



# VS 18000 Model 1950 System & Upgrades

## HIGHLIGHTS

- The Model 1950 provides over 1.7 times the CPU performance of the VS 16000/850 and over 4 times the CPU performance of the VS 8480.
- Substantial improvement in price/performance value as compared to previous high end VS processors
- Available as in-system upgrades for VS 300, 7000, 8000, 9000, 12000/650 and 16000 systems
- Upgrades available for VS 10000 and VS 12550 systems
- No application software changes required. Supported only by Y2K compliant VS Operating System releases.
- Uses existing Wang I/O controllers and peripheral components
- Base Systems are equipped with 256MB of main memory, upgradable to 2GB
- Multi-level system cache enhances performance

## Introduction

The VS 18000 Model 1950 is the first member of a new generation of VS processors that provide increased CPU processing power while retaining backward compatibility with other VS models. The VS 18000 uses the same I/O subsystem and controllers, as Wang's other high-end VS families. The VS 18000 is available as a complete new system and as an in-system upgrade for VS 7000/8000/9000, VS 12650 and VS 16000 systems. Upgrade programs are available for VS 10000 and 12550 systems.

VS 18000 systems feature a complete, new Central Processor Chip (the CP-18 chip) that is housed on a new Wang designed CPU/memory board.

## Designed for Performance

The CP-18 processor design is focused on providing substantial performance gains in the execution of typical mixes of VS instructions. Performance gains are the result of advanced features designed into the system. Not all instructions achieved the same performance gains; thus the relative performance of a VS 18000 is dependent upon the actual instruction mix. The nominal performance gain of the Model 1950 relative to the VS 16850 is over 1.7 times. The gain relative to other processor models is greater.

## Designed for Upgrades

The VS 18000 processor was specifically designed to facilitate in-system upgrades of VS 8000, VS 12000 and VS 16000 class machines. This strategy simplifies the upgrade process by allowing most upgrades to be installed with a minimum of disruption. The VS 18000 processor may be configured in GENEDIT as a VS 16000. The CPU microcode masks all technical differences from the Operating System without impacting performance.

## Complimented with Services and Support

An upgrade can add power to a system, but optimal delivery of that power to end-users can involve extensive configuration planning and tuning. Wang's service organizations are able to provide extensive technical resources to help bring the VS 18000 on-line and to peak performance quickly and with minimum disruption.

## Architectural Overview

The VS 18000 processor implements the general VS architecture with the goal of providing substantially more processing power than its predecessors.

## Central Processor & Memory Subsystem

The VS 18000 central processor chip was designed by Wang's engineering team, and fabricated using LSI Logic's state of the art G10P process. The chip incorporates a CPU engine adapted from the VS 16000 and earlier designs.

The process used for the CP-18 chip provides a  $.25\pm$  micron effective channel length as compared to a  $.5$ -micron effective channel-length in the VS 16000. The actual area of the chip used to process instructions is reduced by about 75% from the space used in the CP-16. Smaller components, packed closer together allow a CPU to operate at a much higher speed.

**Control Store Relocation** – VS processors are built using a micro-program engine that executes a control program generally referred to as CPU microcode. The control program actually controls the operation of the hardware. The CP-18 differs from earlier designs, in that control memory, the place where the CP micro-program is stored, is inside the CPU chip where it can operate at CPU compatible speeds.

**Enhanced Cache Design** – The CP-18 chip provides a significantly larger primary cache in the chip, reducing delays needed to access instructions or data. The VS 18000 processor has a dedicated 16KB instruction cache and a separate dedicated 32KB data cache. The VS 16000 provides a 16KB primary cache that is shared between instructions and data. The larger cache size permits more instructions and data to be on-chip and has a significant impact on the performance of many CPU intensive operations.

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**Added Branch Support** – In a modern processor, the CPU is designed to execute an instruction in several steps, using a technique called pipelining. While one instruction is executing, a part of the CPU is decoding the following instruction, gathering the data it will need and otherwise preparing it for execution. This approach has a problem when a test and branch instruction is being executed. If the test is passed, the next instruction is taken from a new location in memory; the preliminary work on the next instruction is discarded and the CPU must wait for the preliminaries to be completed on the new instruction. In the CP-18 processor, a new technique is being employed. The CPU prepares both possible instructions and is thus able to take a branch with a very small performance penalty.

### **Chip details**

The VS 18000 chip contains the equivalent of 3.5million transistors.

The VS 18000 CPU has a microinstruction cycle time of 17 nanoseconds. When compared to earlier VS processor designs, a larger percentage of instructions can be executed in a single microinstruction cycle.

A two-level cache memory design is used. A 16KB primary instruction cache, located on-chip, operates at CPU speeds, as does a separate 32KB on-chip Data Cache. This architecture allows simultaneous fetch of data and instructions. The 1MB secondary cache is located on the CPU/memory board. In the event of a read miss in the primary cache the data is automatically updated from the secondary cache with only an 8.5 nanosecond penalty. Due to its larger size, the cache structure provides a higher hit rate than prior machines. The dual cache approach allows the CPU to fetch a new instruction at the same time as it is fetching data for the current instruction.

### **System & I/O Buses**

The system bus is a high-speed data path used to provide fast and reliable movement of data within the VS. It interconnects the processor complex with other system components. Operating at a peak interconnect bandwidth of 66.7MB per second, the bus provides a 64 bit data path and a 32-bit address path. A private bus connects the CPU with the memory control unit.

The I/O bus is used to interface up to 15 I/O Controllers (IOCs) to the system. The 32 bit wide I/O bus operates at a speed of 30.3MB/Sec, a speed matched to the performance and needs of the IOCs. An IOC can transfer unlimited amounts of data to and from main memory. The System Bus Interface (SBI) is a specialized interface that is used to interface the I/O and system buses and to complete the movement of data to and from either bus.

### **Memory Subsystem**

The VS 18000 supports an advanced three-level physical memory system. In addition to the primary on-chip cache, and secondary cache, the system provides main memory.

Main memory consists of up to 8 256MB Memory modules. A memory module consists of two custom designed 128MB SIMMs. Main memory provides up to 2GB of main memory.

A high performance interface unit called the Memory Control Unit (MCU) manages requests to memory. The MCU handles:

- Buffered overlapping read and write requests
- Global memory control including refresh, memory scrubbing and read/write access
- Error detection and correction logic during reads and refresh operations
- Double word read and write (64 bits) in a single reference
- Quad word read in a single reference (128 bits)
- Cache Concurrency and Invalidation

The MCU provides direct access memory services to the Central Processor, attached I/O processors and when necessary the Support Control Unit. This direct access allows the I/O subsystem to complete assigned activities without CPU involvement in memory transfers.

### **Support Control Unit (SCU)**

The SCU is an independent PC with custom interface components that allow it to serve as a command and diagnostic console as well as a control workstation or system console (known as workstation zero). The SCU has direct access to the central processor, Memory Control Unit, System Bus Interface Unit(s) via the system bus.

The SCU performs the following functions:

- Dynamic hardware error logging
- Microcode and diagnostic code loading
- Initial Program Load (IPL)
- Local/remote system administration
- Memory Dump Operations (to a private disk located in the SCU)
- Standard VS workstation operations
- Local/remote maintenance including hardware and software support.

### **I/O Subsystem**

The overall performance of the VS 18000 is only partly due to its powerful central processor. In commercial data processing and application server environments, the rapid and efficient movement of data is critical to overall performance and throughput. The design philosophy of the VS is to off-load the management of external devices to satellite processors, called I/O Co-processors (IOCs) that have been specially constructed to provide this service. This design frees the CPU to concentrate on productive computing operations and end user work since the IOC performs all of the time dependent interface activity to peripherals such as disk drives. The design also allows construction of a simpler operating system since code running in the IOC can deal with

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the particular nuances of a device and need report only success or failure to the CPU.

Communications between the CPU and the IOCs depend upon a message-based structure of I/O control words and I/O Status words. In a typical interaction, the CPU sets up an I/O operation by reserving a section of main memory for data that is to be transferred and then giving the IOC specific direction as to which devices are involved and what processing is required. The requesting end user task is then placed upon a queue of tasks awaiting event completion where it remains until the I/O operation is complete and processing can resume.

A wide variety of IOCs are supported. These are generally classified into the following groups:

**Mass Storage IOCs** supporting the connection of shared disk and tape devices.

**Local Connection IOCs** provide attachment of local terminals and printers as well as other devices generally found at the same site as the Central Processor. These include IOCs that provide connection via high performance proprietary links as well as those that provide standards based connections such as Asynchronous and 802.3 LAN.

**Network Connection IOCs** provide a vehicle for the VS to interface to common Wide Area Networks via a variety of protocols including TCP/IP, OSI and SNA.

**Specialty IOCs** are used to interface applications to application unique hardware such as optical jukeboxes.

A full list of supported controllers is located on the last page of this data sheet.

## Supported Devices

Each IOC can support one or more specified devices. Specific Operating System releases or application software may be required to support a given device. Limits to the maximum number of workstations total devices and devices of a specific type may be limited by the operating system release being used.

**Non-Wang Devices** - Wang does not warrant the operation or performance of non-Wang devices and peripherals attached to a VS 18000 system, or the functionality or performance of VS 18000 systems configured with non-Wang devices.

## Licensed Microcodes

VS 18000 systems sold by Wang include licensed CPU microcode that is loaded into the CP-18 chip at system IPL time. This code is the property of Wang Global and is licensed to the original purchaser of the hardware board for their sole and exclusive use in operating the hardware. These microcode files are not transferable to any future owner of the hardware board.

The microcode requires the presence of one or more hardware keys to properly load and operate. These keys, provided with the system or upgrade, are the property of

Wang and must be surrendered if the hardware is transferred to a new owner.

## VS Operating Systems (VSOS) Support

The VS 18000 has been designed to use only the virtual to physical address translation mechanism available in OS 7.53. The micro-code does not support the older, more limited translation mechanism used in prior operating systems and high-end VS systems. Standardization of the translation process on the newer mechanism only allowed other performance enhancements to be added to the processor. The VS 18000 processor has been tested with, and is certified on OS release baselines 7.53.00 or later. This processor will not operate on any earlier OS baselines such as 7.20 or 7.40.

Support for **VS Virtual Machine (VM)** is not available at First Customer release of this processor.

### Software/Microcode Deliverables

VS 18000 systems purchased from Wang include the required VS OS License, licensed processor microcodes, hardware enabling key for microcodes, software license keys and software media and documentation. Licensed OS Software is the VS Century Software Product (CSP), which includes VS OS 7.53.

VS 18000 Upgrades require that the Pre-upgrade systems must be properly licensed with the VS CSP product. Wang recommends that the OS 7.53 component of the VS CSP be installed on the pre-upgrade machine. VS 18000 upgrades include the required VS OS License, licensed processor microcodes, hardware enabling key for microcodes and software license keys. Some upgrades may require more than one enabling key. Upgrades do not include OS Media or Documentation.

The VS Operating System and licensed processor microcodes require the presence of a hardware authorization key, which Wang provides to each valid licensee. Enabling keys remain the property of Wang and are provided to the customer solely for the purpose of allowing access to the software and licensed CP microcodes. Should the license be terminated the key must be surrendered to Wang. Keys may require periodic replacement or updating.

### Application Software

A wide variety of Wang and third party application software is available for the VS 18000. For Wang Licensed Applications the VS 18000 is a tier V machine.

## Warranty

VS 18000 systems are sold with a 90-day limited warranty. System warranty service is provided on-site at the customer location. Warranty service is equivalent to VS 18000 Premium Service when the customer has contracted for post-warranty service. Otherwise warranty service is next business day response.

Warranty terms differ for upgrades. Please consult the applicable upgrade data sheet for details. In locations outside the United States different warranty terms may apply.

Warranty, installation and service information presented in this document is applicable only in the United States. For other locations consult the local Wang Subsidiary or Distributor.

## Manufacturing Location

VS 18000 Systems and Upgrades have been designed and are manufactured by Wang at our Tewksbury, MA facility.

## VS 18000 Architecture Summary

Main Memory Access Time for 16 byte read .....	238 ns
Main Memory Access Time for 8 byte write .....	102 ns
Arithmetic Unit (ALU) Width .....	32 bits
I/O Bus Bandwidth .....	33.3 MB/sec
System Bus Bandwidth .....	66.7 MB/Sec
Main Memory Bandwidth .....	78.4 MB/Sec
Primary Cache Size (on-chip) .....	16KB Instruction + 32KB Data
Secondary Cache .....	1MB
Internal Memory Width (bits) .....	128
32 bit General Registers .....	16
64 bit Floating Point Registers .....	4
32 bit Control Registers .....	16
64 bit Segment Control Registers .....	4
Main Memory Capacity .....	256MB to 2GB
I/O Controller Slots .....	15

Note: Upgraded Systems in certain cabinets have fewer I/O slots.

### Supported I/O Controllers

The VS 18000 supports the Wang I/O Controllers (IOCs) listed below. Not all OS releases support all IOCs in the same manner. Consult with Wang for details.

#### Mass Storage

70V68-2 .....	Dual Port High Performance Caching SCSI IOC
70V98 .....	High Performance Caching SMD Disk IOC
70V14 .....	Fiber Optic Resource Sharing Facility IOC
70V68-1* .....	Single Port Basic Performance SCSI Tape IOC
23V98* .....	Basic Performance SMD Disk IOC
23V95-1* and 23V95-2* .....	Magnetic Tape IOCs
23V14 .....	Cable based Resource Sharing Facility IOC is not supported.

#### Local and Network Connection

23V67 .....	Modular Serial IOC
70V67 .....	High Capacity Modular Serial IOC
23V46 .....	Local Asynchronous IOC
23V86A .....	Asynchronous IOC
70V56 .....	802.3 IOC
23V96 .....	Multi-line TC IOC

#### Image

23V24 .....	WIIS Image Transfer Controller IOC
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- Designates I/O Controllers that are supported for historical reasons. Newer, higher performance alternatives are available and recommended. Performance of the system may degrade when these IOCs are used.
- Note: There are or may be configuration limits on certain IOC combinations due to power requirements, operating system support or other engineering considerations. The Wang representative should validate all configurations.

**Wang Asynchronous Communication Subsystem (WACS)** WACS boards may be installed in an IOC slot, however external mounting is recommended.

**Non-Wang Controllers:** Wang has not tested or certified any non-Wang IOCS on this platform. Wang cannot warrant the performance or functionality of non-Wang controllers in the VS 16000 system. **Wang will not warrant the operations or performance of systems employing non-Wang Controllers.**

## Product Specifications

### Physical Dimensions

Height including Casters .....	42 inches (106.68cm)
Width .....	39 inches (99.06cm)
Depth .....	25 inches (63.5cm)
Weight .....	450 lb. (205kg)

### Temperature Range

Operating Environment .....	60° to 90°F (15.5° to 32°C)
Storage Environment .....	0° to 120°F (-18° to 40.4°C)
Transit Environment .....	-40° to 140°F (-40° to 60°C)
Maximum Rate of Change .....	12°F/Hr (4°C/Hr)

### Humidity Range

Operating Environment .....	20% to 80% non-condensing
.....	[maximum wet bulb temperature 75°F (19°C)]
Storage Environment .....	10% to 90%
Transit Environment .....	5% to 90%
Altitude Range .....	0 to 10,000 ft (0 to 3048m)

### Service Requirements

SCU: .....	115VAC 3.0amp / 220VAC 1.5amp 50 or 60 HZ
CPU: .....	208/240VAC at 30-amp service, 50 or 60HZ
Maximum Heat Dissipation .....	2,750 watts (9,372btu/hr)
Power Connections: Consult the local Wang Service Organization for connection information.	
FCC Environment .....	Class A
Acoustic Environment .....	Class C



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