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TI BUILDS AND BUILDS

Computing in the Real World

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TECHNOLOGY TODAY

TI Builds and Builds

The reason for all the cranes

BY LAURA STADLER

If you haven't noticed or heard about the Texas Instruments (TI) building program, you may be interested to know what's developing. Digital signal processors (DSPs), among other state-of-the-art devices, are the primary components that will be developed and manufactured in the Dallas metal-oxide semiconductor (DMOS) wafer-fabrication facilities, located at Interstate 635 and Central Expressway in Dallas, Texas.

Over the next 18 to 24 months, TI will invest about $2 billion in Dallas to build its largest-ever semiconductor wafer fab and an additional research and development center called R&D 1. The expansion program is considered the largest capital investment made by a corporation in the city of Dallas to date.

The program includes a new research and development facility, a new manufacturing facility and three employee parking garages. Ultimately the expansion will create approximately 1,600 new jobs and will create an additional 3,600 jobs in support of the facility and its employees.

The facilities will add more than $240 million annually to the local economy. In TI terms, the company will invest more than 90 percent of its semiconductor capital expenditures in the development of digital signal processors, mixed signal/analog, and advanced logic products.

R&D 1

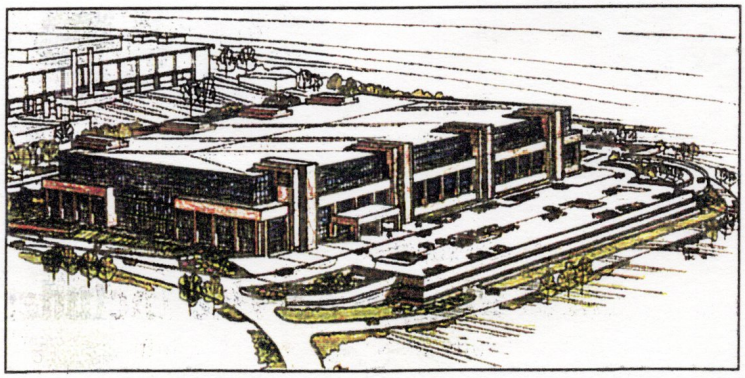
The research and development center, referred to as R&D 1, will be the focal point for work in TI's core competencies of microelectronics and signal processing solutions. The new R&D facility will enhance efforts to design processes that will aid in manufacturing digital solutions of tomorrow.

The semiconductor processes under investigation at R&D 1 will include manufacturing techniques that support 0.18-micron devices and 0.12-micron devices. Eventually, a portion of the cleanroom will house TI's 12-inch (300 millimeter) development program for the next generation of silicon wafer manufacturing.

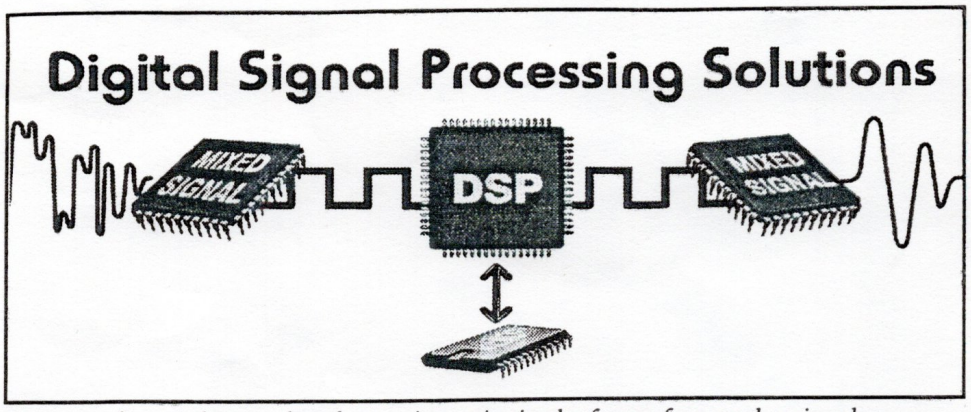
The facility will encompass 580,000 square feet and have an additional 51,000 square feet of cleanroom space. A cleanroom is a very sterile, filtered environment designed to reduce particles in the air that could negatively impact production efficiency. Completion of R&D 1 is scheduled for mid-year 1997, with full operation of the cleanroom expected by the end of 1997.

DMOS 6

TI recently finished construction of phase II of DMOS 5, which is attached to DMOS 4. These facilities are the first in the electronics industry to include a production development center, an equipment evaluation center and a manufacturing plant all inside one building.



An artist rendering of the future R & D1 facility.



A sensor detects the equal and opposing noise in the form of an analog signal. The analog signal is then sent through an A/D, analog digital converter. The DSP then processes the signal by enhancing or suppressing it after the which it is sent back through a D/A, digital to analog converter.

DMOS 6 (shown below) will contain more than 1 million square feet of space, including a 118,000-square foot cleanroom, and initially be equipped to produce approximately 10,000 eight-inch (200 milimeter) silicon wafers per month. As market demand increases, new equipment can be added in the existing space to increase output to about 30,000 wafers per month. Volume production of DMOS 6 is expected to begin by the end of 1997.

DMOS 6 will produce semiconductors with dimensions of 0.25 micron, which is compared to being 400 times smaller than the diameter of a single human hair. The fully outfitted design of DMOS 6 allows the facility to have "real-time" capacity, and in effect react 50 percent faster to changes in market conditions.

"This approach gives us significant flexibility to quickly react to upside market demand. It's also more cost effective, and it improves equipment utilization and minimizes depreciation," said Tom Engibous, TI executive vice president and president of the semiconductor group. This type of preparation is especially important when considering that the DSP market grew 70 percent in 1995.

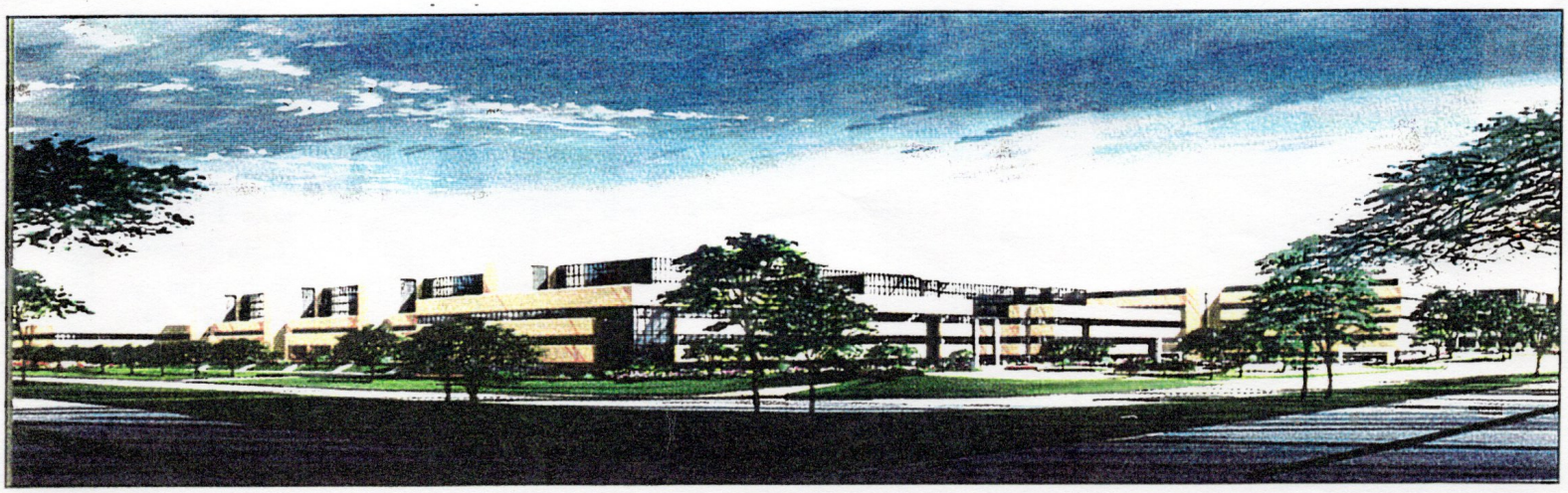
Together, DMOS 6 and R&D 1 will rank as one of the world's cleanest and most environmentally sensitive complexes. Systems inside the facilities will automatically clean exhaust systems, recycle water, reprocess chemicals and reduce energy consumption. Both facilities will be located on the main TI campus in Dallas.

DSPS: THE CHIP OF THE 90S

Digital signal processors are impacting electronics like the microprocessor impacted computers. In fact, applications for DSPs are growing at a rate greater than 40 percent per year. In effect, digital signal processing solutions will enable this decade's advanced products and take us to the next level, into a new generation and way of living.

DSPs are used in a variety of applications found in consumer products such as wireless telephones, PC games, anti-lock brakes, hard disk drives, modems and videoconferencing equipment.

The industry application breakdown of the DSP market encompasses 52 percent in communications, 26 percent in computers, 9 percent in office automation, 6 percent in instrumentation, 4 percent in military, and 3 percent in industrial industries. For example, customers like Ericsson use TI DSPs in cellular phones, and Seagate and US Robotics utilize them in hard disk drives.



REAL-TIME NUMERIC PROCESSING

DSPs are computer chips that add and multiply tens of millions of complex formulas per second. They take the information (a signal), which has been converted to a series of 1s and 0s, and modify it by eliminating unwanted or redundant information and enhancing wanted information.

Until recently, traditional microprocessor chips have been used to speed the transfer of information. However, they aren't fast enough to transmit messages without delays, or in "real time," as things happen. TI DSP solutions offer raw processing power that compresses/decompresses information at rates required for real-time audio and video applications.

DSPs in cellular phones work in voice compression and sending messages over the airwaves. It conditions the voice signal so it can be transferred over the airwaves. For example, if you were talking on a cellular phone in your car and the engine noise was the interfering or "redundant information," a DSP chip would eliminate that "information" and enhance the "signal" from your cellular network, or the voice on the other end. Then, by working with other system chips that translate digital data back into an analog or "real-world" format, DSPs instantly send the information back to you, just the way you need it.

DSPs also increase the capacity of cellular networks through significantly lowering the costs of cellular calls. Because DSPs can many times perform functions that previously required multiple chips, they enable the continued miniaturization of the cellular phone. In addition, DSPs improve the voice quality, add the capability to handle more data, improve security and provide for longer battery life in both talk time and standby modes.

A DSP chip is 10 to 50 times more powerful than other computer central processing units (CPUs) in handling math-intensive tasks. TI's highest performing DSP is as much as 50 times faster than the most powerful general purpose processor.

The first DSP manufactured had a device that could process information at 5 MIPS or millions of instructions per second. Today there are DSPs that can operate at 2 BOPS, or billions of operations per second, to process image, text and sound simultaneously. These devices are especially useful in desktop videoconferencing applications.

DSPs are the tools that make multimedia computers talk, answer the telephone, talk to other computers with their modems and play stereo music, while running video and other functions at the same time. DSPs are the enablers that will allow computers to perform so many functions simultaneously, or multitask, cost effectively.

Someday, interactive enhanced-definition televisions will have decoder boxes for broadcast on demand in our homes. Digitally compressed cable television systems will offer 10 times the number of current channels. Online access to databases, video games and libraries through personal computers via cable and telephone connections will dramatically enhance the widespread availability of detailed information.

In the future, cars will have "autopilots" for driving from electronic maps, noise reduction systems to keep out engine noise, vibration eliminators instead of shock absorbers to "smooth out" bumpy roads, anti-lock brakes for improved safety and collision-avoidance systems to reduce accidents.

What does it take to build a wafer fab?

- Five months of design
- Twelve months of construction
- Three months for equipment installation
- TI team of 200 engineers
- 2,500 contracters

What is in a wafer fab?

- 23 football fields of space
- Enough cooling capacity and electricity for 3,000 homes
- Enough light to illuminate 125 tennis courts
- Enough battery back-up for 125 cars

THE DSP MARKET

According to industry analysts, the worldwide market for digital signal processing solutions is expected to reach $12 billion by the year 2000.

As the leading DSP provider, with more than 20,000 customers worldwide, TI holds 44 percent of the DSP market. In 1994, TI's DSP business realized a 70 percent growth rate, and that rate is currently increasing at 40 percent annually. The numbers have surpassed the projected annual growth rate of the worldwide DSP market.

Throughout the years, beginning with TI's commercialization of the silicon transistor in 1954 and the invention of the integrated circuit in 1958, TI technologies have been on the leading edge of the digital revolution.

When TI pioneered the DSP market in 1982, the first generation of DSP chips sold for about $500. The very same chip now costs $5 in single unit quantities and as little as $3 a piece in large volumes. As is true with computer chips, higher performance has been achieved with each new generation of TI DSPs, while volume production and learning curves have lowered their cost over time.

Ron Wages, DSP marketing manager, said, "From videoconferencing control to audio to video, DSPs are driving the technology curve using state-of-the-art performance and value, with new applications being discovered every day."

DSPs are the devices that will revolutionize the way we live, learn, work and play.★

Laura Stadler is a freelance writer living in Dallas, Tex.

DSP APPLICATIONS

- Assembly line robots
- Caller ID
- Cellular Phones
- Compact discs
- Computer disk drives
- Entertainment systems with life-like sound
- Graphic equalizers
- Grocery scanners
- Imaging systems
- Modems
- Multimedia on computer networks
- Office Automation Equipment
- Radar detectors
- Speech processing
- Stereo recorders
- Tapeless answering machines
- Video telephones
- Voice mail
- Voice telephone dialing
- Workstations