

Custom ASICs and Foundry Services Are Becoming Routine

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The message of this report is simple: Designing for a semiconductor process is becoming as routine as traditional design on a printed circuit board or ceramic substrate. An integrated circuit solution is as viable as one that is assembled of individual components. This trend has been visible for several years, and is reaching the point where it is practical for almost any designer to work with.

The capabilities and limitations of the various IC processes can be very different from classic RF, microwave or high speed digital design. The resistivity and dielectric constant of the substrate, the use of metallization layers, and the thermal response of the material require a unique set of design skills beyond basic circuit theory. Building transistors is a different type of engineering than simply building *with* transistors.

One method for a traditional design to be implemented is through the use of design consulting services. Companies like CDMS Inc., Rivlan and RF Integration in the U.S., Plextek in the U.K., RFIC Technologies in India, and IMST in Germany provide the necessary expertise for dealing with a foundry process instead of a p.c. board. For a first-time exploration of an RFIC or MMIC, they may be a good option versus hiring an employee (or several) with the appropriate experience.

Design Tools

Enabling the transition to IC circuit implementation are the recent efforts made by EDA companies to develop accurate software models and design procedures that accommodate the differences in IC versus discrete design. Close cooperation with major foundries has been established, allowing the nuances of a particular IC process to be incorporated into the software tools. Companies like Agilent Technologies' EEsof EDA division and AWR Corporation offer comprehensive packages, while many other software vendors provide solutions for particular portions of these circuits, such as inductors, transmission lines, transformers, etc.

With roots in the classic p.c. board design realm, Cadence Design Systems' SpectreRF is used in the transition to an IC layout. Many traditional IC layout tools offer some RF/microwave capabilities and may also have established interfaces with traditional microwave EDA tools that allow designs to be co-developed in both the circuit and layout realms.

It should be noted that the design tools are not yet complete. There are new developments in IC processes that may take time to be incorporated into the EDA tools. Also, the inherent programming philosophies of physical layout and fabrication versus circuit design and behav-

ioral analysis remain somewhat of a barrier between the RF/microwave design tools and IC design and layout tools.

Foundry Services

As an example of the number of foundries offering MMIC and/or RFIC services, the following is a list of foundries supported by Agilent's Advanced Design System (ADS) and GoldenGate packages:

Atmel Corporation
austriamicrosystems
Bookham Technology
Cree, Inc.
Gallium Arsenide Enabling Technology Centre
Global Communication Semiconductors, Inc.
IBM Microelectronics
IHP Microelectronics
Infineon Technologies
Jazz Semiconductor, Inc.
Knowledge*on Semiconductor
MagnaChip Semiconductor
Maxim Integrated Products
Northrop Grumman Electronic Systems
Northrop Grumman (Velocium)
NXP Semiconductors
OMMIC
Peregrine Semiconductor
Raytheon RF Components
Semiconductor Manufacturing International Corporation (SMIC)
STMicroelectronics
TriQuint Semiconductor
United Monolithic Semiconductors (UMS)
WIN Semiconductors Corporation
Taiwan Semiconductor Manufacturing Company (TSMC)
United Microelectronics Corporation (UMC)
X-FAB Semiconductor Foundries

As well as working with many of the above foundries, AWR Corp. adds these to the list:

Global Communications Semiconductors
RFMD
Sapphicon Semiconductor

This level of cooperation is evidence that the use of foundries for MMIC/RFIC and mixed signal ICs has reached the point of common use by product developers. We expect to see this trend continue with improved support from both foundries and EDA vendors.