



High-Tech Computing, Cafeteria Style

The Wells American CompuStar 286 packs performance into a design-it-yourself PC

Mark L. Van Name

When it comes to PC engineering, "new" usually means bigger or faster: faster processors, bigger and faster memory caches, bigger and faster hard disk drives. That's why it's nice to see a computer like the Wells American CompuStar 286—a machine that tries something new.

What's new about the CompuStar is that it's the first computer designed to be whatever kind of PC you want. Want an AT clone? The CompuStar can be an AT clone. How about a Micro Channel system—a PS/2 clone? It can be that, too. You can even have both types of PCs in the same box.

You pick your processor, too. You can choose an 8086, a fast 20-MHz 80286, or three different models (16-, 20-, and 25-MHz) of the 80386.

The Secret

The secret to this flexibility is a unique design. The CompuStar base system includes a keyboard and an almost-empty shell: a 24- by 7½- by 26-inch, floor-standing, aluminum-skinned case housing just a 220-watt power supply and what Wells American calls its I/O module. The I/O module supplies two serial ports, one parallel port, PS/2-style 6-pin DIN keyboard and mouse connectors, and both a DB-9 digital monitor connector and a DB-15 VGA analog connector.



Circuitry on the I/O module handles VGA (courtesy of a Paradise PVGA1A chip), EGA, CGA, MDA, and Hercules graphics. This board also acts as a disk drive controller that can handle up to four floppy disk drives.

After you order the \$1195 base system, you then choose from a list of options. You start with a bus module. You can pick an AT- or PS/2 Micro Channel-compatible bus module; if you choose the PS/2 bus module, you also need a special PS/2 adapter. The AT bus module has seven AT-compatible expansion slots, while the PS/2 module contains five Micro Channel-compatible slots and one AT-compatible slot. Since the only card you need to add to most CompuStar basic systems is a hard disk drive controller, you end up with a lot of free slots.

And there's more. You can have not one, but two bus modules—a primary

and a secondary. You can mix and match these any way you want: two AT bus modules, two PS/2 bus modules, or one of each. So, in a single CompuStar chassis, you can have up to 13 AT slots, or 10 PS/2 slots and one AT slot, or a mixed bag of seven AT slots and five PS/2 slots. Talk about expansion space!

After you pick a bus module, you then need to choose a processor, or, in Wells American's terms, a CPU module, which contains a CPU, a socket for a math coprocessor, memory sockets, the ROM BIOS, sockets for two expansion ROM chips, and a battery-backed clock/calendar. Wells American is shipping the 80286 and both 16- and 20-MHz 80386 CPU modules. A company spokesperson said that the 10-MHz 8086 CPU module was scheduled to begin shipping in February.

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Wells American also offers a nifty CPU upgrade option. You can trade in your initial CPU module for another and get a purchase credit toward the cost of the new one. In fact, if you trade in your CPU module within a year after purchase, the company gives you its full purchase price as a credit.

The combination of the bus and CPU modules still doesn't give you a complete system. While the 8086 CPU module comes with 512K bytes of memory, the 80286 and 80386 CPU modules do not include any memory. You purchase separately either 512K-byte or 1-megabyte memory modules from Wells American. These memory modules are 80-nanosecond DRAM zig-zag in-line packages (ZIPs) that plug into the eight ZIP sockets on the CPU modules. You can add a 1-megabyte memory-expansion kit to the 1-megabyte memory modules, so, with eight such expanded modules, you can rev your CompuStar up to its maximum 16 megabytes of memory.

Finally, you must add the other neces-

sities: one or more floppy disk drives, one or more hard disk drives, a monitor, and DOS.

This process sounds like a lot of work, but fortunately Wells American sends the system to you fully assembled, with the hard disk drive formatted and ready to go.

A Cautionary Note

If the CompuStar's flexibility, and especially its dual-bus option, seem too good to be true, you're not alone. I felt the same way. I'm still not sure it will all materialize, because as we go to press, Wells American is not yet shipping any of the PS/2 modules, and the company did not get an 80386 CPU module to BYTE in time for this review because it was only recently completed. A spokesperson said that the PS/2 modules were ready, but that Wells would not ship them until it had secured some patents it was seeking. The company projects that it will ship the PS/2 modules in the first quarter of this year.

Despite the unavailability of some modules, this machine shows some of the nicest engineering I have seen in a long time. Although Wells American isn't a household name, the company has been around for some time. In the late 1970s and early 1980s, it built microcomputers under the name of Intertec Data Systems, which you may remember for its SuperBrain CP/M microcomputers and its later multiuser systems.

The Evaluation System

My evaluation system came with one AT-compatible bus module, the 20-MHz 80286 CPU module, a 10-MHz 80287 math coprocessor, 1 megabyte of 80-ns DRAM in two 512K-byte ZIPs, two 1.44-megabyte 3½-inch floppy disk drives, one 1.2-megabyte 5¼-inch floppy disk drive, a 150-megabyte hard disk drive, a flat-tension-mask VGA color monitor, and IBM's PC-DOS 3.3. Six of the AT slots were empty, with the hard disk drive controller in the seventh slot (see photo 1).

That's a powerful system, and it carries a hefty price tag: \$6570. But you get a lot of performance for the money. In fact, this CompuStar 286 proved to be the fastest 80286-based system that BYTE has tested. Its overall application index was about 9 percent faster than that of the previous 80286 speed champ, the Dell System 220. The CompuStar beat the Dell System 220 on all but the word processing and compiler tests, which it lost by only 3 percent and 2 percent, respectively.

Both systems maximize their performance with interleaved memory banks, so that one bank of memory recharges while the other is ready to go. As you might expect from such a well-engineered machine, the CompuStar offers a nice improvement on traditional two-bank interleaving: If you have four identical memory modules, it can do four-way interleaving, so that three banks are ready while one is recharging. On its 80386-based CPU modules, Wells American combines this interleaving with an Intel 82385 cache controller and 32K bytes of 35-ns static RAM cache to boost performance further.

Wells also borrows a page from most 80386-based systems for the CompuStar 286 by using shadow RAM, a technique that copies the ROM BIOS into RAM at boot time for faster ROM access.

The flip side of performance is always price, and the CompuStar's speed victory over the Dell System 220 would mean a lot less if the CompuStar cost a

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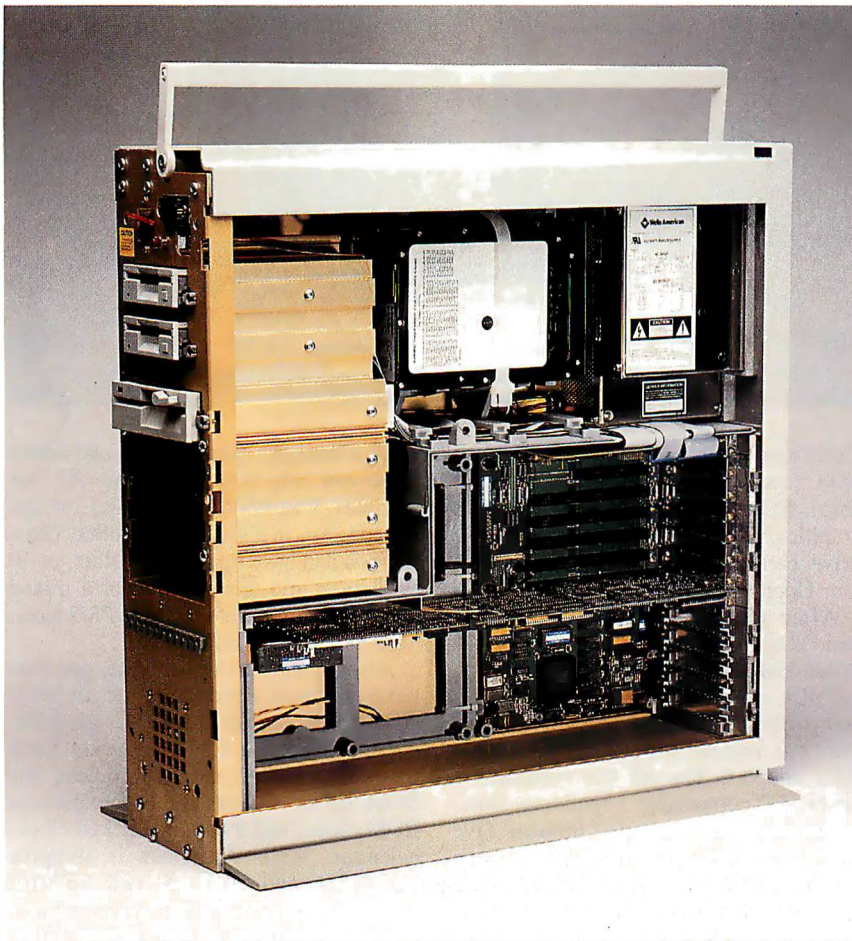


Photo 1: The inside of the CompuStar reveals the nature of the beast: plenty of expansion room and easy access to components.

CompuStar 286**Company**

Wells American Corp.
3243 Sunset Blvd.
West Columbia, SC 29169
(803) 796-7800

Components

Processor: 20-MHz 16-bit Intel 80286;
10-MHz Intel 80287 coprocessor
Memory: 1 megabyte of 16-bit 80-ns
DRAM on 80286 CPU module,
expandable to 16 megabytes; 128K
bytes of BIOS ROM
Mass storage: Two 1.44-megabyte 3½-
inch floppy disk drives; one 1.2-megabyte
5¼-inch floppy disk drive; 150-
megabyte hard disk drive
Display: Flat-tension-mask color VGA-
compatible monitor; VGA support on the
motherboard
Keyboard: 101 keys in IBM Enhanced
layout
I/O interfaces: Two RS-232C serial
ports; DB-25 parallel port; analog monitor
port with DB-15 connector; 6-pin DIN
keyboard connector; 6-pin DIN mouse
connector; seven AT-compatible
expansion slots

Size

24 × 7½ × 26 inches; 66 pounds
(weight can range from 50 to 90 pounds,
depending on the configuration)

Software

Setup disk, which includes a setup
utility, a memory and port management
utility, a video mode utility, a utility for
setting the processor's speed, utilities for
displaying messages on the LED
display, and drivers for LIM/EMS memory
and additional floppy disk drives

Options

CompuStar Base Model 100: \$1195
AT-compatible primary bus module:
\$195
AT-compatible secondary bus module:
\$175
PS/2-compatible primary bus module:
\$295
PS/2-compatible secondary bus
module: \$250
PS/2 adapter module: \$995
8086 CPU module (available as of
February): \$295
80286 CPU module: \$695
80286 memory-extender kit: \$55
16-MHz 80386 CPU module: \$1395
20-MHz 80386 CPU module: \$1695

Documentation

User's manual; Adaptec hard disk drive
controller user's manual

Price

System as reviewed: \$6570

Inquiry 857.

great deal more than the Dell computer. A Dell System 220 with a 40-megabyte hard disk drive, 1 megabyte of memory, three empty AT slots, and Dell's VGA Plus monitor costs \$3299 as I write this. A comparable CompuStar 286 with a 44-megabyte hard disk drive and equivalent VGA monitor runs \$4010, or \$711 more. For that extra \$711, the CompuStar 286 offers more empty slots, a slightly faster overall system, and its built-in flexibility.

But Is It Compatible?

Another concern about any high-speed PC is its level of compatibility. The CompuStar ran everything I threw at it, both hardware and software. I successfully installed an Everex Evercom II 2400-bps internal modem, a Microsoft Serial Mouse, and an Intel Above Board/AT. On the software side, I tested Borland's Quattro 1.0, Reflex 1.14, SideKick Plus 1.0, SuperKey 1.16A, Turbo Basic 1.1, Turbo C 2.0, and Turbo Pascal 4.0; Digitialk's Smalltalk/V 1.2; Kermit 2.30; Lotus 1-2-3 version 2.01, which ran without forcing me to slow the system manually; MicroPro's WordStar 3.3 and 4.0; Microsoft's PC Paintbrush 2.0 and Word 4.0; Quarterdeck Office Systems' DESQview 2.0; the Norton Utilities 3.00; and Symantec's Q&A 1.1.

Wells American sells IBM's own PC-DOS 3.3 and the AT version of IBM's OS/2 1.00, which a Wells spokesperson said runs on the CompuStar. Wells did not include OS/2 with the evaluation unit, however, so I was unable to verify that.

And More Goodies

When you leave the world of external applications and dive into the box itself, you find that the Wells engineers have been at it again. It starts with the fans—one at the bottom front of the unit that blows out enough air that you can feel it if you wear shorts, and one at the top rear inside the power display case. The unit disassembles easily, using Nylatch nylon snap fasteners.

The flexible design also extends to the CompuStar's storage devices: The system can hold up to six half-height devices, all of which you can access from outside the machine, if necessary. Two of these device areas are 3½-inch bays, while the other four can hold 5¼-inch devices. All the devices mount on sliding rails inside the machine.

My evaluation unit had two Mitsubishi 3½-inch floppy disk drives, which DOS saw as drives A and B, in the 3½-inch slots. By using Wells's own special

drivers and CompuStar Extended Diskette Drive BIOS, DOS saw my evaluation unit's third floppy drive, a 1.2-megabyte 5¼-inch TEAC model, as drive E.

The CompuStar also includes one other full-height 5¼-inch drive bay inside the machine. The power supply includes seven device connectors, so you can run the system even if you fill this bay and all six half-height bays. In my unit, this internal bay held a Maxtor 155-megabyte, 18-millisecond hard disk drive managed by an Adaptec 10-mega-bit-per-second ESDI controller in one of the AT slots.

Wells American includes Storage Dimensions' well-respected SpeedStor hard disk device driver, version 5.13b, with the system. The combination of that software and Wells's disk BIOS lets you make a second DOS partition that is larger than the traditional DOS 3.3 limit of 32 megabytes. In my evaluation unit, the C drive was only 2 megabytes, while the D drive was over 150 megabytes. Wells American uses this design to leave drives E and F open for two of the four floppy disk drives that the CompuStar can include.

Wells also offers a slew of other mass storage options, including tape backup systems, a WORM (write once, read many times) drive, and an erasable optical drive from Maxtor.

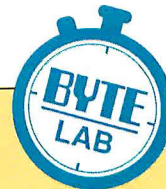
The CompuStar's interior bay design has one flaw: No hard disk light is visible outside the machine. Wells more than compensates for this omission, however, with a little touch that Dell popularized on its early systems: a four-character LED display on the front of the system. That display shows both diagnostic and system status information. For example, it shows "R" when the system is reading the hard disk and "W" when the system is writing to that disk. If you press the Control or Shift keys, the LED shows the current system speed.

Wells American also includes on its standard setup disk two programs, DISP.EXE and SCROLL.EXE, with which you can display four characters of your choice, either statically or scrolling from right to left, in the LED display.

Wells American also did its own ROM BIOS; my unit included the CompuStar Multi-Processor Convertible Microcomputer V1.05 BIOS.

Like most of today's fastest systems, the CompuStar offers a slower compatibility speed. Unlike many systems, however, it offers five slower speeds. You can run the 80286 at 16, 12, 10, 8, or 6 MHz. Wells implements these speeds by

continued



Wells American CompuStar 286

APPLICATION-LEVEL PERFORMANCE

Wells American CompuStar 286 **12.5***

WORD PROCESSING

XyWrite III+ 3.52	Medium/Large
Load (large)	:10
Word count	:03/:20
Search/replace	:05/:22
End of document	:02/:14
Block move	:09/:09
Spelling check	:09/1:00

Microsoft Word 4.0

Forward delete	:13
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Aldus PageMaker 1.0a

Load document	:13
Change/bold	:25
Align right	:20
Cut 10 pages	:18
Place graphic	:05
Print to file	1:46

Index: 2.62

SPREADSHEET

Lotus 1-2-3 2.01

Block copy	:03
Recalc	:01
Load Monte Carlo	:16
Recalc Monte Carlo	:04
Load rlarge3	:03
Recalc rlarge3	:01
Recalc Goal-seek	:03

Microsoft Excel 2.0

Fill right	:05
Undo fill	1:50
Recalc	:01
Load rlarge3	:25
Recalc rlarge3	:01

Index: 3.11

DATABASE

dBASE III+ 1.1	
Copy	:59
Index	:18
List	1:14
Append	1:34
Delete	:02
Pack	1:20
Count	:16
Sort	1:04

Index: 1.65

SCIENTIFIC/ENGINEERING

AutoCAD 2.52

Load SoftWest	1:09
Regen SoftWest	:44
Load StPauls	:11
Regen StPauls	:07
Hide/redraw	14:58

STATA 1.5

Graphics	:19
ANOVA	:14

MathCAD 2.0

IFS 800 pts.	:21
FFT/IFFT 1024 pts.	:22

Index: 3.06

COMPILERS

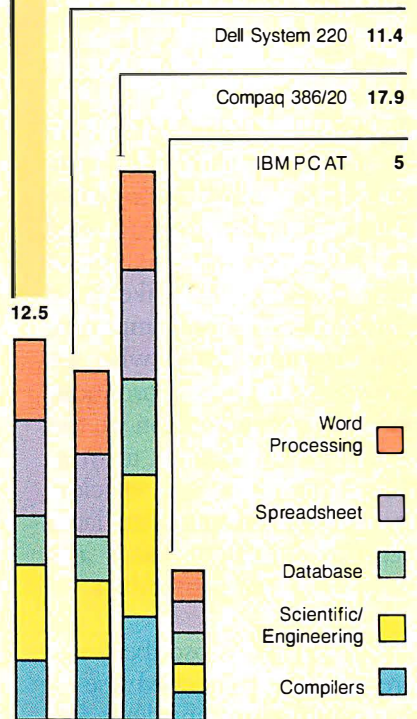
Microsoft C 5.0

XLisp compile	4:37
---------------	------

Turbo Pascal 4.0

Pascal S compile	:06
------------------	-----

Index: 2.06



*Cumulative application index. Graphs are based on indexes at left and show relative performance.

All times are in minutes:seconds. Indexes show relative performance; for all indexes, an 8-MHz IBM PC AT=1.

LOW-LEVEL PERFORMANCE¹

Wells American CompuStar 286

CPU

Matrix	5.20
String Move	
Byte-wide	40.40
Word-wide:	
Odd-bnd.	30.60
Even-bnd.	20.19
Sieve	22.69
Sort	18.95

Index: 2.64

FLOATING POINT

Math	23.12
Error ²	
Sine(x)	9.78
Error	
e^x	8.37
Error	

Index: 2.04

DISK I/O

Hard Seek³	
Outer track	3.29
Inner track	3.33
Half platter	6.66
Full platter	6.68
Average	4.99

DOS Seek

1-sector	8.47
32-sector	25.19

File I/O⁴

Seek	0.11
Read	0.88
Write	0.78

1-megabyte

Write	4.87
Read	5.02

Index: 1.90

VIDEO

Text	
Mode 0	3.95
Mode 1	3.96
Mode 2	3.94
Mode 3	3.92
Mode 7	N/A

Graphics

CGA:	
Mode 4	1.92
Mode 5	1.87
Mode 6	2.01

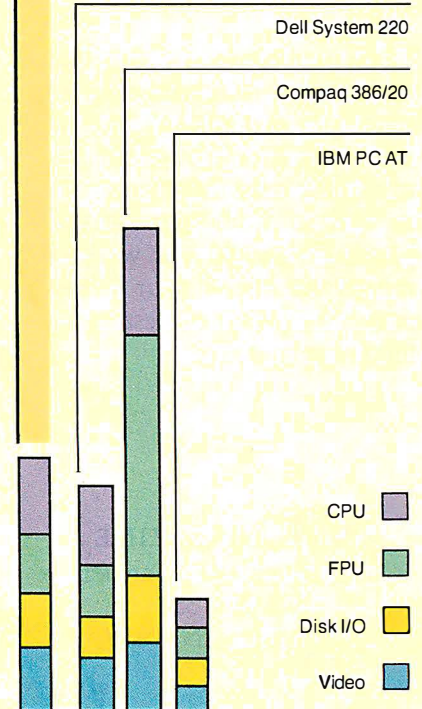
EGA:	
Mode 13	3.46
Mode 14	3.74
Mode 15	N/A
Mode 16	3.77

VGA:	
Mode 18	3.90
Mode 19	2.00
Hercules	N/A

Index: 2.30

CONVENTIONAL BENCHMARKS

LINPACK	478.68
Livermore Loops ⁵ (MFLOPS)	0.46
Dhrystone (MS C 5.0) (Dhry/sec)	5000



N/A=Not supported by graphics adapter.

¹ All times are in seconds. Figures were generated using the 8088/8086 versions (1.1) of Small-C.

² The errors for Floating Point indicate the difference between expected and actual values, correct to 10 digits or rounded to 2 digits.

³ Times reported by the Hard Seek and DOS Seek are for multiple seek operations (number of seeks performed currently set to 100).

⁴ Read and write times for File I/O are in seconds per 64K bytes.

⁵ For the Livermore Loops and Dhrystone tests only, higher numbers mean faster performance.

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using three different crystals/oscillators in the system, one each for the 20-, 16-, and 12-MHz rates. A flip-flop divider off the oscillators provides the three additional slower speeds. You can control the unit's speed from the keyboard with the now-traditional Ctrl/Alt/+ combination to raise the speed, or Ctrl/Alt/- to lower it. The system beeps once each time you lower its speed, and twice each time you raise the speed. You can also use a Wells utility, SPEED.EXE, to set the speed from the DOS command line.

Monitor and Keyboard

In keeping with this abundance of options, you can choose either a "firm touch" or "soft touch" keyboard. Both keyboards follow the IBM 101-key Enhanced layout. My evaluation unit came with the Fujitsu keyboard that is showing up on a lot of machines these days. It has a good, very springy feel with an audible keyclick.

As for the monitor—well, if you haven't seen flat-screen color monitors yet, avoid them at all cost. Once you see one, you'll want one, and they're expensive. Wells charges \$895 for the Zenith-built one on my evaluation unit, and it is gorgeous, albeit big and a bit noisy, since it has its own fan.

The Soft Side

The only standard software is Wells American's Setup disk, which comes in both 3½- and 5¼-inch versions. That disk includes Wells's setup program, which is also in ROM and accessible via the Ctrl/Esc key combination; a LIM/EMS driver; a program that lets you set the system's video mode; another that lets you control its port assignments and memory usage, including its use of interleaving and shadow RAM; Wells American's special disk drivers; and the LED and compatibility speed control programs mentioned earlier.

Documentation and Support

The CompuStar includes a single, 100-plus-page user's manual. Its early chapters are for novices, with step-by-step instructions for adding options to the system. Its later chapters and appendixes contain detailed technical information, including data on the jumpers on all the CPU modules.

Unfortunately, even though it's well done, this book just cannot make a novice comfortable installing all the possible options. The task itself is largely unnecessary, however, since Wells assembles the units at the factory.

My unit also came with a user's man-

ual for my Adaptec hard disk drive controller. That complex book is useful only for skilled users who want detailed information about the controller.

When the manuals leave you wanting, you can call the company's technical support. It's a toll call, which is unfortunate since you're likely to have to wait. Every time I called, I had to sit on hold until I either gave up or gave in to the secretary's request for my name and number. When she took that information, however, someone always called me back. The support people with whom I spoke were courteous and very knowledgeable about every aspect of the system. In a rare sweep of competence, everyone with whom I spoke was able to answer all my test questions, which ranged from simple to complex.

You get a one-year limited warranty on parts and labor, which includes all hardware but not software. You have to get your machine, or at least the defective component, to a Wells Authorized Warranty Repair Center. You can buy on-site service in many locations nationwide through Wells's arrangement with General Electric. Wells American sets prices for this service on a monthly basis by component, such as \$5 for the base system, \$3.50 for the 80286 CPU module, and \$26 for the 150-megabyte hard disk drive. Those prices can add up for a whole system; a year of service for my evaluation unit would run around \$700.

Wells offers another support plan, the C.A.R.E. (components authorized for repair or exchange) program, for which the company has not yet set prices. It lets you quickly replace a defective module. You call with the identity of the module, and the company will send a replacement via overnight delivery service.

A Good System with Great Potential

The CompuStar 286 is the fastest 80286-based system I've seen, and it has as much or more expansion capability as any system I've seen. Those properties, along with a bearable price tag, make it a good machine to consider. The real excitement will come if Wells American delivers its PS/2 module, fulfilling the dual-bus promise of the CompuStar.

I hope Wells meets this challenge, because I like this machine, and I like the engineering behind it. It's nice to see something new in the PC clone business for a change. ■

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