features

- high performance 16-bit fixed-point compatible DSP:
  - ❑ TORNADO-E548: TMS320C548 (80 MIPS)
  - ❑ TORNADO-E549: TMS320VC549 (100 MIPS)
  - ❑ TORNADO-E5402: TMS320VC5402 (100 MIPS)
  - ❑ TORNADO-E5409: TMS320VC5409 (80 MIPS)
  - ❑ TORNADO-E5410: TMS320VC5410 (100 MIPS)
  - ❑ TORNADO-E5416: TMS320VC5416 (160 MIPS)
- 256Kx16 static RAM (SRAM)
- up to 1Mx8 FLASH/EPROM
- dual-channel 10 Mbps universal receiver/transmitter (USART) with synchronous (HDLC/X.25, SDLC, MONO, BISYNC) and asynchronous protocols and 115kBaud RS232 and 10Mbps RS422 external interfaces
- 12 Mbit/s USB device interface
- 8-bit digital I/O
- host access to the DSP on-chip HPI port
- watchdog timer and reset monitor
- modular design with daughter-card modules (DCM)
- industry standard 3U form-factor

I/O expansion

- one site for serial I/O expansion (SIOX rev.B or SIOX rev.C) DCM
- one site for parallel I/O expansion (PIOX-16) DCM

- on-board MXSIOX connector for external *T/SU-X1* SIOX rev.B mini-extender kit
- a variety of AD/DA/DIO DCM
- a variety of application specific SIOX and PIOX-16 I/O coprocessor DCM
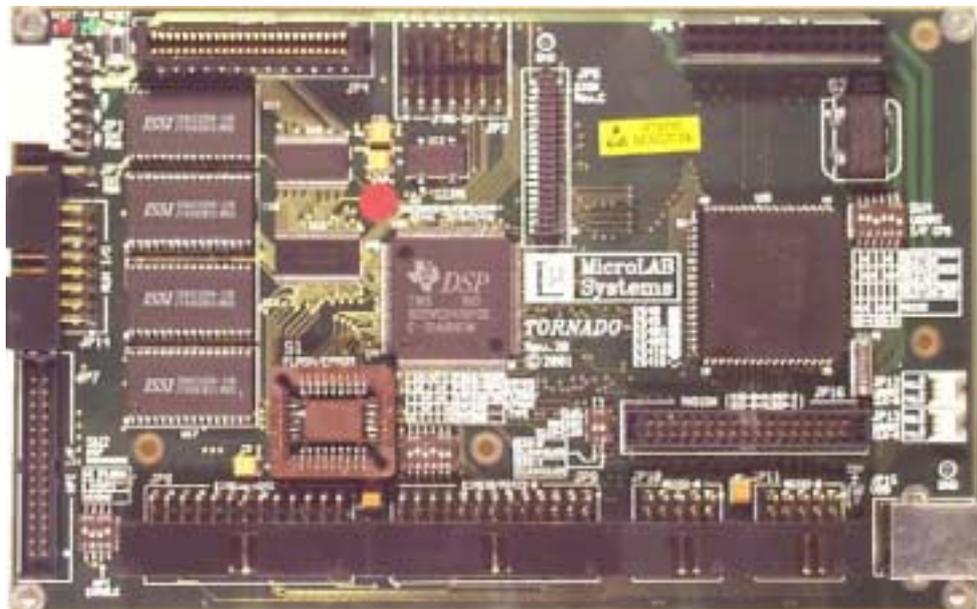
software development tools

- JTAG port for TI XDS510 and MicroLAB Systems *MIRAGE-510DX* JTAG emulators with Code Composer IDE
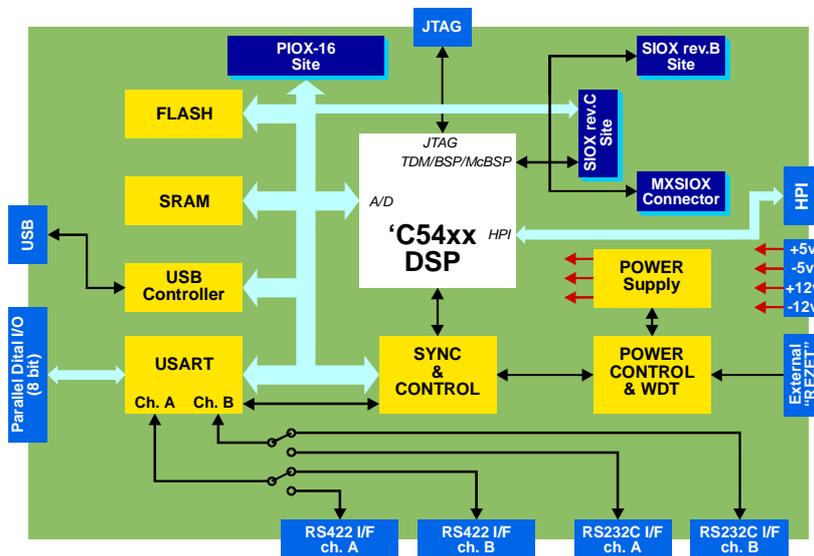- TI C5000 C/Assembler Compiler

application software

- Hypersignal tools for DSP algorithm development
- Virtuoso and Nucleus real-time OS tools
- DSP, math, vector and communication functions
- vocoder/fax/modem function libraries

applications

- vocoders, fax and modems
- telecommunication and telephony
- multimedia and audio processing
- embedded instrumentation and industrial
- digital radio
- biomedical

JTAG

PIOX-16 Site

SIOX rev.B Site

SIOX rev.C Site

FLASH

JTAG
TDM/BSP/McBSP

MXSIOX Connector

SRAM

HPI

A/D

USB

USB Controller

'C54xx DSP   HPI

POWER Supply   +5v -5v +12v -12v

Parallel Dital I/O (8 bit)

USART

SYNC & CONTROL

POWER CONTROL & WDT

External "REZET"

Ch. A Ch. B

RS422 I/F ch. A **RS422 I/F ch. B** **RS232C I/F ch. A** **RS232C I/F ch. B**

TORNADO-E54x are 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-E54x* an ideal selection for embedded telecommunication, telephony, multimedia, instrumentation, digital radio and many more application.

TORNADO-E54x are based around the TI high-performance 16-bit fixed-point compatible TMS320C548/VC549/VC5402/VC5409/VC5410/VC5416 DSP, which feature 80..160 MIPS performance and 16..128Kx16 on-chip memory.

On-board memory of *TORNADO-E54x* comprises of static RAM (SRAM) and FLASH/EPROM memories. On-board SRAM is splitted into 128Kx16 program memory (2 pages of 64Kx16 each) and into 128Kx16 data memory (4 pages of 32Kx16 each or 2 pages of 64Kx16 each).

On-board dual-channel 10 Mbit/s USART (universal synchronous/asynchronous receiver/transmitter) with 10 Mbit RS422 and 115 kBaud RS232C interfaces, and 12 Mbit/s USB device interface deliver outstanding flexibility for networking of multiple *TORNADO-E54x/E3x/E6x* controllers and/or 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-E54x controllers offer access from host computer to HPI port of on-board DSP with optional bootloading feature.

An ultimate benefit of *TORNADO-E54x* is a modular construction with daughter-card module (DCM) options, which allows quick "off-the-shelf" system arrangement and to meet requirements of different DSP applications with real-time data acquisition. *TORNADO-E54x* feature one serial (SIOX rev.B and SIOX rev.C) DCM site, one parallel (PIOX-16) I/O expansion interface DCM site, and on-board MXSIOX connector (*TORNADO-E548/E549/E5409/E5410/E5416*) for external *T/SU-X1* mini-extender kit, which can carry one SIOX rev.B DCM. A variety of 'of-the-shelf' *TORNADO* SIOX and PIOX-16 DCM includes AD/DA/DIO and application specific DSP coprocessor DCM for speech/fax/modem, voice/audio signal processing applications, digital radio, instrumentation, etc.

On-board reset monitor and watchdog timer facilities provide reliable system functionality as stand-alone controller.

On-board 8-bit digital I/O allows control of external power switches, relays, etc and/or input from digital sensors or switches with minimum hardware.

TORNADO-E54x on-board JTAG emulation port is compatible with TI XDS510 and MicroLAB Systems *MIRAGE-510DX* JTAG emulators and is used to debug the on-board TMS320C54x DSP software using TI Code Composer Studio IDE.

TORNADO-E54x resident software can be developed with the TI 'C5000 DSP C/Assembly tools, a variety of compatible real-time operating systems, DSP algorithm development tools, vocoder/fax/modem and DSP/vector/math function libraries, which are available from multiple software vendors.

Technical Specifications

DSP
- TMS320C548, 16 bits, 80 MIPS, 32Kx16 on-chip RAM
- TMS320VC549, 16 bits, 100 MIPS, 32Kx16 on-chip RAM
- TMS320VC5402, 16 bits, 100 MIPS, 16Kx16 on-chip RAM
- TMS320VC5409, 16 bits, 80 MIPS, 32Kx16 on-chip RAM
- TMS320VC5410, 16 bits, 100 MIPS, 64Kx16 on-chip RAM
- TMS320VC5416, 16 bits, 160 MIPS, 128Kx16 on-chip RAM

on-board memory
- 128Kx16 1ws program SSRAM
- 128Kx16 1ws data SSRAM
- 1Mx8 FLASH/EPROM

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
- 8-bit TMS320C54x DSP on-chip HPI port with bootloading option

on-board digital I/O
8-bit digital I/O with individual direction control and DSP interrupt mask

serial I/O expansion interface (SIOX)
One SIOX rev.B DCM site and one SIOX rev.C DCM site.

MXSIOX connector
On-board MXSIOX connector for connection to external *T/SU-X1* SIOX rev.B mini-extender kit.

parallel I/O expansion interface (PIOX)
One PIOX-16 site for daughter card modules.

physical/power
3U (160x100mm) form-factor. Maximum power consumption (with 256Kx32 SRAM)): 5V@1.1A