more of everything you need and want ... *random-access memory* ...

BRYANT Model-2 DISC FILES
SERIES 4000

BIT PATTERN MAGNIFIED 12-1/2 TIMES

ACTUAL BIT PATTERN

6 5 4 3 2 1
DATA ZONES   SEVERA
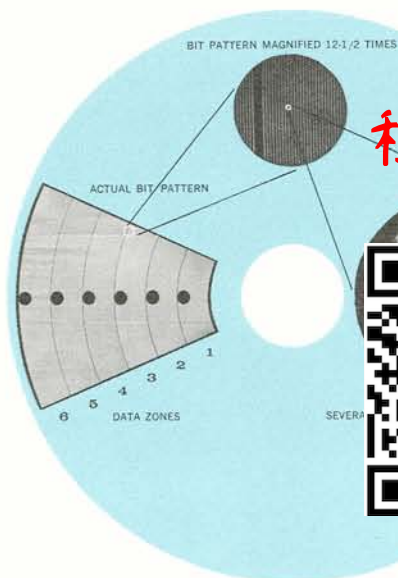
new programming flexibility!
new ... random access!
new environmental independence!
new on-line maintainability!
new long-term reliability!
new lower cost per bit!

☐ Multiple magnification of disc surface at left above shows several bit patterns enlarged 1000 times. With the new MODEL 2 Series 4000C file, cost per bit can be as low as 0.0075 cent!

BRYANT Model 2 DISC FILES
SERIES 4000

You might think, at first glance, that new MODEL 2 Series 4000 disc files are pretty much like their predecessor — the original Bryant Series 4000 random-access mass memories that have served so well so long in over 150 key computer and data processing installations throughout the world. And in a great many respects they are.

Same modular design concept. Same rugged precision mechanical construction. Same basic proven operating principles. Same wide range of capacities — with series and parallel clocked or self-clocked recording, unrestricted record length, and automatic data protection in the event of external power failure.

But there's a lot that's new in the MODEL 2 — many important advancements designed to reduce maintenance, improve reliability and increase programming flexibility. For example:

All Bryant MODEL 2's are equipped with a new self-contained environmental control that maintains the disc file modules at a fixed proper operating temperature, cleans circulating air, and assures positive internal pressurization.

This means shorter warm-up time — usually less than 15 minutes, or almost immediately for reading if self-clocking is used. It also permits convenient on-line maintainability — with total down-time for scheduled maintenance reduced to approximately 42 hours per year, or less than 1% of normal operating time.

Reliability has also been improved — not only through control of environmental factors — but at the component level as well. Two major sub-systems have been simplified, and several precision operating mechanisms have been redesigned for greater accuracy and longer life. As a result, mean-time-between-failures for new MODEL 2 disc files has been determined to be from 2,000 to 3,000 hours — depending upon application conditions, file configuration, and the quality of customer maintenance.

Note, too, that the electronic interface has been consolidated in a completely isolated air-cooled compartment conveniently located up front behind the center panel. All optional read, write,

modules are packaged together in a hinged card rack for quick, easy accessibility and as close to the magnetic heads as possible. Also, a new preamplifier switching device has been mounted near each head bar to minimize cabling and obtain improved playback signals.

Where the original Series 4000 files were available with single access head positioning only, the new Model 2's can be furnished with a Dual/Rapid random access head positioning system that permits independent operation of the two sides or disc file modules and greatly increases programming flexibility.

Last, but by no means least, is the fact that all of these new value features and major improvements have been accomplished in a manner that has actually reduced your cost per bit — down to as low as 0.0075 cent, or only 0.06 cent per 8-bit character!

MODEL 2 SERIES 4000C
Two module file containing maximum of 26 discs or 52 disc surfaces—50 for general data storage, two for clock, track verification, fast access data. Available with speeds of 900 or 1200 rpm—single or dual access.
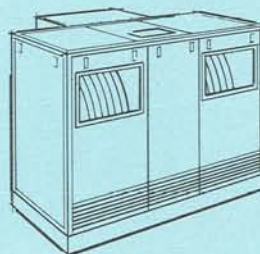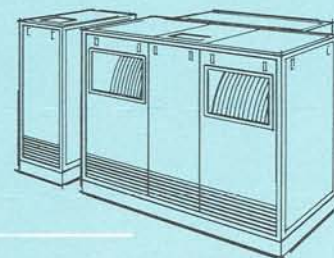
MODEL 2 SERIES 4000B
Two module file containing maximum of 14 discs or 28 disc surfaces—26 for general data storage, two for clock, track verification, fast access data. Available with speeds of 900 or 1200 rpm—single or dual access.

File Organization—"Drum Mode" Concept and Dual/Rapid Random Access Provide Maximum Programming Flexibility

Bryant MODEL 2 Series 4000 disc file was designed to operate with any medium or large computer as a massive external store supplementing an internal memory — or to function with on-line data communications systems. As such, it permits high data transfer rates and greatly increases "thruput" for applications requiring frequent random references of data. Moreover, it offers a computer programmer almost unlimited opportunity to layout records of any type.

FILE ORGANIZATION—One way to look upon the storage capabilities of MODEL 2 from a programming point of view is to visualize organizing data in accordance with the "drum mode" concept illustrated below.

To grasp the effectiveness of this concept, take the largest MODEL 2 file — the "C" size containing the maximum of 50 data surfaces. As illustrated, there are six read/write heads per data surface — 300 heads in all — and each has access to 128 recording tracks. If the file is equipped with the new Dual/Rapid random access head positioning system, the positioning heads for each module or side of the file are connected to separate actuating mechanisms. If equipped with a single access system, the heads are connected to the same actuating/positioning mechanism. Thus, when the file is requested to seek out information, all of the heads attached to the actuating system move together — causing each of the six heads servicing a data disc surface to position over the same relative track as its counterpart servicing any other disc surface. Thus, for each of the six groups of 128 horizontally-aligned tracks across the file, there are 50 write-read heads over the same track position at any one time.

This, then, is like having six 50-head "drums" — the track length within each "drum" being the same but different from

"drum" to another. Thus, access time can be considerably reduced by storing data in accordance with the "drum mode" concept because one instruction can cause six 50-head "drums" to spew out information simultaneously at a rate of up to 40,000 five-character words per second per track. Furthermore, because there are 128 tracks serviced by each data head, a total of 128 50-head "drums" are available for each of six different track lengths — or 768 50-head "drums" in the 26-disc file.

DUAL/RAPID RANDOM ACCESS—Conventionally, computer and edp programmers think of a disc file as a single secondary information store. With the new Bryant Dual/Rapid random access system, however, the bank of heads servicing each module or side of the file can be operated independently. Thus there are literally no restrictions on using the two file modules. One head positioning system can be used to select tracks in a random mode while the other is selecting tracks sequentially. One module of the file can be used with one computer while the other works simultaneously with another computer. Also, both modules of the file can be programmed for use with the same computer by alternately reading or writing on one side and then reading or writing on the other — a programming scheme that can reduce access time by as much as 50% over files equipped with a single random access head positioner.

PROGRAMMING FLEXIBILITY—Data organization within the 768 recording tracks per disc surface is completely unrestricted. Tracks can be divided into equal record lengths or programmed to accept records of varying lengths in either sequential or random form. Thus each user can create the pattern for storing data on a track and establish requirements according to his particular needs.

To take full advantage of the Bryant Dual/Rapid access system,
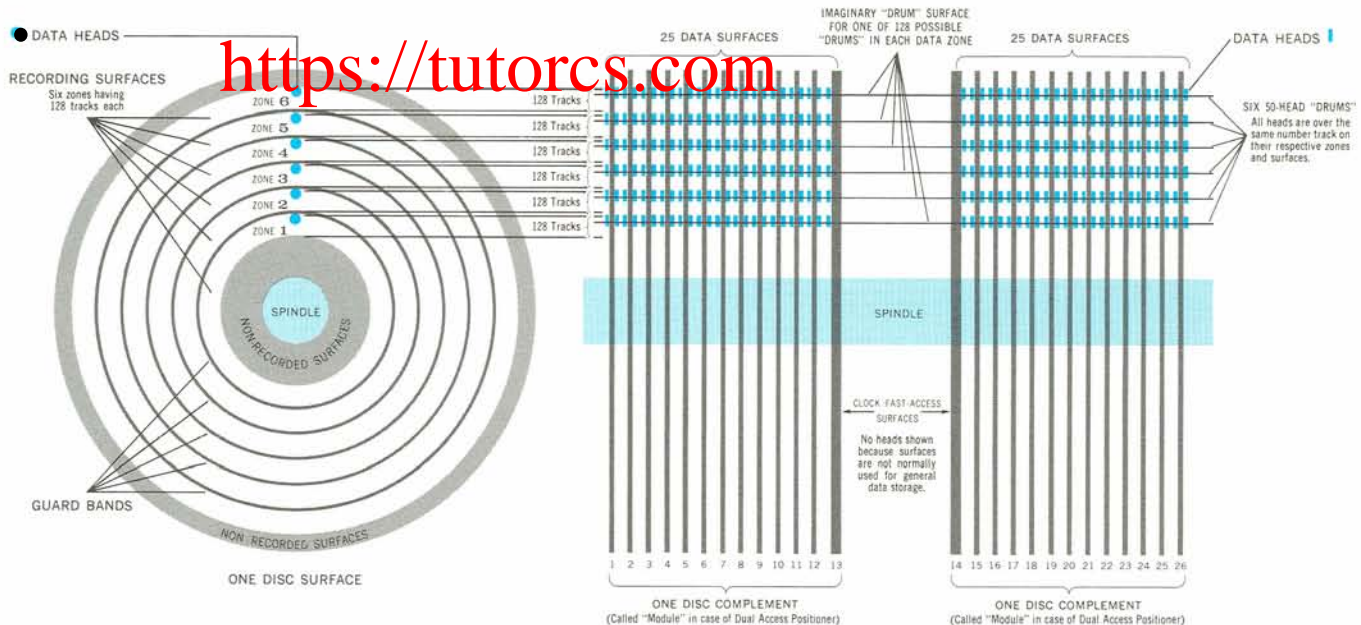
EXPLANATION—For any given head position, there are six 50-head "drums" in operation. Each "drum" services tracks which are the same length. However, one "drum" has different length tracks in it than does the other five. ☐ There are 128 positions (tracks) to which the head can be positioned. Thus there are a total of 768 50-head "drums" possible. ☐ Each annular zone across the whole file contains 128 50-head "drums."
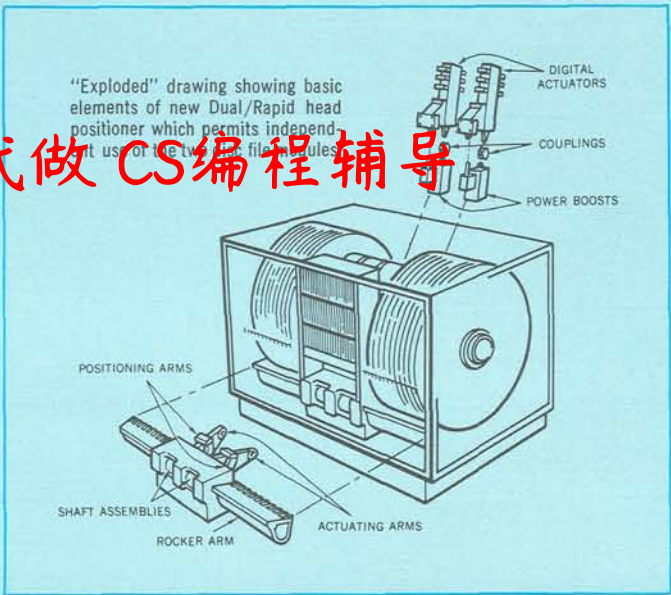
3

however, data format should be planned in accordance with the "drum mode" concept. Records of different lengths can be intermixed through variable format control. Depending on the application, the file can be loaded in a purely random manner or on a partial for fully sequential basis.

Many disc file applications can take advantage of block formatting — a technique for transfering a block of data into and out of a memory in either a sequential or a random mode. Using this approach, all the data in a disc "drum" zone could be transfered at microsecond head switching speeds, with millisecond track-to-track positioning only when it is necessary to access a different disc "drum" zone.

Despite the advantages of block formatting, most applications require at least a partial utilization of the file's indexing capability — that is, its means of locating and selecting record sequences which are located anywhere in the file. This ability of the random access feature facilitates the programming of a computation, particularly in sorting, updating, compiling, multiprogramming, real-time processing and data communications where very large transfers or dumps occur. In these applications, very high transfer rates are of utmost importance — as are short access times.

Each of the two disc surfaces reserved for clock, track verification and fast access data are serviced by sixteen, non-positioning magnetic heads. Because these heads are fixed in place and therefore can write and read on only one track each, they are capable of retrieving high speed data with an average rotational latency time of the disc—or 25 milliseconds for 1,200 rpm files and 33 milliseconds for 900 rpm files. Usually, four of these heads on each clock surface are assigned to clocking functions, leaving the other 12 heads on each surface for use at the customer's option. Thus, 24 tracks are normally available in a file to provide up to 1,217,880 bits (or 152,235 bytes) of storage for fast access data.

Through the use of fast access indexing tracks located on the two clock surfaces, full advantage can be taken of the high transfer rates afforded by sequential recording. These control signals ensure that the data are recorded accurately and that the correct record is selected for transferring data between the disc file and other computer storage during writing and reading operations. Discrete block or character, record, word marks, sector pulses and address data can be recorded by the user on the clock discs or—if desired—prerecorded by Bryant to meet the user's requirements.

Ultra-reliable parallel output/input can be affected with the single access MODEL 2 file with an extraordinarily low error rate of one recoverable error in 10^{11} bits processed. A single strobe is all that is required for parallel reading. The dual-access MODEL 2 can also operate in the parallel mode, but at reduced recording densities and with discrete clocking, or at full densities with the use of de-skewing buffers.

"Exploded" drawing showing basic elements of new Dual/Rapid head positioner which permits independ... use of the two file spindles

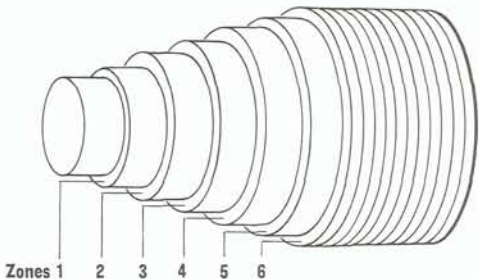## IV—"Drum Mode" Capacities for Bryant Model 2 Series 4000-C Disc File
1200 rpm, 50 Data Surfaces, 600 bpi Track Density

Disc "Drum" Zones	Recording Frequency	Write/Read Rate		Max. Track Capacity		Data Heads Per "Drum" Cylinder	6-FREQUENCY 6-ZONE FORMAT Capacity per "Drum" Cylinder		2-FREQUENCY 6-ZONE FORMAT Capacity per "Drum" Cylinder		1-FREQUENCY 4-ZONE FORMAT Capacity per "Drum Cylinder	
		Bits/Sec.	Bytes/Sec.	Bits	Bytes		Max. Bits	Max. Bytes	Max. Bits	Max. Bytes	Max. Bits	Max. Bytes
(Inner) 1	458 kc	458,000	57,250	22,910	2,864	50	1,145,500	143,187	1,145,500	143,187	(Not Used)	(Not Used)
2	617 kc	617,000	77,125	30,832	3,854	50	1,541,600	192,700	1,145,500	143,187	(Not Used)	(Not Used)
3	776 kc	776,000	97,000	38,791	4,849	50	1,939,550	242,444	1,939,550	242,444	1,939,550	242,444
4	935 kc	935,000	116,875	46,750	5,844	50	2,337,500	292,187	1,939,550	242,444	1,939,550	242,444
5	1,095 kc	1,095,000	136,875	54,731	6,841	50	2,736,550	342,069	1,939,550	242,444	1,939,550	242,444
6 (Outer)	1,254 kc	1,254,000	156,750	62,708	7,839	50	3,135,400	391,925	1,939,550	242,444	1,939,550	242,444
						Totals:	12,836,100	1,604,512	10,049,200	1,256,150	7,758,200	969,776

Disc "Drum" Zones	Capacity per Zone of "Drum" Cylinders		Capacity per Zone of "Drum" Cylinders		Capacity per Zone of "Drum" Cylinders	
	Max. Bits	Max. Bytes	Max. Bits	Max. Bytes	Max. Bits	Max. Bytes
(Inner) 1	146,624,000	18,328,000	146,624,000	18,328,000	(Not Used)	(Not Used)
2	197,324,800	24,665,600	146,624,000	18,328,000	(Not Used)	(Not Used)
3	248,262,400	31,032,800	248,262,400	31,032,800	248,262,400	31,032,800
4	299,200,000	37,400,000	248,262,400	31,032,800	248,262,400	31,032,800
5	350,278,400	43,784,800	248,262,400	31,032,800	248,262,400	31,032,800
6 (Outer)	401,331,200	50,166,400	248,262,400	31,032,800	248,262,400	31,032,800
Totals:	1,643,020,800	205,377,600	1,286,297,600	160,787,200	993,049,600	124,131,200

Zones 1 2 3 4 5 6

High Density Recording—All MODEL 2 Series 4000 Files are capable of writing and reading back data reliably at packing densities up to a nominal 600 bits/inch when recording in phase-modulation mode. This means you can store 32,860,416 bits per data surface—or up to 1,643,020,800 bits in the 26-disc mass memory above!

Electronic Interface—Write, read, head select, and logic electronic circuit modules are mounted in hinged racks conveniently located in separate air-cooled bay accessed through central panel. Systems are designed to meet your special requirements with respect to data rates, control signals, capacity, and mode of operation.

Environmental Controls—All MODEL 2 disc files are equipped with an environmental control unit designed especially to minimize air contamination and maintain the proper environment for optimum file performance, standardize read circuits, and provides all-metal technical filtration and self-contained mechanical cooling.
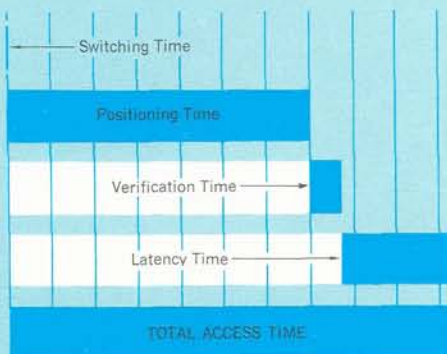
MODEL 2 SERIES 4000 DISC FILE

Power Controls—Furnished in separate cabinet as shown with "C" size files and enclosed in main frame of "B" size files, this compact power control unit features point-to-point connections for all electrical, hydraulic, and pneumatic elements in accordance with recommendations of Underwriters' Laboratories, Inc.

Dual/Rapid Positioning—New rapid and random access system provides two independent open-loop electro-hydraulic digital head positioner for each side of the file—with each positioner controlled by separate signals. This permits use of each module as an individual memory, provides greater versatility and faster access.

Signal Preamplifier—Magnetic heads can be driven from a preamplifier/switching device mounted near the related head bar. Each services 12 heads and provides gain factor of approximately 5 to playback values fed to read amplifiers. This arrangement reduces cabling impedance, improves resonance frequency, minimizes noise.

DIAGRAM BREAKING DOWN TOTAL ACCESS TIME

	BEST CASE Sequential, Track-to-track	WORST CASE Full Stroke, Track 0 to 127 or 127 to 0
Switching Time	µs	µs
Positioning Time	35 ms	140 ms
Verification Time	15 ms	15 ms
Latency Time	0 ms	50 ms
TOTAL ACCESS TIME	50 ms	205 ms

NOTE: Times listed above are based on use of 14-disc single access Model 2 Series 4000B File at 1200 rpm.

I—Maximum Data Storage Capacities

Disc File Size	Max. Data Surfaces		Capacity Per Module		Capacity Per File	
	Module	File	Max. Bits	Max. Bytes	Max. Bits	Max. Bytes
4000-B	13	26	427,185,408	53,398,176	854,370,816	106,796,352
4000-C	25	50	821,510,400	102,688,800	1,643,020,800	205,377,600

II—Maximum Positioning Times*

Type of Access	Discs Per Positioner	Maximum Time
Single	1 to 8	120 ms
	9 to 14	140 ms
	15 to 26	165 ms
Dual/Rapid	1 to 8	160 ms
	9 to 13	180 ms

*Positioning time is defined as time from instant of track selection until selected track is reached and playback signal amplitude is at full minimum value continuously.

III—Dual File Positioning Rates

Positioning Mode	Maximum Positionings	
	1 Module Alone	Simultaneous
Random	7/second	5/second
Full stroke (0 to 127 tracks, 127 to 0 tracks)	6/second	4/second
Sequential (track-to-track)	10/second	10/second

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PHYSICAL SPECIFICATIONS/MODEL 2 SERIES 4000 DISC FILES

MODEL 2 Series 4000B FILE — 2-Ton Environmental Control — 34", 33", 46", 70", 52"

PLAN VIEW

Weight of main frame with full comp[lement]
Shipping—3321 pounds. Installe[d]

Note—Subtract 33 pou[nds]... cker arm and head bar—for files with fewer than maximum number of discs.

MODEL 2 Series 4000C FILE — 51" 3-Ton Environmental Control — 34" 2-Ton Environmental Control — 33", 46", 22", 52"

PLAN VIEW   FRONT ELEVATION

Weight of main frame with full complement of 26 discs plus power control unit:
Shipping—3944 pounds. Installed—3551 pounds.

V—CHARACTERISTICS OF [BRY]ANT MODEL 2 SERIES 4000 DISC FILES

PARAMETER	MODEL 2 SERIES 4000B	MODEL 2 SERIES 4000C	PARAMETER	MODEL 2 SERIES 4000B	MODEL 2 SERIES 4000C
Disc diameter	39 inches	39 inches	[Heads for] single access	1 per file	1 per file
Data zones per disc surface	6	6	[Dual/]Rapid access	2 per file	2 per file
Data tracks—per radial inch	65, nominal	65, nominal	Positioning time	(See Table II)	(See Table II)
—per zone	128	128	Positioning rate	(See Table III)	(See Table III)
—per surface	768	768	Rotational speeds	900 rpm or 1200 rpm	900 rpm or 1200 rpm
Discs per file	14 max.	26 max.	at 900 rpm	33 ms (average)	33 ms (average)
Data surfaces—per module			at 1200 rpm	25 ms (average)	25 ms (average)
—per file	26 max.	50 max.	Power requirements—at 900 rpm	†208-volt, 3-phase 60-cycle, 12.2 KVA source for 14 discs	†208-volt, 3-phase 60-cycle, 18 KVA source for 26 discs
Clock/fast-access surfaces	2 per file	2 per file			
Bit capacity—per disc surface	32,860,416 max.	32,860,416 max.	at 1200 rpm	†208-volt, 3-phase 60-cycle, 14.6 KVA source for 14 discs	††440-volt, 3-phase 60-cycle, 20 KVA source for 26 discs
—per module	427,185,408 max.	821,510,400 max.			
—per file	854,370,81[6] max.	1,643,020,8[00] max.	Recommended recording scheme	Phase modulation with self-clocking	Phase modulation with self-clocking
*Byte capacity—per disc surface	4,107,552 max.	4,107,552 max.	Recording frequencies	Up to 1.254 Mc per sec. (See Table IV)	Up to 1.254 Mc per sec. (See Table IV)
—per module	53,398,176 max.	102,688,800 max.	Recording current per half coil	150 ma	150 ma
—per file	106,796,352 max.	205,377,600 max.	Preamplifier gain factor	5 (approximate)	5 (approximate)
Data heads—per surface	6 max.	6 max.	Warm-up time—self-clocked	Virtually instantaneous	Virtually instantaneous
—per module	78 max.	150 max.	—fully-clocked	Less than 15 minutes	Less than 15 minutes
—per file	156 max.	300 max.	Ambient temperature range—		
Tracks serviced per data head	128	128	—storage	—30° to +130°F	—30° to +130°F
Clock/fast-access head pads	8 per surface	8 per surface	—operating	60° to 100°F	60° to 100°F
Clock/fast-access heads per pad	2	2	Ambient humidity range—operating	10 to 80% relative	10 to 80% relative
Clock heads—per surface	4	4	Dirt control rating	95% N.B.S.**	95% N.B.S.**
—per file	8	8			
Fast-access heads—per surface	12	12			
—per file	24	24			

*Byte capacities based on 8 bits per byte. □ **National Bureau of Standards Rating means that the main filter is 93 to 97% efficient at one micron dust levels.
†Includes power for 2-ton environmental control unit. □ ††Includes power for 3-ton environmental control unit.

BRYANT "TOTAL PRODUCT ASSURANCE" CONCEPT

One reason why Bryant has become the world's leading independent producer of disc files and memory drums is its concept of "total product assurance." For when you buy Bryant equipment, you can be sure that: 1) It's design is based upon proven principles of operation and performance. 2) Every outside purchased component is the very finest obtainable. 3) Every precision part and assembly is controlled to the highest known standard of accuracy and quality. And 4) every finished product has been subjected to thorough computer-simulated testing prior to shipment to assure the ultimate in value and reliability.

Other Bryant customer services include complete installation of equipment by qualified factory engineers, a special training school for instruction of your personnel, and an inventory of spare parts—many having assigned federal stock numbers—to assure prompt field replacements when necessary.

BRYANT COMPUTER PRODUCTS

A Division of EX-CELL-O Corporation