ZR34161 Vector Signal Processor

Market Applications:

- Radar/Sonar
- Image Processing
- Communications
- Image/Data Compression
- Spectral Analysis
- Speech Processing

Functional Applications:

- 1-D and 2-D FFT
- 1-D and 2-D DCT
- Auto/Cross Correlation
- Convolution/Filtering
- Modulation/Demodulation
- Vector Multiply/Add

Performance Benchmarks

Function	Time (us)
1024 point block-floating complex FFT	3300
1024 point integer complex FFT	2400
1024 point block-floating complex FFT (4-VSP system)	1000
16x16 point 2-D DCT	989
128 point DCT	306
128 point block-floating complex FFT	237
8x8 point 2-D complex FFT	164
128 point magnitude square/accumulate	26
128 point complex vector multiply	53
128 point complex demodulation	52
4x4 matrix multiplication	33

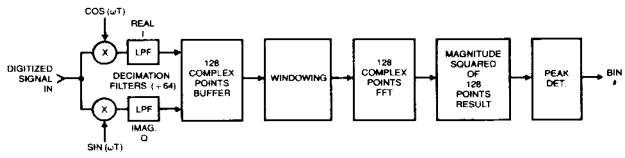
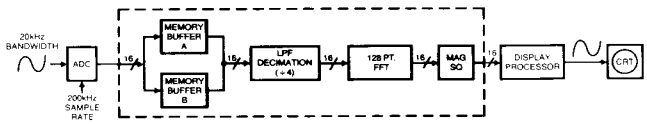


Figure 1. Quadrature-receiver Doppler Application



VSP Spectrum Analyzer Application

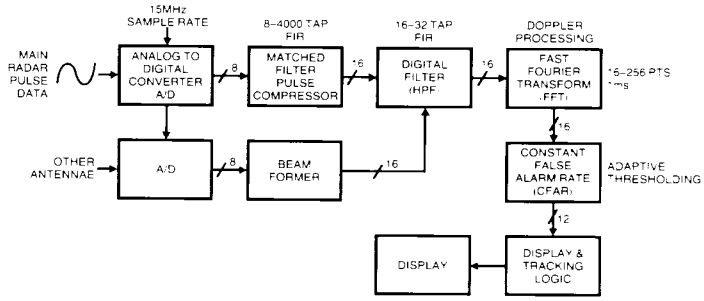


Figure 2. Radar Application

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Applications

Quadrature Receiver: By utilizing the complex demodulation and filtering functions along with its spectral analysis capabilities, the VSP efficiently implements a quadrature receiver (Figure 1). This function can be used for doppler-shift measurement, high-resolution "zoom" spectral analysis, and other similar applications. The VSP can detect, in real-time, a doppler frequency within a 30kHz band from a 4MHz digital input stream. This operation requires approximately 50 instructions. The input sequence is demodulated, filtered, and decimated by the VSP prior to the windowing and FFT operations. The peak bin from the FFT result corresponds to the doppler frequency of interest.

Radar: The FFT is a key function in radars. As the most powerful FFT processor available, the VSP provides the radar designer a new dimension in price/performance.

Image Compression: Using the FFT to compute the discrete-cosine transform (DCT), the VSP computes a 16x16 point DCT in less than 1 millisecond. This provides a powerful solution to a key element of an image compression system.

2-D Filtering: The VSP provides an efficient solution for 2-D filtering in the frequency domain. A 64x64 point 2-D filter is computed in less than 20 milliseconds, that is, real-time at a 30 frames per second rate.

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Description

The ZR34161 Vector Signal Processor (VSP) is a high-performance, programmable 16-bit digital signal processor. Its internal architecture is optimized for efficient, high-speed execution of digital signal processing algorithms. It presents a unique concept to designers of digital signal processing systems. It performs Fast Fourier Transforms (FFT), Discrete Cosine Transforms (DCT), convolutions, correlations, power spectrums, and other vector and matrix operations with the best price/performance ratio available in a single package.

Designed as a peripheral signal processor to work in conjunction with a host microprocessor, **the VSP is a functional replacement for a board-level array processor.** The VSP's silicon is dedicated to arithmetic processing; control functions are left to an inexpensive general-purpose host. The system architecture (Figure 3) attains the performance of building-block solutions, but with the high integration of a microprocessor.

The execution unit (EU) is a powerful arithmetic engine designed for efficient execution of many different digital signal processing algorithms, including FFT butterflies. Also included within the EU is special logic for implementing block floating-point arithmetic used for FFT instructions. Block floating-point arithmetic can provide a significantly higher signal-to-computation-noise ratio than fixed-point integer arithmetic when processing vectors of data.

The VSP instruction set consists of 23 "high-level" DSP-oriented instructions, which operate on either real or complex vectors of data. The high functionality of instructions allows users to concentrate on the *end application*, not the details of software implementation. A dramatic illustration of these powerful characteristics is the complete power spectrum program illustrated in Figure 4. Only four VSP instructions are required to execute the 128 point power spectrum in 238 usec. These instructions load 128 complex data samples into the VSP, compute the 128 point FFT, square the magnitude of each FFT sample, and store the results back into external memory in normal order.

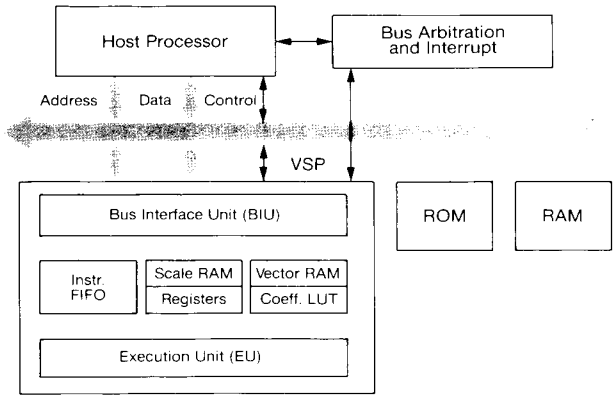

Figure 3. Typical VSP System

LD NMPT:128, RS:0, MDF:2, ZR:1, MBA:0
FFT NMBT:128, RS:0, FPS:64, LPS:1
MGSQ NMPT:128, RS:0, ADF:2
ST NMPT:128, RS:0, RV:1, MDF:2, MBA:256

Instruction	Number Clocks Instruction Fetch	Execution Time (Clocks)
LD	6	134
FFT	6	1850
MGSQ	2	262
ST	6	134
Total	20	2300

Figure 4. Power Spectrum Program

Development Tools: Zoran provides a comprehensive set of both hardware and software development tools with which the user can develop complete VSP applications:

- *Vector Signal Processor Simulator* (VSPS): A powerful software environment, VSPS simulates the VSP architecture, instruction set, bus timing and arithmetic. This tool helps the user quickly develop and evaluate VSP systems, architectures and software.
- *Vector Signal Processor Development Package* (VSPD): A sophisticated and powerful PC/AT-compatible hardware and software development package, VSPD contains a full-speed VSP, 64K memory, hardware breakpoint logic, and high-speed parallel data I/O ports.
- *Vector Signal Processor Evaluation Package* (VSPE): VSPE is an inexpensive, PC/AT-compatible hardware and software evaluation package. It contains a VSP and 16K words of program and data RAM.
- *Vector Signal Processor Assembler* (VSPA): VSPA is an entry-level assembler/linker package for developing VSP programs. It assembles VSP code and interfaces to both the VSPE and VSPD boards.

ZORAN PRICE SUMMARY
Q3/Q4 1986

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Systems Processors:

FAMILY	ORDER NUMBER	DESCRIPTION	1-24	25-99	100-999
VSP	ZR34161JC-20	16-Bit Vector Signal Processor 20MHz Clock	$650	525	395
	ZR34161JC-15	16-Bit Vector Signal Processor 15MHz Clock	510	380	325
	Z234161JC-10	16-Bit Vector Signal Processor 10MHz Clock	360	275	195
DFP	ZR33881JC-20	8-TAP Digital Filter Processor 20MHz Clock	$490	405	280
	ZR33881JC-15	8-TAP Digital Filter Processor 15MHz Clock	370	305	210
	ZR33881JC-10	8-TAP Digital Filter Processor 10MHz Clock	260	215	170
DFP	ZR33481JC-20	4-TAP Digital Filter Processor 20MHz Clock	$275	215	175
	ZR33481JC-15	4-TAP Digital Filter Processor 15MHz Clock	205	160	140
	ZR33481JC-10	4-TAP Digital Filter Processor 10MHz Clock	145	135	125

Development Tools:

Boards:

FAMILY	ORDER NUMBER	DESCRIPTION	PRICE
VSPD	ZR73401	VSP Development Board Package, PC/AT Version, 20MHz	$3000
VSPE	ZR73411	VSP Entry Evaluation Board Package, PC/AT Version, 10MHz	1000
VSPX	ZR73412	VSP Extended Performance Board, PC/AT Version, 20MHz	1800
DFPB	ZR73301-B-15-4	DFP Board with 4 481-15 devices,PC/AT Version	$2400
	ZR73301-B-15-8	DFP Board with 4 881-15 devices, PC/AT Version	3000

Software:

FAMILY	ORDER NUMBER	DESCRIPTION	PRICE
VSPS	ZR63401	VSP Simulator Single Machine--PC/AT Version	$3000
	ZR63402	VSP Simulator Single Machine--VAX/VMS Version	5000
	ZR63403	VSP Simulator Single Machine--VAX/ULTRIX Version	5000
	ZR63400-SL	Site License Upgrade, Both Versions	15,000
	ZR63400-CL	Corporate License Upgrade, Both Version	25,000
VSPA	ZR63411	VSP Assembler Single Machine License Fee--PC/AT Version	$250
	ZR63410-SL	Site License Fee Upgrade	1000
	ZR63410-CL	Corporate License Fee Upgrade	2500
DFPS	ZR63301	DFP Software Single Machine License Fee--PC/AT Version	$995
	ZR63302	DFP Software Single Machine License Fee--VAX/VMS Version	1495
	ZR63303	DFP Software Single Machine License Fee--VAX/ULTRIX Version	1495
	ZR63300-SL	Site License Upgrade, Both Versions	4000
	ZR63300-CL	Corporate License Upgrade, Both Versions	10,000

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ZORAN

A New Class of DSP Solutions

Digital Signal Processing products from Zoran range from a new class of System Processors to board-oriented solutions for many DSP applications. In between is a powerful array of product design and development tools. The customer is fully supported with regularly scheduled training courses on all products and services. In addition, ZORAN Systems engineers, a group of industry-recognized DSP experts, are available for specific instruction or on a contract basis as needed by your organization. With Zoran, you have made the right choice.

Customer Support Services

Courses

Zoran offers courses at its headquarters or at its customers' facilities on the use and application of its products. Many courses are taught with the aid of industry recognized experts. All are structured to maximize the return on your investment of time and energy. They are three days in length and have a registration fee of $1,000 per person. Schedules are published quarterly.

Seminars

On an as-needed basis and at the introduction of new products, Zoran holds one-day applications seminars at various locations around the country. Contact your salesman and watch your mail for announcements regarding these seminars.

Consultation

Systems engineers and applications support personnel are available on a contract basis to assist customers in the use of Zoran products. Consultants fees are approximately $1,000/day, depending on complexity. Contact Zoran for an exact quotation on your needs.

Software Support Package

The software support package includes the following, at a rate of $1000 per year.

- Notification of all software updates
- Annual package of all software updates, plus documentation
- Telephone "Hot Line" service

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