

In response to the unending search for higher throughput and processing bandwidth, Innovative Integration has developed a new generation of 64-bit PCI DSP cards built around the acclaimed C6711 DSP to serve a wide spectrum of technical fields. Our Matador boards are not just development platforms but well-crafted, industry-oriented practical solutions, ready to be deployed and utilized in real life systems for the years to come. In one-of-a-kind systems and high-volume OEM applications, every Matador board delivers a performance beyond expectations with powerful, time saving software tools, at an incredible price.

# Matador DSP Series

## Matador Series

### 64 bit PCI C6711 DSP Solutions

- Vista** The Vista card combines a versatile video decoder for all standard video formats and timings, a powerful TMS320C6711 DSP, a video encoder for direct output to RGB and CVBS monitors, a 64 bit PCI interface and an audio codec to provide the most complete video processing card available today for image processing, factory automation and process control.
- Toro** With 16 simultaneous instrumentation grade analog I/O channels capable of up to 250 kHz acquisition rates and a dedicated interface to a TMS320C6711 DSP, 32 bits of general purpose digital I/O and a 64 bit PCI interface, the Toro card is the price/performance leader in high channel count servo/process control and complex data acquisition applications.
- Conejo** Four 10MHz I/O channels with 14-bit A/D and 16-bit D/A well coupled to the C6711 DSP offer unmatched capture and processing bandwidth. All input can simultaneously stream at full rate to on-chip or off-chip memory. Full flexibility in triggering modes with a hardware event log and elegant multi-card synchronization, Conejo is the champion of multi-channel high-speed processes like radar, medical imaging, semiconductor testing, telecommunication and advanced fields.
- Delfin** With 32 independent 24-bit instrumentation grade sigma-delta A/D and 6 D/A channels up to 192kHz, Delfin provides an unprecedented combination of high dynamic range, high channel count and powerful DSP co-processing with a C6711. Multiple cards can easily be synchronized to build systems of virtually unlimited channel count. Delfin pushes boundaries in advanced sonar, acoustic real-time processing, vibration analysis and high-end audio development.

## Overview

Our new Matador Series offers a full range of performance-oriented DSP boards which employ an advanced, mature design. Ready for application deployment, the Matador family integrates state-of-art components, circuit architecture, logic design and software tools to provide real-time solutions in all leading edge fields. We have carefully designed this product family around an advanced, but mature, chip set: TI's C6711 DSP and Xilinx Virtex and Spartan FPGAs.



## C6711 Core Features

The DSP is the heart of the data movement and processing center. The TMS320C6711 offers an excellent combination of processing speed, off-chip memory usage efficiency and external interface flexibility. It has become a workhorse in the 200MHz range floating-point DSP for industrial and research applications, using the proven, highly parallel architecture of the C6000 series of floating-point DSP from Texas Instruments. It offers 900MFLOPS of processing power at 150MHz and an incredible 1.2GFLOPS at 200 MHz. On-chip resources include 8 highly independent parallel execution units, 16 Enhanced DMA channels, two 32-bit timers and an efficient L1/L2 cache controller that makes external memory usage about 85% as efficient as on-chip memory. On-chip memory includes 4KBytes L1 data cache, 4KBytes L1 program cache and 64KBytes L2 cache.

From the end-user point of view, these features make the C6711 an extremely C-friendly DSP. Large programs no longer need to be sectioned off into different memory regions. One simply utilizes the large 32MB SDRAM and lets the cache controller take charge and deliver near on-chip performance. The 6711 can DMA data into SDRAM nearly as fast as onto on-chip memory. In short, programming is becoming easier as DSP bus and CPU bandwidth is increased.

## Xilinx FPGA Uses

Beyond providing the traditional "glue logic" between DSP and other devices, the Virtex and Spartan II field programmable gate arrays (FPGA) allow us to integrate valuable functions on each board. Our intellectual property utilizes the most recent advances in chip architecture and logic design to provide well integrated, software-configurable, fully-documented building blocks.

The use of advanced FPGAs and efficient logic design provide a fast architecture for interfacing peripherals of the DSP with a high level of integration. The DSP bus is clocked at 75MHz for a bandwidth of 300MBytes/sec and very little CPU overhead. With FPGA and DMA controlling the data movement, the CPU bandwidth is well preserved for the end-user application. Every card in the Matador Series offers a large, high-performance feature set at an incredible price.

## PCI Bus Interface

The PCI interface controller supports 64-bit/32-bit, 3.3V/5V, 33MHz bus, and automatically recognizes the host bus type at Plug-n-Play. This state-of-art PCI interface is implemented in logic on a Spartan II FPGA. It supports busmastering at a maximum burst rate of 264Mbytes/sec on 64-bit busses and can also be used as a slave. Benchmarks of 80MBytes/sec of sustained transfer rates on 32-bit busses have been demonstrated under Win2K. The most attractive aspect is that these high rates are achieved with no burden at all on the target, i.e. 0% CPU utilization and only 25% bus utilization. FIFO buffering is integrated to tolerate system load variations and an arbitrated 256 word dual-port RAM serves a mailbox or bulletin board, where the DSP can swap status and data structures with the host with minimum interference on host and target program execution.

## Expansion and System Integration

The Matador boards offer several features that simplify system integration. One or two banks of 32-bit digital I/O are available for multi-purpose synchronization and control. A FIFOPort interface is provided for high-speed bi-directional 16-bit parallel data transfer to/from external hardware at 50MBytes/sec at TTL level or with LVDS signaling. Configuration of the handshake with external hardware is handled with programmable FIFO flag depth and continuously adjustable FIFO fill-level interrupts.

Card to card synchronization is facilitated with the SyncLink/ClockLink interface that supports the sharing of six signals (five TTL and one LVDS pair) to distributes clocks and triggers across several boards. A simple flat ribbon cable connection and software configuration is all it takes to synchronize multiple boards. These features are described in more detail in our catalog front section, System Level Integration.

## Main Features of the Matador Series

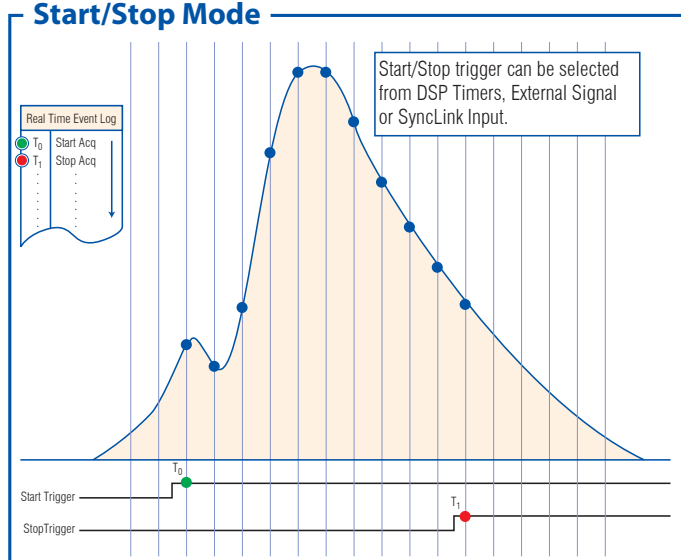
- Texas Instruments' TMS320C6711 Digital Signal Processor
- One or two Xilinx FPGAs
- 64-bit/32-bit, 3.3V/5V, 33MHz PCI interface
- 32-bit PCI sustained transfer rate of 80MBytes/sec with no burden on DSP
- 32MB SDRAM
- 32 to 64-bit digital I/O (except Vista with 8-bit port)
- Programmable DDS timebase 0-25MHz with 0.02Hz resolution
- External Clock and Trigger Input
- Ultra-flexible trigger modes with hardware event log built in logic
- SynLink/ClockLink interface for easy multi-board synchronization
- DSP/BIOS device-drivers for board peripherals
- C++ class libraries to accelerate code development
- Host side software tools Armada

## Features and Uses of Xilinx FPGAs

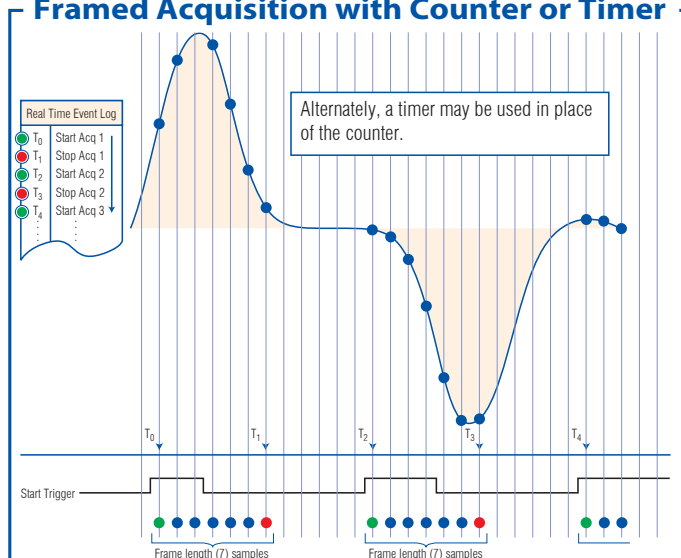
- PCI interface with PCI-FIFO buffering
- Digital I/O
- Adjustable depth FIFO buffering of analog converters data
- Built-in gain and offset error correction
- Three 24-bit "cascadable" timers/counters
- Timebase and trigger routing matrix
- FIFOPort interface (external high-speed parallel data port)
- Ultra-flexible triggering modes
- Built-in real-time hardware event logging

64 bit PCI DSP

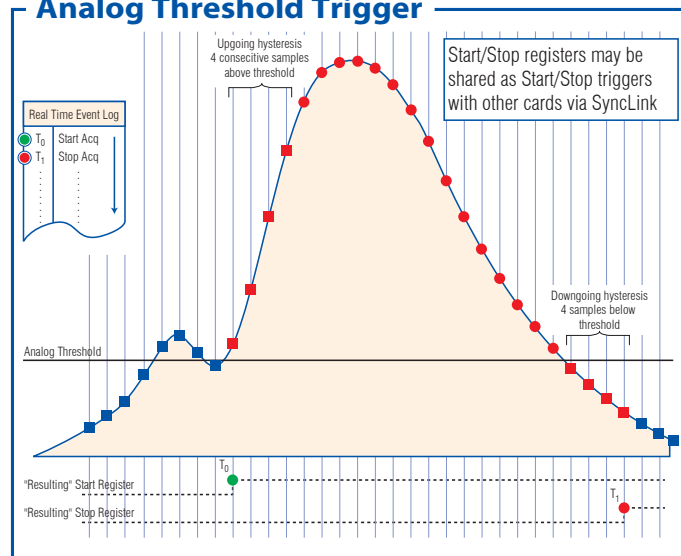
## Start/Stop Mode



## Framed Acquisition with Counter or Timer



## Analog Threshold Trigger



## Time Base and Trigger Mechanisms: Total Flexibility!

The fields of application for the Matador series keep expanding, thanks to a very complete choice of timebase source signals and amazing flexibility in trigger mechanisms. The Matador line offers a user-configurable timebase switch matrix, built in logic, that allows the user to select the source of any timebase from a choice of clock signals: on-chip and off-chip timers, DDS, external clock, SyncLink/ClockLink. The selection is made in SW, with single-line commands.

The triggering methods are extremely flexible and accommodate almost any foreseeable synchronization requirements. The table below shows triggering methods and attributes that Matador cards can quickly be configured for.

### Trigger and Acquisition Modes

- External trigger
- Analog threshold trigger
- Continuous streaming
- Framed acquisition (specified by either duration or sample count)
- Pre/post trigger sampling
- Re-trigger mode

Any of the above acquisition modes is easily configured with a fixed set of parameters that fully define the acquisition start time and stop time.

### Acquisition Mode Parameters

Start Signal	Stop Time	
	Framed Acquisition	Stop Signal
Timer		
SW Command	Duration (microsecond)	Timer
Ext. Trigger	Length (# of samples)	SW Command
SyncLink		Ext. Trigger
Analog Threshold		SyncLink

In multi-card applications, any of these triggers can be shared between cards using the SyncLink/ClockLink interface. For instance, the Start trigger generated on the “master” card can be the analog threshold comparator output and can be routed as an External Trigger to synchronize the start of the acquisition of other channels on a “slave” card.

A real-time event log in the firmware provides the user with a precision record of various events such as trigger times, data integrity monitoring and user-defined events. Its timebase is a 10 MHz 40-bit counter.

These features are all implemented in logic and can therefore be extended or customized to support new applications. The firmware can be upgraded in the field via the PCI-bus, using a “Burn” program provided in the Pismo Toolset.



## Pismo Development Tools provide DSP/BIOS device drivers and C++ class libraries

Our well-known and appraised board support software toolset has been enhanced extensively to take advantage of the 6711 and 6414 chip architecture and newer code development tools. The toolsets for the Matador and Velocia boards have been named Pismo and constitute an elegant evolution of our appraised Zuma toolset.

As do earlier Zuma toolkits, the Pismo software kits include everything the developer will need to immediately begin code development on his specific Matador or Velocia card. From target specific DSP peripheral libraries and device drivers, single-command board-level functions to convenient applets allowing terminal emulation, download, execution and high-level debugging, it also provides a complete set of source code examples demonstrating full bandwidth operation of all hardware resources.

As for new evolutions, the Pismo kit supports and extends each of the features of DSP/BIOS on the Matador DSP boards through a seamless integration of advanced C++ class libraries, BIOS-compliant DSP peripheral device drivers, and clear, illustrative examples. The device drivers fully exploit the available DMA channels in the C6711 chip so that hardware interrupt rate rarely exceeds one kHz! The net effect is that virtually all of the bandwidth of the CPU is available for application processing.

With BIOS-compliant device drivers at hand for every peripheral, the developer may focus exclusively on the end-application, rather than the myriad details involved in peripheral setup, initialization and servicing. Using the Pismo drivers insures maximal CPU availability for application use. In addition to minimal processor loading, automatic DMA configuration and optimal bus utilization, the Pismo BIOS drivers support efficient cooperation in multitasking applications.

Pismo ships with a large library of carefully crafted C++ class libraries, which substantially mitigate the complexity of programming the 6711/6416 DSP hardware and facilitate using the BIOS operating system. Pismo provides C++ extensive support for:

- Dynamic creation and runtime control of tasks
- Simplified management of and access to all TI Chip Support Library (CSL) and BIOS API functions:
  - Semaphores, Mutexes, Mailboxes, Timers, EDMA, QDMA, Atoms, McBSP, Timebases, Counters, etc.
- Data exchange using RTDX
- Streaming I/O
- Foundation (base) classes for DMA-driven device driver development
- Templated queues
- Partial standard-template library functionality via STLPort

One of the benefits of using C++ is that while it helps to mitigate and manage complexity to support creation of larger, more sophisticated applications, it is often simply used as a "better" dialect of the C language. One may freely intermix calls to legacy 'C' functions, newly-written C functions, assembler functions and C++ functions (called methods) within C++ programs. The user does not need to fully understand all of the enhanced capabilities and features of C++ to fully exploit the features of the class libraries provided in Pismo.



## Pismo Speeds Up Host Side Development with Armada Toolset

Pismo also includes a full set of host side software components called Armada. Integrated into either the Borland C++ Builder visual environment or Microsoft Visual C++, Armada offers the most powerful and flexible tools to rapidly integrate data acquisition and signal processing into Windows applications. This advanced graphical programming environment, for Windows, allows you to develop professional-level applications with little code writing. With the Armada tools, you have an incredible collection of software components providing the most efficient solutions in data movement, processing, visualization and logging built in an open-architecture model that allows easy interfacing with the developers algorithms. Within minutes you can easily put together feature-rich graphical applications under Windows that allow you to view the data, log it to disk, perform further signal analysis or provide a control panel for your Matador application. Armada is also compatible with thousands of third party VCL and ActiveX components that provide world-class support for database, multimedia graphics, internet connectivity and many other functions. This allows you to easily integrate Matador in a complete end-to-end solution. Please refer to the Armada section for more details.