AMD

Am186™ER and Am188™ER

High-Performance, 80C186- and 80C188-Compatible, 16-Bit Embedded Microcontrollers with RAM

DISTINCTIVE CHARACTERISTICS

■ **E86™ family 80C186- and 80C188-compatible microcontrollers with enhanced bus interface**
   — Lower system cost with higher performance
   — 3.3-V ± 0.3-V operation with 5-V tolerant I/O
■ **Memory integration**
   — 32 Kbyte of internal RAM
   — Internal RAM provides same performance as zero-wait-state external memory
■ **High performance**
   — 25-, 33-, 40- and 50-MHz operating frequencies
   — Supports zero-wait-state operation at 50 MHz with 55-ns external memory
   — 1-Mbyte memory address space
   — 64-Kbyte I/O space
■ **Enhanced features provide faster access to memory and various clock input modes**
   — Nonmultiplexed address bus provides glueless interface to external RAM and ROM
   — Phase-locked loop (PLL) enables processor to operate at up to four times clock input frequency
■ **Enhanced integrated peripherals**
   — Thirty-two programmable I/O (PIO) pins
   — Asynchronous serial port allows full-duplex, 7-bit or 8-bit data transfers

   — DMA to and from asynchronous serial port
   — Synchronous serial interface allows half-duplex, bidirectional data transfer to and from ASICs
   — Reset configuration register
   — Additional external interrupts
   — Hardware watchdog timer can generate NMI or system reset
■ **Familiar 80C186 peripherals with enhanced functionality**
   — Two independent DMA channels
   — Programmable interrupt controller with six external interrupts
   — Three programmable 16-bit timers
   — Programmable memory and peripheral chip-select logic
   — Programmable wait state generator
   — Power-save clock mode
■ **Software-compatible with the 80C186 and 80C188 microcontrollers**
■ **Widely available native development tools, applications, and system software**
■ **Available in the following packages:**
   — 100-pin, thin quad flat pack (TQFP)
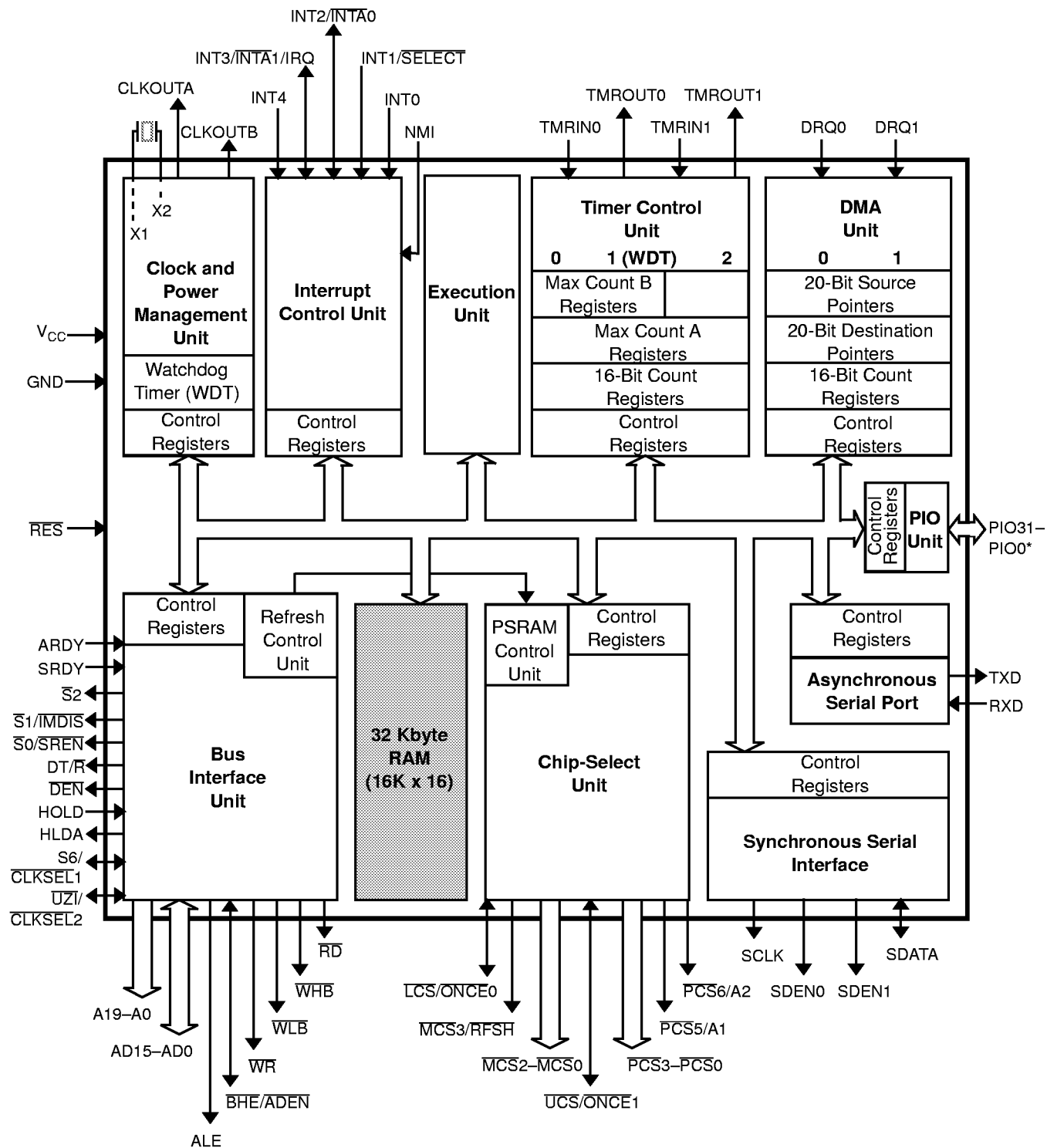   — 100-pin, plastic quad flat pack (PQFP)

GENERAL DESCRIPTION

The Am186™ER and Am188™ER microcontrollers are part of the AMD E86 family of embedded microcontrollers and microprocessors based on the x86 architecture. The Am186ER and Am188ER microcontrollers are the ideal upgrade for designs requiring 80C186/80C188 microcontroller compatibility, increased performance, serial communications, a direct bus interface, and integrated memory.

The Am186ER and Am188ER microcontrollers integrate memory and the functions of the CPU, nonmultiplexed address bus, timers, chip selects, interrupt controller, DMA controller, watchdog timer, asynchronous serial port, synchronous serial interface, and programmable I/O (PIO) pins on one chip. Compared to the 80C186/80C188 microcontrollers, the

Am186ER and Am188ER microcontrollers enable designers to reduce the size, power consumption, and cost of embedded systems, while increasing functionality and performance.

The Am186ER and Am188ER microcontrollers have been designed to meet the most common requirements of embedded products developed for the communications, office automation, mass storage, and general embedded markets. Specific applications include feature phones, cellular phones, PBXs, multiplexers, modems, disk drives, hand-held terminals and desktop terminals, fax machines, printers, photocopiers, and industrial controls.
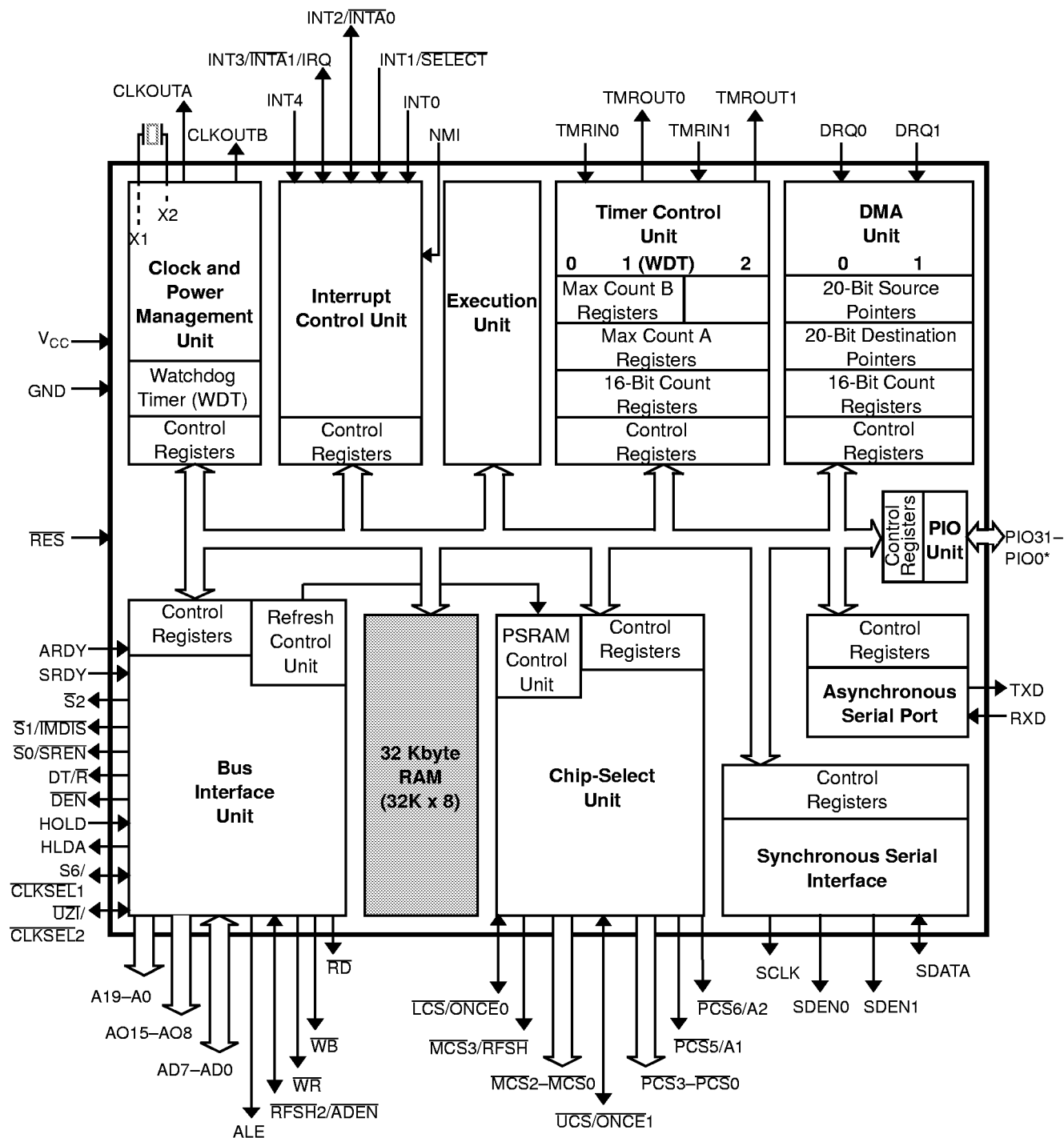
Am186ER MICROCONTROLLER BLOCK DIAGRAM

INT2/$\overline{\text{INTA}}$0

INT3/$\overline{\text{INTA}}$1/IRQ   INT1/$\overline{\text{SELECT}}$

CLKOUTA   INT4   INT0

CLKOUTB   NMI   TMROUT0   TMROUT1

TMRIN0   TMRIN1   DRQ0   DRQ1

X2
X1

Clock and Power Management Unit

Interrupt Control Unit

Execution Unit

Timer Control Unit
0   1 (WDT)   2

Max Count B Registers

Max Count A Registers

16-Bit Count Registers

Control Registers

DMA Unit
0   1

20-Bit Source Pointers

20-Bit Destination Pointers

16-Bit Count Registers

Control Registers

V$_{CC}$

GND

Watchdog Timer (WDT)

Control Registers

Control Registers

$\overline{\text{RES}}$

Control Registers   **PIO Unit**   PIO31–PIO0*

Control Registers   Refresh Control Unit

32 Kbyte RAM (16K x 16)

PSRAM Control Unit   Control Registers

Control Registers

ARDY
SRDY
$\overline{\text{S2}}$
$\overline{\text{S1}}$/$\overline{\text{IMDIS}}$
$\overline{\text{S0}}$/$\overline{\text{SREN}}$
DT/$\overline{\text{R}}$
$\overline{\text{DEN}}$
HOLD
HLDA
S6/
$\overline{\text{CLKSEL}}$1
$\overline{\text{UZI}}$/
$\overline{\text{CLKSEL}}$2

Bus Interface Unit

Chip-Select Unit

Asynchronous Serial Port   TXD   RXD

Control Registers

Synchronous Serial Interface

A19–A0
AD15–AD0

$\overline{\text{RD}}$
$\overline{\text{WHB}}$
$\overline{\text{WLB}}$
$\overline{\text{WR}}$
$\overline{\text{BHE}}$/$\overline{\text{ADEN}}$
ALE

$\overline{\text{LCS}}$/ONCE0
$\overline{\text{MCS3}}$/RFSH
$\overline{\text{MCS2}}$–$\overline{\text{MCS0}}$
$\overline{\text{UCS}}$/ONCE1

$\overline{\text{PCS6}}$/A2
$\overline{\text{PCS5}}$/A1
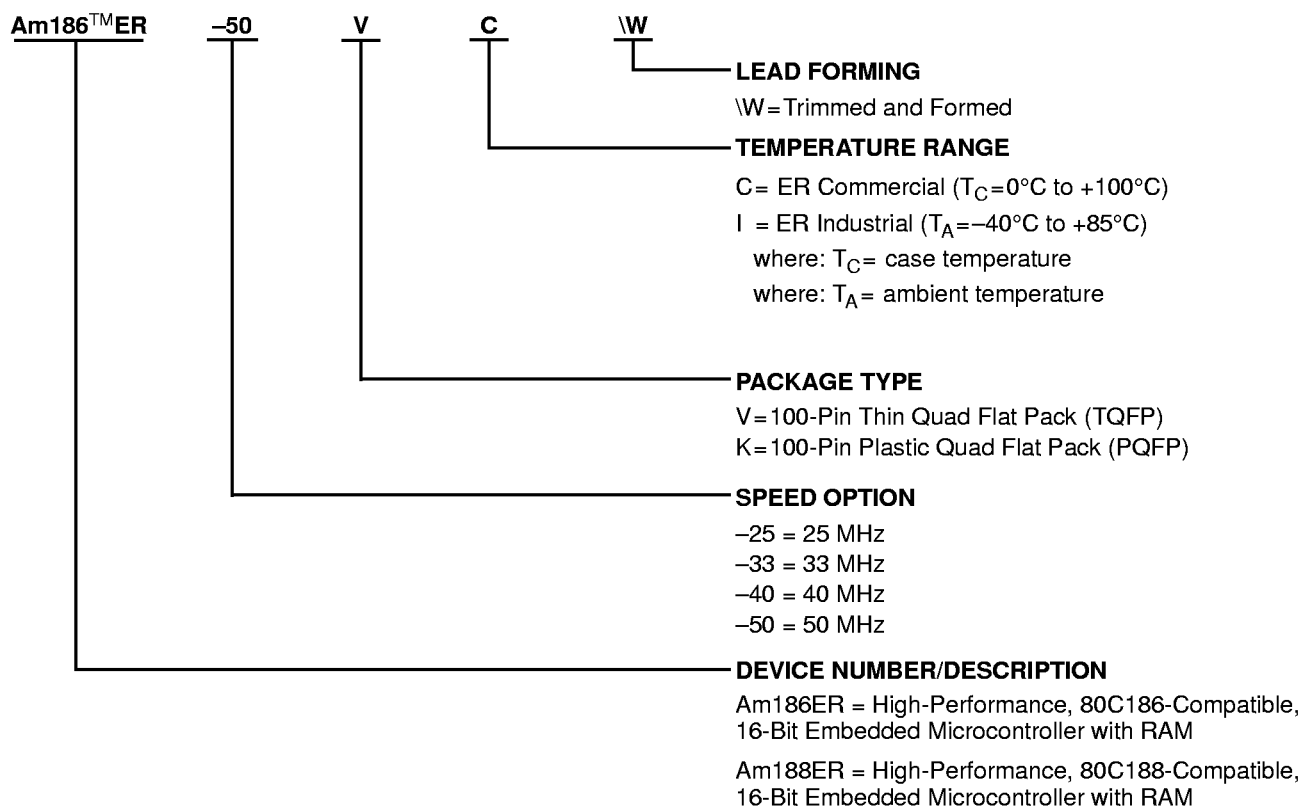$\overline{\text{PCS3}}$–$\overline{\text{PCS0}}$

SCLK   SDATA
SDEN0   SDEN1

Note:
All PIO signals are shared with other physical pins. See the pin descriptions beginning on page 26 and Table 2 on page 32 for information on shared functions.

Am188ER MICROCONTROLLER BLOCK DIAGRAM

ORDERING INFORMATION

Standard Products

AMD standard products are available in several packages and operating ranges. The order numbers (valid combinations) are formed by a combination of the elements below.

Am186™ER   –50   V   C   \W

LEAD FORMING

\W = Trimmed and Formed

TEMPERATURE RANGE

C = ER Commercial ($T_C = 0°C$ to $+100°C$)

I = ER Industrial ($T_A = -40°C$ to $+85°C$)

where: T_C = case temperature

where: T_A = ambient temperature

PACKAGE TYPE

V = 100-Pin Thin Quad Flat Pack (TQFP)

K = 100-Pin Plastic Quad Flat Pack (PQFP)

SPEED OPTION

–25 = 25 MHz

–33 = 33 MHz

–40 = 40 MHz

–50 = 50 MHz

DEVICE NUMBER/DESCRIPTION

Am186ER = High-Performance, 80C186-Compatible, 16-Bit Embedded Microcontroller with RAM

Am188ER = High-Performance, 80C188-Compatible, 16-Bit Embedded Microcontroller with RAM

Valid Combinations	
Am186ER–25 Am186ER–33 Am186ER–40 Am186ER–50	VC\W or KC\W
Am188ER–25 Am188ER–33 Am188ER–40 Am188ER–50	VC\W or KC\W
Am186ER–25 Am186ER–33	KI\W
Am188ER–25 Am188ER–33	KI\W

Valid Combinations

Valid combinations list configurations planned to be supported in volume for this device. Consult the local AMD sales office to confirm availability of specific valid combinations and to check on newly released combinations.

Note:
The industrial versions of the Am186ER and Am188ER microcontrollers are offered only in the PQFP package.