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VX8 Technical Handbook

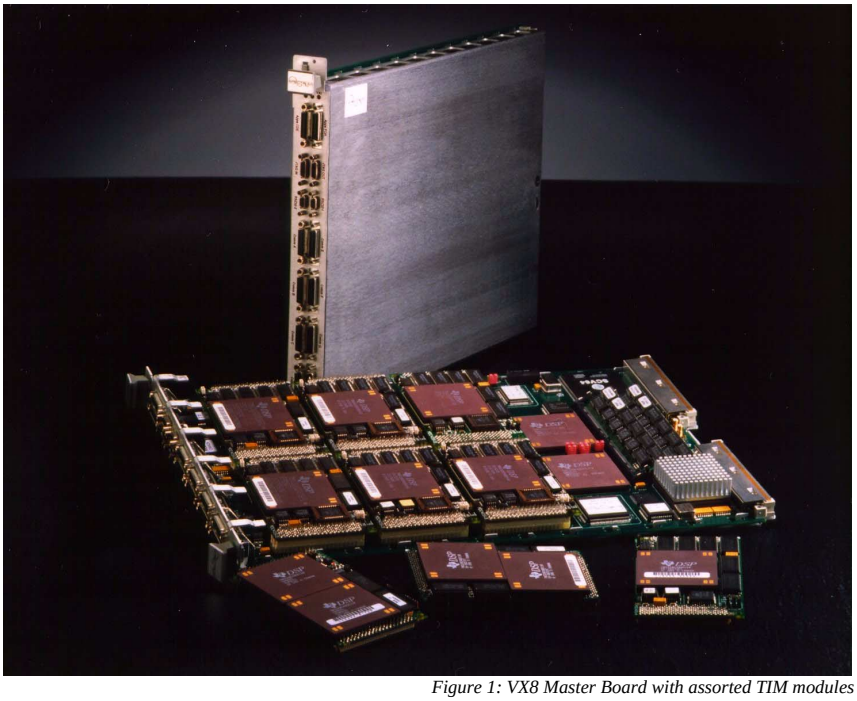


Figure 1: VX8 Master Board with assorted TIM modules

Introduction

Why consider VXI-based digital signal processing for your system solution? Increasing complexity in VXI systems is fueling the movement to scaleable, multi-processor solutions. For higher performance, the scaleable nature of the TMS320C4x DSP allows the parallel processing network to grow beyond the capability of a single VXI board. The high speed P2 local bus interface available on VXI I/O modules provides a high-bandwidth I/O path directly to the DSPs. VXI's EMC/RFI shielding requirement allows sensitive high-resolution analog I/O to reside beside potentially noisy digital (DSP) systems. The combination of high throughput and high integrity I/O with scaleable digital signal processing will enable the Spectrum VXI-based C4x solution to meet the requirements of tomorrow's high performance VXI applications, today.

Spectrum's VX8 Product Suite is a combination of flexibility, modularity and reconfigurability catered to meet the requirements of high speed applications such as automated test, vibration analysis, simulation, wireless communications, and process monitoring and control. Using optional components with the VX8 Product Suite, the user benefits from increased I/O extensions and DSP expansion capability while employing a standard open system architecture. The VXI standard provides excellent signal integrity allowing state of the art I/O products in a standard VXI form factor. High performance I/O products, coupled with the VX8 Product Suite, provides a complete data acquisition and signal processing system that exceed the requirements of the most demanding applications.

The VX8 Master Board delivers high performance signal processing based on a modular DSP architecture creating a configurable DSP-based system in the VXI environment. Four such DSP modules are detailed in this handbook. These TIM-40 modules can be combined to meet your specific processing requirements in a single slot, multiple-DSP system. While the VX8 provides the infrastructure for high performance, parallel DSP, the TIM-40 modules provide expandable

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parallel processing. To facilitate optimal utilization of the Spectrum hardware, a complete range of supplementary third party software is also highlighted in this handbook. Used together, these Spectrum products provide a complete VXI C4x-based system solution.

1. VX8 OCTAL TMS320C4x: VXIbus Master Board

The VX8 is a VXIbus Master/Slave DSP board catered to high performance applications with large volumes of data throughput. The base configuration of the VX8, illustrated as the unshaded or clear portions of Figure 2, features two embedded 60MHz TMS320C40 DSPs (for a base subsystem of 120 MFLOPs), 1MB of SRAM per C40, (512kBytes per local and global buses) , the VXIbus interface, front panel connections for C4x Communication Ports, an asynchronous dual UART (RS-232), and a JTAG front panel interface. Each of these standard features are described in section 1.1, Base Configuration.

Optional features for the VX8 include upgrades to shared DRAM, upgrades to embedded C40 local and global bus SRAM, the addition of TIM-40 modules and the addition of a high-throughput HP Local Bus interface. By populating the VX8 with up to six TIM-40 modules, the processing power can be increased to a maximum of 840 MFLOPS, providing high performance parallel computing for demanding applications. Adding the HP Local Bus provides efficient data transfer compatible with a wide range of Hewlett-Packard VXI I/O modules.

The backbone of the VX8 is the Global Shared Bus which interconnects the VXI interface and the HP Local bus with the shared DRAM and the global SRAM of the embedded C40's or the TIM-40 modules. The VXI interface can access C40/TIM global SRAM and the shared DRAM. The HP Local Bus can only access the C40/TIM global SRAM. C40/TIM SRAM can be accessed from other C40s/TIMs using the shared Global Bus but it is recommended to make use of the dedicated point-to-point communication ports and use the shared global bus for data transfers on and off the VX8.

Figure 2 illustrates the base configuration plus all options of a fully populated VX8 board.

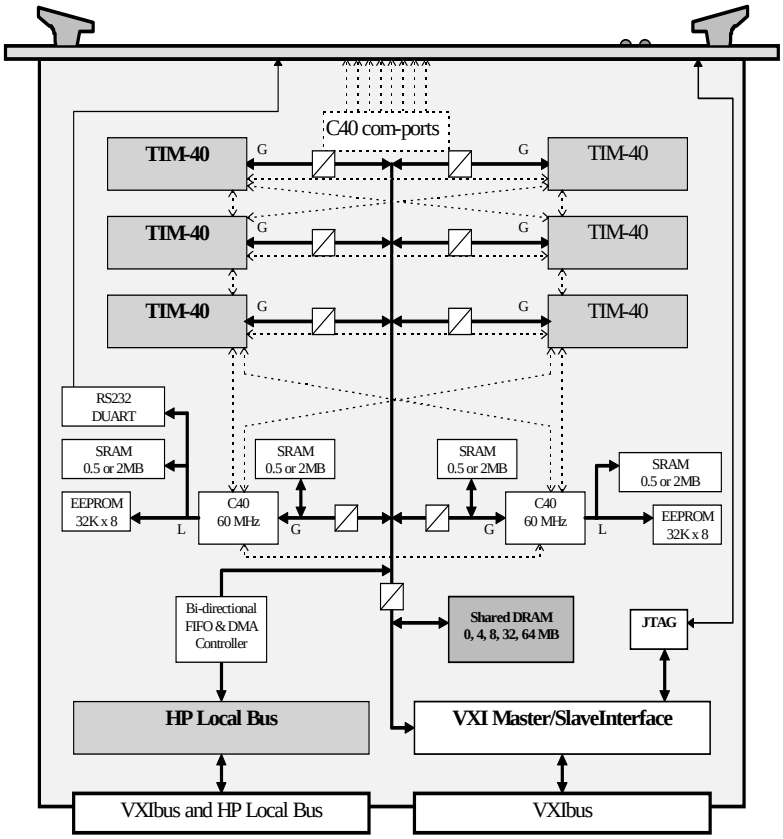


Figure 2: VX8 Master Board (fully populated)

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1.1 Base Configuration

Sections 1.1.1 to 1.1.4 outline the features which are standard to the base configuration of the VX8. Discussed in the base configuration section are the Embedded C40s, the VXIbus Master/Slave Interface, the Front Panel Interfaces, the Debuggers and the Device Drivers.

1.1.1 Embedded C40s

Two embedded TMS320C40s offer increased DSP density and a base level of parallel processing performance. The embedded DSPs are buffered from the shared global bus and offer local and global SRAM. The shared memory architecture allows the global SRAM resources available on-board and on the TIM-40 modules to be accessed directly by any other C40 DSP at 40MByte/s sustained performance. Each embedded C40 has access to 1 or 4 MBytes of zero wait-state SRAM divided equally on its global and local buses.

1.1.2 VXIbus Master/Slave Interface

The VX8 is a C-size VXI board supporting a master/slave A32/A24/A16: D64/D32/D16 interface. TheVX8 supports the Mega Block Transfer (MBLT) capability of VME64, to effectively double the performance of the VXI architecture between VME64 compliant modules, such as the VX8.

The VXI interface is capable of reading or writing data to all TIM-40 or embedded C40's global SRAM. The VXIbus interface also supports broadcast write capability to all global C40/TIM SRAM. The VX8 can become a VXIbus master to read or write directly, or under DMA control, to other VXI modules. Since the VXI interface is buffered from the global shared bus, external VXI accesses to the VX8's DRAM are permitted without affecting performance of the C4xs or the HP Local bus interface.

The VXIbus Interface operates at high data rates based on a decoupled architecture. In a decoupled system, the host transfers data across the primary bus, the VXIbus, and into the internal FIFO of the Tundra SCV64 VXI interface IC. The SCV64 then requests access to the secondary bus, the shared global bus, and transfers the data, thus completing the cycle. By not holding the primary bus during transfer to the secondary bus, throughput is increased. Using a decoupled VXI interface, like the SCV64, allows for simultaneous bus transactions to occur decreasing the time that both buses are locked during a data transfer. Ultimately decoupling attains maximum performance from both the VXIbus and the shared global bus.

1.1.3 Front Panel Interfaces

The front panel interfaces consist of eight C4x communication ports, two RS232 serial ports, an application-specific connector for TIM-40 modules supporting I/O, JTAG In and Out connectors, and three status LED's. The front panel and it's connectors are electrically shielded and grounded to comply with VXI specifications.

Eight buffered C4x communication ports (one from each embedded C40 and one from each TIM-40 site) are routed to the front panel to allow the user to establish communication links between C40s according to the application-specific topology. These communication port connections may be between processors on the same VX8 board, or across multiple VX8 boards. In addition, the communication ports may be used to interface to VXI I/O modules that support the C40 communication port protocol. The remaining C4x communication ports are routed on-board to provide optimum inter-processor communications between the eight C40s (dashed lines on Figure 2 illustrate inter-processor communications).

In addition to the C40 communication port connectors, the front panel has two RS-232 serial ports. The standard asynchronous RS-232 serial ports are controlled from the local bus of one embedded C40. The TIM-40 specification has user-defined pins which are utilized for TIM modules supporting on module I/O. The user-defined pins from each TIM site are carefully routed to application specific connectors on the front panel.

JTAG is an IEEE emulation port standard (superset of IEEE 1149.1 JTAG standard). TI's JTAG implementation allows emulation through a dedicated C4x port offering non-intrusive debugging capabilities which allows monitoring of register and memory locations and does not affect run-time, or load DSP system resources. The JTAG In and Out connectors provide support for multi-board chaining of the C4x JTAG debug path. This allows non-intrusive simultaneous debugging of C4x programs running on multiple DSPs on multiple boards using standard DSP debuggers.

Three front panel LED's represent VX8 system status. The red LED represents system failure (SYSFAIL), the green LED is the power indicator (ACTIVE), and the yellow LED is user definable from the local bus of one embedded C40.

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1.1.4 Debuggers and Device Drivers.

The VX8 JTAG In connector can be used with a Texas Instrument's or Spectrum's XDS emulator board to allow debugging of the VX8 system from a desktop PC. There is also an on-board JTAG-to-VXI interface to allow direct debugging from WinNT based VXIbus resource managers.

Device driver support is available for resource managers hosting HP-UX, and WinNT operating systems. VX8 device drivers are written to the VXI Plug and Play standard, VISA or HP's SICL software interface. Section 4, Software Development Tools, covers debuggers and device drivers in detail as well as additional third party software support available from Spectrum.

1.2 Optional Features

Illustrated as shaded areas (or shaded boxes) in Figure 2, the following section outlines the optional features of the VX8.

1.2.1 TIM Module Sites

Based on the performance requirements of your application, the VX8 can accommodate six TIM-40 modules, in combination of single or double-width modules. Each TIM-40 module can be equipped with one or two TMS320C4x DSPs to provide a wide range of SRAM, or I/O combinations. The TIM sites are buffered from the global shared bus to achieve maximum system efficiency by allowing the DSP to process data stored in global bus SRAM, at zero wait-states, unaffected by global shared bus activity. Spectrum offers a large number of TIM module options, four detailed later in this handbook.

1.2.2 HP Local Bus Support

Hewlett Packard Local Bus is an optional feature for the VX8. When opting for HP Local Bus support, the user has the flexibility to compliment their VX8 purchase with a vast array of HP VXI modules which support local bus I/O. HP offers I/O for many VXI applications including wireless communications, avionics test and measurement, and factory automation.

The HP Local Bus is based on a flexible daisy chain bus structure. Each module on the local bus may communicate at up to 100 MB/s with its adjacent modules. This communication happens independently of transfer between other sets of adjacent modules on the local bus. In this fashion, modules can be configured sequentially to support a very efficient I/O and processing pipeline.

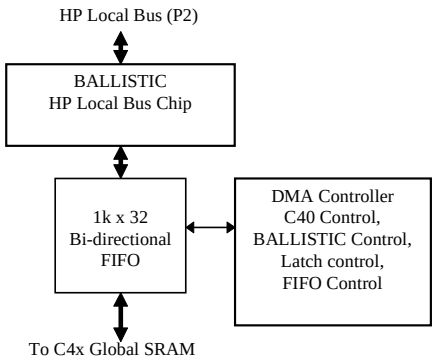


Figure 3: HP Local Bus Block Diagram

The VX8 can be used as a high performance and efficient HP Local Bus data sink. It provides an efficient DMA controller that transfers data at 64 MByte/s from the HP local bus input FIFO to the global SRAM of the embedded C40s. A DMA broadcast write feature provides data transfer from the HP Local Bus input FIFO to all embedded C40 and TIM-40 global bus SRAM. This feature allows all processors to simultaneously receive and process the same input dataset, a feature extremely useful in overlapping processing applications. During a long HP Local Bus DMA transfer an embedded C40 may suspend HP Local Bus transfers to service the VXIbus then resume the HP Local Bus DMA transfer. The VXI and HP local bus interfaces on the VX8 are completely independent, so while data is being transferred over the HP Local Bus, the host can use the VXI interface to retrieve processed results from the VX8's shared DRAM banks. The VX8 can also source data for the HP Local Bus, as any C40 can write data to the local bus output FIFO at 40 MByte/s sustained.

The HP Local Bus offers an extremely efficient, high performance method of data transfer within the VXI system without affecting the VXIbus performance.

1.2.3 Shared DRAM Memory

The VX8 supports a shared bus architecture allowing the on-board C40s, the TIM-40 modules, and the VXIbus interface to access an optional bank of on-board global shared DRAM. Since only one resource can physically use the DRAM at any time, an arbitration scheme determines who gets access. The VXI slave interface has the highest priority, and will pre-empt all other nodes. This feature eliminates VXI bus time-out errors. All other nodes are allowed access to the bus on a round robin basis, where a DSP can never be pre-empted by another DSP.

DRAM options on the VX8 allow 0, 4, 8, 32, or 64 MB of buffered DRAM. The HP local bus DMA transfer does not interfere with Host VXI DRAM accesses. VXI slave accesses to the DRAM operate at 17 MByte/s sustained performance while each embedded C40 accesses the DRAM at 24 MByte/s (for reads) or 20 MByte/s (for writes).

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2. TIM-40 DSP Module Overview

Texas Instruments developed its TIM-40 module to deliver the full performance of the TMS320C4x on a standardized parallel processing element. Each TIM-40 module offers a unique combination of processor, memory and I/O capabilities. By mixing and matching TIM-40 modules, the user can build up a parallel processing system ideally suited to the application at hand. Hence, the industry-standard TIM-40 specification simplifies the design of system architectures which in turn reduces development costs and time to market. All C4x-based systems offered by Spectrum fully exploit the TIM-40 benefits of modularity, flexibility, scalability, maintainability, and share common development tools for VXI, VME, PC and custom form factors. Since its introduction, the TIM-40 module has become the standardized building block for multi-processing TMS320C4x systems.

Each TIM-40 module generally contains a complete C4x-based subsystem, including one or more C4x processors and memory. To allow full communication port inter-connectivity, the minimum implementation of the TIM-40 standard requires six TMS320C40 communication ports be routed to the module connectors. An optional third connector carries all of the TMS320C40s global memory interface signals. The connector allows off-module peripherals and additional memory to be connected directly to the TMS320C40's global bus.

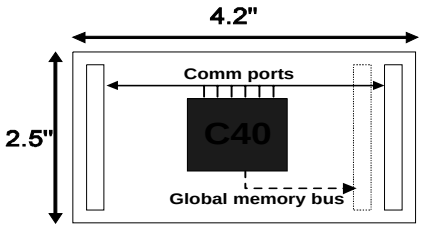


Figure 4: TIM-40 Module Standard

2.1 MDC40SS SRAM DSP TIM Module

The MDC40SS is the basic building block of a C40 system, offering a simple yet powerful DSP plus large, fast SRAM combination. Based on the TIM-40 module standard, the MDC40SS features a 60 MHz TMS320C40 parallel digital signal processor offering a full 60 MFLOPS of computational performance. The C40 DSP is coupled with up to 8MB of fast 0 wait-state SRAM divided equally on both processor busses. On module memory of the MDC40SS consists of four separate banks of zero wait-state 12ns SRAM, two on the local memory port and two on the global memory port. The module incorporates an 80-pin global memory expansion connector, which makes it possible to expand the memory and I/O capabilities off-module. The VX8 makes use of this connector to access the shared global resources of the board such as HP Local Bus, VXIbus, shared DRAM and other TIM-40 modules.

Each C40 communication port features a DMA controller supporting true concurrent I/O, independent of and in parallel with the CPU, allowing efficient interprocessor communications while minimizing data-flow bottlenecks on shared global resources. The six 20 MByte/s C40 communication ports are brought off the module to allow intra-board communication with other VX8 TIM-40 modules or inter-board communication for VX8 to VX8 networked parallel processing.

One of the key features of the module is the ability to run independently from a host by booting from the on-module 32 kByte EEPROM. The ROM also allows multi-processing operating systems to identify the module and its processing or memory capabilities for dynamic allocation of system tasks.

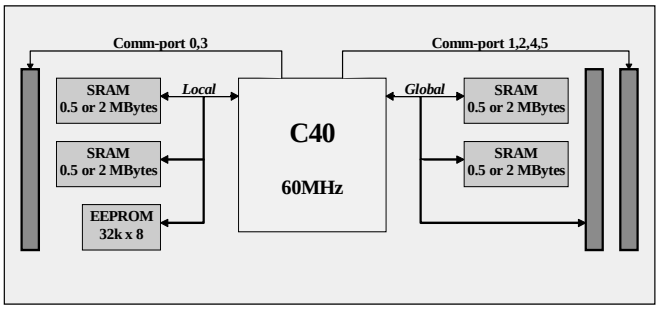


Figure 5: MDC40SS SRAM DSP TIM module

2.2 MDC44ST Dual C44 DSP Module

The MDC44ST is ideally suited for applications that require high density processing. The module integrates two 60 MHz TMS320C44s and up to 8MB of fast SRAM onto a single size module, thus achieving up to 120 MFLOPS of computational performance. By populating all six VX8 TIM sites with MDC44ST modules, densities of fourteen DSPs per VX8 are possible (reaching a maximum of 840 MFLOPS).

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The memory options on the MDC44ST are 2MByte or 8Mbyte 0ws SRAM divided equally amongst the two C44's. Each C44 has one bank of 128Kx32 or 512kx32 SRAM per C44 bus. One C44 has global bus access to the global expansion connector. A global bus paging register increases the 24-bit addressing of this C44 to 31-bits allowing the full address expansion range to be used on the VX8. The VX8 makes use of the global expansion connector and the global paging register to access the shared global resources of the board such as HP Local Bus, VXIbus, shared DRAM and other TIM-40 modules.
Each of the 4 C44 communication ports feature a DMA controller supporting true concurrent I/O, independent of and in parallel with the CPU, allowing efficient interprocessor communications while minimizing data-flow bottlenecks on shared global resources. Six 20MByte/s C44 communication ports are brought off the module to allow intra-board communication with other VX8 TIM-40 modules or inter-board communication for VX8 to VX8 networked parallel processing. The other two C44 Communication ports are connected together on the MDC44ST module allowing on module interprocessor communications

Each TMS320C44 has a 32k x 8 EEPROM on its local bus that may be used to hold system configuration information or as a general non-volatile storage area. The EEPROM allows the MDC44ST to run independently from a host by booting from the on-module ROM or allows multi-processing operating systems to identify the module and its processing or memory capabilities for dynamic allocation of system tasks

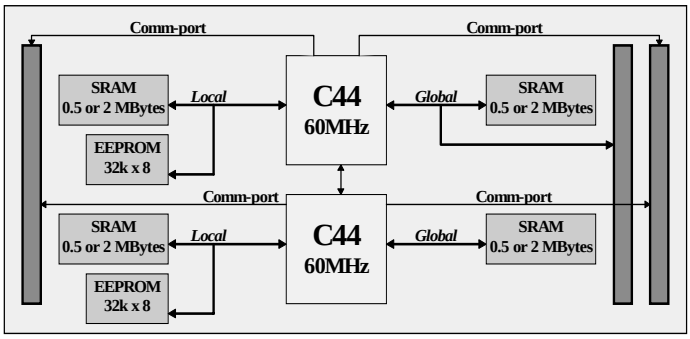


Figure 6: MDC44ST Dual C44 DSP TIM Module

3. The MDC44DDC and MD70MAI: Narrow Band Receiver Module Set

The Narrow Band Receiver (NBR) module Set, based on TI's TMS320C44 parallel Digital Signal Processor, performs digital demodulation of radio signals up to 30 MHz. The set is comprised of Spectrum's MD70MAI and MDC44DDC modules.

Radio signals from High Frequency (HF) to microwave frequency can be monitored using the NBR module set. The signals are first down-converted to the 12 kHz to 30 MHz Intermediate Frequency (IF) range using conventional analog radio circuitry, including a local oscillator, mixer, and appropriate filters. The MD70MAI module samples the IF signal at up to 70 MHz with up to 12-bits of resolution then a high speed serial channel, "GLink", is used to transfer digital data to any number of MDC44DDC modules for digital down-conversion and demodulation. The 1.2Gbit/s GLink serial bus allows data to be distributed from the MD70MAI to the MDC44DDC on a 50 ohm coaxial cable. Each MDC44DDC has two GLink receivers, and can re-transmit GLink data to another MDC44DDC. By daisy-chaining MDC44DDC modules, one MD70MAI can provide sampled IF data to an unlimited number of MDC44DDCs for processing of various narrow band channels within one IF frequency

3.1 MD70MAI 70 MS/s Analog Input TIM Module

The MD70MAI features a 12-bit, 50 MS/s or 8-bit, 70 MS/s A/D converter. A 30 MHz analog signal enters the MD70MAI through a 50 Ohm coax connector. The signal is AC coupled with a 12 kHz high-pass filter then passed to the software-controlled gain control and an anti-aliasing filter section. The A/D converter maximum sample rate is 70 MS/s at 8-bits resolution and 50 MS/s at 12-bit resolution. The A/D output stream is transmitted to the MDC44DDC via a 1.4 Gbit/s GLink serial link. The A/D clock source is jumper-selectable, either internal to the module, or external. This allows multiple A/D converters to be synchronized through clock in/out signals. A programmable "DDC sync" signal is transmitted on GLink to synchronize each MDC44DDC on the GLink network for coherent MDC44DDC processing.

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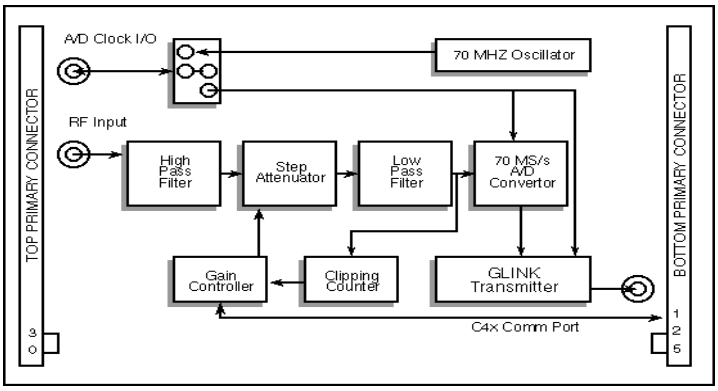


Figure 7: MD70MAI 70MS/s Analog Input TIM module

3.2 MDC44DDC Quad Digital Down Converter TIM Module

The data from the MD70MAI module can be forwarded to any number of MDC44DDC modules via the GLink bus. The MDC44DDC module has two GLink receivers and two GLink transmitters. Each MDC44DDC can receive or re-transmit two GLink data streams. The received GLink digitized IF data is passed to four Harris HSP50016 70 MHz Digital Down Converters (DDCs). Two DDCs are controlled by one C44 global bus and the other two controlled by the other C44 global bus. There are two 50 MHz C44 DSP processors (120 MFLOPS) on-board to handle the most intensive signal processing applications.

Complex down-converted data, selected as floating or fixed point (16 or 32-bit) is passed from the output of each DDC to a C44 communication port through a set of FIFOs. Each DDC has a 16kByte output FIFO which stores 4k of complex data in 16-bit samples.

Each C44 has 128k words of 0ws SRAM and 32 kBytes of EEPROM on its local bus as well as four 20 MByte/s communication ports. Two communication ports are dedicated to communication with the DDCs, and the remaining six C44 communications ports are used for inter-processor communications.

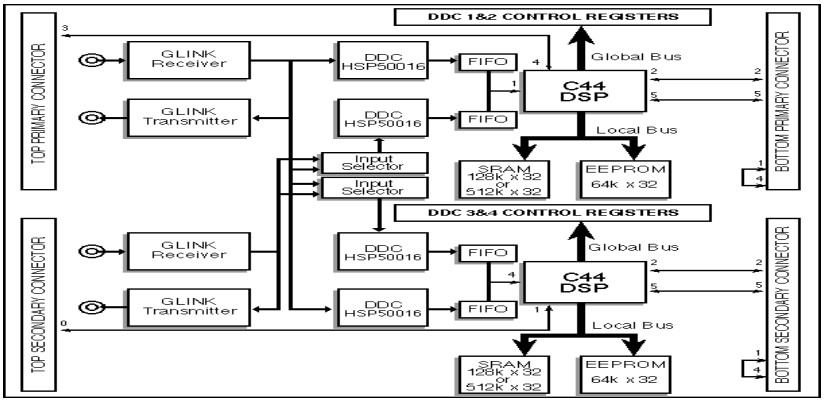


Figure 8: MDC44DDC Quad Digital Down Converter TIM Module

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4. Software Development Tools

The overall design of the VX8 software development tools embrace the goal of providing an easy to use, open design which will minimize obstructions and limitations in your development cycle. Spectrum's Device Drivers and Host Interface Libraries provide you with the low level tools required to ease integration of host and DSP software. By offering both SICL and VISA support, the VX8 is compatible with a wide range of host platforms and operating systems. In addition, the industry standard interfaces on the VX8 allow existing TI TMS320C4x applications to be easily ported to the VXI environment. To speed the development of your VX8 application, Spectrum is working with its software partners to offer industry leading software products to best meet your VXI C40-based application and development requirements.

4.1 Host Interface Library and Device Driver

The Host Interface Library and Device Drivers provide an easy-to-use host interface to the VX8 board and its TIM-40 modules. The software allows users to manage individual boards as well as VX8 systems. Operations such as control (reset, initialize, open, close), DSP code loading, VX8 board I/O, and test and example routines are all provided. Both HP SICL and VXI Plug and Play VISA standards are supported by the VX8 host interface libraries, providing developers with freedom to choose the appropriate host for their application. The SICL and VISA compatibility of the instrument drivers provide a standard interface to application software for LabVIEW. Host support is provided for: HP-UX 9.05 SICL and HP-UX 10.2 VISA on an HP V743 embedded HP-9000 based resource manager. WinNT is supported with the VXI Plug and Play VISA driver for National Instruments embedded Pentium and VXI to PCI bus resource managers as well as HP embedded Pentiums.

4.2 VX8 System Library and Utility Software

The VX8 System Library provides developers with a suite of C40-callable functions to exercise the full functionality of the VX8. The low level C4x library optimizes data transfers and simplifies the task of configuring and controlling the VX8. Supported functionality includes: VXI bus routines (DMA configuration and VXI master transfers), HP Local Bus routines (bus configuration and data transfer), RS-232 communications, and user defined LED control. The VX8 System Library also provides easy to use EEPROM programming utilities and Built in Test software to verify board level functionality at power up.

4.3 Texas Instruments' Compiler Tools

TI offers a highly proven, mature set of development tools for their TMS320 DSP family. This first class compiler software is also supported by a broad range of third parties. TI's C4x Assembler/Linker and ANSI C compiler are available for DOS, SunOS/Solaris and HP-UX (V4.7 or higher), enabling users to develop DSP applications in standard ANSI C. The compiler makes use of chip features such as parallel instructions, optimized multi-pass data addressing and repeat block instructions to ensure the code produced is as efficient as possible. TI's assembly language tools support coding in mixed assembler and C for greater control over code efficiency.

The compiler also features ANSI standard run-time support and parallel run-time support. Standard run-time support provides the standard ANSI C string manipulation, memory allocation, data conversion, and mathematical functions. Parallel run-time support allows C programming of C4x peripherals at a high level. Parallel run-time functionality includes: DMA channel configuration and operation, timer control and operation, communication port configuration and transfers, interrupt support, and multiprocessing support.

4.4 Go DSP Integrated Development

Go DSP offers a development tool called *Code Composer* which integrates C and assembler code download and simultaneous multi-processor debug in a multitasking Windows environment. Code Composer marries the functionality of a tightly Integrated Development Environment (with background compiling), High and low level DSP debuggers, graphical debug tools such as signal probes and scopes and interactive code profiling, all in a tightly integrated native Win95 and WinNT package. Code Composer includes a powerful option which allows the user to extend or customize Code Composer by adding debugging features that may be used to quickly create Windows GUI elements to control the DSP during development. Go DSP Code Composer offers seamless multi-processor support, interactive profiling and analysis, data visualization, memory graphing, animation of break points, and many more features previously unheard of in the DSP development world.

4.4.1 Embedded HP V743 Development

A typical VX8 development system for V743 HP 9000 users is shown in Figure 9. The hardware consists of an embedded V743 resource manager, VX8 DSP boards and VXI I/O boards in a VXI chassis; a desktop PC with a Spectrum XDSC4x JTAG Emulator Board. The XDSC4x JTAG Emulator Board is a separate ISA board that connects via ribbon cable to the VX8 JTAG In header permitting debug of the VX8 system from a desktop PC. Go DSP Code Composer supports Spectrum's XDSC4x Debug hardware with Win3.1, Win95 (16Bit) or WinNT (32Bit) desktop operating systems.

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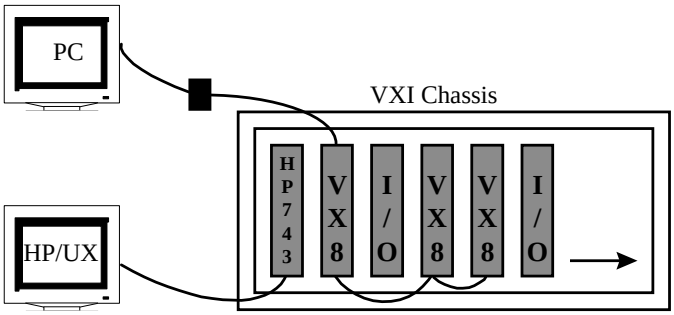


Figure 9: Embedded HP V743 Development

The development environment, illustrated in Figure 9, lends itself to UNIX or DOS C4x compiler options. If the UNIX based TI C4x compiler tools are used, DSP code is compiled, assembled and linked on the HP/UX workstation. Code can then be downloaded to the target VX8 boards using the host interface library or transferred (via FTP) to the desktop PC and then downloaded to the target VX8 boards using the XDSC4x debug hardware.

To debug the target C4x code, if it is downloaded via the VX8 host interface library, a copy of the C4x code must be transferred to the desktop PC (via FTP). If the DOS based C4x compiler tools are chosen, C4x code development and debug is performed on the desktop PC with Go DSP and Spectrum's XDSC4x debug hardware. Once target C4x code is debugged, files can be transferred (via FTP) to the HP/UX host for downloading via the host interface library.

4.4.2 NI PCI-VXI Converter Development

National Instruments offers a PCI to VXI converter board that memory maps PCI space to VXI. The system shown in Figure 10 is a NI PCI MXI2 resource manager with VX8 DSP boards and VXI I/O boards in a VXI chassis. A cable connects a desktop PC to the VXI Chassis. The VX8 on-board JTAG-to-VXI interface allows non-intrusive C4x debug from the desktop PC through the VXI backplane. Using Go DSP's Code Composer on the desktop PC running WinNT the PCI to VXI converter will allow code download and debug through the VISA plug and play driver to the VX8 parallel C4x system.

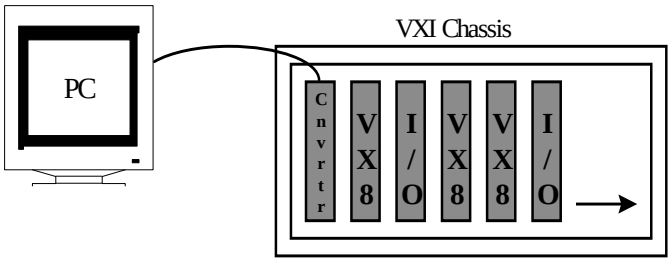


Figure 10: NI PCI-VXI Converter Development

4.4.3 Embedded Pentium Development

Hewlett-Packard and National Instruments offer slot 0 embedded PCs for VXI runtime and development. Figure 11 illustrates a typical embedded PC development environment. The monitor and keyboard are outside the chassis and the PC motherboard is the slot 0 resource manager from HP or National Instruments. The VX8 on-board JTAG-to-VXI interface allows non-intrusive C4x debug from the embedded PC through the VXI backplane. Using Go DSP's Code Composer on the embedded PC running WinNT the PCI to VXI converter will allow code download and debug through the VISA plug and play driver to the VX8 parallel C4x system.

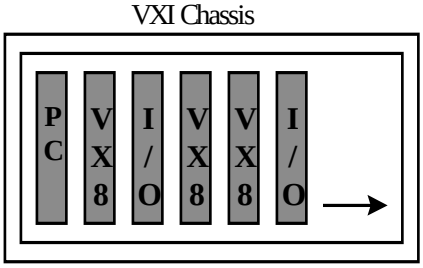


Figure 11: Embedded Pentium Development

4.5 C4x Function Libraries

Third party C40 software vendors such as Sinectonalysis and Ensigma offer varying complexities of DSP function libraries for imaging, signal processing, and general mathematics. These libraries provide most of the commonly used signal processing algorithms. Depending on your application requirements, the libraries offer varying degrees of functionality.

4.5.1 Sinectonalysis Libraries

Sinectonalysis offers five very comprehensive, high performance libraries which provide C-callable, function libraries for trigonometry, matrix, vector, image and signal processing. The Math Library is a run-time library of 33 highly optimized scalar

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functions for all compilation models. The DSP/Vector Library is a DSP/Linear algebra library of over 300 functions. The Image Processing Library is an ultra-optimized image processing library with over 300 standard image processing algorithms optimized for TMS320 architecture. The Linear Algebra Library is a suite of Basic Linear Algebra Subroutines and the Eigenvector Library is a suite of eigenvalue and eigenvector routines. Sinectonalysis offers these libraries hand coded in C or assembly for PC environments.

4.5.2 Ensigma DSPLib

DSPLib is a C coded signal processing library for TMS320C3x and TMS320C4x processors. The C-callable function routines contain many standard DSP algorithms for common signal processing functions. Ensigma provides the functions with C source code.

4.6 DSP Operating Systems

4.6.1 3L Parallel C

3L's Parallel C is a C40 parallel processing development system allowing users to build flexible applications that run on networks containing one or more C40 processors. The Parallel C package builds on the TI ANSI C compiler tools using a powerful, easy-to-use parallel programming environment offering multi-tasking, multi-threading and inter-processor communication facilities. Parallel C makes it easy to map a DSP software application to a given parallel C40 hardware topology, and painlessly reconfigure the distribution of parallel tasks when the C40 hardware configuration is changed. Parallel C automatically ensures communication between various tasks on the network happen over the available communication port connections. By using Parallel C, the user can write a complete DSP application without any concern for the eventual number or configuration of C40 processors.

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VX8 Whole Product Ordering Information: Hardware

For additional information on ordering or to place an order, please contact your Spectrum Sales representative.

VX8 Master Board

Product Description	*Part Number*
VX8S1-60 2MB SRAM without Local Bus *VX8 Master Board with 512kB SRAM per bus per embedded C40. Also includes jumpers and Quick Start Guide.*	**600-04017**
VX8LS1-60 2MB SRAM with Local Bus *VX8 Master Board with HP Local Bus and 512kB SRAM per bus per embedded C40. Also includes jumpers and Quick Start Guide.*	**600-04015**

VX8 Cable Options

Product Description	*Part Number*
Communication Port Cable Kit (2 cables) *Two 10 inch shielded comm. port cables to connect inter-board and intra-board front panel comm. ports.*	**202-00010**
JTAG Daisy Chain Cable *Required to perform inter-board JTAG debug and to daisy chain global reset when inter-board comm. ports are used.*	**202-00012**
RS-232 Cable *Required for RS232 communications between host or I/O boards*	**202-00014**

Shared DRAM Options

Product Description	*Part Number*
VX8 4MB DRAM OPTION	**202-00030**
VX8 8MB DRAM OPTION	**202-00032**
VX8 32MB DRAM OPTION	**202-00034**
VX8 64MB DRAM OPTION	**202-00036**

TIM Module Options

Product Description	*Part Number*
MDC40SS2-60 60MHz C40 with 1.5 MB SRAM *A single size TIM-40 module with one 60Mhz C40 DSP, one bank of 128kx32 SRAM on the Local Bus, and two banks of 128kx32 SRAM on the Global Bus.*	**600-01500**
MDC40SS4-60 60MHz C40 with 2 MB SRAM *A single size TIM-40 module with one 60Mhz C40 DSP and two banks of 128kx32 SRAM on each of the Local and Global Buses.*	**600-02031**
MDC44ST3-60 60MHz C44 with 2 MB SRAM *A single size TIM-40 module with two 60Mhz C44 DSP's and one bank of 128kx32 SRAM on the Local and Global Bus of each C44.*	**600-02025**

Narrow Band Receiver Module Set

Product Description	*Part Number*
VX8 Front Panel Analog Bulkhead *4 SMC bulkhead connectors in place of the Application Specific connector to route analog signals to the MD70MAI or other custom analog I/O modules.*	**202-00015**
MD70MAI 70MSPS A/D TIM *Analog Front End for MDC44DDC. Signals between 0KHz and 30KHz are sampled, filtered and daisy-chained to an unlimited number of DDC modules using a 1.4Gbit/s GLink coax interconnect.*	**600-01516**
MDC44DDC-50 Quad Digital Down Converter *This module accepts GLink input from the MAI module. Each module has 2 C44s and 4 Harris down converters capable of targeting frequencies independently. Any number of DDCs can be daisy-chained on GLink.*	**600-01517**

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Ordering Information: Software

For additional information on ordering or to place an order, please contact your Spectrum Sales representative.

HP/UX Software Development Tools

Product Description	*Part Number*
VX8 HP/UX SICL Development Package Development package includes: VX8 HPUX SICL Interface Library, Device Driver, Example Software, Software Users Manual, VX8 Technical Reference Manual, TI C40 Users Manual, XDS Conversion Board, and one JTAG Chain Cable.	**600-04010**
TI's C4x Assembler/Linker and C Compiler HP/UX based Assembler and ANSI C Compiler	**100-00674**
XDSC4x Debugger with GoDSP Code Composer (DOS and Win95) PC based JTAG debug hardware with advanced debug and development software from GoDSP supporting 16Bit Windows	**600-01548**
XDSC4x Debugger with GoDSP Code Composer (WinNT) PC based JTAG debug hardware with advanced debug and development software from GoDSP supporting WinNT.	**600-01549**

WinNT Software Development Tools

Product Description	*Part Number*
VX8 WinNT VISA Development Package Development package includes: VX8 WinNT VISA Interface Library, Device Driver, Example Software, Software Users Manual, VX8 Technical Reference Manual, TI C40 Users Manual, XDS Conversion Board, and one JTAG Chain Cable.	**600-04012**
TI's C4x Assembler/Linker and C Compiler WinNT compatible Assembler and ANSI C Compiler	**100-00914**
GO-DSP Code Composer supporting the above WinNT VISA Driver Requires 600-04012 and allows C4x code debug over the VXI backplane from NI's Resource Managers supporting WinNT.	**100-00702**
C4x Function Libraries (DOS and Windows Compatible)	
Sinectonalysis C40 Standard Math Library	**100-01387**
Sinectonalysis C40 DSP/Vector Library	**100-01400**
Sinectonalysis C40 C-BLAS (Linear Algebra Library), C	**100-01412**
Sinectonalysis C40 A-BLAS (Linear Algebra Library), Assembler	**100-01414**
Sinectonalysis C40 C-EISPACK (Eigen Vector Library), C	**100-01422**
Sinectonalysis C40 A-EISPACK (Eigen Vector Library), Assembler	**100-01424**
Sinectonalysis C40 EYElib Imaging Library, Assembler	**100-01395**
Ensigma DSPLib	**100-01342**
3L DSP Operating Systems (Available September 1997)	
3L C40 Parallel C	**TBA**
3L C40 Parallel C with TI compiler	**TBA**
3L C40 Parallel C without TI compiler	**TBA**
3L Parallel C Debug Support Kit	**TBA**

Warranty Information

All Spectrum products are warranted against defects in materials and workmanship for one year. Spectrum will replace or repair, at its option, any product found to be defective during the warranty period. The warranty will be invalid if any permanent alterations are made to the circuitry, or if the unit has been abused or mishandled. Damages due to static discharges will void the warranty, as will application of excessive voltages on the power supply rails. Contact your Spectrum Sales Representative for additional warranty information.

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