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Hart K & Slob A. Integrated injection logic: a new approach to LSI. *IEEE J. Solid-State Circuits* SC-7:346-51, 1972. [Philips Research Laboratories, Eindhoven, The Netherlands]

A new type of electronic logic circuit is introduced to enable application of bipolar processes for large-scale integration (LSI) circuit design. The power-delay time product, as well as the packing density, shows improvement of an order of magnitude. Integrated injection logic (I²L) thus gave renewed vigor to bipolar technology. [The SCI[®] indicates that this paper has been cited in over 115 publications since 1972, making it the 2nd most-cited paper ever published in this journal.]

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"When we came to the end of our work on sub-nanosecond logic circuits in May 1970, we realised we had drawn the curtain on two decades of research on improving speeds in this field. A new trend emerged, aiming not at faster circuits but at increased density of gates per chip. That meant a shift of emphasis from bipolar to MOS circuits. However, we could not accept that, as a result, the bipolar circuits would end up in the gutter. So we fought back and found integrated injection logic (I²L). For the two of us, this was such an exciting period that we did not give ourselves time to publish our results. This was because we wanted to show that bipolar processes could also be

used for large-scale integration (LSI). We succeeded and as a result the new method was used in various designs in which the advantage of combining analogue and digital circuits on the same chip was used in particular. This was not only done successfully in our company but also elsewhere. For us, this was enormously stimulating and it took us through a difficult period.

"The summers of 1970 and 1971 were hot, extremely hot. And we were heavily motivated to prove that I²L was right on time for the LSI era. What better proof than that a handful of large-scale circuits could be found? But with the limited CAD tools of those days this really promised to be a hell of a job. Accuracy and working pace were not only enhanced by our enthusiasm, but also by an unconventional cooling method, namely, a sink full of cold water in which to cool our feet.

"A first, short presentation of our work was given in February 1972 at the International Solid-State Circuits Conference in Philadelphia¹ where we showed six LSI circuits. We had 20 minutes to tell and demonstrate what I²L was all about. After that, we were invited to write the now 'classic' article. The reason why our article has been mentioned so often might be that we revealed new opportunities for bipolar design and thus inspired others to use this method creatively.

"In 1975, we and two colleagues from IBM received the Award for Achievement from the magazine *Electronics*.² Later on, in 1980, a book was published in which all the newsworthy articles about I²L were compiled."³

1. **Hart C M & Slob A.** Integrated injection logic—a new approach to LSI. 1972 *IEEE International Solid-State Circuits Conference: digest of technical papers*. New York: Lewis Winner, 1972. p. 92-3.
2. 1975 Award for Achievement: four developers of I²L named top technology achievers. *Electronics* 48:66-9, 1975.
3. **Smith J E**, ed. *Integrated injection logic*. New York: IEEE Press, 1980. 421 p.