SiliconGraphics
Computer Systems

Indigo²™ Product Guide

INDIGO²

POWER
EXtreme
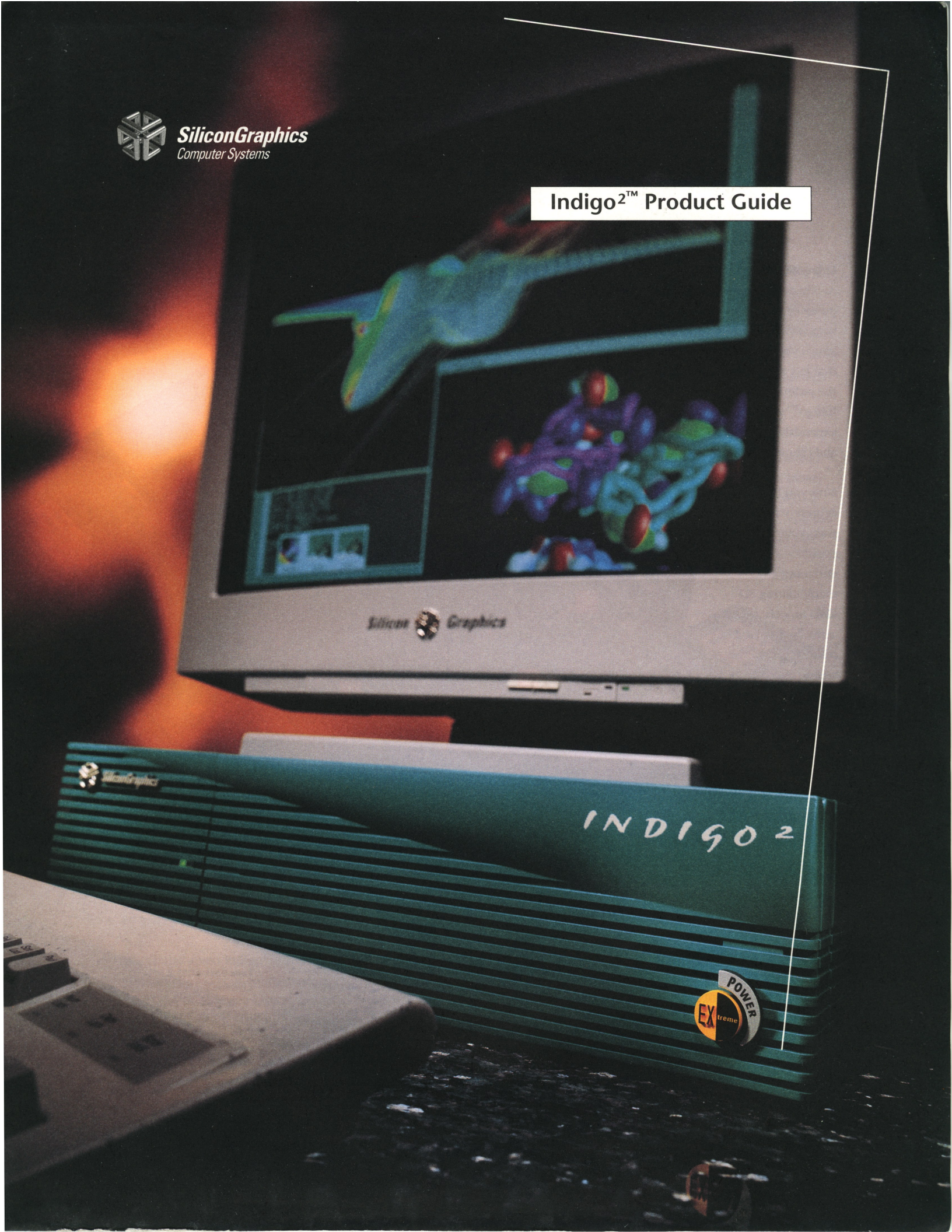
1 High-Bandwidth Bus Architecture
High-speed 64-bit memory bus between the CPU and main memory offers a peak of 400MB/sec while the 64-bit system bus offers peak 267MB/sec

2 Upgradable High-Performance CPU
The processor module, which attaches to the base-board, can be easily upgraded for higher performance

3 2MB 4-Way Streaming Cache
POWER Indigo²™ has the largest cache on a desktop workstation. Indigo² R4400™ has a 1 MB cache- and Indigo² R4600™ has a 512KB cache

4 Huge Memory Expansion
12 SIMM sockets allow for a maximum of 384MB RAM

Extreme Computing

At Silicon Graphics we're interested in building the computers of tomorrow—today. We recognize that you need a system that does more than just assist you with the challenges you face every day. You need a powerful system that lets you conceptualize, innovate, and go beyond the ordinary. With this in mind, we've designed the Indigo²™ workstations—the most powerful, expandable desktop solutions for technical and creative professionals.

Now you have the power to achieve your potential in ways you never thought possible—from designing and manipulating 3D CAD models, to interactively analyzing massive data sets, to creating realistic animations. And you can do all of this collaboratively with your team to create higher quality designs and solutions, faster.

Indigo² delivers the fastest system throughput, combining leading CPU and graphics architectures for your intensive computing needs. You can choose from three types of graphics to suit your tasks, with Indigo² XL, Indigo² XZ, and Indigo² Extreme™. And of course, unprecedented digital media tools are integrated to give you the most natural ways to communicate your work.

A History of Exceptional Technology

The power of the Indigo² architecture represents a culmination of many technologies. At Silicon Graphics, we have been developing computer systems that easily crunch through large data sets for the past ten years. Our state-of-the-art manufacturing capabilities provide revolutionary solutions at highly competitive prices.
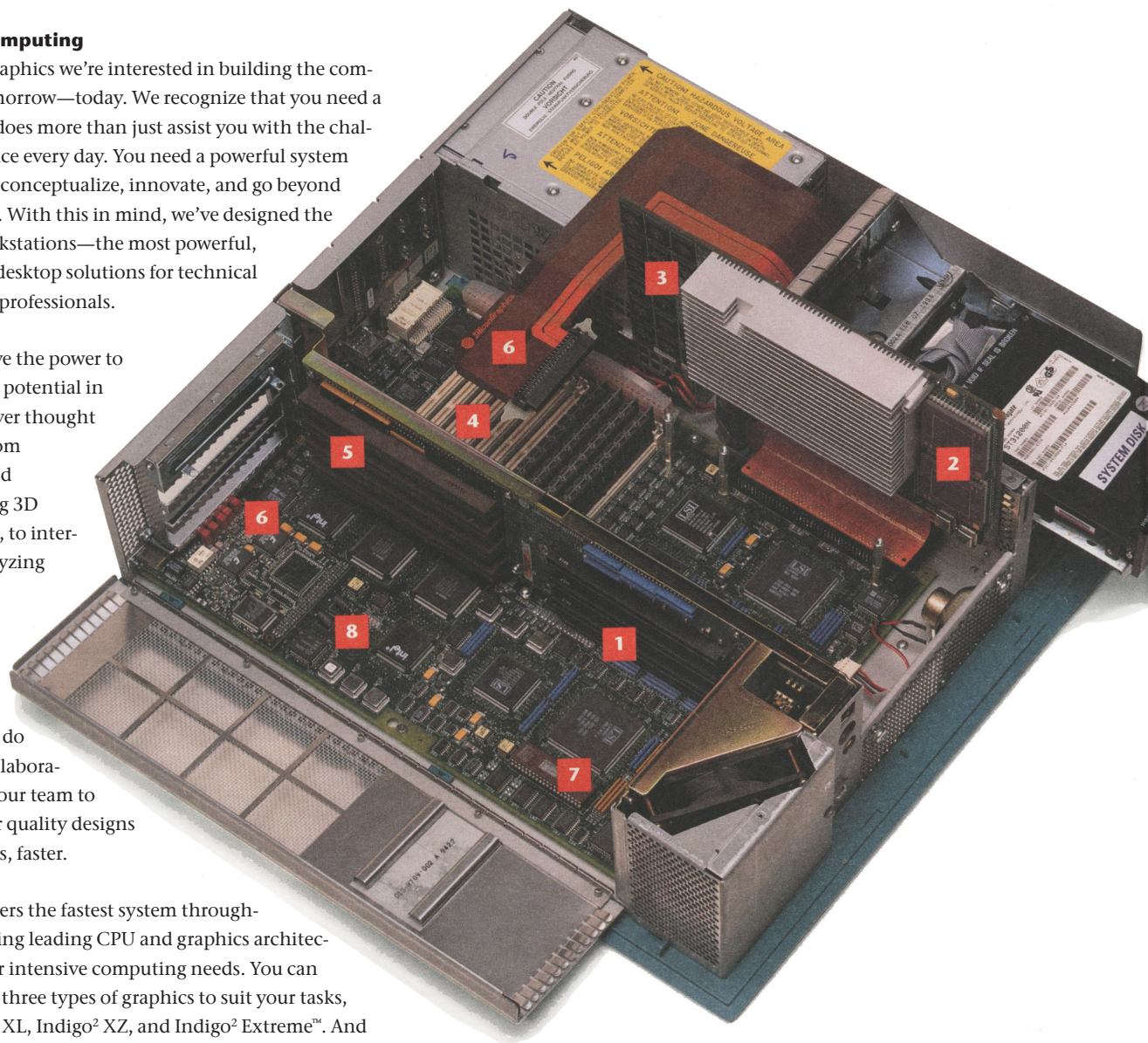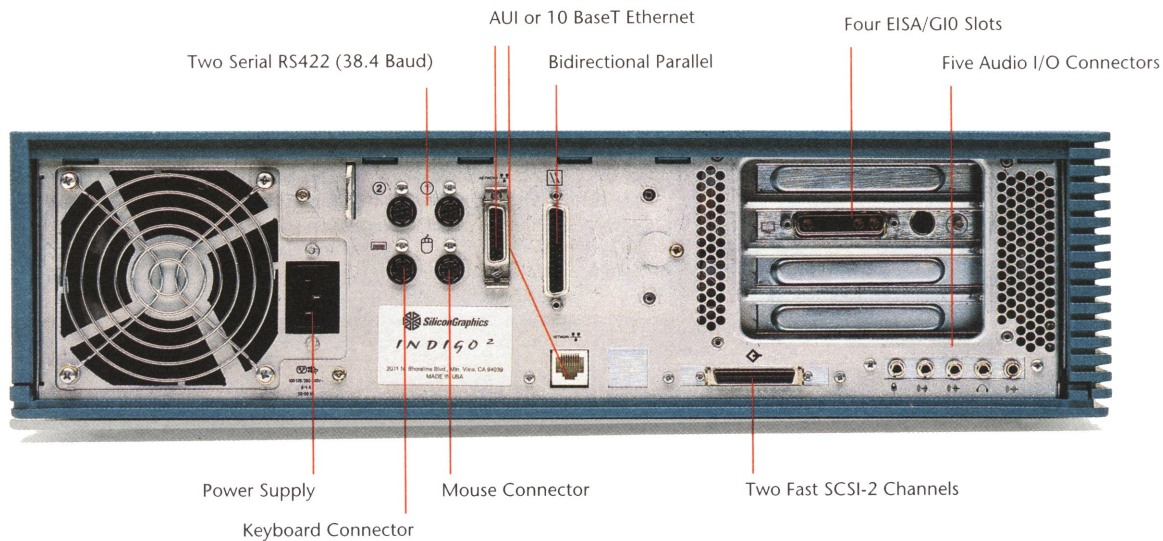
5 EISA Expandability
Four EISA slots allow for a multitude of expansion possibilities with a 33MB/sec transfer rate

6 Two Fast SCSI-2 Channels
Offer a total of 10 SCSI devices for storage and I/O expansion

7 Built-In Networking
Ethernet supplied with every system including both AUI and 10 BaseT

8 Integrated Digital Media
Up to four simultaneous input and output audio channels, plus an integrated video bus

Two Serial RS422 (38.4 Baud)
AUI or 10 BaseT Ethernet
Bidirectional Parallel
Four EISA/GI0 Slots
Five Audio I/O Connectors

Power Supply
Keyboard Connector
Mouse Connector
Two Fast SCSI-2 Channels

In the past five years, we have created seven generations of Geometry Engine®. The Geometry Engine processor now achieves 50 times the performance and occupies one-twentieth the space of the original graphics hardware. The MIPS® R8000™ processor delivers performance comparable to a Cray YMP™—for considerably less money.

Powerful Processors

Indigo² is built around the leading MIPS RISC processors—the 200MHz R4400 and the 133MHz R4600SC. For very large computational tasks, we provide POWER Indigo² based on the 75MHz MIPS R8000 processor. The CPU and memory bus achieve 400MB/sec and the system I/O bus achieves 267MB/sec throughput. Indigo² also has the largest cache on the desktop and a 64-bit data path which moves data at record breaking speeds.

If you need immediate results, this incredible architecture and compute power can be used to move large data sets around, or analyze and compute designs. This combination of tight integration and aggressive design gives you a major price/performance advantage over other architectures. POWER Indigo² Extreme is the most powerful desktop workstation available—with 300 MFLOPS of dedicated CPU performance and 256 MFLOPS of dedicated graphics performance.

We've also given Indigo² unrivaled expandability so that you can choose your configuration. Three industry-standard EISA slots or two EISA slots and a high-performance GIO slot are at your disposal. An assortment of industry-standard I/O, such as AUI and 10 BaseT Ethernet, as well as two serial ports, a parallel port, and five audio connections make Indigo² suitable as a stand-alone system or in a networked environment. Compliance with industry standards gives Indigo² the ability to integrate into a multivendor environment. And Indigo² can read and write Macintosh® and PC files.

Flexible disk and peripheral configuration is facilitated by two independent Fast SCSI-2 controllers. These binary-compatible systems also have three internal Fast SCSI-2 bays for disks, DAT, floppy drives, and CD-ROM. You can protect your investment and expand Indigo² as your needs grow.
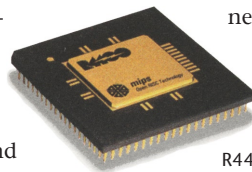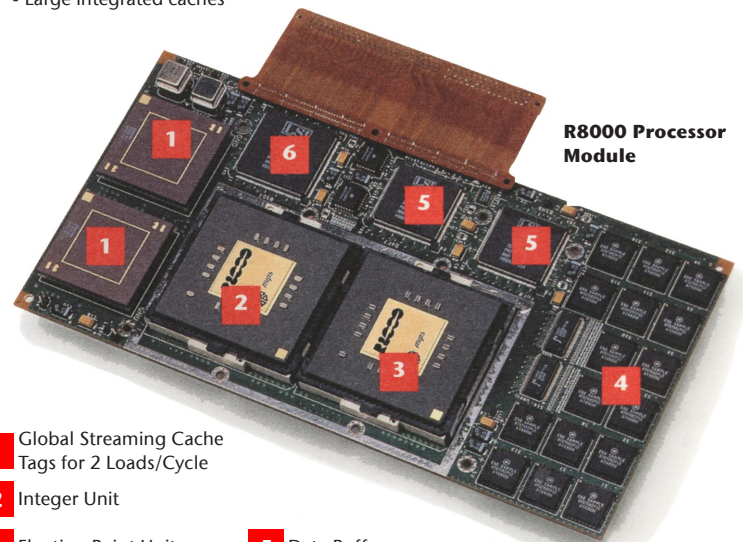

200MHz
R4400 offers 119
SPECint and 131 SPECfp
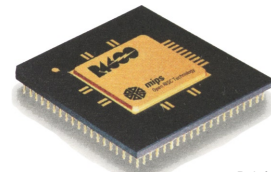
133MHz
R4600SC offers 109
SPECint and 72 SPECfp

Both R4400 and R4600SC use:
- True 64-bit architecture
- On-chip TLB for fast virtual-to-physical address translation
- 8-stage superpipeline architecture
- Large integrated caches

R8000 Processor Module

1 Global Streaming Cache Tags for 2 Loads/Cycle

2 Integer Unit

3 Floating Point Unit

4 2MB Global Streaming Cache

5 Data Buffers

6 Cache Controller

1 **CPU Accelerated Graphics -** The REX3 Raster Engine ASIC converts geometric data processed by the CPU into pixel and line data that it then writes into the framebuffer; as CPU power increases, so does graphics performance

2 **Live Video I/O Slot -** A port for video expansion using Indigo2 Video and Galileo Video options
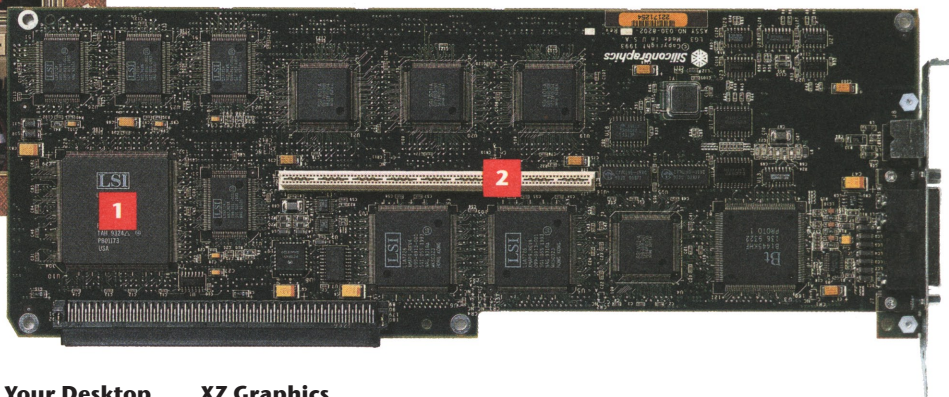
A Family of Extraordinary Graphics on Your Desktop

Indigo^2 is available with a family of graphics subsystems—XL, XZ, or Extreme Graphics—to suit your requirements.

XL Graphics

XL graphics is the entry-level subsystem Indigo^2 product family, giving you an extremely fast X and 2D graphics architecture. But XL also supports 3D through a software Z buffer and host-based geometry calculations. Image processing, entry CAD, and general science problems are solved fast. Indigo^2 comes standard with built-in 24-bit color, crisp 1280x1024 high-resolution frame buffer, and an ergonomically comfortable 76Hz screen refresh rate.
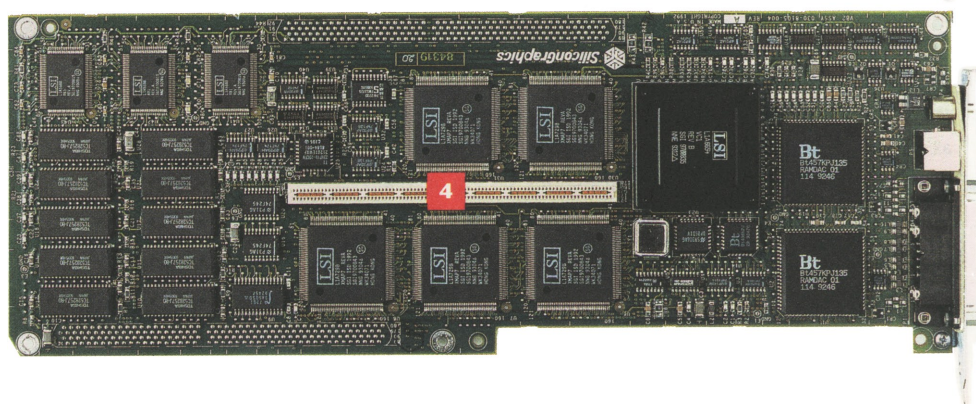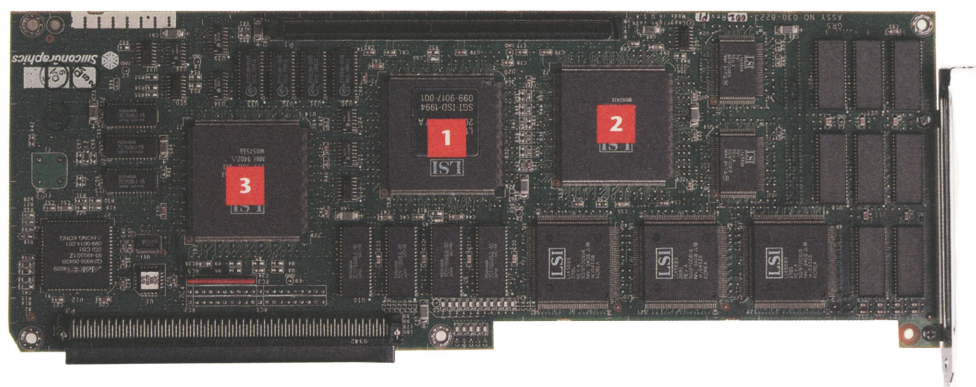
XZ Graphics

When 2D computing isn't enough, XZ graphics is the answer to your need for more intensive visualization. XZ has four Geometry Engine chips in a patented geometry pipeline architecture delivering 100 MFLOPS of graphics compute performance. The Geometry Engine design delivers 408K 3D triangles per second for strong visualization, architecture, and MCAD performance. Professional engineers and scientists can use XZ for working on real-world design and technical challenges.

1 **Four Geometry Engine® Multi-Chip Module -** Provide 100 MFLOPS through an effective multichip module design integrating four GE7 Geometry Engine chips for a total of 320,000 custom gates

2 **Integrated Raster Engine -** The RE3 Raster Engine holds 100,000 custom gates and runs at 50MHz
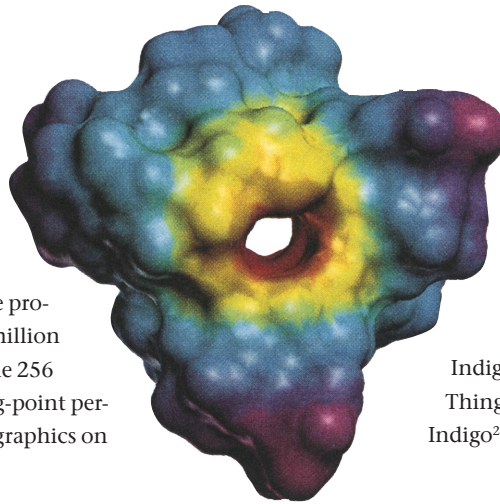
3 **Command Engine -** The HQ2 is an 80,000 gate device that delegates graphics primitives to the Geometry Engine processors

4 **Live Video I/O Slot -** A port for video expansion using Indigo^2 Video and Galileo Video options

Extreme Graphics

Extreme Graphics offers the world's fastest desktop graphics. Using eight Geometry Engine chips, Indigo² Extreme provides 645K triangles and 1.3 million 3D vectors per second from the 256 MFLOPS of dedicated, floating-point performance—for the fastest 3D graphics on the desktop. Complicated MCAD, animation, and molecular modeling projects come alive with the help of 31 custom VLSI gate arrays with over 1.2 million gates.

Indigo² achieves a new level of performance. Things happen faster, more convincingly. Indigo² works at the speed you do.

1 Eight Geometry Engine Chips
Provide 256 MFLOPS through an effective multi-chip module design
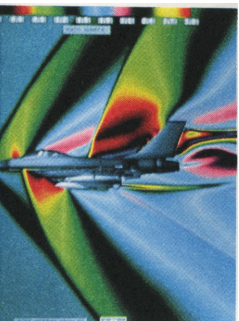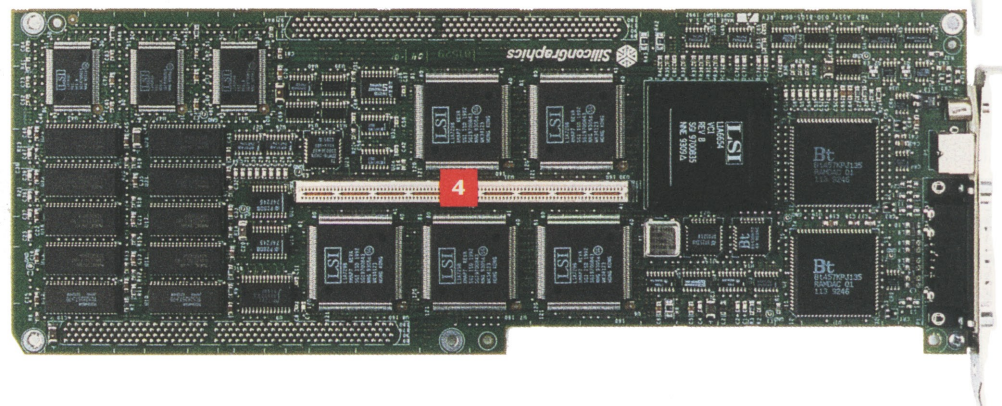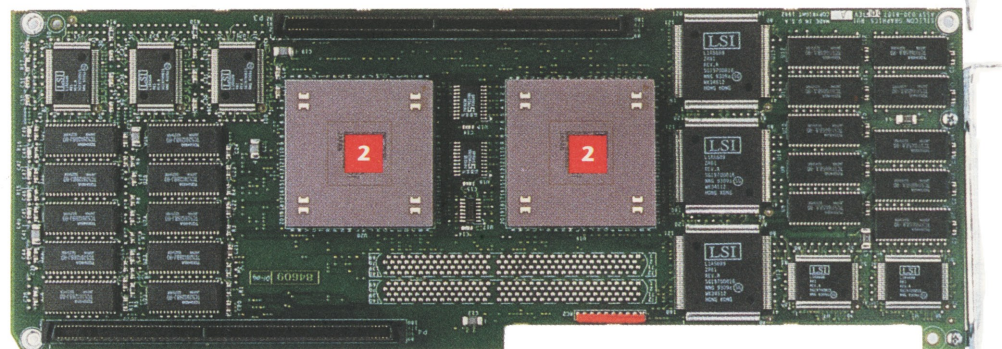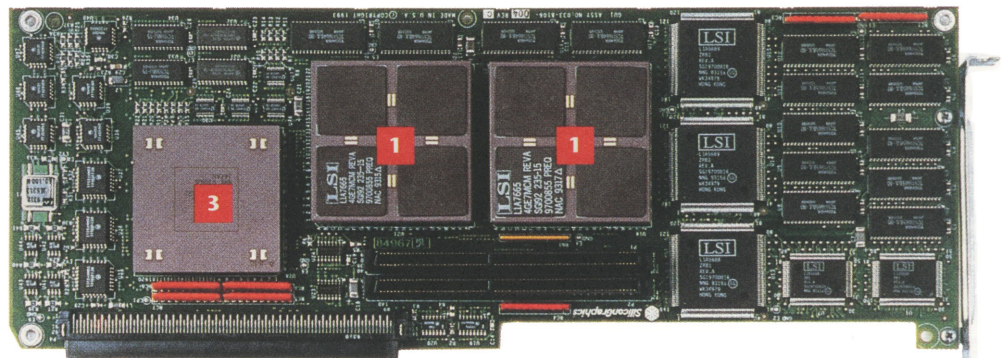
2 Dual Integrated Raster Engines
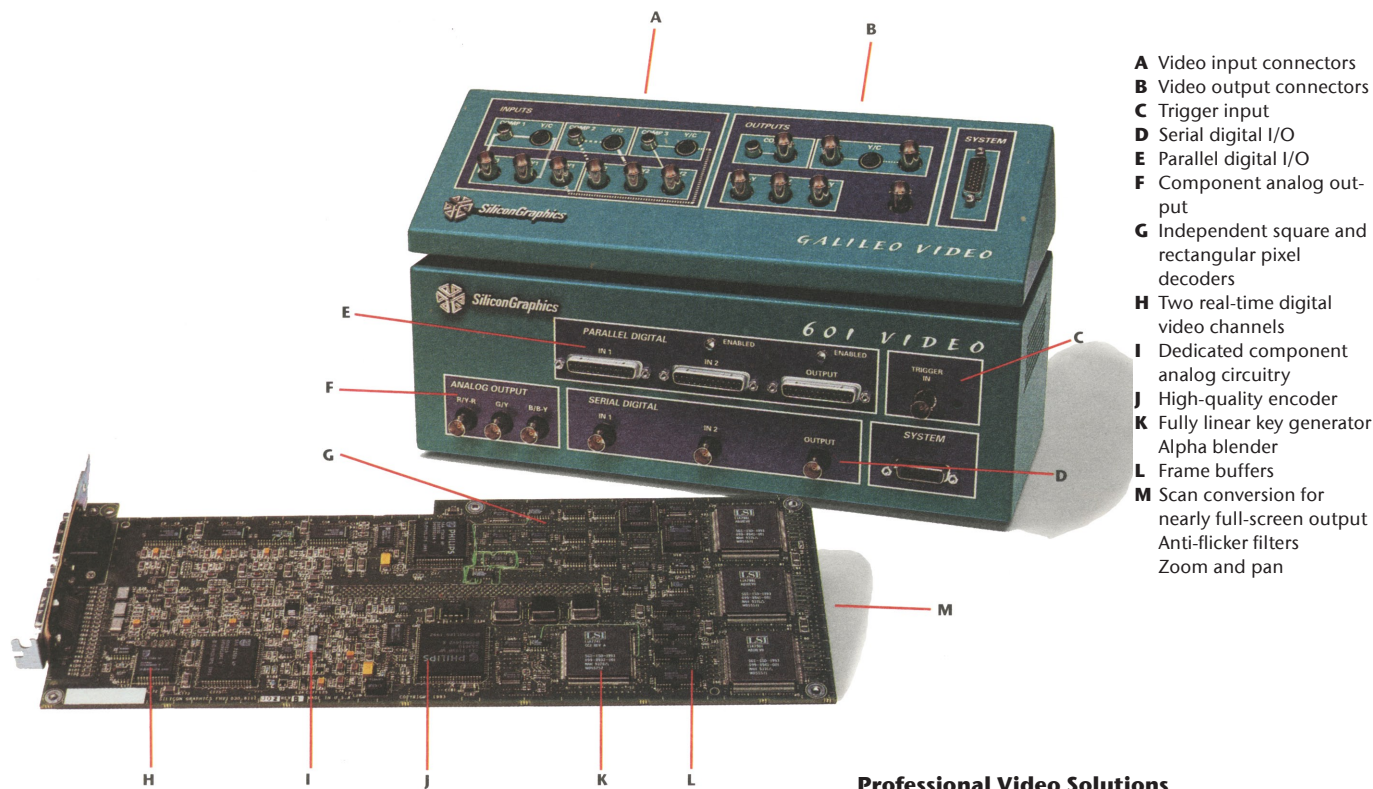Two RE3 Raster Engines hold 200,000 custom gates running at 50MHz

3 Command Engine
The HQ2 is an 80,000 gate device that delegates graphics primitives to the Geometry Engine processors

4 Live Video I/O Slot
A port for video expansion using Indigo² Video and Galileo Video options

A Video input connectors
B Video output connectors
C Trigger input
D Serial digital I/O
E Parallel digital I/O
F Component analog output
G Independent square and rectangular pixel decoders
H Two real-time digital video channels
I Dedicated component analog circuitry
J High-quality encoder
K Fully linear key generator
 Alpha blender
L Frame buffers
M Scan conversion for nearly full-screen output
 Anti-flicker filters
 Zoom and pan

Power Tools for Power Users

Indigo² has a rich set of communication tools to help you document, show, and sell your ideas in new and exciting ways. You can use Indigo² for creating and integrating video, audio, and 3D graphics into your work with unrivaled quality.

Every Indigo² comes standard with high-quality audio, and is video-ready with its own dedicated video bus and a variety of video boards. You get complete CD/DAT-quality sound with five audio connections, a microphone, and a speaker. Up to four simultaneous input and output channels come standard with 16-bit sampling and stereo outputs.

Indigo² coupled with Indigo Magic™, the new user environment, gives you new, productive methods of workgroup collaboration. Imagine the value of being able to send your 3D model to videotape for viewing at a presentation. The Indigo² Video™ option for your R4400/R4600-based system allows you to print graphics to tape and display live video in a graphics window or capture frames of video to disk. Now you can create full video presentations, send media mail, and have a desktop conference with Indigo² Video as well as IndyCam and InPerson (both of which are included with Indigo² Video).

Professional Video Solutions

The Galileo Video™ option board provides high-quality video input and output. You can connect to any source from composite, S-Video and component analog to CCIR 601 digital video. You can also include special effects such as fades and wipes. Cosmo Compress™, designed to partner with Galileo and Indigo² Video, gives you real-time video compression and decompression for intense video manipulation with compression ratios from 4:1 to 100:1.

So you see, Indigo² is an incredibly valuable collaborative communications tool that easily transforms itself for professional audio and video production.

A Digital video input (IndyCam, Galileo 601 option)
B Digital video I/O (Indigo² Video, Galileo)
C Four Field buffers
D Scaled, decompressed video images to system bus: Phillips 7186 video scaler
E Silicon Graphics, Inc. custom ASIC
F Real-time video compression/decompression: C-Cube CL560 JPEG compression processor

Digital
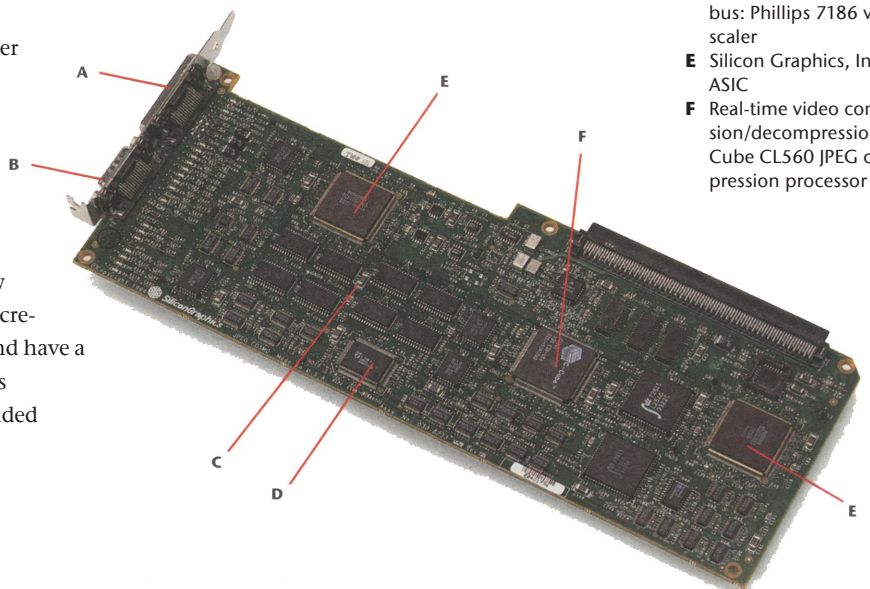
A Desktop Environment to Suit You

Most user interfaces are too rigid, requiring you to adapt to their way of working instead of adapting to yours. The Indigo Magic user environment changes all that by giving you a unique way of collaborating with your design team.

Indigo Magic is a new-generation desktop that combines an intuitive management system with powerful digital media tools in one user interface. In fact, we call it a "Media User Interface", because Indigo Magic simplifies system and network access and facilitates collaborative computing through a unique digital media environment.

The Indigo Magic iconic interface lets you organize your desktop environment to suit the way you work, increasing your communication and productivity. Now you have a point-and-click method of organizing your desktop and accessing resources.

With the Indigo Magic Desk Manager you can create multiple iconic desktops, each having all the applications, files, and tools you'll need to work on specific projects. System administration and management is a breeze. Now you can set up your printer and user accounts and connect to a network, all with the click of an icon. Indigo Magic is "network aware," so that you can work in your networked world. You can easily find and use all the resources on your network.
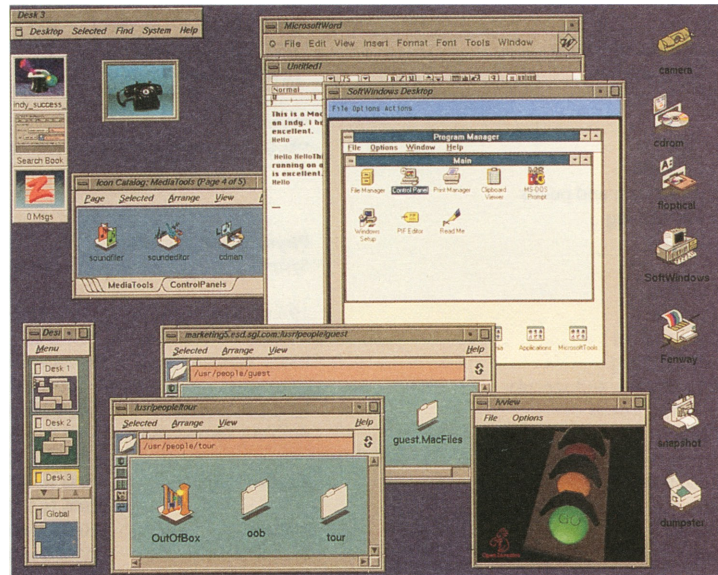
Collaborative Communications

The Indigo Magic user environment includes all of the digital media tools you need to capture, create and communicate your ideas in ways that are more vivid and compelling than you ever imagined. With bundled applications and integrated media tools, you can make the unique environment of interactive visual computing, audio, and video an internal part of your work.

Imagine using your workstation as a powerful communications center. Now you don't have to cram a dozen people into your office to show them your newest model. InPerson, Silicon Graphics' desktop conferencing software, allows you to link together local and remote team members in realtime through live video and audio, as well as instantly share files and images on an interactive whiteboard and sketch your ideas on the fly. InPerson and other media-rich applications, such as MediaMail™ and Showcase™, are a significant advance in collaborative communications, providing a combination of affordability, innovative user-interface design, and superior performance.

Indigo² is, simply the world's fastest, most feature-rich desktop workstation on the market. It is the ultimate power tool for power users. It gives you a new way of working, increasing your productivity and the quality of your output. That kind of phenomenal desktop computing puts Indigo² in a class all of its own.

From Peter Gabriel's video "Steam"—Image produced by Homer & Associates, Colossal Pictures, Real World Productions using Softimage and proprietary software on Silicon Graphics systems.

Processing

CPU/FPU	R4600™	R4400™	R8000™
MHz	100MHz	200MHz	75MHz
Primary Cache (I/D)	16K/16K	16K/16K	16K/16K
Secondary Cache	512KB	1MB	2MB
Memory Storage	32MB to 384MB		

I/O	2	3 1/2" bays
	1	5 1/4" Half-height bay
	2	Serial RS422 (38.4 k baud)
	1	Bidirectional parallel
	5	Audio I/O connectors
	1	Ethernet (AUI or 10BaseT)
	2	GIO-64 slots
	4	EISA slots (total of 4 slots)
SCSI	2	Fast SCSI - 2 channels

Graphics

Advanced Features
- Alpha blending
- Accumulation buffer
- Anti-aliased RGB lines and points
- Full-scene anti-aliasing
- Texture mapping
- Fog
- Lighting features
    - Spot lighting
    - Eight light sources
    - Two-sided lighting
    - Ambient, diffused, and specular
- Arbitrary clipping planes
- Depth cueing
- Soft shadow and depth of field
- Sub-pixel positioning
- Stenciling
- Stereo graphics
- Pan and zoom
- Sphere rendering
- X11 pixel operations

Color Maps
- 2 (4096 colors each)
- XL 1 (4096 colors each)

IRIS GL™ Display Modes
- RGB double buffer
- RGB single buffer
- Color index double buffer
- Color index single buffer
- Stereo viewer connector

Audio/Video

Input
- Mono/Stereo microphone (mono electret condensor microphone ships standard)
- Line-level stereo analog
- Serial digital stereo (IEC958)

Output
- Stereo headphone output/mono (combined stereo) internal speaker
- Line-level stereo analog
- Serial digital stereo (IEC958)

Sampling Rates
- 48, 44.1, 32 KHz, and many lower rates
- Input and output rates are independent

Converters
- Combined DAC and ADC
- 16-bit, delta-sigma, 64x-oversampling
- Two stereo audio codecs,

Connectors
- All 1/8 inch (3.5 mm) stereo jack

Video
- Video slot on graphics board
- Independent video bus
- Genlock

(Video and compression only supported on R4400/R4600 systems)

Performance

	XL**	XZ	Extreme™
3D Lines	1.0M	1.0M	1.3M
3D Lines GouraudZ, Depth Cued	205K	452K	1,0M
Tmesh, Flat NO-Z,	288K	408K	645K
Tmesh, GouraudZ, Lit	52K	181K	405K
Quads, FlatZ	39K	129K	225K
Quads, GouraudZ, Lit	25K	67K	155K
Characters	471K	251K	255K
Screen Clear	10ms	9ms	4.5ms
Rectangle Fill Rate (screen-aligned)	123M pix/sec	40M pix/sec	78M pix/sec

	R4600/133	R4400/200	R8000/75
*SPEC 92int	109	119	108
*SPEC 92fp	72	131	270
*LINPACK 1000x1000DP	23	57	230

*Preliminary

**XL Graphics performance measured with 200MHz R4400 processor

Physical Environment

System	5 inches H x 18.5 inches W x 18.5 inches D 40 lbs.
19-inch Monitor	18.7 inches H x 18.9 inches W x 19.9 inches D 71.6 lbs.
Power Requirements	Voltage and Frequency 100-120/200-240 VAC
Heat Dissipation	1000 BTU/hour
Ambient Temperature	+ 13 to + 35 degrees C operating - 10 to + 65 degrees C non-operating
Relative Humidity	10% to 80% operating no condensation 10% to 95% non-operating no condensation
Altitude	10,000 feet operating 40,000 feet non-operating
Vibration	0.02 inches, 5-19Hz 0.35 G, 19-500HZ

Regulatory Agency Approvals

Electromagnetic Emission	FCC Class A Canada DOC. Class A CISPR 22 Class B Germany VDE Class B VCCI Class 2
Product Safety	EN55022 Class B UL1950 CSA 22.2, No. 950 IEC 950 EN 60950 Class 1 SELV
Ergonomic/Health	Germany ZH618

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