

**Description**

The DN590 TURBO is Apollo's high-end color graphics workstation designed specifically for compute intensive applications that require shaded 3-D graphics. The DN590 TURBO combines the dedicated computing power of the MC68020 microprocessor and the MC68881 floating point coprocessor with a series of highly specialized graphics processors. The result is a uniquely well balanced graphics workstation fully integrated within Apollo's family of workstations.

The DN590 TURBO offers truly spectacular true color graphics. A dedicated video memory offers 24 color planes and the ability to display over 16.7 million colors simultaneously in a window. For high speed 3-D rendering the DN590 TURBO offers both double buffering and Z-buffering operations. The optional 3DGA™ graphics accelerator not only transforms and clips 3-D floating point coordinates, but performs lighting model calculations at extremely fast rates. In addition, the DN590 TURBO has virtual memory graphics that lets users handle the largest and most complex graphics application without display list size limitations.

As a fully compatible member of Apollo's family of workstations, the DN590 TURBO lets users enjoy the high productivity of distributed processing afforded by the Domain® computing environment.

**Features**

- Double buffering of pseudo color images, with full Z-buffer support
- Advanced lighting model including: up to 16 light sources, 24 plane RGB support, colored light sources, attenuation of light sources, spotlights with attenuation, specularity, highlights, and surface properties

- 16.7 million colors displayed, from a palette of 16.7 million colors; 24 color bit-planes planes
- Over 130,000 3-D floating point transformed, clip-checked vectors per second with 3DGA
- Extremely fast, smooth shaded Z-buffered polygons
- 19-inch non-glare monitor; high-resolution 1280 x 1024, bit-mapped display
- Integrated MC68020 processor and MC68881 floating point coprocessor with 16K byte physical cache memory
- Up to 56 concurrent processes; 2G bytes virtual address space per process
- Optional high-performance floating point coprocessor accelerator (FPX™)
- 5¼ inch 190M byte formatted and dual 190M byte Winchester disk options; ¼ inch 60M byte streaming tape drive option
- Four-slot IEEE 796 MULTIBUS adaptor options

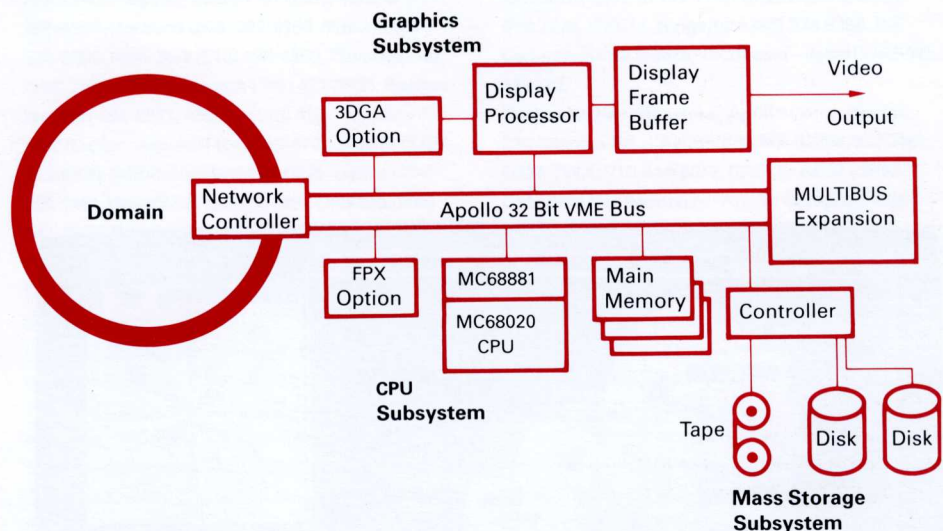
#### Benefits

- High performance compute-intensive capacity coupled with tightly integrated graphics provide a well balanced workstation environment
- Integrated graphics processors yield highest levels of interactive performance in a sophisticated 3-D multiwindow environment
- Double buffering provides smooth dynamic motion of wireframe and solid geometric objects
- Sophisticated lighting model for fast realistic geometry at render time
- 3DGA module provides hardware support for lighting model calculations
- Virtual memory graphics allows rapid display of objects of almost unlimited size without the limitations of dedicated display list memory
- Multiple light sources permit greater control of computer synthesized renderings
- Compatible with entire Apollo product family

#### Advanced Functionality

The DN590 TURBO's computational power, and high resolution graphics are displayed in a true multiwindow, multitasking environment. Apollo's

#### DN590 TURBO's Balanced Architecture



low-profile, detachable keyboard comes with programmable keypad and optional mouse.

Based on the powerful MC68020 microprocessor and the MC68881 floating point coprocessor, the DN590 TURBO also features an optional high performance FPX floating point accelerator. And the DN590 TURBO features 2 gigabytes of virtual address space per process so that users can develop and run extremely large programs.

Apollo supports the two most popular UNIX® operating systems: Berkeley 4.2 and System V Release 2. Users can run applications in either operating system or both simultaneously. Users can enjoy all the benefits of the UNIX standards running in a distributed processing environment.

The AEGIS™ operating system provides a true multiwindow, multitasking environment and a distributed file system that lets users transparently share data and resources. Any of these operating systems can run in different windows simultaneously, letting users easily work in the operating system they select.

In addition the DN590 TURBO takes full advantage of Apollo's Public Domain™ networking, linking workstation networks to a host of other

computing environments such as PC, mainframe, superminis and a host of UNIX-based systems.

#### Advanced System Architecture

The DN590 TURBO's CPU features a combination of some of the industry's most advanced technologies.

The high-speed, 16K byte cache memory is fully integrated into the pipelined CPU architecture. This physical cache memory lets programs access instructions and data in a no-wait state implementation.

The DN590 TURBO also provides access to up to 16M bytes of high-speed ECC memory. This ECC memory features a 120-nanosecond cycle time DRAMs, and provides single-bit error detect-and-correct and double-bit detect.

The DN590 features modular design and construction. Three integrated modules—Processor/Graphics, Mass Storage, and MULTIBUS™ modules—fit neatly into one system unit. Modules feature separate fans and power supplies that lend themselves to high reliability and makes servicing easy.

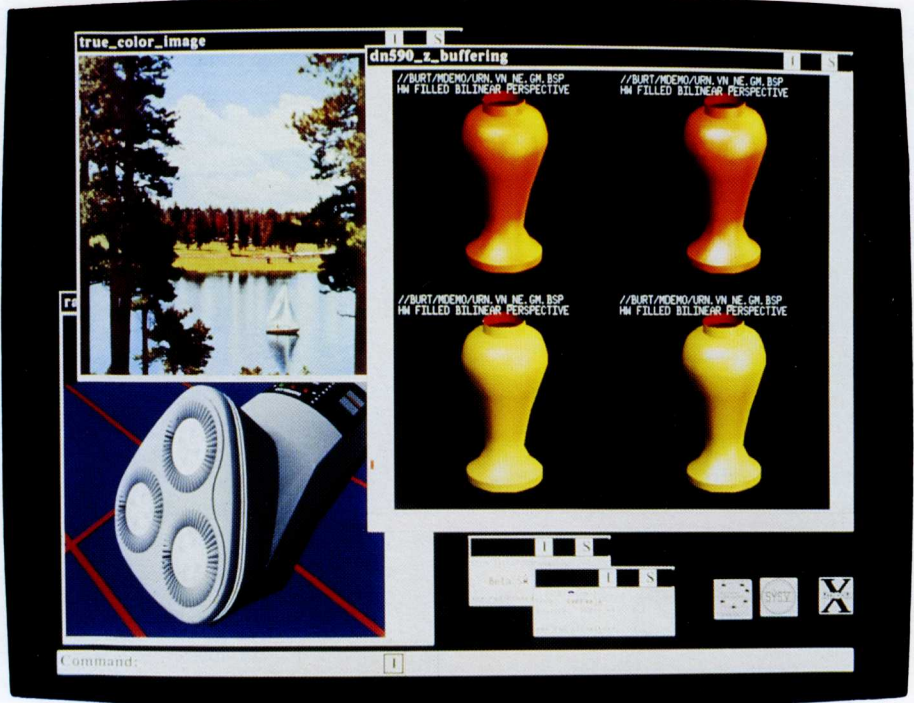
## Graphics Subsystem

The graphics section is the key to the DN590 TURBO's virtual memory graphics capabilities. It includes a display processor, and integral image display memory for such operations as double buffering and Z-buffering, and the optional, 3-D Graphics Accelerator (3DGA). The 3DGA enhances the performance of the display of objects created with Apollo's 3-D Graphics Metafile Resource (GMR™), which is based on The Programmer's Hierarchical Interactive Graphics System (PHIGS) constructs. And the 3DGA can transform and clip 3-D, IEEE 32-bit floating point coordinates at rates up to 130,000 vectors per second.

The display processor supports the DN590's 19-inch, 1280 x 1024 color display that features both tilt and swivel, and a non-glare filter that eliminates the need for special lighting. The display processor contains multiple bipolar drawing processors, dedicated CMOS VLSI draw processors, 6M bytes of dedicated display memory, and the video logic required to directly drive the color monitor. The graphics subsystem performs basic functions such as bit-blts, raster operation, drawing and fill operations. And it performs all high-level functions such as complex light source calculations, Gouraud shading, 3-D matrix transforms, and clipping.

The DN590 TURBO's combination of functionality and performance makes it ideally suited for a wide range of graphics intense applications such as 3-D solids modeling, wire-frame and image processing. Vector generation is at a rate in excess of 16M pixels/second. Rectangular areas can be filled at a rate in excess of 125M pixels/second. Block transfers (bit-blts) are performed at a rate of 22M pixels/second.

The display memory contains on-board microcode and custom gate array logic to directly support bit-blts, fills, and raster operations. Video RAM technology is employed to provide a 2048 x 1024 x 24-plane display memory that features high drawing bandwidth due to the parallel random access and video refresh paths.



The display frame buffer memory is designed to allow advanced operations such as double buffering, and Z-buffering to operate at very high speeds. In addition the 3DGA aids in this process by performing the appropriate transformations. The 3DGA dedicated graphics processor is a multistage processing system that handles all the complex geometry features required for real-time graphics operations. Through the use of a special VLSI processor and an on-board MMU, the 3DGA can actually process complex objects directly from Graphics Metafiles resident in virtual memory. The 3DGA provides a significant technology breakthrough by bringing virtual memory techniques to graphics processing. This allows even very large objects to be rapidly displayed without regard for any limited display list memory.

Once the Metafile is read, the 3DGA traverses the hierarchical structures as required by the selected view, while simultaneously performing bounding box trivial rejection. 3DGA then interprets and executes the commands, attributes, and control information that represent the geometry of the stored object. The 3DGA transforms the three-dimensional floating point coordinates in orthographic or perspective projection using special

VLSI floating point processors and performs hardware clipping prior to output of the resulting screen space primitives to the display processor for drawing.

### *Advanced Lighting Model*

The DN590 TURBO features the most advanced lighting model available on any workstation. Multiple light sources are incorporated to permit greater control of computer synthesized images. Up to 16 light sources can be manipulated with features such as:

- *Direction*
- *Position*
- *Color*
- *Ambient lighting*
- *Concentration*
- *Attenuation*
- *Cone of influence (Spotlights)*

In addition the DN590 TURBO's lighting model allows object surfaces to have distinct properties such as specular hue, base hue, and reflection coefficients, to define and simulate the surface characteristics of many materials. The lighting model is greatly enhanced through the use of the 3DGM software libraries. Apollo's enhanced Phong lighting model is used by the 3DGM to provide realistic computer generated imagery.

### Processor Subsystem

The DN590 TURBO's processor section contains the 32-bit VLSI MC68020 processor that includes a full 32-bit CPU with 16 registers and a 256 byte instruction cache. The MC68020 features 3-stage pipeline processing that allows concurrent execution of up to three instructions. The processor module lets the DN590 support up to 56 concurrent processes with up to 2G bytes of address space per process.

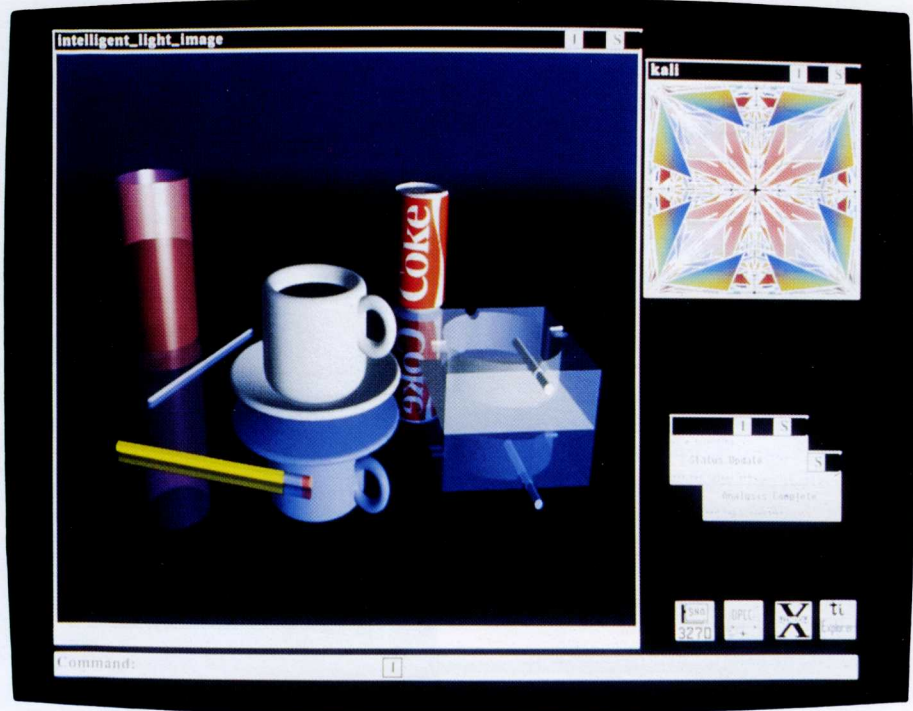
The DN590 TURBO includes the MC68881 floating point coprocessor as standard equipment. The MC68881 performs floating point operations according to the IEEE 754 standard for binary floating point arithmetic. It features an advanced CPU, eight 80-bit registers, three 32-bit control registers, and a coprocessor interface to the MC68020.

The CPU directly addresses memory through an onboard Memory Management Unit (MMU). The MMU is designed to support demand paging requirements from the disk or access to or from the high performance Domain network. This feature allows the Domain network to provide transparent file access around the network, greatly enhancing the sharing of information and graphical data.

The DN590 TURBO is available in 8M and 16M byte ECC memory configurations. Also available is an optional high-performance floating point accelerator (FPX) that transparently increases performance by a factor of up to six depending on operation over the MC68881.

### Mass Storage Module

The DN590 TURBO's 5 1/4 inch 190M byte, dual 190M byte Winchester disks, and 1/4 inch 60M byte streaming cartridge tape drive provides local mass storage and convenient, high-speed backup. A single controller supports both the tape and disk units and uses industry standard interfaces to allow the easy integration of larger capacity devices as they become available. The Mass Storage Module uses an 8088 microprocessor, and contains a VME interface and DMA control logic, a battery-backed clock/calendar device, and a separate power supply and fan.



### Expansion Module

The DN590 TURBO's option expansion module includes a 4-slot MULTIBUS peripheral adaptor, power supply, and fans. Apollo provides a variety of peripherals for the MULTIBUS adaptor; in addition, users can add devices as appropriate for their applications. Apollo's GPIO software lets application programmers write drivers in high level languages for MULTIBUS devices.

### FPX Option

The DN590 TURBO's optional FPX provides a high-performance, industry-standard, IEEE-754/10.0-compliant floating point processor. The FPX uses the Weitek 1164/1165 floating point chip set in a heavily microcoded environment, and performs over 3,800 single-precision Whetstones, and over 2,600 double-precision Whetstones.

In addition, the high performance FPX instruction set can increase performance by as much as 2 to 6 times in floating point intensive applications such as simulation, finite element analysis and modeling.

The FPX option is fully object code-compatible with the MC68881, and transparently runs programs compiled for the MC68881. As a result, recompiling of applications is not required before users and developers

can take advantage of the FPX's high performance levels.

### Domain Graphics Resources

Apollo offers application programmers the most comprehensive set of integrated graphics tools in the industry today. The Domain Graphic Resources (DGR™) provide a range of complementary products that form the foundation needed to develop and execute graphics based applications. DGR software can offload routine graphics tasks and simplify the application programming process. In this way, the Domain Graphics Resources speeds the development cycle and optimizes application performance. DGR products address four functional areas; User Environment, Specialized Program Interfaces, Industry Standard Program Interfaces, and Graphics Terminal Emulation.

### The Toolkit Solution

Apollo's graphics toolkit reduces the software development effort therefore allowing the solution to be brought to market quickly.

Of course, these sophisticated graphics tools can run on any Apollo workstation without modification,

automatically taking advantage of the specific features and functionality that each system offers.

All of the rich hardware-based functionality provided by the high end workstations is emulated by software on the lower-cost family of workstations. This provides users with total graphics integration and a cost-effective alternative for expensive application and program development efforts.

#### DN590 TURBO Hardware Features

- High-performance, no-wait state, pipelined 32-bit VLSI CPU design with 16K byte physical cache memory, based on the MC68020 processor and including an MC68881 floating point coprocessor
- Support for up to 16M bytes of high-speed ECC memory
- 2 gigabytes of virtual address space for each of 56 concurrent processes
- 32-bit system bus with up to 14M byte/second burst mode bandwidth
- High-performance FPX floating point accelerator option
- 3DGA graphics accelerator option
- Low-profile, detachable keyboard with programmable keypad and optional mouse
- 155M and dual 155M byte disks for local storage
- Integral 12M bit/second Domain network
- Two RS232C ports (up to 19.2K baud)

#### Color Display Features

- Double buffering of pseudo color images, with full Z-buffer support
- Advanced lighting model including:
  - Up to 16 light sources
  - 24 plane RGB support
  - Colored light sources
  - Attenuation of light sources
  - Spotlights with attenuation
  - Specularity, highlights
  - Surface properties
- 16.7 million colors displayable, from a palette of 16.7 million colors; 24 color bit-planes planes
- Over 130,000 3-D floating point transformed, clip-checked vectors per second with 3DGA
- Extremely fast, smooth-shaded Z-buffered polygons



- 19 inch tilt and swivel, color display monitor
- High resolution (1280 x 1024 bit map)
- 60Hz non-interlaced refresh rate
- 3DGA renders display lists directly from virtual memory; optional
- Integrated high performance display processor
- Vector generation greater than 16M pixels/second
- Up to 130,000 3-D transformed, floating point, vectors per second with 3DGA
- Smooth shaded Z-buffering and double buffering
- Up to 150,000 2-D integer transformed, clip-checked, vectors per second
- Bit-blts at up to 40M pixels/second
- Sixteen logical raster-ops at up to 30M pixels/second
- Area fills at up to 125M pixels/second
- 2x zoom by pixel replication
- RS343A RGB video output with composite sync on green

#### DN590 TURBO Peripheral Options

- 5¼ inch 86M byte, 155M, or dual 155M byte Winchester disks
- ¼ inch 60M byte streaming tape cartridge
- Four-slot IEEE 796 MULTIBUS adaptor

#### The Domain Network

- Baseband network in a ring topology
- Dual address packet with single token arbitration

- Up to 1000 meters between two nodes
- Transparent access to data, programs, and peripherals
- Gateway and bridge access to remote and foreign facilities/protocols

#### Software

##### Standard

- AEGIS, Apollo's object-oriented operating system
- Multiple window management with cut and paste
- High-level language debugger
- Domain Graphics software
- Power-on diagnostics

##### Optional

- Domain/IX, Apollo's twin port of the UNIX standards: Berkeley 4.2 and System V Release 2
- FORTRAN 77, ISO Pascal, Domain/C™, Domain/CommonLISP™ and Domain/LISP™ support
- Domain Graphics tools
- Database management tools
- Software development tools
- Technical Office Support
- Over 1200 solution-supplier applications packages available

## DN590 TURBO Specifications

### Physical dimensions:

**Electronics Cell:** height 62.2 cm (24.5 in.), width 34.3 cm (13.5 in.), depth 72.4 cm (28.5 in.)

**Color Monitor:** 19-inch, height 53.3 cm (21.0 in.), width 56.4 cm (22.2 in.), depth 54.6 cm (21.5 in.)

### Power:

**Electronics Cell:** *Minimum* – 120 VAC +10/–25%, 7.8A, 50/60Hz +/–1Hz, 1,270 watts, 4325 BTU/hr, 220 VAC +10/–25%, 7.7A, 50/60Hz +/–1Hz, 1,270 watts, 4325 BTU/hr

*Maximum* – 220 VAC +10/–25%, 14.2A, 50/60Hz +/–1Hz, 1,270 watts, 4325 BTU/hr

**Color Monitor:** 19-inch – 90 to 132 VAC, 220 watts, 47/63Hz, 750 BTU/hr.

### Operating Environment:

**Temperature:** 15C to 32C (60F to 90F)

**Humidity:** 20% to 80% relative

**Ceiling:** 0-2.1 km (0-7000 ft)

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