



E86™ FAMILY

32-Bit Microcontrollers
and Microprocessors



www.amd.com



Leverage the billions of
dollars spent annually
developing hardware and
software for the world's
dominant processor
architecture — x86

SECTION I

- ASSURED, FLEXIBLE, AND X86 COMPATIBLE MIGRATION PATH FROM 16-BIT TO FULL 32-BIT BUS DESIGN
- INDUSTRY STANDARD X86 ARCHITECTURE WHICH PROVIDES LARGEST KNOWLEDGE BASE OF INSTALLED DESIGNERS
- ENHANCED PERFORMANCE AND LOWER SYSTEM COSTS
- HIGH LEVEL OF INTEGRATION THAT REDUCES TIME-TO-MARKET AND INCREASES RELIABILITY
- A COMPLETE THIRD-PARTY SUPPORT PROGRAM FROM AMD'S FUSIONE86SM PARTNERS
- BROAD SPECTRUM OF SOLUTIONS SUPPORTING POWER MANAGEMENT AND SMALL FORM FACTORS

HIGH PERFORMANCE x86 EMBEDDED PROCESSORS

The E86™ family of 32-bit microprocessors and microcontrollers represent the highest level of x86 performance that AMD currently offers for the embedded market. This 32-bit family of devices includes the Am386®, Am486®, AMD-K6™-2E, AMD-K6-2E+, and AMD-K6-III+ microprocessors as well as the Élan™ family of integrated microcontrollers.

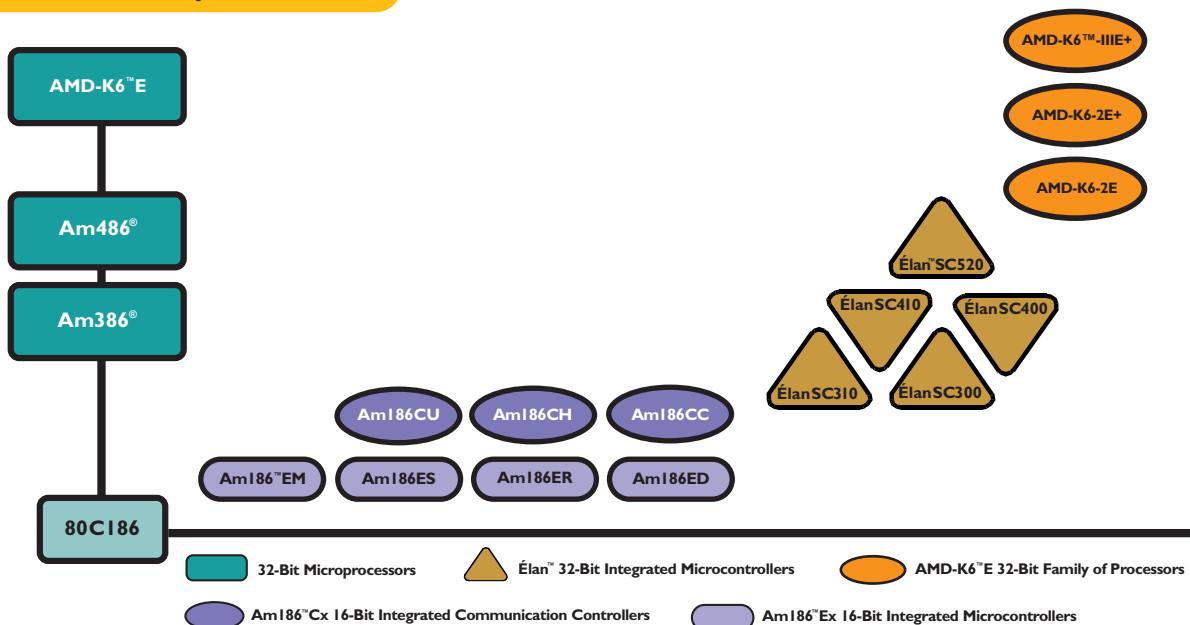
Since all E86 family processors are x86 compatible, a software compatible upgrade path for your next generation design is assured. And since the E86 family is based on the world's dominant processor architecture - x86 - embedded designers are also able to leverage the billions of dollars spent annually developing hardware and software for the PC market. Low cost development tools, readily available chipsets and peripherals, and pre-written software are all benefits of utilizing the x86 architecture in your designs.

HIGH PERFORMANCE 32-BIT MICROPROCESSOR PORTFOLIO

Many customers require the leading edge performance of PC microprocessors, while still desiring the level of support that is typically associated with embedded processors. AMD's Embedded Processor Division is chartered to provide these industry-proven CPU cores with the long-term product support, development tool infrastructure, and technical support that embedded customers have come to expect.

These microprocessors are often used to create information appliances (digital set top boxes, embedded PCs, Windows®-based terminals, point-of-sale terminals), telecommunications infrastructure equipment (central office switch shelf controllers), and data communications applications (high-speed routers, smart residential gateways).

E86™ Family Chart



SECTION I

AMD-K6™-2E+ and AMD-K6-III+ Embedded Processors

Dynamically Manages Power and Performance

Embedded designers can now experience high levels of performance while continuing to leverage the benefits of the x86 architecture. Performance and power are optimized with the new AMD-K6™-2E+ and AMD-K6-III+ processors, the functionally compatible embedded versions of the AMD-K6-2+ and AMD-K6-III+ processors.

By integrating L2 cache and the **AMD PowerNow!™ technology**, the AMD-K6-2E+ and AMD-K6-III+ processors offer new levels of performance for Super7™ and Socket 7 platforms. AMD offers two versions of each processor, a standard-power version and a low-power version. The standard-power versions are based on specifications similar to the corresponding AMD desktop processor versions. The low-power versions offer lower power consumption, along with extended temperature ratings and the AMD PowerNow! technology.

AMD's 3DNow!™ technology offers outstanding multimedia and audio performance, while the **AMD PowerNow!** technology allows the processor to run at different frequencies and voltages under software control in order to reduce power consumption. The AMD PowerNow! technology enables a unique "automatic mode" capability, which allows the system to monitor application use and to continuously vary operating frequency and voltage, delivering performance on demand with minimal power dissipation. When the application requires the processor to run at maximum performance, the AMD PowerNow! technology steps up the performance to meet the demand. As platform demand for performance subsides, AMD PowerNow! technology can be enabled to dynamically drop into a lower power state. Designers can now manage power and performance on demand with the AMD PowerNow! technology.

As the newest edition to the AMD-K6-E family of embedded processors, the AMD-K6-2E+ and AMD-K6-III+ processors are designed to offer compelling yet affordable power and performance for high-end embedded applications, such as information appliances, set-top boxes, embedded PCs, point of sale terminals, printers, public and private communications infrastructure components, and industrial control devices.

Common AMD-K6™-2E+ and AMD-K6-III+ Processor Features

- Six-issue superscalar microarchitecture
- Low-power versions using AMD PowerNow! technology
- 100MHz front-side bus for fast system memory and I/O access
- 3DNow! technology with new instructions for digital signal processing
- Superscalar MMX™ technology for a rich multimedia experience
- Low-voltage, 0.18-micron, 5-layer-metal silicon process technology with reduced power consumption
- Large 64KB on-chip L1 cache
- Now available in Pin-Grid Array (PGA) packages

Development Support

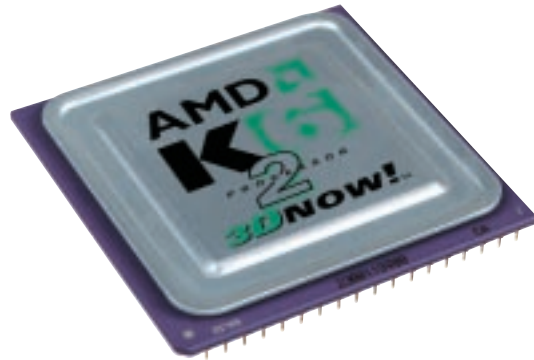
The AMD-K6-2E+ and AMD-K6-III+ processors are Socket 7 and Super7 compatible, allowing a simple, compatible upgrade path for the established Socket 7 motherboard infrastructure with existing BIOS and chip set support. These processors are also supported by numerous Operating Systems and RTOS solutions including Microsoft® Windows®, Linux, QNX, and others. Additionally, the AMD FusionE86™ third-party tool support program offers extensive development support for AMD-K6-2E+ and AMD-K6-III+ processor designs.



AMD-K6-2E MICROPROCESSOR

The AMD-K6-2E processor is a functionally compatible embedded version of the sixth generation, Microsoft® Windows® compatible AMD-K6-2 processor, with AMD's innovative 3DNow!™ technology, superscalar MMX™ instruction execution support, and the Super7 100 MHz frontside bus. The AMD-K6-2E embedded processor is implemented in AMD's low power 0.25-micron process technology with a split plane voltage design to allow the processor core to operate at a lower voltage while the I/O voltage operates at the industry standard 3.3V level. The AMD-K6-2E embedded processor is available in two versions:

- A Low Power offering with a 1.9V core voltage and an extended temperature rating of 0 - 85°C.
- A Standard Power version with a 2.2V core voltage and a temperature rating of 0 - 70°C.



Am486®DX MICROPROCESSOR

The Am486®DX microprocessors are embedded versions of the enhanced Am486 microprocessor. Driven by development in the desktop PC market, these microprocessors are now available with support and lifetimes appropriate for the embedded market. The Am486DX enhances performance by incorporating a 16-Kbyte write-back cache implementation, flexible clock control, and enhanced SMM.



Either of these microprocessors is an excellent choice for high-performance embedded applications such as central office switches, high-speed network routers, industrial automation, information appliances, point-of-sale terminals, and single board computers.

SECTION II

HIGH PERFORMANCE 32-BIT MICROCONTROLLER PORTFOLIO

Over time, as improvements are made in silicon process technology, peripherals can be cost-effectively added to the newer and faster members of AMD's microprocessor portfolio. These high-performance, highly integrated solutions are all part of AMD's Élan family of microcontrollers.

The ÉlanSC300 and ÉlanSC400 microcontrollers, with their many levels of power management and integrated LCD controllers, are often found in handheld, battery powered devices such as personal GPS displays and inventory scanners. The ÉlanSC310 and ÉlanSC410 microcontrollers are variations of the aforementioned devices that have been cost reduced by removing the LCD controller and PCMCIA controllers. These are often used in information appliances, either battery powered or line powered, where small form factor and low system cost are priorities.

The newest member of the Élan family, the ÉlanSC520, provides a PCI bus that allows customers to take advantage of the many PCI-compatible peripheral chips developed for the PC industry. Furthermore, the addition of AMDebug™ technology enables development tool manufacturers to provide a highly functional software debug environment at lower prices than traditionally possible. This is accomplished through the addition of an on-chip instruction trace cache and the use of a low pin count, standardized debug interface.

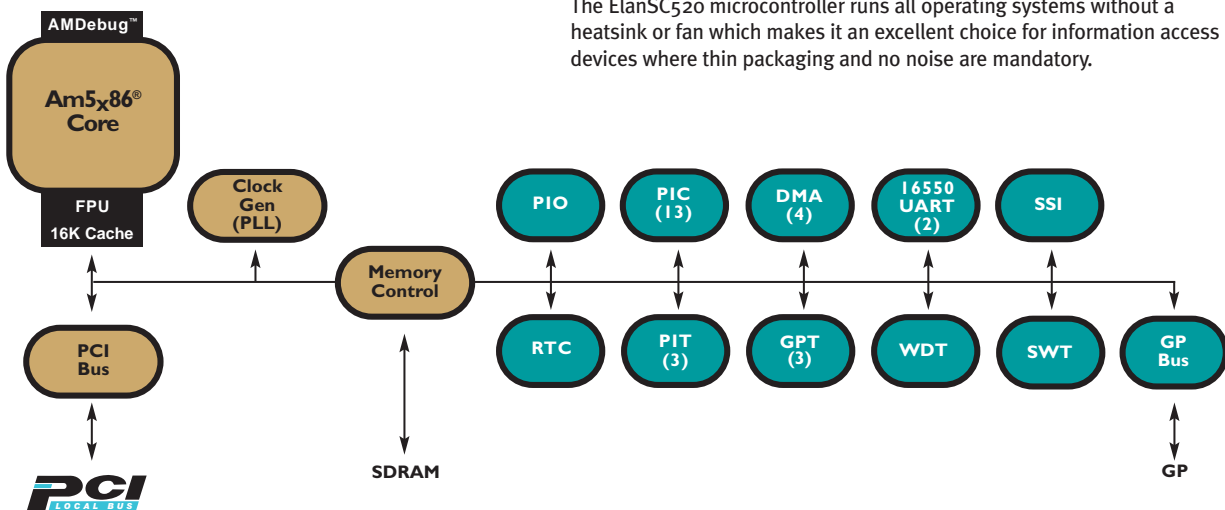
ÉlanSC520 MICROCONTROLLER

The ÉlanSC520 microcontroller combines a 32-bit, low-voltage Am5x86™ CPU with a complete set of integrated peripherals suitable for both real-time and PC/AT-compatible embedded applications. The device also features a 32-bit PCI bus, a 32-bit SDRAM interface and on-chip software debug support known as AMDebug™ technology.

The ÉlanSC520 is designed for medium- to high-performance applications in the telecommunications, data communications, and information appliance markets and is very well suited for applications requiring high throughput combined with low latency. The compact Plastic Ball Grid Array (PBGA) package provides a high degree of functionality in a very small form factor, making it cost-effective for many applications. A 0.25-micron process allows low power consumption along with high performance.

The ÉlanSC520 microcontroller runs all operating systems without a heatsink or fan which makes it an excellent choice for information access devices where thin packaging and no noise are mandatory.

Élan™ SC520 Microcontroller Block Diagram

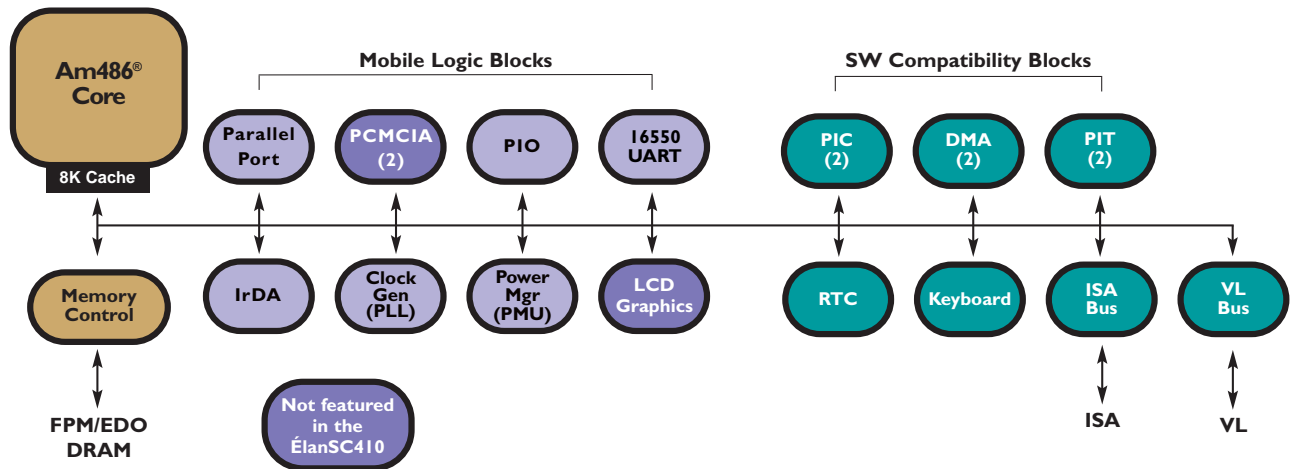


SECTION II

ÉlanSC400 and ÉlanSC410 MICROCONTROLLERS

The ÉlanSC400 and ÉlanSC410 microcontrollers both combine an Am486 CPU with PC/AT system logic, a memory controller, and essential mobile computing peripherals. The mobile computing peripheral set includes multiple phase-locked loops, a power management unit, and an IrDA port. In addition, the ÉlanSC400 microcontroller includes an LCD graphics controller and dual PC Card controller which are often useful for mobile applications.

Élan™ SC400/410 Microcontroller Block Diagram



SECTION III

DEVELOPMENT PLATFORMS AND REFERENCE DESIGNS

E86 family demonstration, evaluation and reference design kits provide platforms for code development, architectural evaluation and benchmarking. Each E86 family demonstration and reference design kit is shipped with an E86 Family CD-ROM* which includes product datasheets and third party support information.

ÉlanSC520 Customer Development Platform

The ÉlanSC520 microcontroller Customer Development Platform (CDP) is a highly functional development platform that is useful for initial software bring-up and debugging. It also serves as a hardware reference design.

The ÉlanSC520 development platform provides:

- Three PCI expansion slots
- Two ISA-like, general-purpose bus slots
- 10/100 Mbps Ethernet port
- 512 Kbytes of flash memory for BIOS storage
- 16 Mbytes flash array for program or data storage
- “SuperI/O” peripherals (serial ports, parallel port, etc.)
- Two 168-pin SDRAM DIMM sockets supporting a maximum of 256 Mbytes
- AMDebug, Test Interface Port, and HP Logic Analyzer Headers

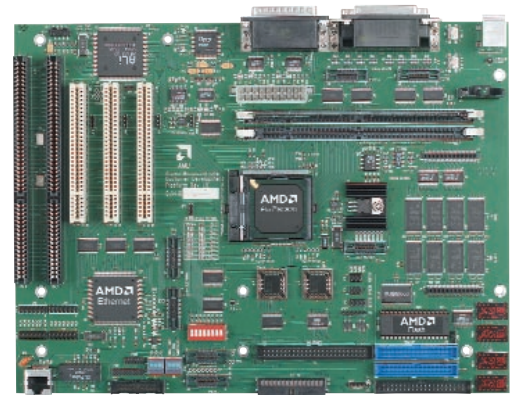
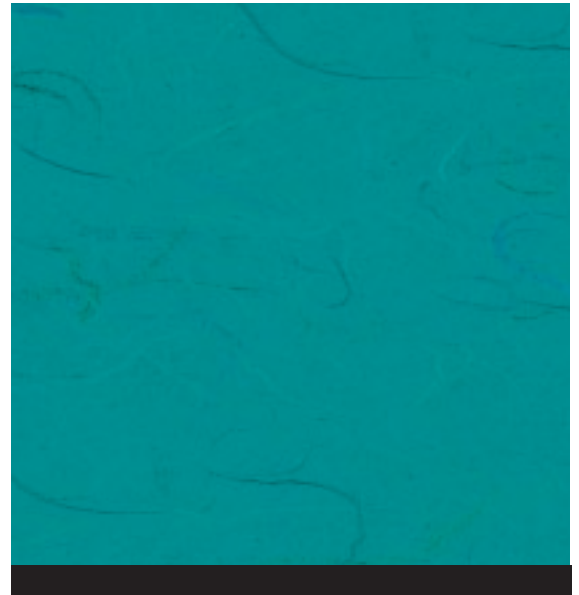
NetSC520 Customer Demonstration Platform

The AMD NetSC520 Demonstration Board is a small demonstration board combining AMD's ÉlanSC520 microcontroller with an Am79C973 10/100 Ethernet controller, 16 Mbytes of synchronous DRAM (SDRAM), and 16 Mbytes of ExIP Flash memory. The board demonstrates a simple, low-cost Ethernet capability that can be added to a wide variety of embedded networking applications.

Typical applications of the demonstration board design include low-cost, managed Ethernet hubs, “smart house” components, industrial control, point-of-sale terminals, and software development tools such as ROM emulators. An entire new class of applications known as “net appliances”, ranging from electric utility meters to coffee pots, could also use a design similar to that of the NetSC520 Demonstration Board. As a higher performance version of the Net186, the new NetSC520 demonstration design function as a network server or appliance and can be easily be expanded by adding PC104 daughter cards to add PCI peripherals.

The NetSC520 Demonstration Board provides the following features:

- ÉlanSC520 microcontroller
- PCnet™-FAST III single-chip 10/100 Mbit/s Ethernet controller
- 16 Mbytes SDRAM
- 16 Mbytes ExIP Flash memory
- Two 1-Kbyte Serial EEPROM memories (one for Ethernet configuration, one for general use).
- PC/104-Plus expansion interface (embedded PCI and ISA-compatible interfaces)
- One RJ-45 connector for 10/100Base-T twisted-pair Ethernet connection
- Two RS-232 serial ports with DB-9 connectors
- One 2-mm-pitch IDE interface (for 2.5-inch hard disk drive)
- LEDs are provided to indicate power status and the activity of serial, Ethernet, and IDE interfaces. Additional software-controlled LEDs are provided via nine Programmable IO (PIO) signals
- Eight software-defined bootstrap configuration switches
- Three system-defined bootstrap configuration switches
- 12-V external power supply (AC wall adapter)
- Onboard power supplies for 2.5 V, 3.3 V, and 5 V
- Banana jacks provided for external supply of PC/104-Plus voltages not provided on-board: -12 V and -5 V.
- Battery backup for the microcontroller's real-time clock (RTC)
- Reset circuitry with onboard reset button and header for external switch.
- Port for JTAG and AMDebug® Technology debugging.

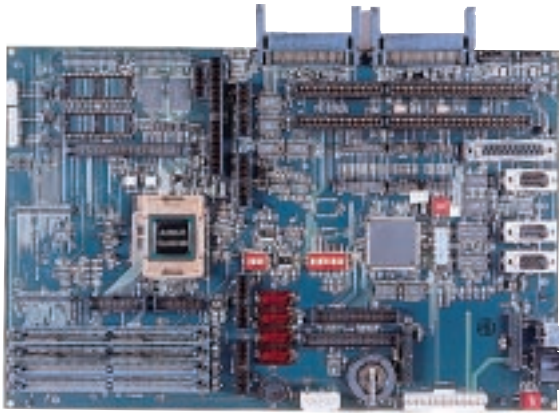


Ordering part no.: ÉlanSC520 – EVAL – KIT

* To order your free E86 Family Products and Development Tools CD-ROM, call 1-800-222-9323 and request Order #21058. For requests from outside the United States, please use the phone numbers on the back cover of this brochure.



Ordering part no.: NetSC520 – EVAL – KIT



Ordering part no.: ÉlanSC400 EVAL

ÉlanSC400 Evaluation Board

The ÉlanSC400 microcontroller evaluation board features an ÉlanSC400 microcontroller operating at 100-MHz and offers one platform for evaluation, debugging, and prototyping. This board is useful for either ÉlanSC400 or ÉlanSC410-microcontroller based designs.

The evaluation board supports a full complement of Super I/O peripheral interfaces that provide a PC-like development environment. Included are two 16550-compatible serial ports, one IrDA device for infrared serial communication, one IDE hard-disk drive connector, one floppy-disk connector, an AT keyboard controller, and one PS/2-style mouse connector.

The ÉlanSC400 microcontroller evaluation board is DOS and Windows compatible and is shipped with evaluation BIOS from Phoenix Technologies and General Software. The BIOS contains the code that allows the ÉlanSC400 microcontroller evaluation board to function just like a standard AT-compatible PC. The ÉlanSC400 microcontroller evaluation board can boot from standard AT-compatible diskettes and can use AT-compatible displays, display adapters, and keyboards.

REFERENCE DESIGNS

ÉlanSC400 μ forCE™ Reference Design Platform

The μ forCE™ (“microforce”) system provides a reference/demonstration platform for mobile and embedded product development using the ÉlanSC400 microcontroller and the Microsoft® Windows® CE operating system. The combination of the ÉlanSC400 microcontroller and the Windows CE operating system offers an attractive alternative to system designers who are looking to enable smaller, more powerful dedicated systems.

The μ forCE demonstration system board includes 4 Mbyte Flash memory, 16 Mbyte DRAM, and a demo copies of the Microsoft Windows CE and QNX operating systems. Additional system features include a 64 key matrix scan keyboard, 480 X 320 LCD with resistive digitizer overlay, NiMH battery pack, and an A/C wall power converter cube.

High-performance, small size, easy connectivity, and low power consumption are the key features of the μ forCE demonstration system. This system can serve as a reference platform for mobile/embedded computing designs, and will enable the designer to understand the functionality of an ÉlanSC400 microcontroller/Window CE O/S-based application.



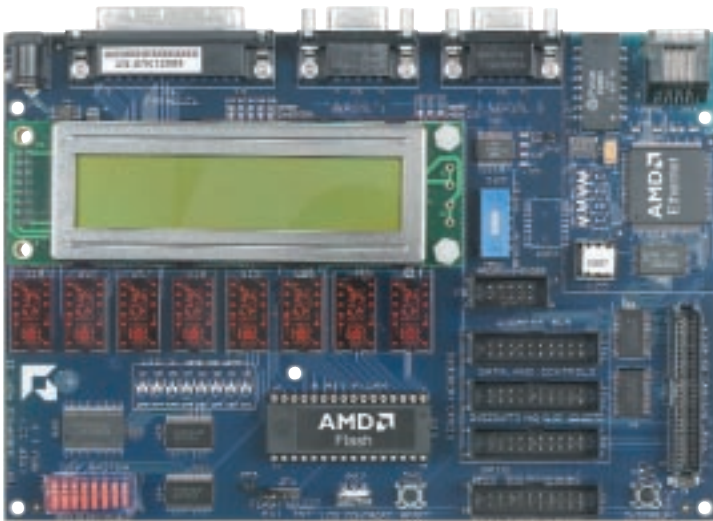
Ordering part no.: ÉlanSC400UFORCE

SECTION III

HARDWARE DEVELOPMENT TOOLS

Test Interface Port (TIP) Board

AMD's Test Interface Port (TIP) board is available to aid embedded designers with software development, debugging and evaluation. The TIP board can be used to monitor and control software through a wide variety of input/output devices. These I/O devices include a 2x20 character ASCII display, eight hexadecimal displays, two serial ports, a parallel port and more. In addition, the TIP board has a 10Base-T Ethernet interface. The target design can be placed on a network so that multiple software engineers can download and debug software to the same target. The TIP board has been designed for use with some AMD systems. Most future systems will be designed with a TIP connector.



Ordering part no.: AMD-TIP-KIT

CodeKit SOFTWARE PACKAGES

A CodeKit is a software package standardized format that AMD's Embedded Processor Division uses to deliver software to customers. CodeKit software packages are designed to deliver higher quality, easier to understand and more consistent source code examples to AMD's embedded customers. At a minimum, a CodeKit software package consists of the following:

- a detailed readme file
- a pre-built executable
- tested source code
- a build script which will build the executable code
- royalty-free modification and distribution rights

The idea is that a CodeKit contains all the information that someone needs to understand, build and execute the code. Best of all, CodeKit software packages are free. CodeKit software is shipped with all E86 family hardware kits, and it is featured on the AMD embedded website. To download CodeKit software, go to www.amd.com.

AMD's E86 Third-Party Support Program

AMD's FusionE86SM partner program offers an extensive network of hardware and software vendors whose products can reduce the time-to-market of your designs. This program includes many of the market's leading vendors of compilers, emulators, software debuggers, logic analyzers, and other useful tools.

The following chart includes FusionE86 partners who provide support for 32-bit microprocessors and microcontrollers. Partners are being added to this list continuously. A more complete list of FusionE86 partners can be found at www.amd.com.

FusionE86SM Third-Party Support Reference Table

FusionE86 Third-Party Support Program Reference			
Company:	Type of Support Products:	Product Name:	Web Address:
Accelerated Technology	RTOS	Nucleus	www.atinucleus.com
Applied Materials	In-Circuit Emulator (ICE)	SuperTAP	www.amc.com
Agranat	Embedded Web Server	Various	www.agranat.com
CAD-UL	Integrated Development Environment	Various	www.cadul.com
Datalight	ROM-DOS, BIOS	ROM-DOS	www.datalight.com
Embedded Power	ICE, Debugger, RTOS	QEC and Visual Probe RTXC	www.embeddedpower.com
General Software	BIOS	Various	www.gensw.com
InterNiche	Routing Software/Stacks	Various	www.iniche.com
Lineo	OS	Linux	www.lineo.com
Microsoft	OS	Windows [®] CE	www.microsoft.com
Opera	Browser	Opera	www.operasoftware.com
Phoenix Technologies	BIOS	Various	www.phoenix.com
QNX	RTOS	Neutrino	www.qnx.com
US Software (USSW)	Embedded Web Server and RTOS	Various	www.ussw.com

AMD's embedded x86 expertise means cost effective, performance oriented solutions for your designs. The E86 family of 32-bit microcontrollers and microprocessors offer unique solutions that are designed to save you time, effort and money. Whether you are designing for telecommunications, networking, mass storage or industrial control applications, AMD's x86 compatible E86 family delivers the features, performance and reliability required to support generations of embedded designs.

E86™ Family 32-Bit Microcontrollers and Microprocessors

	32-Bit Microprocessors				32-Bit Microcontrollers		
	Am486 [®] DX	AMD-K6 [™] -2E	AMD-K6-2E+	AMD-K6-III ⁺	ÉlanSC400	ÉlanSC410	ÉlanSC520
CORE CPU	Am486DX	AMD-K6-2	AMD-K6-2+	AMD-K6-III+	Am486SLE	Am486SLE	Am5x86 [*]
SPEED							
Frequency	66, 100, 133	233, 266, 300, 333, 350, 400	350-450 low power 400-500 std. power	400-500 low power 400-550 std. power	33, 66, 100	33, 66, 100	100, 133
TEMPERATURE							
Commercial (C) Industrial (I)	C, I (66, 100)	Std=0-70°C Low Power=0-85°C	Std=0-70°C Low =0-85°C	Std=0-70°C Low =0-85°C	C, I (33, 66)	C, I (33, 66)	C
PACKAGING							
Packaging	SQFP 208 PGA 168	CPGA 321	CPGA 321	CPGA 321	BGA 292	BGA 292	PBGA 388
CLOCKING SCHEME							
Clocking Scheme*	2x: 66 (DX2) 3x: 100 (DX4) 4x: 133 (DX5)	3x=300 (100 MHz bus) 4.5=300 (66MHz bus)	66 & 100 MHz frequency multipliers	66 & 100 MHz frequency multipliers	**32kHz osc	**32kHz osc	3x: 100 4x: 133
CPU							
Demux'ed Bus	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Internal Bus Width/ External Bus Width	32 / 8, 16, 32	32 / 64	32 / 64	32 / 64	32 / 8, 16, 32	32 / 8, 16, 32	32 / 8, 16, 32
Cache Size	16Kbyte WB/WT	64Kbyte (32K/32K)	64K(L1), 128K(L2)	64K(L1), 256K(L2)	8 Kbyte WB, WT	8 Kbyte WB, WT	16 Kbyte WB, WT
Floating Point	Yes	Yes	Yes	Yes	No	No	Yes
Icc(mA/MHz) 3.3V	7	See Data Sheet	See Data Sheet	See Data Sheet	6.2 mA/MHz	6.2 mA/MHz	4.8 mA/MHz
JTAG Port	Yes	Yes	Yes	Yes	Yes	Yes	Yes
VCORE	3.3V, 3.45V (133)	1.9V Low Power 2.2V Std. Power	1.5-1.7V Low Pwr; 2.0V Std. Pwr.	1.6-1.8V Low Pwr; 2.0V Std. Pwr.	2.7, 3.3v	2.7, 3.3V	2.5V
I/O Tolerance	5V	3.3V	3.3V	3.3V	5V	5V	5V
General Purpose Bus	-	-	-	-	8-, 16-Bit ISA	8-, 16-Bit ISA	8-, 16-, 32-Bit
Expansion Bus	-	-	-	-	32-Bit VL	32-Bit VL	32-Bit PCI
Power Management	-	-	Yes (PowerNow! [™] Tech.)	Yes (PowerNow! [™] Tech.)	Yes	Yes	No
On-Chip Controllers (ROM/RAM)	-	-	-	-	Yes/Yes	Yes/Yes	Yes/Yes
Integrated PC/AT Compatible Peripherals	-	-	-	-	Yes	Yes	Yes
DUAL DMA CONTROLLERS							
Width	-	-	-	-	8, 16	8, 16	8, 16
Total Number of Channels/ External Channels	-	-	-	-	7/2	7/2	7/4
ADDITIONAL PERIPHERALS							
Dual Interrupt Controllers	-	-	-	-	Yes	Yes	Yes
Bi-directional Parallel Port with EEPROM Mode	-	-	-	-	Yes	Yes	Yes
Serial Port (UART)	-	-	-	-	16550- compatible	16550- compatible	(2X) 16550- compatible
Keyboard Interface	-	-	-	-	XT, Matrix	XT, Matrix	No
General Purpose Input/ Output Pins	-	-	-	-	32	32	32
Infrared (IrDA) Port	-	-	-	-	Yes	Yes	No
PC Card Controllers / Slots	-	-	-	-	PCMCIA 2.1/2	No	No
LCD Graphics Controller	-	-	-	-	Yes	No	No
AMDebug	-	-	-	-	No	No	Yes

SYMBOL LEGEND:

- * Clock multiple refers to ratio of processor operating frequency to bus frequency
- ** Indicates external clock requirements



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