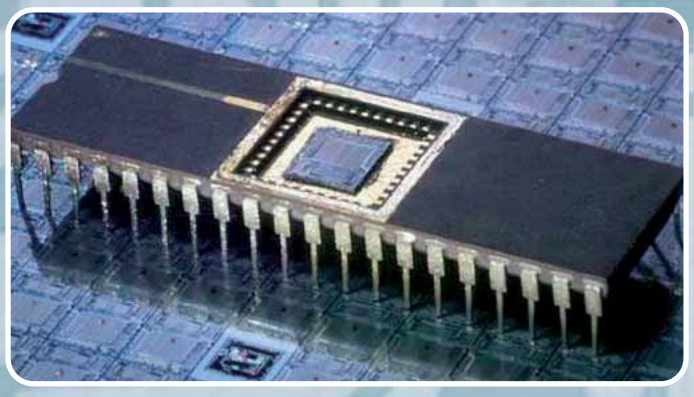
Engineering Excess

KILBY & NOYCE

Just fifty short years ago two brilliant electronics engineers changed our lives forever. Without them the microcomputer revolution may not really have even started at all. The advances in space exploration, medical science, business practice, robotics, advanced manufacturing and almost every conceivable advance in those fifty years is in fact partly attributable to this great pair. So they are rightly featured as TEP's tribute in this Engineering Excess feature.

Kilby and Noyce were both electrical engineers who, in the late 1950s, working separately, invented the integrated circuit, better known as the microchip. Jack St Clair Kilby was employed at Texas Instruments (TI) in Dallas. He soon came up with the idea of putting all the elements of an electronic circuit onto a single chip. Robert Noyce joined a team of scientists headed by William Shockley, one of the inventors of the transistor. In 1957, he and other colleagues left and founded Fairchild Semiconductor. At around the same time as Kilby, Noyce conceived the idea of the integrated circuit. In 1968, Noyce and his friend Gordon Moore founded Intel, which went on to become one of the world's largest manufacturers of microchips.



The 1960s brought the invention of the integrated circuit (IC), which combined many tiny transistors, resistors, and capacitors into one small plastic case. These third generation circuits were smaller, faster, and had increased storage capacity. They made possible the popularity of hand-held calculators.

Both TI and Fairchild wanted to patent the microchip. TI got there first, its application featured "flying wires", based on Kilby's hand-made chip. This idea was of course unsuitable for long term development. Noyce's design however, specified that the interconnections were created at the same time as the transistors on the chip. This became the basis for the chip manufacturing industry, with silicon as the semiconductor and the components connected with aluminium.

After the simultaneous invention of the integrated circuit in 1958, TI and Kilby were the first to patent their device. That circuit had just one transistor, one capacitor and three resistors linked via gold connections on a germanium substrate. Fairchild and Noyce's, was however, easier to mass-produce. By connecting separate electric components such as resistors, transistors and capacitors on to a single silicon device, they laid the foundations for modern micro- electronics and opened the door to the information age.

Texas Instruments - Early Calculators

Jack Kilby, not surprisingly, was awarded a Nobel Prize for Physics for his achievement. Amazingly. it emerged later that an English engineer at the Royal Radar Establishment, had had the monolithic idea back in 1952, and had tried to build a microchip before either of them!

Despite the legal battles that ensued between the two companies, both Kilby and Noyce deserved the credit for this colossal idea that has changed our world. They were regarded as joint inventors, and both were awarded America's National Medal of Science.

Silicon Wafer

Advances in Technology brought on by the integrated circuit and microchip

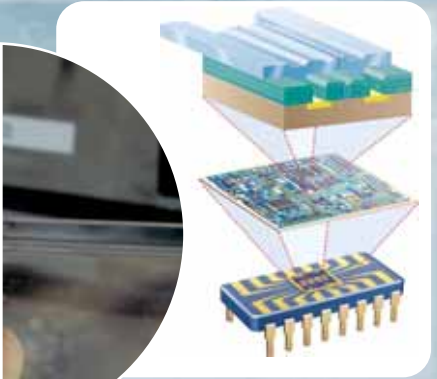
The integrated circuit is, of course, at the heart of every digital device and product. After the introduction of the microchip in the early 1970s, there have been more medical, mathematical and scientific breakthroughs than in any other period of time.

The mission since 1958 has been to fit ever more computing power onto a smaller surface. The chip, or integrated circuit, contains millions of interconnected transistors squeezed onto a few millimetres of a silicon wafer. The most advanced are microprocessors and are capable of calculating several million instructions every second. This is about 5,000 times the speed of the original chips introduced on the market in the early 1970s.

Already we are able to carry around all our documents, photos, music and movies in a pocket-sized device. New chips are being designed for products that don't require even a plug or battery power. Microscopic chips capable of storing vast quantities of information are embedded into passports, credit cards and as RFID tags, into products to track the flow, distribution and identity of them.

Moore's Law - Graph showing growth in chip density

Pocket-sized devices - The ever decreasing size of technology



Our students need to embrace these technologies in order to be empowered for both the world of work and to prepare them to participate fully as citizens in a technical world. The opportunity to understand and develop appropriate and authentic technological experience and education for young people is possible in electronics communications technology (ECT). Understanding the microchip and its development can be taught in the Diploma based electronic units as well.