GT44
GRAPHIC DISPLAY SYSTEM

The GT44 System

The GT44 is a multi-purpose, computer based graphic display system. The system—both hardware and software—has been integrated for functional completeness and operational ease.

The GT44 Features

- PDP-11/40 central processor
- 16K words of high-speed core memory
- Two 1.2 megaword removable disk drives and control
- Disk bootstrap loader
- 30 cps DECwriter Console Terminal
- Display processor with hardware character and vector generator
- 17" CRT monitor
- Light pen
- Programmers table
- RT-11/GT Operating System
- BASIC/GT, a high-level language with graphics capabilities
- Customer training
- On-site installation
- Standard warranty
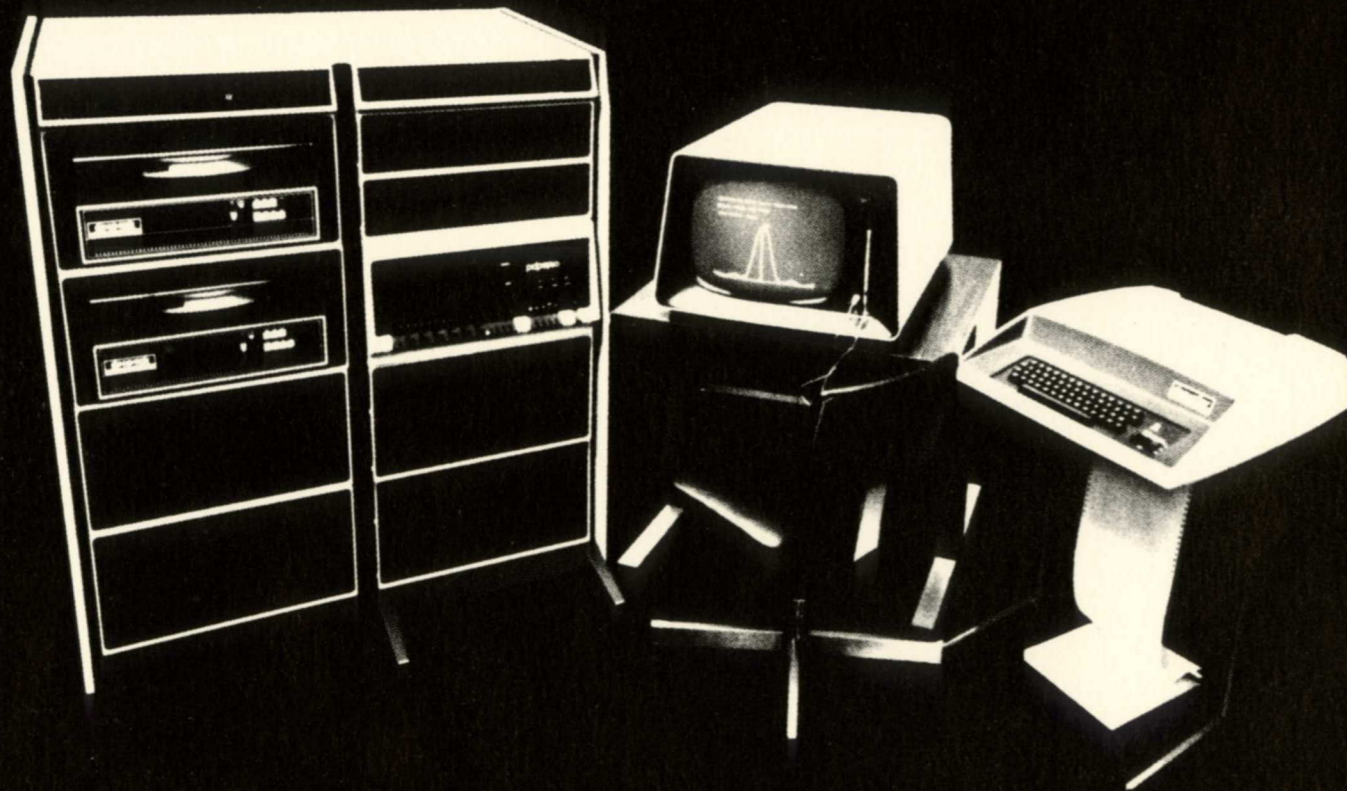
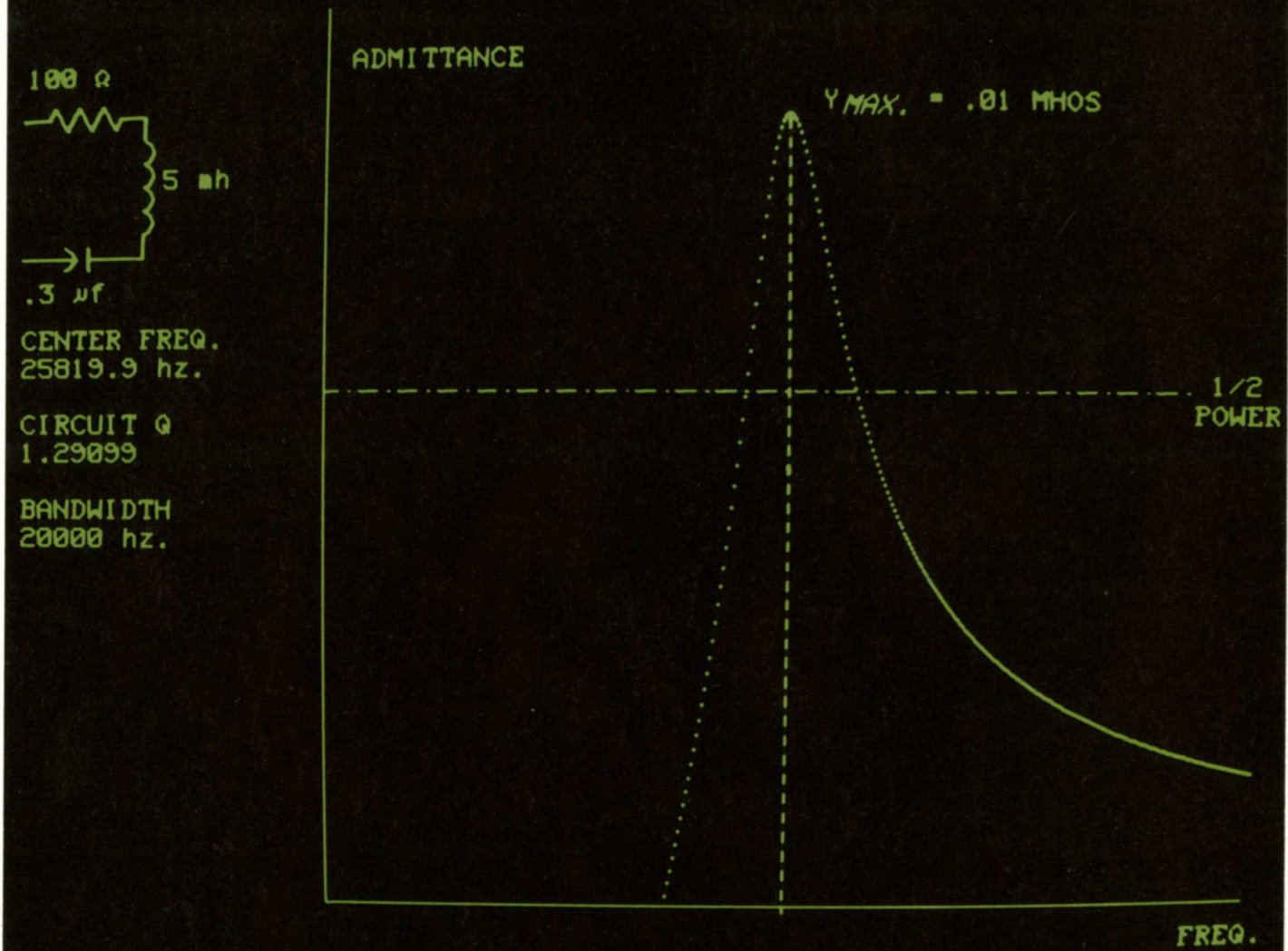PDP and UNIBUS are registered trademarks of Digital Equipment Corporation

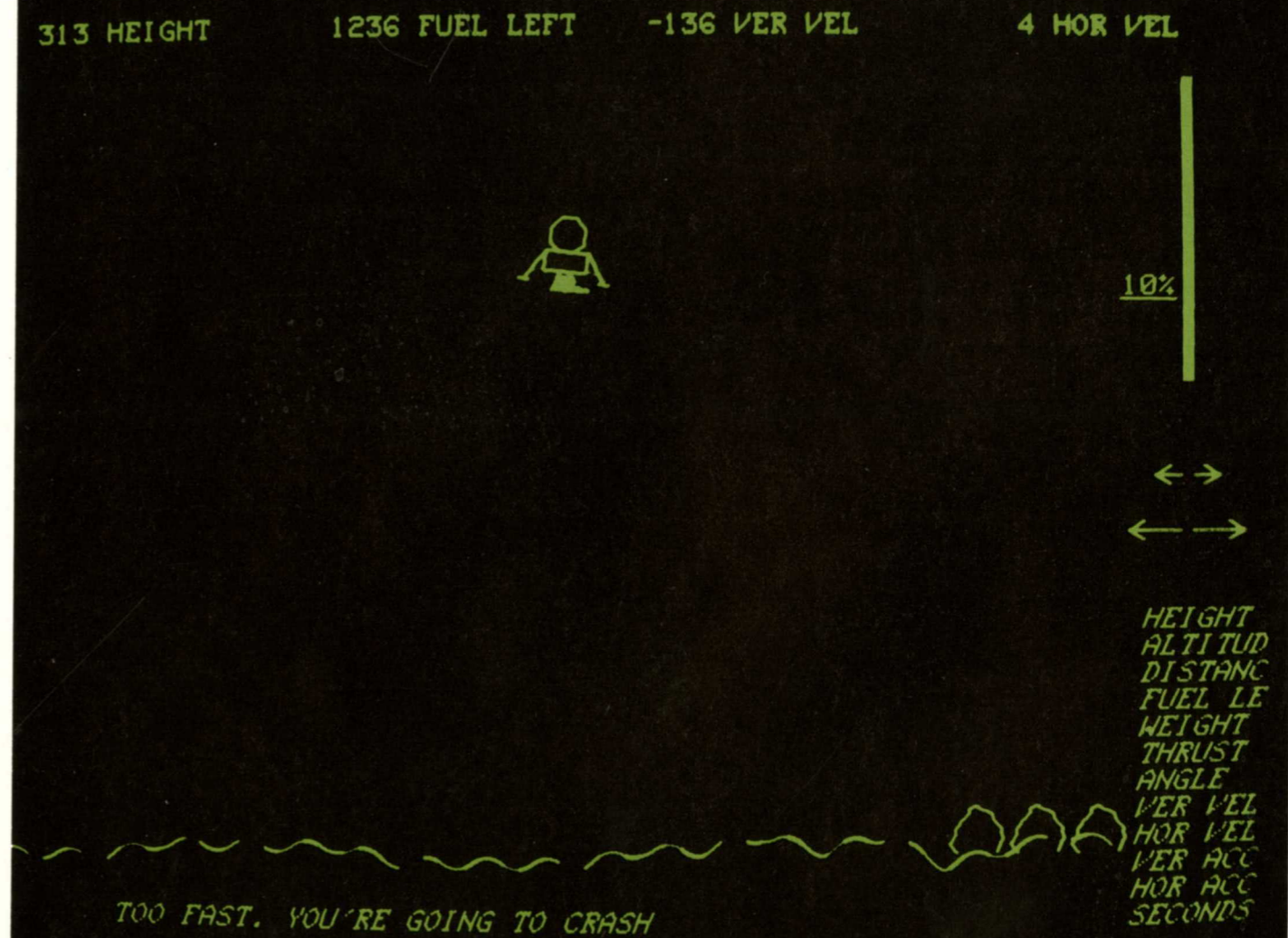# What is Graphics?

GRAPHICS IS COMMUNICATION THROUGH IMAGERY.

In almost everything we do, graphics plays a large part in our comprehension and solution of problems. With the aid of computers, graphic techniques are being successfully applied to more and more tasks. And the better the computer system, the greater the graphics capabilities.

DIGITAL has combined its graphics knowledge with the power of a major 16-bit computer to produce the GT44. The GT44 gives you a full graphic-based operating system at a price unequaled in the industry. That means that graphic capabilities are now within easy reach of all application areas; for example, architectural design, computer-aided instruction, molecular structuring, and industrial control monitoring.

The GT44 Graphic Display System can change your whole perspective.

ADMITTANCE

100 Ω

5 mh

.3 µf

CENTER FREQ.
25819.9 hz.

CIRCUIT Q
1.29099

BANDWIDTH
20000 hz.

Y MAX. = .01 MHOS

1/2
POWER

FREQ.

The GT44 can be used interactively to design an RLC filter for part of an electronic circuit. Interaction with the system via the light pen and/or the keyboard facilitates tasks of this nature.

313 HEIGHT   1236 FUEL LEFT   -136 VER VEL   4 HOR VEL

10%

HEIGHT
ALTITUD
DISTANC
FUEL LE
WEIGHT
THRUST
ANGLE
VER VEL
HOR VEL
VER ACC
HOR ACC
SECONDS

TOO FAST. YOU'RE GOING TO CRASH

With its powerful processing capabilities and graphic output, the GT44 is at home in many situations. In this example, the GT44 is simulating a Lunar Excursion Module landing on the surface of the moon.

The Software

The GT44 comes with a complete software package including a real-time operating system—RT-11—plus DIGITAL's newest BASIC compiler. The user has all the tools needed to write his application program using either the higher level BASIC language or RT-11's macro assembler. (A FORTRAN compiler is also optionally available.)

RT-11 is a high performance, real-time operating system complete with a versatile monitor and a full complement of systems programs. The user may direct output from RT-11 to either the display or the console printer. This offers the distinct advantage of having fast response from the CRT or typewritten copy when desired.

The RT-11 monitor performs device independent input/output so that programs may use a single routine to drive any peripheral on the system. And when a new peripheral handler is added, all programs can use the device immediately without the need for additional coding or reassembly.

RT-11 is designed around a contiguous file structure allowing extremely fast throughput and easy directory manipulation. Mass storage file layout is standardized, consistent with the system's capability for device independent I/O, and easily extended to meet the needs of a particular application.

RT-11 is a real-time system. All input/output is completely asynchronous and is executed at interrupt level. The monitor takes full advantage of the outstanding real-time features of the PDP-11—features such as stack processing, multiple priority levels, and vectored interrupts.

Included in the RT-11 system is a full complement of systems programs: an editor, a macro assembler, a relocatable linking loader, a debugging aid, and a file handling utility program.

EDIT/GT, a special RT-11/GT44 text editor, is used to create and modify ASCII text files. Text may be displayed on the CRT with a cursor that continuously denotes its position in the file. The command language allows both character and line-oriented commands along with full provisions for command iteration, powerful user-defined editing macros, and run-time manipulation. Interactive editing may be accomplished with as few as 10 easily learned commands. The more advanced editing commands may be used to perform complex text manipulation with minimum effort.

MACRO-11 is an upward compatible PDP-11 assembler that runs under RT-11, DOS-11, and RSX-11D. It provides full macro programming with facilities for maintaining and using a macro library on the RT-11 system device as well as conditional
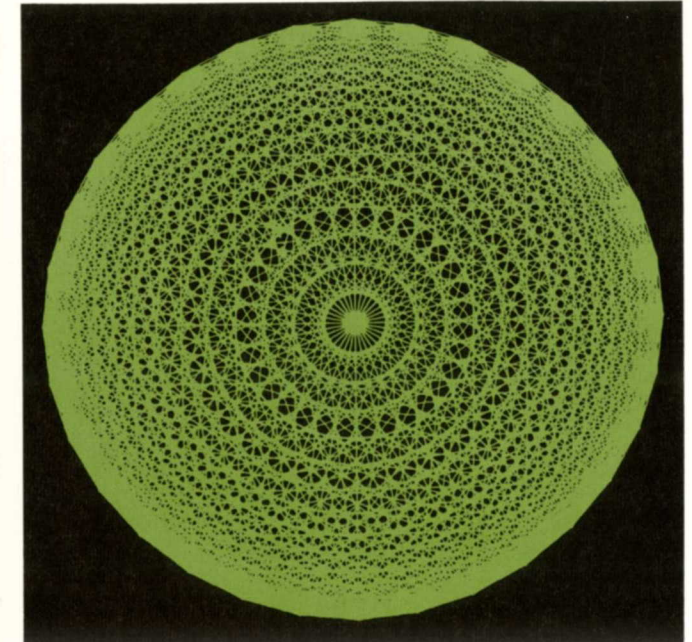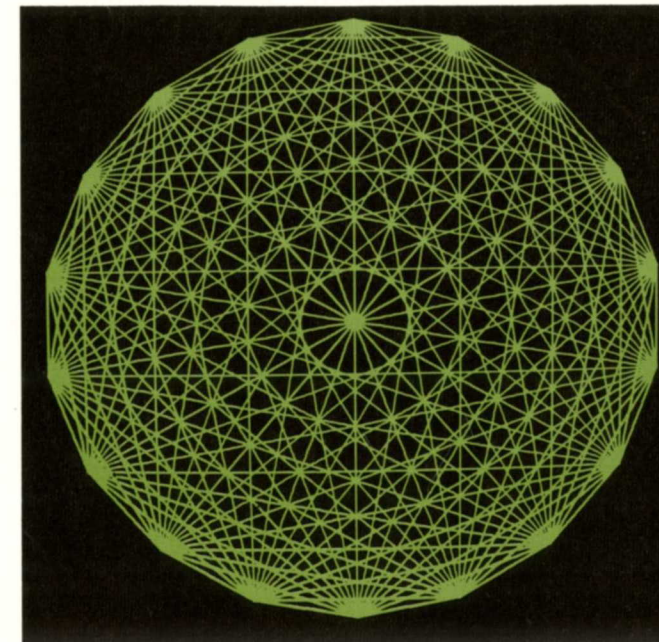
assembly and powerful pseudo-operators. MACRO-11 offers the convenience of global symbols for linking object modules and extensive error diagnostics. The modular programming system implemented under MACRO-11 is particularly well suited to the PDP-11 and its powerful stack facilities.

LINKER, the RT-11 linking loader, converts the relocatable object modules produced by the assembler into a run-time format in a manner that allows the user to easily control the structure of the resulting program module. Services performed by the LINKER include linking global references among object modules and initializing all parameters required by the monitor to save and run a program. An important feature of the LINKER is its ability to implement overlays in a way that is transparent to the assembly language user. Overlays do not require any special instructions or function calls. The user designates an overlay structure, and the LINKER automatically outputs a runnable core image with the desired overlays. While ease of use is paramount, the power of the overlay system has not been compromised. The system allows any number of overlays in any number of memory areas.

ODT, the On-Line Debugging Technique, aids in debugging assembly language programs. For example, ODT may be used to print the contents of any block of memory locations, scan memory to locate a particular instruction or data word, calculate offsets for relative addresses, and fill blocks of words or bytes with designated values. ODT may be requested to interate past any of eight possible breakpoints any number of times before interrupting. During a breakpoint interrupt,

the state of the CPU is preserved for examination, modification, and later restoration when execution continues.

PIP, the RT-11 Peripheral Interchange Program, is a file transfer and maintenance routine that uses the same concepts found in PIP utilities on all DIGITAL systems. RT-11 PIP may be used to transfer files between any supported peripheral devices in any standard format. It will also perform directory operations such as listing the directory for a given device, renaming files, extending the size of a given file, or consolidating empty files into one contiguous space. Segmented files may be merged during a PIP transfer or, alternately, multiple transfers may be executed in response to a single keyboard command. PIP allows "wild card" specifications in file names, so that only one PIP command is required to perform an operation on a whole class of files.

BASIC—GT

BASIC is a conversational programming language developed at Dartmouth College that employs simple English-type statements and familiar mathematical notations to perform an operation. It is one of the simplest computer languages to learn. And once it is learned, BASIC offers the facility of advanced techniques to perform intricate manipulations or express a problem efficiently. With BASIC, even the novice programmer can solve complex data acquisition and processing problems with a minimum amount of effort.

Under RT-11, BASIC is implemented as an incremental compiler which combines the interactive capabilities of an interpreter with the speed of a
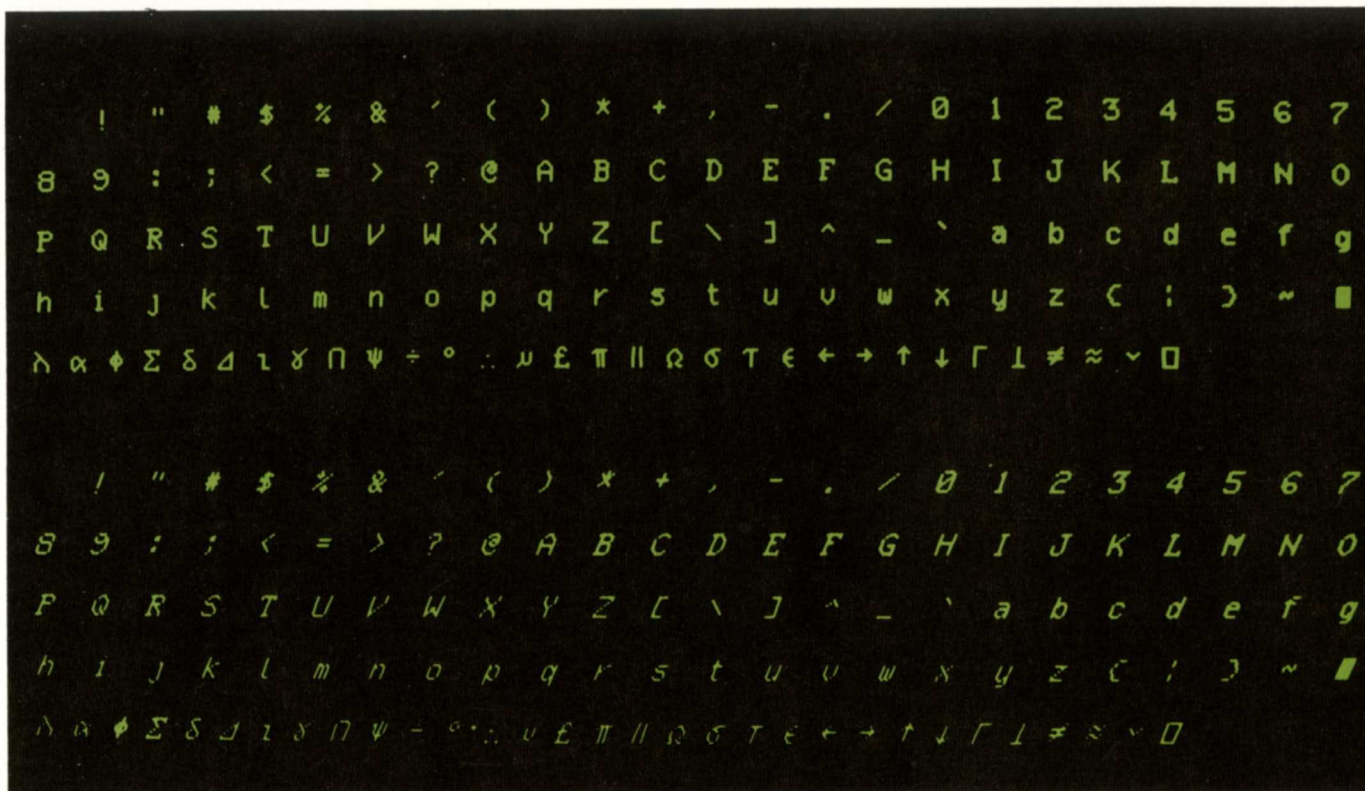
compiler. Features of RT-11's BASIC include:

- String capability; users can have Dartmouth-compatible string support complete with string arrays and functions.
- A "CALL" statement that allows easy interfacing of assembly language functions; the function can be called by name and passed several parameters.
- Interrupt-driven support for standard devices.
- Sequential and virtual memory file support for RT-11 mass storage devices.
- CHAIN and OVERLAY statements to accommodate programs many times larger than available memory.

The versatile file structure implemented under RT-11's BASIC includes provisions for up to seven sequential files and seven virtual memory files, all of which are accessible simultaneously. The sequential files accept any type of ASCII data and are particularly useful for stored text and data strings.

Virtual memory files accept numeric or alphanumeric data in a manner that appears as though the entire set of data were memory resident. The fast access time on a device such as the DECpack permits the system to process the virtual arrays in a real-time environment, using only slightly more time than would be required if the data were actually in the CPU's memory.

BASIC also runs in a fully interactive "desk calculator" mode that can aid program development and perform one-time calculations in response to immediate console commands.

BASIC-GT is a special version of BASIC that implements the full graphics capabilities of the GT44. A complete set of graphics CALLS allow displaying points, text, and lines, display subroutining, and light pen interaction.

A tracking object can be displayed with only one BASIC "CALL" statement; pictures may be defined as subroutines and recalled any number of times; displayed pictures may be stored as files under RT-11 and later retrieved.

Some of the special graphics statements are:

VECT
Draws a vector in ΔX and ΔY on the CRT. Any of the four GT44 line types may be selected.

RDOT
Plots a point at position ΔX and ΔY.

APNT
Plots a point at absolute position X,Y.

XGRA
Plots a graph along the X axis.

TEXT
Displays messages on the CRT. The full ASCII set is available as well as the GT44's special character set.

SUBP
Defines a subpicture or display subroutine.

TRAK
Introduces a tracking object onto the screen which can be moved with the light pen.

SAVE
Saves a display file compatible with RT-11's storage format.

RSTR
Restores a previously saved display file.

DIGITAL Supporting Services

There's more to the GT44 graphics system than meets the eye. As the world's largest manufacturer of minicomputers, DIGITAL offers a wide range of resources.

Our field service personnel handle on-site installation and testing as well as any maintenance work that might be necessary. Nine world-wide DIGITAL Education Centers offer training courses from the most basic subjects to the most complex. DIGITAL offers expert assistance in any application that requires special systems or software development.

DECUS, the Digital Equipment Computer Users Society, is a trading ground of information and fellowship among users of DIGITAL computers. It maintains a library of user-contributed programs, which are available to all members. DECUS also conducts local and international symposia and prints a newsletter as well.

The power, flexibility and price of the GT44 Graphic Display System are unequaled in the industry. As a computer-based system, the GT44 is a valuable tool in a variety of applications.