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TPE3

PowerPC 750/PowerPC 7400 PCI Board



Aimed at high performance, embedded applications, the TPE3 is a high performance processor module based on the latest PowerPC 750 and PowerPC 7400 processors with up to 512Mbytes SDRAM. The TPE3 removes otherwise redundant system I/O such as networking to produce a combination that provides a pure processor node that is both fast and efficient. To support this, the TPE3 also includes a fast DMA engine to move data quickly between other nodes or the host system.

Able to be used on its own, or as part of a multiprocessing system, the TPE3 is ideal for DSP, imaging, computer telephony and transaction processing applications. The TPE3 also benefits from being able to use the latest PowerPC 7400 with AltiVec technology, getting super computer like performance from a single processor board.

- PowerPC 750 or 7400 CPU
- Up to 512Mbytes SDRAM
- AltiVec™ Acceleration [7400]
- Full Length PCI Card
- 120Mbyte/sec PCI Interface
- Bundled GNU Tools & Utilities
- 512Kbyte FLASH BIOS
- VxWorks™ BSP
- OEM Custom Variants Available
- Linux Support

PowerPC 7400 with AltiVec™

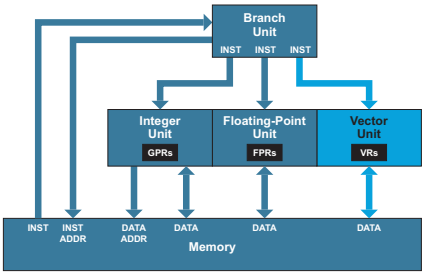
"PowerPC 7400, super-computer like performance on a chip"



The PowerPC 7400 is the latest member of the PowerPC processor family and continues to provide a highly advanced superscalar architecture to deliver very high integer and floating-point performance.

A major feature and centrepiece of the PowerPC 7400 is the addition of a 128-bit vector processing unit. This is otherwise known as the AltiVec extension and operates in a SIMD mode (Single Instruction Multi-Data). See *Figure 1* for an overview. With AltiVec, the PowerPC can accelerate many DSP and multimedia type applications by being able to achieve anything up to 20 operations in a single CPU clock cycle. As an example, the vector unit can process 16x 8-bit data elements in parallel. The vector unit can handle parallel data elements of other lengths including floating-point. See *Table 1 and Figure 2* for summaries.

With the new vector unit come 162 new instructions. These are similar to those found on the scalar units, but in SIMD format. To implement these instructions at a high level, C language extensions have been made available. Using language extensions, rather than relying on compiler efficiencies, permits maximum performance to be achievable.



PowerPC 7400 architecture overview with AltiVec™ vector unit
Figure 1

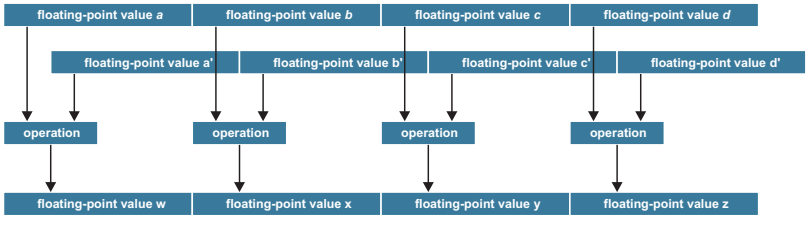
Through the Altivec Instruction Set Architecture many application segments are supported including Voice over IP (VoIP), speech recognition, voice/sound processing and communications including multi-channel modems, software modems, data encryption. The parallel nature of Altivec means that PowerPC 7400 can replace modem banks with a single processor whereas many were previously needed. This simplicity makes development easier and reduces cost.

PowerPC 7400 Summary Specification

- **Internal CPU Speeds**
  350, 400 and 450MHz
  500MHz ~1Q00
- **Bus Interface**
  64-bit bus with MPX/60x protocol
- **Cache**
  L1: 32Kbyte instr + 32Kbyte data
  L2: up to 2Mbytes
- **Power Consumption**
  5W (typ)/8W (max)
- **Package**
  360 ball CBGA
- **Benchmark Estimates (450MHz)**
  21.4 SPECint95
  20.4 SPECfp95
  825 MIPS
- **Execution Units**
  integer (2), floating-point, vector, branch, load/store, system

# Parallel Vector Operations	Data Types Supported
16-way 8-way 4-way	8-bit signed & unsigned ints and chars 16-bit signed & unsigned ints 32-bit signed & unsigned ints and IEEE floating-point numbers

Parallelism with AltiVec technology execution unit
Table 1

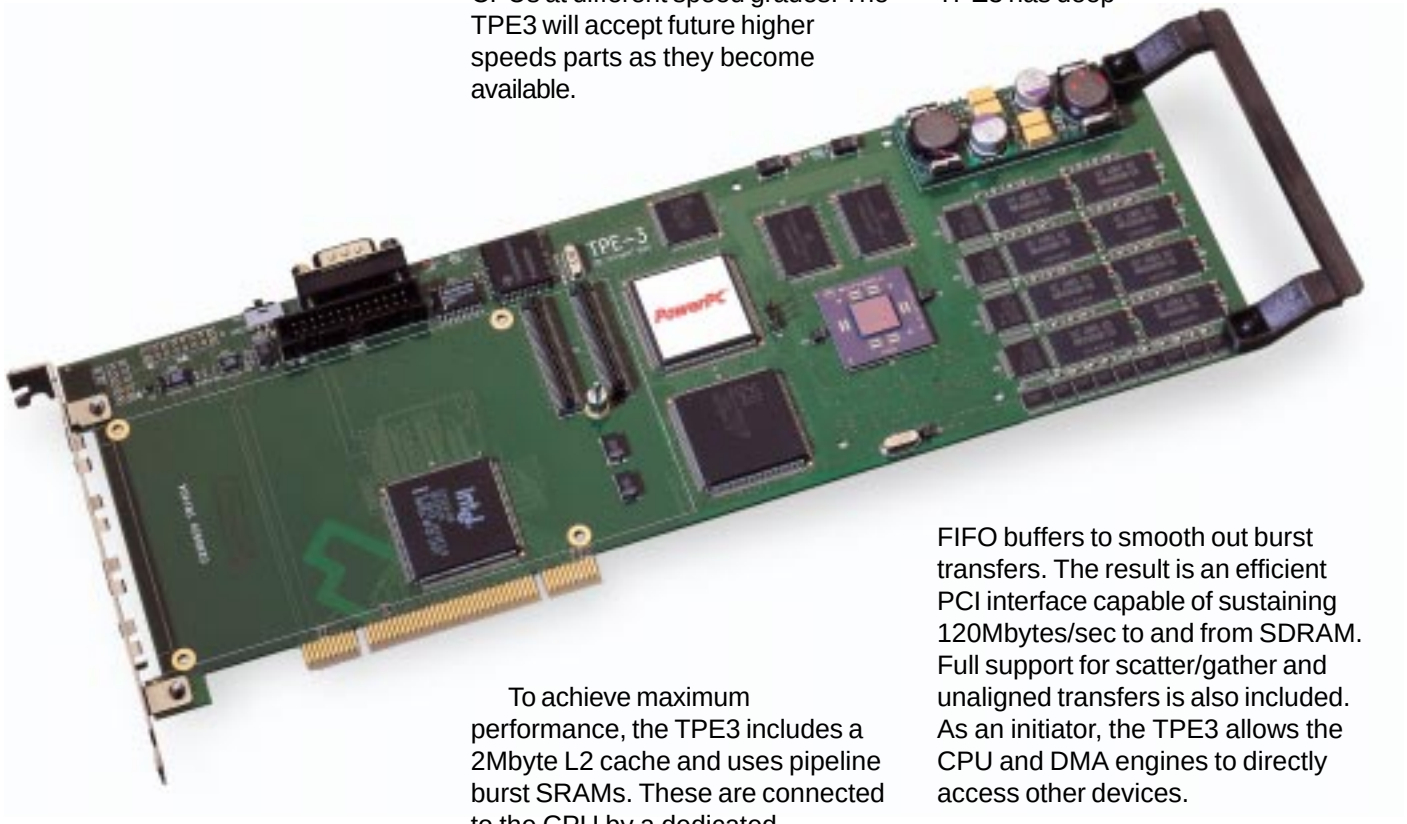


Parallel floating-point operations with AltiVec
Figure 2

TPE3 PowerPC PCI Card

Overview

The TPE3 is provided with a choice of PowerPC 750 or PowerPC 7400 CPUs at different speed grades. The TPE3 will accept future higher speeds parts as they become available.



To achieve maximum performance, the TPE3 includes a 2Mbyte L2 cache and uses pipeline burst SRAMs. These are connected to the CPU by a dedicated [backside] bus running at between 150 and 200MHz, depending on the core speed.

The CPU is connected to the SDRAM memory by an optimised for low latency and high bandwidth data streaming.

PCI Interface

The TPE3 PCI interface is a PCI 2.1 compliant initiator and target. This includes the ability to generate and respond to configuration cycles.

To help maintain data structures across systems, the TPE3 uses byte invariant addressing and hardware endian-conversion. Also included is a pair of DMA engines with bus mastering ability. This powerful combination allows for high performance data transfers without the CPU needing to re-manipulate the data.

As a PCI target, all the TPE3's on board resources are visible. This allows the host and other PCI initiators access the TPE3's SDRAM, peripherals and control registers.

As part of the PCI interface, the TPE3 has deep FIFO buffers to smooth out burst transfers. The result is an efficient PCI interface capable of sustaining 120Mbytes/sec to and from SDRAM. Full support for scatter/gather and unaligned transfers is also included. As an initiator, the TPE3 allows the CPU and DMA engines to directly access other devices.

Local PCI Bus

To maintain PCI compliance, the TPE3 has a local PCI bus segment connecting the processor node, PCI controller and to a PMC expansion module site. This is achieved using a DEC/Intel 21152 PCI-PCI bridge. The local bus has the added advantage of allowing the onboard processor to transfer data to and from the PMC without being affected by system traffic.

The PMC site can accept any standard 32-bit 5 volt PMC module, and its interrupt output is routed to the PowerPC.

Peripherals

The TPE3 includes all the necessary resources required by leading real-time operating system such as a flash BIOS ROM for boot firmware, non-volatile memory, a timer and a serial port. The serial port is available through a 9-way D-type connector, and provides a resource for operating

TPE3 Benefits

- **PowerPC 7400**
  Maximum performance
  Latest generation devices
  Wide software support
- **L2 Cache**
  Maximum performance
  Cost effective
- **Optimized Processor Nodes**
  High performance
  Cost effective
- **Fast DMA Driven PCI**
  Reduce bottleneck
  On-the-fly dataformatting
- **PMC Interface**
  Extra local processors
  High data I/O
  System Networking

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systems to implement diagnostics or configuration support.

Utilities are supplied to test and program the BIOS and NVRAM, as well as programming examples for the timer and serial port.

Multi-Processor Systems

For processor intensive applications, the PMC site can be used to add a second PowerPC processor. Since each processor has its own local memory and CPU bus means that both processors can operate at their full bandwidth. The DMA driven PCI interfaces also helps maintain fast inter-processor communications too.

An example of an add-on PowerPC processor module is the Motorola PPMC750.

Booting the TPE3

For development purposes, the PowerPC processor can be fully controlled by the host through PCI registers. These provide access to reset and interrupt functions, and bootstrap code that may be located in SDRAM. Alternatively, the TPE3 may be configured to boot from its BIOS ROM with no need for host intervention.

Operating Systems

For hard real-time applications, VxWorks is a defacto standard. The TPE3 supports a VxWorks BSP making it suitable for applications ranging from industrial control to telecommunications.

For developers who prefer a UNIX operating system, the TPE3 offers the choice of Linux. And with the addition of POSIX real-time extensions on the road-map, Linux's popularity is set to increase. This, coupled with the fact that Linux support is free, makes the TPE3 a compelling option.

Development Tools

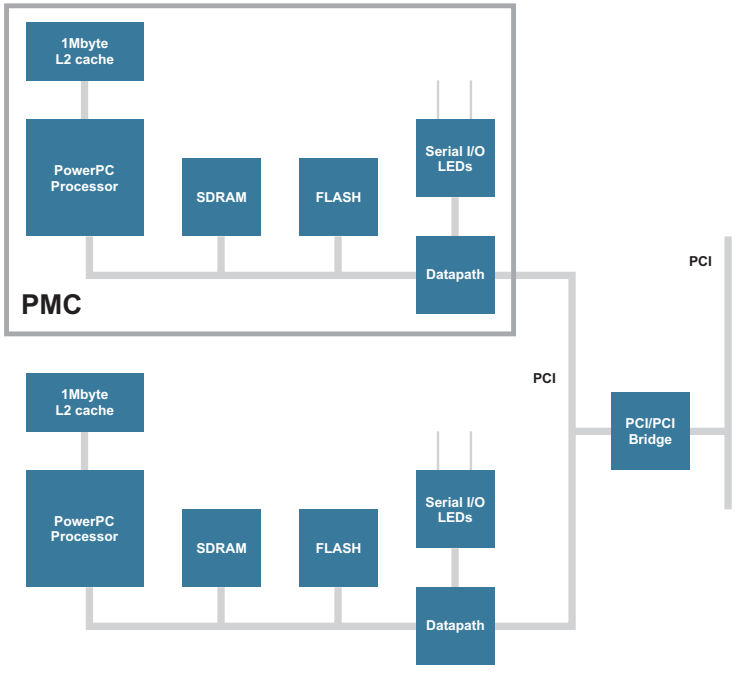
The TPE3 includes a JTAG TAP socket and adapter that is compatible with AMC's PowerTAP™ debugger. This offers power and is functionally similar to a full in-circuit emulator.

The TPE3 is shipped with a CD containing PowerPC resources, tools and utilities including:

- GNU C cross compiler
- Windows and Windows NT host utilities, drivers and examples
- PCI programming examples and libraries

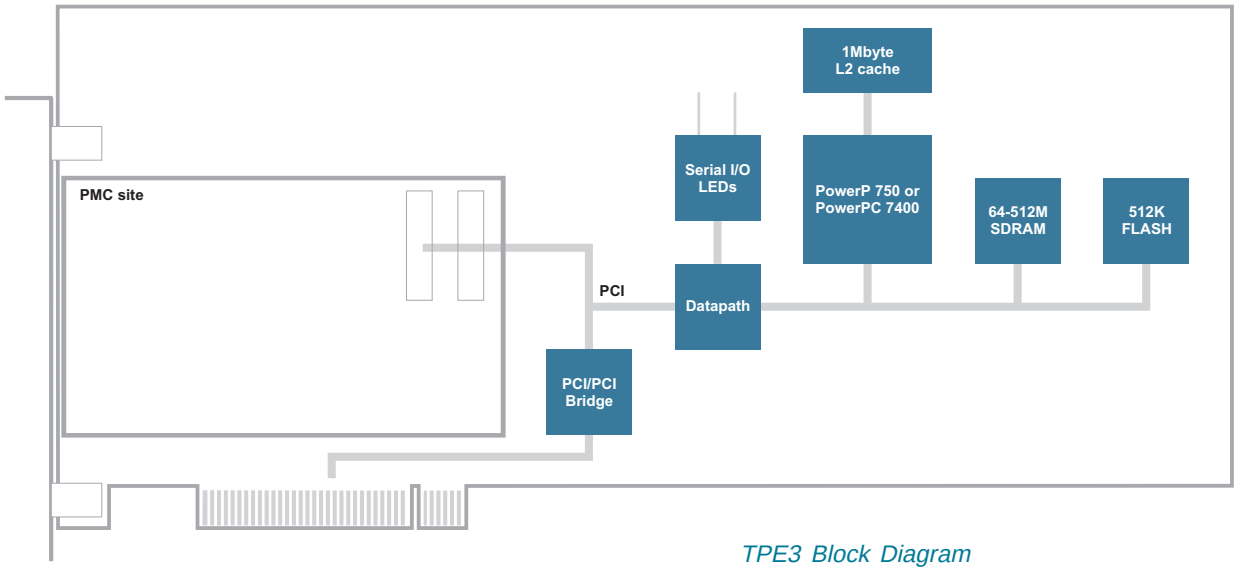
Target Applications

- **Speech Recognition Systems**
- **Telephony Gateways**
- **Image Processing**
- **Real-Time Industrial Control**
- **Scientific Array Processing**
- **Sonar**
- **Pooled Modems**
  V.34, 56K, V.90, RSA
- **Voice over IP (VoIP)**
- **Motion video decode/encode**
  MPEG-1/2/4, H.234
- **Video Conferencing**
  H.261, H.263
- **Voice/Sound Processing**
  G.711, G.721, G.723, G.729A



Multi-Processing with a Second PowerPC CPU
Figure 3

Block Diagram



TPE3 Block Diagram
Figure 4

Technical Specification

Processor

CPU	PowerPC 750: 400MHz PowerPC 7400: 350, 400, 500MHz
L1 cache (on-chip)	32kbyte instruction, 32kbyte data
L2 cache	1Mbyte PBSRAM, 133-200MHz

Memory

Type	SDRAM
Size	64/128/256/512 Mbytes
Bus width	64 bit
Bus speed	66 MHz
Bursting	4-1-1-1-2-1-1-1
FLASH	512Kbytes

PCI Interface

Compliance	PCI 2.1
Width	32 bit
Voltage keying	5V
Speed	33 MHz

Serial Port

Ports	1
Connector	9-way D-type (PC pin-out)
Baud rate (max)	128K; (9600, no parity, stop - def)
I/O Device	16550 compatible

PMC Site

Compliance	IEEE P1386.1 Compliant
Interface	32-bit PCI

Mechanical

Board form factor	PCI full length add-in card
Size	312mm x 107mm
Weight	225 g

Environmental

Power dissipation	10W typical, 15W max
Operating temperature	0 to 65ºC[1]
Storage temperature	-15 to 85ºC
Operating humidity	5% to 75% non condensing
Storage humidity	5% to 95% non condensing

Software

Resources CD-ROM	GNU C cross compiler, libraries, examples and host utilities for Windows 95/98 and Windows NT
Operating Systems	VxWorks BSP, Linux, LynxOS (TBA)

(Note: 1 - current PowerPC 7400 silicon is only available in reduced temperature range)

Ordering Information

TPE3-s-m	*PowerPC 750 (G3) variant - 400MHz only*	
TPE3A-s-m	*PowerPC 7400 (G4) variant*	
where	s : processor speed (MHz)	350, 400, 500
	m : memory (Mbytes)	64, 128, 256, 512
Example:	*TPE3-400-128*	*400MHz PowerPC 750 with 128Mbytes SDRAM*
	TPE3A-350-512	*350MHz PowerPC 7400 with 512Mbytes SDRAM*



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