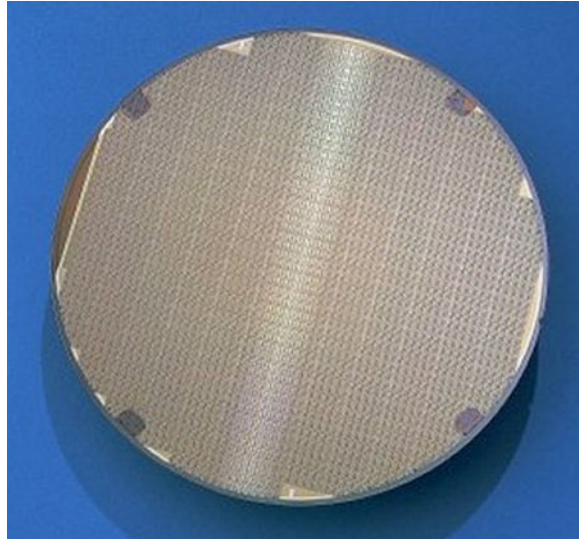




Plextek

Case Study

Wireless Transceiver Chip Design



8" Wafer Containing Transceiver ICs

Through a continuous two-year relationship, Plextek has worked with National Semiconductor Corporation designing and developing a series of digital wireless transceivers for the consumer market.

Timely development of fully integrated wireless systems demands considerable resources, not least the need for a large team of designers. Typical system-on-chip ICs for consumer applications can require 10 or more designers per chip for a period of 1 to 3 years.

Plextek has experience of working as an integral part of such design teams to augment the internal resources of major silicon vendors. This has encompassed activities from system level architecture design and simulation down to detailed component level design.

One example of such a programme is the development of a series of digital wireless transceivers for the consumer market carried out in collaboration with National Semiconductor.

In a continuous two-year working relationship, National Semiconductor commissioned Plextek to undertake design tasks for a series of digital wireless transceiver products in the 1.9 and 2.4GHz frequency bands.

This work included:

- Radio system simulation
- Digital demod design
- Post ADC digital design
- AGC system design
- Active slicing
- Clock recovery design
- Fixed point design
- Diversity selection
- Demod characterisation

Details of some of the tasks undertaken are given below.

Radio System Modelling

Plextek created a model of the digital wireless communication system and used it to assess the impact of sub-circuit performance on system level parameters. This enabled important decisions to be made

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about the overall architecture and performance trade-offs.

Several candidate FSK demodulators were compared to evaluate the impact of channel filter bandwidth, deviation and frequency offset on the bit-error-rate (BER) performance for signals in noise. This allowed the optimum demodulator architecture to be selected.

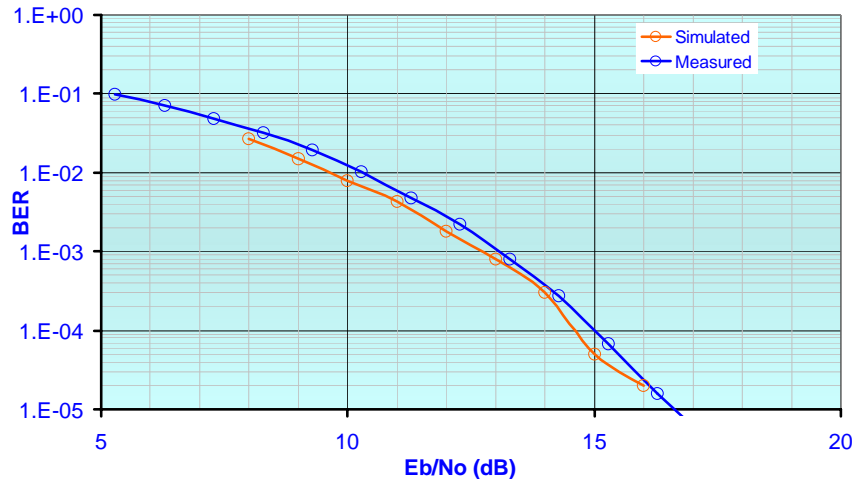
A low-IF demodulator was developed in conjunction with an active slice system to minimise BER degradation caused by frequency offset.

Plextek also developed the “post-ADC” interface stages of the demodulator, including channel and post demodulation filtering.

Ancillary Design Aspects

Further enhancements were made to the radio system model to include:

- The AGC system, including its transient response and stability.
- The clock recovery system, where BER comparisons were made against ideal symbol timing recovery.
- Multilevel FSK modulation schemes including signal tracking throughout a transmission packet.
- The impact of multipath propagation on performance.
- New algorithms for diversity selection.



Measured Versus Simulated Performance

Detailed IC design

The system simulation is used to generate performance requirements for the different sub-circuits of the IC. Detailed simulation of the individual analogue and digital sub-circuits gives predictions of their performance that must then be fed back into the system simulation to confirm the overall performance of the complete IC. This is necessarily an iterative process with the design team working in close collaboration to agree the most appropriate trade-offs in performance, die area and current consumption.

Chip Characterisation

Plextek are also able to perform IC evaluation. In the case of the 1.9GHz transceiver, Plextek carried out both the design and the evaluation of the demodulator.

An excellent correlation was achieved between simulation and

measurements as is clear from the graph above. Assuming a 6dB receiver noise figure, the sensitivity for 0.1% BER is -94.8dBm at nominal IF and deviation, improving to -96.7dBm at maximum deviation.

Project Management

As with the management of all large development projects, the design of highly integrated ICs is broken into a manageable set of tasks that are then distributed amongst the individual designers in the team. As long as close collaboration and strong project management are undertaken the fact that the designers are not permanently co-located need not cause undue problems. This two-year working relationship has contributed to a new product range of digital wireless transceivers for National Semiconductor and is proof that this type of collaboration can yield excellent results.

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