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Cyrix™ Advancing the Standards

FasMath™

CX-EMC87 Coprocessor

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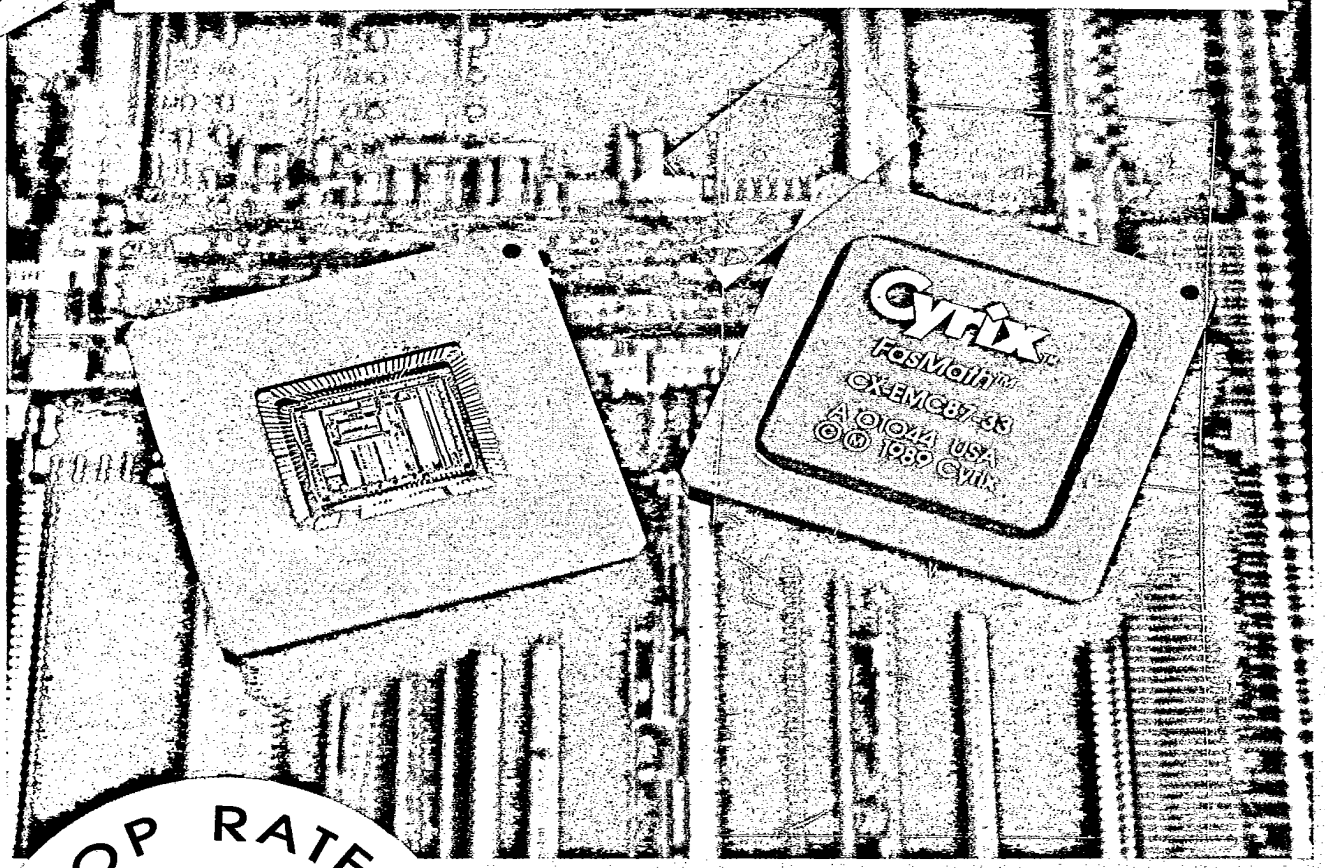

TOP RATED

HUMMER LABS

August 27, 1990

The New Math Coprocessor Standard For 386 Systems

- Highest Performance Full Precision Coprocessor
- High Performance Interface
- Easy Migration of Software
- Advanced CMOS Technology
- 32-Bit Software Applications & Compilers (see back for Software Vendors)

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FasMath™ EMC87

- *Fastest Full Precision Math Coprocessor.*
  ACCELERATES:
  - Compatible Programs 20%-300%
  - Enhanced (EMC) Programs 200%-600%
  - Faster Than 80387.
- *Advanced Host Processor Interface.*
  SUPPORTS:
  - Compatible Sequential Command/Data Interface.
  - Enhanced Parallel Command/Data Interface.
  - Standard 121-pin EMC Socket.
- *Full Numeric Compatibility With 80387.*
  - Identical Results For Precise Operations.
  - Improved Accuracy For Approximations.
  - Identical Status and Exceptions.
- *Full Software Compatibility.*
  - Runs All Existing 80386/80387 Applications.
  - Full IEEE-754 Support Using Either Interface.
- *Low Power Operation.*
  - Built-In Power Management Logic.
  - Advanced Low Power CMOS Process.
  - 20, 25, & 33 MHz Versions Available.

Description:

The Cyrix ***FasMath™*** EMC87 is an Extended Math Coprocessor device for use in 80386 based systems that support the 121-pin EMC socket. The ***FasMath™*** EMC87 combines improved performance and full compatibility with existing 80386/80387 applications. In addition, the EMC87 offers a high performance parallel interface that delivers a 2-3X additional performance boast to "enhanced" applications by eliminating the compatible interface timing overhead. The entire ***FasMath™*** line of coprocessors obtain improved performance by implementing its floating point primitive operations in hardware rather than in a microprogrammed sequencer. This approach allows ***FasMath™*** processors to perform floating point operations in far fewer clock cycles than the 80387. Fewer clock cycles per operation results in faster execution of numerics oriented application programs.

Architecture:

The ***FasMath™*** EMC87 implements a full extended double precision IEEE-754-1985 architecture with parallel adder, multiplier, and exponent units to provide ultra-high performance. In addition, the ***FasMath™*** EMC87 operates using one of two interfaces in response to the instruction being executed: the EMC either emulates 80387 style execution (compatible interface) or, for maximum speed, executes using the EMC parallel command/data interface.

Programming:

To maximize compatibility of numeric results and simplify programming, the ***FasMath™*** EMC87 presents a unified progamming model by implementing a "one-to-one" correspondence of compatible and enhanced (memory-mapped) coprocessor instructions. This correspondence results in a consistent repertoire of numeric operations using either interface. Only processor state management operations vary between the two interfaces. Thus, the net difference between compatible operation and EMC (enhanced) operation is faster execution. All numeric results, status, and exceptions are identical.

The instructions used to program the ***FasMath™*** EMC87 using the compatible interface are binary and function compatible with those defined for the Intel 80387 Numeric Processor Extension. Instructions are provided which load/store data and constants, perform arithmetic, elementary, and transcendental functions, manipulate fraction and exponent fields of operands, and control the status and operating interface of the ***FasMath™*** EMC87.

When using the enhanced interface, the ***FasMath™*** EMC87 provides the user access to all the numerical operations available to the compatible interface via MOV instructions using the EMC memory-mapped addresses. In addition, new instructions are provided to manage the EMC interface registers and ease context switching in multi-user operating systems. Finally, the sophisticated interface of the EMC87 allows both compatible-interface and EMC-interface instructions to be freely interspersed in a single program. This permits selective optimization of only the most time critical portions of a program and the use of the existing library routines.

Circuit:

The ***FasMath™*** EMC87 device is fabricated using a 1.0u gate length, double layer metal CMOS process. This permits the ***FasMath™*** EMC87 to operate at clock rates of 20 Mhz, 25Mhz and 33 Mhz. State of the art ESD protection and latch-up prevention circuits are incorporated into the EMC87 design. The EMC87 is packaged in a ceramic 121-pin pin grid array package.

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Instruction Execution Characteristics

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The *FasMath™* EMC87 instruction set consists of four main groups of instructions: IEEE Load/Store, IEEE Arithmetic, Transcendental Functions, and Processor Control Instructions. The first three instruction groups perform all computational operations in the FasMath processor and consume most of the execution time in typical applications. The processor control group is used to initialize, reset, and perform context switches in the FasMath processor. All groups except transcendental functions provde identical results when compared with the Intel 80387. The characteristics of each group plus a sampling of in-system execution times in clock cycles are summarized below:

	Instruction	*FasMath™* EMC87 EMC Interface	*FasMath™* EMC87 D87 Interface	Intel 80387
IEEE Load/Store: - *Identical* Results Compared With 80387. - Faster Instruction Execution. - All Status, Exception, Control, Tag & Round Bits Are Identical. - Verified Against U.S. Berkeley IEEE Conformance Tests	FLD Reg	4	11	14
	FLD DP	12	20	25
	FLD SP	10	17	20
	FILD Int 16	7	21	61-65
	FILD Int 32	7	17	45-52
	FST Reg	4	11	11
	FST DP	11	30	45
	FST SP	9	26	44
	FIST Int 16	11	25	82-95
	FIST Int 32	11	26	79-93
IEEE Arithmetic: - Dedicated Parallel Adder and Hardware Array Multiplier. - Proprietary High Speed Divide & Square Root Algorithms. - *Identical* Results Compared With 80387. - Faster Instruction Execution. - All Status, Exception, Control, Tag & Round Bits Are Identical. - Verified Against U.S. Berkeley IEEE Conformance Tests	FABS	4	11	22
	FADD Reg	6	15	26-34
	FADD DP	15	25	29-37
	FADD SP	13	21	24-32
	FCHS	4	11	24-25
	FCOM Reg	4	11	24
	FCOM DP	13	20	31
	FCOM SP	11	17	26
	FDIV Reg	14-24	31	91
	FDIV DP	21-32	30	94
	FDIV SP	20-31	27	89
	FMUL Reg	10	19	52
	FMUL DP	18	25	57
	FMUL SP	16	21	35
	FSQRT	26	31	122-129
	FSUB Reg	6	15	29-37
	FSUB DP	15	21	28-36
	FSUB SP	13	21	24-32
Processor Control: - Identical Results In All Cases.	FCLEX	4	16	18
	FINIT	5	18	18
	FSTSW	4	10	10
Transcendental Functions: - Greater accuracy than 80387. - Maximum relative error less than $1.5 * 2^{-66}$. - Faster Instruction Execution. - All Status IEEE Conformal.	F2XM1	63	63	211-476
	FCOS	87	87	123-772
	FPATAN	83	83	314-487
	FPTAN	75	75	91-497
	FSIN	63	63	122-771
	FYL2X	87	87	120-538
	FYL2XPI	79	79	257-547

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SOFTWARE SUPPORT

- ***Compatible Software***
  - the Cyrix EMC87 coprocessor is compatible with all software currently written to use a standard coprocessor

- ***Enhanced Software***
  - the speed of the applications will be dramatically increased for software written with enhanced memory-mapped support for the EMC87

- ***Support***
  - the EMC87 provides the same superior speed advantage of our 83D87 when running compatible software
  - the following software developers will be providing EMC87 support

AMI	**Aptec**	**AT&T**
Evolution	**Award**	**Borland**
Lotus	**DiagSoft**	**Ergo**
Motaware	**Intusoft**	**Lahey**
Phoenix	**Mathworks**	**Mach**
SCO	**Microsoft**	**Microway**
4.4 BSD Unix	**Quarterdeck**	**Rational Systems**
Real Software	**Versacad**	**SVS**

- ***Cyrix supplies several programmer's tools with every EMC87***
  - translator for easy floating point conversion of Borland and Microsoft Compiler Code.
  - Virtual-86 Monitor for mapping the EMC87
  - Macro library for assembly language programmers

For additional information, please contact Cyrix at **1-800/848-2979.**

Cyrix
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