

1984

The ImPP, a non-von Neumann data-driven processor (NEC)

~ Integrated Circuit ~

The rise of microprocessors that began in the latter half of 1970 made visible the existence of von Neumann bottleneck (performance deterioration caused by storing instructions in low-speed external memory) which was pointed out in large scale computer field at the time. In 1984, in order to solve the above bottleneck, NEC proposed a revolutionary data driven method that connects a variable length pipeline structure to a ring type in which execution of instruction is done by the instruction of arrived data itself, and it developed the processor, μ PD7281 (ImPP), with this architecture. It integrated 115,000 transistors on 6.93×6.99 mm die using $1.75\mu\text{m}$ N-channel technology

This LSI has the following features. (1) 32 kinds of operation instructions are implemented that execute all instructions including 16×16 -bit multiplication in 200ns, and in particular, the instructions which exert the effect in image processing such as barrel shift and bit manipulation instruction are enriched. (2) By solving the problems inherent in the von Neumann architecture by data driven and pipeline architecture, it was able to achieve 10 to 20 times performance of mainstream 8086 series processor at that time. (3) Multiprocessor configuration can be easily realized by cascading 40pin DIP package sideways, and the performance can be improved in proportion to the number of connections. (4) By storing instructions in the RAM inside the LSI, it can deal with various applications.

These features are suitable for digital image processing and digital signal processing which are based on repetitive arithmetic processing for large amounts of data, It was the cutting edge of image/signal technology at the time, with the processing speed of 0.7sec for affine transformation for 256×256 images, 0.14sec for tone conversion processing, and $50\mu\text{s}$ for 64 bit TBF. Moreover, since this LSI was innovative also from the architectural aspect, it was announced at the ISSCC in the same year, and it was posted on the top page of the regular newspaper on the day of the press release and attracted attention widely.

This LSI attracted attention in the field of image processing as originally targeted and was adopted for many products in the fields such as seal stamp verification and fingerprint verification, contributing to the launch of the digital image processing market.

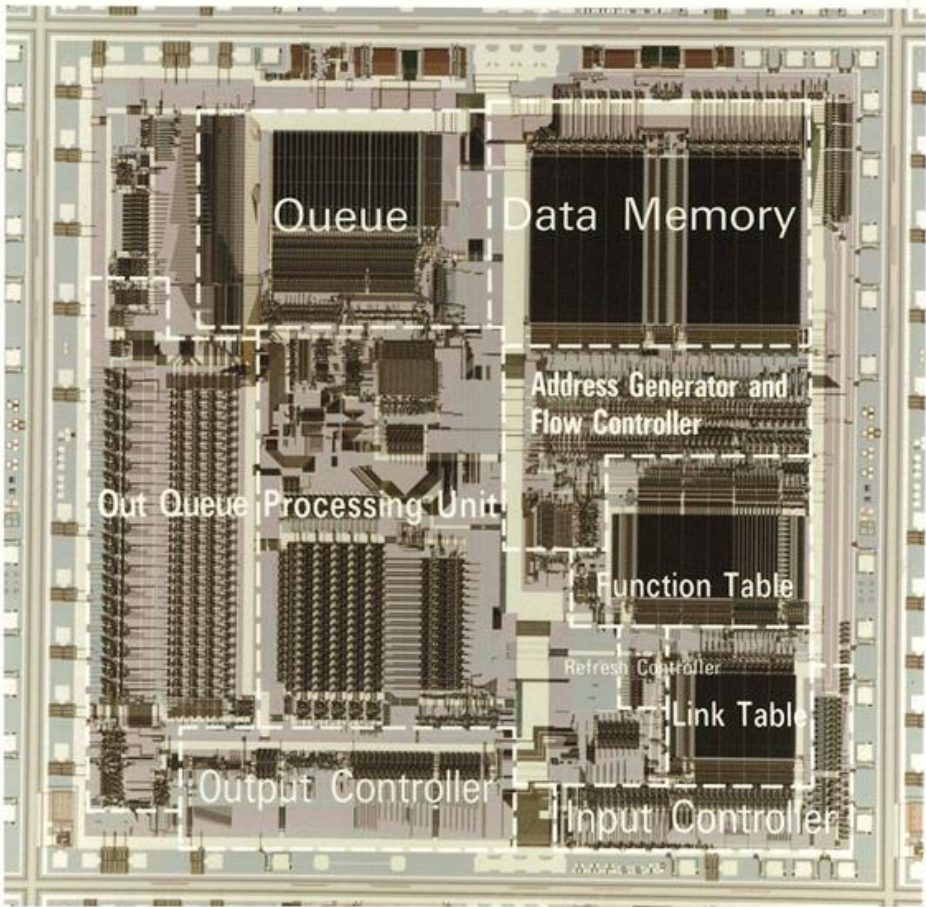


Fig.1: Die photo of Non-von Neumann Data Driven Processor μPD7281
(By courtesy of Renesas Electronics)

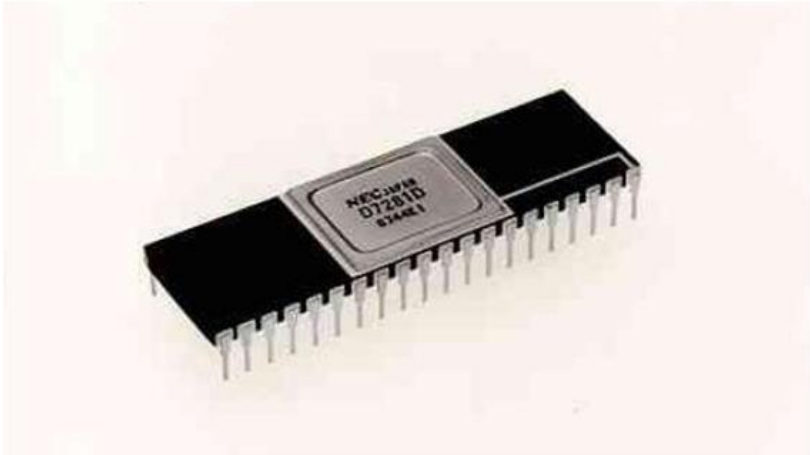


Fig.2: Package photo of Non-von Neumann Data Driven Processor μPD7281
(By courtesy of Renesas Electronics)