

HEAT GENERATION IN INTEGRATED CIRCUITS

Joule Heating is a predominant heat mechanism for heat generation in integrated circuits and is an undesired effect.

Readout integrated circuits

Readout integrated circuit (ROIC) is an electrical circuit multiplexer that mechanically and electrically interfaces or couples to a focal plane array (FPA) sensor/detector serving to function as a voltage buffer which measures or reads individual FPA outputs (sensor data or information) that are driven by incident electromagnetic energy on each and every individual input FPA unit cell or detector and transforms or transmits the sensor data to external electronics. The main function of an infrared readout circuit is to transform a very small diode incremental current, generated by infrared radiation, into a relatively large measurable output voltage. This is commonly done by integrating the photocurrent in a small capacitor during a fixed period of time. The capacitor's voltage at the end of the integration period should be proportional to the current and as such to the incident infrared radiation of a pixel corresponding to the location of the infrared diode photo sensor. Infrared imagers consist of linear or two dimensional arrays including a very large number of infrared photo sensors. These arrays are denoted linear or focal plane arrays. Given that in the most general case each pixel of an image

requires an individual readout circuit, the electronics associated to an infrared imager consists of a very large number (thousands) of readout circuits. Readout electronics are implemented as very large scale application specific integrated circuits or ASIC in CMOS technology. Due to the fact that infrared imagers can have several thousand unit cells, the unit cell is required to be very compact, to have very low power dissipation and at the same time to have high performance characteristics.

A typical FPA may be composed of 512 columns by 512 rows of individual (assuming no crosstalk) unit cells or pixels having a physical size of 30um by 30 um which define the image frame of the electromagnetic energy incident on the surface. The function of the ROIC is to scan the 512 by 512 array, not unlike a raster scan, in such a way as to synchronously read and bring together in a formatted way all the pixel outputs from the FPA into an appropriate lower impedance electrical circuit for video transmission and processing. Each unit cell detector output responds (gain) to a limited range of wavelengths of the electromagnetic energy incident upon the input, thereby defining the image as infrared, visible, x-ray, etc. The ROIC inputs are composed of a source follower FET topology (voltage buffer) such as to transform large unit cell output impedance to low input impedance to drive a transmission via (several hundreds of pF) of the unit cell output response. Each unit cell is given a fixed amount of time (integration time) to sample the incident electromagnetic energy before being readout, not unlike a sample and hold circuit.

The interface of the readout to the array is composed of hybridized indium dots for each and every unit cell-to-source follower interface. For example, GaN detector arrays are

hybridized to a Si ROIC using flip chip bonding technology. An example of a ROIC is Raytheon's CRC-774, 320 by 240 matrix.

Scanning the array can be done in various ways. Several methods exist, including: snapshot; fowler; sampling up the ramp. Integration and readout modes include integrate-while-read and integrate-then-read.

The opposite use of a readout IC (ROIC) is the readin IC (RIIC) which is used to produce or simulate images in a focal plane array. The analogous image system using a RIIC for image simulation is the television image process. Image simulation is used for hardware-in-the-loop (HIL) testing purposes.

Source : <http://en.pschitt.info/page/Integrated+Circuits>