Lattice enters market for programmable analog

HILLSBORO, Ore. — Lattice Semiconductor Corp. is looking to succeed in a market where no other company has truly succeeded before: memory-programmable analog circuits. Lattice is billing its "ispPAC" family, introduced this week, as the "PLD of analog chips," because it allows designers to field-configure analog filters with an array of on-chip amplifiers and passive components.

The introduction of the Lattice ispPAC mimics ambitious efforts by IMP Inc. (San Jose, Calif.) and Motorola Inc. and a less ambitious effort by Xicor Inc. (Milpitas, Calif.) which failed to establish a large market following.

Previous PLDs for analog were "too complicated or expensive," said Andy Robin, Lattice vice president for new business development. Lattice's ispPAC devices integrate up to 60 active and passive analog components with E2PROM values, Robin said, and will be priced at less that $7 each in 100s. Graphical tools that run on PCs with the Windows 98 or Windows NT operating system can program them.

Lattice contends that devices like this will capture a significant slice of the current $15 billion market in standard linear components. Its PLDs are intended to replace up to dozens of IC amplifiers and passive components (resistors and capacitors) that make up analog-signal conditioning and filter circuits.

The programmable logic kits-like IMP's, Motorola's and now Lattice's-allow designers to simulate and configure the filter with a Windows-based program and use it to set the logic for a single PDL or FPGA. Such a device would serve signal-conditioning applications in limited-volume apps like office-automation products and factory-automation systems, or as rapid prototypes for higher-volume consumer circuits.

"We've done a lot of customer research in this," said Randy Skinner, a Burr-Brown Corp. veteran who serves as new-product planning manager for Lattice. The demand is for performance that is comparable to analog circuits using discrete op amps and components, he said. Analog engineers want amplifiers with differential inputs (effectively instrumentation amps, with 70 to 80 dB common-mode rejection), programmable gain and differential outputs to couple easily with outboard A/D converters. "Engineers want 12-bit performance (genuine performance on a single supply)," Skinner said. "None of the previous entries came anywhere near 12-bit performance."
Lattice may have a point: Hans Klein, Lattice’s engineering director for mixed-signal products, engineered the earlier electrically programmable analog circuits (EPAC) for IMP, and understands their drawbacks. "Switched-capacitor filters are nice; the architecture lends itself to programmability," he said. "But the continuous time filter is easier to work with and generates clean outputs." The capabilities of the switched-capacitor filters are generally based on the charging slopes for integral capacitors, while the continuous time filters use linear amplifiers and up to 122 filter poles on the ispPAC, identified by the values of R-C networks.

The continuous time filter also offers an analog bandwidth that is up to 30 times higher than a switched-capacitor topology. The ispPAC has a 550-kHz bandwidth, Klein said. "The EPAC maxed out at 25 kHz."

The first two devices in the Lattice ispPAC family are the ispPAC10 and ispPAC20. The ispPAC10 includes four filter-summation PAC blocks—essential amplifiers—connected by what Lattice calls an "analog routing pool." The amplifiers can be configured to do summation and integration, with up to 20x programmable gain. The PAC blocks can be programmed for continuous time, second-, third- and fourth-order low-pass filtering over a range of 10 to 100 kHz.

The ispPAC20 has two PAC blocks similar to the ispPAC10’s, and adds an 8-bit D-to-A converter and two differential comparators to the available component bank. The two ispPAC devices offer an 88-dB THD (at 10 kHz) and a dynamic range greater than 100 dB. With what Lattice calls "ISP" (in-system programmability), ispPAC PLDs can be programmed and reprogrammed on the circuit board while it is socketed or soldered in place.

Will Lattice’s entry encourage designers to use programmable analog in place of discrete ICs and passives, or programmable DSPs? "This has to be like Crystal’s ‘delta-sigma’ converter architecture," Randy Skinner said. "Everyone said it wouldn't work—but now everyone's using it."

"The world thought we were crazy when we [the then-fledgling programmable logic industry] introduced a $35 PAL to replace $4 worth of SSI and MSI," echoed Robin. "And look where we are today," he said, referring to a $2.3-billion industry.