

features

- ultra-high performance TMS320C6414/C6415/C6416 32-bit fixed-point DSP featuring:
 - up to 8000 MIPS peak DSP performance
 - 1Mbyte on-chip RAM, program and data caches
 - UTOPIA interface (TMS320C6415/C6416)
 - VCP/TCP hardware coprocessors (TMS320C6416)
 - dual-bus external I/O architecture
- up to 512Kx64 synchronous static RAM (SBSRAM)
- up to 16Mx64 synchronous DRAM (SDRAM)
- up to 64Mx8 FLASH
- 64-bit wide SBSRAM/SDRAM/DPRAM interface bus is isolated from the FLASH/EPROM and on-board peripherals in order to enhance system I/O performance
- high-performance host PCI-bus interface for multi-channel PCI-to-DSP and DSP-to-PCI communication:
 - up to 512Kx32 dual-port RAM (DPRAM) between PCI-bus and DSP for fast shared data access with data transfer speed up to 133 Mbyte/s on the PCI side and 533 Mbyte/s on the DSP side
 - DSP-to-PCI access using PCI-bus mastering
 - access from PCI-bus to all DSP memory and I/O areas via DSP on-chip 32-bit HPI port
 - multi-channel bi-directional mailboxes and interrupts
- software configured multi-source external DSP interrupts
- 10-bit general purpose I/O
- 50 MHz 8-bit UTOPIA level 2 slave interface (*TORNADO-P6415/P6416*) for ATM applications
- watch-dog timer and external power/reset monitor
- stand-alone operation with external power
- modular construction with daughter-card modules (DCM)
- half-size PCI card

I/O expansion

- one site for serial I/O expansion (SIOX) rev.B DCM
- two sites for enhanced serial I/O expansion (SIOX) rev.C DCM

- one site for 16/32-bit parallel I/O expansion (PIOX) DCM
- a variety of "off-the-shelf" AD/DA/DIO and application specific coprocessor SIOX/PIOX DCM

multiprocessor expansion

- PIOX/SIOX applications specific coprocessor DCM
- PIOX multi-DSP coprocessor DCM

software development tools

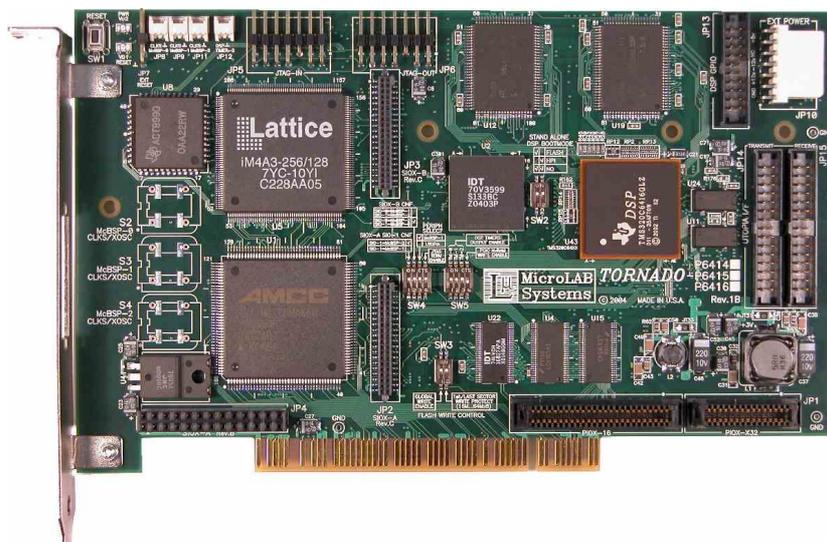
- JTAG-IN/OUT ports for connection to external JTAG emulator for DSP software debugging
- MicroLAB *MIRAGE* and TI XDS external JTAG emulators
- on-board ECC emulation controller chip:
 - replaces external JTAG emulator
 - runs under Code Composer Studio Debugger
- TI C6000 Code Composer Studio Compile and Debug tools

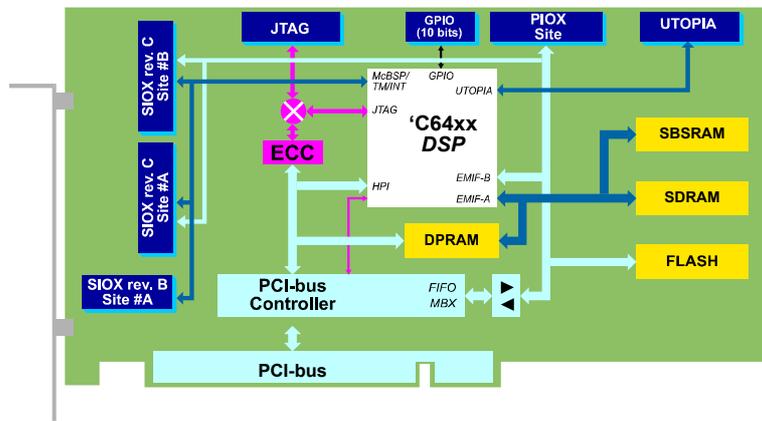
application software

- Hypersignal RIDE tools for DSP algorithm development and real-time simulation
- real-time OS tools
- 3rd party application specific function libraries
- *TORNADO* Software Development Kit (*TSKD*) for DOS and Windows applications

applications

- multichannel vocoders and fax/modems
- multichannel telecommunication and telephony
- multimedia and audio signal processing
- instrumentation and industrial
- image processing
- acoustics and radar
- multichannel digital radio





TORNADO-P64x are ultra-high performance fixed-point 32-bit DSP platforms with flexible modular construction for real-time DSP and data acquisition for both PCI-bus plug-in and stand-alone applications.

TORNADO-P64x use TI TMS320C6414/C6415/C6416 32-bit fixed-point DSP, which provide up to 8000 MIPS peak DSP performance (1 GHz clock) and are optimized for on-chip parallel computing. TMS320C6414/C6415/C6416 DSP feature dual-bus external I/O architecture (EMIF-A and EMIF-B), and include the on-chip 1 Mbyte RAM, UTOPIA interface (TMS320C6415/C6416) and Viterbi/Turbo VCP/TCP coprocessors (TMS320C6416).

TORNADO-P64x on-board external DSP memories comprise a high-speed 64-bit synchronous burst SRAM (SBSRAM), 64-bit synchronous DRAM (SDRAM) and 32-bit synchronous dual-port RAM (DPRAM), which are all connected to the 64-bit DSP EMIF-A bus. Also, a high-capacity 8-bit FLASH/EPROM memory is connected to the DSP EMIF-B bus and is used to store the DSP boot code and/or non-volatile data for stand-alone DSP applications.

An ultimate benefit of **TORNADO-P64x** is on-board multi-path data transfer architecture, which is well suited for high-performance on-board data processing and in-parallel high-speed multichannel host-to-DSP communication. At first, **TORNADO-P64x** exploits unique dual-bus external I/O architecture of TMS320C64xx DSP and provides isolation of on-board high-speed synchronous memories (SBSRAM, SDRAM, DPRAM) from external asynchronous memories and peripherals (FLASH, PIOX/SIOX interfaces, etc). At second, on-board high-speed DPRAM with mutual interrupts offers large shared memory area for both PCI-bus and DSP without arbitration delays for high-speed data transfers between host PC and on-board DSP. Data transfer speed via DPRAM is up to 133 Mbyte/s on the PCI-bus side and equals to 533 Mbyte/s on the DSP side. At third, the DSP on-chip HPI port delivers access from host PCI-bus to all DSP memory and I/O areas including SBSRAM/SDRAM, FLASH, PIOX and DSP on-chip memory and peripherals. At fourth, dual-channel DMA and PCI-bus mastering feature allow access from DSP to all host PCI-bus memory and I/O areas. Finally, multichannel bi-directional mailboxes and multi-source interrupts offer flexible and easy to use communication between PCI-bus and DSP.

Another benefit of **TORNADO-P64x** is a modular construction with daughter-card module (DCM) sites, which allows quick and easy 'off-

the-shelf' system re-configuration in order to meet requirements of virtually any DSP applications. **TORNADO-P64x** provides on-board serial (SIOX) and parallel (PIOX) I/O expansion DCM sites compatible with a variety of 'off-the-shelf' AD/DA, digital I/O, application specific I/O coprocessor, and multi-DSP coprocessor DCM.

Optional on-board I/O resources and peripherals comprise the DSP on-chip 10-bit general purpose I/O for direct control of external power switches, relays, etc, and 50 MHz 8-bit UTOPIA level 2 slave interface for ATM telecom applications.

TORNADO-P64x are ready for stand-alone operation without host PC. After on-board DSP software will be debugged and 'burned' into on-board high-capacity FLASH memory, then the **TORNADO-P64x** can be unplugged from host PCI-bus and run in a stand-alone mode from external power. On-board power/reset monitor and watch-dog timer provide reliable system functionality for stand-alone operation.

TORNADO-P64x on-board JTAG-IN emulation port is compatible with external MicroLAB Systems **MIRAGE** and TI XDS JTAG emulators, and is designed to debug the DSP applications using industry standard TI C6000 Code Composer Studio debug tools. Multiple **TORNADO-P64x** boards can be connected into one JTAG path by simple daisy-chaining via on-board JTAG-IN and JTAG-OUT connectors. In case external JTAG emulator is not available, then **TORNADO-P64x** on-board **ECC** emulator can be used, which is identical to external JTAG emulator and runs under TI C6000 Code Composer Studio debugger.

TORNADO-P64x DSP software can be developed using TI C6000 Code Composer Studio compile tools. A variety of 3rd party real-time operating systems, DSP algorithm development tools, and application specific function libraries are available for design of DSP software. Host PC applications for DOS and Windows can be developed using Microsoft C/C++ tools and **TORNADO** Software Development Kit (**TSDK**) tools.

Ultra-high DSP performance, flexible modular construction, a variety of AD/DA/DIO and multiprocessor expansion DCM, as well as the world class industry standard DSP software development tools make **TORNADO-P64x** an ideal selection for high-speed DSP applications with high-speed host-to-DSP communication.

Technical Specifications

DSP

TMS320C6414/C6415/C6416 fixed-point DSP, 600/720/1000 MHz (4800/5760/8000 MIPS), 32 bits, 1 Mbyte RAM, program and data caches.

on-board memory

128K/256K/512Kx64 SBSRAM. 4M/16x64 SDRAM. 512K/1M/2M/4M/8M/16M/32M/64Mx8 FLASH. 128K/256K/512Kx32 DPRAM.

host PCI-bus interface

Access to DPRAM, bi-directional mailboxes and DSP on-chip HPI port. PCI-bus mastering, multi-source interrupts.

I/O expansion interface sites and external I/O

One site for PIOX/PIOX-16 DCM. Two sites for SIOX rev.C and one site for SIOX rev.B DCM. 10-bit general purpose I/O.

physical/power

215x95mm half-size PCI card. 5V@2.2A