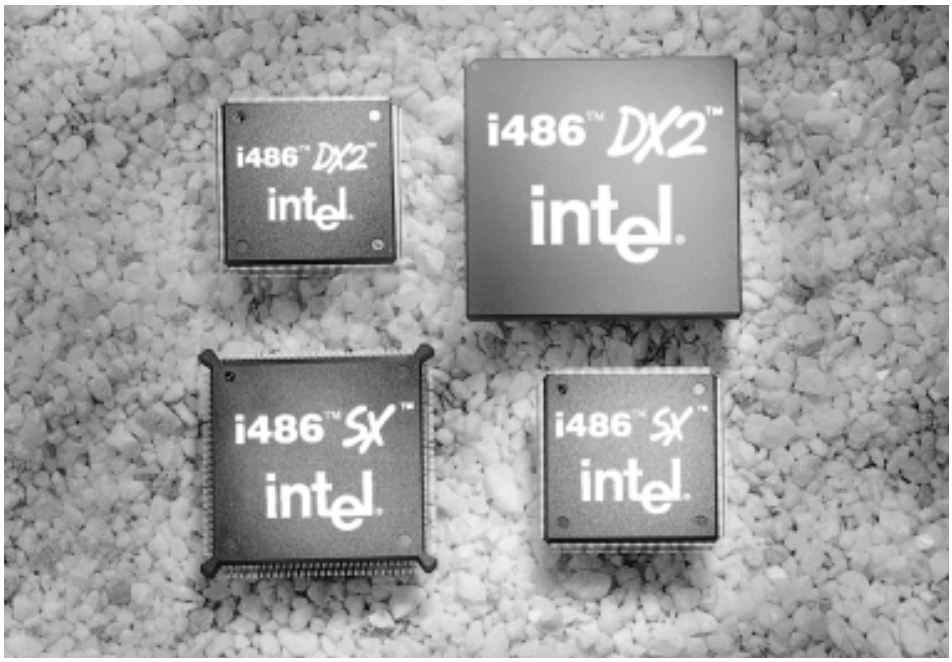
Embedded SL Enhanced Intel486™ Processors

Embedded Intel486™ SX Processor Features

- Complete 32-Bit RISC Technology Integer Core
- 8 Kbyte On-Chip Write-Through Cache
- Both Code and Data Cachable
- Single Cycle Instruction Execution
- 33 MHz Clock Frequency at 5V and 3.3V
- Burst Data Bus
  - 106-Mbyte/Sec Maximum Burst Bus Cycle at 33 MHz
- SL Technology For Intelligent Power-Management Capabilities
  - Static Design
  - Stop Clock, Auto HALT Power Down, I/O Restart
  - System Management Mode (SMM)
- 32-Bit External Data Bus
- Address Range
  - 4 Gigabytes of Physical Memory
  - 64 Terabytes of Virtual Memory
- Binary Compatible With Operating Systems Such as MS-DOS* and Standard Windowing Environments
- JTAG Boundary Scan
- 198-Lead PQFP (Plastic Quad Flat Pack) Supports 5V ± 0.25V at 33 MHz
- 208-Lead SQFP (Shrink Quad Flat Pack) Supports 3.3V ± 0.3V at 33 MHz

Embedded IntelDX2™ Processor Features

- Complete 32-Bit RISC Technology Integer Core
- 8 Kbyte On-Chip Write-Through Cache
- Both Code and Data Cachable
- On-Chip Floating-Point Unit
- Single Cycle Instruction Execution
- Frequencies
  - 66-MHz Core Speed Using 33-MHz Bus Clock at 5V
  - 50-MHz Core Speed Using 25-MHz Bus Clock at 3.3V
- Burst Data Bus
  - 80-Mbyte/Sec Maximum Burst Bus Cycle at 25 MHz
  - 106-Mbyte/Sec Maximum Burst Bus Cycle at 33 MHz
- SL Technology For Intelligent Power-Management Capabilities
  - Static Design
  - Stop Clock, Auto HALT Power Down, Auto Idle Power Down, I/O Restart
  - System Management Mode (SMM)
- 32-Bit External Data Bus
- Address Range
  - 4 Gigabytes of Physical Memory
  - 64 Terabytes of Virtual Memory
- Binary Compatible With Operating Systems Such as MS-DOS and Standard Windowing Environments
- JTAG Boundary Scan
- 168-Pin PGA (Pin Grid Array) Supports 5V ± 0.25V at 66 MHz
- 208-Lead SQFP Supports 3.3V ± 0.3V at 50 MHz

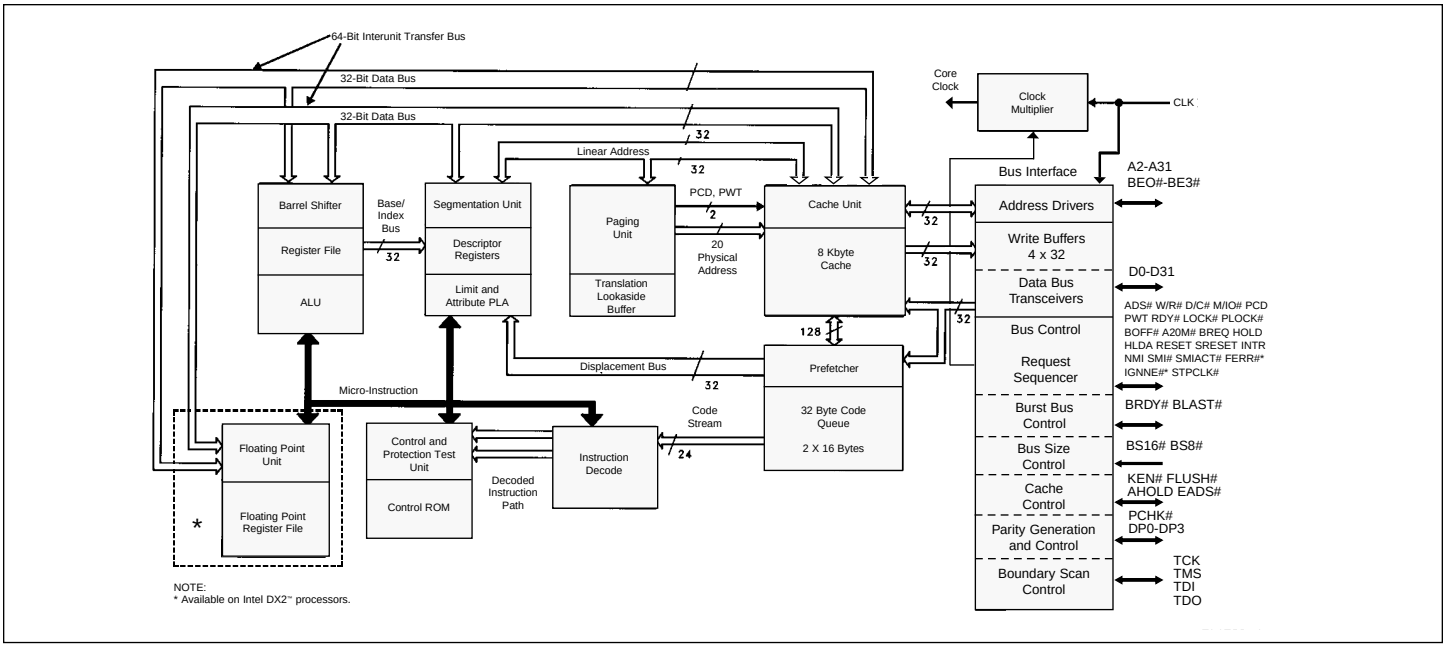


The Intel486 SX and IntelDX2 processors are designed into a wide variety of applications in the embedded market segment. Application examples include terminals, embedded PC boards, industrial control systems, scanners, medical instrumentation etc. In addition, embedded 386 processor customers can also take advantage of the Intel486 processors as a means of extending the performance breadth for embedded systems.

The embedded SL Enhanced Intel486 SX processors bring high levels of performance to lower-cost, entry-level, embedded 486 processor designs. Significant architectural enhancements including on-chip cache provide performance improvements while maintaining code compatibility.

The SL Enhanced IntelDX2 processors bring even higher levels of performance. The IntelDX2 processor performance levels are sustained by such features as internal clock speed-doubling technology, on-chip cache, and on-chip floating point unit.

CONTACT:
Local Intel Sales Office
WWW: http://www.intel.com/embedded/



Intel486™ SX and IntelDX2™ Processor Block Diagram

The Intel SL Technology features in the SL Enhanced Intel486 processors allow system designers to build intelligent power-management capabilities into hardware, making these capabilities independent of application software. Power-management becomes an integral part of the system, regardless of what operating system or application is used. Power-management is improved because SL Technology protects the power-management features from conflicting with other software.

The SL Enhanced Intel486 SX and IntelDX2 processors are part of the Intel Architecture embedded processor family. The family includes the 80186/188, 80C186XL/188XL, 80C186EA/188EA, 80C186EB/188EB, 80C186EC/188EC, 80386SXSA, 80386CXSA, 80386CXSB, 80386EXSA, and the SL Enhanced Intel486 processor family.

Performance

The embedded SL Enhanced Intel486 processors implement a full 32-bit architecture. The integer unit uses RISC design techniques to provide single clock cycle execution of common instructions and general purpose registers for manipulating 32-bit addresses and data. The eight-Kbyte on-chip code and data cache maintains the one-clock-per-instruction execution rate. The 106-Mbyte/sec burst bus at 33 MHz maintains a high level of system throughput even with inexpensive DRAMs. The RISC-technology integer unit, cache, memory management unit with paging, all are integrated on-chip to reduce inter-chip communication delays. From the SPECint92 benchmarks below, it is clear to see that the embedded Intel486 processor can offer a natural performance extension for embedded systems. SPECint92 allows for integer performance predictions using an instruction mix for commercial applications in a business environment.

Processor	SPECint92
Intel386™ SX-33 Processor	6.11
Intel386 DX-33 Processor	8.35
Intel486 SX-33 Processor	18.55
IntelDX2-50 Processor	25.72
IntelDX2-66 Processor	32.44

The embedded SL Enhanced IntelDX2 processor has been optimized for performance. Using Intel's speed-doubling technology, the processor and cache operate at twice the speed of the external memory bus. This delivers increased CPU performance for systems utilizing today's, low-cost design technology.

All Intel486 processors provide a rich instruction set for manipulating integer and floating point data. Special emphasis has been placed on providing optimized instructions for high level languages and operating system functions. Multiple addressing modes ensure that high level languages can be implemented in the most efficient manner possible. The integrated memory management unit supports virtual memory and demand paging. Intel486 processors are capable of addressing up to 4 Gigabytes of physical memory and 64 Terabytes of virtual memory. The on-chip translation lookaside buffer supports efficient paging.

Intel486 processors provide support for multiprocessing systems. Special instructions support memory-based semaphores.

Hardware-enforced cache line invalidations maintain consistency among multiple caches. Support for multilevel caches reduces bus utilization, allowing multiple Intel486 processors to share a single memory bus.

Power and System Management
Intel's SL Technology consists of a number of microprocessor features that deliver superior power-management capabilities. These features operate at two levels: at the system level, controlling the way power is used by the entire system (including peripherals); and at the microprocessor level. Power management at these levels involves putting the CPU into a low-power state during non-CPU intensive tasks (such as word processing), or into a very low-power state when the system is not in use ("sleep" mode).

The embedded Intel486 processor brings the efficient Intel SL Technology to the embedded market segment. SL Technology includes the following features: static design, Stop Clock, Auto Halt Power Down, Auto Idle Power Down, I/O Restart and Intel System Management Mode (SMM).

SL Enhanced Intel486 processors incorporate power-saving technology at the CPU level. One of the SL Technology features used to manage the power consumption of the CPU is Stop Clock. Stop Clock uses a microprocessor input that provides the system fine-tuned control over the CPU's clock frequency, enabling a variety of energy-conservation techniques.

The Stop Clock mechanism provides two low-power states: Stop Grant state, and a Stop Clock state with CLK frequency at 0 MHz. Stop Grant is the hardware and software mechanism that is used to transition the internal CPU core to a low-power state. In this state the processor typically consumes only 175-225 mWatt for the 5V processors, and 76-82 mWatt for the 3.3V processors. While in the Stop Grant state, the system can change the CPU clock frequency, either to operate at a different frequency or stop the CPU clock. If the CPU clock is stopped, the CPU is in the Stop Clock state, lowering power consumption to the 300-1000 micro-watt range. The ability of Stop Clock to vary clock input and CPU speed results in dramatic power savings.

Another approach to CPU power management involves the Auto Halt feature. When the HALT instruction is executed (stopping the CPU from executing further instructions) the CPU automatically enters its low-power (76-225 mWatt) idle mode. This provides higher power savings whenever the software program is idle.

Auto Idle Power Down is a feature of SL Enhanced IntelDX2 processors. Auto Idle causes the IntelDX2 to operate in a non-speed-doubled mode when it is idle during a memory cycle, waiting for I/O or memory to respond. For example, a 66 MHz IntelDX2 processor would operate at 33 MHz when idle, consuming about 50% less power when in this state, and would not affect the system's overall performance.

Intel's System Management Mode (SMM) provides the system designer with means of building software-controlled features into a system at the hardware/firmware level, making them transparent to operating system and application software. The SMM architecture includes the following elements:
– System Management Interrupt (SMI#) for hardware interfacing
– Dedicated and protected memory space (SMRAM) for SMI handler code and CPU state data with a status signal (SMIACT#) for the system to decode access to the memory space
– RESUME (RSM), instruction for exiting the System Management Mode
– Distinct and consistent SMM operating mode
– I/O Restart, for transparent power management of I/O peripherals

The SL Enhanced Intel486 processors are available in 3.3V and 5V versions. The 3.3V versions provide 50% power savings over the 5V versions. The combination of SL Enhanced features, SMM modes and a 3.3V operation can result in decreased power consumption, lower heat dissipation, and reduced system noise.

Architecture
The embedded Intel486 SX and the IntelDX2 processors are binary compatible with the previous members of the Intel Architecture family as well as the entire Intel486 product family.

Development Tools
Embedded systems developers can continue to take advantage of the tremendous number of tools created for the PC industry. The embedded Intel486 processors are widely adopted in the marketplace and provide access to familiar, low cost development tools.

The embedded Intel486 SX and the embedded IntelDX2 processors have a complete development environment including the popular compilers, linker/locators, debuggers, in-circuit emulators, and logic analyzers.

For developing embedded DOS applications, there are ROMable versions of DOS and BIOS. For non-DOS applications, all of the tools necessary to develop multitasking, real-time 32-bit applications, including real-time operating systems are currently available in the market.

The familiar, inexpensive, easy-to-use development environment of the Intel486 embedded processors allows embedded system developers to bring products to market more quickly, at a lower cost.