many different substances and process factors in a variety of environments.

Flame Sensors



Flame sensors are easily constructed using pyroelectric sensing elements, as flames are strong IR emitters. Flame sensors can not only detect the presence of flames, however – they can also discriminate flame sources in triple IR flame detection systems, which compare three specific IR wavelengths, and their ratios to each other, to detect flames with a degree of accuracy. Flame sensors can be much more accurate and respond much faster to flames than smoke or heat detectors. They can be used in fire protection devices, such as in smart homes or in forest fire detection, or in process control systems, such as furnace monitoring and safety equipment.

KEMET's QFC and QFS series of pyroelectric flame sensors are fast and highly sensitive. The QFC series is highly responsive and has a wide field of view in a TO39 package. The QFS series has a high dynamic range in a small SMD package. The QFC series offers analog outputs, while the QFS series offers digital I2C outputs.

KEMET's Pyroelectric Sensors

KEMET's pyroelectric sensors take advantage of the pyroelectric effect of certain ceramic materials to provide highly sensitive, fast infrared sensing for a variety of applications. Whether it's through sensing motion, gas, food, or flame, or simply providing general IR spectroscopy functions, KEMET's versatile and dependable pyroelectric sensors are up to the challenge.