TEK 8540 INTEGRATION UNIT

FLEXIBLE SOLUTIONS
FOR A FUTURE OF CHANGE

Tektronix®
COMMITTED TO EXCELLENCE

A FAST, FLEXIBLE SOLUTION TO MICROPROCE

Making the most of your digital design potential.
Make no mistake.

Microcomputer-based products are here to stay. Along with all the prodigious tasks required to deliver them to the market place. At minimum expense, of course, and ahead of the competition.

Where do you start? By organizing your resources, both people and equipment. And then making the most of what you've got. No small challenge. Especially when you consider the mounting complexity that accompanies each new generation of digital devices.

To top it off, you've got to consider the future as well as the present. By the time you've geared up to work around a chip that's currently popular, its successor will suddenly pop out of the wings.

In short, you've got a problem. One that calls for a digital design approach that's fast, cost effective, and flexible. All at the same time.

The solution comes in two parts. First, software development using your mainframe computer. Second, software/hardware integration with the Tektronix 8540 Integration Unit.

Generate microcomputer software with your present computer system.

Your company or department's mainframe computer plays an important role in contemporary digital design. Soon it will be indispensable.

Why? Because microcomputer design is becoming an increasingly software oriented business. New generations of chips that rival mainframe sophistication are making complex programs in the megabyte range practical. Hardware design is also rapidly changing. Today's engineer must be a systems designer selecting functional rather than discrete components to fit the need. In every case, the trend is toward more functions per chip.

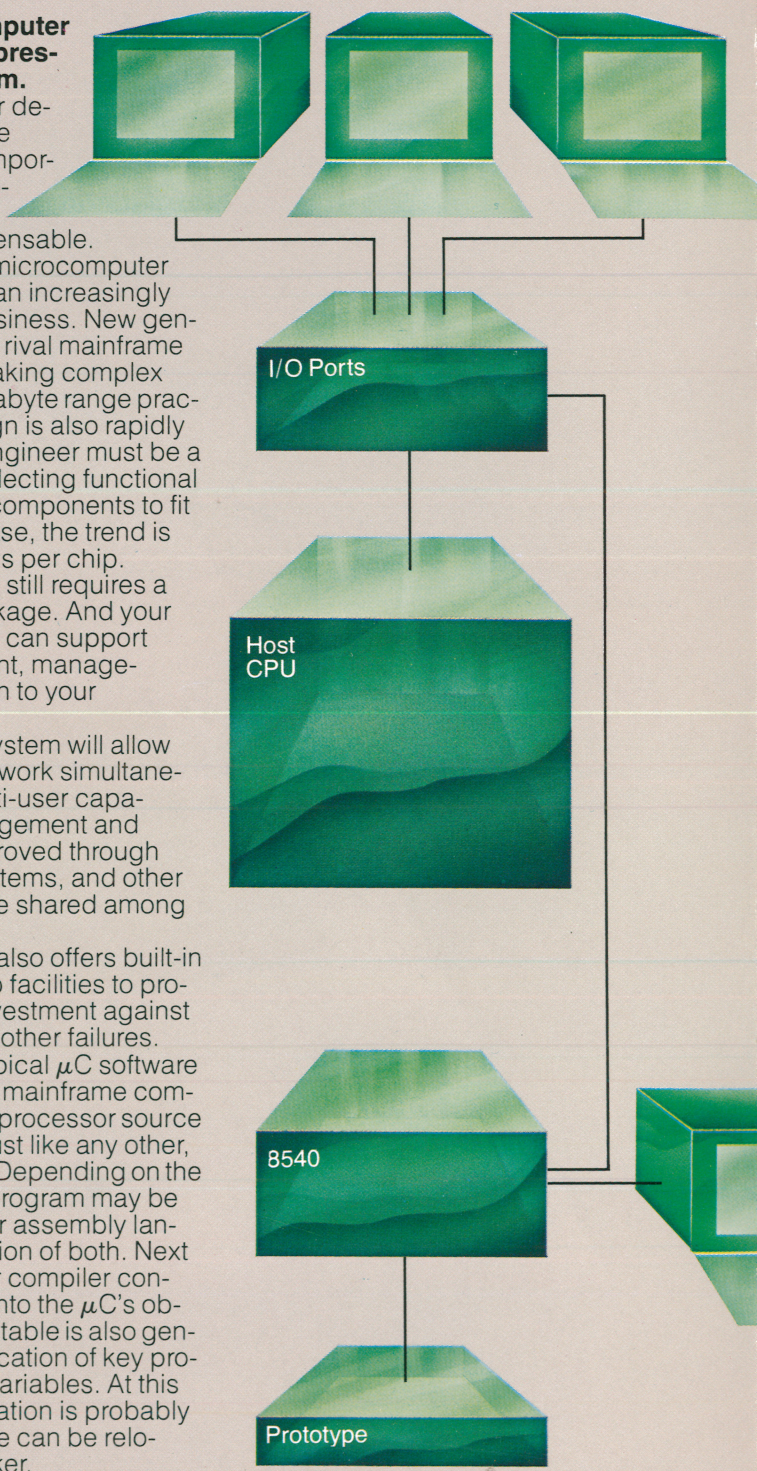
But each design still requires a unique software package. And your mainframe computer can support software development, management, and distribution to your μC system.

The operating system will allow several designers to work simultaneously through its multi-user capabilities. Project management and coordination are improved through sophisticated file systems, and other resources that can be shared among the design team.

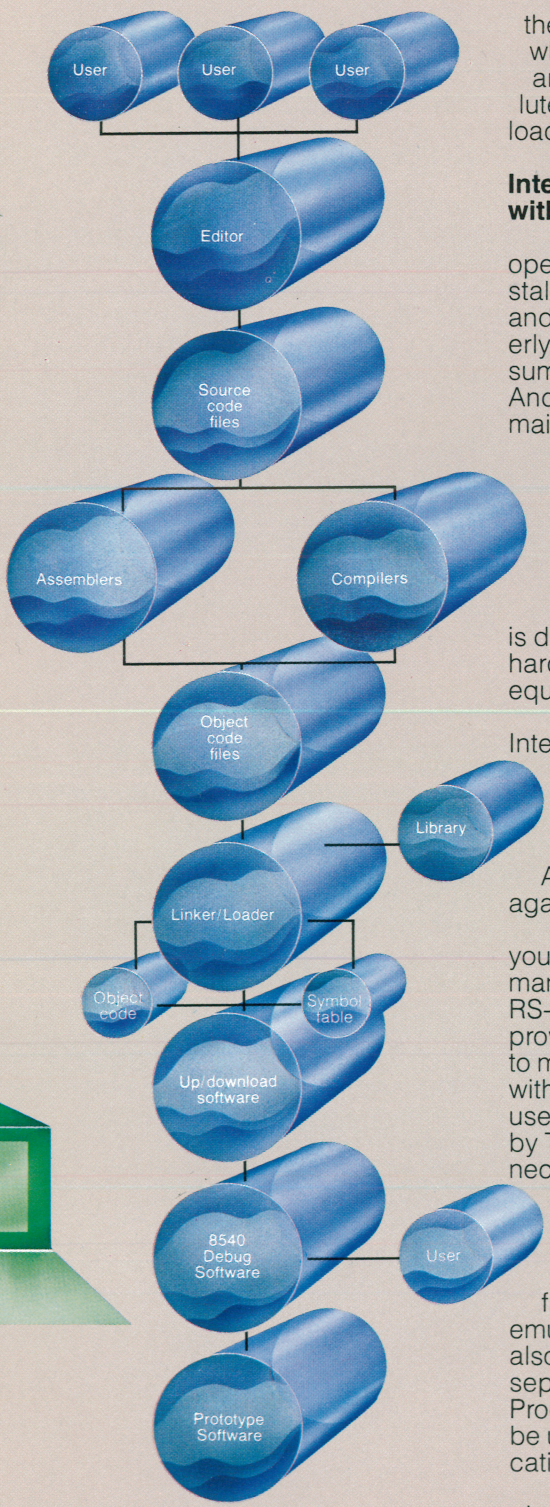
Your mainframe also offers built-in security, plus backup facilities to protect your software investment against hardware crashes or other failures.

Let's review a typical μC software design cycle using a mainframe computer: First, the microprocessor source program is entered just like any other, through a text editor. Depending on the circumstances, the program may be written in high level or assembly language or a combination of both. Next a cross-assembler or compiler converts the source file into the μC's object format. A symbol table is also generated to show the location of key program locations and variables. At this point address information is probably relative so the module can be relocated later by the linker.

During the linking process the object file is grouped with any other object files necessary to form a complete test module. The linker also adds any "run time" files...routines retained in



SSOR HARDWARE/SOFTWARE INTEGRATION.



the library for general use. Finally, when all the modules and routines are together, the linker assigns absolute address information forming a load module that is ready for testing.

At this point you're halfway there.

Integrate software and hardware with 8540 Integration Unit.

Now the micro software developed in your mainframe has to be installed in the microcomputer prototype and debugged until it executes properly. In many cases, this task will consume up to half of the total project time. And it's the one process where your mainframe can't provide much help.

There are some integration techniques that use PROM programmers, or RAM simulators, or possibly some specially designed in-house test equipment. But these approaches can be time consuming and many times it is difficult to tell if the problem is in the hardware, the software or the test equipment itself.

Here's where the Tektronix 8540 Integration Unit comes in. It handles the entire software/hardware integration process. What's more, you can start even before the prototype hardware is available. A valuable asset when you're up against tight deadlines.

First, the 8540 is connected to your mainframe computer in the same manner as a user terminal, through an RS-232 communication port. Tektronix provides a flexible interface package to match communications parameters with your system's protocol. You can use your own terminal or one supplied by Tektronix: the CT8500. Once connected, you can talk directly to the mainframe or to the 8540 during debugging.

Now the completed micro software can be downloaded from the mainframe to the 8540's emulation memory. A symbol table can also be downloaded and is stored in a separate section of system memory. Program labels and symbols can then be used to reference key program locations instead of addresses.

The 8540 can now begin debugging the code through a proven and reliable method called real-time emulation. The code is executed on a processor identical to the one targeted for your prototype design. During execution, the code is monitored by the 8540's powerful debugging software. Unlike some others, Tektronix' emulators can all function in "true" real-time, at the full clock rate of the chip, with no wait states added or clock pulses stretched.

Real-time emulation can occur in three progressive modes letting you gradually introduce the software to the prototype hardware. The first mode actually uses the 8540 as a prototype substitute, with the 8540's emulator processor executing code under control of the system's debug software. Software debugging can begin before the prototype hardware is up and running. The other two modes use a control probe that plugs the emulator directly into the prototype's processor socket, allowing the 8540 to directly control the prototype.

To capture real-time program execution on the prototype bus and selected hardware points, an optional Trigger Trace Analyzer is available. The TTA includes four trigger channels, each with its own word recognizer and 16-bit counter. These channels can be used independently or interactively to capture and observe very specific areas of real-time software flow and control activity.

Also optional is a PROM programmer that can be used to install prototype software in PROM chips that are then used as a memory source aboard the prototype hardware. A series of card modules adapts the PROM programmer to the particular PROM family you're working with.

The widest chip support available.

Besides performance, there's the question of flexibility. You need a hardware/software integration unit that will follow your design strategy from chip to chip as you keep pace with changing technology.

And that's exactly what Tektronix gives you. Nobody offers wider chip support. 8-bit or 16-bit. Microprocessor or microcomputer.

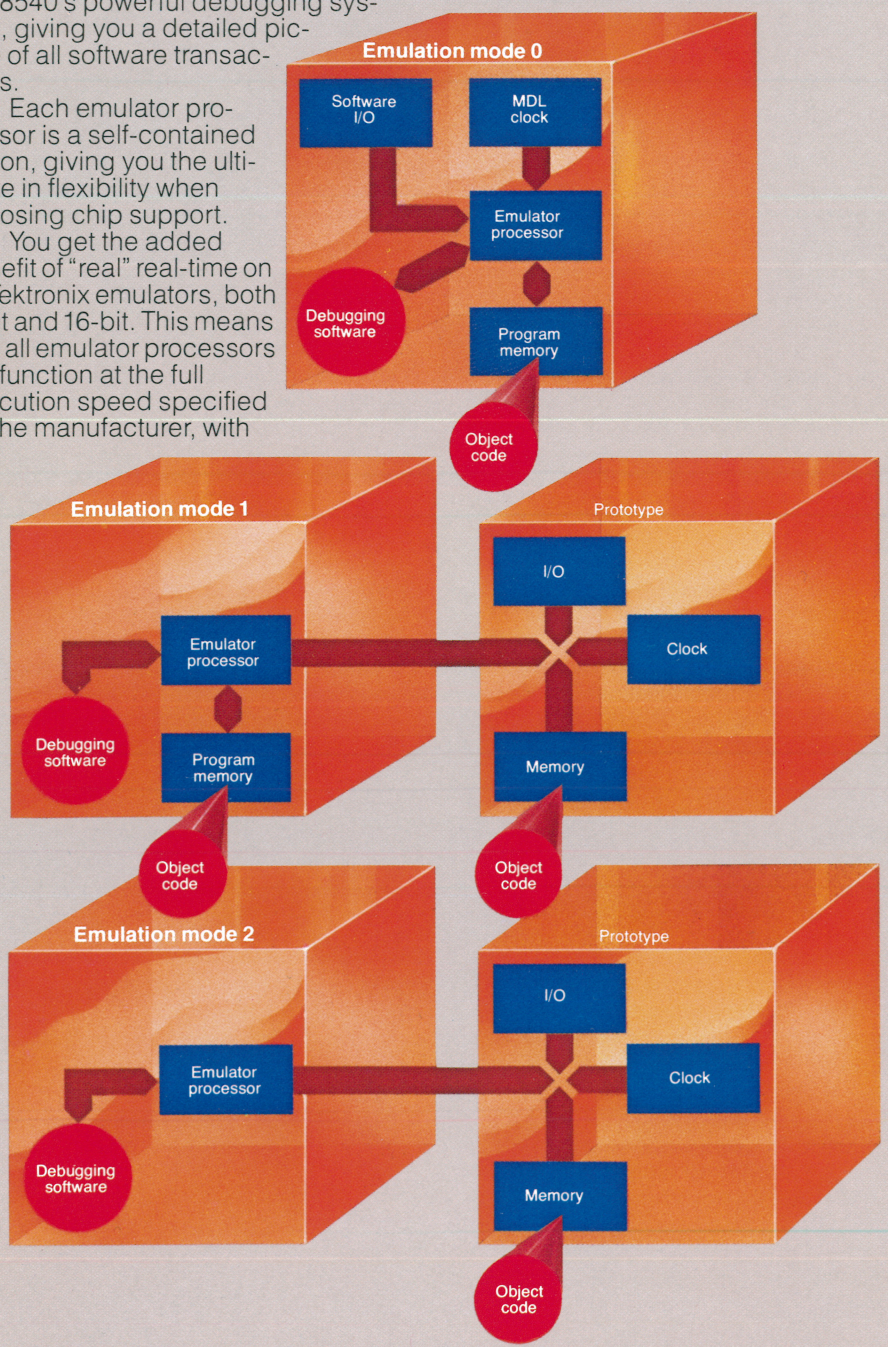
REAL-TIME EMULATION GIVES SUPERIOR PERFORMANCE AND FLEXIBILITY.

"Real" real-time emulation.

There are many possible approaches to hardware/software integration, but only one that makes sense: Real-time emulation. It's a high-performance technique that executes code under development on a processor identical in function to the one targeted for your prototype. Code execution occurs under the control of the 8540's powerful debugging system, giving you a detailed picture of all software transactions.

Each emulator processor is a self-contained option, giving you the ultimate in flexibility when choosing chip support.

You get the added benefit of "real" real-time on all Tektronix emulators, both 8-bit and 16-bit. This means that all emulator processors will function at the full execution speed specified by the manufacturer, with no wait states or stretched clock pulses. In addition, the emulator is fully transparent so there are no "reserved" or special memory or I/O locations you have to program around. In fact, all functions of the emulator processor work just as they do on the target μprocessor.



Three progressive modes of emulation.

Debugging problems will often compound themselves if an entire program is run at once on a prototype system. So Tektronix had divided its emulation capabilities into three progressive modes that let you check out software execution one step at a time.

During emulation mode 0, the prototype code resides entirely in the 8540's program memory. The 8540 also supplies the clock, and there is no connection between the emulator processor and the prototype hardware. I/O transactions are simulated through temporary code insertions that transfer I/O to the console terminal; or by breakpoints that halt the program so certain parameters can be examined or modified. Prototype code can now be executed and debugged on the emulator processor without interference from potential hardware problems.

Emulation mode 1 allows the code to be tested in the actual prototype environment via a prototype control probe. The probe plugs directly into the prototype processor socket. Now all clock and interface signals are supplied from the prototype. Program code can still reside in 8540 emulator memory...up to 128K bytes (128K x 8 or 64K x 16) in fact. Then as sections or modules are debugged they can be "mapped" or transferred into the prototype's own memory.

During emulation mode 2, the entire program is transferred to the prototype memory. The emulator processor now exercises the prototype hardware in a duplication of its standalone condition. Since the emulator probe is still in place, the program execution and debugging remain under the control of the 8540's debugging software until testing is completed.

Now you're ready to plug in the chip.

DEBUGGING SOFTWARE THAT TAKES YOU QUICKLY TO THE SOURCE OF A PROBLEM.

The most comprehensive chip support available.

To widen your decision base in microprocessor design, you need all the processor options you can get. It's the only practical way to strike the optimum balance between performance and cost-effectiveness in the final product.

And nobody gives you more options than Tektronix. We offer the widest chip support available. 8-bit and 16-bit. Microprocessor and microcomputer.

16-bit support:

Z8001
Z8002
68000
8086
8088

8-bit support:

6809	**8080A**	**8039-6**
6800	**8085A**	**8035**
6808	**8049**	**8021**
6802	**8048**	**8022**
Z80A	**8039**	**8041A**

And there's more on the way. Because Tektronix has a permanent commitment to giving you the very best and most timely chip support.

Fast, accurate insights into software performance.

The 8540 has a complete array of debugging tools that are fully usable during all three modes of emulation. Code execution can be monitored and displayed. For each instruction cycle, the status of all key processor registers can be displayed, along with a disassembled listing of instructions and labels. All registers and memory locations can be modified to observe their effect on program flow.

```
> BK 1 LOOP

> GO BEGIN

LOC    INST              R0   R1   R2   R3   R4   R5   R6   R7    FCW
                         R8   R9   R10  R11  R12  R13  R14  R15
SECTION1:000B50 LOOP
000B50 8D07            NOP
                       0002 0000 0000 4000 0000 0B62 0000 0000   5000
                       0000 0326 0000 0000 804F 0000 0000 407C

       <BREAK     BKPT1>

> DS
PC=000B50

  R0=0002  R1=0000   R2=0000   R3=4000   R4=0000   R5=0B62   R6=0000   R7=0000
  R8=0000  R9=0326  R10=0000  R11=0000  R12=804F  R13=0000  R14=0000  R15=407C

  FCW        . Sys EPA VI    NVI . . .    C Z S P/V    D H . .          REFRESH
  5000       x  1   0  1     0  x x x    0 0 0  0     0 0 x x            0

  PSAP  (Offset)   = 1Dxx
  Sys  Stack ($15) = 407C        System Mode
  Norm Stack (N15) = 47FE
```

Breakpoint is set to halt program execution at the address of label "LOOP". Also shown is a detailed display of the processor's internal status when the breakpoint condition occurred.

```
> TRACE,ALL,BEGIN,EXIT

> GO BEGIN

LOC    INST              R0   R1   R2   R3   R4   R5   R6   R7
                         R8   R9   R10  R11  R12  R13  R14  R15

SECTION2:000000 BEGIN
004000 21014000          LD     R1,#4000H
                         0000 4000 0000 0000 0000 0000 0000 0000
                         0000 0000 0000 0000 0000 0000 0000 0000

004004 21020005          LD     R2,#0005H
                         0000 4000 0005 0000 0000 0000 0000 0000
                         0000 0000 0000 0000 0000 0000 0000 0000

004008 C800              LDB    RL0,#00H
                         0000 4000 0005 0000 0000 0000 0000 0000
                         0000 0000 0000 0000 0000 0000 0000 0000

00400A 0018              ADDB   RL0,@R1
                         0001 4000 0005 0000 0000 0000 0000 0000
                         0000 0000 0000 0000 0000 0000 0000 0000
```

Program flow can be traced as it executes. As each instruction is executed it is displayed in mnemonic form along with detailed processor status information.

OPTIONS THAT ANTICIPATE ALL YOUR DESIGN REQUIREMENTS.

The Trigger Trace Analyzer for real-time analysis of both 8-bit and 16-bit prototypes.

Many microcomputer applications involve real-time control situations where the timing of code execution becomes critical. In order to debug the software, it must be run and monitored at real-time operating speeds. What's more, it's often necessary to monitor the code's effect on prototype hardware located off the bus.

A key option to the 8540 is the Trigger Trace Analyzer (TTA) which provides complete real-time debugging facilities for both 8-bit and 16-bit systems. The TTA's acquisition trace memory can capture up to 255 bus transactions including logic states from user-selected points in the prototype hardware.

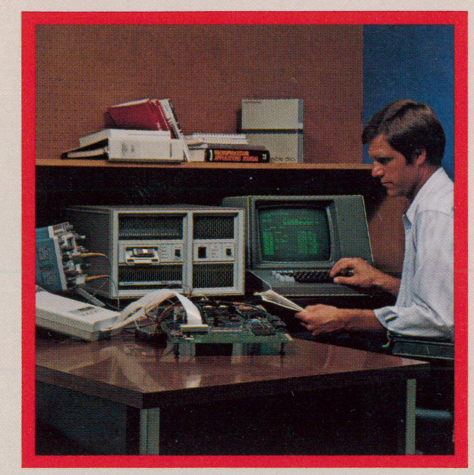
The TTA has four separate trigger channels that permit highly selective data acquisition, both on and off the bus. Each channel includes a word recognizer that monitors 24 address bits, 16 data bits, 14 processor-dependent control bits and 8 external data probe bits. Also included on each channel is a 16-bit counter operable up to 5 MHz for timing or counting prototype events.

The four trigger channels can be used interactively to construct powerful triggers that pinpoint user-defined locations in the software's execution and the hardware's response to it. Each trigger channel also can be used independently so that single or multiple breakpoints can be defined. At each breakpoint, the user has the option to halt prototype program execution or let it continue.

A PROM Programmer adaptable to different chips.

Some design situations call for code under development to be burned into a PROM, which is then installed aboard the prototype as a program memory source.

The 8540 has an optional PROM programmer that includes all the hardware and software necessary to burn your own PROMs. Also, individual card modules are supplied to adapt the Programmer to whatever PROM family your needs require.



Memory Allocation Controller for large address space manipulation.

Some 16-bit applications ultimately call for programs with address ranges in the megabyte range. To accommodate emulation memory manipulation within large address spaces, the 8540 includes an optional Memory Allocation Controller (MAC) module. This powerful option will allocate the 8540's emulator memory within address ranges up to 64 Megabytes.

```
> ACQ ALL FOR 10T CYC AFTER TRIG4
> GO START

LOC    INST              R0   R1   R2   R3   R4   R5   R6   R7    FCW
0002A8 E803            JR     Always,02B0H
                       0002 0000 0000 4000 0000 0B62 0000 0000   5000
                       0000 0326 0000 0000 804F 0000 0000 407C

        <BREAK     TRIG1>
> DISP 20

ADDR DATA     MNEMONIC                    7--PROBE--0   BUS
004038 0B62                               11 11 11 11   S W CD WRD
000B44 2103   LD     R3,#4000H            11 11 11 11   S R F WRD
000B46 4000                               11 11 11 11   S R C WRD
000B48 8D18   CLR    R1                   11 11 11 11   S R F WRD
000B4A 3B17   SOUT   8002H,R1             11 11 11 11   S R F WRD
000B4C 8002                               11 11 11 11   S R C WRD
008002 0000                               11 11 11 11   S W SIO WRD VI
000B4E 8D07   NOP                        11 11 11 11   S R F WRD VI
000B50 8D07   NOP                        11 11 11 11   S R F WRD VI
004080 FFFF                               11 11 11 11   S R VIA WRD
004080 0B50                               11 11 11 11   S W CS WRD
00407E 5040                               11 11 11 11   S W CS WRD
00407C FFFF                               11 11 11 11   S W CS WRD
```

Trigger Trace Analyzer display shows data acquired while processor executes in real-time. Each display line shows the instruction information along with data acquired from eight external probe lines.

8540/HOST COMMUNICATIONS PACKAGE

Adaptable to any major host system.

The 8540's optional Communications Interface package provides all the material and documentation for interfacing the 8540 with virtually any host computer system. The basic requirement is that the host support RS-232, ASCII terminal communications. The 8540 has built-in software to allow programmability of many communication variables, such as echo, parity, turn-around delay. Baud rates are selectable from 110 to 9600 baud, via a real panel switch. The communications package also provides for data set as well as "direct" interface configurations between the host and 8540.

Flexibility through multiple communications modes.

The 8540 system permits three modes of communication with the host computer. These modes give both the hardware and software flexibility needed for optimum performance under a wide variety of working situations.

The terminal mode permits a single terminal to service both the 8540 and the host computer. The terminal is physically connected to the 8540 for direct communication, but a single software command can route the terminal directly to the host, making the 8540 transparent.

In the local mode, the terminal communicates directly with the 8540 for immediate user control over all debugging activity.

In the object code transfer mode, the 8540's serial interface software communicates directly with comparable software on the host. This mode permits object code modules to be transferred between the host and the 8540's program memory, with full error checking during the process.

Migration to other 8500 Series systems.

As design environments evolve to meet changing circumstances, it sometimes becomes desirable to establish an independent multi-user computer system dedicated exclusively to microcomputer design. In this case, the 8540 can be readily transferred to a Tektronix 8560 multi-user system, where it performs the same function as in a host system. This preplanned migration path gives you added flexibility when considering future growth options.

For further information, contact:

U.S.A., Asia, Australia, Central & South America, Japan
Tektronix, Inc.
P.O. Box 4828
Portland, OR 97208
Phone: 800/547-6711
Oregon only 800/452-6773
Telex: 910-467-8708
Cable: TEKTRONIX

Europe, Africa, Middle East
Tektronix International, Inc.
European Marketing Centre
Postbox 827
1180 AV Amstelveen
The Netherlands
Telex: 18312

Canada
Tektronix Canada Inc.
P.O. Box 6500
Barrie, Ontario L4M 4V3
Phone: 705/737-2700

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