ADAGE

ADAGE 3000 COLOR RASTER DISPLAY SYSTEM

Computer graphics—the remarkably successful union of technical innovation and human creativity. Certainly the most efficient way to present, manipulate, and understand vast amounts of complex visual data. Highly productive. And, with its fast response and dynamic interaction, a vital stimulus to human creativity.

The Adage 3000 System—with its high performance, local processing power, and large image memories—takes demanding interactive applications in stride. It is already working for users in cinematography, industry, medicine, and science. It could be working for you, too.
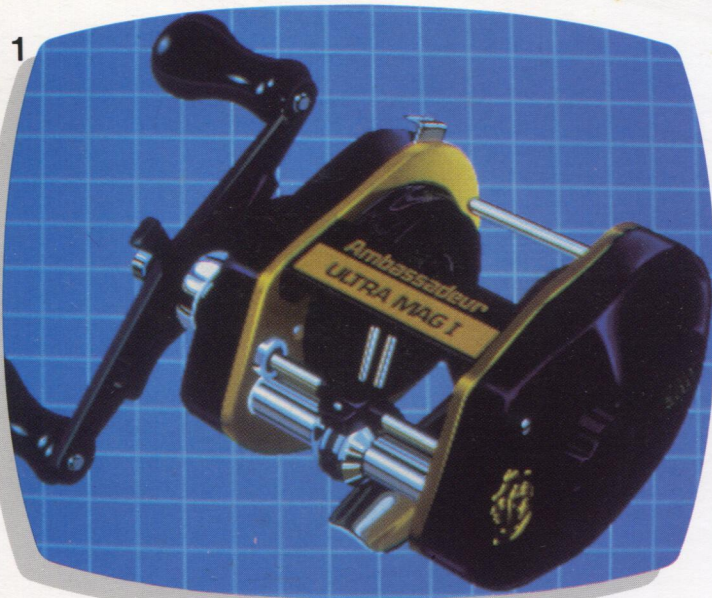
Typical high-resolution, fast-interaction applications being handled by the Adage 3000 System include: Animation, Image Processing, CAD/CAM, 3-D Modeling and Simulation.
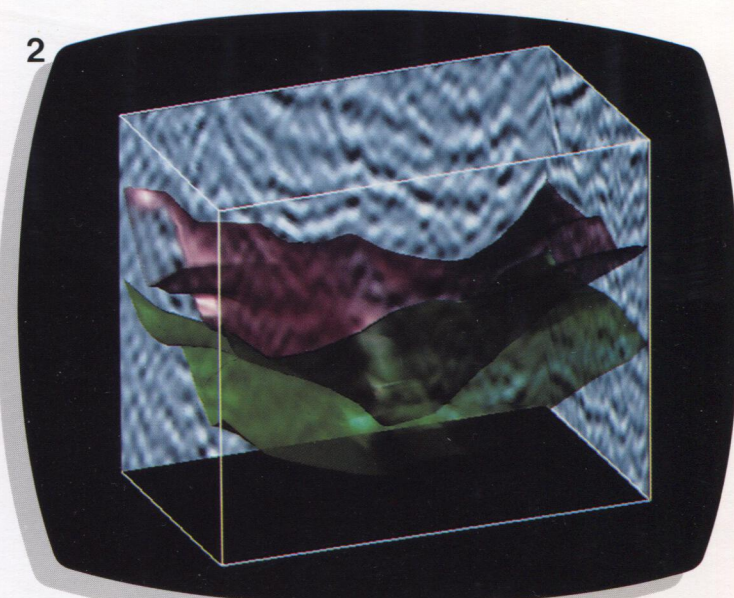
Applications depicted below are:
1. *Animation* (photo credit: Client: Garcia; Agency: Y & R—Special Markets; Production: Computer Creations, Inc.).
2. *Seismic Analysis*
3. *Simulation* (photo credit: Research Triangle Institute and NASA/LARC).
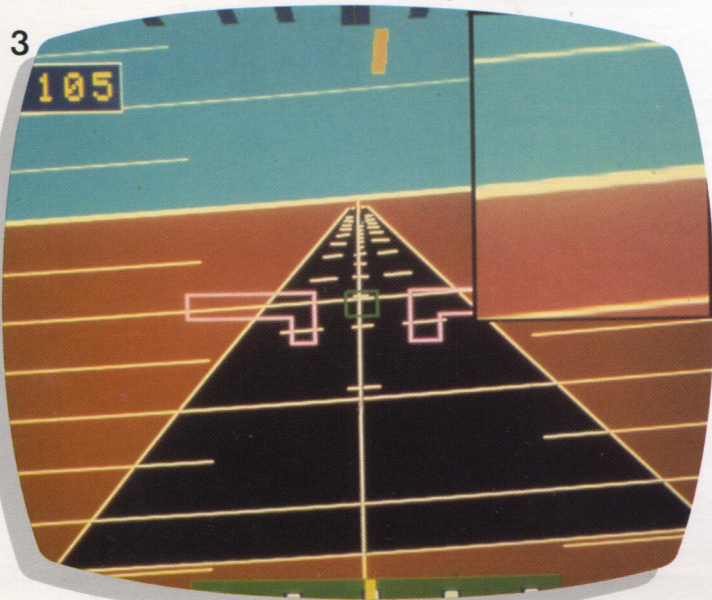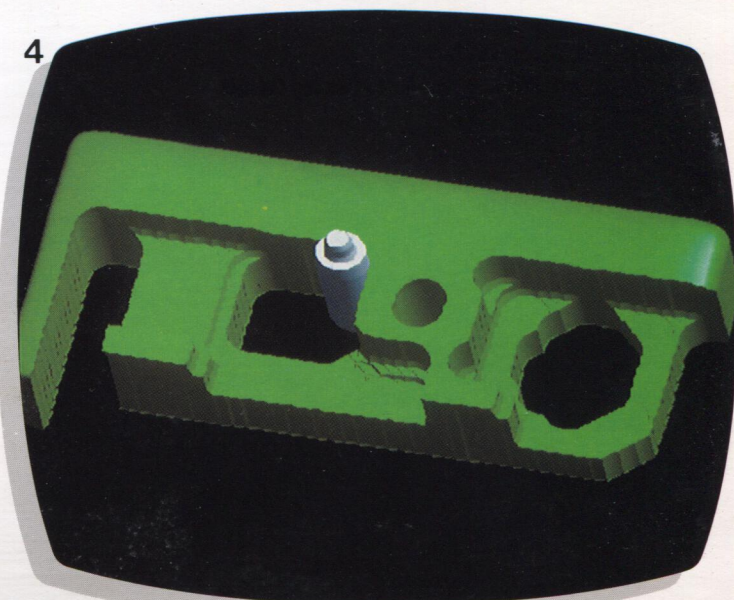4. *Solid Modeling Display*—Milling function

HIGH-PERFORMANCE FEATURES FOR COMPUTER GRAPHICS AND IMAGE PROCESSING APPLICATIONS.

- Wire-frame, solid-fill and shaded-surface images on same display.
- Rapid image generation by multiple processors.
- Programmable display formats.
- Large display memory capacity.
- Host computer interfaces to popular minicomputers.
- Modular design for easy system configuration and expansion.

The Adage 3000—with its multi-processor architecture, advanced hardware and modular design—combines the superior interactive performance common to Adage vector refresh workstations with the unique advantages of color raster technology. With the 3000 System, you'll be able to generate color vectors, polygons, circles and rectangles…create solid-fill areas and shaded surfaces by selecting from up to 16 million colors…and combine high-resolution graphics and text in a single image.
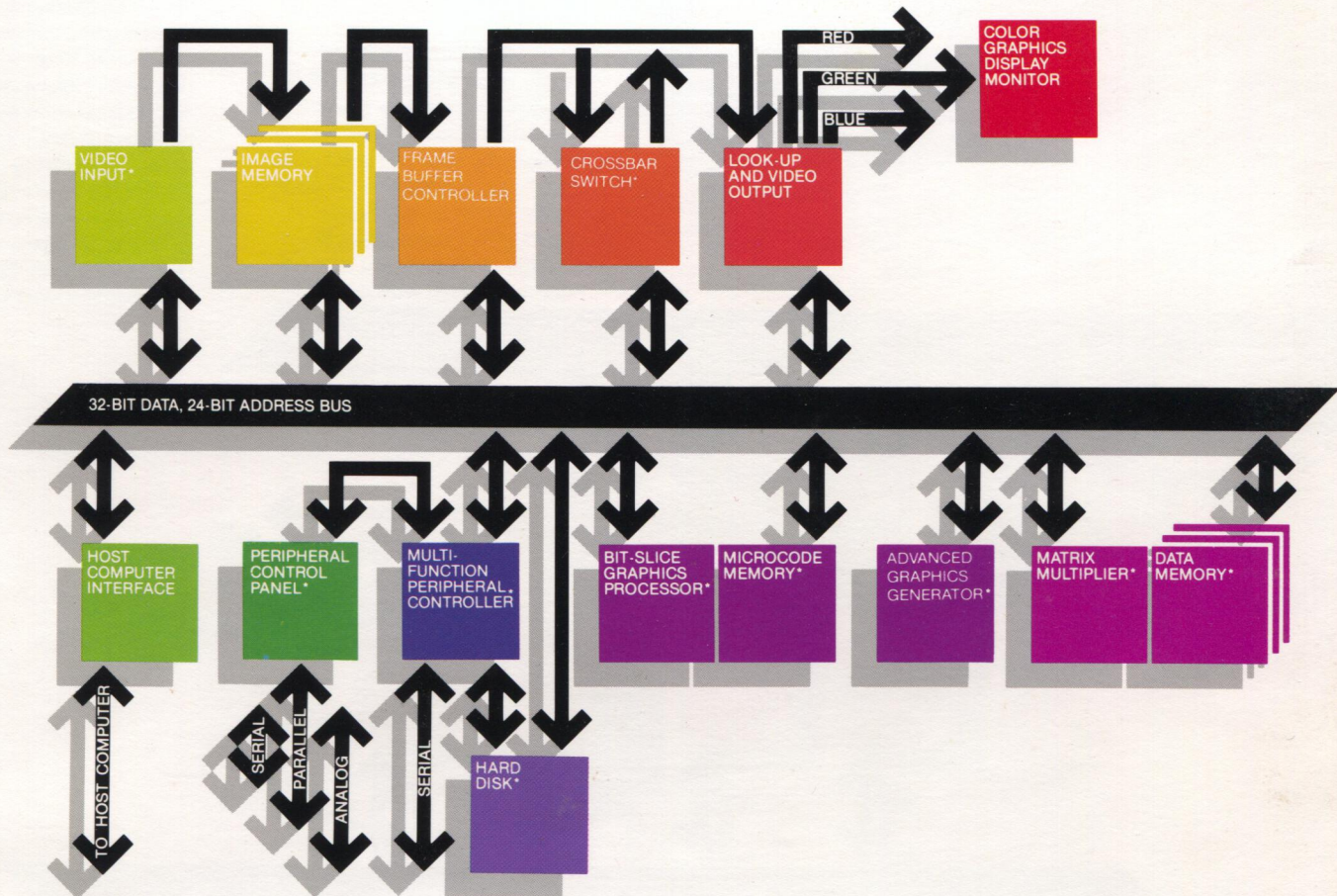
Among the many 3000 System capabilities are:

- Fast image generation—thanks to the system's parallel execution of time-consuming computational tasks.
- User-programmable selection of display formats—to provide the best format for each individual application.

- Real-time multi-tasking software—allowing the user to customize programs to suit the application.
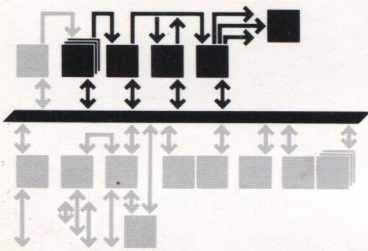- An extensive selection of optional features and peripheral devices.

The Adage 3000 System is made up of a number of hardware modules that provide display, processing, and input/output capabilities. The 3000 System's architecture is based on a synchronous communications bus into which all system modules plug. Microstrip transmission line technology enables this 32-bit data, 24-bit address bus to run with a 208 nanosecond transfer time. All system control registers, as well as memory modules, are within the address space of the bus.

Because all modules are connected independently to the bus, each 3000 System can be configured for a particular application with the most cost-effective selection of memory size, display size, processing power, and other features.

The relationship of the communications bus, individual modules, and functional groups is illustrated below. The functional groups are described on succeeding pages.

RED
GREEN
BLUE

COLOR GRAPHICS DISPLAY MONITOR

VIDEO INPUT*

IMAGE MEMORY

FRAME BUFFER CONTROLLER

CROSSBAR SWITCH*

LOOK-UP AND VIDEO OUTPUT

32-BIT DATA, 24-BIT ADDRESS BUS

HOST COMPUTER INTERFACE

PERIPHERAL CONTROL PANEL*

MULTI-FUNCTION PERIPHERAL CONTROLLER

BIT-SLICE GRAPHICS PROCESSOR*

MICROCODE MEMORY*

ADVANCED GRAPHICS GENERATOR*

MATRIX MULTIPLIER*

DATA MEMORY*

TO HOST COMPUTER

SERIAL
PARALLEL
ANALOG

SERIAL

HARD DISK*

* OPTIONAL

DISPLAY CAPABILITIES

IMAGE MEMORY

The 3000 System's Image Memory provides up to 12 megabytes ($2048^2 \times 24$) of storage. This extensive memory capacity gives the user as many as 16 million display colors and also allows storage of considerably more data than can be displayed at one time. This is an important advantage in such applications as movie-loop animation and remote sensing. With the Display Controller's pan and scroll capabilities, the user can examine different parts of a large image without reloading the image memory.

All 3000 System image memories incorporate write and erase masks which permit the restriction of write and auto-erase functions to selected bit planes. Such flexibility of control is especially useful for double-buffering and movie-looping applications. The user can also write to a single plane without disturbing data on other planes, simplifying the use of a single bit plane as an overlay.

Memory modules GM64 and GM256 incorporate a "Mask Mode" write function, allowing users to write up to 32 pixels of a single color in a single write cycle. This ultra-fast area-fill capability significantly improves display update speeds.

The new DB256 memory modules are more cost-effective in applications which do not require the 2048 x 2048 storage capability of the GM256.

The 3000 System's Image Memory can be dynamically reconfigured under program control to provide either 512^2 or 1024^2 display formats.

FRAME BUFFER CONTROLLER

The Frame Buffer Controller provides a number of advanced features, including pan, scroll, zoom and programmable cursor. It is also responsible for the 3000 System's Program-mable Display Format feature. This unique capability lets the user select the most effective display format for his particular application: 525 lines (30Hz) to video tape images in NTSC format with external sync, 512^2 visible images at 30Hz refresh rate for fast response, 512^2 (60Hz) for flicker-free display, or 1024^2 (30Hz) for high resolution.

COLOR LOOK-UP AND VIDEO OUTPUT

The 3000 System's Color Look-Up/Video Output function allows the user to select either 8-bit pseudocolor or 24-bit full-color display, depending on application requirements. Image enhancement can be accomplished with pseudo-color. Other applications may necessitate the realistic display of smooth-shaded solid reconstruction, requiring the use of full color.
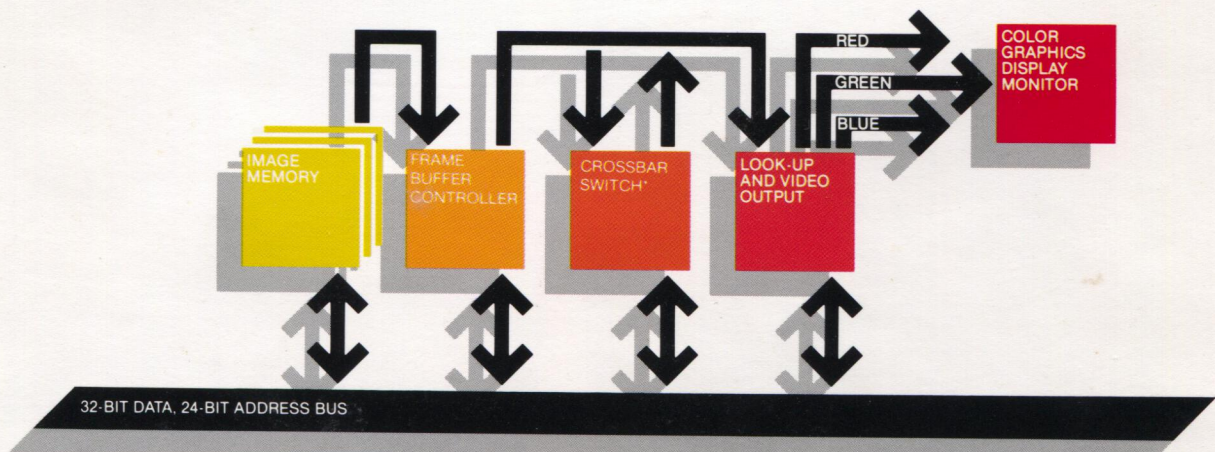
Each Color Look-Up/Video Output module contains three 8-bit look-up tables (one each for red, green and blue) and three ultra-high-speed 8-bit digital-to-analog converters. Optional 10-bit look-up tables and digital-to-analog converters are available for color-critical applications requiring gamma correction. A further 3000 System option, utilized with the Crossbar Switch feature, provides up to eight overlay bit planes.
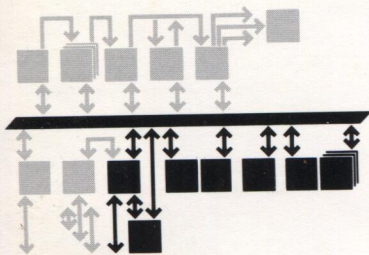
COLOR GRAPHICS DISPLAY MONITORS

Color Graphics Display Monitors for the 3000 System are ultra-high resolution, shadow mask, in-line gun raster scan units. Model MON19/LS supports 512 visible line (30Hz) and MON19/HS supports 512^2 visible (60Hz refresh) flicker-free display format and a 1024^2 visible (30 Hz refresh) display format.

CROSSBAR SWITCH

The 3000 System's Crossbar Switch gives the user complete freedom in mapping stored bit planes to look-up table inputs. Application uses include selecting the number of bits per color; the splitting of stored bits for double-buffering when more than one frame time is needed to compute a new view; and the display of 10-bit data in pseudocolor or gray scale.

RED
GREEN
BLUE

COLOR GRAPHICS DISPLAY MONITOR

IMAGE MEMORY

FRAME BUFFER CONTROLLER

CROSSBAR SWITCH*

LOOK-UP AND VIDEO OUTPUT

32-BIT DATA, 24-BIT ADDRESS BUS

*OPTIONAL

PROCESSING CAPABILITIES

GRAPHICS PROCESSOR

The 3000 System Graphics Processor is a powerful, 32-bit user-programmable bit-slice computer. Able to access and controll all system features, it creates graphics for display, manipulates existing images, creates color look-up tables and controls functions such as pan, zoom and cursor location. With its advanced architecture and highly parallel 64-bit microcode, the Graphics Processor is able to execute several operations in a single instruction cycle, providing exceptionally fast image generation, smooth motion for dynamic images, and high throughput rates for animation. The Graphics Processor is supported by a FORTRAN-based cross assembler and a graphics primitives package.

MATRIX MULTIPLIER

The Matrix Multiplier performs 2-D and 3-D perspective transformation of vectors, polygons, curved surfaces and solids. Performing transformations locally and in parallel with the Graphics Processor assures faster image generation and better real-time response. The Matrix Multiplier also provides clipping assists, and is user programmable for specific functions such as bi-cubic spline manipulation.

MULTIFUNCTION PERIPHERAL CONTROLLER

The Multifunction Peripheral Controller, a building block for workstation and stand-alone configurations, contains a 16/32-bit general-purpose microprocessor (Motorola 68000) with up to 512K bytes of memory. It also has four RS232 ports. By interfacing interactive devices directly to the display device, the 3000 System Multifunction Peripheral Controller eliminates the need for host computer intervention, speeding the acquisition of interactive inputs from the user. Standard software consists of a multi-tasking, real-time monitor with interactive routines and a provision for user-supplied programs. The powerful AUS™ operating system is also available for full flexibility in workstation configurations.
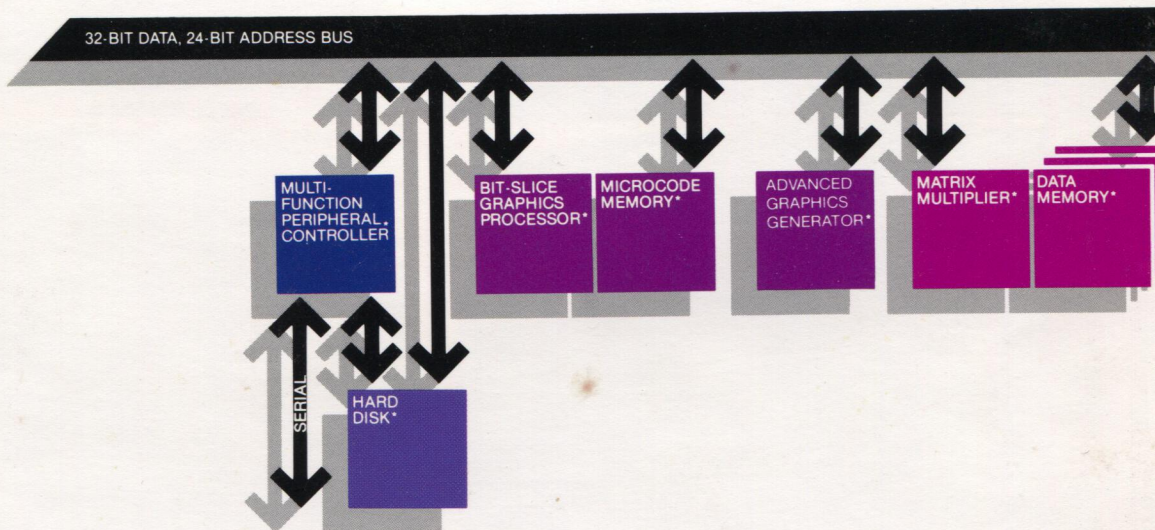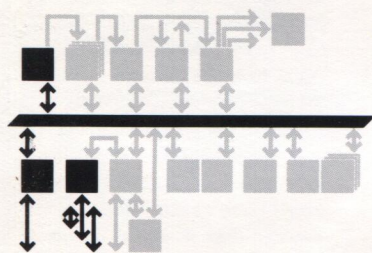
HARD DISK

A dual-ported Hard Disk may be added to the 3000 System. One port, to the system bus, is used to transfer data to other system modules, such as image memory. The other port is to the Multifunction Peripheral Controller and enables the Hard Disk to serve as a system disk in stand-alone configurations.

ADVANCED GRAPHICS GENERATOR

The Advanced Graphics Generator is a 16-bit user-programmable bit-slice computer used in conjunction with the 3000 System Graphics Processor. It provides high-speed rendering of polygons and character strings. This attribute is particularly suited for flight simulation and real-time applications.

32-BIT DATA, 24-BIT ADDRESS BUS

MULTI-FUNCTION PERIPHERAL, CONTROLLER

BIT-SLICE GRAPHICS PROCESSOR*

MICROCODE MEMORY*

ADVANCED GRAPHICS GENERATOR*

MATRIX MULTIPLIER*

DATA MEMORY*

SERIAL

HARD DISK*

* OPTIONAL

INPUT/OUTPUT CAPABILITIES
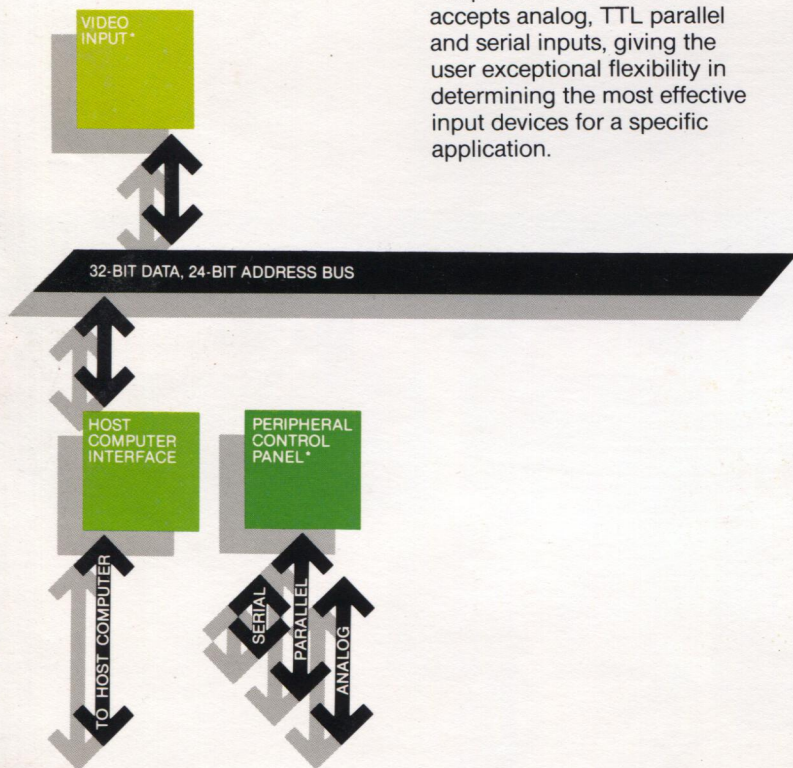
HOST COMPUTER INTERFACE

Host computer access to the 3000 System's image memory, system control registers, graphics processor, and data memory is provided by the Host Computer Interface, which can handle data transfers in both programmed input/output (PIO) and direct memory access (DMA) modes.

VIDEO INPUT MODULE

The 3000 System's Video Input Module digitizes video signals (RS170) from a television camera or video tape recorder and stores them in image memory. The module is available in monochrome (one-channel) or color (three-channel) models and runs in real-time 512 x 512 at 30Hz interlaced.

PERIPHERAL CONTROL PANEL

The Peripheral Control Panel connects to the Multifunction Peripheral Controller, allowing additional interactive input devices to be interfaced directly to the 3000 System. The Peripheral Control Panel accepts analog, TTL parallel and serial inputs, giving the user exceptional flexibility in determining the most effective input devices for a specific application.

VIDEO INPUT*

32-BIT DATA, 24-BIT ADDRESS BUS

HOST COMPUTER INTERFACE

PERIPHERAL CONTROL PANEL*

TO HOST COMPUTER

SERIAL PARALLEL ANALOG

INTERACTIVE PERIPHERAL DEVICES

Interactive peripheral devices supported by the 3000 System interface to either the Multifunction Peripheral Controller (serial devices only) or to the Peripheral Control Panel. Devices available include an alphanumeric CRT console, data tablet, control dials, joystick, lighted function switches, and a trackball.

SOFTWARE

DIAGNOSTICS

All 3000 Systems are supported by a package of diagnostic programs, called AIDS, which fully exercises all system functions. AIDS programs are written in FORTRAN and are run on the host computer.

DRIVERS/SUPPORT

The 3000 System is supported by drivers for the following operating systems: DEC RT-11™, RSX-11M™, and VMS™, UNIX™ Version 7 (16 bit) and UNIX 4.1 (32 bit).

FSS 3000 is the standard package of FORTRAN Support Subroutines that provides such features as local rotation and perspective viewing, anti-aliased vectors, high-speed characters, and Z-buffer hidden surface displays.

IKASM™ is a cross assembler for the microprogrammable elements of the 3000 System— the Graphics Processor and Matrix Multiplier. IKASM is written in FORTRAN and is run on the host computer.

IDL2 is a graphics primitives language which enables the user to write display programs for execution by the Graphics Processor. The IDL2 environment includes a compiler which runs on the host computer, and a set of microcode routines and an interpreter which run on the Graphics Processor. IDL2 is particularly appropriate in simulation applications requiring interaction with a set display format.

The AUS operating system is a UNIX derivative. Used in conjunction with the Multifunction Peripheral Controller and the Hard Disk, it makes the 3000 System a powerful stand-alone system or workstation.

ICROSS-3000, available from Intermetrics, Inc. is a C-to-microcode cross assembler which permits the user to alter or add microcode for execution by the bit-slice Graphics Processor.

SOLID MODEL DISPLAY AND SEISMIC DISPLAY PACKAGES

Microcoded, FORTRAN-callable subroutine packages for solid model display and seismic display are available for the Adage 3000 System. Intended for software developers integrating the Adage 3000 into new or existing interactive CAD applications, the SOLID 3000 package allows the rapid display of 3-D solid modeling data, as well as interactive 3-D transformations of solid, shaded objects.

SEISMIC 3000 allows rapid display and interactive manipulation of 2-D and 3-D seismic data on the Adage 3000 System. The easy-to-use graphics and imaging functions of SEISMIC 3000 are tailored to the data formats and display requirements needed for interactive seismic systems.

Both SOLID 3000 and SEISMIC 3000 are in addition to the standard Adage FSS 3000 FORTRAN package.

UNIX™ is a trademark of Bell Laboratories.
DEC RT-11™, RSX-11M™, and VMS™ are trademarks of Digital Equipment Corporation.
IKASM™ and AUS™ are trademarks of Adage, Inc.

*OPTIONAL

ANIMATION APPLICATIONS

1. The 3000 System is a particularly valuable tool in animation and video production applications. By off-loading display generation from the host computer to its own powerful Graphics Processor, it dramatically reduces the time required to generate complex images. Among the many "artistic" uses for the 3000 System: the realistic rendering of complex solid models and other imagery and the production of special effects such as a "chrome" look or an airbrush treatment. (photo credit: Joblove/Kay)

IMAGE PROCESSING APPLICATIONS

2. The 3000 System's large image memory and programmable Graphics Processor make it the ideal display system for image processing applications. Multispectral imagery, typical of remote sensing applications, is handled with ease. With complete random access to the image memories, the Graphics Processor can process partial-screen as well as full-screen areas. Interpretation of image data is made easier by fast look-up tables for pseudocolor image enhancement, and by overlay planes, which add identifying information to the display. (photo credit: O. Brown, R. Evans/University of Miami)

CAD/CAM APPLICATIONS

3. The 3000 System greatly simplifies the CAD/CAM designer's job, too. Its high-performance architecture and image processing elements permit real-time image manipulation. And its highly parallel microcode can often execute in one instruction operations that require multiple instructions on the other processors. Additional 3000 System features of special interest to the CAD/CAM designer include local 3-D transformations, double-buffering, and ultra-fast area fill.

3-D MODELING APPLICATIONS

4. The 3000 System brings many extra dimensions to 3-D modeling applications. Most important, it can display and manipulate 3-D wire-frame or solid images on the same display system. It can also remove hidden surfaces, shade visible surfaces or add sharp, crisp colors—by the millions. The 3000 makes it easier to visualize inner structures with cut-away views and transparent surfaces. And, it cures the "jaggies" with its special anti-aliasing feature.
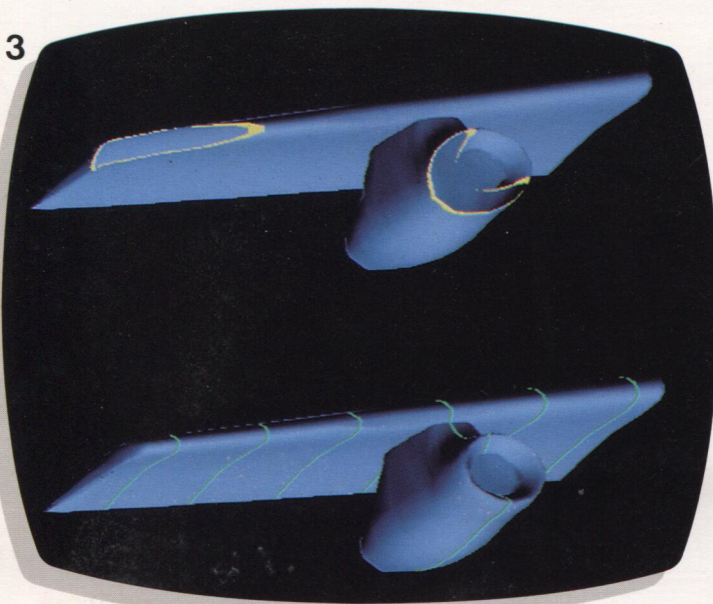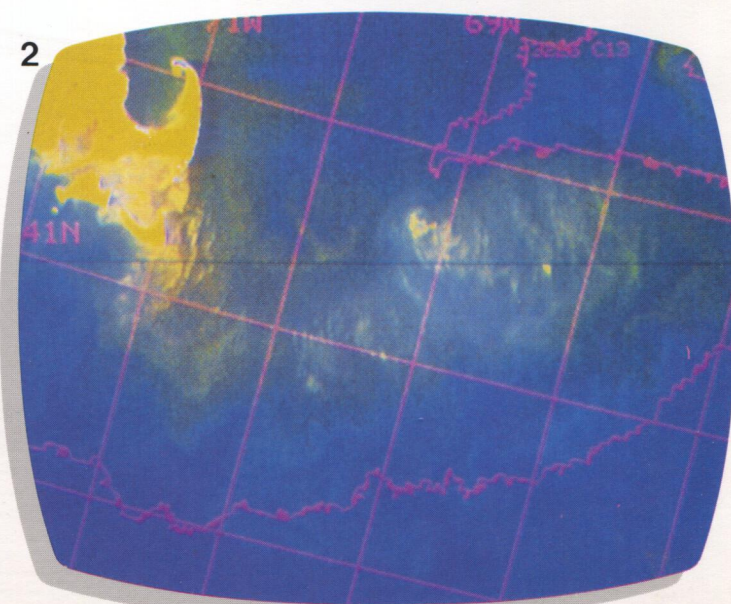
DISPLAY HARDWARE SPECIFICATIONS

■ IMAGE MEMORY

Model	Mode	User-Programmable Format
DR64 and GM64	Storage	512 x 512 x 8 or 1024 x 1024 x 2
	Display	512 x 512 x 8 or 1024 x 1024 x 2
DR256 and GM256	Storage	1024 x 1024 x 8 or 2048 x 2048 x 2
	Display	512 x 512 x 8 or 1024 x 1024 x 2
DB256	Storage	1024 x 1024 x 8 or 2048 x 1024 x 4
	Display	512 x 512 x 8 or 1024 x 1024 x 4

Cycle Time: 416ns

Maximum Memory: 12 megabytes, i.e. Storage 2048 x 2048 x 24
1024 x 1024 x 32
Display 1024 x 1024 x 24
512 x 512 x 32

■ FRAME BUFFER CONTROLLER

Line Rate: 200 to 2000 lines per frame (programmable)
Frame Rate: 20 to 80 frames per second (programmable)
Display: Interlaced or non-interlaced (programmable)
Sync: Internal or external (programmable)
Internal: RS-170A or RS-343 (programmable)
Pan and Scroll: Pixel increments
Zoom: Integer multiples from 1:1 to 16:1

■ COLOR LOOK-UP TABLES AND VIDEO OUTPUT

Channel Selector: For pseudocolor or full color operation
Look-Up Tables: Three 1024 x 8-bit tables
Look-Up Table Inputs: 8 data bits, 1 cursor bit, 1 page bit
Optional Look-Up Tables: Three 1024 x 10-bit tables
Digital-to-Analog Converters: Three 8-bit DACs, 10ns settling time
Optional DACs: 10-bit DACs, 15ns settling time
Output: 75Ω, 1V P-P
Optional Overlay Channel: Provides 8-bit overlay channel supporting 1 to 8 overlay bit planes (requires crossbar switch)

■ COLOR GRAPHICS DISPLAY MONITORS

Technology: In-line gun raster scan
Display Size: 19" diagonal
Tri-Dot Spacing: 0.31mm ultra-high resolution
Bandwidth: 25MHz on model MON19/LS; 50MHz on model MON19/HS
Horizontal Scan Frequency: 15 to 18 KHz on model MON19/LS; 28 to 35KHz on model MON19/HS

■ CROSSBAR SWITCH *

Input (from Display Controller): 32 image-data bits; 2 register bits; and 1 cursor bit
Selector: 34 control registers
Output (to Look-Up Tables): 24 image-data bits (in three 8-bit channels); 8 optional overlay bits; and 2 look-up table page bits

PROCESSING HARDWARE SPECIFICATIONS

■ BIT-SLICE GRAPHICS PROCESSOR *

Microcode-Word Length: 64 bits
Data-Word Length: 32 bits
Instruction-Cycle Time: 208ns
Display List: 32 KB or optional 1MB
Hardware Multiplier: 16 x 16-bit multiply
Microcode Memory: 4K x 64, expandable to 16K x 64
High-Speed Data Memory: 8K x 32, expandable to 256K x 32
Vector-Drawing Rate: 2,000,000 pixels per second maximum
Polygon-Fill Rate: Up to 64×10^6 pixels per second maximum
Software: IKASM:microcode cross assembler; IDL2:graphics primitives; FSS-3000; SOLID 3000; SEISMIC 3000; ICROSS-3000:C-to-microcode cross assembler

■ MATRIX MULTIPLIER *

Coefficient Storage: 1024 x 16 bits
Instruction-Cycle Time: 208ns
Multiply and Accumulate: 16 x 16-bit multiply; 35-bit accumulate
Data-Word Lengths: 16-bit X, Y, Z, W input; 16-bit X, Y, Z, W (transformed) output; and 12-bit X, Y, Z (perspective division) output
Clipping Support: Six comparators
Transformation Rates: 280,000 points per sec. for 3-D; 200,000 points per sec. including perspective

■ MULTIFUNCTION PERIPHERAL CONTROLLER *

Processor: Motorola 68000, 8MHz
Data-Word Length: 32-bit internal, 16-bit external
System Interface: Full access to all 3000 System functions via memory mapping
External Ports: 4 serial RS-232 ports (one reserved for processor console); 1 parallel port (16 bits I/O); and 1 bus expansion port (16 bits data, 24 bits address)
Memory: 8K bytes of ROM; 32K bytes of RAM with parity; Memory Management Unit; and optional 512K bytes of RAM
Software: Multi-tasking, real-time monitor; user interface to monitor; debugging aids (program development requires user-supplied 68000 cross assembler); and optional AUS, a UNIX derivative operating system

■ HARD DISK *

Technology: 14" Winchester
Capacity: 60 or 160 Mbytes unformatted
Transfer Rate: 1 Mbyte/sec. maximum
Controller: Dual ported to 3000 System bus and multifunction peripheral controller; supports up to 4 disks with error correction

INPUT/OUTPUT HARDWARE SPECIFICATIONS

■ HOST COMPUTER INTERFACES

Host: Most popular minicomputers
Data-Transfer Modes: PIO or DMA (programmable)
Maximum Data-Transfer Rate Supported: 5.0 megabytes per sec. (host-dependent)
Host Access: Host computer has direct read/write access to all 3000 System features

■ VIDEO INPUT MODULE *

Input: RS-170 video one-channel monochrome, three-channel color
Sampling Resolution: 8 bits per sample per channel
Sampling Rate: 8 to 12MHz (programmable)
Sample Clock: Internal or external (programmable)
Window and Viewport Control: Fully programmable
Digitization Format: 16 x 16 to 512 x 512 (programmable)
Minification Factor: 1:1 to 16:1

■ PERIPHERAL CONTROL PANEL *

System Interface: Connects to parallel port of multifunction peripheral controller
External Ports: 4 serial RS-232 ports; 8 parallel TTL ports (16 bits); 16 analog ports (12-bit digitization)

INTERACTIVE PERIPHERAL DEVICES *

11" x 11" Data Tablet (serial)
3" Trackball (serial)
16 Lighted Function Switches (parallel)
8 Control Dials (analog)
CRT Terminal (serial)
Three-Axis Joystick (analog)

SOFTWARE SPECIFICATIONS

Host-Resident Software:
AIDS-FORTRAN diagnostics; FORTRAN drivers; FSS 3000; SOLID 3000; SEISMIC 3000.
● *Distribution Medium:* Magnetic tape; 800 bpi, 9 track or 1600 bpi, 9 track
● *Tape Format:* FLX or ANSI
Workstation-Resident Software:
FSS 3000; AUS 3000 (UNIX derivative)
● *Distribution Medium:* ¼" streaming tape cartridge
● *Tape Format:* ANSI

* OPTIONAL

WORLDWIDE SALES AND SERVICE:
Adage Sales and Customer Service Representatives are located throughout the U.S., Europe and Japan. For the location of the nearest Adage sales or service office, contact Adage at one of the offices listed below.

ADAGE