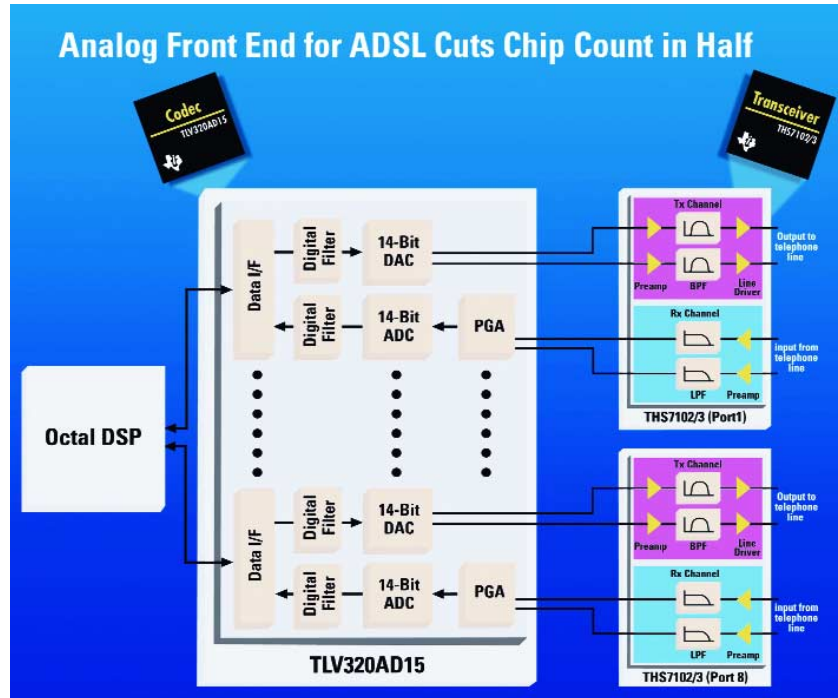


## Analog and Mixed-Signal Technology—Enablers of the Broadband Revolution

Broadband service providers are using digital technology to usher in a new era of telecommunications. However, that new era will not emerge without the evolution and support of analog technology. Today's most advanced broadband services have been built upon and rely on analog for lower power consumption and increased performance.

Analog enables broadband providers to efficiently achieve maximum deployment. Integrating analog and digital frameworks through mixed-signal technology is crucial to broadband network success. Broadband service providers encounter a number of issues as they deploy broadband technology,



The TLV320AD15 and THS7102/3 enable more lines in the same floor space by reducing power and chip count for eight DSL lines.

including efficient power consumption, space restrictions and demands for increased density. Texas Instruments (TI) designs and produces solutions to help service providers work through these often complex issues.

### Reducing Power Consumption

Power consumption is one of the most critical factors in broadband deployment. In fact, the analog components in a digital subscriber line (DSL) chipset consume up to 75 percent of the chipset's total power. Reducing power consumption of analog components can increase cable and DSL service revenue

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## A Better DSL Design

Thousands of miles from Texas Instruments' Dallas headquarters, Gani Subramaniam's design team developed the new TFLD600, a highly integrated AFE, and the TLV320AD15, an octal codec, TI's most recent broadband innovations addressing CPE and CO design concerns for DSL.

"The main focus on the CPE side is price, because it's reaching millions and millions of people," said Subramaniam, who led the Bangalore, India design team.

The team shaved modem costs by 30 percent with improvements

in several areas. "One new idea was to combine a codec, high performance amplifiers, and a high voltage line driver in a traditional three volt process," Subramaniam said. "That's a big change. It's something the competition hasn't been able to match up with."

A second area of cost savings was to lower clocking costs. "We devised circuits which allow the use of a cheaper crystal," he said. "This reduces the bill of materials by approximately \$4 to \$5."

A third cost savings was realized by building passive filters from the board directly into the

codec. These innovations made it possible for the TFLD600 to win the Innovation of the Year award from EDN Asia.

For the central office, TI's new TLV320AD15 codec offers advancements as well. "Power and density are the key areas in the central office. Instead of one channel per codec, the AD15 has eight, which uses shared circuitry to improve density and reduce power consumption," said Subramaniam.

He also promises better things to come. "There are other generations of mixed signal technologies in development that will be even better than these new devices."

Analog technology truly is enabling the broadband revolution

and innovative analog suppliers like Texas Instruments continue to play a leading role in broadband's future. **BB**



**Gani Subramaniam**  
Systems Design Manager  
Mixed-Signal Broadband Communications  
Texas Instruments

# BUILDING BROADBAND

## CABLE DSL WIRELESS

enues for providers by enabling more lines per card in the broadband infrastructure. In CPE, power efficient analog components enable line-powered and lower cost battery back-up solutions.

channel line driver and receiver, the THS7102/3, for ADSL service over either POTS or ISDN. By cutting previous chip counts in half and reducing power consumption by 20 percent, the AFE keeps systems running cooler and

external components, but they also need to meet lower voltage requirements to power high-performance digital signal processors. Efficient and reliable power supplies dissipate less heat, which equates to greater system reliability

or 32 channels per card.

In the CPE space, analog integration enables lower cost and smaller form-factor cable and DSL modems. The TLFD600 from TI is a single-chip AFE consisting of a codec, line driver and line receiver, enabling two-chip solutions for the DSL market – these innovations in integration will eventually lead to modems that are small enough to conform to PCMCIA form-factors for the laptop market.

The recent acquisition of Burr-Brown gives TI an even broader line of high quality, analog front-ends and building blocks for broadband applications to further increase integration in the CPE and infrastructure.

### Analog's Impact on Portable Equipment

Analog technology not only affects the cable and DSL industries; it also affects portable appliances such as PDAs, Bluetooth systems, 3G wireless phones, MP3 players and digital still cameras. Hand-held appliances are making use of broadband content and new services to deliver more value to consumers with email and Internet access from your hand, but all require power management for longer battery life and advanced analog components for signal transmission.

Without advances in analog technology, demand from consumers and businesses for advanced video, data, and voice services delivered directly to their office, their homes, and to their handhelds could not be satisfied.



| Device                  | Description                                   | ADC/DAC Resolution (bits) | Interface (Data/Control) | Supply Voltage (V) |
|-------------------------|---|---------------------------|--------------------------|--------------------|
| <b>Customer Premise</b> |   |                           |                          |                    |
| TLFD600                 | Full-rate/G.lite codec + line driver/receiver | 14/14                     | Serial/Serial            | +3.3 (+12)*        |
| TLFD500                 | G.lite codec†                                 | 14/14                     | Serial/Serial            | +3.3               |
| TLV320AD11A             | Full-rate codec + echo channel†               | 14/14                     | Parallel/Serial          | +3.3               |
| <b>Central Office</b>   |   |                           |                          |                    |
| TLV320AD16              | Full-rate/G.lite codec + line receiver        | 14/14                     | Parallel/Serial          | +3.3               |
| TLV320AD15/THS7102(3)   | Full-rate/G.lite codec, line driver/receiver  | 14/14                     | Serial/Serial            | +3.3/+15           |

\*+12 V is for on-chip line driver. † TI has a full line of line drivers/receivers to complement these devices.

For more information on TI's analog broadband products, please visit [www.ti.com/sc/bw-analog](http://www.ti.com/sc/bw-analog)

Achieving maximum channel density in cable modem terminal systems (CMTSs), DSL central offices (COs), and digital loop carriers (DLCs) is essential for a broadband service provider who is trying to keep up with the demand for service. There is a direct relationship between power consumption and channel density. Broadband infrastructure racks have very tight power consumption restrictions, since the higher the power consumption per line, the less lines that can be supported per rack.

As more lines are deployed from the infrastructure, power consumption can increase, which also increases the amount of heat that is generated. This heightens the probability of system failure, which is an issue when supplying always-on broadband access to a large consumer base.

TI's new analog front end (AFE) for ADSL CO systems is a real world example of efficient power consumption. The AFE includes an eight-channel codec, the TLV320AD15, and a single

within overall power budgets.

In cable modems, multiple service operators (MSOs) are striving to enable the next-generation of high-speed voice enabled modems. The THS6101 upstream line driver from TI is lower power than the DOCSIS 1.1 specification on cable modem power requirements - giving cable modem designers greater margin and more flexibility in system design so they are able to save development costs and reduce time-to-market. Low power consumption is important to future developments in cable services because it helps enable lifeline power for cable telephony. For lifeline service, cable telephones and other voice applications need to operate from the power supplied over the cable itself.

Power management also plays a critical role in service deployment by solving heat dissipation issues, reducing circuit board area and integrating system protection features in broadband infrastructure and CPE. Today, power supplies must be highly efficient with fewer

and higher availability for service networks. TI offers a complete line of power management solutions such as linear regulators, DC to DC converters, supply voltage supervisors, Hot Swap controllers and complete plug-in power solutions to help meet the power needs of broadband equipment.

### Analog Integration and Interoperability—Key to Increasing Subscribers

Analog technology is a crucial element in the drive for maximum deployment by service providers. The increased integration and density of analog products and technologies affect deployment by enabling the maximum number of lines in the same amount of floor space. This, in turn, decreases the cost and space of adding additional subscribers.

The above mentioned TLV320AD15 and THS7102/3 analog front end is a good example of integration because this highly integrated, dense solution enables DSL providers to increase line card density from 4 or 8 to 16, 24,