

features

- ultra-high performance TMS320C6414/C6415/C6416 32-bit fixed-point DSP featuring:
 - up to 8000 MIPS peak 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 1Mx8 plug-in FLASH/EPROM
- 64-bit wide SBSRAM/SDRAM interface bus is isolated from FLASH/EPROM and on-board peripherals in order to enhance system performance
- dual-channel 10 Mbit/s universal receiver/transmitter (USART) with synchronous (HDLC/X.25, SDLC, MONO, BISYNC) and asynchronous protocols and 115 kBaud RS232 and 10 Mbit/s RS422 external interfaces
- 12 Mbit/s USB device interface
- 18-bit general purpose I/O
- host access to DSP on-chip HPI port (16/32-bit modes)
- 50 MHz 8-bit UTOPIA level 2 slave interface (*TORNADO-E6415/E6416*) for ATM applications
- two watch-dog timers (one is programmable within 0.01..99.99 sec) and reset monitor
- real-time clock (RTC) with battery backup, 2100 year calendar, programmable alarm, and 50 bytes NvRAM
- programmable DSP external interrupt sources
- DSP boot from either FLASH/EPROM, via HPI port, or DSP start-up without boot
- modular design with daughter-card modules (DCM)
- industry standard 3U form-factor

I/O expansion

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

- one site for 16-bit parallel I/O expansion DCM (PIOX-16)
- on-board MXSIOX connector for external *T/SU-X1* SIOX rev.B mini extender kit
- a variety of of-the-shelf AD/DA/DIO DCM for speech/fax/modem, audio, telecom, instrumentation, DRR, etc applications
- a variety of of-the-shelf application specific SIOX and PIOX-16 I/O coprocessor DCM

multiprocessor expansion

- PIOX/SIOX DSP coprocessor DCM

software development tools

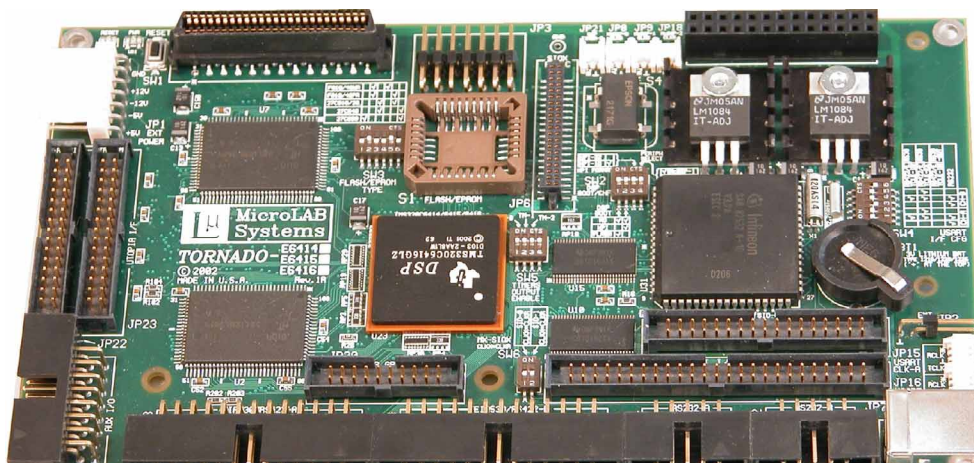
- JTAG port for connection to external JTAG emulator during software debugging
- MicroLAB Systems *MIRAGE-P510D/510DX* and TI XDS510/XDS560 external JTAG emulators
- TI C6000 Code Composer Studio Compile and Debug tools

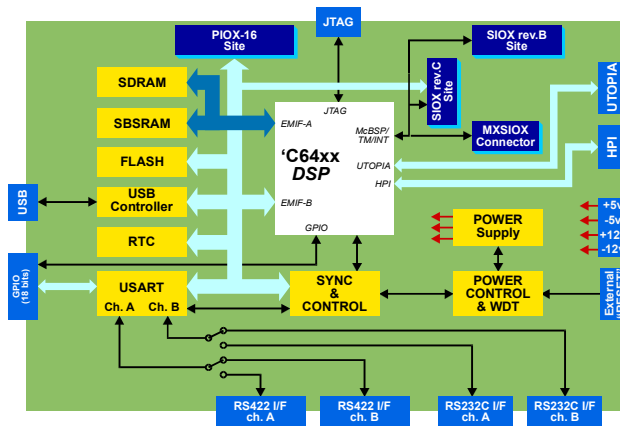
application software

- real-time OS tools
- 3rd party application specific function libraries

applications

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





TORNADO-E64x are ultra-high performance embedded DSP controllers with the industry standard 3U form-factor for real-time data acquisition and DSP. Flexible modular construction and a variety of “off-the-shelf” AD/DA/DIO and I/O coprocessor expansion daughter card modules make **TORNADO-E64x** an ideal selection for embedded telecommunication, telephony, multimedia, acoustics, instrumentation, digital radio and many more application.

TORNADO-E64x utilizes TI TMS320C6414/C6415/C6416 32-bit fixed-point DSP, which provide up to the 8000 MIPS peak DSP performance, are optimized for on-chip parallel computing, 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).

On-board external DSP memories comprises a high-speed 64-bit synchronous burst SRAM (SBSRAM), 64-bit synchronous DRAM (SDRAM), which are connected to the 64-bit DSP EMIF-A bus, and the 8-bit FLASH/EPROM memory, which is connected to the DSP EMIF-B bus. Dual-bus external I/O architecture of TMS320C64xx DSP and ‘isolation’ of external 64-bit wide synchronous memories (SBSRAM and SDRAM) from external asynchronous memories and peripherals (FLASH, USART/USB controllers, PIOX-16/SIOX interfaces, etc) in **TORNADO-E64x** DSP controllers deliver outstanding performance for DSP applications.

On-board dual-channel 10 Mbit/s USART (universal synchronous/asynchronous receiver/transmitter) with external 10 Mbit/s RS422 and 115 kBaud RS232C interfaces and 12 Mbit/s USB device interface deliver outstanding flexibility for networking of multiple **TORNADO-E** DSP controllers and/or for interfacing to external networks, peripherals and host computers. Each channel of USART can be independently configured for either synchronous (HDLC/X.25, SDLC, MONO, BISYNC) or asynchronous protocol with either RS422 or RS232C external interface. **TORNADO-E6415/E6416** DSP controllers provide 50 MHz 8-bit UTOPIA level 2 slave interface for ATM telecom applications.

TORNADO-E64x controllers offer access from host computer to DSP on-chip HPI port via either 16-bit or 32-bit data bus. This feature allows to connect **TORNADO-E64x** DSP controller as an asynchronous peripheral to any external host computer.

TORNADO-E64x on-board DSP can either start-up without boot, or boot either from on-board FLASH/EPROM memory, or via DSP on-chip HPI port.

On-board I/O peripherals also include 18-bit general purpose I/O, reset monitor, two watch-dog timers (one watch-dog timer is programmable within 0.01..99.99 sec), and real-time clock (RTC) with battery back-up, 2100 year calendar, programmable alarm and 50 bytes of NvRAM, which all are extremely useful options for embedded applications.

An ultimate benefit of **TORNADO-E64x** is a modular construction with daughter-card modules (DCM), which allows quick of-the-shelf system arrangement in order to meet requirements of different DSP applications with real-time data acquisition. **TORNADO-E64x** features one serial (SIOX rev.B and SIOX rev.C) and one parallel (PIOX-16) I/O expansion interface sites. Also, on-board MXSIOX connector is provided for connection to external **T/SU-X1** SIOX rev.B mini-extender kit, which can carry one SIOX rev.B DCM. A variety of off-the-shelf **TORNADO** SIOX and PIOX-16 DCM comprises of AD/DA/DIO and application specific I/O coprocessor DCM for speech/fax/modem, voice/audio signal processing applications, digital radio, instrumentation, and many more applications.

TORNADO-E64x on-board JTAG emulation port is compatible with MicroLAB Systems **MIRAGE-510DX/P510D** and TI XDS510/XDS560 JTAG emulators, and shall be used to debug the on-board TMS320C64x DSP software using TI C6000 Code Composer Studio debug tools.

TORNADO-E64x DSP software can be developed with 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 a recommended option.

Technical Specifications

DSP

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

on-board memory

128/256K/512Kx64 SBSRAM. 4M/16x64 100/125 MHz SDRAM. 512Kx8 Plug-in 512Kx8 FLASH or 1Mx8 EPROM (PLCC-32 IC package).

external interfaces

Dual-channel 10 Mbit/s USART synchronous/asynchronous protocols and 10 Mbit/s RS422 and 115kBaud RS232C I/F. 12 Mbit/s USB device I/F. 16/32-bit TMS320C64xx DSP on-chip HPI port with bootloader option. 8-bit UTOPIA level 2 slave I/F (**TORNADO-E6415/E6416**).

on-board general purpose I/O

18-bit general purpose I/O (8 bit with individual DSP interrupt mask control)

serial I/O expansion interface (SIOX)

One SIOX rev.B site and one SIOX rev.C site for compatible DCM. One MXSIOX connector for external **T/SU-X1** SIOX rev.B mini-extender kit.

parallel I/O expansion interface (PIOX)

One PIOX-16 site for compatible DCM.

physical/power

3U (160x100mm) form-factor. Maximum power consumption (with 512Kx64 SBSRAM and 4Mx64 SDRAM): 5V@2.1A